DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY
GEORGE OTIS SMITH, DIRECTOR

WATER-SUPPLY PAPER 266

SURFACE WATER SUPPLY OF THE UNITED STATES

1909

PART VI. MISSOURI RIVER BASIN

PREPARED UNDER THE DIRECTION OF M. O. LEIGHTON

BY

W. A. LAMB, W. B. FREEMAN
AND F. F. HENSHAW

WASHINGTON
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SURFACE WATER SUPPLY OF THE MISSOURI RIVER BASIN, 1909.

By W. A. LAMB, W. B. FREEMAN, and F. F. HENSHAW.

INTRODUCTION.

AUTHORITY FOR INVESTIGATIONS.

This volume contains results of flow measurements made on certain streams in the United States. The work was performed by the water-resources branch of the United States Geological Survey, either independently or in cooperation with organizations mentioned herein. These investigations are authorized by the organic law of the Geological Survey (Stat. L., vol. 20, p. 394), which provides among other things, as follows:

> Provided that this officer [the Director] shall have the direction of the Geological Survey and the classification of public lands and examination of the geological structure, mineral resources, and products of the national domain.

Inasmuch as water is the most abundant and most valuable mineral in nature the investigation of water resources is included under the above provision for investigating mineral resources. The work has been supported since the fiscal year ending June 30, 1895, by appropriations in successive sundry civil bills passed by Congress under the following item:

> For gauging the streams and determining the water supply of the United States, and or the investigation of underground currents and artesian wells, and for the preparation of reports upon the best methods of utilizing the water resources.

The various appropriations that have been made for this purpose are as follows:

Annual appropriations for the fiscal year ending June 30—

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

SCOPE OF INVESTIGATIONS.

These investigations are not complete nor do they include all the river systems or parts thereof that might purposefully be studied. The scope of the work is limited by the appropriations available. The field covered is the widest and the character of the work is believed to be the best possible under the controlling conditions. The work would undoubtedly have greater scientific importance and ultimately be of more practical value if the money now expended for wide areas were concentrated on a few small drainage basins, but such a course is impossible because general appropriations made by Congress are applicable to all parts of the country. Each part demands its proportionate share of the benefits.

It is essential that records of stream flow shall be kept during a period of years long enough to determine within reasonable limits the entire range of flow from the absolute maximum to the absolute minimum. The length of such a period manifestly differs for different streams. Experience has shown that the records for some streams should cover from 5 to 10 years, and for other streams 20 years or even more, the limit being determined by the relative importance of the stream and the interdependence of the results with other long-time records on adjacent streams.

In the performance of this work an effort is made to reach the highest degree of precision possible with a rational expenditure of time and a judicious expenditure of a small amount of money. In all engineering work there is a point beyond which refinement is needless and wasteful, and this statement applies with especial force to stream-flow measurements. It is confidently believed that the stream-flow data presented in the publications of the survey are in general sufficiently accurate for all practical purposes. Many of the records are, however, of insufficient length, owing to the unforeseen reduction of appropriations and consequent abandonment of stations. All persons are cautioned to exercise the greatest care in using such incomplete records.

Records have been obtained at more than 1,550 different points in the United States, and in addition the surface water supply of small areas in Seward Peninsula and the Yukon-Tanana region, Alaska, has been investigated. During 1909 regular gaging stations were maintained by the survey and cooperating organizations at about 850 points in the United States, and many miscellaneous measurements were made at other points. Data were also obtained in regard to precipitation, evaporation, storage reservoirs, river profiles, and water power in many sections of the country and will be made available in the regular surface water-supply papers and in special papers from time to time.

PURPOSES OF THE WORK.

The results contained in this volume are requisite to meet the immediate demands of many public interests, including navigation, irrigation, domestic water supply, water power, swamp and overflow land drainage, and flood prevention.

Navigation.—The Federal Government has expended more than $250,000,000 for the improvement of inland navigation, and prospective expenditures will approximate several times this amount. It is obvious that the determination of stream flow is necessary to the intelligent solution of the many problems involved.

Irrigation.—The United States is now expending $51,000,000 on Federal irrigation systems, and this amount is far exceeded by the private expenditures of this nature in the arid West. The integrity of any irrigation system depends absolutely on the amount of water available. Therefore investigations of stream flow in that portion of the country are not only of first importance in the redemption of the lands, but constitute an insurance of Federal and private investments.

Domestic water supply.—The highest use of water is for domestic supply, and although this branch of the subject is of less direct Federal interest than the branches already named, it nevertheless has so broad a significance with respect to the general welfare that the Federal Government is ultimately and intimately concerned.

Water power.—The development of the water power of the country is an economic necessity. Our stock of coal is being rapidly depleted and the cost of steam power is increasing accordingly. Industrial growth and, as a consequence, the progress of the United States as a nation will cease if cheap power is not available. Water power affords the only avenue now open. When the electric transmission of power was accomplished the relation of our water powers to national economy changed entirely. Before the day of electric transmission water power was important only at the locality at which it was generated, but it has now become a public utility in which the individual citizen is vitally interested. Inasmuch as the amount of water power that may be made available depends on the flow of rivers, the investigation of flow becomes a prerequisite in the judicious management of this source of energy.

Drainage of swamp and overflowed lands.—More than 70,000,000 acres of the richest land in this country are now practically worthless or of precarious value by reason of overflow and swamp conditions. When this land is drained it becomes exceedingly productive and its value increases many fold. Such reclamation would add to the national assets at least $700,000,000. The study of run-off is the first consideration in connection with drainage projects. If by the drainage of a large area into any particular channel that channel

becomes so gorged with water which it had not hitherto been called upon to convey that overflow conditions are created in places where previously the land was not subject to inundation, then drainage results merely in an exchange of land values. This is not the purpose of drainage improvement.

Flood prevention.—The damage from floods in the United States probably exceeds on the average $100,000,000 annually, and in the year 1908, according to estimates based on reliable data, the aggregate damage approximated $250,000,000. Such an annual tax on the property of great regions should be reduced in the orderly progress of government. It goes without saying that any consideration of flood prevention must be based on a thorough knowledge of stream flow, both in the contributing areas which furnish the water and along the great lowland rivers.

PUBLICATIONS.

The data on stream flow collected by the United States Geological Survey since its inception have appeared in the annual reports, bulletins, and water-supply papers. Owing to natural processes of evolution and to changes in governmental requirements, the character of the work and the territory covered by these different publications has varied greatly. For the purpose of uniformity in the presentation of reports a general plan has been agreed upon by the United States Reclamation Service, the United States Forest Service, the United States Weather Bureau, and the United States Geological Survey, according to which the area of the United States has been divided into twelve parts, whose boundaries coincide with certain natural drainage lines. The areas so described are indicated by the following list of papers on surface water supply for 1909. The dividing line between the North Atlantic and South Atlantic drainage areas lies between York and James rivers.

Papers on surface water supply of the United States, 1909.

Part.	No.	Title.	Part.	No.	Title.
I	261	North Atlantic coast.	VI	266	Missouri River basin.
II	262	South Atlantic coast and eastern Gulf of Mexico.	VII	267	Lower Mississippi River basin.
			VIII	268	Western Gulf of Mexico.
III	263	Ohio River basin.	IX	269	Colorado River basin.
IV	264	St. Lawrence River basin.	X	270	Great basin.
V	265	Upper Mississippi River and Hudson Bay basins.	XI	271	California.
			XII	272	North Pacific coast.

The following table gives the character of data regarding stream flow at regular stations to be found in the various publications of the United States Geological Survey exclusive of all special papers. Numbers of reports are inclusive, and dates also are inclusive so far as the data are available.

Stream-flow data in reports of the United States Geological Survey.

[Ann.=Annual Report; B.=Bulletin; W. S.=Water-Supply Paper.]

Report.	Character of data.	Year.
10th Ann., pt. 2	Descriptive information only	
11th Ann., pt. 2	Monthly discharge	1884 to Sept., 1890.
12th Ann., pt. 2	do	1884 to June 30, 1891.
13th Ann., pt. 3	Mean discharge in second-feet	1884 to Dec. 31, 1892.
14th Ann., pt. 2	Monthly discharge (long-time records, 1871 to 1893)	1888 to Dec. 31, 1893.
B. 131	Descriptions, measurements, gage heights, and ratings	1892 and 1894.
16th Ann., pt. 2	Descriptive information only	
B. 140	Descriptions, measurements, gage heights, ratings, and monthly discharge (also many data covering earlier years).	1895.
W. S. 11	Gage heights (also gage heights for earlier years)	1896.
18th Ann., pt. 4	Descriptions, measurements, ratings, and monthly discharge (also similar data for some earlier years).	1895 and 1896.
W. S. 15	Descriptions, measurements, and gage heights, eastern United States, eastern Mississippi River, and Missouri River above junction with Kansas.	1897.
W. S. 16	Descriptions, measurements, and gage heights, western Mississippi River below junction of Missouri and Platte, and western United States.	1897.
19th Ann., pt. 4	Descriptions, measurements, ratings, and monthly discharge (also some long-time records).	1897.
W. S. 27	Measurements, ratings, and gage heights, eastern United States, eastern Mississippi River, and Missouri River.	1898.
W. S. 28	Measurements, ratings, and gage heights, Arkansas River and western United States.	1896
20th Ann., pt. 4	Monthly discharge (also for many earlier years)	1898.
W. S. 35 to 39	Descriptions, measurements, gage heights, and ratings	1899.
21st Ann., pt. 4	Monthly discharge	1899.
W. S. 47 to 52	Descriptions, measurements, gage heights, and ratings	1900.
22d Ann., pt. 4	Monthly discharge	1900.
W. S. 65, 66	Descriptions, measurements, gage heights, and ratings	1901.
W. S. 75	Monthly discharge	1901.
W. S. 82 to 85	Complete data	1902.
W. S. 97 to 100	do	1903.
W. S. 124 to 135	do	1904.
W. S. 165 to 178	do	1905.
W. S. 201 to 214	Complete data, except descriptions	1906.
W. S. 241 to 252	Complete data	1907–8.
W. S. 261 to 272	do	1909.

NOTE.—No data regarding stream flow are given in the 15th and 17th annual reports.

The records at most of the stations discussed in these reports extend over a series of years. An index of the reports containing records prior to 1904 has been published in Water-Supply Paper 119. The first table which follows gives, by years and drainage basins, the numbers of the papers on surface water supply published from 1899 to 1909. Wherever the data for a drainage basin appear in two papers the number of one is placed in parentheses, and the portion of the basin covered by that paper is indicated in the second table. For example, in 1904 the data for Missouri River were published in Water-Supply Papers 130 and 131, and the portion of the records contained in Water-Supply Paper 131, as indicated by the second table, is that relating to Platte and Kansas rivers.

Numbers of water-supply papers containing results of stream measurements, 1899–1909.

	1899[a]	1900[b]	1901	1902	1903	1904	1905	1906	1907–8	1909
Atlantic coast and eastern Gulf of Mexico:										
New England rivers	35	47	65, 75	82	97	124	165	201	241	261
Hudson River to Delaware River, inclusive	35	47, (48)	65, 75	82	97	125	166	202	241	261
Susquehanna River to York River, inclusive	35	48	65, 75	82	97	126	167	203	241	261
James River to Yadkin River, inclusive	(35), 36	48	65, 75	(82), 83	(97), 98	126	167	203	242	262
Santee River to Pearl River, inclusive	36	48	65, 75	83	98	127	168	204	242	262
St. Lawrence River	36	49	65, 75	(82), 83	97	129	170	206	244	264
Hudson Bay	.....	.....	66, 75	85	100	130	171	207	245	265
Mississippi River:										
Ohio River	36	48, (49)	65, 75	83	98	128	169	205	243	263
Upper Mississippi River	36	49	65, 75	83	98, (99)	128, (130)	171	207	245	265
Missouri River	(36), 37	49, (50)	66, 75	84	99	130, (131)	172	208	246	266
Lower Mississippi River	37	50	(65), 66, 75	(83), 84	(98), 99	(128), 131	(169), 173	(205), 209	247	267
Western Gulf of Mexico	37	50	66, 75	84	99	132	174	210	248	268
Pacific coast and Great Basin:										
Colorado River	(37), 38	50	66, 75	85	100	133, (134)	175, (177)	211, (213)	249, (251)	269 (271)
Great Basin	38, (39)	51	66, 75	85	100	133, (134)	176, (177)	212, (213)	250, (251)	270, (271)
South Pacific coast to Klamath River, inclusive	(38), 39	51	66, 75	85	100	134	177	213	251	271
North Pacific coast	38	51	66, 75	85	100	135	(177), 178	214	252	272

[a] Rating tables and index to Water-Supply Papers 35-39 contained in Water-Supply Paper 39.
[b] Rating tables and index to Water-Supply Papers 47-52 and data on precipitation, wells, and irrigation in California and Utah contained in Water-Supply Paper 52.

Numbers of water-supply papers containing data covering portions of drainage basins.

No.	River basin.	Tributaries included.
35	James	
36	Missouri	Gallatin.
37	Colorado	Green, Gunnison, Grand above junction with Gunnison.
38	Sacramento	Except Kings and Kern.
39	Great Basin	Mohave.
48	Delaware	Wissahickon and Schuylkill.
49	Ohio	Scioto.
50	Missouri	Loup and Platte near Columbus, Nebr. All tributaries below junction with Platte.
65	Lower Mississippi	Yazoo.
82	James	
	St. Lawrence	Lake Ontario, tributaries to St. Lawrence River proper.
83	Lower Mississippi	Yazoo.
97	James	
98	Lower Mississippi	Do.
99	Upper Mississippi	Tributaries from the west.
128	Lower Mississippi	Yazoo.
130	Upper Mississippi	Tributaries from the west.
131	Missouri	Platte, Kans.
134	Colorado	Data near Yuma, Ariz., repeated.
	Great Basin	Susan, Owens, Mohave.
169	Lower Mississippi	Yazoo.
177	Colorado	Below junction with Gila.
	Great Basin	Susan repeated, Owens, Mohave.
	North Pacific coast	Rogue, Umpqua, Siletz.
205	Lower Mississippi	Yazoo, Homochitto.
213	Colorado	Data at Hardyville repeated; at Yuma, Salton Sea.
	Great Basin	Owens, Mohave.
251	Colorado	Yuma and Salton Sea stations repeated.
271	Great Basin	Owens River basin.

The order of treatment of stations in any basin in these papers is downstream. The main stem of any river is determined on the basis of drainage area, local changes in name and lake surface being disregarded. After all stations from the source to the mouth of the main stem of the river have been given, the tributaries are taken up in regular order from source to mouth. The tributaries are treated the same as the main stream, all stations in each tributary basin being given before taking up the next one below.

The exceptions to this rule occur in the records for Mississippi River, which are given in four parts, as indicated above, and in the records for large lakes, where it is often clearer to take up the streams in regular order around the rim of the lake than to cross back and forth over the lake surface.

DEFINITION OF TERMS.

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

"Second-foot" is an abbreviation for cubic foot per second and is the rate of discharge 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 by the use of the factors given in the following table of equivalents.

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

The "miner's inch" is the rate of discharge of water that passes through an orifice 1 inch square under a head which varies locally. It is 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.

CONVENIENT EQUIVALENTS.

The following is a list of convenient equivalents for use in hydraulic computations:

1 second-foot equals 40 California miner's inches (law of Mar. 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 equals 18.7 United States gallons per second.
100 California miner's inches equals 96 Colorado miner's inches.
100 California miner's inches for one day equals 4.96 acre-feet.
100 Colorado miner's inches equals 2.60 second-feet.
100 Colorado miner's inches equals 19.5 United States gallons per second.
100 Colorado miner's inches equals 104 California miner's inches.
100 Colorado miner's inches for one day equals 5.17 acre-feet.
100 United States gallons per minute equals 0.223 second-foot.
100 United States gallons per minute for one day equals 0.442 acre-foot.
1,000,000 United States gallons per day equals 1.55 second-feet.
1,000,000 United States gallons equals 3.07 acre-feet.
1,000,000 cubic feet equals 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 kilogram-meters per second.
1 horsepower equals 746 watts.
1 horsepower equals 1 second-foot falling 8.80 feet.
1½ horsepower equals 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.

EXPLANATION OF TABLES.

For each drainage basin there is given a brief description of general conditions covering such features as area, source, tributaries, topography, geology, conditions of forestation, rainfall, ice conditions, irrigation, storage, power possibilities, and other special features of importance or interest.

For each regular current-meter gaging station are given in general, and so far as available, the following data: Description of station, list of discharge measurements, table of daily gage heights, table of daily discharges, table of monthly and yearly discharges and run-off. For stations located at weirs or dams the gage-height table is omitted.

In addition to statements regarding the location and installation of current-meter stations, the descriptions give information in regard to any conditions which may affect the constancy of the relation of gage height to discharge, covering such points as ice, logging, shifting conditions of flow, and backwater; also information regarding diversions which decrease the total flow at the measuring section. Statements are also made regarding the accuracy and reliability of the data.

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

The table of daily gage heights gives the daily fluctuations of the surface of the river as found from the mean of the gage readings taken each day. At most stations the gage is read in the morning and in the evening. The gage height given in the table represents the elevation of the surface of the water above the zero of the gage. All gage heights during ice conditions, backwater from obstructions, etc., are published as recorded, with suitable footnotes. The rating is not applicable for such periods unless the proper corrections to the gage heights are known and applied. Attention is called to the fact that the zero of the gage is placed at an arbitrary datum and has no relation to zero flow or the bottom of the river. In general, the zero is located somewhat below the lowest known flow, so that negative readings shall not occur.

The discharge measurements and gage heights are the base data from which rating tables, daily discharge tables, and monthly discharge tables are computed.

The rating table gives, either directly or by interpolation, the discharge in second-feet corresponding to every stage of the river recorded during the period for which it is applicable. It is not published in this report, but can be determined from the daily gage heights and daily discharges for the purpose of verifying the published results as follows:

First plot the discharge measurements for the current and earlier years on cross-section paper with gage heights in feet as ordinates and discharge in second-feet as abscissas. Then tabulate a number of gage heights taken from the daily gage height table for the complete range of stage given and the corresponding discharges for the days selected from the daily discharge table and plot the values on cross-section paper. The last points plotted will define the rating curve used and will lie among the plotted discharge measurements. After drawing the rating curve, a table can be developed by scaling off the discharge in second-feet for each tenth foot of gage height. These values should be so adjusted that the first differences shall always be increasing or constant except for known backwater conditions.

The table of daily discharges gives the discharges in second-feet corresponding to the observed gage heights as determined from the rating tables.

In the table of monthly discharge the column headed "Maximum" gives the mean flow, as determined from the rating table, for the day when the mean gage height was highest. As the gage height is the mean for the day, it does not indicate correctly the stage when the water surface was at crest height and the corresponding discharge consequently larger than given in the maximum 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 in cubic feet for each second during the month. On this the computations for the remaining columns, which are defined on page 15, are based.

FIELD METHODS OF MEASURING STREAM FLOW.

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 or dam; (3) by measurements of the velocity of the current and of the area of the cross section. The method chosen depends on the local physical conditions, the degree of accuracy desired, the funds available, and the length of time that the record is to be continued.

Slope method.—Much information has been collected relative to the coefficients to be used in the Chezy formula, $v=c\sqrt{Rs}$. This has been utilized by Kutter, both in developing his formula for c and in determining the values of the coefficient n which appears therein. The results obtained by the slope method are in general only roughly approximate, owing to the difficulty in obtaining accurate data and the uncertainty of the value for n to be used in Kutter's formula. The most common use of this method is in estimating the flood discharge of a stream when the only data available are the cross section, the slope as shown by marks along the bank, and a knowledge of the general conditions. It is seldom used by the United States Geological Survey. For full information regarding this method the reader is referred to the various textbooks on hydraulics.

Weir method.—Relatively few stations are maintained at weirs or dams by the United States Geological Survey. Standard types of sharp-crested and broad-crested weirs, within the limits for which accurate coefficients have been experimentally obtained, give very accurate records of discharge if properly maintained. At practically all broad-crested weirs, however, there is a diversion of water either through or around the dam, usually for the purpose of development of water power. The flow is often complicated, and the records are subject to errors from such sources as leakage through the dam, backwater at high stages, uncertainty regarding coefficient, irregularity of crest, obstructions from logs or ice, use of flashboards, old turbines with imperfect ratings, and many others, depending on the type of development and the uses of the diverted water.

In general, records of discharge at dams are usually accurate enough for practical use if no others are available. It has been the general experience of the United States Geological Survey, however, that records at current-meter gaging stations under unobstructed-channel conditions are more accurate than those collected at dams, and where the conditions are reasonably favorable are practically as good as those obtained at sharp-crested weirs.[1]

Velocity method.—Streams in general present throughout their courses to a greater or less extent all conditions of permanent, semipermanent, and varying conditions of flow. In accordance with the location of the measuring section with respect to these physical conditions, current-meter gaging stations may in general be divided into four classes—(1) those with permanent conditions of flow;

[1] The determination of discharge over the different types of weirs and dams is treated fully in "Weir experiments, coefficients, and formulas" (Water-Supply Paper 200) and in the various textbooks on hydraulics. "Turbine water-wheel tests and power tables" (Water-Supply Paper 180) treats of the discharge through turbines when used as meters. The edition of the latter water-supply paper is nearly exhausted. The paper can, however, be consulted at most of the larger libraries of the country or it can be obtained from the Superintendent of Documents, Washington, D. C., at a cost of 20 cents.

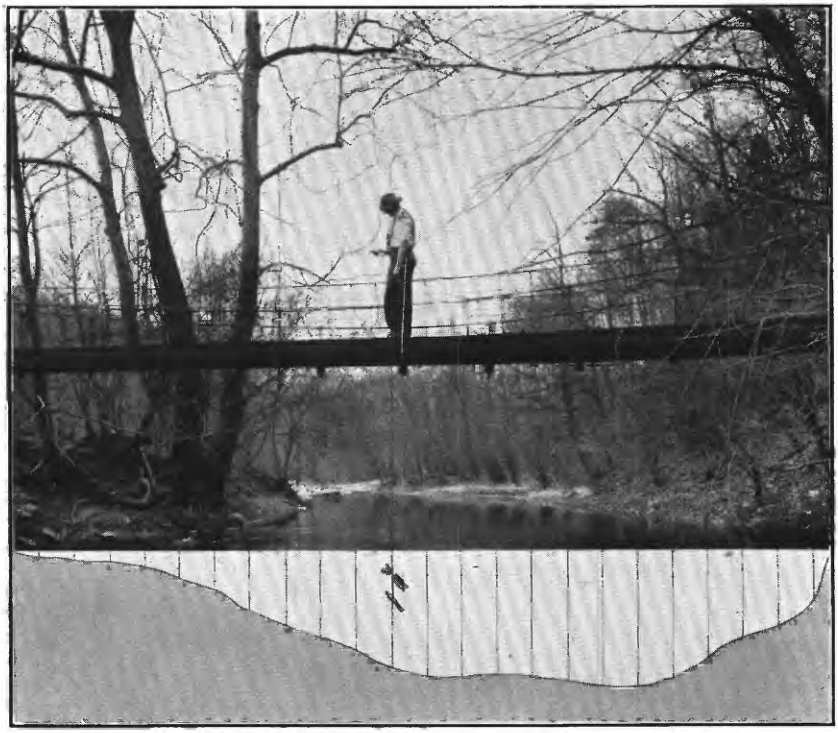
(2) those with beds which change only during extreme high water; (3) those with beds which change frequently but which do not cause a variation of more than about 5 per cent of the discharge curves from year to year; and (4) those with constantly shifting beds. In determining the daily flow different office methods are necessary for each class. The field data on which the determinations are based and the methods of collecting them are, however, in general the same.

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. They are located, as far as possible, at such points that the relation between gage height and discharge will always remain constant for any given stage. The experience of engineers of the Geological Survey has been that permanency of conditions of flow is the prime requisite of any current-meter gaging station when maintained for several years, unless funds are available to cover all changes in conditions of flow. A straight, smooth section, without cross currents, backwater, boils, etc., at any stage is highly desirable, but on most streams is not attainable except at the expense of a cable equipment. Rough, permanent sections, if measurements are properly made by experienced engineers, taking measuring points at a distance apart of 5 per cent or less of the total width, will within reasonable limits yield better results for a given outlay of money than semipermanent or shifting sections with smooth, uniform current. So far as possible, stations are located where the banks are high and not subject to overflow at high stages, and out of the influence of tributary streams, dams, or other artificial obstructions which might affect the relation between gage height and discharge.

A gaging station consists essentially of a gage for determining the daily fluctuations of stage of the river and some structure or apparatus from which discharge measurements are made, usually a bridge or cable.

The two factors required to determine the discharge of a stream past a section perpendicular to the mean direction of the current are the area of the cross section and the mean velocity of flow normal to that section.

In making a measurement with a current meter, a number of points, called measuring points, are measured off above and in the plane of the measuring section at which observations of depth and velocity are taken. (See Pl. I, *A*.) These points are spaced equally for those parts of the section where the flow is uniform and smooth, and are spaced unequally for other parts, according to the discretion and judgment of the engineer. In general, the points should not be



A. FOR BRIDGE MEASUREMENT.

B. GAGING NORTH FORK OF SOUTH PLATTE RIVER AT CASSELLS, COLO.

TYPICAL GAGING STATIONS.

spaced farther apart than 5 per cent of the channel width, nor farther apart than the approximate mean depth of the section at the time of measurement.

The measuring points divide the total cross section into elementary strips, at each end of which observations of depth and velocity are made. The discharge of any elementary strip is the product of the average of the depths at the two ends times the width of the strip times the average of the mean velocities at the two ends of the strip. The sum of the discharges of the elementary strips is the total discharge of the stream.[1]

Depths for the determination of the area are usually obtained by sounding with the current meter and cable. In rough sections or swift current an ordinary weight and cable are used, particular care being taken that all observations shall be in the plane of the cross section.

Two methods of determining the velocity of flow of a stream are in general use—the float method and the current-meter method.

The float method, with its various modifications of surface, subsurface, and tube or rod floats, is now considered obsolete in the ordinary practice of the United States Geological Survey. The use of this method is limited to special conditions where it is impracticable to use the current meter, such as in places where large quantities of ice or débris which may damage the meter are flowing with the current, and for miscellaneous measurements or other work where a high degree of accuracy is not necessary. Tube floats are very satisfactory for use in canals with regular bottoms and even flow of current. Measurements by the float method are made as follows: The velocity of flow of the stream is obtained by observing the time which it takes floats set free at different points across the stream to pass between two range lines about 200 feet apart. The area used is the mean value obtained from several cross sections measured between the two range lines. The chief disadvantages of this method are difficulty in obtaining the correct value of mean area for the course used and uncertainty regarding the proper coefficient to apply to the observed velocity.[2]

The Price current meter is now used almost to the exclusion of other types of meters by the United States Geological Survey in the determination of the velocity of flow of water in open channels, a use for which it is adapted under practically all conditions.[3]

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[1] For a discussion of methods of computing the discharge of a stream, see Engineering News, June 25, 1908.

[2] Further information regarding this method is given in Water-Supply Paper 95 and in the various textbooks covering the general subject of stream flow. The edition of this paper is nearly exhausted. It can, however, be consulted at most of the larger libraries of the country, or can be obtained from the superintendent of documents, Washington, D. C., at a cost of 15 cents.

[3] See Hoyt, J. C., and others, Use and care of the current meter as practiced by the United States Geological Survey: Trans. Am. Soc. C. E., vol. 66, 1910, p. 70.

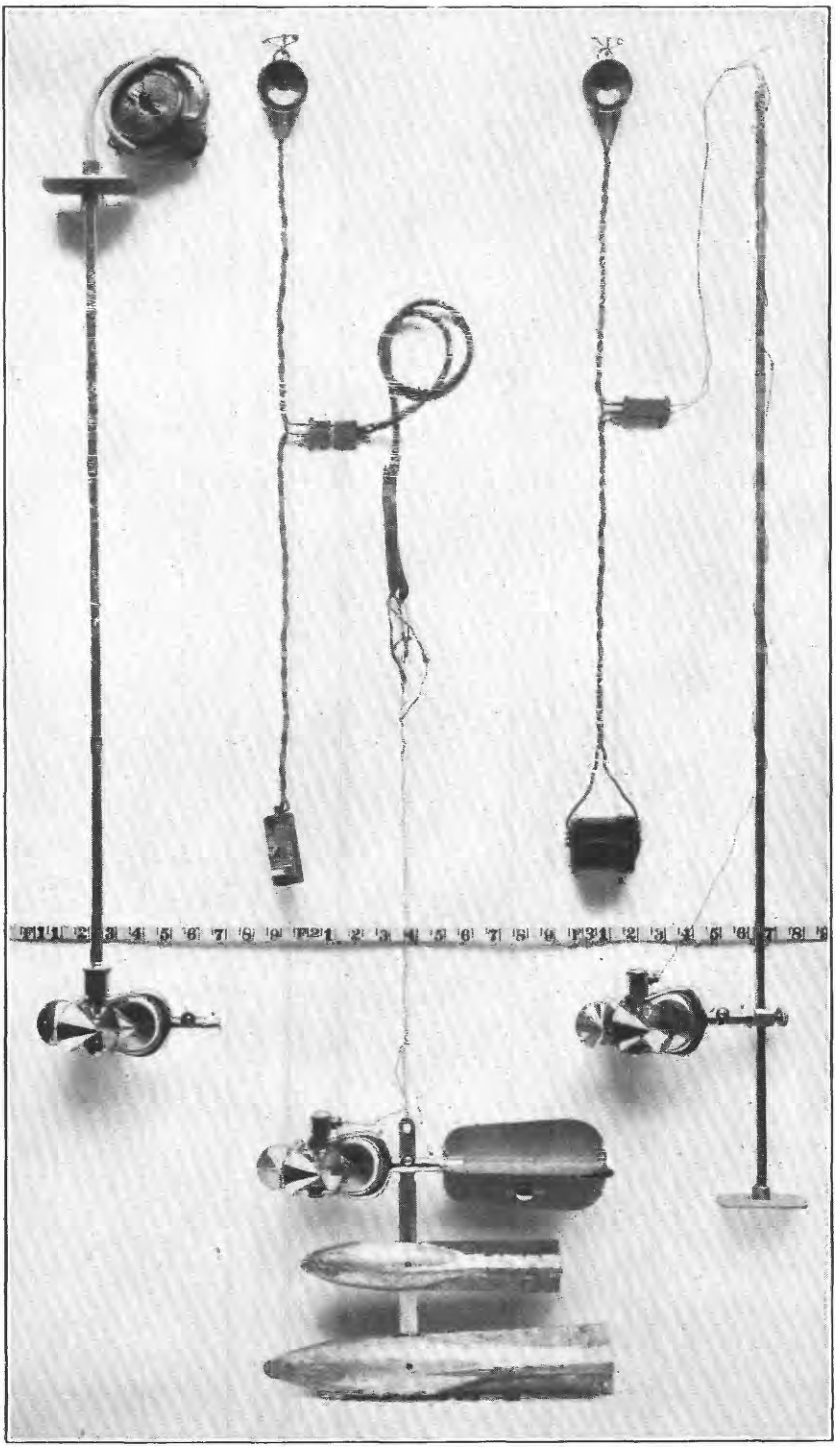
Plate II shows in the center the new type of penta-recording current meter equipped for measurements at bridge and cable stations; on the left the same type of meter is shown equipped for wading measurements, to record by the acoustic method; the meter is shown on the right equipped to record electrically. (See Pl. I, *B*.) Briefly, the meter consists of six cups attached to a vertical shaft, which revolves on a conical hardened-steel point when immersed in moving water. The number of revolutions is indicated electrically. The rating or relation between the velocity of the moving water and the revolutions of the wheel is determined for each meter by drawing it 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 of moving water for any number of revolutions in a given time interval. The ratio of revolutions per second to velocity of flow in feet per second is very nearly a constant for all speeds, and is approximately 0.45.

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

The two principal multiple-point methods in general use are the vertical velocity curve and 0.2 and 0.8 depth.

In the vertical velocity curve method a series of velocity determinations are made in each vertical at regular intervals, usually about 10 to 20 per cent of the depth 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. This method of obtaining the mean velocity in the vertical is probably the best known, but on account of the length of time required to make a complete measurement its use is largely 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 depth, and the mean of the velocities at these two points is taken as the mean velocity for that vertical. (See Pl. I, *A*.) 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 depth will give (closely) the mean velocity in the vertical. Actual observations under a wide range of conditions show that this multiple-point method gives the mean velocity very closely for open-water conditions and that a completed measurement seldom varies as much at 1 per cent from the value given by the vertical velocity curve method. Moreover, the indications are that it holds nearly as well



SMALL PRICE CURRENT METERS.

for ice-covered rivers. It is very extensively used in the regular practice of the United States Geological Survey.

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 or must be assumed.

Extensive experiments by means of vertical velocity curves show that the thread of mean velocity generally occurs between 0.5 and 0.7 total depth. In general practice the thread of mean velocity is considered to be at 0.6 depth, and at this point the meter is held in most of the measurements made by the single-point method. 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. The variation of the coefficient from unity in individual cases is, however, greater than in the 0.2 and 0.8 method and the general results are not as satisfactory.

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 in general from about 0.85 to 0.95, depending on 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 in the correct position for the other methods.

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. In using the Price meter great care should be taken that the vertical movement of the meter is not rapid enough to vitiate the accuracy of the resulting velocity.

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 the 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, and the thickness and character of the ice. 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.[1]

OFFICE METHODS OF COMPUTING AND STUDYING DISCHARGE AND RUN-OFF.

At the end of each year the field or base data for current-meter gaging stations, consisting of daily gage heights, discharge measurements, and full notes, are assembled. The measurements are plotted on cross-section paper and rating curves are drawn wherever feasible. The rating tables prepared from these curves are then applied to the tables of daily gage heights to obtain the daily discharges, and from these applications the tables of monthly discharge and run-off are computed.

Rating curves are drawn and studied with special reference to the class of channel conditions which they represent. The discharge measurements for all classes of stations when plotted with gage heights in feet as ordinates and discharges in second-feet as abscissas define rating curves which are generally more or less parabolic in form. In many cases curves of area in square feet and mean velocity in feet per second are also constructed to the same scale of ordinates as the discharge curve. These are used mainly to extend the discharge curves beyond the limits of the plotted discharge measurements and for checking purposes to avoid errors in the form of the discharge curve and to determine and eliminate erroneous measurements.

For every rating table the following assumptions are made for the period of application of the table: (*a*) That the discharge is a function of and increases gradually with the stage; (*b*) that the discharge is the same whenever the stream is at a given stage, and hence such changes in conditions of flow as may have occurred during the period of application are either compensating or negligible, except that the rating as stated in the footnote of each table is not applicable for known conditions of ice, log jams, or other similar obstructions; (*c*) that the increased and decreased discharge due to change of slope on rising and falling stages is either negligible or compensating.

As already stated the gaging stations may be divided into several classes, as indicated in the following paragraphs:

The stations of class 1 represent the most favorable conditions for an accurate rating and are also the most economical to maintain. The bed of the stream is usually composed of rock and is not subject to the deposit of sediment and loose material. This class includes

[1] For information in regard to flow under ice cover see Water-Supply Paper U. S. Geol. Survey No. 187.

also many stations located in a pool below which is a permanent rocky riffle that controls the flow like a weir. Provided the control is sufficiently high and close to the gage to prevent cut and fill at the gaging point from materially affecting the slope of the water surface, the gage height will for all practical purposes be a true index of the discharge. Discharge measurements made at such stations usually plot within 2 or 3 per cent of the mean discharge curve, and the rating developed from that curve represents a very high degree of accuracy. Stations of this type are found in the north Atlantic coast drainage basins.

Class 2 is confined mainly to stations on rough mountainous streams with steep slope. The beds of such streams are, as a rule, comparatively permanent during low and medium stages, and when the flow is sufficiently well defined by an adequate number of discharge measurements before and after each flood the stations of this class give nearly as good results as those of class 1. As it is seldom possible to make measurements covering the time of change at flood stage, the assumption is often made that the curves before and after the flood converged to a common point at the highest gage height recorded during the flood. Hence the only uncertain period occurs during the few days of highest gage heights covering the period of actual change in conditions of flow. Stations of this type are found in the upper Missouri River drainage basin.

Class 3 includes most of the current-meter gaging stations maintained by the United States Geological Survey. If sufficient measurements could be made at stations of this class results would be obtained nearly equaling those of class 1, but owing to the limited funds at the disposal of the Survey this is manifestly impossible, nor is it necessary for the uses to which discharge data are applied. The critical points are as a rule at relatively high or low stages. The percentage error, however, is greater at low stages. No absolute rule can be laid down for stations of this class. Each rating curve must be constructed mainly on the basis of the measurements of the current year, the engineer being guided largely by the past history of the station and the following general law. If all measurements ever made at a station of this class are plotted on cross-section paper, they will define a mean curve which may be called a "standard curve." It has been found in practice that if after a change caused by high stage a relatively constant condition of flow occurs at medium and low stages, all measurements made after the change will plot on a smooth curve which is practically parallel to the standard curve with respect to their ordinates, or gage heights. This law of the parallelism of ratings is the fundamental basis of all ratings and estimates at stations with semipermanent and shifting channels. It is not absolutely correct, but, with few exceptions, answers all the practical

requirements of estimates made at low and medium stages after a change at a high stage. This law appears to hold equally true whether the change occurs at the measuring section or at some controlling point below. The change is, of course, fundamentally due to change in the channel caused by cut or fill, or both, at or near the measuring section. For all except small streams the changes in section usually occur at the bottom. The following simple but typical examples illustrate this law:

(*a*) If 0.5 foot of planking were to be nailed on the bottom of a well-rated wooden flume of rectangular section, there would result, other conditions of flow being equal, new curves of discharge, area, and velocity, each plotting 0.5 foot above the original curves when referred to the original gage. In other words, this condition would be analogous to a uniform fill or cut in a river channel which either reduces or increases all three values of discharge, area, and velocity for any given gage height. In practice, however, such ideal conditions rarely exist.

(*b*) In the case of a cut or fill at the measuring section there is a marked tendency toward decrease or increase, respectively, of the velocity. In other words, the velocity has a compensating effect, and if the compensation is exact at all stages the discharge at a given stage will be the same under both the new and the old conditions.

(*c*) In the case of uniform change along the crest of a weir or rocky control, the area curve will remain the same as before the change, and it can be shown that here again the change in velocity curve is such that it will produce a new discharge curve essentially parallel to the original discharge curve with respect to their ordinates.

Of course, in actual practice such simple changes of section do not occur. The changes are complicated and lack uniformity, a cut at one place being largely offset by a fill at another, and vice versa. If these changes are very radical and involve large percentages of the total area—as, for example, on small streams—there may result a wide departure from the law of parallelism of ratings. In complicated changes of section the corresponding changes in velocity which tend to produce a new parallel discharge curve may interfere with each other materially, causing eddies, boils, backwater, and radical changes in slope. In such extreme conditions, however, the measuring section would more properly fall under class 4 and would require very frequent measurements of discharge. Special stress is laid on the fact that, in the lack of other data to the contrary, the utilization of this law will yield the most probable results.

Slight changes at low or medium stages of an oscillating character are usually averaged by a mean curve drawn among them parallel to the standard curve, and if the individual measurements do not vary more than 5 per cent from the rating curve the results are

considered good for stations of this class. Stations of this type are found in the south Atlantic coast and eastern Gulf of Mexico drainage basins.

Class 4 comprises stations that have soft, muddy, or sandy beds. Good results can be obtained from such sections only by frequent discharge measurements, the frequency varying from a measurement every two or three weeks to a measurement every day, according to the rate of diurnal change in conditions of flow. These measurements are plotted and a mean or standard curve drawn among them. It is assumed that there is a different rating curve for every day of the year and that this rating is parallel to the standard curve with respect to their ordinates. On the day of a measurement the rating curve for that day passes through that measurement. For days between successive measurements it is assumed that the rate of change is uniform, and hence the ratings for the intervening days are equally spaced between the ratings passing through the two measurements. This method must be modified or abandoned altogether under special conditions. Personal judgment and a knowledge of the conditions involved can alone dictate the course to pursue in such cases. Stations of this type are found in the Platte, Arkansas, Rio Grande, and lower Colorado drainage basins.

The computations have, as a rule, been carried to three significant figures. Computation machines, Crelle's tables, and the 20-inch slide rule have been generally used. All computations are carefully checked.

After the computations have been completed they are entered in tables and carefully studied and intercompared to eliminate or account for all gross errors so far as possible. Missing periods are filled in, so far as is feasible, by means of comparison with adjacent streams. The attempt is made to complete years or periods of discharge, thus eliminating fragmentary and disjointed records. Full notes accompanying such estimates follow the daily and monthly discharge tables.

For most of the northern stations estimates have been made of the monthly discharge during frozen periods. These are based on measurements under ice conditions whenever available, daily records of temperature and precipitation obtained from the United States Weather Bureau, climate and crop reports, observers' notes of conditions, and a careful and thorough intercomparison of results with adjacent streams. Although every care possible is used in making these estimates, they are often very rough, the data for some of them being so poor that the estimates are liable to as much as 25 to 50 per cent error. It is believed, however, that estimates of this character are better than none at all, and serve the purpose of indi-

cating in a relative way the proportionate amount of flow during the frozen period. These estimates are, as a rule, included in the annual discharge. The large error of the individual months has a relatively small effect on the annual total, and it is for many purposes desirable to have the yearly discharge computed, even though some error is involved in doing so.

ACCURACY AND RELIABILITY OF FIELD DATA AND COMPARATIVE RESULTS.

Practically all discharge measurements made under fair conditions are well within 5 per cent of the true discharge at the time of observation. Inasmuch as the errors of meter measurements are largely compensating, the mean rating curve, when well defined, is much more accurate than the individual measurements. Numerous tests and experiments have been made to test the accuracy of current-meter work. These show that it compares very favorably with the results from standard weirs and, owing to simplicity of methods, usually gives results that are much more reliable than those from stations at dams, where uncertainty regarding the coefficient and complicated conditions of flow prevail.

The work is, of course, dependent on the reliability of the obervers. With relatively few exceptions, the observers perform their work honestly. Care is taken, however, to watch them closely and to inquire into any discrepancies. It is, of course, obvious that one gage reading a day does not always give the mean height for that day. As an almost invariable rule, however, errors from this source are compensating and virtually negligible in a period of one month, although a single day's reading may, when taken by itself, be considerably in error.

The effort is made to visit every station at least once each year for the purpose of making a measurement to determine the constancy of conditions of flow since the last measurement made during the preceding year and also to check the elevation of the gage. On account of lack of funds or for other causes some stations were not visited during the current year. If conditions of flow have been reasonably permanent up to the time of the last preceding measurement, it is considered best to publish values of discharge on the basis of the latest verified rating curve rather than to omit them altogether, although it should be distinctly understood that such records are at times subject to considerable error. This is also true, although to a less degree, of the period of records since the date of the last measurement of the current year. As a rule, the accuracy notes are based on the assumption that the rating curve used is strictly applicable to the current year.

In order to give engineers and others information regarding the probable accuracy of the computed results, footnotes are added to the daily discharge tables, stating the probable accuracy of the rating tables used, and an accuracy column is inserted in the monthly discharge table. For the rating tables "well defined" indicates, in general, that the rating is probably accurate within 5 per cent; "fairly well defined," within 10 per cent; "poorly defined" or "approximate," within 15 to 25 per cent. These notes are very general and are based on the plotting of the individual measurements with reference to the mean rating curve.

The accuracy column in the monthly discharge table does not apply to the maximum or minimum nor to any individual day, but to the monthly mean. It is based on the accuracy of the rating, the probable reliability of the observer, and knowledge of local conditions. In this column, A indicates that the mean monthly flow is probably accurate within 5 per cent; B, within 10 per cent; C, within 15 per cent; D, within 25 per cent. Special conditions are covered by footnotes.

USE OF THE DATA.

In general, the policy is followed of making available for the public the base data which are collected in the field each year by the survey engineers. This is done to comply with the law, and also for the express purpose of giving to any engineer the opportunity of examining the computed results and of changing and adjusting them as may seem best to him. Although it is believed that the rating tables and computed monthly discharges are as good as the base data up to and including the current year will warrant, it should always be borne in mind that the additional data collected at each station from year to year nearly always throws new light on data already collected and published, and hence allow more or less improvement in the computed results of earlier years. It is therefore expected that the engineer who makes serious use of the data given in these papers will verify all ratings and make such adjustments in earlier years as may seem necessary. The work of compiling, studying, revising, and republishing data for different drainage basins for 5 or 10 year periods or more is carried on by the United States Geological Survey so far as the funds for such work are available.

The values in the table of monthly discharge are so arranged as 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.

The daily discharges are published to allow a more detailed study of the variation in flow and to determine the periods of deficient flow.

COOPERATIVE DATA.

Cooperative data of various kinds and data regarding the run-off at many stations maintained wholly by private funds are incorporated in the surface water-supply reports of the United States Geological Survey.

Many stations throughout the country are maintained for specific purposes by private parties who supply the records gratuitously to the United States Geological Survey for publication. When such records are supplied by responsible parties and appear to be reasonably accurate they are verified, so far as possible, and estimated values of accuracy are given. Records clearly known to be worthless or misleading are not published. As it is, however, impossible to completely verify all such records furnished—because of lack of funds or for other causes—they are published for what they are worth, as they are of value as a matter of record and afford at least approximate information regarding stream flow at the particular localities. The survey does not, however, assume any responsibility for inaccuracies found in such records, although most of them are believed to be reasonably good.

COOPERATION AND ACKNOWLEDGMENTS.

The greater part of the work in Montana has been done under cooperative agreement with the United States Reclamation Service, the work being done by the Geological Survey and the expense borne by the Reclamation Service. Some aid has been also received from the State. The State engineer has a small fund available for this work, which is expended in accordance with paragraph 3, section 2244, of the Revised Codes of 1907 of the State of Montana, which reads as follows:

> The State engineer shall become conversant with the waterways of the State and the needs of the State as to irrigation matters, shall make or cause to be made measurements and calculations of the ordinary and flood discharge of streams, cooperating in this work as much as possible with the United States Geological Survey and the Montana Experiment Station; such measurements to be made on streams in order of their importance, provided that measurements already made, if deemed reliable, may be adopted.

This fund has been expended for gage-observers' salaries on stations in connection with the Carey Act projects.

Acknowledgments are due to the Glass-Lindsay Land Co. for transportation furnished in connection with work in Sweetgrass County. Acknowledgments are also due to the Great Northern and Northern Pacific railway companies.

In Colorado, Wyoming, and Nebraska assistance has been rendered or records furnished by the following persons or corporations, to whom acknowledgments are due:

The United States Reclamation Service, the United States Weather Bureau, the United States Forest Service, the Central Colorado Power Co., the Denver Reservoir and Irrigation Co., the Geneva Power Co., the Denver Power and Irrigation Co., and the Denver Union Water Co.

Special acknowledgments are due the following parties for financial or cooperative assistance:

The State engineer of Colorado, Mr. Charles W. Comstock, who paid the salaries of the observers and the expenses of the hydrographers at a number of stations, furnished many records which he secured independently, and materially assisted in the work in other ways.

The State engineer of Nebraska, Mr. E. C. Simmons, who, under cooperative contract, paid more than half the expense of carrying on the stream-gaging work in that State.

The State engineer of Wyoming, Mr. C. T. Johnston, who paid the salaries of the observers at three stations in the Wind River drainage basin, Wyoming.

The United States Indian Office, Shoshone irrigation survey, which paid the salary and expenses of a hydrographer and the salaries of the gage observers for several months during 1909 on cooperative work in the Shoshone or Wind River Reservation, Wyo.

Mr. George B. McFadden, of Denver, who paid the salaries of the hydrographers and all other expenses in connection with the maintenance of the two stations on Cache la Poudre River.

Prof. George J. Lyon, of Colorado College, who furnished his services as hydrographer gratis for a number of weeks during the year and gave valuable suggestions and assistance to the work.

DIVISION OF WORK.

The work in Montana was under the charge of J. E. Stewart, district engineer, assisted by W. A. Lamb and Raymond Richards.

The work in North Dakota was carried on by E. F. Chandler, assistant engineer.

The field data in the South Platte and North Platte drainage areas and in the Bighorn drainage area above the Shoshone were collected under the direction of W. B. Freeman, district engineer, assisted by J. B. Stewart, G. H. Russell, C. L. Chatfield, A. P. Poorman, R. L. Cooper, Prof. G. J. Lyon, R. C. Miles, Arthur A. Dobson, and engineers of the United States Reclamation Service.

The field work in the Niobrara, Platte, and Kansas River drainage basins in Nebraska has been under the general supervision of W. B. Freeman, district engineer, but under the more immediate direction of Mr. E. C. Simmons, State engineer, assisted by Arthur A. Dobson, D. D. Price, and employees of the State engineer's office.

The ratings, special estimates, and studies of the completed data were made by W. A. Lamb and F. F. Henshaw for Montana, and by

W. B. Freeman and R. H. Bolster for Wyoming, Colorado, and Nebraska. The computations and the preparation of the completed data for publication were made by R. C. Rice, J. G. Mathers, H. D. Padgett, M. I. Walters, C. E. Ellsworth, G. L. Parker, J. J. Phelan, W. A. Lamb, Raymond Richards, and M. E. McChristie. The report was edited by Mrs. B. D. Wood.

GAGING STATIONS MAINTAINED IN THE MISSOURI RIVER DRAINAGE BASIN.

The following list comprises the gaging stations maintained in the Missouri River drainage basin by the United States Geological Survey and cooperative parties. Data for these stations have been published in the reports listed on page 13. The stations are arranged by river basins, in downstream order, tributaries of main streams being indicated by indention. (See p. 15.)

Red Rock River (head of Missouri) at Red Rock, Mont., 1890.
Red Rock River at Lima, Mont., 1907–1909.
Beaverhead River at Barratts, Mont., 1907–1909.
Beaverhead River at Dillon, Mont., 1907.
Jefferson River near Sappington, Mont., 1896–1905.
Missouri River near Townsend, Mont., 1895–1904.
Missouri River at Canyon Ferry, Mont., 1889.
Missouri River near Craig, Mont., 1890–1902.
Missouri River at Cascade, Mont., 1902–1909.
Missouri River at Great Falls, Mont., 1897–1905.
Missouri River near Williston, N. Dak., 1905–1907.
Missouri River at Mannhaven, N. Dak., 1904.
Missouri River at Washburn, N. Dak., 1905.
Missouri River near Bismarck, N. Dak., 1904–5.
Missouri River at Kansas City, Mo., 1905–6.
Madison River near Red Bluff, Mont., 1890–1893.
Madison River near Norris, Mont., 1897–1905.
Madison River near Three Forks, Mont., 1895–1897.
West Gallatin River (head of Gallatin) near Salesville, Mont., 1895–1905.
West Gallatin River near Bozeman, Mont., 1889–1893.
Gallatin River at Logan, Mont., 1895–1905.
Middle Creek near Bozeman, Mont., 1895–96, 1898–1900, and 1901.
Crow Creek near Radersburg, Mont., 1903.
Prickly Pear Creek near Clancy, Mont., 1908–9.
Prickly Pear Creek at East Helena, Mont., 1908–9.
Lump Gulch Creek at Clancy, Mont., 1908–9.
Tenmile Creek near Helena, Mont., 1908–9.
Sevenmile Creek near Birdseye, Mont., 1908–9.
Little Prickly Pear Creek near Marysville, Mont., 1909.
Little Prickly Pear Creek near Canyon Creek, Mont., 1909.
Deadman Creek near Marysville, Mont., 1909.
Lost Horse Creek near Marysville, Mont., 1909.
Marsh Creek near Marysville, Mont., 1909.
Dearborn River near Clemons, Mont., 1908–9.
Falls Creek near Clemons, Mont., 1908–9.
Smith River at Truly, Mont., 1905–1907.

Missouri River tributaries—Continued.
Sun River (North Fork) at Augusta, Mont., 1889–1890, 1903–1909.
Sun River at Sun River, Mont., 1905–1909.
Sun River near Great Falls, Mont., 1897.
Willow Creek near Augusta, Mont., 1905–1909.
Sun River (South Fork) at Augusta, Mont., 1904–1909.
Ford Creek near Augusta, Mont., 1906–1909.
Smith Creek near Augusta, Mont., 1906–1909.
Belt Creek near Belt, Mont., 1905–6.
Highwood Creek near Highwood, Mont., 1905–6.
Marias River near Shelby, Mont., 1902–1907.
Two Medicine River near Midvale, Mont., 1902–3.
Two Medicine River at Family, Mont., 1907–1909.
Badger Creek near Family, Mont., 1907–1909.
Cutbank Creek at Cutbank, Mont., 1905–1909.
Birch Creek near Dupuyer, Mont., 1907–1909.
Dupuyer Creek at Dupuyer, Mont., 1908–9.
Teton River at Chouteau, Mont., 1905–6.
Teton River near Belleview, Mont., 1905–6 and 1908–9.
Musselshell River (North Fork) near Delpine, Mont., 1909.
Musselshell River (North Fork) near Martinsdale, Mont., 1907–1909.
Musselshell River at Harlowton, Mont., 1907–1909.
Musselshell River at Shawmut, Mont., 1902–1907.
Musselshell River at Lavina, Mont., 1906.
Checkerboard Creek near Delpine, Mont., 1909.
Musselshell River (South Fork) near Martinsdale, Mont., 1907–1909.
American Fork near Harlowton, Mont., 1907–1909.
Lebo Creek near Harlowton, Mont., 1907–1909.
Milk River (South Fork) near Browning, Mont., 1905–1909.
Milk River at Havre, Mont., 1898–1909.
Milk River at Chinook, Mont., 1897.
Milk River at Malta, Mont., 1902–1909.
Milk River at Hinsdale, Mont., 1909.
Milk River (West Fork) at Chinook, Mont., 1906–1909.
Milk River (North Fork) near Chinook, Mont., 1906–1909.
Beaver Creek near Ashfield, Mont., 1903–1906 and 1908–9.
Beaver Creek overflow channel near Bowdoin, Mont., 1903–1906.
Rock Creek near Hinsdale, Mont., 1905–1907.
Porcupine Creek near Nashua, Mont., 1908–9.
Canals in Milk River basin—
Paradise Valley canal near Chinook, Mont., 1903–1909.
Cook canal near Chinook, Mont., 1905–1909.
Matheson canal near Chinook, Mont., 1905–6 and 1908–9.
Reser ditch near Chinook, Mont., 1905–6.
West Fork ditch near Chinook, Mont., 1905–6.
Harlem canal near Zurich, Mont., 1904–1906 and 1908–9.
Agency ditch near Harlem, Mont., 1905–1909.
Fort Belknap canal near Chinook, Mont., 1903–1909.
Winter Anderson canal near Chinook, Mont., 1906 and 1908.
Rock Creek canal near Hinsdale, Mont., 1905–1907.
Little Porcupine Creek near Frazer, Mont., 1908–9.
Wolf Creek at Wolf Point, Mont., 1908–9.
Wolf Point ditch at Wolf Point, Mont., 1909.
Poplar Creek near Poplar, Mont., 1908–9.
Big Muddy River near Culbertson, Mont., 1908–9.

Missouri River tributaries—Continued.
Yellowstone River near Horr, Mont., 1888–1893.
Yellowstone River at Livingston, Mont., 1897–1905.
Yellowstone River at Billings, Mont., 1904–5.
Yellowstone River at Huntley, Mont., 1907–1909.
Yellowstone River at Junction, Mont., 1906–7.
Yellowstone River at Glendive, Mont., 1897–1909.
Big Timber Creek (North Fork) near Big Timber, Mont., 1907–1909.
Big Timber Creek (South Fork) near Big Timber, Mont., 1907–1909.
Boulder River—
Boulder River (East Fork) near McLeod, Mont., 1907–1909.
Boulder River (West Fork) near Bruffeys, 1907–1909.
Boulder River (West Fork) near McLeod, Mont., 1907–1909.
Sweetgrass Creek above Melville, Mont., 1907–1909.
Sweetgrass Creek below Melville, Mont., 1907–1909.
Clark Fork at Fromberg, Mont., 1905–1909.
Pryor Creek near Huntley, Mont., 1904–1909.
Big Wind River (head of Bighorn) near Wind River, Wyo., 1906–1909.
Bighorn River near Hardin, Mont., 1904–1909.
Bighorn River at Thermopolis, Wyo., 1900–1905.
Red River near Dubois, Wyo., 1909.
Dinwoody Creek near Crowheart, Wyo., 1909.
Dry Creek at Crowheart, Wyo., 1909.
Meadow Creek near J. K. Ranch, Wyo., 1909.
Willow Creek at J. K. Ranch, Wyo., 1909.
Bull Lake Creek near J. K. Ranch, Wyo., 1909.
Little Wind River at Fort Washakie, Wyo., 1908–9.
Little Wind River above Arapahoe Agency, Wyo., 1906–1909.
Little Wind River below Arapahoe Agency, Wyo., 1906–1909.
Little Wind River (South Fork) near Wind River, Wyo., 1909.
St. Lawrence Creek, near Wind River, Wyo., 1909.
Trout Creek at Wind River, Wyo., 1909.
Little Popo Agie River at Hudson, Wyo., 1907–1909.
Gray Bull Creek near Meeteetse, Wyo., 1897, 1903.
Shoshone River at Cody, Wyo., 1902–1909.
Shoshone River at Corbett dam., Wyo., 1908–9.
Shoshone River near Lovell, Wyo., 1897–1899.
Shoshone River (South Fork) at Marquette, Wyo., 1903–1909.
Little Bighorn River at Crow Agency, Mont., 1905–6.
Prairie Dog ditch near Story, Wyo., 1903.
Tongue River near Dayton, Wyo., 1903.
Big Goose Creek near Sheridan, Wyo., 1895–1897.
Little Goose Creek near Sheridan, Wyo., 1896–7.
Powder River—
Clear Creek at Buffalo, Wyo., 1896–1904.
Piney Creek at Kearney, Wyo., 1902–1906.
Cruez ditch near Story, Wyo., 1903.
Little Muddy River near Williston, N. Dak., 1904–1909.
Little Missouri River at Alzada, Mont., 1904–1906.
Little Missouri River at Camp Crook, S. Dak., 1903–1906.
Little Missouri River at Medora, N. Dak., 1903–1908.
Knife River at (near) Broncho, N. Dak., 1903–1909.
Heart River near Richardton, N. Dak., 1903–1909.
Apple Creek near Bismarck, N. Dak., 1905
Cannon Ball River at Stevenson, N. Dak., 1903–1909.

Missouri River tributaries—Continued.
- Grand River (North Fork) at Haley, N. Dak., 1908–9.
- Grand River near Seim, S. Dak., 1904–1906.
- Owl (Moreau) River, near Bixby, S. Dak., 1904–1906.
- Cheyenne River at Edgemont, S. Dak., 1903–1906.
  - Beaver Creek near Edgemont, S. Dak., 1905–6.
  - Hat Creek near Edgemont, S. Dak., 1905–6.
  - Battle Creek near Hermosa, S. Dak., 1903.
  - Spring Creek near Rapid, S. Dak., 1903–1906.
  - Rapid Creek at Rapid, S. Dak., 1903–1906.
  - Box Elder Creek at Blackhawk, S. Dak., 1903–1905.
    - Corbin-Morse ditch at Rapid, S. Dak., 1906.
  - Elk Creek near Piedmont, S. Dak., 1903.
  - Belle Fourche River at Belle Fourche, S. Dak., 1903–1906.
  - Belle Fourche River near Belle Fourche, S. Dak., 1906.
    - Redwater River at Belle Fourche, S. Dak., 1903–1906.
    - Redwater River near Minnesela, S. Dak., 1903.
      - Redwater canal at Minnesela, S. Dak., 1904–1906.
      - Spearfish Creek near Spearfish, S. Dak., 1903–1906.
      - Crow Creek near Belle Fourche, S. Dak., 1904.
      - Owl Creek near Belle Fourche, S. Dak., 1904.
      - Indian Creek near Belle Fourche, S. Dak., 1904.
- White River at Interior, S. Dak., 1904–1906.
- Niobrara River near Valentine (Fort Niobrara), Nebr., 1897, 1899, 1901–1906.
- Niobrara River near Spencer, Nebr., 1908.
- Niobrara River near Niobrara, Nebr., 1902.
  - Red Deer Lake (head of Plum Creek) near Woodlake, Nebr., 1904–5.
- James River near Lamoure, N. Dak., 1903.
- Big Sioux River near Watertown, S. Dak., 1900–1903.
- Big Sioux River near Sioux Falls, S. Dak., 1900–1.
  - Grizzly Creek at Hebron, Colo., 1904–5.
- North Platte River (head of Platte River) near Hebron, Colo., 1904–5.
- North Platte River near Cowdrey, Colo., 1904–5.
- North Platte River near Pinkhampton, Colo., 1904.
- North Platte River at Saratoga, Wyo., 1903–1906 and 1909.
- North Platte River at Pathfinder, Wyo., 1905–1909.
- North Platte River at Alcova, Wyo., 1904–5.
- North Platte River near Douglas, Wyo., 1894.
- North Platte River near Orin Junction, Wyo., 1895–1900.
- North Platte River near Fort Laramie, Wyo., 1887–1889.
- North Platte River at Guernsey, Wyo., 1900–1908.
- North Platte River at Whalen, Wyo., 1909.
- North Platte River near Mitchell, Nebr., 1901–1909.
- North Platte River near Gering, Nebr., 1897–1900.
- North Platte River near Camp Clark, Nebr., 1896–1900.
- North Platte River at Bridgeport, Nebr., 1902–1906.
- North Platte River near North Platte, Nebr., 1894–1909.
- Platte River near Lexington, Nebr., 1902–1906.
- Platte River at Columbus, Nebr., 1895–1909.
- Platte River near South Bend, Nebr., 1903.
  - Little Grizzly Creek at Hebron, Colo., 1904–5.
  - North Platte (Roaring Fork) near Hebron, Colo., 1904–5.
  - North Platte (North Fork) at Higho, Colo., 1904–5.
  - Michigan Creek near Walden, Colo., 1904–5.
  - Michigan Creek near Cowdrey, Colo., 1904–5.

Missouri River tributaries—Continued.
Platte River tributaries—Continued.
Canadian River at Cowdrey, Colo., 1904–5.
Grand Encampment Creek near Peryam's ranch, Wyo., 1900.
Medicine Bow River near Medicine Bow, Wyo., 1901.
Sweetwater River near Splitrock, Wyo., 1902–3.
Laramie River at Glendevey, Colo., 1904–5.
Laramie River near Jelm, Wyo., 1904–5.
Laramie River near Woods Landing, Wyo., 1895–1900.
Laramie River near Uba, Wyo., 1895–1900, 1903.
McIntyre Creek near Gleneyre, Colo., 1904–5.
Little Laramie River near Hatton, Wyo., 1902–3.
Little Laramie River near Laramie, Wyo., 1903.
South Platte (South Fork) near Cheesman Lake, Colo., 1899–1901.
South Platte (South Fork) at South Platte, Colo., 1905–1909.
South Platte River at South Platte, Colo., 1902–1909.
South Platte River near Deansbury (Platte Canyon), Colo., 1887–1892, 1895–1900.
South Platte River at Denver, Colo., 1895–1906, 1909.
South Platte River near Kersey, Colo., 1901–1903, 1905–1909.
South Platte River near Orchard, Colo., 1895–1900.
South Platte River near Julesburg, Colo., 1902–1906, 1908–9.
South Platte River near Big Spring., Nebr., 1902–3.
Goose Creek near Cheesman Lake, Colo., 1899.
South Platte River (North Fork) at Cassells, Colo., 1908–9.
South Platte River (North Fork) at South Platte, Colo., 1909.
Geneva Creek above Jackwhacker Creek, near Grant, Colo, 1909.
Geneva Creek at Old Geneva smelter, near Grant, Colo., 1909.
Geneva Creek at Sullivan's ranch, near Grant, Colo., 1908–9.
Smelter Creek at Old Geneva smelter, near Grant, Colo., 1909.
Duck Lake Creek near Grant, Colo., 1909.
Scott Gomer Creek at Geneva Power Co. dam site, Colo., 1909.
Scott Gomer Creek at Sullivan's ranch, near Grant, Colo., 1909.
Bear Creek near Morrison, Colo., 1888–1891, 1895–1902.
Clear Creek at Forkscreek, Colo., 1899–1909.
Clear Creek at Golden, Colo., 1897–1898 and 1909.
St. Vrain Creek near Lyons, Colo., 1888–1892, 1895–1903, and 1909.
Boulder Creek at Orodell, Colo., 1907–8.
Boulder Creek, near Boulder, Colo., 1888–1892, 1895–1901, 1907–1909.
North Boulder Creek near Boulder, Colo., 1887–1890.
South Boulder Creek near Marshall, Colo., 1888–1892, 1895–1901, and 1909.
Community Canal near Marshall, Colo., 1909.
Big Thompson Creek near Arkins, Colo., 1888–1890, 1895–1903, and 1909.
Big Thompson Creek near Loveland, Colo., 1888–1890.
Handy Ditch near Arkins, Colo., 1899–1900, 1903.
Cache la Poudre River near Elkhorn, Colo., 1909.
Cache la Poudre River near Fort Collins, Colo., 1884–1901 and 1909.
Cache la Poudre River near Greeley, Colo., 1903.
Middle Crow Creek near Hecla, Wyo., 1902–3.
Loup River at Columbus, Nebr., 1894–1909.
Middle Loup River near St. Paul, Nebr., 1895, 1897, 1899, 1903.
North Loup River near St. Paul, Nebr., 1895, 1897, 1899, 1903.

Missouri River tributaries—Continued.
Platte River tributaries—Continued.
Elkhorn River near Norfolk, Nebr., 1896–1903.
Elkhorn River near Arlington, Nebr., 1898–1903.
Elkhorn River (South Fork) near Norfolk, Nebr., 1896.
Republican River (North Fork) [head of Kansas River] near Benkleman, Nebr., 1895.
Republican River at Benkleman, Nebr., 1903–1906.
Republican River at Bostwick, Nebr., 1904–1909.
Republican River near Superior, Nebr., 1896–1903.
Republican River at Junction, Kans., 1895–1905.
Kansas River near St. George, Kans., 1904.
Kansas River near Topeka, Kans., 1904.
Kansas River near Lecompton, Kans., 1899–1901, 1903–1906
Kansas River near Lawrence, Kans., 1895–1899.
Republican River:
Republican River (South Fork) at Benkleman, Nebr., 1895, 1903–1906.
Frenchman River near Wauneta, Nebr., 1895.
Frenchman River near Palisade, Nebr., 1895–96.
Smoky Hill River at Ellsworth, Kans., 1895–1902, 1904–5.
Smoky Hill River at Solomon, Kans., 1902–1904.
Beaver (Ladder) Creek near Scott City, Kans., 1904–5.
Saline River near Salina, Kans., 1895–1903.
Solomon River near Niles, Kans., 1895–1903.
Blue River at Manhattan, Kans., 1895–1905.
Little Blue River near Fairbury, Nebr., 1908–9.
Osage River at Ottawa, Kans., 1902–1905.
Gasconade River at Arlington, Mo., 1903–1906.
Gasconade River (Piney Fork) near Houston, Mo., 1908.
Gasconade River (Piney Fork) near Hooker, Mo., 1903. (Also called Big Piney Creek.)
Little Piney Creek near Arlington, Mo., 1903.

MISSOURI RIVER DRAINAGE BASIN.

GENERAL FEATURES.

Missouri River and its innumerable tributaries drain an immense area in the northern and western sections of the United States. The northern boundary of this area is approximately the fiftieth parallel, the southern the thirty-ninth; to the west it is limited by the Rocky Mountains; to the east the divide between it and the upper Mississippi basin crosses eastern North and South Dakota, western Iowa, and northeastern Missouri. Its extent east and west is about 900 miles; north and south it is 600 miles; and it comprises a total of 492,000 square miles.

The topography of the basin shows all gradations from the mountainous regions of Montana, Wyoming, and Colorado to the rolling prairies of the Dakotas, Nebraska, and Kansas. The upper tributaries drain a forested region, but the main stream flows through a country almost wholly devoid of forests. The precipitation in the mountainous portion of the basin is mainly in the form of snow, but a great part of the area lies within the arid and semiarid regions, and

it is probable that the annual average precipitation throughout the entire basin is less than 20 inches.

The tributaries are chiefly in the upper course of the river and from the western side of the basin. The most important of these are Musselshell, Sun, Marias, Milk, Yellowstone, Cheyenne, Platte, and Kansas rivers.

Owing to the high altitude and northern climate ice prevails in the upper portions of this basin from November to April. The Missouri itself freezes over entirely, but many of its tributaries remain partly open on account of the extreme rapidity of the water. The amount of snow falling on the prairies is usually small, but among the mountains the snows begin early, continue late, and accumulate to great depths.

Irrigation is practiced to a great extent on the various tributaries of the Missouri and agriculture has been extensively developed in many of the valleys. The Madison and Gallatin and many other of the mountain tributaries afford unsurpassed storage facilities, the waters of the Beaverhead, Bighole, Madison, Jefferson, and Gallatin rivers furnish great supplies for irrigation, and the basins of Milk, Sun, Yellowstone, and Musselshell rivers, already extensively utilized, still offer opportunities for broader irrigation, storage, and water-power development.

MISSOURI RIVER PROPER.

DESCRIPTION.

Missouri River proper is formed in southwestern Montana by the union of three streams, which were discovered by Lewis and Clark in 1806 and named by them Jefferson, Madison, and Gallatin rivers. Jefferson and Madison forks come together first, and within 2 miles they are joined by the Gallatin. The head of the Missouri thus formed lies about in latitude 45° 56′ north and longitude 111° 32′ west. Each of the three headwater rivers is about 90 feet wide, flows with great velocity, and discharges large quantities of water. The Gallatin is the most rapid of the three, but the Jefferson drains the largest area, and is here treated as the continuation of the main river. The Jefferson itself is formed by the union of two forks—Bighole and Beaverhead rivers—the Beaverhead draining the larger area and having as its master headwater stream Red Rock River. The source of this last-named river—the Red Rock Lakes, lying in the Rocky Mountains 6,700 feet above sea level—may, therefore, be regarded as the ultimate source of the great Missouri.

Below the junction of the Jefferson, Madison, and Gallatin the course of the Missouri lies through mountain valleys and deep canyons, from which it finally emerges through a gorge in a range of

rocks, called by Lewis and Clark the "gates of the Rocky Mountains." Thirty-five miles above Fort Benton the river pours over Great Falls, and from that point onward it is a navigable stream. For miles below the falls the river flows in a deep canyon, with banks ranging from 100 to 160 feet in height. Below the mouth of Marias River, which enters from the north, the banks are less abrupt and rise with gentle slopes to the bluffs. The high-water width of the river, which in the vicinity of Fort Benton is 500 to 1,000 feet, increases to 1,500 feet at the mouth of Milk River and to 2,000 feet near the mouth of the Yellowstone. Below the Yellowstone the width gradually increases from 2,000 to 3,000 feet, and this remains approximately the average width for 600 miles of its course.

From the mouth of the Yellowstone the Missouri follows a winding but on the whole southeasterly course until it is joined by the Kansas; thence it flows more to the east across the State of Missouri, and empties into the Mississippi 16 miles above St. Louis, 189 miles above the mouth of the Ohio, and 2,340[1] miles below the junction of its three upper forks.

For the first 350 miles below the union of the three forks the Missouri is a comparatively clear stream, but approximately midway between the forks and the mouth of the Yellowstone its character gradually changes and it becomes turbid. Although a large amount of the sediment carried by the Missouri is undoubtedly brought in by the drainage of its tributaries, the greater part is derived from the caving of its banks.

Except in the mountain canyons the Missouri flows through an alluvial bottom land of the most fertile character, varying in width from 1½ miles near the mouth to 17 miles in the vicinity of Sioux City.

The volume of Missouri River is subject to great variations, the ordinary high-water discharge at the mouth being about 28 times the low-water discharge. The freshets are caused by melting snows and heavy summer rains. The regular floods occur in May, June, and July, the June discharge being the greatest. Thereafter the river steadily decreases in volume, the minimum being reached during the winter months. Records obtained at Cascade and Townsend indicate 1899 as the wettest year and 1905 as the driest.

The Missouri itself has not been used for irrigation, owing to its high banks and consequent difficulty of diversion. Approximately 150,000 acres of land are now under irrigation in Beaverhead Valley, and by storing the waters of the upper Beaverhead or Red Rock River in Red Rock Lakes fully 125,000 acres more can be put under irrigation.

[1] Given as 2,824 miles in Water-Supply Paper 246. This number was taken from the report of the Tenth Census. More reliable information has since been published. See Water-Supply Paper 44, p. 70.

In Montana the Missouri, with its tributaries, affords many opportunities for power development. A number of large, substantial power stations have been built, and approximately 75,000 horsepower is now being developed. Engineers estimate that 350,000 horsepower can be developed on the Missouri River near Great Falls.

RED ROCK RIVER AT LIMA, MONT.

This station, which was established August 14, 1907, to obtain data concerning the amount of water available for irrigation, is located near the Gleed ranch, 1 mile east of Lima.

The tributaries above the station are small and unimportant, the stream at the gaging station receiving its water supply chiefly from the melting snow in the mountains. Below the station Sheep and Sage creeks are the principal tributaries.

Diversions from this stream are many. Above the station 3 ditches, carrying approximately 900 miner's inches each, receive their water supply from the Red Rock. The water is all appropriated above the station, but the rights are unadjudicated. The dam of the reservoir storing the water of the Red Rock has been completed, but no canals have been built. It is an earthen dam with concrete core, is 50 feet high, and has a capacity of 90,000 acre-feet. The dam is 16 miles above Lima, Mont., and 27 miles below lower Red Rock Lakes. Its top elevation is 6,700 feet. This water will be used to irrigate 25,000 acres of land near Lima.

On October 27, 1908, a new chain gage with a new datum was installed just above the cable, 300 feet farther downstream than the old staff gage which it replaces. The stream bed is permanent and the results obtained are good. A large spring enters the stream just above the gage and the river remains open the entire year. Measurements are made from a cable in ordinary and high-water stages, but in extreme low water measurements may be made by wading just below the cable section.

Discharge measurements of Red Rock River at Lima, Mont., in 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Feb. 19	J. E. Stewart	34	43.6	0.70	49.1
Apr. 29	Raymond Richards	40	135	3.11	537
June. 16	J. E. Stewart	32	42.6	1.00	54.8
Aug. 18[a]	Raymond Richards	32	37.9	1.13	70.5
Nov. 18[a]	.....do	35	54.9	1.40	110

[a] Made by wading.

Daily gage height, in feet, of Red Rock River at Lima, Mont., for 1908–9.

[Alice Gleed, observer.]

Day.	Oct.	Nov.	Dec.	Day.	Oct.	Nov.	Dec.	Day.	Oct.	Nov.	Dec.
1908.				1908.				1908.			
1		1.85	1.25	11		1.6	1.25	21		1.45	1.15
2		1.8	1.2	12		1.7	1.2	22		1.4	1.1
3		1.85	1.3	13		1.65	1.2	23		1.35	1.0
4		1.85	1.2	14		1.6	1.15	24		1.4	1.05
5		1.95	1.25	15		1.65	1.2	25		1.35	1.1
6		1.9	1.2	16		1.6	1.1	26		1.2	1.15
7		1.8	1.25	17		1.5	1.15	27		1.25	1.1
8		1.75	1.2	18		1.6	1.1	28		1.2	1.0
9		1.6	1.3	19		1.45	1.1	29	1.95	1.25	1.15
10		1.55	1.2	20		1.5	1.15	30	1.9	1.2	1.0
								31	1.85		1.1

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1909.												
1				1.2	3.25	2.6	1.8	1.3	1.2	1.7	1.75	1.2
2				1.25	3.6	2.65	1.85	1.25	1.3	1.75	1.75	1.15
3		0.7	0.85	1.35	3.65	2.7	1.9	1.3	1.35	1.7	1.75	1.15
4				1.5	3.7	1.85	1.8	1.3	1.4	1.7	1.7	1.1
5				1.55	3.8	1.65	1.75	1.3	1.45	1.75	1.7	1.2
6	0.9	.75	.85	1.6	3.6	1.6	1.7	1.25	1.4	1.75	1.7	1.25
7			.85	1.65	3.5	1.6	1.65	1.25	1.45	1.75	1.7	1.3
8				1.6	3.4	1.65	1.6	1.2	1.5	1.7	1.6	1.25
9				1.5	3.4	2.4	1.65	1.25	1.55	1.75	1.6	1.3
10	.9	.7	.9	1.45	3.5	2.6	1.7	1.2	1.6	1.75	1.55	1.25
11				1.5	3.45	1.5	1.65	1.25	1.65	1.8	1.55	1.3
12				1.6	2.6	1.6	1.6	1.2	1.6	1.8	1.55	1.3
13	.9	.75	.95	1.65	2.7	1.5	1.6	1.25	1.55	1.8	1.55	1.3
14		.75	.95	1.75	2.75	1.0	1.5	1.2	1.5	1.8	1.55	1.4
15	.85			1.85	2.8	.8	1.4	1.2	1.45	1.7	1.55	1.4
16	.8			2.0	2.8	.7	1.35	1.15	1.45	1.7	1.5	1.35
17		.75	.9	2.25	2.8	.65	1.3	1.1	1.4	1.65	1.5	1.3
18				2.25	2.75	1.4	1.3	1.15	1.35	1.65	1.5	1.3
19		.7		2.25	2.8	1.5	1.25	1.05	1.4	1.6	1.55	1.3
20	.8		1.0	2.0	2.75	1.6	1.2	1.05	1.35	1.6	1.5	1.3
21		.75	1.0	2.25	2.7	1.65	1.3	1.05	1.35	1.65	1.45	1.3
22				2.2	1.85	1.8	1.4	1.0	1.45	1.6	1.45	1.3
23	.75		1.0	2.25	1.9	1.7	1.3	1.05	1.45	1.65	1.4	1.35
24	.7	.8		2.0	2.0	1.65	1.25	1.05	1.5	1.7	1.4	1.35
25				2.4	2.1	1.7	1.4	1.0	1.5	1.65	1.35	1.35
26				2.6	2.3	1.6	1.35	1.05	1.55	1.7	1.3	1.4
27	.65	.85	1.1	3.0	2.4	1.7	1.3	1.05	1.6	1.7	1.35	1.4
28		.8	1.1	3.1	2.5	1.75	1.3	1.0	1.65	1.7	1.3	1.4
29			1.1	3.2	2.6	1.85	1.3	1.05	1.7	1.65	1.25	1.35
30	.6		1.15	3.25	2.65	1.9	1.25	1.1	1.7	1.7	1.2	1.35
31			1.2		2.5		1.2	1.15		1.7		1.35

NOTE.—Gage heights for 1908, prior to Oct. 29 are in error and consequently are not published.

Daily discharge, in second-feet, of Red Rock River at Lima, Mont., for 1908-9.

Day.	Oct.	Nov.	Dec.	Day.	Oct.	Nov.	Dec.	Day.	Oct.	Nov.	Dec.
1908.				1908.				1908.			
1		224	114	11		173	114	21		146	100
2		213	107	12		192	107	22		138	93
3		224	122	13		182	107	23		130	80
4		224	107	14		173	100	24		138	86
5		246	114	15		182	107	25		130	93
6		235	107	16		173	93	26		107	100
7		213	114	17		155	100	27		114	93
8		202	107	18		173	93	28		107	80
9		173	122	19		146	93	29	246	114	100
10		164	107	20		155	100	30	235	107	80
								31	224		93

Daily discharge, in second-feet, of Red Rock River at Lima, Mont., for 1908–9—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1909.												
1	90	44	58	107	583	376	180	93	79	160	170	79
2	90	46	60	114	705	391	190	86	93	170	170	72
3	80	47	62	130	722	406	200	93	100	160	170	72
4	70	48	62	155	740	190	180	93	108	160	160	66
5	70	50	62	164	775	150	170	93	116	170	160	79
6	68	52	62	173	705	141	160	86	108	170	160	86
7	68	51	62	182	670	141	150	86	116	170	160	93
8	68	50	65	173	635	150	141	79	124	160	141	86
9	68	48	68	155	635	319	150	86	132	170	141	93
10	68	47	70	146	670	376	160	79	141	170	132	86
11	68	48	71	155	652	124	150	86	150	180	132	93
12	68	50	72	173	376	141	141	79	141	180	132	93
13	68	52	74	178	406	124	141	86	132	180	132	93
14	65	52	74	195	421	56	124	79	124	180	132	108
15	62	52	72	215	436	39	108	79	116	160	132	108
16	57	52	70	250	436	31	100	72	116	160	124	100
17	57	52	68	300	436	28	93	66	108	150	124	93
18	57	50	72	300	421	108	93	72	100	150	124	93
19	57	47	76	300	436	124	86	61	108	141	132	93
20	57	50	80	240	421	141	79	61	100	141	124	93
21	56	52	80	300	406	150	93	61	100	150	116	93
22	54	54	80	287	190	180	108	56	116	141	116	93
23	52	56	80	300	200	160	93	61	116	150	108	100
24	47	57	84	227	220	150	86	61	124	160	108	100
25	48	58	87	327	243	160	108	56	124	150	100	100
26	46	60	90	382	292	141	100	61	132	160	93	108
27	44	62	93	510	319	160	93	61	141	160	100	108
28	42	57	93	540	347	170	93	56	150	160	93	108
29	41	.....	93	572	376	190	93	61	160	150	86	100
30	40	.....	100	583	391	200	86	66	160	160	79	100
31	42	.....	107	.....	347	.....	79	72	.....	160	.....	100

NOTE.—These discharges are based on rating curves applicable as follows:
Oct. 29 to Dec. 31, 1908, well defined between 50 and 500 second-feet.
Jan. 1 to Apr. 2, 1909, well defined between 40 and 170 second-feet.
Apr. 13 to Apr. 29, 1909, indirect method for shifting channels used.
Apr. 30 to Dec. 31, 1909, well defined between 47 and 775 second-feet.
Discharges interpolated for days when gage was not read.

Monthly discharge of Red Rock River at Lima, Mont., for 1908–9.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
1908.					
November	246	107	168	10,000	A.
December	122	80	101	6,210	A.
1909.					
January	90	40	60.3	3,710	B.
February	62	44	51.6	2,870	B.
March	107	58	75.7	4,650	B.
April	583	107	261	15,500	B.
May	775	190	471	29,000	A.
June	406	28	174	10,400	A.
July	200	79	123	7,560	A.
August	93	56	73.8	4,540	A.
September	160	79	122	7,260	A.
October	180	141	161	9,900	A.
November	170	79	128	7,620	A.
December	108	66	93.2	5,730	A.
The year	775	28	150	109,000	

BEAVERHEAD RIVER AT BARRATTS, MONT.

This station, which was established August 12, 1907, to obtain data for the solution of irrigation problems, is located 1 mile above Barratts and 10 miles southwest of Dillon, Mont.

This stream is called Red Rock River from its source in Red Rock Lakes to the post office of Red Rock, below which to its junction with Big Hole River it is called the Beaverhead. The principal tributaries to the Beaverhead above the station are Grasshopper Creek, 12 miles south of Dillon, Horse Prairie Creek, 20 miles south, and Rattlesnake and Blacktail Deer creeks.

Irrigation has probably been practiced in Beaverhead Valley longer than in any other valley in Montana, ditches constructed in the early seventies being still in operation. Innumerable diversions are made. Decreed water rights aggregating 85,866 inches of water are filed on from Lima on Red Rock River to a point 10 miles above Twin Bridges. The three largest canals diverted below the gaging station are Canyon Creek canal, appropriating 6,000 inches; Union canal, appropriating 4,000, and the Beaverhead canal, diverted just north of Dillon, appropriating 5,000 inches. The Union Electric Co., of Dillon, has a canal with a carrying capacity of 6,000 inches.

An ordinary staff gage, fastened to the downstream side of the bridge, was used till June 22, 1908, when it was replaced by a standard chain gage. Measurements are made from the downstream side of the bridge.

The stream remains open during the winter months. The gaging section has a rocky bottom and should not shift. Records obtained are good.

It is worthy of note that the number and quantity of flow of springs in this valley have increased since irrigation began. The ground evidently serves as a reservoir, the water being absorbed as by a sponge and later coming to the surface as springs.

Discharge measurements of Beaverhead River at Barratts, Mont., in 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Feb. 19	J. E. Stewart	60	151	1.19	413
Apr. 29	Raymond Richards	62.5	221	2.26	841
Aug. 19	....do	62.5	141	.97	307
Nov. 18	....do	64	181	1.53	555

Daily gage height, in feet, of Beaverhead River at Barratts, Mont., for 1909.

[Roy Dingley, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.2	1.1	1.2	1.6	2.15	2.5	1.15	1.4	0.7	1.5	1.55	1.7
2	1.1	1.1	1.25	1.7	2.2	2.6	1.0	1.35	.8	1.55	1.65	1.7
3	1.2	1.15	1.2	1.8	2.2	2.7	1.0	1.25	1.0	1.6	1.7	1.4
4	1.2	1.2	1.25	1.9	2.45	2.7	1.2	1.25	1.05	1.6	1.7	1.2
5	1.15	1.2	1.3	1.75	2.7	3.0	1.2	1.3	1.1	1.65	1.85	1.5
6	1.2	1.0	1.3	1.7	2.8	3.1	1.25	1.3	1.2	1.7	1.65	1.6
7	1.6	1.1	1.2	1.65	2.6	3.1	1.2	1.25	1.25	1.7	1.6	1.6
8	1.6	1.05	1.3	1.55	2.6	3.1	1.1	1.3	1.3	1.7	1.65	1.9
9	1.25	1.1	1.2	1.6	2.5	3.1	1.15	1.25	1.2	1.7	1.7	1.5
10	1.2	1.2	1.2	1.75	2.45	3.25	1.1	1.25	1.15	1.75	1.75	1.5
11	1.45	1.05	1.15	1.7	2.65	2.9	1.1	1.25	1.25	1.7	1.7	1.5
12	1.45	1.1	1.2	1.65	2.4	2.75	1.05	1.25	1.65	1.7	1.7	1.45
13	1.45	1.1	1.2	1.65	2.05	2.5	1.05	1.25	1.6	1.7	1.6	1.45
14	1.4	1.15	1.3	1.7	1.9	2.25	1.0	1.25	1.5	1.7	1.5	1.4
15	1.5	1.2	1.3	1.8	1.8	2.0	1.0	1.15	1.45	1.7	1.5	1.4
16	1.25	1.25	1.3	2.05	1.8	2.05	.95	1.0	1.4	1.65	1.55	1.3
17	1.2	1.2	1.35	2.3	1.9	2.15	.85	.95	1.3	1.6	1.5	1.3
18	1.15	1.1	1.4	2.1	1.9	2.1	.8	.95	1.35	1.6	1.6	1.3
19	1.2	1.2	1.35	2.15	1.85	2.0	.8	.95	1.4	1.55	1.65	1.3
20	1.2	1.2	1.3	2.1	1.7	2.05	1.0	.95	1.4	1.55	1.7	1.25
21	1.2	1.15	1.3	2.1	1.7	2.5	1.3	.9	1.45	1.5	1.6	1.3
22	1.2	1.15	1.25	2.0	1.7	2.15	1.25	.9	1.45	1.45	1.7	1.3
23	1.1	1.15	1.2	2.05	1.75	2.0	1.15	.9	1.4	1.4	1.75	1.3
24	1.1	1.15	1.35	2.0	2.3	1.8	1.25	.9	1.4	1.4	1.7	1.3
25	1.1	1.2	1.5	2.05	2.5	1.7	1.3	.9	1.4	1.4	1.7	1.3
26	1.1	1.25	1.55	2.2	2.6	1.55	1.3	.8	1.35	1.45	1.85	1.3
27	1.2	1.2	1.6	2.35	2.6	1.4	1.75	.7	1.35	1.5	1.9	1.3
28	1.1	1.2	1.6	2.45	2.85	1.45	1.75	.7	1.35	1.55	1.65	1.3
29	1.15	.....	1.45	2.3	3.2	1.2	1.75	.7	1.35	1.6	1.7	1.4
30	1.3	.....	1.5	2.3	2.95	1.2	1.65	.7	1.45	1.6	1.7	1.3
31	1.05	.....	1.5	.....	2.6	.....	1.45	.7	.....	1.6	.....	1.3

Daily discharge, in second-feet, of Beaverhead River at Barratts, Mont., for 1909.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	400	365	400	550	805	1,000	382	470	260	510	530	595
2	365	365	418	595	830	1,060	335	452	280	530	572	595
3	400	382	400	640	830	1,120	335	418	335	550	595	470
4	400	400	418	685	970	1,120	400	418	350	550	595	400
5	382	400	435	618	1,120	1,330	400	435	365	572	662	510
6	400	335	435	595	1,190	1,400	418	435	400	595	572	550
7	550	365	400	572	1,060	1,400	400	418	418	595	550	550
8	550	350	435	530	1,060	1,400	365	435	435	595	572	685
9	418	365	400	550	1,000	1,400	382	418	400	595	595	510
10	400	400	400	618	970	1,510	365	418	382	618	618	510
11	490	350	382	595	1,090	1,260	365	418	418	595	595	510
12	490	365	400	572	940	1,160	350	418	572	595	595	490
13	490	365	400	572	755	1,000	350	418	550	595	550	490
14	470	382	435	595	685	858	335	418	510	595	510	470
15	510	400	435	640	640	730	335	382	490	595	510	470
16	418	418	435	755	640	755	320	335	470	572	530	435
17	400	400	452	885	685	805	292	320	435	550	510	435
18	382	365	470	780	685	780	280	320	452	550	550	435
19	400	400	452	805	662	730	280	320	470	530	572	435
20	400	400	435	780	595	755	335	320	470	530	595	418
21	400	382	435	780	595	1,000	435	305	490	510	550	435
22	400	382	418	730	595	805	418	305	490	490	595	435
23	365	382	400	755	618	730	382	305	470	470	618	435
24	365	382	452	730	885	640	418	305	470	470	595	435
25	365	400	510	755	1,000	595	435	305	470	470	595	435
26	365	418	530	830	1,060	530	435	280	452	490	662	435
27	400	400	550	912	1,060	470	618	260	452	510	685	435
28	365	400	550	970	1,220	490	618	260	452	530	575	435
29	382	.....	490	885	1,480	400	618	260	452	550	595	470
30	435	.....	510	885	1,300	400	572	260	490	550	595	435
31	350	.....	510	.....	1,060	.....	490	260	.....	550	.....	435

NOTE.—These discharges are based on a rating curve that is fairly well defined between 260 and 2,075 second-feet.

Monthly discharge of Beaverhead River at Barratts, Mont., for 1909.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
January	550	350	416	25,600	B.
February	418	335	383	21,300	B.
March	550	382	445	27,400	B.
April	970	530	705	42,000	B.
May	1,480	595	906	55,700	B.
June	1,510	400	921	54,800	B.
July	618	280	402	24,700	B.
August	470	260	358	22,000	B.
September	572	260	438	26,100	B.
October	618	470	549	33,800	B.
November	685	510	581	34,600	B.
December	685	418	477	29,300	B.
The year	1,510	260	548	397,000	

MISSOURI RIVER AT CASCADE, MONT.

This station, which was established July 20, 1902, to obtain records for use in connection with irrigation and power development, is located on the highway bridge on the east side of the town of Cascade, Mont., 100 yards from the Great Northern Railway.

The Missouri receives many tributaries above the station, the most important being Dearborn River, Wolf Creek, and Prickly Pear Creek; within 100 miles below Sun and Marias rivers enter. The drainage area at the station is 18,300 square miles.

Although irrigation is extensively developed in the Missouri River Valley, the water is taken from the tributary streams, the Missouri itself, because of its high banks, great variation in flow, and difficulty of diversion, being little used.

The datum of the standard chain gage on the bridge used at this station has remained unchanged. All measurements are made from the lower side of the bridge.

Records obtained have been very good, the channel being permanent except in extreme floods. Gage heights are affected by ice during the winter months.

Discharge measurements of Missouri River at Cascade, Mont., in 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Apr. 10	J. E. Stewart	365	3,030	5.30	5,310
June 3	Raymond Richards	460	4,950	9.48	21,200
July 13	....do	376	3,560	6.00	7,640
Sept. 4	W. A. Lamb	365	3,450	5.47	5,920
Oct. 11	....do	365	3,410	5.47	5,830

Daily gage height, in feet, of Missouri River at Cascade, Mont., for 1909.

[Frank Warner, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	6.0	6.8	6.7	5.4	5.9	9.55	7.8	5.65	4.4	5.15	5.3	4.6
2	7.0	6.7	6.7	5.4	5.9	9.35	7.5	5.7	4.3	5.3	5.3	4.6
3	7.0	6.7	6.7	5.4	5.9	9.55	7.4	5.55	4.5	5.2	5.3	4.7
4	7.0	6.7	6.7	5.4	6.0	9.9	7.8	5.4	5.4	5.2	5.4	4.9
5	7.0	6.7	6.7	5.4	6.0	10.4	8.2	5.4	5.1	5.2	5.4	4.9
6	7.0	6.65	6.7	5.4	6.1	11.0	8.45	5.25	5.1	5.2	5.4	4.9
7	7.0	6.7	6.7	5.4	6.6	11.35	7.7	5.1	5.1	5.3	5.4	4.9
8	7.2	6.7	6.6	5.3	6.5	11.85	7.4	5.1	5.1	5.4	5.4	4.9
9	7.2	6.7	6.5	5.3	6.6	13.15	7.2	5.05	5.0	5.5	5.4	4.9
10	7.2	6.7	6.5	5.3	6.5	13.25	7.1	4.85	5.0	5.5	5.4	4.9
11	7.2	6.7	6.0	5.3	6.4	12.6	6.7	4.7	5.25	5.5	5.3	4.9
12	7.2	6.7	5.5	5.3	6.3	11.65	6.5	4.7	5.4	5.4	5.3	4.9
13	7.25	6.7	5 5	5.3	6.4	11.05	6.15	4.7	5.55	5.4	5.2	4.9
14	7.45	6.7	5.5	5.3	6.6	10.5	6.0	4.7	5.75	5.4	5.3	4.8
15	7.5	6.7	5.5	5.4	6.5	10.15	5.9	4.7	6.0	5.3	5.4	4.8
16	7.5	6.7	5.5	5.4	6.6	9.65	5.8	4.8	5.95	5.3	5.3	4.8
17	7.5	6.7	5.5	5.4	6.7	9.5	5.65	4.8	5.8	5.3	5.05	4.8
18	7.5	6.7	5.5	5.4	6.8	9.85	5.3	4.7	5.7	5.3	4.8	4.8
19	7.5	6.7	5.4	5.5	6.9	10.2	5.1	4.35	5.6	5.4	4.7	4.8
20	7.5	6.7	5.3	5.6	6.9	10.5	5.2	4.9	5.5	5.4	4.7	4.8
21	7.4	6.7	5.3	5.7	6.9	10.65	5.35	4.4	5.5	5.4	4.7	4.8
22	7.4	6.7	5.2	5.8	6.9	10.55	5.3	4.4	5.5	5.3	4.7	4.8
23	7.3	6.7	5.1	5.8	7.1	10.3	5.25	4.4	5.5	5.3	4.6	4.8
24	7.3	6.7	5.1	5.8	7.75	9.65	5.05	4.75	5.5	5.2	4.6	4.8
25	7.2	6.7	5.2	5.8	8.15	9.15	4.8	4.5	5.35	5.2	4.5	4.8
26	7.2	6.7	5.2	5.7	8.9	8.8	4.9	4.4	5.2	5.2	4.5	4.8
27	7.1	6.7	5.2	5.8	8.85	8.35	5.4	4.4	5.2	5.2	4.5	4.8
28	7.1	6.7	5.3	5.9	9.25	8.2	5.65	4.4	5.2	5.2	4.5	4.8
29	7.0	.....	5.3	5.9	9.75	8.15	5.6	4.4	5.2	5.2	4.5	4.8
30	7.0	.....	5.4	5.8	9.7	8.0	5.5	4.4	5.2	5.2	4.5	4.8
31	6.9	.....	5.4	.....	10.05	.....	5.4	4.4	.....	5.2	.....	4.8

NOTE.—Gage heights January 1 to March 11 and during December affected by ice conditions.

Daily discharge, in second-feet, of Missouri River at Cascade, Mont., for 1909.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	.....	5,630	7,170	22,100	14,400	6,380	3,000	4,910	5,340
2	.....	5,630	7,170	21,200	13,100	6,530	2,780	5,340	5,340
3	.....	5,630	7,170	22,100	12,700	6,080	3,230	5,050	5,340
4	.....	5,630	7,500	23,600	14,400	5,630	5,630	5,050	5,630
5	.....	5,630	7,500	25,900	16,100	5,630	4,770	5,050	5,630
6	.....	5,630	7,830	28,600	17,200	5,200	4,770	5,050	5,630
7	.....	5,630	9,580	30,200	13,900	4,770	4,770	5,340	5,630
8	.....	5,340	9,220	32,400	12,700	4,770	4,770	5,630	5,630
9	.....	5,340	9,580	38,300	11,900	4,640	4,500	5,930	5,630
10	.....	5,340	9,220	38,700	11,500	4,100	4,500	5,930	5,630
11	.....	5,340	8,860	35,800	9,950	3,720	5,200	5,930	5,340
12	5,930	5,340	8,510	31,500	9,220	3,720	5,630	5,630	5,340
13	5,930	5,340	8,860	28,800	8.000	3,720	6,080	5,630	5.050
14	5,930	5,340	9,580	26,400	7,500	3,720	6,690	5,630	5,340
15	5,930	5,630	9,220	24,800	7,170	3,720	7,500	5,340	5,630
16	5,930	5,630	9,580	22,500	6,850	3,970	7,340	5,340	5,340
17	5,930	5,630	9,950	21,800	6,380	3,970	6,850	5,340	4,640
18	5,930	5,630	10,300	23,400	5,340	3,720	6,530	5,340	3,970
19	5,630	5,930	10,700	25,000	4,770	2,890	6,230	5,630	3,720
20	5,340	6,230	10,700	26,400	5,050	4,230	5,930	5,630	3,720
21	5,340	6,530	10,700	27,000	5,480	3,000	5,930	5,630	3,720
22	5,050	6,850	10,700	26,600	5,340	3,000	5,930	5,340	3,720
23	4,770	6,850	11,500	25,400	5,200	3,000	5,930	5,340	3,470
24	4,770	6,850	14,200	22,500	4,640	3,840	5,930	5.050	3,470
25	5,050	6,850	15,800	20,300	3,970	3,230	5,480	5,050	3,230
26	5,050	6,530	19,200	18,700	4,230	3,000	5,050	5,050	3,230
27	5,050	6,850	18,900	16,700	5,630	3,000	5,050	5,050	3,230
28	5.340	7,170	20,700	16,100	6,380	3,000	5,050	5,050	3,230
29	5,340	7,170	23,000	15,800	6,230	3.000	5,050	5,050	3,230
30	5,630	6,850	22,800	15,200	5,930	3,000	5,050	5,050	3,230
31	5,630	.....	24,300	.....	5,630	3,000	.....	5,050	.....

NOTE.—These discharges are based on a rating curve that is well defined between 3,230 and 9,220 second-feet.

Monthly discharge of Missouri River at Cascade, Mont., for 1909.

[Drainage area, 18,300 square miles.]

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
March 12-31	5,930	4,770	5,480	0.299	0.22	217,000	A.
April	7,170	5,340	6,000	.328	.37	357,000	A.
May	24,300	7,170	11,900	.650	.75	732,000	A.
June	38,700	15,200	25,100	1.37	1.53	1,490,000	A.
July	17,200	3,970	8,610	.470	.54	529,000	A.
August	6,530	2,890	4,040	.221	.25	248,000	A.
September	7,500	2,780	5,370	.293	.33	320,000	A.
October	5,930	4,910	5,340	.292	.34	328,000	A.
November	5,630	3,230	4,580	.250	.28	273,000	A.
The period						4,490,000	

PRICKLY PEAR CREEK DRAINAGE BASIN.

DESCRIPTION.

Prickly Pear Creek rises in the mountains in the northwestern part of Jefferson County, Mont., and takes a general northeasterly course to its junction with the Missouri near Eldorado bar in the southeastern part of Lewis and Clark County. Its principal tributaries are McClellan, Lump Gulch, Tenmile, and Silver creeks. Its upper valley is narrow and little irrigation is practiced, but below Helena the entire normal flow is diverted for irrigation.

PRICKLY PEAR CREEK NEAR CLANCY, MONT.

This station, which was established July 15, 1908, to obtain data for use in connection with irrigation projects, is located about 2 miles below Clancy and 12 miles south of Helena, and is directly west of the house of the observer. This station was discontinued June 5, 1909.

Lump Gulch Creek enters about a mile above the station, and McClellan Creek comes in between the station and East Helena. Owing to the very narrow valley and the small amount of irrigable land above the station little water is diverted for irrigation.

The stream bed is of gravel and sand and shifts. Gage heights are affected by ice during the winter months and the records obtained are unsatisfactory. All measurements are made by wading near the staff gage, the datum of which has remained unchanged.

The greatest flood experienced in this valley for many years is probably that of June, 1908.

Discharge measurements of Prickly Pear Creek near Clancy, Mont., in 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Mar. 17	J. E. Stewart	32	30.5	1.51	52.3
May 3	do	31	39.6	1.96	81.1
June 5	do	22	57.2	3.65	255.

Daily gage height, in feet, of Prickly Pear Creek near Clancy, Mont., for 1909.

[W. P. Russell, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	Day.	Jan.	Feb.	Mar.	Apr.	May.	June.
1	1.5	.....	.....	1.5	.....	.....	16	1.7	.....	.....	1.3	.....	.....
2	1.5	.....	.....	1.45	.....	.....	17	1.7	.....	1.5	1.35	.....	.....
3	1.5	.....	.....	1.5	1.95	.....	18	1.7	.....	.....	1.45	.....	.....
4	1.2	.....	.....	1.55	.....	.....	19	.....	.....	.....	1.45	.....	.....
5	1.2	.....	.....	1.5	.....	3.65	20	.....	.....	.....	1.4	.....	.....
6	1.1	.....	.....	1.3	.....	.....	21	.....	.....	.....	1.45	.....	.....
7	1.4	.....	.....	1.1	.....	.....	22	.....	.....	.....	1.4	.....	.....
8	1.4	.....	.....	1.25	.....	.....	23	.....	.....	.....	1.45	.....	.....
9	1.4	.....	.....	1.23	.....	.....	24	.....	.....	.....	1.4	.....	.....
10	1.5	.....	.....	1.6	.....	.....	25	.....	.....	.....	1.5	.....	.....
11	1.5	.....	.....	1.45	.....	.....	26	.....	.....	.....	1.8	.....	.....
12	1.6	.....	.....	1.3	.....	.....	27	.....	.....	.....	.....	.....	.....
13	1.6	.....	.....	1.3	.....	.....	28	.....	.....	.....	.....	.....	.....
14	1.7	.....	.....	1.35	.....	.....	29	.....	.....	1.4	.....	.....	.....
15	1.7	.....	.....	1.4	.....	.....	30	.....	.....	1.4	.....	.....	.....
							31	.....	.....	1.4	.....	.....	.....

Daily discharge, in second-feet, of Prickly Pear Creek near Clancy, Mont., for 1909.

Day.	Jan.	Feb.	Mar.	Apr.	May.	Day.	Jan.	Feb.	Mar.	Apr.	May.
1	51	.....	.....	51	80	16	63	.....	.....	41	.....
2	51	.....	.....	48	80	17	63	.....	51	44	.....
3	51	.....	.....	51	80	18	63	.....	51	48	.....
4	36	.....	.....	54	.....	19	.....	.....	51	48	.....
5	36	.....	.....	51	.....	20	.....	.....	50	46	.....
6	32	.....	.....	41	.....	21	.....	.....	50	48	.....
7	46	.....	.....	32	.....	22	.....	.....	49	46	.....
8	46	.....	.....	33	.....	23	.....	.....	49	48	.....
9	46	.....	.....	41	.....	24	.....	.....	48	46	.....
10	51	.....	.....	57	.....	25	.....	.....	48	51	.....
11	51	.....	.....	48	.....	26	.....	.....	47	70	.....
12	57	.....	.....	41	.....	27	.....	.....	47	70	.....
13	57	.....	.....	41	.....	28	.....	.....	46	70	.....
14	63	.....	.....	44	.....	29	.....	.....	46	70	.....
15	63	.....	.....	46	.....	30	.....	.....	46	80	.....
						31	.....	.....	46	.....	.....

NOTE.—These discharges are based on a rating curve that is fairly well defined between 41 and 130 second-feet.

Monthly discharge of Prickly Pear Creek near Clancy, Mont., for 1909.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
January 1–18	63	32	51.4	1,840	B.
March 17–31	51	46	48.3	1,440	B.
April	80	32	50.3	2,990	B.

PRICKLY PEAR CREEK AT EAST HELENA, MONT.

This station, which was established July 18, 1908, to obtain data for use in irrigation development, is located where the Northern Pacific Railway crosses the stream at East Helena, Mont.

McClellan and Lump Gulch creeks are the only important tributaries entering above the station; Tenmile and Silver creeks come in below. All the normal flow of this stream is used for irrigation, the greater part of the water being diverted below this station.

At the gaging section the channel is rocky, clean, and nonshifting. The bed of the stream is so extremely rough that even in low water measurements are difficult. Fair results, however, have been obtained.

A staff gage is securely fastened to the piling on the Northern Pacific Railway bridge. The gage datum has remained the same. Measurements are made by wading just below the gage or from the highway bridge nearby.

Discharge measurements of Prickly Pear Creek at East Helena, Mont., in 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Feb. 23	J. E. Stewart	19	18.6	1.01	53.6
May 3	do	28	37.1	1.24	98.0
June 2	Raymond Richards	31	74.9	2.00	336.
July 3	do	37	50.7	1.64	197.
Aug. 18	J. E. Stewart	23	35.0	1.04	48.0
Sept. 25	W. A. Lamb	48	36.7	1.23	75.0
Nov. 27	Lamb and Richards	38	41.3	1.09	50.9

Daily gage height, in feet, of Prickly Pear Creek at East Helena, Mont., for 1909.

[J. R. McNamara, observer.]

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	1.0	1.1	1.1	1.9	.....	1.3	1.0	.....	1.2
2	1.05	1.1	1.3	2.0	.....	1.2	1.1	.....	1.2
3	1.05	1.2	1.3	2.1	.....	1.2	1.2	1.1	1.2
4	1.1	1.0	1.5	2.0	1.6	1.2	1.3	1.1	1.2
5	1.0	1.0	1.6	2.0	1.6	1.2	1.2	1.1	1.2
6	1.0	1.0	1.3	2.1	1.7	1.2	1.2	1.1	.....
7	1.0	.9	1.3	2.1	1.6	1.2	1.1	1.0	1.1
8	1.0	1.0	1.2	1.9	1.5	1.1	1.1	1.0	1.2
9	1.0	1.1	.....	1.8	1.5	1.1	1.1	1.1	1.2
10	1.0	1.1	1.4	2.0	1.5	1.1	1.3	1.1	1.2
11	.9	.....	1.2	2.0	1.4	1.1	1.6	1.0	1.2
12	1.0	1.0	1.1	2.0	1.4	1.1	1.6	1.1	1.2
13	1.0	1.0	1.1	1.9	1.3	1.1	1.3	1.1	1.2
14	1.1	1.1	1.2	1.9	1.3	1.15	1.3	1.1	1.2
15	1.1	1.1	1.3	2.1	1.3	1.15	1.2	1.1	1.2
16	1.2	1.1	1.3	2.1	1.2	1.0	1.3	1.1	1.2
17	1.2	1.1	1.3	2.1	1.2	1.0	1.3	1.1	1.2
18	1.2	1.1	1.3	2.3	1.1	1.0	1.2	1.1	1.2
19	1.1	1.1	1.4	2.5	1.1	1.0	1.2	1.0	1.2
20	1.1	1.2	1.4	2.4	1.2	1.0	1.3	1.0	1.2
21	1.1	1.1	1.4	2.2	1.7	1.0	1.2	1.1	1.2
22	1.05	1.1	1.5	2.2	1.5	.9	1.1	1.1	1.2
23	1.1	1.1	2.2	2.0	1.4	.9	1.1	1.1	1.2
24	1.2	1.1	2.2	2.0	1.4	1.1	1.1	1.1	.....
25	1.2	1.1	2.0	2.0	1.2	1.0	1.1	1.1	.....

Daily gage height, in feet, of Prickly Pear Creek at East Helena, Mont., for 1909—Con.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
26	1.2	1.3	2.0	1.9	1.2	1.0	1.1	1.1	.....
27	1.1	1.2	2.1	2.0	1.2	.9	1.1	1.0	.....
28	1.05	1.1	2.1	1.9	1.6	.9	1.1	1.0	.....
29	1.05	1.1	1.9	1.7	1.7	.9	1.1	1.0	.....
30	1.05	1.0	1.8	1.9	1.6	.9	1.1	1.0	1.1
31	1.1	.....	1.9	.....	1.5	.9	.....	1.0	.....

NOTE.—Ice conditions during January, February, and December.

Daily discharge, in second-feet, of Prickly Pear Creek at East Helena, Mont., for 1909.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	52	70	70	295	284	98	43	52	70
2	61	70	112	335	247	77	59	52	70
3	61	90	112	375	212	77	77	52	70
4	70	52	165	335	179	77	98	52	70
5	52	52	195	335	179	77	77	52	70
6	52	52	112	375	212	77	77	52	60
7	52	36	112	375	179	77	59	37	52
8	52	52	90	295	149	59	59	37	70
9	52	70	112	260	149	59	59	52	70
10	52	70	137	335	149	59	58	52	70
11	36	61	90	335	122	59	179	37	70
12	52	52	70	335	122	59	179	52	70
13	52	52	70	295	98	59	90	52	70
14	70	70	90	295	98	68	90	52	70
15	70	70	112	375	98	68	70	52	70
16	90	70	112	375	77	43	90	52	70
17	90	70	112	375	77	43	90	52	70
18	90	70	112	455	59	43	70	52	70
19	70	70	137	535	59	43	70	37	70
20	70	90	137	475	77	43	90	37	70
21	70	70	137	397	212	43	70	52	70
22	61	70	165	397	149	30	52	52	70
23	70	70	415	321	122	30	52	52	70
24	90	70	415	321	122	59	52	52	68
25	90	70	335	321	77	43	52	52	66
26	90	112	335	284	77	43	52	52	63
27	70	90	375	321	77	30	52	37	60
28	61	70	375	284	179	30	52	37	58
29	61	70	295	212	212	30	52	37	55
30	61	52	260	284	179	30	52	37	52
31	70	.....	295	.....	149	30	.....	37	.....

NOTE.—These discharges are based on rating curves applicable as follows: Mar. 1 to June 19—fairly well defined between 52 and 435 second-feet.
June 20 to Sept. 12—fairly well defined between 43 and 240 second-feet.
Sept. 13 to Dec. 3—fairly well defined between 37 and 90 second-feet.

Monthly discharge of Prickly Pear Creek at East Helena, Mont., for 1909.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
March	90	36	65.8	4,050	A.
April	112	36	67.8	4,030	A.
May	415	70	183	11,300	A.
June	535	212	344	20,500	A.
July	284	59	141	8,670	A.
August	98	30	53.6	3,300	A.
September	179	43	75.4	4,490	A.
October	52	37	47.2	2,900	A.
November	70	52	66.8	3,970	A.
The period	.....	.....	.....	63,200	

LUMP GULCH CREEK AT CLANCY, MONT.

Lump Gulch Creek, a small mountain stream with no important tributaries, has been quite extensively used for placer mining. At present the creek furnishes some water for irrigation, but the valley is narrow and affords but little irrigable land. The normal flow of the stream is appropriated.

The gaging station, which was established July 15, 1908, to obtain information concerning the amount of water available for storage and for irrigation, is located at the ranch of Charles Zastron, 1 mile from Clancy, 15 miles from Helena, and one-half mile above the stream's junction with Prickly Pear Creek.

The stream bed is gravelly, unclean, and shifting, making it difficult to obtain satisfactory data. Gage heights are affected by ice. No flood records have been obtained.

A staff gage is located on the left bank of the stream directly south of the observer's house. All measurements are made by wading.

Discharge measurements of Lump Gulch Creek at Clancy, Mont., in 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Mar. 17	J. E. Stewart	12	6.8	0.44	12.2
May 30	do	12	13.0	.83	25.0
June 5	do	12	18.1	1.47	52.0
July 20	Raymond Richards	11	11.7	.80	26.4
Oct. 20	do	11	6.3	.74	11.1

Daily gage height, in feet, of Lump Gulch Creek at Clancy, Mont., for 1909.

[Chas. Zastron, observer.]

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	0.25	0.5	0.7	.....	1.3	0.55	0.6	0.7	0.6
2	.25	.5	.8	.....	1.2	.55	.65	.7	.6
3	.3	.5	.85	.....	1.2	.55	.65	.7	.6
4	.3	.5	.85	.....	1.4	.55	.75	.65	.6
5	.3	.5	.85	.....	1.2	.55	.75	.65	.6
6	.35	.5	.95	.....	1.2	.55	.75	.65	.6
7	.35	.5	.95	1.5	1.15	.55	.75	.65	.6
8	.35	.5	.95	1.8	1.1	.55	.75	.65	.6
9	.35	.5	.95	2.4	1.1	.55	.75	.65	.6
10	.35	.5	.95	2.2	1.0	.55	.75	.6	.6
11	.4	.5	.95	2.1	1.0	.55	.85	.6	.6
12	.4	.5	.95	2.0	.95	.55	.85	.6	.6
13	.4	.5	.95	1.9	.95	.5	.7	.6	.6
14	.4	.95	.95	1.9	.9	.5	.7	.6	.6
15	.45	.8	1.0	1.9	.9	.5	.7	.6	.6
16	.45	.75	1.0	1.9	.8	.5	.7	.6	.6
17	.45	.7	1.0	1.6	.7	.5	.7	.6	.6
18	.45	.75	1.0	1.5	.7	.5	.7	.6	.6
19	.35	.75	1.0	1.5	.65	.45	.7	.6	.6
20	.35	.75	1.1	1.8	.65	.45	.7	.6	.6
21	.35	.75	1.1	1.7	.85	.45	.7	.6	.6
22	.4	.75	1.2	1.75	.7	.45	.7	.6	.6
23	.4	.75	1.2	1.6	.65	.5	.7	.6	.6
24	.4	.8	1.5	1.6	.65	.5	.7	.6	.6
25	.45	.8	1.8	1.5	.65	.5	.7	.6	.6

Daily gage height, in feet, of Lump Gulch Creek at Clancy, Mont., for 1909—Contd.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
26	0.5	0.75	1.9	1.4	0.65	0.5	0.7	0.6	0.6
27	0.5	0.75	2.2	1.45	0.6	0.5	0.7	0.6	0.6
28	0.5	0.75	2.1	1.3	0.6	0.5	0.7	0.6	0.6
29	0.5	0.7	.....	2.1	0.6	0.5	0.7	0.6	0.6
30	0.5	0.7	.....	1.4	0.6	0.5	0.7	0.6	0.6
31	0.5	.....	.....	.....	0.6	0.5	.....	0.6	.....

NOTE.—Ice conditions existing in January, February, and December.

Daily discharge, in second-feet, of Lump Gulch Creek at Clancey, Mont., for 1909.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	9.5	13.6	19.5	69	46	14	13	10.4	8.8
2	9.5	13.6	23	69	42	14	14	10.4	8.8
3	10.0	13.6	25	66	42	14	14	10.4	8.8
4	10.0	13.6	25	59	51	14	16	9.6	8.8
5	10.0	13.6	25	52	42	14	16	9.6	8.8
6	10.7	13.6	29	54	42	14	16	9.6	8.8
7	10.7	13.6	29	54	40	14	16	9.6	8.8
8	10.7	13.6	29	65	37	14	16	9.6	8.8
9	10.7	13.6	29	100	37	14	15	9.6	8.8
10	10.7	13.6	29	90	34	14	15	8.8	8.8
11	11.4	13.6	29	85	34	14	18	8.8	8.8
12	11.4	13.6	29	80	32	14	18	8.8	8.8
13	11.4	13.6	29	74	32	13	13	8.8	8.8
14	11.4	29	29	74	30	13	13	8.8	8.8
15	12.5	23	31	74	30	12	13	8.8	8.8
16	12.5	21	31	74	26	12	13	8.8	8.8
17	12.5	19.5	31	60	22	12	13	8.8	8.8
18	12.5	21	31	55	22	12	13	8.8	8.8
19	10.7	21	31	55	20	11	13	8.8	8.8
20	10.7	21	36	70	20	11	12	8.8	8.8
21	10.7	21	36	65	25	11	12	8.8	8.8
22	11.4	21	40	67	22	11	12	8.8	8.8
23	11.4	21	40	60	20	12	12	8.8	8.8
24	11.4	23	54	60	20	12	12	8.8	8.8
25	12.5	23	69	55	20	11	11.5	8.8	8.8
26	13.6	21	74	50	20	11	11.5	8.8	8.8
27	13.6	21	89	52	17	11	11.5	8.8	8.8
28	13.6	21	84	46	17	11	11.5	8.8	8.8
29	13.6	19.5	69	87	17	11	11.5	8.8	8.8
30	13.6	19.5	69	51	17	10	11.5	8.8	8.8
31	13.6	.....	69	.....	17	10	.....	8.8	.....

NOTE.—These discharges are based on rating curves applicable as follows: Mar. 1 to June 5, fairly well defined between 11.4 and 64 second-feet. June 6 to Oct. 1, indirect method for shifting channels. Oct. 2 to Nov. 30, poorly defined.

Monthly discharge of Lump Gulch Creek at Clancey, Mont., for 1909.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
March	13.6	9.5	11.6	713	B.
April	29	13.6	18.1	1,080	A.
May	89	19.5	40.7	2,500	A.
June	100	46	65.7	3,910	B.
July	51	17	28.8	1,770	B.
August	14	10	12.4	762	C.
September	18	11.5	13.6	809	C.
October	10.4	8.8	9.11	560	C.
November	8.8	8.8	8.80	524	C.
The period	.....	.....	.....	12,600	

TENMILE CREEK NEAR HELENA, MONT.

This station, which is located opposite the Broadwater Hotel, near Helena, Mont., was established July 8, 1908, to determine the amount of water available for irrigation and for municipal supply.

Part of the water supply of the city of Helena is taken from Tenmile Creek above the station. Two irrigation ditches also take their water from this creek above the gage. The entire low-water flow is appropriated and used before it reaches the mouth of the creek.

The principal tributaries above the gaging station are Blue Cloud, Spring, and Walker creeks; Sevenmile Creek enters 2 miles below.

The channel shifts somewhat during flood stages, but at medium and low water the conditions are good for obtaining accurate discharge data. The stream freezes over during the winter months and no records are kept.

The gage is of the staff type and is located on right bank of stream. The datum has remained the same. Measurements are made by wading.

Discharge measurements of Tenmile Creek near Helena, Mont., in 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Mar. 23	J. E. Stewart	15	15.6	2.00	16.0
May 8	....do	30	41.1	2.80	87.0
June 19	....do	56	64.4	3.60	210
July 3	Raymond Richards	38	33.0	2.85	94.3
Aug. 18	J. E. Stewart	16	7.2	1.71	5.7
Oct. 1	Raymond Richards	20	13.0	2.00	16.2

Daily gage height, in feet, of Tenmile Creek near Helena, Mont., for 1909.

[Harry Hillman, observer.]

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.9	2.0	2.3	4.2	3.1	2.2	1.7	2.0	2.1	2.0
2	1.9	2.1	2.4	4.2	3.1	2.2	1.8	2.0	2.2	1.9
3	1.9	2.1	2.6	4.2	3.1	2.1	2.0	2.0	2.3	1.8
4	1.9	2.1	3.0	4.0	3.1	2.1	2.4	2.0	2.4	1.8
5	1.85	2.0	3.2	3.9	3.1	2.1	2.2	2.0	2.4	1.7
6	1.9	1.9	3.0	3.8	2.9	1.9	2.1	2.0	2.4	1.6
7	1.9	1.8	2.9	3.7	2.9	1.9	2.0	2.0	2.4	1.6
8	1.9	2.0	2.85	4.0	2.8	1.9	2.0	2.0	2.3	1.5
9	1.85	2.0	2.9	4.6	2.8	1.9	2.0	2.0	2.2	1.5
10	1.7	2.1	3.2	4.6	2.8	1.9	2.0	2.0	2.1	.....
11	1.6	2.0	3.0	4.7	2.7	1.9	2.1	2.0	2.1	.....
12	1.5	2.0	3.0	4.7	2.6	1.8	2.2	2.0	2.0	.....
13	1.5	2.0	3.0	4.4	2.5	1.8	2.4	2.0	2.0	.....
14	1.7	2.1	3.0	4.2	2.4	1.8	2.3	2.0	1.9	.....
15	1.9	2.1	3.0	4.2	2.3	1.7	2.2	2.0	2.1	.....
16	2.0	2.1	3.2	4.2	2.3	1.7	2.2	2.0	2.1	.....
17	2.0	2.1	3.1	4.1	2.2	1.7	2.1	2.0	2.2	.....
18	2.0	2.1	3.2	4.0	2.1	1.7	2.1	2.0	2.2	.....
19	2.0	2.1	3.2	3.6	2.1	1.7	2.1	2.1	2.2	.....
20	2.0	2.1	3.3	4.0	2.1	1.7	2.1	2.3	2.2	.....
21	2.0	2.1	3.5	3.7	2.4	1.7	2.2	2.2	2.0	.....
22	2.0	2.1	3.8	3.6	2.3	1.7	2.2	2.3	2.0	.....
23	2.0	2.2	4.0	3.5	2.2	1.7	2.1	2.2	2.1	.....
24	2.1	2.2	4.3	3.4	2.2	1.7	2.2	2.0	2.2	.....
25	2.1	2.2	4.5	3.2	2.1	1.7	2.0	2.0	2.2	.....

Daily gage height, in feet, of Tenmile Creek near Helena, Mont., for 1909—Continued.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
26	2.1	2.6	4.5	3.1	2.1	1.7	2.0	2.0	2.2	.....
27	2.0	2.5	4.6	3.1	3.0	1.7	1.9	2.0	2.0	.....
28	2.0	2.5	4.7	3.1	2.6	1.7	1.9	2.0	2.0	.....
29	2.0	2.5	4.6	3.1	2.5	1.7	1.9	2.0	2.0	.....
30	2.0	2.2	4.2	3.3	2.4	1.7	1 9	2.0	2.0	.....
31	2.0	.....	4.0	.....	2.3	1.7	.....	.....	.....	.....

NOTE.—Ice conditions January 1 to February 28 and December 10 to 31.

Daily discharge, in second-feet, of Tenmile Creek near Helena, Mont., for 1909.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	11.5	15.0	32	351	124	25	6.0	15.0	19.0	15.0
2	11.5	19.0	40	351	124	25	8.5	15.0	25	11.5
3	11.5	19.0	59	351	124	19.0	15.0	15.0	32	8.5
4	11.5	19.0	109	303	124	19.0	40	15.0	40	8.5
5	10.0	15.0	140	280	124	19.0	25	15.0	40	6.0
6	11.5	11.5	109	257	95	11.5	19.0	15.0	40	4.0
7	11.5	8.5	95	235	95	11.5	15.0	15.0	40	4.0
8	11.5	15.0	88	303	82	11.5	15.0	15.0	32	2.5
9	10.0	15.0	95	451	82	11.5	15.0	15.0	25	2.5
10	6.0	19.0	140	451	82	11.5	15.0	15.0	19.0	.....
11	4.0	15.0	109	477	70	11.5	19.0	15.0	19.0	.....
12	2.5	15.0	109	477	59	8.5	25	15.0	15.0	.....
13	2.5	15.0	109	401	49	8.5	40	15.0	15.0	.....
14	6.0	19.0	109	351	40	8.5	32	15.0	11.5	.....
15	11.5	19.0	109	351	32	6.0	25	15.0	19.0	.....
16	15.0	19.0	140	351	32	6.0	25	15.0	19.0	.....
17	15.0	19.0	124	327	25	6.0	19.0	15.0	25	.....
18	15.0	19.0	140	303	19.0	6.0	19.0	15.0	25	.....
19	15.0	19.0	140	214	19.0	6.0	19.0	19.0	25	.....
20	15.0	19.0	157	303	19.0	6.0	19.0	32	25	.....
21	15.0	19.0	194	235	40	6.0	25	25	15.0	.....
22	15.0	19.0	257	214	32	6.0	25	32	15.0	.....
23	15.0	25	303	194	25	6.0	19.0	25	19.0	.....
24	19.0	25	376	175	25	6.0	25	15.0	25.0	.....
25	19.0	25	426	140	19.0	6.0	15.0	15.0	25.0	.....
26	19.0	59	426	124	19.0	6.0	15.0	15.0	25.0	.....
27	15.0	49	451	124	109	6.0	11.5	15.0	15.0	.....
28	15.0	49	477	124	. 59	6.0	11.5	15.0	15.0	.....
29	15.0	49	451	124	49	6.0	11.5	15.0	15.0	.....
30	15.0	25	351	157	40	6.0	11.5	15.0	15.0	.....
31	15.0	.....	303	.....	32	6.0	.....	17	.....	.....

NOTE.—These discharges are based on a rating curve that is well defined between 2.5 and 303 second-feet.

Monthly discharge of Tenmile Creek near Helena, Mont., for 1909.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
March	19.0	2.5	12.4	762	A.
April	59	8.5	22.6	1,340	A.
May	477	32	199	12,200	A.
June	477	124	283	16,800	A.
July	124	19.0	60.3	3,710	A.
August	25	6.0	9.79	602	A.
September	40	6.0	19.5	1,160	A.
October	32	15.0	16.9	1,040	A.
November	40	11.5	23.2	1,380	A.
December 1–9	15.0	2.5	6.95	124	A.
The period	.....	.....	.....	39,100	

SEVENMILE CREEK NEAR BIRDSEYE, MONT.

This station, which is located at Richard Tobin's ranch, one-fourth mile from Birdseye, Mont., was established March 27, 1909. From July 16, 1908, to August 26, 1908, a station was maintained on this stream at Dr. Head's ranch, near Helena, Mont. The records determine the value of the stream for irrigation and municipal water supply.

The entire flow of this creek is appropriated and used for irrigation.

The staff gage is used. All measurements are made by wading.

Discharge measurements of Sevenmile Creek near Birdseye, Mont., in 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Mar. 27	Stewart and Richards	11.5	4.8	2.28	10.2
May 8	J. E. Stewart	12	7.1	2.49	17.0
June 15	.....do	14	14.4	3.50	52.6
Aug. 18	.....do	6	3.1	1.82	5.0
Oct. 6	Lamb and Richards	7	3.5	1.96	6.7

Daily gage height, in feet, of Sevenmile Creek near Birdseye, Mont., for 1909.

[Richard Tobin, observer.]

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.35	2.35	2.95	2.45	2.05	1.75	1.95	2.05	1.95
2	2.2	2.25	2.65	2.4	2.05	1.8	1.95	2.05	2.15
3	2.2	2.35	2.6	2.45	2.05	2.2	1.95	2.05	2.15
4	2.25	2.4	2.65	2.45	1.95	2.05	1.85	2.05	2.15
5	2.15	2.6	2.6	2.55	1.95	1.85	1.95	2.05	2.15
6	2.25	2.4	2.65	2.5	1.95	1.85	2.05	2.05	2.15
7	2.3	2.45	2.75	2.45	1.9	2.5	2.05	2.05	2.15
8	2.15	2.45	3.2	2.4	1.75	2.0	2.05	1.95	.....
9	2.3	2.45	4.0	2.35	1.85	2.05	1.95	2.05	.....
10	2.2	2.45	3.95	2.4	1.85	1.95	1.95	2.0	.....
11	2.2	2.5	3.95	2.45	1.85	2.1	2.05	2.05	.....
12	2.2	2.4	3.6	2.4	1.85	1.95	2.05	2.05	.....
13	2.15	2.5	3.65	2.35	1.85	1.9	2.05	2.05	.....
14	2.2	2.4	3.65	2.3	1.85	1.95	2.05	2.05	.....
15	2.1	2.55	3.5	2.25	1.85	1.95	2.05	2.05	.....
16	2.15	2.75	3.45	2.2	1.85	1.9	2.05	2.05	.....
17	2.1	2.45	3.4	2.2	1.85	1.95	2.05	2.15	.....
18	2.2	2.55	3.25	2.2	1.85	1.9	2.05	2.15	.....
19	2.25	2.6	3.25	2.2	1.85	1.85	2.05	2.15	.....
20	2.2	2.65	3.3	2.3	1.9	1.95	2.05	2.15	.....
21	2.15	2.7	3.1	2.2	1.8	2.05	2.05	1.95	.....
22	2.15	2.9	2.7	2.2	1.8	1.95	2.05	1.95	.....
23	2.15	2.9	2.65	2.2	1.7	1.9	2.05	2.05	.....
24	2.25	2.9	2.55	2.2	1.75	1.95	2.05	2.05	.....
25	2.35	3.1	2.5	2.2	1.75	1.9	2.05	2.05	.....
26	2.35	3.1	2.5	3.55	1.75	1.95	2.05	2.05	.....
27	2.3	3.15	2.5	2.55	1.7	1.95	2.05	2.05	.....
28	2.35	3.3	2.55	2.2	1.7	1.95	2.05	2.05	.....
29	2.35	3.2	2.6	2.15	1.75	1.95	2.05	2.05	.....
30	2.25	3.05	2.55	2.1	1.75	2.0	2.05	2.05	.....
31	.....	2.9	.....	2.1	1.75	.....	2.05	.....	.....

NOTE.—Ice Dec. 8 to 31.

Daily discharge, in second-feet, of Sevenmile Creek near Birdseye, Mont., for 1909.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	12.6	12.6	31	14.9	7.6	4.6	6.4	7.6	6.4
2	9.8	10.7	20.5	13.7	7.6	4.9	6.4	7.6	9.0
3	9.8	12.6	18.9	14.9	7.6	9.8	6.4	7.6	9.0
4	10.7	13.7	20.5	14.9	6.4	7.6	5.4	7.6	9.0
5	9.0	18.9	18.9	17.5	6.4	5.4	6.4	7.6	9.0
6	10.7	13.7	20.5	16.1	6.4	5.4	7.6	7.6	9.0
7	11.6	14.9	23.8	14.9	5.9	16.1	7.6	7.6	9.0
8	9.0	14.9	41	13.7	4.6	7.0	7.6	6.4	.....
9	11.6	14.9	74	12.6	5.4	7.6	6.4	7.6	.....
10	9.8	14.9	72	13.7	5.4	6.4	6.4	7.0	.....
11	9.8	16.1	72	14.9	5.4	8.3	7.6	7.6	.....
12	9.8	13.7	57	13.7	5.4	6.4	7.6	7.6	.....
13	9.0	16.1	59	12.6	5.4	5.9	7.6	7.6	.....
14	9.8	13.7	59	11.6	5.4	6.4	7.6	7.6	.....
15	8.3	17.5	53	10.7	5.4	6.4	7.6	7.6	.....
16	9.0	23.8	51	9.8	5.4	5.9	7.6	7.6	.....
17	8.3	14.9	49	9.8	5.4	6.4	7.6	9.0	.....
18	9.8	12.5	43	9.8	5.4	5.9	7.6	9.0	.....
19	10.7	18.9	43	9.8	5.4	5.4	7.6	9.0	.....
20	9.8	20.5	45	11.6	5.9	6.4	7.6	9.0	.....
21	9.0	22.1	37	9.8	4.9	7.6	7.6	6.4	.....
22	9.0	29.1	22.1	9.8	4.9	6.4	7.6	6.4	.....
23	9.0	29.1	20.5	9.8	4.2	5.9	7.6	7.6	.....
24	10.7	29.1	17.5	9.8	4.6	6.4	7.6	7.6	.....
25	12.6	37	16.1	9.8	4.6	5.9	7.6	7.6	.....
26	12.6	37	16.1	55	4.6	6.4	7.6	7.6	.....
27	11.6	39	16.1	17.5	4.2	6.4	7.6	7.6	.....
28	12.6	45	17.5	9.8	4.2	6.4	7.6	7.6	.....
29	12.6	41	18.9	9.0	4.6	6.4	7.6	7.6	.....
30	10.7	35	17.5	8.3	4.6	7.0	7.6	7.6	.....
31	.....	29.1	.....	8.3	4.6	.....	7.6	.....	.....

NOTE.—These discharges are based on a rating curve well defined below 60 second-feet.

Monthly discharge of Sevenmile Creek near Birdseye, Mont., for 1909.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
April	12.6	8.3	10.3	613	A.
May	45	10.7	22.2	1,360	A.
June	72	16.1	35.7	2,120	A.
July	55	8.3	13.5	830	A.
August	7.6	4.2	5.41	333	A.
September	16.1	4.6	6.77	402	A.
October	7.6	5.4	7.30	449	A.
November	9.0	6.4	7.65	455	A.
December 1-7	9.0	6.4	8.63	120	A.
The period	.....	.....	.....	6,680	

LITTLE PRICKLY PEAR CREEK DRAINAGE BASIN.

DESCRIPTION.

Little Prickly Pear Creek rises in the Rocky Mountains near the Continental Divide, about 10 miles northwest of Marysville, Mont., and flows in a northeasterly direction to its junction with Missouri River, about 45 miles below Helena. The principal tributaries are Deadman, Marsh, Canyon, and Wolf creeks.

The valley of the Little Prickly Pear is narrow and bounded by high mountains and is exceptionally well irrigated on the upper portion of the stream. Additional water supply may be obtained by storage.

LITTLE PRICKLY PEAR CREEK NEAR MARYSVILLE, MONT.

This station, which is located on the upper portion of the stream at the Pearce ranch, 6 miles west and 3 miles north of Marysville, Mont., was established May 18, 1909, to obtain data for use in connection with irrigation.

Above this station Little Prickly Pear Creek has no important tributaries. Many small ditches take water from the stream, practically the entire flow of the stream being appropriated.

A staff gage is used, the datum of which has remained unchanged since the station was established. All measurements are made by wading.

The channel bed shifts in high water. During the winter months the creek freezes over.

Discharge measurements of Little Prickly Pear Creek near Marysville, Mont., in 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
May 18	J. E. Stewart	9	6.4	2.78	13.0
June 8	do	16	16.6	3.50	40.0
July 10	do	11	10.0	3.10	21.2
Sept. 29	do	8	5.6	2.71	7.8
Nov. 11	Raymond Richards	29	3.8	2.62	5.1

Daily gage height, in feet, of Little Prickly Pear Creek near Marysville, Mont., for 1909.

[Gertrude M. Pearse, observer.]

Day.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1		3.8	3.2	2.9	2.8	2.7	2.65	2.6
2		4.0	3.2	2.9	2.8	2.7	2.65	2.6
3		4.0	3.2	2.9	2.8	2.7	2.65	2.6
4		3.8	3.15	2.9	2.8	2.7	2.65	2.6
5		3.7	3.15	2.9	2.8	2.7	2.65	2.6
6		3.6	3.1	2.8	2.8	2.7	2.65	2.6
7		3.65	3.1	2.8	2.8	2.7	2.65	2.6
8		3.5	3.1	2.85	2.8	2.7	2.65	2.6
9		3.9	3.1	2.85	2.8	2.7	2.65	2.6
10		4.15	3.1	2.85	2.8	2.7	2.65	2.6
11		4.15	3.1	2.85	2.8	2.7	2.6	2.6
12		4.1	3.1	2.85	2.8	2.7	2.6	2.6
13		4.1	3.05	2.85	2.8	2.7	2.6	2.6
14		4.1	3.05	2.85	2.75	2.7	2.6	2.6
15		4.0	3.05	2.85	2.75	2.7	2.6	2.6
16		3.9	3.0	2.85	2.75	2.7	2.6	2.6
17		3.8	3.0	2.85	2.75	2.7	2.6	2.6
18	2.8	3.8	3.0	2.85	2.75	2.7	2.6	2.6
19	2.8	3.75	3.0	2.85	2.75	2.7	2.6	2.6
20	2.85	3.7	3.0	2.85	2.75	2.7	2.6	2.6
21	3.0	3.6	3.0	2.85	2.75	2.7	2.6	2.6
22	3.3	3.6	3.0	2.85	2.75	2.7	2.6	2.6
23	3.55	3.55	3.0	2.85	2.75	2.7	2.6	2.6
24	3.55	3.4	3.0	2.8	2.7	2.7	2.6	2.6
25	3.6	3.3	2.95	2.8	2.7	2.7	2.6	2.6

Daily gage height, in feet, of Little Prickly Pear Creek near Marysville, Mont., for 1909— Continued.

Day.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
26	3.9	3.3	2.95	2.8	2.7	2.7	2.6	2.6
27	4.15	3.3	3.0	2.8	2.7	2.7	2.6	2.6
28	4.1	3.3	3.0	2.8	2.7	2.7	2.6	2.55
29	3.9	3.3	3.0	2.8	2.7	2.65	2.6	2.55
30	3.8	3.25	2.95	2.8	2.7	2.65	2.6	2.55
31	3.7	.....	2.95	2.8	.....	2.65	.....	2.55

Daily discharge, in second-feet, of Little Prickly Pear Creek near Marysville, Mont., for 1909.

Day.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	62	25	13.6	10.3	7.4	6.0	4.7
2	.....	73	25	13.6	10.3	7.4	6.0	4.7
3	.....	73	25	13.6	10.3	7.4	6.0	4.7
4	.....	61	23	13.6	10.3	7.4	6.0	4.7
5	.....	53	23	13.6	10.3	7.4	6.0	4.7
6	.....	48	21	10.3	10.3	7.4	6.0	4.7
7	.....	50	21	10.3	10.3	7.4	6.0	4.7
8	.....	40	21	12.0	10.3	7.4	6.0	4.7
9	.....	64	21	12.0	10.3	7.4	6.0	4.7
10	.....	79	21	12.0	10.3	7.4	6.0	4.7
11	.....	79	21	12.0	10.3	7.4	4.7	4.7
12	.....	76	21	12.0	10.3	7.4	4.7	4.7
13	.....	76	19	12.0	10.3	7.4	4.7	4.7
14	.....	76	19	12.0	8.8	7.4	4.7	4.7
15	.....	70	19	12.0	8.8	7.4	4.7	4.7
16	.....	64	17.1	12.0	8.8	7.4	4.7	4.7
17	.....	58	17.1	12.0	8.8	7.4	4.7	4.7
18	14	58	17.1	12.0	8.8	7.4	4.7	4.7
19	14	55	17.1	12.0	8.8	7.4	4.7	4.7
20	16	52	17.1	12.0	8.8	7.4	4.7	4.7
21	21	46	17.1	12.0	8.8	7.4	4.7	4.7
22	34	46	17.1	12.0	8.8	7.4	4.7	4.7
23	47	43	17.1	12.0	8.8	7.4	4.7	4.7
24	47	35	17.1	10.3	7.4	7.4	4.7	4.7
25	50	30	15.4	10.3	7.4	7.4	4.7	4.7
26	69	30	15.4	10.3	7.4	7.4	4.7	4.7
27	86	30	17.1	10.3	7.4	7.4	4.7	4.7
28	82	30	17.1	10.3	7.4	7.4	4.7	3.6
29	69	30	17.1	10.3	7.4	6.0	4.7	3.6
30	62	28	15.4	10.3	7.4	6.0	4.7	3.6
31	56	.....	15.4	10.3	.....	6.0	.....	3.6

NOTE.—These discharges are based on rating curves applicable as follows: May 18 to 25, not well defined; May 26 to June 7, indirect method for shifting channels; June 8 to Dec. 31, well defined below 50 second-feet.

Monthly discharge of Little Prickly Pear Creek near Marysville, Mont., for 1909.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
May 18-31	86	14	47.6	1,320	B.
June	79	28	53.8	3,200	A.
July	25	15.4	19.1	1,170	A.
August	13.6	10.3	11.7	719	A.
September	10.3	7.4	9.12	543	A.
October	7.4	6.0	7.26	446	A.
November	6.0	4.7	5.13	305	A.
December	4.7	3.6	4.56	280	A.
The period	.....	.....	.....	7,980	

LITTLE PRICKLY PEAR CREEK NEAR CANYON CREEK, MONT.

This station, which is located near Canyon Creek post office, was established April 1, 1909, to determine the quantity of water available for irrigation. Above this station Canyon, Marsh, Lost Horse, and Deadman creeks are the principal tributaries. Many small ditches take water from this stream and the low-water flow is practically all appropriated.

The channel at the gaging station will shift in flood, but at ordinary stages remains permanent.

Ice is common during the winter months. The staff gage datum has remained the same. Measurements are made by wading.

Discharge measurements of Little Prickly Pear Creek near Canyon Creek, Mont., in 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Apr. 1	Stewart and Wade	30	36.8	2.51	66.8
May 18	J. E. Stewart	34	47.4	2.88	111
June 7	....do	22	57.7	3.52	207
July 9	....do	23	34.4	2.63	64.3
Sept. 29	....do	23	26.5	2.32	33 6
Nov. 11	Raymond Richards	29	23.0	2.21	26.2

Daily gage height, in feet, of Little Prickly Pear Creek near Canyon Creek, Mont., for 1909.

[W. J. Carbis, observer.]

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.5	2.45	4.0	3.1	2.3	2.1	2.3	2.2	2.2
2	2.45	2.45	3.95	3.0	2.25	2.3	2.3	2.2	2.2
3	2.45	3.0	3.95	2.9	2.2	2.45	2.3	2.2	2.2
4	2.2	3.3	3.85	2.8	2.1	2.45	2.3	2.2	2.2
5	2.15	3.1	3.7	2.8	2.0	2.45	2.3	2.2	2.15
6	2.2	3.1	3.5	2.8	2.0	2.4	2.3	2.2	2.15
7	2.05	3.0	3.5	2.75	2.0	2.4	2.3	2.2	2.15
8	2.15	2.85	3.5	2.75	2.0	2.4	2.3	2.2	2.1
9	2.35	2.8	4.25	2.65	2.0	2.35	2.3	2.2	2.1
10	2.5	2.9	4.35	2.65	2.0	2.35	2.3	2.2	2.1
11	2.3	2.9	4.4	2.65	1.95	2.35	2.3	2.2	2.2
12	2.2	2.85	4.35	2.6	2.0	2.4	2.3	2.15	.....
13	2.3	2.9	4.4	2.6	1.95	2.35	2.3	2.15	.....
14	2.4	2.8	4.35	2.5	1.95	2.35	2.2	2.1	.....
15	2.45	2.8	4.2	2.5	1.95	2.3	2.2	2.0	.....
16	2.45	2.95	4.1	2.3	1.95	2.35	2.2	2.1	.....
17	2.45	2.9	3.9	2.2	1.95	2.35	2.2	2.1	.....
18	2.25	2.9	3.85	2.15	1.95	2.35	2.2	2.1	.....
19	2.4	2.9	3.7	2.1	1.95	2.3	2.2	2.2	.....
20	2.5	3.0	3.75	2.0	1.95	2.35	2.2	2.25	.....
21	2.3	3.2	3.9	2.1	1.95	2.35	2.2	2.3	.....
22	2.4	3.7	3.8	2.0	1.95	2.35	2.1	2.3	.....
23	2.45	3.95	3.7	1.9	2.1	2.4	2.1	2.4	.....
24	2.4	4.0	3.6	1.9	2.1	2.35	2.1	2.4	.....
25	2.5	4.1	3.6	1.95	2.1	2.3	2.1	2.4	.....
26	2.7	4.2	3.5	1.9	2.1	2.3	2.1	2.35	.....
27	2.6	4.3	3.4	2.1	2.1	2.35	2.0	2.3	.....
28	2.6	4.4	3.3	2.4	2.0	2.3	2.0	2.3	.....
29	2.5	4.4	3.35	2.4	2.0	2.3	2.0	2.3	.....
30	2.2	4.3	3.2	2.35	2.0	2.3	2.0	2.3	.....
31	.....	4.0	.....	2.3	2.0	.....	2.0	.....	.....

NOTE.—Ice Dec. 12 to 31.

Daily discharge, in second-feet, of Little Prickly Pear Creek near Canyon Creek, Mont., for 1909.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	65	60	293	127	34	19	34	26	26
2	60	60	284	115	30	34	34	26	26
3	60	126	284	101	26	46	34	26	26
4	38	170	265	89	19	46	34	26	26
5	34	140	238	89	13	46	34	26	22
6	38	140	203	89	13	42	34	26	22
7	28	126	203	78	13	42	34	26	22
8	34	106	198	78	13	42	34	26	19
9	50	100	338	66	13	38	34	26	19
10	65	113	355	66	13	38	34	26	19
11	46	113	365	66	11	38	34	26	26
12	38	106	355	61	13	42	34	22	.....
13	46	113	365	61	11	38	34	22	.....
14	55	100	355	51	11	38	26	19	.....
15	60	100	326	51	11	34	26	13	.....
16	60	120	307	34	11	38	26	19	.....
17	60	113	270	26	11	38	26	19	.....
18	42	113	260	22	11	38	26	19	.....
19	55	113	228	19	11	34	26	26	.....
20	65	126	237	13	11	38	26	30	.....
21	46	155	265	19	11	38	26	34	.....
22	55	238	245	13	11	38	19	34	.....
23	60	284	228	9	19	42	19	42	.....
24	55	293	210	9	19	38	19	42	.....
25	65	312	210	11	19	34	19	42	.....
26	88	331	192	9	19	34	19	38	.....
27	76	350	175	19	19	38	13	34	.....
28	76	370	162	42	13	34	13	34	.....
29	65	370	165	42	13	34	13	34	.....
30	38	350	143	38	13	34	13	34	.....
31	.....	293	.....	34	13	.....	13	.....	.....

NOTE.—These discharges are based on curves applicable as follows: Apr. 1 to June 7—Well defined between 50 and 225 second-feet. June 8 to July 8—Indirect method for shifting channels. July 9 to Dec. 11—Well defined between 20 and 80 second-feet.

Monthly discharge of Little Prickly Pear Creek near Canyon Creek, Mont., for 1909.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
April	88	28	54.1	3,220	A.
May	370	60	181	11,100	A.
June	365	143	257	15,300	B.
July	127	9	49.9	3,070	A.
August	34	11	15.1	928	B.
September	46	19	37.8	2,250	A.
October	34	13	26.1	1,600	A.
November	42	13	28.1	1,670	A.
December 1-11	26	19	23.0	502	A.
The period	.....	.....	.....	39,600	

DEADMAN CREEK NEAR MARYSVILLE, MONT.

This station, which is located near the ranch of Charles Johnson, about half a mile above the junction of Lost Horse Creek with Deadman Creek and 6 miles from Marysville, was established April 2, 1909, to obtain data for use in connection with irrigation development. One or two small ditches take water from the stream.

On June 8, 1909, the staff gage was moved down stream 300 yards and was given a new datum.

The channel does not shift. Measurements are made by wading. Ice is common during the colder months.

Discharge measurements of Deadman Creek near Marysville, Mont., in 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Apr. 2	J. E. Stewart	6.4	3.7	2.72	4.5
May 18	do	12	12.3	3.41	24.1
June 8	do	12	19.6	2.60	52.0
July 10	do	11	10.5	2.10	13.8
Sept. 29	do	7.8	4.4	1.89	5.1
Nov. 11	Raymond Richards	9	3.1	1.85	3.7

Daily gage height, in feet, of Deadman Creek near Marysville, Mont., for 1909.

[Charles Johnson, observer.]

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	3.2	4.4	2.4	2.0	1.95	1.9	1.9	1.85
2	2.7	3.2	4.35	2.35	2.0	1.95	1.9	1.9	1.85
3	2.75	3.4	4.3	2.35	2.0	1.95	1.9	1.9	1.85
4	2.75	3.6	4.25	2.3	2.0	1.95	1.9	1.9	1.85
5	2.8	3.9	4.15	2.25	2.0	1.95	1.9	1.9	1.85
6	2.8	3.95	3.7	2.2	2.0	1.95	1.9	1.9	1.85
7	2.8	4.0	3.7	2.2	2.0	1.95	1.9	1.85	1.85
8	2.75	4.0	2.6	2.15	2.0	1.95	1.9	1.85	1.85
9	2.8	3.95	2.95	2.15	2.0	1.95	1.9	1.85	1.85
10	2.8	4.0	3.2	2.1	2.0	2.0	1.9	1.85	1.85
11	2.8	4.0	3.25	2.1	2.0	2.0	1.9	1.85	1.85
12	2.8	3.95	3.2	2.1	1.95	2.0	1.9	1.85	.....
13	2.8	3.95	3.25	2.1	1.95	2.0	1.9	1.85	.....
14	2.85	4.0	3.3	2.1	1.95	2.0	1.9	1.85	.....
15	2.85	4.0	3.2	2.1	1.95	2.0	1.9	1.85	.....
16	2.8	3.8	3.1	2.1	1.95	2.0	1.9	1.85	.....
17	2.85	3.5	3.0	2.1	1.95	2.0	1.9	1.85	.....
18	2.85	3.4	2.9	2.5	1.95	2.0	1.9	1.85	.....
19	2.85	3.45	2.8	2.5	1.95	1.9	1.9	1.85	.....
20	2.90	3.7	2.75	2.5	1.95	1.9	1.9	1.85	.....
21	2.9	3.9	2.7	2.5	1.95	1.9	1.9	1.85	.....
22	2.9	4.05	2.6	2.5	1.95	1.9	1.9	1.85	.....
23	2.9	4.2	2.55	2.5	1.95	1.9	1.9	1.85	.....
24	2.95	4.2	2.5	2.5	1.95	1.9	1.9	1.85	.....
25	2.95	4.3	2.5	2.5	1.95	1.9	1.9	1.85	.....
26	2.95	4.4	2.45	2.5	1.95	1.9	1.9	1.85	.....
27	3.1	4.5	2.45	2.2	1.95	1.9	1.9	1.85	.....
28	3.15	4.5	2.45	2.2	1.95	1.9	1.9	1.85	.....
29	3.15	4.5	2.45	2.2	1.95	1.9	1.9	1.85	.....
30	3.2	4.45	2.4	2.2	1.95	1.9	1.9	1.85	.....
31	.....	4.4	.....	2.0	1.95	.....	1.9	.....	.....

NOTE.—Ice conditions from Dec. 12 to 31.

Daily discharge, in second-feet, of Deadman Creek near Marysville, Mont., for 1909.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	3.5	16.9	64	34	9.0	7.2	5.4	5.4	4.1
2	3.9	16.9	62	30	9.0	7.2	5.4	5.4	4.1
3	5.0	23	60	30	9.0	7.2	5.4	5.4	4.1
4	5.0	30	58	26	9.0	7.2	5.4	5.4	4.1
5	6.1	42	54	23	9.0	7.2	5.4	5.4	4.1

Daily discharge, in second-feet, of Deadman Creek near Marysville, Mont., for 1909—Contd.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
6		6.1	44	34	19.4	9.0	7.2	5.4	5.4	4.1
7		6.1	47	34	19.4	9.0	7.2	5.4	4.1	4.1
8		5.0	47	51	16.5	9.0	7.2	5.4	4.1	4.1
9		6.1	44	86	16.5	9.0	7.2	5.4	4.1	4.1
10		6.1	47	113	13.6	9.0	9.0	5.4	4.1	4.1
11		6.1	47	118	13.6	9.0	9.0	5.4	4.1	4.1
12		6.1	44	113	13.6	7.2	9.0	5.4	4.1	
13		6.1	44	118	13.6	7.2	9.0	5.4	4.1	
14		7.3	47	124	13.6	7.2	9.0	5.4	4.1	
15		7.3	47	113	13.6	7.2	9.0	5.4	4.1	
16		6.1	38	102	13.6	7.2	9.0	5.4	4.1	
17		7.3	26	91	13.6	7.2	9.0	5.4	4.1	
18		7.3	23	81	42	7.2	9.0	5.4	4.1	
19		7.3	24	71	42	7.2	5.4	5.4	4.1	
20		8.5	34	66	42	7.2	5.4	5.4	4.1	
21		8.5	42	61	42	7.2	5.4	5.4	4.1	
22		8.5	49	51	42	7.2	5.4	5.4	4.1	
23		8.5	56	46	42	7.2	5.4	5.4	4.1	
24		9.8	56	42	42	7.2	5.4	5.4	4.1	
25		9.8	60	42	42	7.2	5.4	5.4	4.1	
26		9.8	64	38	42	7.2	5.4	5.4	4.1	
27		13.9	68	38	19.4	7.2	5.4	5.4	4.1	
28		15.4	68	38	19.4	7.2	5.4	5.4	4.1	
29		15.4	68	38	19.4	7.2	5.4	5.4	4.1	
30		16.9	66	34	19.4	7.2	5.4	5.4	4.1	
31			64		9.0	7.2		5.4		

NOTE.—These discharges are based on rating curves applicable as follows: Apr. 2 to June 7, not well defined; June 8 to Dec. 11, fairly well defined below 60 second-feet.

Monthly discharge of Deadman Creek near Marysville, Mont., for 1909.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
April	16.9	3.5	7.96	474	B.
May	68	16.9	44.9	2,760	B.
June	124	34	68.0	4,050	B.
July	42	9.0	25.4	1,560	A.
August	9.0	7.2	7.84	482	A.
September	9.0	5.4	7.02	418	A.
October	5.4	5.4	5.40	332	A.
November	5.4	4.1	4.36	259	A.
December 1–11	4.1	4.1	4.10	89.5	A.
The period				10,400	

LOST HORSE CREEK NEAR MARYSVILLE, MONT.

Lost Horse Creek is a small stream and is fed by springs and melting snow in the mountains.

The gaging station, which was established April 2, 1909, is at the ranch of Charles Johnson, one-fourth mile above the junction of Lost Horse with Deadman Creek, and about 6 miles from Marysville.

One ditch receives its water from Lost Horse Creek. There are no tributaries. Data is of value for irrigation. Channel conditions are good in low and ordinary stages, but will shift in high water. A staff gage is used. Measurements are made by wading.

Discharge measurements of Lost Horse Creek near Marysville, Mont., in 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Apr. 2	J. E. Stewart	.....	.....	1.50	*a* 0.4
May 18	.....do	5.0	2.8	1.96	5.3
June 8	.....do	5.5	4.8	2.68	15.1
July 10	.....do	5.6	3.1	2.20	10.3
Sept. 29	.....do	3.3	1.4	1.79	1.1
Nov. 11	Raymond Richards	4.0	.75	1.74	.55

a Estimated.

Daily gage height, in feet, of Lost Horse Creek near Marysville, Mont., for 1909.

[Charles Johnson, observer.]

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	1.85	3.1	2.65	2.2	1.9	1.75	1.8	1.65
2	1.5	1.95	3.1	2.6	2.0	1.9	1.75	1.8	1.65
3	1.5	1.9	3.15	2.6	2.0	1.9	1.75	1.8	1.6
4	1.55	1.9	3.05	2.55	2.0	1.9	1.75	1.8	1.6
5	1.55	2.1	2.9	2.5	2.0	1.9	1.75	1.8	1.6
6	1.6	2.15	2.9	2.5	2.0	1.9	1.75	1.8	1.6
7	1.6	2.2	2.8	2.45	2.0	1.9	1.75	1.75	1.6
8	1.55	2.2	2.7	2.4	2.0	1.9	1.75	1.75	1.55
9	1.6	2.2	2.4	2.3	2.0	1.9	1.75	1.75	1.55
10	1.55	2.2	2.7	2.25	2.0	2.0	1.75	1.75	1.55
11	1.6	2.2	3.95	2.25	2.0	2.0	1.75	1.75	1.55
12	1.6	2.2	4.1	2.25	2.0	2.0	1.75	1.75	.....
13	1.65	2.2	4.1	2.25	2.0	2.0	1.75	1.75	.....
14	1.6	2.2	4.1	2.25	2.0	1.95	1.75	1.75	.....
15	1.65	2.2	4.0	2.2	2.0	1.95	1.75	1.75	.....
16	1.65	2.15	4.0	2.2	2.0	1.95	1.75	1.75	.....
17	1.65	2.1	3.85	2.25	2.0	1.95	1.8	1.75	.....
18	1.7	1.95	3.65	2.2	2.0	1.95	1.8	1.75	.....
19	1.7	2.0	3.55	2.15	2.0	1.95	1.8	1.75	.....
20	1.7	2.05	3.4	2.1	2.0	1.95	1.8	1.75	.....
21	1.7	2.2	3.2	2.1	2.0	1.9	1.8	1.7	.....
22	1.75	2.35	3.1	2.1	1.95	1.9	1.8	1.7	.....
23	1.75	2.5	2.9	2.3	1.95	1.85	1.8	1.7	.....
24	1.75	2.7	2.9	2.5	1.95	1.85	1.8	1.7	.....
25	1.7	2.85	2.8	2.5	1.95	1.85	1.8	1.7	.....
26	1.7	3.0	2.8	2.5	1.95	1.8	1.8	1.7	.....
27	1.75	3.05	2.75	2.5	1.95	1.8	1.8	1.7	.....
28	1.75	3.2	2.7	2.5	1.95	1.8	1.8	1.7	.....
29	1.8	3.15	2.7	2.5	1.95	1.75	1.8	1.7	.....
30	1.8	3.15	2.7	2.2	1.9	1.75	1.8	1.7	.....
31	.....	3.1	.....	2.2	1.9	.....	1.8	.....	.....

NOTE.—Ice conditions Dec. 12 to 31.

Daily discharge, in second-feet, of Lost Horse Creek near Marysville, Mont., for 1909.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	4.2	22	16.5	9.8	4.5	0.8	1.1	0.4
2	0.4	4.2	22	16.5	6.5	4.5	.8	1.1	.4
3	.4	4.7	22	16.5	6.5	4.5	.8	1.1	.3
4	.9	4.7	21	15.0	6.5	4.5	.8	1.1	.3
5	.9	7.2	18.5	15.0	6.5	4.5	.8	1.1	.3
6	1.4	7.8	18.5	15.0	6.5	4.5	.8	1.1	.3
7	1.4	8.5	17.0	13.6	6.5	4.5	.8	.8	.3
8	.9	8.5	15.5	13.0	6.5	4.5	.8	.8	.2
9	1.4	8.5	11.5	11.5	6.5	4.5	.8	.8	.2
10	.9	8.5	16.0	11.0	6.5	5.6	.8	.8	.2

Daily discharge, in second-feet, of Lost Horse Creek near Marysville, Mont., for 1909— Continued.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
11	1.4	8.5	38	11.0	6.5	5.6	0.8	0.8	0.2
12	1.4	8.5	42	11.0	6.5	5.6	.8	.8	.....
13	2.0	8.5	42	11.0	6.5	5.6	.8	.8	.....
14	1.4	8.5	42	11.0	6.5	5.0	.8	.8	.....
15	2.0	8.5	40	10.2	6.5	5.0	.8	.8	.....
16	2.0	7.8	40	10.2	6.5	5.0	.8	.8	.....
17	2.0	7.2	36	11.0	6.5	5.0	1.1	.8	.....
18	2.5	5.3	32	10.2	6.5	5.0	1.1	.8	.....
19	2.5	5.9	31	9.5	6.5	5.0	1.1	.8	.....
20	2.5	6.6	28	8.8	6.5	5.9	1.1	.8	.....
21	2.5	8.5	24	8.8	6.5	3.5	1.1	.5	.....
22	3.0	10.5	23	8.8	5.0	3.5	1.1	.5	.....
23	3.0	12.6	20	11.5	5.0	2.8	1.1	.5	.....
24	3.0	15.5	20	14.0	5.0	2.8	1.1	.5	.....
25	2.5	17.8	18.0	14.0	5.0	2.8	1.1	.5	.....
26	2.5	20.0	18.0	14.0	5.0	2.3	1.1	.5	.....
27	3.0	21	17.0	14.0	5.0	2.1	1.1	.5	.....
28	3.0	23	16.0	14.0	5.0	2.0	1.1	.5	.....
29	3.6	22	16.0	14.0	5.0	.8	1.1	.5	.....
30	3.6	22	17.0	9.8	4.5	.8	1.1	.5	.....
31	.....	22	.....	9.8	4.5	.....	1.1	.....	.....

NOTE.—These discharges are based on curves applicable as follows: Apr. 2 to June 8, well defined below 20-second feet. June 9 to Sept. 29, indirect method for shifting channels. Sept. 30 to 11, not well defined.

Monthly discharge of Lost Horse Creek near Marysville, Mont., for 1909.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
April 2–30	3.6	0.4	2.00	115	A.
May	23	4.2	10.9	670	A.
June	42	11.5	24.8	1,480	B.
July	16.5	8.8	12.3	756	B.
August	9.8	4.5	6.09	374	B.
September	5.9	.8	4.07	242	B.
October	1.1	.8	.95	58.4	C.
November	1.1	.5	.76	45.2	C.
December 1–11	.4	.2	.28	6.11	C.
The period	.....	.....	.....	3,750	

MARSH CREEK NEAR MARYSVILLE, MONT.

This is a small stream that rises in the mountains about 10 miles from Marysville. The station was established April 1, 1909, and is located at the Hartmiller ranch, about 1 mile above the junction of Marsh Creek with the Little Prickly Pear. Marsh Creek has no tributaries and no diversions of any size. Data is of value for irrigation. Measurements are made by wading near the staff gage.

Discharge measurements of Marsh Creek near Marysville, Mont., in 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Apr. 1	J. E. Stewart	4.5	1.8	1.71	2.9
May 18	.....do	4.4	1.7	1.77	3.4
June 7	.....do	9	4.4	1.98	8.0
July 10	.....do	7	3.9	1.80	6.8
Sept. 29	.....do	4.5	1.3	1.43	1.8
Nov. 11	Raymond Richards	4.7	1.2	1.39	1.6

Daily gage height, in feet, of Marsh Creek near Marysville, Mont., for 1909.

[J. Hartmiller, jr., observer.]

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.7	1.7	2.1	1.85	1.6	1.45	1.4	1.4	1.4
2	1.65	1.8	2.05	1.85	1.6	1.5	1.4	1.4	1.4
3	1.6	1.95	2.05	1.85	1.6	1.75	1.4	1.4	1.4
4	1.6	1.95	2.0	1.8	1.55	1.5	1.4	1.4	1.4
5	1.6	1.95	2.0	1.8	1.55	1.5	1.4	1.4	.....
6	1.6	1.9	2.0	1.85	1.55	1.45	1.4	1.4	.....
7	1.55	1.8	2.0	1.85	1.55	1.4	1.4	1.4	.....
8	1.55	1.85	2.1	1.8	1.55	1.4	1.4	1.4	.....
9	1.6	1.9	2.15	1.8	1.55	1.4	1.4	1.4	.....
10	1.6	1.8	2.15	1.8	1.55	1.4	1.4	1.4	.....
11	1.6	1.8	2.15	1.8	1.5	1.4	1.4	1.4	.....
12	1.6	1.8	2.15	1.75	1.5	1.45	1.4	1.4	.....
13	1.6	1.8	2.15	1.75	1.55	1.5	1.4	1.4	.....
14	1.6	1.85	2.1	1.75	1.5	1.4	1.4	1.4	.....
15	1.6	1.8	2.1	1.75	1.5	1.4	1.4	1.4	.....
16	1.65	1.85	2.1	1.7	1.45.	1.4	1.4	1.4	.....
17	1.6	1.9	2.1	1.7	1.45	1.4	1.4	1.4	.....
18	1.65	1.8	2.1	1.7	1.45	1.4	1.4	1.4	.....
19	1.7	1.9	2.05	1.7	1.5	1.4	1.4	1.4	.....
20	1.6	1.85	2.05	1.8	1.45	1.4	1.4	1.4	.....
21	1.6	1.9	2.05	1.7	1.5	1.4	1.4	1.4	.....
22	1.6	2.0	2.0	1.65	1.5	1.4	1.4	1.4	.....
23	1.6	2.0	2.0	1.65	1.55	1.4	1.4	1.45	.....
24	1.6	2.0	1.95	1.65	1.5	1.4	1.4	1.5	.....
25	2.0	2.0	1.95	1.6	1.5	1.4	1.4	1.45	.....
26	1.8	2.05	1.9	1.65	1.45	1.4	1.4	1.4	.....
27	1.7	2.05	1.9	1.9	1.45	1.4	1.4	1.4	.....
28	1.65	2.1	1.9	1.7	1.45	1.4	1.4	1.4	.....
29	1.65	2.1	1.85	1.65	1.45	1.4	1.4	1.4	.....
30	1.7	2.15	1.85	1.65	1.45	1.4	1.4	1.4	.....
31	.....	2.1	.....	1.6	1.45	.....	1.4	.....	.....

NOTE.—Ice conditions Dec. 4 to 31.

Daily discharge, in second-feet, of Marsh Creek near Marysville, Mont., for 1909.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.8	2.8	11.6	7.1	3.4	2.0	1.6	1.6	1.6
2	2.4	4.0	10.0	7.1	3.4	2.3	1.6	1.6	1.6
3	2.0	7.1	10.0	7.1	3.4	5.9	1.6	1.6	1.6
4	2.0	7.1	8.4	5.9	2.8	2.3	1.6	1.6	1.6
5	2.0	7.1	8.4	5.9	2.8	2.3	1.6	1.6	.....
6	2.0	5.8	8.4	7.1	2.8	2.0	1.6	1.6	.....
7	1.7	4.0	8.4	7.1	2.8	1.6	1.6	1.6	.....
8	1.7	4.9	13.0	7.1	2.8	1.6	1.6	1.6	.....
9	2.0	5.8	15.0	7.1	2.8	1.6	1.6	1.6	.....
10	2.0	4.0	15.0	7.1	2.8	1.6	1.6	1.6	.....
11	2.0	4.0	15.0	7.1	2.3	1.6	1.6	1.6	.....
12	2.0	4.0	15.0	5.9	2.3	2.0	1.6	1.6	.....
13	2.0	4.0	15.0	5.9	2.8	2.3	1.6	1.6	.....
14	2.0	4.9	14.0	5.9	2.3	1.6	1.6	1.6	.....
15	2.0	4.0	14.0	5.9	2.3	1.6	1.6	1.6	.....
16	2.4	4.9	14.3	4.9	2.0	1.6	1.6	1.6	.....
17	2.0	5.8	14.5	4.9	2.0	1.6	1.6	1.6	.....
18	2.4	4.0	14.6	4.9	2.0	1.6	1.6	1.6	.....
19	2.8	5.8	13.0	4.9	2.3	1.6	1.6	1.6	.....
20	2.0	4.9	13.0	6.8	2.0	1.6	1.6	1.6	.....
21	2.0	5.8	13.0	4.9	2.3	1.6	1.6	1.6	.....
22	2.0	8.4	11.2	4.2	2 3.	1.6	1.6	1.6	.....
23	2.0	8.4	11.2	4.2	2.8	1.6	1.6	2.0	.....
24	2.0	8.4	9.4	4.2	2.3	1.6	1.6	2.3	.....
25	8.4	8.4	9.4	3.4	2.3	1.6	1.6	2.0	.....
26	4.0	10.0	7.7	4.2	2.0	1.6	1.6	1.6	.....
27	2.8	10.0	7.7	9.4	2.0	1.6	1.6	1.6	.....
28	2.4	11.6	7.7	4.9	2.0	1.6	1.6	1.6	.....
29	2.4	11.6	7.1	4.2	2.0	1.6	1.6	1.6	.....
30	2.8	13.5	7.1	4.2	2.0	1.6	1.6	1.6	.....
31	.....	11.6	.....	3.4	2.0	.....	1.6	.....	.....

NOTE.—These discharges are based on rating curves applicable as follows: Apr. 1 to June 6—fairly well defined from 2 to 10 second-feet. June 7 to July 11, indirect method for shifting channels. July 12 to Dec. 4, fairly well defined below 8 second-feet.

Monthly discharge of Marsh Creek near Marysville, Mont., for 1909.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
April	8.4	1.7	2.43	145	B.
May	13.5	2.8	6.66	410	A.
June	15.0	7.1	11.4	678	B.
July	9.4	3.4	5.71	351	B.
August	3.4	2.0	2.45	151	B.
September	5.9	1.6	1.88	112	B.
October	1.6	1.6	1.60	98	B.
November	2.3	1.6	1.65	98	B.
The period				2,040	

DEARBORN RIVER DRAINAGE BASIN.

DESCRIPTION.

Dearborn River rises on the eastern slope of the Rocky Mountains in Lewis and Clark County, Mont., and takes a general southeasterly course to its junction with the Missouri about 40 miles southwest of Great Falls.

The construction of a project under the Carey Act to reclaim about 30,000 acres of land was undertaken several years ago. The water supply for this project comes from the natural flow of the Dearborn at a point just below the mouth of Falls Creek.

DEARBORN RIVER NEAR CLEMONS, MONT.

This station, which was established May 4, 1908, to obtain information concerning the amount of water available for irrigation, is located 2 miles above Clemons, Mont., and half a mile above the headworks of the reclamation project.

The only important tributary near the station is Falls Creek, which enters one-half mile below. The drainage area is 110 square miles.

Measurements at this station are made by wading. The conditions are good for obtaining accurate results at low and medium stages, but measurements at flood stages are impossible. The stream freezes over during the winter, and no record of gage heights is kept. The datum of the staff gage has remained unchanged.

Discharge measurements of Dearborn River near Clemons, Mont., in 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
May 6	Raymond Richards	71	73.3	0.43	183
July 9	.....do	50	91.1	.68	260
Sept. 24	.....do	63	48.1	.07	81
Oct. 21	J. E. Stewart	48	65.0	—.08	45.4

Daily gage height, in feet, of Dearborn River near Clemons, Mont., for 1909.

[Dr. O. A. Kenk, observer.]

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1		−0.20	−0.03	1.32	1.04	0.39	0.14	0.10	
2								.06	0.02
3		− .20	0	1.36	1.00	.36	.90		
4			.80					.04	.01
5		− .20	.50	1.75		.35	.38		
6			.42	1.93	.90			.00	
7		− .18		1.89		.27	.30		.02
8			.42		.71				
9		− .18		2.05				−.02	.02
10		− .18	.41		.66	.22	.27		
11				2.06				−.01	.02
12		− .19	.42		.63		.17		
13				2.10		.12			
14		− .20	.42				.15	.00	
15				2.06	.63	.12			
16		− .20	.42				.12		
17				2.06		.11	.12	.00	
18		− .18	.45		.59				
19	−0.25			2.08		.10	.12	.00	
20	− .24	− .14	.52	1.95					
21				1.56	.54	.09			
22	− .24	− .14	.90				.11	.00	
23			1.02	1.28	.53				
24	− .22	− .02				.04		−.01	
25			1.40	1.15	.50		.10		
26	− .22	− .02		1.08		.01		−.01	
27			1.45				.09		
28	− .20	− .03		1.06	.48	0		.00	
29			1.38						
30	− .20	− .02	1.25	1.06	.44		.10	.02	
31						0			

NOTE.—Ice conditions Jan. 1 to Mar. 18 and Nov. 11 to Dec. 31.

Daily discharge, in second-feet, of Dearborn River near Clemons, Mont., for 1909.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1		27	56	566	415	163	94	84	66
2		27	59	577	405	158	222	75	66
3		27	62	588	395	154	349	73	65
4		27	307	704	380	152	254	71	64
5		27	198	820	364	151	160	66	65
6		30	172	928	349	140	148	62	65
7		30	172	904	310	128	136	60	66
8		30	172	952	272	124	134	59	66
9		30	170	1,000	263	119	131	58	66
10		30	169	1,000	254	114	128	59	66
11		30	170	1,010	248	106	115	60	66
12		29	172	1,020	243	98	102	60	
13		28	172	1,030	243	89	99	61	
14		27	172	1,020	243	89	96	62	
15		27	172	1,010	243	89	92	62	
16		27	172	1,010	238	88	89	62	
17		30	177	1,010	233	86	89	62	
18		30	182	1,010	229	85	89	62	
19	20	34	194	1,020	224	84	89	62	
20	22	37	205	940	218	83	88	62	
21	22	37	277	706	212	82	87	62	
22	22	37	349	625	210	79	86	62	
23	22	48	405	544	208	75	85	61	
24	24	58	508	508	203	71	85	60	
25	24	58	610	472	198	68	84	60	
26	24	58	625	435	196	64	83	60	
27	26	57	640	430	194	63	82	61	
28	27	56	620	425	192	62	83	62	
29	27	57	599	425	186	62	83	64	
30	27	58	528	425	179	62	84	66	
31	27		547		171	62		66	

NOTE.—These discharges are based on a rating curve well defined between 40 and 300 second-feet. Discharges interpolated for days when gage was not read.

Monthly discharge of Dearborn River near Clemons, Mont., for 1909.

[Drainage area, 110 square miles.]

Month.	Discharge in second-feet.			Per square mile.	Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.		Depth in inches on drainage area.	Total in acre-feet.	
Mar. 19–31	27	20	24.2	0.220	0.10	624	A.
April	58	27	36.9	.335	.37	2,200	A.
May	640	56	291	2.65	3.06	17,900	A.
June	1,030	425	770	7.00	7.81	45,800	B.
July	415	171	255	2.32	2.68	15,700	A.
August	163	62	98.4	.895	1.03	6,050	A.
September	349	82	122	1.11	1.24	7,260	A.
October	84	58	63.4	.576	.66	3,900	A.
Nov. 1–11	66	64	65.5	.595	.24	1,430	A.
The period						101,000	

FALLS CREEK NEAR CLEMONS, MONT.

This station, which is located 1½ miles above Clemons, Mont., and 500 feet above the mouth of the creek, was established May 4, 1908, to obtain data for use in connection with water-power and irrigation development.

Falls Creek has a large fall above the gaging station and affords opportunities for water-power development. No water is diverted from this stream, its entire flow reaching Dearborn River.

The conditions for obtaining accurate discharge measurements are fair at medium and low stages. Measurements are impossible at flood stages, as they can be made only by wading. No records are kept during the winter, as the gage heights are affected by ice. The datum of the staff gage has remained unchanged.

Discharge measurements of Falls Creek near Clemons, Mont., in 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
May 6	Raymond Richards	36	32	1.30	66.2
July 9	do	55	52	1.61	145
Sept. 24	do	32	26.6	1.09	55.4
Oct. 21	J. E. Stewart	24	20.7	.94	33.6

Daily gage height, in feet, of Falls Creek near Clemons, Mont., for 1909.

[Dr. O. A. Kenck, observer.]

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1		0.82	0.92	2.31	1.96	1.40	1.11	1.12	
2	0.81							1.10	0.96
3		.82	.95	2.37	1.91	1.36	1.71		
4	.81	.82	1.50					1.08	.95
5			1.30	2.80		1.30	1.41		
6	.82	.82	1.30	3.04	1.80			1.04	
7				2.85			1.50		.89
8	.80		1.32		1.65	1.27			
9		.82		2.98				1.00	.89
10	.81	.82	1.33		1.60	1.18	1.32		

Daily gage height, in feet, of Falls Creek near Clemons, Mont., for 1909—Continued.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
11				2.98				1.00	0.88
12	0.81	0.82	1.31		1.59		1.22		
13				3.01		1.10			
14	.82	.82	1.28		1.55		1.22	1.00	
15				2.96		1.10		1.00	
16	.82	.82	1.28				1.20		
17				2.94		1.10	1.20	1.00	
18		.85	1.30		1.55				
19	.83			2.98		1.08	1.18	1.00	
20	.83	.85	1.30	2.98				1.00	
21				2.96	1.51	1.07			
22	.82	.86	1.85				1.15	1.00	
23			1.91	2.32	1.50				
24	.83	.91				1.04		1.00	
25			2.32	2.20	1.48		1.14		
26	.83	.91		2.00		1.01		1.00	
27			2.40				1.10		
28	.82	.88		2.00	1.48	1.01		1.00	
29			2.34			1.00			
30	.82	.91	2.28	1.98	1.45		1.12	1.00	
31						1.00			

NOTE.—Ice conditions during January and February and Nov. 12 to Dec. 31.

Daily discharge, in second-feet, of Falls Creek near Clemons, Mont., for 1909.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	15.7	16.4	24	315	225	103	56	58	39
2	15.7	16.4	25	322	218	100	112	55	38
3	15.7	16.4	26	330	211	96	168	54	37
4	15.7	16.4	100	392	203	90	136	52	36
5	16.0	16.4	66	455	195	85	105	50	34
6	16.4	16.4	66	540	187	84	114	47	32
7	15.7	16.4	68	475	170	82	123	46	30
8	15.0	16.4	70	500	152	80	112	44	30
9	15.4	16.4	74	525	146	73	100	42	30
10	15.7	16.4	78	525	141	66	89	42	30
11	15.7	16.4	74	525	142	62	80	42	29
12	15.7	16.4	70	525	142	58	72	42	
13	16.0	16.4	70	525	138	55	72	42	
14	16.4	16.4	70	518	134	55	72	42	
15	16.4	16.4	70	510	134	55	70	42	
16	16.4	16.4	70	510	134	55	69	42	
17	16.6	17.4	72	510	134	55	69	42	
18	16.8	18.5	73	516	134	54	68	42	
19	17.1	18.5	73	522	131	52	66	42	
20	17.1	18.5	73	522	128	52	65	42	
21	16.8	18.8	126	507	125	51	64	42	
22	16.4	19.2	180	414	124	50	62	42	
23	16.8	21	195	320	123	48	62	42	
24	17.1	33	250	305	121	47	61	42	
25	17.1	22	305	290	119	45	61	42	
26	17.1	22	318	290	119	43	58	42	
27	16.8	22	332	290	119	43	55	42	
28	16.4	21	331	290	119	43	56	42	
29	16.4	22	330	290	116	42	57	42	
30	16.4	23	315	290	113	42	58	42	
31	16.4		315		108	42		40	

NOTE.—These discharges are based on rating applicable as follows: Mar. 1 to May 6, well defined below 100 second-feet; May 7 to July 9, indirect method for shifting channels; July 10 to Nov. 11, well defined below 200 second-feet. Discharges interpolated for days when gage was not read.

Monthly discharge of Falls Creek near Clemons, Mont., for 1909.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
March	17.1	15.0	16.3	1,000	B.
April	23	16.4	18.3	1,090	B.
May	332	24	139	8,550	B.
June	540	290	428	25,500	B.
July	225	108	146	8,980	A.
August	103	42	61.5	3,780	A.
September	168	55	80.4	4,780	A.
October	58	40	44.2	2,720	B.
Nov. 1–11	39	29	33.2	724	B.
The period				57,100	

SUN RIVER DRAINAGE BASIN.

DESCRIPTION.

Sun River rises on the eastern slope of the Rocky Mountains in northwestern Montana, flows southward for about 60 miles, then, turning abruptly, flows eastward through a canyon, emerging on a level plain, through which it runs for 75 miles to its junction with the Missouri at Great Falls. The area of the drainage basin is about 2,240 square miles.

South Fork and Willow Creek, its only important tributaries, rise in the mountains and are perennial streams. The others are small intermittent streams whose drainage areas lie entirely within the plains region.

The valley of Sun River proper is from 1 to 3 miles wide and the river flows from 5 to 25 feet below its general surface. Steeply sloping bluffs, about 300 feet high, border this valley, and between these bluffs and the adjoining river valley are comparatively smooth bench lands. The highest peak in the mountains stands about 8,900 feet above sea level; the altitude of the river at the canyon where it leaves the mountains is 4,450 feet; at its mouth it is 3,300 feet above sea level.

The mountainous part of the basin is included in the Lewis and Clark National Forest and is heavily timbered. The plains section is treeless except for a few willows and cottonwoods along the streams.

The mean annual rainfall varies from 12 inches in the plains region to about 45 inches in the mountainous sections. The heaviest rainfall occurs during the month of June, but the regular June floods are caused by the melting snow in the mountains. During the greater part of the winter season all the streams are frozen over.

Much of the land in the valley has been irrigated, and the ordinary summer flow of the stream is practically all utilized. The United States Reclamation Service has started construction on an irrigation project that will store the flood water of Sun River and its tributaries

and carry it to the higher bench lands at the north of the valley, where 260,000 acres of irrigable land can be reclaimed. A number of reservoir sites have been selected, the largest being the Warm Springs reservoir, with a capacity of 156,800 acre-feet. The other reservoirs are the Willow Creek, with a capacity of 84,320 acre-feet; the Pishkun, with a capacity of 45,747 acre-feet; and the Benton Lake, with a capacity of 140,200 acre-feet.

Natural power opportunities are good, as Sun River has a minimum flow at the point where it leaves the mountains of 150 second-feet and a fall of about 40 feet to the mile.

NORTH FORK OF SUN RIVER NEAR AUGUSTA, MONT.

This station, which is situated below the head of the Kilraven ditch, near Christian's ranch, 12 miles northwest of Augusta and 21 miles southwest of Chouteau, Mont., was established October 31, 1903, to determine the amount of water available for storage and irrigation.

The only important tributaries are Willow Creek and the South Fork of Sun River, both of which enter several miles below the gaging station. Very little water is diverted above the station, but below nearly all of the valley land is irrigated from this stream.

The datum of the chain gage has not been changed since the station was established. Conditions for obtaining accurate discharge data are excellent except during the winter months, when the discharge is affected by ice.

Measurements are made from a cable.

Discharge measurements of North Fork of Sun River near Augusta, Mont., in 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
May 5	Raymond Richards	139	459	1.71	1,020
June 7	do	147	844	4.56	4,670
July 10	do	141	511	2.52	1,570
Sept. 23	do	130	290	.87	388
Oct. 23	J. E. Stewart	131	267	.68	324

Daily gage height, in feet, of North Fork of Sun River near Augusta, Mont., for 1909.

[G. B. Christian, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	.....	.....	0.5	0.5	5.0	3.9	2.0	1.0	0.7	0.6	1.2
2	0.8	.....	.....	.5	.5	5.8	3.7	1.9	1.0	.7	.6	1.2
3	.....	.....	.....	.5	.8	6.0	3.5	1.9	1.0	.7	1.0	1.1
4	.....	.....	.....	.4	1.3	5.5	3.5	1.9	1.0	.7	1.8	1.1
5	.....	.....	.....	.4	1.9	5.3	3.4	1.8	1.0	.7	1.8	.....
6	.....	1.0	1.0	.4	1.3	4.9	3.2	1.7	1.0	.7	1.7	.....
7	.....	.....	.....	.4	1.2	4.6	3.0	1.7	1.0	.7	1.6	.....
8	.....	.....	.....	.3	1.0	4.5	2.8	1.6	1.0	.7	1.5	.....
9	1.0	.....	.....	.3	1.2	4.5	2.7	1.6	1.0	.7	1.5	.....
10	.....	.....	.....	.3	1.6	4.5	2.5	1.6	1.0	.7	1.4	.....

Daily gage height, in feet, of North Fork of Sun River near Augusta, Mont., for 1909—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
11	.....	.....	.....	0.4	1.4	4.5	2.5	1.7	1.0	0.7	1.4	.....
12	.....	.....	.....	.4	1.2	4.5	2.5	1.5	1.0	.7	1.3	.....
13	.....	1.0	0.9	.4	1.3	4.6	2.3	1.4	1.0	.7	1.3	.....
14	.....	.....	.....	.4	1.5	5.1	2.2	1.3	.9	.7	1.2	.....
15	.....	.....	.....	.4	1.7	5.9	2.1	1.3	.9	.7	1.1	.....
16	1.1	.....	.....	.4	1.7	6.0	2.0	1.3	.9	.7	1.0	.....
17	.....	.....	.....	.4	1.5	5.8	2.0	1.3	.9	.7	1.0	.....
18	.....	.....	.....	.4	1.5	5.6	1.9	1.2	.9	.7	.9	.....
19	.....	.....	.....	.4	1.6	5.3	1.8	1.2	.8	.7	.8	.....
20	.....	1.1	.9	.3	1.9	5.0	1.8	1.2	.8	.7	.8	.....
21	.....	.....	.9	.4	2.3	4.9	1.7	1.1	.8	.7	1.0	.....
22	.....	.....	.8	.4	3.2	4.7	1.8	1.1	.8	.6	1.2	.....
23	1.1	.....	.7	.4	3.1	4.4	2.0	1.1	.8	.6	1.3	.....
24	.....	.....	.7	.4	3.9	4.1	2.0	1.1	.8	.6	1.6	.....
25	.....	.....	.6	.5	4.0	4.0	2.0	1.0	.8	.6	1.6	.....
26	.....	.....	.6	.8	4.3	3.8	2.5	1.0	.8	.6	1.6	.....
27	.....	1.1	.5	.6	4.6	3.7	3.0	1.0	.8	.6	1.6	.....
28	.....	.....	.5	.6	4.4	3.7	3.8	1.0	.8	.6	1.5	.....
29	.....	.....	.4	.5	4.4	3.7	3.2	1.0	.8	.6	1.4	.....
30	1.1	.....	.4	.5	3.9	3.8	2.7	1.0	.7	.6	1.4	.....
31	.....	.....	.6	.....	4.0	.....	2.2	1.0	.....	.6	.....	.....

NOTE.—Ice conditions, January, February, March, and Dec. 5 to Dec. 31.

Daily discharge, in second-feet, of North Fork of Sun River near Augusta, Mont., for 1909.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	260	260	5,360	3,650	1,260	480	330	290	600
2	260	260	6,690	3,350	1,160	480	330	290	600
3	260	375	7,030	3,070	1,160	480	330	480	540
4	235	670	6,180	3,070	1,160	480	330	1,070	540
5	235	1,160	5,840	2,930	1,070	480	330	1,070	.....
6	235	670	5,200	2,660	980	480	330	980	.....
7	235	600	4,720	2,400	980	480	330	900	.....
8	215	480	4,560	2,150	900	480	330	820	.....
9	215	600	4,560	2,030	900	480	330	820	.....
10	215	900	4,560	1,790	900	480	330	740	.....
11	235	740	4,560	1,790	980	480	330	740	.....
12	235	600	4,560	1,790	820	480	330	670	.....
13	235	670	4,720	1,570	740	480	330	670	.....
14	235	820	5,520	1,460	670	425	330	600	.....
15	235	980	6,860	1,360	670	425	330	540	.....
16	235	980	7,030	1,260	670	425	330	480	.....
17	235	820	6,690	1,260	670	425	330	480	.....
18	235	820	6,350	1,160	600	425	330	425	.....
19	235	900	5,840	1,070	600	375	330	375	.....
20	215	1,160	5,360	1,070	600	375	330	375	.....
21	235	1,570	5,200	980	540	375	330	480	.....
22	235	2,660	4,880	1,070	540	375	290	600	.....
23	235	2,530	4,400	1,260	540	375	290	670	.....
24	235	3,650	3,950	1,260	540	375	290	900	.....
25	260	3,800	3,800	1,260	480	375	290	900	.....
26	375	4,250	3,500	1,790	480	375	290	900	.....
27	290	4,720	3,350	2,400	480	375	290	900	.....
28	290	4,400	3,350	3,500	480	375	290	820	.....
29	260	4,400	3,350	2,660	480	375	290	740	.....
30	260	3,650	3,500	2,030	480	330	290	740	.....
31	.....	3,800	.....	1,460	480	.....	290	.....	.....

NOTE.—These discharges are based on a rating curve that is well defined up to 5.0 feet.

Monthly discharge of North Fork of Sun River near Augusta, Mont., for 1909.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
April	375	215	246	14,600	B.
May	4,720	260	1,740	107,000	A.
June	7,030	3,350	5,050	300,000	A.
July	3,650	980	1,950	120,000	A.
August	1,260	480	742	45,600	A.
September	480	330	427	25,400	A.
October	330	290	317	19,500	A.
November	1,070	290	682	40,600	A.
The period				673,000	

SUN RIVER AT SUN RIVER, MONT.

This station, which is located at the highway bridge over Sun River, Mont., was established July 31, 1905, to obtain data for use in connection with irrigation projects. The records at this station do not show the total run-off from the drainage area above it, as practically the entire valley above is irrigated from this stream. The greater part of the ordinary summer flow is utilized for irrigation.

The gage is a staff nailed securely to piling on the left bank just above the bridge.

The gage datum has not been changed since the station was established. The discharge is affected at times during the winter by ice. The gaging section at the bridge has been very poor since the high water of 1907, but good low-water measurements can be made by wading.

Discharge measurements of Sun River at Sun River, Mont., in 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
May 8	Raymond Richards	127	822	3.89	844
June 10	do	267	2,010	8.95	9,360
July 12	do	167	749	5.10	1,900
Sept. 25[a]	do	127	126	2.79	467
Oct. 18[a]	J. E. Stewart	118	254	2.77	452

[a] Made by wading.

Daily gage height, in feet, of Sun River at Sun River, Mont., for 1909.

[R. A. Lange, observer.]

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	3.5	3.5	3.5	8.75	6.7	4.95	3.5	3.0	2.8	3.2
2	3.2	3.5	3.6	8.9	6.5	4.5	3.5	3.0	3.0	3.5
3	3.0	3.5	3.8	8.9	6.55	4.45	3.7	3.0	3.5	3.6
4	3.0	3.3	4.0	8.65	6.4	4.3	4.0	3.0	3.55	3.7
5	3.0	3.2	4.2	8.95	9.9	4.1	4.0	3.0	3.6	3.7
6	3.0	3.2	3.85	8.7	8.7	4.0	4.0	3.0	3.6	3.7
7	3.0	3.0	4.0	7.75	8.3	4.0	3.7	2.75	3.6	3.7
8	3.0	3.0	4.0	7.8	6.7	4.0	3.6	2.7	3.6	3.5
9	3.5	3.05	3.95	10.2	6.4	3.95	3.3	2.7	3.6	3.35
10	3.5	3.05	3.95	9.0	6.4	3.9	3.0	2.8	3.6	3.3

Daily gage height, in feet, of Sun River at Sun River, Mont., for 1909—Continued.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
11	3.5	3.05	3.95	8.0	6.35	3.85	3.0	2.9	3.6	3.3
12	3.5	3.0	3.9	8.0	5.0	3.8	2.85	2.85	3.6	3.5
13	3.5	3.0	4.0	8.0	5.0	3.6	2.5	2.8	3.6	3.5
14	3.5	3.0	4.0	8.8	4.8	3.5	2.7	2.8	3.7	3.55
15	3.4	3.0	5.0	8.9	4.8	3.5	2.7	2.7	3.7	3.5
16	3.4	3.1	5.0	9.15	4.6	3.5	2.65	2.7	3.85	3.5
17	3.35	3.15	5.7	9.5	4.3	3.0	2.5	2.75	3.8	3.5
18	3.3	3.2	6.1	9.4	4.3	3.0	2.5	2.75	3.75	3.5
19	3.3	3.2	6.1	9.2	4.1	3.0	2.55	2.75	3.9	3.5
20	3.2	3.1	6.05	9.1	4.1	3.0	2.55	2.75	3.9	3.6
21	3.25	3.0	6.5	9.0	4.0	2.9	2.6	2.75	4.0	3.65
22	3.45	3.0	6.65	8.9	4.15	2.8	2.75	2.75	4.0	3.6
23	3.7	3.0	6.7	7.75	4.05	2.8	2.75	2.75	4.0	3.6
24	3.4	3.35	7.0	7.4	3.95	2.75	2.8	2.7	3.9	3.4
25	3.3	3.5	7.0	7.4	4.8	2.5	2.8	2.7	3.9	3.4
26	3.3	3.5	7.5	7.0	5.95	2.5	3.0	2.7	4.05	3.6
27	3.3	3.5	7.85	7.0	6.95	2.5	3.0	2.7	4.05	3.8
28	3.5	3.1	7.8	6.75	6.5	2.5	2.9	2.7	3.4	3.8
29	3.3	3.0	7.65	6.75	5.5	2.5	2.8	2.75	3.4	3.8
30	3.3	3.0	8.6	6.6	4.2	2.5	2.85	2.75	3.3	3.9
31	3.3	.....	8.65	.....	4.0	2.5	.....	2.8	.....	3.85

NOTE.—Probable ice conditions during January and February.

Daily discharge, in second-feet, of Sun River at Sun River, Mont., for 1909.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	620	620	620	8,020	4,300	1,740	750	530	460	610
2	478	620	673	8,470	3,970	1,380	750	530	530	750
3	395	620	788	8,470	4,040	1,340	855	530	750	800
4	395	523	915	8,150	3,820	1,230	1,030	530	775	855
5	395	478	1,060	8,760	10,600	1,100	1,030	530	800	855
6	395	478	819	8,450	7,700	1,030	1,030	530	800	855
7	395	395	915	6,530	6,900	1,030	855	445	800	855
8	395	395	915	6,850	4,120	1,030	800	430	800	750
9	620	415	882	12,000	3,690	1,000	655	430	800	678
10	620	415	882	9,400	3,690	970	530	460	800	655
11	620	415	882	7,360	3,500	940	530	495	800	655
12	620	395	850	7,360	1,780	910	478	478	800	750
13	620	395	915	7,360	1,780	800	385	460	800	750
14	620	395	915	9,000	1,610	750	430	460	855	775
15	570	395	1,790	9,200	1,610	750	430	430	855	750
16	570	435	1,790	9,600	1,450	750	418	430	940	750
17	546	456	2,560	10,400	1,230	530	385	445	910	750
18	523	478	3,060	10,100	1,230	530	385	445	882	750
19	523	478	3,060	9,660	1,100	530	395	445	970	750
20	478	435	3,000	9,420	1,100	530	395	445	970	800
21	500	395	3,630	9,000	1,030	495	405	445	1,030	828
22	595	395	3,860	8,800	1,130	460	445	445	1,030	800
23	729	395	3,930	6,500	1,060	460	445	445	1,030	800
24	570	546	4,390	5,850	1,000	445	460	430	970	700
25	523	620	4,390	5,850	1,610	385	460	430	970	700
26	523	620	5,210	4,950	2,860	385	530	430	1,060	800
27	523	620	5,950	4,950	4,300	385	530	430	1,060	910
28	620	435	5,940	4,550	3,630	385	495	430	700	910
29	523	395	5,700	4,550	2,330	385	460	445	700	910
30	523	395	7,680	4,300	1,160	385	478	445	655	970
31	523	.....	7,800	.....	1,030	385	.....	460	.....	940

NOTE.—These discharges are based on rating curves applicable as follows: Mar. 1–May 25, well defined between 395 and 8,070 second-feet; May 26–July 12, indirect method for shifting channels used; July 13–Dec. 31, well defined.

Monthly discharge of Sun River at Sun River, Mont., for 1909.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
March	729	395	534	32,800	B.
April	620	395	468	27,800	B.
May	7,800	620	2,770	170,000	B.
June	12,000	4,300	7,800	464,000	B.
July	10,600	1,000	2,910	179,000	A.
August	1,740	385	756	46,500	B.
September	1,030	385	574	34,200	B.
October	530	430	462	28,400	B.
November	1,060	460	843	50,200	A.
December	970	610	787	48,400	A.
The period				1,080,000	

WILLOW CREEK NEAR AUGUSTA, MONT.

Willow Creek rises on the eastern slopes of the Rocky Mountains in the northwestern part of Lewis and Clark County, Mont., and flows in a general northeasterly direction to its junction with North Fork of Sun River.

The gaging station, which is located at Jordan's ranch just below the mouth of Little Willow Creek, about 7 miles northwest of Augusta, Mont., was established June 8, 1905, to obtain run-off data for use in connection with the Sun River irrigation project. Willow Creek dam, work on which has been begun, will provide a reservoir with a capacity of 84,320 acre-feet.

Much of the valley land above the station is irrigated, the water being taken from this stream.

Conditions for obtaining accurate discharge data are excellent. No ice forms at this station, as a large spring enters the creek just above the gage. A standard chain gage, which is located on the right bank near the observer's footbridge, is used. Measurements are made by wading at any convenient section. The datum of the gage has not been changed.

Discharge measurements of Willow Creek near Augusta, Mont., in 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
May 5	Raymond Richards	21	27	1.73	45.8
June 28	....do	29	43	3.90	172.0
July 10	....do	28	32	2.64	76.0
Sept. 23	....do	18	15	1.41	28.9
Oct. 22	J. E. Stewart	12	17	1.24	20.4

Daily gage height, in feet, of Willow Creek near Augusta, Mont., for 1909.

[S. N. Jordan, observer.]

Date.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	0.8	0.95	0.75	1.0	1.0	2.9	3.5	2.55	1.55	1.3	1.2	1.2
2	.8	.95	.75	.9	1.0	2.95	3.35	2.45	1.6	1.3	1.2	1.1
3	.8	.95	.8	.9	1.3	3.0	3.3	2.40	2.4	1.3	1.35	1.05
4	.8	.95	.85	.85	1.55	2.8	3.1	2.40	2.1	1.3	1.3	1.0
5	.75	.9	.8	.8	1.5	2.5	3.0	2.25	1.9	1.3	1.2	1.0
6	.75	.8	.75	.8	1.4	2.45	3.3	2.2	1.75	1.3	1.2	1.0
7	.75	.85	.75	.8	1.35	3.5	3.0	2.2	1.7	1.3	1.2	1.0
8	.75	.75	.8	.8	1.3	3.7	2.8	2.1	1.6	1.3	1.2	1.0
9	.70	.8	.75	.85	1.3	8.1	2.75	2.1	1.55	1.3	1.2	1.05
10	.70	.8	.7	.85	1.5	6.8	2.6	2.05	1.55	1.3	1.2	1.1
11	.70	.8	.6	.85	1.4	5.9	2.55	2.00	1.55	1.3	1.2	1.1
12	.75	.8	.8	.85	1.4	5.7	2.45	2.00	1.65	1.3	1.2	1.25
13	.75	.8	.75	.85	1.45	5.6	2.35	1.9	1.6	1.3	1.0	1.2
14	.7	.75	.75	.85	1.5	5.75	2.3	1.9	1.55	1.3	1.1	1.2
15	.8	.75	.8	.85	1.55	5.8	2.2	1.8	1.5	1.3	1.1	1.15
16	.75	.75	.85	.85	2.1	5.7	2.2	1.8	1.5	1.3	1.1	1.15
17	.8	.8	1.1	.9	1.85	5.35	2.15	1.8	1.5	1.3	1.4	1.1
18	1.5	.75	.9	.8	1.8	5.15	2.1	1.8	1.5	1.3	1.35	1.1
19	1.95	.75	1.0	.8	1.8	5.7	2.05	1.8	1.5	1.3	1.35	1.1
20	4.85	.75	.9	.8	1.8	7.1	2.0	1.8	1.45	1.3	1.4	1.1
21	2.75	.75	.9	.85	2.05	6.1	1.9	1.8	1.45	1.25	1.4	1.1
22	1.65	.75	.9	.9	2.55	5.45	1.8	1.75	1.45	1.25	1.4	1.1
23	1.1	.75	.95	.95	2.5	5.1	1.85	1.7	1.4	1.25	1.55	1.1
24	1.0	.8	.95	.9	2.55	4.8	1.85	1.65	1.4	1.25	1.4	1.1
25	1.0	.8	.95	.9	2.8	4.5	1.8	1.6	1.4	1.25	1.4	1.1
26	1.0	.8	.9	1.3	2.9	4.3	2.4	1.6	1.4	1.2	1.4	1.1
27	1.0	.8	.9	1.1	3.15	4.1	6.15	1.6	1.4	1.2	1.5	1.1
28	1.0	.8	.9	.9	3.15	3.9	4.45	1.6	1.35	1.2	1.6	1.1
29	.95	.....	.9	.95	3.00	3.8	3.3	1.55	1.3	1.2	1.5	1.1
30	.85	.....	.9	1.0	2.8	3.65	2.95	1.5	1.3	1.2	1.3	1.1
31	.9	.....	.9	.....	2.7	.....	2.85	1.5	.....	1.2	.....	1.1

Daily discharge, in second-feet, of Willow Creek near Augusta, Mont. for 1909.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	9.7	14.2	8.4	16.0	16.0	110	143	76	35	24	18	19
2	9.7	14.2	8.4	12.5	16.0	113	132	71	37	24	18	16
3	9.7	14.2	9.7	12.5	27	116	127	68	70	24	24	14
4	9.7	14.2	11.1	11.1	37	104	114	68	56	24	22	13
5	8.4	12.5	9.7	9.7	35	86	106	61	48	23	19	13
6	8.4	9.7	8.4	9.7	31	83	121	59	42	23	19	13
7	8.4	11.1	8.4	9.7	29	146	102	59	38	23	19	13
8	8.4	8.4	9.7	9.7	27	159	89	55	36	23	19	13
9	7.2	9.7	8.4	11.1	27	488	83	55	34	23	19	14
10	7.2	9.7	7.2	11.1	35	384	76	53	34	23	19	16
11	7.2	9.7	5.0	11.1	31	313	73	51	34	23	19	16
12	8.4	9.7	9.7	11.1	31	299	69	51	37	23	19	21
13	8.4	9.7	8.4	11.1	33	292	65	48	36	23	13	19
14	7.2	8.4	8.4	11.1	35	302	63	48	35	23	16	19
15	9.7	8.4	9.7	11.1	37	306	59	44	33	23	16	18
16	8.4	8.4	11.1	11.1	64	299	59	44	33	23	16	18
17	9.7	9.7	19.5	12.5	52	274	57	44	33	23	26	16
18	35	8.4	12.5	9.7	49	260	55	44	33	23	23	16
19	56	8.4	16.0	9.7	49	299	53	44	33	23	23	16
20	240	8.4	12.5	9.7	49	408	51	44	31	23	26	16
21	101	8.4	12.5	11.1	62	328	48	44	31	22	26	16
22	42	8.4	12.5	12.5	89	282	44	42	31	22	26	16
23	19.5	8.4	14.2	14.2	86	257	46	40	29	21	32	16
24	16.0	9.7	14.2	12.5	89	236	46	38	28	21	28	16
25	16.0	9.7	14.2	12.5	104	215	44	36	28	21	28	16
26	16.0	9.7	12.5	27	110	201	68	36	28	18	28	16
27	16.0	9.7	12.5	19.5	125	187	320	36	28	18	31	16
28	16.0	9.7	12.5	12.5	125	173	200	36	26	18	34	16
29	14.2	.....	12.5	14.2	116	165	115	35	24	18	30	16
30	11.1	.....	12.5	16.0	104	154	96	33	24	18	23	16
31	12.5	.....	12.5	.....	98	.....	90	33	.....	18	.....	16

NOTE.—These discharges are based on a rating curve that is fairly well defined between 5.0 and 180 second-feet, used Jan. 1 to June 28. June 29 to Dec. 31 indirect method for shifting channels used.

Monthly discharge of Willow Creek near Augusta, Mont., for 1909.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
January	240	7.2	24.4	1,500	B.
February	14.2	8.4	10.0	555	B.
March	19.5	5.0	11.1	682	B.
April	27	9.7	12.4	738	B.
May	125	16.0	58.6	3,600	B.
June	488	83	235	14,000	C.
July	320	44	90.8	5,580	B.
August	76	33	48.3	2,970	B.
September	70	24	34.8	2,070	B.
October	24	18	21.9	1,350	B.
November	34	13	22.6	1,340	B.
December	21	13	16.0	984	B.
The year	488	5.0	48.8	35,400	

SOUTH FORK OF SUN RIVER AT AUGUSTA, MONT.

This station, which is located at the highway bridge on the road from Augusta to Craig, Mont., about half a mile from Augusta, was established December 2, 1904, to obtain run-off data for use in connection with the Sun River irrigation project.

Water is diverted to irrigate the valley lands, both above and below the stations. During dry seasons the entire summer flow is utilized.

The original gage was spiked to the cribwork of the right abutment on the downstream side of the bridge. On April 17, 1907, a new gage was established 100 yards above the bridge. This gage is spiked to a tree on the left bank and is set at a different datum. Records for 1909 are referred to original gage. The gage heights are affected by ice during the winter.

Measurements in high water may be made from the highway bridge; in low water by wading.

Discharge measurements of South Fork of Sun River at Augusta, Mont., in 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
May 7	Raymond Richards	12	30.6	1.01	93.6
July 8	....do	96	100	1.55	265
Sept. 24	....do	33	27	1.22	75.4
Oct. 21	J. E. Stewart	34	25	1.15	65.0

Daily gage height, in feet, of South Fork of Sun River at Augusta, Mont., for 1909.

[Richard Auchard, observer.]

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1		0.5	0.6	2.2	1.6	1.6	1.25	1.2	1.2
2		.5	.6	2.4	1.6	1.5	1.35	1.2	1.2
3		.5	.7	2.3	1.6	1.5	1.7	1.2	1.2
4		.45	1.0	2.3	1.6	1.4	1.7	1.2	1.2
5		.4	1.1	2.25	1.6	1.4	1.5	1.2	1.2

Daily gage height, in feet, of South Fork of Sun River at Augusta, Mont., in 1909—Continued.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
6	.....	0.4	1.0	2.1	1.9	1.4	1.4	1.2	1.2
7	.....	.4	1.0	2.4	1.6	1.3	1.3	1.2	1.2
8	.....	.4	1.0	3.8	1.6	1.3	1.3	1.2	1.2
9	.....	.4	1.0	4.15	1.5	1.3	1.3	1.2	1.2
10	.....	.5	1.0	3.5	1.5	1.25	1.4	1.2	1.2
11	.....	.4	1.1	3.4	1.4	1.25	1.4	1.2	1.2
12	.....	.4	1.1	3.3	1.4	1.25	1.3	1.2	1.2
13	.....	.4	1.1	3.2	1.4	1.25	1.3	1.2	1.2
14	0.7	.4	1.1	3.3	1.3	1.25	1.2	1.2	1.2
15	.7	.4	1.2	3.3	1.2	1.25	1.2	1.2	1.2
16	.8	.4	1.2	3.25	1.2	1.25	1.2	1.2	1.2
17	.9	.5	1.3	3.0	1.2	1.2	1.2	1.2	1.2
18	.9	.4	1.4	2.9	1.2	1.2	1.2	1.2	1.2
19	.8	.4	1.45	2.8	1.3	1.2	1.2	1.2	1.2
20	.7	.4	1.5	2.6	1.3	1.2	1.2	1.2	1.2
21	.7	.4	1.6	2.5	1.3	1.2	1.2	1.2	1.2
22	.5	.4	2.0	2.3	1.4	1.2	1.2	1.2	1.2
23	.5	.4	2.2	2.2	1.4	1.25	1.2	1.2	1.2
24	.6	.45	2.35	2.1	1.4	1.25	1.2	1.2	1.2
25	.6	.5	2.5	2.0	1.5	1.25	1.2	1.2	1.2
26	.6	.5	2.7	2.0	1.9	1.25	1.2	1.2	1.2
27	.5	.5	2.7	1.9	1.9	1.25	1.2	1.2	1.2
28	.5	.6	2.6	1.8	1.8	1.25	1.2	1.2	1.2
29	.5	.6	2.5	1.6	1.8	1.25	1.2	1.2	1.2
30	.5	.6	2.3	1.5	1.7	1.25	1.2	1.2	1.2
31	.5	.....	2.3	.....	1.6	1.25	.....	1.2	.....

NOTE.—Ice conditions Jan. 1 to Mar. 13, Dec. 1 to Dec. 31.

Daily discharge, in second-feet, of South Fork of Sun River at Augusta, Mont., for 1909.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	.....	37	44	729	289	270	94	76	76
2	.....	37	44	930	289	208	132	76	76
3	.....	37	53	826	289	208	336	76	76
4	.....	34	93	826	289	153	336	76	76
5	.....	32	113	778	289	153	208	76	76
6	.....	32	93	638	475	153	153	76	76
7	.....	32	93	930	289	111	111	76	76
8	.....	32	93	2,590	289	111	111	76	76
9	.....	32	93	3,040	243	111	111	76	76
10	.....	37	93	2,220	243	94	153	76	76
11	.....	32	113	2,100	203	94	153	76	76
12	.....	32	113	1,980	203	94	111	76	76
13	.....	32	113	1,860	203	94	111	76	76
14	53	32	113	1,980	168	94	76	76	76
15	53	32	138	1,980	138	94	76	76	76
16	64	32	138	1,920	138	94	76	76	76
17	77	37	168	1,620	138	76	76	76	76
18	77	32	203	1,500	138	76	76	76	76
19	64	32	223	1,380	168	76	76	76	76
20	53	32	243	1,150	168	76	76	76	76
21	53	32	289	1,040	168	76	76	76	76
22	37	32	553	826	203	76	76	76	76
23	37	32	729	729	203	94	76	76	76
24	44	34	878	638	203	94	76	76	76
25	44	37	1,040	553	243	94	76	76	76
26	44	37	1,260	553	474	94	76	76	76
27	37	37	1,260	475	474	94	76	76	76
28	37	44	1,150	405	404	94	76	76	76
29	37	44	1,040	289	404	94	76	76	76
30	37	44	826	243	336	94	76	76	76
31	37	.....	826	.....	270	94	.....	76	76

NOTE.—These discharges are based on two rating curves that are poorly defined.

Monthly discharge of South Fork of Sun River at Augusta, Mont., for 1909.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
March 14–31	77	37	49.2	1,760
April	44	32	34.7	2,060
May	1,260	44	394	24,200
June	3,040	243	1,220	72,600
July	475	138	259	15,900
August	270	76	111	6,820
September	336	76	114	6,780
October	76	76	76	4,670
November	76	76	76	4,520
The period				139,000

FORD CREEK NEAR AUGUSTA, MONT.

This station, which is located at the ranch of Joseph Ford, 16 miles west of Augusta, was established April 11, 1906, to obtain run-off data for use in connection with the Sun River irrigation project.

Ford and Smith creeks unite and form the South Fork of Sun River. Ford Creek has no tributaries. One small irrigation ditch diverts water from the creek above the gage.

The current is swift and the gage heights are but little affected by ice. Conditions of flow are changeable, requiring frequent measurements to properly define the rating curve.

The datum of the staff gage located on the right bank of the stream near the observer's house has remained unchanged. All measurements are made by wading.

Discharge measurements of Ford Creek near Augusta, Mont., in 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
May 5	Raymond Richards	25	22	1.45	53.8
July 8	do	26	27	1.76	72.1
Sept. 23	do	24	15.6	1.32	23.6
Oct 22	do	14	20.2	1.21	17.5

Daily gage height, in feet, of Ford Creek near Augusta, Mont., for 1909.

[Joseph Ford, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.05	0.9	0.9	0.75	0.9	2.25	2.05	1.5	1.35	1.25	1.25	1.15
2	.9	.9	.9	.75	.95	2.35	1.9	1.55	1.35	1.25	1.25	1.15
3	.9	.9	.9	.8	1.25	2.30	1.9	1.55	1.65	1.25	1.25	1.15
4	1.8	.9	.9	.8	1.55	2.25	1.85	1.55	1.4	1.25	1.25	1.15
5	2.0	.9	.9	.8	1.55	2.30	1.85	1.55	1.35	1.25	1.25	1.15
6	2.0	1.2	.9	.8	1.5	2.10	1.85	1.55	1.35	1.25	1.25	1.15
7	2.0	.9	.9	.8	1.5	2.10	1.85	1.55	1.35	1.25	1.25	1.15
8	2.0	.9	.9	.8	1.5	2.85	1.8	1.55	1.35	1.25	1.25	1.15
9	2.0	.9	.9	.8	1.55	3.1	1.75	1.55	1.35	1.25	1.25	1.15
10	2.0	.9	.9	.8	1.6	2.95	1.75	1.55	1.35	1.25	1.25	1.15

Daily gage height, in feet, of Ford Creek near Augusta, Mont., for 1909—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
11	2.0	1.6	0.9	0.8	1.6	2.90	1.7	1.55	1.35	1.25	1.25	1.15
12	2.0	1.6	.9	.8	1.5	2.80	1.7	1.55	1.35	1.25	1.25	1.15
13	2.0	1.6	.9	.8	1.45	2.80	1.65	1.5	1.35	1.25	1.25	1.15
14	2.0	.9	.9	.8	1.4	2.85	1.65	1.45	1.35	1.25	1.25	1.15
15	1.2	.9	.8	.8	1.4	3.05	1.65	1.45	1.35	1.25	1.25	1.15
16	.9	.9	.8	.8	1.35	3.1	1.65	1.45	1.35	1.25	1.25	1.15
17	.9	.9	.8	.8	1.3	3.1	1.65	1.45	1.35	1.25	1.25	1.15
18	.9	.9	.75	.8	1.3	3.1	1.6	1.4	1.35	1.25	1.25	1.15
19	.9	.9	.75	.8	1.3	4.35	1.6	1.35	1.35	1.25	1.25	1.15
20	.9	.9	.75	.8	1.45	4.25	1.55	1.35	1.35	1.25	1.25	1.15
21	.9	.9	.75	.8	1.65	3.5	1.55	1.35	1.3	1.25	1.25	1.15
22	.9	.9	.75	.8	1.95	2.8	1.55	1.35	1.3	1.25	1.3	1.15
23	1.0	.9	.75	.8	1.9	2.7	1.55	1.35	1.3	1.25	1.35	1.15
24	.9	.9	.75	.8	2.0	2.45	1.55	1.35	1.3	1.25	1.25	1.15
25	.9	.9	.75	.9	2.05	2.4	1.55	1.35	1.3	1.25	1.25	1.15
26	.9	.9	.75	.95	2.25	2.35	1.6	1.35	1.3	1.25	1.25	1.15
27	.9	.9	.75	.90	2.2	2.3	2.15	1.35	1.25	1.25	1.25	1.15
28	.9	.9	.75	.90	2.2	2.3	1.9	1.35	1.25	1.25	1.25	1.15
29	1.3	.....	.75	.90	2.15	2.3	1.8	1.35	1.25	1.25	1.2	1.15
30	.9	.....	.75	.95	2.2	2.2	1.75	1.35	1.25	1.25	1.15	1.15
31	.9	.....	.75	.....	2.15	.....	1.65	1.35	.....	1.25	.....	1.15

NOTE.—Gage heights Jan. 1, Jan. 4 to 15, Jan. 23 and Jan. 29; also Feb. 6 and Feb. 8 to 13 are distorted, due to ice conditions.

Daily discharge, in second-feet, of Ford Creek near Augusta, Mont., for 1909.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	21	21	21	14	21	152	108	39	26	19	19	13.5
2	21	21	21	14	24	168	86	44	26	19	19	13.5
3	21	21	21	16	42	160	86	44	56	19	19	13.5
4	21	21	21	16	64	152	80	44	30	19	19	13.5
5	21	21	21	16	64	160	80	44	26	19	19	13.5
6	21	21	21	16	60	129	80	44	26	19	19	13.5
7	21	21	21	16	60	129	80	44	26	19	19	13.5
8	21	21	21	16	60	270	73	44	26	19	19	13.5
9	21	21	21	16	64	329	67	44	26	19	19	13.5
10	21	21	21	16	69	293	67	44	26	19	19	13.5
11	21	21	21	16	69	281	61	44	26	19	19	13.5
12	21	21	21	16	60	258	61	44	26	19	19	13.5
13	21	21	21	16	56	258	56	39	26	19	19	13.5
14	21	21	21	16	52	270	56	34	26	19	19	13.5
15	21	21	16	16	52	317	56	34	26	19	19	13.5
16	21	21	16	16	48	329	56	34	26	19	19	13.5
17	21	21	16	16	45	329	56	34	26	19	19	13.5
18	21	21	14	16	45	329	50	30	26	19	19	13.5
19	21	21	14	16	45	705	50	26	26	19	19	13.5
20	21	21	14	16	56	670	44	26	26	19	19	13.5
21	21	21	14	16	74	432	44	26	22	19	19	13.5
22	21	21	14	16	108	254	44	26	22	19	22	13.5
23	21	21	14	16	102	231	44	26	22	19	26	13.5
24	21	21	14	16	115	178	44	26	22	19	19	13.5
25	21	21	14	21	122	168	44	26	22	19	19	13.5
26	21	21	14	24	152	158	50	26	22	19	19	13.5
27	21	21	14	21	144	149	123	26	19	19	19	13.5
28	21	21	14	21	144	149	86	26	19	19	19	13.5
29	21	.....	14	21	136	149	73	26	19	19	16	13.5
30	21	.....	14	24	144	131	67	26	19	19	13.5	13.5
31	21	.....	14	.....	136	.....	56	26	.....	19	.....	13.5

NOTE.—Discharges on days where the gage heights were distorted by ice conditions have been estimated. These discharges are based on rating curves applicable as follows: Jan. 1 to June 21 the 1908 curve is used, which is well defined. June 22 to Dec. 31 fairly well defined up to 254 second-feet.

Monthly discharge of Ford Creek near Augusta, Mont., for 1909.

[Drainage area, 18 square miles.]

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
January	21	21	21	1.17	1.35	1,290	B.
February	21	21	21	1.17	1.22	1,170	B.
March	21	14	17.4	.967	1.11	1,070	B.
April	24	14	17.1	.950	1.06	1,020	B.
May	152	21	78.5	4.36	5.03	4,830	B.
June	705	129	256	14.2	15.84	15,200	B.
July	123	44	65.4	3.63	4.18	4,020	B.
August	44	26	34.4	1.91	2.20	2,120	B.
September	56	19	25.4	1.41	1.57	1,510	B.
October	19	19	19.0	1.06	1.22	1,170	B.
November	26	13.5	19.1	1.06	1.18	1,140	B.
December	13.5	13.5	13.5	.750	.86	830	B.
The year	70.5	13.5	19.0	2.72	36.82	35,400	

SMITH CREEK NEAR AUGUSTA, MONT.

This station, which is located 1 mile above J. W. Nixon's ranch, 16 miles southwest of Augusta, Mont., was established April 14, 1906, to obtain run-off data for use in connection with the Sun River irrigation project.

The ordinary summer flow is practically all used for irrigation; but no water is diverted above the gaging station.

The gage is an inclined staff, fastened securely to a bowlder on the left bank just above the ford. Discharge measurements are made by wading.

Discharge measurements of Smith Creek near Augusta, Mont., in 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
May 6	Raymond Richards	26	22.7	1.00	61
July 9	....do	33	30.1	.87	67
Sept. 23	....do	24	17.1	.53	23.4
Oct. 22	J. E. Stewart	17	13.5	.48	15.5

Daily gage height, in feet, of Smith Creek near Augusta, Mont., for 1909.

[Mrs. J. W. Nixon, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	0.6	0.6	0.55	0.55	0.65	1.75	1.1	0.75	0.6	0.5	0.4	0.5
2	.6	.6	.55	.55	1.2	1.65	1.05	.75	.75	.5	.4	.5
3	.6	.6	.55	.55	1.25	1.65	1.05	.7	.95	.5	.4	.5
4	.6	.6	.55	.6	1.25	1.6	1.0	.7	.8	.5	.4	.5
5	.6	.6	.55	.6	1.2	1.45	.95	.7	.8	.5	.4	.5

Daily gage height, in feet, of Smith Creek near Augusta, Mont., for 1909—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
6	0.6	0.6	0.55	0.6	1.0	1.75	0.95	0.7	0.7	0.5	0.4	0.5
7	.6	.6	.55	.6	1.0	2.6	.95	.7	.7	.5	.4	.5
8	.6	.6	.5	.6	.95	2.8	.9	.7	.7	.5	.4	.5
9	.6	.6	.5	.6	.95	2.4	.85	.7	.65	.5	.4	.5
10	.6	.6	.5	.6	.95	2.35	.85	.7	.65	.5	.4	.5
11	.6	.6	.5	.6	.95	2.25	.85	.7	.65	.5	.4	.5
12	.6	.6	.5	.6	.95	2.25	.8	.7	.65	.5	.4	.45
13	.6	.6	.5	.6	.95	2.3	.8	.7	.65	.5	.4	.45
14	.6	.6	.5	.6	.95	2.35	.8	.65	.6	.5	.45	.45
15	.6	.6	.5	.6	.95	2.35	.8	.65	.6	.5	.45	.45
16	.6	.6	.5	.6	1.0	2.2	.75	.65	.6	.5	.45	.45
17	.6	.6	.5	.6	1.0	2.0	.75	.6	.55	.5	.5	.45
18	.6	.6	.5	.6	1.05	1.85	.75	.6	.55	.5	.55	.45
19	.6	.6	.5	.6	1.15	1.8	.75	.6	.55	.5	.55	.4
20	.6	.6	.5	.6	1.3	1.7	.7	.6	.55	.5	.55	.4
21	.65	.55	.55	.6	1.55	1.65	.7	.6	.55	.45	.55	.4
22	.65	.55	.55	.6	1.55	1.5	.7	.6	.55	.45	.55	.4
23	.65	.55	.55	.65	1.55	1.3	.7	.6	.55	.45	.6	.4
24	.65	.55	.6	.65	1.6	1.25	.7	.6	.55	.45	.6	.4
25	.65	.55	.6	.65	1.8	1.2	.7	.6	.55	.4	.6	.4
26	.6	.55	.6	.65	1.75	1.2	1.0	.55	.55	.4	.6	.4
27	.6	.55	.6	.65	1.75	1.2	1.5	.55	.5	.4	.55	.4
28	.6	.55	.6	.65	1.75	1.15	.95	.55	.5	.4	.55	.4
29	.6	.....	.6	.65	1.7	1.1	.9	.55	.5	.4	.55	.4
30	.6	.....	.6	.65	1.7	1.1	.8	.55	.5	.4	.55	.4
31	.6	.....	.6	.....	1.7	.....	.8	.55	.....	.4	.....	.4

Daily discharge, in second-feet, of Smith Creek near Augusta, Mont., for 1909.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	13.5	13.5	10.2	10.2	18.2	218	109	49	30	21	10	17
2	13.5	13.5	10.2	10.2	98	194	100	49	49	21	10	17
3	13.5	13.5	10.2	10.2	108	194	100	42	81	21	10	17
4	13.5	13.5	10.2	13.5	108	183	90	42	56	21	10	17
5	13.5	13.5	10.2	13.5	98	150	81	42	56	21	10	17
6	13.5	13.5	10.2	13.5	62	218	81	42	42	21	10	17
7	13.5	13.5	10.2	13.5	62	420	81	42	42	21	10	17
8	13.5	13.5	7.0	13.5	54	468	72	42	42	21	10	17
9	13.5	13.5	7.0	13.5	54	408	64	42	36	21	10	17
10	13.5	13.5	7.0	13.5	54	396	64	42	36	21	10	17
11	13.5	13.5	7.0	13.5	54	372	64	42	36	21	10	17
12	13.5	13.5	7.0	13.5	54	372	56	42	36	21	10	13.5
13	13.5	13.5	7.0	13.5	54	384	56	42	36	21	10	13.5
14	13.5	13.5	7.0	13.5	54	396	56	36	30	21	13.5	13.5
15	13.5	13.5	7.0	13.5	54	396	56	36	30	21	13.5	13.5
16	13.5	13.5	7.0	13.5	62	360	49	36	30	20	13.5	13.5
17	13.5	13.5	7.0	13.5	62	312	49	30	26	20	17	13.5
18	13.5	13.5	7.0	13.5	70	276	49	30	26	19	22	13.5
19	13.5	13.5	7.0	13.5	88	264	49	30	26	19	22	10
20	13.5	13.5	7.0	13.5	118	241	42	30	26	18	22	10
21	18.2	10.2	10.2	13.5	172	230	42	30	26	13.5	22	10
22	18.2	10.2	10.2	13.5	172	195	42	30	26	13.5	22	10
23	18.2	10.2	10.2	18.2	172	150	42	30	26	13.5	27	10
24	18.2	10.2	13.5	18.2	183	140	42	30	26	13.5	27	10
25	18.2	10.2	13.5	18.2	229	129	42	30	26	10	27	10
26	13.5	10.2	13.5	18.2	218	129	90	26	26	10	27	10
27	13.5	10.2	13.5	18.2	218	129	195	26	21	10	22	10
28	13.5	10.2	13.5	18.2	218	119	81	26	21	10	22	10
29	13.5	.....	13.5	18.2	206	109	72	26	21	10	22	10
30	13.5	.....	13.5	18.2	206	109	56	26	21	10	22	10
31	13.5	.....	13.5	.....	206	.....	56	26	.....	10	.....	10

NOTE.—These discharges are based on three rating curves that are fairly well defined, applicable as follows: Jan. 1 to June 8; June 9 to Oct. 15; and Oct. 16 to Dec. 31, respectively.

Monthly discharge of Smith Creek near Augusta, Mont., for 1909.

[Drainage area, 26 square miles.]

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
January	18.2	13.5	14.3	0.550	0.63	879	B.
February	13.5	10.2	12.6	.485	.50	700	B.
March	13.5	7.0	9.71	.374	.43	597	B.
April	18.2	10.2	14.4	.554	.62	857	B.
May	229	18.2	116	4.46	5.14	7,130	B.
June	468	109	255	9.81	10.94	15,200	C.
July	195	42	68.6	2.64	3.04	4,220	A.
August	49	26	35.3	1.36	1.57	2,170	A.
September	81	21	33.7	1.30	1.45	2,010	A.
October	21	10.0	17.3	.665	.77	1,060	B.
November	27	10.0	16.4	.631	.70	976	B.
December	17	10.0	13.3	.512	.59	818	B.
The year	468	7.0	50.6	1.95	26.38	36,600	

MARIAS RIVER DRAINAGE BASIN.

DESCRIPTION.

The headwaters of Marias River rise on the eastern slope of the main divide of the Rocky Mountains at an elevation of over 8,000 feet and flow in an easterly direction through a region of elevated plains and prairies. Marias River proper is formed by the union of Cutbank and Two Medicine rivers, which meet at the eastern boundary of the Blackfeet Indian Reservation. From this junction to the Missouri, which it enters 14 miles below Fort Benton, its length is about 110 miles and its fall does not exceed 5 feet per mile. Its principal tributaries are Willow and Cottonwood creeks, which enter from the north, and Teton River which comes in from the south.

The general altitude of this country is from 3,000 to 4,000 feet, the plains rising by gentle terraces toward the mountains to elevations of about 5,000 feet. Grass is abundant and the region is devoted to grazing. Considerable spruce and pine timber is found at the headwaters in the mountains, but the remainder of the basin is bare except for fringes and small groves along the streams.

The mean annual rainfall varies from about 60 inches in the mountains to 12 inches near the mouth of the river, the average for the plains section being about 16 inches. The streams are icebound from December until early in March, and this is the season of least flow.

Irrigation has been practiced to a slight extent for a number of years in the valleys of the tributaries, and three large irrigation projects are now under construction. One is being constructed by the United States Reclamation Service, and the other two under the

Carey Act. Altogether about 450,000 acres will be reclaimed. The basin affords a number of excellent reservoir sites, which will be utilized in storing the flood waters of the upper tributaries from which the principal water supply for these projects will come.

The great fall and the abundant water supply of the upper tributaries of Marias River also afford favorable conditions for water-power development.

Run-off records in this basin extend back to 1902. The wettest year since that time was 1903 and the driest was 1905.

TWO MEDICINE RIVER AT FAMILY, MONT.

This station, which is located at the Holy Family Mission, 16 miles southeast of Browning, Mont., and about 6 miles above the mouth of Badger Creek, the nearest tributary, was established April, 1907, to determine the amount of water available for irrigation.

The United States Reclamation Service has under consideration a project which will use about 200 second-feet of water for irrigating land north of the stream for the Blackfeet Indians. The water will be diverted near the mouth of Little Badger Creek, a small tributary entering from the south above the station. A storage reservoir will be built at Two Medicine Lake near the headwaters of the stream to augment the low-water flow. The only diversion from this stream at present is that made by a ditch which supplies water for about 100 acres of land on the farm at the Holy Family Mission. It heads about 2 miles above the gage.

The gage is of the standard chain type and is located on the east bank of the stream directly back of the family mansion. High-water measurements must be made from the old wagon bridge located about 3 miles above the bridge. Wading measurements are made in low water at a section near the gage.

The datum of the gage was lowered 0.95 foot July 21, 1908.

The results are good at this station, except during the winter months when they are affected by ice.

Discharge measurements of Two Medicine River at Family, Mont., in 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Apr. 26[a]	W. A. Lamb	54	122	2.76	375
July 10[b]	do	126	240	3.20	696
Sept. 19[c]	J. E. Stewart	70	72	1.64	86
Oct. 19[c]	W. A. Lamb	66	64	1.60	74

[a] Made from bridge above station. Results fair.
[b] Made by wading below gage.
[c] Made by wading at gage.

NOTE.—From data collected May 31, 1909, the following flood estimate of discharge has been made: Area of section, 670 square feet; gage height, 6.72 feet; $n=0.025$; $R=4.0$; $s=0.0025$, discharge=5,000 second-feet.

Daily gage height, in feet, of Two Medicine River at Family, Mont., for 1909.

[John Ripperger, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.4	1.9	1.9	.....	2.25	6.45	3.8	3.75	1.8	1.65	1.55	2.7
2	1.2	1.95	1.8	.....	2.75	6.65	3.8	3.45	1.7	1.65	1.55	2.7
3	1.25	1.95	1.85	.....	3.05	6.95	3.7	3.25	1.7	1.65	1.9	3.3
4	1.3	2.0	1.85	.....	4.35	6.65	3.7	3.15	1.7	1.65	2.7	4.5
5	1.4	1.9	1.8	.....	4.55	6.65	3.8	3.05	1.7	1.65	2.7	3.9
6	1.5	1.95	1.75	.....	3.85	5.95	3.8	2.85	1.7	1.65	2.7	3.5
7	1.4	1.9	1.75	.....	3.55	5.65	3.7	2.75	1.7	1.65	2.5	3.4
8	1.4	1.85	1.8	.....	3.35	5.65	3.5	2.65	1.7	1.65	2.4	3.3
9	1.35	1.9	1.9	.....	3.55	8.15	3.3	2.55	1.7	1.65	2.3	3.3
10	1.3	1.95	1.85	.....	4.05	6.95	3.2	2.45	1.7	1.65	2.2	3.1
11	1.3	2.1	1.95	2.05	3.55	6.15	3.2	2.35	1.6	1.65	2.1	2.9
12	1.4	2.0	1.9	2.05	3.45	5.45	3.2	2.35	1.6	1.65	2.0	.....
13	1.35	2.0	1.9	2.05	3.25	5.6	3.1	2.25	1.6	1.65	1.9	.....
14	1.35	2.1	1.85	1.95	3.45	5.5	3.0	2.25	1.6	1.65	1.9	.....
15	1.4	1.8	1.85	2.05	3.45	5.5	2.9	2.15	1.6	1.6	1.85	.....
16	1.45	1.85	1.8	2.05	3.25	5.5	2.9	2.15	1.6	1.6	1.85	.....
17	1.35	1.9	1.85	1.95	3.45	5.5	2.8	2.15	1.6	1.6	1.8	.....
18	1.3	1.8	1.8	1.85	3.25	5.75	2.7	2.05	1.6	1.6	1.8	.....
19	1.3	1.8	1.85	1.95	3.45	5.85	2.7	2.05	1.6	1.6	1.8	.....
20	1.3	1.7	1.85	2.05	4.05	5.55	2.7	2.05	1.6	1.6	1.8	.....
21	1.4	1.85	1.85	2.05	4.45	5.45	2.6	1.95	1.6	1.6	2.3	.....
22	1.4	1.8	1.8	2.05	4.55	5.25	2.6	1.95	1.6	1.6	2.0	.....
23	2.1	1.9	1.75	2.25	4.95	4.85	2.6	1.95	1.6	1.6	1.9	.....
24	2.1	1.85	1.7	2.25	5.25	4.65	2.5	1.95	1.6	1.6	3.3	.....
25	2.2	1.85	1.8	2.25	5.65	4.45	2.5	1.85	1.6	1.6	4.3	.....
26	1.95	1.85	1.7	2.95	5.95	4.15	2.7	1.8	1.6	1.6	3.2	.....
27	2.0	1.8	1.75	2.75	6.25	3.95	4.0	1.8	1.6	1.6	2.9	.....
28	2.1	1.9	1.75	2.75	5.65	3.85	8.0	1.8	1.6	1.6	2.8	.....
29	2.25	.....	1.7	2.35	5.95	3.85	6.15	1.8	1.6	1.55	2.7	.....
30	1.9	.....	1.75	2.35	5.65	3.75	5.25	1.8	1.6	1.55	2.6	.....
31	1.95	.....	1.7	.....	5.45	.....	4.35	1.8	.....	1.55	.....	.....

NOTE.—Ice conditions Jan. 23–Mar. 31 and Dec. 12–31.

Daily discharge, in second-feet, of Two Medicine River at Family, Mont., for 1909.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	56	.....	.....	85	190	4,550	1,220	1,170	100	80	70
2	41	.....	.....	90	402	4,870	1,220	902	85	80	70
3	44	.....	.....	95	590	5,380	1,120	740	85	80	115
4	48	.....	.....	100	1,770	4,870	1,120	662	85	80	375
5	56	.....	.....	105	1,980	4,870	1,220	590	85	80	375
6	65	.....	.....	110	1,270	3,790	1,220	460	85	80	375
7	56	.....	.....	115	990	3,360	1,120	402	85	80	280
8	56	.....	.....	120	820	3,360	945	350	85	80	240
9	52	.....	.....	125	990	7,600	780	302	85	80	205
10	48	.....	.....	130	1,460	5,380	700	260	85	80	175
11	48	.....	.....	140	990	4,080	700	222	75	80	150
12	56	.....	.....	140	902	3,090	700	222	75	80	130
13	52	.....	.....	140	740	3,290	625	190	75	80	115
14	52	.....	.....	122	902	3,160	555	190	75	80	115
15	56	.....	.....	140	902	3,160	490	162	75	75	108
16	60	.....	.....	140	740	3,160	490	162	75	75	108
17	52	.....	.....	122	902	3,160	430	162	75	75	100
18	48	.....	.....	108	740	3,500	375	140	75	75	100
19	48	.....	.....	122	902	3,640	375	140	75	75	100
20	48	.....	.....	140	1,460	3,220	375	140	75	75	100
21	56	.....	.....	140	1,880	3,090	325	122	75	75	.....
22	56	.....	.....	140	1,980	2,820	325	122	75	75	.....
23	.....	.....	.....	190	2,450	2,330	325	122	75	75	.....
24	.....	.....	.....	190	2,820	2,100	280	122	75	75	.....
25	.....	.....	.....	190	3,360	1,880	280	108	75	75	.....
26	.....	.....	.....	190	3,790	1,560	375	100	75	75	.....
27	.....	.....	.....	402	4,240	1,360	1,410	100	75	75	.....
28	.....	.....	.....	402	3,360	1,270	7,310	100	75	75	.....
29	.....	.....	.....	222	3,790	1,270	4,080	100	75	70	.....
30	.....	.....	.....	222	3,360	1,170	2,820	100	75	70	.....
31	.....	.....	.....	.....	3,090	.....	1,770	100	.....	70	.....

NOTE.—These discharges are based on a rating curve that is fairly well defined up to 700 second-feet. Above 700 second-feet the curve is based upon a measurement computed from Kutter's formula. Discharges estimated Apr. 1 to 10.

Monthly discharge of Two Medicine River at Family, Mont., for 1909.

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
January 1–22	65	41	52.5	0.143	0.12	2,290	C.
April	402	85	156	.424	.47	9,280	B.
May	4,240	190	1,730	4.70	5.42	106,000	B.
June	7,600	1,170	3,340	9.08	10.12	199,000	B.
July	7,310	280	1,130	3.07	3.54	69,500	B.
August	1,170	100	283	.769	.89	17,400	B.
September	100	75	78.8	.214	.24	4,690	B.
October	80	70	76.8	.209	.24	4,720	B.
November 1–20	375	70	170	.462	.34	6,740	B.
The period						420,000	

BADGER CREEK NEAR FAMILY, MONT.

This station, which is located near the road crossing 4 miles east of Family, Mont., was established April 20, 1907, to determine the amount of water available for irrigation. The United States Reclamation Service proposes to divert the natural flow of the stream to irrigate land in the eastern part of the Blackfeet Indian Reservation and north of Birch Creek.

The gage and bench marks were washed out in June, 1908, and a new gage was established July 22, 1908, about 400 feet farther up stream and at a different datum. As the bench mark was destroyed, the relation between the two gages could not be determined. The gage was again washed out May 25, 1909, and was reset at a different datum some 4 miles below the cable section and just below the old Piegan Mission crossing. High-water measurements are made from a cable. Low-water measurements can be made by wading at the cable section.

On account of poor channel conditions high-water measurements are only fair. The low records, however, are good.

Discharge measurements of Badger Creek near Family, Mont., in 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Apr. 27[a]	W. A. Lamb	44	100	2.05	180
July 12[b]	do	72	122		415
Sept. 19[c]	J. E. Stewart	50	113	3.96	213
Oct. 18[d]	W. A. Lamb	64	82	3.84	157

[a] Made from cable.
[b] Made by wading at road crossing.
[c] Made by wading below gage.
[d] Made by wading above gage.

Daily gage height, in feet, of Badger Creek near Family, Mont., for 1909.

[Oliver J. Racine, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	3.6	.....	1.8	.....	.....	.....	.....	.....	3.9	3.85	4.15
2	.....	.....	.....	1.8	.....	.....	.....	.....	.....	3.9	4.3	4.1
3	3.4	.....	.....	1.8	.....	.....	.....	.....	.....	.....	4.4	4.1
4	.....	.....	.....	1.8	2.7	.....	.....	.....	.....	.....	4.5	4.0
5	.....	.....	.....	1.8	2.8	.....	.....	.....	.....	3.85	4.3	4.0
6	.....	.....	4.2	1.7	2.7	.....	.....	.....	.....	3.85	4.15	6.3
7	.....	.....	.....	1.8	2.6	.....	.....	.....	.....	3.85	4.0	6.6
8	.....	4.2	.....	1.7	2.5	.....	.....	.....	.....	3.85	4.0	7.25
9	.....	.....	.....	1.8	2.6	.....	.....	.....	.....	3.85	3.95	7.2
10	3.5	.....	.....	1.8	2.8	.....	.....	.....	.....	3.85	3.9	7.15
11	.....	.....	.....	1.8	2.6	.....	.....	.....	.....	.....	3.9	.....
12	.....	.....	.....	.....	2.7	.....	.....	.....	.....	3.8	3.85	.....
13	.....	.....	3.4	.....	2.7	.....	.....	.....	.....	.....	3.8	.....
14	.....	.....	.....	1.8	2.6	.....	.....	.....	.....	.....	3.8	.....
15	.....	.....	.....	1.8	2.7	.....	.....	.....	.....	.....	3.8	.....
16	.....	.....	.....	1.8	2.7	.....	.....	.....	.....	.....	3.8	.....
17	3.85	.....	.....	1.8	2.6	.....	.....	.....	.....	.....	3.85	.....
18	.....	.....	.....	1.8	2.8	.....	.....	.....	.....	.....	3.9	.....
19	.....	.....	.....	1.8	2.8	.....	.....	.....	.....	.....	3.9	.....
20	.....	.....	2.2	1.8	2.8	.....	.....	.....	.....	.....	3.9	.....
21	.....	.....	.....	1.8	3.0	.....	.....	.....	.....	.....	3.9	.....
22	.....	3.9	.....	1.8	3.8	.....	.....	.....	3.95	.....	3.95	.....
23	.....	.....	.....	1.8	3.8	.....	.....	.....	3.9	3.8	4.1	.....
24	.....	.....	.....	1.8	3.9	.....	.....	.....	3.9	3.8	4.3	.....
25	3.6	.....	.....	1.8	.....	.....	.....	.....	3.9	3.8	4.4	.....
26	.....	.....	.....	2.1	.....	.....	.....	.....	3.9	3.8	4.25	.....
27	.....	4.1	1.8	2.1	.....	.....	.....	.....	3.9	3.8	4.2	.....
28	.....	.....	.....	2.0	.....	.....	.....	.....	3.9	3.8	4.15	.....
29	.....	.....	.....	2.0	.....	.....	.....	.....	3.9	3.8	4.15	.....
30	.....	.....	.....	2.0	.....	.....	.....	.....	3.9	3.8	4.2	.....
31	.....	.....	1.9	.....	.....	.....	.....	.....	.....	3.8	.....	.....

NOTE.—Ice conditions Jan. 1 to Mar. 26, Nov. 23 to Dec. 31. No gage height records May 25 to Sept. 21.

Daily discharge, in second-feet, of Badger Creek near Family, Mont., for 1909.

Day.	Mar.	Apr.	May.	Sept.	Oct.	Nov.	Day.	Mar.	Apr.	May.	Sept.	Oct.	Nov.
1	.....	118	220	.....	182	158	16	.....	118	383	.....	135	135
2	.....	118	270	.....	182	398	17	.....	118	248	.....	135	158
3	.....	118	330	.....	174	459	18	.....	118	420	.....	135	182
4	.....	118	383	.....	166	523	19	.....	118	420	.....	135	182
5	.....	118	420	.....	158	398	20	.....	118	420	.....	135	182
6	.....	96	383	.....	158	312	21	.....	118	497	.....	135	182
7	.....	118	248	.....	158	232	22	.....	118	839	207	135	207
8	.....	96	314	.....	158	232	23	.....	118	839	182	135	.....
9	.....	118	248	.....	158	207	24	.....	118	884	182	135	.....
10	.....	118	420	.....	158	182	25	.....	118	.....	182	135	.....
11	.....	118	248	.....	146	182	26	.....	193	.....	182	135	.....
12	.....	118	383	.....	135	135	27	118	193	.....	182	135	.....
13	.....	118	383	.....	135	135	28	124	167	.....	182	135	.....
14	.....	118	248	.....	135	135	29	130	167	.....	182	135	.....
15	.....	118	383	.....	135	135	30	136	167	.....	182	135	.....
							31	142	.....	.....	.....	135	.....

NOTE.—These discharges are based on two rating curves that are poorly defined. Discharges estimated during missing gage height observations in October.

Monthly discharge of Badger Creek near Family, Mont., for 1909.

[Drainage area, 224 square miles.]

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
March 27-31	142	118	130	0.580	0.11	1,290	C.
April	193	96	126	.562	.63	7,500	C.
May 1-24	884	220	410	1.83	1.63	19,500	C.
September 22-30	207	182	185	.826	.28	3,300	B.
October	182	135	145	.647	.75	8,920	C.
November 1-22	523	135	231	1.03	.84	10,100	B.

CUTBANK CREEK AT CUTBANK, MONT.

This station, which is located half a mile southwest of Cutbank, one-fourth mile below the Great Northern Railway bridge, and 12 miles above the mouth of Two Medicine, was established August 4, 1905, to obtain data for use in connection with irrigation projects under consideration by the United States Reclamation Service.

The intake of the Great Northern Railway's pumping station is located a hundred yards above the gage. The average quantity pumped is about 14,000 gallons an hour for 18 hours a day—equivalent to a continuous flow of 0.4 second-foot.

The datum of the gage has not been changed since the station was established. The records during the winter months are somewhat affected by ice. The results taken as a whole can be considered as good.

Measurements in high water are made from a cable. The chain gage used at this station is located on the left bank about 100 yards above the cable.

Discharge measurements of Cutbank Creek at Cutbank, Mont., in 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
May 15	W. A. Lamb	104	128	3.50	316
25	do	136	260	4.20	1,040
June 11	do	135	290	4.30	1,150
18	do	136	292	4.32	1,190
July 13	do	105	128	3.48	344
Aug. 28[a]	do	68	71	3.02	84
Sept. 21[b]	J. E. Stewart	50	46	2.88	49
Oct. 23[c]	W. A. Lamb	54	68	2.95	65

[a] Made by wading above cable. [b] Made by wading at cable. [c] Made by wading at gage.

Daily gage height, in feet, of Cutbank Creek at Cutbank, Mont., for 1909.

[Conrad Peters, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	3.5	3.9	4.0	3.5	3.2	4.2	3.7	3.9	3.0	2.9	3.0	3.5
2	3.5	3.8	3.9	3.5	3.3	4.25	3.8	3.8	3.0	2.9	3.0	3.4
3	3.6	3.9	3.9	3.4	3.45	4.4	3.8	3.65	3.0	2.9	3.0	3.25
4	3.8	3.9	3.8	3.4	3.8	4.4	3.8	3.55	3.0	2.9	3.0	3.0
5	3.8	4.0	3.8	3.4	3.9	4.4	3.8	3.5	3.0	2.9	3.25	3.6
6	3.6	3.9	3.8	3.3	3.8	4.3	3.8	3.45	3.0	2.9	3.4	3.5
7	3.7	3.9	3.9	3.3	3.7	4.2	3.8	3.4	3.0	2.9	3.4	3.5
8	3.75	3.9	3.9	3.3	3.55	4.3	3.7	3.4	3.0	2.9	3.4	3.4
9	4.1	3.9	3.9	3.2	3.5	4.35	3.65	3.4	2.9	2.9	3.3	3.4
10	4.1	3.8	3.85	3.2	3.5	4.45	3.55	3.3	2.9	2.9	3.3	3.6
11	4.1	3.9	3.8	3.2	3.5	4.3	3.5	3.3	2.9	2.9	3.2	3.7
12	4.1	4.0	3.9	3.2	3.5	4.15	3.5	3.2	2.9	2.9	3.2	3.9
13	4.1	3.9	3.9	3.2	3.5	4.1	3.5	3.2	2.9	2.9	3.2	3.9
14	4.1	3.9	3.9	3.2	3.5	4.2	3.4	3.2	2.9	2.9	3.2	3.8
15	4.1	3.9	3.9	3.15	3.5	4.2	3.4	3.2	2.9	2.9	3.1	3.8
16	4.05	3.8	3.9	3.1	3.5	4.2	3.4	3.1	2.9	2.9	3.2	3.7
17	3.9	4.0	3.9	3.1	3.6	4.2	3.4	3.1	2.9	2.9	3.3	3.7
18	3.8	4.0	3.9	3.1	3.45	4.3	3.3	3.1	2.9	2.9	3.4	3.7
19	3.8	3.9	3.9	3.1	3.75	4.3	3.3	3.1	2.9	2.9	3.3	3.7
20	3.8	3.8	3.9	3.1	4.1	4.2	3.3	3.1	2.9	2.9	3.3	3.6
21	3.8	3.9	3.8	3.2	4.25	4.1	3.2	3.0	2.9	2.9	3.3	3.6
22	3.7	3.9	3.8	3.2	4.8	4.0	3.2	3.0	2.9	2.9	3.3	3.6
23	3.6	3.9	3.8	3.2	4.75	4.0	3.2	3.0	2.9	2.9	3.4	3.5
24	3.6	3.9	3.8	3.2	4.35	3.95	3.2	3.0	2.9	2.9	3.5	3.5
25	3.6	3.9	3.7	3.2	4.2	3.9	3.2	3.0	2.9	2.9	3.6	3.6
26	3.6	4.0	3.7	3.25	4.2	3.85	3.35	3.0	2.9	2.9	3.6	3.6
27	3.7	4.0	3.7	3.35	4.35	3.8	3.7	3.0	2.9	2.9	3.6	3.6
28	3.8	4.0	3.6	3.5	4.4	3.8	4.65	3.0	2.9	2.9	3.6	3.6
29	3.9	.....	3.5	3.4	4.35	3.7	5.2	3.0	2.9	2.9	3.6	3.5
30	4.0	.....	3.5	3.3	4.3	3.7	4.7	3.0	2.9	2.9	3.6	3.5
31	4.0	.....	3.5	.....	4.3	.....	4.1	3.0	.....	3.0	.....	3.5

NOTE.—Ice conditions Jan. 1 to Mar. 28 and Dec. 1–31.

Daily discharge, in second-feet, of Cutbank Creek at Cutbank, Mont., for 1909.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	.....	352	160	1,040	518	708	77	52	77
2	.....	352	216	1,100	610	610	77	52	77
3	.....	280	316	1,290	610	475	77	52	77
4	.....	280	610	1,290	610	392	77	52	77
5	.....	280	708	1,290	610	352	77	52	188
6	.....	216	610	1,160	610	316	77	52	280
7	.....	216	518	1,040	610	280	77	52	280
8	.....	216	392	1,160	518	280	77	52	280
9	.....	160	352	1,220	475	280	52	52	216
10	.....	160	352	1,350	392	216	52	52	216
11	.....	160	352	1,160	352	216	52	52	160
12	.....	160	352	980	352	160	52	52	160
13	.....	160	352	922	352	160	52	52	160
14	.....	160	352	1,040	280	160	52	52	160
15	.....	136	352	1,040	280	160	52	52	113
16	.....	113	352	1,040	280	113	52	52	160
17	.....	113	432	1,040	280	113	52	52	216
18	.....	113	316	1,160	216	113	52	52	280
19	.....	113	564	1,160	216	113	52	52	216
20	.....	113	922	1,040	216	113	52	52	216
21	.....	160	1,100	922	160	77	52	52	216
22	.....	160	1,810	812	160	77	52	52	216
23	.....	160	1,740	812	160	77	52	52	280
24	.....	160	1,220	760	160	77	52	52	352
25	.....	160	1,040	708	160	77	52	52	432
26	.....	188	1,040	659	248	77	52	52	432
27	.....	248	1,220	610	518	77	52	52	432
28	.....	352	1,290	610	1,610	77	52	52	432
29	352	280	1,220	518	2,330	77	52	52	432
30	352	216	1,160	518	1,680	77	52	52	432
31	352	.....	1,160	.....	922	77	.....	77	.....

NOTE.—These discharges are based on a rating curve that is well defined between 52 and 1,290 second-feet.

Monthly discharge of Cutbank Creek at Cutbank, Mont., for 1909.

[Drainage area, 971 square miles.]

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
April	352	113	198	0.204	0.23	11,800	B.
May	1,810	160	728	.750	.86	44,800	A.
June	1,350	518	982	1.01	1.13	58,400	A.
July	2,330	160	532	.548	.63	32,700	A.
August	708	77	199	.205	.24	12,200	B.
September	77	52	58.7	.060	.07	3,490	A.
October	77	52	52.8	.054	.06	3,250	A.
November	432	77	242	.249	.28	14,400	B.
The period						181,000	

BIRCH CREEK NEAR DUPUYER, MONT.

This station, which is located at Shields ranch, 12 miles northwest of Dupuyer, Mont., and about 25 miles from its junction with Two Medicine River, was established July 25, 1907, to determine the amount of water available for irrigation projects on the Blackfeet Indian Reservation.

No storage is used on this stream, but a number of ditches divert water for irrigation. The largest of these, owned by the Conrad Investment Co., diverts water about half a mile below the station.

The gage datum remained the same from the time the station was established until the high water of June, 1908, when the gage was washed away and the channel changed. A temporary staff gage was put in July 23, 1908, about 200 feet below the original gage. This gage was used until October 1, 1908, when a permanent chain gage was established one-fourth mile above. Measurements are made from a car and cable located three-fourths of a mile downstream from the gage. By wading just below the cable section better low-water results may be obtained.

Discharge measurements of Birch Creek near Dupuyer, Mont., in 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Apr. 27[a]	W. A. Lamb	32	42	4.05	100
July 11[b]	do	56	95	5.24	309
Sept. 20[a]	J. E. Stewart	54	63	4.75	114
Oct. 18[b]	W. A. Lamb	50	60	4.55	98

[a] Made by wading below gage. [b] Made by wading above gage.

Daily gage height, in feet, of Birch Creek near Dupuyer, Mont., for 1909.

[J. A. Earhart, observer.]

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	3.85	4.0	6.8	5.65	6.0	4.85	4.65	4.5	4.6
2	.....	3.85	4.0	7.15	5.6	5.8	4.85	4.6	4.55	4.55
3	.....	3.85	4.3	7.1	5.7	5.6	4.85	4.65	4.7	4.55
4	.....	3.8	4.8	6.85	5.65	5.4	4.8	4.6	4.75	4.55
5	.....	3.85	4.8	6.65	5.5	5.3	4.8	4.65	4.9	.....
6	.....	3.8	4.5	6.4	5.4	5.5	4.75	4.7	4.95	.....
7	.....	3.8	4.5	6.15	5.2	5.55	4.7	4.65	4.95	.....
8	.....	3.8	4.45	7.1	5.2	5.4	4.75	4.6	4.95	.....
9	.....	3.85	4.5	8.5	5.1	5.2	4.75	4.6	4.85	.....
10	.....	3.8	4.45	7.0	5.1	5.1	4.65	4.6	4.6	.....
11	.....	3.8	4.5	6.8	5.25	5.0	4.85	4.65	4.6	.....
12	.....	3.8	4.4	6.7	5.2	5.1	4.85	4.65	4.55	.....
13	.....	3.8	4.4	6.8	5.1	5.15	4.7	4.6	4.55	.....
14	4.75	3.75	4.5	6.7	5.0	5.25	4.7	4.6	4.55	.....
15	4.8	3.8	4.5	6.8	5.0	5.15	4.7	4.6	4.55	.....
16	4.8	3.8	4.6	6.85	5.0	5.2	4.85	4.6	4.5	.....
17	4.85	3.85	4.5	6.65	5.05	5.1	4.75	4.55	4.5	.....
18	4.85	3.8	4.6	6.7	5.0	5.0	4.7	4.55	4.6	.....
19	4.8	3.8	4.7	6.45	4.9	5.05	4.7	4.55	4.6	.....
20	3.8	3.85	4.7	7.0	4.9	5.0	4.7	4.55	4.6	.....
21	3.8	3.8	4.8	6.7	4.8	5.0	4.8	4.5	4.6	.....
22	3.75	3.85	5.45	6.3	4.8	5.05	4.75	4.5	4.55	.....
23	3.75	3.9	5.6	6.1	4.85	4.9	4.8	4.5	4.55	.....
24	3.8	3.9	5.75	6.0	4.85	4.95	4.65	4.5	4.55	.....
25	3.8	3.9	6.1	.....	4.85	4.95	4.7	4.55	4.55	.....
26	3.8	4.15	6.25	5.8	6.5	4.95	4.65	4.55	4.55	.....
27	3.75	4.05	6.65	5.75	8.7	4.9	4.65	4.55	4.55	.....
28	3.75	4.05	6.5	5.65	9.3	4.9	4.55	4.5	4.55	.....
29	3.8	4.05	6.5	5.6	7.5	4.9	4.75	4.5	4.55	.....
30	3.8	4.0	6.25	5.6	6.5	4.8	4.65	4.5	4.55	.....
31	3.8	.....	6.3	.....	6.4	4.85	.....	4.55	.....	.....

NOTE.—Probable ice conditions Jan. 1 to Mar. 13; Dec. 5 to 31.

Daily discharge, in second-feet, of Birch Creek near Dupuyer, Mont., for 1909.

Day.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Day.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	416	457	141	105	82	97	16	251	223	141	97	82	.....
2	401	395	141	97	90	90	17	262	197	122	90	82	.....
3	432	336	141	105	113	90	18	251	173	113	90	97	.....
4	416	279	131	97	122	90	19	230	185	113	90	97	.....
5	372	251	131	105	151	.....	20	230	173	113	90	97	.....
6	345	307	122	113	162	.....	21	210	173	131	82	97	.....
7	296	322	113	105	162	.....	22	210	185	122	82	90	.....
8	296	279	122	97	162	.....	23	220	151	131	82	90	.....
9	273	223	122	97	141	.....	24	220	162	105	82	90	.....
10	273	197	105	97	97	.....	25	220	162	113	90	90	.....
11	308	173	141	105	97	.....	26	680	162	105	90	90	.....
12	296	197	141	105	90	.....	27	1,460	151	105	90	90	.....
13	273	210	113	97	90	.....	28	1,680	151	90	82	90	.....
14	251	237	113	97	90	.....	29	993	151	122	82	90	.....
15	251	210	113	97	90	.....	30	623	131	105	82	90	.....
							31	590	141	.....	90	.....	.....

NOTE.—These discharges are based on rating curves applicable as follows:
July 1 to July 27, 1909, fairly well defined between 80 and 400 second-feet.
July 28 to Dec. 4, not well defined.

Monthly discharge of Birch Creek near Dupuyer, Mont., for 1909.

[Drainage area, 155 square miles.]

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
July	1,680	210	427	2.75	3.17	26,300	C.
August	457	131	218	1.41	1.63	13,400	C.
September	141	90	121	.781	.87	7,200	C.
October	113	82	93.9	.606	.70	5,770	C.
November	162	82	103	.664	.74	6,130	C.
December	.....	.....	[a]85	.549	.63	5,230	
The period	.....	.....	.....	.....	.....	64,000	

[a] Discharge estimated. Mean is approximate.

DUPUYER CREEK AT DUPUYER, MONT.

This station, which is located at the highway bridge at Dupuyer, Mont., was established April 15, 1908, to obtain data for use in connection with irrigation projects in that locality.

The staff gage is nailed to the cribbing under the east end of the highway bridge. The gage was washed out July 28 and replaced September 20, gage readings for September and October being reduced to the old datum. High-water measurements are made from this bridge. Low-water measurements are made by wading.

The datum of the gage has not been changed since the station was established. Frequent discharge measurements are necessary to insure good results at this station, as the channel conditions are poor. Ice affects the results during the winter months.

Discharge measurements of Dupuyer Creek at Dupuyer, Mont., in 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Apr. 28[a]	W. A. Lamb	44	24	1.36	66
June 24[b]	J. E. Stewart	36	70	2.02	209
25[b]	do	36	68	1.94	191
July 11[c]	W. A. Lamb	34	31	1.34	100
Sept. 20[c]	J. E. Stewart	17	18	1.41	39
Oct. 18[c]	W. A. Lamb	18	14	1.30	30

[a] Made by wading below gage. [b] Made from bridge. [c] Made by wading above gage.

Daily gage height, in feet, of Dupuyer Creek at Dupuyer, Mont., for 1909.

[Hildreath Miller, observer.]

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.
1	1.15	1.25	2.05	1.55	.....	.....	1.35
2	1.25	1.35	2.2	1.4	.....	.....	1.35
3	1.25	1.7	2.35	1.65	.....	.....	1.25
4	1.25	2.05	2.2	1.65	.....	.....	1.25
5	1.25	1.75	2.0	1.65	.....	.....	1.35

Daily gage height, in feet, of Dupuyer Creek at Dupuyer, Mont., for 1909—Continued.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.
6	1.25	1.55	1.95	1.7			1.35
7	1.25	1.45	2.2	1.55			1.35
8	1.15	1.35	2.85	1.55			1.35
9	1.05	1.45	3.25	1.45			1.35
10	1.05	1.45	3.0	1.45			1.35
11	.95	1.45	2.75	1.3			1.35
12	.85	1.45	2.75	1.25			1.35
13	.85	1.45	2.65	1.25			1.25
14	1.00	1.55	2.65	1.25			1.25
15	1.15	1.7	2.65	1.25			1.25
16	1.15	2.05	2.65	1.25			1.25
17	1.15	1.4	2.65	1.15			1.35
18	1.15	1.4	2.55	1.15			1.35
19	1.15	1.8	2.45	1.15			1.25
20	1.15	1.95	2.45	1.15		1.35	1.25
21	1.15	2.05	2.45	1.15		1.35	1.25
22	1.15	2.3	2.35	1.05		1.35	1.25
23	1.15	2.35	2.25	1.05		1.35	1.25
24	1.15	2.35	2.15	1.05		1.25	1.25
25	1.15	2.1	2.0	1.05		1.25	1.25
26	1.75	2.4	1.95	1.55		1.25	1.25
27	1.65	2.45	2.25	2.95		1.25	1.25
28	1.35	2.35	1.75			1.25	1.25
29	1.45	2.2	1.65			1.25	1.25
30	1.35	2.0	1.65			1.35	1.2
31		1.95					1.2

NOTE.—No observations July 28 to Sept. 19.

Daily discharge, in second-feet, of Dupuyer Creek at Dupuyer, Mont., for 1909.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.
1	39	50	178	127			34
2	50	62	209	107			34
3	50	114	244	142			25
4	50	178	209	142			25
5	50	122	168	142			34
6	50	90	158	149			34
7	50	76	209	127			34
8	39	62	385	127			34
9	30	76	535	114			34
10	30	76	450	114			34
11	21	76	380	95			34
12	14	76	380	90			34
13	14	76	355	90			25
14	25	90	360	90			25
15	39	114	365	90			25
16	39	178	370	90			25
17	39	69	370	79			34
18	39	69	328	79			34
19	39	131	302	79			25
20	39	158	302	79		34	25
21	39	178	302	79		34	25
22	39	232	277	70		34	25
23	39	244	254	70		34	25
24	39	244	232	70		25	25
25	39	188	202	70		25	25
26	122	257	192	127		25	25
27	106	270	254	444		25	25
28	62	244	157			25	25
29	76	209	142			25	25
30	62	168	142			34	21
31		158					21

NOTE.—These discharges are based on rating curves applicable as follows:
Apr. 1 to June 7, fairly well defined between 25 and 284 second-feet.
June 8 to June 17, the discharges were obtained by the indirect method for shifting channels.
June 18 to July 27, fairly well defined between 66 and 315 second-feet.
Sept. 20 to Oct. 31, fairly well defined between 21 and 48 second-feet.

Monthly discharge of Dupuyer Creek at Dupuyer, Mont., for 1909.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
April	122	14	45.6	2,710	A.
May	270	50	140	8,610	A.
June	535	142	280	16,700	B.
July 1-27	444	70	114	6,110	B.
Sept. 20-30	34	25	29.1	635	B.
October	34	21	28.2	1,730	B.

TETON RIVER NEAR BELLEVIEW, MONT.

Teton River, the most important tributary of Marias River, rises in the Rocky Mountains and flows eastward in a course approximately parallel to that of Sun River, crossing and recrossing the sixth standard parallel north, and emptying into Marias River about a mile above the point where the latter joins the Missouri.

This station, which is located 1 mile north of Peeble's ranch, 16 miles above Chouteau, Mont., was established November 26, 1904, to obtain data for use in connection with irrigation projects. The nearest post office is Belleview.

No important tributaries enter the stream near the station. Deep Creek and Muddy Creek join the Teton below the station. Practically no water is diverted above, but the ordinary flow below is appropriated and used for irrigation.

An irrigation project now being constructed under the Carey Act proposes to store the flood water of Teton River in a reservoir located about 5 miles north of the gaging station. The water will be diverted one-half mile above the gage. The capacity of the reservoir is 90,000 acre-feet and can be increased to 210,000 by raising the top of the dam 20 feet. It will serve 120,000 acres of land on the north side of the river.

The first gage was spiked to a post on the left bank about 40 feet above the bend of Kroff's irrigation ditch. March 9, 1905, it was moved by the observer 250 feet upstream to avoid the effect of the dam erected at the head of the ditch below. On May 8, 1905, the gage was referred to the bench marks, and it was found that the datum had been raised 0.78 foot in moving, while the difference between the level of the water surface at the old and new locations was but 0.10 foot. The gage datum was lowered on this date 0.20 foot. May 8, 1906, the gage was again moved 1½ miles upstream to Mr. Bjornstad's new ranch and set at an entirely different datum. The station was discontinued during 1907, but was reestablished again June 16, 1908, near the location of the gage that was used during 1906, but there is no connection between the gage reading.

A standard chain gage on the left bank is used at this new location. Measurements in flood are made from the cable about one-fourth

mile above the gage. The current is swift at the gage and the river never freezes across. The conditions for obtaining accurate discharge data during high water are rather poor on account of the shifting channel.

Discharge measurements of Teton River near Belleview, Mont., in 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
May 4	Raymond Richards	40	40	4.90	92.8
June 6[a]	do	65	138	6.80	843
July 11	do	82	105	5.53	328
Sept. 22	do	45	504	4.95	118
Oct. 19	J. E. Stewart	36	76	4.56	94.6

[a] Made from cable.

Daily gage height, in feet, of Teton River near Belleview, Mont., for 1909.

[Belle Peebles, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	4.6	4.5	4.5	4.5	4.7	6.7	6.5	6.25	5.0	4.8	4.6	4.7
2	4.6	4.5	4.5	4.5	4.7	6.7	6.5	6.05	5.0	4.8	4.6	4.7
3	4.6	4.5	4.5	4.5	4.8	6.8	6.4	5.9	5.0	4.8	4.6	4.7
4	4.6	4.5	4.6	4.5	4.9	6.8	6.4	5.85	5.0	4.8	4.65	4.8
5	4.7	4.5	4.6	4.5	4.85	6.7	6.35	5.8	5.0	4.8	4.7	4.8
6	4.7	4.5	4.6	4.6	4.8	6.8	6.25	5.7	5.0	4.7	4.7	4.8
7	4.7	4.5	4.6	4.6	4.9	6.9	6.05	5.7	5.0	4.7	4.7	4.8
8	4.7	4.5	4.6	4.6	4.9	6.95	5.85	5.7	4.9	4.7	4.7	4.8
9	4.7	4.6	4.5	4.6	4.9	7.0	5.75	5.65	4.9	4.7	4.7	4.9
10	4.7	4.6	4.5	4.6	4.9	6.9	5.6	5.6	5.0	4.7	4.6	4.9
11	4.7	4.6	4.5	4.6	5.0	6.85	5.45	5.6	5.0	4.7	4.6	4.9
12	4.7	4.6	4.5	4.5	5.0	6.8	5.4	5.5	5.0	4.7	4.6	4.9
13	4.7	4.6	4.5	4.5	5.0	6.8	5.4	5.5	5.0	4.7	4.6	4.8
14	4.7	4.6	4.5	4.5	5.0	6.9	5.5	5.45	5.0	4.7	4.6	4.8
15	4.7	4.7	4.5	4.5	5.1	6.9	5.45	5.4	4.9	4.6	4.55	4.8
16	4.7	4.7	4.5	4.5	5.1	7.0	5.3	5.35	4.9	4.6	4.5	4.8
17	4.7	4.7	4.5	4.5	5.2	7.1	5.3	5.3	4.9	4.6	4.5	4.8
18	4.7	4.7	4.5	4.6	5.2	7.2	5.3	5.3	4.9	4.5	4.5	4.8
19	4.7	4.7	4.5	4.6	5.2	7.3	5.25	5.3	4.9	4.5	4.45	4.8
20	4.6	4.7	4.5	4.6	5.3	7.2	5.2	5.2	4.9	4.5	4.4	4.7
21	4.6	4.8	4.4	4.6	5.3	7.15	5.2	5.2	4.9	4.5	4.45	4.7
22	4.6	4.8	4.4	5.6	5.4	7.05	5.1	5.2	4.9	4.5	4.5	4.65
23	4.6	4.7	4.4	4.6	5.5	6.95	5.1	5.2	4.9	4.4	4.5	4.6
24	4.6	4.7	4.4	4.7	5.6	6.85	5.05	5.2	4.9	4.4	4.5	4.7
25	4.6	4.6	4.4	4.7	5.7	6.7	5.4	5.1	4.9	4.4	4.5	4.7
26	4.6	4.6	4.4	4.7	5.75	6.6	6.35	5.1	4.9	4.5	4.6	4.6
27	4.6	4.5	4.4	4.7	5.9	6.6	7.2	5.1	4.9	4.5	4.6	4.6
28	4.6	4.5	4.5	4.7	6.05	6.6	6.7	5.1	4.8	4.5	4.6	4.6
29	4.6	.....	4.5	4.7	6.25	6.5	6.55	5.1	4.8	4.55	4.6	4.55
30	4.5	.....	4.5	4.7	6.5	6.5	6.45	5.0	4.8	4.6	4.7	4.5
31	4.5	.....	4.5	.....	6.6	.....	6.4	5.0	.....	4.6	.....	4.5

Daily discharge, in second-feet, of Teton River near Belleview, Mont., for 1909.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	50	38	38	32	60	790	695	580	140	105	105	120
2	50	38	38	32	60	790	695	500	140	105	105	120
3	50	38	38	32	75	830	655	445	140	105	105	120
4	50	38	45	32	93	830	655	425	140	105	110	140
5	65	38	45	32	85	790	635	400	140	105	120	140
6	65	38	45	45	85	843	600	360	140	100	120	140
7	65	38	45	45	105	870	520	360	140	100	120	140
8	65	38	45	45	105	890	440	360	115	100	120	140
9	65	50	32	45	105	910	405	345	115	100	120	160
10	65	50	32	45	105	870	350	325	135	100	105	160

Daily discharge, in second-feet, of Teton River near Belleview, Mont., for 1909—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
11	65	50	32	45	130	850	290	325	135	100	105	160
12	65	50	32	32	130	830	275	295	135	100	105	160
13	65	50	32	32	130	830	275	295	135	100	105	140
14	65	50	32	32	130	870	310	280	135	100	105	140
15	65	65	32	32	150	870	290	260	115	95	92	140
16	65	65	32	32	150	910	245	250	115	95	85	140
17	65	65	32	32	190	955	245	230	115	95	85	140
18	65	65	32	45	190	1,000	245	230	115	85	85	140
19	65	65	32	45	190	1,040	230	230	115	85	80	140
20	50	65	32	45	210	995	215	205	115	85	70	120
21	50	80	22	45	210	975	215	205	115	85	80	120
22	50	80	22	45	260	935	190	205	115	85	85	110
23	50	65	22	45	290	835	190	205	115	70	85	105
24	50	65	22	60	325	835	175	205	115	70	85	120
25	50	50	22	60	345	775	270	175	115	70	85	120
26	50	50	22	60	375	735	620	175	115	80	105	105
27	50	38	22	60	430	735	965	175	115	80	105	105
28	50	38	32	60	505	735	760	175	110	80	105	105
29	50	.....	32	60	585	695	700	175	110	92	105	95
30	38	.....	32	60	660	695	655	140	110	105	120	85
31	38	.....	32	.....	720	.....	635	140	.....	105	.....	85

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

Monthly discharge of Teton River near Belleview, Mont., for 1909.

[Drainage area, 170 square miles.]

Month.	Discharge in second-feet.				Run-off.		
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	Accuracy.
January	65	38	56.5	0.332	0.38	3,470	B.
February	80	38	52.1	.306	.32	2,890	B.
March	45	22	32.4	.191	.22	1,990	B.
April	60	32	43.7	.257	.29	2,600	B.
May	720	60	232	1.36	1.57	14,300	A.
June	1,040	695	852	5.01	5.59	50,700	A.
July	965	175	440	2.59	2.99	27,100	A.
August	580	140	280	1.65	1.90	17,200	A.
September	140	110	124	.729	.81	7,380	A.
October	105	70	93.1	.548	.63	5,720	A.
November	120	70	100	.588	.66	5,950	A.
December	160	85	128	.753	.87	7,870	A.
The year	1,040	22	203	1.19	16.23	147,000	

MUSSELSHELL RIVER DRAINAGE BASIN.

DESCRIPTION.

Musselshell River is formed by two forks. The North Fork (or master stream) rises on the southern slopes of the Little Belt Mountains in the northern part of Meagher County, Mont., at an elevation of 8,000 feet above sea level, flows southeastward for 10 miles, emerging into an irrigable valley, one-half mile to 1 mile in width, and joining the South Fork near the town of Martinsdale, 30 miles below its source, at an elevation of 4,700 feet above sea level. The

South Fork has its source in several small streams draining the northward slopes of Crazy Mountains, about 20 miles southwest of Martinsdale, at an elevation of 5,500 feet above sea level, and flows northeastward through a valley 1 mile to 3 miles wide From Martinsdale the Musselshell flows almost due east for 130 miles to Melstone, where it turns abrubtly to the north, and 60 miles farther on it enters the Missouri.

Below the forks the valley widens and is bordered by low rolling hills. The larger part of the basin is covered by glacial deposits. The soil is black loam, and when properly irrigated the land is suitable for agriculture. Forestation is scant. At the headwaters of the North Fork pines are found, but elsewhere the timber consists only of the few cottonwoods and willows that border the stream channels. The mean annual rainfall is about 25 inches in the upper areas of the basin, but near the mouth of the river it decreases to 12 inches.

The principal source of supply for the streams in this basin is the melting snow. Ice forms on the streams during the winter months.

The tributaries of the Musselshell are small intermittent streams, and the river exhibits wide variations in discharge. Much of the water is used for irrigation, the diversions all being small. During the irrigating season the Musselshell carries but little water.

A project now under way under the Carey Land Act will utilize a small but excellent reservior site on the North Fork to store the flood waters of that stream and of Checkerboard Creek, which will be diverted into the reservoir. The dam will be 130 feet high and the reservoir will store 28,000 acre-feet of water. The dam site is 19½ miles from Martinsdale.

The Musselshell basin affords no opportunities for power development. The fall of greatest magnitude occurs on the upper North Fork, but the supply of water is insufficient to warrant an expenditure necessary to develop it.

The longest records of stream flow in the Musselshell basin have been kept at Shawmut and Harlowton. The wettest year recorded was 1908, while the driest was 1906.

NORTH FORK OF MUSSELSHELL RIVER NEAR DELPINE, MONT.

This station, which is located about 16 miles northeast of Martinsdale and 3 miles above Delpine at a proposed dam site, was established May 19, 1909, to determine the amount of water available for storage. The drainage area above the gaging station affords an excellent reservoir site, and with a 130-foot dam at the station 28,000 acre-feet of water may be stored. No important tributaries enter above the station. Several ditches take water for irrigation.

An ordinary staff gage is nailed securely to a foot log, which spans the stream near the left bank. Measurements are made from this log or by wading.

The station is at a high altitude, and the stream freezes entirely over during cold weather. The gage datum has remained unchanged and records obtained are good.

Discharge measurements of North Fork of Musselshell River near Delpine, Mont., in 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
May 26	Raymond Richards	12	8.8	1.72	17.9
Oct. 8	do	10.5	6.0	1.54	9.7

Daily gage height, in feet, of North Fork of Musselshell River near Delpine, Mont., for 1909.

[Thomas Harbor, observer.]

Day.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Day.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1....	1.7	1.9	2.1	1.8	1.5	.....	1.55	16....	1.65	2.15	1.7	1.6	1.5	1.6	.....
2....	1.85	2.0	2.0	.....	1.7	.....	1.55	17....	1.65	2.25	1.65	1.6	1.5	1.6	.....
3....	2.15	1.8	2.0	.....	1.9	.....	1.55	18....	1.6	2.25	1.6	1.6	1.6	1.6	.....
4....	1.75	1.7	1.9	.....	1.7	.....	1.55	19....	1.7	2.0	1.75	1.6	1.55	1.6	.....
5....	1.7	2.15	1.8	.....	1.6	.....	1.55	20....	1.7	2.35	2.1	1.65	1.55	1.6	.....
6....	1.65	2.05	1.85	.....	1.6	.....	1.55	21....	2.0	2.35	1.9	1.65	1.5	1.6	.....
7....	1.7	2.25	1.9	.....	1.55	.....	1.55	22....	1.6	2.35	1.8	1.55	1.5	1.6	1.55
8....	1.7	2.5	1.9	.....	1.55	.....	1.55	23....	1.85	2.3	1.8	1.55	1.5	1.55	1.55
9....	1.6	2.45	1.9	1.8	1.5	1.55	1.55	24....	1.6	2.25	1.75	1.7	1.5	1.55	1.55
10....	1.6	2.45	1.85	1.8	1.5	1.55	.....	25....	1.6	2.3	1.7	1.65	1.5	1.55	1.55
11....	1.65	2.3	1.9	1.75	1.7	1.55	1.55	26....	1.7	2.25	1.7	1.65	1.5	1.55	1.55
12....	1.6	2.1	1.9	1.7	1.65	1.55	1.55	27....	1.75	2.0	1.75	1.6	1.5	1.6	1.55
13....	1.6	2.3	1.7	1.7	1.6	1.55	1.6	28....	1.9	2.1	1.75	1.5	1.5	1.6	2.15
14....	1.6	1.95	1.75	1.7	1.55	1.6	.....	29....	1.95	2.1	1.7	1.5	1.5	1.55	2.1
15....	1.6	2.0	1.7	1.6	1.55	1.6	.....	30....	2.15	2.15	1.75	1.5	1.5	1.55	1.6
								31....	2.0	.....	.....	1.5	.....	1.55	.....

NOTE.—No observations made Aug. 2 to Aug. 8 or Oct. 1 to Oct. 8. Ice conditions Nov. 14 to Nov. 21 and Nov. 28 to Dec. 31.

Daily discharge, in second-feet, of North Fork of Musselshell River near Delpine, Mont., for 1909.

Day.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Day.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1....	16.5	28	43	22	8.2	8.2	10.1	16....	14.2	47	16.5	12.0	8.2	12.0	.....
2....	25	35	35	22	16.5	8.2	10.1	17....	14.2	56	14.2	12.0	8.2	12.0	.....
3....	47	22	35	22	28.0	8.2	10.1	18....	12.0	56	12.0	12.0	12.0	12.0	.....
4....	19.2	16.5	28	22	16.5	8.2	10.1	19....	16.5	35	19.2	12.0	10.1	12.0	.....
5....	16.5	47	22	22	12.0	10.1	10.1	20....	16.5	65	43	14.2	10.1	12.0	.....
6....	14.2	39	25	22	12.0	10.1	10.1	21....	35.0	65	28	14.2	8.2	12.0	.....
7....	16.5	56	28	22	10.1	10.1	10.1	22....	12.0	65	22	10.1	8.2	12.0	10.1
8....	16.5	80	28	22	10.1	10.1	10.1	23....	25	60	22	10.1	8.2	10.1	10.1
9....	12.0	75	28	22	8.2	10.1	10.1	24....	12.0	56	19.2	16.5	8.2	10.1	10.1
10....	12.0	75	25	22	8.2	10.1	10.1	25....	12.0	60	16.5	14.2	8.2	10.1	10.1
11....	14.2	60	28	19.2	16.5	10.1	10.1	26....	16.5	56	16.5	14.2	8.2	10.1	10.1
12....	12.0	43	28	16.5	14.2	10.1	10.1	27....	19.2	35	19.2	12.0	8.2	12.0	10.1
13....	12.0	60	16.5	16.5	12.0	10.1	12.0	28....	28	43	19.2	8.2	8.2	12.0	.....
14....	12.0	32	19.2	16.5	10.1	12.0	.....	29....	32	43	16.5	8.2	8.2	10.1	.....
15....	12.0	35	16.5	12.0	10.1	12.0	.....	30....	47	47	19.2	8.2	8.2	10.1	.....
								31....	35	.....	21	8.2	.....	10.1	.....

NOTE.—These discharges are based on a rating curve that is defined only fairly well. The curve was determined from two measurements and the standard cross section.

Monthly discharge of North Fork of Musselshell River near Delpine, Mont., for 1909.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
May	47	12.0	19.5	1,200	B.
June	80	16.5	49.8	2,960	C.
July	43	12.0	23.5	1,440	C.
August	22	8.2	15.7	965	B.
September	28	8.2	10.8	643	B.
October	12.0	8.2	10.5	646	B.
November, 19 days	12.0	10.1	10.2	384	B.
The period				8,240	

NORTH FORK OF MUSSELSHELL RIVER NEAR MARTINSDALE, MONT.

This station, which was established May 10, 1907, to determine the amount of water available for irrigation, is located at the ranch of Martin J. Settle, 4 miles north of Martinsdale and one-half mile above the junction of the North and South Forks.

All the tributaries to the North Fork enter the stream above the station, the principal ones being Checkerboard and Flagstaff creeks.

Under a Carey Land Act project the water of this fork, which is practically all appropriated, will be stored about 20 miles above the station and used to irrigate land between Martinsdale and Harlowton.

A chain gage on the left bank of the stream just above the observer's private wagon bridge is used. Its datum has remained the same. Measurements may be made from this bridge or by wading.

The bed of the stream is composed of gravel and may shift somewhat during high water, as the current is swift. Ice forms during the winter season, but records obtained during the open season are very good.

Discharge measurements of North Fork of Musselshell River near Martinsdale, Mont., in 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Apr. 9	Raymond Richards	23	13.5	3.36	34.5
May 25	....do	26	71.6	5.25	326
July 13	J. E. Stewart	22	27.3	3.51	38.2
Oct. 9	Raymond Richards	23	21.1	3.60	41.4

Daily gage height, in feet, of North Fork of Musselshell River near Martinsdale, Mont., for 1909.

[Martin J. Settle, observer.]

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	3.6	3.6	4.8	3.7	3.6	3.55	3.6	3.55	3.6
2	3.6	3.7	4.7	3.65	3.6	3.9	3.6	3.55	3.4
3	3.6	4.05	4.7	3.65	3.6	3.8	3.6	3.55	3.6
4	3.55	4.35	4.2	3.65	3.6	3.85	3.65	3.55	3.8
5	3.4	4.85	4.2	3.65	3.5	3.85	3.6	3.55	3.7

Daily gage height, in feet, of North Fork of Musselshell River near Martinsdale, Mont., for 1909—Continued.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
6	3.4	3.9	4.1	4.9	3.5	3.8	3.6	3.55	3.8
7	3.35	3.8	4.25	3.8	3.5	3.85	3.6	3.55	.....
8	3.35	3.75	4.25	3.7	3.5	3.9	3.6	3.55	.....
9	3.35	3.75	4.7	3.7	3.5	3.9	3.6	3.55	.....
10	3.65	3.9	4.55	3.6	3.5	3.65	3.6	3.6	.....
11	3.45	3.9	4.55	3.6	3.55	3.9	3.6	3.6	.....
12	3.4	3.75	4.6	3.55	3.55	3.75	3.6	3.55	.....
13	3.4	3.75	4.5	3.5	3.5	3.6	3.6	3.6	.....
14	3.6	3.75	4.35	3.45	3.75	3.7	3.5	3.6	.....
15	3.6	3.8	4.2	3.45	3.55	3.65	3.5	3.6	.....
16	3.45	3.9	4.15	3.4	3.5	3.65	3.6	3.6	.....
17	4.0	3.85	4.2	3.35	3.5	3.65	3.6	3.6	.....
18	3.5	3.9	4.1	3.3	3.5	3.65	3.6	3.6	.....
19	3.65	3.9	4.05	3.25	3.5	3.6	3.6	3.6	.....
20	3.9	3.9	4.55	6.4	3.5	3.65	3.55	3.65	.....
21	3.6	4.2	4.7	4.25	3.45	3.9	3.55	3.6	.....
22	3.5	4.7	4.4	3.9	3.45	3.65	3.55	3.6	.....
23	3.6	4.7	4.3	3.8	3.45	3.65	3.55	3.6	.....
24	3.5	5.0	4.2	3.8	3.8	3.65	3.55	3.6	.....
25	3.65	5.7	4.1	3.7	3.6	3.6	3.55	3.9	.....
26	4.2	5.0	4.0	3.7	3.55	3.65	3.55	3.6	.....
27	3.85	4.75	4.0	3.7	3.5	3.8	3.55	3.65	.....
28	3.9	5.0	3.9	3.9	3.5	3.8	3.55	3.7	.....
29	3.65	4.95	3.8	3.7	3.5	3.6	3.55	3.65	.....
30	3.5	5.0	3.8	3.65	3.5	3.6	3.55	3.6	.....
31	.....	4.9	.....	3.6	3.5	.....	3.55	.....	.....

NOTE.—Probable ice conditions Jan. 1 to Mar. 31 and Dec. 7–31.

Daily discharge, in second-feet, of North Fork of Musselshell River near Martinsdale, Mont., for 1909.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	63	63	231	61	43	38	43	38	43
2	63	76	214	55	43	79	43	38	24
3	63	128	214	55	43	66	43	38	43
4	57	175	131	55	43	72	48	38	66
5	39	262	131	55	33	72	43	38	54
6	39	105	116	249	33	66	43	38	66
7	34	90	139	73	33	72	43	38	.....
8	34	83	139	61	33	79	43	38	.....
9	34	83	214	61	33	79	43	38	.....
10	70	105	188	49	33	48	43	43	.....
11	44	105	188	49	38	79	43	43	.....
12	39	83	197	44	38	60	43	38	.....
13	39	83	180	38	33	43	43	43	.....
14	63	83	155	33	60	54	33	43	.....
15	63	90	131	33	38	48	33	43	.....
16	44	105	124	28	33	48	43	43	.....
17	120	98	131	24	33	48	43	43	.....
18	51	105	116	20	33	48	43	43	.....
19	70	105	108	16	33	43	43	43	.....
20	105	105	188	520	33	48	38	48	.....
21	63	151	214	135	28	79	38	43	.....
22	51	235	163	79	28	48	38	43	.....
23	63	235	147	66	28	48	38	43	.....
24	51	289	131	66	66	48	38	43	.....
25	70	415	116	54	43	43	38	79	.....
26	151	283	101	54	38	48	38	43	.....
27	98	238	101	54	33	66	38	48	.....
28	105	277	87	79	33	66	38	54	.....
29	70	265	73	54	33	43	38	48	.....
30	51	272	73	48	33	43	38	43	.....
31	.....	250	.....	43	33	.....	38	.....	.....

NOTE.—Discharges from Apr. 1 to May 24 based on a rating curve that is well defined below 200 second-feet. May 25 to 31 and July 20 to 21 discharges obtained by the indirect method for shifting channels. Discharges for remaining year based on a rating curve that is not well defined.

Monthly discharge of North Fork of Musselshell River near Martinsdale, Mont., for 1909.

Month.	Discharge in second-feet.			Run-off, (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
April	151	34	63.6	3,780	B.
May	415	63	163	10,000	B.
June	231	73	148	8,810	B.
July	520	16	74.5	4,580	B.
August	66	28	36.7	2,260	C.
September	79	38	57.4	3,420	B.
October	43	33	40.6	2,500	B.
November	79	38	43.4	2,580	B.
Dec. 1-6	66	24	49.3	586	B.
The period				38,500	

MUSSELSHELL RIVER AT HARLOWTON, MONT.

This station, which was established July 11, 1907, to take the place of the station formerly maintained at Shawmut, is located at the highway bridge 1 mile south of Harlowton. The records furnish information of value for irrigation development.

The tributaries above and below the station are all small streams. American Fork enters the stream between this station and Shawmut.

A large part of the valley is irrigated and many small ditches receive their water supply from the Musselshell. Practically the entire flow of the stream is appropriated. A minimum discharge of 2 second-feet is recorded during the irrigating season at this station.

During the high water of June, 1908, the approaches to the bridge were partly destroyed, but the gage was not disturbed. In October, 1908, the bridge caved in, destroying the gage.

On April 10, 1909, a temporary staff gage was installed which read 0.73 foot too high. On May 24, 1909, a standard chain gage was placed on the upstream side of the new public highway bridge with a datum 0.52 feet greater than the bench mark. The datum of the bench mark was raised 0.52 foot. All gage heights for 1909 have been corrected to this new datum.

Measurements may be made from this bridge or by wading. The bed of the stream is composed of sand and gravel and will probably shift in flood.

Discharge measurements of Musselshell River at Harlowton, Mont., in 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Apr. 10	Raymond Richards	38	30.1	1.19	104
May 24	do.[a]	100	279	2.61	912
July 13	J. E. Stewart	60	88.9	1.33	159
Oct. 8	Raymond Richards	32	32.1	1.18	124

[a] Made from bridge.

Daily gage height, in feet, of Musselshell River at Harlowton, Mont., for 1909.

[G. Yamamota, observer.]

Day.	Apr.	May	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	1.45	2.65	1.8	1.25	1.3	1.15	1.2	1.1
2	.....	1.45	2.65	1.7	1.2	1.45	1.1	1.2	.95
3	.....	1.45	2.7	1.65	1.2	1.35	1.2	1.15	.8
4	.....	1.60	2.75	1.55	1.15	1.45	1.25	1.15	.....
5	.....	2.20	2.7	1.5	1.1	1.45	1.3	1.15	.....
6	.....	1.90	2.7	2.05	1.0	1.35	1.2	1.15	.....
7	.....	1.55	2.6	1.9	1.0	1.5	1.2	1.15	.....
8	.....	1.45	2.65	1.55	1.2	1.55	1.2	1.15	.....
9	.....	1.45	2.85	1.5	1.1	1.4	1.2	1.15	.....
10	1.15	1.35	2.75	1.4	1.1	1.35	1.2	1.15	.....
11	1.1	1.35	2.7	1.4	1.1	1.45	1.2	1.15	.....
12	1.2	1.3	2.65	1.3	1.2	1.3	1.2	1.15	.....
13	1.2	1.25	2.6	1.3	1.2	1.3	1.2	1.15	.....
14	1.2	1.25	2.5	1.2	1.25	1.3	1.2	1.15	.....
15	1.2	1.3	2.5	1.2	1.35	1.3	1.2	1.15	.....
16	1.2	1.25	2.4	1.2	1.25	1.25	1.2	1.2	.....
17	1.2	1.25	2.4	1.2	1.15	1.25	1.2	1.2	.....
18	1.1	1.35	2.3	1.1	1.1	1.2	1.2	1.25	.....
19	1.25	1.25	2.3	1.05	1.1	1.2	1.2	1.25	.....
20	1.3	1.25	2.4	1.1	1.1	1.4	1.2	1.25	.....
21	1.45	1.25	3.1	2.15	1.1	1.3	1.2	1.25	.....
22	1.35	1.4	3.05	1.7	1.0	1.3	1.2	1.25	.....
23	1.3	1.7	2.75	1.45	1.3	1.2	1.2	1.2	.....
24	1.3	2.55	2.6	1.35	1.2	1.2	1.2	1.2	.....
25	1.3	3.2	2.45	1.3	1.15	1.2	1.2	1.2	.....
26	1.35	2.95	2.3	1.3	1.1	1.2	1.2	1.2	.....
27	1.7	2.85	2.25	3.1	1.1	1.2	1.2	1.2	.....
28	1.6	2.85	2.15	1.95	1.1	1.2	1.2	1.2	.....
29	1.55	2.85	2.05	1.5	1.1	1.15	1.2	1.1	.....
30	1.55	2.75	1.9	1.3	1.05	1.15	1.2	1.1	.....
31	.....	2.75	.....	1.3	1.0	.....	1.2	.....	.....

NOTE.—No observations made till Apr. 10. Probably ice conditions January, February, March, and December.

Daily discharge, in second-feet, of Musselshell River at Harlowton, Mont., for 1909.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	182	957	380	136	150	112	123	100
2	.....	182	957	325	123	204	100	123	72
3	.....	182	995	300	123	166	123	112	52
4	.....	250	1,030	245	112	204	136	112	.....
5	.....	616	995	222	100	204	150	112	.....
6	.....	418	995	540	80	166	123	112	.....
7	.....	226	920	440	80	225	123	112	.....
8	.....	182	957	250	123	250	123	112	.....
9	.....	182	1,110	223	100	183	123	112	.....
10	94	146	1,030	175	100	166	123	112	.....
11	83	146	995	175	100	204	123	112	.....
12	106	131	957	150	123	150	123	112	.....
13	106	118	920	150	123	150	123	112	.....
14	106	118	845	123	136	150	123	112	.....
15	106	131	845	123	166	150	123	112	.....
16	106	118	770	123	136	136	123	123	.....
17	106	118	770	123	112	136	123	123	.....
18	83	146	695	100	100	123	123	136	.....
19	118	118	695	90	100	123	123	136	.....
20	131	118	785	100	100	183	123	136	.....
21	182	118	1,310	620	100	150	123	136	.....
22	146	162	1,270	330	100	150	123	136	.....
23	131	302	1,050	204	150	123	123	123	.....
24	131	880	975	166	123	123	123	123	.....
25	131	1,360	825	150	112	123	123	123	.....
26	146	1,180	718	150	100	123	123	123	.....
27	302	1,110	680	1,320	100	123	123	123	.....
28	250	1,110	605	486	100	123	123	123	.....
29	226	1,110	540	225	100	112	123	100	.....
30	226	1,030	440	150	90	112	123	100	.....
31	.....	1,030	.....	150	80	.....	123	.....	.....

NOTE.—These discharges are based on rating curves applicable as follows: Apr. 10 to May 24, not well defined. May 25 to July 11, indirect method for shifting channels. July 12 to Dec. 3, not well defined.

Monthly discharge of Musselshell River at Harlowton, Mont., for 1909.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
Apr. 10–30	302	83	144	5,990	C.
May	1,360	118	426	26,200	B.
June	1,310	440	888	52,800	B.
July	1,320	90	268	16,500	C.
August	166	80	111	6,820	B.
September	250	112	156	9,280	B.
October	150	100	123	7,560	B.
November	136	100	119	7,080	B.
The period				132,000	

CHECKERBOARD CREEK NEAR DELPINE, MONT.

Checkerboard Creek, a small stream with no tributaries, rises in the Little Belt Mountains. The creek is about 12 miles long. It is proposed to carry the water from this creek over a small divide into the reservoir located on the North Fork of Musselshell River.

The gaging station, which is located 2½ miles above the junction of Checkerboard Creek with Musselshell, 21 miles from Martinsdale and 8 miles from Delpine post office, was established May 26, 1909, to determine the amount of water available for irrigation.

The gage is a staff nailed to a foot log and located near the right bank. All measurements are made from this foot log or by wading. As the station is located at a high altitude, ice is common. Since the station was established the gage datum has remained unchanged.

Discharge measurements of Checkerboard Creek near Delpine, Mont., in 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
May 26	Raymond Richards	14.5	16.1	1.30	63.7
Oct. 8	do	12.5	5.2	.49	6.9

Daily gage height, in feet, of Checkerboard Creek near Delpine, Mont., for 1909.

[Thos. Harbor, observer.]

Day.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	0.9	0.7	.....	0.5	.....	0.5	0.5
2	.....	.9	.6	.....	.55	.....	.5	.5
3	1.9	.8	.65	.....	.65	.....	.5	.5
4	2.0	.75	.65	.....	.55	.....	.5	.....
5	1.0	.75	.6	.....	.55	.....	.5	.....
6	.8	.95	.7	.....	.55	.....	.5	.....
7	.7	.95	.6	.....	.55	.....	.5	.....
8	.75	.95	.6	.....	.55	0.45	.5	.....
9	.8	.95	.6	0.55	.5	.5	.5	.....
10	.8	1.05	.6	.55	.5	.5	.5	.....
11	.8	1.0	.6	.53	.55	.5	.5	.....
12	.75	.85	.6	.5	.55	.5	.5	.....
13	.75	.9	.55	.5	.55	.5	.5	.....
14	.75	.85	.55	.5	.5	.5	.5	.....
15	.7	.8	.55	.5	.5	.5	.5	.....

Daily gage height, in feet, of Checkerboard Creek near Delpine, Mont., in 1909—Contd.

Day.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
16	0.8	0.75	0.55	0.5	0.5	0.5	0.5	.....
17	.85	.8	.55	.5	.5	.5	.5	.....
18	.8	.8	.55	.5	.5	.5	.5	.....
19	.8	.8	.55	.5	.55	.5	.5	.....
20	.8	.9	.55	.5	.55.	.5	.5	.....
21	1.0	.85	.55	.5	.55	.5	.5	.....
22	1.2	.8	.55	.5	.5	.5	.5	.....
23	1.2	.8	.55	.5	.5	.5	.5	.....
24	1.0	.75	.55	.52	.5	.5	.5	.....
25	.9	.85	.54	.55	.5	.5	.5	.....
26	1.05	.8	.5	.55	.5	.5	.5	.....
27	1.05	.8	.5	.55	.5	.5	.5	.....
28	1.25	.75	.55	.5	.5	.5	.5	.....
29	.95	.7	.5	.5	.5	.5	.5	.....
30	.9	.7	.5	.5	.5	.5	.5	.....
31	1.0	.....	.5	.5	.....	.5	.....	.....

NOTE.—No observations Aug. 1 to Aug. 8 and Oct. 1 to Oct. 7. Stream frozen over Dec. 4 to 31.

Daily discharge, in second-feet, of Checkerboard Creek near Delpine, Mont., for 1909.

Day.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	133	28	16	7.4	7.2	7.0	7.2	7.2
2	133	28	11.2	7.6	9.2	6.8	7.2	7.2
3	133	22	13.6	7.9	13.6	6.6	7.2	7.2
4	146	19	13.6	8.1	9.2	6.4	7.2	.....
5	36	19	11.2	8.3	9.2	6.2	7.2	.....
6	22	32	16.0	8.6	9.2	6.0	7.2	.....
7	16	32	11.2	8.8	9.2	5.8	7.2	.....
8	19	32	11.2	9.0	9.2	5.6	7.2	.....
9	22	32	11.2	9.2	7.2	7.2	7.2	.....
10	22	40	11.2	9.2	7.2	7.2	7.2	.....
11	22	36	11.2	8.4	9.2	7.2	7.2	.....
12	19	25	11.2	7.2	9.2	7.2	7.2	.....
13	19	28	9.2	7.2	9.2	7.2	7.2	.....
14	19	25	9.2	7.2	7.2	7.2	7.2	.....
15	16	22	9.2	7.2	7.2	7.2	7.2	.....
16	22	19	9.2	7.2	7.2	7.2	7.2	.....
17	22	22	9.2	7.2	7.2	7.2	7.2	.....
18	22	22	9.2	7.2	7.2	7.2	7.2	.....
19	22	22	9.2	7.2	9.2	7.2	7.2	.....
20	22	28	9.2	7.2	9.2	7.2	7.2	.....
21	36	25	9.2	7.2	9.2	7.2	7.2	.....
22	54	22	9.2	7.2	7.2	7.2	7.2	.....
23	54	22	9.2	7.2	7.2	7.2	7.2	.....
24	36	19	9.2	8.0	7.2	7.2	7.2	.....
25	28	25	8.8	9.2	7.2	7.2	7.2	.....
26	40	22	7.2	9.2	7.2	7.2	7.2	.....
27	40	22	7.2	9.2	7.2	7.2	7.2	.....
28	59	19	9.2	7.2	7.2	7.2	7.2	.....
29	32	16	7.2	7.2	7.2	7.2	7.2	.....
30	28	16	7.2	7.2	7.2	7.2	7.2	.....
31	36	.....	7.2	7.2	.....	7.2	.....	.....

NOTE.—These discharges are based on a rating curve that was determined from two discharge measurements and the standard cross section.

Monthly discharge of Checkerboard Creek near Delpine, Mont., for 1909.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
May	146	16	43.0	2,640	B.
June	40	16	24.7	1,470	C.
July	16	7.2	10.1	621	B.
August	9.2	7.2	7.85	483	B.
September	13.6	7.2	8.21	489	B.
October	7.2	5.6	6.97	429	B.
November	7.2	7.2	7.20	428	B.
The period	.....	.....	.....	6,560	

SOUTH FORK OF MUSSELSHELL RIVER NEAR MARTINSDALE, MONT.

This station, which was established June 19, 1907, to determine the amount of water available for irrigation, was located near the ranch of Martin J. Settle, but on April 28, 1908, it was removed upstream about 1½ miles, near the blacksmith shop of the Martinsdale Sheep Co. and near the public highway, 1¼ miles northeast of Martinsdale.

The South Fork has no important tributaries. Many small ditches are taken from the creek, and during the irrigating season all the water is diverted.

When the new station was established a new datum was used, which has remained unchanged. The gage is an ordinary staff nailed to a tree on the right bank of the stream. Measurements may be made by wading near the gage or from a bridge 150 feet below.

The bed of the stream is chiefly gravel and is clean and nonshifting. Ice forms during the winter season, but records obtained during the open season are good.

Discharge measurements of South Fork of Musselshell River near Martinsdale, Mont., in 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Apr. 9	Raymond Richards	40.5	32.0	1.55	33.4
May 25	do	61	255	5.45	1,040
July 13	J. E. Stewart	23	34.4	1.89	56.6
Oct. 9	Raymond Richards	31	25	1.74	41.2

Daily gage height, in feet, of South Fork of Musselshell River near Martinsdale, Mont., for 1909.

[J. G. Wallace, observer.]

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	1.9	1.8	4.7	2.8	1.65	1.35	1.75	1.65
2	1.85	1.75	4.9	2.65	1.55	1.75	1.75	1.65
3	1.85	1.75	5.2	2.55	1.5	2.0	1.75	1.6
4	1.8	2.9	5.0	2.25	1.35	2.0	1.7	1.6
5	1.7	3.75	4.9	2.2	1.35	2.0	1.75	1.6
6	1.7	3.5	4.9	2.5	1.2	1.95	1.75	1.6
7	1.6	2.6	4.6	2.5	1.15	1.9	1.75	1.6
8	1.8	2.4	4.3	2.55	1.25	1.5	1.75	1.6
9	1.6	2.3	4.5	2.5	1.65	2.7	1.75	1.6
10	1.7	2.35	4.4	2.0	1.45	1.7	1.7	1.6
11	1.7	2.7	4.3	2.5	1.35	2.85	1.7	1.6
12	1.5	2.55	4.2	2.0	1.3	1.85	1.8	1.6
13	1.7	2.3	4.2	1.95	1.3	2.00	1.75	1.6
14	1.55	2.4	4.0	1.9	1.4	1.95	1.75	.....
15	1.6	1.95	4.1	1.85	1.5	1.85	1.75	.....
16	1.45	1.95	4.0	1.8	1.35	1.8	1.7	.....
17	1.5	2.7	4.15	1.8	1.35	1.75	1.7	.....
18	1.7	2.5	4.5	1.8	1.45	1.8	1.85	.....
19	1.7	2.5	3.9	1.65	1.45	1.85	1.85	.....
20	1.75	2.4	3.9	1.7	1.45	1.8	1.85	.....
21	1.9	2.7	4.4	2.95	1.3	1.85	1.8	.....
22	1.7	3.3	4.7	2.1	1.3	1.9	1.8	.....
23	1.65	3.65	4.4	1.9	1.3	1.8	1.85	.....
24	1.65	4.3	4.5	1.85	1.5	1.75	1.8	.....
25	1.8	5.6	4.0	1.65	1.6	1.7	1.7	.....

Daily gage height, in feet, of South Fork of Musselshell River near Martinsdale, Mont., for 1909—Continued.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
26	2.3	5.1	3.8	1.65	1.45	1.7	1.65	.....
27	2.45	5.2	3.6	1.85	1.35	1.7	1.65	.....
28	2.0	5.1	3.5	1.85	1.3	1.8	1.65	.....
29	2.0	5.0	3.0	1.9	1.25	1.8	1.5	.....
30	2.7	4.9	3.1	1.65	1.25	1.8	1.5	.....
31	.....	4.55	.....	1.65	.....	.....	1.5	.....

NOTE.—Probable ice conditions from January to March. River frozen over from Nov. 13 to Dec. 31.

Daily discharge, in second-feet, of South Fork of Musselshell River near Martinsdale, Mont., for 1909.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	58	50	642	156	40	22	46	40
2	54	46	740	136	33	46	46	40
3	54	46	902	124	30	66	46	36
4	50	170	792	90	22	66	43	36
5	43	330	740	85	22	66	46	36
6	43	275	740	118	16	62	46	36
7	36	130	597	118	14	58	46	36
8	50	106	480	124	18	30	46	36
9	36	95	555	118	40	143	46	36
10	43	102	516	66	28	43	43	36
11	43	143	480	118	22	163	43	36
12	30	124	447	66	20	54	50	36
13	43	95	447	62	20	66	46	36
14	33	106	390	58	25	62	46	.....
15	36	62	417	54	30	54	46	.....
16	28	62	390	50	22	50	43	.....
17	30	143	432	50	22	46	43	.....
18	43	118	555	50	28	50	54	.....
19	43	118	365	40	28	54	54	.....
20	46	106	365	43	28	50	54	.....
21	58	143	516	178	20	54	50	.....
22	43	236	642	75	20	58	50	.....
23	40	307	516	58	20	50	54	.....
24	40	480	555	54	30	46	50	.....
25	50	1,140	390	40	36	43	43	.....
26	95	846	341	40	28	43	40	.....
27	112	902	296	54	22	43	40	.....
28	66	846	275	54	20	50	40	.....
29	66	792	185	58	18	50	30	.....
30	143	740	201	40	18	50	30	.....
31	.....	576	.....	40	20	.....	30	.....

NOTE.—These discharges are based on a rating curve that is well defined below 300 second-feet.

Monthly discharge of South Fork of Musselshell River near Martinsdale Mont., for 1909.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
April	143	28	51.8	3,080	A.
May	1,140	46	304	18,700	A.
June	902	185	497	29,600	A.
July	178	40	78.0	4,800	A.
August	40	14	24.5	1,510	B.
September	163	22	57.9	3,450	A.
October	54	30	44.8	2,750	A.
November 1–13	40	36	36.6	944	A.
The period	.....	.....	.....	65,800	

AMERICAN FORK NEAR HARLOWTON, MONT.

American Fork rises in the Crazy Mountains and flows northeastward to its junction with the Musselshell, a few miles below the gaging station, which was established July 28, 1907, at the Shaw & Elliott ranch, 5 miles southeast of Harlowton, Mont., to determine the amount of water available for irrigation and storage.

American Fork has no important tributaries except Lebo Creek, which enters the stream a short distance below the station, but receives its water supply from the melting snow on the mountains. The basin of this stream affords some good storage sites, and by holding back the spring flood waters much more land can be put under irrigation.

A chain gage is fastened to the upper bridge rail of a small wagon bridge. Its datum has remained constant. In flood, measurements may be made from this bridge.

Records obtained during the open season are good. The bed of the stream at the gaging station is composed of sand and clay, and shifts only under extreme conditions.

Discharge measurements of American Fork near Harlowton, Mont., in 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Apr. 9	Raymond Richards	10.5	3.5	1.66	2.6
May 24	do	18.0	11.3	1.90	17.1
July 12	J. E. Stewart	19	11.8	1.60	11.4
Oct. 7	Raymond Richards	11	3.2	1.27	1.6

Daily gage height, in feet, of American Fork near Harlowton, Mont., for 1909.

[Samuel A. Shaw, observer.]

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1		1.7	1.75	2.8	1.8	1.45	0.9	1.3	1.3
2		1.7	1.65	2.8	1.75	1.4	.9	1.3	1.3
3		1.7	1.65	2.9	1.8	1.4	1.5	1.3	1.25
4		1.7	1.65	2.9	1.8	1.3	1.6	1.3	1.25
5		1.7	1.75	3.0	1.8	1.2	1.4	1.3	1.25
6		1.7	1.7	3.0	2.0	1.1	1.35	1.3	1.25
7		1.75	1.7	3.0	2.0	1.45	1.35	1.3	1.25
8		1.75	1.65	3.0	1.9	1.5	1.8	1.3	1.25
9		1.7	1.65	3.2	1.8	1.4	1.45	1.3	1.3
10		1.7	1.7	3.1	1.8	1.4	1.4	1.3	1.3
11		1.7	1.7	3.2	1.75	1.4	1.45	1.3	1.3
12		1.7	1.7	3.0	1.75	1.45	1.4	1.3	1.3
13		1.7	1.65	2.9	1.55	1.4	1.4	1.3	1.3
14		1.7	1.65	2.8	1.45	1.35	1.35	1.3	1.3
15		1.7	1.65	2.8	1.4	1.4	1.35	1.3	1.3
16		1.7	1.65	2.7	1.35	1.35	1.3	1.3	1.3
17	1.75	1.7	1.75	2.6	1.35	1.3	1.3	1.35	1.3
18	1.75	1.7	1.75	2.6	1.1	1.25	1.3	1.35	1.3
19	1.75	1.65	1.75	2.6	1.2	1.1	1.3	1.35	1.3
20	1.75	1.65	1.7	3.0	1.35	1.1	1.3	1.35	1.3
21	1.75	1.65	1.7	3.6	2.0	1.0	1.3	1.35	1.3
22	1.7	1.65	2.5	3.3	1.9	.9	1.3	1.35	1.3
23	1.7	1.65	2.0	3.0	1.75	.95	1.3	1.35	1.3
24	1.7	1.65	2.0	2.8	1.4	1.0	1.3	1.35	1.3
25	1.7	1.65	3.0	2.7	1.1	1.0	1.3	1.35	1.3

Daily gage height, in feet, of American Fork near Harlowton, Mont., for 1909—Continued.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
26	1.75	1.65	2.8	2.5	1.45	0.9	1.25	1.35	1.3
27	1.75	1.65	2.7	2.4	1.5	.9	1.25	1.35	1.3
28	1.75	1.65	2.8	2.2	1.6	.9	1.25	1.35	1.3
29	1.75	1.65	2.9	2.0	1.8	.9	1.25	1.35	1.3
30	1.75	1.65	2.8	2.0	1.75	.9	1.25	1.35	1.3
31	1.75	1.65	2.7	.....	1.6	.9	.....	1.35	.....

NOTE.—Ice conditions Jan. 1 to Mar. 16, Dec. 1 to Dec. 31.

Daily discharge, in second-feet, of American Fork near Harlowton, Mont., for 1909.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	.....	4.1	2.6	136	24	6.2	0.0	2.0	2.0
2	.....	4.1	2.6	136	20	6.2	.0	2.0	2.0
3	.....	4.1	2.6	162	24	6.2	8	2.0	1.2
4	.....	4.1	2.6	162	24	2.0	13	2.0	1.2
5	.....	4.1	2.6	191	24	.5	4.5	2.0	1.2
6	.....	4.1	4.1	191	43	.1	3.2	2.0	1.2
7	.....	6.8	4.1	191	43	6.2	3.2	2.0	1.2
8	.....	6.8	2.6	191	33	8.0	26	2.0	1.2
9	.....	4.1	2.6	262	24	4.5	6.2	2.0	2.0
10	.....	4.1	4.1	250	24	4.5	4.5	2.0	2.0
11	.....	4.1	4.1	285	22	4.5	6.2	2.0	2.0
12	.....	4.1	4.1	210	22	6.2	4.5	2.0	2.0
13	.....	4.1	2.6	178	8.2	4.5	4.5	2.0	2.0
14	.....	4.1	2.6	150	6.2	3.2	3.2	2.0	2.0
15	.....	4.1	2.6	150	4.5	4.5	3.2	2.0	2.0
16	.....	4.1	2.6	125	3.2	3.2	2.0	2.0	2.0
17	6.8	4.1	6.8	114	2.2	2.0	2.0	3.2	2.0
18	6.8	4.1	6.8	114	.1	1.2	2.0	3.2	2.0
19	6.8	2.6	6.8	114	.5	.1	2.0	3.2	2.0
20	6.8	2.6	4.1	226	3.2	.1	2.0	3.2	2.0
21	6.8	2.6	4.1	484	44	0	2.0	3.2	2.0
22	4.1	2.6	90	346	34	0	2.0	3.2	2.0
23	4.1	2.6	26	227	22	0	2.0	3.2	2.0
24	4.1	2.6	26	163	4.5	0	2.0	3.2	2.0
25	4.1	2.6	175	137	.1	0	2.0	3.2	2.0
26	6.8	2.6	123	105	6.2	0	1.2	3.2	2.0
27	6.8	2.6	104	87	8.0	0	1.2	3.2	2.0
28	6.8	2.6	123	62	13	0	1.2	3.2	2.0
29	6.8	2.6	146	43	26	0	1.2	3.2	2.0
30	6.8	2.6	123	43	22	0	1.2	3.2	2.0
31	6.8	.....	104	.....	13	0	.....	3.2	.....

NOTE.—These discharges are based on rating curves applicable as follows: Mar. 17 to May 24, fairly well defined between 1.0 and 90 second-feet. May 25 to July 11, the discharges were obtained by the indirect method for shifting channels. July 12 to Nov. 30, fairly well defined between 0.5 and 44 second-feet.

Monthly discharge of American Fork near Harlowton, Mont., for 1909.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
March 17-31	6.8	4.1	6.08	181	C.
April	6.8	2.6	3.68	219	C.
May	175	2.6	36.1	2,220	C.
June	484	43	174	10,400	C.
July	44	.1	17.7	1,090	C.
August	8.0	0	2.38	146	C.
September	26	0	3.87	230	C.
October	3.2	2.0	2.58	159	C.
November	2.0	1.2	1.84	109	C.
The period	.....	.....	.....	14,800	

LEBO CREEK NEAR HARLOWTON, MONT.

Lebo Creek rises at an elevation of 5,600 feet, flows northeastward, and enters American Fork half a mile below the gaging station. It is about 20 miles long, is fed by springs, and its flow is nearly uniform. Its water is used for irrigation.

The gaging station, which was established July 28, 1907, to determine the amount of water available for irrigation, is located near the Shaw & Elliott ranch, 5 miles southeast of Harlowton.

A staff gage is nailed to a pile of the small wagon bridge on the right bank. It has the same datum as American Fork. Measurements are made by wading.

Records obtained are fair. The flow is affected by grass in the stream bed.

Discharge measurements of Lebo Creek near Harlowton, Mont., in 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Apr. 9	Raymond Richards	9.5	6.2	0.87	20.5
May 24	....do	12.0	10.8	1.51	41.1
July 12	J. E. Stewart	10.0	8.0	.83	16.7
Oct. 7	Raymond Richards	13.7	7.8	1.03	17.5

Daily gage height, in feet, of Lebo Creek near Harlowton, Mont., for 1909.

[Samuel A. Shaw, observer.]

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	1.0	0.9	1.3	0.7	0.6	0.9	1.1	1.2
2	1.0	.9	1.2	.5	.55	1.0	1.1	1.2
3	.95	.9	1.2	.5	.5	1.2	1.1	1.2
4	.95	.9	1.3	.5	.5	1.25	1.1	1.2
5	.9	1.5	1.4	.8	.4	1.2	1.1	1.2
6	.9	1.3	1.3	1.6	.4	1.0	1.1	1.2
7	.9	1.2	1.2	1.5	.7	1.0	1.1	1.2
8	.85	1.1	1.2	1.4	.8	1.2	1.1	1.2
9	.8	1.0	2.0	1.2	.8	1.0	1.1	1.2
10	.8	1.2	2.0	1.2	.8	1.0	1.1	1.2
11	.8	1.2	1.6	1.0	.9	1.2	1.1	1.2
12	.8	1.2	1.4	1.0	.85	1.1	1.1	1.2
13	.85	1.1	1.3	.85	.8	1.1	1.1	1.2
14	.85	1.1	1.2	.75	.8	1.1	1.1	1.2
15	.9	1.0	1.2	.65	.8	1.1	1.1	1.2
16	.9	1.0	1.1	.6	.9	1.1	1.1	1.2
17	.9	1.1	1.1	.55	.85	1.0	1.2	1.2
18	.9	1.3	1.0	.5	.8	1.0	1.2	1.2
19	.9	1.3	1.0	.6	.75	1.0	1.2	1.2
20	.9	1.2	1.6	1.2	.7	1.0	1.15	1.2
21	.9	1.15	1.4	1.4	.8	1.0	1.15	1.2
22	.9	1.6	1.4	1.0	.8	1.0	1.15	1.2
23	.9	1.3	1.3	.8	9	1.0	1.15	1.2
24	.9	1.6	1.3	.75	.9	1.0	1.15	1.2
25	.9	2.9	1.2	.5	.95	1.0	1.15	1.2
26	.9	3.0	1.1	.7	.95	1.0	1.15	1.2
27	.9	3.0	1.0	.6	.9	1.0	1.15	1.2
28	.9	3.0	.9	.8	.9	1.0	1.15	1.2
29	.9	2.0	.8	.7	.9	1.0	1.15	1.2
30	.9	1.7	.8	.75	.9	1.0	1.15	1.2
31	.....	1.4	.....	.75	.9	.....	1.15	1.2

NOTE.—Ice conditions: January, February, March, and December.

Daily discharge, in second-feet, of Lebo Creek near Harlowton, Mont., for 1909.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	24	21	31	16	12	16	18	22
2	24	21	27	11	11	17	18	22
3	22	21	27	11	10	23	18	22
4	22	21	31	11	10	25	18	22
5	21	41	35	17	9	23	18	22
6	21	33	31	40	9	17	18	22
7	21	30	27	36	13	17	18	22
8	20	27	27	34	15	23	18	22
9	18	24	70	26	15	17	18	22
10	18	30	70	26	15	17	18	32
11	18	30	45	21	17	23	18	22
12	18	30	35	21	16	20	18	22
13	20	27	31	17	15	20	18	22
14	20	27	27	15	15	20	18	22
15	21	24	27	13	15	20	18	22
16	21	24	24	12	17	20	18	22
17	21	27	24	11	16	17	22	22
18	21	33	22	10	15	17	22	22
19	21	33	22	12	14	17	22	22
20	21	30	42	29	13	17	20	22
21	21	28	34	35	15	17	20	22
22	21	45	34	23	15	17	20	22
23	21	33	29	16	17	17	20	22
24	21	45	29	15	17	17	20	22
25	21	145	27	10	17	17	20	22
26	21	154	24	14	17	17	20	22
27	21	154	22	12	16	17	20	22
28	21	154	18	16	16	17	20	22
29	21	70	17	14	16	17	20	22
30	21	51	17	15	16	17	20	22
31	.....	36	.....	15	16	.....	20	.....

NOTE.—These discharges are based on rating curves applicable as follows:
Apr. 1 to May 24, fairly well defined between 18 and 55 second-feet.
May 25 to Oct. 6 indirect method for shifting channels.
Oct. 7 to Nov. 30 fairly well defined between 16.5 and 33 second-feet.

Monthly discharge of Lebo Creek near Harlowton, Mont., for 1909.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
April	24	18	20.8	1,240	C.
May	154	21	47.4	2,910	C.
June	70	17	30.9	1,840	C.
July	40	10	18.5	1,140	C.
August	17	9	14.5	892	C.
September	25	16	18.5	1,100	C.
October	22	18	19.2	1,180	C.
November	22	22	22.0	1,310	C.
The period	.....	.....	.....	11,600	

MILK RIVER DRAINAGE BASIN.

DESCRIPTION.

Milk River is formed in the southern part of the Canadian Province of Alberta[1] by the union of two streams, the North Fork and the South Fork, that rise in the undulating foothills of the Rocky

[1] Beginning July 1, 1909, the Canadian Government maintained stations on Milk River basin in the Province of Alberta. The data are published in the report of progress of stream measurements for 1909, issued by the Department of the Interior, Dominion of Canada.

Mountains in northeastern Montana, near the international boundary line. For about 100 miles from this junction the Milk flows eastward parallel to and on the northeastern side of the boundary. It then turns to the southeast, passes across the northern part of Montana, and discharges into the Missouri east of Glasgow.

The tributaries of Milk River, except Clear Creek, near Yantic, and North Fork, at Chinook, are for the most part intermittent streams, but the drainage ways that carry them contain local water pockets, which are used as watering places for stock.

From the point at which it leaves Canada and enters Montana to Yantic, 10 miles east of Havre, the Milk is bounded on both sides by high cliffs that rise 200 feet or more above the stream. At Yantic the cliffs recede and become less abrupt and the valley spreads out, and it maintains a width from 3 to 4 miles to its lower end, where it narrows to a mile near Hinsdale. This wider part of the valley was probably the preglacial channel of the Missouri before it was turned aside by the ice sheet and forced to seek a new outlet eastward along the southern face of the glacier.

From the top of the cliffs the country has a rolling aspect, exhibiting no abrupt changes except where tributaries to the main river have eroded deep channels in passing from higher or bench lands to the valley. The general slope of the country is toward the east.

A deposit of glacial drift, varying from a layer so thin as to be unnoticeable to a bed 70 feet thick, covers the greater part of the drainage basin except along the streams, and many small ponds that dry up in summer time are scattered over the area. Most of these ponds occupy shallow depressions with no outlet, and their waters, as a rule, contain salts leached from the soil, and are therefore alkaline. Highly alkaline water was also obtained by a number of wells that have been sunk in the vicinity of Havre and Chinook.

The entire drainage basin lies within the plains section, and is treeless except for a few willows and cottonwoods along the stream.

The mean annual rainfall, which is about 14 inches at Havre, is 19 inches at the extreme western edge of the basin. As a rule, most of this rainfall occurs during the months of May and June. As might be expected in this northern latitude, the streams and lakes are ice bound from the last part of November to the first of April.

As the rainfall is so scanty, irrigation is necessary for successful cultivation of crops. The United States Reclamation Service has begun construction on an irrigation project that will store the flood water of Milk River, reenforce the discharge by water from St. Mary River, and ultimately reclaim 250,000 acres of land in the lower valley.

Reservoirs for the storage of flood waters are possible at a number of places in the basin, as at Chain Lakes, 30 miles northwest of Havre,

and Mud Lake, in Tps. 31 and 32 N., Rs. 31 and 32 E., and at Lake Bowdoin and Lonesome Lake.

Natural power opportunities are wholly lacking in this basin, for the fall of none of the streams is large, and Milk River itself is apt to cease to flow in the late summer and autumn.

The longest run-off record extends back to 1898. The wettest year since that time was 1899 and the driest was 1905. The total flow of the river in the driest year was only one-thirtieth of that of the wettest.

SOUTH FORK OF MILK RIVER NEAR BROWNING, MONT.

This station, which is located at Richard Croff's ranch, about 40 miles northeast of Browning, Mont., and about 6 miles south of the Canadian boundary line, was established April 28, 1905, to obtain data for use in connection with irrigation projects in Milk River valley.

No storage is used above this station. A number of small ditches divert water to irrigate meadow lands in the river bottom, a considerable amount of this water returning to the stream as seepage and waste water.

The river overflows its banks at a gage height of 12 feet. During the high water of June, 1908, the gage was washed out and was not replaced until July 31, 1908. From high-water marks the stage was found to be 15.4 feet. The flood width was 850 feet and the flood cross section about 2,600 square feet.

On July 31 a new chain gage and cable were put in at their original locations. The datum of the gage remains the same.

The results are excellent, except during the winter months, when they are affected by ice.

Discharge curves at this station are shown in figure 1.

Discharge measurements of South Fork of Milk River near Browning, Mont., in 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
May 29	W. A. Lamb	73	182	4.51	448
June 15	do	74	142	3.90	276
July 8	do	74	112	3.55	179
Sept. 17[a]	Stewart and Lamb	32	30	2.60	33
Oct. 15[a]	W. A. Lamb	31	31	2.62	35

[a] Made by wading above cable.

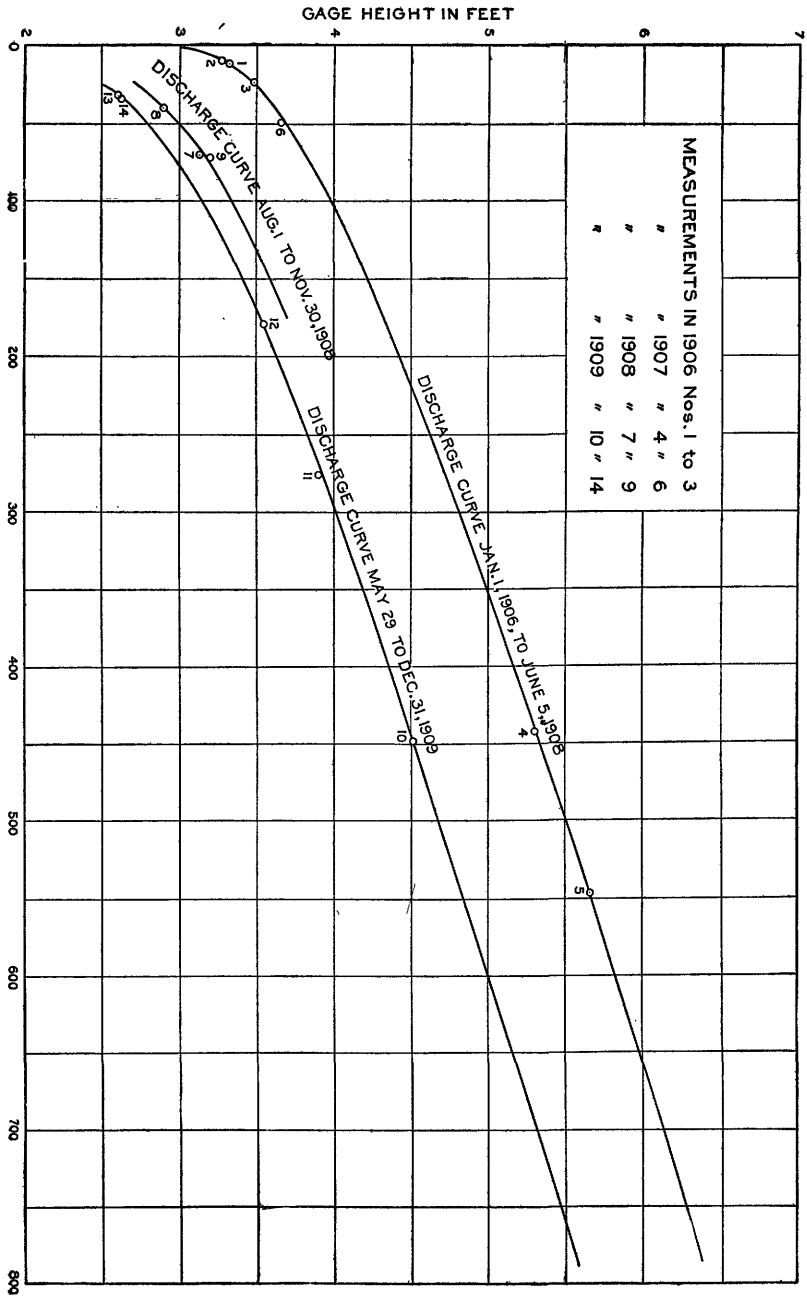


FIGURE 1.—Discharge curves of South Fork of Milk River near Browning, Mont.

Daily gage height, in feet, of South Fork of Milk River near Browning, Mont., for 1909.

[R. J. Croff, observer.]

Day.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	4.3	3.4	3.4	2.65	2.6	2.6	3.0
2	.....	4.35	3.3	3.3	2.7	2.7	2.6	2.9
3	.....	4.35	3.3	3.2	2.7	2.7	2.65	2.7
4	.....	4.2	3.4	3.2	2.7	2.7	2.75	2.8
5	.....	4.3	3.6	3.15	2.7	2.65	2.85	2.8
6	.....	4.0	3.65	3.0	2.7	2.65	2.9	2.8
7	.....	4.0	4.05	3.0	2.65	2.6	2.95	2.7
8	.....	4.8	3.6	3.0	2.65	2.5	3.0	2.7
9	.....	5.65	3.45	2.95	2.6	2.5	2.75	2.8
10	.....	4.85	3.35	2.9	2.6	2.6	2.75	2.8
11	.....	4.35	3.3	2.9	2.6	2.65	2.8	2.8
12	.....	4.2	3.25	2.85	2.7	2.7	3.0	2.7
13	.....	4.1	3.2	2.85	2.8	2.6	3.2	2.6
14	.....	4.0	3.15	2.8	2.7	2.6	2.6	2.7
15	.....	3.9	3.1	2.8	2.65	2.6	2.55	.....
16	.....	3.9	3.5	2.75	2.6	2.6	2.55	.....
17	.....	3.9	3.0	2.75	2.6	2.6	2.5	.....
18	.....	4.3	2.95	2.7	2.7	2.6	2.65	.....
19	.....	3.95	2.95	2.7	2.7	2.65	2.8	.....
20	.....	4.5	2.95	2.7	2.65	2.65	2.7	.....
21	.....	4.55	2.9	2.7	2.7	2.65	2.7	.....
22	.....	4.1	2.85	2.7	2.7	2.65	2.7	.....
23	.....	3.8	2.85	2.7	2.7	2.6	2.9	.....
24	.....	3.7	2.8	2.65	2.65	2.6	2.9	.....
25	.....	3.6	2.8	2.6	2.65	2.65	2.8	.....
26	.....	3.6	3.2	2.6	2.6	2.65	2.7	.....
27	.....	3.55	4.55	2.65	2.6	2.65	2.7	.....
28	.....	3.5	5.9	2.7	2.65	2.65	2.95	.....
29	4.55	3.4	5.55	2.7	2.8	2.6	3.1	.....
30	4.4	3.5	3.95	2.65	2.6	2.65	3.1	.....
31	4.3	.....	3.55	2.6	.....	2.65	.....	.....

NOTE.—Gage not read until May 29. Ice Dec. 15 to 31.

Daily discharge, in second-feet, of South Fork of Milk River near Browning, Mont. for 1909.

Day.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Day.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	.....	385	147	147	36	32	32	16	.....	269	169	47	32	32	30
2	.....	400	127	127	41	41	32	17	.....	269	77	47	32	32	27
3	.....	400	127	109	41	41	36	18	.....	385	70	41	41	32	36
4	.....	355	147	109	41	41	46	19	.....	283	70	41	41	36	52
5	.....	385	192	100	41	36	58	20	.....	445	70	41	36	36	41
6	.....	297	204	77	41	36	64	21	.....	460	64	41	41	36	41
7	.....	297	312	77	36	32	70	22	.....	326	58	41	41	36	41
8	.....	538	192	77	36	27	77	23	.....	242	58	41	41	32	64
9	.....	815	158	70	32	27	46	24	.....	216	52	36	36	32	64
10	.....	554	137	64	32	32	46	25	.....	192	52	32	36	36	52
11	.....	400	127	64	32	36	52	26	.....	192	109	32	32	36	41
12	.....	355	118	58	41	41	77	27	.....	180	460	36	32	36	41
13	.....	326	109	58	52	32	109	28	.....	169	900	41	36	36	41
14	.....	297	100	52	41	32	32	29	460	147	782	41	52	32	41
15	.....	269	92	52	36	32	30	30	415	169	283	36	32	36	41
								31	385	.....	180	32	.....	36	.....

NOTE.—These discharges are based on a rating curve well defined below 500 second-feet. Discharges Nov. 28–30 estimated on account of ice.

Monthly discharge of South Fork of Milk River near Browning, Mont., for 1909.

[Drainage area, 283 square miles.]

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total (in acre-feet).	
June	815	147	334	1.18	1.32	19,900	A.
July	900	52	185	0.654	.75	11,400	A.
August	147	32	60.2	.213	.25	3,700	B.
September	52	32	38.0	.134	.15	2,260	B.
October	41	32	34.5	.122	.14	2,120	B.
November	109	27	48.7	.172	.19	2,900	B.
The period						42,300	

MILK RIVER AT HAVRE, MONT.

This station, which is located at the highway bridge over Milk River at Havre, Mont., was established May 15, 1898, to obtain data for use in connection with a storage project for irrigation in Milk River valley. The nearest important tributaries enter about 20 miles east of the station.

The drainage area above Havre is about 7,300 miles, but the entire run-off from this area does not pass Havre, as an elaborate canal system in southern Alberta is supplied by Milk River. The theoretical discharge of the main canal of this system is about 330 second-feet. The Canadian minister of the interior has granted the canal company 500 second-feet of the low-water flow and 1,500 second-feet of the high-water discharge. As the system has not been wholly in operation, the full effect of the diversions on the flow of Milk River has not yet been felt at Havre.

There are no other important irrigation rights above Havre, but farther downstream are five large canal systems supplied directly from Milk River and irrigating about 22,000 acres. The water rights of these various systems have not yet been adjudicated, although preliminary steps have been taken. A suit in behalf of the Fort Belknap Indians was decided in their favor, with the result that they were given a prior right over the other canals to 125 second-feet, the priority of the other rights not being touched upon. Although no provision for storage has been made by the above claimants, the entire unappropriated flow of the stream has been filed upon by the United States Reclamation Service in connection with its Milk River irrigation project, which is now under construction.

A chain gage fastened to the bridge rail on the downstream side is used; its datum has remained the same since the station was established. Measurements may be made from the bridge or by wading. From the last part of November to the first part of April the river at

Havre is frozen entirely over, and in portions of the cross sections it is usually frozen to the bottom.

Frequent discharge measurements are necessary at this station, and even with these the estimates are subject to considerable error. This characteristic is true of the entire river. In dry years the flow ceases entirely and the water stands in pools for several months.

Discharge measurements of Milk River at Havre, Mont., in 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Apr. 19	Stewart and Lamb	123	195	4.66	286
May 10	W. A. Lamb	60	351	5.90	1,030
14	do	45	380	5.90	1,020
24	do	170	1,070	10.35	3,940
June 4	do	156	283	6.50	723
10	do	155	277	6.25	630
July 3	do	154	191	6.09	417
24	do	173	126	5.30	177
Aug. 21	do	86	74	5.10	90
Sept. 12[a]	Hoyt and Stewart	83	73	5.50	71
22[b]	W. A. Lamb	94	60	5.45	64
Oct. 2[b]	do	50	52	5.50	64
22[c]	do	100	71	5.62	84
Nov. 18[d]	do	35	35	5.60	27

[a] Made from upper side of bridge.
[b] Wading measurement above bridge.
[c] Wading measurement below bridge.
[d] Ice one-half foot thick.

Daily gage height, in feet, of Milk River at Havre, Mont., for 1909.

[L. H. Ling, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	.....	5.15	5.05	5.8	6.9	6.15	7.0	4.8	5.45	5.7	5.7
2	.....	.....	5.05	5.25	5.5	6.7	6.05	6.65	4.8	5.5	5.7	5.7
3	.....	.....	4.95	5.15	5.05	6.65	6.05	6.3	4.75	5.5	5.7	.....
4	.....	.....	4.85	5.05	4.7	6.5	6.0	6.0	4.7	5.5	5.7	.....
5	.....	4.95	4.95	4.9	4.5	6.4	6.4	5.8	.....	5.5	5.7	.....
6	.....	.....	4.95	5.45	8.8	6.4	6.3	5.65	.....	5.5	5.7	.....
7	.....	.....	4.85	5.15	8.8	6.4	6.25	5.6	.....	5.5	5.7	.....
8	.....	.....	4.9	4.95	7.5	6.4	6.3	5.5	.....	5.5	5.7	.....
9	.....	.....	4.85	4.85	6.5	6.3	6.35	5.5	.....	5.5	5.7	.....
10	.....	.....	4.85	4.9	5.9	6.25	6.15	5.55	.....	5.45	5.7	.....
11	.....	.....	4.75	4.9	5.7	6.25	6.2	5.45	.....	5.45	5.7	.....
12	.....	.....	4.75	4.7	5.5	7.25	6.2	5.35	5.5	5.45	5.7	.....
13	.....	.....	4.75	4.65	5.6	7.2	6.45	5.3	5.5	5.45	5.7	.....
14	.....	.....	4.75	4.65	5.9	6.7	6.1	5.3	5.5	5.45	.....	.....
15	.....	.....	4.75	5.0	5.55	6.4	5.8	5.25	5.5	5.45	.....	.....
16	.....	.....	4.65	5.0	5.4	6.3	5.8	5.15	5.4	5.45	.....	.....
17	.....	.....	4.65	4.75	5.4	6.2	5.7	5.1	5.4	5.5	.....	.....
18	.....	.....	4.65	4.65	7.2	6.25	6.15	5.05	5.4	5.55	.....	.....
19	4.85	.....	4.7	4.65	6.8	6.55	5.7	5.05	5.4	5.5	.....	.....
20	5.45	.....	4.7	4.7	6.0	7.0	5.6	5.05	5.4	5.5	.....	.....
21	5.45	.....	4.75	4.65	5.9	6.9	5.4	5.0	5.4	5.5	.....	.....
22	5.3	.....	4.75	4.5	6.05	6.8	5.4	5.0	5.35	5.6	.....	.....
23	6.3	4.95	5.05	4.7	8.3	6.6	5.3	4.95	5.5	5.65	.....	.....
24	.....	.....	5.05	4.8	10.2	6.5	5.5	4.9	5.5	5.65	.....	.....
25	.....	.....	5.05	4.95	11.7	6.9	5.3	4.9	5.5	5.65	.....	.....
26	.....	5.45	4.95	4.85	10.1	6.55	5.2	4.9	5.45	5.65	.....	.....
27	.....	5.25	4.85	4.85	8.7	6.3	5.35	4.85	5.45	5.65	.....	.....
28	.....	5.35	4.75	5.1	8.1	6.25	5.8	4.85	5.45	5.65	.....	.....
29	.....	.....	4.85	6.7	7.8	6.2	5.95	4.8	5.45	5.7	.....	.....
30	5.05	.....	5.05	6.3	7.6	6.95	5.6	4.8	5.45	5.7	5.7	.....
31	.....	.....	4.9	.....	7.3	.....	5.65	4.8	.....	5.7	.....	.....

NOTE.—Ice during January and February and Nov. 14 to Dec. 31.

Daily discharge, in second-feet, of Milk River at Havre, Mont., for 1909.

Day.	Mar.	Apr.	May.	June	July.	Aug.	Sept.	Oct.	Nov.
1	450	430	840	1,160	450	835	38	62	95
2	430	515	685	840	405	650	38	68	95
3	390	470	465	825	405	480	32	65	95
4	355	430	375	745	390	360	27	65	95
5	390	370	305	690	565	290	29	65	95
6	390	610	2,810	690	520	245	29	65	95
7	355	470	2,810	690	495	230	28	65	95
8	370	395	1,980	690	515	190	27	65	95
9	355	355	1,350	635	540	190	25	65	95
10	355	370	1,030	620	450	205	25	62	95
11	315	370	900	620	470	180	70	62	95
12	315	300	590	1,160	470	155	85	62	95
13	315	265	840	1,130	590	145	80	62	95
14	315	265	1,020	830	430	145	78	62	.....
15	315	405	830	670	320	120	75	62	.....
16	285	405	750	620	320	105	55	62	.....
17	285	315	750	570	285	97	55	70	.....
18	285	265	1,860	535	450	95	55	75	.....
19	300	265	1,640	685	285	92	55	70	.....
20	300	300	1,160	930	230	92	55	70	.....
21	315	285	1,070	870	200	90	55	70	.....
22	315	245	1,160	810	200	85	52	84	.....
23	430	305	2,590	705	175	80	68	90	.....
24	430	340	3,780	655	225	70	68	90	.....
25	430	395	4,160	870	170	65	68	90	.....
26	390	360	3,770	650	150	60	62	90	.....
27	335	360	2,790	525	180	52	62	90	.....
28	315	490	2,290	500	310	48	62	90	.....
29	355	1,400	2,120	480	365	40	62	95	.....
30	430	1,140	1,800	865	545	38	62	95	.....
31	370	.....	1,540	.....	260	38	.....	95	.....

NOTE.—These discharges were obtained by the indirect method for shifting channels. Discharges Sept. 5–11 estimated by observer.

Monthly discharge of Milk River at Havre, Mont., for 1909.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
March	450	285	354	21,800	C.
April	1,400	245	430	25,600	C.
May	4,160	305	1,610	99,000	C.
June	1,160	480	742	44,200	C.
July	590	150	367	22,600	C.
August	835	38	180	11,100	C.
September	85	25	52.7	3,140	C.
October	95	62	73.6	4,530	C.
Nov. 1–13, 30	95	95	95.0	2,640	C.
The period	.....	.....	.....	235,000	

MILK RIVER AT MALTA, MONT.

This station, which is located at the highway bridge at Malta, Mont., was established July 31, 1902, to obtain data for irrigation projects in Milk River valley. The nearest tributaries above the station are West and North forks of Milk River, which enter about 60 miles west of Malta.

The drainage area above is about 14,000 square miles, but the entire run-off does not pass this station, for between Havre and Malta seven irrigation canals, which irrigate about 25,000 acres of land, divert water from Milk River and its tributaries. The United States Reclamation Service has under construction a diversion dam at Dodson, about 17 miles above the station, which diverts water for the irrigation of about 108,000 acres of land in Milk River valley east of Malta. There are two canals, one on each side, with a total discharge of 1,000 second-feet.

The chain gage is fastened to the footrail on the down side of the bridge. The gage datum has not been changed since the station was established. Measurements are made from the bridge or by wading. From November until April the gage heights are affected by ice, so that estimates of run-off are only approximate.

Discharge measurements of Milk River at Malta, Mont., in 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Apr. 23	Stewart and Lamb	84	137	2.15	308
May 4	W. A. Lamb	124	302	3.75	1,100
11	do	142	580	5.73	2,380
19	do	115	262	3.40	880
20	do	130	330	4.00	1,220
June 4	do	127	336	4.00	1,250
24	do	174	1,650	12.35	6,300
25	do	163	1,240	9.95	4,680
July 2	do	132	359	4.20	1,350
23	do	89	178	2.70	486
Aug. 23	do	78	97	1.70	132
Sept. 28	do	73	72	1.40	71
Oct. 2[a]	do	63	50	1.45	90
Nov. 19[b]	do	60	62	1.30	65

[a] Made by wading above bridge. [b] Made by wading below bridge. Channel partly frozen over.

Daily gage height, in feet, of Milk River at Malta, Mont., for 1909.

[Ed. Kenayer, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	.....	3.65	2.05	3.55	2.5	5.0	4.3	3.6	1.4	1.4	1.6
2	.....	3.45	.....	3.35	3.55	4.6	4.2	3.2	1.9	1.3	1.6
3	1.35	3.35	4.15	3.25	4.0	4.3	4.2	3.0	1.7	1.4	1.6
4	.....	3.25	.....	3.45	3.7	4.0	4.0	3.7	1.6	1.4	1.6
5	.....	3.15	4.55	3.55	3.4	3.7	3.9	3.6	1.4	1.4	1.6
6	.....	2.95	.....	3.55	3.0	3.2	3.7	3.2	.....	1.4	1.6
7	.....	2.75	4.45	3.95	2.8	2.9	3.5	3.0	.....	1.3	1.6
8	.....	2.75	.....	3.75	3.65	2.8	4.4	2.8	1.3	1.3	1.6
9	.....	2.75	3.45	3.35	6.3	2.9	5.1	2.6	1.35	1.3	1.6
10	1.4	2.65	.....	2.95	6.6	2.9	4.9	2.5	1.3	1.3	1.6
11	.....	2.25	3.95	2.55	5.7	3.0	4.2	2.4	1.3	1.3	1.6
12	.....	2.25	.....	2.75	4.5	3.3	3.8	2.4	1.3	1.3	1.6
13	.....	2.15	3.45	2.85	4.0	3.3	4.1	2.3	1.3	1.3	1.4
14	.....	.....	.....	2.65	3.7	3.2	3.7	2.2	1.3	1.3	1.4
15	.....	2.05	3.35	2.65	3.6	3.7	3.4	2.2	1.2	1.3	1.3
16	.....	.....	.....	2.45	3.4	3.85	3.3	2.1	1.3	1.3	1.3
17	1.35	1.95	3.15	2.25	3.5	3.6	3.2	2.0	1.3	1.3	1.3
18	.....	.....	.....	2.25	3.5	3.4	3.1	2.0	1.4	1.3	1.3
19	.....	1.85	3.35	2.45	3.4	3.2	2.9	2.0	1.4	1.2	1.3
20	.....	.....	.....	2.45	4.1	4.0	2.9	2.0	1.4	1.6	1.3

Daily gage height, in feet, of Milk River at Malta, Mont., for 1909—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
21	.....	1.35	3.45	2.35	4.8	6.9	2.8	1.9	1.4	1.6	1.3
22	.....	.....	.....	2.15	4.7	9.4	2.9	1.8	1.4	1.5	1.3
23	.....	.....	3.25	2.1	4.5	12.75	2.8	1.7	1.4	1.5	1.3
24	2.9	1.05	.....	2.1	.....	13.0	2.6	1.7	1.4	1.5	1.3
25	.....	.....	3.35	2.2	5.6	9.7	2.5	1.6	1.4	1.5	1.3
26	.....	.95	.....	2.2	7.65	6.8	2.4	1.6	1.4	1.5	1.4
27	.....	.....	3.55	2.2	9.2	5.7	2.3	1.5	1.4	1.5	1.4
28	.....	.....	.....	2.3	9.55	5.5	2.3	1.5	1.4	1.5	.....
29	.....	.....	3.55	2.5	8.1	5.0	2.3	1.5	1.3	1.6	.....
30	3.9	.....	.....	2.4	6.4	4.8	2.3	1.4	1.3	1.6	.....
31	.....	.....	3.75	.....	5.4	.....	3.5	1.4	.....	1.6	.....

NOTE.—Ice conditions during January, February, March, and December.

Daily discharge, in second-feet, of Milk River at Malta, Mont., for 1909.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	962	404	1,960	1,440	991	80	80	116
2	846	962	1,660	1,370	760	186	65	116
3	788	1,240	1,440	1,370	649	137	80	116
4	904	1,050	1,240	1,240	1,050	116	80	116
5	962	875	1,050	1.170	991	80	80	116
6	962	649	760	1,050	760	75	80	116
7	1,200	545	596	933	649	70	65	116
8	1,080	1,020	545	1,520	545	65	65	116
9	846	2,860	596	2,040	449	72	65	116
10	622	3,060	596	1,890	404	65	65	116
11	426	2,450	649	1,370	361	65	65	116
12	520	1,590	817	1,110	361	65	65	116
13	570	1,240	817	1,300	320	65	65	80
14	472	1,050	760	1,050	282	65	65	80
15	472	991	1,050	875	282	52	65	65
16	382	875	1,140	817	247	65	65	65
17	301	933	991	760	215	65	65	65
18	301	933	875	704	215	80	65	65
19	382	875	760	596	215	80	52	65
20	382	1,300	1,240	596	215	80	116	65
21	340	1,820	3,260	545	186	80	116	65
22	264	1,740	4,770	596	160	80	97	65
23	247	1,590	6,820	545	137	80	97	65
24	247	1,980	6,980	449	137	80	97	65
25	282	2,380	4,950	404	116	80	97	65
26	282	3,720	3,190	361	116	80	97	80
27	282	4,650	2,450	320	97	80	97	80
28	320	4,860	2,320	320	97	80	97	80
29	404	3,980	1,960	320	97	65	116	80
30	361	2,920	1,820	320	80	65	116	80
31	.....	2,240	.....	933	80	.....	116	.....

NOTE.—These discharges are based on a rating curve that is well defined. Discharges Nov. 28–30 estimated on account of ice.

Monthly discharge of Milk River at Malta, Mont., for 1909.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
April	1,200	247	547	32,500	A.
May	4,860	404	1,830	113,000	B.
June	6,980	545	1,940	115,000	B.
July	2,040	320	913	56,100	A.
August	1,050	80	363	22,300	A.
September	186	52	79.9	4,750	B.
October	116	52	82.5	5,070	B.
November	116	65	88.9	5,290	B.
The period	.....	.....	.....	354,000	

MILK RIVER AT HINSDALE, MONT.

This station, which is located at the highway bridge over Milk River, near Hinsdale, Mont., a point 46 miles from its junction with Missouri River, was established May 13, 1908, to obtain data for use in connection with irrigation projects in Milk River valley.

Three tributaries enter between Malta and Hinsdale: Beaver Creek from the south and Frenchman and Rock creeks from the north. These streams discharge large volumes of water during the rainy weather in the spring and summer, but they are low or even dry during the fall and winter months.

No diversions are made between Malta and Hinsdale. The United States Reclamation Service has appropriated the flow of the stream in connection with the Milk River project and will divert it at a point 9 miles east of Hinsdale to irrigate land in lower Milk River valley.

From late in November until the 1st of April the stream is frozen entirely across and to a considerable depth. It is impracticable to keep gage records here during this period.

A chain gage is located on the upstream side of the highway bridge. The datum has remained unchanged. Measurements are made from the bridge or by wading.

Discharge measurements of Milk River at Hinsdale, Mont., in 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Apr. 23	Stewart and Lamb	126	790	3.29	633
May 4	W. A. Lamb	130	978	4.80	1,540
5	do	130	958	4.58	1,440
11	do	138	1,290	7.10	3,410
20	do	130	876	4.05	1,050
21	do	129	875	4.05	1,060
21	do	131	917	4.35	1,220
June 5	do	130	980	4.76	1,470
24	do	163	2,280	13.25	8,090
July 2	do	139	1,470	8.23	4,090
22	do	120	836	3.72	836
Aug. 23[a]	do	120	658	2.18	194
23[b]	do	92	126	2.18	200
Sept. 18[c]	do	62	124	1.75	77

[a] Made from bridge.
[b] Made by wading three-fourths mile above bridge.
[c] Made by wading one-half mile above bridge.

Daily gage height, in feet, of Milk River at Hinsdale, Mont., for 1909.

[M. F. Chester, observer.]

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	5.15	3.4	6.6	10.95	3.45	1.8	1.6	1.9
2	6.05	3.6	5.8	8.55	4.15	1.8	1.6	1.9
3	5.95	3.8	5.5	7.95	3.85	1.75	1.6	1.9
4	5.75	4.8	5.0	7.35	3.7	1.7	1.6	1.9
5	4.95	4.6	4.7	5.85	4.0	1.7	1.65	1.9
6	4.65	4.3	4.35	5.25	4.1	1.7	1.7	1.9
7	4.6	3.95	4.05	8.7	3.85	1.7	1.75	1.95
8	4.65	3.6	3.65	7.3	3.4	1.7	1.75	2.0
9	4.65	4.6	3.45	7.5	3.2	1.7	1.7	2.0
10	5.05	5.5	3.45	7.8	3.1	1.65	1.7	2.0

Daily gage height, in feet, of Milk River at Hinsdale, Mont., for 1909—Continued.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
11	4.65	7.0	3.4	8.25	3.05	1.65	1.7	2.0
12	4.3	6.6	3.4	6.9	3.0	1.65	1.7	2.0
13	4.35	5.85	3.65	5.85	2.9	1.65	1.7	2.0
14	4.1	5.1	3.6	5.3	2.8	1.65	1.7	.....
15	3.95	4.6	3.65	5.1	2.8	1.65	1.7	.....
16	3.95	4.3	3.6	4.6	2.75	1.65	1.7	2.0
17	3.65	4.2	4.3	4.3	2.7	1.65	1.7	1.7
18	3.45	4.1	4.25	4.3	2.6	1.65	1.7	1.7
19	3.55	4.2	3.9	4.15	2.5	1.65	1.7	1.7
20	3.05	4.1	7.5	4.0	2.4	1.6	1.7	.....
21	3.55	4.05	17.1	3.9	2.3	1.6	1.7	1.7
22	3.25	5.0	18.6	3.7	2.3	1.6	1.7	.....
23	3.3	5.2	14.5	3.6	2.3	1.6	1.7	.....
24	3.0	5.2	13.25	3.5	2.25	1.6	1.7	.....
25	2.7	5.1	13.3	3.3	2.2	1.6	1.75	1.7
26	2.7	5.2	12.55	3.3	2.15	1.6	1.8	.....
27	2.7	6.6	10.15	4.55	2.1	1.6	1.85	.....
28	3.0	7.6	8.05	4.35	2.05	1.6	1.9	1.7
29	3.2	8.6	14.55	4.55	2.0	1.6	1.9	.....
30	3.3	8.8	15.05	5.6	1.9	1.6	1.9	.....
31	.....	7.35	.....	3.9	1.85	.....	1.9	.....

NOTE.—Ice conditions during January, February, March, and December.

Daily discharge, in second-feet, of Milk River at Hinsdale, Mont., for 1909.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	1,770	675	2,850	6,330	700	85	50	110
2	2,430	775	2,240	4,410	1,090	85	50	110
3	2,360	885	2,020	3,930	912	75	50	110
4	2,210	1,520	1,660	3,450	830	65	50	110
5	1,630	1,380	1,460	2,280	1,000	65	58	110
6	1,420	1,180	1,220	1,840	1,060	65	65	110
7	1,380	970	1,030	4,530	812	65	75	122
8	1,420	775	802	3,410	675	65	75	135
9	1,420	1,380	700	3,570	580	65	65	135
10	1,700	2,020	700	3,810	535	58	65	135
11	1,420	3,170	675	4,170	512	58	65	135
12	1,180	2,850	675	3,090	490	58	65	135
13	1,220	2,280	802	2,280	450	58	65	135
14	1,060	1,740	775	1,875	410	58	65	135
15	970	1,380	802	1,740	410	58	65	135
16	970	1,180	775	1,380	390	58	65	135
17	802	1,120	1,180	1,180	370	58	65	65
18	700	1,060	1,150	1,180	330	58	65	65
19	750	1,120	940	1,090	295	58	65	65
20	512	1,060	3,570	1,000	260	50	65	65
21	750	1,030	11,200	940	225	50	65	65
22	602	1,660	12,400	830	225	50	65	65
23	625	1,800	9,170	775	225	50	65	65
24	490	1,800	8,170	725	210	50	65	65
25	370	1,740	8,210	625	195	50	75	65
26	370	1,800	7,610	625	180	50	85	65
27	370	2,850	5,690	1,350	165	50	98	65
28	490	3,650	4,010	1,220	148	50	110	65
29	580	4,450	9,210	1,350	135	50	110	65
30	625	4,610	9,610	2,100	110	50	110	65
31	.....	3,450	.....	940	98	.....	110	.....

NOTE.—These discharges are based on a rating curve that is well defined below 1,800 second-feet. Above 1,800 second-feet it is fairly well defined.
Discharges interpolated for days when gage was not read.

Monthly discharge of Milk River at Hinsdale, Mont., for 1909.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
April	2,430	370	1,090	64,900	A.
May	4,610	675	1,850	114,000	A.
June	12,400	675	3,710	221,000	A.
July	6,330	625	2,190	135,000	A.
August	1,090	98	452	27,800	A.
September	85	50	58.8	3,500	B.
October	110	50	71.3	4,380	B.
November	135	65	96.9	5,770	B.
The period				576,000	

NORTH FORK OF MILK RIVER NEAR CHINOOK, MONT.

This station, which is located about 4½ miles north of Chinook, Mont., and about 7 miles above the junction of North Fork with Milk River, was established April 22, 1905, to obtain data for use in connection with irrigation projects in Milk River valley.

No storage is used on this stream. Three canals which divert an aggregate of about 20 second-feet take out above the station. Several small pumping plants which supply water for irrigating the bottom land along the river valley also operate above the station. Below the station the Matheson and Cook canals divert water for irrigating land in Milk River valley near the mouth of North Fork. The aggregate appropriation of these canals is 78 second-feet.

The results at this station may be considered reliable as a fair rating curve has been obtained. Ice during the winter months makes gage readings impracticable. A chain gage is located on the left bank near the house of the observer. The datum of the gage has remained the same since the station was established in 1905. Measurements may be made by wading or at the cable near the gage.

The greater part of the run-off occurs during floods caused by heavy rains in the spring and early summer. The stream often goes dry in the fall.

Discharge measurements of North Fork of Milk River near Chinook, Mont., in 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Apr. 30	W. A. Lamb	56	57	1.11	57
May 22	do	55	79	1.56	102
June 10[a]	do	28	34	.95	36
25	do	62	352	4.50	1,000
July 3	do	53	123	1.70	157
24[a]	do	24	30	.75	38
Aug. 21[a]	do	17	7.9	.25	6.8
Sept. 72[b]	do	6	1.6	.11	1.3

[a] Made by wading above gage. [b] Made by wading at gage.

Daily gage height, in feet, of North Fork of Milk River near Chinook, Mont., for 1909.

[Mrs. R. B. Snedecor, observer.]

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	1.2	1.35	1.4	2.6	0.8	0.1	0.15	0.4	0.6
2	.....	1.35	1.3	1.35	2.0	.7	.1	.2	.4	.6
3	.....	1.4	1.15	1.3	1.55	.7	.1	.3	.4	.6
4	.....	1.3	1.3	1.3	1.3	.65	.1	.3	.4	.6
5	.....	1.35	1.5	1.2	3.0	.6	.1	.25	.4	.6
6	.....	.95	1.1	1.1	6.5	.65	.1	.25	.4	.6
7	.....	1.3	2.05	1.0	5.6	.65	.1	.25	.4	.6
8	.....	1.2	3.2	1.05	3.9	.6	.1	.25	.4	.6
9	.....	.9	2.25	1.05	2.15	.5	.1	.3	.4	.6
10	.....	1.1	1.8	.95	3.15	.5	.1	.3	.45	.6
11	.....	1.6	1.65	.95	3.0	.5	.1	.3	.5	.6
12	.....	1.3	1.6	.9	2.9	.5	.1	.25	.55	.....
13	.....	1.2	1.45	.8	2.25	.5	.1	.25	.65	.....
14	.....	1.35	1.4	.8	1.6	.5	.1	.25	.7	.....
15	.....	1.3	1.4	.8	1.45	.45	.1	.25	.7	.....
16	.....	1.2	1.4	.85	1.6	.45	.1	.3	.7	.....
17	.....	1.0	1.5	.9	1.1	.45	.1	.3	.7	.....
18	.....	.95	1.55	.9	1.0	.45	.1	.3	.7	.....
19	.....	.9	1.4	.8	1.0	.45	.1	.3	.65	.....
20	.....	1.05	1.35	4.6	1.0	.45	.1	.3	.65	.....
21	.....	1.0	2.3	11.25	1.0	.25	.1	.35	.65	.....
22	.....	1.0	2.4	6.7	1.0	.25	.1	.35	.65	.....
23	1.0	1.1	5.35	4.5	.95	.25	.1	.35	.65	.....
24	1.0	1.0	3.95	3.95	.8	.2	.1	.4	.65	.....
25	1.0	1.0	2.5	4.45	.75	.2	.1	.4	.65	.....
26	1.05	1.1	2.2	3.4	.7	.2	.1	.4	.65	.....
27	1.2	1.35	1.95	3.15	.9	.1	.1	.4	.65	.....
28	1.25	1.25	1.85	2.6	2.75	.1	.1	.4	.65	.....
29	1.0	1.2	1.8	2.2	1.65	.1	.1	.4	.6	.....
30	.8	1.15	1.55	2.2	1.25	.1	.15	.4	.6	.....
31	.8	.....	1.4	.....	1.05	.1	.....	.....	.....	.....

NOTE.—Ice conditions from Jan. 1 to Mar. 22 and after Nov. 13.

Daily discharge, in second-feet, of North Fork of Milk River near Chinook, Mont., for 1909.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	.....	62	81	88	372	38	1.2	2.1	12.0
2	.....	81	74	81	219	30	1.2	3.0	12.0
3	.....	88	56	74	132	30	1.2	7.0	12.0
4	.....	74	74	74	93	26	1.2	7.0	12.0
5	.....	81	103	62	492	23	1.2	5.0	12.0
6	.....	36	51	51	1,770	26	1.2	5.0	12.0
7	.....	74	205	40	1,430	26	1.2	5.0	12.0
8	.....	62	528	46	800	23	1.2	5.0	12.0
9	.....	32	251	46	254	17.0	1.2	7.0	12.0
10	.....	51	154	36	540	17.0	1.2	7.0	14.5
11	.....	119	128	36	492	17.0	1.2	7.0	17.0
12	.....	74	119	32	461	17.0	1.2	5.0	20.0
13	.....	62	96	24	278	17.0	1.2	5.0	.....
14	.....	81	88	24	140	17.0	1.2	5.0	.....
15	.....	74	88	24	115	14.5	1.2	5.0	.....
16	.....	62	88	28	140	14.5	1.2	7.0	.....
17	.....	40	103	32	68	14.5	1.2	7.0	.....
18	.....	36	111	32	57	14.5	1.2	7.0	.....
19	.....	32	88	24	57	14.5	1.2	7.0	.....
20	.....	46	81	1,030	57	14.5	1.2	7.0	.....
21	.....	40	263	3,570	57	5.0	1.2	9.5	.....
22	.....	40	288	1,840	57	5.0	1.2	9.5	.....
23	40	51	1,320	1,020	52	5.0	1.2	9.5	.....
24	40	40	798	818	38	3.0	1.2	12.0	.....
25	40	40	314	1,000	34	3.0	1.2	12.0	.....
26	46	51	239	625	30	3.0	1.2	12.0	.....
27	62	81	184	540	47	1.2	1.2	12.0	.....
28	68	68	164	372	416	1.2	1.2	12.0	.....
29	40	62	154	266	149	1.2	1.2	12.0	.....
30	24	56	111	266	86	1.2	2.1	12.0	.....
31	24	.....	88	.....	62	1.2	.....	12.0	.....

NOTE.—These discharges are based on rating curves applicable as follows: Mar. 23 to June 21, well defined below 200 second-feet; June 22 to Nov. 12, well defined below 200 second-feet.

Monthly discharge of North Fork of Milk River near Chinook, Mont., for 1909.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
March 23–31	68	24	42.7	762	B.
April	119	32	59.9	3,560	B.
May	1,320	51	209	12,900	B.
June	3,570	24	407	24,200	B.
July	1,770	30	290	17,800	B.
August	38	1.2	14.2	873	B.
September	2.1	1.2	1.23	73.2	C.
October	12	2.1	7.73	475	C.
November 1–12	20	12	13.3	317	B.
The period				61,000	

BEAVER CREEK NEAR ASHFIELD, MONT.

Beaver Creek rises in the little Rocky Mountains, flows northeastward, and enters Milk River near Hinsdale, Mont.

The gaging station, which was established December 31, 1903, to obtain data for use in connection with irrigation projects in Milk River valley, is located at Craig's ranch, about 18 miles from Malta and 3 miles south of Ashfield, Mont., the nearest post office.

The only diversion is that for the irrigation of land bordering the stream. The water is diverted by small ditches leading from the stream and by small pumping plants near the banks.

The entire run-off from this area does not pass the station. At medium and high stages a second channel, known as Beaver Creek overflow, leaves the stream above the station, follows a depression to the west of the main channel, and reenters at a point some distance below the gage. Records are kept of the flow of this channel.

A staff gage was first established at Bridge No. 455 of the Great Northern Railway, half a mile west of Ashfield, Mont. It was moved to its present location 2½ miles upstream December 31, 1903. Measurements are made from a cable or by wading. The stream carries but little water except at the times of the spring floods or heavy rains. During the summer months the channel is obstructed by a dense growth of weeds and willows, which have to be cleared out occasionally, thus making it a difficult matter to procure a permanent rating. The results therefore are only fair.

Discharge measurements of Beaver Creek near Ashfield, Mont., in 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Apr. 22 [a]	W. A. Lamb	9	2.8	0.14	3.0
June 19	do	44	99	3.40	107
20	do	42	132	4.25	159
July 1	do	40	118	4.00	151
23 [b]	do	19	20	.60	15
Aug. 23 [c]	do			−.30	.1

[a] Made by wading at gage. [b] Made by wading near gage. [c] Estimated.

Daily gage height, in feet, of Beaver Creek near Ashfield, Mont., for 1909.

[Mrs. W. P. Craig, observer.]

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Day.	Mar.	Apr.	May.	June.	July.	Aug.
1	.....	0.05	0.1	1.4	4.1	1.6	16	2.95	.15	.....	5.5	1.6	0.3
2	.....	.15	.1	1.3	3.5	1.7	17	2.75	.15	.....	4.5	1.5	.15
3	.....	.15	.1	1.3	3.5	1.8	18	2.55	.15	.....	4.1	1.5	.05
4	.....	.15	.1	1.3	3.5	1.6	19	2.35	.15	.....	4.1	1.4	0
5	.....	.15	.1	1.3	3.5	1.4	20	2.25	.15	.1	4.3	1.2	0
6	.....	.15	.1	1.2	3.4	.7	21	5.55	.15	.4	5.1	1.1	.....
7	1.7	.15	.1	1.1	3.35	.6	22	6.65	.15	.5	5.25	1.0	.....
8	5.35	.15	.1	1.1	3.15	.5	23	7.75	.1	.9	5.4	.8	.....
9	5.15	.15	.....	1.1	2.1	.3	24	6.85	.1	1.9	5.85	.6	.....
10	4.75	.15	.....	1.1	2.0	.2	25	5.35	.1	1.9	8.2	.5	.....
11	4.65	.15	.....	1.1	2.0	.2	26	2.75	.1	1.8	9.2	.5	.....
12	4.05	.15	.....	1.1	2.0	.2	27	2.05	.1	1.7	8.45	.5	.....
13	3.75	.15	.....	2.3	2.0	.3	28	2.05	.1	1.6	8.0	.5	.....
14	3.65	.15	.....	5.6	1.8	.3	29	1.55	.1	1.6	7.3	.7	.....
15	3.55	.15	.....	5.6	1.75	.3	30	.95	.1	1.5	6.1	.95	.....
							31	.25	.....	1.5	.....	1.5	.....

Daily discharge, in second-feet, of Beaver Creek near Ashfield, Mont., for 1909.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Day.	Mar.	Apr.	May.	June.	July.	Aug.
1	.....	3.5	4.0	35	151	41	16	90	5.0	4.0	240	41	8.0
2	.....	5.0	4.0	32	116	44	17	82	5.0	4.0	175	38	5.0
3	.....	5.0	4.0	32	116	47	18	74	5.0	4.0	151	38	3.5
4	.....	5.0	4.0	32	116	41	19	66	5.0	4.0	151	35	3.0
5	.....	5.0	4.0	32	116	35	20	62	5.0	4.0	163	29	3.0
6	.....	5.0	4.0	29	111	16	21	244	5.0	10	212	26	.....
7	44	5.0	4.0	26	108	14	22	326	5.0	12	222	23	.....
8	230	5.0	4.0	26	98	12	23	445	4.0	20	233	18	.....
9	250	5.0	4.0	26	56	8.0	24	342	4.0	50	264	14	.....
10	190	5.0	4.0	26	53	6.0	25	230	4.0	50	516	12	.....
11	184	5.0	4.0	26	53	6.0	26	82	4.0	47	755	12	.....
12	148	5.0	4.0	26	53	6.0	27	54	4.0	44	565	12	.....
13	130	5.0	4.0	64	53	8.0	28	54	4.0	41	482	12	.....
14	124	5.0	4.0	247	47	8.0	29	40	4.0	41	385	16	.....
15	118	5.0	4.0	247	46	8.0	30	22	4.0	38	282	22	.....
							31	7	.....	38	.....	38	.....

NOTE.—These discharges were obtained from a rating curve that is fairly well defined. No flow Aug. 21–Dec. 31.

Monthly discharge of Beaver Creek near Ashfield, Mont., for 1909.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
March 7–31	445	7	146	7,240	A.
April	5	3.5	4.68	278	C.
May	50	4	14.9	916	B.
June	755	26	190	11,300	A.
July	151	12	54.2	3,330	A.
August	47	0	10.4	640	B.
September	0	0	0	0	
October	0	0	0	0	
November	0	0	0	0	
December	0	0	0	0	
The period	.....	.....	.....	23,700	

BEAVER CREEK OVERFLOW NEAR BOWDOIN, MONT.

This station which was established June 29, 1903, discontinued August 30, 1906, and reestablished May 2, 1908, is located at John Turmell's ranch, 14 miles from Malta, Mont.

The flow of this channel must be added to that of the Beaver Creek station to get the total flow from the drainage area. The channel was practically without flow during the season of 1909 as the water was standing in pools.

The datum of the staff gage has remained unchanged. Flood measurements are made at a bridge half a mile below the gage. Low-water measurements are made near the gage by wading.

Discharge measurements of Beaver Creek overflow near Bowdoin, Mont., in 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
June 20[a]	W. A. Lamb	70	236	6.50	168
July 1[b]	.....do	34	59	5.30	46

[a] Made from bridge. [b] Made by wading.

Daily gage height, in feet, of Beaver Creek overflow near Bowdoin, Mont., for 1909.

[John Turmell, observer.]

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	.....	3.9	2.6	2.1	5.5	3.0	2.2	16	7.25	2.8	2.4	6.5	4.0	2.5	.....
2	.....	3.8	2.6	2.1	5.0	3.0	2.2	17	6.0	2.8	2.4	6.25	3.8	2.5	.....
3	.....	3.8	2.6	2.1	5.4	2.9	2.1	18	5.8	2.8	2.4	5.25	3.6	2.5	.....
4	.....	3.7	2.6	2.1	5.5	2.9	2.1	19	5.6	2.8	2.4	4.9	3.4	2.4	.....
5	.....	3.6	2.5	2.0	5.3	2.8	2.1	20	5.0	2.8	2.4	5.25	3.4	2.4	.....
6	.....	3.5	2.5	2.0	5.1	2.8	2.1	21	4.5	2.8	2.4	6.35	3.4	2.4	.....
7	.....	3.3	2.5	2.0	5.0	2.7	2.1	22	4.95	2.8	2.3	6.3	3.3	2.4	.....
8	.....	3.2	2.5	2.0	5.0	2.7	2.0	23	7.3	2.8	2.3	6.15	3.2	2.4	.....
9	.....	3.0	2.5	2.0	4.7	2.7	2.0	24	7.55	2.8	2.3	7.95	3.2	2.3	.....
10	.....	2.9	2.4	2.0	4.6	2.6	2.0	25	6.85	2.7	2.3	8.9	3.2	2.3	.....
11	.....	2.9	2.4	1.9	4.5	2.6	.....	26	6.25	2.7	2.3	8.9	3.2	2.3	.....
12	.....	2.9	2.4	1.9	4.4	2.6	.....	27	6.0	2.7	2.3	7.75	3.1	2.3	.....
13	.....	2.9	2.4	3.95	4.3	2.6	.....	28	5.5	2.7	2.2	6.5	3.1	2.2	.....
14	4.5	2.9	2.4	6.6	4.2	2.5	.....	29	4.5	2.7	2.2	6.3	3.1	2.2	.....
15	6.6	2.9	2.4	6.75	4.1	2.5	.....	30	4.2	2.7	2.2	5.8	3.1	2.2	.....
								31	4.0	.....	2.1	.....	3.0	2.2	.....

NOTE.—Water standing in pools April 1 to June 12 and July 17 to September 10.

Daily discharge, in second-feet, of Beaver Creek overflow near Bowdoin, Mont., for 1909.

Day.	Mar.	Apr.	May.	June.	July.	Aug	Sept.	Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	.....	0.2	0	0	57	0	0	16	253	0	0	145	1.0	0	.....
2	.....	0	0	0	27	0	0	17	96	0	0	119	0	0	.....
3	.....	0	0	0	50	0	0	18	79	0	0	41	0	0	.....
4	.....	0	0	0	57	0	0	19	64	0	0	21.9	0	0	.....
5	.....	0	0	0	44	0	0	20	27	0	0	41	0	0	.....
6	.....	0	0	0	32	0	0	21	9.0	0	0	129	0	0	.....
7	.....	0	0	0	27	0	0	22	24.3	0	0	124	0	0	.....
8	.....	0	0	0	27	0	0	23	262	0	0	110	0	0	.....
9	.....	0	0	0	14.1	0	0	24	315	0	0	424	0	0	.....
10	.....	0	0	0	11.3	0	0	25	189	0	0	956	0	0	.....
11	.....	0	0	0	9.0	0	.....	26	119	0	0	956	0	0	.....
12	.....	0	0	0	7.0	0	.....	27	96	0	0	364	0	0	.....
13	.....	0	0	.6	5.2	0	.....	28	57	0	0	145	0	0	.....
14	9.0	0	0	157	3.6	0	.....	29	9.0	0	0	124	0	0	.....
15	157	0	0	176	2.2	0	.....	30	3.6	0	0	79	0	0	.....
								31	1.0	.....	0	.....	0	0	.....

NOTE.—These discharges were obtained from a rating curve that is fairly well defined below 200 second-feet.

Monthly discharge of Beaver Creek overflow near Bowdoin, Mont., for 1909.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
March 14–31	315	1.0	98.3	3,510	B.
April	.2	0	0	0	
May	0	0	0	0	
June	956	0	137	8,150	B.
July	57	0	12.1	744	C.
August	0	0	0	0	

PORCUPINE CREEK AT NASHUA, MONT.

Porcupine Creek rises in the northern part of Valley County, Mont., flows southward, forming the west boundary of the Fort Peck Indian Reservation, and enters Milk River at Nashua, a point about 5 miles from the junction of Milk River with the Missouri.

The drainage area comprises a strip of rolling prairie about 40 miles long and extending but a short distance back from the narrow valley formed by the stream. Forestation is lacking, except a growth of willows and cottonwoods along the banks of the stream.

The greater part of the run-off comes from the melting snow in the early spring and from heavy rains during the summer. In the late summer and winter the stream is dry. The annual rainfall is about 13 inches. The water of this stream is neither diverted nor stored.

The only gaging station is at the road crossing at Nashua. It was established July 11, 1908, to obtain data for an irrigation project under construction by the United States Reclamation Service for the Fort Peck Indians.

Measurements are made by wading near the staff gage, which is nailed securely to a tree on the right bank of the stream at the road crossing.

Discharge measurements of Porcupine Creek at Nashua, Mont., in 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
May 8[a]	W. A. Lamb	24	9.0	2.10	6.9
June 23[a]	do	5	1.4	1.85	1.0
July 15[b]	do	38	152	5.85	173
16[a]	do	42	107	4.98	110
21[a]	do	28	20	2.70	27

[a] Made by wading at the ford. [b] Made from a raft.

Daily gage height, in feet, of Porcupine Creek at Nashua, Mont., for 1909.

[Mollie E. Martin, observer.]

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Day.	Apr.	May.	June.	July.	Aug.	Sept.
1	.....	2.7	2.0	2.0	2.1	0.9	16	.....	2.1	1.9	4.9	1.8	.....
2	.....	2.7	2.0	1.9	2.1	.9	17	.....	2.1	1.9	3.1	1.7	.....
3	.....	2.6	2.0	1.9	2.1	.8	18	.....	2.2	1.9	3.0	1.6	.....
4	.....	2.5	2.0	1.9	2.1	.8	19	.....	2.1	1.9	3.0	1.4	.....
5	.....	2.3	2.0	1.9	2.0	.....	20	.....	2.0	1.9	3.1	1.2	.....
6	.....	2.1	2.0	1.9	2.0	.....	21	.....	2.0	2.1	2.5	1.1	.....
7	.....	2.1	2.0	3.1	2.0	.....	22	.....	2.0	2.1	2.4	1.1	.....
8	.....	2.1	2.0	4.0	2.0	.....	23	.....	2.0	2.1	2.4	1.1	.....
9	.....	2.1	2.0	4.1	2.0	.....	24	.....	2.7	2.0	2.1	2.4	1.1	.....
10	.....	2.1	2.0	3.9	1.9	.....	25	.....	2.5	2.0	2.0	2.2	1.0	.....
11	.....	2.1	2.0	3.9	1.8	.....	26	.....	2.6	2.0	2.0	2.1	1.0	.....
12	.....	2.1	2.0	5.1	1.8	.....	27	.....	2.6	2.0	2.0	2.1	1.0	.....
13	.....	2.1	2.0	5.1	1.8	.....	28	.....	2.7	2.0	2.0	2.1	1.0	.....
14	.....	2.1	1.9	9.15	1.8	.....	29	.....	2.8	2.0	2.0	2.1	1.0	.....
15	.....	2.1	1.9	7.05	1.8	.....	30	.....	2.9	2.0	2.0	2.1	1.0	.....
							31	.....	.....	2.0	.....	2.1	1.0	.....

Daily discharge, in second-feet, of Porcupine Creek at Nashua, Mont., for 1909.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Day.	Apr.	May.	June.	July.	Aug.	Sept.
1	.....	25	4.2	4.2	7.0	0	16	.....	7.0	2.8	112	0.6	.....
2	.....	25	4.2	2.8	7.0	0	17	.....	7.0	2.8	38	.1	.....
3	.....	22.0	4.2	2.8	7.0	0	18	.....	10.0	2.8	34	0	.....
4	.....	19.0	4.2	2.8	7.0	0	19	.....	7.0	2.8	34	0	.....
5	.....	13.0	4.2	2.8	4.2	.....	20	.....	4.2	2.8	38	0	.....
6	.....	7.0	4.2	2.8	4.2	.....	21	.....	4.2	7.0	19.0	0	.....
7	.....	7.0	4.2	38	4.2	.....	22	.....	4.2	7.0	16.0	0	.....
8	.....	7.0	4.2	72	4.2	.....	23	.....	4.2	7.0	16.0	0	.....
9	.....	7.0	4.2	76	4.2	.....	24	25	4.2	7.0	16.0	0	.....
10	.....	7.0	4.2	68	2.8	.....	25	19.0	4.2	4.2	10.0	0	.....
11	.....	7.0	4.2	68	.6	.....	26	22.0	4.2	4.2	7.0	0	.....
12	.....	7.0	4.2	122	.6	.....	27	22.0	4.2	4.2	7.0	0	.....
13	.....	7.0	4.2	122	.6	.....	28	25	4.2	4.2	7.0	0	.....
14	.....	7.0	2.8	408	.6	.....	29	28	4.2	4.2	7.0	0	.....
15	.....	7.0	2.8	244	.6	.....	30	31	4.2	4.2	7.0	0	.....
							31	.....	4.2	.....	7.0	0	.....

NOTE.—These discharges were obtained from a rating curve that is fairly well defined below 120 second-feet.

Monthly discharge of Porcupine River at Nashua, Mont., for 1909.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
April 24-30	31	19.0	25	342	B.
May	25	4.2	8.2	507	C.
June	7.0	4.2	4.2	253	C.
July	408	2.8	56	3,440	B.
August	7.0	0	1.8	110	C.

PRIVATE CANALS IN MILK RIVER VALLEY.

DESCRIPTION.

Since 1905 a number of stations have been maintained on private canals in Milk River valley for the purpose of ascertaining the extent of private water rights. With the exception of Rock Creek canal, which is near Hinsdale, in Valley County, these canals are located in

Chouteau County and are used to irrigate lands in the vicinity of Harlem and Chinook.

The canals are all built on small grades and in soil which is easily eroded. In many of them silt has been deposited, and nearly all of them contain a growth of weeds and moss. At low stages the water is uniformly sluggish. In order to divert water into the laterals checks are erected in the main canals, and these checks often produce back-water effects for long distances above. They were put up under a great variety of conditions, and as a result velocities are found to differ widely at the same gage height during the season. In order to establish the correct relation between gage height and discharge it is necessary to make several rating curves for the same canal station. Frequent discharge measurements are necessary to obtain reliable results. Staff gages are located on all canals and most measurements are made by wading.

PARADISE VALLEY CANAL NEAR CHINOOK, MONT.

This station, which was established in June, 1903, is located near the head gate at Rudolph Friede's ranch and is reached by driving along the south river road from Chinook.

Discharge measurements of Paradise Valley canal near Chinook, Mont., in 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
May 3	W. A. Lamb	13.8	2.1	1.71	10.2
18	do	15	13.4	1.85	14.2
June 9	do	.....	.....	1.10	0
26	do	6	1.2	1.30	.4
July 14	do	8	2.1	1.45	1.1
Aug. 1	do	16	15.6	2.30	13.8
20	.....	.....	.....	.....	0

Daily gage height, in feet, of Paradise Valley canal near Chinook, Mont., for 1909.

[Rudolph Friede, observer.]

Day.	Apr.	May.	June.	July.	Aug.	Day.	Apr.	May.	June.	July.	Aug.
1	.....	1.70	1.43	1.30	2.25	16	.....	1.44	1.84	1.10	.....
2	.....	1.63	1.48	1.46	1.70	17	.....	1.30	1.70	.....	.....
3	.....	1.60	1.10	1.60	2.08	18	.....	1.93	1.74	.....	.....
4	.....	1.58	.....	1.50	2.00	19	.....	1.80	2.10	1.70	.....
5	.....	1.37	.....	1.40	1.92	20	.....	1.73	2.40	1.43	.....
6	.....	1.74	.....	2.01	1.50	21	.....	1.82	1.49	1.39	.....
7	.....	1.12	.....	1.32	1.50	22	.....	1.86	1.40	1.75	.....
8	.....	1.86	.....	1.37	1.28	23	.....	1.89	1.35	2.19	.....
9	.....	1.80	.....	1.78	1.24	24	.....	1.84	1.32	2.10	.....
10	.....	1.79	1.88	1.65	.....	25	.....	1.30	1.32	2.03	.....
11	.....	1.70	1.90	1.88	.....	26	.....	1.25	1.32	2.15	.....
12	.....	1.58	1.87	1.66	.....	27	.....	1.22	1.31	2.15	.....
13	.....	1.42	2.30	1.41	.....	28	1.10	1.58	1.31	2.55	.....
14	.....	1.43	1.96	1.41	.....	29	1.30	1.74	1.29	1.80	.....
15	.....	1.55	2.08	1.30	.....	30	2.10	1.70	1.28	1.64	.....
						31	.....	1.51	.....	2.05	.....

Daily discharge, in second-feet, of Paradise Valley canal near Chinook, Mont., for 1909.

Day.	Apr.	May.	June.	July.	Aug.	Day.	Apr.	May.	June.	July.	Aug.
1		10.0	4.2	0.2	13.8	16		4.4	12.1	0	
2		8.3	5.1	2.0	1.7	17		2.2	7.6	0	
3		7.6	0	3.9	8.1	18		16.3	9.6	0	
4		7.2	0	2.3	6.4	19		12.6	18.4	3.9	
5		3.2	0	1.1	4.9	20		10.8	28	.3	
6		11.0	0	12.6	.1	21		13.2	3.4	.1	
7		.2	0	.1	.1	22		14.3	1.9	4.1	
8		14.3	0	.6	0	23		15.1	1.3	14.1	
9		12.6	0	7.0		24		13.7	.7	11.2	
10		12.3	14.4	4.1		25		2.2	.5	9.2	
11		10.0	15.0	9.0		26		1.6	.4	11.9	
12		7.2	13.6	4.2		27		1.2	.4	11.5	
13		4.1	27	.7		28	0	7.2	.4	23.2	
14		4.2	16.2	.7		29	2.2	11.0	.3	3.4	
15		6.6	19.4	.2		30	22.0	10.0	.2	1.2	
						31		5.7		8.0	

NOTE.—These discharges are based on rating curves as follows:
Apr. 28 to June 3, fairly well defined.
June 10 to June 26, indirect method for shifting channels.
June 27 to August, curve fairly well defined.

Monthly discharge of Paradise Valley canal near Chinook, Mont., for 1909.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
May	16.3	0.2	8.40	516	C.
June	28	0	6.67	397	C.
July	23.2	0	4.86	299	C.
Aug. 1–7	13.8	.1	5.01	69.6	C.

COOK CANAL NEAR CHINOOK, MONT.

This station, which was established April 10, 1905, is located at a small wooden highway bridge on the road running parallel to the Great Northern Railway, about 3 miles east of Chinook.

Discharge measurements of Cook canal near Chinook, Mont., in 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Apr. 21	W. A. Lamb	12.5	30	2.85	18
May 3	do	13	32	3.03	20
18	do	12	32	3.20	20
June 9	do	13	38	3.33	18
26	do	7	3.0	1.70	1.9
July 14	do	7	3.4	1.80	1.8
Aug. 1	do			1.20	0
20	do	9	4.6	2.00	3.7

Daily gage height, in feet, of Cook canal near Chinook, Mont., for 1909.

[Herbert Reynolds, observer.]

Day.	Apr.	May.	June.	July.	Aug.	Day.	Apr.	May.	June.	July.	Aug.
1		3.0	1.4	2.2	2.2	16		3.3	3.0	1.6	1.5
2		2.9	2.5	1.9	1.7	17		3.3	3.1	1.5	1.4
3		3.0	3.3	1.7	1.4	18	2.9	3.3	2.9	1.3	1.5
4		3.1	3.3	1.7	1.4	19	2.7	3.1	3.1	1.3	1.6
5		2.9	3.2	1.7	1.3	20	2.9	3.0	3.0	1.3	2.3
6		2.9	3.2	2.7	1.2	21	2.9	3.5	3.1	1.3	2.1
7		3.4	3.3	2.3	1.2	22	2.7	3.3	3.0	1.3	2.2
8		3.5	3.4	2.0	1.1	23	2.8	3.5	2.5	1.2	2.0
9		3.0	3.3	2.3	1.0	24	2.8	2.8	2.3	1.4	1.8
10		2.7	3.2	1.9	1.0	25	2.9	2.3	2.4	1.5	1.8
11		3.4	3.3	1.8	1.2	26	2.9	2.0	1.7	1.9	1.9
12		3.3	3.2	1.5	1.3	27	3.0	1.9	1.6	2.1	2.0
13		3.3	2.9	1.3	1.4	28	2.9	2.3	1.6	2.1	2.1
14		3.2	2.8	1.2	1.3	29	2.9	1.9	1.5	2.2	2.0
15		3.2	2.6	1.9	1.4	30	3.0	1.8	1.5	2.3	2.5
						31		1.5		2.3	2.6

Daily discharge, in second-feet, of Cook canal near Chinook, Mont., for 1909.

Day.	Apr.	May.	June.	July.	Aug.	Day.	Apr.	May.	June.	July.	Aug.
1		19.6	2.0	5.0	5.0	16		21.2	13.4	1.2	0.8
2		18.3	7.8	2.8	1.7	17		21.2	14.7	.8	.4
3		19.6	17.5	1.7	.4	18	18.3	21.2	12.2	0	.8
4		21.0	17.5	1.7	.4	19	15.7	18.6	14.7	0	1.2
5		18.3	16.1	1.7	0	20	18.3	17.3	13.4	0	5.9
6		18.3	16.1	9.9	0	21	18.3	23.8	14.7	0	4.2
7		22.5	17.5	5.9	0	22	15.7	21.2	13.4	0	5.0
8		23.8	18.9	3.5	0	23	17.0	23.8	7.8	0	3.5
9		17.3	17.5	5.9	0	24	17.0	14.7	5.9	.4	2.2
10		13.5	16.1	2.8	0	25	18.3	8.8	6.8	.8	2.2
11		22.5	17.5	2.2	0	26	18.3	6.0	1.7	2.8	2.8
12		21.2	16.1	.8	0	27	19.6	5.2	1.2	4.2	3.5
13		21.2	12.2	0	.4	28	18.3	8.8	1.2	4.2	4.2
14		19.9	11.0	0	0	29	18.3	5.2	.8	5.0	3.5
15		19.9	8.8	2.8	.4	30	19.6	4.4	.8	5.9	7.8
						31		2.5		5.9	8.8

NOTE.—These discharges are based on three rating curves, fairly well defined, applicable from Apr. 18 to May 6, May 7 to June 1, June 2 to Aug. 31, respectively.

Monthly discharge of Cook canal near Chinook, Mont., for 1909.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
April 18–30	19.6	15.7	17.9	462	D.
May	23.8	2.5	16.8	1,030	D.
June	18.9	.8	11.2	666	D.
July	9.9	0	2.51	154	D.
August	8.8	0	2.10	129	D.

MATHESON CANAL NEAR CHINOOK, MONT.

This station, which was established April 10, 1905, is located at a footbridge 200 feet below the head gate near the main road, 3½ miles east of Chinook.

Discharge measurements of Matheson canal near Chinook, Mont., in 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Apr. 21	W. A. Lamb	8	6.8	2.25	6.6
May 3	do	8	6.1	2.20	6.2
18	do	8	8.6	2.45	7.0
June 9	do	8	9.4	2.55	5.8
26	do	6	4.8	2.30	2.0
July 14	do	2	.8	2.10	.3
Aug. 1	do	3	1.7	2.30	1.2

Daily gage height, in feet, of Matheson canal near Chinook, Mont., for 1909.

[Herbert Reynolds, observer.]

Day.	Apr.	May.	June.	July.	Aug.	Day.	Apr.	May.	June.	July.	Aug.
1	.....	2.5	2.3	2.2	2.3	16	2.3	2.4	2.0	2.6	1.4
2	2.2	2.6	2.3	2.1	2.0	17	2.0	2.4	2.5	2.5	1.3
3	2.8	2.4	3.1	2.0	1.9	18	2.3	2.4	2.6	2.5	1.3
4	2.4	2.5	2.8	2.0	1.9	19	2.2	2.4	2.7	2.7	1.3
5	2.4	2.4	2.8	2.1	1.8	20	2.2	2.4	3.0	2.5	1.3
6	2.4	2.3	2.8	2.7	1.9	21	2.3	2.7	3.5	2.4	1.5
7	2.3	3.0	2.3	2.3	1.9	22	2.7	2.3	2.6	2.4	1.4
8	2.3	3.0	2.6	2.1	1.8	23	2.8	3.0	2.4	2.3	1.4
9	2.0	2.8	2.6	2.2	1.8	24	2.9	2.7	2.4	2.0	1.3
10	1.9	2.7	2.5	2.4	1.8	25	2.4	2.5	2.4	2.0	1.3
11	1.9	3.0	2.5	2.3	1.8	26	2.4	2.4	2.9	2.1	1.4
12	1.9	2.7	2.5	1.9	1.7	27	2.5	2.4	2.3	2.5	1.4
13	1.8	2.4	2.5	1.8	1.6	28	2.5	2.5	2.3	3.3	1.5
14	1.8	2.4	2.3	2.1	1.6	29	2.5	2.6	2.2	3.0	1.6
15	1.7	2.3	2.0	2.4	1.5	30	2.3	2.5	2.1	2.6	1.3
						31	.....	2.4	.....	2.5	1.3

Daily discharge, in second-feet, of Matheson canal near Chinook, Mont., for 1909.

Day.	Apr.	May.	June.	July.	Aug.	Day.	Apr.	May.	June.	July.	Aug.
1	.....	8.8	4.6	1.2	1.2	16	7.0	6.8	.9	3.5	.....
2	6.2	9.7	4.5	.6	.....	17	4.6	6.7	4.5	2.6	.....
3	11.5	7.9	11.3	0	.....	18	7.0	6.7	5.2	2.6	.....
4	7.9	8.7	8.5	0	.....	19	6.2	6.6	5.9	4.1	.....
5	7.9	7.7	8.5	.6	.....	20	6.2	6.5	8.4	2.6	.....
6	7.9	6.7	8.5	4.5	.....	21	7.0	8.8	13.1	1.9	.....
7	7.0	13.0	4.0	1.7	.....	22	10.6	5.2	4.8	1.9	.....
8	7.0	12.8	6.4	.3	.....	23	11.5	9.6	3.1	1.2	.....
9	4.6	10.8	5.8	.9	.....	24	12.5	8.7	3.0	0	.....
10	4.0	9.9	5.2	2.1	.....	25	7.9	6.9	3.0	0	.....
11	4.0	12.7	5.2	1.4	.....	26	7.9	5.8	7.0	0	.....
12	4.0	9.8	5.0	0	.....	27	8.8	5.8	2.0	2.6	.....
13	3.4	7.0	4.9	0	.....	28	8.8	6.6	2.0	9.4	.....
14	3.4	7.0	3.3	.3	.....	29	8.8	7.5	1.3	6.7	.....
15	2.9	6.1	.9	1.9	.....	30	7.0	6.2	.3	3.4	.....
						31	.....	5.4	.....	2.6	.....

NOTE.—These discharges are based on rating curves applicable as follows:
Apr. 2 to May 3, poorly defined.
May 4 to Aug. 31, indirect method for shifting channels.

Monthly discharge of Matheson canal near Chinook, Mont., for 1909.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
Apr. 2-30	12.5	2.9	7.02	404	C.
May	13.0	5.2	8.01	493	C.
June	13.1	.3	5.04	300	C.
July	9.4	0	1.95	120	D.
August	1.2	0	.04	2.5	D.

HARLEM CANAL NEAR ZURICH, MONT.

This station, which was established in June, 1903, is located about 500 feet below the head gates of the canal, 1½ miles southeast of the Great Northern Railway section house at Zurich. It is reached by driving from Chinook.

The canal was not in use in 1907, as the headworks were out of order.

Discharge measurements of Harlem canal near Zurich, Mont., in 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Apr. 21	Stewart and Lamb	24	53	3.13	70
May 3	W. A. Lamb	24	57	3.25	77
18	do	26	56	3.20	74
June 9	do	19	27	1.85	32
26	do	.....	.....	.20	0
Aug. 1	do	10	10	1.10	8.9
20	do	.....	.....	.40	.5

Daily gage height, in feet, of Harlem canal near Zurich, Mont., for 1909.

[Joel Lean, observer.]

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Day.	Mar.	Apr.	May.	June.	July.	Aug.
1	.....	3.4	3.3	.....	.....	1.1	16	.....	3.1	3.0	2.2	1.5	.....
2	.....	3.5	3.3	2.5	.....	1.0	17	.....	3.0	2.9	2.2	1.2	.....
3	.....	3.5	3.2	2.5	.....	1.0	18	.....	3.1	3.0	2.9	1.0	.....
4	.....	3.4	3.2	2.6	.....	.....	19	.....	3.1	3.1	2.9	1.0	.....
5	.....	3.0	3.0	2.5	.....	.....	20	.....	3.1	3.2	3.0	1.1	.....
6	.....	2.9	2.2	2.5	2.9	.....	21	.....	3.2	3.2	2.9	1.0	.....
7	.....	2.9	2.0	2.0	2.9	.....	22	.....	3.2	3.0	.....	1.0	.....
8	.....	2.9	3.2	2.0	2.8	.....	23	.....	3.2	3.2	.....	1.2	.....
9	.....	3.0	3.3	1.9	2.6	.....	24	.....	3.1	3.1	.....	1.2	.....
10	.....	3.0	3.2	1.9	2.2	.....	25	.....	3.2	.....	.....	1.2	.....
11	.....	2.9	3.2	1.8	2.0	.....	26	.....	3.2	.....	.....	1.1	.....
12	.....	2.9	3.1	1.9	1.8	.....	27	.....	3.3	.....	.....	1.2	.....
13	.....	2.7	3.0	2.1	2.0	.....	28	2.0	3.3	.....	.....	2.2	.....
14	.....	2.7	2.8	2.3	1.8	.....	29	2.4	3.3	.....	.....	2.0	.....
15	.....	3.0	3.0	2.3	1.6	.....	30	2.7	3.4	.....	.....	1.3	.....
							31	3.1	.....	.....	.....	1.2	.....

Daily discharge, in second-feet, of Harlem canal near Zurich, Mont., for 1909.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Day.	Mar.	Apr.	May.	June.	July.	Aug.
1	.....	81	77	0	0	9.0	16	.....	71	68	42	17.5	.....
2	.....	84	77	51	0	7.2	17	.....	68	64	42	10.9	.....
3	.....	84	74	51	0	7.2	18	.....	71	68	64	7.2	.....
4	.....	81	74	54	0	.....	19	.....	71	71	64	7.2	.....
5	.....	68	68	51	0	.....	20	.....	71	74	68	9.0	.....
6	.....	64	42	51	59	.....	21	.....	74	74	64	72	.....
7	.....	64	36	36	59	.....	22	.....	74	68	0	72	.....
8	.....	64	74	36	55	.....	23	.....	74	74	0	10.9	.....
9	.....	68	77	33	49	.....	24	.....	71	71	0	10.9	.....
10	.....	68	74	33	37	.....	25	.....	74	0	0	10.9	.....
11	.....	64	74	30	31	.....	26	.....	74	0	0	9.0	.....
12	.....	64	71	33	26	.....	27	.....	77	0	0	10.9	.....
13	.....	58	68	39	31	.....	28	36	77	0	0	37	.....
14	.....	58	61	45	26	.....	29	48	77	0	0	31	.....
15	.....	68	68	45	20	.....	30	58	81	0	0	12.9	.....
							31	71	.....	0	.....	10.9	.....

NOTE.—These discharges are based on rating curves applicable as follows:
Mar. 28 to June 21, fairly well defined between 22 and 84 second-feet.
July 6 to Aug. 3, fairly well defined between 7.2 and 31 second-feet.

Monthly discharge of Harlem canal near Zurich, Mont., for 1909.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
April	84	58	71.4	4,250	B.
May	77	0	53.1	3,260	B.
June	68	0	31.1	1,850	B.
July	59	0	19.5	1,200	B.

AGENCY DITCH NEAR HARLEM, MONT.

This station, which was established July 14, 1905, is located at the highway bridge, about one-fourth mile below the head gate. It is reached by driving south from Harlem, Mont.

The head gates were opened for the season April 21, 1908, but were closed again for repairs from May 4 to 17, and also June 13 to July 6. The ditch was emptied August 1, 1908, and later a small flow was admitted to furnish water for the steam plow, but not for irrigation.

The following discharge measurement was made by W. A. Lamb:

June 28, 1909: Width, 14.5 feet; area, 12 square feet; gage height, 2.83 feet; discharge, 11 second-feet.

Daily gage height, in feet, of Agency ditch near Harlem, Mont., for 1909.

[Carl A. Grant, observer.]

Day.	June.	July.	Day.	June.	July.	Day.	June.	July.
1	.....	.....	11	4.9	2.85	21	.....	2.9
2	.....	.....	12	5.0	2.8	22	.....	2.85
3	.....	.....	13	5.1	2.75	23	.....	2.8
4	.....	2.7	14	5.45	2.8	24	.....	2.85
5	.....	2.8	15	5.3	2.85	25	.....	.....
6	5.25	2.9	16	5.2	2.8	26	.....	.....
7	5.35	2.8	17	5.3	2.85	27	.....	.....
8	5.0	2.75	18	4.85	2.8	28	.....	.....
9	4.9	2.9	19	4.7	2.85	29	.....	.....
10	5.0	2.8	20	5.3	2.75	30	.....	.....
						31	.....	.....

FORT BELKNAP CANAL NEAR CHINOOK, MONT.

This station, which was established June 21, 1903, is located at the highway bridge, about 500 feet below the head gates of the canal, 8 miles east of Chinook.

The high water of June, 1908, washed out both the bridge and the gage. A new gage was installed on June 27, 1908, at a different datum, within a few feet of the site of the old gage.

A new bridge was built about one-fourth mile upstream from the site of the old one. Measurements can be made from this bridge only when the canal is running full. Wading measurements are made at a section about 300 feet downstream from the gage.

There was flow in the canal on the single days for which gage heights are missing. During a few of the days when the canal was at its highest, owing to the flood in Milk River, the water was wasted, but the greatest part of the time from June 5 to 30 the water was used for irrigation.

The head gates were closed for the season September 22, 1907, September 23, 1908, and November 18, 1909.

Discharge measurements of Fort Belknap canal near Chinook, Mont., in 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Apr. 20	W. A. Lamb	46	93	2.70	67
May 12	do	42	66	2.65	64
22	do	38	50	2.25	43
June 8	do	48	58	2.75	63
30	do	36	34	2.25	38
Aug. 2	do	32	34	2.25	33
20	do	32	32	2.18	29
Sept. 13	do	34	25	2.01	17.2
27	do	30	28	2.15	24
Nov. 18	do				0

Daily gage height, in feet, of Fort Belknap canal near Chinook, Mont., for 1909.

[Bruce Glenn, observer.]

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1		3.0	2.4	2.25	1.7			2.15
2		2.95	2.5	2.3	2.2	2.2		
3		2.8	2.6	2.4	2.2		2.05	2.15
4		2.8	2.7	2.4	2.3			
5		2.8	2.8	2.45	2.4		2.05	2.05
6		2.9	2.8	2.45	2.4	2.2		2.00
7		2.8	2.8	2.4	2.3		2.10	
8		2.8	2.8	2.4	2.3			
9		2.75	2.8	2.45		2.2		
10		2.7	2.8	2.45	2.25			
11	2.8	2.75	2.75	2.4	2.25		2.15	
12	2.8	2.8	2.7	2.4	2.3			
13	2.8	2.8	2.7	2.35		2.0		
14	2.8	2.8	2.7	2.35	2.4		2.15	
15	2.85	2.8	2.75		2.4			
16	2.85	2.9	2.75	2.3	2.35	1.9	2.15	
17	2.9	2.8	2.8	2.3				
18	2.9	2.65	2.8	2.3	2.5		2.20	
19	2.95	2.45	2.9	2.25	2.25	1.85		
20	2.95	2.3	3.0	2.4			2.20	

Daily gage height, in feet, of Fort Belknap canal near Chinook, Mont., for 1909—Contd.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
21	2.95	2.3	.....	2.5	2.2	.....	.....	.....
22	2.9	2.25	.....	2.45	2.2	2.1	.....	.....
23	2.9	2.2	.....	2.45	.....	.....	2.15	.....
24	2.95	2.2	.....	2.4	2.25	2.1	.....	.....
25	2.95	2.4	.....	2.5	.....	.....	2.15	.....
26	3.0	2.35	.....	2.5	2.2	.....	.....	.....
27	3.0	2.3	2.2	2.6	.....	2.05	.....	.....
28	3.0	2.3	2.2	2.6	2.2	.....	2.2	.....
29	2.95	2.3	2.25	.....	.....	.....	.....	.....
30	3.0	2.35	2.25	.....	.....	2.05	2.2	.....
31	.....	2.4	.....	.....	.....	.....	.....	.....

Daily discharge, in second-feet, of Fort Belknap canal near Chinook, Mont., for 1909.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	.....	89	50	38	16	30	20	24
2	.....	85	55	40	30	30	20	24
3	.....	74	61	44	30	30	20	24
4	.....	74	67	44	34	30	20	22
5	.....	74	66	46	38	30	20	20
6	.....	81	66	46	38	30	21	18
7	.....	74	66	44	34	30	22	18
8	.....	74	66	44	34	30	22	18
9	.....	70	66	46	34	30	23	18
10	.....	67	66	46	32	17	24	18
11	74	70	63	44	32	17	24	18
12	74	74	60	44	34	17	24	18
13	74	74	60	42	36	17	24	18
14	74	74	60	42	38	16	24	.....
15	78	74	63	42	38	15	24	.....
16	78	81	63	42	36	14	24	.....
17	81	74	66	42	38	13	25	.....
18	81	64	66	42	43	13	26	.....
19	85	52	73	38	32	12	26	.....
20	85	45	80	44	30	12	26	.....
21	85	45	0	49	30	12	25	.....
22	81	43	0	46	30	22	25	.....
23	81	41	0	46	30	22	24	.....
24	85	41	0	44	32	22	24	.....
25	85	50	0	49	30	21	24	.....
26	89	48	0	49	30	21	25	.....
27	89	45	36	54	30	20	25	.....
28	89	45	36	54	30	20	26	.....
29	85	45	38	0	30	20	26	.....
30	89	48	38	0	30	20	26	.....
31	.....	50	.....	0	30	.....	25	.....

NOTE.—Owing to heavy growth of vegetation in canal five rating curves were necessary to determine season's rating.

Monthly discharge of Fort Belknap canal near Chinook, Mont., for 1909.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
April 11–30	89	74	82.1	3,260	A.
May	89	41	62.8	3,860	A.
June	80	0	47.7	2,840	A.
July	54	.....	40.4	2,480	A.
August	43	16	32.5	2,000	A.
September	30	12	21.1	1,260	B.
October	26	20	23.7	1,460	B.
November 1–13	24	18	19.9	513	B.
The period	.....	.....	.....	17,700	

LITTLE PORCUPINE CREEK DRAINAGE BASIN.

LITTLE PORCUPINE CREEK NEAR FRAZER, MONT.

Little Porcupine Creek rises near the central-western part of the Fort Peck Indian Reservation, flows southward, and enters Missouri River near Frazer, Mont.

The drainage area comprises a strip of land about 25 miles long, extending but a short distance back from the narrow valley bordering the stream. Except for a growth of cottonwoods and willows, the basin is without forestation.

The run-off comes from the melting snow in the spring and from heavy rains during the summer. During the greater part of the year the channel is dry, except for about one-half second-foot of water derived from springs near the mouth of the stream. The annual rainfall is about 13 inches. The stream is not used for diversion.

The only gaging station in this basin is about 2 miles south of Frazer, Mont. A staff gage is located on the stream near the house of the observer. Measurements are made by wading. The station was established July 13, 1908, to obtain data for use in connection with an irrigation project being constructed by the United States Reclamation Service for the Fort Peck Indians.

Discharge measurements of Little Porcupine Creek near Frazer, Mont., in 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
July 17	W. A. Lamb	4	1.8	1.50	3.7
20	do	4	.6	1.45	.6

NOTE.—The following flood estimate was made by Kutter's formula: Gage height, 5.0 feet; discharge, 315 second-feet, only approximate.

Daily gage height, in feet, of Little Porcupine Creek near Frazer, Mont., for 1909.

[T. C. Flynn, observer.]

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.
1	.....	1.3	1.3	1.2	1.2	1.2	1.4	1.4
2	.....	1.3	1.4	1.2	1.3	1.2	1.4	1.4
3	.....	1.6	1.4	1.2	1.3	1.2	1.4	1.4
4	.....	2.3	1.3	1.2	1.3	1.2	1.4	1.4
5	.....	2.3	1.3	1.2	1.3	1.3	1.3	1.4
6	.....	2.2	1.3	1.2	1.3	1.3	1.3	1.4
7	.....	2.0	1.3	1.2	1.3	1.3	1.3	1.4
8	.....	1.7	1.4	1.2	3.0	1.3	1.3	1.4
9	.....	1.7	1.4	1.2	5.0	1.4	1.3	1.4
10	.....	1.7	1.3	1.3	4.0	1.4	1.3	1.4
11	.....	1.5	1.4	1.3	3.1	1.4	1.35	1.4
12	.....	1.5	1.35	1.3	3.0	1.4	1.3	1.4
13	.....	1.4	1.3	1.3	2.7	1.4	1.3	1.4
14	.....	1.3	1.3	1.3	2.0	1.4	1.3	1.4
15	1.2	1.3	1.3	1.2	2.0	1.4	1.3	1.4
16	1.2	1.3	1.3	1.2	1.8	1.4	1.3	1.4
17	1.2	1.3	1.3	1.2	1.5	1.4	1.3	1.4
18	1.2	1.4	1.3	1.2	1.4	1.4	1.3	1.4
19	1.2	1.4	1.3	1.2	1.4	1.3	1.3	1.4
20	1.3	1.3	1.2	1.2	1.4	1.3	1.3	1.4

Daily gage height, in feet, of Little Porcupine Creek near Frazer, Mont., in 1909—Contd.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.
21	1.7	1.3	1.2	1.15	1.4	1.35	1.4	1.4
22	1.8	1.3	1.2	1.1	1.4	1.35	1.4	1.4
23	2.5	1.3	1.2	1.1	1.4	1.4	1.4	1.4
24	2.3	1.3	1.2	1.1	1.35	1.4	1.4	1.4
25	2.0	1.3	1.2	1.2	1.3	1.4	1.4	1.4
26	1.7	1.3	1.3	1.2	1.3	1.4	1.4	1.4
27	1.7	1.3	1.3	1.2	1.3	1.4	1.4	1.4
28	1.5	1.3	1.3	1.2	1.3	1.4	1.4	1.4
29	1.5	1.4	1.35	1.2	1.3	1.4	1.4	1.4
30	1.4	1.4	1.3	1.2	1.3	1.4	1.4	1.4
31	1.4	.....	1.3	.....	1.3	1.4	.....	1.4

NOTE.—Water standing in pools for all gage heights below 1.5 feet.

Daily discharge, in second-feet, of Little Porcupine Creek near Frazer, Mont., for 1909.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.
1	.....	0	0	0	0	0	0	0
2	.....	0	0	0	0	0	0	0
3	.....	7	0	0	0	0	0	0
4	.....	43	0	0	0	0	0	0
5	.....	43	0	0	0	0	0	0
6	.....	36	0	0	0	0	0	0
7	.....	25	0	0	0	0	0	0
8	.....	11	0	0	97	0	0	0
9	.....	11	0	0	315	0	0	0
10	.....	11	0	0	198	0	0	0
11	.....	3	0	0	106	0	0	0
12	.....	3	0	0	97	0	0	0
13	.....	0	0	0	72	0	0	0
14	.....	0	0	0	25	0	0	0
15	0	0	0	0	25	0	0	0
16	0	0	0	0	15	0	0	0
17	0	0	0	0	3	0	0	0
18	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0
21	11	0	0	0	0	0	0	0
22	15	0	0	0	0	0	0	0
23	57	0	0	0	0	0	0	0
24	43	0	0	0	0	0	0	0
25	25	0	0	0	0	0	0	0
26	11	0	0	0	0	0	0	0
27	11	0	0	0	0	0	0	0
28	3	0	0	0	0	0	0	0
29	3	0	0	0	0	0	0	0
30	0	0	0	0	0	0	0	0
31	0	.....	0	.....	0	0	0	0

NOTE.—These discharges are based on a curve that is fairly well defined between 0 and 300 second-feet. Water standing in pools on dates showing no discharge. It is probable that there was no flow Jan. 1 to Mar. 14 and Nov. 1 to Dec. 31.

Monthly discharge of Little Porcupine Creek near Frazer, Mont., for 1909.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
January	0	0	0	0	
February	0	0	0	0	
March	57	0	5.8	357	C.
April	43	0	6.4	381	C.
May	0	0	0	0	
June	0	0	0	0	
July	315	0	31	1,910	C.
August	0	0	0	0	
September	0	0	0	0	
October	0	0	0	0	
November	0	0	0	0	
December	0	0	0	0	
The year	315	0	3.6	2,650	

NOTE.—There is no record for Jan. 1 to Mar. 14 and Nov. 1 to Dec. 31, but it is probable that there was no flow.

WOLF CREEK DRAINAGE BASIN.

WOLF CREEK AT WOLF POINT, MONT.

Wolf Creek rises near the center of the Fort Peck Indian Reservation, flows southward, and enters Missouri River near the Wolf Point Agency. The drainage area comprises the central part of the Fort Peck Indian Reservation. The entire area, with the exception of a narrow valley along the stream, is a rolling prairie. The only forestation is the growth of willows and cottonwoods along the banks of the streams.

The run-off comes from the melting snow in the spring and heavy rains during the summer. The upper part of the channel is dry during the late summer and winter, but near the mouth the flow is kept up by springs. The annual rainfall is about 13 inches. The stream is not used for storage and the only diversion is that made by the Indian agency ditch at Wolf Point, which diverts the entire flow during the low period.

The gaging station, which was established August 15, 1908, to determine the amount of water available for an irrigation project under consideration by the United States Reclamation Service for the Fort Peck Indians, is located at William Smith's ranch, 2½ miles northwest of Wolf Point.

Measurements are made by wading near the staff gage, which is located close to the house of the observer.

The Wolf Point ditch heads above the gage and practically the entire low-water flow of the creek is diverted through it.

Discharge measurements of Wolf Creek at Wolf Point, Mont., in 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
May 8	W. A. Lamb	2.0	0.2	1.42	0.1
June 22	do	8	4.8	2.00	5.4
July 16	do	18	15	2.32	9.3
Aug. 27	do			1.52	.1

Daily gage height, in feet, of Wolf Creek at Wolf Point, Mont., for 1909.

[W. H. Smith, observer.]

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1		3.2	1.8	1.9	2.5	1.8	1.4	1.5	1.6
2		3.2	1.8	1.9	2.2	1.8	1.4	1.5	1.6
3		3.2	1.8	1.9	2.2	1.5	1.4	1.6	1.6
4		3.0	1.8	1.9	2.5	1.5	1.4	1.6	1.6
5		3.0	1.8	1.9	2.6	1.5	1.4	1.6	1.6
6		3.0	1.8	2.2	2.6	1.5	1.4	1.6	1.6
7		2.5	1.8	2.2	2.8	1.5	1.4	1.6	1.7
8		2.5	1.8	2.2	2.8	1.5	1.4	1.6	1.7
9		2.5	1.4	2.2	2.8	1.5	1.4	1.6	1.7
10		2.5	1.4	2.2	2.8	1.5	1.4	1.6	1.7

Daily gage height, in feet, of Wolf Creek at Wolf Point, Mont., for 1909—Continued.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
11	.....	2.5	1.4	2.2	2.7	1.5	1.4	1.6	1.7
12	.....	2.5	1.4	2.2	2.7	1.5	1.5	1.6	1.7
13	.....	2.5	1.4	2.2	2.7	1.5	1.5	1.6	1.7
14	.....	2.5	1.4	2.2	2.5	1.5	1.5	1.6	1.7
15	.....	2.5	1.4	2.2	2.3	1.5	1.5	1.6	1.7
16	.....	2.5	1.4	2.2	2.3	1.5	1.5	1.6	1.8
17	.....	2.5	1.4	2.2	2.3	1.5	1.5	1.6	1.8
18	.....	2.0	1.5	2.2	2.0	1.5	1.5	1.6	1.8
19	5.2	2.0	1.5	2.2	2.0	1.5	1.5	1.6	1.8
20	5.2	2.0	1.5	2.2	1.9	1.5	1.5	1.6	1.8
21	5.2	2.0	1.5	2.2	1.9	1.5	1.5	1.5	1.9
22	5.2	2.0	1.5	2.2	1.9	1.5	1.5	1.6	1.9
23	5.2	2.0	1.6	1.9	1.9	1.5	1.5	1.6	1.9
24	5.2	2.0	1.6	1.9	1.9	1.5	1.5	1.8	1.9
25	5.2	1.8	1.6	1.9	1.9	1.5	1.5	1.8	1.9
26	5.2	1.8	1.6	1.9	1.9	1.5	1.5	1.8	1.9
27	5.2	1.8	1.6	2.2	1.8	1.5	1.5	1.8	1.9
28	5.2	1.8	1.6	2.2	1.8	1.5	1.5	1.8	1.9
29	5.2	1.8	1.6	2.2	1.8	1.4	1.5	1.8	1.9
30	3.2	1.8	1.9	2.2	1.8	1.4	1.5	1.8	1.9
31	3.2	.....	1.9	.....	1.8	1.4	.....	1.6	.....

NOTE.—Ice conditions existing where observations are missing.

Daily discharge, in second-feet, of Wolf Creek at Wolf Point, Mont., for 1909.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	.....	21.5	3.3	4.3	11.6	2.9	0	0	0.8
2	.....	21.5	3.3	4.3	7.7	2.9	0	0	.8
3	.....	21.5	3.3	4.3	7.7	0	0	.8	.8
4	.....	18.6	3.3	4.3	11.6	0	0	.8	.8
5	.....	18.6	3.3	4.3	13.0	0	0	.8	.8
6	.....	18.6	3.3	7.7	13.0	0	0	.8	.8
7	.....	11.6	3.3	7.7	15.8	0	0	.8	1.8
8	.....	11.6	3.3	7.7	15.8	0	0	.8	1.8
9	.....	11.6	.1	7.7	15.8	0	0	.8	1.8
10	.....	11.6	.1	7.7	15.8	0	0	.8	1.8
11	.....	11.6	.1	7.7	14.4	0	0	.8	1.8
12	.....	11.6	.1	7.7	14.4	0	0	.8	1.8
13	.....	11.6	.1	7.7	14.4	0	0	.8	1.8
14	.....	11.6	.1	7.7	11.6	0	0	.8	1.8
15	.....	11.6	.1	7.7	9.0	0	0	.8	1.8
16	.....	11.6	.1	7.7	9.0	0	0	.8	.....
17	.....	11.6	.1	7.7	9.0	0	0	.8	.....
18	.....	5.4	.6	7.7	5.4	0	0	.8	.....
19	52	5.4	.6	7.7	5.4	0	0	.8	.....
20	52	5.4	.6	7.7	4.3	0	0	.8	.....
21	52	5.4	.6	7.7	4.0	0	0	.8	.....
22	52	5.4	.6	7.7	4.0	0	0	.8	.....
23	52	5.4	1.4	4.3	4.0	0	0	.8	.....
24	52	5.4	1.4	4.3	4.0	0	0	2.9	.....
25	52	3.3	1.4	4.3	4.0	0	0	2.9	.....
26	52	3.3	1.4	4.3	4.0	0	0	2.9	.....
27	52	3.3	1.4	7.7	2.9	0	0	2.9	.....
28	52	3.3	1.4	7.7	2.9	0	0	2.9	.....
29	52	3.3	1.4	7.7	2.9	0	0	2.9	.....
30	21.5	3.3	4.3	7.7	2.9	0	0	2.9	.....
31	21.5	.....	4.3	.....	2.9	0	.....	.8	.....

NOTE.—These discharges are based on two rating curves fairly well defined, applicable Mar. 19 to July 20, July 21 to Dec. 1, respectively.

Monthly discharge of Wolf Creek at Wolf Point, Mont., for 1909.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
March 19–31	52	21.5	47.3	1,220	C.
April	21.5	3.3	10.2	607	B.
May	4.3	.1	1.57	97	B.
June	7.7	4.3	6.68	397	B.
July	15.8	2.9	8.49	522	B.
August	2.9	0	.19	12	C.
September	0	0	0	0	
October	2.9	0	1.22	75	B.
November 1–15	1.8	.8	1.40	42	B.
The period				2,970	

Discharge measurements of Wolf Point ditch at Wolf Point, Mont., in 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
May 8	W. A. Lamb	3.5	2.1	2.30	3.1
June 22	do	2.0	.6	1.82	.3
July 16	do	1.5	.3	1.80	.2
Aug. 27	do			1.70	.05

Daily gage height, in feet, of Wolf Point ditch at Wolf Point, Mont., for 1909.

[W. H. Smith, observer.]

Day.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Day.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1			1.7	1.5	1.5	1.7	2.2	16	2.6		1.7	1.7	1.4	2.0	
2			1.7	1.5	1.5	1.7	2.2	17	2.6	2.0	1.7	1.7	1.4	2.0	
3			1.7	1.7	1.5	2.0	2.2	18	2.6	2.0	1.7	1.7	1.4	2.0	
4			1.9	1.7	1.5	2.0	2.2	19	2.6	2.0	1.7	1.7	1.8	2.0	
5			1.9	1.7	1.5	2.0	2.2	20	2.6	2.0	1.7	1.7	1.8	2.0	
6			1.9	1.7	1.5	2.0	2.3	21	2.3	2.0	1.7	1.7	1.8	2.0	
7			1.9	1.7	1.5	2.0	2.3	22	2.3	2.0	1.7	1.6	1.8	2.0	
8			1.9	1.7	1.5	2.0	2.3	23	2.3	2.0	1.7	1.6	1.8	2.0	
9	2.3		1.9	1.7	1.5	2.0	2.3	24	2.3	2.0	1.6	1.6	1.8	2.0	
10	2.3		1.8	1.7	1.5	2.0	2.3	25	2.3	1.8	1.6	1.6	1.8	2.0	
11	2.3		1.8	1.7	1.5	2.0	2.3	26	2.3	1.8	1.6	1.6	1.8	2.0	
12	2.3		1.8	1.7	1.4	2.0	2.3	27	2.3	1.8	1.5	1.6	1.8	2.0	
13	2.3		1.8	1.7	1.4	2.0	2.3	28	2.3	1.8	1.5	1.6	1.8	2.0	
14	2.3		1.8	1.7	1.4	2.0		29	2.3	1.8	1.5	1.5	1.7	2.0	
15	2.6		1.7	1.7	1.4	2.0		30			1.5	1.5	1.7	2.0	
								31			1.5	1.5		2.2	

Daily discharge, in second-feet, of Wolf Point ditch at Wolf Point, Mont., for 1909.

Day.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Day.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1			0.1	0	0	0.1	2.3	16	6.1		.1	.1	0	1.0	
2			.1	0	0	.1	2.3	17	6.1	1.0	.1	.1	0	1.0	
3			.1	.1	0	1.0	2.3	18	6.1	1.0	.1	.1	0	1.0	
4			.5	.1	0	1.0	2.3	19	6.1	1.0	.1	.1	.2	1.0	
5			.5	.1	0	1.0	2.3	20	6.1	1.0	.1	.1	.2	1.0	
6			.5	.1	0	1.0	3.1	21	3.1	1.0	.1	.1	.2	1.0	
7			.5	.1	0	1.0	3.1	22	3.1	1.0	.1	0	.2	1.0	
8			.5	.1	0	1.0	3.1	23	3.1	1.0	.1	0	.2	1.0	
9	3.1		.5	.1	0	1.0	3.1	24	3.1	1.0	0	0	.2	1.0	
10	3.1		.2	.1	0	1.0	3.1	25	3.1	.2	0	0	.2	1.0	
11	3.1		.2	.1	0	1.0	3.1	26	3.1	.2	0	0	.2	1.0	
12	3.1		.2	.1	0	1.0	3.1	27	3.1	.2	0	0	.2	1.0	
13	3.1		.2	.1	0	1.0	3.1	28	3.1	.2	0	0	.2	1.0	
14	3.1		.2	.1	0	1.0		29	3.1	.2	0	0	.1	1.0	
15	6.1		.1	.1	0	1.0		30			0	0	.1	1.0	
								31			0	0		2.3	

NOTE.—These discharges are based on a rating curve that is fairly well defined.

Monthly discharge of Wolf Point ditch at Wolf Point, Mont., for 1909.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
May 9–29	6.1	3.1	3.96	165	A.
June 17–29	1.0	.2	.69	18	A.
July	.5	.0	.17	10	B.
August	.1	.0	.06	4	B.
September	.2	.0	.073	4	B.
October	2.3	.1	.98	60	A.
November 1–13	3.1	2.3	2.79	72	A.

POPLAR CREEK DRAINAGE BASIN.

POPLAR CREEK NEAR POPLAR, MONT.

Poplar Creek rises in the southern part of the Canadian Province of Saskatchewan, flows southeastward through the northern part of Valley County, Mont., thence through the Fort Peck Indian Reservation, and unites with Missouri River near Poplar, Mont. The largest tributary is the West Branch, which enters near the north boundary of the Fort Peck Reservation. The greater part of the drainage area is a rolling prairie cut by a number of small coulees and the valley of the creek. The only forestation is a growth of willows and cottonwoods along the banks of the stream.

The run-off comes from melting snow in the spring and heavy rains during the summer. The dry-season flow is considerable. The annual rainfall at Poplar is about 13 inches.

The United States Reclamation Service has under consideration a project which will divert the water of this stream to irrigate land along its lower course and along Missouri River near Poplar, Mont.

The gaging station was established August 15, 1908, at Buershia's ranch, 6 miles north of Poplar, Mont.

A staff gage fastened to a tree is located on the right bank of the stream and across the river from the house of the observer. The gage datum has not changed. All measurements are made by wading.

Discharge measurements of Poplar Creek near Poplar, Mont., in 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Mar. 25	C. J. Moody	50	48	2.90	49
29	do	50	35	2.70	32
Apr. 3	do	66	61	3.20	86
May 9	W. A. Lamb	54	60	3.10	79
June 22	do	52	44	2.80	43
July 20	do	64	102	3.70	191
Aug. 26	do	27	25	2.65	24
Sept. 30	do	20	21	2.50	15

Daily gage height, in feet, of Poplar Creek near Poplar, Mont., for 1909.

[Louis Obersham, observer.]

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	.....	2.9	3.2	2.9	2.7	3.0	2.5	2.5	2.6
2	.....	3.3	3.2	2.9	2.7	3.0	2.5	2.5	2.6
3	.....	3.3	3.2	2.8	2.7	3.0	2.5	2.5	2.6
4	.....	3.2	3.1	2.9	2.7	2.9	2.5	2.5	2.6
5	.....	3.4	3.1	2.9	2.7	2.9	2.5	2.5	2.6
6	.....	3.9	3.1	3.0	2.7	2.9	2.5	2.5	2.6
7	.....	3.9	3.2	3.0	2.8	2.9	2.5	2.5	2.6
8	.....	4.3	3.2	3.1	3.1	2.8	2.5	2.5	2.7
9	.....	4.2	3.3	3.1	3.0	3.0	2.4	2.5	2.7
10	.....	4.2	3.3	3.0	3.5	3.0	2.4	2.5	2.7
11	.....	4.0	3.4	3.0	4.4	2.9	2.4	2.5	2.7
12	.....	4.0	3.5	3.1	4.5	2.9	2.4	2.5	2.7
13	.....	3.9	3.4	3.0	4.3	2.8	2.4	2.5	.....
14	.....	4.1	3.3	3.0	4.3	2.8	2.4	2.5	.....
15	.....	4.0	3.2	3.0	4.3	2.8	2.4	2.5	.....
16	.....	4.0	3.2	3.0	4.2	2.8	2.4	2.5	.....
17	.....	4.0	3.1	2.9	4.0	2.8	2.4	2.5	.....
18	.....	3.9	3.1	2.9	4.0	2.8	2.4	2.5	.....
19	.....	3.8	3.1	2.9	3.9	2.8	2.4	2.5	.....
20	.....	3.6	3.1	2.8	3.7	2.7	2.4	2.5	.....
21	.....	3.4	2.9	3.0	3.7	2.7	2.4	2.5	.....
22	.....	3.4	2.9	2.8	3.8	2.6	2.5	2.6	.....
23	2.7	3.4	2.8	2.8	3.6	2.6	2.5	2.6	.....
24	2.9	3.4	2.8	2.8	3.5	2.6	2.5	2.6	.....
25	2.9	3.6	2.8	2.7	3.4	2.6	2.5	2.6	.....
26	3.1	3.6	2.8	2.8	3.3	2.6	2.5	2.6	.....
27	2.9	3.4	2.7	2.8	3.2	2.6	2.5	2.6	.....
28	2.9	3.4	2.7	2.7	3.2	2.6	2.5	2.6	.....
29	2.9	3.3	2.8	2.7	3.2	2.6	2.5	2.6	.....
30	2.8	3.2	2.8	2.7	3.1	2.5	2.5	2.6	.....
31	2.8	.....	2.9	.....	3.0	2.5	.....	2.7	.....

NOTE.—Ice conditions existing during times of missing observations.

Daily discharge, in second-feet, of Poplar Creek near Poplar, Mont., for 1909.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	.....	52	95	52	30	65	15	15	22
2	.....	112	95	52	30	65	15	15	22
3	.....	112	95	40	30	65	15	15	22
4	.....	95	79	52	30	52	15	15	22
5	.....	130	79	52	30	52	15	15	22
6	.....	235	79	65	30	52	15	15	22
7	.....	235	95	65	40	52	15	15	22
8	.....	331	95	79	79	40	15	15	30
9	.....	307	112	79	65	65	10	15	30
10	.....	307	112	65	150	65	10	15	30
11	.....	259	130	65	355	52	10	15	30
12	.....	259	150	79	381	52	10	15	30
13	.....	235	130	65	331	40	10	15	.....
14	.....	283	112	65	331	40	10	15	.....
15	.....	259	95	65	331	40	10	15	.....
16	.....	259	95	65	307	40	10	15	.....
17	.....	259	79	52	259	40	10	15	.....
18	.....	235	79	52	259	40	10	15	.....
19	.....	213	79	52	235	40	10	15	.....
20	.....	170	79	40	191	30	10	15	.....
21	.....	130	52	65	191	30	10	15	.....
22	.....	130	52	40	213	22	15	22	.....
23	30	130	40	40	170	22	15	22	.....
24	52	130	40	40	150	22	15	22	.....
25	52	190	40	30	130	22	15	22	.....
26	79	190	40	40	112	22	15	22	.....
27	52	130	30	40	95	22	15	22	.....
28	52	130	30	30	95	22	15	22	.....
29	52	112	40	30	95	22	15	22	.....
30	40	95	40	30	79	15	15	22	.....
31	40	.....	52	.....	65	15	.....	30	.....

NOTE.—These discharges are based on a rating curve that is well defined between 10 and 213 second-feet.

Monthly discharge of Poplar Creek near Poplar, Mont., for 1909.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
March 23–31	79	30	49.9	891	B.
April	331	52	190	11,300	A.
May	150	30	78.1	4,800	A.
June	79	30	52.9	3,150	B.
July	381	30	158	9,720	A.
August	65	15	39.5	2,430	B.
September	15	10	12.8	762	B.
October	30	15	17.5	1,080	B.
November 1–12	30	22	25.3	602	B.
The period				34,700	

BIG MUDDY RIVER DRAINAGE BASIN.

BIG MUDDY RIVER NEAR CULBERTSON, MONT.

Big Muddy River rises in the Province of Saskatchewan, Canada, flows southward into Montana, forms the eastern boundary of the Fort Peck Indian Reservation, and unites with Missouri River near Blair, Mont. It drains a rolling prairie country cut by many small coulees. The greater part of the run-off comes from the melting snow in the spring months.

The gaging station, which was established July 14, 1908, to determine the amount of water available for irrigation projects under consideration by the United States Reclamation Service for the Fort Peck Indians, is located about 3 miles above the mouth of the stream.

Because of backwater effect from Missouri River, this station was discontinued July 19, 1909, and a new station was established at Gustave Sholtz's ranch, 8 miles above.

The results obtained at the new station are considered good.

The gage is the inclined-rod type and is located on the left bank of the stream, near the residence of the observer. The gage datum has remained the same. All measurements are made by wading.

Discharge measurements of Big Muddy River near Culbertson, Mont., in 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
May 7	W. A. Lamb	36	30	1.91	33
June 21	do	32	31	6.15	31
July 19	do	30	53	3.19	19
Aug. 24	do	12	20	2.75	6.8
Sept. 29	do	10	2.1	1.85	.9

Daily gage height, in feet, of Big Muddy River near Culbertson, Mont., for 1909.

[James Boyd, observer.]

Day.	Mar.	Apr.	May.	June.	July.[a]	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	6.5	2.0	3.9	.....	3.3	2.7	1.8	1.7	1.4
2	.....	6.0	1.9	3.8	.....	3.8	2.6	1.8	1.7	1.4
3	.....	5.3	2.0	3.8	.....	3.4	2.6	1.8	1.7	1.4
4	.....	6.9	2.0	3.7	.....	3.4	2.4	1.8	1.7	1.4
5	.....	4.1	1.9	3.7	.....	3.4	2.3	1.8	1.7	1.4
6	.....	4.3	1.9	3.7	.....	3.4	2.1	1.8	1.6	.....
7	.....	4.4	1.9	4.0	.....	3.4	1.9	1.8	1.6	.....
8	.....	4.5	1.9	4.4	.....	3.4	1.9	1.8	1.6	.....
9	.....	5.8	1.9	4.6	.....	3.3	1.9	1.8	1.6	.....
10	.....	6.1	2.0	4.6	.....	3.3	1.9	1.8	1.6	.....
11	.....	5.5	2.1	5.2	.....	3.3	1.7	1.8	1.6	.....
12	.....	4.7	2.1	6.0	.....	3.3	1.7	1.8	1.6	.....
13	.....	3.9	2.0	6.0	.....	3.2	1.7	1.8	1.5	.....
14	.....	3.3	2.0	6.9	.....	3.2	1.7	1.8	1.5	.....
15	.....	3.2	2.1	7.0	.....	3.2	1.7	1.8	1.5	.....
16	.....	3.2	2.0	6.6	.....	3.2	1.7	1.8	1.5	.....
17	.....	3.4	2.0	6.0	.....	3.2	1.6	.....	1.5	.....
18	.....	3.3	2.1	5.7	.....	3.1	1.6	1.7	1.5	.....
19	.....	3.0	2.1	5.5	3.2	3.1	1.6	1.7	1.5	.....
20	.....	2.8	1.9	5.7	3.2	3.1	1.6	1.7	1.5	.....
21	3.5	2.7	1.9	5.8	3.2	3.1	1.6	1.7	1.5	.....
22	3.7	2.5	1.9	6.9	3.2	3.1	1.7	1.7	1.5	.....
23	4.0	2.4	1.9	7.9	3.2	3.0	1.7	1.7	1.5	.....
24	4.5	2.4	1.9	6.7	3.2	2.8	1.7	1.7	1.5	.....
25	4.7	2.3	1.9	6.7	3.2	2.8	1.8	1.7	1.5	.....
26	5.0	2.2	2.1	6.9	3.3	2.7	1.8	1.7	1.5	.....
27	5.6	2.2	3.0	6.4	3.3	2.7	1.8	1.7	1.5	.....
28	5.8	2.1	3.1	5.8	3.3	2.7	1.8	1.7	1.4	.....
29	6.1	2.1	3.1	5.5	3.3	2.7	1.8	1.7	1.4	.....
30	6.2	2.0	3.0	6.3	3.3	2.7	1.8	1.7	1.4	.....
31	6.5	.....	3.7	.....	3.3	2.7	.....	1.7	.....	.....

[a] New gage.

NOTE.—Gage heights Mar. 21 to Apr. 19 and May 26 to June 30 of little value on account of backwater from Missouri River. No observations made July 1 to July 18. Ice conditions Jan. 1 to Mar. 20 and from Nov. 13 to Dec. 31.

Daily discharge, in second-feet, of Big Muddy River near Culbertson, Mont., for 1909.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	.....	47	.....	.....	22.3	6.6	0.7	0.5
2	.....	32	.....	.....	22.3	5.2	.7	.5
3	.....	47	.....	.....	26.3	5.2	.7	.5
4	.....	47	.....	.....	26.3	3.2	.7	.5
5	.....	32	.....	.....	26.3	2.5	.7	.5
6	.....	32	.....	.....	26.3	1.6	.7	.3
7	.....	32	.....	.....	26.3	1.0	.7	.3
8	.....	32	.....	.....	26.3	1.0	.7	.3
9	.....	32	.....	.....	22.3	1.0	.7	.3
10	.....	47	.....	.....	22.3	1.0	.7	.3
11	.....	64	.....	.....	22.3	.5	.7	.3
12	.....	64	.....	.....	22.3	.5	.7	.3
13	.....	47	.....	.....	18.7	.5	.7	.....
14	.....	47	.....	.....	18.7	.5	.7	.....
15	.....	64	.....	.....	18.7	.5	.7	.....
16	.....	47	.....	.....	18.7	.5	.7	.....
17	.....	47	.....	.....	18.7	.3	.6	.....
18	.....	64	.....	.....	15.5	.3	.5	.....
19	.....	64	.....	18.7	15.5	.3	.5	.....
20	200	32	.....	18.7	15.5	.3	.5	.....
21	180	32	.....	18.7	15.5	.3	.5	.....
22	140	32	.....	18.7	15.5	.5	.5	.....
23	120	32	.....	18.7	12.7	.5	.5	.....
24	101	32	.....	18.7	8.3	.5	.5	.....
25	82	32	.....	18.7	8.3	.7	.5	.....
26	82	.....	.....	22.3	6.6	.7	.5	.....
27	82	.....	.....	22.3	6.6	.7	.5	.....
28	64	.....	.....	22.3	6.6	.7	.5	.....
29	64	.....	.....	22.3	6.6	.7	.5	.....
30	47	.....	.....	22.3	6.6	.7	.5	.....
31	.....	.....	.....	22.3	6.6	.....	.5	.....

NOTE.—These discharges are based on two partially defined curves. Applicable Apr. 20 to May 25 and July 19 to Nov. 12, respectively.

Monthly discharge of Big Muddy River near Culbertson, Mont., for 1909.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
April 20–30	200	47	109	2,380	D.
May 1–25	64	32	43.2	2,140	D.
July 19–31	22.3	18.7	20.4	526	A.
August	26.3	6.6	17.1	1,050	A.
September	6.6	.3	1.28	76	B.
October	.7	.5	.61	38	C.
November 1–12	.5	.3	.38	9	C.

YELLOWSTONE RIVER DRAINAGE BASIN.

DESCRIPTION.

The upper Yellowstone rises in the Shoshone Mountains, in northwestern Wyoming, near the southeast corner of the Yellowstone National Park, flows northwestward for 40 or 50 miles, and then enters Yellowstone Lake, which may be considered the great source of the main river. This lake is about 15 miles long by 20 miles wide, lies at an elevation of 7,778 feet above the sea, and is hemmed in on every side by lofty mountains, from whose snow-covered slopes its chief supply of water must come, since it receives no important streams. Issuing from the lake at the north end, the river flows northwestward for 10 or 15 miles, plunges over the Great Falls of the Yellowstone, and for the next 20 miles runs through its "Grand Canyon," which is impassable throughout. About 80 miles from the lake it emerges from the Snow Mountains, and thence runs eastward and northeastward until it joins the Missouri at Fort Buford, N. Dak. At this point it has an elevation of about 1,900 feet. (See Pl. III.)

As it leaves the mountains the river is about 600 feet wide; thence to Clark Fork, which enters from the south about 15 miles above Billings, Mont., it is characterized by bold, sweeping curves and many islands. Between Clark Fork and the mouth of the Bighorn it is from 1,500 to 1,800 feet wide, is free from rapids, and has a current from 3 to 4 miles an hour. Between the Bighorn and the Powder the main stream increases in width from 2,400 to 2,700 feet and becomes turbid, like the Missouri. Below the mouth of the Powder the banks are low and caving, and the stream contains some rapids and shoals and numerous densely timbered islands.

The Yellowstone is about 500 miles long; the area of its basin is approximately 67,500 square miles.

Of the tributaries of the Yellowstone the most important is the Bighorn,[1] which has its source in the many small streams draining the slopes of the Wind River Range. Other important tributaries of the Yellowstone are Shields, Boulder, Big Timber, Sweetgrass,

[1] See description of basin on pp. 169–171.

A. YELLOWSTONE RIVER ABOVE UPPER FALLS, YELLOWSTONE NATIONAL PARK.

B. HEADGATES ON LOWER YELLOWSTONE PROJECT, YELLOWSTONE RIVER, MONTANA.

Stillwater, Clark Fork, Tongue, and Powder rivers. Shields, Big Timber, and Sweetgrass rivers have their sources in the Crazy Mountains, rising to an elevation of 10,000 feet; the Boulder, Stillwater, and Clark Fork rise on the southeastern slope of the Shoshone Mountains, at an elevation of 10,500 feet. Powder and Tongue rivers have their sources in the high plains region and Bighorn Mountains of Wyoming, flowing parallel and in a northeasterly direction until they join the Yellowstone.

The headwaters of the Yellowstone and many of its tributaries drain portions of heavily timbered areas. The Yellowstone, Crazy Mountain, Bighorn, and Otter national forests are thus drained. However, the greater part of the drainage basin lies within the plains section and is treeless except for a few willows and cottonwoods along the stream channels.

The mean annual rainfall in Yellowstone Park is approximately 17 inches; at Billings, 15 inches; Glendive, 10 inches; and at Buford, 12½ inches. A greater portion of the rainfall occurs in June. Snow lies in the mountains from November to June. The streams are partly frozen during the colder months.

The great areas of irrigable land and the abundant water supply afford wonderful opportunities for irrigation in the Yellowstone basin. The United States Reclamation Service has practically completed irrigation projects diverting water from the Yellowstone and reclaiming 100,000 acres of arid land. The Shoshone project, reclaiming 132,000 acres, is partly finished. Several private irrigation projects are completed and more are under construction.

Many possible reservoir sites for the storage of flood water are found on the upper portion of the Yellowstone and its tributaries. Shoshone dam, 325 feet high, on the Shoshone River, stores 456,000 acre-feet.

The Yellowstone basin contains many natural power sites. The abundance of water and the magnitude of fall in the higher altitudes make the development of hydro-electric power most feasible. Power for municipal purposes is now generated at Livingston, Big Timber, and Billings.

The run-off record extends back to 1889, although a few stream measurements were made on the Yellowstone River in the national park as early as 1878. The wettest year recorded at Livingston from 1897 to 1908 was 1899; the driest was 1905.

YELLOWSTONE RIVER AT HUNTLEY, MONT.

This station, which is located at the new steel highway bridge 1 mile below Huntley, Mont., and replaces that formerly maintained at Junction, was established October 1, 1907, to obtain data applicable to irrigation and power development.

The only tributary near the station is Pryor Creek, which enters the Yellowstone 1 mile above. The drainage area at Huntley is about 12,000 square miles.

The Huntley canal, built by the United States Reclamation Service, takes water from the river about 2 miles above the gaging station; its normal capacity is 400 second-feet, and it supplies water for 29,000 acres of land. (See Pl. IV.) Near Laurel are the head gates of the Billings Land & Irrigation Co.'s large canal, which carries about 305 second-feet and irrigates 28,000 acres. Many small ditches take water from the tributaries of the Yellowstone, but few from the stream itself, owing to the variation of the stages of the water surface and consequent difficulty in diversion.

This river freezes entirely over in places during the winter, but during the coldest seasons open channels with floating ice are not uncommonly seen. Conditions for obtaining accurate data at this station are only fair, as the channel is shifting and extra measurements are necessary to obtain a good rating curve.

Measurements are made from the downstream side of the bridge. The chain gage used at this station is fastened to the bridge rail. The gage datum has remained unchanged.

Discharge measurements of Yellowstone River at Huntley, Mont., in 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Apr. 7	Raymond Richards	432	1,420	1.79	2,770
May 20	do	460	1,780	2.60	4,820
June 25	do	530	5,110	8.19	31,200
July 19	J. E. Stewart	479	3,750	5.77	17,200
Sept. 15	Raymond Richards	247	1,850	3.36	7,790

Daily gage height, in feet, of Yellowstone River at Huntley, Mont., for 1909.

[Arthur Foster, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	1.9			1.9	2.0	6.5	9.45	4.85		2.85	2.45
2	1.8			1.9	2.0	6.5	9.55	4.75		2.85	2.45
3	2.2			1.9	2.0	7.8	9.65	4.75		2.85	2.45
4	2.0			1.9	2.0	9.0	9.65	4.55		2.85	2.45
5	1.8			1.9	2.2	10.0	9.05	4.45		2.85	2.45
6	1.75			1.9	2.3	9.9	8.65	4.35		2.85	2.45
7	1.75			1.9	2.6	9.5	8.25	4.35		2.85	2.45
8	1.7			1.9	2.6	9.0	8.15	4.95		2.85	2.45
9			3.5	1.9	2.6	8.1	7.85	4.45		2.85	2.45
10			3.4	1.9	2.5	7.5	7.6			2.85	2.45
11			3.4	1.9	2.6	7.1	7.45			2.8	2.45
12			3.3	1.9	2.8	7.0	7.25			2.8	2.45
13			3.1	1.9	2.8	6.7	6.85			2.75	2.45
14			3.0	1.9	2.7	6.5	6.75			2.75	2.35
15			3.1	1.9	2.6	7.5	6.55		3.35	2.7	2.35

A. CONCRETE-LINED PORTION OF MAIN CANAL THROUGH ROCK CUT, LOOKING TOWARD PORTAL OF TUNNEL NO. 2.

B. WASTEWAY GATES AND PORTAL OF TUNNEL NO. 3.

HUNTLEY PROJECT, MONTANA.

Daily gage height, in feet, of Yellowstone River at Huntley, Mont., for 1909—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
16	.....	.....	3.1	1.9	2.5	7.8	6.25	.....	.....	2.75	2.35
17	.....	.....	2.95	2.0	2.6	8.85	5.85	.....	.....	2.75	2.35
18	.....	.....	2.8	2.0	2.6	9.65	5.85	.....	.....	2.75	2.35
19	.....	.....	2.7	1.9	2.7	9.65	5.8	.....	.....	2.7	2.35
20	.....	.....	2.5	1.95	2.7	9.65	5.7	.....	.....	2.7	2.35
21	.....	.....	2.35	2.05	2.8	9.35	5.55	.....	.....	2.7	2.35
22	.....	.....	2.1	2.0	2.8	8.95	5.5	.....	.....	2.65	2.35
23	.....	.....	2.1	1.9	3.7	8.55	5.45	.....	.....	2.65	2.35
24	.....	.....	2.0	1.9	4.7	8.25	5.35	.....	.....	2.55	2.45
25	.....	.....	2.0	1.9	6.8	8.15	5.35	.....	.....	2.55	2.55
26	.....	.....	2.1	1.9	6.5	8.15	5.25	.....	.....	2.55	2.45
27	.....	.....	2.05	1.9	6.3	8.15	5.25	.....	3.05	2.45	2.45
28	.....	.....	2.05	1.9	6.5	8.45	5.45	.....	3.05	2.45	2.35
29	.....	.....	2.0	2.05	6.5	9.05	5.25	.....	2.95	2.45	2.35
30	.....	.....	2.0	2.0	6.5	9.30	4.95	.....	2.95	2.45	.....
31	.....	.....	1.9	.....	6.5	.....	4.85	.....	.....	2.45	.....

NOTE.—Ice conditions Jan. 1 to Mar. 8 and Dec. 1 to 31.

Daily discharge, in second-feet, of Yellowstone River at Huntley, Mont., for 1909.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	.....	3,000	3,230	21,200	38,900	12,800	5,800	6,050	4,880
2	.....	3,000	3,230	21,200	39,500	12,400	5,900	6,050	4,880
3	.....	3,000	3,230	29,000	40,100	12,400	5,900	6,050	4,880
4	.....	3,000	3,230	36,200	40,100	11,500	6,900	6,050	4,880
5	.....	3,000	3,720	42,200	36,500	11,100	8,000	6,050	4,880
6	.....	3,000	3,980	41,600	34,100	10,700	10,000	6,050	4,880
7	.....	3,000	4,780	39,200	31,700	10,700	9,300	6,050	4,880
8	.....	3,000	4,780	36,200	31,100	13,400	8,800	6,050	4,880
9	7,520	3,000	4,780	30,800	29,300	11,100	8,100	6,050	4,880
10	7,190	3,000	4,510	27,200	27,800	10,700	8,000	6,050	4,880
11	7,190	3,000	4,780	24,800	26,900	10,400	8,000	5,900	4,880
12	6,870	3,000	5,350	24,200	25,700	10,100	8,000	5,900	4,880
13	6,240	3,000	5,350	22,400	23,300	9,800	7,900	5,750	4,880
14	5,940	3,000	5,060	21,200	22,700	9,600	7,800	5,750	4,600
15	6,240	3,000	4,780	27,200	21,500	9,400	7,790	5,600	4,600
16	6,240	3,000	4,510	29,000	19,800	9,300	7,700	5,750	4,600
17	5,790	3,230	4,780	35,300	17,800	9,100	7,700	5,750	4,600
18	5,350	3,230	4,780	40,100	17,800	9,000	7,600	5,750	4,600
19	5,060	3,000	5,060	40,100	17,600	8,700	7,500	5,600	4,600
20	4,510	3,120	5,060	40,100	17,100	8,500	7,200	5,600	4,600
21	4,110	3,350	5,350	38,300	16,400	8,300	7,000	5,600	4,600
22	3,470	3,230	5,350	35,900	16,100	8,100	6,900	5,460	4,600
23	3,470	3,000	8,210	33,500	15,800	8,000	6,800	5,460	4,600
24	3,230	3,000	12,100	31,700	15,400	7,500	6,700	5,160	4,880
25	3,230	3,000	23,000	31,100	15,400	7,300	6,700	5,160	5,160
26	3,470	3,000	21,200	31,100	14,800	7,200	6,700	5,160	4,880
27	3,350	3,000	20,100	31,100	14,800	7,000	6,670	4,880	4,880
28	3,350	3,000	21,200	32,900	15,800	6,400	6,670	4,880	4,600
29	3,230	3,350	21,200	36,500	14,800	5,900	6,360	4,880	4,600
30	3,230	3,230	21,200	38,000	13,400	5,800	6,360	4,880	4,600
31	3,000	.....	21,200	.....	12,800	5,800	.....	4,880	.....

NOTE.—These discharges are based on rating curves applicable as follows:
Jan. 1 to Aug. 8 fairly well defined between 2,100 and 33,200 second-feet
Aug. 9 to Sept. 26 discharge estimated from hydrographs of Yellowstone at Glendive and Big Horn at Hardin and measurement made Sept. 15.
Sept. 27 to Nov. 30 curve fairly well defined between 4,460 and 6,830 second-feet.

Monthly discharge of Yellowstone River at Huntley, Mont., for 1909.

[Drainage area, 12,200 square miles.]

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
March 9–31	7,520	3,000	4,840	0.397	0.34	221,000	A.
April	3,350	3,000	3,060	.251	.28	182,000	A.
May	23,000	3,230	8,680	.711	.82	534,000	B.
June	42,200	21,200	32,300	2.65	2.96	1,920,000	B.
July	40,100	12,800	23,400	1.92	2.21	1,440,000	B.
August	13,400	5,800	9,290	.761	.88	571,000	C.
September	10,000	5,800	7,360	.603	.67	438,000	C.
October	6,050	4,880	5,620	.461	.53	346,000	B.
November	5,160	* 4,600	4,770	.391	.44	284,000	B.
The period						5,940,000	

YELLOWSTONE RIVER AT GLENDIVE, MONT.

This station, which was established in 1893 by the United States War Department, was transferred to the Department of Agriculture, which has kept daily records of river height. When a study of the lower Yellowstone Valley was begun in 1903 the station was taken up by the United States Geological Survey, whose records began August 1, 1903. The station is located at the steel highway bridge leading northward from Glendive, about one-fourth mile from the post office. The records are used to determine the amount of water available for the lower Yellowstone project and other irrigation enterprises. The drainage area of Yellowstone River at Glendive is 66,000 square miles.

The only large diversion from the Yellowstone near Glendive is the lower Yellowstone canal, built by the United States Reclamation Service. It leaves the river 18 miles below Glendive and diverts water to irrigate 66,000 acres of land.

A standard chain gage fastened to a bridge rail is used, and since 1903 no change in gage datum has been made. All measurements are made from the bridge. The records obtained at this station are good during the open season, although in low water the old piling and cribwork of a former bridge somewhat obstruct the flow. Ice exists from December to April.

Discharge measurements of Yellowstone River at Glendive, Mont., in 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Apr. 8	Raymond Richards	710	2,500	1.32	5,640
Sept. 17	do	740	4,040	3.56	13,300

Daily gage height, in feet, of Yellowstone River at Glendive, Mont., for 1909.

(Howard Roby, observer.)

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1				1.8	1.6	7.5	10.3	5.15	2.8	2.5	1.7
2	4.2			1.7	1.7	7.3	10.6	4.95	2.8	2.5	1.7
3		2.3		1.5	1.6	7.1	10.3	4.7	2.75	2.4	1.65
4				1.4	1.5	7.8	10.45	4.55	2.7	2.4	1.6
5				1.4	1.5	9.0	10.4	4.5	2.95	2.3	1.6
6	4.5	2.0		1.4	1.5	9.75	10.65	4.45	3.9	2.3	1.6
7				1.4	1.6	10.5	11.3	4.5	4.15	2.3	1.6
8				1.4	1.95	11.9	10.6	4.2	4.45	2.3	1.6
9				1.3	2.7	12.0	9.95	5.15	4.05	2.25	1.6
10	4.1			1.2	2.65	11.1	9.2	5.4	3.85	2.3	1.6
11		2.0		1.15	2.45	10.7	8.7	5.75	3.8	2.25	1.6
12				1.2	2.4	10.1	9.25	4.75	3.7	2.2	1.6
13			1.3	1.1	2.4	9.85	7.8	5.0	3.6	2.2	1.5
14	2.6	1.8		1.2	2.45	8.8	7.5	4.8	3.6	2.2	1.5
15				1.2	2.6	8.1	6.9	4.45	3.6	2.2	1.45
16	2.6			1.2	2.35	8.0	6.6	4.35	3.8	2.2	
17			2.0	1.2	2.4	8.45	6.5	4.35	3.6	2.15	
18		1.4		1.2	2.5	9.1	6.25	4.15	3.55	2.1	
19				1.3	2.55	10.05	6.15	4.00	3.5	2.1	
20	2.7			1.3	2.5	10.65	6.05	3.85	3.35	2.0	
21				1.3	2.5	10.95	6.85	3.70	3.15	2.0	
22				1.4	2.9	11.15	6.5	3.6	3.0	2.0	
23				1.5	2.65	11.1	6.4	3.5	2.9	2.0	
24				1.4	2.65	10.5	6.25	3.35	2.9	1.9	
25				1.4	3.35	10.2	5.95	3.25	2.85	1.85	
26				1.4	5.2	9.8	5.65	3.25	2.8	1.8	
27				1.3	6.65	9.6	5.6	3.3	2.7	1.8	
28				1.3	6.85	9.7	5.5	3.05	2.6	1.8	
29				1.35	7.0	9.7	5.6	2.9	2.6	1.8	
30	3.1			1.4	7.55	10.5	5.5	2.9	2.55	1.8	
31					7.65		5.45	2.8		1.8	

NOTE.—River frozen over from Jan. 1 to Mar. 31 and Nov. 16 to Dec. 31.

Daily discharge, in second-feet, of Yellowstone River at Glendive, Mont., for 1909.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	6,740	6,240	44,900	82,200	22,600	9,920	8,820	6,490
2	6,490	6,490	42,500	86,400	21,200	9,920	8,820	6,490
3	5,990	6,240	40,300	82,200	19,500	9,730	8,480	6,360
4	5,760	5,990	48,500	84,300	18,600	9,540	8,480	6,240
5	5,760	5,990	64,000	83,600	18,200	10,500	8,160	6,240
6	5,760	5,990	74,500	87,100	18,000	14,900	8,160	6,240
7	5,760	6,240	85,000	96,500	18,200	16,200	8,160	6,240
8	5,760	7,160	106,000	86,400	16,500	18,000	8,160	6,240
9	5,530	9,540	107,000	77,300	22,600	15,700	8,010	6,240
10	5,300	9,360	93,500	66,800	24,300	14,600	8,160	6,240
11	5,190	8,650	87,800	60,000	27,100	14,400	8,010	6,240
12	5,300	8,480	79,400	54,200	19,800	13,900	7,860	6,240
13	5,080	8,480	75,900	48,500	21,500	13,400	7,860	5,990
14	5,300	8,650	61,300	44,900	20,200	13,400	7,860	5,990
15	5,300	9,180	52,200	38,100	18,000	13,400	7,860	5,880
16	5,300	8,320	50,900	34,900	17,400	14,400	7,860	
17	5,300	8,480	56,800	33,900	17,400	13,400	7,720	
18	5,300	8,820	65,400	31,400	16,200	13,100	7,580	
19	5,530	9,000	78,700	30,600	15,400	12,900	7,580	
20	5,530	8,820	87,100	29,600	14,600	12,200	7,300	
21	5,530	8,820	91,300	37,600	13,900	11,300	7,300	
22	5,760	10,300	94,200	33,900	13,400	10,700	7,300	
23	5,990	9,360	93,500	32,900	12,900	10,300	7,300	
24	5,760	9,360	85,000	31,400	12,200	10,300	7,020	
25	5,760	12,200	80,800	28,800	11,800	10,100	6,880	
26	5,760	22,900	75,200	26,300	11,800	9,920	6,740	
27	5,530	35,400	72,400	25,900	12,000	9,540	6,740	
28	5,530	37,600	73,800	25,100	10,900	9,180	6,740	
29	5,640	39,200	73,800	25,900	10,300	9,180	6,740	
30	5,760	45,500	85,000	25,100	10,300	9,000	6,740	
31		46,700		24,700	9,920		6,740	

NOTE.—These discharges are based on a rating curve that is well defined for all discharges.

Monthly discharge of Yellowstone River at Glendive, Mont., for 1909.

[Drainage area, 66,100 square miles.]

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage	Total in acre-feet.	
April	6,740	5,080	5,630	0.085	0.09	335,000	A.
May	46,700	5,990	14,000	.212	.24	861,000	A.
June	107,000	40,300	74,200	1.12	1.25	4,420,000	A.
July	96,500	24,700	50,020	.759	.88	3,090,000	A.
August	27,100	9,920	16,700	.253	.29	1,030,000	A.
September	18,000	9,000	12,100	.183	.20	720,000	A.
October	8,820	6,740	7,650	.116	.13	470,000	A.
November 1–15	6,490	5,880	6,220	.094	.05	185,000	A.
The period					3.13	11,100,000	

NORTH FORK OF BIG TIMBER CREEK NEAR BIG TIMBER, MONT.

This station, which was established May 6, 1907, is located 1 mile above the Tintinger ranch, 15 miles northwest of Big Timber, just above the junction with the South Fork.

The source of North Fork is two lakes in the Crazy Mountains. These lakes form excellent reservoir sites. It is proposed to utilize the flow of the North Fork in connection with a project under the Carey Land Act. The drainage area above the station is only 40 square miles.

Several ditches above the station divert water to irrigate approximately 300 acres of land. A large ditch appropriating 50,000 inches of water has its head gate just below the gage. This appropriation includes both forks. The water rights on Big Timber Creek have never been adjudicated.

A staff gage is located on the left bank of the stream. Its datum has remained constant. Measurements are made by wading.

At the gaging station the bed of the stream is composed of bowlders and coarse gravel, and is probably permanent. Results obtained during the open season are good.

Discharge measurements of North Fork of Big Timber Creek near Big Timber, Mont., in 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Apr. 2	Raymond Richards	17	10.8	0.92	15.8
May 18	....do	22	15.7	1.16	31.5
June 12	J. E. Stewart	34	40.7	1.81	109
23	Raymond Richards	44	45.4	1.94	146
Sept. 11	....do	38	29.4	1.51	58.8
Nov. 22	....do	20	11.3	1.02	20.0

Daily gage height, in feet, of North Fork of Big Timber Creek near Big Timber, Mont., for 1909.

[N. S. Tintinger, observer.]

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	0.65	0.85	0.95	2.25	1.7	1.6	1.4	1.65	0.9	0.85
2	.65	.95	1.05	2.35	1.7	1.55	2.25	1.35	.9	1.05
3	.75	.95	1.35	2.95	1.7	1.45	1.95	1.25	.9	.....
4	.65	.95	1.45	2.95	1.65	1.35	1.95	1.25	.95	.....
5	.65	.95	1.35	3.00	2.05	1.35	1.95	1.25	.95	.....
6	.65	.95	1.15	2.95	1.95	1.45	1.85	1.25	.9	.....
7	.65	.95	1.15	2.75	1.55	1.35	1.7	1.25	.9	.....
8	.65	.95	1.05	2.45	1.45	1.35	1.55	1.25	.9	.....
9	.65	.95	1.05	2.2	1.45	1.35	1.4	1.25	.9	.....
10	.75	.95	1.05	2.25	1.7	1.45	1.35	1.25	.9	.....
11	.8	.95	1.25	1.95	1.7	1.35	1.95	1.35	.95	.....
12	.65	1.0	1.25	1.8	1.7	1.35	1.8	1.25	.95	.....
13	.65	1.0	1.25	1.95	1.6	1.35	1.6	1.25	.95	.....
14	.65	1.0	1.25	2.45	1.55	1.35	1.4	1.25	1.05	.....
15	.65	1.0	1.3	2.15	1.6	1.35	1.35	1.25	.95	.....
16	.75	1.0	1.3	2.45	1.55	1.35	1.3	1.25	.95	.....
17	.75	.95	1.25	2.25	1.55	1.35	1.35	1.25	.95	.....
18	.75	1.0	1.25	2.35	1.55	1.35	1.35	1.25	1.1	.....
19	.8	1.0	1.25	2.15	1.7	1.35	1.3	1.2	1.05	.....
20	.8	1.0	1.4	3.0	1.95	1.35	1.25	1.2	1.0	.....
21	.75	1.0	1.55	2.65	1.75	1.35	1.25	1.2	.95	.....
22	.8	1.05	1.8	2.15	1.7	1.35	1.25	1.2	.95	.....
23	.8	1.05	1.85	2.05	1.7	1.35	1.25	1.2	.95	.....
24	.8	1.05	2.45	1.95	1.55	1.55	1.25	1.15	.95	.....
25	.8	1.05	2.55	1.8	1.7	1.5	1.25	1.15	1.0	.....
26	.8	1.15	2.35	1.7	1.55	1.35	1.25	1.15	1.05	.....
27	.8	1.15	2.55	1.7	1.7	1.35	1.25	1.1	1.05	.....
28	.8	1.1	2.55	1.95	1.7	1.3	1.25	1.05	.95	.....
29	.8	1.05	2.15	1.9	1.65	1.3	1.25	1.05	.95	.....
30	.8	.95	1.95	1.7	1.55	1.3	1.25	.95	.85	.....
31	.8	.....	1.95	.....	1.55	1.3	.....	.95	.....	.....

NOTE.—Stream frozen over during January, February, and December.

Daily discharge, in second-feet, of North Fork of Big Timber Creek near Big Timber, Mont., for 1909.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	9	14	17	230	90	73	46	82	15	13.5
2	9	17	22	262	90	66	230	42	15	22
3	11	17	42	479	90	52	146	34	15	.....
4	9	17	52	479	82	42	146	34	17	.....
5	9	17	42	498	172	42	146	34	17	.....
6	9	17	27	479	146	52	122	34	15	.....
7	9	17	27	404	66	42	90	34	15	.....
8	9	17	22	296	52	42	66	34	15	.....
9	9	17	22	214	52	42	46	34	15	.....
10	11	17	22	230	90	52	42	34	15	.....
11	12	17	34	146	90	42	146	42	17	.....
12	9	19	34	110	90	42	110	34	17	.....
13	9	19	34	146	73	42	73	34	17	.....
14	9	19	34	296	66	42	46	34	22	.....
15	9	19	37	209	73	42	42	34	17	.....
16	11	19	37	296	66	42	37	34	17	.....
17	11	17	34	230	66	42	42	34	17	.....
18	11	19	34	262	66	42	42	34	24	.....
19	12	19	34	200	90	42	37	30	22	.....
20	12	19	46	498	146	42	34	30	19	.....
21	11	19	66	368	100	42	34	30	17	.....
22	12	22	110	200	90	42	34	30	17	.....
23	12	22	122	172	90	42	34	30	17	.....
24	12	22	296	146	66	66	34	27	17	.....
25	12	22	332	110	90	58	34	27	19	.....
26	12	27	262	90	66	42	34	27	22	.....
27	12	27	332	90	90	42	34	24	22	.....
28	12	24	332	146	90	37	34	22	17	.....
29	12	22	200	133	82	37	34	22	17	.....
30	12	17	146	90	66	37	34	17	14	.....
31	12	.....	146	.....	66	37	.....	17	.....	.....

NOTE.—These discharges are based on a rating curve that is well defined between 11 and 185 second-feet. Above 185 second-feet the rating curve has been extended and at the best is only approximate.

Monthly discharge of North Fork of Big Timber Creek near Big Timber, Mont., for 1909.

Month.	Discharge in second-feet.			Run-off total in acre-feet.	Accuracy.
	Maximum.	Minimum.	Mean.		
March	12.0	9.0	10.6	652	B.
April	27	13.5	19.2	1,140	A.
May	332	17.0	96.7	5,950	A.
June	498	90	250	14,900	B.
July	172	52	85.5	5,260	A.
August	73	37	45.4	2,790	A.
September	230	34	67.6	4,020	A.
October	82	17	32.5	2,000	A.
November	24	13.5	17.4	1,040	A.
The period				37,800	

SOUTH FORK OF BIG TIMBER CREEK NEAR BIG TIMBER, MONT.

This station, which was established May 6, 1907, to determine the amount of water available for irrigation in connection with a Carey Land Act project, is located 1 mile above Tintinger's ranch, 15 miles northwest of Big Timber. The station is just above the junction with the North Fork.

The drainage area above the station is about 10 square miles. A few diversions are made, and practically all the water is appropriated.

A staff gage is used on the South Fork of Big Timber Creek. Its datum has remained constant. All measurements are made by wading near the gage.

Ice forms during the winter months. The channel is practically permanent and fairly good results have been obtained during the open season.

Discharge measurements of South Fork of Big Timber Creek near Big Timber, Mont., in 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Apr. 2	Raymond Richards	14	7.4	0.42	7.4
May 18	do	22	12.4	.58	16.1
June 12	J. E. Stewart	24	23.2	1.03	71.5
23	Raymond Richards	24	23.6	1.02	71.9
Sept. 11	do	20	14.3	.82	34.5
Nov. 22	do	15	9.9	.58	13.7

Daily gage height, in feet, of South Fork of Big Timber Creek near Big Timber, Mont., for 1909.

[N. S. Tintinger, observer.]

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	0.3	0.4	0.4	1.35	1.05	0.75	0.55	0.75	0.5	0.6
2	.3	.4	.55	1.55	1.0	.75	1.2	.65	.5	.65
3	.3	.45	.75	1.65	.95	.75	1.05	.6	.5	.....
4	.3	.45	.85	1.6	.95	.75	1.05	.55	.55	.....
5	.3	.45	.75	1.65	1.3	.75	1.05	.6	.55	.....
6	.3	.45	.65	1.55	1.05	.7	.95	.6	.5	.....
7	.3	.45	.55	1.5	.95	.65	.8	.6	.5	.....
8	.3	.45	.55	1.45	.85	.55	.65	.6	.5	.....
9	.3	.45	.55	1.25	.85	55	.65	.6	.5	.....
10	.3	.45	.55	1.25	1.0	.65	.6	.6	.55	.....

Daily gage height, in feet, of South Fork of Big Timber Creek near Big Timber, Mont., for 1909—Continued.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
11	0.3	0.5	0.55	1.1	0.95	0.65	1.05	0.65	0.55	.....
12	.35	.5	.55	1.05	1.0	.65	.95	.55	.55	.....
13	.3	.5	.55	1.15	.9	.65	.8	.55	.6	.....
14	.3	.5	.6	1.55	.85	.65	.7	.55	.6	.....
15	.3	.5	.6	1.35	.75	.55	.65	.55	.6	.....
16	.3	.5	.6	1.45	.85	.55	.65	.55	.55	.....
17	.3	.5	.6	1.35	.8	.55	.65	.55	.55	.....
18	.3	.5	.6	1.3	.8	.55	.7	.55	.55	.....
19	.35	.5	.6	1.25	.85	.55	.7	.55	.55	.....
20	.35	.5	.6	2.05	.9	.55	.65	.6	.55	.....
21	.35	.5	.75	1.9	.85	.55	.65	.6	.55	.....
22	.35	.55	.85	1.35	.75	.55	.65	.6	.55	.....
23	.35	.55	.9	1.0	.75	.55	.65	.6	.55	.....
24	.4	.55	1.55	1.0	.75	.65	.6	.6	.55	.....
25	.4	.55	1.65	.95	.75	.55	.6	.55	.55	.....
26	.4	.55	1.55	.95	.8	.55	.6	.55	.6	.....
27	.35	.65	1.45	.95	.75	.45	.6	.55	.6	.....
28	.35	.7	1.65	1.05	.75	.45	.6	.5	.65	.....
29	.35	.65	1.45	1.0	.75	.45	.6	.5	.6	.....
30	.35	.45	1.05	1.05	.75	.45	.6	.5	.6	.....
31	.35	.....	1.05	.....	.75	.45	.....	.5	.....	.....

NOTE.—Stream frozen over during January, February, and December.

Daily discharge, in second-feet, of South Fork of Big Timber Creek near Big Timber, Mont., for 1909.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	3	6	6	164	80	28	12	28	10
2	3	6	12	228	68	28	119	19	10
3	3	8	28	260	58	28	80	15	10
4	3	8	40	244	58	28	80	12	12
5	3	8	28	260	149	28	80	15	12
6	3	8	19	228	80	23	58	15	10
7	3	8	12	212	58	19	33	15	10
8	3	8	12	196	40	12	19	15	10
9	3	8	12	134	40	12	19	15	10
10	3	8	12	134	68	19	15	15	12
11	3	10	12	92	58	19	80	19	12
12	4.5	10	12	80	68	19	58	12	12
13	3	10	12	106	48	19	33	12	15
14	3	10	15	228	40	19	23	12	15
15	3	10	15	164	28	12	19	12	15
16	3	10	15	196	40	12	19	12	12
17	3	10	15	164	33	12	19	12	12
18	3	10	15	149	33	12	23	12	12
19	4.5	10	15	134	40	12	23	12	12
20	4.5	10	15	395	48	12	19	15	12
21	4.5	10	28	344	40	12	19	15	12
22	4.5	12	40	164	28	12	19	15	12
23	4.5	12	48	68	28	12	19	15	12
24	6	12	228	68	28	19	15	15	12
25	6	12	260	58	28	12	15	12	12
26	6	12	228	58	33	12	15	12	15
27	4.5	19	196	58	28	8	15	12	15
28	4.5	23	260	80	28	8	15	10	19
29	4.5	19	196	68	28	8	15	10	15
30	4.5	8	80	80	28	8	15	10	15
31	4.5	.....	80	.....	28	8	.....	10	.....

NOTE.—These discharges are based on a rating curve that is well defined below 92 second-feet. Above 92 second-feet the rating curve has been extended and is only approximate.

Monthly discharge of South Fork of Big Timber Creek near Big Timber, Mont., for 1909.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
March	6.0	3.0	3.82	235	B.
April	23	6.0	10.5	625	A.
May	260	6.0	63.4	3,900	A.
June	395	58	160	9,520	B.
July	149	28	47.1	2,900	A.
August	28	8.0	15.9	978	A.
September	119	12	33.1	1,970	A.
October	28	10	13.9	855	A.
November	19	10	12.5	744	A.
The period				21,700	

EAST FORK OF BOULDER RIVER NEAR McLEOD, MONT.

This station, which was established August 13, 1907, to determine the value of the stream for power and irrigation, is located at the first highway bridge over the East Boulder, 4 miles from McLeod. The station is 1 mile above the mouth.

This fork, which drains a valley of well-irrigated land, has no important tributaries. Several ditches receive their water from the East Boulder.

The bed of the stream is composed of coarse gravel and bowlders and should be permanent, but the swiftness of the current at high stages and the rough rocky bed make it difficult to obtain good results. This stream freezes over during the winter months.

A staff gage is fastened to the lower side of the bridge from which measurements were made in flood. Low-water measurements were made by wading just above the bridge.

No change in gage datum has been made. This station was discontinued December 31, 1909.

Discharge measurements of East Fork of Boulder River near McLeod, Mont., in 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Mar. 31	Raymond Richards	28	20.3	0.01	19.8
May 19	do	30	24.8	.13	28.9
June 13	J. E. Stewart	30	61.5	.80	251.0
Sept. 7	Raymond Richards	29	29.8	.17	53.9

Daily gage height, in feet, of East Fork of Boulder River near McLeod, Mont., for 1909.

[E. C. McConnell, observer.]

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	0.05	0.0	0.0	1.05	1.1	0.1	0.05	0.1	0.05	0.0
2	.05	.0	.0	1.3	.95	.2	.0	.1	.05	.0
3	.05	.0	.1	1.65	.9	.15	.3	.1	.05	.0
4	.05	.0	.15	1.75	.8	.1	.3	.1	.05	.0
5	.05	.0	.2	1.45	.85	.1	.2	.1	.05	.0
6	.05	.0	.1	1.15	.8	.1	.2	.1	.05	.0
7	.05	.0	.1	.8	.7	.1	.2	.1	.05	.0
8	.05	.0	.1	.8	.5	.1	.2	.1	.05	.....
9	.05	.0	.1	.85	.55	.1	.15	.1	.05	.....
10	.05	.0	.1	.75	.55	.05	.1	.1	.05	.....

Daily gage height, in feet, of East Fork of Boulder River near McLeod, Mont., for 1909— Continued.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
11	0.05	0.0	0.1	0.7	0.6	0.05	0.1	0.1	0.05	.....
12	.05	.0	.1	.8	.5	.1	.15	.1	.05	.....
13	.05	.0	.1	.75	.45	.1	.1	.1	.05	.....
14	.05	.0	.1	1.0	.5	.1	.15	.1	.05	.....
15	.05	.0	.1	1.25	.45	.1	.2	.1	.0	.....
16	.05	.0	.1	1.3	.45	.1	.2	.1	.0	.....
17	.05	.0	.1	1.7	.5	.1	.15	.1	.0	.....
18	.05	.0	.1	1.85	.45	.1	.15	.1	.0	.....
19	.05	.0	.1	1.5	.45	.05	.1	.1	.0	.....
20	.05	.0	.15	1.4	.4	.05	.15	.1	.0	.....
21	.05	.0	.2	1.4	.4	.0	.15	.1	.0	.....
22	.05	.0	.3	1.2	.4	.0	.1	.1	.0	.....
23	.05	.0	.7	1.15	.4	.0	.15	.1	.0	.....
24	.05	.0	1.35	1.15	.4	.0	.1	.1	.05	.....
25	.05	.0	.85	1.25	.35	.0	.1	.1	.05	.....
26	.05	.0	.8	1.2	.3	.05	.1	.1	.05	.....
27	.05	.0	.8	1.1	.3	.1	.1	.1	.05	.....
28	.05	.0	.9	1.25	.25	.1	.1	.1	.0	.....
29	.05	.0	.8	1.3	.2	.1	.1	.05	.0	.....
30	.05	.0	.7	1.15	.2	.05	.1	.05	.0	.....
31	.0	.....	.7	.....	.15	.05	.....	.05	.....	.....

NOTE.—Ice conditions January, February, and December.

Daily discharge, in second-feet, of East Fork of Boulder River near McLeod, Mont., for 1909.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	21	18	18	378	415	42	35	42	35	28
2	21	18	18	540	328	59	28	42	35	28
3	21	18	24	785	300	50	79	42	35	28
4	21	18	30	860	250	42	79	42	35	28
5	21	18	36	640	275	42	59	42	35	28
6	21	18	24	440	250	42	59	42	35	28
7	21	18	24	250	205	42	59	42	35	28
8	21	18	24	250	132	42	59	42	35	.....
9	21	18	24	275	149	42	50	42	35	.....
10	21	18	24	228	149	35	42	42	35	.....
11	21	18	24	205	166	35	42	42	35	.....
12	21	18	24	250	132	42	50	42	35	.....
13	21	18	24	228	118	42	42	42	35	.....
14	21	18	24	355	132	42	50	42	35	.....
15	21	18	24	515	118	42	59	42	28	.....
16	21	18	24	553	118	42	59	42	28	.....
17	21	18	24	840	132	42	50	42	28	.....
18	21	18	24	952	118	42	50	42	28	.....
19	21	18	24	690	118	35	42	42	28	.....
20	21	18	30	620	103	35	50	42	28	.....
21	21	18	36	620	103	28	50	42	28	.....
22	21	18	55	480	103	28	42	42	28	.....
23	21	18	180	448	103	28	50	42	28	.....
24	21	18	564	448	103	28	42	42	35	.....
25	21	18	255	515	91	28	42	42	35	.....
26	21	18	232	480	79	35	42	42	35	.....
27	21	18	232	415	79	42	42	42	35	.....
28	21	18	283	515	69	42	42	42	28	.....
29	21	18	232	553	59	42	42	35	28	.....
30	21	18	193	448	59	35	42	35	28	.....
31	18	.....	193	.....	50	35	.....	35	.....	.....

NOTE.—These discharges are based on rating curves applicable as follows:
Mar. 1 to May 23 fairly well defined between 18 and 180 second-feet.
May 24 to June 6 indirect method for shifting channel used.
June 7 to Dec. 7 fairly well defined between 28 and 355 second-feet.

Monthly discharge of East Fork of Boulder River near McLeod, Mont., for 1909.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
March	21	18	20.9	1,290	B.
April	18	18	18.0	1,070	B.
May	564	18	95.1	5,850	B.
June	952	205	493	29,300	B.
July	415	50	149	9,160	B.
August	59	28	39.0	2,400	B.
September	79	28	49.3	2,930	B.
October	42	35	41.3	2,540	B.
November	35	28	32.2	1,920	B.
December 1–7	28	28	28.0	389	B.
The period				56,800	

WEST FORK OF BOULDER RIVER NEAR BRUFFEYS, MONT.

This station, which is located at the highway bridge on the Livingston road about 7 miles from Bruffeys and 30 miles from Big Timber, was established May 7, 1904, by the State engineer of Montana, for the purpose of obtaining data in connection with irrigation projects. On May 4, 1907, it was transferred to the United States Geological Survey.

West Fork receives numerous small tributaries which enter from both sides above the station, the largest being Davis Creek, which comes in from the west 1½ miles upstream. One small irrigation ditch above the station diverts 3 or 4 second-feet of water. The drainage area is 94 square miles.

The channel is composed of small bowlders and coarse gravel and is reasonably permanent. The gage datum has remain unchanged since the station was established and the results obtained are excellent for the entire open season. At times during the winter this stream is open, but during the greater part of this period the gage heights are affected by ice.

A staff gage is located on the bridge from which flood measurements are made. For low and medium stages better results may be obtained by wading.

Discharge measurements of West Fork of Boulder River near Bruffeys, Mont., in 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
June 13	J. E. Stewart	68	140	2.53	484
Sept. 8	Raymond Richards	63	67	1.61	119
Nov. 23	.....do	50	40	1.36	68

Daily gage height, in feet, of West Fork of Boulder River near Bruffeys, Mont., for 1909.

[E. W. Gregory, observer.]

Day.	Nov.	Dec.	Day.	Nov.	Dec.	Day.	Nov.	Dec.
1		1.35	11		1.7	21		1.4
2		1.35	12		1.7	22		1.4
3		1.35	13		1.7	23	1.35	1.4
4		1.45	14		1.65	24	1.35	1.45
5		1.75	15		1.7	25	1.35	1.45
6		1.8	16		1.7	26	1.35	1.45
7		1.8	17		1.6	27	1.45	1.4
8		1.8	18		1.6	28	1.5	1.4
9		1.8	19		1.4	29	1.35	1.4
10		1.8	20		1.35	30	1.35	1.4
						31		1.5

NOTE.—All gage heights prior to Nov. 23 are in error.

WEST FORK OF BOULDER RIVER AT McLEOD, MONT.

This station was established May 4, 1907, at Koozer's private bridge, several hundred yards upstream from the highway bridge at McLeod post office, to determine the value of the stream for irrigation and power.

The West Fork has no important tributaries, deriving the greater part of its water from melting snow. It joins the main Boulder about 1 mile below the gaging station. The drainage area above the station is 137 square miles.

Water to irrigate about 800 acres of land is diverted above this station. A Carey Land Act project reclaiming 12,000 to 15,000 acres is now under investigation, the water to be diverted from the West Fork about 12 miles above the station.

The staff gage is fastened securely to a piling of the bridge near the right bank. The gage datum has remained unchanged. Measurements are made from this bridge or by wading. The bed of the stream is composed of bowlders and is rough but permanent. Ice forms during the winter months, but results obtained are good during the open season.

Discharge measurements of West Fork of Boulder River at McLeod, Mont., in 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Mar. 31	Raymond Richards	38	42.6	0.29	35.3
May 19	....do	52	63.6	.61	73.8
June 13	J. E. Stewart	56	129	1.97	569
Sept. 8	Raymond Richards	42	59	.78	110

Daily gage height, in feet, of West Fork of Boulder River at McLeod, Mont., for 1909.

[C. E. Walles, observer.]

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	0.3	0.4	2.0	2.9	1.3	0.6	1.0	0.6	0.5
2	.3	.4	3.2	2.8	1.2	.7	.9	.6	.5
3	.3	.5	3.4	2.8	1.1	.8	.85	.6	.4
4	.3	.9	3.5	2.6	1.1	1.0	.8	.6	.4
5	.3	.6	3.1	2.4	1.0	.8	.8	.6	.....
6	.3	.6	3.0	2.3	1.0	.8	.8	.6	.....
7	.3	.6	2.7	2.3	1.0	.8	.8	.55	.....
8	.4	.5	2.7	2.1	.9	.8	.7	.55	.....
9	.4	.5	2.6	2.0	.9	.8	.7	.55	.....
10	.4	.6	2.3	1.8	.8	.7	.7	.55	.....
11	.6	.6	2.3	1.95	.8	.8	.7	.55	.....
12	.3	.6	1.9	1.9	.8	.8	.7	.55	.....
13	.3	.6	2.0	1.9	.8	.8	.7	.55	.....
14	.1	.6	2.6	1.8	.7	1.0	.7	.55	.....
15	.3	.6	2.7	1.8	.7	.9	.7	.7	.....
16	.3	.6	3.3	1.8	.7	.9	.7	.7	.....
17	.3	.6	3.6	1.7	.8	.9	.7	.7	.....
18	.3	.6	3.0	1.6	.7	.8	.7	.8	.....
19	.3	.6	2.8	1.6	.7	.8	.7	.8	.....
20	.3	.7	2.9	1.6	.7	.8	.7	.5	.....
21	.3	.7	2.8	1.6	.7	.8	.65	.5	.....
22	.3	1.3	2.6	1.6	.7	.9	.65	.5	.....
23	.4	1.6	2.6	1.6	.6	.9	.65	.5	.....
24	.3	2.8	2.8	1.6	.6	.9	.65	.5	.....
25	.4	2.3	2.8	1.6	.6	.95	.65	.5	.....
26	.3	2.2	2.8	1.5	.6	.95	.6	.5	.....
27	.4	2.35	2.85	1.5	.6	.95	.6	.5	.....
28	.4	2.4	2.8	1.5	.6	1.0	.6	.5	.....
29	.3	2.0	2.7	1.4	.6	1.0	.6	.5	.....
30	.3	1.7	2.8	1.4	.6	1.0	.6	.5	.....
31	.....	1.7	.....	1.3	.6	.....	.6	.....	.....

NOTE.—Ice conditions during January, February, March, and December.

Daily discharge, in second-feet, of West Fork of Boulder River at McLeod, Mont., for 1909.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	34	44	602	1,280	264	73	165	73	57
2	34	44	1,570	1,190	228	92	138	73	57
3	34	57	1,780	1,190	195	114	126	73	44
4	34	138	1,880	1,020	195	165	114	73	44
5	34	73	1,470	868	165	114	114	73	.....
6	34	73	1,370	797	165	114	114	73	.....
7	34	73	1,100	797	165	114	114	65	.....
8	44	57	1,100	664	138	114	92	65	.....
9	44	57	1,020	602	138	114	92	65	.....
10	44	73	797	489	114	92	92	65	.....
11	73	73	797	572	114	114	92	65	.....
12	34	73	543	543	114	114	92	65	.....
13	34	73	602	543	114	114	92	65	.....
14	22	73	1,020	489	92	165	92	65	.....
15	34	73	1,100	489	92	138	92	92	.....
16	34	73	1,670	489	92	138	92	92	.....
17	34	73	1,990	438	114	138	92	92	.....
18	34	73	1,370	390	92	114	92	114	.....
19	34	73	1,190	390	92	114	92	114	.....
20	34	92	1,280	390	92	114	92	57	.....
21	34	92	1,190	390	92	114	82	57	.....
22	34	264	1,020	390	92	138	82	57	.....
23	44	390	1,020	390	73	138	82	57	.....
24	34	1,190	1,190	390	73	138	82	57	.....
25	44	797	1,190	390	73	152	82	57	.....
26	34	729	1,190	345	73	152	73	57	
27	44	832	1,230	345	73	152	73	57	.....
28	44	868	1,190	345	73	165	73	57	.....
29	34	602	1,100	303	73	165	73	57	.....
30	34	438	1,190	303	73	165	73	57	.....
31	.....	438	.....	264	73	.....	73	.....	.....

NOTE.—These discharges are based on a rating curve that is fairly well defined between 34 and 729 second-feet. Above a discharge of 729 second-feet the curve is based on one measurement only and is only approximate.

Monthly discharge of West Fork of Boulder River at McLeod, Mont., for 1909.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
April	73	22	37.2	2,210	B.
May	1,190	44	261	16,000	B.
June	1,990	543	1,190	70,800	B.
July	1,280	264	564	34,700	B.
August	264	73	117	7,190	B.
September	165	73	128	7,620	B.
October	165	73	94.5	5,810	B.
November	114	57	69.6	4,140	B.
The period				148,000	

SWEETGRASS CREEK ABOVE MELVILLE, MONT.

Sweetgrass Creek rises in the Crazy Mountains and flows southeastward to the Yellowstone, which it joins a short distance below Big Timber. It has no important tributaries. The drainage area is about 47 square miles.

The gaging station, which was established May 5, 1907, to determine the amount of water available for irrigation, storage, and power, is located at C. M. Rein's ranch, 16 miles northwest of Melville and 35 miles from Big Timber, on the reservoir site of a project proposed under the Carey Land Act.

A few small ditches divert water above the station. The stream freezes over during the winter months.

When the station was established a secondary staff gage, to be used during extreme high water, was installed at a different datum about 300 feet below the regular gage. During the high water of June and July, 1908, the regular gage was undermined, and after August 19 readings were discontinued. Beginning October 1, 1908, all gage heights refer to the secondary gage, which will be used hereafter as the regular gage. The new gage heights are not comparable with the old ones. Measurements are made from the foot bridge to which the gage is fastened or by wading.

The stream bed is composed of rough gravel and is permanent.

Discharge measurements of Sweetgrass Creek above Melville, Mont., in 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Apr. 1	Raymond Richards	32	15.4	1.30	11.3
May 17	do	32	12.7	1.33	12.8
June 11	J. E. Stewart	68	103	2.31	214
23	Raymond Richards	54	101	2.78	404
Sept. 10	do	48	49.4	1.99	104

Daily gage height, in feet, of Sweetgrass Creek above Melville, Mont., for 1909.

[Mrs. C. M. Rein, observer.]

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.3	1.35	3.1	2.8	2.05	1.8	1.9	1.8	1.6
2	1.3	1.35	3.4	2.7	2.0	1.85	1.9	1.8	1.6
3	1.3	1.35	3.6	2.5	2.0	2.0	1.9	1.75	1.6
4	1.3	1.35	3.5	2.5	2.0	2.1	1.9	1.75	.....
5	1.3	1.35	3.8	3.15	2.0	1.95	1.9	1.75	.....
6	1.3	1.35	3.0	2.7	2.0	1.95	1.9	1.75	.....
7	1.3	1.35	2.65	2.5	2.0	1.95	1.9	1.75	.....
8	1.3	1.35	2.6	2.4	2.0	1.95	1.9	1.7	.....
9	1.3	1.35	2.55	2.3	2.0	1.95	1.9	1.7	.....
10	1.35	1.35	2.45	2.3	1.95	1.95	1.9	1.7	.....
11	1.35	1.35	2.35	2.5	1.95	2.1	1.9	1.7	.....
12	1.35	1.35	2.4	2.35	1.95	2.1	1.9	1.7	.....
13	1.35	1.35	2.5	2.25	1.9	2.0	1.9	1.7	.....
14	1.35	1.35	2.5	2.2	1.9	2.0	1.9	1.7	.....
15	1.35	1.35	2.85	2.2	1.9	1.95	1.9	1.7	.....
16	1.35	1.35	3.25	2.2	1.9	1.95	1.9	1.65	.....
17	1.35	1.35	3.35	2.15	1.9	1.9	1.85	1.65	.....
18	1.35	1.35	3.2	2.15	1.9	1.9	1.85	1.65	.....
19	1.35	1.35	3.0	2.15	1.9	1.9	1.85	1.65	.....
20	1.35	1.35	4.7	2.2	1.9	1.9	1.85	1.65	.....
21	1.35	1.35	4.0	2.2	1.9	1.9	1.85	1.65	.....
22	1.35	1.35	3.15	2.2	1.9	1.9	1.85	1.6	.....
23	1.35	1.8	2.75	2.15	1.85	1.9	1.85	1.6	.....
24	1.35	2.30	2.7	2.15	1.85	1.9	1.85	1.6	.....
25	1.35	2.65	2.65	2.15	1.85	1.9	1.8	1.6	.....
26	1.35	2.95	2.75	2.15	1.8	1.9	1.8	1.6	.....
27	1.35	3.1	2.9	2.15	1.8	1.9	1.8	1.6	.....
28	1.35	3.0	3.0	2.1	1.8	1.9	1.8	1.6	.....
29	1.35	2.8	3.0	2.1	1.8	1.9	1.8	1.6	.....
30	1.35	2.5	2.9	2.1	1.8	1.9	1.8	1.6	.....
31	.....	2.6	.....	2.05	1.8	.....	1.8	.....	.....

NOTE.—Ice onditions during January, February, March, and December.

Daily discharge, in second-feet, of Sweetgrass Creek above Melville, Mont., for 1909.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	11	12	559	416	120	60	80	60	30
2	11	12	710	371	105	70	80	60	30
3	11	12	814	284	105	105	80	52	30
4	11	12	762	284	105	134	80	52	.....
5	11	12	920	584	105	92	80	52	.....
6	11	12	510	371	105	92	80	52	.....
7	11	12	349	284	105	92	80	52	.....
8	11	12	327	243	105	92	80	44	.....
9	11	12	306	204	105	92	80	44	.....
10	12	12	264	204	92	92	80	44	.....
11	12	12	224	284	92	134	80	44	.....
12	12	12	243	224	92	134	80	44	.....
13	12	12	284	186	80	105	80	44	.....
14	12	12	284	167	80	105	80	44	.....
15	12	12	439	167	80	92	80	44	.....
16	12	12	634	167	80	92	80	37	.....
17	12	12	684	150	80	80	70	37	.....
18	12	12	609	150	80	80	70	37	.....
19	12	12	510	150	80	80	70	37	.....
20	12	12	1,410	167	80	80	70	37	.....
21	12	12	1,030	167	80	80	70	37	.....
22	12	12	584	167	80	80	70	30	.....
23	12	60	394	150	70	80	70	30	.....
24	12	204	371	150	70	80	70	30	.....
25	12	349	349	150	70	80	60	30	.....
26	12	486	394	150	60	80	60	30	.....
27	12	559	462	150	60	80	60	30	.....
28	12	510	510	134	60	80	60	30	.....
29	12	416	510	134	60	80	60	30	.....
30	12	284	462	134	60	80	60	30	.....
31	.....	327	.....	120	60	80	60	.....	.....

NOTE.—These discharges are based on a rating curve that is well defined between 11 and 510 second-feet.

Monthly discharge of Sweetgrass Creek above Melville, Mont., for 1909.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
April	12	11	11.7	696	B.
May	559	12	112	6,890	A.
June	1,410	224	530	31,500	A.
July	584	120	215	13,200	A.
August	120	60	84.1	5,170	A.
September	134	60	90.1	5,360	A.
October	80	60	72.9	4,480	A.
November	60	30	40.8	2,430	A.
The period				69,700	

SWEETGRASS CREEK BELOW MELVILLE, MONT.

This station, which was established May 4, 1907, to determine the amount of water available for irrigation, was located at Adams's ranch, 9 miles below Melville, 20 miles from Big Timber, and 2½ miles below the head gate of the Glass-Lindsay Land Co.'s canal, a Carey Land Act project. It was discontinued April 1, 1909, and a new station was established at McAllister's ranch about 3 miles above Adams's ranch and just above the head gate of the canal owned by the Glass-Lindsay Land Co.

Many diversions are made on this stream, with a total appropriation of 550 second-feet of adjudicated rights. The Glass-Lindsay Canal, partly completed, will carry 575 second-feet and irrigate 30,000 acres. This canal will divert water into two storage reservoirs, with capacities of 12,000 and 6,000 acre-feet, respectively, which will be filled from the spring run-off, the low-water flow being all appropriated.

The staff gage is located on the left bank of the stream near the observer's house. Measurements are best made by wading at this section.

The stream bed is composed of clean gravel and is nonshifting. Ice forms during the winter season. Records obtained are good.

Discharge measurements of Sweetgrass Creek below Melville, Mont., in 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Apr. 1	Raymond Richards	22	13.8	1.17	23.8
May 17	....do	32	22.9	1.26	37.3
June 11	J. E. Stewart	70	104	2.24	310
June 22	Raymond Richards	85	144	2.67	551
Sept. 9	....do	29	33	1.63	98.4

Daily gage height, in feet, of Sweetgrass Creek below Melville, Mont., for 1909.

[Peter McDonald, observer.]

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	1.2	1.2	2.45	2.2	1.6	1.5	1.7	1.55
2	1.2	1.2	2.55	2.2	1.55	1.6	1.7	1.55
3	1.2	1.05	2.7	2.2	1.55	1.8	1.65	1.55
4	1.15	1.1	2.75	2.05	1.5	1.8	1.65	1.55
5	1.1	1.05	2.75	2.1	1.45	1.7	1.65	1.5
6	1.15	1.2	2.7	2.4	1.4	1.6	1.6	1.5
7	1.1	1.2	2.4	2.05	1.45	1.7	1.6	.....
8	1.15	1.2	2.45	1.85	1.4	1.6	1.6	.....
9	1.1	1.2	2.65	1.65	1.35	1.6	1.6	.....
10	1.15	1.2	2.5	1.6	1.3	1.6	1.65	.....
11	1.15	1.2	2.3	1.6	1.3	1.8	1.65	.....
12	1.2	1.2	2.2	1.55	1.3	1.7	1.65	.....
13	1.2	1.15	2.2	1.55	1.35	1.85	1.65	.....
14	1.2	1.15	2.35	1.5	1.4	1.7	1.65	.....
15	1.2	1.15	2.45	1.5	1.35	1.7	1.65	.....
16	1.2	1.2	2.7	1.5	1.3	1.6	1.65	.....
17	1.2	1.3	2.85	1.5	1.3	1.65	1.6	.....
18	1.2	1.3	2.85	1.5	1.35	1.65	1.6	.....
19	1.2	1.3	2.7	1.5	1.4	1.65	1.6	.....
20	1.2	1.2	3.0	1.5	1.4	1.65	1.6	.....
21	1.2	1.2	3.3	2.1	1.4	1.65	1.6	.....
22	1.2	1.25	2.7	1.75	1.4	1.7	1.6	.....
23	1.2	1.4	2.5	1.7	1.4	1.65	1.6	.....
24	1.2	1.85	2.4	1.7	1.6	1.6	1.6	.....
25	1.2	2.25	2.2	1.7	1.55	1.6	1.6	.....
26	1.2	2.35	2.15	1.5	1.4	1.6	1.6	.....
27	1.2	2.55	2.15	1.8	1.4	1.6	1.55	.....
28	1.2	2.55	2.2	1.7	1.35	1.6	1.5	.....
29	1.2	2.5	2.35	1.65	1.35	1.6	1.5	.....
30	1.2	2.3	2.2	1.65	1.35	1.65	1.5	.....
31	.....	2.15	.....	1.65	1.4	.....	1.55	.....

NOTE.—Ice conditions in January, February, March, November, and December.

Daily discharge, in second-feet, of Sweetgrass Creek below Melville, Mont., for 1909.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	30	30	421	288	91	73	113	82
2	30	30	480	288	82	91	113	82
3	30	14	575	288	82	138	102	82
4	24	19	608	223	73	138	102	82
5	19	14	608	243	65	113	102	73
6	24	30	575	392	57	91	91	73
7	19	30	392	223	65	113	91	.....
8	24	30	421	153	57	91	91	.....
9	19	30	543	102	50	91	91	.....
10	24	30	450	91	43	91	102	.....
11	24	30	338	91	43	138	102	.....
12	30	30	288	82	43	113	102	.....
13	30	24	288	82	50	153	102	.....
14	30	24	365	73	57	113	102	.....
15	30	24	421	73	50	113	102	.....
16	30	30	575	73	43	91	102	.....
17	30	43	675	73	43	102	91	.....
18	30	43	675	73	50	102	91	.....
19	30	43	575	73	57	102	91	.....
20	30	30	778	73	57	102	91	.....
21	30	30	988	243	57	102	91	.....
22	30	36	575	126	57	113	91	.....
23	30	57	450	113	57	102	91	.....
24	30	153	392	113	91	91	91	.....
25	30	313	288	113	82	91	91	.....
26	30	365	266	73	57	91	91	.....
27	30	480	266	138	57	91	82	.....
28	30	480	288	113	50	91	73	.....
29	30	450	365	102	50	91	73	.....
30	30	338	288	102	50	102	73	.....
31	.....	266	.....	102	57	.....	82	.....

NOTE.—These discharges are based on a rating curve that is well defined between 8 and 778 second-feet.

Monthly discharge of Sweetgrass Creek below Melville, Mont., for 1909.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
April	30	19	27.9	1,660	B.
May	480	13.5	114	7,010	A.
June	988	266	474	28,200	A.
July	392	73	142	8,730	A.
August	91	43	58.8	3,620	A.
September	153	73	104	6,190	A.
October	113	73	93.6	5,760	A.
Nov. 1-6	82	73	79.0	940	A.
The period				62,100	

CLARK FORK AT FROMBERG, MONT.

Clark Fork enters Yellowstone River from the south about 15 miles southwest of Billings, Mont. The stream is bordered by irrigable land which is used for agriculture.

The gaging station, which was established June 3, 1905, to determine the amount of water available for irrigation, is located on the highway bridge one-half mile east of the Northern Pacific Railway station at Fromberg, Mont.

One small stream, Red Rock Creek, flows into the river between the gaging station and its mouth. The drainage area above the station is about 2,500 square miles.

As almost all the valley land is under irrigation many diversions are made, but owing to the abundance of water only a small portion of the flow is used.

The ice period ranges from December to the middle of March, but frequently during this period the river breaks up and floating ice may be seen.

The original staff gage has been replaced by a standard chain gage fastened to the upstream side of the bridge but no change in gage datum has occurred. Records obtained are excellent. The gaging section which is from the bridge would be ideal if it were not for the middle pier of the bridge which divides the channel. The bed of the stream is composed of rock and gravel, is free from vegetation, and is permanent.

Discharge measurements of Clark Fork at Fromberg, Mont., in 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Apr. 5	Raymond Richards	123	295	3.50	320
May 22	do	183	470	4.68	1,300
June 24	do	230	1,210	8.25	7,780
July 17	J. E. Stewart	210	780	6.11	3,050
Sept. 13	Raymond Richards	151	446	4.49	1,030

Daily gage height, in feet, of Clark Fork at Fromberg, Mont., for 1909.

[Mrs. E. V. Moran, observer.]

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	3.7	3.5	3.55	8.15	9.5	5.0	4.2	3.85	3.45
2	3.7	3.5	3.55	8.6	9.5	4.95	5.1	3.85	3.45
3	3.7	3.5	3.8	8.9	9.7	5.0	5.1	3.85	3.45
4	3.7	3.45	3.8	9.1	9.7	4.9	4.85	3.85	3.45
5	3.7	3.4	4.0	8.9	9.6	5.0	4.55	3.85	3.45
6	3.7	3.4	4.0	8.7	9.3	4.8	4.5	3.85	3.45
7	3.7	3.4	4.0	8.4	8.95	4.8	4.5	3.85	3.45
8	3.7	3.4	4.5	8.3	8.35	4.9	4.5	3.75	3.45
9	3.7	3.45	4.5	8.0	7.95	4.8	4.45	3.75	3.45
10	3.6	3.45	4.5	7.85	7.2	4.8	4.6	3.75	3.45
11	3.6	3.5	4.0	7.75	6.95	4.8	4.7	3.75	3.45
12	3.6	3.5	4.0	7.5	6.6	4.75	4.55	3.75	3.45
13	3.6	3.5	4.25	7.7	6.3	4.7	4.45	3.75	3.45
14	3.6	3.5	4.05	7.55	5.95	4.7	4.35	3.75	3.45
15	3.6	3.55	4.15	7.65	5.8	4.8	4.3	3.65	3.45
16	3.6	3.6	4.35	7.7	5.8	4.75	4.2	3.65	3.45
17	3.6	3.55	4.1	8.25	5.75	4.8	4.15	3.65	3.45
18	3.6	3.5	3.95	8.9	5.7	4.8	4.1	3.65	3.45
19	3.6	3.5	4.0	9.4	5.7	4.8	4.1	3.65	3.45
20	3.6	3.5	4.1	9.1	5.7	4.7	4.1	3.65	3.45
21	3.6	3.5	4.4	8.95	5.7	4.7	4.1	3.65	3.45
22	3.6	3.5	4.8	8.4	5.7	4.7	4.05	3.65	3.45
23	3.6	3.5	5.5	8.4	5.6	4.7	3.9	3.65	3.45
24	3.6	3.5	6.05	8.4	5.55	4.6	3.9	3.6	3.45
25	3.6	3.5	6.0	8.4	5.45	4.6	3.9	3.55	3.45
26	3.6	3.5	6.5	8.7	5.4	4.55	3.9	3.55	3.45
27	3.6	3.5	6.9	8.8	5.3	4.45	3.9	3.55	3.45
28	3.6	3.5	6.9	8.95	5.3	4.4	3.9	3.55	3.45
29	3.6	3.5	7.65	9.15	5.15	4.4	3.9	3.55	3.45
30	3.5	3.5	7.9	9.4	5.05	4.35	3.9	3.55	3.45
31	3.5	.....	7.9	.....	5.0	4.25	.....	3.55	.....

NOTE.—Ice during January, February, and December.

Daily discharge, in second-feet, of Clark Fork at Fromberg, Mont., for 1909.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	430	325	350	7,480	11,500	1,560	780	522	300
2	430	325	350	8,810	11,500	1,500	1,680	522	300
3	430	325	490	9,410	12,100	1,560	1,680	522	300
4	430	300	490	10,300	12,100	1,440	1,390	522	300
5	430	275	625	9,710	11,800	1,560	1,080	522	300
6	430	275	625	9,110	10,900	1,340	1,040	522	300
7	430	275	625	8,210	9,860	1,340	1,040	522	300
8	430	275	1,040	7,910	8,060	1,440	1,040	460	300
9	430	300	1,040	7,030	6,900	1,340	990	460	300
10	375	300	1,040	6,620	5,050	1,340	1,130	460	300
11	375	325	625	6,360	4,530	1,340	1,230	460	300
12	375	325	625	5,740	3,880	1,280	1,080	460	300
13	375	325	820	6,230	3,360	1,230	990	460	300
14	375	325	663	5,860	2,780	1,230	900	460	300
15	375	350	740	6,600	2,560	1,340	860	403	300
16	375	375	902	6,230	2,560	1,280	780	403	300
17	375	350	700	7,760	2,500	1,340	740	403	300
18	375	325	590	9,710	2,420	1,340	700	403	300
19	375	325	625	11,200	2,420	1,340	700	403	300
20	375	325	700	10,300	2,420	1,230	700	403	300
21	375	325	945	9,860	2,420	1,230	700	403	300
22	375	325	1,340	8,210	2,420	1,230	663	403	300
23	375	325	2,160	8,210	2,290	1,230	555	403	300
24	375	325	2,940	8,210	2,220	1,130	555	375	300
25	375	325	2,860	8,210	2,100	1,130	555	350	300
26	375	325	3,700	9,110	2,040	1,080	555	350	300
27	375	325	4,440	9,410	1,920	990	555	350	300
28	375	325	4,440	9,860	1,920	945	555	350	300
29	375	325	6,100	10,500	1,620	945	555	350	300
30	325	325	6,760	11,200	1,620	900	555	350	300
31	325	.....	6,760	.....	1,560	820	.....	350	.....

NOTE.—These discharges were obtained from a rating curve well defined between 200 and 8,000 second-feet.

Monthly discharge of Clark Fork at Fromberg, Mont., for 1909.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
March	430	325	359	22,100	A.
April	375	275	319	19,000	A.
May	6,760	350	1,810	111,000	A.
June	11,200	5,740	8,430	502,000	A.
July	12,100	1,560	4,880	300,000	A.
August	1,560	820	1,260	77,500	A.
September	1,680	555	878	52,200	A.
October	522	350	430	26,400	A.
November	300	300	300	17,900	B.
The period				1,130,000	

PRYOR CREEK AT HUNTLEY, MONT.

Pryor Creek rises in the Pryor Mountains in southern Carbon County, Mont., flows northeastward, and enters Yellowstone River from the south about 15 miles northeast of Billings.

The channel is straight with uniform slope for 800 feet above and below the station. The banks are steep and uniformly graded, are clean, and will not overflow. The current is moderate. The bed is composed of clay and gravel and may change somewhat. On the upper portion of the stream some water is diverted for irrigation.

The gaging station was originally established August 6, 1904, to determine the amount of water available for irrigation. On June 15–16, 1906, the creek was turned into a new channel by the United States Reclamation Service, and a station was established on the steel highway bridge crossing this channel one-half mile from the railroad station at Huntley. Since then the chain gage datum has not been changed. Measurements are made from this bridge.

The stream freezes over during the winter months. Results obtained are good.

Discharge measurements of Pryor Creek at Huntley, Mont., in 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Apr. 7	Raymond Richards	29	25.7	1.48	43.7
May 20	do	32.5	60.8	1.94	93.4
June 25	do	29	47.9	1.49	46.9
July 19	J. E. Stewart	33	38.4	1.18	17.3
Sept. 15	Raymond Richards	28.5	51.1	1.41	33.9

Daily gage height, in feet, of Pryor Creek at Huntley, Mont., for 1909.

[Arthur Foster, observer.]

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	.....	1.5	1.8	2.0	1.4	1.2	.....	1.1	1.25
2	.....	1.5	1.75	2.0	1.4	1.2	.....	1.1	1.25
3	.....	1.5	1.7	2.0	1.4	1.15	.....	1.05	1.25
4	.....	1.6	1.7	1.9	1.4	1.15	.....	1.05	1.25
5	.....	1.55	1.7	1.8	1.4	1.2	.....	1.05	1.25
6	.....	1.55	1.8	1.8	1.4	1.2	.....	1.05	1.25
7	.....	1.5	1.9	1.75	1.4	1.2	.....	1.1	1.25
8	.....	1.5	1.9	1.75	1.4	6.3	.....	1.1	1.25
9	.....	1.5	1.8	1.8	1.4	.....	.....	1.05	1.25
10	.....	1.5	1.7	2.0	1.4	.....	.....	1.15	1.25
11	.....	1.5	1.7	2.0	1.4	.....	.....	1.15	1.25
12	.....	1.5	1.7	2.0	1.4	.....	.....	1.15	1.25
13	.....	1.5	1.7	2.4	1.4	.....	.....	1.15	1.25
14	.....	1.5	1.6	2.2	1.3	.....	.....	1.35	1.25
15	.....	1.8	1.6	1.9	1.3	.....	1.4	1.25	1.25
16	.....	1.7	1.6	1.8	1.3	.....	.....	1.25	1.25
17	.....	1.6	1.9	1.7	1.3	.....	.....	1.25	1.25
18	.....	1.6	1.9	1.7	1.3	.....	.....	1.25	1.25
19	.....	1.6	1.9	1.7	1.2	.....	.....	1.35	1.25
20	.....	1.85	1.9	1.7	1.2	.....	.....	1.35	1.25
21	.....	1.8	1.9	1.6	1.2	.....	.....	1.25	1.25
22	.....	1.8	1.9	1.6	1.2	.....	.....	1.2	1.25
23	.....	1.7	3.3	1.6	1.2	.....	.....	1.25	1.35
24	.....	1.65	2.8	1.5	1.2	.....	.....	1.25	1.35
25	1.9	1.65	4.4	1.5	1.2	.....	.....	1.25	1.35
26	1.7	1.7	3.2	1.5	1.2	.....	.....	1.25	1.35
27	1.65	1.7	2.6	1.5	1.2	.....	1.15	1.25	1.4
28	1.6	1.6	2.4	1.5	1.4	.....	1.05	1.25	1.4
29	1.6	1.6	2.2	1.4	1.3	.....	1.05	1.25	1.4
30	1.6	1.7	2.1	1.4	1.2	.....	1.15	1.25	.....
31	1.5	.....	2.1	.....	1.2	.....	.....	1.25	.....

NOTE.—Ice conditions Jan. 1 to Mar. 24 and Dec. 24 to 31.

Daily discharge, in second-feet, of Pryor Creek at Huntley, Mont., for 1909.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	.....	46	78	102	38	19	.....	13	22
2	.....	46	72	102	38	19	.....	13	22
3	.....	46	67	102	37	16	.....	10	22
4	.....	56	67	90	37	16	.....	10	22
5	.....	51	67	78	37	19	.....	10	22
6	.....	51	78	78	36	19	.....	10	22
7	.....	46	90	72	36	19	.....	13	22
8	.....	46	90	72	36	990	.....	13	22
9	.....	46	78	78	35	.....	.....	10	22
10	.....	46	67	102	35	.....	.....	16	22
11	.....	46	67	102	34	.....	.....	16	22
12	.....	46	67	102	34	.....	.....	16	22
13	.....	46	67	156	34	.....	.....	16	22
14	.....	46	56	128	26	.....	.....	29	22
15	.....	78	56	90	26	.....	33	22	22
16	.....	67	56	78	26	.....	.....	22	22
17	.....	56	90	67	26	.....	.....	22	22
18	.....	56	90	67	26	.....	.....	22	22
19	.....	56	90	67	19	.....	.....	29	22
20	.....	84	90	67	19	.....	.....	29	22
21	.....	78	90	56	19	.....	.....	22	22
22	.....	78	90	56	19	.....	.....	19	22
23	.....	67	309	56	19	.....	.....	22	29
24	.....	62	218	46	19	.....	.....	22	29
25	90	62	555	46	19	.....	.....	22	29
26	67	67	290	46	19	.....	.....	22	29
27	62	67	186	47	19	.....	16	22	33
28	56	56	156	47	33	.....	10	22	33
29	56	56	128	38	25	.....	10	22	33
30	56	67	115	38	19	.....	16	22	33
31	46	.....	115	.....	19	.....	.....	22	.....

NOTE.—These discharges are based on rating curves applicable as follows:
Mar. 25 to June 25, fairly well defined between 12 and 171 second-feet.
July 20 to Nov. 30, fairly well defined between 13 and 41 second-feet.

Monthly discharge of Pryor Creek at Huntley, Mont., for 1909.

[Drainage area, 800 square miles.]

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
March 25–31	90	46	61.9	0.077	0.02	859	B.
April	84	46	57.4	.072	.08	3,420	B.
May	555	56	120	.150	.17	7,380	B.
June	156	38	75.9	.095	.11	4,520	B.
July	38	19	27.9	.035	.04	1,720	B.
August 1–8	990	16	140	.175	.05	2,220	C.
September, 5 days	33	10	17.0	.021	.004	168	B.
October	29	10	18.7	.023	.03	1,150	B.
November	33	22	24.4	.030	.03	1,450	B.
The period						22,900	

BIGHORN RIVER BASIN.

DESCRIPTION.

Bighorn River is formed by the junction of Big and Little Wind rivers near Riverton, Wyo.

Big Wind River rises some 50 miles southeast of the Yellowstone National Park in the mountains of the Shoshone and Wind River ranges, whose highest peaks attain altitudes of more than 12,000 feet, and flows in a general southeasterly direction for about 100 miles to its mouth, where the elevation is 5,100 feet. The upper part of its basin is hilly and mountainous except along the river and its tributaries, where the bottom lands average a mile or so in width. About 40 miles above Riverton the valley broadens out and includes stretches of land several miles in width excellently adapted to agriculture. The most important tributary of Big Wind River is Bull Lake Creek; among other tributaries may be mentioned Red Dinwoodie, Dry, Willow, and Meadow creeks.

Little Wind River rises on the eastern side of the Wind River Range and flows eastward for about 50 miles to its confluence with Big Wind River. At the junction of the North and South forks of the Little Wind, near Fort Washakie, the valleys of these streams widen out into an excellent agricultural section. Above Fort Washakie the drainage area is generally hilly and mountainous in character.

The principal tributary of Little Wind River is the Popo Agie, which rises in the high mountains and flows in a northeasterly direction to its confluence with the Little Wind River at Arapahoe, Wyo., and which emerges from the mountains about 8 miles above Lander, Wyo. This stream at its mouth is considerably larger than Little Wind River. Important tributaries of the Popo Agie are the North Fork, which enters just below Lander, and the Little Popo Agie, which comes in at Hudson, about 10 miles below Lander. The

valleys of the Popo Agie and its tributaries are comparatively wide and form one of the oldest irrigated sections of Wyoming. Among the other tributaries of the Little Wind River are St. Lawrence, Sage, and Trout creeks.

From Riverton, Wyo., to its junction with the Yellowstone near Bighorn, Mont., a distance of about 250 miles, the Bighorn flows northward. At Thermopolis, 55 miles below Riverton, the elevation is about 4,200 feet; at the mouth of the Shoshone, 90 miles below Thermopolis, it is 3,800 feet; and at the mouth of the Bighorn it is about 2,700 feet.

Owl Creek, No Wood River, Greybull River, Shell Creek, Shoshone River, and Little Bighorn are important tributaries of the Bighorn. The drainage area of the Bighorn River above the mouth of the Shoshone is about 15,500 square miles.

The mountainous area drained by the Bighorn and its tributaries contains several hundred square miles of timber land, a great part of which is included in national forests. The remainder of the area, with the exception of occasional strips of land under cultivation, may be classed as range and sagebrush land.

The rainfall seems to vary from 20 inches or more above an altitude of 9,000 feet to an average of 12 to 15 inches at elevations from 4,000 to 7,000 feet. Below an altitude of 4,000 feet the rainfall is locally less than 12 inches.

The winters on the upper Bighorn above an altitude of 4,500 feet are severe. Snowfall is abundant in the high mountains, and heavy snowstorms also take place in the more open country, but in the plains section the snow does not usually remain for long periods. As compared with those in the upper basin the winters in what is called the Bighorn Basin are mild. This basin begins where the river emerges from the canyon above Thermopolis and extends nearly to the mouth of the river. Most of the lower drainage area of Shoshone River is included in this basin. This belt is subject to the influence of the so-called chinook winds. Nearer the mouth of the stream the winters are more severe.

Irrigation along Bighorn River is developing very rapidly. For a number of years irrigation has been practiced in comparatively restricted tracts at various points along the stream and its tributaries, as in the Lander and Thermopolis districts in Wyoming, and in the Crow Reservation in Montana, as well as on the No Wood, Greybull, Shoshone, and other tributaries; but such irrigation has used only a small part of the total flow of these streams. Extensive irrigation works now being constructed by the Indian Service on the Shoshone Reservation in Wyoming and the Crow Reservation in Montana will eventually serve probably 225,000 acres; the Shoshone project of the United States Reclamation Service will provide for the

irrigation of more than 125,000 acres along Shoshone River; by using some of the storage sites on Big Wind River the Wyoming Central Irrigation Co. will irrigate several hundred thousand acres of land near Riverton, and other private enterprises will irrigate considerable land near Basin. Many opportunities for additional projects are to be found on the tributary streams.

As a large part of the drainage area of Bighorn River has never been carefully surveyed, the full extent of the storage possibilities is not very well known, but undoubtedly many excellent reservoir sites exist at the headwaters of Big Wind and Little Wind rivers. Among others may be mentioned the site on Bull Lake Creek, which is situated at a natural lake on this stream, and many similar lakes are to be found in that locality. It is believed that very good sites can be found for storing the flood waters of Paint Rock, Owl Creek, Shell Creek, and Greybull River. Many of these streams have a large annual run-off, but some of them are intermittent in character.

Probably the best reservoir site in the area is the one which the Reclamation Service is now developing on Shoshone River 8 miles above Cody, Wyo. With a dam 310 feet high above foundation, the reservoir will have a capacity of 456,000 acre-feet.

The value of the land along the Bighorn River and its tributaries for agriculture will probably restrict water-power development to streams of the headwater regions. The fall of many of these streams exceeds 300 feet to the mile. Popo Agie and Little Wind rivers probably afford the best opportunities. In the canyon of the Bighorn above Thermopolis, where the Big Horn Co. is now constructing a plant with a capacity of about 5,000 horsepower, at least 25,000 horsepower can be developed. Of the 100,000 horsepower or more which might easily be developed, probably less than 1,000 horsepower are now being utilized.

BIG WIND RIVER NEAR WIND RIVER, WYO.

This station, which was established November 3, 1908, to replace the station near Riverton, Wyo., and to obtain data for the United States Indian Service concerning the amount of water available for irrigation, was located at Speed Stagner's ranch, about 20 miles north of Wind River and 35 miles above Riverton. It is about 4 miles below the mouth of Bull Lake Creek, the only important tributary in the vicinity. The station was discontinued September 22, 1909.

The United States Indian Service has recently completed several irrigation canals which will divert water from numerous tributaries above for the irrigation of several thousand acres. Excellent reservoir sites are to be found on many of these tributaries. It is believed that considerable opportunities exist for additional filings on Big

Wind River, though the Wyoming Central Irrigation Co. has filed on practically all of the available flow.

The vertical rod gage first established was replaced in the early part of 1909 by a chain gage on the right bank. The datum of the gage remained unchanged. The gage was not read except by the engineers on their occasional visits. Discharge measurements were made mainly from a cable about 100 yards downstream from the gage.

Ice affects the flow for about four months each year, but otherwise conditions favored very good results.

Discharge measurements of Big Wind River at Speed Stagner's, near Wind River, Wyo., in 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Jan. 18[a]	R. L. Cooper	115	242	2.64	513
Mar. 12[a]	do	90	97	.50	234
Apr. 13	do	90	115	.66	305
May 16	do	108	177	1.22	583
June 8	do	247	934	5.20	7,202
Sept. 22	Poorman and Gonin	137	347	1.32	915

[a] Ice conditions.

BIGHORN RIVER NEAR HARDIN, MONT.[1]

This station, which was established June 16, 1904, to determine the amount of water available for irrigation, is located at the bridge of the Burlington & Missouri River Railroad about half a mile above the junction of Bighorn and Little Bighorn rivers, and 2 miles from Hardin. Water is diverted a few miles above the station by a private irrigation company to irrigate land on the west side of the river.

The river freezes over during the winter months.

The present gage datum is 3 feet higher than that of the original chain gage; but on August 10, 1905, the gage was moved to the west span of the bridge and the datum lowered 2 feet. Gaging conditions at this station are good. The bed of the stream is of gravel, and is free from vegetation. All measurements are made from this railroad bridge.

Discharge measurements of Bighorn River near Hardin, Mont., in 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Apr. 6	Raymond Richards	437	1,520	3.21	1,880
May 21	do	438	1,720	3.78	3,150
June 26	do	438	3,660	8.17	24,200
July 18	J. E. Stewart	437	3,170	6.25	11,800
Sept. 14	Raymond Richards	438	2,410	4.80	5,970

[1] Referred to as at "Fort Custer" in Water-Supply Paper 208, p. 96.

Daily gage height, in feet, of Bighorn River near Hardin, Mont., for 1909.

[J. S. Tupper, observer.]

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	5.45	3.95	3.3	5.95	9.0	5.3	4.3	3.5	3.3	3.9
2	5.35	3.85	3.3	6.15	9.2	5.2	4.3	3.5	3.3	3.9
3	5.25	3.85	3.4	6.45	9.3	5.1	4.4	3.5	3.3	3.8
4	5.35	3.55	3.4	7.25	9.5	5.0	4.4	3.4	3.3	3.8
5	5.55	3.35	3.6	7.75	9.6	5.0	5.2	3.4	3.3	3.6
6	5.65	3.2	3.6	7.95	8.9	4.8	5.1	3.4	3.3	3.6
7	5.55	3.2	3.7	8.25	8.5	4.8	5.0	3.5	3.3	3.8
8	5.45	3.2	3.7	7.55	7.9	4.8	4.9	3.5	3.2	3.7
9	5.25	3.25	3.7	7.85	7.7	4.8	4.7	3.5	3.2	3.6
10	4.95	3.3	3.6	7.95	7.4	4.9	4.7	3.5	3.2	3.6
11	4.75	3.3	3.6	7.55	7.0	4.9	4.6	3.5	3.2	3.6
12	4.55	3.3	3.6	7.15	6.8	4.8	4.6	3.5	3.2	3.5
13	4.65	3.3	3.7	6.95	6.8	4.7	4.6	3.4	3.2	.....
14	4.75	3.2	3.7	7.25	6.6	4.6	4.8	3.4	3.2	.....
15	4.75	3.2	3.7	7.45	6.5	4.6	4.7	3.4	3.2	.....
16	4.95	3.2	3.7	7.55	6.3	4.6	4.6	3.4	3.2	.....
17	5.15	3.1	3.65	7.75	6.2	4.6	4.5	3.4	3.3	.....
18	5.05	3.1	3.65	8.15	6.25	4.6	4.3	3.4	3.3	.....
19	5.05	3.1	3.65	8.95	6.2	4.5	4.3	3.4	3.3	.....
20	4.25	3.1	3.75	9.35	6.2	4.5	4.1	3.4	3.4	.....
21	3.95	3.2	4.15	8.75	6.1	4.5	4.0	3.4	3.4	.....
22	3.95	3.2	4.55	8.65	6.0	4.5	4.0	3.3	3.4	.....
23	4.15	3.2	4.65	8.55	6.0	4.4	3.9	3.3	3.6	.....
24	4.15	3.3	4.85	8.25	6.0	4.3	3.9	3.3	3.7	.....
25	4.05	3.3	5.15	8.15	5.9	4.3	3.8	3.3	3.7	.....
26	3.85	3.3	5.45	8.05	5.9	4.2	3.8	3.3	4.0	.....
27	3.95	3.3	5.55	8.25	6.1	4.3	3.6	3.3	4.1	.....
28	4.05	3.4	5.65	8.35	5.9	4.3	3.6	3.3	4.1	.....
29	4.05	3.4	5.85	8.85	5.8	4.3	3.6	3.3	4.0	.....
30	3.95	3.3	5.85	8.95	5.6	4.2	3.5	3.3	4.0	.....
31	3.95	.....	5.75	.....	5.4	4.2	.....	3.3	.....	.....

NOTE.—Ice conditions in January and February, also Dec. 13 to Dec. 31.

Daily discharge, in second-feet, of Bighorn River near Hardin, Mont., for 1909.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	8,280	3,480	2,060	10,400	30,900	7,690	4,410	2,450	2,060	3,350
2	7,880	3,230	2,060	11,300	32,600	7,310	4,410	2,450	2,060	3,350
3	7,500	3,230	2,250	12,800	33,400	6,950	4,700	2,450	2,060	3,110
4	7,880	2,560	2,250	17,400	35,000	6,600	4,700	2,250	2,060	3,110
5	8,680	2,160	2,660	20,900	35,900	6,600	7,310	2,250	2,060	2,660
6	9,100	1,880	2,660	22,400	30,100	5,930	6,950	2,250	2,060	2,660
7	8,680	1,880	2,880	24,800	26,800	5,930	6,600	2,450	2,060	3,110
8	8,280	1,880	2,880	19,400	22,000	5,930	6,260	2,450	1,880	2,880
9	7,500	1,970	2,880	21,600	20,500	5,930	5,610	2,450	1,880	2,660
10	6,430	2,060	2,660	22,400	18,400	6,260	5,610	2,450	1,880	2,660
11	5,770	2,060	2,660	19,400	15,900	6,260	5,300	2,450	1,880	2,660
12	5,150	2,060	2,660	16,800	14,700	5,930	5,300	2,450	1,880	2,450
13	5,460	2,060	2,880	15,600	14,700	5,610	5,300	2,250	1,880	.....
14	5,770	1,880	2,880	17,400	13,600	5,300	5,930	2,250	1,880	.....
15	5,770	1,880	2,880	18,800	13,100	5,300	5,610	2,250	1,880	.....
16	6,430	1,880	2,880	19,400	12,100	5,300	5,300	2,250	1,880	.....
17	7,130	1,710	2,770	20,900	11,600	5,300	5,000	2,250	2,060	.....
18	6,780	1,710	2,770	24,000	11,800	5,300	4,410	2,250	2,060	.....
19	6,780	1,710	2,770	30,500	11,600	5,000	4,410	2,250	2,060	.....
20	4,270	1,710	3,000	33,800	11,600	5,000	3,860	2,250	2,250	.....
21	3,480	1,880	4,000	28,800	11,100	5,000	3,600	2,250	2,250	.....
22	3,480	1,880	5,150	28,000	10,600	5,000	3,600	2,060	2,250	.....
23	4,000	1,880	5,460	27,200	10,600	4,700	3,350	2,060	2,660	.....
24	4,000	2,060	6,100	24,800	10,600	4,410	3,350	2,060	2,880	.....
25	3,730	2,060	7,130	24,000	10,200	4,410	3,110	2,060	2,880	.....
26	3,230	2,060	8,280	23,200	10,200	4,130	3,110	2,060	3,600	.....
27	3,480	2,060	8,680	24,800	11,100	4,410	2,660	2,060	3,860	.....
28	3,730	2,250	9,100	25,600	10,200	4,410	2,660	2,060	3,860	.....
29	3,730	2,250	9,960	29,700	9,740	4,410	2,660	2,060	3,600	.....
30	3,480	2,060	9,960	30,500	8,890	4,130	2,450	2,060	3,600	.....
31	3,480	.....	9,520	.....	8,080	4,130	.....	2,060	.....	.....

NOTE.—These discharges are based on a rating curve that is well defined between 1,710 and 24,000 second-feet.

Monthly discharge of Bighorn River near Hardin, Mont., for 1909.

[Drainage area, 20,700 square miles.]

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
March	9,100	3,230	5,790	0.280	0.32	356,000	A.
April	3,480	1,710	2,110	.102	.11	126,000	A.
May	9,960	2,060	4,410	.213	.25	271,000	A.
June	33,800	10,400	22,200	1.07	1.19	1,320,000	A.
July	35,900	8,080	17,000	.821	.95	1,050,000	A.
August	7,690	4,130	5,440	.263	.30	334,000	A.
September	7,310	2,450	4,580	.221	.25	273,000	A.
October	2,450	2,060	2,250	.109	.13	138,000	A.
November	3,860	1,880	2,370	.114	.13	141,000	A.
December 1–12	3,350	2,450	2,890	.139	.06	68,800	A.
The period						4,080,000	

RED CREEK NEAR DUBOIS, WYO.

Red Creek is tributary to Big Wind River from the south, entering about 15 miles below Dubois, Wyo. This station was established April 10, 1909, in cooperation with the United States Indian Office and abandoned on October 30, 1909. It is located just upstream from the crossing of the Fort Washakie-Dubois stage road and a short distance above the mouth of the stream.

The vertical staff gage on the right bank remained constant while the station was maintained. Discharge measurements were made by wading.

Discharge measurements of Red Creek near Dubois, Wyo., in 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Apr. 10	R. L. Cooper	8	3	0.90	2.6
May 14	do	8	3	.90	2.0

Daily gage height, in feet, of Red Creek near Dubois, Wyo., for 1909.

[Jim Locke, observer.]

Day.	June.	July.	Aug.	Sept.	Oct.	Day.	June.	July.	Aug.	Sept.	Oct.
1	1.0	1.1	.....	0.8	0.8	16	1.2	0.9	0.9	0.8	0.8
2	1.0	1.2	0.9	.8	.8	17	1.2	.9	.9	.8	.....
3	1.0	1.3	.9	.8	.....	18	1.1	.....	.9	.8	.8
4	1.1	.....	1.0	.8	.8	19	1.3	.9	.9	.....	.8
5	1.4	1.3	.9	.....	.8	20	.....	1.0	.9	.8	.8
6	.....	1.2	.9	.8	.8	21	.9	1.0	.9	.8	.8
7	1.1	1.1	.9	.8	.8	22	.9	.9	.....	.8	.8
8	1.1	.9	.....	.8	.8	23	1.1	.9	.9	.8	.8
9	1.0	1.1	.9	.8	.8	24	.9	.9	.9	.8	.....
10	1.0	.9	.9	.8	.....	25	.9	1.0	.9	.8	.8
11	1.0	.....	.9	.8	.8	26	.9	.9	.8	.....	.8
12	.9	.9	.9	.....	.8	27	.....	1.0	.8	.8	.8
13	.....	.9	.9	.8	.8	28	1.2	.9	.8	.8	.8
14	.9	1.0	.9	.8	.8	29	1.3	.9	.....	.8	.8
15	.9	1.0	.....	.8	.8	30	1.1	.9	.8	.8	.8
						31	.....	.9	.8	.....	.....

DINWOODY CREEK NEAR CROWHEART, WYO.

This station was established December 15, 1908, in cooperation with the United States Indian Office and was discontinued October 31, 1909. It was located 7 miles above Crowheart, Wyo., at the highway bridge on the stage road from Wind River to Dubois. The records are useful in determining the amount of water available for irrigation.

As the station is but a short distance above the confluence of the stream with Big Wind River, no tributaries enter below. A little water is diverted above for irrigation.

The chain gage is on the highway bridge at an elevation of about 6,200 feet above sea level. The location and datum of the gage have not changed.

Measurements are made by wading or from a cable 400 yards above the bridge. On account of large bowlders in the stream bed, it is difficult to obtain measurements. Ice affects the flow for several months during the winter season.

Discharge measurements of Dinwoody Creek near Crowheart, Wyo., in 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec-ft.*
Jan. 16[a]	R. L. Cooper	.....	.....	.....	30
Mar. 11[a]	do	.....	.....	1.00	30
Apr. 10[a]	do	28	24	1.00	14.5
May 14[a]	do	28	28	1.00	32
June 12[a]	do	47	72	2.00	199
July 1[a]	do	55	152	3.30	679
Aug. 26	Poorman and Gonin	53	126	2.70	505

[a] Ice; discharge estimated.

Daily gage height, in feet, of Dinwoody Creek near Crowheart, Wyo., for 1909.

[Jim Locke, observer.]

Day.	Jan.	Mar.	May.	June.	July.	Aug.	Sept.	Oct.
1	.....	.....	.....	1.8	3.2	.....	2.8	1.6
2	.....	.....	.....	1.8	3.3	2.2	3.7	1.6
3	.....	.....	.....	1.8	3.5	2.2	3.9	1.6
4	.....	.....	.....	2.5	.....	2.3	3.3	1.6
5	.....	.....	.....	3.2	3.9	2.2	.....	1.5
6	.....	.....	.....	.....	4.0	2.2	2.4	1.5
7	.....	.....	.....	2.9	4.1	2.3	2.2	1.5
8	.....	.....	.....	2.6	3.8	.....	2.4	1.5
9	.....	.....	.....	2.2	3.4	2.5	2.1	1.4
10	.....	.....	.....	2.1	3.2	2.6	2.1	.....
11	.....	1.0	.....	2.1	.....	3.3	2.1	1.5
12	.....	.....	.....	2.0	3.1	3.3	.....	1.5
13	.....	.....	.....	.....	2.6	3.2	2.1	1.5
14	.....	.....	.....	1.9	2.3	3.2	2.0	1.4
15	.....	.....	.....	2.0	2.3	.....	2.0	1.4
16	1.0	.....	.....	2.5	2.4	2.9	2.0	1.3
17	.....	.....	1.1	2.9	2.6	3.3	1.9	.....
18	.....	.....	1.1	3.3	.....	3.3	1.9	1.3
19	.....	.....	1.2	3.4	3.1	3.2	.....	1.3
20	.....	.....	1.4	.....	3.3	3.0	1.8	1.3
21	.....	.....	1.2	2.9	3.3	2.9	1.9	1.3
22	.....	.....	1.6	2.6	3.3	.....	1.8	1.3
23	.....	.....	.....	2.4	3.1	2.9	1.8	1.2
24	.....	.....	1.6	2.5	3.2	2.8	1.8	.....
25	.....	.....	1.4	2.6	.....	2.9	1.8	1.2
26	.....	.....	1.9	2.7	3.1	2.6	.....	1.2
27	.....	.....	1.9	.....	3.1	2.3	1.6	1.2
28	.....	.....	1.9	3.1	3.1	2.2	1.2	1.2
29	.....	.....	1.7	3.3	2.8	.....	1.8	1.2
30	.....	.....	.....	3.4	2.3	2.7	1.7	1.2
31	.....	.....	1.5	.....	2.2	2.1	.....	.....

DRY CREEK AT CROWHEART, WYO.

This station was established December 14, 1908, at the highway bridge at Crowheart, Wyo., which is on the Fort Washakie-Dubois stage line about 40 miles from Wind River. It was discontinued October 31, 1909. The records are used to determine the amount of water available for irrigation by the United States Indian Office.

The Dry Creek ditch of the United States Indian Office, which will irrigate about 4,000 acres, is taken out about a mile above the station; Big Wind ditch No. 2 from Big Wind River comes into the creek above the station and is diverted 1 mile below. Neither of these ditches has as yet carried water for irrigation.

It has been observed that considerable water sinks into the stream bed between Crowheart and the intake of Big Wind River ditch No. 2, but it commences to rise again just below this intake.

The first gage was on the highway bridge, which was washed out by high water on June 5, 1909. When the bridge was replaced at a slightly different location a chain gage was installed at a new datum, and the gage readings prior to June 30, 1909, have been reduced to this datum by adding 0.18 foot.

Discharge measurements were made from the highway bridge, at the footbridge just above the intake of Dry Creek ditch, and at the intake of Big Wind River ditch No. 2.

When the two canals commence to operate it will be necessary to move the gage to a position upstream from the head of the Dry Creek ditch in case it is decided to reestablish the station.

Discharge measurements of Dry Creek at Crowheart, Wyo., in 1909.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
Jan. 16	Robt. L. Cooper	.....	.....	.....	4.98	[a] 12
Mar. 11	.....do	.....	.....	.....	5.38	[a] 4
May 12	.....do	18	14	1.07	3.03	15
June 13	.....do	34	54	2.78	4.07	150
30	.....do	32	80	5.32	5.00	426
Aug. 13	A. P. Poorman	30	51	2.9	4.1	147
26	.....do	32	63	1.62	4.0	102
26	Poorman and Gonin	30	30	2.57	4.0	77

[a] Estimated.

Daily gage height, in feet, of Dry Creek at Crowheart, Wyo., for 1909.

[Jim Locke, observer.]

Day.	Jan.	Mar.	May.	June.	Aug.	Sept.	Oct.	Day.	Jan.	Mar.	May.	June.	Aug.	Sept.	Oct.
1	.....	.....	.....	3.6	.....	4.6	3.1	16	4.98	.....	.....	.....	.....	3.5	3.0
2	.....	.....	.....	3.9	.....	4.9	3.0	17	.....	.....	3.3	.....	.....	4.1	.....
3	.....	.....	.....	5.0	.....	4.3	.....	18	.....	.....	3.3	.....	.....	3.1	2.9
4	.....	.....	.....	5.5	.....	4.0	3.1	19	.....	.....	3.3	.....	.....	.....	2.9
5	.....	.....	.....	.....	.....	.....	3.0	20	.....	.....	3.3	.....	.....	3.1	2.9
6	.....	.....	.....	.....	.....	3.9	3.0	21	.....	.....	3.6	.....	.....	3.3	2.9
7	.....	.....	.....	.....	.....	4.0	3.0	22	.....	.....	3.6	.....	.....	3.3	2.9
8	.....	.....	.....	.....	.....	4.1	3.1	23	.....	.....	.....	.....	.....	3.2	2.9
9	.....	.....	.....	.....	.....	3.9	3.1	24	.....	.....	3.6	.....	.....	3.3	.....
10	.....	.....	.....	.....	.....	3.8	.....	25	.....	.....	3.6	.....	4.0	3.2	2.9
11	.....	5.38	.....	.....	.....	3.8	3.1	26	.....	.....	4.1	.....	3.9	.....	2.9
12	.....	.....	.....	.....	.....	.....	3.1	27	5.18	.....	.....	.....	3.8	3.2	2.9
13	.....	.....	.....	.....	.....	3.8	3.1	28	.....	.....	3.9	.....	3.7	3.1	2.9
14	.....	.....	.....	.....	.....	3.8	3.1	29	.....	.....	3.9	.....	.....	3.0	2.9
15	.....	.....	.....	.....	.....	3.6	3.0	30	.....	.....	.....	.....	3.6	3.0	2.9
								31	.....	.....	3.7	.....	3.6	.....	.....

MEADOW CREEK NEAR J. K. RANCH POST OFFICE, WYO.

This station was established December 14, 1908, to determine the amount of water available for the Meadow Creek ditch of the United States Indian Office. It was located about 1½ miles above the Wind River-Dubois stage road, and a few miles from J. K. ranch, the nearest post office. It was abandoned October 31, 1909.

The main gage is attached to the head gate of the Meadow Creek ditch; a secondary rod gage was established at the crossing of the stage road, so that the stage driver could take daily readings. The gages remained constant in position while the station was in operation.

The station is below all tributaries of any importance, and the Meadow Creek ditch, the only important diversion from the stream, is not yet carrying water for irrigation.

Ice affects the discharge for several months during the winter season. Discharge measurements were made by wading.

Discharge measurements of Meadow Creek at J. K. ranch post office, Wyo., in 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Jan. 17[a]	R. L. Cooper	9	6.2	1.40	8.8
Mar. 10	do	9	7	1.50	7.6
Apr. 7	do	9	7	1.30	9.0
May 15	do	7	4	1.30	8.0
June 13	do	9	9	1.90	27
Aug. 13	A. P. Poorman	12	14	1.80	23

[a] Ice conditions.

Daily gage height, in feet, of Meadow Creek at J. K. ranch post office, Wyo., for 1909.

[Jim Locke, observer.]

Day.	Mar.	May.	June.	July.	Aug.	Sept.	Oct.	Day.	Mar.	May.	June.	July.	Aug.	Sept.	Oct.
1	.....	.....	1.6	1.8	.....	1.8	1.1	16	.....	.....	1.8	1.5	1.5	1.4	1.2
2	.....	.....	1.6	1.8	1.5	1.9	1.1	17	.....	1.3	1.8	1.5	1.6	1.4	.....
3	.....	.....	1.9	1.8	1.4	1.7	.....	18	.....	1.3	1.8	.....	1.4	1.4	1.1
4	.....	.....	1.9	.....	1.4	1.5	1.1	19	.....	1.2	1.9	1.5	1.5	.....	1.1
5	.....	.....	2.1	1.9	1.1	.....	1.1	20	.....	.8	.....	1.7	1.6	1.3	1.1
6	.....	.....	.....	1.9	1.4	1.5	1.1	21	.....	1.3	1.7	1.7	1.5	1.4	1.1
7	.....	.....	1.7	1.6	1.5	1.6	1.1	22	.....	1.5	1.6	1.7	.....	1.3	1.1
8	.....	.....	2.1	1.5	.....	1.6	1.3	23	.....	.....	1.5	1.5	1.4	1.3	1.1
9	.....	.....	1.7	1.7	1.6	1.5	1.2	24	.....	1.4	1.6	1.6	1.6	1.2	.....
10	1.5	.....	1.8	1.7	1.5	1.5	.....	25	.....	1.3	1.6	.....	1.4	1.2	1.1
11	.....	.....	1.4	.....	1.6	1.4	1.3	26	.....	1.4	1.7	1.4	1.4	.....	1.1
12	.....	.....	1.4	1.5	1.7	.....	.8	27	.....	1.3	.....	1.5	1.4	1.3	1.1
13	.....	.....	.....	1.4	1.6	1.6	.8	28	.....	1.7	1.8	1.5	1.3	1.2	1.3
14	.....	.....	1.6	1.4	1.6	1.5	.8	29	.....	1.7	1.9	1.5	.....	1.2	1.1
15	.....	.....	1.4	1.5	.....	1.4	1.2	30	.....	.....	1.8	1.5	1.3	1.2	1.1
								31	.....	1.7	.....	1.5	1.3	.....	.....

NOTE.—These gage heights were taken on the gage at the stage road and bear no relation to the gage heights of the measurements.

WILLOW CREEK AT J. K. RANCH POST OFFICE, WYO.

This station was established December 13, 1908, to obtain records of the amount of water available for the Willow Creek ditch of the United States Indian Office. It is located at the J. K. ranch post

office, which is on the Wind River-Dubois stage line, about 30 miles from Wind River. It was discontinued October 31, 1909.

The creek receives no tributaries below the station; the Willow Creek ditch, about 2 miles above, is the only diversion of any importance. There are about 1,500 acres of land under this ditch, but it has not yet carried water for irrigation.

A staff gage is located on the highway bridge. The datum has not changed. Discharge measurements are made from the bridge or by wading. Ice affects the discharges for several months during the winter season.

Discharge measurements of Willow Creek at J. K. ranch post office, Wyo., in 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec. ft.*
Jan. 17[a]	R. L. Cooper	15	13.9	1.80	12.6
Mar. 11	do	14	9	1.20	9.0
Apr. 13	do	12	5.2	1.20	7.2
May 15	do	12	6	1.20	8.0
June 8	do	16	32	3.00	155.
13	do	14	19	2.30	72
Aug. 14	A. P. Poorman	12	8.7	1.40	20

[a] Ice conditions.

Daily gage height, in feet, of Willow Creek at J. K. ranch post office, Wyo., for 1909.

[Jim Locke, observer.]

Day.	Mar.	May.	June.	July.	Aug.	Sept.	Oct.	Day.	Mar.	May.	June.	July.	Aug.	Sept.	Oct.
1			1.7	3.4		1.4	1.2	16				1.6	1.2	1.4	1.1
2			2.1	2.8	1.4	1.4	1.2	17		1.3	3.7	2.1	1.3	1.4	1.2
3			2.9	3.3	1.3	1.3		18		1.3	3.4		1.3	1.3	1.2
4			3.7		1.3	1.4	1.2	19		1.3	3.6	1.8	1.3		1.2
5			4.5	3.1	1.2		1.1	20		1.4		2.1	1.2	1.3	1.1
6				3.2	1.3	1.4	1.1	21			2.5	1.6	1.1	1.3	1.2
7			3.6	2.4	1.6	1.4	1.2	22		1.3	2.8	1.6		1.2	1.2
8			3.4	2.3		1.2	1.2	23			2.5	1.3	1.1	1.2	
9			3.5	2.2	1.5	1.2	1.2	24		1.4	3.2	1.5	1.1	1.2	1.1
10			3.4	2.3	1.5	1.1		25		1.4	2.5		1.1	1.2	1.1
11	1.2		2.2		1.4	1.1	1.2	26		1.4	3.2	1.5	1.1		1.0
12			2.4	1.8	1.5		1.2	27		2.7		1.5	1.1	1.2	1.0
13				2.1	1.4	1.0	1.2	28			3.1	1.5	1.1	1.2	1.0
14			2.7	1.8	1.3	1.1	1.2	29		1.9	3.6	1.5		1.1	1.0
15			2.9	1.8		1.3	1.1	30			2.8	1.4	1.1	1.1	
								31		1.9		1.4	1.1		

BULL LAKE CREEK NEAR J. K. RANCH POST OFFICE, WYO.

This station was established November 3, 1908, at the highway bridge on the stage road from Wind River to Dubois, three-eighths of a mile above the confluence of the creek with Wind River. The records are used to determine the amount of water available for irrigation and storage, particularly for the purposes of the United States Indian Office. It was discontinued August 27, 1909.

The Bull Lake Creek ditch, which the United States Indian Office proposes to divert some distance above the station, will probably irrigate 15,000 acres of land. There are no tributaries below the station. Bull Lake Reservoir site, which is at a natural location a few miles above, is capable of equalizing the entire flow of the stream.

The chain gage is located on the bridge and its datum has not changed. Gage readings were obtained only when the station was visited to make measurements.

Measurements were made from the bridge or from a cable some distance down stream. The roughness of the stream bed makes it difficult to obtain accurate measurements. Ice conditions affect the flow for several months each year.

Discharge measurements of Bull Lake Creek near J. K. ranch post office, Wyo., in 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sq. ft.*
Jan. 18[a]	Robt. L. Cooper	70	108	1.20	81
Mar. 12	.....do	65	90	1.00	54
Apr. 6	.....do	72	64	1.00	39
May 16	.....do	73	81	1.30	94
June 14	.....do	106	226	1.80	827
29	.....do	115	480	4.90	3,105
Aug. 12	A. P. Poorman	109	289	3.50	1,309
27	.....do	93	182	2.90	730

[a] Ice conditions.

LITTLE WIND RIVER AT FORT WASHAKIE, WYO.

This station, which was established October 31, 1908, to obtain data for use by the Indian Office in connection with irrigation development, is located about three-fourths of a mile below the junction of North and South forks. Gage readings were discontinued June 30, 1909, but discharge measurements were made until September 23, 1909, when the station was abandoned.

The Indian Office has recently built a number of small canals diverting water from various tributaries above the station—the Coolidge ditch, about 2 miles below, which will irrigate some 15,000 acres of Indian land, and the Sub-Agency ditch, 20 miles below, which will water about the same acreage.

The datum of the chain gage on the right bank remained the same while the station was in operation. Discharge measurements were made from a footbridge near the gage. The stream freezes during the winter.

Discharge measurements of Little Wind River at Fort Washakie, Wyo., in 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Jan. 29[a]	R. L. Cooper	72	155	3.07	90
Mar. 19[a]	.....do	40	60	2.47	49
25[a]	.....do	47	65	1.87	60
May 7	.....do	54	78	1.87	100
17	.....do	54	78	1.87	107
25	.....do	62	113	2.47	315
June 3	.....do	84	178	3.32	700
6	.....do	100	368	5.17	2,662
16	.....do	94	306	4.57	1,960
Aug. 2	Gonin and Poorman	81	166	2.97	594
11	A. P. Poorman	83	169	3.17	650
19	Gonin and Poorman	64	136	2.77	450
Sept. 14	A. P. Poorman	68	123	2.57	329
23	Gonin and Poorman	58	96	2.17	166

[a] Ice conditions.

Daily gage height, in feet, of Little Wind River at Fort Washakie, Wyo., for 1909.

[John S. Guyer, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.
1....	2.4	3.55	3.1	1.5	1.7	2.7	4.95	16....	3.65	3.5	2.4	1.45	2.0	4.7	.....
2....	2.5	3.45	2.9	1.55	1.65	3.0	.....	17....	3.7	3.35	2.6	1.5	2.0	4.95	.....
3....	2.55	3.45	2.7	1.6	1.7	3.45	.....	18....	3.85	3.4	2.6	1.55	2.0	5.05	.....
4....	2.7	3.35	2.75	1.55	1.85	4.05	.....	19....	3.9	3.35	2.4	1.6	2.1	5.2	.....
5....	2.65	3.2	2.85	1.5	2.4	4.75	.....	20....	3.75	3.4	2.4	1.55	2.2	5.3	.....
6....	2.6	2.7	2.7	1.4	2.05	5.4	.....	21....	3.85	3.35	2.35	1.6	2.45	4.85	.....
7....	2.65	3.45	2.65	1.45	2.0	4.95	.....	22....	3.8	3.4	2.3	1.5	2.6	4.6	.....
8....	2.7	3.5	2.1	1.4	1.95	4.8	.....	23....	3.85	3.25	2.25	1.5	2.6	4.5	.....
9....	2.95	3.45	2.75	1.5	1.95	4.25	.....	24....	3.6	2.9	2.3	1.45	2.5	4.7	.....
10....	2.75	3.45	2.4	1.45	2.0	3.9	.....	25....	3.55	3.15	1.8	1.55	2.55	4.65	.....
11....	2.8	3.45	2.45	1.45	2.15	3.65	.....	26....	3.7	2.7	1.6	1.6	2.75	4.9	.....
12....	2.8	3.4	2.5	1.4	2.0	3.5	.....	27....	3.7	2.7	1.5	1.7	2.85	5.05	.....
13....	2.9	3.35	2.75	1.5	1.85	3.55	.....	28....	3.7	3.2	1.55	1.75	2.95	5.2	.....
14....	3.15	3.4	2.7	1.45	1.90	3.9	.....	29....	3.6	.....	1.5	1.8	2.9	5.15	.....
15....	3.85	3.45	2.65	1.5	1.95	4.05	.....	30....	3.5	.....	1.5	1.6	2.8	5.0	.....
								31....	3.5	.....	1.45	.....	2.85	.....	.....

NOTE.—Ice conditions Jan. 1 to Mar. 25.

Daily discharge, in second-feet, of Little Wind River at Fort Washakie, Wyo., for 1908–9.

Day.	Nov.	Dec.	Day.	Nov.	Dec.	Day.	Nov.	Dec.
1908.			1908.			1908.		
1	108	120	11	98	95	21	108	90
2	120	88	12	79	95	22	88	90
3	108	100	13	79	95	23	70	90
4	108	100	14	120	95	24	79	90
5	108	100	15	146	95	25	70	90
6	108	100	16	175	95	26	79	90
7	108	100	17	160	95	27	108	90
8	108	100	18	146	95	28	88	90
9	108	100	19	132	90	29	108	90
10	88	100	20	108	90	30	120	90
						31	.....	90

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.
1909.								1909.							
1....	90	70	70	40	70	410	2,400	16....	90	70	50	34	132	2,100	.....
2....	90	70	70	47	62	570	.....	17....	90	70	50	40	132	2,400	.....
3....	90	70	70	54	70	870	.....	18....	90	70	50	47	132	2,520	.....
4....	90	70	70	47	98	1,400	.....	19....	90	70	50	54	160	2,700	.....
5....	90	70	70	40	265	2,160	.....	20....	90	70	50	47	190	2,820	.....
6....	90	70	70	28	146	2,950	.....	21....	90	70	60	54	288	2,280	.....
7....	90	70	70	34	132	2,400	.....	22....	90	70	60	40	360	1,990	.....
8....	90	70	70	28	120	2,220	.....	23....	90	70	60	40	360	1,880	.....
9....	90	70	70	40	120	1,610	.....	24....	90	70	60	34	310	2,100	.....
10....	90	70	70	34	132	1,250	.....	25....	90	70	60	47	335	2,040	.....
11....	90	70	50	34	175	1,030	.....	26....	90	70	54	54	435	2,340	.....
12....	90	70	50	28	132	910	.....	27....	90	70	40	70	488	2,520	.....
13....	90	70	50	40	98	950	.....	28....	90	70	47	79	542	2,700	.....
14....	90	70	50	34	108	1,250	.....	29....	90	.....	40	88	515	2,640	.....
15....	90	70	50	40	120	1,400	.....	30....	90	.....	40	54	460	2,460	.....
								31....	90	.....	34	.....	488	.....	.....

NOTE.—These discharges based on a curve that is fairly well defined below 2,600 second-feet. Discharges estimated Nov. 30, 1908, to Mar. 25, 1909, on account of ice conditions.

Monthly discharge of Little Wind River at Fort Washakie, Wyo., for 1908–9.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
1908.					
November	175	70	108	6,430	B.
December	.....	.....	94.8	5,830	D.
1909.					
January	.....	.....	90	5,530	D.
February	.....	.....	70	3,890	D.
March	.....	.....	56.6	3,480	D.
April	88	28	45	2,680	C.
May	542	62	231	14,200	B.
June	2,950	410	1,900	113,000	A.
The period	.....	.....	.....	143,000	

NOTE.—Discharges Nov. 30, 1908, to Mar. 25, 1909, estimated, on account of ice conditions.

LITTLE WIND RIVER ABOVE ARAPAHOE, WYO.

This station, which was established May 11, 1906, to determine the amount of water available for irrigation and storage, is located at the Government bridge a short distance above the mouth of Popo Agie River and about one-half mile west of the post office at Arapahoe, Wyo. The drainage area is about 650 square miles.

Water is diverted from Little Wind River and various tributaries above the station by the United States Indian Office canal systems, which will eventually irrigate several thousand acres of land. Some of the canals are already in operation.

A rod gage was fastened to a pile of the bridge when the station was established but this was replaced by a chain gage installed October 21, 1907, on the handrail of the bridge. The datum of the gage was not changed.

Measurements were made from the bridge or by wading. Fair results have been obtained but measurements are somewhat affected by the pile bents of the bridge. The river is icebound for several months during the winter.

The station was discontinued December 17, 1909.

Discharge measurements of Little Wind River above Arapahoe, Wyo., in 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Jan. 19[a]	R. L. Cooper	96	207	2.43	100
Feb. 27[a]	.....do	.....	.....	1.42	.....
Apr. 15	.....do	86	62	.98	76
May 5	.....do	98	80	1.20	136
20	.....do	101	83	1.30	169
June 5	.....do	110	321	3.50	1,550
22	.....do	110	343	3.59	1,650
Aug. 9	Poorman and Gonin	105	184	2.20	578
17	Poorman and Burbank	104	158	1.97	471
30	C. E. Burbank	102	112	1.46	249
Sept. 9	.....do	105	177	2.06	534
17	A. P. Poorman	103	137	1.56	310

[a] Ice conditions.

Daily gage height, in feet, of Little Wind River above Arapahoe, Wyo., for 1909.

[Miss Dora Dietz and Miss Mildred Vincent, observers.]

Day.	Jan.	Feb.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.2	1.9	1.15	1.1	1.95	4.2	1.75	1.65	1.25	1.05	1.45
2	1.2	2.1	1.1	1.1	2.0	4.15	1.8	2.15	1.35	1.05	1.35
3	1.2	2.1	1.10	1.1	2.15	4.0	1.75	2.25	1.25	1.05	1.25
4	1.2	1.95	.....	1.1	2.65	4.05	1.75	2.15	1.25	1.05	1.45
5	1.2	.....	.....	1.2	3.6	4.2	1.65	2.05	1.25	1.05	1.35
6	1.2	.....	.....	1.25	4.2	4.4	1.7	2.05	1.25	1.05	1.25
7	1.2	.....	.....	1.3	4.3	4.2	1.9	2.25	1.25	1.05	1.15
8	1.2	.....	.....	1.25	4.0	3.7	.2	2.1	1.25	1.05	1.45
9	1.2	.....	.....	1.25	3.65	3.35	2.2	2.0	1.25	1.05	1.55
10	1.2	.....	.....	1.2	3.2	3.0	2.3	1.95	1.25	1.05	1.55
11	1.2	.....	.....	1.3	2.9	2.9	2.25	1.85	1.25	1.05	1.75
12	1.2	.....	.....	1.3	2.7	2.8	2.2	1.85	1.25	1.05	1.75
13	1.2	.....	.....	1.3	2.6	2.65	2.2	1.8	1.25	1.05	1.85
14	1.2	.....	.....	1.2	3.1	2.55	2.15	1.75	1.25	.95	1.75
15	1.2	.....	.....	1.2	3.15	2.6	2.1	1.65	1.15	1.05	1.85
16	1.2	.....	.....	1.3	3.55	2.55	1.95	1.55	1.15	1.0	1.85
17	2.3	.....	.....	1.3	3.85	2.55	1.9	1.55	1.15	1.05	1.65
18	2.3	.....	1.1	1.2	4.1	2.5	1.85	1.55	1.05	1.05	.....
19	2.3	.....	1.1	1.2	4.2	2.6	1.85	1.45	1.05	1.25	.....
20	2.5	.....	1.05	1.3	4.35	2.6	1.75	1.45	1.15	1.15	.....
21	2.55	.....	1.1	1.55	4.1	2.55	1.75	1.45	1.15	1.25	.....
22	2.5	.....	1.1	1.7	3.75	2.5	1.65	1.45	1.15	1.25	.....
23	2.4	.....	1.1	1.7	3.7	2.4	1.7	1.45	1.15	1.25	.....
24	2.65	.....	1.1	1.7	3.75	2.4	1.65	1.45	1.15	1.25	.....
25	2.6	.....	1.05	1.8	3.8	2.4	1.7	1.45	1.15	1.25	.....
26	2.3	.....	1.05	1.9	3.9	2.3	1.6	1.6	1.15	1.15	.....
27	2.4	.....	1.1	1.9	4.0	2.2	1.65	2.6	1.15	1.15	.....
28	2.45	.....	1.2	1.95	4.25	2.2	1.5	1.3	1.05	1.25	.....
29	2.35	.....	1.15	2.05	4.3	2.05	1.5	1.25	1.05	1.25	.....
30	2.1	.....	1.15	2.0	4.2	1.95	1.45	1.25	1.05	1.50	.....
31	1.7	.....	.....	2.0	.....	1.6	1.5	.....	1.05	.....	.....

NOTE.—Ice conditions Jan. 1 to Apr. 17 and Nov. 30 to Dec. 31.

Daily discharge, in second-feet, of Little Wind River above Arapahoe, Wyo., for 1909.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	.....	105	468	2,140	365	315	152	92
2	.....	105	495	2,100	390	580	190	92
3	.....	105	580	1,970	365	640	152	92
4	.....	105	910	2,010	365	580	152	92
5	.....	130	1,640	2,140	315	522	152	92
6	.....	152	2,140	2,320	340	522	152	92
7	.....	170	2,230	2,140	440	640	152	92
8	.....	152	1,970	1,720	610	550	152	92
9	.....	152	1,680	1,440	610	495	152	92
10	.....	130	1,320	1,160	670	468	152	92
11	.....	170	1,090	1,090	640	415	152	92
12	.....	170	945	1,020	610	415	152	92
13	.....	170	875	910	610	390	152	92
14	.....	135	1,240	840	580	365	152	68
15	.....	135	1,280	875	550	315	120	92
16	.....	170	1,600	840	468	270	120	80
17	.....	170	1,840	840	440	270	120	92
18	105	135	2,060	805	415	270	92	92
19	105	135	2,140	875	415	230	92	152
20	92	170	2,280	875	365	230	120	120
21	105	270	2,060	840	365	230	120	152
22	105	340	1,760	805	315	230	120	152
23	105	340	1,720	735	340	230	120	152
24	105	340	1,760	735	315	230	120	152
25	92	390	1,800	735	340	230	120	152
26	92	440	1,880	670	290	290	120	120
27	105	440	1,970	610	315	290	120	120
28	135	468	2,180	610	250	170	92	152
29	120	522	2,230	522	250	152	92	152
30	120	495	2,140	468	230	152	92	150
31	.....	495	.....	390	250	.....	92	.....

NOTE.—These discharges are based on a rating curve that is fairly well defined between 35 and 1,970 second-feet. Discharge Nov. 30 estimated on account of ice.

Monthly discharge of Little Wind River below Arapahoe, Wyo., for 1909.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
May	522	105	239	14,700	B.
June	2,280	468	1,610	95,800	A.
July	2,320	390	1,140	70,100	A.
August	670	230	414	25,500	B.
September	640	152	356	21,200	B.
October	190	92	130	7,990	B.
November		68	112	6,660	B.
The period				242,000	

LITTLE WIND RIVER BELOW ARAPAHOE, WYO.

This station, which was established May 11, 1906, to obtain data for use in general studies of run-off, is located at the Government bridge, 200 yards below the mouth of Popo Agie River, one-half mile south of the post office at Arapahoe, and about 6 miles above the junction of Little Wind and Big Wind rivers. Beaver Creek enters from the south between the station and the mouth of the river. The drainage area of Little Wind River at its mouth is about 1,900 square miles.

The records at this station show practically the entire flow of Little Wind River except a small amount of water used for irrigation.

Many diversions are made for irrigation from Little Wind and Popo Agie rivers above this station, but opportunities for additional development both for power and irrigation yet remain.

The location of the rod gage, which is fastened to a pile of the bridge, has remained unchanged since the establishment of the station, but the bridge was raised 0.17 foot at the gage when the ice went out in the spring of 1908, and all the gage readings for 1908 are low by that amount. They have not been corrected to the old datum. Gage heights for 1909 have been corrected by subtracting 0.23 foot to reduce them to the datum used in 1908, as there was a settlement of the bridge when the ice went out in the spring.

Conditions at this station are not favorable for accurate results because of the eddies around the pile bents at all stages and the sluggishness of the current at low water. The stream is icebound for several months during the winter season.

The station was discontinued November 27, 1909.

Discharge measurements of Little Wind River below Arapahoe, Wyo., in 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Jan. 20 [a]	R. L. Cooper	100	509	3.20	525
Feb 26 [a]	do	95	277	2.70	173
Apr. 15	do	96	342	1.22	155
May 5	do	99	391	1.82	386
20	do	100	369	2.17	601
June 5	do	107	851	6.02	4,570
19	do	110	917	6.57	[b] 5,430
22	do	109	851	5.97	4,620
Aug. 9	Poorman and Gonin	101	518	2.97	1,120
17	Poorman and Burbank	100	467	2.63	816
30	C. E. Burbank	99	411	1.97	497
Sept. 9	do	101	502	2.90	1,030
17	A. P. Poorman	100	417	2.12	508

[a] Ice. [b] Discharge estimated by comparison with measurement of June 5.

Daily gage height, in feet, of Little Wind River below Arapahoe, Wyo., for 1909.

[Miss Dora Dietz and Miss Mildred Vincent, observers.]

Day.	Jan.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	.....	1.50	1.55	3.55	6.35	2.55	2.55	1.75	1.15
2	.....	1.6	1.6	3.85	6.35	2.6	3.5	1.8	1.2
3	.....	1.55	1.45	4.55	6.25	2.55	3.3	1.75	1.15
4	.....	.....	1.65	5.3	6.3	2.55	3.1	1.8	1.2
5	.....	.....	1.9	6.15	6.35	2.45	2.95	1.75	1.15
6	.....	.....	2.05	7.0	6.45	2.45	2.95	1.75	1.15
7	.....	.....	2.1	7.0	6.15	2.8	3.3	1.7	1.2
8	.....	.....	2.05	6.65	5.25	3.05	3.05	1.65	1.15
9	.....	.....	1.95	6.1	4.95	3.05	2.9	1.7	1.2
10	.....	.....	1.85	5.45	4.55	2.75	2.75	1.65	1.15
11	.....	.....	2.05	4.95	4.35	3.05	2.65	1.65	1.15
12	.....	.....	2.1	4.7	4.25	3.10	2.7	1.7	1.2
13	.....	.....	1.95	4.75	3.95	3.0	2.55	1.55	1.05
14	.....	.....	2.0	5.2	3.95	2.95	2.5	1.6	.....
15	.....	1.22	1.95	5.35	3.95	2.75	2.45	1.55	.....
16	.....	.....	2.0	5.85	3.85	2.65	2.25	1.45	.....
17	.....	.....	2.1	6.35	3.9	2.7	2.25	1.5	.....
18	.....	1.6	2.0	6.6	3.8	2.55	2.05	1.45	.....
19	.....	1.55	2.1	6.85	4.0	2.5	2.0	1.4	.....
20	3.15	1.45	2.2	7.1	3.95	2.4	1.9	1.35	.....
21	3.05	1.5	2.45	6.55	3.9	2.35	1.9	1.35	.....
22	3.0	1.35	2.7	5.85	3.2	2.3	1.95	1.4	.....
23	.....	1.4	2.85	5.75	3.45	2.25	1.85	1.35	.....
24	.....	1.3	3.1	5.8	3.5	2.4	1.9	1.4	1.35
25	.....	1.25	3.2	5.85	3.35	2.35	1.85	1.35	1.4
26	.....	1.4	3.25	6.1	3.15	2.2	1.75	1.35	1.35
27	.....	1.55	3.5	6.3	3.2	2.1	1.8	1.3	1.35
28	.....	1.7	3.6	6.55	3.15	2.05	1.75	1.15	.....
29	.....	1.65	3.85	6.7	3.0	2.1	1.8	1.2	.....
30	.....	1.55	3.65	6.5	2.7	1.95	1.75	1.15	.....
31	.....	.....	3.6	.....	2.55	1.95	.....	1.15	.....

NOTE.—Ice January, February, March, and Nov. 14 to Dec. 31.

Daily discharge, in second-feet, of Little Wind River below Arapahoe, Wyo., for 1909.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	290	308	1,640	5,080	818	818	380	178
2	325	325	1,940	5,080	850	1,590	400	190
3	308	272	2,710	4,940	818	1,410	380	178
4	300	345	3,640	5,010	818	1,240	400	190
5	290	445	4,790	5,080	752	1,110	380	178
6	280	515	6,070	5,240	752	1,110	380	178
7	260	540	6,070	4,790	995	1,410	360	190
8	250	515	5,540	3,570	1,190	1,190	345	178
9	240	468	4,720	3,190	1,190	1,070	360	190
10	220	422	3,830	2,710	958	958	345	178
11	210	515	3,190	2,480	1,190	885	345	178
12	200	540	2,880	2,360	1,240	920	360	190
13	180	468	2,940	2,040	1,150	818	308	152
14	170	490	3,500	2,040	1,110	785	325	.....
15	155	468	3,700	2,040	958	752	308	.....
16	215	490	4,370	1,940	885	625	272	.....
17	270	540	5,080	1,990	920	625	290	.....
18	325	490	5,460	1,890	818	515	272	.....
19	308	540	5,840	2,090	785	490	255	.....
20	272	595	6,230	2,040	720	445	235	.....
21	290	752	5,380	1,990	688	445	235	.....
22	235	920	4,370	1,320	655	468	255	.....
23	255	1,030	4,240	1,540	625	422	235	.....
24	220	1,240	4,300	1,590	720	445	255	.....
25	205	1,320	4,370	1,460	688	422	235	.....
26	255	1,360	4,720	1,280	595	380	235	.....
27	308	1,590	5,010	1,320	540	400	220	.....
28	360	1,690	5,380	1,280	515	380	178	.....
29	345	1,940	5,610	1,150	540	400	190	.....
30	308	1,740	5,310	920	468	380	178	.....
31	.....	1,690	.....	818	468	.....	178	.....

NOTE.—These discharges are based on a rating curve that is fairly well defined between 290 and 5,310 second-feet. Discharges Apr. 4–14, 16, and 17 interpolated.

Monthly discharge of Little Wind River below Arapahoe, Wyo., for 1909.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
April	360	155	262	15,600	C.
May	1,940	272	792	48,700	B.
June	6,230	1,640	4,430	264,000	A.
July	5,240	818	2,590	159,000	B.
August	1,240	468	820	50,400	B.
September	1,590	380	764	45,500	B.
October	400	178	293	18,000	C.
The period	.....	.....	.....	601,000	

SOUTH FORK OF LITTLE WIND RIVER NEAR WIND RIVER, WYO.

On August 7, 1909, a temporary station was established on the South Fork of Little Wind River, 3 miles west of Wind River, Wyo., and 3 miles above the junction of the North and South forks, to determine the amount of water which is available for diversion into the Ray ditch of the United States Indian Office, which takes out water just below. This ditch, with an auxiliary supply from Trout Creek and by storage in the Ray Lake reservoir, a natural depression 3 miles east of Wind River, which will have a storage capacity of about 10,000 acre-feet, will provide for the irrigation of about 15,000 acres.

No gage has been set at the station, but river stages are referred to the corner of the west wall of the concrete intake to the Ray ditch. The level of the sill of the gate is the assumed zero and the top of the wing wall is 10 feet, with an elevation of 5,715.50 feet above sea level.

Measurements are made by wading. Only one measurement has been made, and there is no record of daily gage height.

The following discharge measurement was made by A. P. Poorman:

August 7, 1909: Width, 75 feet; area, 166 square feet; gage height, 4.10 feet; discharge, 397 second-feet.

ST. LAWRENCE CREEK NEAR WIND RIVER, WYO.

This station, which was established January 22, 1909, to determine the amount of water available for storage and irrigation by the United States Indian Office, is located about 100 feet above the confluence of this tributary with the North Fork of Little Wind River, about 10 miles west of Wind River, Wyo.

The St. Lawrence basin, the lower edge of which is less than 1 mile above the mouth of the stream, is a natural excellent reservoir site. The United States Indian Office proposes to divert a canal out of this stream for irrigation.

Very good opportunities for power development are presented, as the stream has a fall of over 1,000 feet in the last mile above its mouth.

The rod gage remained constant as to position and datum while the station was in operation. Discharge measurements were made by wading.

Daily gage readings were not taken, and the station was abandoned at the end of the season of 1909.

Discharge measurements of St. Lawrence Creek near Wind River, Wyo., in 1910.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Jan. 22[a]	R. L. Cooper	11	13.1	1.50	5.2
May 23	....do	11.5	12	2.30	23

[a] Ice conditions.

TROUT CREEK AT WIND RIVER, WYO.

This station, which was established December 22, 1908, to determine the amount of water in the creek available for diversion into the Ray ditch of the United States Indian Office, is located 100 yards south of Wind River post office. It was abandoned August 31, 1909.

The creek receives no tributaries below the station, and very little water is being diverted above or below.

The staff gage which is fastened to the footbridge remained constant in position during the maintenance of the station. Discharge measurements have been made from the footbridge or by wading.

Discharge measurements of Trout Creek at Wind River, Wyo., in 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Jan. 25[a]	R. L. Cooper	11.5	5.0	2.00	4.0
Mar. 15	do	9.6	10.8	2.20	6.8
24	do	10.6	18	2.35	36
May 6	do	10	7	1.75	11
8	do	10	8	1.80	14
21	do	9	14	2.05	24
26	do	11	14	2.30	41
31	do	11	16	2.50	54
June 6	do	13	22	2.95	98
Aug. 3	A. P. Poorman	10	8	1.72	5.9
3	do	6.5	41	1.72	6.5
3	do	13	7.6	1.72	5.7
31	do	10	8.0	1.68	4.5

[a] Ice conditions.

Daily gage height, in feet, of Trout Creek at Wind River, Wyo., for 1909.

[Jas. D. Miller, observer.]

Day.	Jan.	Feb.	Mar.	May.	June.	July.	Day.	Jan.	Feb.	Mar.	May.	June.	July.
1	2.4	2.1	.....	.....	2.5	2.1	16	2.3	.....	.....	.....	.....	2.0
2	2.4	2.2	.....	.....	2.5	2.1	17	2.2	.....	.....	.....	2.6	2.0
3	2.9	2.2	.....	.....	2.7	2.1	18	2.2	.....	.....	.....	2.7	2.0
4	2.7	2.2	.....	.....	2.8	2.1	19	1.7	.....	.....	.....	2.6	2.0
5	2.4	1.9	.....	.....	2.8	2.1	20	1.7	.....	.....	.....	2.5	2.0
6	1.8	1.8	.....	1.75	2.9	.....	21	1.7	.....	.....	2.05	2.4	.....
7	2.9	.....	.....	.....	2.9	.....	22	1.7	.....	.....	2.2	2.4	.....
8	2.8	.....	.....	1.8	2.9	2.1	23	1.7	.....	.....	2.3	2.4	2.0
9	2.6	.....	.....	.....	2.8	2.1	24	1.7	.....	2.4	2.2	2.3	2.0
10	2.1	.....	.....	.....	2.8	2.0	25	1.7	.....	1.6	2.2	2.3	1.7
11	1.6	.....	.....	.....	2.7	1.9	26	2.1	.....	.....	2.3	2.2	1.7
12	1.8	.....	.....	.....	2.6	1.9	27	2.1	.....	1.6	2.3	.....	.....
13	2.9	.....	.....	.....	2.6	2.0	28	2.2	.....	.....	2.4	2.1	.....
14	2.9	.....	.....	.....	2.5	2.0	29	2.2	.....	1.6	2.5	2.1	.....
15	2.9	.....	2.2	.....	2.6	2.0	30	2.2	.....	1.6	2.5	2.1	.....
							31	1.8	.....	1.6	.....	.....	.....

LITTLE POPO AGIE RIVER AT HUDSON, WYO.

This station, which was established August 26, 1907, to determine the amount of unused water in the stream available for additional irrigation and storage, is located at the highway bridge three-eighths of a mile southwest of the post office at Hudson, Wyo., and a few hundred yards above the mouth of the stream. The station is below all the tributaries of the Little Popo Agie. The drainage area is about 360 square miles.

For 20 miles or more above this station small ditches take out water to irrigate the valley lands along the stream.

The present chain gage, which was established on June 13, 1908, is located 100 yards downstream from the bridge and the old rod gage. It was set at a different datum from the old gage, but the reading was the same as the reading of the old gage at the time it was located.

High-water measurements were taken from the bridge, but the location is not specially good. There is a bend in the stream a short distance above, the right bank is subject to overflow at high stages, and the bridge itself is sometimes overflowed at extreme stages. However, the results obtained here have been very satisfactory. The flow is affected by ice for several months during the winter season.

The station was discontinued December 31, 1909.

The following discharge measurement was made by R. L. Cooper:

May 5, 1909; width, 36 feet; area, 73 square feet; gage height, 2.85 feet; discharge, 143 second-feet.

Daily gage height, in feet, of Little Pope Agie River at Hudson, Wyo., for 1909.

[O. S. Riggs, observer.]

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	2.5	4.1	5.0	2.5	2.6	2.15	2.1	2.15
2	.....	2.55	4.25	4.9	2.4	3.0	2.15	2.1	2.15
3	.....	2.5	4.55	4.8	2.4	2.8	2.15	2.1	2.15
4	3.5	2.6	4.8	5.0	2.4	2.65	2.15	2.1	2.15
5	2.9	2.8	5.2	5.35	2.3	2.6	2.15	2.1	2.15
6	2.5	2.8	6.0	.....	2.3	2.6	2.3	2.1	2.15
7	2.4	2.75	6.15	4.7	2.4	2.75	2.3	2.1	2.15
8	2.25	2.8	6.0	4.15	2.4	2.6	2.35	2.1	2.15
9	2.25	2.8	5.8	3.9	2.4	2.6	2.35	2.1	2.15
10	2.15	2.7	5.2	3.8	.....	2.5	2.3	2.1	2.15
11	2.4	2.85	4.8	3.6	.....	2.5	2.3	2.5	2.15
12	2.45	2.9	4.6	3.5	2.5	2.5	2.3	2.0	2.15
13	2.35	2.85	4.65	3.3	2.5	2.45	2.3	2.0	2.15
14	2.35	2.8	4.7	3.25	2.5	2.4	2.25	1.95	2.15
15	2.45	2.85	4.95	3.2	2.4	.....	2.2	1.9	2.15
16	2.5	2.9	5.15	3.15	.....	2.35	2.2	1.9	2.15
17	2.6	2.85	5.4	3.1	2.4	2.3	2.15	2.1	2.15
18	2.75	2.9	5.6	3.1	2.3	2.3	2.15	2.1	2.15
19	2.7	2.9	5.8	3.1	2.3	2.3	2.15	2.1	2.15
20	2.55	3.0	6.45	3.1	2.3	2.25	2.15	2.1	2.15
21	2.5	3.1	6.25	3.0	2.3	2.25	2.1	2.1	2.15
22	2.45	3.2	6.35	2.9	2.3	2.2	2.1	.....	2.15
23	2.4	3.3	5.2	2.9	2.3	2.25	2.1	2.15	2.15
24	2.35	3.5	5.1	2.8	2.3	2.25	2.1	2.15	2.15
25	2.4	3.9	5.25	2.8	2.3	2.25	2.1	.....	2.15
26	2.5	3.8	5.3	2.8	2.3	2.25	2.1	2.2	2.15
27	2.6	3.75	5.35	2.8	2.3	2.2	2.1	2.2	2.15
28	2.65	3.9	5.4	2.8	2.25	2.2	2.1	2.2	2.15
29	2.7	3.95	5.5	2.7	2.25	2.2	2.1	2.2	2.15
30	2.55	3.85	5.3	2.65	2.25	2.15	2.5	2.15	2.15
31	.....	3.85	.....	2.6	2.25	.....	2.5	.....	2.15

SHOSHONE RIVER AT CODY, WYO.

This station, which is located at the highway bridge 1 mile northeast of Cody, Wyo., was established April 26, 1902, to obtain data to be used in connection with the Shoshone reclamation project.

The principal tributaries are the North and South forks, which unite 8 miles above Cody to form the Shoshone. The drainage area above the gaging station is 1,400 square miles, but the entire run-off from this area does not pass the station as a number of private irrigation canals divert water from the Shoshone and its branches above the station. These canals irrigate about 35,000 acres of land. Below

Cody irrigation has been carried on extensively by means of private canal systems that serve about 45,000 acres.

A staff gage, the datum of which has not changed, is spiked to a crib pier of the bridge. Measurements are made from the bridge.

The conditions for obtaining accurate discharge data are good. Ice does not affect the flow at this station, as the river is kept open by springs which enter the river a short distance above the gage.

Daily gage height, in feet, of Shoshone River at Cody, Wyo., for 1909.

[S. C. Bovard, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.2	2.4	2.5	2.5	2.8	5.5	8.2	5.1	3.7	3.5	3.2	3.0
2	2.2	2.4	2.5	2.5	2.8	6.4	8.0	5.0	4.3	3.5	3.2	2.9
3	2.2	2.4	2.5	2.5	3.0	6.8	9.1	5.0	4.3	3.5	3.2	2.9
4	2.2	2.4	2.5	2.5	3.05	8.0	9.0	5.0	4.3	3.5	3.2	2.9
5	a1.5	2.4	2.5	2.5	4.0	8.0	8.0	5.0	4.3	3.5	3.2	2.9
6	a1.5	2.4	2.5	2.6	3.55	7.5	7.8	4.9	4.2	3.5	3.1	2.9
7	2.2	2.4	2.4	2.6	3.55	7.0	7.6	4.8	4.2	3.5	3.0	2.9
8	2.2	2.4	2.4	2.6	3.45	6.6	7.1	4.7	4.2	3.5	3.0	2.9
9	2.2	2.4	2.4	2.7	3.45	6.0	7.1	4.7	4.2	3.4	3.0	2.9
10	2.2	2.4	2.4	2.8	3.75	6.0	6.6	4.7	4.1	3.4	2.9	2.9
11	2.2	2.4	2.4	2.5	3.7	5.5	6.4	4.7	4.1	3.4	2.9	2.9
12	2.2	2.4	2.4	2.5	3.6	5.45	6.1	4.6	4.1	3.4	2.9	.....
13	2.2	2.4	2.4	2.5	3.5	5.5	6.1	4.5	4.0	3.4	2.9	.....
14	2.2	2.4	2.4	2.6	3.45	5.9	6.1	4.5	4.0	3.4	2.9	.....
15	2.2	2.4	2.4	2.6	3.45	6.5	6.1	4.5	4.0	3.4	2.9	.....
16	2.3	2.4	2.4	2.6	3.45	6.55	6.1	4.4	4.0	3.4	2.9	.....
17	2.3	2.4	2.6	2.8	3.45	7.4	6.1	4.4	3.9	3.4	2.9	.....
18	2.7	2.4	2.6	2.8	3.45	7.9	6.1	4.4	3.9	3.3	2.9	.....
19	2.7	2.4	2.5	2.8	3.45	8.4	6.1	4.4	3.9	3.3	2.9	.....
20	2.7	2.4	2.5	2.8	3.6	7.5	5.9	4.4	3.9	3.3	2.9	.....
21	2.7	2.4	2.6	2.85	4.1	7.0	5.8	4.3	3.9	3.3	2.9	.....
22	2.7	2.4	2.6	2.85	4.6	7.0	5.6	4.3	3.9	3.2	2.9	.....
23	2.7	2.4	2.6	2.8	4.7	7.0	5.6	4.2	3.9	3.2	2.9	.....
24	2.7	2.4	2.6	2.9	5.1	7.1	5.5	4.1	3.9	3.2	3.2	.....
25	2.7	2.4	2.7	2.9	5.1	7.3	5.4	4.0	3.9	3.2	3.2	.....
26	2.7	a1.9	2.8	3.1	5.1	7.4	5.4	3.9	3.8	3.2	3.2	.....
27	2.7	2.4	2.7	3.1	5.5	7.4	5.4	3.8	3.7	3.2	3.2	.....
28	2.6	2.4	2.4	2.95	5.7	8.2	5.3	3.8	3.7	3.2	3.2	.....
29	2.6	.....	2.5	2.8	5.5	8.6	5.3	3.7	3.7	3.2	3.1	.....
30	2.5	.....	2.6	2.8	5.4	7.9	5.2	3.7	3.6	3.2	3.1	.....
31	2.4	.....	2.6	.....	5.1	.....	5.2	3.7	.....	3.2	.....	.....

a Ice conditions.

Daily discharge, in second-feet, of Shoshone River at Cody, Wyo., for 1909.

Day.	Jan.	Feb.	Mar.	Apr.	May.	Day.	Jan.	Feb.	Mar.	Apr.	May.
1	190	265	310	310	480	16	225	265	265	360	.....
2	190	265	310	310	480	17	225	265	360	480	.....
3	190	265	310	310	620	18	420	265	360	480	.....
4	190	265	310	310	660	19	420	265	310	480	.....
5	190	265	310	310	1,870	20	420	265	310	480	.....
6	190	265	310	360	1,180	21	420	265	360	515	.....
7	190	265	265	360	1,180	22	420	265	360	515	.....
8	190	265	265	360	1,060	23	420	265	360	480	.....
9	190	265	265	420	1,060	24	420	265	360	550	.....
10	190	265	265	480	1,470	25	420	265	420	550	.....
11	190	265	265	310	1,390	26	420	265	480	700	.....
12	190	265	265	310	1,250	27	420	265	420	700	.....
13	190	265	265	310	1,120	28	360	265	265	585	.....
14	190	265	265	360	1,060	29	360	.....	310	480	.....
15	190	265	265	360	.....	30	310	.....	360	480	.....
						31	265	.....	360	.....	.....

NOTE.—The above discharges are based on the 1908 curve, which is not well defined.

Monthly discharge of Shoshone River at Cody, Wyo., for 1909.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
January	420	190	284	17,500
February	265	265	265	14,700
March	480	265	319	19,600
April	700	310	434	25,800
May 1–14	1,870	480	1,060	30,400

NOTE.—No measurements were made in 1909 and these estimates are only approximate. They are carried to the beginning of the records at Corbett Dam, which start before high water, to give an idea of the flow of the river for the full year.

SHOSHONE RIVER AT CORBETT DAM, WYO.

This station, which is located 8 miles below Cody, Wyo., at the Corbett diversion dam built by the United States Reclamation Service, was established April 20, 1908.

The dam is a reenforced concrete structure of the buttressed type, having on the upstream side a deck 2½ feet thick, sloping 1 to 1, and supported by buttresses 2 feet thick, spaced 14 feet on centers. It raises the low-water elevation of the river 10.2 feet. The length between abutments is 400 feet. (See Pl. V, *a*.)

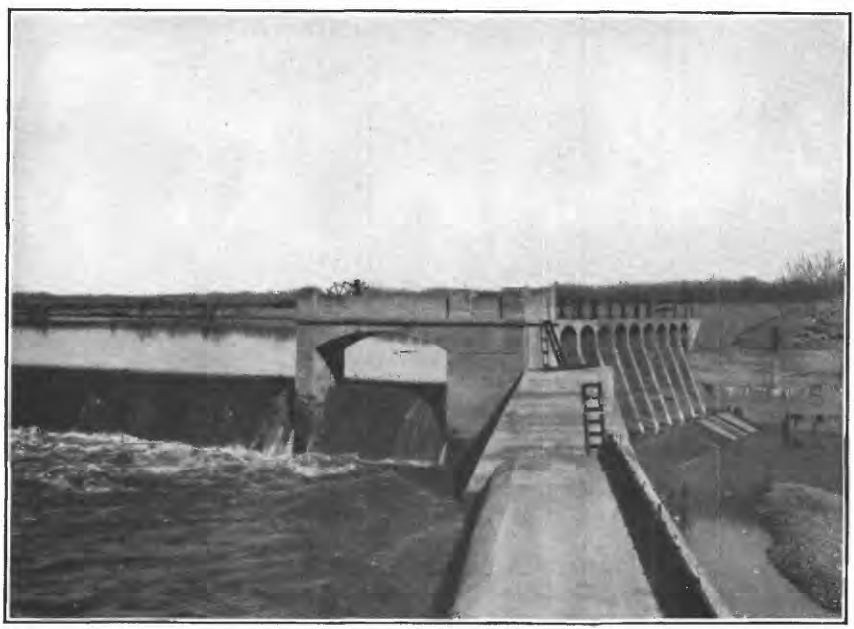
Sage Creek, the only important tributary that enters between this station and that at Cody, drains only about 25 square miles. During the irrigating season of 1908 about 75 second-feet were diverted above the dam through Corbett tunnel and used on the Shoshone reclamation project.

The gage is situated 40 feet above the crest of the dam, and it reads the height of the water above the crest.

Daily gage height, in feet, of Shoshone River over Corbett dam, Wyo., for 1909.

Day.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	1.58	3.93	1.43	0.77	0.37	0.49	0.56
2	.....	2.70	3.98	1.41	1.21	.35	.47	.54
3	.....	3.30	4.65	1.35	.97	.33	.48	.....
4	.....	3.75	4.79	1.31	.96	.32	.48	.....
5	.....	3.88	3.91	1.31	.83	.34	.48	.....
6	.....	3.50	3.76	1.26	.80	.32	.49	.....
7	.....	3.12	3.41	1.18	.45	.32	.50	.....
8	.....	2.85	3.00	1.21	.75	.30	.48	.....
9	.....	2.43	2.83	1.19	.71	.28	.46	.....
10	.....	2.37	2.70	1.15	.62	.28	.47	.....
11	.....	2.24	2.55	1.12	.64	.40	.48	.....
12	.....	2.10	2.32	1.08	.74	.37	.49	.....
13	.....	1.95	2.10	1.14	.97	.36	−2.00	.....
14	.....	2.25	2.03	1.19	.89	.47	−2.00	.....
15	0.76	2.77	2.13	1.00	.74	.35	−2.00	.....
16	.78	3.44	2.42	1.04	.65	−2.00	−2.00	.....
17	.78	3.67	2.40	1.03	.58	−2.00	−2.00	.....
18	.71	3.90	2.36	.95	.58	−2.00	−2.00	.....
19	.75	4.03	2.31	.91	.55	−2.00	−2.00	.....
20	.85	3.50	2.28	.89	.53	−2.00	.53	.....
21	1.18	3.07	2.28	.84	.50	−2.00	.57	.....
22	1.48	3.06	2.00	.82	.54	.47	.64	.....
23	1.72	3.10	1.90	.77	.52	.44	.65	.....
24	2.00	3.25	1.77	.90	.64	.49	.64	.....
25	1.73	3.43	1.91	.74	.53	.53	.61	.....

A. CORBETT DIVERSION DAM, SHOSHONE PROJECT, WYOMING.



B. WHALEN DIVERSION DAM AND HEADWORKS, NORTH PLATTE PROJECT, NEBRASKA-WYOMING.

Looking up river from north side.

Daily gage height, in feet, of Shoshone River over Corbett dam, Wyo., for 1909—Continued.

Day.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
26	1.78	3.45	1.76	0.77	0.46	0.56	0.58	.....
27	2.10	3.54	1.75	.71	.47	.58	.59	.....
28	2.11	3.98	1.90	.63	.46	.56	.57	.....
29	2.10	4.10	1.55	.58	.43	.54	.58	.....
30	1.84	3.82	1.48	.59	.40	.51	.58	.....
31	1.70	.....	1.50	.64	.....	.50	.....	.....

NOTE.—The zero of the gage is at the top of the dam, hence minus readings indicate the distance of the water surface below the top.

Daily discharge, in second-feet, of Shoshone River and sluices at Corbett dam, Wyo., for 1909.

Day.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	2,650	11,300	2,380	952	636	446	550
2	.....	6,040	11,600	2,340	1,800	614	420	520
3	.....	8,380	14,700	2,190	1,310	589	433	.....
4	.....	10,500	15,400	2,090	1,290	578	433	.....
5	.....	11,100	11,200	2,090	1,060	600	433	.....
6	.....	9,380	10,500	1,980	1,000	578	446	.....
7	.....	7,760	8,980	1,800	1,510	578	460	.....
8	.....	6,710	7,280	1,860	1,110	556	433	.....
9	.....	5,250	6,640	1,820	1,050	538	406	.....
10	.....	5,050	6,170	1,730	900	538	420	.....
11	.....	4,640	5,650	1,660	932	669	433	.....
12	.....	4,220	4,890	1,580	838	636	446	.....
13	.....	3,790	4,220	1,710	1,250	625	984	.....
14	.....	4,670	4,020	1,820	1,100	420	984	.....
15	872	6,420	4,310	1,420	838	270	984	.....
16	906	9,110	5,220	1,500	690	540	984	.....
17	906	10,100	5,150	1,480	580	540	984	.....
18	787	11,100	5,020	1,330	580	477	984	.....
19	855	11,700	4,860	1,260	535	477	00	.....
20	1,030	9,370	4,770	1,220	505	477	505	.....
21	1,680	7,560	4,770	1,130	805	00	575	.....
22	2,390	7,520	3,930	1,040	865	420	674	.....
23	3,020	7,680	3,650	952	835	379	690	.....
24	3,800	8,300	3,290	1,180	1,020	446	674	.....
25	3,050	9,070	3,680	903	850	505	626	.....
26	3,190	9,150	3,260	952	751	550	580	.....
27	4,090	9,550	3,230	850	765	580	595	.....
28	4,120	11,600	3,650	711	751	550	565	.....
29	4,090	12,100	2,700	643	710	520	580	.....
30	3,350	10,800	2,520	658	669	475	580	.....
31	2,970	.....	2,560	737	.....	460	.....	.....

NOTE.—These discharges were computed considering the dam as a weir and the sluices as submerged orifices.

Monthly discharge of Shoshone River and sluices at Corbett dam, Wyo., for 1909.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
May 15–31	4,120	787	2,420	81,600	C.
June	12,100	2,650	8,050	479,000	C.
July	15,400	2,520	6,110	376,000	C.
August	2,380	643	1,450	89,200	C.
September	1,800	535	929	55,300	C.
October	669	00	510	31,400	C.
November	984	00	592	35,200	C.
The period	.....	.....	.....	1,150,000	

Daily discharge, in second-feet, of Corbett tunnel at Corbett, Wyo., for 1909.

Day.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Day.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	.....	106	200	195	169	121	111	16	103	112	207	216	122	178	.....
2	.....	110	200	195	171	121	111	17	103	113	207	216	121	178	.....
3	.....	112	203	195	169	120	111	18	102	114	207	216	121	178	.....
4	.....	113	205	193	169	120	111	19	103	114	207	216	121	178	.....
5	.....	152	171	208	169	120	111	20	103	112	207	216	121	178	.....
6	.....	149	170	208	169	120	111	21	104	111	207	215	121	178	.....
7	.....	148	169	208	166	120	81	22	105	148	205	215	121	199	.....
8	.....	147	183	208	169	120	81	23	106	148	203	215	121	170	.....
9	.....	144	181	208	169	120	76	24	107	149	201	216	121	150	.....
10	.....	144	181	208	167	120	76	25	106	149	203	215	91	131	.....
11	.....	144	180	208	167	122	76	26	106	149	201	215	121	131	.....
12	.....	143	179	208	169	122	0	27	107	169	201	215	121	131	.....
13	.....	146	179	218	00	179	.....	28	107	172	203	192	121	131	.....
14	.....	108	211	218	00	179	.....	29	107	172	200	192	120	131	.....
15	103	110	206	216	122	179	.....	30	106	198	192	192	120	131	.....
								31	106	.....	192	192	.....	121	.....

NOTE.—These discharges were computed considering the gate openings as submerged orifices.

Monthly discharge of Corbett tunnel near Corbett, Wyo., for 1909.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
May 15–31	107	102	105	3,540	C.
June	198	106	137	8,150	C.
July	207	169	196	12,100	C.
August	218	192	208	12,800	C.
September	171	0	131	7,800	C.
October	199	120	144	8,850	C.
November 1–12	111	0	88	2,090	C.
The period	.....	.....	.....	55,300	

LITTLE MUDDY RIVER DRAINAGE BASIN.

DESCRIPTION.

Little Muddy River is a prairie stream that receives the drainage from an area of about 1,000 square miles—35 miles from north to south and 30 miles from east to west—in the center of Williams County, the northwestern county of North Dakota. It flows southward and joins the Missouri at Williston. About one-sixth of the whole area of the Little Muddy is drained by Stony Creek, a tributary which enters a few rods above its mouth. Altitudes in this basin range from 1,850 to 2,400 feet above sea level. The area is entirely without trees or shrubs, but is everywhere covered with rank prairie grass. The mean annual rainfall is about 15 inches.

Only a minor fraction of the run-off from this drainage area is carried by the stream. The entire region is deeply covered by glacial drift and there are many hollows and pools that receive the run-off and hold it till it evaporates, except when the rains are very heavy and long continued or the annual rainfall unusually great.

The headwaters of the main stream and the tributaries afford some storage sites, but only in shallow reservoirs from which evaporation

is rapid. Several such reservoirs holding from 10 acre-feet to 200 each are already in use, and a number of small irrigation plants with ditches carrying 2 or 3 second-feet or less are in operation.

About 50 filings for water rights, aggregating 2,000 second-feet, were made on this stream and its tributaries prior to the passage by the legislature in 1905 of the revised irrigation code, but many of these claims have been abandoned and nearly all call for quantities greater than are ever available except sometimes during a few days of spring flood.

About 12,000 acres in this valley are included in the Williston reclamation project, 8,500 acres being under canals already completed. Owing to the variability in annual discharge of the Little Muddy, which even with complete storage would probably not furnish an adequate supply in dry years, the water for the Williston project is obtained by pumping from the Missouri.

One station has been maintained in this basin—Little Muddy River near Williston, N. Dak., 1904 to 1909.

LITTLE MUDDY RIVER NEAR WILLISTON, N. DAK.

This station, which is located about 7 miles north of Williston, N. Dak., at the center of sec. 19, T. 155 N., R. 100 W., was established February 4, 1904, to determine the value of the stream for irrigation.

Camp Creek, a small tributary, comes in from the right a few rods below the station. The drainage area above this point is about 800 square miles.

An inclined staff gage is securely fastened to posts on the right bank. The gage datum has not been changed since the station was established. Measurements are made from a cable near by in flood and from a foot log or by wading in low water.

Changes in channel conditions have been slight. Low-stage estimates of discharge are correct within a few second-feet, although the flow is so small that a change of one-tenth of a foot in gage height indicates a very large percentage change in flow. As only a few discharge measurements have been made at high water, the high-stage rating table is not perfectly checked, but the monthly estimates at such times are fairly good.

The station was discontinued April 24, 1909.

This station was last inspected September 13, 1908. The accuracy of the daily and monthly discharges given therefore depends on the permanency of conditions of flow and of the elevation of the gage since that date.

Conditions of flow are known to be reasonably permanent at this station, and the 1907 rating table will apply fairly well.

Daily gage height, in feet, of Little Muddy River near Williston, N. Dak., for 1909.

[W. O. Hollar, observer.]

Day.	Mar.	Apr.	Day.	Mar.	Apr.	Day.	Mar.	Apr.
1	3.1	3.45	11	.....	3.0	21	6.9	2.3
2	3.15	4.0	12	.....	3.0	22	6.0	2.3
3	3.2	3.6	13	.....	2.85	23	5.5	2.3
4	3.35	3.45	14	3.3	2.85	24	5.2	2.3
5	3.3	3.4	15	3.2	2.6	25	4.95	.....
6	3.3	4.05	16	3.25	2.65	26	5.05	.....
7	.....	4.25	17	3.2	2.6	27	4.9	.....
8	.....	4.0	18	3.3	2.45	28	4.55	.....
9	.....	3.4	19	3.35	2.4	29	4.4	.....
10	.....	3.1	20	4.3	2.4	30	4.3	.....
						31	3.95	.....

NOTE.—Ice conditions during January and February.

Daily discharge, in second-feet, of Little Muddy River near Williston, N. Dak., for 1909.

Day.	Mar.	Apr.	Day.	Mar.	Apr.	Day.	Mar.	Apr.
1	42	83	11	61	34	21	1,730	6
2	46	239	12	61	34	22	1,200	6
3	51	114	13	61	24	23	930	6
4	67	83	14	61	24	24	780	6
5	61	74	15	51	12	25	655	6
6	61	257	16	56	14	26	705	6
7	61	340	17	51	12	27	630	6
8	61	239	18	61	8	28	472	6
9	61	74	19	67	7	29	405	6
10	61	42	20	361	7	30	361	6
						31	224	.....

NOTE.—These discharges are based on a rating curve which is not well defined. Discharges Mar. 7 to 13 and Apr. 25 to 30 estimated.

Monthly discharge of Little Muddy River near Williston, N. Dak., for 1909.

[Drainage area, 800 square miles.]

Month.	Discharge in second-feet.				Depth in inches on drainage area.	Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.			
March	1,730	42	310	.388	.447	19,100	C.
April	340	6	59	.074	.083	3,510	C.

KNIFE RIVER DRAINAGE BASIN.

DESCRIPTION.

Knife River rises in the northeast portion of Billings County, N. Dak., and flows eastward to Missouri River at Stanton, N. Dak., 90 miles in a direct line. It drains a basin whose greatest width is 40 miles and whose area comprises about 2,500 square miles. One-fifth of this basin is drained by the chief tributary, Spring Creek, which enters the Knife about 20 miles above its mouth.

Altitudes range from 1,700 to 2,500 feet above sea level. The mean annual rainfall varies from 15 to 17 inches. There are no forests and only a few scattered trees along the streams.

Through most of the year the flow is small, but owing to the steep slopes of the sides of the valley there are occasional sudden floods after heavy rains.

The land in the lower portion of the valley is very favorably located for irrigation if the flood waters can be stored, but no really economical localities for storage have yet been found.

KNIFE RIVER NEAR BRONCHO, N. DAK.

This station, which is located at C. D. Smith's ranch, in the SE. ¼ sec. 4, T. 142 N., R. 90 W., the former site of the post office of Broncho, N. Dak., was established on May 29, 1903, to determine the amount of water available for irrigation. The present location of the post office is some 6 miles from the old site.

Spring Creek enters about 15 miles below the station and Elm Creek one-half mile above. The drainage area is 1,260 square miles.

The station was originally 2 miles farther down the river, but it was moved to its present location March 23, 1905, and since that time the gage datum has been unchanged. The drainage areas at the two locations are practically identical, the area at the lower point being perhaps about 5 square miles greater.

The channel conditions at this point do not change perceptibly. Sufficient discharge measurements at high stages have not yet been made to check the rating curve satisfactorily, but it is approximately defined. The chain gage is located on the left bank of the stream just below the observer's house. Measurements in flood are made from a car and cable just below the gage. Low-water measurements are made by wading.

The following discharge measurement was made by J. W. Bliss:

April 3, 1909; width, 45 feet, area, 96.3 square feet; gage height, 5.70 feet; discharge, 194 [1] second-feet.

Daily gage height, in feet, of Knife River near Broncho, N. Dak., for 1909.

[C. D. Smith, observer.]

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	4.0	6.0	3.9	13.3	9.5	3.7	3.7	3.6	3.7
2	7.8	5.3	3.9	15.1	9.0	3.7	3.7	3.6	3.7
3	9.8	5.0	3.8	11.15	6.5	3.7	3.8	3.6	3.7
4	10.4	5.2	3.8	7.1	6.1	3.6	3.8	3.7	3.7
5	10.0	5.6	3.8	5.5	5.0	3.6	3.8	3.8	3.7
6	9.8	6.0	3.8	5.2	6.0	3.6	3.8	3.7	3.7
7	9.25	5.2	3.8	5.2	5.0	3.6	3.8	3.7	3.7
8	8.85	4.9	3.8	5.1	4.8	3.6	3.8	3.7	3.7
9	8.4	4.7	3.7	5.0	4.6	3.8	3.7	3.6	3.7
10	8.3	4.7	3.7	5.5	4.6	3.8	3.7	3.6	3.7

[1] Measurement was probably affected by ice lodged in the channel.

Daily gage height, in feet, of Knife River near Broncho, N. Dak., for 1909—Continued.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
11	8.2	4.5	3.7	9.5	4.5	5.55	3.7	3.6	3.7
12	8.2	4.4	3.7	6.3	4.4	7.25	3.7	3.6	3.7
13	8.35	4.3	3.6	6.2	4.4	8.9	3.6	3.65	3.7
14	8.1	4.1	3.6	6.2	4.3	9.0	3.6	3.65	3.7
15	8.0	4.1	3.6	7.2	4.2	8.15	3.6	3.7	3.7
16	8.2	4.1	3.6	6.8	4.2	6.6	3.6	3.7	3.7
17	7.4	4.1	3.7	4.6	4.2	6.1	3.6	3.7	.....
18	7.1	4.2	3.7	4.6	4.1	5.3	3.6	3.7	.....
19	6.9	4.2	3.7	4.5	4.0	4.5	3.6	3.7	.....
20	7.3	4.1	3.9	4.4	3.9	4.2	3.5	3.7	.....
21	9.4	4.0	4.5	4.4	3.9	3.9	3.5	3.7	.....
22	10.85	4.0	5.9	4.3	3.9	3.9	3.5	3.7	.....
23	11.3	4.0	4.9	4.1	3.8	3.9	3.5	3.7	.....
24	11.9	4.0	4.8	4.1	3.8	3.9	3.5	3.7	.....
25	10.3	4.0	4.5	4.0	5.2	3.9	3.5	3.7	.....
26	9.7	4.0	4.1	3.9	4.8	3.8	3.5	3.7	.....
27	9.3	4.0	4.1	3.9	4.1	3.8	3.5	3.7	.....
28	8.05	3.9	4.0	3.9	4.0	3.8	3.5	3.7	.....
29	8.0	3.9	5.9	3.8	3.8	3.8	3.5	3.7	.....
30	7.2	3.9	8.55	3.9	3.7	3.7	3.5	3.7	.....
31	6.7	.....	8.55	.....	3.7	3.7	.....	3.7	.....

NOTE.—Ice conditions probably prevailed during January, February, March, and after Nov. 16. The river was frozen Nov. 17.

Daily discharge, in second-feet, of Knife River near Broncho, N. Dak., for 1909.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	318	25	2,140	1,080	14	14	10	14
2	197	25	2,580	960	14	14	10	14
3	151	19	1,510	411	14	19	10	14
4	181	19	534	336	10	19	14	14
5	249	19	232	151	10	19	19	14
6	318	19	181	318	10	19	14	14
7	181	19	181	151	10	19	14	14
8	136	19	166	122	10	19	14	14
9	108	14	151	95	19	14	10	14
10	108	14	232	95	19	14	10	14
11	82	14	1,080	82	240	14	10	14
12	70	14	373	70	566	14	10	14
13	59	10	354	70	936	10	12	14
14	40	10	354	59	960	10	12	14
15	40	10	555	49	764	10	14	14
16	40	10	471	49	431	10	14	14
17	40	14	95	49	336	10	14	.....
18	49	14	95	40	197	10	14	.....
19	49	14	82	32	82	10	14	.....
20	40	25	70	25	49	7	14	.....
21	32	82	70	25	25	7	14	.....
22	32	300	59	25	25	7	14	.....
23	32	136	40	19	25	7	14	.....
24	32	122	40	19	25	7	14	.....
25	32	82	32	181	25	7	14	.....
26	32	40	25	122	19	7	14	.....
27	32	40	25	40	19	7	14	.....
28	25	32	25	32	19	7	14	.....
29	25	300	19	19	19	7	14	.....
30	25	856	25	14	14	7	14	.....
31	.....	856	.....	14	14	.....	14	.....

NOTE.—These discharges are based on a rating curve that is well defined below 82 second-feet. Discharges November 17–30 estimated for ice conditions as equivalent to 14 second-feet per day.

Monthly discharge of Knife River near Broncho, N. Dak., for 1909.

[Drainage area, 1,260 square miles.]

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
March	.....	.....	[a] 640	0.508	0.59	39,400	D.
April	318	25	91.8	.073	.08	5,460	C.
May	856	10	102	.081	.09	6,270	B.
June	2,580	19	373	.296	.33	22,200	C.
July	1,080	14	153	.121	.14	9,410	B.
August	960	10	159	.126	.15	9,780	B.
September	19	7	11.5	.0091	.01	684	C.
October	19	10	13.1	.010	.01	806	C.
November	.....	.....	[b] 14.0	.011	.01	833	D.
The period	.....	.....	.....	.....	.....	94,800	

[a] Estimated. [b] Partly estimated.

HEART RIVER DRAINAGE BASIN.

DESCRIPTION.

Heart River rises in eastern Billings County, N. Dak., flows eastward and southeastward for about 100 miles by general course, then turns abruptly to the north and northeast for 30 miles, and enters Missouri River at Mandan, N. Dak. The entire drainage area is 3,350 square miles.

The largest tributaries are Big Muddy Creek, which enters from the north a few miles above the big bend and drains 480 square miles, and Green River, which is one of the headwaters and drains 340 square miles.

Altitudes range from 1,640 feet above sea level at Mandan to about 2,700 feet at the western boundary of the basin. The mean annual rainfall is from 13 to 17 inches, of which about half falls in the three months of May, June, and July. There is no forestation, merely scattering fringes and groves along the streams.

HEART RIVER NEAR RICHARDTON, N. DAK.

This station, which is located at the steel highway bridge 10 miles south of Richardton, N. Dak., in or near sec. 21, T. 138, R. 92, and half a mile below the mouth of Blacktail Creek, was established May 18, 1903, to obtain data as to irrigation possibilities. The drainage area above this point is 1,250 square miles.

The datum of the gage has been unchanged, but the channel bottom is not permanent and occasional small changes in the rating curve are required. No extreme high-stage measurements have yet been obtained, and not enough medium high-stage measurements to properly define the upper portion of the rating curve; hence the

estimates of the extreme floods are only approximate. A standard chain gage is fastened securely to the downstream side of the highway bridge. Flood measurements are made from this bridge.

The following discharge measurement was made by J. W. Bliss:

April 3, 1909: Width, 60 feet; area, 108 square feet; gage height, 6.10 feet; discharge, 169[1] second-feet.

Daily gage height, in feet, of Heart River near Richardton, N. Dak., for 1909.

[W. F. Church, observer.]

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	.....	6.6	4.6	14.2	11.5	4.7	4.8	4.3	4.4
2	.....	6.3	4.6	18.0	10.2	4.6	4.7	4.3	4.4
3	.....	6.1	4.6	14.4	9.0	4.6	4.7	4.2	4.4
4	.....	6.1	4.6	11.2	8.4	4.5	4.7	4.2	4.4
5	.....	6.1	4.5	8.0	7.2	4.5	4.7	4.2	4.4
6	10.4	6.1	4.5	7.7	7.3	4.6	4.7	4.2	4.4
7	10.2	5.8	4.5	7.1	7.5	4.6	4.6	4.2	.....
8	10.1	5.6	4.5	6.7	7.7	4.5	4.6	4.3	4.5
9	10.0	5.8	4.5	6.5	7.2	4.5	4.6	4.3	4.5
10	9.6	5.7	4.5	6.4	6.1	9.6	4.6	4.3	4.5
11	9.4	5.5	4.5	9.2	6.6	7.4	4.5	4.3	4.5
12	9.3	5.4	4.5	8.7	6.7	13.9	4.5	4.3	4.5
13	.....	5.2	4.4	8.5	6.7	14.2	4.5	4.3	4.5
14	.....	5.1	4.4	9.2	5.8	13.8	4.5	4.2	4.5
15	.....	5.1	4.4	8.0	5.8	10.4	4.5	4.2	4.5
16	.....	5.1	4.4	6.9	5.7	9.1	4.5	4.2	4.5
17	.....	5.0	4.6	6.3	5.5	8.6	4.5	4.3	.....
18	.....	5.0	4.8	6.1	5.3	7.3	4.5	4.3	.....
19	.....	4.9	5.0	5.8	5.1	6.5	4.5	4.3	.....
20	.....	4.9	5.3	5.6	5.0	6.1	4.5	4.4	.....
21	10.2	4.9	9.9	5.4	5.0	5.9	4.4	4.4	.....
22	10.7	4.8	9.7	5.4	4.9	5.7	4.4	4.4	.....
23	11.0	4.8	9.0	5.3	4.9	5.5	4.4	4.4	.....
24	10.7	4.8	7.2	5.3	4.8	5.3	4.4	4.4	.....
25	10.3	4.8	5.7	5.2	5.4	5.2	4.4	4.4	.....
26	9.6	4.7	5.6	5.1	5.2	5.0	4.4	4.4	.....
27	9.0	4.7	5.4	4.9	5.0	5.0	4.4	4.4	.....
28	8.5	4.7	5.2	4.8	4.9	4.9	4.3	4.4	.....
29	8.1	4.7	5.1	4.7	4.8	4.9	4.3	4.4	.....
30	7.6	4.6	7.6	7.0	4.8	4.8	4.3	4.4	.....
31	6.9	.....	9.2	.....	4.7	4.8	.....	4.4	.....

NOTE.—Ice conditions probably prevailed during January, February, March, and after Nov. 15. The river was frozen Mar. 13–20.

Daily discharge, in second-feet, of Heart River near Richardton, N. Dak., for 1909.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	260	21	2,350	1,420	27	33	7	11
2	212	21	3,920	1,040	21	27	7	11
3	182	21	2,430	741	21	27	4	11
4	182	21	1,330	607	16	27	4	11
5	182	16	523	365	16	27	4	11
6	182	16	462	384	21	27	4	11
7	138	16	347	422	21	21	4	14
8	111	16	277	462	16	21	7	16
9	138	16	244	365	16	21	7	16
10	124	16	228	182	885	21	7	16
11	98	16	788	260	403	16	7	16
12	86	16	673	277	2,240	16	7	16
13	65	11	629	277	2,350	16	7	16
14	56	11	788	138	2,200	16	4	16
15	56	11	523	138	1,190	16	4	16

[1] Measurement was probably affected by ice lodged in the channel.

Daily discharge, in second-feet, of Heart River near Richardton, N. Dak., for 1909— Continued.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
16	56	11	311	124	764	16	4	.....
17	48	21	212	98	651	16	7	.....
18	48	33	182	75	384	16	7	.....
19	40	48	138	56	244	16	7	.....
20	40	75	111	48	182	16	11	.....
21	40	960	86	48	152	11	11	.....
22	33	910	86	40	124	11	11	.....
23	33	741	75	40	98	11	11	.....
24	33	365	75	33	75	11	11	.....
25	33	124	65	86	65	11	11	.....
26	27	111	56	65	48	11	11	.....
27	27	86	40	48	48	11	11	.....
28	27	65	33	40	40	7	11	.....
29	27	56	27	33	40	7	11	.....
30	21	442	329	33	33	7	11	.....
31	.....	788	.....	27	33	.....	11	.....

NOTE.—These discharges are based on a rating curve that is fairly well defined below 523 second-feet. Discharge Nov. 16–30 estimated for ice conditions is equivalent to 15 second-feet per day.

Monthly discharge of Heart River near Richardton, N. Dak., for 1909.

[Drainage area, 1,250 square miles.]

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
April	260	21	86.8	0 069	0.08	5,160	B.
May	960	11	160	.128	.15	9,840	B.
June	3,920	27	578	.462	.52	34,400	C.
July	1,420	27	257	.206	.24	15,800	B.
August	2,350	16	401	.321	.37	24,700	C.
September	33	7	17.0	014	.02	1,010	C.
October	11	4	7.8	.0062	.007	480	C.
November	.....	.....	a14.4	.012	.01	857	D.

a Partly estimated.

GRAND RIVER BASIN.

NORTH FORK OF GRAND RIVER AT HALEY, N. DAK.

The North Fork of Grand River unites with the South Fork to form the Grand in the northeastern part of Butte County, S. Dak., the main stream flowing from this junction eastward across the Standing Rock Indian Reservation to the Missouri.

This station, which is located about 20 rods south of the post office at Haley, N. Dak., near the northeast corner of sec. 36, T. 129, R. 100, was established May 17, 1908, to obtain data for the reclamation project under survey at that point. Two hundred feet below the staff gage is a standard car and cable outfit from which high-water gagings may be made. Low-water measurements are made by wading.

The drainage area above the station includes only the North Fork of the Grand and comprises about 500 square miles. As no measurements at high stage have yet been made, no rating curve has been prepared.

Discharge measurements of Grand River at Haley, N. Dak., in 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Apr. 5	R. M. Stee	37	64	1.27	15.2
6	do	37	61	1.23	16.6

Daily gage height, in feet, of Grand River at Haley, N. Dak., for 1909.

[H. N. Lungwitz, observer.]

Day.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	6.30	1.35	1.10	6.62	1.12	1.00	0.95	0.95	0.95	0.95
2	.....	6.25	1.35	1.00	6.42	1.15	1.00	.95	.95	.95	.95
3	.....	5.50	1.30	.98	4.40	1.10	1.00	.95	.95	.95	.95
4	.....	4.70	1.20	.95	2.85	1.15	1.00	.95	.95	.95	.95
5	.....	4.00	1.15	.95	2.25	1.20	1.00	.95	.95	.95	.95
6	.....	3.45	1.15	.95	2.00	1.32	1.00	.95	.95	.95	.95
7	0.90	3.20	1.20	.95	1.80	1.40	1.00	.95	.95	.95	.95
8	.90	3.15	1.15	1.00	1.82	1.40	1.00	.95	1.00	.95	.95
9	.90	2.55	1.15	1.00	6.75	1.30	1.00	.95	1.00	.95	.95
10	.90	2.80	1.05	1.00	4.30	1.30	1.00	.95	.95	.95	.95
11	.90	2.80	1.10	.98	3.15	1.50	1.00	.95	.95	.95	.95
12	.90	2.80	1.10	.90	3.35	1.42	3.58	.95	.95	.95	.95
13	.90	2.80	1.10	.90	4.90	1.35	1.85	.95	.95	.95	.95
14	.90	2.80	1.08	.90	3.32	1.40	1.45	.95	.95	.95	.95
15	.90	2.30	1.05	.90	2.50	1.35	1.25	.95	.95	.95	.95
16	.90	1.80	1.05	.90	2.50	1.32	1.10	.95	.95	.95	.95
17	.90	1.60	1.00	1.00	1.85	1.20	1.10	.95	.95	.95	.95
18	.90	1.55	1.00	.98	1.65	1.10	1.10	.95	.95	.95	.95
19	.90	1.75	1.00	.98	1.48	1.05	1.08	.95	.95	.95	.95
20	.90	2.05	1.00	.90	1.45	1.05	1.05	.95	.95	.95	.95
21	2.30	2.05	1.00	.90	1.35	1.10	1.05	.95	.95	.95	.95
22	2.30	2.55	.90	.90	1.30	1.05	1.00	.95	.95	.95	.95
23	2.30	2.40	.90	1.00	1.30	1.05	1.00	.95	.95	.95	.95
24	2.30	2.10	.90	1.00	1.30	1.05	1.00	.95	.95	.95	.95
25	3.60	1.85	.95	1.00	1.20	1.05	1.00	95	95	95	95
26	4.15	1.70	.95	1.00	1.20	1.00	1.00	.95	.95	.95	.....
27	5.05	1.70	.95	1.00	1.20	1.00	1.00	.95	.95	.95	.....
28	5.95	1.70	.95	1.00	1.20	1.00	.95	.95	.95	.95	.....
29	.....	1.65	1.00	1.45	1.20	1.00	.95	.95	.95	.95	.....
30	.....	1.40	1.10	1.60	1.15	1.00	.95	.95	.95	.95	.....
31	.....	1.35	.....	7.80	.....	1.00	.95	.....	.95	.....	.....

NOTE.—Ice conditions Feb. 7 to 20 and Mar. 10 to 13.

PLATTE RIVER DRAINAGE BASIN.

GENERAL FEATURES.

Considered only with regard to extent of the area drained, the Platte is the most important tributary of the Missouri. It is formed by two forks, North Platte and South Platte, which rise, respectively, in northern and in central Colorado and unite a little southwest of the center of Nebraska. Its entire drainage basin comprises about 84,000 square miles, of which 28,500 square miles belong to the North Platte and 24,000 to the South Platte. The lower course of

the river is fairly well settled, but farther west the population is more scattered.

For convenience the description of the basin is divided, and the North Platte, Platte River proper, and South Platte are considered separately, being arranged in downstream order.

NORTH PLATTE RIVER.

DESCRIPTION.

The source of North Platte River is in North Park, Colo., or rather in the mountains which, rising to elevations from 4,000 to 5,000 feet above its general level, hem it in on all sides. The park is just east of the Continental Divide, some of the peaks of which in that locality exceed 12,000 feet in altitude. From the steep slopes of the mountains numerous small streams descend, unite below into large creeks, and flow outward to the center of the basin. The two which may be said to form the real head of the North Platte are Grizzly and Little Grizzly creeks, but within the park the river is joined by four large tributaries, Roaring Fork and North Fork from the west and Michigan and Canadian Creeks from the east. Leaving the park, the river makes a bold curve northward into Wyoming, but near Casper, on the north side of the Casper Range, it turns abruptly to the east and southeast, maintaining the latter course to its point of junction with the South Platte in central Nebraska.

Within North Park the topographic features are diversified, including every degree of roughness from the snow-capped peaks of the Park and Medicine Bow ranges to the level prairie mesas along the lower portion of the stream. Dense forests cover the mountain tracts, the heaviest being those on the east slope of the Park Range and the west slope of the Medicine Bow Range. At an elevation of 8,500 feet above sea level the forests give way to the open prairie country, which, except for the dense growth of willows along the river bottoms, is entirely free from forests of any description.

The soil, composed principally of sandy and gravelly loam on the mesas and of sandy and black loam along the river bottoms, is in general fertile, but climatic conditions are such that the agricultural products are limited to wild hay, roots, and a few of the hardier grains.

In its northward course through Wyoming the stream receives many tributaries, the Snowy Range on the east contributing its drainage through Douglas, French, and Brush creeks, while the northeast slope of the Sierra Madre is drained by Beaver, Big Cow, and Spring creeks and Grand Encampment River. Medicine Bow and Sweetwater rivers are added to the North Platte between Saratoga and Casper, beyond which the only important tributary is the Laramie, which enters at old Fort Laramie.

The greater part of the region below Saratoga is a rolling, undulating prairie. The soil throughout Wyoming is a sandy loam of sufficient depth to produce meadows of rich grasses, even up to elevations of 7,000 feet. At lower elevations the soil becomes more friable and deeper.

Throughout its course in western Nebraska the valley of the North Platte is 10 to 15 miles wide. The present floor, consisting of sediments deposited in a former greater valley, is bordered by terraces and table-lands scarred by numerous tributaries and arroyos. The stream is broad and shallow, with a flood plain from 1 mile to 4 miles wide.

The character of the river bed at the Big Bend and at the Seminoe Mountains, in Wyoming, seems to indicate a considerable underflow. A part of this is collected at the Big Bend, and probably the entire amount is brought to the surface as the river passes through the Seminoe Range. In its lower course the bed of the stream is of fine quicksand underlain at a depth of 15 to 20 feet by a hard layer which seems to be clay.

The total length of the river from source to mouth is nearly 650 miles. At Pinkhampton, Colo., it is about 8,000 feet above sea level; at Fort Steele, Wyo., about 500 miles above its mouth, it is 6,500 feet; at Fort Laramie it is 4,200 feet, and at North Platte, Nebr., 2,800 feet.

The drainage area includes about 28,800 square miles, of which 1,800 square miles are in Colorado, 20,000 in Wyoming, and nearly 7,000 in Nebraska.

In the mountain districts precipitation, usually in the form of snow during the winter and spring months, varies from 7 to 15 inches, the average being about 11 inches; in the high mountains it is 20 inches and upward. Throughout the lower portion of the basin the precipitation is from 15 to 18 inches, and the evaporation from the water surface is 5 to 6 feet annually.

The stream is subject to periodic floods, which reach the maximum at the mouth sometime during the latter part of June and are caused by the melting snow on the high ranges. The river runs lowest in winter and is usually covered with thick ice. High water prevails from the middle of April until the middle of July, during which period the river is frequently bank full.

The winters are quite severe throughout the basin of this stream, and particularly so above an altitude of 4,000 feet. On the plains areas, although there is considerable snowfall, the snow does not lie for more than a few days at a time.

Agriculture in the basin of the North Platte has been confined largely to the valleys of the tributaries, and most of the available agricultural lands on these tributaries are now occupied. At present irrigation is most extensively practiced on Laramie and Little Lara-

mie Rivers in the vicinity of Laramie; on the Laramie in the vicinity of Wheatland, and on the North Platte itself for a considerable distance on both sides of the Wyoming-Nebraska line.

The Laramie-Poudre project will divert a considerable portion of the flow of Laramie River in Colorado across the divide by means of a tunnel into the headwaters of the Cache la Poudre, where the waters will be used to irrigate land in the South Platte drainage. Construction is about to be begun on this project. The nearly completed North Platte project of the Reclamation Service will provide for the irrigation of about 100,000 acres of land along the North Platte in Nebraska and Wyoming. Numerous other irrigation projects are contemplated or are in course of construction, and many additional opportunities for development by storage of flood waters still remain.

The basin contains many excellent reservoir sites, a few of which have been developed. The most notable is the Pathfinder reservoir of the United States Reclamation Service. This reservoir, with a dam 215 feet high, will have a capacity of over 1,000,000 acre-feet. Another excellent site is at what is usually known as the "Devils Gate" on Sweetwater River a few miles above its mouth. It has a capacity of over 300,000 acre-feet, but has never been developed on account of the inadequacy of the water supply; and as the Pathfinder reservoir will store the flood waters of the Sweetwater it is not likely that the Devils Gate reservoir will ever be built. On the North Platte and its tributaries in Colorado are several fairly good reservoir sites, the largest being on the North Platte near Pinkhampton, which would have a capacity of nearly 100,000 acre-feet with a dam 100 feet high. The reservoir site on Laramie River near Glendevey, Colo., has a capacity of about 15,000 acre-feet.

Power development on the North Platte will be limited largely to the upper river and its tributaries and probably never will be in excess of 50,000 horsepower. Present development amounts to only a few hundred horsepower.

The more recent records of the United States Geological Survey indicate 1902 as the driest and 1909 as the wettest year.

PLATTE RIVER.

DESCRIPTION.

From the point of junction of North and South Platte rivers the main stream winds eastward across Nebraska for over 200 miles, uniting with the Missouri at Plattsmouth, about 10 miles south of Omaha. Its course lies chiefly through broad, level bottom lands, rather sandy in places, but for the most part fertile, bordered by bluffs varying in height from 50 to 300 or 400 feet. From its source to a point near Ashland, Saunders County, it is a broad, shallow stream, flowing in many places as a network of interlacing channels among numerous islands and sand bars, but farther east it is con-

fined between heavily wooded limestone bluffs. The average fall is about 6 feet per mile.

The average annual precipitation is about 23 inches, of which 69 per cent falls during the five months of the growing season, from April to August; about one-half of the remainder is snowfall. The evaporation averages about 4½ feet. The stream is subject to periodic floods caused by melting of snows in the headwaters regions of North and South Platte rivers. These floods reach a maximum in June and July and often do considerable damage to property on the lower portions of the stream. In the western part of the drainage area the waters of the stream are extensively used for irrigation.

The records of the Survey indicate 1905 and 1909 as years of high water, and 1902 and 1908 as low-water years.

NORTH PLATTE RIVER AT SARATOGA, WYO.

This station, which was established June 9, 1903, and discontinued October 31, 1906, was reestablished on April 1, 1909, to determine the amount of water coming down for storage in the new Pathfinder reservoir of the United States Reclamation Service, which was just beginning to store water. It was located about 100 yards below the two-span iron-truss highway bridge connecting East and West Saratoga, in T. 17 N., R. 84 W. The station was abandoned December 17, 1909.

Spring Creek enters the river about 2 miles above the station and Jack Creek comes in several miles downstream. Water for the irrigation of several thousand acres, mostly meadow land, is diverted in the vicinity of Saratoga and from the North Platte and various tributaries above. The drainage area above the station is about 2,900 square miles and the elevation at the station is about 6,700 feet above sea level.

The drainage basin contains many reservoir sites, and it is believed that opportunities for considerable irrigation exist without interfering with the needs of the United States Reclamation Service.

Measurements were made from the highway bridge above the gage. Ice interferes with the flow for several months each year, and at certain stations "tie drive" blocks the stream for a few days.

The location and datum of the gage have remained constant since the station was established.

Discharge measurements of North Platte River at Saratoga, Wyo., in 1909.

Date.		Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
			Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
July	2	C. L. Chatfield	262	1,720	6.15	10,500
	3	....do	254	1,710	6.17	10,400
	4	....do	254	1,640	6.00	9,610
	5	....do	254	1,740	6.35	11,000

Daily gage height, in feet, of North Platte River at Saratoga, Wyo., for 1909.

[J. M. Sterrett, observer.]

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.00	3.45	5.10	6.30	2.80	2.55	2.10	2.05	2.00
2	2.10	3.40	5.20	6.20	2.85	2.60	2.10	2.00	2.00
3	2.25	3.30	5.70	6.05	2.85	2.60	2.10	2.00	1.75
4	2.30	3.80	6.25	6.05	2.80	2.50	2.05	2.00	1.60
5	2.45	4.40	6.85	6.20	2.70	2.55	2.10	2.00	1.65
6	1.95	4.65	7.35	6.00	2.70	2.85	2.10	2.00	1.80
7	2.00	4.55	7.55	5.75	2.70	3.10	2.10	2.00	1.95
8	1.95	4.50	7.70	5.50	2.95	3.10	2.10	1.95	2.10
9	2.00	4.50	7.60	5.05	2.90	3.00	2.10	1.90	2.10
10	2.00	4.50	7.25	4.70	3.10	2.80	2.05	1.95	2.10
11	2.00	4.70	7.00	4.50	3.10	2.65	2.05	1.90	2.00
12	2.00	4.80	6.80	4.30	3.10	2.60	2.05	1.90	1.90
13	2.00	4.90	6.65	4.10	3.20	2.60	2.10	1.90	1.90
14	2.10	4.60	6.65	3.95	3.05	2.70	2.10	1.80	1.90
15	2.20	4.45	6.75	3.85	2.85	2.55	2.05	1.75	2.05
16	2.30	4.40	6.70	3.75	2.70	2.50	2.05	1.75	1.95
17	2.60	4.40	6.80	3.70	3.05	2.40	2.00	1.75	1.80
18	2.95	4.45	7.00	3.60	3.20	2.35	2.00	1.80	.....
19	2.70	4.60	7.20	3.70	3.20	2.30	2.00	2.00	.....
20	2.85	4.80	7.30	3.70	3.05	2.30	2.00	2.20	.....
21	2.85	4.90	7.30	3.70	2.85	2.30	2.00	2.20	.....
22	2.75	5.15	7.15	3.55	2.80	2.40	2.05	2.20	.....
23	2.70	5.40	6.95	3.40	2.70	2.40	2.00	2.20	.....
24	2.75	5.50	7.00	3.85	2.60	2.35	2.00	2.30	.....
25	2.85	5.35	6.90	3.80	2.65	2.30	2.00	2.30	.....
26	3.20	5.00	6.75	3.60	2.60	2.25	2.00	2.25	.....
27	3.70	4.90	6.70	3.65	2.50	2.20	1.95	2.30	.....
28	4.15	5.10	6.60	3.45	2.40	2.20	1.90	1.85	.....
29	4.30	5.35	6.50	3.25	2.40	2.10	1.90	1.85	.....
30	3.90	5.15	6.45	3.15	2.40	2.10	1.90	2.00	.....
31	.....	5.15	.....	2.90	2.40	.....	1.95	.....	.....

NOTE.—Ice conditions January, February, March, and December 17 to 31.

Daily discharge, in second-feet, of North Platte River at Saratoga, Wyo., for 1909.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	485	2,560	7,210	11,200	1,380	1,030	565	525	485
2	565	2,460	7,530	10,800	1,450	1,100	565	485	485
3	702	2,250	9,150	10,300	1,450	1,100	565	485	328
4	750	3,390	11,000	10,300	1,380	970	525	485	255
5	912	5,030	13,100	10,800	1,230	1,030	565	485	278
6	450	5,780	14,900	10,200	1,230	1,450	565	485	355
7	485	5,480	15,600	9,320	1,230	1,870	565	485	450
8	450	5,320	16,200	8,500	1,610	1,870	565	450	565
9	485	5,320	15,800	7,050	1,530	1,700	565	415	565
10	485	5,320	14,500	5,940	1,870	1,380	525	450	565
11	485	5,940	13,600	5,325	1,870	1,160	525	415	485
12	485	6,260	12,900	4,740	1,870	1,100	525	415	415
13	485	6,570	12,400	4,180	2,060	1,100	565	415	415
14	565	5,630	12,400	3,780	1,780	1,230	565	355	415
15	655	5,180	12,700	3,520	1,450	1,030	525	328	525
16	750	5,030	12,600	3,270	1,230	970	525	328	450
17	1,100	5,030	12,900	3,140	1,780	855	485	328	355
18	1,610	5,180	13,600	2,900	2,060	802	485	355	.....
19	1,230	5,630	14,300	3,140	2,060	750	485	485	.....
20	1,450	6,260	14,700	3,140	1,780	750	485	655	.....
21	1,450	6,570	14,700	3,140	1,450	750	485	655	.....
22	1,300	7,370	14,200	2,790	1,380	855	525	655	.....
23	1,230	8,180	13,400	2,460	1,230	855	485	655	.....
24	1,300	8,500	13,600	3,520	1,100	802	485	750	.....
25	1,450	8,010	13,300	3,390	1,100	750	485	750	.....
26	2,060	6,890	12,700	2,900	1,100	702	485	702	.....
27	3,140	6,570	12,600	3,020	970	655	450	750	.....
28	4,320	7,210	12,200	2,560	855	655	415	385	.....
29	4,740	8,010	11,900	2,150	855	565	415	385	.....
30	3,640	7,370	11,700	1,960	855	565	415	485	.....
31	.....	7,370	.....	1,530	855	.....	450	.....	.....

NOTE.—These discharges are based on a curve that is well defined between 328 and 10,150 second-feet.

Monthly discharge of North Platte River at Saratoga, Wyo., for 1909.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
April	4,740	450	1,310	78,000	B.
May	8,500	2,250	5,860	360,000	B.
June	16,200	7,210	12,900	768,000	B.
July	11,200	1,530	5,190	319,000	B.
August	2,060	855	1,420	87,300	B.
September	1,870	565	1,010	60,100	B.
October	565	415	511	31,400	B.
November	750	328	500	29,800	B.
Dec. 1–17	565	255	435	14,700	B.
The period				1,750,000	

NORTH PLATTE RIVER AT PATHFINDER, WYO.

This station, which is located one-half mile south of Pathfinder post office and 500 feet below the mouth of the canyon, in sec. 24, T. 29 N., R. 84 W., sixth principal meridian, Wyoming, was established May 9, 1905, and has been maintained by the United States Reclamation Service to show the amount of water available for storage in connection with the North Platte project.

The Pathfinder dam site is about one-fourth mile above the station, which is at an elevation of nearly 5,700 feet, and Sweetwater River enters the North Platte about 3 miles above. The drainage area is about 12,000 square miles.

Very little water is diverted above the station. Some land is irrigated on the North Platte and its tributaries, but opportunities for much additional development can be found.

The datum of the gage has remained constant during the maintenance of the station. The flow is affected by ice for several months during the winter season. The results obtained at this station have been on the whole very satisfactory.

Discharge measurements of North Platte River at Pathfinder, Wyo., in 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Jan. 30[a]	L. V. Branch	175	437	2.52	449
Mar. 5[a]	do	181	560	3.02	706
June 8	do	213	1,760	7.23	7,970
Oct. 15	do	198	1,180	4.02	2,430
16	do	193	852	2.42	849

[a] Gaging made under ice 18 inches thick.

Daily gage height, in feet, of North Platte River at Pathfinder, Wyo., for 1909.

[W. F. Costello and Charles E. Hamilton, observers.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.35	2.20	2.45	3.20	3.65	7.00	7.55	7.40	4.30	6.25	2.10	2.20
2	2.30	2.20	2.50	3.15	4.25	7.00	7.55	7.40	4.30	6.20	2.10	2.25
3	2.40	2.30	2.55	3.15	5.75	7.00	7.55	7.40	4.30	6.20	2.10	2.25
4	2.40	2.25	2.60	3.20	5.75	7.00	7.50	7.40	4.30	6.15	2.10	1.90
5	2.55	2.25	2.95	3.20	5.70	7.05	7.65	7.40	4.30	6.10	2.10	1.75
6	2.90	2.20	3.00	3.30	5.70	7.10	7.65	7.40	4.30	6.05	2.10	1.60
7	2.95	2.20	3.10	3.30	5.75	7.20	7.65	7.35	4.30	6.00	2.20	1.70
8	2.90	2.20	2.70	3.30	5.80	7.20	7.65	7.35	4.30	5.90	2.20	1.70
9	2.80	2.10	2.80	3.30	6.20	7.20	7.60	7.30	4.30	5.85	2.20	1.70
10	2.85	2.20	2.80	3.25	6.65	7.30	7.60	7.30	4.30	5.80	2.15	1.70
11	2.75	2.25	2.55	3.20	6.70	7.35	7.60	7.30	4.50	5.70	2.10	1.80
12	2.70	2.30	2.40	3.20	6.65	7.35	7.60	7.25	4.70	5.60	2.10	2.05
13	2.85	2.30	2.40	3.20	6.60	7.40	7.60	7.25	4.70	5.40	2.10	2.20
14	2.80	2.35	2.40	3.15	6.60	7.35	7.60	7.25	4.70	5.10	2.00	2.10
15	2.60	2.40	2.40	3.10	6.60	7.40	7.60	7.25	4.65	4.20	2.00	2.00
16	2.70	2.35	2.25	3.10	6.70	7.40	7.60	7.25	4.65	2.40	1.60	1.95
17	2.70	2.40	2.30	3.10	6.65	7.40	7.60	7.20	4.65	2.40	1.45	1.90
18	2.80	2.40	2.50	3.10	6.65	7.40	7 60	7.20	4.65	2.20	1.45	1.80
19	2.90	2.40	2.70	3.20	6.65	7.45	7.60	6.90	4.65	1.95	1.45	1.70
20	2.80	2.45	2.80	3 30	6.60	7.50	7.55	6.65	4.65	1.75	1.60	1.70
21	2.85	2.45	2.90	3.35	6.65	7.50	7.55	6.30	4.65	2.25	2.30	1.60
22	2.75	2.45	3.00	3.40	6.65	7.55	7.55	5.90	4.60	2.20	2.40	1.60
23	2.70	2.40	3.10	3.40	6.60	7.55	7.55	5.90	4.60	2.20	2.50	1.65
24	2.60	2.40	3.20	3.45	6.70	7.50	7.50	5.90	4.60	2.20	2.60	1.70
25	2.50	2.40	3.20	3.50	6.75	7.50	7.50	5.35	4.60	2.20	2.60	1.70
26	2.45	2.40	3.25	3.45	6.80	7.55	7.50	4.80	4.60	2.20	2.65	1.70
27	2.40	2.40	3.25	3.45	6.85	7.55	7.50	4.80	4.65	2.15	2.60	1.80
28	2.45	2.40	3.30	3.45	6.90	7.60	7.50	4.55	5.50	2.15	2.60	1.80
29	2.35	.....	3.30	3.50	6.90	7.60	7.50	4.30	6.35	2.10	2.55	1.80
30	2.30	.....	3.25	3.60	6.90	7.55	7.45	4.30	6.25	2.10	2.25	1.80
31	2.40	.....	3.20	.....	6.95	.....	7.45	4.30	.....	2.10	.....	1.80

NOTE.—River frozen over January 1 to March 19 and December 9 to 31.

Daily discharge, in second-feet, of North Platte River at Pathfinder, Wyo., for 1909.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	475	425	505	1,400	1,840	7,240	8,450	8,120	2,590	5,640	665	715
2	455	425	520	1,360	2,530	7,240	8,450	8,120	2,590	5,540	665	742
3	490	455	550	1,360	4,690	7,240	8,450	8,120	2,590	5,540	665	742
4	490	444	565	1,400	4,690	7,240	8,340	8,120	2,590	5,440	665	565
5	535	440	685	1,400	4,600	7,350	8,670	8,120	2,590	5,340	665	498
6	640	425	705	1,490	4,600	7,460	8,670	8,120	2,590	5,240	665	430
7	655	425	750	1,490	4,690	7,680	8,670	8,010	2,590	5,140	715	475
8	640	425	640	1,490	4,780	7,680	8,670	8,010	2,590	4,960	715	475
9	610	395	685	1,490	5,540	7,680	8,560	7,900	2,590	4,870	715	475
10	625	425	700	1,440	6,480	7,900	8,560	7,900	2,590	4,780	690	475
11	595	440	640	1,400	6,580	8,010	8,560	7,900	2,850	4,600	665	520
12	580	455	610	1,400	6,480	8,010	8,560	7,790	3,110	4,430	665	640
13	625	455	625	1,400	6,370	8,120	8,560	7,790	3,110	4,100	665	715
14	610	475	640	1,360	6,370	8,010	8,560	7,790	3,110	3,640	615	665
15	550	490	670	1,310	6,370	8,120	8,560	7,790	3,040	2,470	615	615
16	580	475	685	1,310	6,580	8,120	8,560	7,790	3,040	835	430	590
17	580	490	770	1,310	6,480	8,120	8,560	7,680	3,040	835	370	565
18	610	490	900	1,310	6,480	8,120	8,560	7,680	3,040	715	370	520
19	640	490	1,000	1,400	6,480	8,230	8,560	7,020	3,040	590	370	475
20	610	505	1,070	1,490	6,370	8,340	8,450	6,480	3,040	498	430	475
21	625	505	1,140	1,540	6,480	8,340	8,450	5,740	3,040	742	780	430
22	595	505	1,220	1,590	6,480	8,450	8,450	4,960	2,980	715	835	430
23	580	490	1,310	1,590	6,370	8,450	8,450	4,960	2,980	715	880	457
24	550	490	1,400	1,640	6,580	8,340	8,340	4,960	2,980	715	940	457
25	520	485	1,400	1,690	6,690	8,340	8,340	4,020	2,980	715	940	442
26	505	480	1,440	1,640	6,800	8,450	8,340	3,240	2,980	715	970	427
27	490	475	1,440	1,640	6,910	8,450	8,340	3,240	3,040	690	940	457
28	500	475	1,490	1,640	7,020	8,560	8,340	2,920	4,260	690	940	442
29	470	.....	1,490	1,690	7,020	8,560	8,340	2,590	5,840	665	910	427
30	445	.....	1,440	1,790	7,020	8,450	8,230	2,590	5,640	665	742	422
31	490	.....	1,400	.....	7,130	.....	8,230	2,590	.....	665	.....	427

NOTE.—Discharges January 1–March 18 and December 23–31 estimated by Reclamation Service engineers because of ice conditions. Other discharges were obtained from a rating curve which is well defined.

Daily discharge, in second-feet, into Pathfinder reservoir at Pathfinder, Wyo., for 1909.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.
1	.....	6,920	9,250	14,600	3,180	1,140	870	16	.....	6,160	17,300	4,190	1,700	1,140	785
2	.....	4,230	9,300	13,600	2,880	1,140	875	17	.....	6,260	17,800	4,150	1,600	1,140	.....
3	.....	3,460	12,300	13,100	2,580	1,150	875	18	2,280	6,210	15,800	3,140	2,200	1,140	.....
4	.....	4,720	12,800	13,100	2,280	1,160	880	19	2,470	6,210	16,400	3,130	2,030	1,140	.....
5	.....	2,410	14,500	12,900	1,980	1,160	880	20	2,960	6,060	18,600	3,050	1,540	1,040	.....
6	.....	4,480	14,000	13,400	1,680	1,290	880	21	3,380	6,560	16,600	3,540	1,320	1,040	.....
7	.....	7,440	18,800	13,400	1,680	1,940	880	22	2,940	8,480	18,700	3,040	2,040	1,050	.....
8	.....	6,290	22,100	12,400	1,670	2,590	890	23	2,360	8,980	17,700	2,940	1,340	1,050	.....
9	.....	8,580	25,400	10,800	1,840	2,590	895	24	2,060	8,630	18,600	2,930	1,130	1,050	.....
10	.....	6,910	27,600	9,190	2,000	2,390	900	25	2,180	11,300	17,600	2,930	950	1,050	.....
11	.....	6,740	21,800	6,730	2,170	1,790	910	26	1,660	12,000	17,700	2,930	800	1,050	.....
12	.....	7,320	20,800	5,710	2,340	1,450	920	27	2,420	11,000	15,700	2,930	1,160	1,040	.....
13	.....	8,060	20,400	6,210	2,340	1,350	930	28	3,080	9,080	15,700	2,930	1,010	960	.....
14	.....	7,860	15,200	4,700	1,430	1,250	940	29	4,500	8,580	16,200	2,350	990	870	.....
15	.....	6,710	15,800	4,190	1,270	1,140	920	30	4,680	9,590	16,100	2,810	1,030	870	.....
								31	.....	10,700	.....	3,810	1,140	.....	.....

NOTE.—These discharges are the estimated daily flow of North Platte River into Pathfinder reservoir, where they differ from the discharge below the dam.

Monthly discharge of North Platte River at Pathfinder, Wyo., for 1909.

[Drainage area, 12,000 square miles.]

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
January	655	445	560	0.047	0.05	34,400	C.
February	505	395	462	.039	.04	25,700	C.
March	1,490	505	938	.078	.09	57,700	C.
April	1,790	1,310	1,480	.123	.14	88,100	B.
May	7,130	1,840	5,920	.493	.57	364,000	A.
June	8,560	7,240	8,010	.668	.75	477,000	A.
July	8,670	8,230	8,480	.708	.82	521,000	A.
August	8,120	2,590	6,390	.532	.61	393,000	A.
September	5,840	2,590	3,100	.258	.29	184,000	B.
October	5,640	498	2,670	.222	.26	164,000	B.
November	970	370	697	.058	.06	41,500	B.
December	742	427	522	.044	.05	32,100	C.
The year	8,670	370	3,270	.272	3.73	2,380,000	

Monthly discharge into Pathfinder reservoir near Pathfinder, Wyo., for 1909.

[Drainage area, 12,000 square miles.]

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
January	655	445	560	0.047	0.05	34,400	C.
February	505	395	462	.039	.04	25,700	C.
March	1,490	505	938	.078	.09	57,700	C.
April	4,680	1,310	2,030	.169	.19	121,000	C.
May	12,000	2,410	7,350	.612	.71	452,000	C.
June	27,600	9,250	17,200	1.43	1.60	1,020,000	C.
July	14,600	2,350	6,610	.551	.64	406,000	C.
August	3,180	800	1,720	.143	.16	106,000	C.
September	2,590	870	1,310	.109	.12	78,000	C.
October	940	498	792	.066	.08	48,700	C.
November	970	370	697	.058	.06	41,500	C.
December	742	427	522	.044	.05	32,100	C.
The year	27,600	370	3,350	.279	3.79	2,420,000	

NOTE.—The above data are estimated inflow. The difference between the total yearly inflow and the total discharge below the dam (at Pathfinder) represents estimated evaporation and remaining silt.

NORTH PLATTE RIVER AT WHALEN, WYO.

This station, which is located at the head of the Interstate canal at Whalen, Wyo., about 7 miles below Guernsey, was established May 1, 1909, by the United States Reclamation Service at the recently completed Whalen weir, to obtain data on stream flow available in connection with the North Platte project, and to replace the station on the North Platte at Guernsey. (See Pl. V, B.)

No important tributaries enter the river for several miles above the station. Laramie River comes in about 6 miles below.

The zero of the weir gage is at the level of the weir crest, which is 300 feet wide. To the computed flow over the weir is added the flow through the four sluice gates in the weir, which are $5\frac{3}{4}$ feet wide and 6 feet high when fully opened, and the discharge through the nine diversion gates of the Interstate canal, which are the same size as the sluiceway gates.

Another gage is fastened to the retaining wall 75 feet downstream from the weir crest, the zero of which is 10 feet below the zero of the weir gage.

The canal gage is painted on the retaining wall about 1,000 feet below the diversion gate, and its zero is on a level with the canal bottom.

The readings on the river and canal gages have been used only when it is necessary to compute the discharges through the gates, when the gate openings are submerged.

The weir and discharge coefficients have been rather uncertain, and it is the intention during the season of 1910 to check them up by meter measurements of the canal and by measurements of the river from a cable which will be installed 1 mile down stream.

The seven diversions of the proposed Fort Laramie canal are the same size as those of the Interstate canal and are situated at the other end of the Whalen weir. The canal has not yet been constructed.

Daily discharge, in second-feet, of North Platte River at Whalen, Wyo., for 1909.

Day.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2,750	9,970	8,090	7,280	2,970	4,730	1,060	1,140
2	2,590	16,100	8,200	7,270	2,980	5,210	1,060	967
3	2,690	20,200	7,910	7,270	3,130	5,280	1,060	830
4	2,740	14,900	8,070	6,990	2,880	5,560	1,060	473
5	3,690	12,500	7,850	6,980	2,820	5,480	1,000	153
6	5,450	12,100	7,870	6,990	2,820	5,530	1,000	125
7	5,780	12,800	7,870	6,990	2,810	5,480	1,000	125
8	5,560	17,300	7,890	6,990	2,810	5,350	1,000	150
9	5,560	14,200	7,920	6,990	2,810	5,350	1,000	306
10	5,560	12,000	7,500	6,990	2,810	5,210	1,000	474
11	5,560	12,100	7,560	6,990	2,730	5,210	1,000	643
12	6,700	12,300	7,700	7,280	2,810	5,080	1,000	767
13	6,700	10,700	7,790	7,970	2,780	5,080	1,000	968
14	6,700	10,600	7,630	7,580	2,860	4,820	1,000	968
15	6,700	9,830	7,840	6,950	3,190	4,690	770	968

Daily discharge, in second-feet, of North Platte River at Whalen, Wyo., for 1909—Contd.

Day.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
16	6,700	9,910	7,520	7,000	3,150	4,440	620	832
17	6,700	9,230	7,620	7,000	3,150	4,083	458	900
18	6,700	9,240	8,070	6,860	3,150	3,280	500	1,060
19	6,700	8,970	7,700	6,860	3,150	2,090	880	1,220
20	6,700	8,990	7,560	6,860	3,140	1,680	1,320	1,220
21	6,700	8,660	7,420	6,720	3,140	1,520	1,140	1,140
22	6,700	8,750	8,150	6,170	3,140	1,440	1,230	1,140
23	7,070	8,550	7,610	5,900	3,270	1,260	1,010	1,060
24	7,670	8,290	7,610	5,040	3,270	1,130	1,010	831
25	9,330	8,360	7,490	4,800	3,140	1,130	1,010	900
26	11,600	8,130	7,460	4,820	3,140	1,130	1,080	831
27	10,000	8,280	7,460	4,810	3,060	1,130	1,080	703
28	9,210	8,000	7,460	4,130	3,060	1,130	1,140	703
29	9,210	8,040	7,460	3,510	3,060	1,130	1,230	643
30	9,970	8,060	7,180	3,510	3,060	1,130	1,320	703
31	9,630	.....	7,180	3,250	.....	1,130	.....	703

Monthly discharge of North Platte River at Whalen, Wyo., for 1909.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
May	11,600	2,590	6,620	407,000
June	20,200	8,000	10,900	649,000
July	8,200	7,180	7,700	473,000
August	7,970	3,250	6,280	386,000
September	3,270	2,730	3,010	179,000
October	5,560	1,130	3,450	212,000
November	1,320	458	1,000	59,500
December	1,220	125	763	46,900

NOTE.—The records of discharge published above have been furnished by engineers of the United States Reclamation Service. They have not been verified by engineers of the United States Geological Survey.

NORTH PLATTE RIVER NEAR MITCHELL, NEBR.

This station, which was established June 3, 1901, to replace the station at Gering, is located at a highway bridge 1 mile south of Mitchell, Nebr., in sec. 27, T. 23 N., R. 56 W. The records at this point show the amount of water passing the Wyoming-Nebraska State line, and are of especial value in connection with interstate questions concerning the distribution of water. Laramie River and Rawhide Creek enter the river in Wyoming below the Guernsey station, and Horse Creek comes in just below the State line. No important tributaries enter below the station. Important diversions for irrigation are made both above and below the station.

The chain gage is fastened to the upstream handrail of the pile bridge from which discharge measurements are usually made. The datum of the gage was lowered 1 foot May 3, 1902, to obviate negative readings. As the river sometimes freezes solid, few records have been obtained during the winter.

As the bed of the river is of shifting sand, and the measurements are insufficient in number to indicate all changes, the results obtained are unsatisfactory.

Discharge measurements of North Platte River near Mitchell, Nebr., in 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Mar. 25	G. W. Bates	960	889	2.90	1,950
Apr. 9	A. A. Dobson	1,060	1,140	2.85	2,630
May 14	do	1,570	2,610	4.00	7,220
June 14	E. C. Simmons	1,580	4,030	5.28	16,500
July 11	A. A. Dobson	1,260	2,980	4.32	13,800
Aug. 27	do	8,680	1,560	3.28	3,900
Sept. 6	D. D. Price	962	919	2.95	2,050

Daily gage height, in feet, of North Platte River near Mitchell, Nebr., for 1909.

[B. H. Newbold, observer.]

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	2.8	3.1	4.7	4.6	.....	2.9	3.0	2.4	2.6
2	.....	2.8	.....	4.9	4.6	3.8	2.9	3.0	2.4	2.6
3	.....	2.8	3.2	6.0	4.6	3.9	2.9	.....	2.3	2.6
4	.....	.....	3.2	6.0	.....	3.9	2.9	3.5	2.3	2.5
5	.....	2.7	3.2	5.5	4.6	3.9	.....	3.5	2.3	.....
6	.....	2.8	3.3	.....	4.4	3.9	3.0	3.6	2.3	.....
7	.....	2.8	3.5	5.3	4.4	3.9	3.0	4.0	.....	.....
8	.....	2.9	3.7	5.4	4.2	.....	2.9	3.7	2.3	.....
9	2.6	2.9	.....	5.4	4.2	4.0	2.9	3.8	2.3	.....
10	2.5	2.8	3.7	5.6	4.5	3.9	2.9	.....	2.3	.....
11	2.5	.....	3.8	5.2	4.3	3.9	2.9	3.7	2.3	.....
12	2.5	2.9	3.8	5.4	4.3	3.9	.....	3.7	2.3	.....
13	2.6	2.8	4.0	.....	4.4	3.8	2.8	3.6	2.4	2.9
14	.....	2.8	4.0	5.4	4.5	3.8	2.8	3.5	.....	3.0
15	2.5	2.8	3.9	5.4	4.5	.....	2.8	3.5	2.4	3.1
16	2.4	2.8	.....	5.4	4.5	4.0	2 9	3.5	3.0	3.0
17	2.4	2.8	3.9	5.2	4.2	4.0	2.9	.....	3.0	3.0
18	2.6	.....	3.9	4.8	.....	4.0	2.9	3.4	3.4	3.0
19	2.5	2.8	4.0	4.8	4.2	3.9	.....	3.4	3.2	.....
20	2.5	2.9	4.0	.....	4.1	3.8	2.9	3.0	3.3	3.0
21	.....	2.9	4.0	4.7	4.1	3.8	3.0	2.8	.....	2.9
22	2.8	3.0	4.0	4.7	4.1	.....	2.9	2.7	2.7	2.9
23	2.8	3.0	.....	4.7	4.1	3.6	2.9	2.8	2.7	2.9
24	2.9	3.1	4.2	4.7	4.1	3.6	2.9	.....	2.6	2.8
25	2.9	.....	4.3	4.7	.....	3.5	2.9	2.8	2.6	2.8
26	2.9	3.0	4.85	4.7	4.1	3.5	.....	2.7	2.4	.....
27	2.8	2.9	5.0	.....	4.1	3.5	3.0	2.7	2.4	2.8
28	.....	2.9	4.8	4.7	3.9	3.5	3.0	2.7	.....	2.8
29	2.9	2.9	4.8	4.7	3.9	.....	3.0	2.6	2.6	2.9
30	2.9	3.0	.....	4.7	3.9	3.0	3.0	2.6	2.6	2.9
31	2.8	.....	4.7	.....	3.8	2.9	.....	.....	.....	3.0

NOTE.—Ice conditions prevailed January 1 to March 8 and December 6–11.

Daily discharge, in second-feet, of North Platte River near Mitchell, Nebr., for 1909.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	1,620	2,570	11,600	14,100	8,350	2,200	2,230	760	1,130
2	.....	1,620	2,750	13,100	14,300	8,280	2,150	2,230	760	1,130
3	.....	1,620	2,930	23,000	14,500	8,800	2,090	3,180	600	1,130
4	.....	1,490	2,930	23,000	14,700	8,700	2,020	4,120	600	930
5	.....	1,360	2,930	18,100	14,900	8,630	2,070	4,120	600	900
6	.....	1,620	3,310	17,200	13,500	8,540	2,230	4,570	600	800
7	.....	1,620	4,700	16,400	13,800	8,480	2,230	6,540	600	800
8	.....	1,910	5,660	17,200	12,300	8,700	1,910	5,030	600	800
9	1,130	1,910	5,660	17,200	12,500	8,910	1,910	5,510	600	900
10	930	1,620	5,660	19,000	15,100	8,220	1,910	5,270	600	1,000

Daily discharge, in second-feet, of North Platte River near Mitchell, Nebr., for 1909— Continued.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct..	Nov.	Dec.
11	930	1,760	6,160	15,500	13,700	8,140	1,910	5,030	600	1,200
12	930	1,910	6,160	17,200	13,800	8,080	1,760	5,030	600	1,600
13	1,130	1,620	7,200	17,200	14,300	7,410	1,620	4,570	760	1,910
14	1,030	1,620	7,200	17,200	15,200	7,340	1,620	4,120	760	2,230
15	930	1,620	6,670	17,600	14,900	8,100	1,620	4,120	760	2,570
16	760	1,620	6,670	17,800	14,900	8,300	1,910	4,120	2,230	2,230
17	760	1,620	6,670	16,300	12,300	8,200	1,910	3,910	2,230	2,230
18	1,130	1,620	6,670	13,200	12,300	8,110	1,910	3,700	3,700	2,230
19	930	1,620	7,200	13,400	12,200	7,460	1,910	3,700	2,930	2,230
20	930	1,910	7,200	13,200	11,400	6,830	1,910	2,230	3,310	2,230
21	1,280	1,910	7,200	13,000	11,300	6,760	2,230	1,620	2,340	1,910
22	1,620	2,230	7,200	13,100	11,200	6,150	1,910	1,360	1,360	1,910
23	1,620	2,230	7,760	13,300	11,100	5,590	1,910	1,620	1,360	1,910
24	1,910	2,570	8,330	13,500	11,100	5,510	1,910	1,620	1,130	1,620
25	1,910	2,400	8,940	13,700	10,900	4,970	1,910	1,620	1,130	1,620
26	1,910	2,230	12,700	13,900	10,800	4,880	2,070	1,360	760	1,620
27	1,620	1,910	13,900	14,100	10,700	4,820	2,230	1,360	760	1,620
28	1,760	1,910	12,400	14,300	9,300	4,700	2,230	1,360	945	1,620
29	1,910	1,910	12,400	14,500	9,250	3,660	2,230	1,130	1,130	1,910
30	1,910	2,230	12,000	14,700	9,120	2,620	2,230	1,130	1,130	1,910
31	1,620	.....	11,600	.....	8,450	2,250	.....	945	.....	2,230

NOTE.—These discharges are based on rating curves applicable as follows: March 9 to May 6 and September 6 to December 31 (fairly well defined between 760 and 13,800 second-feet); May 7 to June 14 (not well defined above 7,200 second-feet); June 15 to September 5 (indirect method for shifting channels used). Discharges were interpolated for days on which gage was not read.

Monthly discharge of North Platte River near Mitchell, Nebr., for 1909.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
March 9–31	1,910	760	1,330	60,700	C.
April	2,570	1,360	1,830	109,000	C.
May	13,900	2,570	7,140	439,000	B.
June	23,000	11,600	15,200	904,000	C.
July	15,200	8,450	12,500	769,000	D.
August	8,910	2,250	6,950	427,000	D.
September	2,230	1,620	1,990	118,000	C.
October	6,540	945	3,180	196,000	B.
November	3,700	600	1,210	72,000	B.
December	2,570	800	1,610	99,000	D.
The period	.....	.....	.....	3,193,700	

NORTH PLATTE RIVER NEAR NORTH PLATTE, NEBR.

This station was established October 5, 1894; to determine the amount of water contributed by the North Platte to the Platte below all diversions. The highway bridge from which measurements are made is located 3½ miles above the junction of North and South Platte rivers about one-half mile north of the city of North Platte, in sec. 28, T. 14 N., R. 30 W. The gage, which is a vertical rod, is at the Union Pacific Railroad bridge, 2 miles below.

Many diversions are made between the Mitchell station and the measuring section. One small tributary, Birchwood Creek, maintains a small flow of water at the measuring section at times when the river itself would otherwise be dry.

The drainage area is 28,500 square miles.

During the winter the river often freezes solid, as it is very shallow. Records at this station are subject to the same limitations of shifting channel and poor measuring conditions as other stations on the river, though to a somewhat less degree.

The datum of the gage has remained unchanged since the station was established.

Discharge measurements of North Platte River near North Platte, Nebr., in 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Mar. 23	G. W. Bates	1,070	962	2.40	2,040
Apr. 10	A. A. Dobson	1,570	1,260	2.70	3,140
May 15	....do	1,930	2,470	3.00	6,350
June 11	E. C. Simmons	2,030	7,160	5.00	29,600
July 12	A. A. Dobson	1,950	3,430	3.25	9,670
Aug. 18	....do	1,920	2,620	3.12	6,220

Daily gage height, in feet, of North Platte River near North Platte, Nebr., for 1909.

[C. P. Miller, observer.]

Day.	Jan.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.7	.....	2.3	2.5	3.4	3.2	2.85	2.2	2.1	2.0	2.5
2	2.7	.....	2.4	2.5	3.15	3.1	2.8	2.3	2.1	2.1	2.5
3	2.8	.....	2.4	2.5	3.3	3.1	2.8	2.4	2.1	2.2	2.5
4	2.8	.....	2.4	2.55	3.3	3.1	2.8	2.3	2.1	2.2	2.6
5	2.8	.....	2.4	2.6	3.75	3.1	2.8	2.3	2.1	2.1	2.6
6	2.7	.....	2.4	2.6	4.8	3.1	2.8	2.2	2.2	2.15	2.6
7	2.6	.....	2.4	2.5	4.4	3.1	2.8	2.2	2.35	2.15	2.5
8	2.5	.....	2.5	2.5	4.05	3.1	2.8	2.2	2.45	2.1	2.5
9	2.5	.....	2.6	2.55	3.9	3.2	2.8	2.2	2.65	2.2	2.5
10	.....	.....	2.7	2.75	4.1	3.3	2.9	2.2	2.7	2.2	2.5
11	.....	.....	2.7	2.95	4.55	3.1	2.8	2.2	2.7	2.2	2.5
12	.....	.....	2.7	3.0	4.5	3.1	2.8	2.1	2.7	2.1	2.5
13	.....	.....	2.6	3.0	3.9	3.1	2.7	2.1	2.8	2.2	2.5
14	.....	.....	2.6	3.0	3.65	3.1	2.7	2.1	2.8	2.1	2.5
15	.....	.....	2.6	3.0	3.6	3.1	2.6	2.1	2.9	2.3	2.4
16	.....	.....	2.45	3.1	3.7	3.2	2.6	2.1	3.0	2.3	2.4
17	.....	.....	2.4	3.1	3.9	3.2	2.9	2.2	2.9	2.3	2.4
18	.....	.....	2.4	3.2	3.7	3.1	2.9	2.1	2.85	2.3	2.4
19	.....	.....	2.4	3.2	3.55	3.1	2.9	2.1	2.8	2.4	2.45
20	.....	.....	2.4	3.1	3.5	2.95	2.9	2.1	2.8	2.4	2.5
21	.....	2.6	2.4	3.1	3.5	2.8	2.65	2.1	2.8	2.4	2.6
22	.....	2.5	2.4	3.1	3.5	2.8	2.6	2.1	2.7	2.4	2.7
23	.....	2.4	2.4	3.25	3.5	2.8	2.55	2.2	2.7	2.5	2.7
24	.....	2.5	2.4	3.3	3.45	2.7	2.7	2.2	2.6	2.45	2.8
25	.....	2.6	2.65	3.35	3.4	2.4	2.6	2.2	2.5	2.4	2.85
26	.....	2.5	2.65	3.4	3.3	2.4	2.6	2.15	2.4	2.3	2.9
27	.....	2.5	2.5	3.4	3.3	2.4	2.5	2.2	2.3	2.3	2.9
28	.....	2.4	2.5	3.45	3.2	2.6	2.5	2.2	2.2	2.4	2.9
29	.....	2.4	2.5	3.75	3.15	2.6	2.4	2.2	2.15	2.4	3.0
30	.....	2.4	2.5	3.7	3.1	2.85	2.25	2.2	2.10	2.4	3.0
31	.....	2.3	.....	3.6	.....	2.9	2.2	.....	2.1	.....	3.0

NOTE.—Ice probably existed from January 1 to March 20 and during December.

Daily discharge, in second-feet, of North Platte River near North Platte, Nebr., for 1909.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	.....	1,530	2,350	10,200	8,000	4,600	1,230	980	780
2	.....	1,900	2,350	7,450	6,900	4,200	1,530	980	980
3	.....	1,900	2,350	9,100	6,900	4,200	1,900	980	1,230
4	.....	1,900	2,620	9,100	6,900	4,200	1,530	980	1,230
5	.....	1,900	2,900	14,400	6,900	4,200	1,530	980	980
6	.....	1,900	2,900	27,100	6,900	4,200	1,230	1,230	1,100
7	.....	1,900	2,350	22,200	6,900	4,200	1,230	1,720	1,100
8	.....	2,350	2,350	18,000	6,900	4,200	1,230	2,120	980
9	.....	2,900	2,620	16,200	8,000	4,200	1,230	3,200	1,230
10	.....	3,500	3,850	18,600	9,100	5,000	1,230	3,500	1,230
11	.....	3,500	5,450	24,000	6,900	4,200	1,230	3,500	1,230
12	.....	3,500	5,900	23,400	6,900	4,200	980	3,500	980
13	.....	2,900	5,900	16,200	6,900	3,500	980	4,200	1,230
14	.....	2,900	5,900	13,200	6,900	3,500	980	4,200	980
15	.....	2,900	5,900	12,600	6,900	2,900	980	5,000	1,530
16	.....	2,120	6,900	13,800	8,000	2,900	980	5,900	1,530
17	.....	1,900	6,900	16,200	8,000	5,000	1,230	5,000	1,530
18	.....	1,900	8,000	13,800	6,900	5,000	980	4,600	1,530
19	.....	1,900	8,000	12,000	6,900	5,000	980	4,200	1,900
20	.....	1,900	6,900	11,400	5,450	5,000	980	4,200	1,900
21	2,900	1,900	6,900	11,400	4,200	3,200	980	4,200	1,900
22	2,350	1,900	6,900	11,400	4,200	2,900	980	3,500	1,900
23	1,900	1,900	8,550	11,400	4,200	2,620	1,230	3,500	2,350
24	2,350	1,900	9,100	10,800	3,500	3,500	1,230	2,900	2,120
25	2,900	3,200	9,650	10,200	1,900	2,900	1,230	2,350	1,900
26	2,350	3,200	10,200	9,100	1,900	2,900	1,100	1,900	1,530
27	2,350	2,350	10,200	9,100	1,900	2,350	1,230	1,530	1,530
28	1,900	2,350	10,800	8,000	2,900	2,350	1,230	1,230	1,900
29	1,900	2,350	14,400	7,450	2,900	1,900	1,230	1,100	1,900
30	1,900	2,350	13,800	6,900	4,600	1,380	1,230	980	1,900
31	1,530	.....	12,600	.....	5,000	1,230	.....	980	.....

NOTE.—The discharges are based on a rating curve that is only approximate.

Monthly discharge of North Platte River near North Platte, Nebr., for 1909.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
March	2,900	1,530	2,210	48,200
April	3,500	1,530	2,350	140,000
May	14,400	2,350	6,630	408,000
June	27,100	6,900	13,500	803,000
July	9,100	1,900	5,820	358,000
August	5,000	1,230	3,600	221,000
September	1,900	980	1,190	70,800
October	5,900	980	2,750	169,000
November	2,350	780	1,470	87,500
The period	.....	.....	.....	2,305,500

NOTE.—Owing to unreliability of daily gage heights these estimates can only be considered as approximate.

PLATTE RIVER NEAR COLUMBUS, NEBR.

This station, which was established June 4, 1895, and has been kept continuously since that date except during the winter months, is located above the mouth of Loup River, at Meridian Bridge, about 3 miles south of Columbus, in sec. 31, T. 17 N., R. 1 E. No important tributaries enter the river between the junction of the North Platte and the South Platte and this station, and Loup River and

Elkhorn River are the only large tributaries below. The drainage area is 56,900 square miles.

In the late summer practically all the water of the river disappears, either from diversion or evaporation from the wide shallow channels. No records have been obtained during the ice period of the winter.

The bed of the river is of shifting sand and at low water the stream flows in many shallow channels, so that determination of discharge is largely a matter of estimation. Poor measuring conditions, combined with shifting channel, render the records liable to considerable error. The gage datum has remained the same throughout.[1]

The river at this point flows in three channels, known as the main, middle, and south channels, which are each spanned by pile bridges, from the upstream side of which discharge measurements are made. The chain gage is fastened to the upstream side of the main channel bridge, which is called the Meridian Bridge, and has a span of nearly 2,000 feet. The middle channel bridge is over 300 feet long, and the south channel bridge is about 80 feet long.

Discharge measurements of Platte River near Columbus, Nebr., in 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Mar. 20	A. A. Dobson	1,490	2,240	3.85	5,870
Apr. 13	do	1,770	1,900	3.55	4,270
May 8	do	1,720	1,330	3.38	2,690
July 8	do	2,300	4,550	4.53	11,800
Aug. 31	do	2,000	1,890	3.30	3,690
Oct. 22	do	2,130	2,680	3.90	6,240
Nov. 5	do	1,640	3,600	3.63	3,560

Daily gage height, in feet, of Platte River near Columbus, Nebr., for 1909.

[W. D. Benson, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.20	.....	.....	3.55	3.7	4.6	4.95	3.6	3.2	3.3	3.45	.....
2	.....	.....	.....	3.5	3.65	4.6	5.1	3.45	4.0	3.35	3.75	4.1
3	3.2	.....	.....	3.5	3.5	4.6	4.8	3.9	3.85	3.25	3.65	5.0
4	.....	4.0	4.25	3.55	3.4	4.55	4.8	3.85	3.55	3.15	3.45	6.8
5	.....	4.1	4.0	3.4	3.35	4.65	4.8	3.4	3.55	3.2	3.35	6.8
6	.....	.....	3.5	.....	3.4	4.85	4.75	3.4	3.65	3.1	3.35	.....
7	4.5	.....	4.75	3.55	3.45	4.6	4.65	3.45	3.7	3.25	3.25	.....
8	.....	.....	4.0	3.55	3.35	.....	4.55	3.45	3.6	3.35	3.2	.....
9	.....	.....	3.95	3.65	3.3	5.3	.....	3.25	3.35	3.4	3.3	.....
10	.....	.....	.....	3.65	3.4	5.2	4.6	3.65	3.35	3.55	3.25	.....
11	.....	.....	3.55	3.55	3.6	5.1	4.9	3.35	3.15	3.6	2.95	.....
12	.....	.....	3.25	3.55	3.4	5.55	4.85	3.35	3.05	3.75	2.95	.....
13	5.2	.....	4.2	3.5	3.5	5.7	4.9	3.35	2.85	3.75	3.1	.....
14	.....	.....	3.6	3.5	.....	5.55	4.55	3.4	2.85	3.6	3.25	.....
15	.....	.....	3.35	3.45	3.85	5.6	4.55	3.55	2.85	3.7	.....	.....
16	5.3	.....	3.7	3.45	4.05	5.3	4.7	3.75	2.6	3.8	2.9	.....
17	.....	.....	3.6	3.4	4.15	5.25	4.5	3.45	2.7	3.85	3.0	.....
18	.....	.....	3.55	3.3	3.95	5.35	4.4	3.45	2.7	3.85	.....	.....
19	.....	.....	.....	3.55	3.8	5.35	4.3	3.5	2.65	3.95	3.1	.....
20	.....	.....	3.8	3.8	4.0	5.3	4.2	3.45	2.6	4.0	2.9	.....

[1] Data collected at this station prior to 1908 have been compiled in Water-Supply Paper 230: Surface water supply of Nebraska.

Daily gage height, in feet, of Platte River near Columbus, Nebr., for 1909—Contd.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
21	.....	.....	3.5	3.4	3.9	5.2	4.15	3.45	2.8	3.9	3.25	.....
22	.....	.....	3.45	3.35	4.0	5.1	3.85	3.4	2.85	3.75	3.0	.....
23	.....	.....	3.6	3.45	4.1	5.05	3.7	3.5	2.9	3.75	.....	.....
24	3.0	.....	3.45	3.45	4.1	.....	3.6	3.45	2.95	3.85	3.7	.....
25	3.1	.....	3.6	3.3	4.05	5.25	3.9	3.45	3.1	3.85	.....	.....
26	3.3	.....	3.6	3.2	4.7	5.1	3.9	3.45	3.25	3.7	4.2	.....
27	3.85	.....	3.5	3.25	4.25	5.0	3.9	3.35	3.25	3.65	4.45	.....
28	.....	.....	3.4	3.35	4.25	4.95	3.7	3.3	3.35	3.65	4.2	.....
29	.....	.....	3.5	.....	4.55	5.0	3.45	3.35	3.35	3.65	.....	.....
30	.....	.....	3.55	3.3	4.15	5.0	3.45	3.3	3.3	3.65	3.95	.....
31	.....	.....	3.55	.....	4.25	.....	3.6	3.25	.....	3.35	.....	.....

NOTE.—Ice conditions Jan. 1–Mar. 3 and Dec. 6–31. The river was frozen at the gage on Nov. 18.

Daily discharge, in second-feet, of Platte River near Columbus, Nebr., for 1909.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	.....	4,160	4,630	11,200	14,700	5,300	3,150	3,130	3,020
2	.....	3,870	4,430	11,200	15,700	4,370	8,180	3,470	4,450
3	.....	3,880	3,480	11,300	13,600	7,300	7,100	2,800	3,800
4	8,600	4,200	2,860	10,900	13,700	6,950	5,130	3,400	2,750
5	6,900	3,280	2,630	11,800	13,800	4,150	5,050	2,600	4,200
6	3,200	3,750	2,870	13,200	13,500	4,150	5,700	2,200	2,250
7	12,300	4,220	3,090	11,300	12,700	4,450	6,020	2,750	1,900
8	6,900	4,230	2,670	14,000	11,800	4,450	5,380	3,250	1,730
9	6,500	4,820	2,360	16,700	12,100	3,320	3,800	3,500	2,070
10	5,200	4,850	2,800	16,000	12,400	5,700	3,800	4,350	1,900
11	4,000	4,260	3,800	15,200	14,700	3,860	2,750	4,550	1,030
12	2,500	4,270	2,800	18,600	14,200	3,860	2,350	5,600	1,030
13	8,300	3,880	3,260	19,800	14,700	3,860	1,600	5,600	1,430
14	4,300	3,920	4,310	18,700	12,000	4,200	1,600	4,550	1,900
15	2,950	3,660	5,360	19,100	12,000	5,080	1,600	5,050	1,400
16	4,900	3,660	6,780	16,900	14,700	6,400	920	5,700	900
17	4,300	3,410	7,490	16,500	11,700	4,460	1,120	6,050	1,150
18	4,000	2,800	6,110	17,400	10,900	4,460	1,120	6,050	1,290
19	4,760	4,210	5,260	17,400	10,100	4,760	1,000	6,650	1,430
20	5,530	5,780	6,470	17,000	9,400	4,460	890	6,950	900
21	3,720	3,390	5,900	16,300	9,050	4,460	1,370	6,300	1,900
22	3,460	3,140	6,470	15,700	6,940	4,200	1,500	5,250	1,150
23	4,350	3,650	7,260	15,300	5,930	4,850	1,650	5,180	2,550
24	3,500	3,450	7,400	16,000	5,300	4,550	1,820	5,750	3,950
25	4,360	2,660	7,070	16,800	7,200	4,550	2,300	5,780	5,550
26	4,370	2,250	11,800	15,700	7,300	4,550	2,950	4,620	7,150
27	3,800	2,460	8,460	14,900	7,300	3,950	2,950	4,250	8,900
28	3,280	2,900	8,460	14,700	6,000	3,700	3,450	4,200	7,150
29	3,830	2,720	11,500	15,100	4,400	3,950	3,470	4,150	6,300
30	4,110	2,540	7,900	15,100	4,350	3,700	3,130	4,100	5,450
31	4,120	.....	8,600	.....	5,320	3,450	.....	2,500	.....

NOTE.—These discharges were obtained by the indirect method for shifting channels. Discharges interpolated for days when gage was not read.

Monthly discharge of Platte River near Columbus, Nebr., for 1909.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
Mar. 4–31	12,300	2,500	4,930	274,000	C.
April	5,780	2,250	3,680	219,000	C.
May	11,800	2,360	5,620	346,000	C.
June	19,800	10,900	15,300	910,000	C.
July	15,700	4,350	10,600	652,000	C.
August	7,300	3,320	4,560	280,000	C.
September	8,180	890	3,100	184,000	C.
October	6,950	2,200	4,530	279,000	C.
November	8,900	900	3,020	180,000	C.
The period	.....	.....	.....	3,320,000	

SOUTH PLATTE RIVER.

DESCRIPTION.

The South Platte rises in the mountainous region surrounding the large basin near the center of the State of Colorado, known as South Park, and in the long eastern slopes of the high mountains forming the Continental Divide. The river might properly be said to be formed at South Platte, Colo., by the junction of the North and South forks. The drainage area of the South Fork comprises about 2,150 square miles, and that of the North Fork only about 450 square miles, but there is little difference in the mean annual flow of the two branches. The North Fork is about 50 miles long and the South Fork a little over 100 miles. Geneva Creek, with a drainage area of 50 square miles, is the most important tributary of the North Fork, other tributaries being Deer Park, Elk, and Buffalo creeks. Tarryall Creek and Goose Creek are the principal tributaries of the South Fork.

South Fork, usually considered the main branch of the river, flows in an easterly direction to Lake George, then northward to its junction with the North Fork, and on to the mouth of the Cache la Poudre near Greeley. From Greeley its general course is eastward, until it joins the North Platte at the town of North Platte, Nebr.

At the mouth of the South Platte its elevation is 2,800 feet above sea level; 100 miles above the mouth it is 3,600 feet; at Denver, 288 miles above the mouth, it is 5,170 feet; and at South Platte, 30 miles above Denver, it is about 6,100 feet. Lake George, about 50 miles up the South Fork, is 8,000 feet above sea level, and Cheesman reservoir, 23 miles up from South Platte, is 6,850 feet. At the mouth of Geneva Creek, at Grant, Colo., 40 miles up the North Fork from South Platte, the elevation is about 8,500 feet.

The drainage basin, which comprises about 20,000 square miles above Julesburg, Colo., is bisected in an irregular way by the channel of the South Platte. To the north and west lies the mountainous portion, which consists of a long, narrow strip, extending in a north-south direction from a point a short distance above the south boundary of Wyoming to Palmer Lake, Colo. This area furnishes at least 90 per cent of the total run-off of the basin. South and east of the river the basin lies entirely within the plains region.

The mountainous region consists of peaks and jagged masses of granite, with sedimentary rocks cut and gashed by stream channels along the foothills. The stream gradients are steep, and many of the streams consist of series of cascades and rapids. The soil cover as a whole is light, and except during spring freshets or heavy storms the streams are remarkably free from sediment in suspension.

The lower basin, somewhat scarred and broken along the foothills, gradually merges farther east into the undulating prairies so characteristic of the Great Plains east of the Rocky Mountains. The soils of the plains are the product of the disintegration of shales and sandstones, and range from adobe clays to sandy loams. The controlling vegetation is largely native grasses, the only timber being a few bunches of scraggly cottonwoods along the stream channels and small patches of pine, cedar, and piñon along the higher portions.

The forest cover of the mountains, consisting originally of coniferous trees, is rapidly disappearing, but through the occurrence of fires a foothold has been furnished for the deciduous aspen, which is gradually increasing its dominion. Most of the timber land in this drainage is included in the Pike and Medicine Bow national forests; in all there are probably 1,000 square miles of merchantable timber lands.

The tributaries of South Platte comprise, first, the small streams that rise on the eastern slope of the Rocky Mountains, and, second, the plain streams. The mountain streams furnish a perennial supply of water, the amount of which, however, varies with the snowfall, being light during the latter part of the summer and in the fall and winter, and large during the spring floods. This water is almost entirely diverted for irrigation and does not reach the South Platte except in times of heavy floods. The principal streams of this class are Bear, Clear, Boulder, and St. Vrain creeks and Big Thompson and Cache la Poudre rivers. The plains streams are all intermittent in their nature and furnish water only during storms or in the season of melting snow. The chief streams of this class are Cherry, Lone Tree, Crow, Kiowa, Boxelder, Bijou, Beaver, and Pawnee creeks.

In the mountainous regions the flow of the South Platte is perennial, but in the plains area the volume is greatly diminished by the numerous irrigation diversions. At North Platte, Nebr., just above the mouth of the river, the stream channel is dry for the greater part of the year, or consists of several small channels carrying a few second-feet of water.

The river is subject to periodic floods that occur in May and June, the magnitude varying from year to year with seasonal precipitation and temperature. At Julesburg, Colo., the stream flow varies from nothing up to 12,000 second-feet.

The rainfall is 25 inches or more in the highest mountains; 15 to 20 inches between altitudes of 5,500 and 9,000 feet; 10 to 15 inches between 4,000 and 5,000 feet; and in the lower basin, below an elevation of 4,000 feet, from 15 to 20 inches annually.

The winters are very severe, especially above the points where the mountain streams emerge into the more open country. In the mountain sections the snowfall is heavy, and snowstorms are com-

mon on the plains areas, but here the snow usually disappears within a few days after each storm. During the winter months the river and its tributaries are frequently frozen over throughout their entire courses. The ice period varies from about two months in the vicinity of Julesburg, Colo., to about five months in the high mountains, where the streams are frozen almost to the bottom.

The South Platte basin contains the oldest cultivated and irrigated areas in Colorado. At present nearly 1,000,000 acres are under irrigation in Colorado from the South Platte and its tributaries. In fact, the entire normal flow is being used for this purpose, and additional irrigation will necessitate the construction of storage reservoirs or the diversion of water from other drainage areas. The North Grand ditch, which has been in operation for several years, diverts water from the North Fork of Grand River across the divide into Cache la Poudre River. The Laramie-Poudre project, which will soon be begun, contemplates the diversion of the headwaters of Laramie River, in the watershed of the North Platte, into the Cache la Poudre, in the watershed of the South Platte; and the Denver Reservoir & Irrigation Co. proposes to divert the headwaters of Fraser River, a tributary of the Grand, into the headwaters of South Boulder, a tributary of the South Platte. Other similar projects are under consideration. The storage of the flood waters of the intermittent streams in the lower basin offer opportunities for considerable irrigation development. Very little is known as to the flow of these streams, but it is certainly very large at times and many excellent storage sites are available.

About a half million acre-feet of the annual flow from the mountain section of this basin are now being stored for irrigation in many small reservoirs, and a large part of the mountain flow is still available for irrigation by proper conservation and storage.

Conditions on the upper South Platte and its tributaries are unusually favorable for storage. Some of the many good sites are natural depressions or are situated on small tributaries, so that the reservoirs will have to be supplied by feeder canals. Of this type is the Standley reservoir of the Denver Reservoir & Irrigation Co. This reservoir, which is now under construction, will have a maximum capacity of about 100,000 acre-feet.

The largest reservoir which has been constructed in the South Platte basin is the Cheesman Lake of the Denver Union Water Co. This reservoir, which was completed in 1904, has a maximum capacity of 79,000 acre-feet. Among other proposed reservoirs may be mentioned the Antero, Tarryall, Lake George, Lost Park, Eagle Rock, and Geneva. Opportunities for storage are also found on Clear Creek, Boulder, St. Vrain, Big Thompson, and the Cache la Poudre. Some excellent reservoir sites have been surveyed on the last-named stream,

and no doubt will be developed shortly. The reservoirs on the upper portions of these streams will be used primarily for power development, but the stored waters can also be used for irrigation in the valleys below.

Water-power development is necessarily limited to the mountainous parts of the drainage area. Many favorable opportunities for such development are presented on Geneva Creek, the South Fork, Clear Creek, Boulder Creek, Big Thompson, and Cache la Poudre. Many power sites have been filed upon. The ultimate power development in this drainage basin will probably amount to nearly 200,000 horsepower, but present development is limited to numerous small plants with a total capacity of less than 5,000 horsepower. Most of these plants are on Clear Creek and Boulder Creek. The plant of the Eastern Colorado Power Co., on Boulder Creek, a few miles above Boulder, Colo., is now under construction, and when completed will have a capacity of probably 20,000 horsepower.

Of the years for which survey records are available, 1902 seems to be the driest, while 1908 was also very dry. It is believed that 1909 is the high-water year in this basin; 1899 and 1907 were also very high years, and 1900 was quite high in some parts of the basin.

SOUTH FORK OF SOUTH PLATTE RIVER AT SOUTH PLATTE, COLO.

This station, which was established May 8, 1905, to determine the run-off in this basin and the amount of water available on this branch of the South Platte for power and irrigation, is located at South Platte, Colo., in T. 7 S., R. 70 W.

The North and South forks of the South Platte unite about 500 feet below the station, and the Cheesman reservoir, which intercepts the flow of Tarryall and Goose Creeks in addition to that of the main branch, is about 20 miles above. No very important tributaries enter below Cheesman Lake. The drainage area above the station is 2,160 square miles, of which probably less than 20 per cent can be classed as timbered land.

No water is diverted above this point except for the irrigation of hay lands in South Park, but the flow is regulated by the Cheesman reservoir, which has a capacity of 79,000 acre-feet. So many filings for power development have been made on this stream that it is doubtful whether additional filings can be made except near the headwaters.

The flow of the river at this station is affected by ice for about three months in the winter season.

No change has been made in the inclined rod gage since it was first established, and the datum remains the same. Discharge measurements are made from a cable near the gage and by wading.

Fair results should be obtained at this station, but as the bed is shifting, frequent measurements are necessary. The gage heights are apt to show fluctuation at certain times of the year owing to storage or release of water in the Cheesman reservoir.

Discharge measurements of South Fork of South Platte River at South Platte, Colo., in 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1909		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Feb. 9[a]	W. B. Freeman	12.8	20.4	1.90	19.9
Mar. 11[a]	J. B. Stewart	33	28	.81	33
Apr. 27	W. B. Freeman	41	39	1.15	67
June 4	....do	40	72	2.05	193
9	Miles and Lewis	70	150	3.25	597
26	R. C. Miles	69	169	3.30	621
July 28	Lyons and Russell	66	98	2.50	280
Aug. 14	G. H. Russell	60	103	2.60	382
Sept. 7	....do	66	250	5.10	1,400
27	....do	62	148	4.00	593
Oct. 16	J. B. Stewart	64	94	2.80	299
Nov. 19[b]	G. H. Russell	40	54	2.40	147
Dec. 15[a]	....do	34	39	2.18	121

[a] Measurement made by wading. Ice conditions.
[b] Made by wading 100 feet above the cable.

Daily gage height, in feet, of South Fork of South Platte River at South Platte, Colo., for 1909.

[Miss E. H. Jardine, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.8	2.5	1.25	0.9	1.1	2.0	3.2	1.95	3.6	3.6	2.65	2.5
2	1.75	2.1	1.25	.9	1.1	2.0	3.1	1.9	3.75	3.4	2.65	2.55
3	1.75	1.9	1.0	.9	1.1	2.1	3.1	1.9	3.95	3.35	2.65	2.4
4	1.8	1.75	1.0	.9	1.1	2.05	3.6	2.15	4.10	3.3	2.65	2.35
5	1.8	1.85	1.0	.85	1.1	2.2	4.1	2.2	4.4	3.2	2.65	2.25
6	1.85	1.85	1.0	.85	1.1	2.2	4.45	2.2	4.6	3.2	2.6	2.1
7	1.9	1.85	1.0	.8	1.1	2.5	4.65	2.3	5.15	3.2	2.45	2.1
8	1.9	1.8	1.1	.8	1.1	2.9	4.45	2.35	5.5	3.2	2.35	2.1
9	2.3	2.1	1.1	.8	1.1	3.3	4.20	2.3	5.6	3.2	2.35	2.15
10	1.15	2.0	1.0	1.0	1.2	3.3	3.6	2.3	5.45	3.2	2.2	2.3
11	1.15	1.95	.8	1.1	1.15	3.4	3.2	2.5	5.2	3.05	2.2	2.25
12	1.2	1.70	1.0	1.1	1.1	3.25	2.8	2.75	5.1	3.00	2.3	2.25
13	1.6	1.2	1.0	1.1	1.1	3.2	2.45	2.75	5.6	2.9	2.3	2.2
14	1.7	1.2	.8	1.1	1.1	3.4	2.15	2.8	5.85	2.9	2.3	2.15
15	1.7	1.3	.8	1.1	1.3	3.2	2.0	2.8	5.9	2.9	2.4	2.1
16	2.15	1.3	.75	1.2	1.75	3.2	2.05	2.8	5.7	2.85	2.3	2.0
17	2.15	1.3	.7	1.1	1.7	3.2	2.3	2.8	5.5	2.85	2.2	2.0
18	1.6	1.3	.7	1.3	1.8	3.2	2.1	4.05	5.3	2.85	2.4	2.0
19	1.6	2.0	.8	1.3	1.9	3.5	2.0	5.15	5.0	2.85	2.35	2.0
20	1.6	1.6	.8	1.3	1.85	3.65	1.9	5.40	4.8	2.85	2.3	2.0
21	1.6	1.6	.8	1.2	2.1	3.75	2.05	4.60	4.6	3.05	2.45	2.0
22	1.6	1.6	.8	1.1	2.15	3.85	2.1	4.2	4.55	2.8	2.5	2.0
23	1.6	1.5	.8	1.1	2.2	3.7	2.5	4.05	4.4	2.8	2.55	2.1
24	1.55	1.5	.9	1.1	2.25	3.5	3.1	3.95	4.25	2.8	2.5	2.2
25	1.50	1.5	.9	1.1	2.3	3.4	3.5	3.8	4.15	2.7	2.5	2.3
26	1.55	1.25	.9	1.1	2.45	3.3	3.3	3.6	4.00	2.7	2.6	2.5
27	1.6	1.2	1.0	1.1	2.3	3.2	2.95	3.6	3.95	2.7	2.6	2.5
28	1.6	1.2	.95	1.1	2.15	3.2	2.55	3.45	3.9	2.65	2.6	2.45
29	1.0	.....	.9	1.2	2.1	3.15	2.4	3.25	3.8	2.65	2.5	2.4
30	.85	.....	.9	1.2	2.0	3.15	2.35	3.3	3.55	2.65	2.5	2.3
31	2.0	.....	.9	.....	2.0	.....	2.15	3.4	.....	2.65	.....	2.2

NOTE.—Ice conditions Jan. 1 to Mar. 10 and Dec. 23 to 31.

Daily discharge, in second-feet, of South Fork of South Platte River at South Platte, Colo., for 1909.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	25	22	33	50	58	189	576	168	747	467	225	172
2	25	22	33	50	58	189	534	161	812	400	225	183
3	25	22	33	50	58	211	534	163	900	392	225	153
4	25	22	33	50	58	200	747	218	966	375	225	146
5	25	22	33	39	58	235	966	234	1,100	350	225	128
6	25	22	33	39	58	235	1,120	240	1,190	360	202	107
7	25	22	33	36	58	316	1,210	268	1,430	368	171	107
8	25	22	33	36	58	452	1,120	288	1,580	368	152	107
9	25	22	33	36	58	618	1,000	272	1,630	376	152	114
10	25	22	33	50	68	618	700	275	1,560	384	128	138
11	25	22	36	58	63	661	565	340	1,450	343	128	128
12	25	22	50	58	58	597	410	429	1,410	334	145	128
13	25	22	50	58	58	576	295	430	1,630	310	136	120
14	25	22	36	58	58	661	215	455	1,740	310	136	114
15	25	22	36	58	78	576	178	450	1,760	318	151	107
16	25	22	33	68	142	576	187	445	1,640	313	136	95
17	25	22	30	58	134	576	244	438	1,530	305	118	95
18	25	22	30	78	151	576	197	970	1,420	305	150	95
19	25	22	36	78	169	704	176	1,440	1,240	305	140	95
20	25	22	36	78	160	768	156	1,540	1,140	305	138	95
21	25	22	36	68	211	812	185	1,190	1,020	370	163	95
22	25	22	36	58	223	856	189	1,010	970	290	172	95
23	25	22	36	58	235	790	288	944	870	290	183	100
24	25	22	42	58	248	704	491	900	775	275	172	100
25	25	22	42	58	261	661	660	834	690	250	172	105
26	25	22	42	58	302	618	575	747	620	250	191	105
27	25	22	50	58	261	576	432	747	570	250	191	105
28	25	22	46	58	223	576	298	682	555	238	191	105
29	25	.....	50	68	211	555	260	597	524	238	172	105
30	25	.....	50	68	189	555	250	618	438	238	172	105
31	25	.....	50	.....	189	.....	205	661	.....	225	.....	105

NOTE.—The above discharges are based on a curve that is fairly well defined, applicable the following dates: Mar. 11 to July 7 and Aug. 21 to Sept. 15. Indirect method for shifting channels used for other periods. Jan. 1 to Mar. 10 and Dec. 23 to 31 discharges estimated on account of ice conditions.

Monthly discharge of South Fork of South Platte River at South Platte, Colo., for 1909.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
January	.....	.....	25	1,540	D.
February	.....	.....	22	1,220	D.
March	.....	.....	38.2	2,350	D.
April	78	36	56.6	3,370	B.
May	302	58	136	8,360	B.
June	856	189	541	32,200	B.
July	1,210	156	483	29,700	C.
August	1,540	161	586	36,000	C.
September	1,760	438	1,130	67,200	C.
October	467	225	319	19,600	C.
November	225	118	170	10,100	C.
December	183	95	115	7,100	C.
The year	1,760	.....	302	219,000	

SOUTH PLATTE RIVER AT SOUTH PLATTE, COLO.

This station, which was established March 28, 1902, furnishes valuable data for use in connection with storage, irrigation, and water-power development. It is located on the Colorado & Southern Railroad in T. 7 S., R. 7 W., about 9 miles above the mouth of the canyon and just below the junction of the North and South Forks.

Records at Platte Canyon and at Deansbury, a few miles below, extend back to 1887, with the exception of the years 1893 and 1894, and records at Platte Canyon are still being taken by the Denver Union Water Co. The earlier records, 1887–1892, were taken by the State engineer, and the records from 1895 to 1898 were taken under the direction of the Denver Power & Irrigation Co.

The station is especially important because of its location above the head gates of all irrigation systems and also above the intake of the Denver Union Water Co. The location of the Cheesman storage reservoir on the South Fork, 20 miles above this station, and the proposed installation of several power plants on both forks of the river above add to the importance of the station.

A great many filings for power development have been made on the tributaries of the river above this point, but doubtless opportunities for additional filings still exist.

The flow of the South Fork of the South Platte is regulated by storage in Cheesman reservoir. The flow of the North Fork is natural, except for slight variations due to the many ice and fish ponds for 30 miles above its mouth.

The river and its tributaries are usually frozen over from two to four months during the winter time.

On May 7, 1905, the gage was moved from the county bridge to a point 150 feet downstream, which no doubt caused some change in the relation of gage readings. This last gage, which is an inclined rod, is still in use. Discharge measurements are made from a cable near the gage and by wading.

The stream bed is more or less shifting, and frequent discharge measurements are necessary to obtain the best results. The gage readings taken twice each day are apt to show considerable fluctuation owing to the regulation of the flow from the Cheesman reservoir. The records from 1895 to 1898 were bought by the Denver Union Water Co. from J. E. Rhodes, representing the Denver Power & Irrigation Co.

Discharge measurements of South Platte River at South Platte, Colo., in 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1909.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Feb. 9[a]	W. B. Freeman	21.3	36	1.55	48
Mar. 11[a]	J. B. Stewart	39	39	1.40	56
Apr. 27[b]	W. B. Freeman	75	125	2.16	262
June 4	....do	77	206	3.35	758
9	Miles and Lewis	85	323	4.10	1,558
15	W. B. Freeman	77	254	3.90	1,025
July 28	Lyon and Russell	78	190	3.20	629
Aug. 14	G. H. Russell	79	186	3.28	698
Sept. 27	....do	82	237	3.90	1,022
Oct. 16	J. B. Stewart	78	168	3.18	598
Nov. 19[b]	G. H. Russell	74	125	2.40	281
Dec. 15[a]	....do	58	67	2.15	181

[a] Measurement made by wading. Ice conditions. [b] Measurement made by wading.

Daily gage height, in feet, of South Platte River at South Platte, Colo., for 1909.

[Miss E. H. Jardine, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.75	2.10	1.50	1.50	2.05	2.95	3.90	2.85	3.90	4.00	2.65	2.50
2	1.75	2.15	1.55	1.50	2.05	3.00	3.85	2.80	3.95	4.00	2.65	2.50
3	1.70	2.20	1.55	1.55	2.10	3.10	4.30	2.75	4.10	3.95	2.65	2.45
4	1.70	1.90	1.60	1.55	2.10	3.35	4.50	2.75	4.25	3.90	2.65	2.35
5	1.80	1.90	1.60	1.60	2.15	3.70	4.45	2.75	4.50	3.75	2.60	2.35
6	1.85	1.40	1.60	1.60	2.10	3.75	5.15	2.80	4.80	3.70	2.60	2.10
7	1.80	1.30	1.60	1.55	2.20	3.90	5.25	2.85	5.95	3.70	2.50	2.20
8	1.80	1.40	1.60	1.50	2.40	3.85	4.80	2.90	6.05	3.70	2.40	2.20
9	2.15	1.45	1.70	1.50	2.40	4.20	4.85	2.90	6.20	3.65	2.40	2.25
10	1.80	1.40	1.60	1.70	2.35	4.00	4.10	2.90	6.20	3.60	2.45	2.30
11	1.80	1.40	1.50	1.80	2.45	4.05	3.80	3.05	5.75	3.50	2.40	2.20
12	1.80	1.30	1.55	1.80	2.45	3.95	3.55	3.20	5.50	3.40	2.50	2.15
13	1.80	1.20	1.50	1.75	2.35	3.95	3.25	3.25	6.25	3.35	2.40	2.20
14	1.80	1.90	1.50	1.80	2.40	3.95	3.15	3.20	6.45	3.30	2.35	2.15
15	1.75	1.90	1.50	1.80	2.45	3.85	3.05	3.20	6.50	3.20	2.40	2.15
16	2.10	1.85	1.50	2.00	2.65	3.90	3.00	3.20	6.30	3.15	2.30	2.25
17	2.10	1.85	1.50	2.05	2.80	4.00	3.05	3.45	6.10	3.15	2.30	2.10
18	1.60	1.85	1.50	2.15	2.80	4.00	2.95	4.40	5.90	3.15	2.50	2.45
19	1.60	1.80	1.50	2.10	2.80	4.35	2.90	5.75	5.85	3.15	2.40	2.45
20	1.60	1.80	1.50	2.10	2.85	4.40	3.00	6.05	5.35	3.15	2.40	2.50
21	1.60	1.80	1.50	1.90	3.05	4.45	3.00	5.05	5.15	3.20	2.45	2.50
22	1.55	1.80	1.50	1.95	3.15	4.60	3.00	4.30	5.00	3.00	2.55	2.50
23	1.50	1.80	1.50	1.95	3.20	4.50	3.40	4.20	4.75	3.00	2.55	2.60
24	1.40	1.80	1.60	1.90	3.25	4.35	3.60	4.10	4.60	2.95	2.55	2.80
25	1.50	2.10	1.60	1.90	3.30	4.30	3.85	4.10	4.55	2.90	2.60	2.75
26	1.50	1.50	1.60	1.95	3.25	4.15	3.70	4.00	4.40	2.80	2.60	2.80
27	1.60	1.50	1.55	2.10	3.15	4.05	3.40	4.00	4.40	2.70	2.60	2.60
28	1.60	1.50	1.60	2.25	3.10	4.00	3.20	3.85	4.30	2.75	2.60	2.60
29	1.65	.....	1.55	2.30	3.05	3.90	3.25	3.70	4.20	2.75	2.60	2.80
30	1.70	.....	1.50	2.15	3.00	3.90	3.15	3.70	4.15	2.75	2.50	2.60
31	1.90	.....	1.50	.....	3.00	.....	2.95	3.70	.....	2.75	.....	2.60

NOTE.—Ice conditions Jan. 1 to Mar. 15 and Nov. 22 to Dec. 31.

Daily discharge, in second-feet, of South Platte River at South Platte, Colo., for 1909.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	60	50	60	90	214	563	1,020	488	1,020	1,040	369	190
2	60	50	60	90	214	585	993	467	1,050	1,040	369	190
3	60	50	60	99	229	630	1,260	446	1,140	1,010	369	190
4	60	50	60	99	229	758	1,400	446	1,230	978	369	190
5	60	50	60	108	245	960	1,360	446	1,400	894	350	190
6	60	50	60	108	229	990	1,850	467	1,600	867	350	190
7	60	50	60	99	261	1,080	1,920	488	2,460	867	314	190
8	60	50	60	90	333	1,050	1,600	510	2,540	867	280	190
9	60	50	60	90	333	1,270	1,640	510	2,660	840	280	190
10	60	50	60	128	314	1,080	1,140	510	2,660	812	297	190
11	60	50	60	150	355	1,110	964	578	2,300	758	280	190
12	60	50	60	150	355	1,050	827	647	2,100	706	314	190
13	60	50	60	139	314	1,050	672	672	2,700	681	280	190
14	60	50	60	150	333	1,050	624	647	2,860	656	264	190
15	60	50	60	150	353	993	578	647	2,900	608	280	190
16	60	50	90	200	436	1,020	555	647	2,660	584	248	190
17	60	50	90	214	499	1,080	578	774	2,580	584	248	190
18	60	50	90	245	499	1,080	532	1,330	2,420	584	314	190
19	60	50	90	229	499	1,260	510	2,300	2,380	584	280	190
20	60	50	90	229	520	1,330	555	2,540	1,990	584	280	190
21	60	50	90	174	608	1,360	555	1,780	1,850	608	297	190
22	60	50	90	187	655	1,460	555	1,260	1,740	515	280	190
23	60	50	90	187	680	1,400	747	1,200	1,570	515	280	190
24	60	50	108	174	705	1,260	854	1,140	1,460	492	280	190
25	60	50	108	174	730	1,260	993	1,140	1,430	470	280	190
26	60	50	108	187	705	1,170	908	1,080	1,330	428	280	190
27	60	50	99	229	655	1,110	747	1,080	1,330	388	280	190
28	60	50	108	278	630	1,080	647	993	1,260	408	280	190
29	60	.....	99	296	608	1,020	672	908	1,200	408	280	190
30	60	.....	90	245	585	1,020	624	908	1,170	408	280	190
31	60	.....	90	.....	585	.....	532	908	.....	408	280	190

NOTE.—The above discharges are based on 3 curves that are applicable, as follows: Mar. 16 to June 9–June 10 to Sept. 30, and Oct. 1 to ice period. They are fairly well defined. Discharges estimated Jan. 1, Mar. 15 and Nov. 22 to Dec. 3.

Monthly discharge of South Platte River at South Platte, Colo., for 1909.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
January	.....	.....	60	3,690	D.
February	.....	.....	50	2,780	D.
March	108	.....	78.4	4,820	C.
April	296	90	166	9,880	C.
May	730	214	449	27,600	C.
June	1,460	563	1,070	63,700	C.
July	1,920	510	917	56,400	C.
August	2,540	446	902	55,500	C.
September	2,900	1,020	1,900	113,000	C.
October	1,040	388	663	40,800	C.
November	369	248	298	17,700	C.
December	.....	.....	190	11,700	D.
The year	2,540	.....	563	408,000	

SOUTH PLATTE RIVER AT DENVER, COLO.

This station, which is located a short distance below the mouth of Cherry Creek, was maintained under the direction of the United States Geological Survey from 1895 to 1906, and since that time more or less intermittent records have been taken by the State engineer's office.[1] The station affords data concerning the amount of water available for irrigation.

The rod gage used from 1906 to August 11, 1909, inclusive, is located on the right bank about 100 feet above the Sixteenth Street Viaduct. Beginning August 12, 1909, a Bristol automatic gage, at practically the same datum, fastened to a pier of the Sixteenth Street Viaduct, has been used.

Discharge measurements are made from the Fifteenth Street Bridge and by wading.

The flow of the stream at this point is seldom affected by ice.

The 1909 records were taken under the direction of the State engineer of Colorado and are published as furnished by him.

Discharge measurements of South Platte River at Denver, Colo., in 1909.

Date.	Hydrographer.	Area of section.	Gage height.	Discharge.
		Sq. ft.	*Feet.*	*Sec.-ft.*
May 28	F. Cogswell	183	1.90	453
June 18	.....do	355	2.80	1,122
29	.....do	260	2.10	670
July 7	Chatfield and Grieve	512	3.75	2,246
Aug. 21	C. L. Chatfield	445	3.40	1,814
Sept. 11	F. Cogswell	567	4.00	2,568
Nov. 10	.....do	118	1.02	220
Dec. 30	Chatfield and Grieve	115	1.35	226

[1] This station is fully described in Water-Supply Paper U. S. Geol. Survey No. 208, p. 154.

Daily gage height, in feet, of South Platte River at Denver, Colo., for 1909.

Day.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	.....	.....	1.45	2.05	2.45	1.25	1.55
2	.....	.....	.....	1.5	2.2	2.4	1.25	1.5
3	.....	.....	.....	1.15	2.25	2.3	1.3	1.5
4	.....	.....	.....	1.6	2.6	2.25	1.3	1.5
5	.....	.....	3.5	1.8	3.2	2.2	1.35	1.25
6	.....	.....	.....	.....	3.25	2.1	1.4	1.25
7	.....	.....	3.75	1.65	3.7	2.1	1.2	1.25
8	.....	.....	.....	1.85	4.25	2.2	1.15	1.2
9	.....	.....	.....	2.2	4.3	2.2	1.05	1.3
10	.....	.....	.....	1.95	4.25	2.15	1.05	1.45
11	.....	.....	.....	2.05	4.0	2.1	1.0	1.45
12	.....	.....	.....	1.85	3.6	2.1	1.05	1.35
13	1.3	.....	.....	1.95	3.8	2.05	1.3	1.35
14	.....	.....	.....	1.9	4.05	2.0	1.3	1.35
15	.....	.....	.....	1.85	4.1	1.95	1.2	1.30
16	.....	.....	.....	1.8	4.25	1.95	1.35	1.30
17	.....	.....	.....	2.0	4.25	1.85	1.35	1.25
18	.....	2.8	.....	2.9	4.1	1.75	1.4	.95
19	.....	.....	1.0	4.0	3.7	1.75	1.55	.80
20	.....	.....	.....	4.1	3.3	1.7	1.55	1.0
21	.....	.....	.85	3.4	3.1	1.65	1.55	1.2
22	.....	.....	.....	2.45	3.0	1.6	1.6	1.15
23	.....	.....	1.6	2.4	2.9	1.65	1.5	1.15
24	.....	.....	2.25	2.2	2.8	1.6	1.4	1.25
25	2.6	.....	2.3	2.0	2.8	1.65	1.4	1.2
26	.....	.....	2.2	2.15	2.7	1.55	1.65	1.25
27	.....	.....	1.9	2.15	2.65	1.55	1.35	1.3
28	1.9	.....	1.6	2.05	2.5	1.45	1.6	1.3
29	.....	2.1	2.0	2.1	2.5	1.35	1.45	1.2
30	.....	.....	1.95	1.96	2.5	1.3	1.55	1.4
31	.....	.....	1.5	2.0	.....	1.25	.....	1.5

Daily discharge, in second-feet, of South Platte River at Denver, Colo., for 1909.

Day.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	.....	.....	360	640	895	285	285
2	.....	.....	.....	380	730	860	285	265
3	.....	.....	.....	255	760	790	300	265
4	.....	.....	.....	420	1,010	760	300	265
5	.....	.....	1,930	510	1,590	730	320	180
6	.....	.....	.....	460	1,640	670	340	180
7	.....	.....	2,235	440	2,170	670	270	180
8	.....	.....	.....	535	2,940	730	255	165
9	.....	.....	.....	730	3,010	730	228	195
10	.....	.....	.....	585	2,940	700	228	248
11	.....	.....	.....	640	2,575	670	215	248
12	.....	.....	.....	535	2,050	670	228	212
13	195	.....	.....	585	2,300	640	300	212
14	.....	.....	.....	560	2,650	610	300	212
15	.....	.....	.....	535	2,720	585	270	195
16	.....	.....	.....	510	2,940	585	320	195
17	.....	.....	.....	610	2,940	535	320	180
18	.....	1,130	.....	1,270	2,720	485	340	100
19	.....	.....	215	2,580	2,170	485	400	70
20	.....	.....	190	2,720	1,700	460	400	110
21	.....	.....	182	1,810	1,480	440	400	165
22	.....	.....	270	895	1,380	420	420	150
23	.....	.....	420	860	1,270	440	380	150
24	.....	.....	760	730	1,180	420	340	180
25	950	.....	790	610	1,180	440	340	165
26	.....	.....	730	700	1,090	400	440	180
27	.....	.....	560	700	1,050	400	320	195
28	450	.....	420	640	930	360	420	195
29	.....	670	610	670	930	320	360	165
30	.....	.....	585	585	930	300	400	230
31	.....	.....	380	610	.....	285	.....	265

NOTE.—These discharges are based on two rating curves, applicable as follows: Jan. 1 to June 18 and Dec. 1 to Dec. 31 fairly well defined. June 29 to Nov. 30 well defined. Discharges interpolated for days having no gage readings. Discharges for December may be slightly in error, due to ice conditions. The rating tables were computed by the State engineer of Colorado and published as received.

Monthly discharge of South Platte River at Denver, Colo., for 1909.

[Drainage area, 3,840 square miles.]

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Minimum.	Maximum.	Mean.	Per square mile.	Depth in inches on drainage area	Total in acre-feet.	
July 19–31	790	182	470	0.122	0.06	12,100	B.
August	2,720	255	775	.202	.23	47,600	B.
September	3,010	640	1,790	.466	.52	107,000	B.
October	895	285	564	.147	.17	34,700	B.
November	440	215	324	.084	.09	19,300	B.
December	285	70	197	.051	.06	12,100	C.

SOUTH PLATTE RIVER NEAR KERSEY, COLO.

This station, which was established April 27, 1901, is located at a pile bridge about 1½ miles north of Kersey, on the Union Pacific Railroad about 6 miles east of Greeley, in T. 5 N., R. 64 W. The station was discontinued during the fall of 1903, but was reestablished March 5, 1905.

The station is below all the important tributaries of the South Platte that derive their supply from the mountain region, and the records are therefore particularly important as showing the amount of water available for storage reservoirs in northeastern Colorado.

Cache la Poudre River, a very important tributary of the South Platte, enters 2 or 3 miles above the station. Crow Creek and Box-elder Creek, two intermittent streams, come in from the north and south sides, 4 or 5 miles below. The drainage area at Kersey is 9,500 square miles.

Above Kersey are numerous irrigation and canal systems serving one of the most extensively irrigated areas in Colorado. Nearly 790,000 acres were irrigated above this station in 1907, about 380,000 acre-feet of water were stored, and about half of it used during the season. In 1908 about 300,000 acre-feet were stored, all of which was used for irrigation.

No important water-power plants are operated on the South Platte or its tributaries above the station, but one or two are now under construction and several are contemplated. In order to secure additional water rights for irrigation it will be necessary to construct storage works on some of the tributaries, as filings greatly in excess of the natural flow of the stream have been on record for a number of years.

The river is generally frozen over from the middle of December to the first of March.

In the fall of 1906 a chain gage was established on each of the two channels into which the river is divided at ordinary stages. Formerly one rod gage was used, but it was found that the elevation of the

water surface in the two channels differed considerably. In 1909 the observed gage heights for the two channels were properly weighted and combined and a single curve used to obtain the total discharge. Owing to the shifting character of the stream bed, a slight change in the datum of the gage is not apt to seriously affect the value of the results, as marked changes occur in the rating curve from one season to the next and often during a single season.

Measurements should be taken at this station on an average of at least once every three weeks, except when the river is at a constant stage. Accurate results are rather difficult to obtain on account of the piles of the bridge and the fact that the bridge is not at right angles to the direction of the current. Whenever possible measurements should be taken by wading. At high stages the river flows in three channels and during extreme floods overflows into one or two channels on the left bank.

Discharge measurements of South Platte River near Kersey, Colo., in 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
May 24	W. B. Freeman	228	365	3.22	751
June 10	R. C. Miles	549	2,600	6.97	7,260
July 10	Russell and Miles	471	1,780	6.53	5,870
26	Russell and Lyon	160	227	3.09	274
Sept. 1	Russell and Campbell	80	128	2.59	192
24	G. H. Russell	316	857	5.06	2,210
Oct. 22	....do	217	462	3.85	1,100
Nov. 12	....do	217	416	3.66	928
Dec. 13	....do	280	565	5.23	1,120

Daily gage height, in feet, of South Platte River near Kersey, Colo., for 1909.

[Mrs. J. C. Maisner, observer.]

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1		4.25	3.4	5.35	2.75	2.55	4.35	3.55	3.85
2		4.1	3.4	5.25	2.65	2.5	4.15	3.55	3.9
3		4.2	3.5	5.0	2.65	2.55	4.05	3.65	3.95
4		3.95	3.7	5.25	2.65	2.7	4.05	3.65	3.85
5		4.0	3.9	6.2	2.65	3.3	4.05	3.65	3.75
6		3.8	4.4	7.6	2.65	4.6	4.0	3.6	3.65
7		3.95	5.9	7.5	2.55	4.8	4.1	3.65	3.75
8		3.8	6.35	7.05	2.65	5.2	4.1	3.65	5.45
9		3.8	6.95	6.75	2.7	5.2	4.0	3.55	5.4
10		3.9	6.95	6.55	3.1	5.5	4.4	3.55	5.4
11		3.7	7.1	6.35	3.05	5.65	4.15	3.55	5.25
12		3.6	6.95	5.95	2.85	5.65	4.2	3.55	5.2
13		3.25	6.45	5.1	2.85	5.65	4.25	3.55	4.8
14		3.0	6.65	4.45	2.65	5.75	4.2	3.65	4.4
15		2.75	6.6	4.15	2.65	5.85	4.55	3.75	4.15
16		2.6	6.7	3.6	2.55	5.9	4.55	3.65	3.95
17		2.5	6.6	3.4	2.55	6.15	4.55	3.75	3.6
18		2.2	6.6	3.1	2.55	6.05	4.05	3.7	3.45
19		2.4	6.85	3.0	2.7	5.85	3.95	3.7	3.5
20		2.3	7.35	2.85	4.2	5.7	3.85	3.7	3.5
21		2.45	7.65	2.75	4.6	5.55	3.85	3.8	3.5
22	4.0	2.7	7.35	2.65	4.7	5.35	3.8	3.75	3.55
23	4.0	3.0	6.9	2.55	4.2	5.25	3.7	3.85	3.5
24	3.9	3.15	6.5	2.7	3.65	5.1	3.7	3.85	3.55
25	3.85	3.75	6.5	2.75	3.45	4.9	3.75	3.75	3.65

Daily gage height, in feet, of South Platte River near Kersey, Colo., for 1909—Contd.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
26	3.8	4.5	6.3	3.0	3.15	4.9	3.7	3.75	3.65
27	3.8	4.2	6.15	2.95	3.0	4.75	3.75	3.75	3.65
28	3.9	3.9	5.75	2.8	2.85	4.65	3.7	3.75	3.65
29	4.05	3.65	5.35	2.75	2.8	4.55	3.65	3.75	3.65
30	4.0	3.7	5.45	2.75	2.7	4.45	3.65	3.85	3.65
31	.....	3.5	.....	2.75	2.55	.....	3.55	.....	3.7

NOTE.—Ice conditions Dec. 8 to 16, 1909.

Daily discharge, in second-feet, of South Platte River near Kersey, Colo., for 1909.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	1,360	815	2,730	210	180	1,450	892	1,080
2	.....	1,250	815	2,540	200	190	1,290	892	1,110
3	.....	1,320	865	2,140	200	205	1,220	950	1,140
4	.....	1,140	980	2,540	200	245	1,220	950	1,080
5	.....	1,180	1,110	4,780	200	390	1,220	950	1,012
6	.....	1,040	1,490	9,470	200	960	1,180	920	950
7	.....	1,140	3,990	9,100	180	1,130	1,250	950	1,012
8	.....	1,040	5,200	7,480	200	1,500	1,250	950	1,100
9	.....	1,040	7,120	6,440	205	1,580	1,180	892	1,100
10	.....	1,110	7,120	5,800	270	2,000	1,490	892	1,100
11	.....	980	7,650	5,000	260	2,360	1,290	892	1,100
12	.....	920	7,120	3,680	230	2,500	1,320	892	1,100
13	.....	742	5,500	1,920	230	2,650	1,360	892	1,100
14	.....	635	6,120	1,240	200	3,040	1,320	950	1,100
15	.....	538	5,960	980	200	3,440	1,630	1,010	1,100
16	.....	490	6,280	670	180	3,780	1,630	950	1,100
17	.....	460	5,960	560	180	4,540	1,630	1,010	920
18	.....	380	5,960	430	180	4,380	1,220	980	840
19	.....	430	6,780	380	205	3,860	1,140	980	865
20	.....	405	8,550	325	570	3,500	1,080	980	865
21	.....	495	9,660	280	740	3,160	1,080	1,040	865
22	1,180	520	8,550	250	780	2,730	1,040	1,010	892
23	1,180	635	6,950	220	570	2,540	980	1,080	865
24	1,110	698	5,650	230	395	2,290	980	1,080	892
25	1,080	1,010	5,650	225	340	2,010	1,010	1,010	950
26	1,040	1,580	5,060	250	280	2,010	980	1,010	950
27	1,040	1,320	4,640	240	250	1,830	1,010	1,010	950
28	1,110	1,110	3,620	220	230	1,720	980	1,010	950
29	1,220	950	2,730	210	220	1,630	950	1,010	950
30	1,180	980	2,940	210	205	1,540	950	1,080	950
31	.....	865	.....	210	180	.....	892	.....	980

NOTE.—The above discharges are based on a curve that is fairly well defined between 635 and 4,000 second-feet, applicable Jan. 1 to July 11 and Sept. 21 to Dec. 31. Indirect method for shifting channels used July 12 to Sept. 20. Discharges estimated Dec. 8 to 16.

Monthly discharge of South Platte River near Kersey, Colo., for 1909.

[Drainage area, 9,470 square miles.]

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
Apr. 22–30	1,220	1,040	1,130	0.119	0.04	20,200	A.
May	1,580	380	894	.094	.11	55,000	A.
June	9,660	815	5,030	.531	.59	299,000	A.
July	9,470	210	2,280	.241	.28	140,000	C.
August	780	180	280	.030	.03	17,200	C.
September	4,380	180	2,130	.225	.25	127,000	B.
October	1,630	892	1,200	.127	.15	73,800	A.
November	1,080	892	970	.102	.11	57,700	A.
December	1,140	840	1,000	.106	.12	61,500	C.
The period	.....	.....	.....	.....	.....	851,000	

SOUTH PLATTE RIVER AT JULESBURG, COLO.

This station, which is located 1 mile south of Julesburg, Colo., in T. 12 N., R. 44 W., below all irrigation ditches taking water from the South Platte in Colorado except one, was established April 2, 1902, but was not in operation during 1907. It was reestablished on May 2, 1908, at a new pile bridge about 2,000 feet upstream from the old location.

The greatest value of this station lies in the fact that it is situated less than a mile from the Colorado-Nebraska line, and its records therefore show the amount of water passing into Nebraska. It has also some importance in obtaining data on the flow of return waters.

All the tributaries for 100 miles or more above the station are intermittent streams and none is of any importance. The same may be said of the tributaries between Julesburg and North Platte, where the river joins the North Platte River to form the Platte. The drainage area at Julesburg is 20,600 square miles. Numerous irrigation systems and reservoirs are located on the South Platte and tributaries above Julesburg for a distance of 250 miles. In 1907 more than 900,000 acres were irrigated in this valley. Nearly 450,000 acre-feet were stored in reservoirs, and over half of this quantity was used for irrigation in that year. Additional rights can not be provided for in the South Platte Valley without constructing reservoirs to store surplus flood waters.

The flow of the river at Julesburg during the irrigation season depends on the amount of water diverted above and is likely to be small except when the river is in flood. During the nonirrigating season considerable water is diverted by feeder canals to storage reservoirs from the main river or its tributaries or is intercepted by reservoirs on the tributaries.

The river is usually frozen over wholly or in part for two or three months during the winter.

When the station was reestablished in 1908 the gage was moved 2,000 feet upstream and it is in no way referred to the old gage. However, the recorded gage heights give no indication of the discharge of the river from one season to the next because of the sandy and extremely shifting character of the stream bed. In low water the river consists of a number of small rivulets flowing between sand bars. In order to procure reliable results measurements should be taken as often as once every two weeks throughout the year. They are made from the bridge at high stages and by wading when the river is low.

Discharge measurements of South Platte River at Julesburg, Colo., in 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Feb. 25[a]	W. B. Freeman	361	274	2.70	298
Mar. 20	do	420	376	2.25	760
Apr. 23	do	718	636	2.53	1,270
May 24	do	340	136	1.50	164
June 18	G. J. Lyon	1,440	1,910	3.38	4,710
26	do	1,350	1,920	3.36	4,580
Sept. 2	G. H. Russell	.....	167	1.20	276
25	do	896	1,200	3.05	2,960
Nov. 13	do	.....	574	2.40	1,190
Dec. 14[a]	do	267	380	3.20	800

[a] Ice conditions.

Daily gage height, in feet, of South Platte River at Julesburg, Colo., for 1909.

[Mrs. M. C. Wood, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	.....	3.05	.....	.....	.....	2.7	.....	.....	2.6	.....	2.65
2	.....	.....	.....	.....	.....	.....	2.45	0.85	1.15	.....	2.3	2.6
3	.....	.....	.....	.....	.....	.....	2.4	.....	.....	.....	.....	.....
4	.....	.....	.....	.....	.....	1.35	2.35	.....	.....	.....	2.5	.....
5	.....	.....	2.85	.....	2.4	.....	.....	.....	.....	2.45	2.45	.....
6	.....	.....	.....	.....	.....	.....	2.3	.....	.....	2.4	.....	.....
7	.....	.....	.....	.....	.....	.....	.....	.....	.....	2.45	.....	.....
8	.....	.....	2.50	2.35	.....	.....	.....	.....	.....	2.45	2.4	.....
9	.....	.....	.....	.....	.....	.....	3.2	1.2	.....	2.45	2.4	.....
10	.....	.....	.....	2.35	2.15	.....	3.5	1.1	.....	.....	2.4	.....
11	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
12	.....	.....	.....	.....	.....	2.80	.....	.....	.....	2.15	.....	.....
13	.....	.....	2.35	.....	1.9	.....	3.0	.....	.....	2.15	2.4	.....
14	.....	.....	.....	.....	.....	.....	2.85	.....	2.6	.....	.....	3.1
15	.....	.....	.....	.....	1.9	3.60	2.7	.....	.....	2.20	.....	3.1
16	.....	.....	.....	2.6	.....	.....	2.5	.....	2.75	.....	.....	3.1
17	.....	.....	.....	2.65	.....	3.40	2.15	.....	2.85	2.25	.....	3.1
18	.....	.....	.....	2.6	1.65	3.35	.....	.....	2.9	.....	.....	3.1
19	.....	.....	.....	.....	.....	.....	.....	.....	2.9	.....	2.6	3.1
20	.....	.....	2.25	.....	.....	3.30	.....	.....	2.95	2.40	2.6	3.1
21	3.0	.....	.....	2.5	1.55	.....	1.5	.....	.....	2.40	.....	3.1
22	3.05	.....	.....	2.5	.....	.....	.....	.....	3.1	2.40	2.45	3.1
23	3.05	.....	.....	2.55	.....	.....	1.45	.....	3.05	2.35	2.6	1.8
24	3.1	.....	.....	.....	1.5	3.35	.....	.....	3.05	.....	.....	1.8
25	3.0	2.7	.....	.....	.....	.....	.....	.....	3.05	2.40	2.5	1.8
26	3.0	.....	2.40	2.3	.....	3.35	1.15	.....	2.95	2.40	.....	1.8
27	.....	.....	2.40	.....	.....	3.10	1.10	.....	2.85	2.45	.....	1.75
28	.....	.....	.....	.....	.....	3.05	.....	.....	2.75	2.45	2.55	3.4
29	.....	.....	2.45	2.3	1.4	3.0	.....	.....	2.75	.....	2.6	3.4
30	.....	.....	.....	.....	.....	2.85	1.0	.....	2.6	.....	2.6	3.42
31	.....	.....	.....	.....	.....	.....	.95	.....	.....	.....	.....	3.45

NOTE.—Ice conditions Jan. 1 to Mar. 19 and Dec. 1 to 31.

Daily discharge, in second-feet, of South Platte River at Julesburg, Colo., for 1909.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	.....	1,040	860	80	1,680	.....	.....	1,570	1,080
2	.....	1,020	890	76	1,080	.....	.....	1,500	1,040
3	.....	1,000	920	73	980	.....	.....	1,430	1,200
4	.....	980	950	70	905	.....	.....	1,360	1,370
5	.....	960	980	310	865	.....	.....	1,280	1,280
6	.....	940	910	550	830	.....	.....	1,190	1,250
7	.....	920	840	790	1,800	.....	.....	1,280	1,220
8	.....	905	770	1,030	2,760	.....	.....	1,280	1,190
9	.....	905	700	1,270	3,730	.....	.....	1,280	1,190
10	.....	905	640	1,510	5,420	.....	.....	1,140	1,190

Daily discharge, in second-feet, of South Platte River at Julesburg, Colo., for 1909— Continued.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
11	.....	985	555	1,740	4,530	.....	.....	1,000	1,190
12	.....	1,070	470	1,980	3,640	.....	.....	855	1,190
13	.....	1,150	380	3,330	2,750	.....	.....	855	1,190
14	.....	1,230	380	4,680	2,160	.....	1,570	882	1,260
15	.....	1,310	380	6,040	1,680	.....	1,760	910	1,320
16	.....	1,400	325	5,430	1,170	.....	1,960	942	1,390
17	.....	1,540	270	4,820	640	.....	2,260	975	1,450
18	.....	1,400	210	4,540	.....	.....	2,430	1,050	1,510
19	.....	1,320	190	4,400	.....	.....	2,430	1,120	1,570
20	765	1,240	170	4,250	.....	.....	2,620	1,190	1,570
21	800	1,170	155	4,320	.....	.....	2,920	1,190	1,430
22	835	1,170	150	4,390	.....	.....	3,230	1,190	1,280
23	870	1,280	140	4,460	.....	.....	3,020	1,120	1,570
24	905	1,130	130	4,540	.....	.....	3,020	1,160	1,470
25	940	980	122	4,540	.....	.....	3,020	1,190	1,370
26	980	830	114	4,540	.....	.....	2,620	1,190	1,400
27	980	830	106	3,220	.....	.....	2,260	1,280	1,430
28	1,030	830	98	2,980	.....	.....	1,960	1,280	1,470
29	1,080	830	90	2,750	.....	.....	1,960	1,230	1,570
30	1,060	830	87	2,160	.....	.....	1,570	1,180	1,570
31	1,050	.....	83	.....	.....	.....	.....	1,130	.....

NOTE.—These discharges are based on two rating curves that are fairly well defined, applicable as follows: Mar. 20 to June 26 and June 27 to Nov. 30; discharge, July 18 to Aug. 31, low but very uncertain as to quantity. Discharges interpolated for days when gage was not read.

Monthly discharge of South Platte River at Julesburg, Colo., for 1909.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
March 20–31	1,080	765	1,030	22,500	C.
April	1,540	830	1,070	63,700	C.
May	980	83	421	25,900	C.
June	6,040	70	2,830	168,000	C.
July 1–17	5,420	640	2,150	72,500	C.
September 14–30	3,230	1,570	2,390	80,600	C.
October	1,570	855	1,170	71,900	C.
November	1,570	1,040	1,340	79,700	C.

NORTH FORK OF SOUTH PLATTE RIVER AT CASSELLS, COLO.

This station, which is located at a private highway bridge at Cassells, Colo., was established July 4, 1908, to determine the value of the stream for power development.

Geneva Creek, one of the most important tributaries, comes in about 2 miles above, and supplies a large part of the water passing the station.

The drainage area above the basin comprises 100 square miles, a considerable part of which is timbered. No diversions of any importance are made above this point on the main stream or any of its tributaries, but many filings have been made for power sites, especially on Geneva Creek. Additional power sites are, however, probably available.

The stream is liable to freeze over from the middle of November to the 1st of April.

No change has been made in the datum of the gage since it was first established. The vertical rod gage originally installed was replaced in December, 1908, by a chain gage on the bridge.

Very good results should be obtained except in extremely high water. Measurements can be taken by wading the greater part of the year (Pl. I, *B*), those at the higher stages being taken from the bridge. Frequent measurements are necessary to determine the winter flow accurately.

Discharge measurements of North Fork of South Platte River at Cassells, Colo., in 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Jan. 1[a]	W. B. Freeman	18	12	1.10	19
3[a]	do	18	12	1.07	18
27[a]	do	8.6	9	1.28	15
28[a]	do	9	7.4	1.10	14
29[a]	do	9	9.6	1.40	14
29[a]	do	14	15	1.55	18
Feb. 28[a]	J. B. Stewart	10	11	1.50	12
28[a]	do	11	13	1.50	11
Mar. 1	do	10	9.3	1.40	11
Apr. 11[b]	W. B. Freeman	20	14	.90	23
12[b]	do	14	13	.90	14
12[b]	do	23	24	1.10	50
May 9	do	29	61	1.48	110
10	do	34	45	1.50	96
31	do	44	57	1.79	188
June 14	do	32	84	2.30	395
July 5	do	28	92	2.60	525
Aug. 2	do	41	52	1.70	147
16	do	43	54	1.78	181
18	do	29	73	2.03	259
Sept. 2	do	46	56	1.80	173
Oct. 17	J. B. Stewart	28	55	1.60	88
20	do	30	56	1.45	76
Dec. 5[a]	W. B. Freeman	28	34	2.45	43
7[a]	do	26	52	3.35	39

[a] Ice conditions. [b] Slush ice in the morning.

Daily gage height, in feet, of North Fork of South Platte River at Cassells, Colo., for 1909.

[Miss Lulu Cassell, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.1	1.3	1.4	0.9	1.2	1.8	2.55	1.75	1.8	1.65	1.35	1.15
2	1.1	1.25	1.25	.9	1.2	1.8	2.5	1.7	1.75	1.65	1.3	1.2
3	1.1	1.3	1.5	.9	1.2	2.05	2.55	1.7	1.75	1.7	1.4	1.4
4	1.05	1.2	1.3	.9	1.35	2.35	2.6	1.7	1.8	1.7	1.35	1.2
5	1.05	1.2	1.3	.7	1.5	2.55	2.5	1.65	2.0	1.65	1.3	2.1
6	1.0	1.3	1.3	.85	1.4	2.3	2.5	1.6	2.1	1.6	1.3	3.2
7	1.0	1.3	1.2	1.0	1.5	2.45	2.5	1.65	2.45	1.6	1.2	3.3
8	1.0	1.3	1.3	1.0	1.55	2.7	2.35	1.6	2.35	1.6	1.2	3.6
9	1.0	1.35	1.4	1.0	1.5	2.4	2.8	1.75	2.3	1.5	1.2	3.3
10	1.0	1.45	1.5	1.1	1.5	2.4	2.55	1.7	2.3	1.6	1.3	2.9
11	1.0	1.5	1.3	.9	1.65	2.4	2.55	1.7	2.25	1.6	1.3	2.3
12	1.0	1.5	1.3	1.0	1.6	2.35	2.25	1.7	2.2	1.6	1.3	2.6
13	1.05	1.5	1.4	.85	1.55	2.35	2.2	1.7	2.25	1.55	1.35	2.1
14	1.1	1.3	1.4	.85	1.6	2.35	.....	1.7	2.1	1.5	1.5	2.1
15	1.05	1.4	1.25	.9	1.5	2.3	.....	1.8	2.1	1.5	1.7	2.0
16	1.1	1.25	1.2	1.0	1.6	2.25	2.1	1.8	2.05	1.5	1.6	2.0
17	1.05	1.3	1.1	1.45	1.65	2.4	2.0	2.05	2.1	1.6	1.75	1.8
18	1.05	1.2	1.0	1.25	1.8	2.75	2.0	2.0	2.05	1.55	1.65	1.7
19	1.05	1.2	1.1	1.25	1.75	2.75	2.0	2.35	2.1	1.45	1.4	1.8
20	1.05	1.2	1.0	1.1	1.8	2.8	2.05	2.05	2.05	1.4	1.3	1.25

Daily gage height, in feet, of North Fork of South Platte River at Cassells, Colo., for 1909—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
21	1.05	1.45	1.0	1.15	1.8	2.7	2.0	1.95	2.1	1.4	1.3	1.3
22	1.0	1.4	1.0	1.05	1.95	2.7	2.15	2.05	2.0	1.4	1.15	1.3
23	1.0	1.3	1.0	.95	1.9	2.6	2.1	2.0	1.95	1.35	1.1	1.5
24	1.05	1.4	.9	1.0	1.8	2.65	2.05	2.05	1.9	1.4	1.1	1.35
25	1.0	1.1	.95	1.1	1.7	2.7	2.1	1.9	1.9	1.3	1.1	1.15
26	1.05	1.35	.95	1.1	1.7	2.5	2.0	1.8	1.8	1.3	1.1	1.0
27	1.25	1.5	.85	1.3	1.75	2.5	2.0	1.75	1.8	1.35	1.15	1.7
28	1.15	1.5	.8	1.4	1.8	2.5	1.9	1.9	1.8	1.3	1.1	1.65
29	1.45	.....	.8	1.3	1.85	2.5	2.1	1.8	1.8	1.25	1.25	1.25
30	1.5	.....	.85	1.2	1.8	2.6	1.9	1.85	1.7	1.25	1.2	1.15
31	1.4	.....	.8	.....	1.8	.....	1.75	1.8	.....	1.25	.....	1.15

NOTE.—Ice conditions January 1 to March 26 and November 14 to December 31.

Daily discharge, in second-feet, of North Fork of South Platte River at Cassells, Colo., for 1909.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	19	14	11	24	60	182	545	168	182	142	82	54
2	19	14	12	24	60	182	510	154	168	142	74	52
3	18	14	12	24	60	270	545	154	168	154	90	49
4	16	14	11	24	82	420	580	154	182	154	82	46
5	16	14	11	8	108	545	510	168	250	142	74	43
6	13	14	11	20	90	390	510	130	290	130	74	40
7	13	14	11	34	108	480	510	168	480	130	60	40
8	13	14	12	34	119	650	420	130	420	130	60	40
9	13	14	14	34	108	450	720	168	390	168	60	40
10	13	15	16	46	108	450	545	154	390	130	74	40
11	13	15	14	24	142	450	545	154	365	130	74	35
12	13	15	14	34	130	420	365	154	340	130	74	35
13	16	15	16	20	119	420	340	154	365	119	82	35
14	19	12	16	20	130	420	325	154	290	168	106	35
15	13	12	17	24	108	390	305	182	290	108	149	35
16	18	12	17	34	130	365	290	182	270	108	125	35
17	15	12	18	99	142	450	250	270	290	130	164	35
18	15	12	18	67	182	685	250	250	270	119	137	35
19	15	12	19	67	168	685	250	420	290	99	89	35
20	15	11	18	46	182	720	270	270	270	90	75	35
21	15	12	18	53	182	650	250	232	290	90	75	30
22	12	11	18	40	282	650	315	270	250	90	54	30
23	12	11	18	29	214	580	290	250	232	82	48	30
24	14	11	18	34	182	615	270	270	214	90	48	30
25	12	10	19	46	154	650	290	214	214	74	48	30
26	14	10	19	46	154	510	250	182	182	74	48	30
27	15	11	20	74	168	510	250	168	182	82	54	30
28	14	12	16	90	182	510	214	214	182	74	48	30
29	16	.....	16	74	198	510	290	182	182	67	68	30
30	17	.....	20	60	182	580	214	198	154	67	61	30
31	14	.....	16	.....	182	.....	168	182	.....	67	.....	30

NOTE.—Discharges during the frozen period partly estimated from discharge measurement and partly computed by shifting channel methods. The open-channel estimates are based on a curve that is fairly well defined.

Monthly discharge of North Fork of South Platte River at Cassells, Colo., for 1909.

Month.	Discharge in second-feet.			Run-off (total in acre-feet.	Accuracy.
	Maximum.	Minimum.	Mean.		
January	19	12	14.8	910	C.
February	15	10	12.8	711	C.
March	20	11	15.6	959	C.
April	99	8	41.8	2,490	B.
May	232	60	141	8,670	A.
June	720	182	493	29,300	A.
July	720	168	367	22,600	A.
August	420	130	197	12,100	A.
September	480	154	268	15,900	A.
October	154	67	108	6,640	A.
November	164	48	78.6	4,680	C.
December	.....	.....	36.3	2,230	C.
The year	720	.....	148	107,000	

NORTH FORK OF SOUTH PLATTE RIVER AT SOUTH PLATTE, COLO.

This station, which was established June 4, 1909, to show the total run-off of the creek available for power and storage and, in connection with the records at the station on the South Fork of the South Platte, to serve as a check on the South Platte station below the forks, is located about one-third mile above the mouth of the stream. The station is maintained in cooperation with the Denver Power & Irrigation Co.

The drainage area above the station is about 450 square miles.

Measurements are made from a cable 100 yards upstream from the inclined rod gage and by wading. The channel is quite shifting in character and the results obtained have not been very satisfactory. Ice affects the gage heights for several months during the winter. The datum has remained constant since the station was established.

Discharge measurements of North Fork of South Platte River at South Platte, Colo., in 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1909.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Feb. 9[a]	W. B. Freeman	19	21.8	.....	23
Apr. 27[a]	.....do	58	78	.....	161
June 5	.....do	75	153	3.87	870
9	Miles and Lewis	70	178	4.00	1,060
14	W. B. Freeman	70	135	3.65	628
26	R. C. Miles	70	174	3.80	948
July 28	Lyons and Russell	55	88	2.60	253
Aug. 14	G. H. Russell	59	89	2.40	265
Sept. 7	.....do	79	193	4.55	1,190
27	.....do	65	110	3.30	488
Oct. 16	J. B. Stewart	61	90	2.60	261
Nov. 19[b]	G. H. Russell	45.5	54	2.20	123
Dec. 15[b]	.....do	15	31	2.10	68

[a] Made by wading. [b] Made by wading. Ice along edges.

Daily gage height, in feet, of North Fork of South Platte River at South Platte, Colo., for 1909.

[Miss E. H. Jardine, observer.]

Day.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Day.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1....	.....	3.55	2.6	2.8	3.2	2.3	2.2	16....	3.6	2.95	2.4	4.1	2.65	2.1	2.2
2....	.....	3.45	2.6	2.7	3.2	2.3	2.15	17....	3.75	2.75	3.1	4.0	2.6	2.2	2.4
3....	.....	3.65	2.5	2.85	3.2	2.3	2.1	18....	3.7	2.7	3.25	3.9	2.6	2.4	2.5
4....	3.4	4.2	2.4	3.05	3.2	2.3	2.0	19....	4.05	2.7	3.9	3.8	2.6	2.2	2.5
5....	3.85	3.6	2.4	3.4	3.1	2.2	1.9	20....	4.1	2.9	3.25	3.75	2.6	2.2	2.6
6....	3.8	3.6	2.4	3.3	3.0	2.2	1.9	21....	3.9	2.75	3.1	3.7	2.6	2.25	2.7
7....	3.9	3.45	2.4	4.35	3.0	2.2	2.0	22....	3.8	2.7	3.1	3.65	2.5	2.2	2.7
8....	3.75	3.35	2.45	3.85	3.0	2.15	1.9	23....	3.7	3.15	3.1	3.6	2.5	2.1	2.7
9....	3.95	3.85	2.5	3.95	2.9	2.35	2.2	24....	3.7	3.15	3.0	3.5	2.4	2.1	2.8
10....	3.6	3.6	2.5	4.0	2.9	2.3	2.35	25....	3.8	3.0	3.1	3.4	2.4	2.0	2.6
11....	3.75	3.35	2.65	3.9	2.9	2.05	2.05	26....	3.75	2.9	2.85	3.4	2.4	2.0	2.7
12....	3.55	3.2	2.5	3.85	2.8	2.15	1.8	27....	3.6	2.75	2.8	3.35	2.3	1.95	2.8
13....	3.6	3.1	2.55	4.2	2.75	2.1	2.1	28....	3.55	2.65	2.8	3.3	2.3	1.8	2.8
14....	3.7	3.1	2.4	4.1	2.7	1.95	2.1	29....	3.5	2.85	2.8	3.25	2.3	2.2	2.75
15....	3.65	3.05	2.4	4.15	2.7	2.1	2.1	30....	3.5	2.7	2.75	3.25	2.3	2.2	2.8
								31....	.....	2.65	2.75	.....	2.3	.....	2.7

NOTE.—Ice December 9 to 31.

Daily discharge, in second-feet, of North Fork of South Platte River at South Platte, Colo., for 1909.

Day.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Day.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1....	.....	780	270	355	450	160	130	16....	640	440	250	920	280	107	70
2....	.....	730	270	315	450	160	117	17....	730	335	490	870	260	130	70
3....	.....	830	240	380	465	160	107	18....	730	315	610	800	260	190	70
4....	630	1,120	210	460	465	160	87	19....	930	315	930	750	260	130	70
5....	860	780	220	640	420	130	72	20....	980	395	610	720	260	130	70
6....	860	780	225	560	380	130	72	21....	890	320	520	700	260	145	70
7....	940	706	230	1,090	390	130	87	22....	860	300	520	675	220	130	70
8....	900	660	240	815	395	117	72	23....	830	490	520	630	220	107	70
9....	1,040	896	275	865	360	170	70	24....	850	490	470	590	190	107	70
10....	800	760	280	890	360	160	70	25....	920	410	520	540	190	87	70
11....	830	640	340	840	370	98	70	26....	920	365	410	535	190	87	70
12....	680	580	290	815	340	117	70	27....	820	310	385	510	160	80	70
13....	660	500	315	970	320	107	70	28....	800	270	385	500	160	58	70
14....	650	500	265	920	300	80	70	29....	770	350	385	470	160	130	70
15....	655	480	250	950	300	107	70	30....	770	295	340	470	160	130	70
								31....	.....	285	335	.....	160	.....	70

NOTE.—A discharge curve, fairly well defined, with the indirect method for shifting channels used. Discharges estimated Dec. 9 to 31.

Monthly discharge of North Fork of South Platte River at South Platte, Colo., for 1909.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
June 4 to 30	1,040	630	813	43,500	C.
July	1,120	270	530	32,600	C.
August	930	210	374	23,000	C.
September	1,090	315	685	40,800	C.
October	465	160	295	18,100	C.
November	190	58	124	7,380	C.
December	130	.....	75.9	4,670	C.
The period	.....	.....	.....	170,000	

GENEVA CREEK ABOVE JACKWHACKER CREEK, NEAR GRANT, COLO.

A temporary station was established on Geneva Creek August 17, 1909, to obtain run-off and power data. It is located 100 feet above the mouth of Jackwhacker Creek, 12 miles above Grant, Colo.

The vertical staff gage has remained unchanged in datum and location since the station was established. Discharge measurements are made by wading.

Discharge measurements of Geneva Creek above Jackwhacker Creek, near Grant, Colo., in 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec. ft.*
Aug. 17	W. B. Freeman	17	10	0.82	19.7
Oct. 19	J. B. Stewart	10	4.1	.55	6.6

Daily gage height, in feet, of Geneva Creek above Jackwhacker Creek, near Grant, Colo., for 1909.

[Edward Sullivan, observer.]

Day.	Aug.	Sept.	Oct.	Day.	Aug.	Sept.	Oct.	Day.	Aug.	Sept.	Oct.
1				11				21			
2				12				22			
3				13				23			0.55
4				14				24			
5				15				25			
6				16				26		0.30	.50
7			0.70	17	0.82			27			
8			.65	18				28			
9				19				29			
10				20	.90			30			
								31			

GENEVA CREEK AT OLD GENEVA SMELTER, NEAR GRANT, COLO.

This is a temporary station, established August 17, 1909, to determine the amount of water available for storage and power development, and is located a short distance below the mouth of Smelter Creek, and 10 miles above Grant, Colo.

The vertical staff gage has remained in the same position since the establishment of the station. Discharge measurements are made by wading.

The stream is covered with ice and snow for several months every winter.

Discharge measurements of Geneva Creek at Old Geneva smelter, near Grant, Colo., in 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Aug. 17	W. B. Freeman	17	15	1.78	37
Oct. 19	J. B. Stewart	.....	8	1.40	12.8

Daily gage height, in feet, of Geneva Creek at Old Geneva smelter, near Grant, Colo., for 1909.

[Edward Sullivan, observer.]

Day.	Aug.	Sept.	Oct.	Day.	Aug.	Sept.	Oct.	Day.	Aug.	Sept.	Oct.
1				11				21			
2				12				22			
3				13				23			1.4
4				14				24			
5				15			1.5	25			
6				16				26		1.6	1.4
7			1.5	17	0.8			27			
8				18			1.35	28			
9			1.45	19				29			
10				20	2.0			30			
								31			

GENEVA CREEK AT SULLIVAN'S RANCH, NEAR GRANT, COLO.

This station, which is located at Sullivan's ranch, 3½ miles above Grant, Colo., in T. 6 S., R. 74 W., was established July 5, 1908, to obtain data concerning the run-off from a small mountain drainage area and also to determine the flow available for power development.

The station is about 3½ miles above the confluence of Geneva Creek with the North Fork of the South Platte, about 50 feet below the mouth of Gold Run, or Threemile Creek, and about a mile below the mouth of Scott Gomer Gulch, which is called on some of the old maps the North Fork of the South Platte. The drainage area, which is very mountainous and part of which area is heavily timbered, comprises 49 square miles above the station.

No water is diverted above the station. Several power sites have been filed on, but the stage of construction at none of these has yet been reached. The creek has a fall of 900 feet in the last 4 miles, and a very much greater fall above. With proper storage it will be possible to develop 10,000 horsepower during a six months' period. The development of the Continental reservoir site, about 3 miles above the station, is under consideration.

The creek is frozen wholly or in part for four or five months during the year.

The datum or position of the vertical rod gage has not been changed since the station was established.

Very good results should be obtained except at very high stages, when the current is likely to be swift. Measurements can be made by wading at most seasons of the year, but for flood measurements a cable must be installed. Such high-water measurements as there are have been made from the highway bridge at Grant, 3½ miles downstream.

Discharge measurements of Geneva Creek at Sullivan's ranch, near Grant, Colo., in 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec. ft.*
Jan. 2[a]	W. B. Freeman	12.1	7.6	.....	12.7
28[a]	do	12	9.4	.....	11.9
Feb. 28[a]	J. B. Stewart	11	7.7	.....	9.4
Apr. 12[a]	W. B. Freeman	14	12.6	.....	22.6
May 10[a]	do	19.8	17.8	.....	55
30	do	43	41.4	1.07	123
June 13[a]	do	22.5	48	1.85	297
July 5[a]	do	22.5	51	1.85	325
Aug. 2	do	42	43	1.20	110
16	do	38	42	1.20	114
Sept. 4	do	43.5	41	1.20	123
Oct. 18	J. B. Stewart	29.5	31	.90	66
Dec. 6[b]	W. B. Freeman	21	44.5	1.88	27.5

[a] Measurement made at Grant, Colo. [b] Ice.

Daily gage height, in feet, of Geneva Creek at Sullivan's ranch, near Grant, Colo., for 1909.

[M. A. Sullivan, observer.]

Day.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	1.20	1.80	1.30	1.30	1.30	.....	.....
2	.....	1.35	1.65	1.25	1.25	1.25	.....	.....
3	.....	1.55	1.80	1.20	1.20	1.15	.....	.....
4	.....	1.80	2.00	1.15	1.20	1.10	.....	.....
5	.....	1.95	1.95	1.25	1.50	1.10	.....	1.90
6	.....	1.90	1.95	1.20	1.45	1.10	.....	1.90
7	.....	1.95	1.85	1.15	1.70	1.10	.....	1.90
8	.....	2.20	1.75	1.15	1.60	1.00	.....	1.90
9	.....	1.80	2.25	1.15	1.60	.90	.....	1.95
10	.....	1.75	1.85	1.20	1.60	1.00	.....	2.00
11	.....	1.65	1.80	1.45	1.50	1.05	.....	1.90
12	.....	1.80	1.75	1.30	1.60	1.00	.....	1.80
13	.....	1.90	1.70	1.25	1.60	.95	.....	1.80
14	.....	1.85	1.70	1.25	1.60	.95	.....	.....
15	.....	1.65	1.70	1.25	1.50	.95	.....	.....
16	.....	1.85	1.55	1.30	1.50	.95	.....	.....
17	.....	1.95	1.45	1.50	1.50	.95	.....	.....
18	.....	2.10	1.40	1.55	1.50	.90	.....	.....
19	.....	2.15	1.45	1.60	1.40	.90	.....	.....
20	.....	2.30	1.45	1.50	1.40	.90	.....	.....
21	.....	2.10	1.50	1.50	1.40	.90	.....	.....
22	.....	1.90	1.60	1.50	1.30	.90	.....	.....
23	.....	2.00	1.70	1.45	1.30	.85	.....	.....
24	.....	2.10	1.65	1.50	1.30	.85	.....	.95
25	.....	2.00	1.50	1.35	1.30	.80	.....	.95
26	.....	1.90	1.50	1.30	1.25	.80	.....	.85
27	.....	1.90	1.50	1.30	1.40	.80	.....	.75
28	.....	1.85	1.50	1.30	1.45	.70	.....	.70
29	.....	1.90	1.60	1.30	1.45	.80	.....	.70
30	1.05	1.90	1.45	1.35	1.40	.75	.....	.70
31	1.05	.....	1.35	1.40	.....	.....	.....	.70

NOTE.—Ice during December.

Daily discharge, in second-feet, of Geneva Creek at Sullivan's ranch, near Grant, Colo., for 1908–9.

Day.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Day.	June.	July.	Aug.	Sept.	Oct.
1908.							1909.					
1	47	54	35	30	35	15	1	151	295	136	136	136
2	47	54	41	25	25	15	2	184	258	126	126	126
3	47	47	41	25	25	15	3	232	295	116	116	107
4	47	47	47	22	25	15	4	295	346	107	116	98
5	47	47	41	22	30	15	5	333	333	126	182	98
6	54	60	35	22	25	15	6	320	333	116	170	98
7	47	54	30	25	30	15	7	333	308	107	230	98
8	47	47	35	22	25	15	8	404	282	107	206	81
9	60	47	30	25	25	15	9	295	420	107	206	66
10	60	47	35	25	35	15	10	282	268	116	206	81
11	60	47	25	25	25	15	11	258	255	170	182	90
12	60	47	25	25	35	15	12	295	242	136	206	81
13	54	54	35	25	30	15	13	320	230	126	206	74
14	60	54	35	25	25	15	14	308	230	126	206	74
15	60	47	41	22	25	15	15	258	230	126	182	74
16	60	60	35	25	25	15	16	308	192	136	182	74
17	60	60	35	25	25	15	17	333	170	182	182	74
18	54	75	30	25	25	15	18	374	158	192	182	66
19	60	68	25	25	25	15	19	389	170	206	158	66
20	54	60	25	30	25	15	20	436	170	182	158	66
21	68	60	25	25	20	15	21	374	182	182	158	66
22	54	47	25	35	20	15	22	320	206	182	136	66
23	54	47	25	25	20	12	23	346	230	170	136	59
24	54	47	25	25	20	12	24	374	218	182	136	59
25	47	47	25	25	20	12	25	346	182	147	136	52
26	35	41	35	25	15	12	26	320	182	136	126	52
27	35	47	25	25	15	12	27	320	182	136	158	52
28	35	41	30	25	15	11	28	308	182	136	170	40
29	35	35	25	25	15	14	29	320	206	136	170	52
30	54	41	25	30	15	14	30	320	170	147	158	46
31	54	41	.....	35	.....	14	31	.....	147	158	.....	46

NOTE.—These discharges are based on rating curves applicable as follows:
July 5 to November 14, 1908, and June 1 to July 9, 1909, not well defined.
July 10 to October 31, 1909, not well defined.
July 1 to 4, 1908, interpolated.
November 15 to December 31, 1908, estimated on account of ice conditions.

Monthly discharge of Geneva Creek near Grant, Colo., for 1908–9.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
1908.					
July	68	35	51.9	3,190	B.
August	75	35	50.6	3,110	B.
September	47	25	31.5	1,870	C.
October	35	22	25.6	1,570	C.
November	.....	.....	24.0	1,430	C.
December	.....	.....	14.3	879	C.
The period	.....	.....	.....	12,000	
1909.					
January	.....	.....	11.3	695	D.
February	.....	.....	9	500	D.
March	.....	.....	10.5	646	D.
April	.....	.....	30	1,790	D.
May	.....	.....	97	5,960	D.
June	436	151	315	18,700	C.
July	420	158	235	14,400	C.
August	206	107	144	8,850	C.
September	230	116	167	9,940	C.
October	136	40	74.8	4,600	C.
November	.....	.....	57	3,390	D.
December	.....	.....	24.4	1,500	D.
The year	.....	.....	97.9	71,000	

NOTE.—Monthly discharge for 1908 supersedes that published in Water-Supply Paper 246. Means for January, February, March, April, May, November, and December, 1909, estimated.

SMELTER CREEK NEAR GRANT, COLO.

A temporary station on Smelter Creek, about one-fourth mile above its confluence with Geneva Creek at the old Geneva smelter, 10 miles above Grant, Colo., was established August 17, 1909.

None of the water in this stream has been diverted for any purpose, but some opportunity is presented for power development on account of the precipitous character of the stream bed.

There has been no change in the location of the vertical staff gage since the station was established. Discharge measurements are made by wading.

The stream is covered with ice and snow for several months during the winter season.

Discharge measurements of Smelter Creek near Grant, Colo., in 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Aug. 17	W. B. Freeman	11	7.2	0.78	12
Oct. 19	J. B. Stewart	11	4.8	.70	3.6

Daily gage height, in feet, of Smelter Creek near Grant, Colo., for 1909.

[Edward Sullivan, observer.]

Day.	Aug.	Sept.	Oct.	Day.	Aug.	Sept.	Oct.	Day.	Aug.	Sept.	Oct.
1				11				21			
2				12				22			
3				13				23			0.7
4				14				24			
5				15			0.7	25			
6				16				26			.65
7			0.7	17	0.78			27			
8			.8	18				28			
9			.8	19				29			
10				20	.87			30			
								31			

DUCK LAKE CREEK NEAR GRANT, COLO.

Duck Lake Creek has a total drainage area of about 8 square miles, at an elevation varying between 9,700 and 13,000 feet.

It is proposed to make a storage reservoir out of Duck Lake, which is about 5 miles above the mouth of the stream, at an elevation of 11,000 feet.

A temporary station was established August 17, 1909, about 50 yards above the confluence of Duck Lake Creek with Geneva Creek, about 7 miles above Grant, Colo.

A vertical staff gage is fastened to the crib abutment of an old bridge, and measurements are taken from a footlog at the gage or by wading.

So far no water has been diverted from this creek, though filings have been made both for power and irrigation projects.

Discharge measurements of Duck Lake Creek near Grant, Colo., in 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
May 30	W. B. Freeman	8	5.2	.....	9.3
June 13	.....do	11	12.6	.....	35.1
July 5	.....do	.....	14.0	.....	36.7
Aug. 17	.....do	.....	.....	1.30	.....
Oct. 19	J. B. Stewart	12.5	7.1	1.00	6.5
Dec. 6[a]	W. B. Freeman	2.8	3.1	.....	3.9
6[a]	.....do	8	5.05	.....	4.5

[a] Ice.

NOTE.—Measurements were made at various sections.

SCOTT GOMER CREEK AT SULLIVAN'S RANCH, NEAR GRANT, COLO.

Scott Gomer Creek, an important tributary of Geneva Creek, has a total drainage area of 21 square miles, at elevations from 9,500 to 14,000 feet. As the fall of this creek is large, it offers excellent opportunities for power development. At present no water is being diverted from the stream.

A temporary station, with a vertical staff gage, was established on Scott Gomer Creek, 3 miles above its mouth and three-eighths of a mile above the Geneva Power Co.'s dam site, August 16, 1909, to determine the amount of water available for power development.

As the location was very inaccessible, another vertical rod gage was established on September 4, 1909, at the highway bridge, one-fourth mile above the junction of the stream with Geneva Creek. The station is one mile above Sullivan's ranch which is 3½ miles above Grant. Several small tributaries come in between the two stations, but there are none below the lower one.

The creek is covered with ice and snow for several months each winter. Discharge measurements are made by wading.

Discharge measurements of Scott Gomer Creek at Sullivan's ranch, near Grant, Colo., in 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Oct. 19	J. B. Stewart	25.5	26.2	1.90	19.6
Dec. 6[a]	W. B. Freeman	6.5	4.6	1.37	7.5

[a] Ice.

CLEAR CREEK AT FORKSCREEK, COLO.

This station, which is located at Forkscreek, Colo., in T. 3 S., R. 71 W., was established May 29, 1899, to determine the amount of water available for irrigation and power development.

This station is at a foot bridge a few hundred feet below the mouth of the North Fork. No other important tributaries enter between this fork and the mouth of the stream. For 13 miles below the station the creek flows in a deep canyon, falling in that distance 1,225 feet. It then emerges into a broad valley, where the entire normal flow is used for irrigation. The drainage area above the station comprises a narrow strip of very mountainous country, composed entirely of granitic rock, in many places barren of soil and studded with heavy patches of coniferous timber, remnants of a once extensively forested area. This area is 345 square miles.

Two of the oldest mining districts in Colorado lie in this basin, and in these districts the waters of the upper tributaries of the stream have been used for mining. The stream now carries in suspension immense quantities of tailings and sediment, and the name Clear Creek has long been a misnomer.

The water is used to some extent for power, and 4,000 horsepower are at present developed by about a dozen small plants. Several other plants are planned or in the course of construction. By utilizing all the storage facilities on the stream above Forkscreek it will be possible to develop about 30,000 horsepower for six months during the year and 20,000 more between that point and its mouth.

The natural flow of the stream is more or less affected by storage in various ponds and reservoirs above. The creek is frozen over for three or four months during the winter.

On July 19, 1905, the gage was moved 30 feet upstream from its original location, but it is not likely that the relation of gage heights was materially affected thereby. This last gage, which is a chain gage fastened to the footbridge, is still in use. Very good results should be obtained at this station except in times of high water, when it is very difficult to measure, on account of the swiftness of the current As the channel is occasionally shifted by floods, new rating curves must from time to time be constructed.

The creek is subject to disastrous floods, due to the heavy rains in summer months, which frequently wash out the tracks of the Colorado & Southern Railway in the bottom of the canyon.

Discharge measurements of Clear Creek at Forkscreek, Colo., in 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
June 2	Miles and Lewis	43	78	5.72	480
16	R. C. Miles	45	143	6.70	1,070
July 29	G. H. Russell	30	123	5.35	545
Aug. 12	....do	24	96	5.18	444
Sept. 9	....do	28	109	5.25	512
Nov. 16[a]	....do	24	41	3.95	66

[a] Ice.

Daily gage height, in feet, of Clear Creek at Forkscreek, Colo., for 1909.

[C. W. Hoisington, observer.]

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	.....	5.2	5.8	6.5	5.2	4.9	4.85	4.3
2	.....	5.25	5.75	6.45	5.2	4.9	4.85	4.25
3	.....	5.3	5.9	6.5	5.1	5.0	4.8	4.3
4	.....	5.25	6.1	6.95	5.0	5.1	4.8	4.3
5	.....	5.3	6.3	6.65	5.0	5.2	4.8	4.3
6	.....	5.4	6.7	6.55	5.0	5.3	4.75	4.25
7	.....	5.45	6.55	6.45	5.2	5.4	4.75	4.25
8	.....	5.5	6.6	6.4	5.3	5.4	4.7	4.2
9	.....	5.4	6.6	6.35	5.2	5.3	4.7	4.2
10	.....	5.45	6.6	6.25	5.2	5.25	4.65	4.2
11	.....	5.45	6.6	6.0	5.2	5.2	4.65	4.2
12	.....	5.4	6.6	5.9	5.2	5.35	4.6	4.2
13	.....	5.45	6.7	5.8	5.2	5.4	4.6	.....
14	.....	5.5	6.7	5.7	5.1	5.3	4.55	.....
15	.....	5.4	6.7	5.6	5.1	5.3	4.5	.....
16	.....	5.4	6.7	5.6	5.0	5.2	4.5	.....
17	.....	5.5	6.8	5.55	5.15	5.2	4.45	4.25
18	.....	5.6	6.95	5.55	5.45	5.2	4.4	4.25
19	.....	5.65	7.1	5.55	5.5	5.15	4.4	4.2
20	.....	5.8	7.15	5.55	5.4	5.15	4.4	4.2
21	5.1	5.8	6.85	5.55	5.3	5.1	4.4	4.2
22	5.0	5.9	6.65	5.5	5.25	5.1	4.35	4.2
23	5.0	6.0	6.55	5.6	5.2	5.0	4.35	4.2
24	5.0	6.0	6.7	5.7	5.2	5.0	4.35	4.2
25	5.0	5.9	6.75	5.55	5.15	4.95	4.3	4.2
26	5.05	5.9	6.55	5.5	5.1	4.95	4.3	4.2
27	5.25	5.9	6.5	5.5	5.0	4.9	4.3	4.2
28	5.35	6.0	6.5	5.4	5.0	4.9	4.35	4.15
29	5.3	6.0	6.6	5.3	5.0	4.85	4.35	4.2
30	5.25	5.85	6.5	5.25	4.9	4.85	4.3	4.2
31	.....	5.8	.....	5.25	4.9	.....	4.3	.....

NOTE.—Ice November 13 to December 31.

Daily discharge, in second-feet, of Clear Creek at Forkscreek, Colo., for 1909.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	.....	190	440	1,020	472	334	313	140
2	.....	210	420	995	472	334	313	128
3	.....	230	565	1,020	426	380	292	140
4	.....	210	670	1,250	380	426	292	140
5	.....	230	775	1,090	380	472	292	140
6	.....	270	980	1,110	380	518	273	128
7	.....	290	915	1,020	472	564	273	128
8	.....	310	950	990	518	564	254	116
9	.....	270	960	960	472	518	254	116
10	.....	290	970	910	472	495	237	116

Daily discharge, in second-feet, of Clear Creek at Forkscreek, Colo., for 1909—Contd.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
11	.....	290	975	790	472	472	237	116
12	.....	270	980	760	472	541	220	116
13	.....	290	1,040	710	472	564	220	100
14	.....	310	1,050	660	426	518	205	75
15	.....	270	1,060	615	426	518	190	70
16	.....	270	1,070	615	380	472	190	65
17	.....	310	1,130	580	449	472	177	65
18	.....	350	1,210	590	588	472	164	65
19	.....	370	1,280	600	612	449	164	65
20	.....	440	1,320	610	564	449	164	65
21	160	440	1,160	610	518	426	164	65
22	130	485	1,060	590	495	426	152	65
23	130	530	1,030	635	472	380	152	65
24	130	530	1,100	700	472	380	152	65
25	130	485	1,130	630	449	357	140	65
26	145	485	1,030	610	426	357	140	65
27	210	530	1,000	610	380	334	140	65
28	245	530	1,000	565	380	334	152	65
29	230	460	1,070	520	380	313	152	65
30	210	440	1,020	495	334	313	140	65
31	.....	.....	.....	495	334	.....	140	.....

NOTE.—The above discharges are based on a curve fairly well defined, applicable July 30 to November 12. Indirect method for shifting channels April 21 to July 29. Discharge estimated November 13 to 30.

Monthly discharge of Clear Creek at Forkscreek, Colo., for 1909.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
April 21–30	245	130	172	3,410	C.
May	530	190	357	22,000	C.
June	1,320	440	979	58,300	B.
July	1,250	495	753	46,300	B.
August	612	334	450	27,700	B.
September	564	313	438	26,100	B.
October	313	140	205	12,600	B.
November	140	.....	91.5	5,440	C.
The period	.....	.....	.....	202,000	

NOTE.—Discharge estimated November 13 to 30.

CLEAR CREEK NEAR GOLDEN, COLO.

This station, which was established about December 1, 1908, by the Denver Reservoir & Irrigation Co. and maintained throughout 1909, is located about 2 miles above Golden, Colo. It is about 10 miles below the Forkscreek station and above all irrigation diversions except one.

Several small tributaries which carry considerable water during the spring and early summer enter the stream between Forkscreek and this station. During the winter, when there is no water being diverted, however, the flow at the station should not differ greatly from the discharge at Forkscreek.

Gage heights have been obtained by means of a Lallie automatic gage, the datum of which has remained constant. Discharge measurements have been made from a cable near the gage.

Though the flow is naturally affected by ice during the winter months, the channel has been kept quite open by a ditch rider employed by the company.

The records are published practically as furnished by the company, the only modifications being to make them conform to the rule of three significant figures in use by the United States Geological Survey.

Discharge measurements of Clear Creek near Golden, Colo., in 1909.

Date.	Hydrographer.	Area of section.	Gage height.	Discharge.
		Sq. ft.	*Feet.*	*Sec.-ft.*
Jan. 4	Stanley Krajicek	29.4	1.11	58
26	....do	42.9	1.43	78
30	....do	22.3	0.94	21
Feb. 2	....do	34.8	1.28	60
6	....do	25.2	1.07	24
11	....do	25.2	1.40	42
13	....do	46.2	1.32	71
16	....do	43.8	1.20	59
17	....do	43.8	1.14	56
23	....do	39.0	1.13	47
Mar. 1	....do	54.3	1.25	74
5	....do	52.8	1.11	59
9	....do	36.9	1.09	44
13	....do	50.2	1.30	67
17	....do	46.2	1.04	50
20	....do	49.2	1.10	55
23	....do	44.4	1.04	46
26	....do	47.5	1.09	56
Apr. 1	....do	44.1	1.02	53
6	....do	44.1	1.04	53
12	....do	28.7	1.13	60
23	....do	39.0	1.37	131
24	....do	36.0	1.39	111
May 1	....do	42.5	1.50	143
4	....do	43.2	1.48	136
9	....do	50.2	1.90	193
12	....do	54.5	1.93	223
20	....do	86.1	2.46	480
22	....do	86.1	2.53	468
30	....do	102	2.69	532
June 4	....do	105	2.73	542
8	....do	166	3.69	1,250
.....	....do	166	3.73	1,340
15	....do	166	3.70	1,340
18	....do	171	4.10	1,600
July 7	Ripple	172	4.10	1,190
9	....do	155	3.80	1,080
19	....do	112	3.05	588
20	....do	120	3.20	702
31	....do	79.5	2.51	497
Aug. 8	....do	70.6	2.25	306
10	....do	84.2	2.52	419
23	....do	85.1	2.55	424
28	....do	77.6	2.38	357

Daily gage height, in feet, of Clear Creek near Golden, Colo., for 1909.

[Stanley Krajicek, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.07	1.31	1.15	1.07	1.61	2.49	3.85	2.06	2.35	2.04	1.44	1.42
2	1.25	1.28	1.16	1.10	1.49	2.52	4.12	2.03	2.29	2.10	1.41	1.41
3	1.20	1.31	1.25	1.20	1.42	2.92	4.75	2.13	2.22	2.08	1.39	1.43
4	1.11	1.30	1.19	1.21	1.56	2.90	4.90	2.39	2.11	2.03	1.44	1.32
5	1.14	1.25	1.30	1.21	1.73	3.08	4.80	2.12	2.20	2.01	1.43	1.26
6	1.17	1.10	1.16	1.10	1.84	3.28	4.40	2.39	3.00	1.99	1.45	1.31
7	1.34	1.13	1.13	1.14	2.10	3.31	4.35	2.52	3.00	1.97	1.45	1.35
8	1.26	1.45	1.00	1.05	2.00	3.51	4.39	2.78	2.83	2.01	1.43	1.42
9	1.21	1.50	1.10	1.08	1.87	3.65	4.26	2.34	2.77	2.00	1.42	1.42
10	1.20	1.16	1.18	1.21	1.84	3.53	4.10	2.21	2.75	2.03	1.41	1.45

Daily gage height, in feet, of Clear Creek near Golden, Colo., for 1909—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
11	1.18	1.03	1.18	1.25	1.84	3.43	4.00	2.25	2.75	2.02	1.40	1.43
12	1.21	1.37	1.06	1.16	1.91	3.80	4.01	2.41	2.74	2.01	1.40	1.21
13	1.12	1.39	1.16	1.22	1.99	3.40	3.70	2.42	2.81	1.99	1.43	1.22
14	1.11	1.26	1.20	1.28	2.01	3.42	3.30	2.45	2.74	1.98	1.46	1.37
15	1.39	1.21	1.14	1.33	2.01	3.45	3.07	2.38	2.76	1.93	1.42	1.32
16	1.29	1.21	1.14	1.39	2.01	3.57	2.90	2.61	2.72	1.88	1.39	1.27
17	1.20	1.20	1.13	1.52	2.14	3.50	3.00	2.82	2.68	1.87	1.36	1.30
18	1.17	1.18	1.12	1.53	2.16	4.19	3.12	3.11	2.68	1.85	1.41	1.13
19	1.14	1.11	1.12	1.51	2.26	4.58	3.24	2.88	2.63	1.84	1.43	1.21
20	1.15	1.08	1.09	1.49	2.45	4.23	3.17	2.82	2.66	1.81	1.41	1.41
21	1.16	1.12	1.09	1.41	2.49	4.41	3.06	2.98	2.65	1.81	1.40	1.41
22	1.15	1.08	1.09	1.33	2.56	4.19	3.10	2.54	2.63	1.84	1.39	1.50
23	1.22	1.13	1.10	1.32	2.73	4.10	3.06	2.54	2.55	1.82	1.37	.....
24	1.11	1.14	1.14	1.34	2.73	3.99	3.06	2.54	2.49	1.81	1.37	.....
25	1.05	1.08	1.16	1.35	2.65	4.16	3.06	2.54	2.46	1.74	1.32	.....
26	1.27	1.15	1.05	1.00	2.60	4.35	3.06	2.50	2.28	1.71	1.29	.....
27	1.40	1.05	1.15	1.57	2.62	4.80	2.90	2.40	2.20	1.66	1.29	.....
28	1.25	.97	1.12	1.90	2.63	3.58	2.98	2.40	2.08	1.58	1.30	.....
29	1.29	.....	1.12	1.90	2.65	4.29	2.50	2.40	2.01	1.53	1.44	.....
30	1.07	.....	1.12	1.60	2.66	4.65	2.34	2.36	1.99	1.48	1.42	.....
31	1.01	.....	1.16	.....	2.49	.....	2.17	2.36	.....	1.48	.....	.....

Daily discharge, in second-feet, of Clear Creek near Golden, Colo., for 1909.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	52	51	66	56	171	430	1,370	260	365	252	127	124
2	66	60	66	58	141	442	1,510	250	340	270	123	123
3	63	54	71	65	119	692	2,120	280	312	264	120	126
4	58	47	64	66	108	630	2,290	380	274	249	127	111
5	60	44	74	66	212	756	2,210	275	305	243	126	103
6	61	26	60	61	183	895	1,830	380	700	238	129	110
7	74	25	54	61	267	923	1,800	440	700	233	129	114
8	68	48	42	54	274	1,170	1,820	570	602	243	126	124
9	63	52	45	57	212	1,250	1,720	360	571	240	124	124
10	62	27	52	66	209	1,120	1,580	310	560	249	123	129
11	60	20	54	69	211	1,000	1,540	320	560	246	121	126
12	62	39	49	62	234	1,480	1,500	390	554	243	121	98
13	55	59	57	79	266	1,010	1,250	395	592	238	126	100
14	55	67	59	80	275	1,010	898	408	554	235	131	117
15	75	62	55	99	275	1,040	738	380	565	222	124	111
16	68	61	55	108	264	1,270	707	485	542	209	120	105
17	61	59	54	148	327	1,140	694	592	521	207	115	108
18	59	58	54	152	347	1,660	792	800	521	203	123	90
19	57	73	55	145	386	1,970	721	685	497	200	126	99
20	57	50	54	140	445	1,840	701	592	512	193	123	123
21	58	52	54	115	499	1,520	743	685	507	193	121	123
22	57	47	43	99	535	1,650	782	404	497	200	120	120
23	62	50	52	91	538	1,580	745	404	458	196	117	120
24	53	48	56	97	496	1,480	745	404	429	193	117	100
25	49	47	60	100	480	1,620	745	404	415	178	111	100
26	65	56	56	135	485	1,780	722	434	336	172	108	90
27	75	51	61	163	485	2,150	664	389	305	162	108	90
28	63	49	53	185	507	1,150	688	389	264	148	109	90
29	66	.....	53	185	510	1,530	434	389	243	140	124	90
30	50	.....	53	157	430	1,530	361	368	235	134	124	85
31	26	.....	55	.....	435	.....	295	368	.....	134	.....	85

Monthly discharge of Clear Creek near Golden, Colo., for 1909.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
January	75	26	60.0	3,690
February	67	20	48.6	2,700
March	74	42	56.0	3,440
April	185	54	101	6,010
May	538	108	333	20,500
June	2,150	430	1,260	75,000
July	2,290	295	1,120	68,900
August	800	250	425	26,100
September	700	235	461	27,400
October	270	134	211	13,000
November	131	108	121	7,200
December	129	80	108	6,640
The year	2,290	20	359	261,000

NOTE.—The above records were furnished by the Denver Reservoir & Irrigation Co. and have not been verified by engineers of the United States Geological Survey.

ST. VRAIN CREEK AT LYONS, COLO.

This station, which is located one-half mile below Lyons and 300 feet below the junction of the North and South forks of St. Vrain Creek, was maintained under the direction of the United States Geological Survey from 1895 to 1903.[1] Since 1903 it has been maintained more or less continually under the direction of the State engineer's office.

Several ditches take water above the station for irrigation, besides the water supply of Lyons and Longmont.[2]

The drainage area above this station is about 200 square miles.

The location and datum of the gage are probably the same as for the station used in 1903. On August 9, 1909, a new slope gage was put in, which is practically at the same datum as the old gage. The old bench mark could not be found.

The flow of the stream is affected by ice for several months during the winter.

These records were taken under the direction of the State engineer of Colorado and are published as furnished by him.

Discharge measurements of St. Vrain Creek at Lyons, Colo., in 1909.

Date.	Hydrographer.	Area of section.	Gage height.	Discharge.
		Sq. ft.	*Feet.*	*Sec.-ft.*
July 14	C. L. Chatfield	93	3.15	316
Aug. 9	do	80	2.87	189
Sept. 27	do	54	2.20	54
Oct. 22	do	48	2.08	35.1
Dec. 2	Chatfield and T. Grieve	18.2	1.85	15.9

[1] This station is fully described in Water-Supply Paper U. S. Geol. Survey No. 99, p. 193.
[2] Idem, p. 195.

Daily gage height, in feet, of St. Vrain Creek at Lyons, Colo., for 1909.

[Wm. Siglinger, observer.]

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	2.95	2.95	4.1	2.95	2.7	2.3	1.95	1.8
2	.....	2.8	3.25	4.2	2.9	2.7	2.3	2.0	1.9
3	.....	2.8	3.5	4.5	2.95	2.7	2.3	2.0	1.9
4	.....	2.9	3.7	4.6	2.9	2.85	2.3	2.0	1.8
5	.....	3.0	4.05	4.55	2.9	3.0	2.3	1.9	1.7
6	.....	3.2	4.05	4.6	2.8	2.95	2.35	1.9	1.8
7	.....	3.1	4.1	4.2	2.8	3.3	2.4	1.95	1.8
8	.....	3.1	4.05	4.05	2.9	3.2	2.3	2.0	2.0
9	.....	3.1	4.1	3.95	2.85	2.95	2.3	2.0	2.1
10	.....	3.0	4.1	3.9	2.8	2.85	2.3	2.0	2.05
11	.....	3.1	4.05	3.8	2.95	2.7	2.2	2.0	2.0
12	.....	3.1	4.05	3.65	3.1	2.7	2.2	1.9	1.95
13	.....	3.0	4.05	3.45	3.0	2.75	2.1	2.0	2.0
14	.....	3.0	4.05	3.25	3.0	2.65	2.0	1.95	1.95
15	.....	3.0	4.05	3.2	2.9	2.55	2.0	1.9	1.9
16	.....	3.05	4.0	3.25	2.85	2.5	2.1	1.9	1.8
17	.....	3.0	4.05	3.35	3.05	2.5	2.2	1.9	1.9
18	.....	3.0	4.2	3.35	3.1	2.4	2.3	2.1	1.9
19	2.85	3.0	4.5	3.45	3.0	2.4	2.2	2.1	1.85
20	3.0	3.3	4.5	3.35	3.0	2.35	2.15	2.05	1.9
21	2.95	3.4	4.25	3.3	2.9	2.35	2.1	2.1	1.8
22	2.9	3.45	4.2	3.3	2.8	2.35	2.05	2.05	1.85
23	2.9	3.45	4.2	3.15	2.8	2.3	2.0	2.0	1.8
24	2.95	3.5	4.2	3.05	2.9	2.3	2.0	2.0	1.9
25	3.0	3.45	4.25	3.35	2.85	2.25	1.9	2.0	1.85
26	3.1	3.3	4.1	3.25	2.7	2.2	1.95	2.0	1.9
27	3.15	3.3	4.15	3.25	2.7	2.2	1.9	1.9	1.85
28	3.3	3.35	4.1	3.15	2.7	2.2	1.9	1.9	1.9
29	3.3	3.4	4.15	3.1	2.7	2.15	2.0	1.9	1.85
30	3.1	3.2	4.2	3.0	2.6	2.15	2.0	1.9	1.9
31	.....	3.2	.....	2.95	2.6	.....	1.95	.....	1.95

Daily discharge, in second-feet, of St. Vrain Creek at Lyons, Colo., for 1909.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	214	214	755	214	143	65	24	12
2	.....	168	342	805	196	143	65	29	20
3	.....	168	461	955	214	143	65	29	20
4	.....	196	558	1,000	196	182	65	29	12
5	.....	232	730	980	196	232	65	20	7.5
6	.....	318	730	1,000	168	214	73	20	12
7	.....	273	755	805	168	365	81	24	12
8	.....	273	730	730	196	318	65	29	29
9	.....	273	755	680	182	214	65	29	39
10	.....	232	755	656	168	182	65	29	34
11	.....	273	730	607	214	143	51	29	29
12	.....	273	730	534	273	143	51	20	24
13	.....	232	730	437	232	156	39	29	29
14	.....	232	730	342	232	132	29	24	24
15	.....	232	730	318	196	110	29	20	20
16	.....	252	705	342	182	99	39	20	12
17	.....	232	730	389	252	99	51	20	20
18	.....	232	805	389	273	81	65	39	20
19	182	232	955	437	232	81	51	39	16
20	232	365	955	389	232	73	45	34	20
21	214	413	830	365	196	73	39	39	12
22	196	437	805	365	168	73	34	34	16
23	196	437	805	295	168	65	29	29	20
24	214	461	805	252	196	65	29	29	20
25	232	437	830	389	182	58	20	29	16
26	273	365	755	342	143	51	24	29	20
27	295	365	780	342	143	51	20	20	16
28	365	389	755	295	143	51	20	20	20
29	365	413	780	273	143	45	29	20	16
30	273	318	805	232	120	45	29	20	20
31	.....	318	.....	214	120	.....	24	.....	24

NOTE.—These discharges are based on a rating curve that is well defined to 400 second-feet. It was constructed by the State engineer of Colorado and published as received.

Monthly discharge of St. Vrain Creek at Lyons, Colo., for 1909.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
Apr. 19–30	365	182	253	6,020
May	461	168	298	18,300
June	955	214	726	43,200
July	1,000	214	513	31,500
August	273	120	191	11,700
September	365	45	126	7,620
October	81	20	45.8	2,820
November	39	20	26.8	1,600
December	39	7.5	19.5	1,200
The period				124,000

BOULDER CREEK AT ORODELL, COLO.

This station, which was established March 18, 1907, is located just above the mouth of Fourmile Creek, about 4 miles above Boulder Colo. The records are valuable chiefly in connection with power development. Boulder Creek has an immense amount of fall, and the distance from the Continental Divide at its headwaters to the plains at Boulder is only 20 miles.

No diversions are made above the station. The first canal has its intake a short distance below.

The creek is frozen four or five months of the year and discharges for such periods have been obtained by interpolation between discharge measurements and weir records.

The records at this station since May 20, 1907, have been kept and furnished by the Central Colorado Power Co.

Discharge measurements of Boulder Creek at Orodell, Colo., in 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Jan. 8	C. L. Chatfield	14	9.8	0.52	9.6
9	....do	14	10.9	.58	12
22	....do	14	10.5	.48	6.3
23	....do	14	10.7	.51	7.3
Feb. 8	....do	14	10.0	.57	6.7
9	....do	14	9.3	.49	5.7
16	....do	14	9.3	.64	7.8
17	....do	14	7.7	.53	7.2
26	....do	28	17.5	1.60	10.0
Mar. 8	....do	12	11.0	1.62	6.5
Apr. 3	....do	33	19.0	1.88	30.0
15	....do	38	25.0	2.08	47.0
27	....do	38	41.0	2.42	11.0

Daily gage height, in feet, of Boulder Creek at Orodell, Colo., for 1909.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	0.54	0.60	1.53	1.70	2.34	2.72	3.82	2.68	2.47	2.08	1.51	1.50
2	.52	.53	1.50	1.74	2.29	2.75	3.82	2.64	2.40	2.02	1.69	1.50
3	.51	.50	1.53	1.96	2.29	2.92	3.79	2.64	2.34	1.97	1.69	1.46
4	.50	.48	1.57	2.05	2.39	3.14	3.78	2.61	2.55	1.96	1.67	.....
5	.51	.52	1.57	2.03	2.56	3.28	3.85	2.57	2.63	2.00	1.74	.....
6	.55	.50	1.55	1.95	2.63	3.42	3.84	2.57	2.61	2.03	1.75	.....
7	.58	.48	1.55	1.88	2.65	3.51	3.72	2.60	2.78	2.03	1.77	.....
8	.53	.47	1.60	1.86	2.66	3.60	3.59	2.76	2.67	2.00	1.71	.....
9	.52	.44	1.65	1.92	2.54	3.56	3.53	2.74	2.62	1.95	1.71	.....
10	.56	.45	1.61	1.98	2.59	3.53	3.46	2.69	2.60	.....	1.73	.....
11	.57	.54	1.60	2.04	2.71	3.41	3.37	3.02	2.55	.....	1.63	.....
12	.59	.53	1.61	2.03	2.73	3.39	3.34	2.94	2.59	.....	1.75	.....
13	.53	.51	1.61	2.03	2.59	3.34	3.21	2.91	2.63	.....	1.67	.....
14	.55	.49	1.55	2.06	2.58	3.33	3.12	2.90	2.60	.....	1.76	.....
15	.54	.79	1.50	2.17	2.52	3.32	3.10	2.81	2.59	.....	1.77	.....
16	.52	.61	1.50	2.34	2.62	3.38	3.05	2.76	2.57	.....	1.90	.....
17	.49	1.55	1.53	2.43	2.63	3.51	2.98	2.90	2.58	1.96	1.85	.....
18	.49	1.60	1.53	2.49	2.70	3.60	2.93	3.02	2.52	1.95	1.98	.....
19	.50	1.67	1.53	2.46	2.74	3.87	2.98	2.90	2.49	1.95	1.81	.....
20	.50	1.64	1.50	2.42	2.87	4.00	3.05	2.89	2.41	1.92	1.78	.....
21	.52	1.74	1.50	2.33	2.90	3.92	3.14	2.79	2.29	1.89	1.80	.....
22	.51	1.70	1.50	2.26	2.92	3.89	3.12	2.79	2.30	1.90	1.77	.....
23	.50	1.78	1.60	2.21	2.98	3.83	3.05	2.75	2.29	1.86	1.78	.....
24	.51	1.69	1.70	2.22	2.87	3.85	3.10	2.76	2.26	1.86	1.78	3.75
25	.48	1.61	1.70	2.28	2.82	3.86	3.02	2.71	2.21	1.81	1.65	3.75
26	.52	1.69	1.75	2.37	2.78	3.79	2.97	2.64	2.19	1.78	1.47	3.75
27	.55	1.70	1.75	2.48	2.85	3.76	2.98	2.60	2.12	1.78	1.36	3.75
28	.56	1.57	1.69	2.56	2.97	3.72	2.94	2.61	2.10	1.79	1.20	3.75
29	.56	.....	1.70	2.56	3.01	3.74	2.86	2.57	2.10	1.79	1.60	3.35
30	.52	.....	1.69	2.44	2.84	3.82	2.79	2.55	2.09	1.75	1.56	3.35
31	.53	.....	1.65	.....	2.78	.....	2.73	2.48	.....	1.63	.....	3.35

NOTE.—An automatic register was used Feb. 17 to Dec. 3.

Daily discharge, in second-feet, of Boulder Creek at Orodell, Colo., for 1909.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	10	7	8	17	91	176	608	164	115	50	8	7
2	9	6	7	19	80	186	609	155	102	43	16	7
3	9	6	8	37	80	237	595	154	91	38	16	6
4	9	6	10	47	102	315	590	147	133	37	15	.....
5	9	6	10	44	137	370	622	138	153	41	19	.....
6	11	6	9	36	152	430	618	137	147	44	20	.....
7	12	6	9	31	158	471	564	144	193	44	22	.....
8	10	5	11	29	159	510	507	189	163	41	18	.....
9	10	5	14	34	131	493	479	181	150	36	18	.....
10	11	5	12	39	142	477	449	167	146	.....	19	.....
11	12	6	11	46	175	423	407	272	132	.....	13	.....
12	13	7	12	45	178	416	392	242	142	.....	20	.....
13	10	7	12	45	143	393	341	234	153	.....	15	.....
14	11	7	9	49	141	389	307	230	146	.....	21	.....
15	10	12	7	64	129	384	298	204	144	.....	22	.....
16	8	8	7	90	150	410	284	188	137	.....	32	.....
17	7	9	8	107	151	469	257	229	139	37	28	.....
18	7	11	8	119	169	510	240	268	128	36	39	.....
19	7	15	8	114	180	632	257	230	121	36	25	.....
20	7	13	7	104	222	698	279	228	104	34	22	.....
21	8	19	7	89	229	654	315	197	81	31	24	.....
22	7	17	7	76	237	640	308	196	83	32	22	.....
23	7	22	11	68	256	612	282	184	81	29	22	.....
24	7	16	17	71	221	621	301	187	76	29	22	9
25	6	12	17	79	205	628	271	175	68	25	14	9
26	8	16	20	97	194	593	253	155	65	22	6	9
27	9	17	20	118	216	580	256	145	56	22	5	9
28	9	10	16	136	255	566	242	148	53	23	3	9
29	9	.....	17	135	266	573	219	138	53	23	11	8
30	8	.....	16	110	213	609	196	134	52	20	10	8
31	8	.....	14	.....	195	.....	178	118	.....	12	.....	8

Monthly discharge of Boulder Creek at Orodell, Colo., for 1909.

[Drainage area, 108 square miles.]

Month.	Discharge in second-feet.				Depth in inches on drainage area.	Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	Per square mile.		
January	13	6	9	0.083	0.10	553
February	22	5	10.1	.094	.10	561
March	20	7	11.3	.105	.12	695
April	136	17	69.8	.646	.72	4,150
May	266	80	173	1.6	1.84	10,600
June	698	176	482	4.46	4.98	28,700
July	622	178	372	3.44	3.97	22,900
August	272	118	183	1.69	1.95	11,300
September	193	52	114	1.06	1.18	6,780
October (24 days)	50	12	32.7	.303	.27	1,560
November	39	3	18.2	.169	.19	1,080
December (11 days)	9	6	8.1	.075	.03	177
The period						89,100

NOTE.—The above records were furnished by outside parties and have not been verified by engineers of the United States Geological Survey.

BOULDER CREEK NEAR BOULDER, COLO.

This station, which is located 1½ miles above the town of Boulder, in T. 1 N., R. 71 W., was established May 13, 1895, to determine the quantity of water available for irrigation and power development. Records were also kept on this stream near Boulder from 1888 to 1892. From 1895 to 1901 the station was maintained in cooperation with the State engineer of Colorado. From 1902 to 1906 the records are published only in the reports of the State engineer of Colorado.

The station is at the mouth of Boulder Canyon, about 1½ miles below Fourmile Creek and some 20 miles above the confluence with the St. Vrain.

Two small irrigation ditches take water above the station, but their combined flow amounts to only a few second-feet. The municipal supply of Boulder is also taken out above the station.

This valley is broad and is practically all under irrigation, the entire normal flow of the stream being used for that purpose.

The upper portions of this creek and its tributaries flow through mountainous areas which are extensively timbered, although they have been deforested to a very considerable extent. The drainage area above the Boulder station is 129 square miles, and at the junction with the St. Vrain, 434 square miles.

The Eastern Colorado Power Co. is now constructing a plant on Boulder Creek which will have a capacity of probably 20,000 horsepower. By making use of storage facilities it would be possible to develop at least 50,000 horsepower on this stream during six months of the year. The upper waters are now being used for placer mining and by small power plants which aggregate less than 1,000 horsepower. Sites for additional power filings no doubt exist.

As good measurements can not be made during high water at the bridge where the gage is located, an auxiliary gage was located at the Ninth Street Bridge in Boulder, and high-water measurements have since been made at this point. Between the two gages the Farmers' canal and the Anderson ditch are diverted and Sand Creek and Gregory Creek come in, so allowance is made for these in using the measurements made at the Ninth Street Bridge to obtain the discharge at the upper gage.

Boulder Creek, like other mountain streams in this part of Colorado, is frozen over wholly or partly for three or four months in the winter time. The natural flow is not at present greatly modified by reservoirs, but will be when some of the reservoirs now under construction are completed.

The gage was washed out during the flood on August 1, 1908, and was replaced on August 14 by another sloping rod gage in practically the same location, but the datum of which was about 0.5 foot lower than that of the old gage. No other changes in the gage datum are on record since the station was established.

As the stream is very swift and the bed is composed of bowlders it is impossible to procure very accurate results during high water. At moderate and low stages very good measurements can be obtained.

The United States Geological Survey did not cooperate in maintaining the station during 1909. Unfortunately such gage heights and records as were obtained were worthless, so only the list of discharge measurements is published.

Discharge measurements of Boulder Creek near Boulder, Colo., in 1909.

Date.	Hydrographer.	Area of section.	Gage height.	Discharge.
		Sq. ft.	*Feet.*	*Sec.-ft.*
Aug. 13	C. L. Chatfield	.....	2.00	224
Sept. 24	do	32	1.57	61
28	do	27	1.45	54
Oct. 20	do	18.3	1.10	26.3
Dec. 11[a]	do	7.3	1.90	10.5
20[a]	do	9.8	0.40	8.9

[a] Through ice.

SOUTH BOULDER CREEK NEAR MARSHALL, COLO.

This station, which is located at the mouth of the canyon about 3 miles west of the Colorado & Southern Railway station at Marshall, was maintained under the direction of the United States Geological Survey from 1895 to 1901,[1] and since then more or less intermittent records have been obtained under the direction of the State engineer's office.

[1] See Water-Supply Paper U. S. Geol. Survey No. 49, p. 287.

Two ditches, the more important being the Community ditch, divert water above the station.

The rod gage, which has the same location and datum as in 1901, is located a short distance below the Community canal.

The drainage area above this station is about 195 square miles.

During 1909 the station was maintained both by the State engineer and by the Denver Reservoir & Irrigation Co., and they have used the same daily gage readings. The daily discharges have been computed from discharge measurements made by both parties and they have both agreed upon them. The Denver Reservoir & Irrigation Co. also obtained records of the flow of the Community ditch.

The river station is maintained for run-off purposes and to obtain data on the amount of water available for irrigation.

Ice forms for several months during the winter periods.

Daily gage height, in feet, of South Boulder Creek near Marshall, Colo., for 1909.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	0.98	0.95	0.95	1.25	2.02	2.48	2.72	1.70	1.62	1.58	1.25	1.28
2	.98	.98	.98	1.35	1.95	2.45	2.70	1.70	1.60	1.58	1.28	1.25
3	.98	.95	1.00	1.48	1.92	2.52	2.80	1.65	1.60	1.55	1.30	1.20
4	.98	.95	1.05	1.55	2.00	2.52	2.95	1.65	1.70	1.55	1.30	.98
5	.95	.90	1.08	1.48	2.30	2.60	2.92	1.62	1.85	1.55	1.28	.88
6	.92	.90	1.12	1.35	2.38	2.88	2.85	1.60	1.80	1.55	1.22	1.02
7	1.00	.90	1.00	1.50	2.38	2.95	2.72	1.60	2.45	1.55	1.25	1.12
8	1.00	.90	.88	1.50	2.38	3.02	2.58	1.82	2.40	1.55	1.25	1.22
9	1.00	.90	.90	1.50	2.22	3.05	2.45	1.78	2.08	1.45	1.22	1.28
10	.95	.90	1.00	1.50	2.25	2.92	2.35	1.75	2.08	1.52	1.28	1.25
11	.90	.90	1.00	1.65	2.30	2.92	2.28	1.88	1.92	1.50	1.20	1.20
12	.88	.90	.98	1.55	2.35	2.88	2.25	2.10	1.95	1.50	1.28	1.20
13	.92	.90	1.00	1.60	2.28	2.85	2.18	1.78	2.10	1.48	1.25	1.20
14	.98	.92	.98	1.60	2.28	2.82	2.10	1.72	1.95	1.45	1.15	1.20
15	1.00	.92	.98	1.68	2.22	2.78	2.05	1.68	1.95	1.40	1.10	1.18
16	1.00	.95	.92	1.92	2.25	2.78	2.02	1.65	1.90	1.40	1.12	1.18
17	1.00	.95	1.00	2.08	2.25	2.88	2.02	1.70	1.90	1.40	1.18	1.15
18	1.00	1.00	1.05	2.10	2.32	3.08	1.98	1.80	1.85	1.40	1.38	1.10
19	1.00	.98	1.05	2.00	2.35	3.20	2.00	2.08	1.80	1.40	1.35	1.05
20	1.00	.95	1.08	1.90	2.45	3.22	2.05	1.95	1.80	1.40	1.35	1.05
21	1.00	.92	1.10	1.88	2.50	2.98	2.05	1.88	1.70	1.40	1.38	1.02
22	1.00	.95	1.10	1.82	2.45	3.08	2.02	1.82	1.70	1.40	1.30	1.00
23	1.00	.95	1.10	1.82	2.50	2.90	2.02	1.75	1.68	1.35	1.30	1.05
24	.85	.95	1.20	1.82	2.52	2.85	2.05	1.75	1.68	1.35	1.32	1.08
25	.92	.95	1.22	1.80	2.50	2.92	1.98	1.72	1.68	1.35	1.25	1.10
26	.98	.95	1.22	1.95	2.48	2.88	1.92	1.70	1.65	1.35	1.22	1.10
27	.98	.95	1.22	2.08	2.42	2.82	1.90	1.65	1.60	1.32	1.22	1.10
28	1.00	.95	1.20	2.18	2.48	2.78	1.82	1.65	1.60	1.30	1.08	1.10
29	.72	.....	1.20	2.20	2.52	2.68	1.80	1.65	1.60	1.32	1.35	1.10
30	.78	.....	1.20	2.05	2.45	2.72	1.82	1.60	1.60	1.30	1.28	1.10
31	.95	.....	1.22	.....	2.45	.....	1.78	1.60	.....	1.28	.....	1.12

Monthly discharge of South Boulder Creek near Marshall, Colo., for 1909.

[Drainage area, 125 square miles.]

Month.	Discharge in second-feet.				Run-off.	
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.
January	13	5	12	0.096	0.111	738
February	13	10	11	.088	.102	611
March	28	10	18	.144	.166	1,107
April	206	32	106	.848	.978	6,307
May	326	130	258	2.064	2.380	15,864
June	910	303	571	4.568	5.267	33,977
July	635	110	253	2.024	2.334	15,556
August	176	67	98	.784	.904	6,026
September	268	54	101	.808	.932	6,010
October	54	24	36	.288	.332	2,214
November	32	11	21	.168	.194	1,250
December	24	3	13	.104	.120	799
The year	910	3	125	1.000	13.820	90,459

NOTE.—The above records were furnished by outside parties and have not been verified by engineers of the United States Geological Survey.

COMMUNITY CANAL NEAR MARSHALL, COLO.

This canal diverts water from South Boulder Creek just above the Marshall gaging station. The 1909 records were obtained by the Denver Reservoir & Irrigation Co. A Lallie automatic gage was used, and as the canal at this section is of concrete the rating is permanent.

Daily discharge, in second-feet, of Community canal near Marshall, Colo., for 1909.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	0	38	89.5	15.5	0	0	0	16	0	40	0	0	0	0	64.8
2	0	40	89.5	17	19	0	0	17	0	0	0	89.4	0	7.2	40.2
3	0	60	89.5	18.9	43	0	0	18	0	0	0	89.4	0	0	59
4	0	65	109	12.7	35.5	0	17	19	0	0	0	104.5	0	0	33
5	0	60	95.5	0	35	0	107	20	0	0	0	116	0	0	19.5
6	0	50	105.5	0	35.5	0	104	21	0	0	0	83.8	0	0	0
7	0	65	131	0	27	0	163.5	22	0	0	0	70.9	0	0	0
8	0	50	131	29.6	29.4	0	157.5	23	0	0	0	0	0	0	0
9	0	50	65	70.9	14	0	141	24	0	0	0	41	0	0	0
10	0	50	0	70.9	0	0	139	25	5	0	0	41	0	0	0
11	0	62.5	0	47.2	0	0	123.7	26	5	0	0	61.2	0	0	0
12	0	55	0	0	0	0	75	27	5	0	0	89.4	0	0	0
13	0	60	0	0	0	0	64.8	28	25	8.4	0	89.4	0	0	0
14	0	63	0	0	0	0	64.8	29	25	89.5	0	0	0	0	8.3
15	0	65	0	0	0	0	64.8	30	25	89.5	0	0	0	0	0
								31	25	0	0	0	0	0	0

Monthly discharge of Community canal near Marshall, Colo., for 1909.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
March	25	0	3.7	228
April	89.5	0	35.4	2,110
May	131	0	30.1	1,850
June	116	0	33.5	2,290
July	43	0	7.6	468
August	7.2	0	.2	14
September	163.5	0	50.7	3,020
The period				9,980

NOTE.—The above records have been furnished by outside parties and have not been verified by engineers of the United States Geological Survey.

BIG THOMPSON CREEK NEAR ARKINS, COLO.

This station, which is located at a private wagon bridge 10 or 12 miles above Loveland, 4 miles southwest of Arkins, Colo., and about 400 feet below the Handy dam, was maintained under the direction of the United States Geological Survey from 1895 to 1903.[1] Since that time it has been continued more or less intermittently under the direction of the State engineer. The station furnishes data concerning the amount of water available for irrigation.

A rod gage on the bridge pier was established in 1909 at a different datum from the 1903 gage, as the old bench mark could not be found. The Handy ditch [2] diverts water for irrigation above the station. In 1903 this ditch used 17,000 acre-feet of water.

The flow of the creek is affected by ice for several months during the winter season.

The 1909 records were taken under the direction of the State engineer and published as furnished by him.

Discharge measurements of Big Thompson Creek near Arkins, Colo., in 1909.

Date.	Hydrographer.	Area of section.	Gage height.	Discharge.
		Sq. ft.	*Feet.*	*Sec.-ft.*
July 13	C. L. Chatfield	149	2.80	473
Aug. 6	....do	104	1.90	238
Sept. 25	....do	99	1.55	113
Oct. 25	....do	58.8	1.10	29.8
Do	....do		1.27	49.0
Dec. 1	Chatfield and Grieve	64.9	1.20	47.5

[1] See Water-Supply Paper U. S. Geol. Survey No. 99, p. 189. [2] Idem, p. 191.

Daily gage height, in feet, of Big Thompson Creek near Arkins, Colo., for 1909.

[Minnie V. Lammon, observer.]

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	1.9	2.3	3.65	2.15	2.05	1.35	1.2	1.2
2	.....	1.85	2.35	3.65	2.2	2.0	1.4	1.25	1.1
3	.....	1.9	2.55	3.7	2.15	2.0	1.35	1.25	1.1
4	.....	2.05	3.05	3.85	2.05	1.9	1.3	1.25	1.1
5	.....	2.3	3.2	4.05	2.0	1.9	1.3	1.25	1.1
6	.....	2.4	3.45	3.75	1.9	2.1	1.3	1.3	1.1
7	.....	2.45	3.6	3.65	1.95	2.8	1.35	1.25	1.25
8	.....	2.4	3.75	3.4	2.1	2.55	1.35	1.25	1.65
9	.....	2.35	3.6	3.25	2.05	2.2	1.4	1.2	2.2
10	.....	2.25	3.45	3.2	2.05	2.2	1.4	1.2	2.2
11	.....	2.45	3.35	3.05	2.1	2.05	1.4	1.2	1.9
12	.....	2.45	3.15	2.95	2.1	2.0	1.4	1.15	1.45
13	.....	2.35	3.25	2.75	2.05	2.0	1.4	1.1	1.2
14	.....	2.35	3.25	2.65	2.1	1.95	1.4	1.1	1.2
15	.....	2.35	3.15	2.5	2.05	1.9	1.4	1.05	1.25
16	.....	2.35	3.15	2.55	2.0	1.8	1.3	1.05	1.35
17	1.65	2.25	3.35	2.65	2.3	1.8	1.3	1.1	1.35
18	1.65	2.2	3.6	2.6	2.8	1.75	1.3	1.3	1.3
19	1.4	2.35	3.95	2.65	2.25	1.7	1.3	1.3	1.25
20	1.25	2.65	4.05	2.7	2.3	1.7	1.25	1.2	1.25
21	1.3	2.55	3.7	2.75	2.1	1.65	1.25	1.25	1.3
22	1.35	2.5	3.6	2.65	2.0	1.6	1.25	1.2	1.3
23	1.4	2.55	3.55	2.7	2.1	1.6	1.2	1.25	1.2
24	1.4	2.6	3.7	2.75	2.1	1.6	1.15	1.1	1.2
25	1.35	2.5	3.8	2.7	2.1	1.55	1.1	.95	1.2
26	1.65	2.35	3.75	2.6	1.95	1.5	1.1	.95	1.4
27	2.0	2.3	3.7	2.45	1.9	1.5	1.1	.9	1.5
28	2.15	2.5	3.75	2.5	1.95	1.5	1.1	.8	1.5
29	2.3	2.7	3.65	2.35	1.95	1.4	1.05	1.0	1.42
30	2.05	2.45	3.65	2.3	2.0	1.4	1.05	1.2	1.5
31	.....	2.35	.....	2.25	2.1	.....	1.2	.....	1.6

NOTE.—Gage heights Dec. 7 to 31 distorted by presence of ice.

Daily discharge, in second-feet, of Big Thompson Creek near Arkins, Colo., for 1909.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	196	337	1,390	278	242	67	42	42
2	.....	182	360	1,390	296	226	76	50	28
3	.....	196	460	1,430	278	226	67	50	28
4	.....	242	850	1,560	242	196	58	50	28
5	.....	337	983	1,740	226	196	58	50	28
6	.....	382	1,210	1,480	196	259	58	58	28
7	.....	407	1,340	1,390	211	627	67	50	.....
8	.....	382	1,480	1,160	259	460	67	50	.....
9	.....	360	1,340	1,030	242	296	76	42	.....
10	.....	316	1,210	983	242	296	76	42	.....
11	.....	407	1,120	850	259	242	76	42	.....
12	.....	407	938	760	259	226	76	35	.....
13	.....	360	1,030	589	242	226	76	28	.....
14	.....	360	1,030	520	259	211	76	28	.....
15	.....	360	938	432	242	196	76	23	.....
16	.....	360	938	460	226	168	58	23	.....
17	120	316	1,120	520	337	168	58	28	.....
18	130	296	1,340	488	627	155	58	58	.....
19	76	360	1,660	520	379	142	58	58	.....
20	50	520	1,740	551	337	142	50	42	.....
21	58	460	1,430	589	259	130	50	50	.....
22	67	432	1,340	520	226	118	50	42	.....
23	76	460	1,300	551	259	118	42	50	.....
24	76	488	1,430	589	259	118	35	28	.....
25	67	432	1,520	551	259	107	28	15	.....
26	130	360	1,480	488	211	96	28	15	.....
27	226	337	1,430	407	196	96	28	12	.....
28	278	432	1,480	432	211	96	28	8	.....
29	337	551	1,390	360	211	76	23	18	.....
30	242	407	1,390	337	226	76	23	42	.....
31	.....	360	.....	316	259	.....	42	.....	.....

NOTE.—These discharges are based on a rating curve constructed by the State engineer of Colorado and are published as received. Ice from Dec. 7 to 31. Discharge estimated to be equivalent to 28 second-feet daily.

Monthly discharge of Big Thompson Creek near Arkins, Colo., for 1909.

Month.	Discharge in second-feet.			Run-off (total in acre-feet.)
	Maximum.	Minimum.	Mean.	
April 17–30	337	50	139	3,860
May	551	182	370	22,800
June	1,740	337	1,190	70,800
July	1,740	316	786	48,300
August	627	196	265	16,300
September	627	76	198	11,800
October	76	23	55.1	3,390
November	58	8	37.6	2,240
December	42	28	28.5	1,750
The period				181,000

NOTE.—Discharge from Dec. 7 to 31 estimated.

CACHE LA POUDRE RIVER NEAR ELKHORN, COLO.

This station, which was established January 6, 1909, to determine the amount of water available for storage and power development, is located at the lower bridge at Fry's ranch, on the stage line 50 miles above Fort Collins, 7 miles above Elkhorn post office, and 20 miles below Chambers Lake.

Sheep Gulch comes in about a mile above the station, and Elkhorn Creek enters about 8 miles below. The drainage area is about 250 square miles, at elevations from 7,500 to 11,500 feet.

No water is diverted for irrigation above the station, but the North Grand ditch has been diverting water from the North Fork of Grand River into the Cache la Poudre, above the station, for a number of years, and the Chambers Lake reservoir has been used to regulate the flow for irrigation below. The proposed Roosevelt reservoir, which is to be used in connection with a power project, is located about 3 miles above the station and will have a capacity of 117,000 acre-feet, with a dam 231 feet high above the stream bed.

Discharge measurements at high and medium stages are made from the highway bridge, upon which the chain gage is located. Winter measurements are made through the ice.

The stream flow is affected by ice for several months each winter.

During 1909 frequent measurements were made by parties cooperating with the United States Geological Survey through George B. McFadden, an engineer of Denver, Colo. Computations of daily and monthly discharges have been made by engineers of the United States Geological Survey.

In developing rating curves for this station, the discharge measurements were considered in groups as the channel conditions are permanent, though rough. Owing to the erratic plotting of high-water measurements, the estimates for this period should be used with caution.

Discharge measurements of Cache la Poudre River near Elkhorn, Colo., in 1909.

[By N. W. Fry and H. Mertens.]

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*		*Feet.*	*Sec.-ft.*		*Feet.*	*Sec.-ft.*		*Feet.*	*Sec.-ft.*
Jan. 6	2.38	25	Apr. 1	2.39	40	June 17	6.75	1,970	Sept. 2	3.82	281
6	.....	29	2	2.39	43	18	6.80	2,570	3	3.63	225
7	2.09	25	3	2.20	35	19	7.30	3,110	4	3.58	227
8	2.08	27	4	2.26	35	20	6.77	2,700	5	3.61	223
9	2.15	32	5	2.27	33	21	6.77	2,530	6	3.69	256
10	2.22	36	6	2.36	42	22	6.76	2,400	7	4.31	469
17	2.19	34	7	2.35	42	23	6.68	1,980	8	4.19	376
18	2.16	33	8	2.35	40	24	6.73	1,920	9	4.13	341
19	2.13	32	9	2.37	44	25	6.82	2,300	10	3.93	290
20	2.15	36	10	2.36	46	26	6.85	2,470	11	3.81	281
21	2.10	30	11	2.39	39	27	6.80	2,580	12	3.70	241
22	2.17	34	12	2.15	28	28	6.76	2,490	13	3.66	215
23	2.20	35	13	2.25	33	29	6.85	2,240	14	3.60	204
24	2.29	32	14	2.10	22	30	6.96	2,220	15	3.63	191
25	2.25	32	15	2.16	26	July 1	6.93	2,010	16	3.49	181
26	2.21	35	16	2.25	30	2	6.68	1,960	17	3.40	173
27	2.13	28	17	2.35	43	3	6.40	1,750	18	3.32	145
28	2.11	30	18	2.46	52	4	6.36	1,820	19	3.28	147
29	2.45	22	19	2.50	54	5	6.43	1,900	20	3.20	132
30	2.90	35	20	2.40	49	6	6.38	1,880	21	3.24	135
31	2.75	31	21	2.34	44	7	6.24	1,370	22	3.21	133
Feb. 1	2.19	28	22	2.31	38	8	5.87	1,100	23	3.22	137
2	2.11	27	23	2.30	40	9	5.89	1,120	24	3.20	127
3	2.13	28	24	2.25	37	10	5.82	1,130	25	3.14	121
4	2.19	30	25	2.31	41	11	5.53	947	26	3.10	113
5	2.20	30	26	2.42	46	12	5.43	859	27	3.08	110
6	2.41	23	27	2.45	54	13	5.32	798	28	3.06	110
7	2.38	22	28	2.58	65	14	5.05	715	29	3.02	105
8	2.06	28	29	2.51	58	15	4.90	686	30	3.00	104
9	2.27	32	30	2.48	54	16	5.06	751	Oct. 1	2.98	111
10	2.27	32	May 1	2.61	64	17	4.95	703	2	2.91	101
11	2.05	28	2	2.50	55	18	5.02	695	3	2.87	106
12	2.05	27	3	2.42	47	19	5.03	750	4	2.86	98
13	2.07	29	4	2.48	51	20	5.05	733	5	2.90	94
14	2.10	23	5	2.70	72	21	4.86	688	6	2.89	93
15	2.11	27	6	2.81	96	22	4.73	633	7	3.03	111
16	2.10	27	7	2.92	108	23	4.70	604	8	2.99	109
17	2.10	28	8	3.05	120	24	5.07	777	9	2.87	103
18	2.13	29	9	2.94	112	25	4.80	646	10	3.04	112
19	2.17	33	10	3.10	152	26	4.67	647	12	2.91	99
20	2.30	30	11	3.30	178	27	4.66	639	13	2.92	94
21	2.13	30	12	3.41	190	28	4.65	595	14	2.90	93
22	2.10	27	13	3.32	191	29	4.55	486	15	2.90	98
23	2.12	26	14	3.29	182	30	4.50	522	16	2.86	89
24	2.38	35	15	3.38	179	31	4.33	432	17	2.86	92
25	2.25	35	16	3.43	200	Aug. 1	4.20	401	18	2.80	82
26	2.21	35	17	3.41	200	2	4.24	451	19	2.84	86
27	2.22	37	18	3.74	283	3	4.20	443	20	2.82	85
28	2.40	39	19	3.90	291	4	4.06	345	21	2.74	82
Mar. 1	2.71	63	20	4.03	342	5	3.97	316	22	2.75	78
2	2.25	41	21	4.18	458	6	3.96	319	23	2.73	79
3	2.21	34	22	4.34	494	7	4.04	344	24	2.70	68
4	2.15	32	23	4.63	622	8	4.00	332	25	2.69	68
5	2.20	32	24	4.48	545	9	4.09	360	26	2.70	70
6	2.27	36	25	4.18	457	10	3.98	319	27	2.72	78
7	2.20	28	26[a]	4.02	370	11	4.05	371	28	2.70	67
8	2.27	37	27	4.15	410	12	4.09	351	29	2.73	73
9	2.39	37	28	4.55	539	13	4.10	383	30	2.66	70
10	2.30	34	29	4.85	700	14	4.01	325	31	2.69	67
11	2.37	33	30	4.45	523	15	3.91	322	Nov. 1	2.68	72
12	2.15	27	31	4.45	530	16	3.82	283	2	2.67	65
13	2.28	35	June 1	4.30	490	17	4.30	478	3	2.70	69
14	2.26	35	2	4.50	561	18	4.82	683	4	2.72	69
15	2.39	40	3	4.95	747	19	4.40	521	5	2.72	70
16	2.76	73	4	5.30	988	20	4.10	385	6	2.68	66
17	2.63	62	5	5.80	1,376	21	3.97	348	7	2.67	63
18	2.35	39	6	5.85	1,482	22	3.90	341	8	2.47	39
19	2.22	30	7	6.70	1,917	23	3.82	294	9	2.56	49
20	2.46	48	8	6.80	2,116	24	3.78	280	10	2.60	54
21	2.30	35	9	6.65	2,076	25	3.72	250	11	2.63	48
22	2.15	27	10	6.64	1,864	26	3.61	228	12	2.59	48
23	2.25	30	11	6.27	1,611	27	3.60	210	15	2.63	46
24	2.20	33	12	6.03	1,437	28	3.69	257	16	2.58	35
25	2.27	38	13	6.08	1,480	29	3.57	224	17	2.70	46
26	2.30	38	14	6.36	1,686	30	3.57	199	18	2.70	54
27	2.20	35	15	6.35	1,680	31	3.62	231	19	2.61	52
31	2.30	36	16	6.35	1,610	Sept. 1	4.03	352	20	2.57	52

[a] Made by W. B. Freeman and N. W. Fry.

Discharge measurements of Cache la Poudre River near Elkhorn, Colo., in 1909—Contd.

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*		*Feet.*	*Sec.-ft.*		*Feet.*	*Sec.-ft.*		*Feet.*	*Sec.-ft.*
Nov. 21	2.60	53	Nov. 29	2.61	48	Dec. 13	2.58	37	Dec. 22	2.64	38
22	2.71	65	30	2.64	55	14	2.68	35	23	2.72	23
23	2.59	47	Dec. 1	2.53	43	15	2.78	30	27	2.82	31
24	2.57	47	2	2.63	51	16	2.78	35	28	2.59	25
25	2.53	44	8	3.13	35	17	2.67	34	29	2.76	26
26	2.50	41	9	3.07	50	18	2.73	43	30	2.60	25
27	2.49	40	11	3.14	34	19	2.92	27	31	2.59	25
28	2.47	39	12	2.80	34	21	2.78	31			

NOTE.—Measurements made under ice conditions January 6 to March 23 and November 8 to December 31.

Daily gage height, in feet, of Cache la Poudre River near Elkhorn, Colo., for 1909.

[Norman W. Fry, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	2.19	2.71	2.39	2.61	4.32	6.96	4.20	4.03	2.98	2.68	2.53
2	.....	2.11	2.25	2.39	2.50	4.48	6.71	4.24	3.82	2.91	2.67	2.63
3	.....	2.13	2.21	2.20	2.42	5.02	6.42	4.20	3.63	2.87	2.70	2.50
4	.....	2.19	2.15	2.26	2.48	5.38	6.39	4.06	3.58	2.86	2.72	2.84
5	.....	2.20	2.20	2.27	2.70	5.85	6.64	3.97	3.61	2.90	2.72	2.73
6	2.38	2.41	2.27	2.36	2.81	5.92	6.39	3.96	3.69	2.89	2.68	3.10
7	2.09	2.38	2.20	2.35	2.92	6.80	6.22	4.04	4.31	3.03	2.67	3.18
8	2.09	2.06	2.27	2.35	3.05	6.90	5.91	4.00	4.19	2.99	2.47	3.13
9	2.15	2.27	2.39	2.37	2.94	6.62	5.91	4.09	4.13	2.87	2.56	3.07
10	2.22	2.23	2.30	2.36	3.10	6.64	5.81	3.98	3.93	3.04	2.60	2.90
11	2.22	2.05	2.37	2.39	3.30	6.30	5.51	4.05	3.81	2.99	2.63	3.14
12	2.58	2.05	2.15	2.15	3.41	6.06	5.44	4.09	3.70	2.91	2.59	2.80
13	2.19	2.07	2.28	2.25	3.32	6.10	5.44	4.10	3.66	2.92	2.60	2.58
14	2.15	2.10	2.26	2.10	3.29	6.23	5.01	4.01	3.60	2.90	2.51	2.68
15	2.12	2.11	2.39	2.16	3.38	6.43	4.87	3.91	3.63	2.90	2.53	2.78
16	2.14	2.10	2.75	2.25	3.43	6.53	5.00	3.82	3.49	2.86	2.58	2.78
17	2.19	2.10	2.63	2.35	3.41	6.69	4.93	4.30	3.40	2.86	2.70	2.67
18	2.16	2.13	2.35	2.46	3.74	6.83	5.00	4.82	3.32	2.80	2.70	2.73
19	2.13	2.17	2.22	2.50	3.90	7.41	5.05	4.40	3.28	2.84	2.61	2.92
20	2.15	2.30	2.46	2.40	4.03	6.91	5.03	4.10	3.20	2.82	3.57	3.00
21	2.10	2.13	2.30	2.34	4.18	6.71	4.88	3.97	3.24	2.74	2.60	2.78
22	2.10	2.10	2.15	2.31	4.34	6.78	4.74	3.90	3.21	2.75	2.71	2.64
23	2.20	2.12	2.25	2.30	4.63	6.62	4.70	3.82	3.22	2.73	2.59	2.72
24	2.17	2.38	2.20	2.25	4.48	6.79	5.04	3.78	3.20	2.70	2.57	2.84
25	2.25	2.25	2.27	2.31	4.18	6.77	4.77	3.72	3.14	2.69	2.53	2.96
26	2.21	2.21	2.30	2.42	4.02	6.83	4.65	3.61	3.10	2.70	2.50	2.84
27	2.13	2.22	2.20	2.45	4.15	6.80	4.63	3.60	3.08	2.72	2.49	2.82
28	2.11	2.40	2.18	2.58	4.55	6.78	4.60	3.69	3.06	2.70	2.47	2.59
29	2.45	.....	2.15	2.51	4.85	6.86	4.51	3.57	3.02	2.73	2.61	2.76
30	2.90	.....	2.20	2.48	4.45	6.96	4.47	3.57	3.00	2.66	2.64	2.60
31	2.75	.....	2.30	.....	4.45	.....	4.31	3.62	.....	2.69	.....	2.59

NOTE.—Ice Jan. 6 to Mar. 23 and about Nov. 8 to Dec. 31.

Daily discharge, in second-feet, of Cache la Poudre River near Elkhorn, Colo., for 1909.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	28	28	63	42	64	468	2,430	420	360	108	72	43
2	28	27	41	42	53	536	2,140	436	291	99	71	51
3	28	28	34	29	45	796	1,840	420	238	94	74	48
4	28	30	32	33	51	1,000	1,810	371	225	93	76	46
5	28	30	32	33	74	1,320	2,060	340	232	98	76	43
6	27	23	36	40	87	1,380	1,810	336	252	97	72	40
7	25	22	28	39	100	2,240	1,380	364	464	114	71	38
8	27	28	37	39	118	2,360	1,150	350	416	109	39	35
9	32	32	37	41	103	2,040	1,150	382	396	94	49	50
10	36	32	34	40	125	2,060	1,090	343	326	116	54	42

Daily discharge, in second-feet, of Cache la Poudre River near Elkhorn, Colo., for 1909— Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
11	36	28	33	42	161	1,720	901	368	288	109	48	34
12	35	27	27	27	184	1,490	862	382	255	99	48	34
13	35	29	35	32	165	1,530	862	385	245	100	47	37
14	35	23	35	25	159	1,650	715	354	230	98	47	35
15	35	27	40	27	178	1,850	686	318	238	98	46	30
16	34	27	73	32	189	1,950	751	291	203	93	35	35
17	34	28	62	39	184	2,120	703	460	182	93	46	34
18	33	29	39	49	267	2,280	695	695	165	86	54	43
19	32	33	30	53	315	2,980	750	500	157	91	52	27
20	36	30	48	43	360	2,370	733	385	143	88	52	29
21	30	30	35	38	413	2,140	688	340	150	79	53	31
22	34	27	27	36	476	2,220	655	315	145	80	65	38
23	35	26	30	35	604	2,040	635	291	147	78	47	23
24	32	35	29	32	536	2,230	807	279	143	74	47	25
25	32	35	33	36	413	2,210	670	261	132	73	44	27
26	35	35	35	45	357	2,280	612	232	125	74	41	29
27	28	37	29	48	402	2,240	604	230	122	76	40	31
28	30	39	28	61	568	2,220	590	252	119	74	39	25
29	22	.....	27	54	710	2,310	550	222	113	78	48	26
30	35	.....	29	51	522	2,430	532	222	110	70	55	25
31	31	.....	35	.....	522	.....	464	235	.....	73	.....	25

NOTE.—Discharges estimated Jan. 1 to 5; Jan. 6 to Mar. 23; July 14 to July 21; Nov. 8 to Dec. 31, discharges obtained from measurements. The remaining discharges are based on a rating curve which is well defined below 785 second-feet, July 7 to 13 a high water curve parallel to first.

Monthly discharge of Cache la Poudre River near Elkhorn, Colo., for 1909.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
January	36	22	31.5	1,940	A.
February	39	22	29.5	1,640	A.
March	73	27	36.5	2,240	A.
April	61	25	39.4	2,340	A.
May	710	45	274	16,800	A.
June	2,980	468	1,880	112,000	C.
July	2,430	464	1,010	62,100	C.
August	695	222	348	21,400	A.
September	464	110	220	13,100	A.
October	116	70	90.5	5,560	A.
November	76	35	53.6	3,190	A.
December	51	23	34.8	2,140	A.
The year	2,980	22	338	244,000	

CACHE LA POUDRE RIVER NEAR FORT COLLINS, COLO.

This station, which was established January 8, 1909, to determine the amount of water available for storage, irrigation, and power development, is situated about 1,000 feet below the Fort Collins waterworks intake, 16 miles above Fort Collins, and 500 yards above the mouth of the North Fork of the Cache la Poudre.

Practically no water is diverted from the main stream or its tributaries above the station, with the exception of that taken for the Fort Collins water supply. The station is below all tributaries above the North Fork.

Discharge measurements are taken from a cable about 120 yards downstream from the vertical rod gage, which is driftbolted to a cliff on the left bank, and which has remained constant. Winter and low-water measurements are made by wading.

Ice affects the gage heights for several months each winter.

All of the ordinary flow and a considerable proportion of the flood waters have been filed upon for irrigation below, but if the flood waters are stored opportunities for power development will be afforded.

The proposed Elkhorn reservoir, the dam for which is to be located 2 miles below the mouth of Elkhorn Creek, will have a capacity of 113,000 acre-feet, with a dam 400 feet high; and the proposed Stove Prairie reservoir, located 8 miles above the gaging station, will have a capacity of 26,500 acre-feet with a dam 200 feet high.

During 1909 frequent measurements were made by parties cooperating with the United States Geological Survey through George B. McFadden, an engineer of Denver, Colo. Computations of daily and monthly discharges have been made by engineers of the United States Geological Survey. In developing the rating table for this station the discharge measurements were considered in groups, as the channel conditions are permanent, though rough.

Discharge measurements of Cache la Poudre River near Fort Collins, Colo., in 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Jan. 8[a]	W. B. Freeman	34	33.2	2.50	47.7
May 27	do	75	167	4.02	622
Aug. 31	G. H. Russell	68	96	3.15	313
Sept. 14	do	68	96	3.15	268
Oct. 23	do	53	60	2.30	104
Nov. 11	do	64	53	2.15	83.0

[a] Made through ice.

Discharge measurements of Cache la Poudre River near Fort Collins, Colo., in 1909.

[By F. E. Epperly and F. H. Stearley.]

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*		*Feet.*	*Sec.-ft.*		*Feet.*	*Sec.-ft.*		*Feet.*	*Sec.-ft.*
Jan. 9	2.42	38.5	Jan. 28	2.30	44.9	Feb. 20	2.27	34.7	Mar. 9	2.20	59.6
14	2.70	52.8	31	2.34	28.0	21	2.44	55.2	12	2.02	38.6
15	2.72	59.9	Feb. 1	2.52	62.7	23	2.62	36.8	13	2.22	62.7
16	2.62	59.8	2	2.50	56.4	24	2.62	43.0	14	2.22	59.4
17	2.54	56.6	3	2.40	48.4	25	2.54	41.7	15	2.22	60.1
18	2.52	50.8	4	2.34	44.7	26	2.52	43.3	16	2.24	74.7
19	2.50	52.0	5	2.34	44.6	27	2.54	41.8	17	2.04	49.6
20	2.42	49.5	6	2.00	21.5	28	2.52	43.7	18	2.10	55.9
21	2.34	48.6	7	2.30	33.8	Mar. 1	2.54	47.8	19	2.10	58.7
22	2.32	53.3	11	2.40	43.1	2	2.62	42.9	20	2.02	44.8
23	2.32	58.6	12	2.32	37.7	3	2.50	63.7	21	2.10	58.9
24	2.20	34.9	15	2.42	42.4	4	2.30	60.2	22	2.14	57.4
25	2.10	29.2	16	2.34	39.0	5	2.20	48.0	23	2.10	60.8
26	2.22	38.0	18	2.40	43.2	6	2.02	53.9	24	2.30	87.5
27	2.30	46.8	19	2.32	42.3	8	2.02	53.5	25	2.30	86.4

Discharge measurements of Cache la Poudre River near Fort Collins, Colo., in 1909— Continued.

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*		*Feet.*	*Sec.-ft.*		*Feet.*	*Sec.-ft.*		*Feet.*	*Sec.-ft.*
Mar. 26	2.26	84.2	May 15	3.40	347.0	Sept. 28	2.60	137.0	Nov. 15	2.00	60.5
28	2.22	60.8	16	3.50	400.0	29	2.60	142.0	16	2.00	60.4
29	2.10	61.6	17	3.50	374.0	30	2.60	148.0	17	2.22	54.1
30	2.22	59.7	18	3.66	447.0	Oct. 1	2.55	155.0	18	2.30	93.8
31	2.22	59.2	19	3.75	484.0	2	2.50	144.0	19	2.30	79.2
Apr. 1	2.30	87.7	20	3.95	554.0	3	2.50	147.0	20	2.20	82.8
2	2.30	88.3	21	4.10	637.0	4	2.50	137.0	21	2.20	83.2
3	2.36	99.7	22	4.18	689.0	5	2.50	146.0	22	2.20	84.9
4	2.48	117.0	23	4.43	816.0	6	2.50	147.0	23	2.20	81.6
5	2.46	121.0	25	4.10	659.0	7	2.59	165.0	24	2.20	80.5
6	2.30	92.0	26	4.00	575.0	8	2.59	161.0	25	2.15	78.2
7	2.30	91.2	27	4.16	650.0	9	2.55	172.0	26	2.15	78.4
8	2.28	92.6	28	4.48	842.0	10	2.50	146.0	27	2.20	74.7
9	2.39	114.0	29	4.70	1,010.0	11	2.50	154.0	28	2.00	67.9
10	2.46	128.0	30	4.40	800.0	12	2.50	154.0	29	2.10	66.8
12	2.36	113.0	June 16	6.15	2,040.0	13	2.47	146.0	30	2.10	66.5
13	2.40	110.0	July 10	5.30	1,420.0	14	2.50	154.0	Dec. 1	2.20	92.9
14	2.44	129.0	Aug. 17	3.66	408.0	15	2.49	130.0	2	2.10	78.2
15	2.44	130.0	21	3.45	472.0	16	2.45	130.0	3	2.10	78.3
16	2.54	154.0	22	3.40	407.0	17	2.45	130.0	4	1.70	26.2
17	2.67	157.0	23	3.33	375.0	18	2.40	128.0	5	1.65	11.8
19	2.75	161.0	24	3.30	370.0	19	2.39	124.0	6	1.95	18.1
20	2.69	170.0	25	3.30	337.0	20	2.37	116.0	7	2.05	27.1
21	2.63	144.0	26	3.20	309.0	21	2.38	122.0	8	2.20	35.2
22	2.56	106.0	27	3.10	266.0	22	2.31	107.0	9	2.10	32.3
23	2.60	143.0	28	3.25	290.0	23	2.30	103.0	10	2.95	79.0
24	2.60	132.0	29	3.12	251.0	24	2.30	106.0	11	3.00	83.4
25	2.65	154.0	Sept. 8	3.65	492.0	25	2.27	82.0	12	3.35	66.9
26	2.73	184.0	9	3.50	411.0	26	2.30	77.4	13	3.10	81.5
27	2.90	208.0	10	3.50	400.0	27	2.22	81.6	14	2.95	69.2
28	2.99	255.0	11	3.65	487.0	28	2.20	77.3	15	2.95	65.8
29	2.98	249.0	12	3.30	321.0	29	2.20	80.8	16	2.70	60.5
30	2.77	174.0	13	3.20	292.0	30	2.20	77.7	17	2.60	53.5
May 1	2.70	160.0	14	3.15	267.0	31	2.20	78.3	18	2.45	44.2
2	2.73	167.0	15	3.10	264.0	Nov. 1	2.20	75.6	19	2.53	47.8
3	2.74	169.0	16	3.00	249.0	2	2.20	85.9	20	2.25	38.3
4	2.83	176.0	17	2.95	254.0	3	2.20	83.2	21	2.20	38.1
5	3.04	245.0	18	2.95	217.0	4	2.20	83.3	22	2.25	41.0
6	3.07	257.0	19	2.80	195.0	5	2.20	74.2	23	2.30	38.8
7	3.19	277.0	20	2.80	192.0	6	2.20	75.0	24	2.40	37.4
8	3.26	319.0	21	2.80	177.0	7	2.20	81.9	25	2.70	54.3
9	3.16	294.0	22	2.80	185.0	8	2.17	78.7	26	2.65	53.0
10	3.30	329.0	23	2.80	175.0	10	2.15	69.4	27	2.65	51.5
11	3.52	400.0	24	2.70	171.0	11	2.17	66.2	28	2.65	53.6
12	3.60	453.0	25	2.70	177.0	12	2.15	56.9	29	2.60	55.4
13	3.47	369.0	26	2.70	173.0	13	2.15	58.1	30	2.60	54.3
14	3.41	370.0	27	2.70	167.0	14	2.05	58.7	31	2.65	52.8

NOTE.—Discharge measurements made under ice conditions January 9 to March 16, and December 4 to 13.

Daily gage height, in feet, of Cache la Poudre River near Fort Collins, Colo., for 1909.

[Fred Stearley, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	2.5	2.5	2.3	2.75	4.2	6.8	3.65	3.2	2.5	2.2	2.2
2	.....	2.5	2.5	2.3	2.8	4.4	6.7	3.6	3.1	2.5	2.2	2.1
3	.....	2.35	2.5	2.35	2.8	4.7	6.6	3.6	3.2	2.5	2.2	2.05
4	.....	2.3	2.3	2.5	2.85	5.1	6.75	3.6	3.2	2.5	2.2	1.7
5	.....	2.3	2.2	2.45	3.05	5.85	6.45	3.5	3.2	2.5	2.2	1.7
6	.....	2.1	2.0	2.3	3.1	6.25	6.35	3.5	3.2	2.5	2.2	2.0
7	.....	2.15	2.0	2.3	3.2	6.65	6.05	3.5	3.7	2.6	2.2	2.1
8	2.5	2.2	1.85	2.3	3.3	7.0	5.7	3.6	3.65	2.55	2.2	2.25
9	2.45	2.0	2.0	2.4	3.15	6.75	5.5	3.5	3.5	2.55	2.2	2.25
10	2.45	2.15	2.05	2.45	3.3	6.55	5.2	3.4	3.5	2.5	2.15	2.9
11	2.4	2.35	2.15	.....	3.55	6.3	5.0	3.5	3.6	2.5	2.15	3.05
12	2.25	2.3	1.9	2.35	3.65	5.7	4.9	3.6	3.3	2.5	2.15	3.3
13	2.5	2.3	2.1	2.4	3.55	6.0	4.7	3.65	3.2	2.5	2.1	3.05
14	2.7	2.3	2.0	2.45	3.45	6.25	4.6	3.55	3.15	2.5	2.05	2.95
15	2.7	2.4	2.0	2.45	3.45	6.3	4.4	3.3	3.1	2.5	2.0	2.9

Daily gage height, in feet, of Cache la Poudre River near Fort Collins, Colo., for 1909—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
16	2.6	2.3	2.1	2.55	3.5	6.1	4.4	3.2	3.0	2.45	2.05	2.7
17	2.55	2.3	2.0	2.65	3.55	6.7	4.4	3.7	2.95	2.45	2.2	2.55
18	2.5	2.4	2.15	2.8	3.65	7.4	4.35	4.3	2.95	2.4	2.3	2.45
19	2.5	2.3	2.05	2.75	3.8	7.9	4.65	3.95	2.8	2.4	2.3	2.45
20	2.4	2.1	2.05	2.7	3.95	7.9	4.60	3.75	2.8	2.4	2.2	2.2
21	2.35	2.4	2.15	2.7	4.2	7.1	4.5	3.5	2.8	2.4	2.2	2.2
22	2.3	2.3	2.1	2.6	4.25	7.0	4.35	3.45	2.8	2.3	2.2	2.25
23	2.3	2.45	2.05	2.6	4.5	7.05	4.25	3.2	2.8	2.3	2.2	2.35
24	2.2	2.55	2.3	2.6	4.3	7.45	4.35	3.3	2.75	2.3	2.2	2.45
25	2.2	2.5	2.25	2.65	4.1	7.35	4.3	3.3	2.7	2.25	2.15	2.7
26	2.3	2.5	2.3	2.75	4.0	7.1	4.2	3.2	2.7	2.3	2.15	2.65
27	2.3	2.45	2.25	2.9	4.1	6.95	4.2	3.1	2.7	2.25	2.1	2.6
28	2.35	2.45	2.2	3.0	4.4	7.0	3.95	3.25	2.66	2.2	2.0	2.65
29	2.05	.....	2.15	3.0	4.65	6.85	3.8	3.15	2.6	2.2	2.1	2.6
30	2.15	.....	2.2	2.8	4.4	6.85	3.75	3.0	2.6	2.2	2.1	2.6
31	2.4	.....	2.2	.....	4.3	.....	.....	3.75	.....	2.2	.....	2.7

NOTE.—Ice effect at intervals Jan. 1 to Mar. 16 and Dec. 4 to 31.

Daily discharge, in second-feet, of Cache la Poudre River near Fort Collins, Colo., for 1909.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	45	63	48	95	177	696	2,840	454	292	127	81	81
2	45	56	43	95	188	805	2,740	434	264	127	81	68
3	45	48	64	102	188	992	2,640	434	292	127	81	62
4	45	45	60	127	200	1,260	2,780	434	292	127	81	26
5	45	45	48	118	250	1,900	3,480	395	292	127	81	12
6	45	22	54	95	264	2,280	2,380	395	292	127	81	18
7	45	34	55	95	292	2,680	2,080	395	475	146	81	27
8	48	30	54	95	324	3,040	1,760	434	454	136	81	35
9	38	30	60	110	278	2,780	1,580	395	395	136	81	32
10	35	30	60	118	324	2,580	1,340	358	395	127	74	79
11	30	43	60	110	414	2,340	1,190	395	434	127	74	83
12	25	38	39	102	454	1,760	1,120	434	324	127	74	67
13	45	40	63	110	414	2,040	992	454	292	127	68	82
14	53	40	59	118	376	2,280	928	414	278	127	62	69
15	60	42	60	118	376	2,340	805	324	264	127	57	66
16	60	39	68	136	395	2,140	805	292	237	118	62	60
17	57	40	57	156	414	2,740	805	475	224	118	81	54
18	51	43	74	188	454	3,440	777	749	224	110	95	44
19	52	42	62	177	517	3,940	960	582	188	110	95	48
20	50	35	62	166	582	3,940	928	496	188	110	81	38
21	49	55	74	166	696	3,140	865	395	188	110	81	38
22	53	40	68	146	722	3,040	777	376	188	95	81	41
23	59	37	62	146	865	3,080	722	292	188	95	81	39
24	35	43	95	146	749	3,480	777	324	177	95	81	37
25	29	42	88	156	646	3,380	749	324	166	88	74	54
26	38	43	95	177	604	3,140	696	292	166	95	74	53
27	47	48	88	212	646	2,980	696	264	166	88	68	52
28	45	44	81	237	805	3,040	582	308	146	81	57	54
29	35	.....	74	237	960	2,880	560	278	146	81	68	55
30	30	.....	81	188	805	2,880	517	237	146	81	68	54
31	28	.....	81	.....	749	.....	496	292	.....	81	.....	53

NOTE.—These discharges were obtained as follows:
Jan. 1 to Mar. 16 and Dec. 4 to 31, actual measurements or estimated from measurements.
Mar. 17 to Dec. 3, from a well-defined rating curve.

Monthly discharge of Cache la Poudre River near Fort Collins, Colo., for 1909.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
January	60	.....	44.1	2,710	A.
February	63	22	41.3	2,290	A.
March	95	39	65.7	4,040	A.
April	237	95	141	8,390	A.
May	960	177	488	30,000	A.
June	3,940	696	2,570	153,000	A.
July	3,480	496	1,300	79,900	A.
August	749	237	391	24,000	A.
September	475	146	259	15,400	A.
October	146	81	113	6,950	A.
November	95	57	76.2	4,530	A.
December	83	12	51.0	3,140	A.
The year	3,940	12	462	334,000	

LOUP RIVER BASIN.

DESCRIPTION.

The Loup and its branches, which form the most important tributaries of the Platte below the forks, drain an area 13,540 square miles in extent, lying in the heart of Nebraska. The Loup proper is formed by the junction of North and Middle Loup rivers, which unite near the city of St. Paul, the middle Loup in turn receiving the south Loup in the southwestern part of Howard County. The principal tributaries are Beaver, Cedar, Calamus, and Dismal creeks. A comparatively small amount of water is diverted for irrigation, the ditches generally being small and covering limited areas. A number of power plants are in operation and others of considerable extent have been proposed, particularly one near Columbus, by which it is believed that about 20,000 continuous horsepower may be developed. On Loup River the flow was probably lowest in 1895.

LOUP RIVER AT COLUMBUS, NEBR.

This station, which was established October 13, 1894, is located at the highway bridge in the outskirts of Columbus and about 3 miles above the mouth of the river, in sec. 25, T. 17 N., R. 1 W.

The records show the total discharge of the river at its mouth, and are valuable in connection with power development. They show also the remarkably uniform flow of the stream. A comparatively small amount of water is diverted for irrigation.

Records have usually been suspended during the winter months on account of the severe ice conditions.

Measurements at this station are rough at best, owing to the soft and constantly shifting bed and the high and uneven velocity. Gage heights are only an approximate index of discharge, as the swift current changes the channel very rapidly, and at least one measurement a week would be required to give even fairly good results.

No daily discharges have been computed for 1909, as any computation based on the data at hand would be misleading, and a fair idea of the discharge can be obtained from the discharge measurements. Two gages have been used at this station: A chain gage at the highway bridge has been used since 1904; and a staff gage at the former cable location, 1½ miles above, was used prior to that time. The datum of the staff gage is 8.56 feet above the present gage datum. Otherwise, no changes in datum have been made. Discharge measurements are being made from the highway bridge to which the gage is attached.

Discharge measurements of Loup River at Columbus, Nebr., in 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Mar. 13	G. W. Bates	300	645	4.60	3,340
20	A. A. Dobson	360	712	4.55	2,800
Apr. 13	do	870	714	4.55	3,010
May 8	do	870	788	4.68	2,370
July 8	do	850	1,210	4.79	6,640
Aug. 31	do	412	742	4.55	1,850
Oct. 22	do	530	917	4.57	2,660
Nov. 5	do	650	902	4.77	2,290

Daily gage height, in feet, of Loup River at Columbus, Nebr., for 1909.

[W. D. Benson, observer.]

Day.	Jan.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	4.5	.....	4.45	4.75	.....	4.55	5.05	4.5	4.65	4.7	.....
2	4.4	.....	4.35	4.55	4.85	4.55	4.85	4.75	4.65	4.8	4.75
3	4.45	.....	4.4	4.2	4.7	4.65	5.35	4.8	4.65	4.75	4.4
4	4.55	6.35	4.5	4.3	4.8	4.75	5.3	4.9	4.7	4.7	5.8
5	.....	6.3	4.5	4.45	4.8	4.9	4.95	4.85	4.7	4.55	4.0
6	.....	5.55	.....	4.45	4.7	6.65	4.85	5.8	4.7	4.65	3.8
7	4.45	5.2	4.65	4.6	4.85	5.15	4.7	5.05	4.75	4.75	4.65
8	.....	4.8	4.5	4.35	.....	4.8	4.65	4.9	4.8	4.8	4.55
9	.....	4.65	4.55	4.6	4.85	.....	4.6	4.85	4.9	4.6	4.7
10	.....	.....	4.65	4.6	4.75	5.1	4.6	4.85	5.05	4.55	4.85
11	.....	4.6	4.4	4.65	4.85	5.55	4.75	4.75	4.00	4.5	4.9
12	.....	4.75	4.35	4.6	4.9	5.6	4.65	4.75	4.75	4.5	4.9
13	.....	4.6	4.45	4.45	4.8	5.1	4.6	4.85	4.75	4.8	4.95
14	.....	4.7	4.4	4.0	4.8	4.7	4.8	4.85	4.5	5.05	5.0
15	.....	4.6	4.35	4.9	4.75	4.65	4.9	4.85	4.5	.....	5.0
16	.....	4.5	4.35	4.75	4.75	4.7	5.05	4.7	4.55	5.0	5.7
17	5.75	4.4	4.5	4.85	4.5	4.6	4.8	4.75	4.5	4.8	5.65
18	.....	4.45	4.45	4.7	4.6	4.6	4.7	4.7	4.55	4.45	5.7
19	.....	.....	4.4	4.7	4.5	4.55	4.65	4.65	4.5	4.4	5.2
20	.....	4.55	4.45	4.65	4.5	4.4	4.7	4.6	4.45	4.55	5.2
21	6.2	4.55	4.45	4.7	4.95	4.4	4.6	4.7	4.4	5.2	5.25
22	6.4	4.5	4.55	4.7	4.6	4.4	4.5	4.65	4.45	5.15	5.2
23	6.7	4.5	4.45	4.7	4.75	4.4	4.5	4.7	4.5	4.85	5.15
24	6.5	4.55	4.45	4.65	.....	4.45	4.45	4.75	4.6	4.8	5.1
25	6.3	4.6	4.45	6.35	4.95	4.6	4.45	4.65	4.55	4.8	5.1
26	.....	4.4	4.45	5.5	4.75	4.7	4.45	4.6	4.45	4.8	5.15
27	6.75	5.5	4.5	4.9	4.65	4.9	4.45	4.6	4.55	4.75	.....
28	.....	4.35	4.55	4.8	4.55	4.7	4.5	4.6	4.6	4.65	.....
29	.....	4.45	4.45	4.85	4.65	4.65	4.6	4.6	4.6	.....	.....
30	.....	4.45	4.9	4.85	4.5	4.65	4.6	4.6	4.6	4.65	.....
31	.....	4.45	.....	4.9	.....	4.7	4.5	.....	4.7	.....	.....

NOTE.—Ice Jan. 7 to Mar. 3 and Dec. 27–31.

KANSAS RIVER DRAINAGE BASIN.

DESCRIPTION.

The drainage basin of Kansas River lies between the basins of the Platte and the Arkansas, entirely within the region of the Great Plains. The Kansas as such is a comparatively short stream, being formed by the union of Smoky Hill and Republican rivers in Geary County, Kans., whence it flows eastward, entering the Missouri at Kansas City, Mo.

The Smoky Hill rises near the boundary between Kansas and Colorado, pursues a winding but on the whole easterly course through Kansas, and near Junction unites with the Republican. Its length is 335 miles and the extreme width of its basin is about 100 miles. The river runs close to the northern border of the Arkansas basin, and its chief tributaries are from the north. Solomon and Saline rivers are the most important, the former draining the northern part of Kansas and the latter the territory between the Solomon and the Smoky Hill.

Republican River rises in the arid plains of eastern Colorado, flows northeastward into southwestern Nebraska, then eastward through the southern tier of counties to Superior, where it turns to the southeast, enters Kansas, and finally joins the Smoky Hill. The length of the basin east and west is approximately 360 miles, its greatest width is 120 miles, and the total area drained is 25,840 square miles. The river is wide and rather shallow, with a rapid descent, and the bed is largely shifting quicksand of the most unstable character. In its upper course the Republican receives many tributaries, chiefly from the south. Nearly all of these flow through a region where the rainfall is less than 22 inches, but as this part of the basin is covered with buffalo grass, which sheds rain like a roof, the per cent of rainfall reaching the streams is great. Near the mouth the drainage area is very narrow and the tributaries are small and unimportant, but here the rainfall is 28 to 30 inches a year. Many small springs are found along the main stream and its branches, and the ground water generally lies at medium depth. The soil of the middle part of the basin is porous, sandy loam, and about 55 per cent of the land is under cultivation; along the lower course the soil is black loam and clay, and about 75 per cent of the land is cultivated. The rainfall in the lower basin is considered sufficient for all growing crops. The Republican is subject to sudden rises and falls and occasionally overflows its banks.

The most important feeder of the Kansas below the junction of Smoky Hill and Republican rivers is the Blue, which rises in southeastern Nebraska, flows to the southeast and south into Kansas, and joins Kansas River at Manhattan. The principal tributary of the

Blue is the Little Blue, which rises in southern Nebraska, flows southeastward, and unites with the main stream near Blue Rapids.

The basin of the Kansas comprises the richest portion of the State of Kansas, consists of bottoms and rolling uplands, well timbered with oak, cottonwood, ash, elm, hickory, etc. The section is under a high state of cultivation and produces a great variety of crops. The river flows through a rich alluvial bottom land. The banks are sandy and easily cave in. In places the bed contains rock and bowlders, but in general it is composed of sand and at many points of quicksand. The channel as a rule hugs one bank or the other and is somewhat shifting. Islands are formed here and there by the deposit of sediment during high water, drift lodges upon them, and a thick growth of brush, mainly cottonwood, soon springs up. At Topeka the river is 900 feet wide between banks. At ordinary low water the channel occupies 150 to 200 feet of this width and has a depth of 8 to 9 feet; at mean high water the average depth is probably 10 feet for the entire distance between banks.

REPUBLICAN RIVER AT BOSTWICK, NEBR.

This station, which is located at a highway bridge 1 mile north of Bostwick, Nebr., in sec. 23, T. 1 N., R. 8 W., was established June 6, 1904, to replace the station at Superior, Nebr., which had been maintained from 1896 to 1903. Records at this point show the amount of water carried by the river at the Nebraska-Kansas State line, and are of value in connection with irrigation above and flood control below.

No records have been obtained during the winter period. No storage is used on the stream to reduce floods or to reenforce the low-water flow, so that the variation in discharge is great. Owing to the unstable condition of the stream bed the records are more or less unsatisfactory.

The chain gage has remained the same since the establishment of the station. It is fastened to the bridge from which discharge measurements are made.

Discharge measurements of Republican River at Bostwick, Nebr., in 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Mar. 26	A. A. Dobson	315	440	1.95	794
Apr. 13	do	870	714	4.55	3,010
17	do	.....	302	1.66	572
June 24	do	2,400	962	3.60	2,450
July 23	do	310	239	1.56	386
Sept. 16	do	200	165	1.12	206
Nov. 20	do	290	208	1.47	382

Daily gage height, in feet, of Republican River at Bostwick, Nebr., for 1909.

[Jos. W. Keifer, observer.]

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	2.0	1.45	2.0	2.1	1.45	0.65	1.3	1.2	1.85
2	.....	1.95	1.5	2.0	2.0	1.25	2.15	1.3	2.0	1.75
3	.....	1.9	1.5	2.0	4.5	2.25	2.1	1.25	1.55	1.75
4	.....	1.9	1.5	1.75	3.0	2.0	1.45	1.2	1.35	1.7
5	.....	1.9	1.5	1.85	3.15	1.65	1.25	1.15	1.3	1.8
6	.....	1.85	1.45	1.7	4.45	1.4	1.05	1.1	1.25	.....
7	2.0	1.85	1.45	2.0	3.5	1.25	1.0	1.1	1.2	1.8
8	2.0	1.85	1.45	4.3	2.95	1.2	.95	1.2	1.2	1.8
9	2.0	1.85	1.45	2.4	2.15	1.15	1.0	1.25	1.3	.....
10	1.9	1.8	1.4	2.65	2.05	1.05	1.0	1.2	1.3	.....
11	1.9	1.85	1.4	2.3	5.1	1.15	1.0	1.1	1.3	.....
12	1.75	1.85	1.35	2.6	4.0	1.4	1.0	1.1	1.25	.....
13	1.9	1.8	1.3	2.4	3.25	1.2	1.1	1.05	1.5	.....
14	1.9	(a)	1.35	2.4	3.05	1.1	1.2	1.05	1.5	.....
15	1.8	(a)	1.4	3.4	2.9	1.05	1.25	1.05	1.45	.....
16	1.8	(a)	1.5	3.6	2.4	1.0	1.1	1.05	1.3	.....
17	1.8	1.7	1.3	3.35	2.15	1.45	1.0	1.0	1.2	.....
18	1.8	1.65	1.35	3.25	2.0	1.05	1.0	1.0	1.2	.....
19	1.9	1.6	1.3	2.9	1.9	1.05	1.9	1.0	1.4	.....
20	1.9	1.6	1.3	2.65	1.75	.95	5.85	1.05	1.45	.....
21	1.9	1.6	1.25	2.55	1.7	.85	4.35	1.05	1.45	.....
22	1.8	1.6	1.2	4.15	1.6	.85	3.2	1.1	1.5	.....
23	1.8	1.65	1.2	4.95	1.5	.75	2.85	1.1	1.45	.....
24	2.0	1.65	1.2	3.6	1.5	.7	2.0	1.1	1.45	.....
25	1.95	1.65	1.3	4.0	1.45	.65	1.75	1.15	1.5	.....
26	2.0	1.6	1.25	3.05	1.45	.65	1.6	1.1	1.6	.....
27	1.95	1.6	3.75	2.65	1.4	1.4	1.5	1.1	1.7	.....
28	2.0	1.6	3.2	3.1	1.4	1.1	1.45	1.1	1.85	.....
29	2.2	1.6	2.75	2.35	1.35	.9	1.4	1.05	1.85	.....
30	2.1	1.55	2.35	2.15	1.45	.7	1.35	1.1	1.85	.....
31	2.0	.....	2.15	.....	1.95	.7	.....	1.15	.....	.....

a Gage out of order; flood.

NOTE.—Ice probably from Jan. 1 to Mar. 6; ice Dec. 5 to 31, 6 inches thick on Dec. 7.

Daily discharge, in second-feet, of Republican River at Bostwick, Nebr., for 1909.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	640	360	805	800	348	65	270	230	605
2	.....	590	385	805	720	250	845	270	720	535
3	.....	515	385	805	3,590	940	800	250	405	535
4	.....	495	385	790	1,740	720	348	230	295	500
5	.....	480	400	670	1,900	468	250	212	270	570
6	.....	420	375	550	3,520	320	178	195	250	.....
7	865	400	375	805	2,320	250	160	195	230	.....
8	865	380	375	3,480	1,680	230	145	230	230	.....
9	860	370	375	1,230	845	212	160	250	270	.....
10	765	325	350	1,500	760	178	160	230	270	.....
11	765	335	350	1,130	4,410	212	160	195	270	.....
12	645	315	325	1,440	2,940	320	160	195	250	.....
13	765	280	300	1,230	2,020	230	195	178	375	.....
14	765	(a)	325	1,230	1,800	195	230	178	375	.....
15	670	(a)	350	2,360	1,630	178	250	178	348	.....
16	670	(a)	400	2,610	1,100	160	195	178	270	.....
17	670	600	300	2,300	845	348	160	160	230	.....
18	670	480	325	2,180	720	178	160	160	230	.....
19	755	440	300	1,780	640	178	640	160	320	.....
20	755	440	300	1,500	535	145	5,480	178	348	.....
21	750	440	280	1,390	500	115	3,400	178	348	.....
22	660	440	270	3,240	435	115	1,960	195	375	.....
23	660	480	270	4,300	375	88	1,580	195	348	.....
24	840	480	270	2,440	375	75	720	195	348	.....
25	795	480	320	2,940	348	65	535	212	375	.....

a Flood.

Daily discharge, in second-feet, of Republican River at Bostwick, Nebr., for 1909—Contd.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
26	835	440	295	1,800	348	65	435	195	435	.....
27	755	440	2,740	1,360	320	320	375	195	500	.....
28	770	440	2,060	1,850	320	195	348	195	605	.....
29	930	440	1,560	1,040	295	130	320	178	605	.....
30	710	410	1,140	845	348	75	295	195	605	.....
31	675	.....	945	.....	680	75	.....	212	.....	.....

NOTE.—The discharges from Mar. 7 to June 23 were obtained by the indirect method for shifting channels. Discharges June 24 to Dec. 8 were obtained from a rating curve that is fairly well defined between 65 and 2,600 second-feet.

Monthly discharge of Republican River at Bostwick, Nebr., for 1909.

[Drainage area, 23,300 square miles.]

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
March 7–31	930	660	755	0.032	0.03	37,400	C.
April	640	280	444	.019	.02	23,800	D.
May	2,740	270	555	.024	.03	34,100	C.
June	4,300	550	1,680	.072	.08	100,000	C.
July	4,410	295	1,250	.054	.06	76,900	B.
August	940	65	238	.010	.01	14,600	B.
September	5,480	65	690	.030	.03	41,100	B.
October	270	160	201	.0086	.01	12,400	B.
November	720	230	358	.015	.02	21,300	B.
December 1–5	605	500	549	.024	.004	5,440	B.
The period	.....	.....	.....	.....	.....	367,040	

LITTLE BLUE RIVER NEAR FAIRBURY, NEBR.

This station, which is located at the highway bridge 1½ miles south of Fairbury and about 12 miles above the Nebraska-Kansas State line, was established May 23, 1908, to obtain data for use in studies of run-off and flood control and in power development. A chain gage, the datum of which has remained constant, is fastened to the bridge, from which discharge measurements are made.

Sandy Creek, the principal tributary, enters about 10 miles above. Muddy Creek, a small stream, is the only tributary between the station and the Kansas line.

The dam of the Fairbury roller mill is about 2 miles above the station, and may possibly cause some daily fluctuation in stage.

Gage heights are apparently little affected by ice.

Records have been fairly satisfactory, though the channel shifts at high stages. The maximum discharges are somewhat uncertain, as the river overflows its banks at about 11 feet gage height. The amount of overflow has been estimated.

Discharge measurements of Little Blue River near Fairbury, Nebr., in 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Feb. 25[a]	G. W. Bates	90	201	3.96	329
Mar. 31	do	80	113	3.00	202
Apr. 24[b]	A. A. Dobson	75	102	2.91	171
May 22	do	84	186	3.65	372
June 10	do	.....	127	10.85	3,310
July 16	do	110	669	4.69	1,250
23	do	55	118	3.20	207
Sept. 16	do	90	205	3.80	387
Nov. 11	D. D. Price	70	112	3.10	188

[a] Fine slush ice running. [b] Wind strong across stream.

Daily gage height, in feet, of Little Blue River near Fairbury, Nebr., for 1909.

[Fred Borland, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.6	3.5	3.5	3.0	2.9	3.2	4.0	3.2	2.6	3.2	2.8	4.5
2	2.75	3.5	3.35	3.0	2.8	3.4	4.7	4.3	4.4	3.2	2.9	7.9
3	2.9	3.1	3.25	3.0	2.8	3.3	3.4	3.4	3.1	3.1	4.2	7.7
4	3.0	3.25	3.15	2.9	2.8	3.2	3.4	3.2	9.2	3.1	4.8	5.8
5	3.0	3.25	3.1	2.9	2.8	3.5	8.2	3.0	7.5	3.0	4.1	3.9
6	3.0	3.3	3.0	3.0	2.8	3.4	11.5	3.0	6.0	3.0	4.0	4.0
7	3.0	3.2	3.0	2.9	2.8	3.5	8.8	3.9	6.0	3.0	3.6	3.8
8	3.0	3.15	3.0	2.9	2.8	12.3	8.9	3.9	5.8	3.0	3.3	3.9
9	3.0	3.15	3.0	3.0	2.8	11.0	8.1	3.8	3.8	4.0	3.2	4.0
10	3.2	3.2	2.95	2.8	2.7	10.9	9.5	3.9	3.5	4.0	3.2	4.2
11	3.2	3.2	2.95	3.0	2.8	6.3	6.0	3.8	3.6	4.0	3.1	4.1
12	3.2	3.3	2.95	2.9	2.8	5.2	6.0	3.6	4.9	3.2	3.1	3.9
13	3.2	3.3	2.95	2.9	2.8	5.0	5.6	3.6	5.3	3.2	4.7	3.6
14	3.4	3.3	2.95	2.8	2.9	4.5	5.3	2.7	5.2	3.1	7.9	3.5
15	3.4	3.35	2.95	3.0	3.7	4.0	4.7	2.6	4.5	3.2	7.7	3.7
16	3.4	3.35	2.95	2.9	4.6	4.3	4.6	2.6	5.4	3.0	5.8	3.5
17	3.5	2.95	2.95	2.9	4.5	4.0	4.1	2.6	5.2	3.0	4.5	4.1
18	3.5	2.9	3.0	2.9	5.45	3.6	3.8	2.6	3.2	3.2	4.0	4.1
19	3.5	3.0	3.0	2.9	7.6	3.4	3.6	2.6	3.2	3.2	3.9	4.0
20	3.5	3.0	2.95	2.9	4.0	3.2	3.6	2.6	3.4	3.2	3.8	4.1
21	2.9	3.0	2.95	2.8	3.5	3.0	3.5	2.6	3.4	3.0	3.6	4.0
22	2.95	3.0	2.95	2.9	4.0	5.3	3.4	2.6	5.3	3.0	3.6	3.9
23	2.95	3.0	2.95	2.9	4.1	12.6	3.4	2.6	5.1	3.0	3.6	3.8
24	2.95	3.9	3.0	2.9	3.0	7.7	3.2	2.6	5.2	3.1	3.6	3.7
25	3.0	3.9	3.3	2.9	4.45	6.5	3.2	2.6	4.8	2.9	3.5	3.8
26	3.0	3.8	3.2	2.8	5.8	6.3	3.2	2.6	4.0	2.9	3.4	3.8
27	3.0	3.7	3.1	2.9	3.8	5.3	3.2	2.6	3.7	3.0	3.4	3.9
28	3.0	3.65	3.3	2.8	3.5	4.5	3.1	2.6	3.7	.....	4.8	3.7
29	3.5	.....	2.95	2.8	3.4	4.0	3.1	2.6	3.4	.....	5.9	3.7
30	3.5	.....	2.9	2.9	3.4	4.5	3.1	2.6	3.2	2.8	4.7	3.8
31	3.5	.....	2.9	.....	3.8	.....	3.1	2.6	.....	2.8	.....	3.6

NOTE.—Ice conditions Jan. 5 to 20, Jan. 29 to Feb. 2, and Feb. 10 to 16.

Daily discharge, in second-feet, of Little Blue River near Fairbury, Nebr., for 1909.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	150	190	255	190	180	210	330	210	150	210	170	480
2	165	190	232	190	170	240	540	425	450	210	180	2,390
3	180	200	218	190	170	225	240	240	200	200	400	2,220
4	190	218	205	180	170	210	270	210	3,650	200	575	990
5	190	218	200	180	170	255	2,890	190	2,060	190	375	330
6	190	225	190	190	170	240	8,200	190	1,090	190	350	350
7	190	210	190	180	170	255	3,740	330	1,090	190	270	310
8	190	205	190	180	170	9,550	3,990	330	990	190	225	330
9	190	205	190	190	170	4,780	3,200	310	310	350	210	350
10	180	180	185	170	160	3,380	5,200	330	255	350	210	400

Daily discharge, in second-feet, of Little Blue River near Fairbury, Nebr., for 1909—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
11	180	180	185	190	170	470	1,650	310	270	350	200	375
12	180	180	185	180	170	300	1,750	270	610	210	200	330
13	180	180	185	180	170	230	1,570	270	770	210	540	270
14	180	180	185	170	180	180	1,450	160	730	200	2,390	255
15	180	180	185	190	290	130	1,170	150	480	210	2,220	290
16	180	180	185	180	510	180	1,200	150	810	190	990	255
17	180	185	185	180	480	150	710	150	730	190	480	375
18	180	180	190	180	830	130	580	150	210	210	350	375
19	180	190	190	180	2,140	120	400	150	210	210	330	350
20	180	190	195	180	350	110	270	150	240	210	310	375
21	180	190	195	170	255	100	255	150	240	190	270	350
22	185	190	195	180	350	450	240	150	770	190	270	330
23	185	190	195	180	375	8,300	240	150	690	190	270	310
24	185	330	190	180	190	1,680	210	150	730	200	270	290
25	190	330	225	180	465	1,010	210	150	575	180	255	310
26	190	310	210	170	990	960	210	150	350	180	240	310
27	190	290	200	180	310	580	210	150	290	190	240	330
28	190	280	225	170	255	350	200	150	290	180	575	290
29	190	.....	185	170	240	290	200	150	240	180	1,040	290
30	190	.....	180	180	240	430	200	150	210	170	540	310
31	190	.....	180	.....	310	.....	200	150	.....	170	.....	270

NOTE.—Discharges June 9 to July 19 were obtained by the indirect method for shifting channels. Discharges for the balance of the year were obtained from a rating curve that is well defined between 180 and 2,100 second-feet. Discharges Jan. 10 to 20, Jan. 29 to Feb. 2, and 10 to 16, estimated.

Monthly discharge of Little Blue River near Fairbury, Nebr., for 1909.

Month.	Discharge in second-feet.			Run-off (total in acre-feet.)	Accuracy.
	Maximum.	Minimum.	Mean.		
January	.....	150	183	11,300	D.
February	330	.....	213	11,800	D.
March	255	180	197	12,100	B.
April	190	170	180	10,700	B.
May	2,140	160	354	21,800	C.
June	9,550	100	1,180	70,200	D.
July	8,200	200	1,350	83,000	D.
August	425	150	204	12,500	B.
September	3,650	150	656	39,000	C.
October	350	170	209	12,900	B.
November	2,390	170	498	29,600	C.
December	2,390	270	477	29,300	C.
The year	9,550	100	479	344,000	

GASCONADE RIVER DRAINAGE BASIN.

DESCRIPTION.

The drainage basin of the Gasconade lies in the south-central part of Missouri. The river is formed by Piney, Lock, and Osage forks and Roubidoux Creek, which rise in southern Missouri and flow northward to unite in Laclede and Pulaski counties. From the junction of the forks to the point where the Gasconade enters the Missouri the distance by general course is about 60 miles, but including the windings it is probably more than 100 miles. The total area of the basin is about 3,500 square miles.

The headwater region comprises an area of regular outline, about 65 miles long by 45 miles wide, forming part of an elevated tableland belonging to the Ozark Range of hills, and along the streams the surface is very rough and broken. The lower part of the basin, below Arlington, is long and narrow, its average width for a distance of about 55 miles being less than 15 miles. Below Vienna the valley averages about half a mile in width and is bordered by bluffs 100 to 200 feet high. Throughout the lower section the river flows in a succession of shoals and pools. On the shoals the stream bed is usually gravel, but the pools contain considerable deposits of sand and mud. Depth to rock beneath the stream bed is estimated at 10 to 30 feet. The rocks along the stream are chiefly limestone and sandstone.

The sources of the river are from 1,400 to 1,600 feet above sea level. At Arlington the elevation is about 650 feet and at the mouth of the river it is about 490 feet above the sea.

Above the junction of the forks the drainage basin is partly forested, but below that point it may be considered a deforested region. The mean annual rainfall is about 40 inches. The winters are mild. Facilities for storage have not been investigated.

The basin contains a great number of springs, some of those in the upper part being very large, and these springs help to maintain the low-season flow of the river. The streams offer fair opportunities for power development. As the main river is very crooked, it may be possible in some localities to shorten it by cutting across the narrow necks and to utilize the fall thus developed. Some of the tributaries may offer sites with good heads, as the slope of the tributaries is much greater than that of the main stream.

The Gasconade is subject to sudden floods, reaching approximately 25 feet above low water.

PINEY FORK OF GASCONADE RIVER NEAR HOUSTON, MO.

This station, which is located about 3½ miles northwest of Houston, Mo., was established October 7, 1908, to obtain data for use in connection with water-power development. The station was discontinued June 30, 1909.

Brushy Creek enters about 200 feet above the station. The low-water flow is modified by a power plant a short distance above the station.

The datum of the chain gage, which is located 50 feet below the measuring section, has remained unchanged.

Measurements are made by means of a boat and cable or by wading in low water.

Daily gage height, in feet, of Piney Fork of Gasconade River near Houston, Mo., for 1909.

[G. A. Stewart, observer.]

Day.	Jan.	Apr.	May.	June.	Day.	Jan.	Apr.	May.	June.	Day.	Jan.	Apr.	May.	June.
1	.....	.....	.....	6.12	11	4.98	.....	7.88	5.47	21	6.32	10.00	.....	6.28
2	.....	.....	6.09	6.10	12	.....	.....	7.18	5.48	22	6.40	16.09	.....	6.30
3	4.98	.....	6.08	6.12	13	.....	.....	6.78	5.48	23	6.48	16.06	7.01	6.27
4	4.98	.....	6.08	6.10	14	.....	7.92	6.72	5.48	24	6.46	.....	7.05	6.26
5	4.94	.....	6.07	6.11	15	.....	7.93	6.66	5.46	25	6.46	.....	7.32	6.23
6	4.88	.....	6.04	.....	16	.....	7.93	6.60	.....	26	6.46	.....	7.17	.....
7	4.89	.....	5.90	.....	17	.....	7.90	5.92	10.56	27	.....	.....	7.12	.....
8	.....	.....	5.92	6.06	18	.....	7.90	5.84	6.60	28	.....	.....	.....	.....
9	.....	.....	16.04	6.02	19	6.29	8.01	5.85	6.48	29	.....	.....	.....	.....
10	4.94	.....	8.60	.....	20	6.30	8.08	5.85	.....	30	.....	.....	6.15	.....
										31	.....	.....	6.15	.....

MISCELLANEOUS MEASUREMENTS.

The miscellaneous measurements made in the Missouri River basin in 1909 are presented in the following pages. They have been listed under drainage basins in the same order as the regular stations.

Miscellaneous measurements in Missouri River basin.

Missouri River proper.

Date.	Stream.	Tributary to—	Locality.	Gage height.	Discharge.
				Feet.	*Sec.-ft.*
Nov. 17	Missouri River	Mississippi River[a]	Kansas City, Mo.	[b] 17.40	171,000
Nov. 23	do	do	do	[b] 11.09	76,000

Musselshell River basin.

June 6	Poplar Creek	Musselshell River	Martinsdale, Mont.	.....	4.9

Yellowstone River basin.

Sept. 16	Yellowstone River	Missouri River	Billings, Mont.	.....	7,790
10	Sweetgrass Creek	Yellowstone River	In canyon 8 miles above upper gaging station on Sweetgrass Creek.	.....	25.2
Feb. 2	North Fork of Little Wind River.	Little Wind River	Wyoming	.....	42
Mar. 1	Tongue River	Yellowstone River	Dayton, Wyo.	.....	50
2	do	do	do	.....	45

[a] At Hannibal Railway bridge, near foot of Broadway.
[b] Gage on bridge. Stages are referred to St. Louis directrix, which is 303.3 feet below the zero of the gage.

Miscellaneous measurements in Missouri River basin—Continued.

Cheyenne River basin.

Date.	Stream.	Tributary to—	Locality.	Gage height.	Discharge.
				Feet.	*Sec.-ft.*
Sept. 19	Castle Creek	Rapid River	Near E. line NE. ¼ sec. 12, T. 1 N., R. 3 E., B. H. M., S. Dak.		32.6
19	do	do	do		28
19	do	do	do		25
24	do	do	do		29
24	do	do	do		28
19	do	do	NE. ¼ of NW. ¼ sec. 7, T. 1 N., R. 4 E., B. H. M., S. Dak.		31
19	do	do	Near N. line SW ¼ sec. 8, T. 1 N., R. 4 E., B. H. M., S. Dak.		30
19	do	do	do		28

North Platte River basin.

Aug. 7	North Platte River	Platte River	½ mile below head of Lucerne Canal, Fort Laramie, Wyo.		6,980
Sept. 4	do	do	do		1,900
29	do	do	do		2,120
July 3	Medicine Bow River	North Platte River	Medicine Bow, Wyo.		1,790
6	do	do	do		2,300
Mar. 24	Horse Creek	do	Nebraska–Wyoming State line.		56.3
20	Spotted Tail Creek	do	Sec. 10, T. 23 N., R. 56 W., Nebr.		7.4

Platte River basin.

June 8	Middle Loup River	Loup River	St. Paul, Nebr.		1,210

South Platte River basin.

Mar. 23	South Platte River	Platte River	North Platte, Nebr.		814
Jan. 2	North Fork of South Platte River.	South Platte River	Grant, Colo		7.4
28	do	do	do		5.4
Apr. 12	do	do	do		7.1
10	do	do	do	[a] 1.85	4.4
30	do	do	do	[a] 1.48	7.4
June 13	do	do	do	[a] 1.20	
July 5	do	do	do	[a] .95	
May 30	Geneva Creek	North Fork of South Platte River.	Continental dam site above Scott Gomer Creek, Geneva Park, Colo.		68
Aug. 17	Jackwhacker Creek	Geneva Creek	At mouth, Grant, Colo.		5.9
July 5	Duck Lake Creek	do	100 feet below outlet of Duck Lake.		16.1
5	do	do	2 miles below outlet of Duck Lake.		26.4
Aug. 16	Scott Gomer Creek	do	Geneva Power Co.'s dam site, Grant, Colo.	2.50	52.5
7	Threemile Creek (or Gold Run).	do	Sullivan's Ranch, Colo.		[b] 6
16	do	do	do		[b] 50
Sept. 4	do	do	do		13.5
Dec. 6	do	do	do		[b] 2.0
Aug. 19	Cook Creek	North Fork of South Platte River.	½ mile east of Shawnee, Colo.		[a] 4.5
19	Crow Creek	do	Baileys, Colo		[a] 2.0
19	Deer Park Creek	do	Above Crossons, Colo		[a] 50
Dec. 7	do	do	Crossons, Colo		[a] 7

[a] Distance of water surface below reference mark on downstream stringer near left edge.
[b] Estimated.

Miscellaneous measurements in Missouri River basin—Continued.

South Platte River basin—Continued.

Date.	Stream.	Tributary to—	Locality.	Gage height.	Discharge.
				Feet.	*Sec.-ft.*
Aug. 19	Elk Creek	North Fork of South Platt River.	Shaffers Crossing, Colo.		a 4.0
Dec. 7	do	do	Pine Grove, Colo.		a 2
Aug. 17	Buffalo Creek	do	Buffalo Creek, Colo.		14.6
May 5	Plum Creek	South Platte River	Castle Rock, Colo.		a 7.0
Aug. 19	Turkey Creek	Bear Creek	4 miles north of Conifer, Colo.		a 1.0
20	do	do	Morrison, Colo		a .5
20	North Fork of Turkey Creek.	Turkey Creek	At mouth		a .5
Feb. 7	Cherry Creek	South Platte River	Country Club, Denver, Colo.		a 4
Mar. 14	do	do	do		a 1.5
May 5	do	do	At bridge near Union Station, Denver, Colo.		a 2
9	do	do	do		a 8
Aug. 9	Left Hand Creek	St. Vrain Creek	Altona, Colo	1.50	55
July 16	do	do	do	1.75	90
Jan. 7	North Fork of Cache la Poudre.	Cache la Poudre	Livermore, Colo.		33

Minor Missouri River drainage basins in Nebraska.

May 5	Weeping Water Creek	Missouri River	Weeping Water, Nebr.		8.6

Kansas River basin.

Mar. 29	Republican River	Kansas River	Cambridge, Nebr.		439
29	Medicine Creek	Republican River	do		48.5
29	do	do	do		56.9
Mar. 30	Cook Creek	Republican River	Alma, Nebr.		.4
30	Prairie Dog Creek	do	6 miles south of Alma, Nebr.		3.0
30	Methodist Creek	Prairie Dog Creek	Alma, Nebr.		1.4

a Estimated.

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