DEPARTMENT OF THE INTERIOR
JOHN BARTON PAYNE, Secretary

UNITED STATES GEOLOGICAL SURVEY
GEORGE OTIS SMITH, Director

Water-Supply Paper 456

SURFACE WATER SUPPLY OF THE UNITED STATES

1917

PART VI. MISSOURI RIVER BASIN

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Prepared in cooperation with the
STATES OF COLORADO, MONTANA, WYOMING, AND KANSAS

WASHINGTON
GOVERNMENT PRINTING OFFICE
1921

CONTENTS.

ILLUSTRATIONS.

SURFACE WATER SUPPLY OF MISSOURI RIVER BASIN, 1917.

AUTHORIZATION AND SCOPE OF WORK.

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

The data presented in these reports were collected by the United States Geological Survey under the following authority contained in the organic law (20 Stat. L., p. 394):

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

The work was begun in 1888 in connection with special studies relating to irrigation in the arid West. Since the fiscal year ending June 30, 1895, successive sundry bills passed by Congress have carried the following item and appropriations:

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

Annual appropriation for the fiscal years ending June 30, 1895–1918.

1895	$12,500
1896	20,000
1897 to 1900, inclusive	50,000
1901 to 1902, inclusive	100,000
1903 to 1906, inclusive	200,000
1907	150,000
1908 to 1910, inclusive	100,000
1911 to 1917, inclusive	150,000
1918	175,000

In the execution of the work many private and State organizations have cooperated either by furnishing data or by assisting in collecting data. Acknowledgments for cooperation of the first kind are made in connection with the description of each station affected; cooperation of the second kind is acknowledged on page 11.

Measurements of stream flow have been made at about 4,240 points in the United States and also at many points in Alaska and the Hawaiian Islands. In July, 1917, 1,180 gaging stations were being maintained by the Survey and the cooperating organizations. Many mis-

cellaneous discharge measurements are made at other points. In connection with this work data were also collected in regard to precipitation, evaporation, storage reservoirs, river profiles, and water power in many sections of the country and will be made available in water-supply papers from time to time. Information in regard to publications relating to water resources is presented in the appendix to this report.

DEFINITION OF TERMS.

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

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

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

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

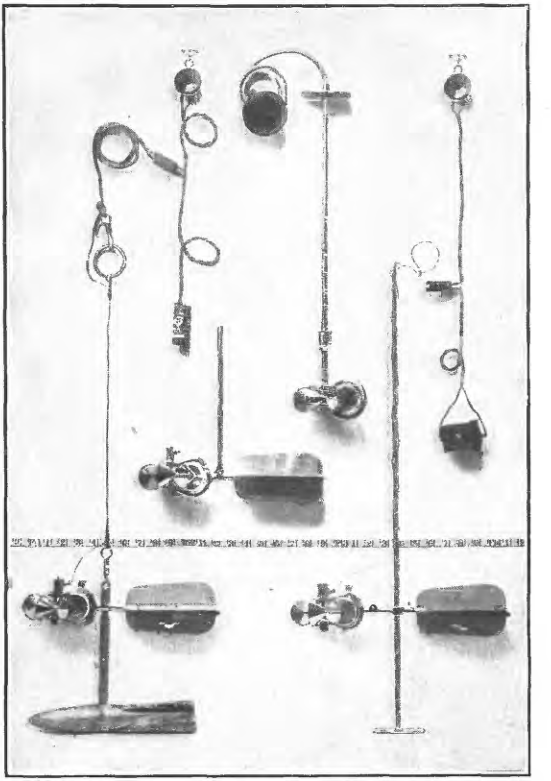
An "acre-foot," equivalent to 43,560 cubic feet, is the quantity required to cover an acre to the depth of 1 foot. The term is commonly used in connection with storage for irrigation.

The following terms not in common use are here defined:

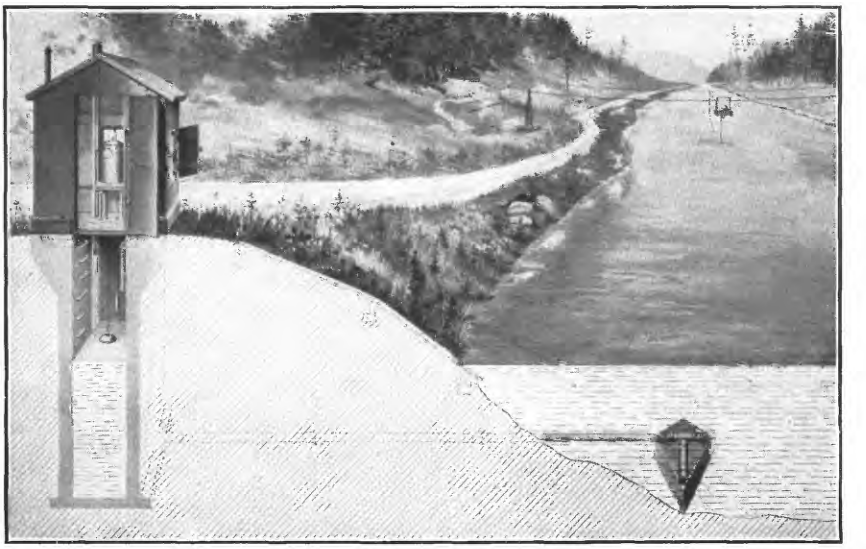
"Stage-discharge relation," an abbreviation for the term "relation of gage height to discharge."

"Control," a term used to designate the section or sections of the stream below the gage which determine the stage-discharge relation at the gage. It should be noted that the control may not be the same section or sections at all stages.

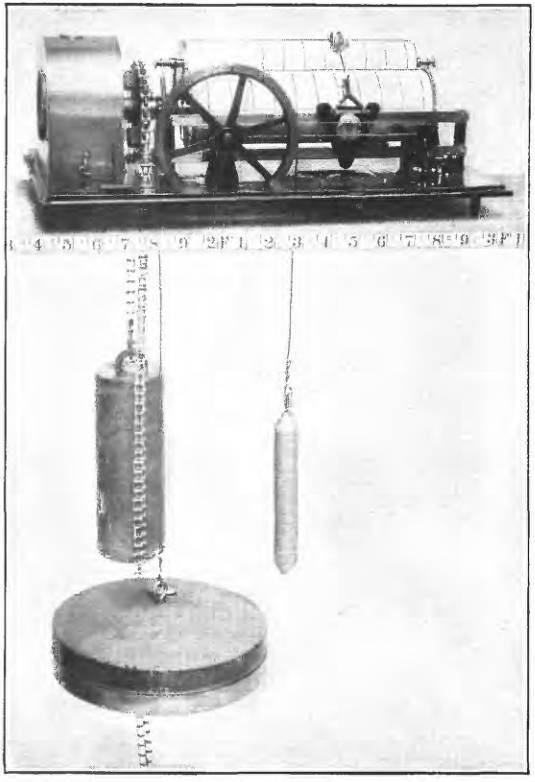
The "point of zero flow" for a given gaging station is that point on the gage—the gage height—to which the surface of the river would fall if there were no flow.



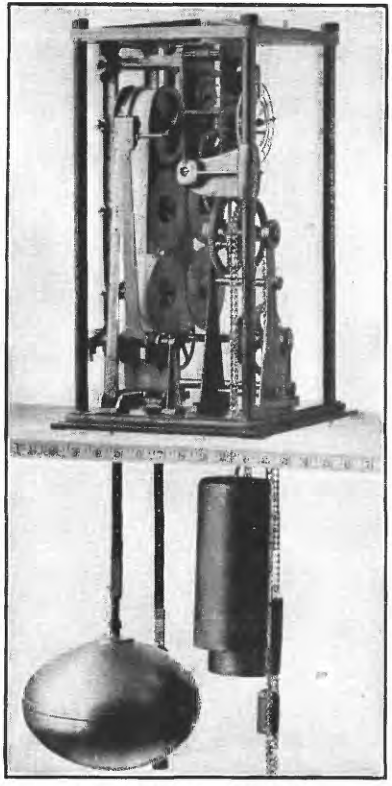
A. PRICE CURRENT METERS.



B. TYPICAL GAGING STATION.



A. STEVENS CONTINUOUS.



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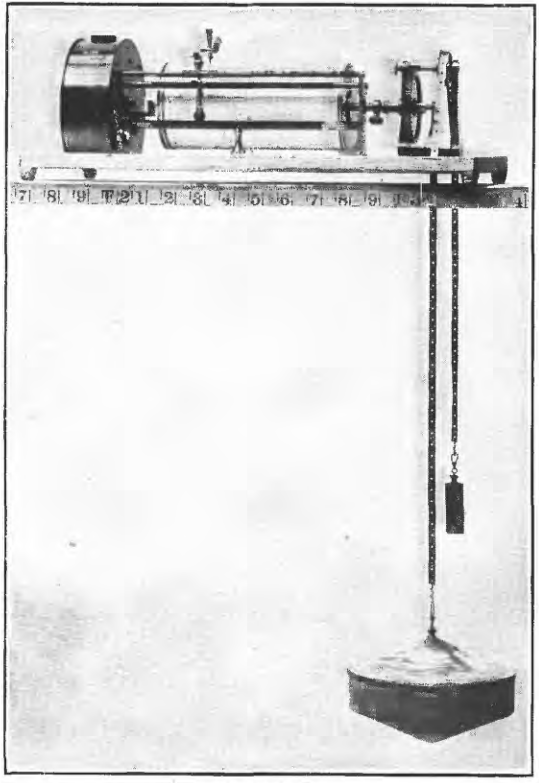

C. FRIEZ.

WATER-STAGE RECORDERS.

EXPLANATION OF DATA.

The data presented in this report cover the year beginning October 1, 1916, and ending September 30, 1917. At the beginning of January in most parts of the United States much of the precipitation in the preceding three months is stored as ground water in the form of snow or ice, or in ponds, lakes, and swamps, and this stored water passes off in the streams during the spring break-up. At the end of September, on the other hand, the only stored water available for run-off is possibly a small quantity in the ground; therefore the run-off for the year beginning October 1 is practically all derived from precipitation within that year.

The base data collected at gaging stations consist of records of stage, measurements of discharge, and general information used to supplement the gage heights and discharge measurements in determining the daily flow. The records of stage are obtained either from direct readings on a staff gage or from a water-stage recorder that gives a continuous record of the fluctuations. Measurements of discharge are made with a current meter. (See Pls. I, II.) The general methods are outlined in standard textbooks on the measurement of river discharge.

From the discharge measurements rating tables are prepared that give the discharge for any stage, and these rating tables, when applied to the gage heights, give the discharge from which the daily, monthly, and yearly mean discharge is determined.

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

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

The description of the station gives, in addition to statements regarding location and equipment, information in regard to any conditions that may affect the constancy of the stage-discharge relation, covering such subjects as the occurrence of ice, the use of the stream for log driving, shifting of control, and the cause and effect of backwater. It gives also information as to diversions that decrease the flow at the gage, artificial regulation, maximum and minimum recorded stages, and the accuracy of the records.

The table of daily discharge gives, in general, the discharge in second-feet corresponding to the mean of the gage heights read each day. At stations on streams subject to sudden or rapid diurnal fluctuation the discharge obtained from the rating table and the

mean daily gage height may not be the true mean discharge for the day. If such stations are equipped with water-stage recorders, the mean daily discharge may be obtained by averaging discharge at regular intervals during the day, or by using the discharge integrator, an instrument operating on the principle of the planimeter and containing as an essential element the rating curve of the station.

In the table of monthly discharge the column headed "Maximum" gives the mean flow for the day when the mean gage height was highest. As the gage height is the mean for the day, it does not indicate correctly the stage when the water surface was at crest height, and the corresponding discharge was consequently larger than given in the maximum column. Likewise, in the column headed "Minimum," the quantity given is the mean flow for the day when the mean gage height was lowest. The column headed "Mean" is the average flow in cubic feet for each second during the month. On this average flow computations recorded in the remaining columns, which are defined on page 8, are based.

ACCURACY OF FIELD DATA AND COMPUTED RESULTS.

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

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

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

The monthly means for any station may represent with high accuracy the quantity of water flowing past the gage, but the figures showing discharge per square mile and depth of run-off in inches may be subject to gross errors caused by the inclusion of large non-contributing districts in the measured drainage area, by lack of information concerning water diverted for irrigation or other use, or by inability to interpret the effect of artificial regulation of the flow of the river above the station. "Second-feet per square mile" and "Run-off (depth in inches)" are therefore not computed if such

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

errors appear probable. The computations are also omitted for stations on streams draining areas in which the annual rainfall is less than 20 inches. All figures representing "second-feet per square mile" and "run-off (depth in inches)" previously published by the Survey should be used with caution because of possible inherent sources of error not known to the Survey.

The table of monthly discharge gives only a general idea of the flow at the station and should not be used for other than preliminary estimates. The tables of daily discharge allow more detailed studies of the variation in flow. It should be borne in mind, however, that the observations in each succeeding year may be expected to throw new light on data previously published.

COOPERATION.

Much of the work in Montana has been carried on 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. The legislature of the State of Montana made an appropriation for stream-gaging work, which was expended by the State engineer, as provided in the act, 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 was expended largely on work in connection with the several Carey projects in Montana and in computing data on water-right filings and adjudications. A State hydrographer was employed who worked directly with the Geological Survey.

The expense of work on the Crow Reservation in Montana, the Standing Rock Reservation in North and South Dakota, and the Pine Ridge and Rosebud Reservations in South Dakota was borne by the Office of Indian Affairs.

Officials of the Yellowstone National Park have furnished valuable hydrometric and climatic data and paid a large part of the expense of work in the park.

All stations in Wyoming were maintained in cooperation with the State, through Mr. J. B. True, State engineer.

The United States Reclamation Service paid for the maintenance of the stations on North Platte River above Pathfinder, Wyo., and on Sage Creek above Pathfinder.

The Laramie Water Co. furnished gage-height records for the following stations: Laramie River and Pioneer canal near Woods; Laramie River at Two Rivers; Laramie River near Lookout; Laramie River below McGill; and Little Laramie River at Two Rivers.

The Rock Creek Conservation Co., through Mr. Frank C. Bosler, furnished field data for stations on Rock and Deep creeks near Arlington, Wyo. The United States Forest Service furnished gage-height records for Big Creek near Big Creek. The Hawk Springs Development Co., through Mr. J. A. Whiting, furnished record of gage heights and provided transportation necessary to obtain data for the station on Horse Creek near La Grange, Wyo.

The L. Z. Leiter estate, through Mr. J. C. Beebe, manager, furnished gage-height records for station at Ucross, Wyo, and a number of discharge measurements at several stations. Gage-height records were also furnished as follows: The Buffalo Manufacturing Co., for Clear Creek near Buffalo; the Swan Land & Cattle Co., for Chugwater Creek at Chugwater; the Wyoming Irrigation Co. for Shell Creek at Shell, Wyo.

Messrs. Johnson and Cronberg furnished gage-height records and other assistance in connection with the station on Medicine Bow River near Medicine Bow, Wyo., and Mr. F. H. Richards assisted in like manner in obtaining the record at the station on Muddy Creek near Shirley.

Records were furnished by the State engineer of Colorado for Laramie River near Jelm, Wyo., and by the North Laramie Land Co. for North Laramie River near Wheatland, Wyo.

The Farmers' Reservoir & Irrigation Co. furnished the gage-height records and paid for the maintenance of the station on Clear Creek near Golden, Colo. The State engineer paid the gage observers at the following stations in Colorado: South Platte River at South Platte; North Fork of South Platte River at Grant and at South Platte; and Geneva Creek at Grant. The Tarryall Canal & Reservoir Co. paid the expense of maintaining the station on Tarryall Creek near Jefferson, Colo.

In South Dakota the State engineer, Dr. H. M. Derr, paid the observer's salary at the station on Cheyenne River near Hot Springs.

The stations in Kansas were maintained in cooperation with the Kansas Water Commission.

DIVISION OF WORK.

Data for stations in the upper Missouri River basin in Montana and North Dakota were collected and prepared for publication under the direction of W. A. Lamb, district engineer, who was assisted by E. F. Chandler, A. H. Tuttle, R. F. Edwards, and Lois H. Hershner, and by C. S. Heidel, State hydrographer for Montana.

Data relating to tributaries of Missouri River in Colorado, South Dakota, and Wyoming were collected and prepared for publication under the direction of Robert Follansbee, district engineer, who was assisted by S. B. Soulé, H. W. Fear, P. V. Hodges, H. K. Smith, and Miss Jane Hanna.

Data for two stations in the Yellowstone National Park were collected and prepared for publication under the direction of G. C. Baldwin, district engineer, who was assisted by C. G. Paulsen and E. Hazel Haugse.

Data for stations in Kansas were collected and prepared for publication by R. C. Rice, district engineer.

GAGING-STATION RECORDS.

MISSOURI RIVER PROPER.

RED ROCK CREEK BELOW RED ROCK RESERVOIR, NEAR MONIDA, MONT.

LOCATION.—In sec. 32, T. 13 S., R. 6 W., at weir 150 yards below reservoir of Red Rock Reservoir & Irrigation Co., 8 miles northeast of Monida and 15 miles east of Lima, in Beaverhead County.

DRAINAGE AREA.—560 square miles.

RECORDS AVAILABLE.—July 22, 1911, to September 30, 1917; also miscellaneous measurements made in summer of 1910.

GAGE.—Stage determined by measuring with graduated rod the depth on a peg in concrete well set with its top at elevation of crest of weir. Observations made by P. V. Maxwell. Float gage in concrete well used in 1912 and 1913. During 1911 a temporary vertical staff on left bank 300 yards below dam was read. Gage heights beginning with those for 1912 indicate head on crest of 40-foot weir 150 yards below dam.

DISCHARGE MEASUREMENTS.—Made from footbridge 40 feet above weir or by wading.

CHANNEL AND CONTROL.—Bed composed of coarse gravel, pebbles, and boulders. Banks high; right bank is subject to overflow only during extremely high water. Current so swift at high stages that channel above weir, if cleaned out, soon becomes partly filled with rocks and pebbles, which cause considerable velocity of approach. Stage-discharge relation seldom changes after natural deposit has been allowed to rest undisturbed.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 2.8 feet at 6 p. m. May 13 and 8 a. m. May 14 (discharge, 1,080 second-feet; minimum stage recorded, 0.66 foot August 28-31, and September 1-3 and 6-9 (discharge, 75 second-feet).

1911-1917: Maximum stage recorded, 3.2 feet April 28, 1914 (discharge, 1,220 second-feet); minimum stage recorded, 0.10 foot January 1 to April 10, 1913 (discharge, 5 second-feet).

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

DIVERSIONS.—None.

REGULATION.—Dam is used to store flood waters which are released as required during irrigating season.

ACCURACY.—Stage-discharge relation practically permanent both before and after weir was cleaned July 11–13, a change occurring at that time. Rating curve used to July 11 well defined between 200 and 500 second-feet; rating curve used after July 13 well defined. Gage read to hundredths twice daily. Daily discharge ascertained by applying mean daily gage height to rating tables, except for July 11–13, when it was interpolated. Records good.

COOPERATION.—Record of daily gage height furnished by Red Rock Reservoir & Irrigation Co.

The following discharge measurement was made by C. S. Heidel:
October 5, 1916: Gage height, 1.20 feet; discharge, 230 second-feet.

Daily discharge, in second-feet, of Red Rock Creek below Red Rock reservoir, near Monida, Mont., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Apr.	May.	June.	July.	Aug.	Sept.
1	252	200	.....	775	955	234	111	75
2	252	200	.....	787	943	234	102	75
3	241	200	.....	804	943	200	102	75
4	234	207	.....	847	931	200	102	78
5	234	207	.....	925	919	200	102	78
6	234	191	.....	955	919	200	92	75
7	234	178	.....	955	907	200	92	75
8	234	166	.....	955	907	200	92	75
9	234	158	.....	955	895	200	92	75
10	234	141	.....	955	895	200	82	77
11	234	.....	.....	967	895	176	82	78
12	234	.....	.....	1,000	895	152	82	78
13	234	.....	.....	1,050	895	128	82	80
14	234	.....	.....	1,020	895	104	84	78
15	303	.....	106	955	895	104	82	78
16	436	.....	106	967	895	104	82	78
17	548	.....	110	969	883	124	82	78
18	631	.....	158	973	835	147	82	78
19	659	.....	208	979	835	147	78	78
20	659	.....	210	979	835	142	82	78
21	659	.....	214	979	570	142	82	78
22	659	.....	234	985	522	142	82	78
23	631	.....	260	985	495	142	82	78
24	631	.....	267	967	470	133	82	78
25	659	.....	337	979	445	124	82	78
26	659	.....	465	955	445	124	78	78
27	659	.....	581	955	436	122	78	78
28	659	.....	671	955	422	122	75	78
29	631	.....	746	955	422	122	75	78
30	548	.....	775	955	422	115	75	82
31	376	.....	.....	955	.....	115	75	.....

NOTE.—May 4 to June 20, 1917, water passed around weir; estimated by observer as follows:

	Second-feet.		Second-feet.
May 4	25	June 10–12	15
May 11–26	37	June 13–16	12
May 27 to June 4	25	June 17–20	7.5
June 5–9	20		

Monthly discharge of Red Rock Creek below Red Rock reservoir, near Monida, Mont., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	659	234	430	26,400
November 1–10	207	141	185	3,670
April 15–30	775	106	340	10,800
May	1,050	775	948	58,300
June	955	422	754	44,900
July	234	115	155	9,530
August	111	75	85.6	5,260
September	82	75	77.5	4,610

BEAVERHEAD RIVER AT BARRATTS, MONT.

LOCATION.—In SW. ¼ SW. ¼ sec. 20, T. 8 S., R. 9 W., at highway bridge at point where highway crosses railroad and where both highway and railroad bridges cross river, 1 mile above Barratts, in Beaverhead County, 2 miles below mouth of Grasshopper Creek, and 10 miles southwest of Dillon.

DRAINAGE.—Not measured.

RECORDS AVAILABLE.—August 12, 1907, to September 30, 1917.

GAGE.—Chain gage on downstream side of bridge; read twice daily by T. Masuno. Before June 22, 1908, a staff gage was used. Datum of chain gage same as that of staff gage.

DISCHARGE MEASUREMENTS.—Made from downstream side of bridge.

CHANNEL AND CONTROL.—Banks high, covered with brush, and not subject to overflow. Stream bed clean and rocky. Two channels at low and medium stages, caused by an old pier; sudden changes unlikely.

EXTREMES OF DISCHARGE.—Maximum stage recorded during the year, 5.70 feet at 7.45 a. m. May 16 (discharge, 3,200 second-feet); minimum stage 0.95 foot at 3.55 p. m. February 18 (discharge, 240 second-feet).

1907–1917: Maximum stage recorded, 6 feet June 19 and 20, 1908 (discharge, 3,640 second-feet); minimum stage recorded, 0.42 foot June 23, 1910 (discharge, 114 second-feet).

ICE.—Stage-discharge relation not affected by ice during 1917.

DIVERSIONS.—Numerous diversions are made above station. Water rights aggregating 85,866 inches of water are decreed from Lima on Red Rock Creek to a point 10 miles above Twin Bridges. The three largest canals diverting below the station are Canyon Creek canal, appropriating 6,000 inches; Union canal, appropriating 4,000 inches; and Beaverhead canal, diverting just north of Dillon, appropriating 5,000 inches. Union Electric Co. of Dillon has a canal with a carrying capacity of 6,000 inches.

REGULATION.—Operation of the dam on Red Rock Creek near Monida, used to store flood waters, has some effect on the flow at this station.

ACCURACY.—Stage-discharge relation not affected by ice or shifting control during year. Rating curve fairly well defined between 400 and 2,200 second-feet. Gage read to half-tenths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table. Records good.

Beaverhead River is called Red Rock Creek from its source in Red Rock Lakes to Red Rock post office, below which it is called the Beaverhead. Principal tributaries of Beaverhead River above 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, because ditches constructed in the early seventies are still in operation.

The following discharge measurement was made by C. S. Heidel:

October 3, 1916: Gage height, 1.65 feet; discharge, 532 second-feet.

Daily discharge, in second-feet, of Beaverhead River at Barratts, Mont., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	467	840	332	375	332	292	332	1,210	2,150	1,080	256	292
2	467	840	332	375	312	292	312	1,210	1,870	961	256	292
3	542	840	332	375	292	292	292	1,210	1,730	961	256	292
4	567	840	332	375	292	292	292	1,210	2,010	900	292	292
5	619	840	332	375	292	292	292	1,210	2,150	840	292	292
6	619	782	332	332	312	292	312	1,210	2,150	699	292	274
7	619	726	375	332	292	292	354	1,340	1,940	619	292	256
8	619	672	375	332	292	292	375	1,470	1,870	619	292	256
9	567	567	375	332	292	292	420	1,540	1,870	516	292	256
10	567	467	375	332	292	292	672	1,540	1,870	516	292	256
11	593	467	375	332	292	292	726	1,600	2,290	467	292	274
12	619	420	354	332	256	292	840	1,730	2,150	398	292	292
13	593	420	332	332	256	256	840	1,940	1,870	354	292	292
14	619	467	375	332	256	256	840	2,220	1,800	292	292	292
15	619	467	375	332	256	256	726	2,570	1,730	292	312	292
16	619	444	375	332	256	256	699	3,130	1,730	292	332	292
17	672	420	375	332	256	256	672	2,990	1,800	292	332	292
18	726	375	375	332	256	256	619	2,570	2,010	274	332	292
19	782	375	375	332	292	256	567	2,010	2,290	256	332	292
20	840	375	375	332	292	256	593	2,150	2,570	256	332	292
21	840	354	332	332	292	256	961	2,430	2,010	256	332	292
22	840	354	332	332	292	256	1,080	2,150	1,870	256	292	292
23	840	375	375	332	292	256	1,150	2,150	1,800	256	292	292
24	900	375	375	292	292	256	1,210	2,220	1,730	256	332	292
25	900	375	375	292	292	256	1,340	2,150	1,660	256	332	292
26	900	375	375	292	292	256	1,340	2,010	1,540	256	332	292
27	961	375	375	292	292	256	1,340	1,870	1,340	256	312	292
28	961	375	375	292	292	274	1,210	1,870	1,210	256	292	292
29	961	375	375	292	.....	312	1,150	2,010	1,150	256	292	292
30	900	354	375	292	.....	354	1,150	2,150	1,080	256	292	292
31	900	.....	375	312	.....	332	.....	2,220	.....	256	292	.....

Monthly discharge of Beaverhead River at Barratts, Mont., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	961	467	717	44,100
November	840	354	511	30,400
December	375	332	362	22,300
January	375	292	329	20,200
February	332	256	286	15,900
March	354	256	278	17,100
April	1,340	292	757	45,000
May	3,130	1,210	1,910	117,000
June	2,570	1,080	1,840	109,000
July	1,080	256	442	27,200
August	332	256	301	18,500
September	292	256	286	17,000
The year	3,130	256	670	484,000

MISSOURI RIVER AT FORT BENTON, MONT.

LOCATION.—In NE. ¼ sec. 26, T. 24 N., R. 8 E., on highway bridge at Fort Benton, Choteau County.

DRAINAGE AREA.—24,600 square miles.

RECORDS AVAILABLE.—July 1, 1902, to April 27, 1910, gage heights recorded by United States Weather Bureau; April 28, 1910, to September 30, 1917, United States Geological Survey records.

GAGE.—Chain gage on upstream side of bridge installed July 30, 1917. Mott gage read April 11, 1907, to July 30, 1917. Gage heights for 1911–1917 are referred to datum used by United States Army Engineers from 1880–1890, which is 0.43 foot higher than that used by United States Geological Survey in 1910.

CHANNEL AND CONTROL.—Channel composed of coarse gravel and sand. Control is rock ledge covered with heavy boulders, located 1,000 feet below gage; may shift slightly.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 9.90 feet at 9 a. m. May 27 (discharge, 55,200 second-feet); minimum stage recorded, 0.36 foot, August 26 (discharge, 3,650 second-feet).

1881–1917: Maximum stage recorded, 9.90 feet May 27, 1917 (discharge, 55,200 second-feet); maximum stage recorded by United States Weather Bureau, 15.3 feet June 7, 1908 (discharge not computed); minimum open-water stage recorded, −0.2 foot September 10, 1914 (discharge, 2,250 second-feet); minimum stage recorded by United States Weather Bureau, −0.5 foot August 7–10, 17, and 18, 1910 (discharge not computed). Open-season records only; flow may have been lower during winter.

ICE.—Stage-discharge relation seriously affected by ice; December 13 to March 20, flow not computed.

DIVERSIONS.—Numerous diversions from tributaries.

REGULATION.—Flow partly regulated by operation of storage reservoirs and power plants of Montana Power Co. above station.

ACCURACY.—Stage-discharge relation affected by ice December 13 to March 21; otherwise permanent. Rating curve well defined above 2,050 second-feet. Gage read to hundredths twice daily; readings July 1–19 unreliable and were not used. Daily discharge ascertained by applying mean daily gage height to rating table. Records only fair October 14 to July 19 on account of trouble with Mott gage; good after July 20.

Discharge measurements of Missouri River at Fort Benton, Mont., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Oct. 14	A. H. Tuttle	1.22	6,470	July 30	A. H. Tuttle	1.06	5,270
June 25	do	8.45	44,800	Sept. 10	W. A. Lamb	.53	3,871

Daily discharge, in second-feet, of Missouri River at Fort Benton, Mont., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	.....	6,700	4,750	.....	15,500	17,500	51,000	40,700	6,000	3,750
2	.....	6,700	4,750	.....	15,000	17,000	50,300	39,400	6,000	3,750
3	.....	6,350	4,750	.....	15,000	17,000	51,000	37,400	6,000	3,750
4	.....	6,350	4,750	.....	15,000	16,000	50,300	36,200	6,000	3,750
5	.....	6,350	4,750	.....	15,000	14,000	49,600	34,300	5,650	3,750
6	.....	6,350	4,750	.....	16,500	14,000	46,800	32,500	6,000	4,000
7	.....	6,000	5,000	.....	19,000	14,000	46,100	31,300	6,000	4,000
8	.....	5,300	5,000	.....	19,600	19,000	42,600	29,500	5,650	4,000
9	.....	5,300	5,300	.....	19,600	24,700	44,700	28,300	5,650	4,000
10	.....	5,000	5,300	.....	19,000	25,900	45,400	26,500	5,650	4,000
11	.....	4,750	5,650	.....	18,500	26,500	46,100	24,700	5,650	4,000
12	.....	4,250	6,000	.....	18,000	27,100	46,800	23,500	5,650	4,000
13	.....	4,250	.....	.....	17,500	28,900	47,500	21,200	5,650	4,000
14	6,000	4,250	.....	.....	14,500	31,300	51,000	20,100	5,300	4,000
15	6,000	4,250	.....	.....	14,000	36,200	51,000	18,000	5,000	4,000
16	5,650	4,250	.....	.....	14,500	42,000	50,300	16,500	5,000	4,000
17	5,650	4,250	.....	.....	14,000	39,400	51,000	15,000	4,750	4,500
18	5,650	4,250	.....	.....	14,000	39,400	48,900	13,500	4,750	4,750
19	5,650	4,250	.....	.....	13,500	40,700	48,900	12,000	3,750	5,000
20	6,000	4,500	.....	.....	12,000	41,400	48,900	10,400	3,750	5,000
21	6,000	4,500	.....	13,500	9,600	41,400	48,900	10,000	3,750	5,300
22	6,000	4,500	.....	12,500	12,500	42,000	48,200	9,200	3,750	5,300
23	6,000	4,500	.....	12,500	18,500	42,000	47,500	9,200	3,750	5,300
24	6,000	4,500	.....	12,500	19,000	41,400	44,700	8,800	3,750	5,650
25	6,000	4,500	.....	11,200	20,100	39,400	44,700	8,450	3,750	6,000
26	6,350	4,500	.....	10,800	19,000	54,500	43,300	7,750	3,750	6,000
27	6,350	4,500	.....	11,600	19,000	55,200	42,600	7,400	3,750	6,350
28	6,700	4,500	.....	13,000	18,000	53,100	42,000	7,050	3,750	6,350
29	6,700	4,500	.....	14,500	18,000	53,100	42,000	6,000	3,750	6,700
30	6,700	4,750	.....	16,500	18,000	52,400	42,000	6,000	3,750	7,050
31	6,700	.....	.....	18,000	.....	52,400	.....	6,000	3,750	.....

NOTE.—Stage-discharge relation seriously affected by ice; flow not computed Dec. 13 to Mar. 20, although gage-height record is continuous for period. No readings Oct. 1–13; flow not computed. Gage-height records July 1–19 discarded owing to errors in observer's readings; discharge interpolated for period.

Monthly discharge of Missouri River at Fort Benton, Mont., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October 14–31	6,700	5,650	6,120	219,000
November	6,700	4,250	4,960	295,000
December 1–12	6,000	4,750	5,060	120,000
March 21–31	18,000	10,800	13,300	290,000
April	20,100	9,600	16,400	976,000
May	55,200	14,000	34,200	2,100,000
June	51,000	42,000	47,100	2,800,000
July	40,700	6,000	19,300	1,190,000
August	6,000	3,750	4,810	296,000
September	7,050	3,750	4,730	281,000

MADISON RIVER BASIN.

MADISON RIVER NEAR YELLOWSTONE, MONT.

LOCATION.—Approximately in sec. 5, T. 14 S., R. 6 E. Montana meridian, 250 feet downstream from old footbridge at fording place of old Gallatin trail 300 feet north of stage road to Yellowstone, almost directly in front of Riverside soldier station, and 4 miles east of Yellowstone and west boundary of Yellowstone National Park. Gibbon and Firehole rivers unite to form the Madison 8 miles upstream.

DRAINAGE AREA.—410 square miles (measured on topographic maps).

RECORDS AVAILABLE.—June 16, 1913, to September 30, 1917.

GAGE.—Vertical staff on left bank; read by Chas. A. Smith and other soldiers attached to Riverside soldier station.

DISCHARGE MEASUREMENTS.—High-stage measurements made from cable one-third mile below gage, installed September 9, 1917. Previous to this date high-stage measurements made from old footbridge 250 feet upstream from gage. Medium and low stage measurements made by wading at gage.

CHANNEL AND CONTROL.—One channel at all stages. Bed of stream is gravel and boulders; somewhat rough; control is probably permanent. Aquatic growth is present during greater part of year and during summer affects the stage-discharge relation.

ICE.—Stage-discharge relation not seriously affected by ice. Temperature of water except during extremely cold weather kept above freezing point by numerous hot springs and geysers.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 2.64 feet at 6 p. m. June 10 (discharge, 1,950 second-feet); minimum stage recorded 1.30 feet at 4 p. m., January 22 (discharge, 420 second-feet).

1913–1917: Maximum stage recorded, 2.64 feet at 6 p. m. June 10, 1917 (discharge, 1,950 second-feet); minimum stage recorded, 1.25 feet July 21–25, 1915 (discharge, 370 second-feet).

DIVERSIONS.—None above station.

REGULATION.—None.

ACCURACY.—Stage-discharge relation practically constant during year, except during August and September, when it was affected by aquatic growth. Two fairly well defined rating curves used, one applicable October 1 to July 31; the other August 17 to September 30. Shifting-control methods used August 1–16. Gage read to half-tenths once daily. Daily discharge ascertained by applying daily gage height to rating table. Records only fair, chiefly on account of unstable condition of gage during most of the year.

Discharge measurements of Madison River near Yellowstone, Mont., during the year ending Sept. 30, 1917.

[Made by G. C. Baldwin.]

Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*
June 28	2.22	1,450
Sept. 9	1.42	495

Daily discharge, in second-feet, of Madison River near Yellowstone, Mont., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	522	522	471	522	471	522	563	502	1,070	1,300	642	497
2	522	522	522	522	522	522	563	502	1,020	1,300	638	497
3	522	574	522	522	548	522	563	440	980	1,190	634	497
4	420	522	522	522	574	522	615	440	930	1,190	630	497
5	574	522	522	522	625	522	612	440	880	1,190	625	497
6	574	522	522	522	574	522	608	440	832	1,190	621	579
7	728	522	522	522	548	522	604	481	780	1,070	617	579
8	625	522	522	522	522	522	656	481	780	1,070	613	497
9	574	522	522	522	471	522	707	532	1,360	961	518	497
10	574	574	522	522	471	522	646	532	1,950	961	515	497
11	574	522	522	522	522	574	646	635	1,450	961	513	497
12	574	471	522	471	522	574	594	625	1,220	853	510	497
13	522	471	522	471	522	522	543	780	983	853	507	497
14	522	471	522	471	522	522	512	832	972	853	505	535
15	522	522	522	471	522	522	481	994	1,260	749	502	535
16	522	522	522	471	522	522	481	1,040	1,560	749	500	535
17	522	522	522	471	471	522	481	1,150	1,560	749	579	497
18	676	522	522	471	522	522	481	1,120	1,570	749	579	497
19	574	522	522	471	522	522	471	1,100	1,570	479	579	497
20	574	471	522	471	522	522	471	1,210	1,580	749	497	497
21	574	471	522	471	522	522	471	1,030	1,580	749	497	497
22	625	471	522	420	522	574	471	1,080	1,590	749	497	497
23	522	471	522	471	522	548	574	1,200	1,600	646	497	535
24	574	471	522	488	522	522	563	1,140	1,600	646	497	535
25	574	471	522	505	522	522	563	1,190	1,610	646	497	579
26	574	522	522	522	522	522	563	1,190	1,420	646	497	535
27	574	522	522	522	522	574	512	1,190	1,420	646	497	497
28	574	522	522	574	522	600	492	1,250	1,400	646	497	497
29	574	522	522	522	.....	625	472	1,360	1,420	646	497	497
30	522	522	522	522	.....	574	451	1,410	1,420	646	497	497
31	522	.....	522	471	.....	574	.....	1,120	.....	646	497	.....

NOTE.—Discharge interpolated Dec. 8–10, 14, 23, 25; Jan. 1–5, 16–20, 24–25; Feb. 3, 7, 15, 26; Mar. 3, 9, 16, 23, 28; Apr. 5–6, 8, 12, 14, 16, 20–21, 28–29; May 18; June 1–5, 9, 12, 17–23; and Aug. 10.

Monthly discharge of Madison River near Yellowstone, Mont., for the year ending Sept. 30, 1917.

[Drainage area, 410 square miles.]

Month.	Discharge in second-feet.				Run-off.	
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches.	Total in acre-feet.
October	728	522	562	1.37	1.58	34,600
November	574	471	510	1.24	1.38	30,300
December	522	471	520	1.27	1.46	32,000
January	574	420	499	1.22	1.41	30,700
February	625	471	524	1.28	1.33	29,100
March	625	522	539	1.31	1.51	33,100
April	707	451	548	1.34	1.50	32,600
May	1,410	440	885	2.16	2.49	54,400
June	1,950	780	1,310	3.20	3.57	78,000
July	1,300	646	863	2.10	2.42	53,100
August	642	497	542	1.32	1.52	33,300
September	579	497	513	1.25	1.40	30,500
The year	1,950	420	652	1.59	21.6	472,000

PRICKLY PEAR CREEK BASIN.

TENMILE CREEK NEAR RIMINI, MONT.

LOCATION.—In NE. ¼ sec. 20, T. 9 N., R. 5 W., opposite Moose Creek ranger station, 500 feet above mouth of Moose Creek, and 3 miles north of Rimini, in Lewis and Clark County.

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—March 13, 1915, to September 30, 1917.

GAGE.—Friez water-stage recorder on left bank opposite ranger station; observer, D. H. Lewis, a forest ranger.

DISCHARGE MEASUREMENTS.—Made by wading just below gage.

CONTROL.—Gravel and boulders; slightly shifting. Left bank high and steep; composed of loose material; will not be overflowed but will erode. Right bank sloping and subject to overflow.

EXTREMES OF DISCHARGE.—Maximum stage recorded during the year, 4.87 feet at 2 p. m., May 15 (discharge, 948 second-feet); minimum stage recorded, 1.28 feet at 6 p. m., October 10, 1916 (discharge, 1.4 second-feet).

1915–1917: Maximum stage recorded, 4.87 feet at 2 p. m., May 15, 1917 (discharge, 948 second-feet); minimum stage, 1.28 feet at 6 p. m., October 10, 1916 (discharge, 1.4 second-feet).

ICE.—Stage-discharge relation affected very little, if any, by ice; open-channel conditions assumed.

DIVERSIONS.—Small ditch diverts in summer for water supply of Helena.

REGULATION.—Small reservoir of water supply system of Helena is above station, but operation of reservoir has probably little, if any, effect upon the flow past gaging station.

ACCURACY.—Stage-discharge relation changed during year. Fairly well defined rating curves used for short periods. Water-stage recorder did not operate satisfactorily, except for short periods in October, November, April, and May. After January 2 staff gage was read to hundredths once daily, except for periods indicated in footnote to daily-discharge table. Daily discharge ascertained by applying to rating table mean daily gage height determined from recorder graph, or daily reading from staff gage. Records fair.

Discharge measurements of Tenmile Creek near Rimini, Mont., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Nov. 11	W. A. Lamb	1.45	6.8	May 8	W. A. Lamb	2.80	101
15	do	1.64	7.7	10	Lamb and Heidel	3.07	136
Dec. 7	do	1.50	5.4	25	W. A. Lamb	4.23	596
Jan. 2	do	1.47	5.2	31	do	3.60	278
Feb. 3	A. H. Tuttle	1.36	3.7	July 21	A. H. Tuttle	1.91	15.3
Mar. 17	do	1.35	4.1	Aug. 25	W. A. Lamb	1.47	2.0
May 1	W. A. Lamb	2.18	29.1	Sept. 24	Tuttle and Lamb	1.70	6.0

NOTE.—Nov. 11, 15; Dec. 7; Jan. 2; Feb. 3; amd Mar. 17, ice present. Stage-discharge relation apparently not affected.

Daily discharge, in second-feet, of Tenmile Creek near Rimini, Mont., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	5.1	10	5.5	4.4	3.8	4.4	23	257	85	7.5	4.2
2	4.5	10	5.2	3.9	3.8	4.2	30	232	72	7.5	4.2
3	4.0	11	5.0	3.8	3.8	4.2	32	204	64	7.5	4.4
4	5.1	13	4.8	4.0	3.8	4.2	31	191	59	7.5	4.6
5	5.1	13	4.7	4.0	3.8	4.7	39	204	54	7.0	4.6
6	5.7	11	4.6	4.0	3.8	4.6	49	217	49	6.8	4.6
7	5.7	11	4.4	4.0	3.8	4.9	76	310	35	6.5	4.6
8	4.9	11	5.3	3.8	3.8	8.2	104	354	33	6.0	4.6
9	3.0	12	4.7	3.8	3.8	7.8	106	417	33	5.6	4.6
10	3.8	9.0	4.8	4.0	3.9	10	130	392	33	5.2	4.6
11	6.3	6.5	4.7	3.8	3.8	13	150	331	28	4.8	4.6
12	6.5	6.7	4.6	3.9	4.0	13	199	258	25	4.4	4.6
13	7.4	7.1	4.6	3.8	4.0	13	290	238	23	4.2	4.6
14	7.2	7.6	4.6	3.8	4.0	12	569	264	22	4.0	4.6
15	.....	8.1	4.6	4.0	4.0	9.0	811	322	19	3.8	4.6
16	.....	8.1	4.8	3.8	4.0	9.5	600	402	19	3.7	7.2
17	.....	8.1	5.0	4.7	4.1	9.0	480	444	17	7.2	7.2
18	.....	8.1	5.8	4.4	4.0	9.0	390	344	13	3.2	7.2
19	.....	.....	4.2	4.5	4.0	9.0	400	272	11	3.0	7.2
20	.....	.....	4.3	4.7	4.0	12	380	264	12	2.3	7.2
21	.....	.....	4.1	4.5	4.0	24	370	226	16	1.9	7.2
22	.....	.....	4.0	4.0	4.0	25	360	204	13	1.9	7.2
23	.....	.....	3.8	3.8	4.0	31	340	180	12	1.9	15
24	.....	.....	3.9	3.8	4.0	33	440	191	11	1.7	15
25	.....	.....	3.9	3.8	3.9	35	596	158	11	1.7	6.7
26	.....	.....	3.9	3.8	3.9	32	780	130	10	1.7	6.7
27	.....	.....	4.0	3.8	4.3	35	800	122	9.8	3.2	6.7
28	.....	.....	4.0	3.8	4.8	38	700	106	8.8	3.7	6.2
29	.....	.....	4.0	.....	5.4	20	540	99	8.2	3.7	6.2
30	.....	.....	3.9	.....	4.7	19	420	92	8.0	3.8	6.2
31	.....	.....	4.0	.....	4.5	.....	282	.....	8.0	4.0	.....

NOTE.—Water-stage recorder was in operation Oct. 1–14, Nov. 1–12, 15–18, Apr. 22 to May 6, and May 8–15; no records Oct. 15–31, Nov. 19–30, Dec. 1–6 and 8–31; discharge for other periods determined from records from staff gage, except for the following periods for which it was interpolated: Nov. 13, 14; Jan. 1, 3–16, 21, 22, Mar. 24, 25, 28, 31; Apr. 1, 10; May 7, 16–24, and 26–30.

Monthly discharge of Tenmile Creek near Rimini, Mont., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October 1–14	7.4	3.0	5.31	147
November 1–18	13	6.5	9.52	340
January	5.8	3.8	4.51	277
February	4.7	3.8	4.01	223
March	5.4	3.8	4.05	249
April	38	4.2	15.3	910
May	811	23	338	20,800
June	444	92	248	14,800
July	85	8.0	26.5	1,630
August	7.5	1.7	4.42	272
September	15	4.2	6.24	371

TENMILE CREEK NEAR HELENA, MONT.

LOCATION.—In SW. ¼ SE. ¼ sec. 22, T. 10 N., R. 4 W., opposite Broadwater Hotel, near Helena, in Lewis and Clark County.

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—July 8, 1908, to September 30, 1917.

GAGE.—Staff on right bank; read by J. W. Jackson.

DISCHARGE MEASUREMENTS.—Made by wading, or from highway bridge 500 feet below gage.

CHANNEL AND CONTROL.—Bed of stream composed of coarse gravel and boulders; shifting occasionally.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 5.60 feet at 6.30 p. m. May 28 (discharge, 865 second-feet); minimum stage recorded, 1.75 feet August 24–28 (discharge, 2.3 second-feet).

1908–1917: Maximum stage recorded, 5.60 feet at 6.30 p. m. May 28, 1917 (discharge, 865 second-feet); minimum stage recorded, 1.15 feet August 5 to September 10, 1910 (discharge, 0.15 second-foot).

ICE.—Stage-discharge relation slightly affected by ice. For flow during period, see note to table of daily discharge.

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

REGULATION.—None.

ACCURACY.—Stage-discharge relation affected by shifting control; very little, if any, by ice effect. Rating curve used October 1 to May 31 fairly well defined between 10 and 700 second-feet; indirect method used June 1 to September 30. Gage read to half-tenths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table. Records good October to December and March 15 to May 31; fair for rest of year.

Discharge measurements of Tenmile Creek, near Helena, Mont., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Jan. 2	W. A. Lamb	1.94	7.9	May 11	W. A. Lamb	3.72	228
Feb. 7	Tuttle and Lamb	1.83	5.6	26	do	5.2	708
Mar. 20	Lamb and Anderson	1.77	5.8	June 24	do	[a] 3.72	148
May 2	W. A. Lamb	2.68	58	Aug. 25	do	1.76	2.3

[a] Mean gage height for day from observer's record.

Daily discharge, in second-feet, of Tenmile Creek near Helena, Mont., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	13	18	13	7.5	5	.....	19	60	552	68	4.0	2.6
2	15	18	13	7.5	5	.....	15	60	530	57	4.0	2.6
3	15	18	13	9	5	.....	19	60	517	45	4.0	2.6
4	15	18	10.5	9	5.3	.....	25	55	500	43	3.5	2.6
5	15	13	10.5	9	5.6	.....	26	55	486	39	3.6	2.6
6	15	10	10.5	9	5.6	.....	50	73	473	35	3.9	2.7
7	18	10	10.5	9	5.6	.....	52	104	470	35	4.2	2.9
8	18	9.0	10.5	7	5.6	.....	69	104	520	32	4.9	2.9
9	18	9	10.5	7	.....	.....	60	136	555	32	4.3	3.4
10	18	9	10.5	7	.....	.....	58	193	541	30	4.3	3.4
11	20	7.5	10.5	7	.....	.....	52	237	457	29	4.3	3.9
12	20	7.5	10.5	7	.....	.....	52	275	428	25	4.3	3.9
13	20	6.5	10.5	7	.....	.....	52	406	413	26	3.8	3.9
14	23	7.5	10.5	7	.....	.....	50	665	367	18	3.8	3.9
15	23	10.5	10.5	7	.....	.....	41	745	325	18	3.8	4.6
16	23	10.5	10.5	6	.....	5.5	41	793	320	15	3.3	4.6
17	23	13	10.5	6	.....	5.5	30	590	314	13	3.8	4.9
18	30	13	10.5	5	.....	5.8	30	428	295	11	3.9	4.9
19	30	15	10.5	5	.....	5.8	26	416	262	9.9	3.6	6.3
20	26	15	10	6	.....	5.8	35	422	244	9.6	3.4	6.3
21	26	15	10	7	.....	5.8	41	406	216	9.0	2.9	6.7
22	26	13	10	7	.....	5.5	48	397	187	8.1	2.6	7.3
23	26	13	10	7	.....	5.5	60	367	167	7.3	2.6	7.3
24	26	13	10	7	.....	5.5	71	397	149	6.1	2.3	8.7
25	23	13	10	7	.....	5.5	73	422	128	5.2	2.3	9.3
26	23	13	10	7	.....	5.5	77	572	128	4.9	2.3	10.2
27	23	13	9	7	.....	13	71	697	109	4.4	2.3	11
28	23	13	9	7	.....	18	71	845	98	4.2	2.3	12
29	23	13	9	6	.....	50	62	705	91	3.9	2.4	11
30	23	13	9	5	.....	145	62	583	82	3.9	2.6	10.2
31	20	.....	9	5	.....	71	.....	538	.....	3.9	2.6	.....

NOTE.—Stage-discharge relation affected by ice Dec. 20–25, Jan. 8–31, Feb. 1–Mar. 21. Discharge, Feb. 9 to Mar. 15 estimated as 5.0 second-feet.

Monthly discharge of Tenmile Creek near Helena, Mont., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	30	13	21.3	1,310
November	18	6.5	12.3	732
December	13	9	10.4	640
January	9	5	6.97	429
February	5.6	5.0	5.10	283
March	145	5.0	14.0	861
April	77	15	47.9	2,850
May	845	55	381	23,400
June	555	82	331	19,700
July	68	3.9	21.0	1,290
August	4.9	2.3	3.43	211
September	12	2.6	5.64	336
The year	845	2.3	71.9	52,000

LITTLE PRICKLY PEAR CREEK BASIN.

LITTLE PRICKLY PEAR CREEK NEAR MARYSVILLE, MONT.

LOCATION.—At highway bridge on ranch of Casper Traufer, about a quarter of a mile below mouth of Deadman Creek and 6 miles northwest of Marysville, in Lewis and Clark County.

DRAINAGE AREA.—49 square miles (measured on topographic map).

RECORDS AVAILABLE.—May 24, 1913, to September 30, 1917, at present site; April 12, to May 23, 1913, a quarter of a mile above present site; May 18, 1909, to December 31, 1911, at station formerly maintained above mouth of Deadman Creek.

GAGE.—Vertical staff spiked to upstream side of left abutment of highway bridge; read by Casper Traufer. April 12 to May 23, 1913, vertical staff a quarter of a mile above present site; washed out by high water and replaced by present gage at different datum; discharge practically the same at the two points. Gage used May 18, 1909, to December 31, 1911, was a vertical staff on downstream side of Mr. Pearce's private bridge, half a mile above mouth of Deadman Creek.

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

CHANNEL AND CONTROL.—Sand and gravel; shifts slightly.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 3.8 feet May 25 and 26 (discharge, 454 second-feet); minimum discharge, 7.5 second-feet, September 23 and 24.

1909–1911 and 1913–1917: Maximum stage recorded, 3.8 feet May 25 and 26, 1917 (discharge, 454 second-feet); minimum stage, 2.28 feet (old gage) March 7–13, 1911 (discharge, 1.2 second-feet).

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

DIVERSIONS.—Numerous small ditches divert water from the stream, practically the entire normal flow being appropriated.

REGULATION.—None.

ACCURACY.—Stage-discharge relation not permanent; affected by shifting control and occasionally by ice. Rating curve used October 1 to June 10 well defined between 15 and 340 second-feet; curve used July 28 to September 30 poorly defined; shifting-control method used June 11 to July 27. Gage read to half-tenths twice daily. Daily discharge obtained by applying mean daily gage height to rating table.

Discharge measurements of Little Prickly Pear Creek near Marysville, Mont., during the year ending Sept. 30, 1917.

[Made by W. A. Lamb.]

Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*
June 2	3.28	338
July 28	1.65	35.3

Daily discharge, in second-feet, of Little Prickly Pear Creek near Marysville, Mont., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Apr.	May.	June.	July.	Aug.	Sept.
1	19	13	10.5	8	22	312	118	31	16
2	19	13	10.5	8	22	332	105	31	16
3	19	13	10.5	8	22	326	100	31	16
4	19	13	10.5	8	22	318	96	31	16
5	19	13	10.5	8	25	292	90	31	16
6	19	13	10.5	8	28	282	87	31	16
7	19	13	10.5	8	35	282	83	31	13
8	19	13	8	8	42	312	78	31	13
9	19	13	8	9	49	354	74	31	10
10	19	13	8	13	66	354	71	31	10
11	19	10.5	8	19	82	330	67	31	10
12	19	10.5	8	22	108	288	64	27	10
13	19	10.5	8	22	132	255	62	27	10
14	16	10.5	8	22	182	248	59	27	10
15	16	10.5	8	20	278	248	55	23	10
16	16	10.5	8	19	343	255	55	23	10
17	16	10.5	8	19	272	257	52	23	10
18	16	10.5	8	16	217	244	49	23	10
19	16	10.5	8	16	205	233	45	23	10
20	16	10.5	8	18	226	219	43	23	10
21	16	10.5	8	22	254	205	42	23	10
22	16	10.5	8	28	235	193	42	23	10
23	16	10.5	8	33	205	186	41	23	7.5
24	16	10.5	8	30	208	177	40	23	7.5
25	16	10.5	8	30	397	162	40	23	10
26	16	10.5	8	30	436	155	40	23	10
27	16	10.5	8	26	390	143	40	23	10
28	16	10.5	8	26	364	140	36	16	10
29	13	10.5	8	26	364	126	36	16	10
30	13	10.5	8	22	347	122	36	16	10
31	13	.....	8	.....	322	.....	36	16	.....

Monthly discharge of Little Prickly Pear Creek near Marysville, Mont., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	19	13	17.0	1,050
November	13	10.5	11.3	672
December	10.5	8.0	8.56	526
April	33	8	18.4	1,090
May	436	22	190	11,700
June	354	122	245	14,600
July	118	36	60.7	3,730
August	31	16	25.3	1,560
September	16	7.5	11.2	666

LITTLE PRICKLY PEAR CREEK NEAR CANYON CREEK, MONT.

LOCATION.—In NW. ¼ sec. 9, T. 12 N., R. 5 W., near ford on Carbis ranch, below mouth of Canyon Creek, and 1¼ miles from Canyon Creek post office, in Lewis and Clark County.

DRAINAGE AREA.—180 square miles (measured on topographic map).

RECORDS AVAILABLE.—April 1, 1909, to December 31, 1911; and April 12, 1913, to September 30, 1917.

GAGE.—Vertical staff attached to tree on right bank about 40 feet above ford; gage installed June 2, 1917, at independent datum, to replace the one washed out May 13; read by Melville Carbis.

DISCHARGE MEASUREMENTS.—Made by wading near gage, or from wagon bridge 300 feet above gage.

CHANNEL AND CONTROL.—Sand and gravel; shifting. Banks overgrown with brush.

EXTREMES OF DISCHARGE.—Maximum discharge recorded during year, 534 second-feet June 3–5; minimum stage, 0.50 foot July 28–31 and August 3–5 (discharge, 6.5 second-feet).

1909–1911 and 1913–1917: Maximum stage recorded, 4.8 feet May 29, 1913 (discharge, 665 second-feet); creek reported dry June 21–28, July 1–9, 21–22, August 1–2, 1910; July 22–27, 29, and 31, 1911.

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

DIVERSIONS.—Many small ditches divert from the stream; low-water flow practically all appropriated.

REGULATION.—None.

ACCURACY.—Stage-discharge relation permanent during year but a change of datum was made June 2 when new gage was installed. Rating curve well defined between 10 and 350 second-feet. Records good.

Discharge measurements of Little Prickly Pear Creek near Canyon Creek, Mont., during the year ending Sept. 30, 1917.

[Made by W. A. Lamb.]

Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*
June 2	3.64	499
July 28	.49	6.2

Daily discharge, in second-feet, of Little Prickly Pear Creek near Canyon Creek, Mont., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Apr.	May.	June.	July.	Aug.	Sept.
1	34	42	42	.....	137	.....	30	8.5	16
2	42	42	42	.....	145	496	30	8.5	16
3	46	46	34	.....	153	534	30	6.5	16
4	46	46	34	.....	170	534	30	6.5	16
5	42	51	38	.....	179	534	30	6.5	20
6	42	51	38	.....	188	510	34	8.5	20
7	51	46	27	.....	217	510	34	8.5	20
8	51	42	27	.....	207	486	30	10.5	23
9	51	51	27	.....	217	463	30	10.5	23
10	46	51	21	.....	248	440	30	10.5	23
11	46	51	30	.....	296	440	26	10.5	23
12	42	46	34	.....	440	417	26	10.5	23
13	42	42	34	.....	.....	452	26	10.5	23
14	42	42	34	.....	.....	350	23	10.5	23
15	38	38	34	60	.....	350	23	13	23
16	34	38	42	60	.....	350	23	13	23
17	34	34	42	60	.....	350	23	13	23
18	42	34	46	51	.....	328	20	13	23
19	42	34	46	60	.....	306	20	16	26
20	46	27	42	122	.....	285	16	16	26
21	51	30	42	137	.....	265	16	16	30
22	51	30	38	137	.....	246	16	16	30
23	51	27	38	122	.....	227	16	16	30
24	42	27	.....	107	.....	209	10.5	20	30
25	38	34	.....	122	.....	191	10.5	20	38
26	34	34	.....	122	.....	174	8.5	23	46
27	42	38	.....	137	.....	174	8.5	23	46
28	51	38	.....	137	.....	158	6.5	23	46
29	51	42	.....	122	.....	142	6.5	23	46
30	51	38	.....	122	.....	127	6.5	20	46
31	42	.....	.....	.....	.....	.....	6.5	20	.....

Monthly discharge of Little Prickly Pear Creek near Canyon Creek, Mont., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	51	34	44.0	2,710
November	51	27	39.7	2,360
December 1–23	46	21	36.2	1,650
April 15–30	137	51	105	3,330
May 1–12	440	137	216	5,140
June	534	127	335	19,900
July	34	6.5	20.8	1,280
August	23	6.5	13.9	855
September	46	16	27.2	1,620

SUN RIVER BASIN.

NORTH FORK OF SUN RIVER NEAR AUGUSTA, MONT.

LOCATION.—In sec. 36, T. 22 N., R. 9 W. (unsurveyed), at Sun River diversion dam, 18 miles northwest of Augusta, in Lewis and Clark County.

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—January 1, 1916, to September 30, 1917, at present site. From August 5, 1889, to December 31, 1890, and October 31, 1903, to December 31, 1915, a station in sec. 33, T. 22 N., R. 7 W., at the Henningson ranch, 8 miles downstream from present site. The flow is practically the same at both points, there being no large intervening tributaries entering and no diversions.

GAGE.—A sloping staff gage on right abutment of the Sun River diversion dam; read twice daily by employees of United States Reclamation Service. From October 31, 1903, to December 31, 1915, an overhanging chain gage was on left bank below ranch buildings of the Henningson Co. From August 5, 1889, to December 31, 1890, the gage was also near this point.

DISCHARGE MEASUREMENTS.—Made from footbridge at siphon half a mile below gage.

CHANNEL AND CONTROL.—Control is crest of Sun River diversion dam—a concrete structure with an arch section 153.3 feet long, and a gravity section 59.2 feet long, separated by a pier.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 8.2 feet at 6 p. m. May 25 (discharge, 18,700 second-feet); minimum stage recorded, 0.23 foot April 2 (discharge, 64 second-feet).

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

DIVERSIONS.—None.

REGULATION.—None.

ACCURACY.—Stage-discharge relation permanent. Rating curve well defined. Gage read to hundredths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table. Records good.

The following discharge measurement was made by W. A. Lamb:
May 13, 1917: Gage height, 2.92 feet; discharge, 3,380 second-feet.

Daily discharge, in second-feet, of North Fork of Sun River near Augusta, Mont., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	461	372	332	217	217	184	124	254	4,630	3,780	825	204
2	461	372	332	217	217	184	64	254	5,000	3,920	557	204
3	461	372	332	217	217	184	113	291	4,270	4,230	528	184
4	461	372	291	217	217	184	132	332	4,020	4,190	538	184
5	461	332	291	217	217	184	152	372	3,720	4,060	509	184
6	461	332	291	217	217	152	152	461	3,820	4,060	461	184
7	416	332	217	184	217	152	184	557	4,940	3,980	443	372
8	416	332	254	184	254	184	217	944	6,300	3,520	461	372
9	416	372	254	184	254	184	291	1,320	9,210	3,310	416	372
10	372	372	254	217	254	152	291	1,760	7,830	3,320	416	152
11	372	372	291	217	254	152	332	2,240	5,700	2,950	372	152
12	372	372	291	217	254	152	372	3,230	4,450	2,660	372	152
13	372	372	291	217	291	152	372	3,660	3,920	2,420	356	152
14	372	372	291	217	291	152	291	5,350	4,230	2,080	332	152
15	372	372	254	217	254	152	291	6,800	5,820	1,900	332	152
16	372	372	254	184	254	152	291	8,650	7,960	1,710	509	152
17	372	372	254	184	254	184	254	4,890	9,790	1,680	509	107
18	372	372	254	184	254	184	254	4,120	8,650	1,530	490	107
19	372	372	254	217	217	152	254	4,020	7,570	1,420	291	107
20	372	372	254	217	217	152	291	4,670	7,000	1,320	291	96
21	372	372	254	217	217	124	291	4,670	6,680	1,230	254	96
22	372	372	291	217	217	124	332	4,020	5,870	1,100	217	96
23	372	372	291	184	184	124	332	4,120	5,300	980	217	96
24	372	372	291	217	184	124	332	3,820	5,350	944	217	172
25	372	372	254	217	184	124	332	12,500	4,890	871	217	158
26	372	332	254	217	184	107	332	15,500	4,890	813	184	152
27	372	332	254	217	184	107	332	8,930	4,630	756	184	124
28	372	332	254	217	217	124	372	7,700	4,710	713	184	107
29	372	332	217	184	.....	152	372	8,240	5,000	659	184	107
30	372	332	217	184	.....	152	291	6,060	4,230	756	184	107
31	372	.....	217	184	.....	152	.....	4,890	.....	825	204	.....

Monthly discharge of North Fork of Sun River near Augusta, Mont., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	461	372	393	24,200
November	372	332	360	21,400
December	332	217	269	16,500
January	217	184	206	12,700
February	291	184	228	12,700
March	184	107	153	9,410
April	372	64	268	15,900
May	15,500	254	4,340	267,000
June	9,790	3,720	5,680	338,000
July	4,230	659	2,180	134,000
August	825	184	363	22,300
September	372	96	165	9,820
The year	15,500	64	1,220	884,000

SUN RIVER AT FORT SHAW, MONT.

LOCATION.—In SW. ¼ sec. 1, T. 20 N., R. 2 W., at highway bridge at Fort Shaw, Cascade County.

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—May 16, 1912, to September 30, 1917, A station on Sun River at Sun River, maintained July 31, 1905, to December 31, 1912, gave records for practically the same drainage area.

GAGE.—Chain gage at highway bridge read since November 24, 1916, by C. G. Peterson, an employee of the United States Reclamation Service; stage prior to September 1, 1913, measured by standard chain gage fastened to footbridge near right bank and 1,000 feet downstream. Staff gage September 1, 1913, to November 23, 1916, on right bank 400 feet above highway bridge. The three gages referred to different datums.

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

CHANNEL AND CONTROL.—Bed composed of gravel and rock; fairly permanent; shifting only at extremely high stages.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 13.3 feet at 10.15 a. m. May 26 (discharge, 17,600 second-feet); minimum stage recorded, 4.70 feet December 5 (discharge, 265 second-feet); lower minimum probably occurred during frozen season.

1905–1917: Maximum stage recorded, 13.4 feet June 7, 1908 (discharge, 18,400 second-feet); minimum stage recorded at Sun River, 1.3 feet September 14, 1906 (discharge, 47 second-feet); at Fort Shaw, 1.65 feet August 5, 6, and 8, 1914 (discharge, 95 second-feet). The high-stage discharge at Fort Shaw and Sun River is practically the same but at low stages the operation of Sun River canal (capacity about 50 second-feet), which takes out between the stations, may cause a material difference.

ICE.—Stage-discharge relation affected by ice November 12–18, 28, and December 5. Flow estimated for first period, and interpolated for others. Gage-height record continuous but discharge not computed December 10 to March 31.

DIVERSIONS.—Adjudicated rights for diverting 248 second-feet from Sun River direct and 664 second-feet from tributaries above this station. In addition, the Fort Shaw canal of the United States Reclamation Service takes out about 200 second-feet during irrigation season.

REGULATION.—Willow Creek reservior has a capacity of 84,200 acre-feet.

ACCURACY.—Rating curve well defined below 1,500 second-feet; used October 1 to December 9, except during ice-affected period. Curve fairly well defined between 470 and 8,760 second-feet; used April 1 to September 30. Gage read to half tenths twice daily. Daily discharge obtained by applying mean daily gage height to rating table. Open-water records good; records for periods of ice effect fair.

Discharge measurements of Sun River at Fort Shaw, Mont., during the year ending Sept. 30, 1917.

[Made by W. A. Lamb.]

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*		*Feet.*	*Sec.-ft.*		*Feet.*	*Sec.-ft.*
Nov. 6	1.70	590	June 7	8.10	5,900	July 24	5.27	922
May 13	7.46	4,520	19	9.50	8,790	Sept. 17	4.45	451
22	7.89	5,510	July 3	7.44	4,230			

NOTE.—Gage height for measurement of Nov. 6, from old staff gage 400 feet above present chain gage. Later measurements referred to chain gage.

Daily discharge, in second-feet, of Sun River at Fort Shaw, Mont., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Apr.	May.	June.	July.	Aug.	Sept.
1	985	590	365	852	852	7,490	4,180	680	410
2	985	590	365	745	852	6,960	4,080	540	410
3	1,050	590	365	650	890	6,230	4,180	430	410
4	985	590	365	620	890	5,700	4,180	492	410
5	782	590	365	852	890	5,390	4,180	492	410
6	652	590	365	1,060	890	5,080	4,180	450	410
7	782	590	365	815	1,060	5,600	3,980	450	450
8	985	590	365	815	1,460	6,760	3,780	492	540
9	985	590	265	890	1,810	8,330	3,480	565	450
10	918	590	.....	815	2,130	9,200	3,390	515	410
11	850	590	.....	680	2,650	8,120	3,200	540	410
12	715	590	.....	780	3,390	6,650	2,830	540	390
13	652	590	.....	815	4,280	5,500	2,650	492	372
14	590	590	.....	745	5,500	5,280	2,300	470	430
15	590	590	.....	712	6,650	6,120	1,970	450	410
16	590	590	.....	680	7,919	7,800	1,970	540	410
17	590	715	.....	620	6,340	9,420	1,740	592	410
18	590	652	.....	650	4,980	9,420	1,660	515	430
19	590	590	.....	650	4,580	8,330	1,460	450	450
20	590	590	.....	712	5,180	7,700	1,390	372	442
21	590	590	.....	890	6,120	7,380	1,160	372	442
22	590	590	.....	930	5,390	6,650	970	372	453
23	590	474	.....	930	4,780	6,120	970	390	450
24	590	590	.....	1,110	4,380	5,810	890	372	582
25	590	365	.....	970	8,760	5,700	890	372	638
26	590	474	.....	970	15,400	5,280	745	372	540
27	590	365	.....	1,060	11,000	4,980	712	390	492
28	590	478	.....	1,020	9,640	5,080	620	410	484
29	590	590	.....	890	11,000	5,080	620	410	484
30	590	474	.....	890	8,540	4,780	540	430	470
31	590	.....	.....	.....	7,490	.....	620	410	.....

Monthly discharge of Sun River at Fort Shaw, Mont., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	1,050	590	708	43,500
November	715	365	566	33,700
December 1–9	365	265	354	6,320
April	1,110	620	827	49,200
May	15,400	852	5,020	309,000
June	9,420	4,780	6,600	393,000
July	4,180	540	2,240	138,000
August	680	372	463	28,500
September	638	372	450	26,800

WILLOW CREEK NEAR AUGUSTA, MONT.

LOCATION.—In NW. ¼ SW. ¼ sec. 26, T. 21 N., R. 7 W., at Clark Co.'s ranch, just below mouth of Little Willow Creek and 7 miles northwest of Augusta, in Lewis and Clark County.

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—June 8, 1905, to May 14, 1911; April 1, 1912, to September 30, 1917.

GAGE.—Chain gage on right bank, 300 feet back of Thomas Clark's house; read by Thomas Clark.

DISCHARGE MEASUREMENTS.—Made by wading or from bridge 1,000 feet below gage.

CHANNEL AND CONTROL.—An old dam of timber and rock 20 feet below gage forms the principal control; shifts slightly at long intervals.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 5.88 feet June 5 (discharge, 390 second-feet); water over gage May 25 to June 4 (discharge not determined); minimum (discharge, 13 second-feet) February 23 to March 5 and March 18–25.

1905–1917: Maximum stage recorded, 10.8 feet June 23, 1916 (discharge, 1,150 second-feet); minimum stage, dry July 17, 1910.

ICE.—Probably no ice forms at this station, as a large spring enters the creek just above gage, but winter flow should be used with caution.

DIVERSIONS.—Adjudicated water rights above station amount to 36.2 second-feet from Willow Creek and 42.26 second-feet from tributaries. The United States Reclamation Service has an old right of 2.1 second-feet and has also filed on the total flow of the creek, subject to prior appropriations. No water diverted from Willow Creek proper below station, the amount used by the United States Reclamation Service being diverted from Sun River below mouth of Willow Creek.

REGULATIONS.—None. Willow Creek dam, 2 miles below station, forms a reservoir with a capacity of 84,320 acre-feet, for use on Fort Shaw unit of Sun River project. In addition to flow of Willow Creek, water will be diverted from North Fork of Sun River for storage in this reservoir.

ACCURACY.—Stage-discharge relation not permanent; affected by occasional shifts of control, usually at high stage. Rating curve used October 1 to November 15 and March 28 to May 24 well defined between 25 and 700 second-feet; curve used June 5 to September 30 fairly well defined between 20 and 250 second-feet. Gage read to half-tenths once daily; occasionally twice daily. Daily discharge ascertained by applying daily gage height to rating table. Records fair.

Discharge measurements of Willow Creek near Augusta, Mont., during the year ending Sept. 30, 1917.

[Made by W. A. Lamb.]

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*		*Feet.*	*Sec.-ft.*
May 12	4.55	275	July 25	1.58	44.4
June 19	4.13	200	Sept. 18	.98	17.5

Daily discharge, in second-feet, of Willow Creek near Augusta, Mont., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	28	28	25	18	15	13	48	72	.....	107	36	23
2	30	28	25	18	15	13	36	82	.....	107	34	23
3	30	30	24	17	15	13	36	88	.....	101	34	23
4	31	28	22	17	15	13	30	85	.....	95	34	22
5	31	28	22	17	15	13	32	76	390	89	34	22
6	31	26	20	17	15	14	36	123	352	83	34	22
7	31	26	18	17	15	14	36	148	364	73	34	22
8	31	26	18	18	15	14	36	188	351	73	34	22
9	30	24	17	19	15	14	36	198	351	73	34	22
10	26	20	15	19	15	14	36	216	387	73	32	22
11	30	20	15	18	16	14	36	252	350	68	30	22
12	32	19	15	17	17	14	48	272	282	63	30	22
13	31	19	17	17	17	14	32	282	242	58	30	22
14	30	19	19	17	17	14	32	314	231	54	28	22
15	30	24	19	17	16	14	32	348	241	54	28	22
16	30	25	19	17	16	14	30	357	240	54	26	22
17	31	25	20	17	15	14	30	261	220	50	26	22
18	32	25	20	16	15	13	46	233	219	50	26	18
19	31	25	20	16	15	13	40	232	209	50	26	22
20	28	25	20	16	15	13	72	312	199	48	26	20
21	28	25	19	16	14	13	94	368	180	48	26	20
22	32	26	19	16	14	13	72	300	164	46	23	20
23	32	26	19	16	13	13	82	259	156	46	23	18
24	34	24	19	16	13	13	82	269	148	44	23	30
25	32	25	19	17	13	13	82	.....	134	42	22	26
26	31	26	19	17	13	14	72	.....	134	42	22	22
27	31	24	18	17	13	14	72	.....	127	40	22	20
28	31	22	17	16	13	20	72	.....	120	38	22	20
29	30	22	17	16	.....	112	48	.....	120	38	22	20
30	30	24	17	15	.....	82	54	.....	113	38	22	18
31	28	.....	17	15	.....	56	.....	.....	.....	38	23	.....

Monthly discharge of Willow Creek near Augusta, Mont., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	34	26	30.4	1,870
November	30	19	24.5	1,460
December	25	15	19.0	1,170
January	19	15	16.8	1,030
February	17	13	14.8	822
March	112	13	20.5	1,260
April	94	30	49.7	2,960
May 1–24	368	72	222	10,600
June 5–30	390	113	232	12,000
July	107	38	60.7	3,730
August	36	22	27.9	1,720
September	30	18	21.7	1,290

SOUTH FORK OF SUN RIVER AT AUGUSTA, MONT.

LOCATION.—In NW. ¼ SE. ¼ sec. 17, T. 20 N., R. 6 W., at highway bridge on road from Augusta to Craig, half a mile from Augusta, in Lewis and Clark County.

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—December 2, 1904, to September 30, 1917.

GAGE.—Original gage was vertical staff spiked to cribwork of right abutment on downstream side of bridge; a new gage installed April 17, 1907, at a different datum, was used during 1907 and 1908; records for 1909 to 1917 referred to original gage, which is read by W. J. Auchard.

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

CHANNEL AND CONTROL.—Bed of stream gravel; no definite control. One channel at low and medium stages; at high stages water overflows right bank a quarter of a mile above the gage and there are two to four channels. Control subject to change at high stages.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 5.40 feet at 7 a. m. May 26 (discharge, 2,400 second-feet); minimum stage recorded, 2.3 feet August 29–31 (discharge, 30 second-feet).

1905–1917: Maximum stage recorded, 6.8 feet June 2, 1908 (discharge, 4,300 second-feet); minimum stage, dry July 28–30, 1910.

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

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

REGULATION.—None. Melting snow in mountains caused small diurnal fluctuation during spring.

ACCURACY.—Stage-discharge relation seriously affected by channel improvements and ice. Rating curve used October 1 to November 11 well defined between 50 and 1,600 second-feet; curve used November 17 to May 10 (open-channel only) poorly defined; June 13 to September 6 well defined between 40 and 650 second-feet; September 18–30 poorly defined; November 12–16 and September 7–16, interpolated; shifting-control method used May 11 to June 12. Gage read to half-tenths once daily; during high water twice daily. Daily discharge ascertained by applying daily gage height to rating table. Records fair.

Discharge measurements of South Fork of Sun River near Augusta, Mont., during the year ending Sept. 30, 1917.

[Made by W. A. Lamb.]

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*		*Feet.*	*Sec.-ft.*		*Feet.*	*Sec.-ft.*
May 12	3.55	749	July 3	3.53	323	Aug. 22	2.50	48
23	4.05	809	25	2.75	83	Sept. 18	1.93	44.1
June 20	4.15	575						

Daily discharge, in second-feet, of South Fork of Sun River at Augusta, Mont., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	66	114	111	.....	86	170	1,500	370	76	38
2	76	114	111	.....	98	205	1,330	351	60	38
3	88	114	111	.....	98	205	1,190	314	60	38
4	76	114	98	.....	98	243	1,070	314	54	38
5	76	114	98	.....	98	243	939	278	48	48
6	76	114	98	.....	111	387	866	260	48	48
7	76	114	86	.....	111	599	898	260	60	48
8	76	114	74	.....	111	599	877	243	60	48
9	88	114	63	.....	125	693	1,020	226	60	48
10	88	114	63	.....	125	693	993	226	60	47
11	88	100	63	.....	98	746	816	226	60	47
12	88	97	63	.....	111	766	696	209	60	46
13	100	94	63	.....	98	939	596	209	48	46
14	100	92	63	.....	98	1,070	552	269	48	45
15	100	90	.....	.....	63	1,190	596	176	48	45
16	100	88	.....	.....	74	1,230	640	176	48	44
17	100	86	.....	.....	74	982	640	145	48	44
18	100	86	.....	.....	54	856	640	145	48	44
19	100	86	.....	.....	54	696	596	132	48	40
20	100	86	.....	.....	63	1,150	574	132	48	40
21	100	63	.....	.....	125	1,230	552	118	48	40
22	114	63	.....	.....	243	982	531	95	48	40
23	114	86	.....	.....	286	806	510	95	48	40
24	100	86	.....	.....	243	836	468	95	48	118
25	100	111	.....	44	243	1,790	448	95	48	94
26	127	98	.....	44	205	2,210	428	76	48	73
27	142	98	.....	44	205	1,860	408	76	38	55
28	142	98	.....	74	205	1,780	389	76	38	40
29	127	111	.....	1,120	139	1,670	389	76	30	40
30	127	111	.....	1,120	170	1,570	389	76	30	40
31	114	.....	.....	86	.....	1,530	.....	76	30	.....

NOTE.—Stage-discharge relation affected by ice Nov. 12–16 and Dec. 15–23; gage not read Dec. 24 to Mar. 24.

Monthly discharge of South Fork of Sun River at Augusta, Mont., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	142	66	99.0	6,090
November	114	63	99.0	5,890
December 1–14	111	63	83.2	2,310
March 25–31	1,120	44	362	5,030
April	286	54	130	7,740
May	2,210	170	965	59,300
June	1,500	389	718	42,700
July	370	76	179	11,000
August	76	30	49.8	3,060
September	118	38	48.7	2,900

MARIAS RIVER BASIN.

TWO MEDICINE RIVER AT FAMILY, MONT.

LOCATION.—In NE. ¼ sec. 2, T. 31 N., R. 9 W., at Holy Family Mission, in Teton County, 16 miles southeast of Browning and 6 miles above mouth of Badger Creek, the nearest tributary.

DRAINAGE AREA.—368 square miles.

RECORDS AVAILABLE.—April, 1907, to September 30, 1917.

GAGE.—Overhanging chain gage installed July 15, 1916, on left bank about 150 feet below barn belonging to Holy Family Mission; read twice daily by John Gobert. Temporary staff gage used May 4 to July 7, 1917, on account of high water. Datum of original gage, which was at same site as present gage, was lowered 0.95 foot July 21, 1908. Original chain gage and bench marks were destroyed by flood of June 2, 1913, and on June 10 a staff gage was installed at a different datum on left bank about 125 feet above site of chain gage. On July 23, 1913, this staff gage was removed to site of chain gage and was set to read 1.85 feet higher than staff gage installed June 10. Overhanging chain gage, installed September 18, 1913, was set to read 1 foot higher than staff gage installed July 23, 1913, and read to May 7, 1916, when destroyed by flood. Temporary gages at independent datum read May 16 to July 15, 1916, when present gage was installed.

DISCHARGE MEASUREMENTS.—Made by wading near gage or from old wagon bridge 3 miles above mission.

CHANNEL AND CONTROL.—Composed of gravel; shifting. Banks high and not subject to overflow except at extreme floods.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 7.65 feet June 8 (discharge 5,020 second-feet); minimum stage recorded, 2.50 feet August 23–25, September 14–16, 18, 20 (discharge, 24 second-feet).

1907–1917: Maximum stage recorded, 8.15 feet June 9, 1909 (discharge, 7,600 second-feet); undoubtedly higher in June, 1908, but no record available, as gage was washed out; minimum stage recorded, 1.3 feet January 12 to March 8, 1908 (discharge, 17 second-feet).

ICE.—Stage-discharge relation seriously affected by ice. Gage-height record continuous; flow estimated January 1, 11, 12, 19, 21–23, 28–31, February 1, 2, 18–28, March 1–5.

DIVERSIONS.—Water diverted about 2 miles above gage by ditch which supplies 100 acres on farm at the Holy Family Mission. From May 14 to October 24, a total diversion of 13,500 acre-feet was made by the United States Reclamation Service above the station to irrigate lands near Seville on the Blackfeet Indian Reservation.

REGULATION.—None.

ACCURACY.—Stage-discharge relation changed by high water occurring in May and June. Rating curve used until May 10, fairly well defined below 1,100 second-feet; curve used May 11 to September 30 well defined between 20 and 3,200 second-feet. Gage read twice daily to hundredths. Gage heights apparently in error and discharge estimated July 2–8; discharge interpolated July 18 and 19. Records good.

Discharge measurements of Two Medicine River near Family, Mont., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Mar. 6	A. H. Tuttle	2.28	73	July 23	W. A. Lamb	3.59	282
May 15	W. A. Lamb	6.35	3,240	Aug. 22	do	2.55	30.0
June 16	do	5.60	2,250	Sept. 16	do	2.47	23.8
July 1	do	4.63	1,250				

NOTE.—Measurements of May 15, June 16, and July 1 made from highway bridge 3 miles above gage; others by wading near gage.

Daily discharge, in second-feet, of Two Medicine River at Family, Mont., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	160	184	92	77	70	75	77	256	2,320	1,220	110	42
2	160	149	149	77	67	75	109	274	2,860	1,150	90	30
3	149	197	124	64	67	76	77	330	2,480	970	90	35
4	149	256	109	70	77	76	118	526	2,110	1,000	99	30
5	149	225	109	70	80	77	128	446	2,170	940	90	35
6	149	172	118	70	80	77	194	678	2,170	950	80	35
7	149	149	149	64	77	77	225	1,010	2,410	930	90	30
8	160	197	84	77	84	84	256	1,220	5,020	916	99	35
9	128	197	84	77	84	77	274	1,530	3,640	818	80	35
10	128	197	100	77	92	70	352	1,760	3,380	818	80	35
11	128	172	92	75	92	77	310	2,600	3,180	867	80	35
12	128	149	109	72	92	77	420	1,760	2,260	769	72	30
13	128	149	92	70	92	64	373	3,120	2,290	720	63	30
14	128	100	84	70	92	70	420	3,240	2,170	576	48	24
15	138	84	84	70	92	64	330	3,570	2,110	576	42	24
16	138	64	80	70	92	70	256	4,740	3,120	491	35	24
17	138	128	128	70	77	70	225	2,600	3,050	454	35	30
18	128	109	109	77	.....	70	225	2,350	3,050	441	35	24
19	149	149	109	77	.....	70	197	2,230	2,790	428	30	30
20	149	172	109	77	.....	70	225	2,110	2,530	416	35	24
21	149	160	172	77	.....	70	330	2,350	2,230	323	35	30
22	149	160	80	77	.....	70	526	2,110	1,870	295	30	30
23	149	149	62	77	.....	70	498	2,110	1,990	271	24	30
24	149	113	77	77	.....	70	526	2,110	1,760	226	24	30
25	138	109	128	77	.....	58	526	2,790	1,760	172	24	56
26	138	138	109	70	.....	58	471	2,600	1,700	144	30	48
27	138	109	109	77	.....	64	373	3,120	1,540	144	30	48
28	291	109	92	75	.....	77	274	3,180	1,430	144	35	42
29	471	77	58	70	.....	77	274	3,240	1,220	144	30	42
30	471	109	77	70	.....	70	274	2,720	1,380	132	35	35
31	197	.....	77	70	.....	64	.....	2,530	.....	120	35	.....

Monthly discharge of Two Medicine River at Family, Mont., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	471	128	170	10,400
November	256	64	148	8,810
December	172	58	102	6,270
January	77	64	73.2	4,500
February	92	67	79.7	4,430
March	84	58	71.4	4,390
April	526	77	295	17,600
May	4,740	256	2,100	129,100
June	5,020	1,220	2,400	143,000
July	1,220	120	567	34,900
August	110	24	55.3	3,400
September	56	24	33.6	2,000
The year	5,020	24	509	369,000

MARIAS RIVER NEAR SHELBY, MONT.

LOCATION.—In sec. 20, T. 31 N., R. 2 W., at highway bridge near James A. Johnson's ranch, 7 miles south of Shelby, in Toole County.

DRAINAGE AREA.—2,610 square miles.

RECORDS AVAILABLE.—April 4, 1902, to January 12, 1908; April 23, 1911, to September 30, 1917.

GAGE.—Chain gage on downstream side of bridge. April 4, 1902, to January 12, 1908, chain gage on highway bridge, 100 feet below present bridge; during 1911 and 1912 Bristol water-stage recorder; all gages at practically the same datum. Gage read by G. J. Moser to November 18, 1916, and by Emma Moser April 4, to September 30.

DISCHARGE MEASUREMENTS.—Made from downstream side of highway bridge.

CHANNEL AND CONTROL.—Bed composed of gravel and boulders; control shifts. Left bank steep and high; not subject to overflow. Right bank gently sloping; subject to overflow at extreme stages.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year 8.4 feet May 31 (discharge, 10,000 second-feet); minimum stage recorded, 2.4 feet September 17–21 (discharge, 274 second-feet).

1902–1907 and 1911–1917: Maximum stage recorded, 14.9 feet June 24, 1907 (discharge, 29,500 second-feet); minimum stage recorded, 1.7 feet November 16–20, 1904 (discharge, 150 second-feet).

ICE.—Stage-discharge relation affected by ice November 15–18 and April 4–6; observations discontinued November 19 to April 3.

DIVERSIONS.—The Valier-Montana Land & Water Co.'s Carey project and the Blackfeet project of United States Reclamation Service divert water above this station; also a number of smaller private diversions.

REGULATION.—None.

ACCURACY.—Stage-discharge relation not permanent; affected by shift of control and by ice. Rating curve used October 1 to November 14 fairly well defined; shifting-control method used April 7 to May 31; curve used June 1 to September 30 well defined between 350 and 10,000 second-feet. Gage read to tenths (occasionally to half-tenths) once daily. Daily discharge ascertained by applying daily gage height to rating table. Records October 1 to November 14, fair; April 7 to May 31, poor; June 1 to September 30, good.

Discharge measurements of Marias River near Shelby, Mont., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*
Apr. 17	W. A. Lamb	3.45	852
June 12	....do	7.85	8,680
Sept. 14	C. S. Heidel	2.54	370

Daily discharge, in second-feet, of Marias River near Shelby, Mont., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Apr.	May.	June.	July.	Aug.	Sept.
1	550	780	.....	1,060	7,340	3,330	668	600
2	595	700	.....	1,260	7,580	3,500	668	600
3	640	620	.....	1,480	6,620	3,160	668	510
4	686	700	.....	1,480	5,230	3,160	600	420
5	732	620	.....	1,650	7,580	2,700	600	476
6	778	700	.....	1,820	7,340	2,700	536	368
7	824	620	1,370	2,260	4,030	2,700	536	420
8	870	550	3,830	2,700	5,910	3,330	476	420
9	780	480	3,340	3,130	5,680	3,160	600	368
10	780	550	2,870	4,530	5,730	3,160	536	368
11	700	480	2,420	4,670	6,780	3,000	600	368
12	700	410	1,950	4,390	8,830	3,160	536	320
13	700	350	1,480	5,370	7,340	1,780	476	320
14	700	410	1,590	7,080	5,680	2,020	420	320
15	620	.....	1,340	6,210	5,230	1,160	368	368
16	700	.....	1,090	6,210	5,800	1,240	368	320
17	620	.....	850	6,350	6,140	1,160	320	274
18	620	.....	875	5,650	7,340	980	536	274
19	620	.....	900	4,950	7,340	1,020	420	274
20	620	.....	825	6,350	6,380	980	476	274
21	410	.....	900	6,070	6,380	1,060	420	274
22	620	.....	900	5,790	5,680	1,160	368	320
23	620	.....	900	5,510	5,230	896	420	320
24	700	.....	1,700	5,370	4,610	740	368	368
25	700	.....	1,700	5,930	4,610	816	320	476
26	620	.....	1,620	6,930	6,860	740	420	476
27	620	.....	1,550	7,080	3,160	816	368	420
28	620	.....	1,480	7,230	4,220	740	368	368
29	620	.....	1,340	6,930	3,850	668	420	320
30	620	.....	1,200	8,460	3,330	668	476	320
31	700	.....	.....	10,000	.....	740	600	.....

NOTE.—Stage-discharge relation affected by ice Nov. 15–18 and Apr. 4–6. Gage not read Nov. 19 to Apr. 3; also Oct. 1–7, Apr. 5, 9–12, 15, 16, 18, 26, 27, 29, 30, May 5, 7, 8, 21, June 10, 11, Sept. 3 and 19.

Monthly discharge of Marias River near Shelby, Mont., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	870	410	667	41,000
November 1–14	780	350	569	23,700
April 7–30	3,830	825	1,580	75,200
May	10,000	1,060	4,960	305,000
June	8,830	3,160	5,930	353,000
July	3,500	668	1,820	112,000
August	668	320	482	29,600
September	600	274	377	22,400

BADGER CREEK NEAR FAMILY, MONT.

LOCATION.—In NE. ¼ sec. 19, T. 31 N., R. 8 W., near road crossing 4 miles east of Family, in Teton County.

DRAINAGE AREA.—241 square miles (revised); measured on topographic maps.

RECORDS AVAILABLE.—April 20, 1907, to September 30, 1917.

GAGE.—Chain gage read October 1–31, 1916, by O. J. Racine, and June 1, to September 30, by Joe Trombley. April 1, to May 31, by Aaron Racine. The original staff gage established April 20, 1907, and bench marks were washed out in the flood of June, 1908. New chain gage was established July 22, 1908, 400 feet farther upstream at a different datum. This gage was washed out May 25, 1909, and a new gage reset at different datum on the right bank, 400 feet below the old Piegan Mission crossing.

DISCHARGE MEASUREMENTS.—Made from a cable 4 miles above the gage or by wading at ford.

CHANNEL AND CONTROL.—Shifting; two channels at medium and low stages; several channels at high stage. Banks low and subject to overflow above gage.

EXTREMES OF DISCHARGE.—Maximum stage recorded during the year, 6.30 feet at 9 a. m., June 12 (discharge, 1,910 second-feet); minimum stage recorded, 4.15 feet at 6 p. m., April 18 (discharge, 122 second-feet).

1907–1917: Maximum stage recorded is that of June 12, 1917; minimum stage recorded, 3.45 feet September 25, 28, 30, 1914 (discharge, 92 second-feet); records for open-water season only; mean discharge for February, 1911, estimated at 25 second-feet.

ICE.—Observations discontinued during winter.

DIVERSIONS.—United States Reclamation Services proposes to divert the natural flow of Badger Creek to irrigate land in the eastern part of Blackfeet Indian Reservation north of Birch Creek. A small amount of water was diverted in 1917 above gage.

REGULATION.—None.

ACCURACY.—Stage-discharge relation changed June 10–19. Gage heights October 1–31 are the mean of two readings daily to half-tenths; June 1 to September 30 are the mean of two readings daily to nearest tenth. Records considered fair. Daily discharge October 1–31, April 14–20, and May 30 to June 9 are determined from a rating curve well defined between 160 and 1,600 second-feet; June 10–19 determined by indirect method for shifting control; June 20 to September 30 determined from a rating curve well defined between 140 and 800 second-feet. Records good after June 20; previous to that, fair.

Discharge measurements of Badger Creek near Family, Mont., during the year ending Sept. 30, 1917.

[Made by W. A. Lamb.]

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*		*Feet.*	*Sec.-ft.*		*Feet.*	*Sec.-ft.*
May 15	6.02	1,570	July 23	4.70	309	Sept. 16	4.31	165
July 1	5.42	733	Aug. 22	4.33	167			

NOTE.—Measurement May 15 made partly by wading and partly by floats; soundings from measurement of July 23. Measurement July 1 made 1 mile above gage. Other measurements made by wading at gage.

Daily discharge, in second-feet, of Badger Creek near Family, Mont., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Apr.	May.	June.	July.	Aug.	Sept.
1	275	.....	.....	.....	1,300	725	223	161
2	275	.....	.....	.....	1,480	725	223	136
3	265	.....	.....	.....	1,240	655	190	190
4	216	.....	.....	.....	1,120	725	223	190
5	189	.....	.....	.....	1,120	655	223	190
6	189	.....	.....	.....	1,180	690	190	161
7	202	.....	.....	.....	1,480	655	223	161
8	189	.....	.....	.....	1,740	620	223	161
9	189	216	.....	.....	1,910	585	190	161
10	202	.....	.....	.....	1,680	585	190	161
11	189	.....	.....	.....	1,480	554	190	161
12	189	.....	.....	.....	1,220	522	190	161
13	189	.....	.....	.....	1,030	522	161	161
14	189	.....	140	.....	950	460	161	161
15	202	.....	160	1,570	1,220	431	161	161
16	189	.....	140	.....	1,490	402	161	164
17	189	.....	140	.....	1,660	402	161	161
18	189	.....	122	.....	1,580	350	161	158
19	189	.....	180	.....	1,320	350	161	156
20	189	.....	225	.....	1,180	350	161	154
21	189	.....	.....	.....	1,120	303	161	154
22	189	.....	.....	.....	1,020	303	167	154
23	189	.....	.....	.....	970	303	136	148
24	202	.....	.....	.....	925	261	136	223
25	202	.....	.....	.....	925	261	136	216
26	202	.....	.....	.....	880	261	136	164
27	189	.....	.....	.....	880	261	136	161
28	189	.....	.....	.....	800	223	136	161
29	189	.....	.....	.....	840	223	136	148
30	202	.....	.....	1,420	762	223	161	148
31	189	.....	.....	1,240	.....	223	161	.....

Monthly discharge of Badger Creek near Family, Mont., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	275	189	201	12,400
June	1,910	762	1,220	72,600
July	725	223	445	27,400
August	223	136	175	10,600
September	223	136	165	9,820

BIRCH CREEK AT SWIFT DAM, NEAR DUPUYER, MONT.

LOCATION.—At Swift dam, on south boundary of Blackfeet Indian Reservation, Teton County, 20 miles west of Dupuyer and 34 miles west of Valier. North and South forks of Birch Creek unite in reservoir above station.

DRAINAGE AREA.—120 square miles.

RECORDS AVAILABLE.—March 26, 1913, to September 30, 1917.

GAGE.—Vertical iron gage on right bank 800 feet below dam, read by Herbert C. Stalzer. Prior to July 11, 1915, a vertical wooden staff on right bank a quarter of a mile below dam was read, except June 5 to July 16, 1913, when a temporary gage on left bank immediately below dam was used to obtain high-water records. Gage for spillway overflow is inclined staff attached to left wall of the concrete canal which carries the overflow away from spillway.

DISCHARGE MEASUREMENTS.—Discharge through valves measured from footbridge 300 feet above gage or by wading near gage. The spillway overflow is measured from a footbridge or by wading on crest of spillway.

CHANNEL AND CONTROL.—Stream bed clean, coarse gravel and boulders. Banks at gage high; not subject to overflow, but at old gage site 500 feet below may be overflowed at extreme stages. Canal from spillway has concrete lining not subject to shifts.

EXTREMES OF DISCHARGE—Maximum combined flow through gates and over spillway occurred on June 17 (total discharge, 1,180 second-feet); minimum flow estimated at 1 second-foot February 14–29, March 28 to April 21.

1913–1917: Maximum discharge, 5,275 second-feet at 5 a. m. June 21, 1916; minimum discharge, 0.9 second-foot March 6, 1915. Minimum flow is controlled and maximum partly regulated by valves at dam.

ICE.—Stage-discharge relation seriously affected by ice January 18–23 and February 1 to March 27. Discharge interpolated January 18–23; February 1–5 by interpolation from measurements January 31 and February 6; February 7–13, estimated. Gates closed February 14–28. Flow estimated 1 second-foot daily. March 1–27 flow estimated by observer from gate openings on following dates and discharge computed accordingly: March 1, 20 second-feet; March 4, 20 second-feet; March 14, 60 second-feet; March 22, 40 second-feet.

DIVERSIONS.—Two small ditches divert water just below dam and above gage.

REGULATION.—Dam is used to store flood and winter flow, and during dry periods will release no more water than can be handled by the canal system of the Valier Carey project in addition to amount required by prior rights. Acre-feet in storage at end of each month was as follows: October, 2,760; November, 0; December, 0; January, 0; February, 1,940; March, 3,065; April, 6,092; May, 18,610; June, 29,750; July, 21,790; August, 8,080; September, 0.

DETERMINATION OF DISCHARGE.—Flow through gates in dam passes down main channel past gage; flow over spillway passes down an artificial channel and joins creek about a quarter of a mile below dam and below gage. Gage heights indicate flow through gates not diverted between dam and gage. Flow over spillway computed from gage heights by observer by applying same to rating table for short periods of each day and mean discharge for 24 hours computed. Total mean daily flow from reservoir is obtained by adding mean daily discharge from spillway to mean daily flow past gage. Spillway overflowed June 16 to July 3.

ACCURACY.—Stage-discharge relation permanent for both gages. Rating curve used October 1 to June 1 for gage in channel conveying flow from valves well defined; shifting control method used June 2 to September 30. Rating curve for gage in spillway fairly well defined below 3,000 second-feet, and roughly approximate above 3,000 second-feet. Gage in channel from valves read twice daily to hundredths. Gage in spillway channel read several times daily June 16–23 and 30 and once daily June 24–29 and July 1–3; no flow over spillway during rest of year. Comparison of records for this station with those for Birch Creek near Dupuyer indicates that one or the other is in error June 1 to August 31.

COOPERATION.—All field data furnished by the engineering department of the Valier-Montana Land & Water Co.; computations made by United States Geological Survey.

Discharge measurements of Birch Creek through valves at Swift dam, near Dupuyer, Mont., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Jan. 9	Ebner and Atwood	2.17	69	June 18	Ebner and Wardwell	3.65	578
Feb. 6	do	3.45	64	Aug. 22	Ebner and Atwood	3.18	370
Apr. 3	G. Ebner	1.15	1.3	Sept. 2	Wardwell and Gleason	3.12	295
June 1	Ebner and Smith	3.46	555	27	G. Ebner	2.80	174

NOTE.—Measurements made by employees of the Valier-Montana Land & Water Co.

Discharge measurements of Birch Creek, showing flow over spillway of Swift dam, near Dupuyer, Mont., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*
June 18	Ebner and Wardwell	2.40	505
30	.....do	1.18	153

NOTE.—Measurements made by employees of the Valier-Montana Land & Water Co.

Daily discharge, in second-feet, of Birch Creek at Swift dam, near Dupuyer, Mont., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	263	197	87	76	70	20	1	159	565	864	360	295
2	259	197	87	79	69	20	1	175	557	832	365	295
3	259	187	87	74	68	20	1	178	549	664	365	291
4	259	187	87	71	66	20	1	187	549	581	365	286
5	259	187	84	71	65	20	1	197	549	581	365	286
6	259	187	84	68	64	20	1	197	541	573	365	286
7	259	187	84	68	60	20	1	197	533	573	365	286
8	259	184	84	68	60	20	1	207	525	573	365	286
9	259	178	84	67	60	20	1	227	518	581	365	282
10	259	167	84	68	60	20	1	241	510	581	360	282
11	259	167	84	74	20	20	1	256	510	581	365	282
12	259	167	84	74	20	20	1	295	503	503	360	282
13	259	164	82	70	20	40	1	332	533	406	365	282
14	259	159	81	70	1	60	1	400	605	376	370	282
15	252	156	81	71	1	60	1	496	630	376	365	278
16	238	153	79	76	1	60	1	510	826	370	365	278
17	230	153	79	77	1	60	1	503	1,180	370	370	278
18	227	148	79	76	1	60	1	503	1,080	370	370	271
19	220	148	79	72	1	60	1	503	1,050	354	370	271
20	220	143	77	68	1	60	1	503	1,030	354	370	263
21	220	140	76	66	1	60	1	503	965	360	370	244
22	220	133	76	62	1	40	41	510	872	360	370	238
23	216	128	76	58	1	40	46	510	775	354	365	238
24	216	117	76	57	1	40	52	510	740	360	360	210
25	213	133	79	52	1	40	55	533	739	354	348	197
26	213	148	77	64	1	40	74	541	605	354	338	178
27	213	133	76	57	1	25	91	541	734	360	327	173
28	213	117	77	57	1	1	91	549	680	360	309	150
29	210	106	79	64	.....	1	91	557	637	360	304	110
30	207	102	79	68	.....	1	104	565	724	365	300	96
31	207	.....	79	71	.....	1	.....	573	.....	365	295	.....

NOTE.—The above table shows flow through valves and over spillway. Gates closed Feb. 14–28 and Mar. 28 to Apr. 21; flow estimated at 1 second-foot, and represents leakage through gates. Mar. 1–27 flow estimated by observer, based upon gate openings, as stage-discharge relation was affected by backwater from ice in channel. See "Ice" for periods Jan. 18–23 and Feb. 1–13.

Monthly discharge of Birch Creek at Swift dam, near Dupuyer, Mont., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	263	207	238	14,600
November	197	102	156	9,280
December	87	76	80.9	4,970
January	79	52	68.2	4,190
February	.....	.....	25.6	1,420
March	.....	.....	31.9	1,960
April	104	.....	22.2	1,320
May	573	159	392	24,100
June	1,180	503	694	41,300
July	864	354	465	28,600
August	370	295	355	21,800
September	295	96	249	14,800
The year	1,180	.....	233	168,000

NOTE.—The above table shows total flow through valves and over spillway. Minimum flow of February, March, and April estimated at 1 second-foot, and represent leakage through gates which were closed during parts of these months.

BIRCH CREEK NEAR DUPUYER, MONT.

LOCATION.—In sec. 28, T. 29 N., R. 8 W., at Kepple's ranch, half a mile above head gates of B canal of Valier-Montana Land & Water Co., 12 miles northwest of Dupuyer, Teton County, and 20 miles above mouth of Dupuyer Creek.

DRAINAGE AREA.—155 square miles (measured on Land Office map).

RECORDS AVAILABLE.—July 25, 1907, to September 30, 1917.

GAGE.—Vertical 1-inch square steel bar marked to tenths located same as previous one; was replaced July 5, 1916, and referred to approximately the same datum as the previous gages at this location. May 12 a high-water staff gage was set at this same section but was not used. Low-water section was washed out June 18 and a new one installed on June 19, which was loose and unsatisfactory until June 30, when it was set to correct datum and securely fastened. June 23–30 the old sloping gage was read. Gage read by John Ryan.

A chain gage on right bank about 250 feet below inclined staff was used July 25, 1907, until June, 1908, when it was washed out. A temporary staff 200 feet below old chain gage was used July 23 to October 1, 1908, when a new chain gage was installed on right bank a quarter of a mile above old site. Chain gage used until December 31, 1913. Inclined staff read with datum unchanged January 1, 1914, to December 31, 1915. There is no relation determined between gage datums for the different sections. January 1, 1916, a vertical 1-inch square steel bar marked to tenths and located about 1,000 feet downstream was used. This was washed out June 21, 1916; observer set temporary gage at same location June 23 and it was read until July 5, 1916.

DISCHARGE MEASUREMENTS.—Made by wading or from cable. Cable originally 100 feet below inclined gage, but was moved downstream to 75 feet below new vertical steel staff; washed out June 21, 1916, and replaced May 7, 1917, at original site.

CHANNEL AND CONTROL.—Rock and gravel at inclined gage; principal control is riffle about 100 feet below; shifting. Large clean gravel at new gage section; control is gravel bar about 250 feet below gage. Banks at both sections are of medium height covered with brush and subject to overflow.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 6.62 feet June 17 (discharge, 1.080 second-feet); minimum stage recorded, 3.66 feet April 19 (discharge, 28 second-feet). A lower stage may have been reached during the winter period.

1907–1917: Maximum stage recorded, 10.0 feet June 21, 1916 (discharge estimated, 5,000 second-feet); minimum stage recorded April 21–30, 1915 (discharge 7 second-feet.)

ICE.—Stage-discharge relation seriously affected by ice; data inadequate to warrant estimates of flow December 12 to April 6.

DIVERSIONS.—Two or three small ditches divert above station.

REGULATION.—The flow is largely controlled by Swift dam at the Birch Creek reservoir with a storage capacity of 30,000 acre-feet, 12 miles upstream from station.

ACCURACY.—Stage-discharge relation affected by shifting control. Rating curve used October 1 to June 20 well defined between 20 and 1,000 second-feet; curve used June 21-30 based on gage heights of inclined gage, fairly well defined between 600 and 850 second-feet; July 1, to September 30 well defined between 80 and 750 second-feet. Gage read to hundredths once daily. Daily discharge obtained by applying daily gage height to rating table. Records fair.

COOPERATION.—Gage heights and most of discharge measurements furnished by engineering department of Valier-Montana Land & Water Co.

Discharge measurements of Birch Creek near Dupuyer, Mont., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Oct. 16	Ebner and Dean [a]	4.89	245	May 3	Ebner and Stalzer [a]	4.71	182
Dec. 22	Ebner and Palin [a]	6.04	78.2	5	G. Ebner	4.70	185
Jan. 6	do	5.35	84.1	12	Ebner and Gleason [a]	5.32	359
23	Ebner and Piper [a]	5.60	68.6	June 19	Ebner and Wardwell [a]	6.40	926
Feb. 9	G. Ebner	5.90	79	23	T. M. Wardwell	5.82	725
28	Atwood [a] and Ebner	3.75	25.0	30	Ebner and Wardwell	5.86	743
Mar. 17	Ebner and English [a]	3.70	20.1	July 21	T. M. Wardwell	5.08	384
Apr. 7	do	4.72	49.6	Aug. 17	do	4.95	328
19	Ebner and Heidel	3.66	29.1	Sept. 17	Ebner and Carmody [a]	4.69	270

[a] Employee of Valier-Montana Land & Water Co.

Daily discharge, in second-feet, of Birch Creek near Dupuyer, Mont., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Apr.	May.	June.	July.	Aug.	Sept.
1	245	206	110	.....	138	562	715	352	304
2	245	206	110	.....	161	430	663	352	304
3	245	206	118	.....	184	391	663	352	304
4	245	206	118	.....	184	391	663	352	304
5	245	206	127	.....	184	373	663	352	288
6	245	195	127	.....	200	373	663	352	288
7	245	195	110	145	216	373	663	352	288
8	245	190	85	82	231	373	663	352	288
9	245	184	110	55	245	373	663	352	288
10	231	184	102	55	289	373	663	352	288
11	231	184	102	50	321	430	562	352	274
12	231	174	.....	44	355	430	562	352	274
13	231	164	.....	44	391	493	427	352	274
14	231	145	.....	42	450	493	388	336	274
15	231	145	.....	39	515	493	388	336	259
16	231	184	.....	39	515	515	388	336	259
17	231	174	.....	34	515	1,080	388	336	259
18	231	174	.....	30	515	860	388	336	246
19	231	164	.....	28	515	930	388	336	246
20	218	174	.....	29	562	860	388	319	232
21	218	164	.....	30	562	798	388	319	232
22	218	154	.....	30	515	750	388	319	232
23	218	154	.....	35	515	708	388	319	232
24	206	145	.....	35	515	665	388	319	220
25	206	145	.....	40	515	590	388	319	207
26	206	136	.....	45	538	590	388	319	207
27	206	136	.....	69	515	590	370	319	184
28	206	118	.....	85	613	590	352	319	184
29	206	110	.....	100	562	590	352	319	163
30	206	110	.....	115	538	665	352	319	144
31	206	.....	.....	.....	613	.....	352	319	.....

NOTE.—Discharge interpolated on account of no gage-height record Oct. 13, Nov. 8, Apr. 14, 28, 29, May 1, 2, 4, 6, and 7.

Monthly discharge of Birch Creek near Dupuyer, Mont., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	245	206	227	14,000
November	206	110	168	10,000
December 1–11	127	85	111	2,420
April 7–30	145	28	54.2	2,580
May	613	138	409	25,100
June	1,080	373	571	34,000
July	715	352	486	29,900
August	352	319	336	20,700
September	304	144	252	15,000

BIRCH CREEK AT NELSON'S RANCH, NEAR DUPUYER, MONT.

LOCATION.—In NW. ¼ sec. 27, T. 29 N., R. 8 W., a quarter of a mile below headworks of B canal of Valier-Carey project, at Nelson's ranch, 11 miles northwest of Dupuyer, in Teton County.

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—May 8, 1914, to September 30, 1917.

GAGE.—Vertical iron staff on right bank a short distance above the ranch building; read since July 1, 1916. The inclined wooden staff at same location and datum used prior to June 18, 1916, was destroyed by flood June 19–21, 1916; gage read by John Ryan.

DISCHARGE MEASUREMENTS.—Made by wading 100 feet above gage.

CHANNEL AND CONTROL.—Composed of cobblestones and gravel; shifts at extreme floods. Occasionally obstructed by growth of aquatic plants in summer.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 5.30 feet June 18 (discharge, 1,040 second-feet); minimum stage recorded was 2.70 feet September 22, 25, and 26 (discharge, 14 second-feet).

1914–1917: Maximum stage recorded, 5.30 feet June 18, 1917 (discharge, 1,040 second-feet); a higher stage occurred June 19–21, 1916, when gage was washed away (stage and discharge unknown). No flow October 18–24, 1914, March 28 to April 5 and April 8–30, 1915.

ICE.—Stage-discharge relation seriously affected by ice December 8 to March 19; data are inadequate to compute flow for period; gage-height record practically complete for period.

DIVERSIONS.—The B canal and several small ditches divert water above station.

REGULATION.—Except during floods, the discharge is controlled by Swift dam and by the headworks of B canal.

ACCURACY.—Stage-discharge relation permanent during open-channel periods. Rating curve based on 6 measurements and is very well defined between 25 and 350 second-feet. Gage read to hundredths once daily. Daily discharge ascertained by applying daily gage height to rating table. Records good.

COOPERATION.—Gage heights and some of discharge measurements furnished by engineering department of Valier-Montana Land & Water Co.

Discharge measurements of Birch Creek at Nelson's ranch, near Dupuyer, Mont., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Oct. 16	G. Ebner[a]	3.79	241	July 14	Wardwell and Ebner	3.42	121.2
Apr. 19	Ebner and Heidel	2.89	30.7	July 21	T. M. Wardwell	3.15	62.2
Aug. 17	T. M. Wardwell[a]	3.12	59				

[a] Employee of Valier-Montana Land & Water Co.

Daily discharge, in second-feet, of Birch Creek at Nelson's ranch, near Dupuyer, Mont, for the year ending Sept., 30, 1917.

Day.	Oct.	Nov.	Dec.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	255	219	141	.....	27	.....	710	600	59	52
2	255	219	100	.....	.....	.....	562	567	59	52
3	255	219	102	.....	.....	179	512	545	59	52
4	259	215	119	.....	.....	.....	485	545	62	52
5	259	211	138	.....	438	.....	480	545	61	52
6	259	211	138	.....	141	.....	480	518	59	52
7	263	211	156	.....	72	.....	474	490	59	52
8	263	209	.....	.....	56	.....	474	490	59	52
9	259	207	.....	.....	51	.....	474	490	59	52
10	250	207	.....	.....	43	.....	490	490	59	52
11	246	204	.....	.....	39	.....	572	438	59	51
12	246	190	.....	.....	34	.....	534	396	59	51
13	246	166	.....	.....	33	.....	655	242	59	51
14	246	141	.....	.....	32	.....	655	141	58	51
15	246	141	.....	.....	32	545	655	72	58	51
16	246	190	.....	.....	27	545	677	69	58	51
17	246	156	.....	.....	22	545	858	66	58	51
18	246	150	.....	.....	32	545	1,040	64	56	51
19	238	163	.....	.....	31	545	875	64	56	53
20	238	172	.....	792	31	600	858	64	56	53
21	230	163	.....	518	32	611	836	64	56	53
22	230	156	.....	386	32	594	732	64	56	14
23	226	147	.....	572	34	589	710	64	56	56
24	226	144	.....	682	34	589	710	62	56	56
25	226	133	.....	694	39	589	644	62	56	14
26	226	125	.....	738	43	644	644	62	56	14
27	226	119	.....	638	76	594	545	61	55	59
28	226	117	.....	572	.....	732	545	59	53	59
29	226	114	.....	584	.....	710	545	59	53	56
30	223	128	.....	545	.....	682	545	59	53	56
31	219	.....	.....	412	.....	765	.....	59	53	.....

NOTE.—No gage heights on following days: Oct. 13, Nov. 8, Apr. 14 and June 17 (discharge interpolated); Apr. 2–4, Apr. 28 to May 2, May 4–14 (discharge not determined owing to diversions).

Monthly discharge of Birch Creek at Nelson's ranch, near Dupuyer, Mont., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	263	219	242	14,900
November	219	114	172	10,200
December 1–7	156	100	128	1,780
March 20–31	792	386	594	14,200
June	1,040	474	632	37,600
July	600	59	244	15,000
August	62	53	57.3	3,520
September	59	14	49.0	2,920

BIRCH CREEK AT ROBARE, MONT.

LOCATION.—In N. ½ sec. 31, T. 30 N., R. 7 W., near former post office of Robare, 14 miles west of Valier and 10 miles north of Dupuyer, in Teton County.

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—June 4, 1914, to September 30, 1917.

GAGE.—An inclined staff on right bank, half a mile downstream from old post office at Robare. This was washed out in spring of 1917. April 14, 1917, a vertical steel staff graduated to tenths was installed at the same location and the same datum.

DISCHARGE MEASUREMENTS.—Made by wading near the gage.

CHANNEL AND CONTROL.—Bed of stream is composed of cobblestones and is fairly permanent. Stream flows in two channels at high stages.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 3.45 feet June 18 (discharge, 870 second-feet); minimum stage recorded, 1.25 feet September 26 (discharge, 24 second-feet).

1914–1917: Maximum stage recorded, 4.11 feet June 17, 1916 (discharge, 1,010 second-feet); minimum stage, 1.64 feet May 11, 1915 (discharge, 0.4 second-foot).

ICE.—Stage-discharge relation seriously affected by ice. Observations discontinued November 10 to April 13.

DIVERSIONS.—Most of water at ordinary stages is diverted or stored above station.

REGULATION.—Discharge largely controlled by operation of Swift dam, the B canal headworks, and several smaller ditches.

ACCURACY.—Stage-discharge relation affected by shifting control. The rating curves are well defined except at high stages. Shifting-control method used July 11–19. Gage read to hundredths once daily. Daily discharge obtained by applying daily gage height to rating table. Records good.

COOPERATION.—Discharge measurements and gage heights furnished by engineering department of Valier-Montana Land & Water Co.

Discharge measurements of Birch Creek at Robare, Mont., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec. ft.*			*Feet.*	*Sec. ft.*
Apr. 14	Ebner and Angell	1.33	44.1	July 20	G. Ebner	1.52	55.9
May 9	Ebner and Hipp	2.05	237	28	Wardwell and Ebner	1.42	36.6
July 10	G. Ebner	2.58	459	Sept. 6	G. Ebner	1.44	39.3

NOTE.—Measurements made by employees of engineering department of Valier-Montana Land & Water Co.

Daily discharge, in second-feet, of Birch Creek at Robare, Mont., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Apr.	May.	June.	July.	Aug.	Sept.
1	268	233	.....	164	578	534	38	47
2	276	236	.....	192	574	520	37	46
3	272	233	.....	192	448	506	38	46
4	281	233	.....	192	430	506	50	46
5	276	233	.....	181	439	484	40	46
6	276	229	.....	206	452	493	45	42
7	268	225	.....	225	430	466	45	44
8	268	229	.....	225	434	462	45	41
9	264	229	.....	236	444	466	46	44
10	264	.....	.....	272	462	466	46	44
11	256	.....	.....	281	547	457	46	44
12	256	.....	.....	293	547	376	42	41
13	256	.....	.....	358	560	297	45	41
14	256	.....	45	380	565	155	44	41
15	256	.....	45	448	556	125	44	49
16	260	.....	47	457	565	116	45	41
17	264	.....	41	452	805	62	44	41
18	260	.....	40	452	870	59	45	42
19	252	.....	41	470	770	52	45	44
20	252	.....	41	493	795	53	46	44
21	252	.....	45	506	745	53	47	41
22	248	.....	45	493	655	53	47	37
23	248	.....	47	480	646	44	46	40
24	248	.....	47	480	650	42	46	53
25	244	.....	48	516	610	40	46	50
26	244	.....	55	520	610	40	44	24
27	248	.....	79	516	560	40	45	52
28	236	.....	104	583	516	38	46	53
29	236	.....	112	624	520	38	46	49
30	236	.....	109	588	520	38	46	45
31	233	.....	.....	578	.....	38	46	.....

NOTE.—Gage not read Sept. 29 and 30; discharge interpolated.

Monthly discharge of Birch Creek at Robare, Mont., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	281	233	257	15,800
November 1-9	236	225	231	4,120
April 14-30	112	40	58.3	1,970
May	624	164	389	23,900
June	870	430	577	34,300
July	534	38	230	14,100
August	50	37	44.5	2,740
September	53	24	43.9	2,610

DUPUYER CREEK NEAR VALIER, MONT.

LOCATION.—In NE. ¼ NW. ¼ sec. 33, T. 29 N., R. 6 W., at Cowell ranch, 1,000 feet above diversion dam at head of D canal from Dupuyer Creek to Lake Frances reservoir and outlet of B canal, which diverts water from Birch Creek to Dupuyer Creek; 6 miles below mouth of Sheep Creek and 11 miles southwest of Valier, Teton County, the nearest railway point.

DRAINAGE AREA.—111 square miles (measured by Valier-Montana Land & Water Co.).

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

GAGE.—Vertical steel staff on right bank, 1,000 feet above diversion dam, since June 23, 1916; read by E. D. Perkins. An overhanging chain gage was used to May 15, 1913; a vertical wooden staff May 16, 1913, to April 1, 1914; an inclined wooden staff April 2, 1914, to March 12, 1915; and a vertical steel staff March 13, 1915, to February 17, 1916, when it was bent over by ice. The inclined wooden staff was read until a new vertical steel staff was set March 24, which was read until both it and the inclined wooden staff were washed out on June 21; datum unchanged; all gages at same site. A Bristol water-stage recorder was installed but has not been used since 1912, and the well was completely washed out June 21, 1916.

DISCHARGE MEASUREMENTS.—Made by wading at low stages. High-water measurements made by floats, or from bridge 5 miles below gage. Cable 30 feet below gage has not been repaired since support on right bank was undermined June 21, 1916.

CHANNEL AND CONTROL.—Bed of stream coarse gravel; right bank high and steep; left slopes gradually and is overflowed only at flood stage. A bar or ledge that produces a riffle about 400 feet below the gage forms the control at certain stages. Measuring section obstructed during the late summer and fall by growth of algae.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 6.94 feet March 29 at 9.50 a. m. (discharge, 1,500 second-feet, based on measurements made March 28 and 29); minimum open-water stage, 2.76 feet September 23 at 3 p. m. (discharge, 25 second-feet). A lower minimum occurred during winter as indicated by measurement of March 16.

1912–1917: Maximum stage recorded, 6.5 feet on June 21, 1916, determined by level from flood marks (discharge, 2,180 second-feet); minimum stage, 2.22 feet August 9, 1914 (discharge, 4.4 second-feet).

ICE.—Stage-discharge relation seriously affected by ice. Discharge November 15–30 and March 1 to April 9 estimated by comparison with Birch Creek and by special study in connection with temperatures and measurements made during winter. No discharge computed December 1 to February 28.

DIVERSIONS.—A number of small ditches divert water for irrigation from Dupuyer Creek and tributaries; many of the numerous water-right filings have been perfected by use.

REGULATION. None.

ACCURACY.—Stage-discharge relation changed during the last part of April. Rating curve used for the open-water periods October 1 to April 17 well defined between 50 and 1,800 second-feet; shifting-control method used April 18–30; curve used May 1 to September 30 well defined between 20 and 2,000 second-feet. Gage read to hundredths once daily. Daily discharge ascertained by applying daily gage height to rating table.

Discharge measurements of Dupuyer Creek near Valier, Mont., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Oct. 14	Ebner and Carmody	2.92	54	Apr. 10	G. Ebner	3.33	130
Nov. 20	Chadwick and Pieper	[a] 3.47	55	18	Ebner and Heidel	2.94	54
Dec. 29	Ebner and Savage	[a] 3.58	44.9	May 10	Ebner and Lamb	3.76	236
Jan. 20	G. Ebner	[a] 3.75	38.4	22	Ebner and Gleason	4.18	401
Feb. 7	do	[a] 4.62	49.6	June 1	Chadwick and Gleason	4.83	771
9	Ebner and Chadwick	[a] 4.55	52.8	13	Ebner and Wardwell	4.14	444
Mar. 16	G. Ebner	[a] 3.96	22.4	July 2	T. M. Wardwell	3.52	155
28	Ebner and Hipp	[a] 5.04	173	17	Wardwell and Thomas	3.13	71
29	do	[a] 6.56	[b] 1,150	Aug. 11	Wardwell and Siverson	2.96	44.9
Apr. 4	Ebner and Wilke	[a] 4.62	169	Sept. 8	T. M. Wardwell	2.82	30.8
7	Ebner and English	[a] 4.42	249				

[a] Stage-discharge relation affected by ice. [b] Velocity determined by use of floats.

Daily discharge, in second-feet, of Dupuyer Creek near Valier, Mont., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	46	61	.....	.....	.....	.....	300	95	815	156	45	35
2	48	57	.....	.....	.....	.....	250	87	716	150	51	32
3	50	58	.....	.....	.....	.....	220	85	510	148	45	34
4	52	60	.....	.....	.....	.....	200	89	594	130	45	34
5	58	61	.....	.....	.....	.....	200	105	538	125	39	34
6	65	62	.....	.....	.....	.....	220	130	409	125	51	32
7	70	60	.....	.....	50	.....	250	184	434	116	49	32
8	68	57	.....	.....	.....	.....	190	203	458	114	50	32
9	65	55	.....	.....	53	.....	130	212	484	105	49	35
10	64	54	.....	.....	.....	.....	128	229	1,000	103	54	37
11	62	52	.....	.....	.....	.....	108	262	885	99	51	35
12	60	58	.....	.....	.....	.....	100	280	748	95	45	32
13	58	57	.....	.....	.....	.....	87	300	409	87	45	30
14	53	55	.....	.....	.....	.....	85	300	363	83	44	34
15	52	.....	.....	.....	.....	.....	65	280	363	83	38	32
16	52	.....	.....	.....	.....	.....	57	300	363	80	34	34
17	56	.....	.....	.....	.....	.....	55	320	320	68	32	28
18	61	.....	.....	.....	.....	.....	54	243	342	69	28	28
19	65	.....	.....	.....	.....	.....	60	262	342	68	27	30
20	74	.....	.....	38	.....	.....	55	280	342	60	30	29
21	83	.....	.....	.....	.....	.....	104	510	280	58	28	28
22	77	.....	.....	.....	.....	.....	140	409	262	51	30	26
23	71	.....	.....	.....	.....	.....	119	320	300	49	30	25
24	65	.....	.....	.....	.....	.....	110	280	243	47	30	58
25	58	.....	.....	.....	.....	.....	113	320	216	45	30	51
26	52	.....	.....	.....	.....	70	135	363	209	51	30	39
27	62	.....	.....	.....	.....	120	113	594	194	52	32	28
28	71	.....	.....	.....	.....	173	98	623	194	51	32	28
29	69	.....	45	.....	.....	1,500	94	654	178	44	28	28
30	67	.....	.....	.....	.....	800	89	684	178	45	28	28
31	65	.....	.....	.....	.....	400	.....	594	.....	51	35	.....

NOTE.—Discharge interpolated on account of missing gage readings: Oct. 1–3, 5, 8, 10, 12, 15, 17, 18, 20, 22, 24, 25, 27, 29, 30; Nov. 1, 3–5, 7, 8, 10; Sept. 20. Discharge June 10 estimated from comparison of records for Birch Creek.

Discharge Nov. 15 to Apr. 9 estimated because of ice, as follows: Nov. 15–30, 55 second-feet; Mar. 1–5, 33 second-feet; Mar. 6–10, 28 second-feet; Mar. 11–15, 23 second-feet; Mar. 16–20, 22 second-feet; Mar. 21–25, 70 second-feet.

Monthly discharge of Dupuyer Creek near Valier, Mont., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	83	46	61.9	3,810
November	62	52	56.2	3,340
March	1,500	.....	127	7,810
April	300	54	131	7,800
May	684	85	310	19,100
June	1,000	178	423	25,200
July	156	44	84.1	5,170
August	54	27	38.2	2,350
September	58	25	32.9	1,960

CUT BANK CREEK AT CUT BANK, MONT.

LOCATION.—In SW. ¼ sec. 1, T. 33 N., R. 6 W., at Great Northern Railway bridge 12 miles above junction with Two Medicine River, half a mile west of Cut Bank, in Toole County.

DRAINAGE AREA.—971 square miles.

RECORDS AVAILABLE.—August 4, 1905, to September 30, 1917.

GAGE.—Vertical staff nailed to pier protecting left bank of creek 10 feet above center line of Great Northern Railway bridge; used since August 31, 1911; prior to that date, a chain gage on left bank 200 yards farther downstream. Read by Charles Ferres.

DISCHARGE MEASUREMENTS.—Made from highway bridge a quarter of a mile below gage or by wading.

CHANNEL AND CONTROL.—Rock and gravel bar 200 feet below gage forms principal control; shifts. At high stages creek is 200 to 300 feet wide, but at low stages narrows at principal control.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 6.1 feet at 7 a. m. June 12 (discharge, 1,740 second-feet); minimum stage recorded, 3.80 feet September 19–21 (discharge, 20 second-feet).

1905–1917: Maximum stage recorded, 10.0 feet June 5, 1908, (discharge computed from extension of rating curve, 8,810 second-feet); minimum, 2.5 feet November 29, 30, 1905 (discharge, 5 second-feet).

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

DIVERSIONS.—Intake of Great Northern Railway's pumping station is 100 feet below gage; 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. There are also some small diversions for irrigation on the Blackfeet Indian Reservation above gage.

REGULATION.—None.

ACCURACY.—Stage-discharge relation seriously affected by ice and by radical changes in the control. Rating curve used October 1 to November 9 fairly well defined; curve used April 11 to May 12 and May 27 to August 24 well defined between 60 and 1,600 second-feet; shifting-control method used August 25 to September 30. Gage read to half-tenths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table. Records only fair, as observer's readings have been found in error occasionally.

Discharge measurements of Cut Bank Creek at Cut Bank, Mont., during the year ending Sept. 30, 1917.

[Made by W. A. Lamb.]

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*		*Feet.*	*Sec.-ft.*
Nov. 28	[a] 4.42	43.3	Aug. 20	3.96	65
June 12	5.95	1,540	Sept. 12	3.98	45
28	5.09	622			

[a] Stage-discharge relation affected by ice.

Daily discharge, in second-feet, of Cut Bank Creek at Cut Bank, Mont., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Apr.	May.	June.	July.	Aug.	Sept.
1	62	62	.....	239	1,350	592	136	62
2	73	62	.....	216	1,290	592	129	62
3	79	62	.....	262	1,110	555	120	60
4	88	62	.....	338	1,000	555	120	60
5	97	62	.....	311	800	555	120	57
6	110	62	.....	301	710	555	136	57
7	110	62	.....	301	710	520	136	55
8	103	69	.....	311	850	485	136	55
9	97	79	.....	364	1,170	485	136	55
10	88	.....	.....	422	1,350	422	136	49
11	73	.....	1,350	485	1,540	422	136	44
12	69	.....	1,110	485	1,610	422	120	46
13	62	.....	592	.....	1,540	422	120	39
14	62	.....	454	.....	1,350	393	120	35
15	62	.....	364	.....	1,110	364	120	35
16	62	.....	286	.....	950	364	120	32
17	73	.....	262	.....	1,060	311	120	28
18	88	.....	253	.....	1,230	301	120	23
19	79	.....	262	.....	1,060	286	103	20
20	73	.....	272	.....	900	262	75	20
21	73	.....	262	.....	900	262	103	20
22	69	.....	286	.....	900	239	103	28
23	62	.....	311	.....	850	216	103	28
24	62	.....	364	.....	800	208	97	35
25	55	.....	364	.....	800	195	86	35
26	51	.....	364	.....	755	182	83	44
27	51	.....	364	950	710	174	81	49
28	62	.....	311	1,000	670	166	78	35
29	62	.....	301	1,110	630	155	78	35
30	62	.....	262	1,350	630	155	64	35
31	62	.....	.....	1,480	.....	136	64	.....

NOTE.—Stage-discharge relation may have been slightly affected by ice Nov. 8 and 9.

Monthly discharge of Cut Bank Creek at Cut Bank, Mont., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	110	51	73.6	4,530
November 1–9	79	62	64.7	1,150
April 11–30	1,350	253	420	16,700
June	1,610	630	1,010	60,100
July	592	136	353	21,700
August	136	64	110	6,760
September	62	20	41.3	2,460

TETON RIVER AT STRABANE, MONT.

LOCATION.—In SE. ¼ NE. ¼ sec. 35, T. 25 N., R. 7 W., at highway bridge on Peebles's ranch, at Strabane, in Teton County, 16 miles above Chouteau.

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—November 26, 1904, to December 31, 1906, and June 1, 1908, to September 30, 1917.

GAGE.—Chain gage on upstream side of highway bridge installed March 23, 1911; read by Jas. Peebles, jr. November 26, 1904, to March 8, 1905, a staff gage 40 feet above head of Kroff's irrigation ditch; March 9, 1905, to May 7, 1906, a staff gage 250 feet upstream; May 8, 1906, to December 31, 1906, a staff gage at Bjornstad's ranch 1½ miles above gage at site of gage used to May 7, 1906. All gages at different datums.

DISCHARGE MEASUREMENTS.—Made by wading or from bridge.

CHANNEL AND CONTROL.—Bed composed of coarse gravel, likely to shift. Several channels at medium and high stages.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year 6.45 feet at 11 a. m. May 26 (discharge, 2,460 second-feet); minimum stage, 3.15 feet March 13 (discharge, 42 second-feet).

ICE.—Stage-discharge relation seriously affected by ice except for short periods, as current is swift and river is seldom under complete ice cover.

DIVERSIONS.—The Teton Cooperative Co.'s canal diverts water 1 mile above gage for a Carey Act project.

ACCURACY.—Stage-discharge relation changed during May. Rating curve used October 1 to May 12 well defined below 2,000 second-feet; curve used May 28 to September 30 well defined between 70 and 1,000 second-feet; shifting-control method used May 13–27. Gage read to hundredths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table. Records good, except those for May 13–27, which are fair.

Discharge measurements of Teton River at Strabane, Mont., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Apr 14	C. S. Heidel	3.34	54	July 24	W. A. Lamb	2.71	218
June 8	W. A. Lamb	4.88	918	Sept. 17	do	2.10	84
28	do	3.80	493				

Daily discharge, in second-feet, of Teton River at Strabane, Mont., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	128	96	79	82	68	54	49	62	928	493	192	126
2	128	96	78	80	66	54	49	60	873	493	192	137
3	128	96	78	79	66	55	49	58	775	465	192	126
4	128	58	79	77	62	53	49	62	775	465	181	126
5	121	66	79	77	58	52	50	63	775	465	181	126
6	121	65	79	75	54	52	50	64	775	437	181	126
7	121	64	79	73	53	50	50	64	822	437	181	122
8	118	66	78	73	50	50	50	64	928	437	170	118
9	114	66	78	71	52	47	52	85	873	383	170	116
10	111	68	79	66	52	45	52	136	775	383	170	116
11	108	71	79	70	50	44	52	164	775	383	170	111
12	106	76	80	71	52	42	53	220	692	383	159	111
13	108	85	80	71	54	42	53	475	522	383	159	105
14	108	80	80	72	58	43	54	725	552	357	159	105
15	102	79	80	72	58	43	52	850	654	331	148	84
16	102	77	81	71	56	44	50	1,140	822	306	148	94
17	104	75	81	71	56	44	52	942	988	306	148	88
18	106	77	80	70	55	45	52	942	928	282	148	88
19	108	75	80	70	54	46	52	942	822	282	148	84
20	108	75	80	70	54	47	52	895	732	259	137	84
21	108	77	79	70	55	47	52	895	618	259	137	84
22	106	79	79	70	56	47	58	942	552	248	137	88
23	108	80	79	70	56	47	60	942	552	236	137	94
24	108	81	79	71	56	47	62	990	552	225	137	101
25	106	80	79	71	58	47	63	1,570	522	214	137	105
26	106	79	80	71	58	47	63	2,290	522	214	137	113
27	104	80	80	72	58	48	64	1,710	493	214	126	124
28	106	79	80	72	56	48	63	1,510	493	203	126	122
29	107	79	82	72	.....	48	62	1,260	552	203	126	105
30	108	79	82	70	.....	49	62	1,190	493	192	126	94
31	108	.....	82	70	.....	49	.....	988	.....	192	126	.....

NOTE.—Stage-discharge relation affected by ice jam Nov. 28; discharge interpolated.

Monthly discharge of Teton River at Strabane, Mont., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	128	102	111	6,820
November	96	58	76.8	4,570
December	82	78	79.6	4,890
January	82	66	72.3	4,450
February	68	50	56.5	3,140
March	55	42	47.6	2,930
April	64	49	54.4	3,240
May	2,290	58	719	44,200
June	988	493	704	41,900
July	493	192	327	20,100
August	192	126	154	9,470
September	137	84	107	6,370
The year	2,290	42	210	152,000

TETON RIVER NEAR CHOUTEAU, MONT.

LOCATION.—On south line of SW. ¼ sec. 25, T. 24 N., R. 5 W., at highway bridge 1½ miles southwest of Chouteau, Teton County.

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—November 30, 1904, to July 31, 1906; May 27 to December 6, 1913; and April 14, 1915, to September 30, 1917.

GAGE.—Vertical staff fastened to pile on downstream side of bridge near left bank; read by M. G. Read. Original gage, a chain attached to upstream handrail of bridge, was stolen before any observations were made; replaced May 9, 1905, by chain gage at same datum fastened to floor of bridge. Gage used in 1913 same as that used in 1915–16.

DISCHARGE MEASUREMENTS.—Made by wading from bridge at gage, or from bridge 2 miles below gage. If made from lower bridge, the flow of Deep Creek is deducted

CHANNEL AND CONTROL.—Stream bed gravelly and likely to shift. Right bank high and not subject to overflow; left bank lower and may be overflowed during extreme floods.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 7.1 feet June 18 (discharge 1,550 second-feet); water was over top of gage, 6.7 feet, May 21–29; minimum stage recorded, 3.45 feet September 17 (discharge, 2.8 second-feet).

1904–1906, 1913, and 1915–1917: Maximum stage recorded, 8.7 feet June 21, 1916 (determined from flood marks) (discharge not determined); minimum discharge recorded 1 second-foot August 9–16, 20, 1913. Discharge also estimated at 1 second-foot several days in April, May, and July, 1906.

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

DIVERSIONS.—Numerous diversions above gage for irrigation. See miscellaneous measurements, page —.

REGULATION.—Low flow during summer caused by diversions.

ACCURACY.—Stage-discharge relation not permanent; affected by shifting control, by ice, and by drift lodged against pier of bridge. Rating curve used October 1 to December 19 fairly well defined below 1,000 second-feet; curve used April 14 to May 13, and June 18 to September 30 well defined below 1,000 second-feet. May 14–22, and May 30 to June 17 stage-discharge relation seriously affected by brush lodged against bridge pier; discharge obtained by indirect method for shifting control. May 23–29 water above gage; flow not computed on account of uncertainty in flow in canals above station. Records poor owing to unsatisfactory gage-height record during most of year.

Discharge measurements of Teton River near Chouteau, Mont., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Apr. 14	C. S. Heidel	4.62	73	July 2	W. A. Lamb	5.71	370
May 22	W. A. Lamb	[a] 5.78	539	23	do	4.08	24.4
June 7	do	[a] 6.45	736	Aug. 24	do	3.70	7.6
18	do	6.70	1,150	Sept. 17	do	3.45	2.9

[a] Stage-discharge relation seriously affected by brush lodged against bridge pier.

Daily discharge, in second-feet, of Teton River near Chouteau, Mont., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Apr.	May.	June.	July.	Aug.	Sept.
1	56	61	56	.....	92	1,190	320	.....	.....
2	56	56	56	.....	94	1,110	371	.....	.....
3	56	56	56	.....	94	983	280	.....	.....
4	56	56	56	.....	99	954	262	.....	.....
5	56	56	56	.....	99	926	244	.....	.....
6	56	56	53	.....	99	851	211	.....	.....
7	59	56	50	.....	113	737	135	.....	.....
8	63	56	48	.....	116	656	99	.....	.....
9	67	56	44	.....	116	729	.....	.....	.....
10	71	56	40	.....	135	664	.....	.....	.....
11	75	56	40	.....	135	664	.....	.....	.....
12	75	56	40	.....	157	640	.....	.....	.....
13	70	56	40	.....	157	644	.....	.....	.....
14	66	56	40	74	205	648	.....	.....	.....
15	66	56	40	74	211	588	.....	.....	.....
16	69	56	40	71	269	762	.....	24	.....
17	72	56	40	56	361	1,450	.....	12	2.8
18	75	56	40	59	625	1,550	.....	12	.....
19	75	56	40	71	437	1,110	.....	.....	.....
20	86	56	.....	80	737	779	71	.....	.....
21	86	56	.....	87	638	695	.....	.....	.....
22	75	56	.....	81	538	545	.....	.....	.....
23	75	56	.....	80	.....	479	26	.....	.....
24	70	56	.....	71	.....	449	.....	7.5	.....
25	66	56	.....	74	.....	419	.....	.....	.....
26	66	56	.....	80	.....	392	.....	.....	.....
27	66	56	.....	84	.....	343	.....	.....	.....
28	66	56	.....	84	.....	320	.....	.....	.....
29	66	56	.....	92	.....	300	.....	.....	.....
30	66	56	.....	92	1,290	280	.....	.....	.....
31	66	.....	.....	.....	1,170	.....	.....	.....	.....

NOTE.—Gage read on following days: Oct. 2, 4, 6, 11–12, 14–15, 18–23, 25–29, 31; Nov. 2, 4, 6, 8, 11–12, 16, 28; Dec. 1–3, 5, 8, 10, 12, 14, 17, 19. No gage readings Dec. 20 to Apr. 13; Apr. 14–30; May 1–20, 22, 30–31; June 1–12, 14–30; July 1–8; 20, 23; Aug. 16–18, 24; Sept. 17. Discharge interpolated for days of missing gage readings Oct. 1 to Dec. 19, May 21, and June 13. Stage above top of gage, May 23–29; discharge not computed on account of numerous diversions between this station and the one at Strabane.

Monthly discharge of Teton River near Chouteau, Mont., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	86	56	67.5	4,150
November	61	56	56.2	3,340
December 1–9	56	40	46.1	1,740
April 14–30	92	56	77.1	2,600
June	1,550	280	729	43,400

SPRING CREEK NEAR STRABANE, MONT.

LOCATION.—In NE. ¼ SE. ¼ sec. 2, T. 24 N., R. 7 W., at highway bridge half a mile southeast of buildings on Peebles ranch, and 16 miles west of Chouteau, Teton County.

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—May 30 to December 31, 1913, and April 14 to September 30, 1917.

GAGE.—Vertical staff on left bank at upstream side of wagon bridge. From May 30 to December 31, 1913, the gage used was a staff on the left bank, 200 feet above the highway bridge.

DISCHARGE MEASUREMENTS.—Made from bridge or by wading.

CHANNEL AND CONTROL.—Banks low; covered with grass above gage and with brush below bridge; not subject to overflow except during extreme high water. Bed composed of earth, sand, and gravel, and is fairly permanent.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 2.44 feet at 4 p. m. May 31 (discharge, 66 second-feet); minimum stage, 0.06 foot July 30 to August 3 (discharge, 0.9 second-foot).

1913 and 1917: Maximum stage recorded 2.44 feet at 4 p. m. May 31, 1917 (discharge, 66 second-feet); minimum discharge, 0.5 second-foot August 26, 1913.

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

DIVERSIONS.—None.

REGULATION.—None.

ACCURACY.—Stage-discharge relation permanent during the year; not affected by ice. Rating curve well defined between 1 and 22 second-feet. Gage read to hundredths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table. Records good.

Discharge measurements of Spring Creek near Strabane, Mont., during the year ending Sept. 30, 1917

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec. ft.*			*Feet.*	*Sec. ft.*
Apr. 14	C. S. Heidel	1.14	16.8	Sept. 17	W. A. Lamb	0.18	1.3
July 24	W. A. Lamb	.07	.96				

Daily discharge, in second-feet, of Spring Creek near Strabane, Mont., for the year ending Sept. 30, 1917.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Day.	Apr.	May.	June.	July.	Aug.	Sept.
1	.....	23	52	4.0	0.9	1.5	16	12.5	12.1	15.8	1.7	1.1	1.5
2	.....	29	35	3.8	.9	1.5	17	12.1	10.9	19	1.7	1.1	1.5
3	.....	33	29	3.6	.9	1.5	18	12.1	8.4	23	1.5	1.1	1.4
4	.....	33	31	3.5	1.0	1.5	19	15.8	7.7	22	1.5	1.2	1.4
5	.....	20	29	3.1	1.0	1.5	20	26	15.8	18	1.4	1.2	1.4
6	.....	20	23	2.9	1.1	1.7	21	29	26	15.8	1.4	1.2	1.4
7	.....	19	14.8	2.7	1.1	1.7	22	28	23	13.7	1.2	1.2	1.5
8	.....	19	13.3	2.5	1.2	1.5	23	24	19	10.8	1.2	1.2	1.5
9	.....	18	13.1	2.3	1.2	1.5	24	23	17	8.4	1.1	1.1	2.3
10	.....	18	39	2.2	1.4	1.5	25	18	64	6.6	1.0	1.1	2.8
11	.....	13.7	47	2.0	1.4	1.5	26	19	35	5.0	1.0	1.1	2.7
12	.....	13.3	33	2.0	1.2	1.4	27	19	29	4.8	1.0	1.2	2.5
13	.....	12.9	24	1.8	1.2	1.4	28	20	45	4.3	1.0	1.2	2.7
14	17	12.9	20	1.8	1.2	1.4	29	20	64	4.0	1.0	1.4	2.7
15	12.9	12.9	17	1.8	1.1	1.5	30	23	59	4.0	.9	1.4	2.7
							31	.....	64	.....	.9	1.4	.....

Monthly discharge of Spring Creek near Strabane, Mont., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
Apr. 14–30	29	12.1	19.5	658
May	64	7.7	25.7	1,580
June	52	4.0	19.8	1,180
July	4.0	.9	1.92	118
August	1.4	.9	1.16	71
September	2.8	1.4	1.75	104
The period				3,710

SPRING CREEK NEAR CHOUTEAU, MONT.

LOCATION.—At McDonald's ranch, near east line of sec. 33, T. 25 N., R. 6 W., half a mile above mouth and 13 miles northwest of Chouteau, in Teton County.

RECORDS AVAILABLE.—April 13 to September 30, 1917.

DRAINAGE AREA.—Not measured.

GAGE.—Vertical staff with enamel face, on right bank 100 feet below wagon bridge; read by Roland Brooks and Katherine McDonald.

DISCHARGE MEASUREMENTS.—Made by wading or from the bridge 100 feet above the gage.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 3.35 feet at 9 a. m., May 26 (discharge, 138 second-feet); minimum stage, 2.10 feet September 12–30 (discharge, 12.0 second-feet).

ICE.—Station not maintained during winter.

DIVERSIONS.—Several small ditches divert some water for irrigation above station; amount is small.

REGULATION.—None.

ACCURACY.—Stage-discharge relation not permanent. Rating curve used, April 13 to August 23 well defined between 10 and 40 second-feet. Shifting-control method used August 24 to September 30. Gage read to quarter-tenths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table. Records good, April 13 to August 23; fair, August 24 to September 30.

Discharge measurements of Spring Creek near Chouteau, Mont., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Apr. 13	C. S. Heidel	2.35	32.7	July 24	W. A. Lamb	2.09	14.6
July 2	W. A. Lamb	2.25	25.6	Sept. 17	do	2.08	11.8

Daily discharge, in second-feet, of Spring Creek near Chouteau, Mont., for the year ending Sept. 30, 1917.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Day.	Apr.	May.	June.	July.	Aug.	Sept.
1	.....	.37	98	15	14	15	16	26	35	42	15	15	12
2	.....	46	71	15	15	17	17	26	33	44	15	15	12
3	.....	47	56	15	15	14	18	26	29	56	15	15	12
4	.....	44	56	15	15	14	19	33	31	54	15	15	12
5	.....	42	54	15	15	14	20	33	42	46	15	15	12
6	.....	39	54	15	15	14	21	35	56	42	15	15	12
7	.....	35	44	15	15	13	22	33	46	37	15	15	12
8	.....	35	44	15	15	13	23	33	44	33	15	15	12
9	.....	35	56	15	15	13	24	35	39	31	15	15	12
10	.....	35	54	15	15	13	25	33	87	31	15	15	12
11	.....	33	76	15	15	12	26	33	138	31	15	14	12
12	.....	33	71	15	15	12	27	37	87	31	15	14	12
13	33	33	56	15	15	12	28	33	104	29	15	14	12
14	33	31	46	15	15	12	29	33	120	29	14	14	12
15	29	33	44	15	15	12	30	37	98	28	14	14	12
							31	.....	98	.....	14	14	.....

NOTE.—Gage not read; discharge interpolated Apr. 17, May 28, July 7 and 22.

Monthly discharge of Spring Creek near Chouteau, Mont., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
April 13–30	37	26	32.3	1,150
May	138	29	53.1	3,260
June	98	28	48.1	2,860
July	15	14	14.9	916
August	15	14	14.8	910
September	17	12	12.7	756
The period				9,850

DEEP CREEK NEAR CHOUTEAU, MONT.

LOCATION.—In SW. ¼ NW. ¼ sec. 15, T. 23 N., R. 5 W., at Hugh Robinson's ranch, 5 miles southwest of Chouteau, in Teton County.

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—March 24, 1911, to September 30, 1917.

GAGE.—Overhanging chain on right bank, 400 feet above Hugh Robinson's house; read by Hugh Robinson.

DISCHARGE MEASUREMENTS.—Made by wading.

CHANNEL AND CONTROL.—Bar of gravel 50 feet below gage forms principal control. Channel clean and fairly permanent. Right bank high and not subject to overflow; left bank may be overflowed.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 9.1 feet at 8 a. m. May 26 (discharge, 1,930 second-feet); minimum stage recorded, 5.3 feet March 8, 9, 11–15, 17, 19, 22–26 (discharge, 12 second-feet).

1911–1917: Maximum stage recorded, 10.5 feet, 7 a. m. June 21, 1916 (discharge, from extension of rating curve, 3,050 second-feet); minimum stage recorded, 5.28 feet, September 25, 1913, and 5.27 feet, September 6, 1914 (discharge, 11 second-feet).

ICE.—Stage-discharge relation seriously affected by ice after December 5; observations discontinued December 24 to March 7; flow interpolated November 10–13 on account of ice.

DIVERSIONS.—A few small ditches divert from creek above gage.

REGULATION.—None.

ACCURACY.—Stage-discharge relation changed during high water in May and June; affected by ice. Daily gage heights are from observer's readings to nearest half-tenth once daily. Daily discharge ascertained by applying to daily gage heights for October 1 to November 9, November 14 to December 5, and March 8 to June 24 a rating table well defined below 700 second-feet and fairly well defined above. Daily discharge for the period June 25 to September 30 obtained as above by means of a rating table based upon a curve fairly well defined.

Discharge measurements of Deep Creek near Chouteau, Mont., during the year ending Sept. 30, 1917.

[Made by W. A. Lamb.]

Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*
June19	7.25	512
July24	5.70	66

Daily discharge, in second-feet, of Deep Creek near Chouteau, Mont., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	67	58	44	.....	107	130	1,530	270	54	49
2	58	67	44	.....	118	142	1,060	237	54	49
3	76	58	51	.....	76	244	835	237	54	49
4	67	67	44	.....	96	212	706	237	54	49
5	96	67	51	.....	182	168	646	222	60	49
6	107	58	.....	.....	244	182	588	207	60	49
7	96	58	.....	.....	168	227	588	194	54	49
8	107	44	.....	12	260	227	706	180	66	49
9	96	67	.....	12	196	227	770	168	66	54
10	107	65	.....	17	118	227	835	168	66	54
11	107	63	.....	12	96	296	980	156	60	54
12	86	61	.....	12	118	356	835	145	60	49
13	96	59	.....	12	96	426	532	134	54	44
14	76	58	.....	12	76	426	452	134	54	49
15	76	86	.....	12	58	588	478	124	49	49
16	76	58	.....	17	38	646	532	114	49	44
17	67	51	.....	12	28	532	617	105	49	44
18	76	67	.....	14	38	378	646	105	49	44
19	76	76	.....	12	44	335	532	96	49	44
20	107	96	.....	14	76	335	532	88	49	40
21	142	67	.....	14	118	706	505	73	49	40
22	118	67	.....	12	212	588	478	73	44	40
23	107	76	.....	12	142	478	426	66	44	40
24	96	86	.....	12	142	378	378	66	40	73
25	96	51	.....	12	107	770	343	66	40	73
26	96	67	.....	12	142	1,930	324	66	44	54
27	76	96	.....	17	118	1,290	305	66	44	49
28	86	86	.....	196	44	1,060	288	60	40	44
29	67	76	.....	706	44	1,690	270	54	40	44
30	76	67	.....	426	96	1,530	270	54	44	36
31	76	.....	.....	182	.....	1,370	.....	54	49	.....

Monthly discharge of Deep Creek near Chouteau, Mont., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	142	58	88.9	5,470
November	96	44	67.4	4,010
December 1–5	51	44	46.8	464
March 8–31	706	12	73.8	3,510
April	244	28	113	6,720
May	1,930	130	584	35,900
June	1,530	270	600	35,700
July	270	54	130	7,990
August	66	40	51.4	3,160
September	73	36	48.5	2,890

WILLOW CREEK NEAR CHOUTEAU, MONT.

LOCATION.—In sec. 14, T. 23 N., R. 6 W., at McPhee's ranch, 12 miles southwest of Chouteau, in Teton County.

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—April 2, 1912, to September 30, 1917.

GAGE.—Staff gage on left bank, half a mile below house of S. A. McPhee; read by S. A. McPhee.

DISCHARGE MEASUREMENTS.—Made by wading at gage, except at extremely high stages, when they may be made from bridge half a mile below gage.

CHANNEL AND CONTROL.—A gravel bar 30 feet below gage is the control; shifts occasionally. Banks are about 4 feet high and are overflowed only at extreme flood stages.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 5.60 feet at 1.20 p. m. May 26 (discharge, 663 second-feet); minimum stage, 1.13 feet August 25 and 30 (discharge, 0.4 second-foot).

1912-1917: Maximum stage recorded, 6.60 feet June 21, 1916 (discharge, 880 second-feet); minimum stage, dry July 20 to end of season, 1914.

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

DIVERSIONS.—Several small diversions above station, mostly to water hay land; very little water used except during very dry periods.

REGULATION.—None.

ACCURACY.—Stage-discharge relation fairly permanent during year; apparently not seriously affected by aquatic growths this year. Rating curve well defined between 3 and 400 second-feet. Gage read to quarter-tenths once daily. Daily discharge ascertained by applying daily gage height to rating table. Records good.

Discharge measurements of Willow Creek near Chouteau, Mont., during the year ending Sept. 30, 1917.

[Made by W. A. Lamb.]

Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*
June 19	2.49	96
July 24	1.42	4.2

Daily discharge, in second-feet, of Willow Creek near Chouteau, Mont., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Apr.	May.	June.	July.	Aug.	Sept.
1	24	21	26	117	60	615	26	0.8	0.8
2	26	21	23	103	84	548	90	.8	1.7
3	30	20	21	78	103	358	72	.7	2.2
4	34	20	21	52	120	283	54	1.4	3.0
5	30	20	23	90	114	247	43	2.0	3.5
6	32	20	23	97	179	208	33	2.6	3.5
7	39	21	24	101	233	195	24	3.2	3.5
8	34	23	24	103	258	203	19	5.3	3.5
9	30	23	23	90	244	212	16	7.7	4.4
10	34	21	23	68	233	454	15	12	5.9
11	30	23	23	60	247	358	14	13	5.9
12	29	23	23	54	244	212	14	9.7	5.9
13	26	26	23	52	238	179	12	7.7	6.5
14	24	29	23	48	238	155	12	5.3	6.5
15	23	30	23	41	265	117	9.7	3.5	6.5
16	20	34	.....	33	212	110	8.1	3.2	5.9
17	20	37	.....	26	166	90	7.7	2.6	5.9
18	23	39	.....	32	147	78	5.9	2.2	5.3
19	26	34	.....	38	124	90	5.3	2.0	5.3
20	30	32	.....	45	212	84	4.4	1.7	4.4
21	32	30	.....	43	377	78	4.4	1.4	4.4
22	37	30	.....	90	247	72	4.4	1.0	3.5
23	34	29	.....	124	192	66	3.5	.8	4.4
24	32	26	.....	97	377	54	4.1	.7	4.4
25	30	24	.....	72	596	63	3.0	.4	5.3
26	29	23	.....	68	663	43	2.6	.8	5.9
27	26	23	.....	66	596	43	2.2	.7	5.9
28	26	24	.....	57	377	38	2.0	.7	5.3
29	24	26	.....	48	452	35	1.7	.7	5.3
30	23	29	.....	43	514	35	1.4	.4	4.4
31	23	.....	.....	.....	470	.....	1.0	.7	.....

NOTE.—Gage not read Dec. 16 to Mar. 31.

Monthly discharge of Willow Creek near Chouteau, Mont., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	39	20	28.4	1,750
November	39	20	26.0	1,550
December 1–15	26	21	23.1	687
April	124	26	67.9	4,040
May	663	60	277	17,000
June	615	35	177	10,500
July	90	1.0	16.6	1,020
August	13	.4	3.09	190
September	6.5	.8	4.63	276

MUDDY CREEK NEAR BYNUM, MONT.

LOCATION.—In NW. ¼ SE. ¼ sec. 22, T. 26 N., R. 6 W., 400 feet above mouth of Blackleaf Creek and 2 miles above Bynum, in Teton County.

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—May 24, 1912, to September 30, 1917.

GAGE.—Vertical staff on right bank; read by George Miller. June 23, 1916, a temporary vertical staff was set about 20 feet downstream to replace regular gage, which had been washed out. July 21, 1916, new low-water staff was set at regular section. Prior to October 5, 1914, gage in use was overhanging chain on left bank 100 feet upstream from present gage, and at different datum.

CHANNEL AND CONTROL.—Stream bed sand and gravel; may shift. Left bank high and not subject to overflow; right bank gradually sloping; apparently one channel at all stages.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 5.90 feet at 7.50 a. m. May 26 (discharge, 720 second-feet); minimum stage, 2.30 feet September 1–24 (discharge, 1.0 second-feet).

1912–1917: Maximum stage recorded, 6.9 feet June 21, 1916, determined by leveling from flood marks (discharge, determined from extension of rating curve, 976 second-feet); channel dry August 18, 23, 24, 31; September 1–3, 10, 29; and October 7, 1912.

ICE.—Ice present November 9–11; discharge not computed; no readings, November 12, to April 1.

DIVERSIONS.—Three small ditches divert above the station, and the Teton Cooperative Co. proposes to store the flood waters.

REGULATION.—None.

ACCURACY.—Stage-discharge relation not permanent, owing to shifting control and ice. Rating curve used October 1 to November 8 well defined below 600 second-feet; curve used April 2 to May 20 poorly defined; June 7 to September 30, fairly well defined; shifting-control method used May 21–29. Gage read to quarter-tenths twice daily April 20 to June 10, and once daily during rest of year. Daily discharge ascertained by applying daily gage height to rating table. Records good.

Discharge measurements of Muddy Creek near Bynum, Mont., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Apr. 13	C. S. Heidel	3.25	31.9	July 23	W. A. Lamb	2.35	2.1
June 8	W. A. Lamb	3.48	108	Sept. 16	do	2.30	.5
July 2	do	27.2	17.9				

Daily discharge, in second-feet, of Muddy Creek near Bynum, Mont., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Apr.	May.	June.	July.	Aug.	Sept.
1	4.0	7.2	.....	51	290	24	1.9	1.0
2	4.0	8.0	90	58	330	20	1.9	1.0
3	6.4	8.0	84	54	220	20	1.9	1.0
4	7.2	8.0	80	67	150	20	1.9	1.0
5	12	8.0	84	42	120	16	1.9	1.0
6	24	9.0	88	42	100	13	1.9	1.0
7	31	7.2	88	42	89	10	1.9	1.0
8	26	7.2	71	42	100	7.9	1.9	1.0
9	20	.....	71	33	105	7.9	1.9	1.0
10	19	.....	62	33	127	5.8	1.9	1.0
11	18	.....	59	29	258	5.8	1.9	1.0
12	16	.....	53	29	216	5.8	1.9	1.0
13	13	.....	33	37	110	4.3	1.9	1.0
14	12	.....	23	29	81	5.8	1.9	1.0
15	10	.....	16	37	74	4.3	1.9	1.0
16	9	.....	8	42	67	2.8	1.9	1.0
17	9	.....	6	42	74	2.8	1.9	1.0
18	10	.....	7	42	74	2.8	1.9	1.0
19	13	.....	22	33	67	2.8	1.9	1.0
20	13	.....	70	37	67	2.8	1.9	1.0
21	10	.....	83	260	74	2.8	1.9	1.0
22	19	.....	62	135	61	2.8	1.0	1.0
23	20	.....	54	80	61	2.8	1.0	1.0
24	19	.....	42	65	44	2.8	1.0	4.3
25	16	.....	37	145	38	2.8	1.0	1.0
26	13	.....	48	720	38	2.8	1.0	1.0
27	13	.....	48	200	33	2.8	1.0	1.0
28	12	.....	8	175	33	1.9	1.0	1.0
29	12	.....	26	185	28	1.9	1.0	1.0
30	10	.....	29	300	24	1.9	1.0	1.0
31	9	.....	.....	290	.....	1.9	1.0	.....

NOTE.—Discharge, May 30 to June 6, determined from records of flow of Blackleaf Creek for same period on basis of comparisons for preceding and following periods.

Monthly discharge of Muddy Creek near Bynum, Mont., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	31	4.0	13.9	855
November 1–8	9.0	7.2	7.83	124
April 2–30	90	6	50.1	2,880
May	720	29	109	6,700
June	330	24	105	6,250
July	24	1.9	6.83	420
August	1.9	1.0	1.61	99
September	4.3	1.0	1.11	66

NOTE.—See footnote to daily discharge table regarding discharge May 30 to June 6, 1917.

MUDDY CREEK NEAR AGAWAM, MONT.

LOCATION.—In sec. 35, T. 26 N., R. 4 W., at highway bridge 2 miles southeast of Agawam, in Teton County.

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—June 17 to September 30, 1917, when station was discontinued.

GAGE.—Wire gage on the downstream handrail of bridge near left bank, read by Wm. Moser.

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

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 3.18 feet June 17 (discharge, 150 second-feet); minimum stage, 1.50 feet September 20 (discharge, 9 second-feet).

ICE.—Station not maintained during winter.

DIVERSIONS.—Several ditches divert water for irrigation above station.

REGULATION.—Flow increased by Teton Cooperative Reservoir.

ACCURACY.—Stage-discharge relation changed July 1–17. Rating curve used June 17 to July 1 well defined below 152 second-feet; curve used July 18 to September 30 well defined between 8 and 109 second-feet; shifting-control method used July 2–17. Gage read to hundredths once daily. Daily discharge ascertained by applying daily gage height to rating table. Records good, except those for July 2–17, which are fair.

Discharge measurements of Muddy Creek near Agawam, Mont., during the period June 17 to Nov. 8, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec. ft.*			*Feet.*	*Sec. ft.*
June 17	W. A. Lamb	3.18	150	Aug. 22	W. A. Lamb	2.27	50
28	do	2.33	66	Sept. 16	do	1.62	11.9
July 23	do	2.1	39.9	Nov. 8	Lamb and Jones	1.65	19.0

Daily discharge, in second-feet, of Muddy Creek near Agawam, Mont., for the year ending Sept. 30, 1917.

Day.	June.	July.	Aug.	Sept.	Day.	June.	July.	Aug.	Sept.
1	.....	49	57	36	16	.....	30	60	12
2	.....	43	57	41	17	150	39	60	12
3	.....	41	56	30	18	145	49	56	11
4	.....	38	57	28	19	136	50	55	10
5	.....	34	66	28	20	127	48	44	9
6	.....	31	65	27	21	132	44	50	10
7	.....	25	67	24	22	127	45	48	12
8	.....	27	69	17	23	105	39	50	29
9	.....	19	70	21	24	90	39	52	51
10	.....	29	68	24	25	81	37	48	34
11	.....	41	69	20	26	74	38	43	40
12	.....	39	66	14	27	70	37	30	29
13	.....	39	63	13	28	63	41	29	19
14	.....	30	61	12	29	56	50	35	13
15	.....	31	60	13	30	53	58	41	10
					31	.....	59	30	.....

Monthly discharge of Muddy Creek near Agawam, Mont., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
June 17–30	150	53	101	2,800
July	59	19	39.3	2,420
August	70	29	54.3	3,340
September	51	9	21.6	1,290
The period	.....	.....	.....	9,850

BLACKLEAF CREEK NEAR BYNUM, MONT.

LOCATION.— In NW. ¼ SE. ¼ sec. 22, T. 26 N., R. 6 W., 200 feet above mouth of creek and 2 miles above Bynum, in Teton County.

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—May 24, 1912, to September 30, 1917.

GAGE.—Overhanging chain gage on left bank, 100 feet west of an abandoned barn; read by George Miller.

DISCHARGE MEASUREMENTS.—Made by wading near gage.

CHANNAL AND CONTROL.—Banks fairly high, and not subject to overflow. Stream bed fine sand and gravel; shifts occasionally.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 5.0 feet May 26 (discharge, 333 second-feet); minimum stage recorded, 2.78 feet July 31, August 1–4 and 26 (discharge, 0.1 second-feet).

1912–1917: Maximum stage recorded, 5.85 feet June 21, 1916, determined by leveling from flood marks (discharge, determined from extension of rating curve, 600 second-feet); channel dry July 21 to October 3, 1914.

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

DIVERSIONS.—Most of flow at low stages is diverted above station for irrigation, and Teton Cooperative Reservoir Co. proposes to use the flood waters.

REGULATION.—None.

ACCURACY.—Stage-discharge relation changed during April and May. Rating curve used October 1 to November 7 well defined below 400 second-feet; shifting-control method used April 3 to June 2; curve used June 3 to September 30 well defined below 100 second-feet. Gage read to quarter-tenths once daily; occasionally twice daily. Daily discharge ascertained by applying daily gage height to rating table. Records good, October 1 to November 7 and after June 2; fair, April 3 to June 3.

Discharge measurements of Blackleaf Creek near Bynum, Mont., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Apr. 13	C. S. Heidel	3.53	27.7	July 23	W. A. Lamb	2.88	[a] 0.5
June 8	W. A. Lamb	4.00	83	Sept. 16	do	2.99	1.3
July 2	do	3.33	18.9				

[a] Estimated.

Daily discharge, in second-feet, of Blackleaf Creek near Bynum, Mont., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Apr.	May.	June.	July.	Aug.	Sept.
1	16	16	.....	80	300	16	0.1	1.0
2	15	16	.....	84	319	16	.1	1.0
3	16	18	233	75	223	14	.1	.8
4	13	16	230	107	140	16	.1	1.3
5	21	16	210	84	101	16	.1	1.3
6	33	16	114	86	92	16	.4	1.3
7	38	15	103	114	83	12	.6	1.3
8	40	.....	83	210	83	9.9	.8	1.3
9	36	.....	57	103	83	11	1.3	1.3
10	31	.....	57	80	114	9.9	.5	1.5
11	29	.....	36	72	120	8.2	.8	1.3
12	29	.....	40	66	292	6.6	.8	1.3
13	27	.....	33	72	304	6.6	.8	1.3
14	25	.....	26	69	144	9.9	.6	1.3
15	22	.....	18	80	138	5.5	.6	1.3
16	18	.....	9.5	75	81	4.7	.5	1.3
17	18	.....	10	63	87	3.5	.5	1.3
18	20	.....	14	52	81	2.3	.5	1.3
19	20	.....	40	49	77	1.5	.5	1.3
20	20	.....	94	52	30	1.3	.5	1.0
21	18	.....	72	294	25	1.3	.4	.8
22	29	.....	77	155	24	1.0	.2	.8
23	31	.....	83	91	24	1.0	.1	.8
24	29	.....	66	78	23	.8	.1	11.0
25	25	.....	64	105	23	.8	.1	6.6
26	22	.....	83	323	20	.8	.1	2.3
27	22	.....	88	162	18	.8	.1	1.3
28	22	.....	45	122	18	.5	.5	1.3
29	20	.....	28	191	16	.5	.6	1.0
30	20	.....	49	303	16	.4	.5	1.0
31	20	.....	.....	300	.....	.1	1.0	.....

Monthly discharge of Blackleaf Creek near Bynum, Mont., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	40	13	24.0	1,480
November 1–7	18	15	16.1	224
April 3–30	233	9.5	73.7	4,090
May	323	49.	122	7,500
June	319	16	103	6,130
July	16	.1	6.29	387
August	1.3	.1	.45	27.7
September	11	.8	1.72	102.0

MUSSELSHELL RIVER BASIN.

MUSSELSHELL RIVER AT HARLOWTON, MONT.

LOCATION.—In sec. 26, T. 8 N., R. 15 E., at highway bridge 1 mile south of Harlowton, Meagher County.

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—July 11, 1907, to September 30, 1917.

GAGE.—Chain gage on upstream side of public highway bridge; read by W. G. Yamamoto. Before October, 1908, a staff gage fastened to the center pier of old highway bridge was read. April 10, 1909, a temporary staff gage was installed which read 0.73 foot high. This gage was used until May 24, 1909, when gage was lowered and the datum changed, so that the difference between the bench mark and the zero of the gage is 0.52 foot greater than formerly. No change has been made in gage or datum since May 24, 1909.

DISCHARGE MEASUREMENTS.—Made from bridge or by wading.

CHANNEL AND CONTROL.—Stream bed composed of sand and gravel; bar or ridge crosses the stream about 75 feet below the gage; shifts. Banks fairly high and probably not subject to overflow. Water confined to one channel under bridge, owing to road fill at the ends.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 5.3 feet at 8 a. m. May 27 (discharge, 4,020 second-feet); minimum stage, 0.52 foot August 30 (discharge, 43 second-feet).

1907–1917: Maximum stage recorded, 5.3 feet at 8 a. m. May 27, 1917 (discharge, 4,020 second-feet); minimum stage recorded, dry August 4–11, 1910.

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

DIVERSIONS.—Numerous ditches divert from headwater streams, and from Musselshell River above station.

REGULATION.—None.

ACCURACY.—Stage-discharge relation changed during April. Rating curve used October 1 to December 23 and April 26 to September 30 well defined above 40 second-feet. Shifting-control method used April 1–25. Gage read to quarter-tenths twice daily. Daily discharge ascertained by applying mean daily gage heights to rating table. Records fair.

Discharge measurements of Musselshell River at Harlowton, Mont., during the year ending Sept. 30, 1917.

[Made by C. S. Heidel.]

Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*
Apr. 7	0.90	123
June 21	3.90	2,400

Daily discharge, in second-feet, of Musselshell River at Harlowton, Mont., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Apr.	May.	June.	July.	Aug.	Sept.
1	56	84	78	72	310	2,680	1,360	86	48
2	62	84	86	76	329	2,500	1,220	76	52
3	78	84	86	80	425	2,390	1,090	68	53
4	88	84	80	95	555	2,600	1,030	76	53
5	84	84	78	100	543	2,960	988	88	56
6	84	84	70	107	524	2,740	876	90	60
7	90	86	68	124	673	2,480	830	90	62
8	93	88	66	127	838	2,520	785	86	65
9	100	84	62	156	988	3,000	778	84	65
10	100	84	60	209	1,160	3,420	750	78	68
11	100	78	62	256	1,450	3,780	701	72	70
12	93	84	65	278	1,710	3,060	632	68	76
13	93	107	60	300	1,970	2,780	543	68	88
14	88	149	60	292	2,260	2,480	470	68	107
15	88	170	59	247	2,570	2,390	414	65	112
16	88	142	56	189	2,830	2,480	363	60	115
17	93	112	56	156	3,120	2,720	324	60	115
18	93	100	60	146	2,490	2,870	287	56	110
19	98	124	60	163	2,080	2,660	256	54	107
20	93	118	60	193	2,370	2,480	221	53	102
21	88	110	60	238	2,960	2,380	201	53	100
22	88	100	60	348	2,520	2,300	181	53	100
23	88	78	60	868	2,220	2,170	177	53	98
24	88	70	.....	792	1,950	2,050	170	53	93
25	88	68	.....	822	2,320	1,980	156	53	100
26	88	65	.....	743	3,440	1,890	156	52	107
27	88	60	.....	482	3,730	1,690	156	51	110
28	88	59	.....	363	3,000	1,590	146	51	112
29	88	60	.....	315	3,080	1,530	130	47	112
30	84	68	.....	305	3,300	1,450	115	43	112
31	84	.....	.....	.....	2,940	.....	98	47	.....

NOTE.—Gage not read Dec. 24 to Mar. 31.

Monthly discharge of Musselshell River at Harlowton, Mont., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	100	56	87.8	5,400
November	170	59	92.3	5,490
December 1–23	86	56	65.7	3,000
April	868	72	288	17,100
May	3,730	310	1,960	121,000
June	3,780	1,450	2,470	147,000
July	1,360	98	503	30,900
August	90	43	64.6	3,970
September	115	48	87.6	5,210

FLATWILLOW CREEK NEAR FLATWILLOW, MONT.

LOCATION.—In sec. 23, T. 12 N., R. 25 E., at Flatwillow Ranch Co.'s ranch, 8 miles above Flatwillow, Fergus County, and 30 miles north of Roundup.

DRAINAGE AREA.—200 square miles (measured on 1916 map of Fergus County).

RECORDS AVAILABLE.—May 1, 1911, to September 30, 1917.

GAGE.—Vertical staff just below wagon bridge near the ranch buildings; read by J. D. Brinegar.

DISCHARGE MEASUREMENTS.—Made from footbridge at house, or by wading at ford below house.

CHANNEL AND CONTROL.—Banks high and thickly overgrown with willows. Stream bed earth; current sluggish; weeds grow in bed during summer; control shifts.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year 9.0 feet, estimated by observer June 4–11 (discharge, 454 second-feet in creek and 500 second-feet additional in canal); minimum stage recorded, 2.45 feet October 13–16 (discharge, 26 second-feet).

1911–1917: Maximum stage recorded 9.0 feet, estimated by observer June 4–11, 1917 (discharge, 454 second-feet in creek and 500 second-feet additional in canal); minimum stage 2.1 feet September 3, 4, 1912 (discharge, 1.0 second-foot).

ICE.—Stage-discharge relation seriously affected by ice; data inadequate to warrant estimates of winter flow.

DIVERSIONS.—Numerous above gage. The diversion canal of the Flatwillow Carey project heads about 3 miles upstream from the station. The wooden head gate washed out, allowing considerable water to pass through the canal without ever passing gage. This is listed under "Overflow in Flatwillow canal."

REGULATION.—None.

ACCURACY.—Stage-discharge relation changed by ice conditions which prevailed November 11 to April 10. Rating curve used to June 4 well defined below 100 second-feet and fairly well defined above that stage. Rating curve used June 21 to September 30 fairly well defined. Canal discharge can be considered at best as only fair, because of the indirect methods used in deriving them. Creek gage read to half-tenths daily. Daily discharge of creek ascertained by applying daily gage height to rating table. Total daily discharge May 12 to September 30 obtained by adding daily discharge of creek to discharge of canal. Records good, except May 12 to about September 30, for which period they are fair.

Discharge measurements of Flatwillow Creek near Flatwillow, Mont., during the year ending Sept. 30, 1917.

[Made by C. S. Heidel.]

Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*
Apr. 6	3.8	[a]50
June 23	6.1	[b]245

[a] Estimated; current-meter measurement could not be made because of ice.
[b] Total flow of creek includes additional 207 second-feet flowing down canal and which did not pass gage.

Daily discharge, in second-feet, of Flatwillow Creek near Flatwillow, Mont., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Apr.	May.	June.	July.	Aug.	Sept.
1	28	28	50	104	396	164	57	44
2	30	28	50	98	415	157	52	44
3	30	26	50	93	434	157	48	44
4	32	26	50	110	454	151	44	44
5	30	28	50	116	454	151	40	44
6	28	28	50	110	454	145	40	44
7	28	26	50	110	454	139	36	44
8	28	26	50	140	454	139	36	44
9	30	28	50	173	454	133	40	44
10	28	28	50	201	454	133	44	44
11	28	.....	88	215	437	127	44	46
12	28	.....	82	285	419	121	44	46
13	26	.....	88	327	402	115	48	48
14	26	.....	93	358	384	109	48	48
15	26	.....	77	406	367	104	44	52
16	26	.....	67	406	349	98	44	52
17	28	.....	77	358	332	93	44	52
18	28	.....	88	334	314	87	44	48
19	30	.....	88	327	297	87	48	48
20	28	.....	77	320	279	87	48	48
21	30	.....	77	342	262	82	44	44
22	28	.....	82	358	245	82	44	44
23	28	.....	88	342	245	82	44	44
24	30	.....	93	327	238	77	44	44
25	30	.....	98	327	224	77	44	48
26	28	.....	104	320	210	72	44	48
27	28	.....	98	320	190	67	44	48
28	28	.....	104	334	183	62	44	48
29	28	.....	110	342	177	62	44	44
30	30	.....	110	358	170	57	44	44
31	30	.....	.....	377	.....	57	44	.....

Daily discharge, in second-feet, of overflow in Flatwillow canal near Flatwillow, Mont., for the year ending Sept. 30, 1917.

Day.	May.	June.	July.	Aug.	Sept.	Day.	May.	June.	July.	Aug.	Sept.
1	.....	422	71	3	3	16	436	358	3	3	3
2	.....	448	60	3	3	17	372	335	3	3	3
3	.....	473	48	3	3	18	337	309	3	3	3
4	.....	500	37	3	3	19	327	285	3	3	3
5	.....	500	25	3	3	20	318	258	3	3	3
6	.....	500	14	3	3	21	347	232	3	3	3
7	.....	500	3	3	3	22	372	207	3	3	3
8	.....	500	3	3	3	23	347	192	3	3	3
9	.....	500	3	3	3	24	327	178	3	3	3
10	.....	500	3	3	3	25	327	164	3	3	3
11	.....	476	3	3	3	26	318	150	3	3	3
12	267	453	3	3	3	27	318	133	3	3	3
13	327	430	3	3	3	28	337	116	3	3	3
14	372	407	3	3	3	29	347	99	3	3	3
15	436	382	3	3	3	30	372	82	3	3	3
						31	396	.....	3	3	.....

Daily discharge, in second-feet, of Flatwillow Creek and canal near Flatwillow, Mont., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Apr.	May.	June.	July.	Aug.	Sept.
1	28	28	50	104	818	235	60	47
2	30	28	50	98	863	217	55	47
3	30	26	50	93	907	205	51	47
4	32	26	50	110	954	188	47	47
5	30	28	50	116	954	176	43	47
6	28	28	50	110	954	159	43	47
7	28	26	50	110	954	142	39	47
8	28	26	50	140	954	142	39	47
9	30	28	50	172	954	136	43	47
10	28	28	50	201	954	136	47	47
11	28	.....	88	215	913	130	47	49
12	28	.....	82	552	872	124	47	49
13	26	.....	88	654	832	118	51	51
14	26	.....	93	730	791	112	51	51
15	26	.....	77	842	749	107	47	55
16	26	.....	67	842	707	101	47	55
17	28	.....	77	730	667	96	47	55
18	28	.....	88	671	623	90	47	51
19	30	.....	88	654	582	90	51	51
20	28	.....	77	638	537	90	51	51
21	30	.....	77	689	494	85	47	47
22	28	.....	82	730	452	85	47	47
23	28	.....	88	689	437	85	47	47
24	30	.....	93	654	416	80	47	47
25	30	.....	98	654	388	80	47	51
26	28	.....	104	638	360	75	47	51
27	28	.....	98	638	323	70	47	51
28	28	.....	104	671	299	65	47	51
29	28	.....	110	689	276	65	47	47
30	30	.....	110	730	252	60	47	47
31	30	.....	.....	773	.....	60	47	.....

Monthly discharge of Flatwillow Creek near Flatwillow, Mont., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	32	26	28.5	1,750
November 1–10	28	26	27.2	540
April	110	.....	76.3	4,540
May	842	93	495	30,400
June	954	252	675	40,200
July	235	60	116	7,130
August	60	39	47.4	2,910
September	55	47	49.1	2,920

NOTE.—Figures for May 12 to September 30 include estimates of flow in canal.

MILK RIVER BASIN.

SOUTH FORK OF MILK RIVER NEAR INTERNATIONAL BOUNDARY.

LOCATION.—In SW. ¼ sec. 29, T. 37 N., R. 9 W., at Richard Croff's ranch, just above Kennedy Coulee, in Teton County, 5 miles south of international boundary and 30 miles northeast of Browning.

DRAINAGE AREA.—288 square miles (measured on topographic maps).

RECORDS AVAILABLE.—April 28, 1905, to September 30, 1917.

GAGE.—Stevens water-stage recorder installed April 13, 1913, on left bank, opposite house of observer; April 28 to May 8, 1905, a staff; May 8, 1905, to Apr. 13, 1913, an overhanging chain gage. Gage read by Wm. Welch to May 31, 1917; thereafter by Mrs. Viola Saffell.

DISCHARGE MEASUREMENTS.—Made from cable 100 feet below gage or by wading.

CHANNEL AND CONTROL.—Bottom of channel is composed of clay and small boulders. Growth of aquatic plants affects stage-discharge relation at low stages during summer. Banks are high and not subject to overflow.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 6.42 feet at 6 p. m., August 8 (discharge, 1,520 second-feet); minimum stage recorded 2.5 feet November 8 (discharge, 18 second-feet).

1905–1917: Maximum stage recorded 15.4 feet June 6, 1908, determined from high-water marks (discharge not computed); flood width 850 feet; flood cross section about 2,600 square feet. Minimum stage recorded, 2.9 feet August 18–20, 1906 (discharge, 1 second-foot).

ICE.—Stage-discharge relation affected by ice for short periods.

DIVERSIONS.—None.

REGULATION.—None.

ACCURACY.—Stage-discharge relation affected by ice and shifting control. Rating curves were used directly or indirectly as follows: curve well defined between 40 and 1,520 second-feet October 1 to December 31; well defined between 21 and 1,430 second-feet January 5–10 and April 4 to September 30; and well defined between 20 and 40 second-feet January 19 to April 3. Gage heights from automatic record April 4–15, 28, May 1, 2, 5, 29, 30 and June 11–13; observer's readings used for rest of the year. Observer read to half-tenths daily to May 31, and to hundredths daily thereafter. Discharge determined by applying gage height to rating table directly October 1 to December 17, January 5–10, January 19 to April 3, April 4–10, May 17–31, June 21 to July 11, and August 9 to September 30; shifting-control method used January 11–18, April 11 to May 16, June 1–20, and July 12 to August 8. Records good.

COOPERATION.—Station maintained in cooperation with the Reclamation Service, Department of the Interior, Canada.

Discharge measurements of South Fork of Milk River near international boundary during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Nov. 16	S. H. Frame[a]	2.90	53	May 31	A. W. P. Lowrie	4.76	680
26	W. A. Lamb	2.90	62	June 16	W. A. Lamb	4.11	315
Jan. 5	H. W. Rowley[a]	2.65	27	21	A. W. P. Lowrie	3.83	273
24	do	2.80	29	29	W. A. Lamb	3.43	162
Feb. 22	G. S. Wenden[a]	2.81	33	July 11	A. W. P. Lowrie	3.12	96
Mar. 8	A. H. Tuttle	2.70	23	22	W. A. Lamb	2.86	56
15	G. S. Wenden	2.81	32	28	A. W P. Lowrie	2.78	46
Apr. 4	A. W. P. Lowrie[a]	2.75	35	Aug. 21	W. A. Lamb	2.68	28
16	W. A. Lamb	3.87	217	26	A. W. P. Lowrie	2.62	23
May 5	A. W. P. Lowrie	3.91	267	Sept. 12	W. A. Lamb	2.70	34
17	W. A. Lamb	4.32	450				

[a] Engineer, Reclamation Service, Department of the Interior, Canada.

Daily discharge in second-feet, of South Fork of Milk River near international boundary for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	59	74	45	28	28	23	23	214	601	154	45	40
2	59	74	45	27	23	28	26	372	497	159	42	35
3	66	66	52	27	23	20	28	366	393	154	40	35
4	74	74	45	26	23	28	117	361	350	154	53	37
5	90	66	52	26	28	23	423	327	311	132	55	37
6	98	74	45	26	32	28	829	491	308	112	49	37
7	90	74	45	21	28	23	975	616	272	101	52	37
8	98	18	52	26	23	23	1,170	741	301	97	67	37
9	98	22	48	26	23	23	1,160	841	314	97	56	48
10	90	22	45	26	28	26	1,110	796	405	97	56	53
11	98	37	34	31	23	28	1,050	751	602	91	53	42
12	98	52	34	30	23	23	1,010	781	826	88	48	35
13	90	45	40	18	23	20	490	811	590	101	45	32
14	90	45	34	28	23	23	303	799	314	114	40	32
15	82	52	40	32	23	33	179	787	262	97	35	30
16	82	52	30	24	20	23	238	776	288	79	35	30
17	74	66	30	22	23	23	207	456	253	79	30	28
18	74	59	30	21	23	28	238	410	247	72	30	27
19	74	74	30	20	23	23	270	365	256	73	35	26
20	82	74	30	23	23	23	318	470	250	58	30	25
21	74	66	29	32	23	23	377	575	268	52	30	24
22	74	66	29	32	33	20	354	681	278	55	25	23
23	74	64	29	28	32	23	331	609	232	52	28	28
24	66	62	29	29	38	23	308	537	226	49	25	32
25	59	59	29	23	28	23	293	537	218	49	23	53
26	59	59	28	23	28	23	278	537	218	46	25	37
27	66	45	28	23	28	28	242	537	191	46	28	35
28	74	45	28	23	23	23	207	491	166	44	25	37
29	66	45	28	23	.....	28	200	765	159	41	23	32
30	66	52	28	28	.....	30	196	801	154	44	23	32
31	66	.....	28	28	.....	32	.....	706	.....	44	35	.....

NOTE.—No gage-height records for the following periods: Nov. 11, Dec. 9, Feb. 19, 20, Mar. 10, 30, Apr. 3, 18, 19, 22, 23, 25, 27, 29, May 3, 7, 10, 14, 15, 18, 20, 21, 23, 25, 26, June 1, 2, July 13, Sept. 6, 7, 17, 21, 23, and 30; discharge interpolated. Discharge estimated because of ice, Nov. 23-24 and Dec. 18 to Jan. 4.

Monthly discharge of South Fork of Milk River near international boundary for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.				Run-off.	
	Maximum.	Minimum.	Mean.	Per square mile.	Inches.	Acre-feet.
October	98	59	77.7	0.270	0.31	4,780
November	74	18	56.1	.195	.22	3,340
December	52	28	36.1	.125	.14	2,220
January	32	18	25.8	.090	.10	1,590
February	38	20	25.7	.089	.09	1,430
March	33	20	24.8	.086	.10	1,520
April	1,170	23	431	1.50	1.67	25,600
May	841	214	591	2.05	2.36	36,300
June	826	154	325	1.13	1.26	19,300
July	159	41	84.9	.295	.34	5,220
August	67	23	38.3	.133	.15	2,360
September	53	23	34.5	.120	.13	2,050
The year	1,170	18	146	.507	6.87	106,000

MILK RIVER AT EASTERN CROSSING,[1] MONT.

LOCATION.—In NE. ¼ sec. 5, T. 37 N., R. 9 E.,[2] at international boundary, 30 miles north of Rudyard, Hill County, Mont., and 37 miles south of Many Berries, Alberta, the nearest railway stations.

DRAINAGE AREA.—2,514 square miles (measured by engineers of the Reclamation Service, Department of the Interior, Canada).

[1] Formerly called Milk River at international boundary.

[2] Station located on south side instead of north side of international boundary as given in Water Supply Paper 436.

RECORDS AVAILABLE.—April 1, 1913, to September 30, 1917. From August 7, 1909, to April 1, 1913, station was maintained by Irrigation Branch (now Reclamation Service), Department of the Interior, Canada.

GAGE.—Gurley printing gage on right (south) bank installed September 18, 1917, and used to September 30, 1917; referred to two staff gages, one inside of well and the other in trench outside. April 1, 1913, to August 13, 1913, staff gage on left (north) bank 200 feet below present gage. August 13, 1913, to March 22, 1917, Gurley printing gage referred to staff gage in river 10 feet below gage house. April 9 to June 13, 1917, several temporary gages were used, but all readings have been referred to the staff gage at the site of the one used August 13, 1913, to March 22, 1917. June 14 to September 18, readings on a staff gage at present location. The zero of the north bank gage to which readings to June 14 are referred is at elevation 2,696. 58 feet above sea level, and the present south bank gage to which readings after June 14 are referred is 2,698.92 feet above sea level.

DISCHARGE MEASUREMENTS.—Made from cable 90 feet below gage or by wading.

CHANNEL AND CONTROL.—A bar composed of heavy boulders, gravel, and sand makes a decided riffle at medium and low stages: shifts occasionally.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 9.60 feet, April 9 (discharge, 4,860 second-feet); minimum stage, lowest recorded discharge was that of discharge measurement of March 10, of 23 second-feet; stage-discharge relation seriously affected by ice, and lower stages may have occurred during winter.

1909–1917: Maximum stage recorded, that of April 9, 1917; minimum stage, channel recorded dry August 3–17, 22, 23, 1914.

ICE.—Stage-discharge relation seriously affected by ice November 6 to April 8.

DIVERSIONS.—None.

REGULATION.—Low-water flow materially increased by water from St. Mary canal during July, August, and September.

ACCURACY.—Stage-discharge relation affected by ice and shifting control. Rating curves as follows were used during the year: fairly well defined October 1 to November 5; fairly well defined May 1 to June 6; and well defined between 100 and 1,600 second-feet June 15 to September 30. Gage heights from observer's readings until September 17 and from automatic gage September 17–30. Discharge ascertained by applying gage height to rating tables; shifting-control methods used April 9–30 and June 7–14. Records October 1 to November 6, May 1 to June 6, and after June 15 good; records November 7 to April 8 poor; and records April 9–30 and June 7–14 fair.

COOPERATION.—Maintained in cooperation with Reclamation Service, Department of the Interior, Canada.

Discharge measurements of Milk River at eastern crossing, Mont., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Oct. 2	Rowley and Newhall[a]	3.34	143	June 6	A. H. Tuttle	4.14	689
Nov. 2	H. W. Rowley[a]	3.35	171	13	P. A. Fetterly[a]	4.62	856
Mar. 10	A. H. Tuttle	[b] 5.13	23	14	do	[c] 3.47	1,550
Apr. 26	J. C. Milligan[a]	4.69	856			[d] 5.51	
May 7	do	4.29	820	21	A. H. Tuttle	2.38	534
9	A. H. Tuttle	4.67	1,090	July 30	P. A. Fetterly	1.70	249
15	V. A. Newhall	4.83	1,200	Aug. 3	A. H. Tuttle	1.81	258
25	A. H. Tuttle	4.32	886	Sept. 19	P. A. Fetterly	[b] 1.24	138

[a] Engineer of the Reclamation Service, Department of the Interior, Canada.
[b] Stage-discharge relation seriously affected by ice Mar. 10.
[c] South bank gage.
[d] North bank gage.

NOTE.—Prior to June 13 all measurements referred to gage on north bank at old water-stage recorder site; thereafter to gage on south bank at new water-stage recorder site.

Daily discharge, in second-feet, of Milk River at eastern crossing, Mont., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	120	172	.....	1,000	512	1,320	240	264	300
2	144	171	.....	900	485	946	238	264	310
3	162	182	.....	800	533	908	240	267	299
4	204	193	.....	700	568	870	260	270	324
5	237	204	.....	600	1,330	570	280	277	313
6	262	.....	.....	1,500	1,200	271	300	280	313
7	245	.....	.....	3,500	757	505	300	277	313
8	196	.....	.....	4,000	713	458	306	277	318
9	181	.....	.....	4,860	683	437	303	277	324
10	232	.....	.....	4,460	1,410	520	296	283	331
11	285	.....	.....	3,790	1,210	596	289	299	324
12	276	.....	.....	3,130	1,250	526	289	347	321
13	245	.....	.....	3,040	1,090	870	289	328	325
14	220	.....	.....	2,370	1,090	1,530	286	328	328
15	204	.....	.....	1,220	1,140	990	289	328	255
16	212	.....	.....	978	1,180	809	299	328	222
17	212	.....	.....	705	1,220	623	306	317	210
18	204	.....	.....	735	1,240	492	306	310	167
19	188	.....	.....	735	1,300	431	296	306	116
20	188	.....	.....	698	1,340	380	289	299	112
21	200	.....	.....	839	647	375	289	293	104
22	212	.....	.....	824	757	380	283	293	98
23	245	.....	.....	713	794	359	277	286	215
24	254	.....	.....	1,080	847	347	273	277	165
25	228	.....	.....	1,080	824	339	258	280	130
26	228	.....	200	817	757	321	247	280	100
27	216	.....	700	632	757	286	247	280	85
28	212	.....	1,400	794	832	280	247	280	77
29	196	.....	1,000	691	1,100	270	252	280	79
30	192	.....	1,000	633	908	241	258	283	77
31	173	.....	1,050	.....	946	.....	258	289	.....

NOTE.—Stage-discharge relation seriously affected by ice Nov. 6 to Apr. 8; flow estimated by comparison with Milk River at Milk River, Alberta, and at Havre, as follows: Nov. 6–10, 180 second-feet; 11–15, 120 second-feet; 16–30, 110 second-feet; Dec. 1–5, 110 second-feet; 6–10, 100 second-feet; 11–15, 80 second-feet; 16–20, 60 second-feet; 21–25, 50 second-feet; 26–31, 40 second-feet; Jan. 1–31, 45 second-feet; Feb. 1–28, 35 second-feet; Mar. 1–15, 35 second-feet; 16–20, 40 second-feet; 21–25, 50 second-feet. Daily flow Mar. 26–31 and Apr. 1–8 estimated as published. Flow during July, August, and part of September materially increased by flow of St. Mary canal.

Monthly discharge of Milk River at eastern crossing, Mont., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	285	120	212	13,000
November	.....	.....	[a] 135	8,030
December	.....	.....	[a] 72	4,430
January	.....	.....	[a] 45	2,770
February	.....	.....	[a] 35	1,940
March	[a] 1,400	.....	[a] 204	12,500
April	4,860	600	[b] 1,590	94,600
May	1,410	485	949	58,400
June	1,530	241	575	34,200
July	306	238	277	17,000
August	347	264	292	18,000
September	331	77	222	13,200
The year	4,860	.....	384	278,000

[a] Flow estimated from flow of Milk River at Milk River and at Havre. See footnote to table of daily discharge.
[b] Apr. 1–8 estimated. See footnote to table of daily discharge.

MILK RIVER AT HAVRE, MONT.

LOCATION.—In SW. ¼ SW. ¼ sec. 4, T. 32 N., R. 16 E., at highway bridge over Milk River at Havre, in Hill County.

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—May 15, 1898, to September 30, 1917.

GAGE.—Chain gage fastened to downstream rail of bridge; read by Chas. Ling, jr. Owing to shifting of bed of river, it has often been necessary to move gage from one end of bridge to the other, but the datum has not been changed.

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

CHANNEL AND CONTROL.—Bed of stream composed of fine gravel and sand, shifting frequently. Both banks are overflowed at high stages.

EXTREMES OF DISCHARGE.—Maximum stage recorded during the year, 15.3 feet April 10 (stage-discharge relation affected by ice); maximum discharge occurred April 11 at stage 15.15 feet (discharge, 7,940 second-feet); minimum stage recorded, 5.83 feet February 13 and March 17; flow not computed on account of ice.

1898–1917: Maximum stage recorded, 17.2 feet March 12, 1916 (discharge not known); minimum stage recorded, channel recorded dry July 16–18, 1898, August 16–20, 1904, July 25, August 18–26, 1905, November 16 to December 31, 1906, July 28 to September 14, 1910, and July 29 to August 22, 1914.

ICE.—Stage-discharge relation affected by ice November 11 to April 8.

DIVERSIONS.—None.

REGULATION.—During 1917, the St. Mary canal was in operation and a total of 33,600 acre-feet was added to Milk River flow.

ACCURACY.—Stage-discharge relation affected by ice and shifting control. Rating curve well defined between 100 and 1,500 second-feet used October 1 to November 10 and April 11 to May 15; well defined between 100 and 750 second-feet used June 16 to August 18; and well defined between 100 and 400 second-feet used August 28 to September 30. Gage heights from observer's readings twice daily during open channel and three times a week during ice season. Discharge determined by applying gage heights to rating tables. Shifting-control method used May 16 to June 15 and August 18 to 27. Records good for periods covered by rating tables and fair for other periods.

Discharge measurements of Milk River at Havre, Mont., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Oct. 8	A. H. Tuttle	7.05	337	May 23	A. H. Tuttle	7.93	1,050
Nov. 5	Tuttle and Lamb	6.54	195	26	do	8.10	1,130
Dec. 22	W. A. Lamb	6.48	47	June 8	do	7.91	769
Mar. 5	A. H. Tuttle	7.61	29	19	do	8.01	704
31	Tuttle and Anderson	10.90	2,330	22	do	7.75	607
Apr. 9	A. H. Tuttle	15.17	5,020	Aug. 2	do	6.88	275
14	M. D. Anderson	11.90	4,410	29	Heidel and Tuttle	7.06	282
20	W. A. Lamb	8.67	1,170	Sept. 10	W. A. Lamb	7.33	381
May 5	Tuttle and Anderson	8.27	953	22	do	6.42	129

NOTE.—Stage-discharge relation seriously affected by ice Dec. 22, Mar. 5, Mar. 31 and Apr. 9.

Daily discharge, in second-feet, of Milk River at Havre, Mont., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	154	256	.....	2,450	958	978	.....	326	300
2	165	227	.....	2,630	896	1,360	.....	296	300
3	200	213	.....	2,450	838	1,220	.....	311	300
4	200	213	.....	2,150	896	1,080	.....	311	317
5	200	200	.....	2,080	958	902	.....	311	317
6	323	200	.....	1,980	989	890	.....	326	317
7	323	188	.....	1,920	1,020	867	.....	326	317
8	360	176	.....	2,750	896	769	.....	326	334
9	379	188	.....	5,000	838	724	.....	342	408
10	360	144	.....	6,500	1,240	736	.....	358	370
11	341	.....	.....	7,940	1,310	749	.....	358	300
12	360	.....	.....	5,730	1,160	759	.....	393	370
13	341	.....	.....	4,220	1,310	855	393	393	370
14	341	.....	.....	4,110	1,380	1,080	375	393	408
15	305	.....	.....	3,200	1,460	1,500	375	411	408
16	288	.....	.....	2,700	1,400	1,180	393	411	389
17	288	.....	.....	2,220	1,470	986	393	393	328
18	288	.....	.....	2,130	1,480	791	393	375	268
19	272	.....	.....	1,680	1,330	706	393	355	222
20	305	.....	.....	1,240	1,260	681	375	352	208
21	272	.....	.....	1,160	1,200	618	375	336	158
22	272	.....	.....	1,460	1,130	596	375	330	125
23	241	.....	.....	1,240	1,050	573	358	299	108
24	241	.....	.....	1,380	1,020	530	342	291	300
25	227	.....	.....	1,380	1,350	489	326	288	532
26	256	.....	.....	1,310	1,130	469	296	271	352
27	256	.....	.....	1,160	1,180	449	296	280	252
28	256	.....	1,630	958	1,110	430	326	282	252
29	256	.....	2,330	1,020	1,180	411	326	284	203
30	256	.....	3,300	1,020	1,240	375	296	284	151
31	256	.....	2,500	.....	1,100	.....	311	284	.....

NOTE.—Flow not computed for period Nov. 11 to Mar. 27; gage heights reported approximately 3 times a week. Discharge Mar. 28 to Apr. 10 determined from discharge measurements of Mar. 31 and Apr. 9 and daily gage heights for period. No gage reading on following days: Apr. 19, May 6, 20, 29, June 10, 17, July 1–12, Aug. 28, Sept. 17 and 29. Flow interpolated for all, except July 1–12, which has been computed at 370 second-feet daily after comparison with Milk River at eastern crossing.

Monthly discharge of Milk River at Havre, Mont., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	379	154	277	17,000
November 1–10	256	144	200	3,970
March 28–31	3,300	1,630	2,440	19,400
April	7,940	958	2,570	153,000
May	1,480	838	1,150	70,700
June	1,500	375	792	47,100
July	393	296	360	22,100
August	411	271	332	20,400
September	532	108	300	17,900

MILK RIVER AT MALTA, MONT.

LOCATION.—In NW. ¼ sec. 17, T. 30 N., R. 30 E., at old highway bridge at Malta, in Phillips County.

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—July 31, 1902, to September 30, 1917.

GAGE.—Chain fastened to handrail on downstream side of bridge; read by employees of United States Reclamation Service.

DISCHARGE MEASUREMENTS.—Made from bridge or by wading.

CHANNEL AND CONTROL.—Bed of stream composed of gravel; permanent except for slight shifts at low stages. Partial control at gage at low water, but the principal control is formed by a bar or ridge that produces a riffle considerably below the gage.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 19.05 feet at 9 a. m. April 6 (discharge, 10,000 second-feet); minimum stage recorded, 1.05 feet at 4 p. m. August 6 (discharge, 48 second-feet). Lower flow may have occurred during winter.

1902–1917: Maximum stage recorded, 19.75 feet, April 10, 1907 (discharge, 11,200 second-feet); channel recorded dry August 13 to November 10, 1904; April 24 to May 8, and August 30 to end of year, 1905; April 10, 27–29, May 1, 4–23, 1906; July 16 to December 8, 1910.

ICE.—Stage-discharge relation affected by ice December 6–20 and March 30 to April 5.

DIVERSIONS.—Entire run-off from drainage basin above does not pass the station for seven irrigation canals, used to irrigate about 25,000 acres of land, divert water from Milk River and its tributaries between Havre and Malta. The United States Reclamation Service has constructed a diversion dam at Dodson, 17 miles above station, which will eventually divert water to irrigate about 108,000 acres in Milk River Valley. East of Malta two canals are nearing completion, one on each side, their combined capacity will be 1,000 second-feet.

REGULATION.—Part of flood flow will be diverted into Nelson reservoir and held for use in irrigation.

ACCURACY.—Stage-discharge relation practically permanent except when affected by ice. Rating curve very well defined was used October 1 to December 5 and April 6 to September 30. Gage read to half-tenths twice daily October 1 to December 16 and March 30 to May 17, and to half-tenths once daily May 18 to September 30. Discharge determined by applying gage height to rating table. Records good.

Discharge measurements of Milk River at Malta, Mont., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Oct. 6	A. H. Tuttle	1.84	139	Apr. 20	M. D. Anderson	15.65	8,410
Dec. 20[a]	W. A. Lamb	2.16	137	21	do	10.97	5,630
Apr. 2[a]	Anderson and Tuttle	14.60	4,240	May 19	A. H. Tuttle	6.75	3,150
5[a]	do	16.04	5,270	June 1	do	3.94	1,180
7[b]	do	16.90	9,130	15	do	3.17	713
8	do	15.28	8,440	Aug. 8	do	1.13	53.6

[a] Stage-discharge relation affected by ice.
[b] Surface velocities were taken on account of floating ice. Used 0.90 coefficient to reduce to mean. Sounding from measurement of Apr. 8.

Daily discharge, in second-feet, of Milk River at Malta, Mont., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	159	327	180	.....	4,100	2,650	1,280	104	55	64
2	167	327	180	.....	4,300	2,520	1,280	104	55	64
3	180	327	180	.....	4,200	2,320	1,280	104	55	64
4	180	327	180	.....	4,500	2,100	1,280	97	55	64
5	167	327	180	.....	5,700	1,820	1,410	97	51	64
6	150	327	177	.....	10,100	1,680	1,410	104	48	64
7	155	308	174	.....	9,580	1,680	1,410	104	51	64
8	174	290	171	.....	8,470	1,960	1,410	104	55	64
9	254	290	168	.....	8,280	1,680	725	68	59	64
10	327	290	165	.....	8,020	1,760	495	68	64	68
11	365	237	162	.....	7,890	2,180	860	68	68	73
12	426	220	159	.....	8,020	2,520	790	64	78	73
13	545	220	156	.....	8,150	3,060	790	59	79	78
14	600	220	153	.....	8,280	3,500	725	55	97	78
15	472	220	150	.....	8,340	3,740	725	59	104	90
16	426	205	147	.....	8,540	3,920	758	55	164	90
17	385	180	144	.....	8,670	3,800	895	55	141	90
18	385	167	141	.....	8,800	3,260	1,280	55	97	90
19	365	167	139	.....	8,860	2,990	1,210	55	79	90
20	365	167	137	.....	8,410	2,780	1,000	59	78	97
21	346	180	.....	.....	6,060	2,650	965	68	68	104
22	365	180	.....	.....	4,710	2,380	545	64	64	90
23	365	180	.....	.....	3,560	1,960	545	64	59	84
24	365	190	.....	.....	3,440	1,820	426	64	59	78
25	365	190	.....	.....	3,800	1,680	327	64	64	73
26	365	190	.....	.....	4,290	1,540	112	59	68	68
27	346	180	.....	.....	4,530	1,410	112	64	68	64
28	327	180	.....	.....	4,040	1,410	112	59	64	90
29	327	180	.....	.....	3,860	1,410	112	59	64	177
30	327	180	.....	1,000	2,860	1,280	104	59	68	220
31	327	.....	.....	2,800	.....	1,280	.....	55	64	.....

NOTE.—Discharge Dec. 6–20 interpolated and Mar. 30 to Apr. 5 estimated from measurements of Apr. 2 and 5 because of ice. No records Dec. 21 to Mar. 29.

Monthly discharge of Milk River at Matla, Mont., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	600	150	325	20,000
November	327	167	232	13,800
December 1–20	180	137	162	6,430
April	10,100	2,860	6,410	381,000
May	3,920	1,280	2,280	140,000
June	1,410	104	812	48,300
July	104	55	71.5	4,400
August	164	48	72.4	4,450
September	220	64	84.7	5,040

NOTE.—Stage-discharge relation affected by ice Dec. 6–20 and Apr. 1–5.

MILK RIVER NEAR VANDALIA, MONT.

LOCATION.—In sec. 7, T. 30 N., R. 37 E., at Vandalia dam of United States Reclamation Service, 2 miles west of Vandalia, in Valley County.

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—May 5, 1915, to September 30, 1917. Station maintained at Hinsdale, 8 miles upstream from May 13, 1908, to November 13, 1914. Discharge nearly same at both points.

GAGE.—Sloping gage painted on concrete of right abutment downstream side of dam; read by employees of United States Reclamation Service.

DISCHARGE MEASUREMENTS.—Made from bridge over crest of dam or by wading. High-water measurements prior to 1917 made from highway bridge at Vandalia, 4 miles downstream.

CHANNEL AND CONTROL.—Channel of sand and gravel. Control for medium and low stages is a gravel bar; no definite control for high stages.

EXTREMES OF DISCHARGE.—Maximum stage reported during year, 34.5 feet at 5 p. m., April 11 (discharge, 25,200 second-feet); minimum stage, 3.9 feet September 2–14 (discharge, 32 second-feet).

1908–1917: Maximum stage, that of April 11, 1917; channel recorded dry August 9–13, 1910.

ICE.—Stage-discharge relation seriously affected by ice January 1 to March 31, 1917.

DIVERSIONS.—Numerous canals divert water for irrigation from main stream and nearly all tributaries.

REGULATION.—Flow partly regulated by the diversion dams and by storage in Nelson reservoir.

ACCURACY.—Stage-discharge relation affected by ice and shifting control. Rating curves are fairly well defined for periods October 1 to June 27 and June 28 to September 30. Gage heights are subject to error when flow over crest of dam or through gates causes wave action on gage. Gage read to tenths twice daily. Daily discharge ascertained by applying gage height to rating table. Records fair.

Discharge measurements of Milk River near Vandalia, Mont., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec. ft.*			*Feet.*	*Sec. ft.*
Oct. 7	A. H. Tuttle	4.75	[b] 176	May 15	A. H. Tuttle	15.6	[c] 4,920
Dec. 21	W. A. Lamb	4.45	[d] 114	30	do	9.1	[c] 1,810
Jan. 27	Tuttle and Freegans [a]	4.40	[d] 83	June 13	do	6.70	[c] 909
Apr. 3	Anderson and Tuttle	18.0	[c d] 4,460	Aug. 7	do	4.30	77
19	M. D. Anderson	28.7	[c] 17,400				

[a] Engineer, United States Reclamation Service.
[b] Made from highway bridge 2½ miles below gage; poor section.
[c] Made from bridge at dam.
[d] Stage-discharge relation affected by ice.

Daily discharge, in second-feet, of Milk River near Vandalia, Mont., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Apr.	May.	June.	July.	Aug.	Sept.
1	144	398	188	400	6,950	1,640	116	77	40
2	144	300	188	1,800	6,510	1,730	165	92	32
3	165	300	213	4,460	6,160	1,640	165	92	32
4	176	300	240	5,500	5,620	1,600	108	92	32
5	165	300	213	6,250	5,000	1,690	108	92	32
6	188	300	240	8,300	4,260	1,730	108	92	32
7	188	300	213	11,500	3,850	1,730	144	77	32
8	213	300	200	18,000	3,600	1,640	125	77	32
9	213	300	200	21,000	3,200	1,600	108	77	32
10	240	300	176	23,700	3,800	1,560	125	77	32
11	240	300	176	25,100	3,150	1,210	108	77	32
12	300	300	188	24,500	4,000	830	108	77	32
13	365	240	188	23,700	4,100	830	92	63	32
14	432	240	188	22,800	4,590	952	92	50	32
15	870	240	188	21,700	5,120	952	77	50	36
16	570	240	188	20,600	5,760	952	77	50	40
17	500	240	144	19,500	5,820	952	165	50	40
18	535	240	144	18,200	5,820	952	165	50	36
19	678	240	144	17,300	5,620	952	144	50	92
20	754	188	144	16,600	4,940	1,040	134	63	144
21	754	188	114	15,900	4,100	1,510	108	63	144
22	754	188	114	14,400	3,850	1,380	108	63	144
23	754	188	114	11,000	3,550	1,040	92	63	125
24	716	188	114	8,200	3,150	910	92	63	125
25	716	188	114	7,800	2,790	716	77	63	108
26	716	188	114	7,880	2,520	754	77	50	108
27	642	188	114	8,460	2,350	432	77	50	108
28	570	188	114	8,620	2,170	108	77	50	108
29	570	188	114	8,370	2,040	108	77	40	108
30	570	188	114	8,040	1,860	108	77	40	108
31	398	.....	114	.....	1,600	.....	77	40	.....

NOTE.—Discharge estimated Dec. 21–31 at 114 second-feet because of ice. Apr. 1–9 daily discharge estimated from measurement of Apr. 3. Observations discontinued during January, February, and March.

Monthly discharge of Milk River near Vandalia, Mont., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	870	144	459	28,200
November	398	188	248	14,800
December	240	a 114	162	9,960
April	25,100	a 400	13,700	815,000
May	6,950	1,600	4,120	253,000
June	1,730	108	1,110	66,000
July	165	77	109	6,700
August	92	40	64.8	3,980
September	144	32	67.7	4,030

a Estimated.

NORTH FORK OF MILK RIVER NEAR INTERNATIONAL BOUNDARY.[1]

LOCATION.—In NE. ¼ sec. 11, T. 1, R. 23 W. fourth meridian, about 300 yards above road crossing at Peters ranch, 2 miles north of international boundary and 18 miles east of Kimball, Alberta.

DRAINAGE AREA.—101 square miles (measured on topographic maps).

RECORDS AVAILABLE.—January 1, 1913, to September 30, 1917. July 21, 1909, to December 31, 1912, station was maintained by Irrigation Branch (now Reclamation Service), Department of Interior of Canada, in NE. ¼ sec. 13, T. 1, R. 23 W. fourth meridian, 2 miles downstream; May 8, 1911, to December 31, 1912, station was maintained at Alexander Dubray's ranch, 2 miles south of international boundary.

GAGE.—Stevens water-stage recorder on left bank; W. Wheeler and Charles Barnett, observers.

DISCHARGE MEASUREMENTS.—Made by wading or from footbridge 700 feet below gage.

CHANNEL AND CONTROL.—Bed of stream at gage and principal control composed of clay and small boulders; slightly shifting. Banks high and not subject to overflow at ordinary stages.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 3.95 feet April 9 (discharge, 482 second-feet); minimum discharge, 13.8 second-feet December 29, 1916.

1909–1917: Maximum stage recorded 3.9 feet (referred to station maintained by Canada; see paragraph on "Records available") July 27, 28, 1909 (discharge, 591 second-feet); minimum discharge, 5.0 second-feet February 12, 1916.

ICE.—Stage-discharge relation seriously affected by ice November 11 to April 8.

DIVERSIONS.—None.

REGULATION.—Amount of water turned into river by St. Mary canal: July, 12,500 acre-feet; August, 15,600 acre-feet; September 1–13, 5,540 acre-feet; approximate total of 33,600 acre-feet.

ACCURACY.—Stage-discharge relation affected by ice and shifting control. Rating curves were used as follows: Well defined between 40 and 65 second-feet October 1 to November 10; well defined between 86 and 500 second-feet April 9 to July 1, and August 14 to September 10; well defined between 29 and 46 second-feet September 16–30. Gage heights obtained from water-stage recorder by graphic method October 1 to November 10, April 9 to May 30, and June 21 to September 30. Gage read to half-tenths once daily November 11 to April 5, and May 31 to June 20. Discharge determined by applying gage height to rating table October 1 to November 10, April 9 to July 1, August 14 to September 10, and September

[1] Formerly called "North Fork of Milk River near Kimball, Alberta."

16–30; temperature records, observer's notes, and discharge measurements used November 11 to April 8; and shifting-control method used July 2 to August 13, and September 11–15. Records very good for periods when rating tables were used; fair for other periods.

COOPERATION.—Station maintained in cooperation with Reclamation Service, Department of the Interior, Canada.

Discharge measurements of North Fork of Milk River near international boundary during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Nov. 15	S. H. Frame[a]	2.49	[b] 53	May 4	A. W. P. Lowrie	2.64	181
16	do	2.41	[b] 55	5	do	2.44	142
Jan. 4	H. W. Rowley[a]	2.29	[b] 32	30	do	2.34	129
6	do	3.10	[b] 45	June 16	W. A. Lamb	1.99	84
23	do	2.49	[b] 27	21	A. W. P. Lowrie	1.96	82
Feb. 21	G. S. Wenden[a]	2.20	[b] 38	July 10	do	3.12	264
Mar. 14	do	2.22	[b] 28	20	W. A. Lamb	3.10	265
Apr. 3	A. W. P. Lowrie[a]	2.23	[b] 46	27	A. W. P. Lowrie	3.20	305
9	do	4.05	462	Aug. 18	W. A. Lamb	3.23	304
9	do	3.98	491	26	A. W. P. Lowrie	3.24	303
10	do	3.25	311	Sept. 15	W. A. Lamb	1.81	51
10	do	3.29	319	20	A. W. P. Lowrie	1.73	41
16	W. A. Lamb	2.16	101				

[a] Engineer, Reclamation Service, Department of the Interior, Canada.
[b] Stage-discharge relation seriously affected by ice.

Daily discharge, in second-feet, of North Fork of Milk River near international boundary for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	53	53	49	20	17	23	45	132	119	192	323	316
2	56	55	48	24	18	24	45	204	119	194	328	311
3	56	54	48	28	20	25	46	252	112	208	323	311
4	59	53	47	31	23	26	48	184	105	223	328	316
5	65	53	47	40	27	26	50	150	102	236	322	316
6	80	50	47	45	31	27	52	271	98	236	319	309
7	80	54	47	47	36	27	150	295	94	234	319	302
8	64	81	46	47	40	28	300	225	90	232	326	302
9	60	56	45	47	44	28	482	219	121	243	323	309
10	60	44	44	46	46	28	326	208	152	262	323	287
11	63	46	42	44	47	28	410	208	184	248	328	304
12	62	48	41	41	47	28	375	216	154	273	321	266
13	58	50	40	38	47	28	255	212	123	283	319	128
14	54	52	40	35	47	28	198	196	110	292	311	64
15	53	53	38	32	47	28	159	182	97	290	307	50
16	53	55	37	28	46	27	105	170	93	285	307	44
17	56	56	36	27	45	27	98	122	89	273	304	43
18	62	56	35	27	44	27	121	121	85	271	304	43
19	63	56	34	28	42	27	139	122	91	266	309	42
20	72	56	32	28	40	28	160	140	97	264	314	41
21	85	56	30	28	38	30	161	166	89	278	311	50
22	72	56	28	28	37	32	173	136	81	290	309	46
23	60	56	26	27	34	34	170	136	82	297	309	46
24	60	56	24	27	30	36	128	145	90	297	309	58
25	57	55	21	28	21	38	146	154	89	314	309	50
26	57	54	19	28	20	39	145	156	85	304	304	46
27	60	54	17	28	21	40	139	142	85	302	304	47
28	57	53	15.2	28	21	41	110	151	83	316	304	47
29	54	52	13.8	25	.....	42	118	204	84	319	304	46
30	53	51	15	21	.....	43	161	135	84	316	309	45
31	55	.....	17	18	.....	44	.....	119	.....	326	321	.....

NOTE.—Gage not read on following days: Nov. 13, 14, 21–23, 29, 30, Dec. 1, Apr. 6–8, June 1, 3, 5, 7, 9, 10, 12, 14, 16, 17, and 19; discharge interpolated except for period Apr. 6–8, included in winter studies. Discharge estimated because of ice Nov. 11 to Apr. 8 from discharge measurements, temperature records, and observer's notes.

Monthly discharge of North Fork of Milk River near international boundary for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	85	53	61.3	3,770
November	81	44	54.1	3,220
December	49	13.8	34.5	2,120
January	47	18	31.9	1,960
February	47	17	34.9	1,940
March	44	23	30.9	1,900
April	482	45	167	9,940
May	295	119	177	10,900
June	184	81	103	6,130
July	326	192	270	16,600
August	328	304	315	19,400
September	316	41	153	9,100
The year	482	13.8	120	87,000

NOTE.—Stage-discharge relation affected by ice Nov. 11 to Apr. 8; discharge estimated from discharge measurements, temperature records, and observer's notes.

FORT BELKNAP CANAL NEAR CHINOOK, MONT.

LOCATION.—In SE. ¼ sec. 20, T. 33 N., R. 18 E., at highway bridge half a mile below head gates of canal on Milk River, 8 miles west of Chinook, in Blaine County.

RECORDS AVAILABLE.—June 21, 1903, to September 30, 1917.

GAGE.—Vertical staff on downstream side of first bent of piles from left bank; read by O. E. Walters. Enamel face placed May 3, 1917, with datum raised 0.62 foot at same location. Prior to 1910 gage located at highway bridge a quarter of a mile below. Gage and bridge washed out by high water of June, 1908, and new gage reinstalled June 27, 1908, at different datum within a few feet of old site.

CHANNEL AND CONTROL.—Slope is main factor in determining the flow for given gate opening, but the check weir half a mile below caused backwater at gage. Aquatic plants that grow in canal reduce velocity considerably in latter part of irrigation season.

ACCURACY.—Stage-discharge relation shifting during year. Two rating tables, well defined between 20 and 60 second-feet, were used during the year; one applicable May 6 to May 29 and July 15 to September 30, and the other May 30 to July 14. Gage read to hundredths once daily. Daily discharge determined by applying daily gage heights to rating tables. Records fair.

The water in the Fort Belknap canal is diverted from the north bank of Milk River in SE. ¼ sec. 20, T. 33 N., R. 18 E., to irrigate lands on the north side of the river. Most of water diverted is used, but it can be wasted into Lodge Creek, north of Chinook, 8 miles below the head gate. Check gates erected on the main canal to divert water into the laterals often back the water for long distances. As the gates are put up under a great variety of conditions, velocities differ widely at the same gage height during the season.

Discharge measurements of Fort Belknap canal near Chinook, Mont., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
May 3	Anderson and Tuttle...	[a] 0.78	12.4	June 23	A. H. Tuttle.....	2.14	58.0
22	A. H. Tuttle.....	1.47	25.5	Aug. 2	.....do.....	1.85	48.8
June 2	.....do.....	1.87	39.6	8	.....do.....	1.74	41.4
16	.....do.....	1.92	43.0				

[a] New gage installed on this date; old gage read 1.40 feet. Gates not open; flow caused by leakage through gates and surface drainage.

Daily discharge, in second-feet, of Fort Belknap canal near Chinook, Mont., for the year ending Sept. 30, 1917.

Day.	May.	June.	July.	Aug.	Sept.	Day.	May.	June.	July.	Aug.	Sept.
1.....	12	40	48	56	30	16.....	21	44	59	38	12
2.....	12	41	48	49	22	17.....	22	39	59	37	12
3.....	12	34	48	55	22	18.....	22	42	59	32	11
4.....	13	30	48	45	22	19.....	26	42	59	18	11
5.....	14	32	48	45	22	20.....	24	48	58	22	9.7
6.....	15	30	48	43	22	21.....	24	58	58	22	8.5
7.....	24	30	48	43	22	22.....	26	58	55	23	8.5
8.....	24	30	62	41	22	23.....	26	58	53	23	4.2
9.....	24	36	62	38	15	24.....	26	44	53	26	3.5
10.....	24	42	78	33	15	25.....	31	48	52	23	4.2
11.....	24	43	78	33	15	26.....	31	48	52	25	4.2
12.....	24	42	78	33	14	27.....	33	55	51	26	4.2
13.....	24	39	78	32	12	28.....	37	48	51	26	4.2
14.....	25	39	62	33	12	29.....	43	48	52	26	4.2
15.....	21	35	59	37	12	30.....	46	48	52	27	.5
						31.....	46	.....	52	30	.....

NOTE.—Discharge interpolated May 1, 2, 4, and 5.

Monthly discharge of Fort Belknap canal near Chinook, Mont., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
May	46	12	25.0	1,540
June	58	30	42.4	2,520
July	78	48	57.0	3,500
August	56	18	33.5	2,060
September	30	.5	12.7	756
The period	.....	.....	.....	10,400

LODGE CREEK AT INTERNATIONAL BOUNDARY.

LOCATION.—In SE. ¼ sec. 12, T. 1, R. 29 W. third meridian, at Willow Creek barracks of Royal Northwest Mounted Police, 1 mile north of international boundary, in Saskatchewan, Canada, and 36 miles north of Havre, Mont.

DRAINAGE AREA.—806 square miles (measured by engineers of Reclamation Service, Department of Interior, Canada).

RECORDS AVAILABLE.—April 1 to September 30, 1917. April 25, 1910, to October 31, 1916, maintained by Irrigation Branch (now Reclamation Service), Department of Interior, Canada.

GAGE.—Inclined staff on right bank at the Willow Creek post; read by Corl. A. R. Price and William Tudgay.

DISCHARGE MEASUREMENTS.—Made from cable or by wading. Some low-water measurements made with weir.

CHANNEL AND CONTROL.—Composed of heavy boulders, gravel, and sand; shifting.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 10.13 feet April 10 (discharge, 2,100 second-feet); creek dry after July 16.

ICE.—Station discontinued during winter. Stage-discharge relation affected by ice and snow April 1–17.

DIVERSIONS.—Several small ditches divert water for irrigation above station.

REGULATION.—None.

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ACCURACY.—Stage-discharge relation affected by ice and shifting control. Rating curve well defined throughout and applicable April 17, 29, May 3, 8–15, 23, 30 to July 16. Gage heights are mean of readings to hundredths twice daily. Discharge determined by applying gage heights to rating table. Shifting-control method used April 7–16, 18–28, 30 to May 2, May 4–7, 16–22, and 24–29. Records fair.

COOPERATION.—Maintained in cooperation with Reclamation Service, Department of Interior, Canada.

Discharge measurements of Lodge Creek at international boundary during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.ft.*			*Feet.*	*Sec.ft.*
Apr. 7	G. S. Wenden[a]	[b]5.30	283	May 24	A. H. Tuttle	2.35	63
17	do	[b]6.42	974	25	G. S. Wenden	2.28	65
27	do	4.32	368	30	do	2.04	29
30	do	3.85	233	June 7	A. H. Tuttle	1.82	17.5
May 4	Anderson and Tuttle	4.35	358	20	do	1.56	6.9
8	G. S. Wenden	4.82	453	22	P. A. Fetterly[a]	1.50	5.7
15	do	4.20	317	July 28	do	.70	0
17	do	3.73	174	Sept. 25	do		0

[a] Engineer, Reclamation Service, Department of the Interior, Canada.
[b] Stage discharge affected by ice.

Daily discharge, in second-feet, of Lodge Creek at international boundary for the year ending Sept. 30, 1917.

Day.	Apr.	May.	June.	July.	Day.	Apr.	May.	June.	July.
1	0.1	160	25	0.3	16	1,560	234	10.4	0.1
2	.2	155	23	.3	17	1,090	158	8.8	.0
3	.5	206	22	.3	18	682	142	8.0	.0
4	5.0	309	22	.3	19	506	114	8.0	.0
5	198	331	22	.3	20	538	89	6.6	.0
6	193	319	21	.3	21	952	84	4.6	.0
7	284	301	18	.2	22	1,410	65	4.6	.0
8	948	447	17	.1	23	1,540	63	4.6	.0
9	1,780	613	16	.2	24	1,250	63	4.1	.0
10	2,100	654	16	.1	25	864	65	3.0	.0
11	1,480	593	16	.1	26	503	53	2.5	.0
12	1,580	547	15	.1	27	361	48	2.0	.0
13	1,500	418	14	.1	28	372	41	.6	.0
14	1,330	365	13	.1	29	381	35	.4	.0
15	1,520	323	12	.1	30	249	30	.3	.0
					31		28		.0

NOTE.—Discharge estimated Apr. 1–6 because of ice and snow. No flow after July 16.

Monthly discharge of Lodge Creek at international boundary for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
April	2,100	0.1	839	49,900
May	654	28	228	14,000
June	25	.3	11.4	678
July	.3	.0	.097	6
The period				65,000

BATTLE CREEK AT INTERNATIONAL BOUNDARY.

LOCATION.—In SE. ¼ sec. 4, T. 1, R. 26 W. fourth meridian, a quarter of a mile above point where creek crosses international boundary in Saskatchewan, just across line from Buckley's ranch in United States, and 35 miles north of Chinook, Mont.

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—April 1 to September 30, 1917.

GAGE.—Stevens water-stage recorder referred to two vertical staff gages, one in well and one outside; read by John Buckley.

DISCHARGE MEASUREMENTS.—Made from cable 45 feet below gage or by wading.

CHANNEL AND CONTROL.—Bed composed of heavy boulders with sand and gravel; not likely to shift except during extreme stages.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 8.50 feet at 9.40 a. m. April 13 (discharge, 3,200 second-feet); minimum stage recorded, 1.96 feet August 13 (discharge, 0.6 second-foot).

ICE.—Records not maintained during winter. Stage-discharge relation seriously affected by ice April 1–10.

DIVERSIONS.—Several small ditches divert water for irrigation above station.

REGULATION.—None.

ACCURACY.—Stage-discharge relation practically permanent except for period April 1–10 when affected by ice. Rating curve well defined between 60 and 3,000 second-feet and fairly well defined below 60 second-feet, used April 16 to September 4; curve fairly well defined was used September 6–11. Daily gage heights determined from Stevens water-stage recorder April 16 to September 11, and from observer's readings twice daily September 12–30. Discharge determined by applying daily gage height to rating table. Discharge April 1–4 determined from the station at Nash's ranch 20 miles above; April 5–10 by interpolation between measurements of April 5 and 11; April 11–15 by computing discharge for hourly periods and averaging these discharges for each day; September 5 and 12–30 determined by shifting-control method. Records good.

COOPERATION.—Maintained in cooperation with Reclamation Service, Department of the Interior, Canada.

Discharge measurements of Battle Creek at international boundary during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Oct. 24	H.W. Rowley	2.79	61	May 11	G. S. Wenden	5.63	975
Nov. 16	....do	[b]2.81	30	21	A. H. Tuttle	3.80	273
Apr. 5	G. S. Wenden[a]	.....	56	22	G. S. Wenden	3.65	250
11	....do	[b]6.20	886	29	....do	3.34	168
12	Anderson and Tuttle	[b]6.85	1,680	June 3	A. H. Tuttle	3.16	129
13	G. S. Wenden	[b]8.09	2,830	17	....do	3.05	89
21	....do	4.79	594	26	P. A. Fetterly[a]	2.76	60
25	....do	5.05	762	July 27	....do	2.10	2.1
May 2	M. D. Anderson	3.83	256	Aug. 1	A. H. Tuttle	2.01	[c]1.5
4	G. S. Wenden	3.75	236				

[a] Engineer of Reclamation Service, Department of Interior, Canada.
[b] Stage-discharge relation affected by ice Nov. 16, Apr. 5, 11, 12, 13.
[c] Flow estimated.

Daily discharge, in second-feet, of Battle Creek at international boundary for the year ending Sept. 30, 1917.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Day.	Apr.	May.	June.	July.	Aug.	Sept.
1....	5	311	137	42	1.0	7.4	16....	1,860	516	126	30	17	21
2....	15	271	133	42	.8	8.7	17....	1,230	467	108	27	13	22
3....	25	249	124	40	.9	8.7	18....	953	417	103	32	12	19.2
4....	40	249	129	42	1.1	9.4	19....	718	352	95	28	13	16.5
5....	56	323	129	42	1.2	10.0	20....	645	305	85	23	12	15.6
6....	195	349	124	42	.9	11.5	21....	645	265	82	18	11	16.5
7....	334	329	124	40	.9	18.3	22....	764	227	74	12	10	19.2
8....	473	477	122	40	.8	18.3	23....	942	208	67	8.0	8.0	17.4
9....	612	538	120	42	.7	19.2	24....	937	182	64	8.0	5.6	30
10....	751	733	115	42	.8	18.3	25....	748	174	70	6.8	4.4	33
11....	1,160	996	115	39	.9	16.5	26....	516	172	67	5.0	3.8	28
12....	1,580	1,220	112	36	.7	19.2	27....	480	158	64	2.0	2.6	28
13....	2,830	1,280	101	35	.6	20	28....	467	156	60	1.8	2.6	28
14....	2,560	1,030	106	36	1.2	28	29....	446	160	54	1.4	3.2	22
15....	2,610	636	128	37	12	28	30....	374	152	47	1.1	5.6	23
							31....	.....	144	.....	1.0	8.0	.....

NOTE.—Discharge Apr. 1–4 determined from station at Nash's ranch 20 miles above, Apr. 5–10 by interpolation between measurements Apr. 5 and 11.

Monthly discharge of Battle Creek at international boundary for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
April	2,830	5	832	49,500
May	1,280	144	419	25,800
June	137	47	99.5	5,920
July	42	1.0	25.9	1,590
August	17	.6	5.04	310
September	33	7.4	19.4	1,150
The period	.....	.....	.....	84,300

BATTLE CREEK[1] NEAR CHINOOK, MONT.

LOCATION.—In sec. 3, T. 33 N., R. 19 E., 500 feet above new highway bridge at point 4½ miles north of Chinook, in Blaine County, 7 miles above junction with Milk River.

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—April 22, 1905, to September 30, 1917.

GAGE.—Chain on left bank near house of R. B. Snedecor, 500 feet above the highway bridge; read by Mrs. R. B. Snedecor.

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

CHANNEL AND CONTROL.—Sandy and shifting. Banks high and not subject to overflow. At low water principal control is sand bar below gage; no well-defined control at high water.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 11.8 feet at 7.10 p. m. April 10 (discharge, 6,380 second-feet); pool stage reported August 10 to September 9.

1905–1917: Maximum stage recorded, that of April 10, 1917; channel reported dry September 3 to October 22, 1905; July 8 to November 20, 1908; June 21 to end of year, 1910; July 22 to September 3, 1911; September 7–23, 1913; July 14 to October 4, 1914; and August 10 to September 9, 1917.

ICE.—Stage-discharge relation seriously affected by ice November 23 to April 1; observations discontinued January 1 to March 27.

[1] Decision of U. S. Geographic Board; formerly known as North Fork of Milk River.

DIVERSIONS.—Three canals, which divert about 20 second-feet, take out above the station in the United States, and several small pumping plants, which supply water for irrigating the bottom land along the valley, are also operated above the station. Below the station the Matheson and Cook canals divert water used to irrigate land in Milk River valley near the mouth of Battle Creek. For record of diversions by Cook and Matheson canals, see pages 86–87. About fifteen ditches divert water from this creek in Canada before it crosses the boundary line.

REGULATION.—None.

ACCURACY.—Stage-discharge relation affected by ice and shifting control. Rating curve well defined betweeen 40 and 700 second-feet used October 1 to November 22 and April 1–8; curve fairly well defined above 150 second-feet used April 9 to June 5; curve well defined below 100 second-feet used June 22 to August 5 and September 10–30. Gage heights from observer's readings to quarter-tenths or hundredths twice daily. Discharge determined by applying daily gage height to rating table; June 6–21 by shifting-control method. Records good.

Discharge measurements of Battle Creek near Chinook, Mont., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Oct. 5	A. H. Tuttle	1.12	50.7	May 21	A. H. Tuttle	1.85	331
Apr. 8	Tuttle and Anderson	4.88	1,080	June 4	do	.97	161
9	M. D. Anderson	10.75	5,390	22	do	.52	64
9	do	9.95	4,300	Aug. 1	do	—.42	4.8
23	do	4.14	992	Sept. 22	W. A. Lamb	—.18	12.2
May 11	A. H. Tuttle	4.12	869				

Daily discharge, in second-feet, of Battle Creek near Chinook, Mont., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Apr.	May.	June.	July.	Aug.	Sept.
1	41.	56	411	363	182	46	4.0	0
2	47	55	411	341	174	46	3.2	0
3	48	54	515	298	174	44	3.0	0
4	59	54	640	277	166	40	2.6	0
5	58	54	1,190	298	166	36	2.0	0
6	65	53	1,200	363	162	33	1.4	0
7	63	52	640	385	156	31	.8	0
8	63	52	1,030	407	152	30	.4	0
9	63	52	4,050	543	147	29	.2	0
10	63	52	5,500	692	144	28	.0	8.0
11	63	52	2,570	910	150	27	0	12
12	61	52	2,710	1,130	148	26	.0	14
13	61	52	2,020	1,340	145	25	.0	16
14	63	52	2,990	1,130	121	23	.0	16
15	63	56	3,300	920	120	22	.0	18
16	63	65	2,260	710	126	22	.0	17
17	63	70	1,380	500	112	20	.0	21
18	63	72	1,000	476	95	16	.0	21
19	63	72	765	453	88	14	.0	21
20	63	72	765	385	80	13	.0	20
21	63	72	820	341	77	12	.0	16
22	63	72	820	319	67	11	.0	12
23	62	72	925	298	60	8.8	.0	12
24	61	72	970	277	58	7.4	.0	26
25	59	70	880	247	55	6.8	.0	30
26	58	70	716	217	52	5.6	.0	31
27	58	70	548	208	50	4.6	.0	31
28	58	70	524	208	48	4.2	.0	30
29	58	70	476	208	47	3.8	.0	28
30	56	70	430	199	46	3.6	.0	28
31	56	.....	.....	199	.....	3.4	.0	.....

NOTE.—Discharge Nov. 23–30 estimated at 70 second-feet daily on account of ice. Daily discharge May 14–16 interpolated on account of no gage readings. Daily discharge Aug. 6–10 estimated flow, assuming steady fall.

Monthly discharge of Battle Creek near Chinook, Mont., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	65	41	59.6	3,670
November	72	52	61.9	3,680
April	5,500	411	1,420	84,500
May	1,340	199	472	29,000
June	182	46	112	6,660
July	46	3.4	20.7	1,270
August	4.0	.0	.57	35
September	31	.0	14.3	851

COOK CANAL NEAR CHINOOK, MONT.

LOCATION.—In N. ½ sec. 30, T. 33 N., R. 20 E., half a mile below head gates and 3 miles east of Chinook, in Blaine County.

RECORDS AVAILABLE.—April 10, 1905, to September 30, 1917.

GAGE.—Vertical staff on left bank 1,000 feet above point where canal turns west and runs parallel to road; read by Adam Jamison.

DISCHARGE MEASUREMENTS.—Made by wading near point where canal passes under Great Northern Railway.

CHANNEL AND CONTROL.—No well-defined control. Weeds grow in canal and frequently cause backwater.

ACCURACY.—Owing to delay in making repairs to flume and head gates, very little water was used in 1917. Canal was in operation during June and July; records fair.

Canal diverts water from Battle Creek in SE. ¼ sec. 19, T. 33 N., R. 20 E., for irrigation of lands in the Milk River valley south of Milk River. Water can be wasted into Milk River at point where canal crosses river in a flume about 2 miles below gage. Flume sometimes acts as throttle when too much water is turned into canal.

Discharge measurements of Cook canal near Chinook, Mont., during the year ending Sept. 30, 1917.

[Made by A. H. Tuttle.]

Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*
June 18	2.48	8.2
23	2.90	14.7
July 14	2.60	9.6

Daily discharge, in second-feet, of Cook canal near Chinook, Mont., for the year ending Sept. 30, 1917.

Day.	June.	July.	Day.	June.	July.	Day.	June.	July.
1	.....	22	11	.....	14	21	17	0.6
2	.....	23	12	.....	13	22	16	.4
3	.....	21	13	8.3	11	23	16	.1
4	.....	20	14	8.1	9.7	24	16	.....
5	.....	21	15	6.0	9.0	25	17	.....
6	.....	19	16	7.9	8.1	26	17	.....
7	.....	18	17	9.4	7.8	27	18	.....
8	.....	17	18	7.9	6.9	28	19	.....
9	.....	17	19	15	5.5	29	21	.....
10	.....	15	20	18	1.8	30	22	.....
						31	.....	.....

Monthly discharge of Cook canal near Chinook, Mont., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
June	22	6.0	14.4	514
July	23	.0	9.06	557
The period				1,070

MATHESON CANAL NEAR CHINOOK, MONT.

LOCATION.—In NW. ¼ sec. 29, T. 33 N., R. 20 E., at farm bridge forming head gate of canal, a quarter of a mile north of main road and 3½ miles east of Chinook, in Blaine County.

RECORDS AVAILABLE.—April 10, 1905, to September 30, 1917.

GAGE.—Vertical staff on right bank 10 feet below head gate; read by Adam Jamison.

DISCHARGE MEASUREMENTS.—Made by wading.

CHANNEL AND CONTROL.—Bed of canal is earth; no well-defined control. Aquatic plants in bottom of canal during summer may cause backwater.

ACCURACY.—Stage-discharge relation permanent. Rating curve well defined below 7 second-feet and applicable June 27 to July 28. Gage heights from observer's readings to hundredths once daily. Discharge by applying gage height to rating table. Records fair.

Water is diverted from Battle Creek and used to irrigate lands on north side of Milk River valley. Water can be wasted into a small tributary of Milk River.

The following discharge measurement was made by A. H. Tuttle:

July 14, 1917: Gage height, 3.95 feet; discharge, 7.0 second-feet.

Daily discharge in second-feet, of Matheson canal near Chinook, Mont., for the year ending Sept. 30, 1917.

Day.	June.	July.	Day.	June.	July.	Day.	June.	July.
1		0.6	11		6.1	21		4.2
2		.7	12		6.8	22		3.7
3		3.0	13		7.0	23		2.3
4		3.2	14		7.2	24		2.0
5		3.7	15		7.6	25		1.5
6		5.4	16		7.2	26	0.0	1.4
7		6.4	17		6.3	27	1.8	1.1
8		7.4	18		6.9	28	2.3	.7
9		6.8	19		7.4	29	2.7	.0
10		5.1	20		5.4	30	.9	.0
						31		.0

Monthly discharge of Matheson canal near Chinook, Mont., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
June 26–30	2.7	0	1.54	15.3
July	7.6	.0	4.10	252
The period				267

NOTE.—Canal was in operation June 27 to July 28. Canal was dry during remainder of year, except possibly during the high water in spring, when the river overflowed into the canal, but no records were obtained.

PARADISE CANAL NEAR CHINOOK, MONT.

LOCATION.—In SW. ¼ sec. 35, T. 33 N., R. 20 E., 300 feet below head gate, 30 feet below flume of Cook canal, on ranch of Rudolph Friede, 6 miles southeast of Chinook, in Blaine County, and 3 miles southwest of Zurich.

RECORDS AVAILABLE.—June, 1903, to August, 1909; and January 1, 1911, to September 30, 1917.

GAGE.—Vertical staff on left bank, 300 feet below head gate and 30 feet below flume carrying Cook canal over Paradise Valley canal; read by Rudolph Friede.

DISCHARGE MEASUREMENTS.—Made by wading.

CHANNEL AND CONTROL.—Bed of canal is earth; silt is deposited during irrigation season. Weeds grow in bottom of canal during summer. A large slough into which the canal flows a few hundred feet below gage may affect results, the height of the water in the slough possibly affecting the slope of the water surface at the gage.

ACCURACY.—Stage-discharge relation affected by shifting control. Measurements made June 23, August 1 and 9, and point of zero flow give a well-defined curve below 12 second-feet which is applicable June 5 to July 12; and July 26 to September 30. Gage read to hundredths twice daily; records June 5 to September 30. Discharge determined by applying daily gage height to rating table. Shifting-control method used July 13–25. Records good.

Paradise canal diverts water from Milk River to irrigate land on the south side of Milk River valley. No water is returned to river.

Discharge measurements of Paradise canal near Chinook, Mont., during the year ending Sept. 30, 1917.

[Made by A. H. Tuttle.]

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*		*Feet.*	*Sec.-ft.*
June 23	1.63	4.1	Aug. 1	2.16	10.9
July 14	1.96	11.5	9	2.08	9.8

Daily discharge, in second-feet, of Paradise canal near Chinook, Mont., for the year ending Sept. 30, 1917.

Day.	June.	July.	Aug.	Sept.	Day.	June.	July.	Aug.	Sept.
1	.....	6.8	10.6	4.3	16	0.1	9.4	8.9	2.6
2	.....	6.0	11.3	5.2	17	.0	10.3	8.9	2.6
3	.....	4.6	11.6	5.6	18	.0	11.8	8.7	2.4
4	.....	6.8	11.6	6.5	19	.0	12.1	8.5	2.0
5	.....	7.3	11.6	7.2	20	.0	11.4	9.6	1.4
6	.0	8.6	11.8	7.2	21	.0	10.2	6.9	.7
7	.0	8.6	11.8	10.2	22	.5	8.6	6.8	.0
8	.0	7.3	11.9	7.8	23	4.6	8.7	5.9	.0
9	.0	8.6	9.7	7.0	24	.8	8.5	5.8	.0
10	.0	7.7	9.9	6.8	25	.6	5.8	4.9	.0
11	.0	6.6	10.0	7.4	26	.9	7.3	4.3	8.9
12	.0	6.0	9.2	8.1	27	8.6	11.0	3.5	1.5
13	.0	9.4	9.6	4.7	28	8.1	11.4	3.2	.0
14	.0	11.5	8.2	2.4	29	8.0	11.4	4.5	.0
15	.0	10.3	8.9	2.3	30	7.0	11.3	4.7	.0
					31	.....	11.0	4.2	.....

Monthly discharge of Paradise canal near Chinook, Mont., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
June	8.6	0	1.51	77.9
July	12.1	4.6	8.91	548
August	11.9	3.2	8.29	510
September	10.2	0	3.83	228
The period				1,364

NOTE.—Water standing in pools June 5–15, 17–21, Sept. 22–25, and 28–30.

HARLEM CANAL NEAR ZURICH, MONT.

LOCATION.—In SW. ¼ sec. 33, T. 33 N., R. 21 E., 500 feet below head gates and 1½ miles southeast of Zurich, in Blaine County.

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

GAGE.—Vertical staff on right bank, 500 feet below head gates; read by Howsan Kirby.

DISCHARGE MEASUREMENTS.—Made by wading.

CHANNEL AND CONTROL.—Bed of canal is earth with no definite control. Check weirs several miles below gage may cause some backwater at high stages. Aquatic plants growing in canal during the irrigation season also cause backwater, and much silt is deposited.

ACCURACY.—Stage-discharge relation shifted during year. Rating curve well defined between 30 and 85 second-feet used April 19 to June 11 and July 10–27; curve well defined between 35 and 50 second-feet used July 28 to September 30. Gage read to hundredths twice daily. Discharge determined by applying mean daily gage height to rating table. Discharge June 12 to July 9 determined by shifting-control method because of silt in canal. Records fair.

Water is diverted from Milk River to irrigate lands on north side of river near Harlem. Water can be wasted into Milk River, but most of the water diverted is used.

Discharge measurements of Harlem canal near Zurich, Mont., during the year ending Sept. 30, 1917.

[Made by A. H. Tuttle.]

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*		*Feet.*	*Sec.-ft.*		*Feet.*	*Sec.-ft.*
May 22	3.64	47.6	June 23	3.78	44.6	Aug. 1	[a]4.30	42.5
June 4	3.35	39.4	July 14	4.50	82	9	[a]4.08	37.8
18	3.71	45.4						

[a] Stage-discharge relation affected by backwater from checks below gage.

Daily discharge, in second-feet, of Harlem canal near Zurich, Mont., for the year ending Sept. 30, 1917.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Day.	Apr.	May.	June.	July.	Aug.	Sept.
1	.....	36	45	47	43	32	16	.....	47	53	81	27	31
2	.....	39	50	43	42	32	17	.....	48	53	69	27	31
3	.....	46	49	53	42	30	18	.....	48	47	53	27	29
4	.....	38	43	56	40	23	19	4.0	46	44	66	28	29
5	.....	41	38	63	40	28	20	3.2	50	35	66	23	30
6	.....	46	38	65	40	33	21	3.5	49	29	65	22	31
7	.....	42	36	72	41	35	22	2.8	46	30	67	20	30
8	.....	40	31	71	40	34	23	2.8	46	45	65	20	28
9	.....	46	27	73	38	33	24	2.9	44	44	66	20	28
10	.....	40	25	88	38	29	25	2.8	43	42	67	20	30
11	.....	31	24	90	38	29	26	2.2	49	30	62	20	44
12	.....	28	24	89	25	28	27	2.2	45	29	43	20	30
13	.....	32	24	83	24	27	28	16	40	40	40	16	28
14	.....	39	29	83	34	28	29	22	39	44	32	16	25
15	.....	43	52	81	27	30	30	26	40	47	31	16	16
							31	.....	44	.....	43	22	.....

Monthly discharge of Harlem canal near Zurich, Mont., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
April 19–30	26	2.2	7.53	179
May	50	28	42.3	2,600
June	53	24	38.2	2,270
July	90	31	63.6	3,910
August	43	16	28.9	1,780
September	44	16	29.7	1,770
The period				12,500

AGENCY DITCH NEAR HARLEM, MONT.

LOCATION.—In NW. ¼ S.W. ¼ sec. 33, T. 32 N., R. 23 E., at spillway 1,000 feet below highway bridge, half a mile below head gate, and 4 miles south of Harlem, in Blaine County.

RECORDS AVAILABLE.—July 14, 1905, to September 30, 1917.

GAGE.—Vertical staff on right-hand downstream post of check weir at spillway; read by Estey M. Knapp.

DISCHARGE MEASUREMENTS.—Made from bridge.

CHANNEL AND CONTROL.—Bed of canal is earth; backwater is caused by aquatic plants growing in the canal during irrigation season, and also by check gate 1 mile below station; that due to diversion at check gate varies with the quantity of water diverted.

ACCURACY.—Stage-discharge relation affected by placing and removing checks below gage. Measurements made June 18, August 1, and August 9 give a well-defined curve beween 0 and 45 second-feet when checks below gage are in place. A parallel curve drawn through measurement made July 14 gives a rating curve for the time when checks below gage are removed. Gage read to tenths twice daily. Checks were removed June 26 and date of replacing is uncertain. Curve for period when checks were in place was used June 15–21 and July 31 to August 11. Curve for periods when checks were not in place was used June 26 to July 16. Shifting-control method used July 17–30. Records fair.

The canal takes water from Milk River for the irrigation of lands on Fort Belknap Indian Reservation. Water not required for irrigation can be wasted into White Bear Creek, 12 miles below head gate. This canal has been given a prior right by court decree to 125 second-feet of the water of Milk River and tributaries above the point of diversion.

Discharge measurements of Agency ditch near Harlem, Mont., during the year ending Sept. 30, 1917.

[Made by A. H. Tuttle.]

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*		*Feet.*	*Sec.-ft.*
June 18	5.18	33.3	Aug. 1	4.40	0
July 14	4.55	26.1	9	4.49	4.8

Daily discharge, in second-feet, of Agency ditch near Harlem, Mont., for the year ending Sept. 30, 1917.

Day.	June.	July.	Aug.	Day.	June.	July.	Aug.	Day.	June.	July.	Aug.
1		26	0	11		20	5	21	8	16	
2		32	0	12		20		22	0	15	
3		32	0	13		28		23	0	14	
4		28	0	14		28		24	0	12	
5		24	0	15	44	20		25	0	11	
6		24	5	16	54	22		26	36	10	
7		24	5	17	54	22		27	32	9	
8		24	5	18	42	21		28	32	8	
9		24	5	19	25	19		29	36	7	
10		24	5	20	16	18		30	34	5	
								31		0	

Monthly discharge of Agency ditch near Harlem, Mont., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
June 15–30	54	0	25.8	819
July	32	0	18.9	1,160
Aug. 1–11	5	0	2.73	59.6
The period				2,040

NOTE.—Irrigation season ended Aug. 11.

FRENCHMAN RIVER AT INTERNATIONAL BOUNDARY.

LOCATION.—In SW. ¼ sec. 4, T. 1, R. 10 W. third meridian at Ball's ranch, in Saskatchewan, just across the international boundary from east side of lot 3, sec. 6, T. 37 N., R. 34 E. in United States.

DRAINAGE AREA.—1,875 square miles (measured by Reclamation Service, Department of Interior, Canada).

RECORDS AVAILABLE. April 1 to September 30, 1917.

GAGE.—Stevens water-stage recorder referred to staff gage in well was used after April 5. Mrs. W. B. Chamberlain read gage during year.

DISCHARGE MEASUREMENTS.—Made from cable 20 feet above gage or by wading.

CHANNEL AND CONTROL.—Bar composed of boulders and gravel forms principal control at low and medium stage. At high stages this bar is drowned out and control is below.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 9.99 feet at 11.30 a. m. April 30 (discharge, 2,780 second-feet); minimum flow occurred during winter, lowest measurement being March 27 (discharge, 5.2 second-feet).

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

DIVERSIONS.—Several ditches divert water for irrigation 60 miles above station in Saskatchewan.

REGULATION.—None.

ACCURACY.—Stage-discharge relation fairly permanent during the year when not affected by ice. Rating curve used April 12 to September 30 well defined between 20 and 2,820 second-feet. Gage heights April 6 to September 30 from automatic record. Discharge ascertained by applying gage height to rating table. Records fair, April 1–11; good, April 12 to end of year.

COOPERATION.—Station maintained in cooperation with Reclamation Service, Department of Interior, Dominion of Canada.

Discharge measurements of Frenchman River at international boundary during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Nov. 3	W. A. Lamb	2.60	59	Apr. 24	P. A. Fetterly	9.97	2,760
Mar. 26	P. A. Fetterly [a]		[b] 5.6	25	do	9.21	2,440
27	do		[b] 5.2	25	Anderson and Fetterly	9.28	2,480
30	do	3.70	[b] 45.0	30	P. A. Fetterly	9.94	2,770
31	do	3.82	[b] 37.0	May 1	do	8.62	2,240
Apr. 2	do	3.59	[b] 28.0	2	do	7.54	1,910
4	do	3.48	[b] 36.0	3	do	6.88	1,660
5	do	3.48	[b] 48.0	4	do	6.56	1,440
6	do	3.88	[b] 155	5	do	6.15	1330
7	do	4.52	[b] 333	6	do	5.87	1,220
8	do	4.32	[b] 438	11	do	6.19	1,330
9	do	4.97	[b] 788	18	A. H. Tuttle	5.22	[b] 969
10	do	6.48	[b] 1,370	19	P. A. Fetterly	4.72	844
11	do	7.87	[b] 2,070	19	do	5.02	849
12	do	8.32	2,130	23	do	4.26	588
13	do	8.08	2,060	24	do	4.03	485
14	do	9.18	2,450	25	do	3.85	392
16	do	8.88	2,300	31	A. H. Tuttle	3.54	274
18	do	7.96	1,980	July 11	P. A. Fetterly	2.78	62
19	do	7.48	1,800	Aug. 15	do	2.30	13.8
20	do	7.06	1,640				
21	do	6.74	1,540				
23	do	8.56	2,210				

[a] Engineer, Reclamation Service, Department of the Interior, Canada.
[b] Stage-discharge relation affected by ice.

Daily discharge, in second-feet, of Frenchman River at international boundary for the year ending Sept. 30, 1917.

Day.	Apr.	May.	June	July.	Aug.	Sept.	Day.	Apr.	May.	June.	July.	Aug.	Sept.
1	30	2,210	234	55	19	18	17	2,140	1,070	147	54	17	42
2	28	1,790	234	47	18	19	18	1,990	962	181	49	17	34
3	30	1,580	234	42	18	19	19	1,810	834	178	46	18	34
4	36	1,440	234	55	18	19	20	1,620	710	150	40	19	33
5	48	1,300	214	78	18	19	21	1,540	656	133	36	18	33
6	155	1,200	203	91	18	18	22	1,690	648	125	34	19	33
7	333	1,240	190	87	18	18	23	2,140	571	103	32	18	29
8	438	1,280	184	81	18	18	24	2,720	478	100	31	17	28
9	788	1,320	217	76	17	18	25	2,520	410	98	29	18	29
10	1,370	1,370	210	64	16	18	26	2,340	356	91	28	23	25
11	2,070	1,330	190	61	16	18	27	2,330	325	87	25	24	18
12	2,080	1,360	181	59	16	19	28	2,480	310	76	24	22	19
13	2,130	1,450	165	55	16	24	29	2,700	284	64	23	19	25
14	2,440	1,500	165	47	15	27	30	2,670	281	57	21	19	22
15	2,420	1,290	162	46	16	54	31	.....	252	.....	20	18	.....
16	2,360	1,120	147	55	16	63							

NOTE.—Flow Apr. 1–11 when affected by ice determined by discharge measurements and recorder records.

Monthly discharge of Frenchman River at international boundary for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
April	2,720	28	1,580	94,000
May	2,210	252	998	61,400
June	234	57	158	9,400
July	91	20	48.1	2,960
August	24	15	18.0	1,110
September	63	18	26.4	1,570
The period				170,000

BEAVER CREEK NEAR MALTA, MONT.

LOCATION.—In NW. ¼ sec. 30, T. 28 N., R. 33 E., on highway at Hales crossing, at site of proposed reservoir of United States Reclamation Service, 28 miles southeast of Malta, in Phillips County.

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—March 31 to September 30, 1917.

GAGE.—Chain gage on downstream handrail of highway bridge; read by Charles Hales.

DISCHARGE MEASUREMENTS.—Made from highway bridge or by wading at old ford crossing, 500 feet above bridge.

CHANNEL AND CONTROL.—Channel is straight for 150 feet above and 200 feet below gage. Banks are high and practically without vegetation. Left bank is overflowed at gage height 18.5 feet. The low-water control is gravel and cobblestone bar, 400 feet below gage; probably shifting. At stages above gage height 12.5 feet the river cuts across the first oxbow below and has a decided increase of slope, materially increasing the discharge. Stage of zero flow about 0.10 foot.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 19.5 feet April 6 (discharge, 4,990 second-feet); no flow July 1 to September 30.

ICE.—Creek freezes practically solid during winter and ice jams are frequent during the spring breakup.

DIVERSIONS.—No diversion from main stream; several on small tributaries above.

REGULATION.—None.

ACCURACY.—Stage-discharge relation not affected by ice or shifting control. Rating curve well defined between 10 and 3,000 second-feet. Gage read to hundredths once daily. Daily discharge obtained by applying daily gage heights to rating table. Records good.

Discharge measurements of Beaver Creek near Malta, Mont., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*
Apr. 21	Anderson and Hill	3.40	222
May 19	Tuttle and Stratton	.88	22.1

Daily discharge, in second-feet, of Beaver Creek near Malta, Mont., for the year ending Sept. 30, 1917.

Day.	Mar.	Apr.	May.	June.	Day.	Mar.	Apr.	May.	June.
1	.....	803	70	7.1	16	.....	264	20.0	17.2
2	.....	2,130	63	6.5	17	.....	176	18.4	18.4
3	.....	2,840	63	7.1	18	.....	165	17.6	20.0
4	.....	2,430	77	7.1	19	.....	176	20.0	16.8
5	.....	3,240	70	6.8	20	.....	231	12.5	15.3
6	.....	4,990	57	6.5	21	.....	231	15.3	14.2
7	.....	4,290	51	7.7	22	.....	275	16.0	14.6
8	.....	4,220	51	8.3	23	.....	253	22	13.9
9	.....	3,380	46	8.9	24	.....	264	20	12.5
10	.....	2,170	36	9.5	25	.....	231	17.6	11.9
11	.....	1,200	32	10.4	26	.....	176	16.0	9.5
12	.....	943	28	11.3	27	.....	100	13.6	8.9
13	.....	712	24	11.9	28	.....	70	12.8	6.5
14	.....	517	21	12.5	29	.....	70	12.5	4.5
15	.....	341	20.0	16.4	30	.....	70	10.7	3.0
					31	429	.....	8.9	.....

NOTE.—No flow after June 30.

Monthly discharge of Beaver Creek near Malta, Mont., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
April	4,990	70	1,230	73,200
May	77	8.9	31.1	1,910
June	20.0	3.0	10.8	643
The period	.....	.....	.....	75,800

ROCK CREEK NEAR HINSDALE, MONT.

LOCATION.—In sec. 10, T. 31 N., R. 36 E., at Ottenstror's ranch, 2 miles below head gates of Rock Creek canal and 6 miles northeast of Hinsdale, in Valley County.

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—April 19, 1912, to September 30, 1917. From July 5, 1905, to December 31, 1907, data were obtained at a station 2 miles upstream, just below the diversion dam of the Rock Creek canal. Flow at these two points is practically the same.

GAGE.—Combined overhanging chain and staff gage on left bank, back of John Ottenstror's house; chain gage reads to 16.0 feet; staff 16.0 to 24 feet. Original gage washed out during spring flood of 1917 and new one, installed 30 feet above old site, is now in use; read by Mrs. John Ottenstror and John Hoerster.

DISCHARGE MEASUREMENTS.—Made by wading a quarter of a mile below gage or from bridge 2 miles below.

CHANNEL AND CONTROL.—Water at gage is deep and sluggish at low stages. Control is a gravel bar a quarter of a mile below; shifts slightly at high water. Left bank high and is not overflowed at gage; right bank fairly high but is overflowed at flood stages.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 20.0 feet at 6 a. m. April 11 (discharge, 4,020 second-feet); no flow after September 13.

1906–1907 and 1912–1917: Maximum stage recorded, 18.40 feet June 9, 1906, determined by leveling from flood marks (discharge, determined from extension of rating curve, 6,220 second-feet); no flow April 14 to May 2, May 9–24, and after July 12, 1906; after September 28, 1907; April 23, 25, 27, 28, 30, May 1, 2, and 4, 1913; May 3, 5, 8, 10, and 13, 1915; and after September 13, 1917.

ICE.—Stage-discharge relation seriously affected by ice. Observations discontinued during winter.

DIVERSIONS.—There is no storage, but the normal summer flow is appropriated and used during the irrigation season.

REGULATION.—None.

ACCURACY.—Stage-discharge relation affected by ice and shifting control. Rating curve well defined between 0 and 300 second-feet used October 1 to November 25 and May 5 to June 5; curve fairly well defined between 0 and 3,400 second-feet used April 9–27 and June 28 to September 30. Gage read to tenths daily by Mrs. J. Ottenstror until July 4, and by John Hoerster after August 19; no records July 15 to August 18. Discharge determined by applying gage height to rating table; shifting-control method used April 28 to May 4, June 6–19, and June 20–27. Records fair.

Discharge measurements of Rock Creek near Hinsdale, Mont., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Apr. 28[a]	M. D. Anderson	7.20	248	May 30	A. H. Tuttle	5.50	5.4
May 17	A. H. Tuttle	6.00	59	June 13	do	5.87	23.0

[a] Measured from bridge, 1½ miles below gage.

Daily discharge, in second-feet, of Rock Creek near Hinsdale, Mont., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Apr.	May.	June.	July.	Aug.	Sept.
1	10	10	.....	173	10	0	.....	2
2	10	10	.....	162	4	2	.....	0
3	10	10	.....	173	0	2	.....	0
4	10	10	.....	173	0	0	.....	2
5	10	10	.....	162	0	2	.....	0
6	10	10	.....	140	0	0	.....	2
7	10	10	.....	162	0	2	.....	2
8	19	10	.....	162	0	0	.....	2
9	44	10	3,620	140	347	2	.....	0
10	31	10	3,820	118	232	2	.....	0
11	31	10	3,860	98	184	2	.....	0
12	19	10	2,880	79	41	0	.....	2
13	19	10	3,000	79	26	2	.....	0
14	19	10	2,400	79	9	0	.....	.....
15	19	10	2,700	61	0	.....	.....	.....
16	19	10	2,100	61	0	.....	.....	.....
17	19	10	1,200	61	2	.....	.....	.....
18	19	10	750	0	0	.....	.....	.....
19	19	10	500	0	0	.....	2	.....
20	19	10	700	0	0	.....	0	.....
21	19	10	900	0	0	.....	2	.....
22	10	10	750	0	0	.....	0	.....
23	10	10	900	10	0	.....	0	.....
24	10	10	1,200	10	0	.....	0	.....
25	10	10	900	10	1	.....	0	.....
26	10	10	400	10	0	.....	0	.....
27	10	9	288	10	2	.....	2	.....
28	10	9	250	10	2	.....	0	.....
29	10	9	195	10	2	.....	0	.....
30	10	9	184	10	2	.....	0	.....
31	10	.....	.....	10	.....	.....	0	.....

NOTE.—Observer absent Apr. 13–26, discharge estimated by comparison with Frenchman River and Porcupine Creek. No observer July 15 to Aug. 18. Discharge estimated because of ice Nov. 26–30.

Monthly discharge of Rock Creek near Hinsdale, Mont., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	44	10	15.6	959
November	10	9	9.86	587
April 9-30	3,860	184	1,520	66,300
May	173	0	70.1	4,310
June	347	0	28.8	1,710
July 1-14	2	0	1.14	31.7
August 19-31	2	0	.46	11.9
September	2	0	.40	23.8

PORCUPINE CREEK AT NASHUA, MONT.

LOCATION.—In sec. 31, T. 28 N., R. 42 E., 500 feet above ford, a quarter of a mile mile above highway bridge, three-eights of a mile north of Nashua, in Valley County.

DRAINAGE AREA.—Not measured.

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

GAGE.—Vertical staff in three sections nailed to trees on the left bank; read by Rosie Brocksmith.

DISCHARGE MEASUREMENTS.—Made by wading near gage or, at high stages, from a bridge a quarter of a mile below.

CHANNEL AND CONTROL.—Bed of stream is mud. Slight gravel bar forms the control at low stages. This is soon drowned out, as the creek rises, and the control is the whole channel below gage.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 16.6 feet at 8 a. m. April 10 (discharge, 1,080); no flow most of the time after June 30.

1909–1917: Maximum stage recorded, 18.0 feet, April 11, 1916, determined by leveling from flood marks (discharge, determined from extension of rating curve, 2,700 second-feet); no flow during periods in 1909, 1910, 1911, 1913, 1916, and 1917.

ICE.—Stage-discharge relation seriously affected by ice. Discharge very small. Observations discontinued during winter.

DIVERSIONS.—None during 1917. A United States Reclamation Service canal is practically completed which will divert the entire flow during irrigation season.

REGULATION.—None developed. A United States Reclamation Service reservoir on the middle fork of stream will partially regulate flood flow.

ACCURACY.—Stage-discharge relation not permanent; affected by shifting control and seriously affected by ice. Rating curve used October 1 to November 18, well defined below 60 second-feet, and fairly well defined to 1,000 second-feet. curve used April 1 to June 1 well defined between 7 and 1,000 second-feet; June 12 to July 12 fairly well defined. Shifting-control method used June 2 to 10, Gage read to tenths twice daily during fluctuating stage and once daily at other times. Daily discharge ascertained by applying daily gage height to rating table. Records fair.

Discharge measurements of Porcupine Creek at Nashua, Mont., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Apr. 18	M. D. Anderson	8.16	260	May 29	A. H. Tutte	3.68	7.2
May 14	A. H. Tuttle	4.27	28.4	June 12	do	3.78	6.6

NOTE.—Measurement Apr. 18 made from highway bridge a quarter of a mile below gage; all others by wading 100 feet above gage.

Daily discharge, in feet, of Porcupine Creek at Nashua, Mont., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Apr.	May.	June.	July.	Day.	Oct.	Nov.	Apr.	May.	June.	July.
1	1.6	5.5	33	82	7.9	.0	16	3.9	3.9	709	13.7	3.3	.....
2	1.6	5.5	42	72	9.9	.0	17	3.9	3.9	434	13.7	3.3	.....
3	1.6	5.5	42	67	7.6	.0	18	5.5	3.9	250	13.7	3.3	.....
4	1.6	5.5	42	62	7.2	.0	19	5.5	.....	194	13.7	3.3	.....
5	2.7	5.5	102	57	6.8	.0	20	5.5	.....	281	13.7	3.3	.....
6	3.9	5.5	458	52	6.4	.2	21	5.5	.....	345	10.8	3.3	.....
7	3.9	3.9	353	47	6.0	.2	22	5.5	.....	254	10.8	3.3	.....
8	3.9	5.5	800	37	5.6	.0	23	5.5	.....	297	7.9	3.3	.....
9	3.9	3.9	989	33	5.2	.2	24	5.5	.....	416	7.9	3.3	.....
10	3.9	3.9	1,060	33	6.2	.2	25	5.5	.....	385	7.9	2.2	.....
11	3.9	3.9	935	33	6.4	.2	26	5.5	.....	269	7.9	1.3	.....
12	3.9	3.9	962	33	6.4	.0	27	5.5	.....	173	7.9	.6	.....
13	3.9	3.9	956	33	4.7	.0	28	5.5	.....	126	5.5	.2	.....
14	3.9	3.9	855	29	4.7	.0	29	5.5	.....	102	5.5	.2	.....
15	3.9	3.9	905	21	3.3	.0	30	5.5	.....	92	5.5	.0	.....
							31	5.5	.....	.....	5.5	.....	.....

Monthly discharge of Porcupine Creek at Nashua, Mont., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	5.5	1.6	4.29	264
November 1–18	5.5	3.9	4.52	161
April	1,060	33	429	25,500
May	82	5.5	27.2	1,670
June	9.9	.0	4.28	255
July	.2	.0	.....	.....
August	.0	.0	0	0
September	.0	.0	0	0

NOTE.—Creek standing in pools after June 29 except July 6–7, 9–10, when approximately 0.2 second-foot was flowing.

POPLAR RIVER BASIN.

POPLAR RIVER NEAR POPLAR, MONT.

LOCATION.—In S. ½ sec. 8, T. 28 N., R. 51 E., at United States Reclamation Service camp 5 miles north of Poplar, in Sheridan County.

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—October 5, 1913, to September 30, 1917, at present site; August 15, 1908, to June 30, 1911, in S. ½ sec. 5, T. 28 N., R. 51 E., at Obershaw's ranch, 6 miles north of Poplar; May 2, 1911, to October 4, 1913, at United States Reclamation camp in NE. ¼ sec. 4, T. 29 N., R. 51 E., 18 miles north of Poplar.

GAGE.—Chain gage on left bank at United States Reclamation Service camp; read by Art Pronovort and F. W. Cothren, employees of Reclamation Service.

DISCHARGE MEASUREMENTS.—Made by wading near gage or from highway bridge at Poplar, 8 miles below.

CHANNEL AND CONTROL.—Composed of gravel, clay, and boulders; shifts slightly, usually at extreme stages.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 10.95 feet at 8 a. m., April 14 (discharge, 5,280 second-feet); minimum stage recorded, 3.75 feet July 31 to August 4 (discharge, 1.5 second-feet).

1908–1917: Maximum stage recorded, 12.0 feet April 10, 1912; determined by leveling from flood marks (discharge, determined from extension of rating curve, 10,000 second-feet); minimum stage, 3.75 feet July 31 to August 4, 1917 (discharge, 1.5 second-feet).

ICE.—Stage-discharge relation seriously affected by ice November 29 to December 5; April 3–9. Discharge estimated November 29–30 at 47 and 43 second-feet, respectively. No records December 6 to April 2.

DIVERSIONS.—Poplar River canals, East and West, diverted water above gage for irrigation of approximately 10,000 acres. When the system of reservoirs is completed about 28,000 acres can be irrigated. Low flow during July, August, and September owing to the fact that all the water was diverted above station.

REGULATION.—None.

ACCURACY.—Stage-discharge relation not permanent, affected by shifting control and by ice. Daily gage heights are the mean of two readings daily during high water, and one reading daily at other times. Daily discharge October 1 to May 14 obtained from rating curve well defined below 1,800 second-feet; June 11 to September 30 from a rating curve well defined between 5 and 120 second-feet; May 15 to June 10 by shifting-control method. Low flow July 14 to September 18 represents return water and seepage only, as all the water is diverted above. Water was turned into the river on September 18.

Discharge measurements of Poplar River near Poplar, Mont., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Apr. 17[a]	M. D. Anderson	8.34	2,410	June 11	A. H. Tuttle	4.88	114
May 13	A. H. Tuttle	5.20	244	Aug. 5	do	3.92	3.2
28	do	4.78	108				

[a] Made from highway bridge at Poplar, 8 miles below gage. All others by wading near gage.

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

Day.	Oct.	Nov.	Apr.	May.	June.	July.	Aug.	Sept.
1	36	43	.....	550	75	42	1.5	2.5
2	36	43	.....	484	75	38	1.5	2.5
3	47	43	.....	441	98	35	1.5	2.5
4	50	43	.....	420	92	32	1.5	2.5
5	50	43	.....	380	92	30	2.0	2.5
6	57	43	.....	361	77	30	2.0	2.5
7	57	43	.....	342	72	28	2.0	2.5
8	57	43	.....	324	72	26	2.5	2.5
9	57	43	.....	324	70	21	2.5	2.5
10	50	43	2,550	324	102	18	2.5	2.5
11	50	62	3,090	306	116	14	2.5	2.5
12	50	50	4,100	272	166	30	2.5	2.5
13	50	62	4,960	239	166	26	2.5	2.5
14	50	53	5,220	239	147	8	2.5	4.0
15	50	50	4,460	229	138	8	2.5	4.0
16	50	50	3,530	217	131	7	2.5	5.5
17	50	50	2,550	207	124	5.5	2.5	5.5
18	50	50	1,440	184	116	5.5	2.5	8.0
19	50	43	1,130	181	110	5.5	2.5	8.0
20	47	43	990	155	96	5.5	2.5	11
21	43	47	925	152	86	4.0	2.5	14
22	50	50	695	152	91	3.0	2.5	14
23	50	50	865	150	91	2.5	2.5	14
24	50	50	1,130	150	79	2.5	2.5	14
25	50	50	990	136	63	2.5	2.5	18
26	50	50	1,200	125	59	2.5	2.5	18
27	50	50	865	116	59	2.5	2.5	18
28	47	50	750	108	52	2.5	2.5	13
29	43	47	695	94	46	2.5	2.5	11
30	43	43	645	88	46	2.0	2.5	11
31	43	.....	.....	83	.....	1.5	2.5	.....

Monthly discharge of Poplar River near Poplar, Mont., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	57	36	48.8	3,000
November	62	43	47.7	2,840
April 10–30	5,220	645	2,040	85,000
May	550	83	243	14,900
June	166	46	93.6	5,570
July	42	1.5	14.3	879
August	2.5	1.5	2.32	143
September	18	2.5	7.45	443

BIG MUDDY CREEK BASIN.

BIG MUDDY CREEK NEAR CULBERTSON, MONT.

LOCATION.—In NE. ¼ sec. 20, T. 29 N., R. 54 E., at Kraft's (formerly Sholtz's) ranch, 11 miles above mouth of stream, 15 miles northwest of Culbertson, in Sheridan County, and 8 miles above site of original station at Boyd's ranch, which was discontinued.

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—July 19, 1909, to September 30, 1917, at present station; July 14, 1908, to July 19, 1909, at original station.

GAGE.—An inclined staff on left bank near the house on Kraft's ranch. Since August 19, 1916, read by Jacob Kraft. This gage has been read since July 19, 1909. Previous to that date a staff gage at Boyd's ranch, 8 miles downstream, was read.

DISCHARGE MEASUREMENTS.—Made by wading or from bridge about 9 miles below gage.

CHANNEL AND CONTROL.—A bar of gravel with a few small boulders forms the extreme low-water control; but this is soon drowned out, as the creek rises, and the control is the whole bed of the stream below. The creek has a very small slope, crooked channel, and mud banks which are fairly high and are seldom overflowed. Weeds grow thick in the channel above the control during summer, and cause backwater at gage.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 11.10 feet April 16, 17, 18 (discharge, 1,460 second-feet); minimum stage recorded during year, 1.70 feet August 22, 23, and September 13 (discharge, 0.5 second-foot).

1909–1917: Maximum stage recorded, 11.4 feet March 31, 1916 (discharge, 1,550 second-feet); minimum stage, 1.5 feet September 16–18, 1915 (discharge, 0).

ICE.—Little, if any, flow during winter.

DIVERSIONS.—Several small pumping plants divert water for irrigation above station; amount unknown.

REGULATION.—None.

ACCURACY.—Stage-discharge relation not permanent; seriously affected by ice and by occasional shifts in control. Rating curve used October 1 to November 11, fairly well defined below 30 second-feet; curve used March 30 to September 30, well defined. Gage read to half-tenths once daily. Daily discharge ascertained by applying daily gage height to rating table. Records fair, October and November; good, April to September.

Discharge measurements of Big Muddy Creek near Culbertson, Mont., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Apr. 16	M. D. Anderson	11.10	1,450	June 9	A. H. Tuttle	3.55	79
May 12	A. H. Tuttle	5.32	256	Aug. 4	do	1.92	2.3
27	do	4.34	152				

NOTE.—Measurements Apr. 16 and May 12 made from highway bridge 9 miles below gage; all others by wading at ford 300 feet below gage.

Daily discharge, in second-feet, of Big Muddy Creek near Culbertson, Mont., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	5.5	6.2	.....	206	572	90	34	4.0	0.8
2	6.2	7.0	.....	188	494	86	26	4.0	1.0
3	7.0	5.5	.....	194	449	106	24	2.0	1.0
4	7.0	5.5	.....	200	389	102	26	2.0	.8
5	8.0	7.0	.....	406	372	94	32	2.0	.8
6	9.0	6.2	.....	729	356	90	34	2.0	.8
7	8.0	7.0	.....	795	406	82	34	1.5	.8
8	7.0	8.0	.....	960	332	78	36	1.5	.8
9	7.0	8.0	.....	927	280	78	34	1.5	1.0
10	8.0	9.0	.....	1,150	274	90	34	1.0	1.0
11	8.0	9.0	.....	1,430	267	86	30	1.5	1.0
12	8.0	.....	.....	1,430	254	82	30	1.5	.8
13	9.0	.....	.....	1,430	254	72	26	1.5	.5
14	9.0	.....	.....	1,430	242	50	24	2.0	.8
15	7.0	.....	.....	1,430	218	50	18	2.0	1.0
16	8.0	.....	.....	1,460	294	56	18	1.0	2.0
17	8.0	.....	.....	1,460	240	65	18	1.0	1.5
18	9.0	.....	.....	1,460	133	62	18	1.0	2.0
19	9.0	.....	.....	1,410	162	59	16	.8	1.5
20	10.0	.....	.....	1,390	194	56	16	.8	2.0
21	9.0	.....	.....	1,190	178	62	14	.8	3.0
22	8.0	.....	.....	1,190	162	62	14	.5	3.0
23	7.0	.....	.....	1,050	152	56	14	.5	4.0
24	7.0	.....	.....	1,030	115	53	12	.8	4.0
25	6.2	.....	.....	971	133	53	10	.8	5.5
26	5.5	.....	.....	806	147	50	12	.8	5.5
27	5.5	.....	.....	828	138	50	10	.8	5.5
28	5.5	.....	.....	784	115	53	7	.8	7.0
29	7.0	.....	.....	718	106	47	7	.8	7.0
30	9.0	.....	152	652	102	44	5.5	.8	7.0
31	7.0	.....	224	.....	98	.....	5.5	.8	.....

Monthly discharge of Big Muddy Creek near Culbertson, Mont., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	10	5.5	7.56	465
November 1-11	9.0	5.5	7.13	156
April	1,460	188	977	58,100
May	572	98	246	15,100
June	106	44	68.8	4,090
July	36	5.5	20.6	1,270
August	4.0	.5	1.38	85
September	7.0	.5	2.45	146

YELLOWSTONE RIVER BASIN.

YELLOWSTONE RIVER NEAR CANYON HOTEL, YELLOWSTONE NATIONAL PARK.

LOCATION.—Approximately in sec. 16, T. 13 S., R. 10 E. Montana meridian, half a mile upstream from Upper Falls and Canyon soldier station, 1¼ miles south of Canyon Hotel, and 13 miles below outlet of Lake Yellowstone.

DRAINAGE AREA.—1,280 square miles (measured on topographic maps).

RECORDS AVAILABLE.—June 23, 1913, to September 30, 1917.

GAGE.—Friez water-stage recorder on left bank, 450 feet above Chittenden Bridge, and 900 feet below former vertical staff installed October 11, 1916, at about same datum. Vertical staff used September 13, 1913, to October 11, 1916. Original gage used June 22 to September 12, 1913, was of same type and at same site but set to datum 1.03 feet higher than later staff. Readings on original gage reduced to datum of later staff. Gage read by privates and noncommissioned officers attached to Canyon soldier station.

DISCHARGE MEASUREMENTS.—Made by wading at low stages at a gravel and boulder section 100 feet below former staff gage. High-stage measurements made from cable one-fifth of a mile above new gage.

CHANNEL AND CONTROL.—One channel at all stages. Bed of stream composed of gravel and boulders; control formed by upper portion of the Upper Yellowstone Falls and is practically permanent.

ICE.—Stage-discharge relation affected by ice; gage reading discontinued during winter.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 4.08 feet at 4.30 p. m. July 11 (discharge, 7,220 second-feet); minimum stage recorded, 1.00 foot at 11 a. m. May 12 (discharge, 875 second-feet). A less gage height and discharge occurred during period of no record.

1913–1917: Maximum stage recorded, 4.08 feet at 4.30 p. m., July 11, 1917 (discharge, 7,220 second-feet); minimum stage recorded, 0.75 foot October 16, 1915 (discharge, 675 second-feet). A less gage height and discharge occurred during periods of no records.

DIVERSIONS.—None above station.

REGULATION.—None.

ACCURACY.—Stage-discharge relation practically permanent. Gage read once daily to half-tenths prior to May 26, except during winter. Rating curve is well defined. Daily discharge ascertained by applying daily gage height to rating table prior to May 26. After that date, daily discharge ascertained by applying mean daily height obtained by inspection of recorder graph to rating table. Records good.

Discharge measurements of Yellowstone River near Canyon Hotel, Yellowstone National Park, during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Oct. 9	C. G. Paulsen	1.34	1,200	June 27	G. C. Baldwin	3.57	5,690
11	do	1.31	1,180	Sept. 3	do	2.02	2,140
June 26	G. C. Baldwin	3.51	5,560				

Daily discharge, in second-feet, of Yellowstone River near Canyon Hotel, Yellowstone National Park, for the year ending Sept. 30, 1917.

Day.	Oct.	May.	June.	July.	Aug.	Sept.	Day.	Oct.	May.	June.	July.	Aug.	Sept.
1	.....	.....	1,820	6,380	4,980	2,270	16	1,120	1,050	2,630	6,980	3,240	1,780
2	.....	.....	1,820	6,530	4,850	2,270	17	1,110	1,090	2,940	6,820	3,140	1,750
3	.....	.....	1,800	6,530	4,720	2,190	18	.....	1,140	3,250	6,820	3,140	1,730
4	.....	.....	1,780	6,680	4,720	2,100	19	.....	1,180	3,550	6,680	3,030	1,700
5	.....	.....	1,750	6,680	4,570	2,070	20	.....	1,240	3,860	6,680	2,930	1,680
6	.....	.....	1,820	6,820	4,430	2,060	21	.....	1,290	4,160	6,530	2,930	1,650
7	.....	.....	1,900	6,820	4,280	2,020	22	.....	1,350	4,470	6,380	2,820	1,630
8	.....	.....	2,060	7,130	4,140	1,980	23	.....	1,400	4,770	6,380	2,730	1,600
9	.....	.....	2,270	7,130	3,990	1,920	24	.....	1,460	5,080	6,240	2,630	1,590
10	1,180	.....	2,360	7,130	3,840	1,870	25	.....	1,530	5,390	6,090	2,630	1,560
11	1,180	.....	1,980	7,130	3,700	1,840	26	.....	1,590	5,520	5,950	2,540	1,520
12	1,180	875	2,270	7,130	3,700	1,800	27	.....	1,610	5,800	5,800	2,540	1,490
13	1,170	918	2,270	7,130	3,590	1,770	28	.....	1,750	5,950	5,660	2,440	1,470
14	1,140	962	2,440	7,130	3,470	1,800	29	.....	1,800	6,090	5,520	2,440	1,420
15	1,130	1,000	2,540	7,130	3,360	1,800	30	.....	1,800	6,240	5,390	2,360	1,430
							31	.....	1,810	.....	5,250	2,270	.....

NOTE.—Discharge interpolated May 13–18, 20–25, May 30–June 1, June 17–24, Aug. 5–10, and Sept. 16–21.

Monthly discharge of Yellowstone River near Canyon Hotel, Yellowstone National Park, for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October 10-17	1,180	1,110	1,150	18,200
May 12-31	1,810	875	1,340	53,200
June	6,240	1,750	3,350	199,000
July	7,130	5,250	6,540	402,000
August	4,980	2,270	3,420	210,000
September	2,270	1,420	1,790	107,000

YELLOWSTONE RIVER AT CORWIN SPRINGS, MONT.

LOCATION.—In NE. ¼ sec. 30, T. 8 S., R. 8 E., at highway bridge in canyon at Corwin Springs, in Park County, 8 miles below Gardiner, northern entrance to Yellowstone National Park.

DRAINAGE AREA.—2,630 square miles.

RECORDS AVAILABLE.—September 2, 1910, to September 30, 1917.

GAGE.—Chain gage fastened to floor of highway bridge on downstream side near right bank. Before October 25, 1911, staff gage set to same datum and fastened to pile beside concrete abutment on right bank. Gage read by Mrs. C. H. Wilks and Mrs. Lena Bassett.

DISCHARGE MEASUREMENTS.—Made from downstream side of highway bridge.

CHANNEL AND CONTROL.—Bed of stream composed of small rocks. Current swift at all stages; no definite control visible but has not shifted since station was established. Banks high and not subject to overflow.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 9.6 feet June 25 (discharge, 20,200 second-feet); minimum stage recorded, 0.7 foot February 9 (discharge, 870 second-feet).

1910–1917: Maximum stage recorded, 10.2 feet June 13, 1911 (discharge, 22,800 second-feet); minimum stage recorded, 0.6 foot January 1, 1916 (discharge, 830 second-feet).

ICE.—On account of missing gage readings and severe ice conditions for short period, the flow for the months of December and January was not computed; February 18 and 19 was estimated on account of anchor ice at 970 second-feet.

DIVERSIONS.—No water diverted from the Yellowstone above station.

REGULATION.—Yellowstone Lake furnishes a natural but uncontrolled regulation.

ACCURACY.—Stage-discharge relation permanent since station was established, except during ice-affected periods. Rating curve well defined between 1,000 and 18,300 second-feet. Gage read to half-tenths once daily. Gage not read on October 17, December 10–14, December 27 to January 5, January 18–24. Daily discharge ascertained by applying gage height to rating table, except October 17, when discharge was interpolated, and February 18–19, when discharge was estimated on account of ice. Records for open channel are good. There may have been slight ice effect during November and February, and records for these months may be slightly high.

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

Daily discharge, in second-feet, of Yellowstone River at Corwin Springs, Mont., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	2,180	1,500	1,070	935	1,220	1,400	5,700	16,400	6,970	3,190
2	2,230	1,450	1,010	960	1,220	1,450	6,490	16,400	6,730	3,060
3	2,230	1,600	1,040	960	1,220	1,400	6,020	16,400	6,490	3,060
4	2,010	1,600	960	1,010	1,220	1,400	5,590	16,600	6,490	3,060
5	2,010	1,600	985	1,010	1,240	1,400	5,280	17,700	6,490	3,330
6	2,010	1,550	960	1,010	1,310	1,450	5,180	17,400	6,250	3,190
7	2,060	1,500	935	1,010	1,240	1,600	5,590	16,900	5,800	3,470
8	2,060	1,400	910	1,010	1,360	1,650	6,020	17,100	5,380	3,060
9	2,010	1,500	870	1,010	1,360	1,750	8,900	16,800	5,380	3,060
10	2,010	1,400	890	1,010	1,400	1,960	8,360	15,800	5,280	3,060
11	2,010	1,360	910	1,040	1,450	2,280	8,230	14,900	5,180	2,930
12	1,900	1,140	890	1,070	1,500	2,680	7,970	14,400	4,980	2,860
13	1,850	1,070	910	1,070	1,500	3,120	7,270	13,000	4,980	2,680
14	1,800	1,260	960	1,070	1,400	3,980	8,490	12,800	4,790	2,800
15	1,850	1,500	985	1,070	1,360	5,380	10,700	12,200	4,600	3,060
16	1,900	1,700	985	1,080	1,310	7,220	14,300	11,600	4,600	3,060
17	1,820	1,500	985	1,080	1,360	5,180	17,700	11,000	4,600	2,930
18	1,750	1,400	970	1,080	1,310	4,980	19,900	11,000	4,240	2,800
19	1,700	1,310	970	1,100	1,310	5,180	18,600	11,000	4,240	2,680
20	1,600	1,260	960	1,160	1,310	5,910	18,300	10,700	4,240	2,680
21	1,650	1,220	985	1,180	1,310	5,800	18,300	10,200	3,900	2,560
22	1,700	1,180	985	1,100	1,400	5,590	19,900	9,870	3,900	2,500
23	1,650	1,260	960	1,140	1,500	6,250	18,500	9,870	3,900	2,500
24	1,700	1,220	985	1,140	1,550	7,220	18,900	9,590	3,900	2,680
25	1,700	1,180	1,000	1,140	1,650	6,610	20,200	9,590	3,750	2,560
26	1,700	1,220	985	1,140	1,600	6,970	18,500	8,760	3,470	2,560
27	1,750	1,260	985	1,100	1,600	6,490	17,500	8,490	3,400	2,450
28	1,700	1,310	985	1,140	1,400	7,220	18,000	8,230	3,400	2,560
29	1,700	1,260	.....	1,260	1,400	8,230	18,900	7,600	3,400	2,500
30	1,700	1,260	.....	1,360	1,400	7,720	19,300	7,220	3,330	2,500
31	1,650	.....	.....	1,260	.....	6,250	.....	7,220	3,330	.....

Monthly discharge of Yellowstone River at Corwin Springs, Mont., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	2,230	1,600	1,860	114,000
November	1,700	1,070	1,370	81,500
February	1,070	870	965	53,600
March	1,360	935	1,090	67,000
April	1,650	1,220	1,380	82,100
May	8,230	1,400	4,380	269,000
June	20,200	5,180	12,800	762,000
July	17,700	7,220	12,500	769,000
August	6,970	3,330	4,750	292,000
September	3,470	2,450	2,850	170,000

YELLOWSTONE RIVER AT INTAKE, MONT.

LOCATION.—In NW. ¼ sec. 36, T. 18 N., R. 56 E., at Lower Yellowstone diversion dam at Intake, in Dawson County, 18 miles below Glendive.

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—January 1, 1911, to September 30, 1917. At Glendive, 18 miles above, by War Department and Department of Agriculture 1893 to 1903, and by Geological Survey, August 1, 1903, to December 31, 1910.

GAGE.—Chain gage on north abutment of dam showing depth of water on crest; read by Howard Roby and Matt Griebler, employees of United States Reclamation Service.

DISCHARGE MEASUREMENTS.—Made from bridge at Glendive.

CHANNEL AND CONTROL.—Dam forming the principal control is a rock filled timber crib structure on pile foundation, completed January 29, 1910; 700 feet long; crosses the stream at right angles to current, and raises low-water level about 4 feet; specially designed to resist the destructive effects of ice by approach on a slope of 3 to 1; downstream face is ogee-shaped and protected by a heavy rock apron.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 15 and 16 feet at 8 a. m. April 3 (stage-discharge relation affected by ice jam 2½ miles below; discharge not computed); minimum stage recorded, 1.2 feet November 15 (discharge, 4,040 second-feet). A lower stage may have occurred during frozen period.

1903–1917: Maximum stage, open channel recorded, 10.1 feet July 4, 1912 (discharge, 112,000 second-feet); minimum stage recorded, 0.9 foot December 26–28 (discharge, 2,950 second-feet).

ICE—Stage-discharge relation seriously affected by ice January 1 to April 3; flow not computed.

DIVERSIONS.—The Lower Yellowstone canal, which divers water to irrigate 66,000 acres of land, heads at north abutment of dam. There are also many diversions on the tributaries above station.

REGULATION.—Yellowstone Lake and Shoshone reservoir form the only important regulation above, and control only a small part of the flood flow.

ACCURACY.—Stage-discharge relation permanent, except as affected by ice. Rating curve fairly well defined by discharge measurements made at Glendive and curve of relation between gage heights at Glendive and at Lower Yellowstone dam. Gage read to tenths twice daily, except for period January 6 to March 23 when they are estimated from hole cut in ice near gage. Daily discharge ascertained by applying mean daily gage height to rating table. Records fair.

No discharge measurements made during year.

Daily discharge, in second-feet, of Yellowstone River at Intake, Mont., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Apr.	May.	June.	July.	Aug.	Sept.
1	6,240	7,800	7,260	.....	13,600	56,800	86,400	25,400	9,540
2	6,240	7,800	6,740	.....	13,600	53,800	84,800	23,400	9,540
3	6,740	7,800	6,740	.....	14,400	56,800	86,400	21,400	9,540
4	6,740	7,800	7,800	50,800	14,400	47,900	81,600	19,500	9,540
5	6,740	7,260	6,740	36,800	14,400	42,200	72,200	17,700	9,540
6	6,740	7,260	6,740	36,800	14,400	47,900	69,100	17,700	9,540
7	6,740	7,260	5,760	35,600	15,200	42,200	70,600	16,000	9,540
8	6,740	6,740	6,240	39,400	15,200	36,800	72,200	16,000	9,540
9	6,740	6,740	6,740	33,100	16,000	32,000	72,200	14,400	9,540
10	6,740	6,740	7,260	32,000	16,000	30,800	73,800	14,400	9,540
11	7,260	6,740	6,740	29,600	16,000	34,300	75,300	13,600	9,540
12	7,260	6,740	6,240	25,400	16,800	39,400	75,300	13,600	9,540
13	7,800	4,860	6,240	21,400	16,800	55,200	72,200	12,900	9,540
14	7,800	4,440	5,760	19,500	16,000	59,800	69,100	12,900	10,200
15	7,800	4,040	5,760	18,600	16,800	50,800	62,900	12,200	10,200
16	7,260	4,440	5,760	17,700	17,700	45,000	55,200	11,500	10,200
17	7,260	4,860	4,860	16,800	21,400	42,200	50,800	11,500	10,200
18	7,800	4,860	4,860	16,000	27,500	42,200	45,000	10,800	10,800
19	7,800	4,860	5,300	14,400	35,600	55,200	42,200	10,200	11,500
20	7,800	5,300	4,860	14,400	34,300	70,600	39,400	10,200	11,500
21	7,800	6,740	4,860	13,600	34,300	81,600	38,100	10,200	11,500
22	7,800	8,940	4,860	12,900	33,100	91,400	36,800	10,200	11,500
23	7,800	8,940	4,860	11,500	39,400	94,600	34,300	10,200	11,500
24	7,800	8,940	4,860	10,800	42,200	91,400	33,100	10,200	11,500
25	8,360	8,360	4,440	11,500	40,800	94,600	32,000	10,200	10,200
26	8,360	8,360	4,440	11,500	38,100	94,600	32,000	10,200	9,540
27	8,360	8,360	4,440	12,200	42,200	91,400	30,800	10,200	9,540
28	8,360	7,800	5,300	12,900	42,200	91,400	29,600	9,540	8,940
29	8,360	7,800	5,300	12,900	45,000	94,600	29,600	9,540	8,940
30	8,360	7,800	5,300	12,900	45,000	89,700	27,500	9,540	8,940
31	8,360	.....	5,300	.....	47,900	.....	27,500	9,540	.....

Monthly discharge of Yellowstone River at Intake, Mont., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	8,360	6,240	7,480	460,000
November	8,940	4,040	6,880	409,000
December	7,800	4,440	5,750	354,000
Apr. 3–30	50,800	10,800	21,500	1,151,000
May	47,900	13,600	26,300	1,620,000
June	94,600	30,800	61,900	3,680,000
July	86,400	27,500	55,100	3,390,000
August	25,400	9,540	13,400	824,000
September	11,500	8,940	10,000	595,000

BIG TIMBER CREEK NEAR BIG TIMBER, MONT.

LOCATION.—In SE. ¼ sec. 5, T. 2 N., R, 14 E., at Webb's ranch, 4 miles below junction of forks of Big Timber Creek and 9 miles northwest of Big Timber, in Sweetgrass County.

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—April 13, 1912, to September 30, 1917.

GAGE.—Chain gage on left bank below lower barns, and about one-eighth of a mile below house at Webb's ranch; read by L. E. Webb to May 21. This was destroyed by high water and on August 8, 1917, a temporary overhanging chain gage was set on left bank opposite sheep sheds and 500 feet above site of old gage. Read by John Kremper.

DISCHARGE MEASUREMENTS.—Made by wading.

CHANNEL AND CONTROL.—Bed and banks are of gravel and boulders and are subject to change at each high stage.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 4.10 feet May 12 (discharge, 212 second-feet); minimum stage, 3.25 feet October 5–7 and November 12 (discharge, 18 second-feet).

1912–1917: Maximum stage recorded, 4.8 feet June 5, 1914 (discharge, 937 second-feet); minimum stage, 2.65 feet March 20, 1915 (discharge, 7 second-feet).

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

DIVERSIONS.—Numerous irrigating ditches divert water both above and below the gage.

REGULATION.—None.

ACCURACY.—Stage-discharge relation entirely changed by high water of June, requiring a new gage location; stage-discharge relation unchanged at new site during period of record. Rating curves fairly well defined. Gage read to half-tenths daily to May 21 and twice daily August 8 to September 30. Daily discharge ascertained by applying mean daily gage height to rating tables except for October 1, interpolated. Records fair.

Discharge measurements of Big Timber Creek near Big Timber, Mont., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*
Oct 2	C. S. Heidel	3.35	27.7
Aug. 8	W. A. Lamb	2.45	80

Daily discharge, in second-feet, of Big Timber Creek near Big Timber, Mont., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Apr.	May.	Aug.	Sept.	Day.	Oct.	Nov.	Apr.	May.	Aug.	Sept.
1	26	23	.....	68	.....	37	16	35	.....	.....	.....	67	40
2	29	29	.....	78	.....	34	17	35	.....	.....	.....	80	34
3	29	29	.....	100	.....	28	18	35	.....	.....	.....	70	40
4	23	29	.....	88	.....	31	19	29	.....	.....	.....	74	34
5	18	29	.....	88	.....	40	20	29	.....	.....	50	74	34
6	18	23	.....	100	.....	34	21	29	.....	.....	78	62	40
7	18	23	.....	112	.....	31	22	29	.....	50	.....	62	34
8	29	23	.....	112	80	34	23	29	.....	78	.....	44	34
9	23	23	.....	140	80	37	24	23	.....	88	.....	40	42
10	23	23	.....	173	80	34	25	23	.....	112	.....	44	40
11	29	23	.....	192	74	28	26	29	.....	88	.....	44	37
12	29	18	.....	212	74	31	27	29	.....	78	.....	40	40
13	29	.....	.....	.....	80	34	28	29	.....	68	.....	44	40
14	35	.....	.....	.....	74	67	29	29	.....	68	.....	40	37
15	35	.....	.....	.....	87	57	30	29	.....	68	.....	44	34
							31	23	.....	.....	.....	44	.....

Monthly discharge of Big Timber Creek near Big Timber, Mont., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	35	18	27.6	1,700
November 1–12	29	18	24.6	586
April 22–30	112	50	77.6	1,380
August 8–31	87	40	62.6	2,980
September	67	28	37.2	2,210

SWEETGRASS CREEK ABOVE MELVILLE, MONT.

LOCATION.—About in middle of sec. 27, T. 5 N., R. 13 E., on T. S. Lavold's ranch, 9 miles northwest of Melville, in Sweet Grass County.

DRAINAGE AREA.—About 63 square miles (measured on topographic map).

RECORDS AVAILABLE.—August 21, 1913, to September 30, 1917; May 5, 1907, to December 31, 1912, for station at C. M. Reins's ranch in SW. ¼ sec. 24, T. 5 N., R. 12 E., 17 miles northwest of Melville. No diversions or tributaries between two stations.

GAGE.—Vertical staff on left bank three-fourths of a mile above T. S. Lavold's house; read by T. S. Lavold.

DISCHARGE MEASUREMENTS.—Made by wading 100 feet above gage or from bridge near observer's house.

CHANNEL AND CONTROL.—Stream bed of gravel and boulders; slightly shifting. Banks high; not subject to overflow.

EXTREMES OF DISCHARGE.—Maximum stage during year, 3.2 feet June 10 (discharge, 1,260 second-feet); minimum stage, 0.5 foot November 13–14 (discharge, 13 second-feet).

1907–1912: Maximum stage recorded at old section, 5.15 feet June 1, 1908 (discharge, 1,490 second-feet); minimum stage, 1.42 feet April 18–19, 1911, and April 23–30, 1912 (discharge, 8.6 second-feet).

1913–1917: Maximum stage recorded at present site, 2.7 feet June 4, 1914 (discharge, 1,280 second-feet); minimum stage, 0.45 foot April 29, 1915 (discharge, 11 second-feet).

ICE.—Stage-discharge relation seriously affected by ice. Observations discontinued during winter.

DIVERSIONS.—Two small ditches divert water above gage; quantity diverted is negligible.

REGULATION.—None.

ACCURACY.—Stage-discharge relation fairly permanent. Rating curve well defined below 700 second-feet. Gage read to half-tenths once daily. Daily discharge ascertained by applying daily gage height to rating table. Records good.

Discharge measurements of Sweetgrass Creek above Melville, Mont., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*
Oct. 2	C. S. Heidel	0.78	32.4
Aug. 7	W. A. Lamb	1.35	128

Daily discharge, in second-feet, of Sweetgrass Creek above Melville, Mont., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	May.	June.	July.	Aug.	Sept.
1	37	27	19	19	247	578	178	80
2	37	27	19	27	210	578	178	80
3	37	27	19	19	210	450	149	80
4	37	27	19	19	210	450	149	80
5	37	27	19	19	290	511	149	80
6	37	27	19	27	247	511	178	80
7	37	23	19	27	210	450	136	80
8	32	23	19	27	210	511	136	80
9	32	23	19	27	650	578	136	63
10	32	23	.....	37	1,260	578	123	63
11	32	23	.....	37	797	511	123	63
12	32	19	.....	37	450	450	123	56
13	32	13	.....	80	340	393	112	56
14	32	13	.....	80	247	340	100	56
15	32	19	.....	80	290	290	100	56
16	32	19	.....	63	723	290	100	72
17	32	27	.....	100	872	290	100	72
18	37	27	.....	123	650	290	100	72
19	37	19	.....	210	723	247	100	63
20	37	19	.....	450	723	247	90	63
21	37	19	.....	290	650	247	80	63
22	32	23	.....	247	797	247	72	63
23	32	23	.....	210	650	247	72	63
24	32	23	.....	210	650	247	72	63
25	32	23	.....	340	650	247	72	63
26	32	19	.....	450	797	247	72	63
27	27	19	.....	290	723	210	72	63
28	27	19	.....	290	650	210	72	63
29	27	19	.....	340	650	210	72	80
30	27	19	.....	290	578	210	72	80
31	27	.....	.....	247	.....	210	72	.....

Monthly discharge of Sweetgrass Creek above Melville, Mont., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	37	27	33.0	2,030
November	27	13	21.9	1,300
December 1-9	19	19	19.0	339
May	450	19	152.	9,350
June	1,260	210	545.	32,400
July	578	210	357.	22,000
August	178	72	108.	6,640
September	80	56	68.6	4,080

SWEETGRASS CREEK BELOW MELVILLE, MONT.

LOCATION.—Near middle of south line of sec. 27, T. 4 N., R. 15 E., at Crum's ranch, a quarter of a mile above head of intake canal of Big Timber Carey project and 6 miles southeast of Melville, Sweet Grass County.

DRAINAGE AREA.—137 square miles (measured on topographic maps).

RECORDS AVAILABLE.—April 1, 1909, to November 10, 1916; and August 8 to September 30, 1917, May 4, 1907, to April 1, 1909, at Adam's ranch 2½ miles downstream.

GAGE.—Overhanging chain gage on left bank 100 feet west of Crum's house; read by Swen Johnson October 1 to November 10; and by Chas. E. Crum August 8 to September 30.

DISCHARGE MEASUREMENTS.—Made by wading or from highway bridge half a mile above gage.

CHANNEL AND CONTROL.—Stream bed of clean gravel; bar producing riffle 300 feet around a bend below gage, likely to shift. Right bank low; subject to overflow during high stages; left bank is a cut bank at the gage and not overflowed at that point, but is lower and may be subject to overflow about 200 feet below gage.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year 1.97 feet at 7.30 a. m. August 9 (discharge, 95 second-feet); minimum stage 1.2 feet October 1, 2, 13, and 14 (discharge 38 second-feet).

1909–1917: Maximum stage recorded, 4.2 feet during June high water, as estimated on June 27, 1916, from high-water marks (discharge, from extension of rating table, 1,700 second-feet); minimum stage recorded, 1 foot August 23–25, September 2–4 and 6, 1913 (discharge, 10 second-feet).

ICE.—Stage-discharge relation seriously affected by ice; no record for ice period.

DIVERSIONS.—There are adjudicated rights from Sweetgrass Creek amounting to over 500 second-feet, and numerous ditches divert water both above and below station. The intake canal of the Big Timber Carey project, which will carry 600 second-feet, diverts into two connecting storage reservoirs, one of 6,000, and the other 12,000 acre-feet capacity.

REGULATION.—None.

ACCURACY.—Stage-discharge relation changed during period of no records from November 11 to August 7; both rating curves used are fairly well defined. Gage read to half-tenths once daily October 1 to November 10, 1916; and to hundredths twice daily after August 7, 1917. Daily discharge ascertained by applying mean daily gage height to rating table. Records fair.

Discharge measurements of Sweetwater Creek below Melville, Mont., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*
Oct. 2	C. S. Heidel	1.23	41.4
Aug. 8	W. A. Lamb	1.91	93

Daily discharge, in second-feet, of Sweetgrass Creek below Melville, Mont., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Aug.	Sept.	Day.	Oct.	Nov.	Aug.	Sept.
1	38	48	.....	62	16	43	.....	67	67
2	38	48	.....	62	17	48	.....	65	62
3	43	43	.....	59	18	48	.....	65	62
4	48	43	.....	62	19	54	.....	69	62
5	48	43	.....	62	20	48	.....	68	57
6	54	48	.....	62	21	43	.....	64	57
7	48	48	.....	62	22	48	.....	62	57
8	48	43	85	62	23	43	.....	63	59
9	54	48	90	59	24	48	.....	54	77
10	48	48	86	59	25	48	.....	50	67
11	43	.....	83	56	26	48	.....	53	64
12	43	.....	77	53	27	48	.....	55	64
13	38	.....	76	53	28	43	.....	55	62
14	38	.....	72	73	29	48	.....	53	63
15	43	.....	67	80	30	48	.....	55	69
					31	48	.....	62	.....

Monthly discharge of Sweetgrass Creek below Melville, Mont., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	54	38	46.0	2,830
November 1–10	48	43	46.0	912
August 8–31	90	50	66.5	3,170
September	80	53	62.5	3,720

PRYOR CREEK AT COBURN, MONT.

LOCATION.—In SE. ¼ sec. 35, T. 1 S., R. 27 E., on Crow Indian Reservation at Coburn, in Yellowstone County, 12 miles southwest of Billings and 13 miles above mouth of creek.

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—September 13, 1911, to September 30, 1917.

GAGE.—Overhanging chain gage on left bank, opposite observer's house; read by Harry Foster.

DISCHARGE MEASUREMENTS.—Made by wading.

CHANNEL AND CONTROL.—Bed of stream gravel and clay. Principal control is gravel bar which forms a riffle at low stages about 300 feet below gage; at a medium stage the riffle disappears and no well defined control exists. Both banks high and not subject to overflow except at extreme stages. Current at gage is sluggish at low stages but of medium velocity at high stages.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 10.44 feet at 7 p. m. June 5 (discharge, 750 second-feet); minimum stage recorded, 4.1 feet August 25 and 30, September 4 (discharge, 20 second-feet).

1911–1917: Maximum stage recorded, that of June 5, 1917; minimum stage, 3.6 feet September 1, 1913 (discharge, 6 second-feet).

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

DIVERSIONS.—Water sufficient to irrigate approximately 1,000 acres near Pryor is diverted about 30 miles above Coburn.

REGULATION.—None.

ACCURACY.—Stage-discharge relation not permanent; affected by shift in control and by ice. Rating curve used October 1 to November 20 and April 8 to June 8 well defined between 14 and 282 second-feet; curve used June 19 to August 31 fairly well defined; shifting-control method used June 9–18 and September 1–30. Gage read to half-tenths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table. Records good.

Discharge measurements of Pryor Creek at Coburn, Mont., during the year ending Sept. 30, 1917.

[Made by W. A. Lamb.]

Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*
Dec. 5	[a]4.50	56.3
June 23	5.39	156
Aug. 9	4.33	37.2

[a] Stage discharge relation affected by ice.

Daily discharge, in second-feet, of Pryor Creek at Coburn, Mont., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Apr.	May.	June.	July.	Aug.	Sept.
1	40	49	.....	199	635	88	37	22
2	40	49	.....	179	609	66	37	22
3	44	49	.....	179	332	66	37	23
4	49	49	.....	179	312	66	37	20
5	49	49	.....	179	713	60	33	24
6	49	49	.....	416	687	60	37	25
7	58	49	.....	486	405	66	37	26
8	58	49	394	416	322	66	37	26
9	58	49	372	292	292	55	37	24
10	58	49	342	238	282	55	33	28
11	58	49	352	199	282	41	37	28
12	58	49	438	189	273	46	37	29
13	49	.....	332	179	264	41	37	46
14	49	.....	292	179	229	37	37	52
15	49	.....	273	199	209	37	33	58
16	49	.....	255	219	199	33	37	68
17	49	.....	273	209	255	37	37	68
18	49	.....	273	219	203	37	30	58
19	49	.....	255	209	186	37	30	47
20	99	.....	255	219	175	30	26	49
21	110	.....	255	209	169	26	23	49
22	110	.....	229	199	175	30	23	58
23	88	.....	219	199	157	30	23	58
24	58	.....	199	199	151	30	23	49
25	58	.....	179	238	138	30	20	58
26	58	.....	179	273	119	26	23	58
27	58	.....	189	209	126	30	23	58
28	58	.....	199	199	112	30	23	58
29	58	.....	199	199	112	30	23	58
30	58	.....	199	302	112	30	20	58
31	49	.....	.....	510	.....	30	23	.....

Monthly discharge of Pryor Creek at Coburn, Mont., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	110	40	58.8	3,620
November 1–12	49	49	49.0	1,170
April 8–30	438	179	267	12,200
May	510	179	243	14,900
June	713	112	274	16,300
July	88	26	43.4	2,670
August	37	20	30.6	1,880
September	68	20	43.5	2,590

WIND RIVER AT RIVERTON, WYO.

LOCATION.—In sec. 2, T. 1 S., R. 4 E., at highway bridge three-fourths of a mile east of Riverton, in Fremont County. Popo Agie River enters three-fourths of a mile below.

DRAINAGE AREA.—2,320 square miles (measured on base map of Wyoming; scale, 1:500,000).

RECORDS AVAILABLE.—May 15, 1911, to October 31, 1912; April 1, 1915, to September 30, 1917. From May 14, 1906, to November 1, 1908, a station was maintained at Walker's ferry about 1 mile above present station. No streams enter between the sites; records directly comparable.

GAGE.—Friez water-stage recorder installed April 4, 1917; referred to chain gage on downstream side of first pier bent from left. This chain gage used previous to installation of recorder.

DISCHARGE MEASUREMENTS.—Made from bridge.

CHANNEL AND CONTROL.—Channel composed of sand and gravel; high water during 1917 formed large sand bar just below gage completely changing the control. Right bank will overflow at extreme high water.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year 10.9 feet at 7.30 a. m. July 1 (discharge, 9,530 second-feet); minimum discharge occurs during winter.

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

DIVERSIONS.—Water is diverted from Wind River and its tributaries for the irrigation of approximately 27,000 acres. Under the Wyoming law of 1 second-foot for 70 acres, this would require 386 second-feet.

REGULATION.—None.

ACCURACY.—Stage-discharge relation shifted seriously during high water of 1917; affected by ice during winter. Rating curve used October 1 to July 31 well defined between 300 and 8,000 second-feet; and curve used August 1 to September 30 fairly well defined between 400 and 3,000 second-feet. Gage read to quarter-tenths October 1 to November 11. Operation of the water-stage recorder was satisfactory April 4 to September 30. Daily discharge ascertained by applying to the rating table mean daily gage height determined from two daily gage readings and by inspecting the gage-height graph. Records excellent, except for periods June 20 to August 15 when they are fair, and August 16 to September 30 when they are good.

Discharge measurements of Wind River at Riverton, Wyo., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Oct. 6	H. K. Smith	4.88	552	July 5	P. V. Hodges	10.8	9,310
Apr. 4	P. V. Hodges	4.52	393	Sept. 14	....do	7.29	995
May 4	....do	4.45	381				

Daily discharge, in second-feet, of Wind River at Riverton, Wyo., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Apr.	May.	June.	July.	Aug.	Sept.
1	478	498	.....	422	1,890	9,080	2,870	1,230
2	478	540	.....	422	1,740	7,540	2,740	1,230
3	478	459	.....	422	1,780	7,120	2,420	1,150
4	540	498	404	387	1,640	7,120	2,180	1,110
5	586	478	459	422	1,510	8,420	2,120	1,110
6	562	440	498	440	1,420	8,640	2,180	1,190
7	562	387	518	422	1,470	8,420	2,010	1,280
8	610	404	518	478	1,640	8,200	1,850	1,410
9	586	404	562	459	2,090	8,200	1,700	1,360
10	562	404	692	459	3,600	7,540	1,600	1,320
11	562	440	586	540	4,340	7,120	1,550	1,190
12	586	.....	478	753	3,600	6,500	1,600	1,110
13	586	.....	498	1,010	3,060	5,910	1,600	1,040
14	586	.....	478	1,300	2,570	7,540	1,550	965
15	586	.....	498	2,090	2,850	4,980	1,550	1,000
16	586	.....	459	2,640	4,000	4,620	1,550	1,000
17	562	.....	422	2,380	5,530	4,450	1,500	930
18	586	.....	422	2,090	6,700	4,450	1,460	895
19	610	.....	404	2,140	7,540	4,450	1,550	860
20	562	.....	387	2,570	7,330	4,620	1,550	828
21	518	.....	387	2,640	7,120	4,620	1,460	795
22	564	.....	478	2,200	7,880	4,450	1,460	795
23	610	.....	562	2,090	8,640	4,260	1,460	795
24	540	.....	562	1,980	8,420	4,450	1,410	795
25	540	.....	610	1,930	8,420	4,260	1,360	860
26	562	.....	610	1,930	8,640	4,090	1,360	930
27	586	.....	692	1,930	7,980	3,920	1,460	930
28	586	.....	540	1,740	8,420	3,920	1,650	828
29	586	.....	498	1,830	8,860	3,920	1,550	762
30	518	.....	459	2,090	8,420	3,760	1,410	762
31	518	.....	.....	2,040	.....	3,290	1,320	.....

NOTE.—July 6–31, discharge computed by the shifting-control method.

Monthly discharge of Wind River at Riverton, Wyo., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	610	478	561	34,500
November 1–11	540	387	450	9,820
April 4–30	692	387	507	27,200
May	2,640	387	1,430	87,900
June	8,860	1,420	4,970	296,000
July	9,080	3,290	5,800	357,000
August	2,870	1,320	1,710	105,000
September	1,410	762	1,020	60,700

BIG HORN RIVER AT THERMOPOLIS, WYO.

LOCATION.—In sec. 36, T. 43 N., R. 95 W., at highway bridge between Thermopolis and Hot Springs, Hot Springs County. Nearest tributary, Buffalo Creek, enters 3 miles upstream.

DRAINAGE AREA.—8,080 square miles (measured on base map of Wyoming; scale, 1:500,000).

RECORDS AVAILABLE.—May 28, 1900, to December 31, 1905; June 30, 1910, to October 7, 1912; April 1, 1915, to September 30, 1917. State engineer maintained station at this point during 1913 and 1914.

GAGE.—Chain gage on downstream handrail on bridge, installed May 4, 1916, at datum 1 foot lower than staff gage used previously; read by Mrs. H. E. Holdrege and Miss Florence Erlos.

DISCHARGE MEASUREMENTS.—Made from two-span bridge.

CHANNEL AND CONTROL.—Channel composed of coarse gravel and small boulders. Control a short distance below gage; practically permanent. High-water control is vertical walls of canyon entrance half a mile downstream. Banks high and not subject to overflow.

EXTREMES OF DISTANCE.—Maximum stage recorded during year, 13.4 feet at 7 p. m. June 24, and 6 p. m. June 27 (discharge, 19,400 second-feet); minimum discharge occurs during winter.

ICE.—Stage-discharge relation affected by ice. Records discontinued during winter.

DIVERSIONS.—Prior to December 31, 1916, there were adjudications of 41 second-feet from Big Horn River above station and 202 second-feet below. In addition there is an adjudicated diversion of 366 second-feet for power above station.

REGULATION.—None.

ACCURACY.—Stage-discharge practically permanent; affected by ice during winter. Rating curve well defined between 800 and 17,000 second-feet. Gage read to quarter-tenths twice daily. Daily discharge ascertained by applying the mean daily gage height to rating table. Records excellent.

Discharge measurements of Big Horn River at Thermopolis, Wyo., during the year ending Sept. 30, 1917.

[Made by P. V. Hodges].

Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*
May 7	2.02	1,030
July 1	11.92	16,800
Sept. 18	2.42	1,400

Daily discharge, in second-feet, of Big Horn River at Thermopolis, Wyo., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	720	890	510	.....	1,740	1,280	3,520	16,900	5,170	1,880
2	760	890	535	.....	1,080	980	3,360	16,700	4,340	1,740
3	800	890	562	.....	650	890	3,360	15,700	3,850	1,740
4	800	890	590	.....	980	935	3,520	14,400	3,520	1,880
5	800	800	650	.....	935	935	3,520	12,400	3,020	1,880
6	800	800	650	.....	1,080	980	3,520	13,100	2,860	1,880
7	845	760	720	.....	1,030	1,030	3,360	13,700	2,860	1,880
8	890	650	650	.....	1,230	1,080	3,360	14,100	2,530	1,880
9	890	650	535	.....	1,130	1,080	3,520	13,700	2,530	1,880
10	890	590	423	.....	1,080	1,080	4,510	13,700	2,360	1,880
11	890	590	375	.....	1,230	1,030	6,820	13,600	2,360	1,880
12	935	535	423	.....	1,230	1,080	8,140	11,400	2,200	1,880
13	935	423	350	.....	1,500	1,390	7,480	10,400	2,040	1,740
14	935	405	.....	562	1,280	1,880	5,830	10,100	1,880	1,620
15	890	405	.....	562	1,180	2,360	6,490	9,300	1,880	1,500
16	935	390	.....	562	1,230	3,520	8,140	8,300	1,880	1,500
17	980	462	.....	535	1,130	4,340	8,140	7,810	2,040	1,500
18	980	535	.....	590	980	4,180	10,600	7,640	2,040	1,390
19	980	720	.....	590	890	4,020	13,100	7,150	2,360	1,390
20	1,030	890	.....	620	845	4,510	16,100	6,160	2,360	1,280
21	1,030	935	.....	685	890	5,500	17,400	6,160	2,200	1,230
22	1,030	800	.....	590	980	6,000	17,900	6,000	2,040	1,230
23	1,030	760	.....	590	1,080	4,680	18,200	6,000	1,880	1,180
24	1,030	590	.....	685	1,130	4,680	19,400	5,830	1,880	1,180
25	980	650	.....	720	1,280	4,840	19,000	5,830	1,880	1,180
26	980	620	.....	650	1,500	4,840	19,000	5,830	1,740	1,280
27	980	590	.....	685	1,390	4,840	19,400	5,660	1,880	1,390
28	935	562	.....	720	1,500	4,510	18,500	5,660	1,880	1,390
29	935	535	.....	1,080	1,390	4,180	17,700	5,340	2,530	1,280
30	935	535	.....	1,280	1,130	3,680	17,000	5,340	2,360	1,280
31	935	.....	.....	2,200	.....	3,520	.....	5,340	2,040	.....

Monthly discharge of Big Horn River at Thermopolis, Wyo., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	1,030	720	919	56,500
November	935	390	658	39,200
December 1–13	720	350	536	13,800
March 14–31	2,200	535	773	27,600
April	1,740	650	1,160	69,000
May	6,000	890	2,900	178,000
June	19,400	3,360	10,300	613,000
July	16,900	5,340	9,650	593,000
August	5,170	1,740	2,460	151,000
September	1,880	1,180	1,560	92,800

BIG HORN RIVER NEAR HARDIN, MONT.

LOCATION.—In SW. ¼ sec. 13, T. 1 S., R. 33 E., at bridge of Chicago, Burlington & Quincy Railroad on Crow Indian Reservation, half a mile above junction of Big Horn and Little Horn rivers, 2 miles from Hardin, in Big Horn County.

DRAINAGE AREA.—20,700 square miles.

RECORDS AVAILABLE.—June 16, 1904, to September 30, 1917.

GAGE.—Chain gage attached to west span, upstream side of railroad bridge; read by H. R. Kean. A temporary staff gage 20 feet farther downstream was used October 11 to November 22, 1913, and the readings reduced to datum of chain gage.

DISCHARGE MEASUREMENTS.—Made from railroad bridge.

CHANNEL AND CONTROL.—Stream bed gravel; free from vegetation; slightly shifting. Banks high and not subject to overflow.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 9.90 feet June 26 (discharge, 36,700 second-feet); minimum discharge recorded, 625 second-feet by current-meter measurement January 25.

1904–1917: Maximum stage recorded, 9.8 feet June 17, 1908 (discharge, 40,800 second-feet); minimum discharge recorded that of January 15, 1917.

ICE.—Stage-discharge relation seriously affected by ice December 9, 1916, to March 24, 1917.

DIVERSIONS.—Water is diverted a few miles above station, by a private irrigation company, to irrigate land on west side of river. Water is also diverted from Shoshone River at Corbett dam, Wyo., by United States Reclamation Service, and many private ditches divert water from tributaries above station.

REGULATION.—Shoshone reservoir above Cody controls flow of Shoshone River, an important tributary of the Big Horn.

ACCURACY.—Stage-discharge relation affected by ice and by shifting control. Rating curve used October 1 to December 8 fairly well defined between 3,020 and 14,500 second-feet; curve used March 25 to July 1 well defined between 800 and 34,000 second-feet; July 6 to September 30 well defined between 1,600 and 8,000 second-feet; shifting control method used July 2–5. Gage read to half-tenths once daily. Daily discharge ascertained by applying daily gage height to rating table. Discharge December 9 to March 24 determined from observer's notes, weather records, and six discharge measurements. Records good for open flow; only fair for winter.

Discharge measurements of Big Horn River near Hardin, Mont., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Dec. 1	W. A. Lamb	[a] 3.58	2,140	Mar. 16	W. A. Lamb	[a] 5.37	1,780
29	do	[a] 5.67	1,020	May 27	do	5.87	10,100
Jan. 15	A. H. Tuttle	[a] 5.12	625	June 22	do	9.47	[b] 33,200
Feb. 3	W. A. Lamb	[a] 5.07	1,740	Aug. 9	do	5.25	4,830
Mar. 3	do	[a] 5.82	2,040				

[a] Stage-discharge relation affected by ice.
[b] Velocity determined by surface method applying a coefficient of 0.90 to obtain mean velocity.

Daily discharge, in second-feet, of Big Horn River near Hardin, Mont., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	1,940	2,450	2,140	.....	18,600	4,300	12,200	35,200	8,330	3,800
2	2,040	3,070	2,140	.....	11,100	3,530	10,100	32,200	8,120	3,950
3	1,940	2,780	2,140	.....	9,200	2,840	9,200	29,300	7,480	3,800
4	2,140	2,340	2,240	.....	8,320	3,100	8,320	26,500	6,450	3,950
5	2,140	2,140	2,560	.....	6,720	3,100	8,110	23,000	6,260	3,800
6	1,940	2,240	2,340	.....	4,300	3,980	11,100	23,000	5,860	3,520
7	2,140	2,240	2,140	.....	4,300	3,680	10,600	23,000	5,120	3,800
8	2,240	1,940	1,850	.....	3,980	3,680	10,100	22,300	5,120	3,800
9	2,100	2,140	.....	.....	4,300	3,240	7,500	23,700	5,120	3,660
10	2,300	2,140	.....	.....	4,620	3,380	8,110	23,700	5,120	3,260
11	2,340	2,140	.....	.....	4,780	3,380	9,430	23,400	4,260	3,260
12	2,340	1,940	.....	.....	4,620	3,380	11,900	22,000	4,420	3,390
13	2,240	2,140	.....	.....	3,830	3,240	14,400	22,000	4,100	3,260
14	2,450	1,010	.....	.....	3,980	3,980	13,600	20,700	3,660	3,520
15	2,340	1,140	.....	.....	3,980	4,620	11,400	18,400	3,800	3,520
16	2,140	1,590	.....	.....	3,680	6,160	10,900	17,800	3,800	3,260
17	2,340	1,760	.....	.....	4,140	8,320	12,500	16,600	3,390	3,520
18	2,340	1,940	.....	.....	3,980	10,100	12,200	14,300	3,520	3,520
19	2,140	2,240	.....	.....	3,380	10,600	23,300	13,700	3,520	3,520
20	2,340	2,340	.....	.....	3,680	11,100	29,100	13,200	3,660	3,260
21	2,450	2,340	.....	4,660	3,380	10,600	29,100	12,100	3,520	3,520
22	2,560	2,240	.....	5,560	3,100	12,700	32,100	11,900	3,800	3,520
23	2,450	2,140	.....	8,060	2,720	12,500	32,800	12,100	3,800	3,000
24	2,900	2,040	.....	12,400	3,100	11,900	33,600	12,100	3,520	3,130
25	2,780	1,760	.....	17,300	3,240	10,600	33,600	11,400	3,800	3,130
26	2,450	2,140	.....	17,300	3,100	9,660	36,700	11,100	3,800	2,550
27	2,780	2,560	.....	16,700	3,680	10,100	34,400	11,100	3,520	2,660
28	3,020	2,240	.....	18,600	4,620	10,100	33,200	9,920	3,800	2,550
29	2,670	2,340	.....	18,600	4,460	10,100	33,600	10,200	3,660	2,550
30	2,670	2,240	.....	18,600	4,620	11,900	33,600	9,680	3,660	2,340
31	2,560	.....	.....	29,100	.....	11,900	.....	9,000	3,390	.....

NOTE.—Discharge estimated because of ice as follows:

	Second-feet.		Second-feet.
Dec. 9–15	1,440	Feb. 1–10	1,840
Dec. 16–28	1,100	Feb. 11–20	2,250
Dec. 29–31	1,020	Feb. 21–28	1,580
Jan. 1–10	1,320	Mar. 1–10	2,230
Jan. 11–20	880	Mar. 11–20	2,240
Jan. 21–31	1,250		

Monthly discharge of Big Horn River near Hardin, Mont., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	3,020	1,940	2,360	145,000
November	3,070	1,010	2,130	127,000
December	.....	.....	1,450	89,200
January	.....	.....	1,150	70,700
February	.....	.....	1,910	106,000
March	29,100	.....	6,820	419,000
April	18,600	2,720	5,050	300,000
May	12,700	2,840	7,150	440,000
June	36,700	7,500	19,200	1,140,000
July	35,200	9,000	18,200	1,120,000
August	8,330	3,390	4,560	280,000
September	3,950	2,340	3,340	199,000
The year	36,700	.....	6,130	4,440,000

POPO AGIE RIVER BELOW ARAPAHOE, WYO.[1]

LOCATION.—In sec. 23, T. 1 S., R. 3 E., at highway bridge half a mile below Arapahoe, Fremont County. Nearest tributary, Little Wind River, enters 200 yards above. Popo Agie River joins Wind River 6 miles below to form Big Horn River.

DRAINAGE AREA.—1,530 square miles (measured on base map of Wyoming, scale 1:500,000).

RECORDS AVAILABLE.—May 11, 1906, to November 27, 1909; May 14, 1911, to October 31, 1912; April 1, 1915, to September 30, 1917.

GAGE.—Vertical staff on downstream side of first pier from left bank; read by R. H. Knox. From June 19 to July 19, 1911, a temporary gage was used with datum 2.95 feet higher; during 1915, a temporary gage was used with datum 0.55 foot higher. All readings have been reduced to the original datum.

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

CHANNEL AND CONTROL.—Bed composed of sand and gravel. Control slightly shifting from year to year. Right bank will be overflowed at high water.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 9.3 feet for several days during latter part of June from high-water mark (discharge, 9,710 second-feet); minimum discharge probably occurs during winter.

DIVERSIONS.—Between this station and that on Little Wind above Arapahoe, there were adjudicated diversions of 583 second-feet from the Popo Agie and its tributaries, prior to December 31, 1916.

REGULATION.—None.

ACCURACY.—Stage-discharge relation slightly shifting; affected by ice during winter. Rating curve used October 1 to November 9 well defined between 100 and 400 second-feet; curve used April 1 to September 30 well defined between 200 and 6,000 second-feet but not well defined above 6,000 second-feet. Gage read to hundredths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table. Records excellent up to 6,000 second-feet; above this they are fair.

Discharge measurements of Popo Agie River below Arapahoe, Wyo., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Oct. 6	H. K. Smith	1.34	186	July 5	P. V. Hodges	6.70	5,100
May 3	P. V. Hodges	1.77	344	Sept. 15	do	1.89	390

[1] Formerly known as Little Wind River below Arapahoe, Wyo.

Daily discharge, in second-feet, of Popo Agie River below Arapahoe, Wyo., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Apr.	May.	June.	July.	Aug.	Sept.
1	96	252	282	318	1,280	7,100	926	486
2	101	235	282	318	1,280	5,120	804	440
3	136	235	282	356	1,360	4,610	690	396
4	156	235	248	318	1,440	4,610	584	356
5	204	220	248	337	1,520	5,120	584	356
6	204	220	300	356	1,440	5,460	584	396
7	220	176	265	463	1,600	5,120	584	463
8	340	164	265	396	1,690	5,290	610	510
9	322	176	300	356	2,360	4,950	440	510
10	303	.....	337	318	3,480	4,440	396	463
11	286	.....	356	318	3,480	4,100	396	440
12	286	.....	356	396	3,100	3,770	396	440
13	268	.....	356	510	2,460	3,480	376	418
14	268	.....	356	690	2,360	3,100	376	396
15	268	.....	356	990	2,870	2,760	376	376
16	252	.....	337	1,280	4,100	2,560	356	396
17	252	.....	300	1,280	5,290	2,560	376	376
18	235	.....	300	1,280	6,650	2,360	376	356
19	268	.....	282	1,280	8,520	2,360	418	318
20	252	.....	248	1,960	8,860	2,360	440	300
21	286	.....	248	2,260	8,860	2,160	418	300
22	322	.....	248	1,600	9,250	2,060	396	282
23	322	.....	300	1,360	9,710	1,780	356	282
24	235	.....	376	1,360	9,710	1,870	337	356
25	268	.....	396	1,360	9,500	1,780	337	418
26	322	.....	396	2,060	9,710	1,600	300	418
27	322	.....	463	1,870	8,800	1,440	318	418
28	303	.....	396	1,520	7,900	1,360	510	376
29	303	.....	356	1,520	7,000	1,440	559	356
30	252	.....	337	1,600	7,300	1,280	559	318
31	235	.....	.....	1,440	.....	1,130	486	.....

NOTE.—June 22-July 2, gage could not be read on account of high water. Maximum stage of 9.3 feet from water marks, and length of time water remained at this stage from testimony of observer.

Monthly discharge of Popo Agie River below Arapahoe, Wyo., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	340	96	254	15,600
November 1-9	252	164	213	3,800
April	463	248	319	19,000
May	2,260	318	1,020	62,700
June	9,710	1,280	5,100	303,000
July	7,100	1,130	3,200	197,000
August	926	300	473	29,100
September	510	282	391	23,300

LITTLE POPO AGIE RIVER AT HUDSON, WYO.

LOCATION.—About sec. 12, T. 2 S., R. 2 E., at highway bridge three-eighths of a mile southwest of Hudson, Fremont County. No tributary between station and mouth of river, half a mile below.

DRAINAGE AREA.—346 square miles (measured on base map of Wyoming; scale, 1:500,000).

RECORDS AVAILABLE.—August 26, 1907, to December 31, 1909; June 19, 1911, to October 31, 1912; April 1, 1915, to September 30, 1917.

GAGE.—Vertical staff on downstream side of center pier of bridge, installed August 25, 1915, at datum 1 foot higher than that of original gage, a vertical staff attached to right abutment and used from August 26, 1907, to June 12, 1908; June 13, 1908, chain gage was installed 100 yards downstream from bridge and at a new datum; chain gage was abandoned July 24, 1912, and readings were resumed on the original gage, which was also used from April 1 to August 25, 1915. Gage read by Mrs. A. C. Ladd.

DISCHARGE MEASUREMENTS.—Made from bridge or by wading.

CHANNEL AND CONTROL.—Bed composed of sand and gravel washed in from new channel cut above station during winter of 1915. Control is at gage; permanent during 1917.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 6.6 for about one week, June 19–26, as determined by leveling to high-water marks (discharge, 1,490 second-feet); minimum discharge occurs during winter.

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

DIVERSIONS.—Prior to December 31, 1916, adjudicated diversions from Little Popo above the station amounted to 50 second-feet.

REGULATION.—None.

ACCURACY.—Stage-discharge relation practically permanent; affected by ice during winter. Rating curve well defined between 40 and 800 second-feet but poorly defined above 800 second-feet. Gage read to hundredths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table. Records excellent up to 800 second-feet; above this they are fair.

Discharge measurements of Little Popo Agie River at Hudson, Wyo., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Oct. 7	H. K. Smith	0.94	61	July 4	P. V. Hodges	4.12	715
May 3	P. V. Hodges	1.50	122	Sept. 15	do	.98	64

Daily discharge, in second-feet, of Little Popo Agie River at Hudson, Wyo., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Apr.	May.	June.	July.	Aug.	Sept.
1	46	46	84	112	347	1,160	112	74
2	46	46	84	106	325	943	100	68
3	56	46	79	118	347	798	88	66
4	56	46	67	100	393	740	82	64
5	56	46	84	106	441	769	82	60
6	56	46	106	106	393	827	82	64
7	60	42	86	146	417	769	77	67
8	94	42	90	118	441	740	74	72
9	79	44	118	100	517	740	66	64
10	68	.....	139	94	682	653	61	62
11	66	.....	154	94	798	543	58	60
12	64	.....	146	118	856	570	59	60
13	62	.....	162	146	653	491	64	58
14	56	.....	154	204	597	441	70	57
15	54	.....	132	282	682	393	65	60
16	52	.....	100	370	769	370	66	65
17	46	.....	96	370	972	325	64	68
18	45	.....	100	325	1,230	303	65	66
19	48	.....	94	325	1,300	282	76	64
20	44	.....	87	491	1,400	282	82	62
21	54	.....	88	625	1,490	261	82	65
22	54	.....	100	466	1,490	241	77	66
23	56	.....	125	347	1,490	222	73	62
24	44	.....	154	370	1,490	213	73	64
25	46	.....	154	347	1,490	196	70	67
26	56	.....	139	653	1,390	178	65	72
27	56	.....	154	570	1,290	154	73	69
28	52	.....	125	466	1,230	154	100	68
29	50	.....	112	441	1,190	162	100	66
30	46	.....	100	441	1,190	146	94	64
31	45	.....	.....	417	.....	139	82	.....

NOTE.—June 19–26 gage could not be read on account of high water. Maximum stage 6.6 feet from water marks, and continued for nearly a week, according to statements by observer.

Monthly discharge of Little Popo Agie River at Hudson, Wyo., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	94	44	55.3	3,400
November 1-9	46	42	44.9	802
April	162	67	114	6,780
May	653	94	289	17,800
June	1,490	325	910	54,100
July	1,160	139	458	28,200
August	112	58	76.8	4,720
September	74	57	64.8	3,860

LITTLE WIND RIVER ABOVE ARAPAHOE, WYO.

LOCATION.—In sec. 23, T. 1 S., R. 3 E., at railroad bridge opposite Indian subagency, a quarter of a mile above Arapahoe, Fremont County. Little Wind River enters Popo Agie River a quarter of a mile below station.

DRAINAGE AREA.—716 square miles (measured on base map of Wyoming; scale, 1:500,000).

RECORDS AVAILABLE.—May 14, 1911, to October 31, 1912; April 1, 1915, to September 30, 1917. From May 11, 1906, to December 17, 1909, a station was maintained a short distance above present one. The flow at the two points is comparable.

GAGE.—Chain gage on upstream side of railroad bridge; read by R. H. Knox.

DISCHARGE MEASUREMENTS.—Made from single-span bridge.

CHANNEL AND CONTROL.—Channel composed of sand and gravel. Control a short distance downstream; shifted slightly during 1917. Banks high and not subject to overflow.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 6.25 feet, mornings of June 23, 24, and 26 (discharge, 3,280 second-feet). Records discontinued during winter, when minimum discharge probably occurs.

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

DIVERSIONS.—Water is diverted from Little Wind River and tributaries for the irrigation of approximately 52,000 acres. Under the Wyoming law of 1 second-foot for 70 acres, this would require 742 second-feet.

REGULATION.—None.

ACCURACY.—Stage-discharge relation not permanent; affected by ice during winter. Rating curve well defined between 40 and 3,000 second-feet. Gage read to hundredths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table, except for periods April 8 to May 31 and July 16 to September 30, when discharge was computed by the shifting-control method. Records good.

Discharge measurements of Little Wind River above Arapahoe, Wyo., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Oct. 7	H. K. Smith	2.00	49.7	July 5	P. V. Hodges	5.08	1,780
May 3	P. V. Hodges	2.46	110	Sept. 15	do	2.96	164

Daily discharge, in second-feet, of Little Wind River above Arapahoe, Wyo., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Apr.	May.	June.	July.	Aug.	Sept.
1	25	78	.....	103	390	2,640	500	192
2	24	72	.....	103	390	1,980	418	175
3	24	72	.....	107	418	1,870	318	160
4	30	72	.....	101	445	1,870	272	145
5	39	72	.....	112	390	1,980	250	132
6	46	72	.....	122	390	2,340	210	145
7	46	65	.....	140	418	2,220	145	175
8	68	59	88	154	472	2,220	110	210
9	74	60	88	130	625	2,220	110	230
10	72	64	90	114	1,160	1,980	94	210
11	72	44	92	112	1,080	1,870	94	210
12	72	54	86	145	955	1,870	94	210
13	72	56	86	210	840	1,760	94	175
14	78	44	86	318	765	1,540	94	175
15	84	.....	98	418	878	1,440	94	160
16	76	.....	107	530	1,260	1,260	82	160
17	74	.....	96	472	1,650	1,260	80	160
18	74	.....	92	472	2,100	1,260	86	145
19	81	.....	86	472	2,700	1,260	132	132
20	76	.....	81	730	2,960	1,260	160	132
21	84	.....	81	955	2,960	1,080	132	120
22	89	.....	80	592	3,090	995	132	110
23	90	.....	82	500	3,220	955	132	110
24	81	.....	98	472	3,220	878	110	120
25	89	.....	118	472	3,090	840	145	160
26	98	.....	118	660	3,220	802	132	175
27	92	.....	166	625	2,960	730	145	175
28	90	.....	135	500	2,700	730	210	160
29	86	.....	118	530	2,580	730	230	160
30	80	.....	110	560	2,700	695	230	132
31	74	.....	.....	472	.....	625	230	.....

Monthly discharge of Little Wind River above Arapahoe, Wyo., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	98	24	69.7	4,290
November 1-14	78	44	63.1	1,750
April 8-30	166	80	99.2	4,530
May	955	101	368	22,600
June	3,220	390	1,670	99,400
July	2,640	625	1,460	89,800
August	500	80	170	10,500
September	230	110	162	9,640

OWL CREEK NEAR THERMOPOLIS, WYO.

LOCATION.—About sec. 16, T. 43 N., R. 95 W., at Whetstine's ranch 6 miles northwest of Thermopolis, Hot Springs County. No tributary between station and mouth.

DRAINAGE AREA.—463 square miles (measured on base map of Wyoming; scale, 1:500,000).

RECORDS AVAILABLE.—July 30, 1910, to October 31, 1912; April 1, 1915, to November 30, 1917, when station was discontinued. Station maintained by State engineer during 1913 and 1914.

GAGE.—Slope gage installed October 13, 1915, at footbridge 50 feet downstream from chain gage used by State engineer, and referred to same datum; read by W. E. Whetstine. Owing to slope of creek, slope gage reads approximately 0.1 foot lower. Chain gage on upstream side of highway bridge a quarter of a mile above used from 1910 to 1912. No definite relation between the gage readings.

DISCHARGE MEASUREMENTS.—Made from footbridge or by wading.

CHANNEL AND CONTROL.—Bed composed of compact gravel. Control 100 feet downstream at small rapids which remained fairly permanent during 1917. Right bank not subject to overflow; left bank is overflowed at stage about 6.6 feet.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 6.8 feet at 7 p. m. June 17 (discharge, 980 second-feet); minimum discharge occurs during winter.

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

DIVERSIONS.—Prior to December 31, 1916, there were adjudicated diversions of 116 second-feet from Owl Creek above station and 66 second-feet below.

REGULATION.—None.

ACCURACY.—Stage-discharge relation practically permanent; affected by ice during winter. Rating curve well defined up to 600 second-feet. Gage read to quarter-tenths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table. Records probably good; reliability of gage-height record questioned.

Discharge measurements of Owl Creek near Thermopolis, Wyo., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Oct. 3	H. K. Smith	1.82	[a]2.0	July 1	P. V. Hodges	4.12	259
May 6	P. V. Hodges	2.32	32.5	1	do	4.18	260
8	do	2.38	35.2	Sept. 18	do	1.49	.94

[a] Estimated.

Daily discharge, in second-feet, of Owl Creek near Thermopolis, Wyo., for the period Oct. 1, 1916, to Nov. 30, 1917.

Day.	Oct.	Nov.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	5	7	.....	33	149	315	11	0.9	0.6	10.8
2	7	7	.....	27	216	265	12	2.0	.6	10.0
3	7	7	.....	27	216	226	8.5	3.0	1.3	10.0
4	7	7	.....	33	207	198	4.6	3.0	4.0	10.0
5	8	.....	.....	30	207	149	4.0	3.0	4.0	12.0
6	7	.....	.....	26	236	129	4.6	3.0	4.0	10.0
7	7	.....	.....	16	216	106	3.6	3.0	4.0	10.0
8	7	.....	.....	22	245	142	1.7	3.0	4.0	12.0
9	7	.....	.....	6	207	129	1.7	2.8	4.0	10.8
10	4	.....	.....	9	189	90	4.0	2.4	4.0	10.0
11	4	.....	.....	63	315	40	3.0	2.4	3.0	10.8
12	4	.....	.....	129	465	37	3.0	2.4	3.6	10.0
13	7	.....	.....	106	216	28	3.6	2.4	4.0	10.0
14	7	.....	.....	265	226	22	4.0	3.0	4.0	12.0
15	10	.....	.....	515	315	14	4.0	2.0	4.60	12.0
16	14	.....	.....	465	440	8	4.0	2.0	7.0	13.2
17	19	.....	.....	123	740	6	2.4	1.2	8.5	10.0
18	19	.....	.....	164	740	14	4.6	.5	10.0	10.0
19	18	.....	.....	265	740	15	5.2	.6	10.0	10.0
20	18	.....	.....	180	740	13	3.6	5.5	10.0	14.8
21	19	.....	.....	129	710	13	3.2	4.6	10.0	10.8
22	14	.....	.....	156	740	24	3.2	4.6	10.0	10.0
23	8	.....	.....	172	680	22	3.0	.6	10.0	10.8
24	7	.....	.....	172	590	24	3.0	.6	10.0	14.0
25	7	.....	.....	189	565	20	3.0	.6	10.0	14.0
26	8	.....	.....	156	650	36	3.2	.6	9.4	15.0
27	10	.....	.....	136	415	16	3.2	.6	8.5	12.0
28	8	.....	.....	198	315	44	3.0	.6	10.0	14.0
29	7	.....	30	226	290	31	3.0	.6	12.0	14.0
30	8	.....	29	226	340	22	3.0	.6	13.2	14.0
31	10	.....	.....	164	.....	25	3.0	.....	14.0	.....

Monthly discharge of Owl Creek, near Thermopolis, Wyo., for the period Oct. 1, 1916, to Nov. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
1916.				
October	19	4	9.4	578
1917.				
May	515	6	143	8,790
June	740	149	411	24,500
July	315	6	71.7	4,410
August	12	1.7	4.09	251
September	5.5	.5	2.07	153
October	14.0	.6	6.85	421
November	15.0	10,0	11.6	690

NO WOOD CREEK AT BONANZA, WYO.

LOCATION.—In sec. 13, T. 49 N., R. 91 W., at Bonanza, Big Horn County. Nearest tributary, Paintrock Creek, enters some distance above.

DRAINAGE AREA.—1,790 square miles (measured on base map of Wyoming, scale 1:500,000).

RECORDS AVAILABLE.—July 29, 1910, to October 31, 1912; April 1, 1915, to September 30, 1917.

GAGE.—Chain on left bank 1,000 feet below the store at Bonanza; read by Mrs. W. E. Taylor. Datum may be slightly different from that used 1910 to 1912, as bench mark had been destroyed and there was no means of checking the old gage.

DISCHARGE MEASUREMENTS.—Made from two-span highway bridge a quarter of a mile below gage or by wading.

CHANNEL AND CONTROL.—Bed of channel composed of gravel. Control 100 feet downstream at small rapids, which shift between narrow limits.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 7.2 feet at 8 a. m. June 18 (discharge, 3,480 second-feet); minimum discharge probably occurred during winter.

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

DIVERSIONS.—Prior to December 31, 1916, there were adjudicated diversions of 80 second-feet from No Wood Creek above station and 42 second-feet below; all for irrigation. In addition, there is a decree for a power diversion of 115 second-feet below.

ACCURACY.—Stage-discharge relation shifts slightly at long intervals; rating curve well defined throughout; gage read to quarter-tenths once daily. Daily discharge ascertained by applying daily gage heights to rating table. Records good.

Discharge measurements of No Wood Creek at Bonanza, Wyo., during the year ending Sept. 30, 1917.

[Made by P. V. Hodges.]

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*		*Feet.*	*Sec.-ft.*
May 10	2.98	282	Aug. 4	2.50	132
June 29	5.92	2,430	Sept. 21	2.75	197

Daily discharge, in second-feet, of No Wood Creek at Bonanza, Wyo., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Apr.	May.	June.	July.	Aug.	Sept.
1	122	246	.....	310	1,100	1,170	143	108
2	136	229	.....	290	1,030	1,240	143	118
3	150	229	.....	271	1,240	1,380	143	130
4	196	212	.....	271	1,170	1,380	130	143
5	212	229	.....	290	1,100	1,740	115	143
6	229	229	.....	290	1,030	1,590	90	143
7	212	229	.....	310	960	1,520	90	130
8	212	212	895	290	1,030	1,240	90	130
9	246	212	960	353	1,030	1,240	78	128
10	264	212	830	353	2,320	1,240	78	115
11	246	180	530	353	2,500	1,100	78	115
12	246	212	530	353	1,820	960	76	128
13	229	212	449	645	1,450	960	56	128
14	212	.....	353	895	1,240	895	56	128
15	229	.....	399	1,450	1,450	645	46	115
16	212	.....	399	2,230	1,980	585	46	179
17	196	.....	353	2,500	2,680	502	37	195
18	180	.....	353	2,320	3,480	530	100	195
19	180	.....	310	2,410	3,080	585	271	195
20	165	.....	290	2,590	3,080	530	331	195
21	150	.....	271	2,880	3,080	475	310	201
22	282	.....	271	2,590	3,080	475	310	201
23	282	.....	353	1,900	2,780	423	201	185
24	320	.....	530	1,820	2,680	449	201	185
25	383	.....	765	1,660	2,880	423	148	185
26	282	.....	502	1,740	2,500	423	217	185
27	264	.....	399	1,660	2,230	375	201	201
28	246	.....	310	1,450	2,140	375	201	201
29	264	.....	271	1,520	2,320	217	173	185
30	264	.....	310	1,380	2,230	201	159	201
31	246	.....	.....	1,170	.....	156	120	.....

Monthly discharge of No Wood Creek at Bonanza, Wyo., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	383	122	228	14,000
November 1–13	246	180	219	5,650
April 8–30	960	271	462	21,100
May	2,880	271	1,240	76,200
June	3,480	960	2,020	120,000
July	1,740	156	807	49,600
August	331	37	143	8,790
September	201	108	160	9,520

TENSLEEP CREEK NEAR TENSLEEP, WYO.

LOCATION.—In sec. 12, T. 47 N., R. 88 W., 800 feet east of county bridge at Burke's ranch, 5 miles above Tensleep, Washakie County. Nearest tributary, Canyon Creek, enters a quarter of a mile upstream.

DRAINAGE AREA.—228 square miles (measured on base map of Wyoming; scale, 1:500,000.

RECORDS AVAILABLE.—September 21, 1910, to December 31, 1912; April 19, 1915, to September 30, 1917.

GAGE.—Inclined staff on left bank, 800 feet above county bridge, opposite vertical rock cliff; read by Lynn Burke.

DISCHARGE MEASUREMENTS.—Made from cable 100 feet below gage or by wading.

CHANNEL AND CONTROL.—Bed composed of coarse gravel and small boulders. Control just below gage at rapids; fairly permanent in 1917. Right bank is vertical rock cliff; left bank subject to overflow at extremely high water.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 5.8 feet at 7 a. m. June 18 (discharge, 1,860 second-feet); minimum stage occurs during winter.

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

DIVERSIONS.—There is a diversion of approximately 8 second-feet for power above the station. Prior to December 31, 1916, there were adjudicated diversions of 35 second-feet for irrigation, all below station.

REGULATION.—None.

ACCURACY.—Stage-discharge relation slightly shifting; only slightly affected by ice. Rating curve well defined between 40 and 800 second-feet, not well defined above 800 second-feet. Gage read to hundredths once daily, except during high water when it is read twice daily. Daily discharge ascertained by applying daily gage reading or the mean of two daily gage readings to the rating table, except for period October 1 to January 20, when the discharge is computed by the shifting-control method. Records excellent below 800 second-feet and fair above.

Discharge measurements of Tensleep Creek near Tensleep, Wyo., during the year ending Sept. 30, 1917.

[Made by P. V. Hodges.]

Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*
May 10	1.11	51
June 29	3.78	909
Aug. 4	1.49	106

Daily discharge, in second-feet, of Tensleep Creek near Tensleep, Wyo., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	69	64	69	62	.....	51	52	372	1,060	128	108
2	84	62	65	62	.....	52	55	388	1,060	118	99
3	80	63	66	62	.....	50	52	388	1,110	108	99
4	79	64	66	63	.....	62	50	420	1,010	108	90
5	72	64	68	63	.....	76	52	340	960	90	84
6	89	65	64	61	.....	66	49	294	960	128	76
7	101	63	66	60	.....	54	54	309	865	90	83
8	120	62	65	62	.....	52	60	420	775	84	74
9	101	65	68	62	.....	54	58	640	685	83	68
10	94	66	64	63	.....	53	62	1,010	560	87	69
11	84	64	66	64	50	62	83	1,060	525	64	66
12	80	52	65	60	51	63	108	600	525	59	70
13	79	50	65	56	50	65	128	388	490	52	71
14	76	55	66	57	51	64	190	372	490	54	118
15	75	69	64	58	52	70	324	685	455	51	128
16	74	64	65	57	54	60	455	1,110	420	53	84
17	74	65	66	57	50	59	490	1,560	420	50	83
18	75	71	65	59	50	64	560	1,760	420	64	86
19	77	69	66	58	49	62	640	1,310	388	214	83
20	80	68	63	59	50	66	775	1,460	372	253	99
21	84	66	65	.....	51	58	600	1,460	372	202	90
22	87	70	64	.....	51	61	420	1,310	340	138	90
23	74	69	66	.....	52	59	455	1,060	324	128	90
24	72	71	64	.....	53	60	490	1,360	309	128	90
25	69	71	71	.....	60	64	455	1,410	294	108	99
26	66	74	66	.....	90	56	455	1,260	266	118	99
27	66	72	64	.....	148	54	490	1,160	240	128	90
28	64	71	65	.....	227	55	525	910	227	118	90
29	63	68	64	.....	128	53	490	865	214	108	83
30	66	66	65	.....	54	54	404	640	168	118	76
31	64	.....	63	.....	52	.....	356	.....	158	118	.....

NOTE.—Stage-discharge relation affected by ice Jan. 12; discharge interpolated.

Monthly discharge of Tensleep Creek near Tensleep, Wyo., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	120	63	78.6	4,830
November	74	50	65.4	3,890
December	71	63	65.5	4,030
January 1–20	64	56	60.2	2,390
March 11–31	227	49	70.1	2,920
April	76	50	59.3	3,530
May	775	49	304	18,700
June	1,760	294	877	52,200
July	1,110	158	531	32,600
August	253	50	108	6,640
September	128	66	87.8	5,220

PAINTROCK CREEK NEAR BONANZA, WYO.

LOCATION.—About sec. 19, T. 49 N., R. 90 W., at Paumer's ranch, 1½ miles above Bonanza, Big Horn County. No tributary between station and mouth half a mile below.

DRAINAGE AREA.—398 square miles (measured on base map of Wyoming; scale, 1:500,000).

RECORDS AVAILABLE.—July 28, 1910, to October 31, 1912; April 19, 1915, to September 30, 1917.

GAGE.—Chain on right bank 300 feet below ranch; read by Mrs. Wm. Paumer; used since April 11, 1917. From April 19, 1915, to November 18, 1916, staff gage at same location and datum. From July 28, 1910, to October 31, 1912, there was a chain gage near house. No definite relation between gages at two locations, as high water changed channel between.

DISCHARGE MEASUREMENTS.—Made from cable 65 feet below gage or by wading nearby.

CHANNEL AND CONRTOL.—Bed composed of gravel; control at rapids composed of small boulders 150 feet below gage; somewhat shifting. The right bank is low and is overflowed at stage of 2 feet.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 4.2 feet at 7 a. m. June 17 (discharge, 2,180 second-feet); minimum discharge probably occurs during winter.

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

DIVERSIONS.—Prior to December 31, 1916, there were adjudicated diversions of 66 second-feet from Paintrock Creek, practically all being above station.

REGULATION.—None.

ACCURACY.—Stage-discharge relation slightly shifting; affected by ice during winter. Rating curve used October 1 to November 10 well defined between 20 and 200 second-feet; curve used April 11 to September 30 well defined between 20 and 1,800 second-feet. Gage read to hundredths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table. Records excellent.

Discharge measurements of Paintrock Creek near Bonanza, Wyo., during the year ending Sept. 30, 1917.

[Made by P. V. Hodges.]

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*		*Feet.*	*Sec.-ft.*
May 10	1.42	60	Aug. 4	1.35	53
June 29	3.22	1,110	Sept. 20	1.48	78

Daily discharge, in second-feet, of Paintrock Creek near Bonanza, Wyo., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Apr.	May.	June.	July.	Aug.	Sept.
1	41	75	.....	43	342	630	102	49
2	52	75	.....	43	400	630	83	55
3	59	71	.....	43	462	560	53	51
4	67	71	.....	45	462	700	53	47
5	75	71	.....	47	342	815	43	45
6	75	71	.....	39	320	775	47	47
7	71	71	.....	39	285	738	35	47
8	89	75	.....	39	310	738	31	43
9	80	77	.....	43	528	775	30	41
10	75	89	.....	66	1,110	665	21	41
11	75	.....	21	78	1,110	700	19	38
12	71	.....	49	116	738	495	21	38
13	71	.....	36	173	528	430	20	35
14	71	.....	27	180	462	370	15	38
15	71	.....	33	376	700	342	14	61
16	71	.....	68	462	1,300	242	12	71
17	71	.....	63	665	1,960	247	15	83
18	71	.....	25	665	2,180	260	21	83
19	87	.....	20	895	1,740	275	170	83
20	89	.....	23	935	1,630	342	180	80
21	97	.....	24	775	1,410	275	123	75
22	99	.....	39	630	1,740	242	75	68
23	99	.....	36	665	1,300	234	63	66
24	99	.....	99	665	1,410	234	57	71
25	99	.....	31	630	1,630	224	73	66
26	97	.....	31	595	1,200	212	73	71
27	85	.....	35	495	1,110	229	71	71
28	75	.....	45	495	1,110	229	80	61
29	77	.....	45	495	1,200	200	55	61
30	77	.....	43	462	1,410	170	51	55
31	77	.....	.....	364	.....	139	43	.....

Monthly discharge of Paintrock Creek near Bonanza, Wyo., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	99	41	77.8	4,780
November 1–10	89	71	74.6	1,480
April 11–30	99	20	39.6	1,570
May	935	39	363	22,300
June	2,180	285	1,010	60,100
July	815	139	423	26,000
August	180	12	56.4	3,470
September	83	35	58.0	3,450

WOOD RIVER NEAR MEETEETSE, WYO.

LOCATION.—Near line between secs. 26 and 27, T. 48 N., R. 101 W., 1,200 feet above mouth of Wood River and 7 miles southwest of Meeteetse, Park County.

DRAINAGE AREA.—218 square miles (measured on base map of Wyoming; scale, 1:500,000).

RECORDS AVAILABLE.—September 15, 1910, to October 31, 1912; May 10, 1915, to September 30, 1917, when station was discontinued.

GAGE.—Chain gage on left bank 400 feet above bridge, used since April 25, 1916; read by Mrs. Adah River. Original gage, used during 1910–1912, was vertical staff at bridge. Vertical staff at bridge, but referred to different datum from original gage, used from May 10, 1915, to April 24, 1916.

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

CHANNEL AND CONTROL.—Channel composed of boulders; control a short distance below gage at small rapids; shifted considerably during 1917. Right bank will be overflowed at extremely high water.

EXTREMES OF STAGE.—Maximum stage recorded during year, 4.4 feet at 5 p. m. May 15; minimum discharge probably occurs during winter when records are discontinued.

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

DIVERSIONS.—Prior to December 31, 1916, there were adjudicated diversions of 66 second-feet from Wood River.

REGULATION.—None.

ACCURACY.—Stage-discharge relation shifts seriously; affected by ice during winter. Rating curve used October 1 to November 11 well defined between 50 and 100 second-feet. Gage read to quarter-tenths once daily. Daily discharge ascertained by applying daily gage height to rating table. Records good for October and November. Data inadequate for determination of discharge April 10 to September 30.

Discharge measurements of Wood River near Meeteetse, Wyo., during the year ending Sept. 30, 1917.

[Made by P. V. Hodges.]

Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*
May 16	3.55	587
June 24	3.50	969

Daily discharge, in second-feet, of Wood River near Meeteetse, Wyo., for the year ending Sept. 30, 1917

Day.	Oct.	Nov.	Day.	Oct.	Nov.	Day.	Oct.	Nov.
1	74	66	11	74	52	21	74	.....
2	74	66	12	74	.....	22	74	.....
3	84	66	13	74	.....	23	74	.....
4	84	66	14	74	.....	24	78	.....
5	74	71	15	74	.....	25	84	.....
6	74	58	16	74	.....	26	84	.....
7	74	66	17	71	.....	27	84	.....
8	74	58	18	71	.....	28	78	.....
9	74	58	19	66	.....	29	74	.....
10	74	58	20	74	.....	30	74	.....
						31	74	.....

Daily gage height, in feet, of Wood River near Meeteetse, Wyo., for the year ending Sept. 30, 1917.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Day.	Apr.	May.	June.	July.	Aug.	Sept.
1	.....	1.62	2.8	3.4	2.4	2.4	16	1.67	3.5	3.7	2.9	2.4	2.4
2	.....	1.60	2.75	3.4	2.4	2.4	17	1.62	3.2	4.1	2.85	2.4	2.4
3	.....	1.67	2.7	3.4	2.4	2.4	18	1.52	2.9	3.6	2.8	2.4	2.4
4	.....	1.62	2.7	3.3	2.4	2.4	19	1.57	2.9	3.6	2.75	2.4	2.4
5	.....	1.52	2.55	3.2	2.4	2.4	20	1.52	3.5	.....	2.7	2.4	2.4
6	.....	1.72	2.75	3.3	2.4	2.4	21	1.67	2.8	.....	2.7	2.4	2.4
7	.....	1.72	2.85	3.4	2.4	2.4	22	2.04	2.6	.....	2.6	2.4	2.4
8	.....	1.72	3.0	3.4	2.4	2.4	23	2.32	2.7	.....	2.5	2.4	2.4
9	.....	1.82	4.0	3.2	2.4	2.4	24	2.07	2.95	3.7	2.6	2.4	2.4
10	1.92	2.12	3.6	3.2	2.4	2.4	25	2.00	3.0	3.8	2.6	2.4	2.4
11	1.92	2.32	3.4	3.2	2.4	2.4	26	1.92	2.95	3.5	2.6	2.4	2.4
12	1.94	2.8	3.1	3.4	2.4	2.4	27	1.74	3.0	3.5	2.6	2.4	2.4
13	1.97	2.75	3.1	3.0	2.4	2.4	28	1.67	3.0	3.5	2.6	2.4	2.4
14	1.77	3.4	2.9	3.0	2.4	2.4	29	1.64	3.2	3.5	2.6	2.4	2.4
15	1.62	4.4	3.2	2.9	2.4	2.4	30	1.72	3.0	3.5	2.6	2.4	2.4
							31	.....	2.9	.....	2.45	2.4	.....

Monthly discharge of Wood River near Meeteetse, Wyo., for the period Oct. 1 to Nov. 11, 1916.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	84	66	75.4	4,640
November 1-11	71	52	62.3	1,360

SHELL CREEK AT SHELL, WYO.

LOCATION.—Near the western edge of sec. 26, T. 53 N., R. 91 W., 450 feet above head gate of Shell canal, three-quarters of a mile northeast of Shell, Big Horn County. Nearest tributary, Trapper Creek, enters a short distance above.

DRAINAGE AREA.—256 square miles (measured on base map of Wyoming; scale, 1:500,000).

RECORDS AVAILABLE.—April 1, 1915, to September 30, 1917. From July 1, 1911, to October 31, 1914, station maintained by Wyoming Irrigation Co. and published in reports of State engineer.

GAGE.—Vertical staff on right bank 450 feet above canal head gate; read by J. G. Tatlock.

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

CHANNEL AND CONTROL.—Bed composed of gravel. Control just below gage at gravel bar which may shift during high water. Banks not subject to overflow.

EXTREMES OF DISCHARGE. Maximum stage recorded during year, 7.75 feet at 12.30 p. m., June 17 (discharge, 1,500 second-feet); minimum discharge probably occurred during winter.

ICE.—No information as records are discontinued during winter.

DIVERSIONS.—Prior to December 31, 1916, there were adjudicated diversions of 8 second-feet from Shell Creek above the station, and 104 second-feet below.

REGULATION.—Flow controlled to a certain extent by storage of water in Adelaide reservoir, located on Shell Creek, 25 miles above Shell; capacity of reservoir 1,410 acre-feet. Water stored in reservoir beginning of high-water period and released in latter part of summer.

ACCURACY.—Stage-discharge relation not permanent. Rating curve well defined between 50 and 700 second-feet, but not well defined above 700 second-feet. Gage read to hundredths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table, except for period June 29 to September 30, when discharge was computed by indirect method for shifting control. Records excellent up to 700 second-feet; above this they are good.

Discharge measurements of Shell Creek at Shell, Wyo., during the year ending Sept. 30, 1917.

[Made by P. V. Hodges.]

Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*
May 11	4.17	71
June 28	6.15	657
Sept. 22	4.09	83

Daily discharge, in second-feet, of Shell Creek at Shell, Wyo., for the year ending Sept. 30, 1917.

Day.	Oct.	Apr.	May.	June.	July.	Aug.	Sept.
1	77	60	60	205	528	108	101
2	82	58	58	218	508	108	98
3	89	58	58	218	488	107	98
4	91	58	63	205	468	102	95
5	88	58	58	205	488	96	95
6	82	58	58	192	410	92	92
7	82	58	59	205	374	92	92
8	89	54	63	205	374	89	92
9	85	59	63	480	357	86	92
10	82	56	68	680	340	89	92
11	79	63	74	780	322	89	92
12	79	63	85	385	306	89	89
13	77	64	107	300	282	86	91
14	74	59	131	300	215	86	95
15	74	58	255	520	215	89	100
16	74	68	368	980	202	95	110
17	74	64	300	1,420	178	95	108
18	75	59	315	1,300	168	101	100
19	79	59	480	1,080	168	104	89
20	82	60	480	980	178	104	78
21	79	60	402	1,080	168	101	81
22	79	63	385	1,030	158	101	75
23	75	63	368	1,030	138	94	75
24	74	68	368	1,080	138	92	72
25	75	68	402	1,030	133	89	72
26	75	58	368	830	98	89	72
27	75	59	300	780	124	98	72
28	75	58	300	780	124	98	75
29	75	58	315	780	124	94	77
30	75	59	255	680	124	92	77
31	75	.....	218	.....	124	92	.....

Monthly discharge of Shell Creek at Shell, Wyo., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	91	74	78.9	4,850
April	68	54	60.3	3,590
May	480	58	222	13,600
June	1,420	192	665	39,600
July	528	98	259	15,900
August	108	86	95.1	5,850
September	110	72	88.2	5,250

SHOSHONE RIVER NEAR ISHAWOOA, WYO.

LOCATION.—On line between secs. 26 and 27, T. 51 N., R. 104 W., at Coe's private bridge, 1½ miles northeast of Ishawooa, Park County. Nearest tributary, Belknap Creek, enters at Ishawooa.

DRAINAGE AREA.—532 square miles (measured on base map of Wyoming; scale, 1:500,000).

RECORDS AVAILABLE.—May 7, 1915, to September 30, 1917.

GAGE.—Vertical staff on first right downstream piling of bridge; read by Miss Ina Spaulding and Loyd Spaulding.

DISCHARGE MEASUREMENTS.—Made from five-span pile bent bridge or by wading.

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CHANNEL AND CONTROL.—Channel composed of boulders, control not well defined; shifts during high water. Right bank not subject to overflow; left bank will be overflowed at high stages.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 6.0 feet at 8.15 p. m. July 5 (discharge, 4,420 second-feet); minimum discharge probably occurred during winter.

ICE.—No information, as records are discontinued.

DIVERSIONS.—Prior to December 31, 1916, there were approved diversions of 26 second-feet from Shoshone River above the station and 40 second-feet above Shoshone reservoir.

REGULATION.—None.

ACCURACY.—Stage-discharge relation not permanent. Rating curve fairly well defined between 200 and 4,400 second-feet. Gage read to hundredths once daily. Daily discharge ascertained by applying daily gage height to rating table, except for period June 24 to September 30, when discharge was computed by indirect method for shifting control. Records good, except during high stages when they are only fair, owing to wave action at gage, and diurnal fluctuation.

Discharge measurements of Shoshone River near Ishawooa, Wyo., during the year ending Sept. 30, 1917.

[Made by P. V. Hodges.]

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*		*Feet.*	*Sec.-ft.*
May 13	2.59	778	Aug. 2	3.20	973
June 22	5.70	4,130	Sept. 24	1.80	256

Daily discharge, in second-feet, of Shoshone River near Ishawooa, Wyo., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Apr.	May.	June.	July.	Aug.	Sept.
1	235	200	.....	107	669	3,300	895	378
2	272	200	.....	107	860	3,030	965	334
3	312	200	.....	122	731	3,580	895	334
4	235	200	.....	122	669	4,280	895	334
5	272	200	.....	136	554	4,420	763	334
6	292	200	.....	184	669	3,580	700	378
7	272	200	.....	200	669	3,580	700	334
8	272	184	.....	218	795	3,930	640	312
9	254	167	.....	218	2,530	3,930	640	292
10	235	167	.....	312	2,410	3,510	582	292
11	254	167	.....	501	554	3,230	610	292
12	254	.....	.....	731	1,150	3,650	610	292
13	235	.....	.....	731	501	3,230	610	292
14	235	.....	.....	1,470	1,070	3,160	554	292
15	235	.....	.....	2,410	1,850	2,180	501	292
16	235	.....	.....	1,560	3,160	2,180	501	272
17	235	.....	.....	1,070	3,440	2,290	501	292
18	235	.....	.....	1,000	4,140	2,180	554	254
19	235	.....	.....	1,960	3,720	2,410	554	254
20	218	.....	.....	582	4,000	2,350	450	254
21	235	.....	.....	610	3,860	2,120	450	254
22	235	.....	136	610	4,140	2,020	450	254
23	235	.....	152	860	4,000	2,590	450	254
24	235	.....	167	1,000	4,210	2,020	401	254
25	235	.....	152	795	3,790	2,020	450	254
26	218	.....	167	1,000	3,650	1,650	401	254
27	235	.....	136	731	3,650	1,850	501	254
28	235	.....	136	795	3,930	1,750	501	254
29	200	.....	107	860	4,210	860	501	254
30	200	.....	122	860	3,510	860	501	254
31	200	.....	.....	731	.....	930	401	.....

Monthly discharge of Shoshone River near Ishawooa, Wyo., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	312	200	241	14,800
November 1–11	200	167	190	4,150
April 22–30	167	107	142	2,540
May	2,410	107	729	44,800
June	4,210	501	2,440	145,000
July	4,420	860	2,670	164,000
August	965	401	585	36,000
September	378	254	288	17,100

SOAP CREEK NEAR ST. XAVIER, MONT.

LOCATION.—In sec. 20, T. 5 S., R. 32 E., at Henry Reed's ranch, 9 miles south of St. Xavier and 1 mile above mouth of stream, in Big Horn County.

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—September 11, 1911, to September 30, 1917. April 25, 1914, to June 12, 1915, at Frank Annerer's ranch, half a mile above present site; September 11, 1911, to November 30, 1913, in W. ½ NW. ¼ sec. 2, T. 6 S., R. 32 E., a quarter of a mile above headworks of Soap Creek ditch.

GAGE.—Overhanging chain gage on right bank opposite Henry Reed's house; read by Henry Reed. Original gage, in use September 11, 1911, to November 30, 1913, was overhanging chain gage about a quarter of a mile above headworks of Soap Creek ditch; gage used April 25, 1914, to June 12, 1915, a chain gage on footbridge near Frank Annerer's house, a quarter of a mile above present site.

DISCHARGE MEASUREMENTS.—Made by wading or from highway bridge 1 mile upstream from gage.

CHANNEL AND CONTROL.—Bed of stream at principal control is composed of gravel and silt; shifts slightly. Stage-discharge relation affected at times by growth of aquatic plants in channel.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 11.69 feet March 25, determined by level from stake set by observer at water level during heavy ice jam (discharge not computed); minimum stage recorded, 2.80 feet August 13 (discharge, 11 second-feet).

1911–1917: Maximum stage recorded, 12.8 feet May 11, 1914, determined by leveling from flood marks (discharge, determined from extension of rating curve, 438 second-feet); minimum stage recorded, 2.1 feet September 10, 1914 (discharge, 1 second-foot).

ICE.—Stage-discharge relation seriously affected by ice November 11 to March 24. Flow not computed; gage heights were obtained November 12 to December 31.

DIVERSIONS.—Soap Creek ditch diverts above station during summer for irrigation.

REGULATION.—None.

ACCURACY.—Stage-discharge relation not permanent; seriously affected by ice during winter and by shifting control May 30 to September 30. Rating curve used October 1 to November 11 poorly defined; curve used April 1 to May 29 fairly well defined; indirect method for shifting control used May 30 to September 30. Gage read to hundredths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table. Records October 1 to November 11 are poor; April 1 to September 30 fair.

Discharge measurements of Soap Creek near St. Xavier, Mont., during the year ending Sept. 30, 1917.

[Made by W. A. Lamb.]

Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*
May 4	2.94	20.2
June 22	3.35	38.4
Aug. 11	2.85	11.7

Daily discharge, in second-feet, of Soap Creek near St. Xavier, Mont., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Apr.	May.	June.	July.	Aug.	Sept.
1	22	21	108	27	225	17	13	15
2	22	21	85	26	91	16	13	16
3	22	21	87	22	56	16	12	17
4	22	21	107	21	64	16	14	17
5	22	22	190	66	204	16	14	17
6	22	22	249	204	252	16	12	17
7	22	22	69	164	127	17	12	17
8	25	22	151	40	100	17	13	17
9	26	22	181	35	90	16	13	17
10	22	23	140	37	94	16	12	17
11	23	21	86	39	123	16	12	18
12	22	.....	82	40	81	15	11	18
13	22	.....	62	46	74	15	11	18
14	22	.....	57	56	60	15	12	18
15	22	.....	68	65	57	16	13	19
16	22	.....	55	72	54	16	12	21
17	21	.....	48	66	48	16	13	23
18	22	.....	37	44	46	16	13	22
19	25	.....	37	39	44	16	14	23
20	26	.....	26	38	44	15	14	21
21	26	.....	23	42	44	15	14	21
22	26	.....	32	38	34	17	14	22
23	25	.....	31	30	23	17	14	21
24	23	.....	37	30	27	14	14	23
25	22	.....	29	29	20	14	14	23
26	22	.....	28	28	24	14	14	24
27	22	.....	35	30	24	14	14	24
28	23	.....	24	26	24	13	14	23
29	23	.....	26	37	22	13	15	24
30	22	.....	26	249	22	12	15	24
31	22	.....	.....	226	.....	13	15	.....

Monthly discharge of Soap Creek near St. Xavier, Mont., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	26	21	22.9	1,410
November 1–11	23	21	221.6	471
April	249	23	73.9	4,400
May	249	21	61.7	3,790
June	252	20	73.3	4,360
July	17	12	15.3	941
August	15	11	13.2	812
September	24	15	19.9	1,180

ROTTENGRASS CREEK NEAR ST. XAVIER, MONT.

LOCATION.—In NW. ¼ sec. 6, T. 5 S., R. 23 E., a quarter of a mile above crossing of Big Horn canal, on Crow Indian Reservation, 4 miles south of St. Xavier, in Big Horn County.

DRAINAGE AREA.—Not measured.

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

GAGE.—Overhanging chain on left bank a quarter of a mile above crossing of Big Horn canal; read by Loren S. Stanley.

DISCHARGE MEASUREMENTS.—Made from footbridge 500 feet above gage or by wading.

CHANNEL AND CONTROL.—Bed of stream gravel and silt; shifts. Banks above and below gage high and steep; not subject to overflow below gage height 11 feet (discharge, about 400 second-feet).

EXTREMES OF DISCHARGE.—Maximum stage during year, 11.3 feet at 5.30 p. m. March 30 (discharge, from extension of rating curve, 500 second-feet); minimum stage recorded, 2.90 feet 6 p. m. August 16 (discharge, 2.5 second-feet).

1911–1917: Maximum stage recorded, 11.3 feet March 30, 1917 (discharge, 500 second-feet); minimum stage recorded, 2.3 feet September 27, 1911 (discharge 0.3 second-foot).

ICE.—Stage-discharge relation seriously affected by ice; observations discontinued November 10 to March 30.

DIVERSIONS.—None.

REGULATION.—None.

ACCURACY.—Stage-discharge relation changed by high water in March. Rating curve used October 1 to November 9 well defined below 100 second-feet; curve used March 30 to September 30 well defined below 60 second-feet. Gage read to half-tenths twice daily; read occasionally to quarter-tenths. Daily discharge ascertained by applying mean daily gage height to rating table. Records good.

Discharge measurements of Rottengrass Creek near St. Xavier, Mont., during the year ending Sept. 30, 1917.

[Made by W. A. Lamb.]

Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*
May 4	4.12	31.6
June 22	4.59	46.2
Aug. 11	3.04	4.8

Daily discharge, in second-feet, of Rottengrass Creek near St. Xavier, Mont., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	8.0	8.0	.....	139	36	200	21	5.8	3.2
2	8.0	8.0	.....	133	34	270	20	5.8	3.2
3	8.0	8.0	.....	133	30	228	19	5.8	3.2
4	7.0	8.0	.....	139	32	228	16	5.8	3.2
5	8.0	8.0	.....	284	37	228	14	5.8	3.2
6	8.0	8.0	.....	284	82	181	14	5.8	3.2
7	8.0	8.0	.....	163	103	151	14	5.8	3.2
8	7.5	8.0	.....	163	103	92	14	5.8	3.2
9	8.0	8.0	.....	181	77	82	14	5.8	3.2
10	8.0	.....	.....	163	55	109	14	5.8	3.2
11	7.5	.....	.....	127	47	115	14	5.4	3.2
12	7.5	.....	.....	92	47	109	14	4.0	3.2
13	8.0	.....	.....	82	47	87	14	4.0	2.8
14	8.0	.....	.....	72	51	87	14	4.0	4.0
15	8.0	.....	.....	72	72	63	14	3.2	4.0
16	8.2	.....	.....	55	97	63	14	2.5	4.8
17	8.0	.....	.....	51	169	59	14	4.0	5.0
18	8.2	.....	.....	36	175	63	14	4.0	5.0
19	8.2	.....	.....	36	145	59	14	3.7	4.8
20	8.2	.....	.....	61	151	55	14	3.2	4.8
21	8.5	.....	.....	28	82	59	14	3.2	5.0
22	9.5	.....	.....	34	82	51	12	2.8	5.0
23	10	.....	.....	34	77	43	12	2.5	4.8
24	10	.....	.....	37	51	42	9	2.5	5.0
25	10	.....	.....	37	63	43	13	2.5	4.0
26	10	.....	.....	34	63	38	11	3.2	4.0
27	10	.....	.....	40	59	31	9.6	3.2	5.0
28	9.0	.....	.....	40	63	25	6.6	3.2	5.0
29	9.0	.....	.....	40	72	24	5.6	3.2	5.0
30	9.0	.....	496	34	115	24	5.6	3.2	5.0
31	9.0	.....	352	.....	175	.....	5.6	3.2	.....

Monthly discharge of Rottengrass Creek near St. Xavier, Mont., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	10	7.5	8.46	520
November 1–9	8.0	8.0	8.00	143
March 30–31	.....	.....	.....	1,690
April	284	28	93.1	5,540
May	175	30	80.4	4,940
June	270	24	97.0	5,770
July	21	5.6	13.1	806
August	5.8	2.5	4.15	255
September	5.0	2.8	4.05	241

LITTLE HORN RIVER NEAR WYOLA, MONT.

LOCATION.—In W. ½ SW. ¼ sec. 28, T. 2 S., R. 35 E., a quarter of a mile below proposed headworks of Little Big Horn canal No. 3, 16 miles above Lodgegrass Creek, and 4 miles southwest of Wyola, in Big Horn County.

DRAINAGE AREA.—260 square miles.

RECORDS AVAILABLE.—September 7, 1911, to September 30, 1917.

GAGE.—Overhanging chain gage on right bank; read by Ida M. Shipman and Granville Collins.

DISCHARGE MEASUREMENTS.—Made from cable 75 feet below gage or by wading near cable.

CHANNEL AND CONTROL.—Composed of boulders and gravel; shifts occasionally at high stage. Left bank high and not subject to overflow; right bank high but subject to overflow 100 feet below gage.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 7.1 feet at 7 a. m. June 22 (discharge, 1,580 second-feet); minimum stage, 4.20 feet March 15–20 and 22–24 (discharge, 82 second-feet).

1912–1917: Maximum stage recorded, 7.1 feet June 22, 1917 (discharge, 1,580 second-feet); minimum stage, 4.2 feet April 10 and 12, 1915 (discharge, 32 second-feet).

ICE.—Stage-discharge relation seriously affected by ice; observations discontinued December 10 to March 11.

DIVERSIONS.—Small amount diverted for irrigation.

REGULATION.—None.

ACCURACY.—Stage-discharge relations not permanent; affected by shifting control and by ice. Rating curve used October 1 to April 15 well defined below 500 second-feet; shifting-control method used April 16 to September 30. Gage read to half-tenths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table. Records fair.

Discharge measurements of Little Horn River near Wyola, Mont., during the year ending Sept. 30, 1917.

[Made by W. A. Lamb.]

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*		*Feet.*	*Sec.-ft.*
Dec. 2	4.31	99	June 21	6.15	958
May 3	4.32	97	Aug. 11	4.53	162

Daily discharge, in second-feet, of Little Horn River near Wyola, Mont., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	120	110	106	.....	131	100	396	702	166	124
2	120	110	104	.....	120	99	373	675	166	124
3	124	116	104	.....	120	98	331	648	166	124
4	131	116	108	.....	131	112	373	648	180	122
5	124	116	104	.....	131	180	568	621	180	122
6	124	116	110	.....	131	144	373	568	180	122
7	131	114	110	.....	120	114	373	568	164	120
8	124	110	111	.....	120	104	373	516	161	120
9	124	110	112	.....	129	112	516	491	161	120
10	120	110	.....	.....	133	106	785	466	161	118
11	120	110	.....	120	131	118	730	418	159	118
12	124	112	.....	100	124	140	648	373	159	118
13	120	110	.....	100	122	156	542	373	159	116
14	116	114	.....	91	120	208	516	274	156	116
15	120	110	.....	82	120	274	648	193	156	116
16	120	110	.....	82	120	396	785	161	156	120
17	120	112	.....	82	114	373	950	149	152	118
18	124	112	.....	82	108	396	1,250	161	142	114
19	120	108	.....	82	98	396	1,250	193	142	114
20	120	108	.....	82	102	442	1,190	223	135	114
21	122	110	.....	91	106	418	1,070	208	131	112
22	120	110	.....	82	106	331	1,510	193	131	112
23	116	108	.....	82	96	312	1,130	193	129	112
24	114	106	.....	82	114	352	1,070	193	129	112
25	114	108	.....	91	104	352	1,190	208	129	100
26	116	108	.....	91	95	373	1,010	193	129	91
27	120	110	.....	100	108	331	840	193	127	91
28	122	110	.....	120	102	352	621	193	127	91
29	120	110	.....	223	102	442	1,070	180	127	89
30	116	108	.....	193	101	542	950	166	127	89
31	110	.....	.....	142	.....	418	.....	166	124	.....

Note.—Discharge interpolated Dec. 8, Mar. 18, Apr. 1, 13, 15, 25, 29, 30, May 1 and 2.

Monthly discharge of Little Horn River near Wyola, Mont., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	131	110	121	7,440
November	116	106	111	6,600
December 1–9	112	104	108	1,930
March 11–31	223	82	105	4,370
April	133	95	115	6,840
May	542	98	267	16,400
June	1,510	331	781	46,500
July	702	149	339	20,800
August	180	124	148	9,100
September	124	89	113	6,720

LITTLE HORN RIVER NEAR CROW AGENCY, MONT.

LOCATION.—In W. ½ sec. 18, T. 3 S., R. 35 E., at Chicago, Burlington & Quincy Railroad bridge 2 miles south of Crow Agency, in Big Horn County, 14 miles above junction with Big Horn River.

DRAINAGE AREA.—1,190 square miles.

RECORDS AVAILABLE.—September 7, 1911, to September 30, 1917; March 24, 1905, to June 30, 1906, for station at Crow Agency, 2 miles below present station; Crow Agency ditch diverts water between the stations.

GAGE.—Stevens water-stage recorder on right bank 40 feet below railway bridge set to same datum as chain gage; chain gage on downstream side of railway bridge 1912 to 1916. Records for 1911 were obtained from staff on bridge pier near left bank; gages at same datum. Records 1905–6 obtained from chain gage on upstream side of railroad bridge at Crow Agency.

DISCHARGE MEASUREMENTS.—Made from upstream side of highway bridge 200 feet below gage or by wading.

CHANNEL AND CONTROL.—Bed of stream composed of gravel; slightly shifting. Banks high; not subject to overflow below gage height, about 14 feet.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 10.8 feet at 8 a. m. April 6 (discharge, 3,930 second-feet); minimum stage, 4.40 feet October 1–7, November 1, August 29 to September 9, September 14, 22–30 (discharge, 129 second-feet).

1905 and 1912–1917: Maximum stage recorded, 10.8 feet April 6, 1917 (discharge, 3,930 second-feet); minimum stage, 1.8 September 25–29, 1905 (discharge, 60 second-feet).

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

DIVERSIONS.—Several small diversions for irrigation from main stream and tributaries above station.

REGULATION.—None.

ACCURACY.—Stage-discharge relation permanent except as affected by ice. Rating curve well defined between 150 and 4,000 second-feet. Gage read to half-tenths once daily. Daily discharge ascertained by applying mean daily gage height to rating table. Records good.

Discharge measurements of Little Horn River near Crow Agency, Mont., during the year ending Sept. 30, 1917.

[Made by W. A. Lamb.]

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*		*Feet.*	*Sec.-ft.*
Oct. 11	4.52	168	May 27	5.75	758
Dec. 4	4.58	178	June 22	6.85	1,410
Apr. 6	10.35	[a] 3,530	Aug. 10	4.61	196
May 5	5.15	398			

[a] Velocity determined by surface method, using a coefficient of 0.90 to obtain mean velocity. Stage fell at rate of 0.3 foot per hour during measurement.

Daily discharge, in second-feet, of Little Big Horn River near Crow Agency, Mont., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Apr.	May.	June.	July.	Aug.	Sept.
1	129	171	.....	1,180	940	820	186	129
2	129	171	.....	1,150	820	791	186	129
3	129	171	.....	1,150	880	791	186	129
4	129	156	.....	1,150	820	762	156	129
5	129	156	.....	436	676	704	156	129
6	129	156	3,600	540	940	733	156	129
7	129	142	2,920	514	880	648	156	129
8	156	142	2,240	488	850	621	156	129
9	156	142	2,370	436	704	594	156	129
10	142	142	2,470	386	880	594	186	142
11	156	129	2,180	339	1,180	567	186	142
12	156	.....	2,040	339	1,150	540	186	142
13	156	.....	1,780	436	1,120	488	156	142
14	142	.....	1,660	436	1,060	436	156	129
15	156	.....	1,600	488	1,060	411	156	142
16	142	.....	1,570	567	1,030	386	156	156
17	142	.....	1,540	567	1,030	362	156	156
18	142	.....	1,480	648	1,180	339	156	156
19	142	.....	1,480	648	1,420	317	156	156
20	156	.....	1,480	704	1,360	317	156	142
21	171	.....	1,480	704	1,330	295	156	142
22	171	.....	1,420	676	1,330	275	156	129
23	186	.....	1,420	648	1,480	275	156	129
24	186	.....	1,390	594	1,390	255	156	129
25	186	.....	1,360	594	1,300	237	156	129
26	186	.....	1,330	621	1,240	237	156	129
27	186	.....	1,300	676	1,210	219	156	129
28	186	.....	1,240	621	1,120	202	156	129
29	186	.....	1,240	648	1,090	202	129	129
30	186	.....	1,210	880	1,060	186	129	129
31	186	.....	.....	1,300	.....	186	129	.....

Monthly discharge of Little Horn River near Crow Agency, Mont., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	186	129	157	9,650
November 1–11	171	129	153	3,340
April 6–30	3,600	1,210	1,750	86,800
May	1,300	339	663	40,800
June	1,480	676	1,080	64,300
July	820	186	445	27,400
August	186	129	159	9,780
September	156	129	136	8,090

LODGEGRASS CREEK AT LODGEGRASS, MONT.

LOCATION.—In S. ½ sec. 13, T. 6 S., R. 35 E., 600 feet above Chicago, Burlington & Quincy Railroad bridge and a quarter of a mile south of Lodgegrass, on Crow Indian Reservation, in Big Horn County.

DRAINAGE AREA.—Not measured (142 square miles at old site, 6 miles upstream).

RECORDS AVAILABLE.—March 24, 1916, to September 30, 1917, at present site; September 9, 1911, to December 28, 1915, at old site 6 miles above in SW. ¼ sec. 29, T. 6 S., R. 35 E., a quarter of a mile above Lodgegrass ditch.

GAGE.—Overhanging wire gage on left bank; at old site, an overhanging chain gage at different datum.

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

CHANNEL AND CONTROL.—Control is an outcrop of sandstone overlain by boulders and gravel; boulders and gravel likely to shift.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 5.05 feet March 31, when stage-discharge relation was affected by ice (discharge not computed); minimum stage, 1.85 feet October 1, 2, and 15 (discharge, 14 second-feet).

1911–1917: Maximum stage, 7.0 feet June 13, 1915 (discharge, 695 second-feet); minimum stage, 1.80 feet September 9 and 13, 1916 (discharge, 11 second-feet).

ICE.—Stage-discharge relation seriously affected by ice November 17 to March 31; flow not determined. No records December 23 to March 29.

DIVERSIONS.—Lodgegrass ditch diverts water for irrigation 6 miles above present site. Old station was a quarter of a mile above headworks of this ditch; hence flow during irrigation season is not comparable to that at present site.

REGULATION.—None.

ACCURACY.—Daily gage heights taken from observer's readings to nearest quarter-tenth once daily. Two readings were taken during rapid change in stage. Daily discharge obtained by applying daily gage heights to rating table, October 1 to November 17, April 16 to July 28, and August 10 to September 20. Discharge obtained April 1–15 and July 28 to August 9 by shifting-control method; records fair. Curve used October 1 to November 17 and April 16 to July 28 fairly well defined between 15 and 400 second-feet; records good.

Discharge measurements of Lodgegrass Creek at Lodgegrass, Mont., during the year ending Sept. 30, 1917.

[Made by W. A. Lamb.]

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*		*Feet.*	*Sec.-ft.*		*Feet.*	*Sec.-ft.*
Dec. 2	[a] 2.23	27.2	May 3	2.39	62	Aug. 10	2.17	29.1
Apr. 5	3.65	374	June 21	3.90	378			

[a] Stage-discharge relation affected by ice.

Daily discharge, in second-feet, of Lodgegrass Creek at Lodgegrass, Mont., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Apr.	May.	June.	July.	Aug.	Sept.
1	14	22	503	55	296	290	48	21
2	14	20	235	58	187	237	45	21
3	18	20	146	63	170	225	41	21
4	22	20	131	63	154	218	40	21
5	22	20	350	90	187	213	37	18
6	20	20	373	237	394	209	36	18
7	20	22	148	166	180	195	33	18
8	22	20	387	94	166	187	32	18
9	22	22	600	80	166	174	31	18
10	22	24	346	74	187	170	30	18
11	20	26	182	74	318	160	30	18
12	18	26	161	77	318	136	30	16
13	18	26	133	87	258	108	30	16
14	17	22	116	98	202	104	27	16
15	14	18	156	116	180	101	27	21
16	18	20	87	132	202	90	27	30
17	18	20	87	166	268	87	24	30
18	20	.....	68	150	347	80	24	30
19	20	.....	63	124	428	63	24	72
20	20	.....	63	141	378	63	24	27
21	20	.....	72	154	381	63	22	24
22	24	.....	74	146	353	63	22	22
23	26	.....	74	124	394	63	22	21
24	22	.....	90	113	394	63	22	21
25	20	.....	74	113	394	63	21	21
26	22	.....	63	116	418	63	21	22
27	24	.....	74	141	332	63	21	24
28	26	.....	63	132	318	60	21	24
29	26	.....	74	160	310	59	21	24
30	24	.....	58	202	318	55	21	22
31	22	.....	.....	250	.....	51	21	.....

Monthly discharge of Lodgegrass Creek at Lodgegrass, Mont., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	26	14	20.5	1,260
November 1–17	26	18	21.6	728
April	600	58	168	10,000
May	250	55	122	7,500
June	428	154	287	17,100
July	290	51	122	7,500
August	48	21	28.2	1,730
September	30	16	21.6	1,290

TONGUE RIVER AT CARNEYVILLE, WYO.

LOCATION.—In sec. 20, T. 57 N., R. 84 W., at highway bridge at Carneyville, Sheridan County. Nearest important tributary, Goose Creek, enters 3 miles below.

DRAINAGE AREA.—495 square miles (measured on base map of Wyoming; scale, 1: 500,000).

RECORDS AVAILABLE.—May 25, 1911, to October 31, 1912; April 4, 1915, to June 30, 1917, when station was discontinued.

GAGE.—Chain gage on downstream side of bridge; read by Walter Bone.

DISCHARGE MEASUREMENTS.—Made from two-span bridge or by wading.

CHANNEL AND CONTROL.—Bed composed of gravel and small boulders; shifts; no well defined control. Banks not subject to overflow.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 7.3 feet at 11.30 a. m., June 18 (discharge, 2,690 second-feet); minimum stage probably occurred during winter.

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

DIVERSIONS.—Prior to December 31, 1916, there were adjudicated diversions of 188 second-feet from Tongue River above station and 33 second-feet below.

REGULATION.—None.

ACCURACY.—Stage-discharge relation not permanent; affected by ice during winter. Rating curve used October 1 to November 12 is fairly well defined between 100 and 1,400 second-feet and curve used June 15–30 is well defined between 100 and 2,800 second-feet; shifting-control method used April 8 to June 14. Gage read to quarter-tenths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table. Records good.

Discharge measurements of Tongue River at Carneyville, Wyo., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*
Apr. 26	Robert Follansbee	3.34	151
June 18	P. V. Hodges	7.27	2,660

Daily discharge, in second-feet, of Tongue River at Carneyville, Wyo., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Apr.	May.	June.	Day.	Oct.	Nov.	Apr.	May.	June.
1	120	110	.....	135	986	16	112	.....	152	1,080	1,860
2	130	120	.....	169	1,050	17	124	.....	152	1,020	2,260
3	138	133	.....	142	992	18	130	.....	142	962	2,600
4	138	128	.....	152	1,110	19	105	.....	128	1,030	2,260
5	138	116	.....	264	1,170	20	94	.....	126	1,150	2,180
6	124	108	.....	202	992	21	140	.....	133	1,150	2,100
7	124	112	.....	174	998	22	198	.....	126	917	2,180
8	133	91	730	174	998	23	128	.....	158	974	2,100
9	138	94	675	174	1,240	24	105	.....	163	1,030	2,020
10	128	140	542	177	2,160	25	124	.....	163	974	1,940
11	124	118	329	206	2,250	26	138	.....	163	1,100	1,710
12	120	88	283	291	1,630	27	138	.....	140	980	1,640
13	124	.....	244	333	1,300	28	133	.....	138	1,040	1,430
14	116	.....	226	573	1,300	29	140	.....	147	1,160	1,430
15	124	.....	193	741	1,500	30	124	.....	133	1,990	1,310
						31	124	.....	.....	1,230	.....

Monthly discharge of Tongue River at Carneyville, Wyo., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	198	94	128	7,870
November 1–12	140	88	113	2,690
April 8–30	730	126	234	10,700
May	1,990	135	700	43,000
June	2,600	986	1,620	96,400

POWDER RIVER NEAR ARVADA, WYO.

LOCATION.—Near line between Tps. 56 and 57 N., R. 76 W., at State bridge 17 miles north of Arvada, Sheridan County. Nearest tributary, Clear Creek, enters 200 yards below.

DRAINAGE AREA.—6,580 square miles (measured on base map of Wyoming; scale, 1:500,000).

RECORDS AVAILABLE.—September 1, 1915, to September 30, 1917.

GAGE.—Chain gage on upstream guard-rail of bridge, since May 4, 1916; read by John Watt. Prior to that date, gage was inclined staff 1 mile upstream at K ranch.

DISCHARGE MEASUREMENTS.—Made from two-span highway bridge or by wading.

CHANNEL AND CONTROL.—Bed composed of silt and gravel. Control just above mouth of Clear Creek. During high water there may be backwater from Clear Creek as there is only 2 feet fall between station and creek.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 8 feet at 1.30 p. m. May 22 (discharge, 8,780 second-feet); minimum stage recorded, 475 feet on August 27 (discharge, 6 second-feet).

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

DIVERSIONS.—Prior to December 31, 1916, there were adjudicated diversions of 9 second-feet from Powder River above station and none below.

REGULATION.—None.

ACCURACY.—Stage-discharge relation fairly permanent, except for a short time during high water when it was affected by backwater from Clear Creek. Affected by ice during winter. Rating curve well defined below 2,000 second-feet but poorly defined above. Gage read to hundredths once daily. Daily discharge ascertained by applying daily gage height to rating table. Owing to flashy character of stream, one gage height per day will not give true mean stage for the day. Records fair.

Discharge measurements of Powder River near Arvada, Wyo., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*
May 1	Robert Follansbee	4.30	403
June 14	P. V. Hodges	5.48	2,110
July 29	do	3.44	81

Daily discharge, in second-feet, of Powder River near Arvada, Wyo., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Apr.	May.	June.	July.	Aug.	Sept.
1	34	175	.....	485	.....	975	40	87
2	37	192	.....	390	.....	692	27	87
3	58	192	.....	740	.....	636	18	78
4	55	182	.....	740	.....	620	18	51
5	58	175	.....	795	.....	602	27	51
6	55	159	.....	645	.....	522	100	44
7	61	159	.....	645	.....	452	92	42
8	64	159	.....	1,680	1,280	421	84	38
9	89	172	.....	850	3,180	390	38	38
10	246	175	.....	740	1,910	378	38	38
11	295	.....	.....	645	2,660	344	38	37
12	265	.....	.....	645	3,180	305	37	36
13	210	.....	.....	485	2,660	255	37	34
14	189	.....	.....	485	2,160	305	25	33
15	98	.....	.....	560	1,280	214	22	32
16	102	.....	.....	2,410	1,470	175	22	31
17	107	.....	.....	3,700	1,470	159	18	42
18	107	.....	.....	4,220	1,680	159	18	47
19	116	.....	.....	4,740	2,410	143	18	68
20	143	.....	.....	3,960	2,410	130	16	55
21	149	.....	.....	3,700	2,410	130	11	54
22	159	.....	.....	8,780	2,410	116	11	55
23	169	.....	.....	5,000	2,410	111	38	54
24	175	.....	.....	3,180	2,160	84	24	52
25	175	.....	.....	2,660	2,160	130	18	48
26	169	.....	.....	3,440	2,160	104	12	48
27	175	.....	.....	3,180	1,910	66	6	48
28	210	.....	522	3,180	1,910	74	22	44
29	206	.....	522	2,660	1,470	84	27	44
30	182	.....	522	5,000	1,050	51	22	46
31	182	.....	.....	.....	.....	48	22	.....

NOTE.—Discharge estimated July 8, Aug. 7, 11, 12, 25, 26, and Sept. 30, Rating table applied indirectly June 17–23, on account of backwater from Clear Creek.

Monthly discharge of Powder River near Arvada, Wyo., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	295	34	140	8,610
November 1–10	192	159	174	3,450
May 1–30	8,780	390	2,340	139,000
June 8–30	3,180	1,050	2,080	94,900
July	975	48	286	17,600
August	100	6	30.5	1,880
September	87	31	48.7	2,900

CLEAR CREEK NEAR BUFFALO, WYO.

LOCATION.—In sec. 6, T. 50 N., R. 82 W., just above power house of Buffalo Manufacturing Co., 4 miles west of Buffalo, in Johnson County.

DRAINAGE AREA.—120 square miles (measured on topographic map).

RECORDS AVAILABLE.—June 16 to September 30, 1917. From May 2, 1896, to February 28, 1900, station maintained at measuring flume 1 mile upstream. Flow at two points comparable. From October 24, 1902, to December 31, 1904, and May 8, 1911, to June 11, 1912, a station was maintained at highway bridge in Buffalo. Flow not comparable, as several ditches divert water between.

GAGE.—Chain gage at left bank 300 feet above power house.

DISCHARGE MEASUREMENTS.—Made from cable located 50 feet upstream from gage. Low-water measurements made by wading opposite power house.

CHANNEL AND CONTROL.—Channel composed of large boulders; control at large boulders 10 feet downstream; permanent during 1917. Banks low, but not subject to overflow because of small range of stage.

ICE.—Stage-discharge relation seriously affected by ice; records discontinued.

EXTREMES OF DISCHARGE.—Maximum stage recorded 4.2 feet at 6.30 a. m. June 18 (discharge, 1,120 second-feet); minimum discharge occurred during winter.

DIVERSIONS.—Pipe line of Buffalo Manufacturing Co. diverts water from Clear Creek 1½ miles upstream. A separate record of flow through pipe line is kept and flow added to that at gaging station to give total flow of creek. Four lakes and French Creek canal had adjudicated decrees for diversion of 25 second-feet from North Fork into French Creek prior to December 31, 1916. During 1917, 10,360 acre-feet were diverted between June 10 and September 30. North Fork and French Creek canal diverted 1,230 acre-feet between June 10 and July 21. Below there are adjudicated decrees for diversion of 428 second-feet.

REGULATION.—Alternate melting and freezing of snow in mountains during spring causes diurnal fluctuation in flow. No artificial regulation.

ACCURACY.—Stage-discharge relation practically permanent; affected by ice during winter. Rating curve well defined between 10 and 800 second-feet. Gage read to half-tenths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table. Records good.

Discharge measurements of Clear Creek near Buffalo, Wyo., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Apr. 29	Robert Follansbee	0.86	5.4	Aug. 9	Mull	1.60	61.3
June 16	Hodges and Beebe	3.18	600	Sept. 28	P. V. Hodges	1.28	26.2
July 31	do	1.84	107				

Daily discharge, in second-feet, of Clear Creek near Buffalo, Wyo., for the year ending Sept. 30, 1917.

Day.	June.	July.	Aug.	Sept.	Day.	June.	July.	Aug.	Sept.
1		433	98	57	16	637	208	44	33
2		369	89	44	17	900	192	57	28
3		476	72	38	18	1,040	208	80	28
4		476	80	38	19	750	225	134	28
5		632	80	38	20	825	225	162	28
6		542	80	38	21	700	208	147	28
7		520	64	38	22	900	192	98	33
8		542	64	38	23	775	192	80	28
9		565	64	28	24	775	192	72	28
10		498	64	28	25	875	162	64	28
11		454	57	28	26	700	162	64	28
12		348	64	28	27	725	162	64	27
13		329	50	28	28	700	177	64	26
14		293	50	33	29	750	162	64	23
15		242	50	38	30	700	134	57	23
					31		109	50	

NOTE.—The above table does not include water diverted by pipe line of the Buffalo Manufacturing Co.

Monthly discharge of Clear Creek near Buffalo, Wyo., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
June 16-30	1,040	637	783	23,300
July	632	109	311	19,100
August	162	44	75.1	4,620
September	57	23	31.9	1,900
The period				48,900

NOTE.—The above table does not include water diverted by the pipe line of the Buffalo Manufacturing Co.

Combined monthly discharge of Clear Creek and pipe line of Buffalo Manufacturing Co., near Buffalo, Wyo., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
June 16-30	1,050	649	795	23,700
July	644	121	323	19,900
August	174	56	87.1	5,360
September	69	34	43.3	2,580
The period				51,500

CLEAR CREEK NEAR ARVADA, WYO.

LOCATION.—In sec. 36, T. 57 N., R. 77 W., at Sorenson's ranch, 1½ miles above mouth of creek and 16 miles north of Arvada, Sheridan County. No tributary between station and mouth of creek.

DRAINAGE AREA.—1,110 square miles (measured on base map of Wyoming; scale 1:500,000).

RECORDS AVAILABLE.—August 8, 1915, to September 30, 1917.

GAGE.—Chain gage on right bank a quarter mile below diversion dam at Sorenson's ranch; read by Miss Carrier Sorenson.

DISCHARGE MEASUREMENTS.—Made from cable 50 feet below gage or by wading.

CHANNEL AND CONTROL.—Bed composed of sand and gravel. Multiple control consisting of two rock dikes across the river 150 feet apart; upper dike 100 feet below gage acts as low-water control. At high water, lower dike is control. At low stages silt collects in the crevices of the rock dike changing the stage-discharge relation. Banks not subject to overflow. Stage of zero flow, 3.8 feet.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 8.2 feet at 7 p.m. June 18 (discharge, 2,630 second-feet); minimum discharge probably occurred during winter.

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

DIVERSIONS.—Prior to December 31, 1916, there were adjudicated diversions of 428 second-feet from Clear Creek.

REGULATION.—None.

ACCURACY.—Stage-discharge relation not permanent; affected by ice during winter. Rating curve well defined between 20 and 2,800 second-feet. Gage read to hundredths once daily except during flood stages when it was read twice daily. Daily discharge ascertained by applying to rating table the daily gage height, or the mean of two daily gage heights. Records good.

Discharge measurements of Clear Creek near Arvada, Wyo., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
May 2	Robert Follansbee	5.02	208	June 19	P. V. Hodges	8.16	2,570
June 14	P. V. Hodges	6.68	1,140	July 29	do	4.98	184

Daily discharge, in second-feet, of Clear Creek near Arvada, Wyo., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Apr.	May.	June.	July.	Aug.	Sept.
1	16	39	.....	195	1,400	1,080	65	56
2	17	34	.....	210	1,320	720	57	77
3	17	34	.....	242	1,240	590	44	75
4	18	34	.....	225	1,320	590	34	75
5	19	34	.....	225	1,320	590	34	53
6	19	34	.....	225	1,160	560	32	53
7	20	34	.....	225	1,000	530	73	53
8	18	34	.....	260	930	545	30	52
9	21	34	.....	260	1,080	560	20	52
10	21	34	.....	260	1,680	590	15	48
11	22	34	.....	260	2,180	620	16	47
12	20	.....	.....	320	1,880	505	16	49
13	21	.....	.....	430	1,400	380	17	49
14	21	.....	.....	530	1,160	300	18	49
15	20	.....	.....	1,000	1,160	242	20	48
16	16	.....	340	825	1,400	195	20	48
17	18	.....	260	1,160	2,080	152	23	56
18	20	.....	260	1,160	2,620	105	23	53
19	20	.....	280	1,000	2,620	88	26	53
20	21	.....	225	1,240	2,180	54	26	52
21	21	.....	225	2,180	2,180	42	28	52
22	20	.....	242	1,490	2,180	54	82	50
23	28	.....	242	1,240	2,080	62	114	53
24	31	.....	260	1,240	1,880	54	92	53
25	26	.....	300	1,490	1,780	53	50	52
26	25	.....	280	1,780	1,780	54	58	52
27	34	.....	260	1,490	1,680	54	65	50
28	34	.....	242	1,400	1,490	44	60	57
29	44	.....	210	1,400	1,320	225	57	57
30	39	.....	195	2,290	1,240	73	50	60
31	34	.....	.....	1,780	.....	70	57	.....

NOTE.—Oct. 1 to Nov. 11, Sept. 1 to 30 discharge computed by indirect method for shifting control. July 8, Aug. 11–12, 26 no gage readings. Discharge interpolated.

Monthly discharge of Clear Creek near Arvada, Wyo., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	44	16	23.3	1,430
November 1–11	39	34	34.5	753
Apr. 16–30	340	195	255	7,590
May	2,290	195	904	55,600
June	2,620	930	1,620	96,400
July	1,080	42	316	19,400
August	114	15	42.6	2,620
September	77	47	54.5	3,240

PINEY CREEK AT KEARNEY, WYO.

LOCATION.—In sec. 26, T. 53 N., R. 83 W., at highway bridge 300 yards south of Kearney, Johnson County.

DRAINAGE AREA.—117 square miles (measured on base map of Wyoming; scale, 1:500,000).

RECORDS AVAILABLE.—September 6, 1902, to June 30, 1906; May 13, 1911, to October 31, 1912; April 24, 1915, to July 31, 1917, when station was discontinued.

GAGE.—Chain gage on downstream side of bridge; read by Mrs. Lena Noyce. Gage used 1902–1916 was at same site but referred to different datum.

DISCHARGE MEASUREMENTS.—Made from single-span bridge or by wading.

CHANNEL AND CONTROL.—Bed composed of gravel and small boulders; control 100 feet downstream at well-defined rapids, which shifted slightly during 1917. At high water there is flow through a small channel at the left bank which diverts water from Piney Creek some distance above the station. Flow through this channel begins at stage of approximately 5 feet.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 4.7 feet at 6 p. m June 17 (discharge, 1,220 second-feet); minimum discharge probably occurred during winter.

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

DIVERSIONS.—Prior to December 31, 1916, there were adjudicated diversions of 278 second-feet from Piney Creek above station and 74 second-feet below.

REGULATION.—None.

ACCURACY.—Stage-discharge relation slightly shifting; affected by ice during winter. Rating curve well defined between 10 and 1,000 second-feet. Gage read to half-tenths twice daily. Daily discharge ascertained by applying mean daily heights to rating table, except for period June 8 to July 31, when discharge was computed by indirect method for shifting control. Records excellent.

Discharge measurements of Piney Creek at Kearney, Wyo., during the year ending Sept. 30, 1917.

[Made by P. V. Hodges.]

Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*
June 17	4.28	984
July 31	1.82	59

Daily discharge, in second-feet, of Piney Creek at Kearney, Wyo., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Apr.	May.	June.	July.	Day.	Oct.	Nov.	Apr.	May.	June.	July.
1	18	38	.....	44	444	298	16	13	.....	50	397	746	62
2	18	36	.....	44	420	248	17	13	.....	50	397	1,100	32
3	18	36	.....	44	532	206	18	13	.....	50	420	1,050	40
4	18	34	.....	50	553	178	19	13	.....	39	420	938	41
5	18	34	.....	44	574	206	20	13	.....	56	680	944	141
6	18	34	.....	63	632	181	21	13	.....	59	494	834	63
7	18	34	.....	67	646	270	22	13	.....	63	444	889	110
8	20	34	50	78	730	270	23	13	.....	95	374	840	48
9	20	34	63	78	730	212	24	23	.....	78	374	840	75
10	20	34	63	86	784	257	25	34	.....	70	374	894	76
11	20	34	50	114	779	212	26	39	.....	70	374	735	84
12	18	34	63	136	562	173	27	39	.....	70	420	845	93
13	13	.....	63	186	411	99	28	39	.....	56	420	653	78
14	13	.....	56	260	454	56	29	39	.....	44	444	600	95
15	13	.....	50	374	531	60	30	39	.....	54	420	425	80
							31	39	.....	.....	397	.....	59

Monthly discharge of Piney Creek at Kearney, Wyo., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	39	13	21.2	1,300
November 1-12	38	34	34.7	826
April 8-30	95	44	59.2	2,700
May	680	44	275	16,900
June	1,100	332	670	39,900
July	298	32	132	8,120

PINEY CREEK AT UCROSS, WYO.

LOCATION.—In NW. ¼ sec. 18, T. 53 N., R. 80 W., at highway bridge a quarter of a mile from Ucross, in Sheridan County. No tributary between station and mouth, half a mile below.

DRAINAGE AREA.—253 square miles (measured on base map of Wyoming; scale 1 : 500,000).

RECORDS AVAILABLE.—May 12 to September 30, 1917.

GAGE.—Chain gage attached to highway bridge; read by Miss Alma Larsen.

DISCHARGE MEASUREMENTS.—Made from highway bridge or by wading 200 feet downstream.

CHANNEL AND CONTROL.—Bed composed of silt and gravel which will shift. Control 50 feet downstream at riffle composed of compact gravel; shifted slightly during 1917. Banks not subject to overflow.

ICE.—Stage-discharge relation affected by ice.

EXTREME OF DISCHARGE.—Maximum stage recorded during period, 4.2 feet at 11 a. m. June 20 (discharge, 1,070 second-feet); minimum stage recorded, 1.3 feet at 8.20 a. m. July 20 (discharge, 4 second-feet).

DIVERSIONS.—Prior to December 31, 1916, adjudicated diversions of 351 second-feet from Piney Creek, all above station.

REGULATION.—Head waters are chain of small mountain lakes, the largest of which, Cloud Peak, is used as reservoir for irrigation. Alternate melting and freezing of mountain snow in spring of year causes some diurnal fluctuation.

ACCURACY.—Stage-discharge relation slightly shifting; affected by ice during winter. Rating curve well defined between 6 and 1,200 second-feet. Gage read to quarter-tenths twice daily. Daily discharge ascertained by applying mean daily gage height to the rating table; shifting-control method used August 21 to September 30. Records good, June 8 to August 20; fair, August 21 to September 30.

Discharge measurements of Piney Creek at Ucross, Wyo., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
May 12	J. C. Beebe	2.45	172	July 31	Hodges and Beebe	1.76	35.0
June 16	P. V. Hodges	3.90	818	Aug. 7	Mull	1.50	13.9
20	Hodges and Beebe	4.22	1,100	14	do		7.47
July 5	J. C. Beebe	2.60	304	30	do	1.45	14.2
14	do	1.90	45.9	Sept. 29	P. V. Hodges	1.59	16.6
19	do	1.40	6.0				

Daily discharge, in second-feet, of Piney Creek at Ucross, Wyo., for the year ending Sept. 30, 1917.

Day.	May.	June.	July.	Aug.	Sept.	Day.	May.	June.	July.	Aug.	Sept.
1			290	24	11	16		768	37	7.0	14
2			227	14	11	17		910	27	6.4	18
3			190	13	11	18		871	7.7	7.0	18
4			160	10	11	19		858	5.8	6.7	18
5			196	14	11	20		988	4.6	21	20
6			175	20	10	21		832	35	34	18
7			160	17	10	22		832	24	37	18
8		406	190	14	10	23		750	21	34	18
9		535	227	14	10	24		665	22	29	18
10		750	178	13	10	25	485	878	20	28	17
11		878	184	8.4	8.4	26		750	17	22	17
12	175	665	150	8.4	6.4	27		665	28	24	17
13		485	87	7.0	8.4	28		610	44	20	17
14	196	438	53	5.8	8.4	29		510	55	15	17
15		535	50	6.4	9.8	30		500	42	12	17
						31			32	13	

NOTE.—Sept. 2–9, 16, 18, 23–28, and 30, no gage-height record; discharge interpolated.

Monthly discharge of Piney Creek at Ucross, Wyo., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
June 8–30	988	406	699	31,900
July	290	4.6	94.8	5,830
August	37	5.8	16.3	1,000
September	20	6.4	13.6	809
The period				39,500

LITTLE MISSOURI RIVER BASIN.

LITTLE MISSOURI RIVER NEAR ALZADA, MONT.

LOCATION.—Near southwest corner of T. 8 S., R. 60 E., at Walker's ranch, 300 yards below site of proposed dam, 2 miles below mouth of Thompson Creek, and 4 miles below Alzada, in Fallon County.

DRAINAGE AREA.—780 square miles.

RECORDS AVAILABLE.—June 18, 1911, to September 30, 1917.

GAGE.—Overhanging chain gage on right bank, read by John Walker; gage used during 1911 was vertical staff on left bank, 150 feet downstream. Datum of chain gage 0.08 foot lower than that of staff gage.

DISCHARGE MEASUREMENTS.—Made by wading or from cable.

CHANNEL AND CONTROL.—Bed shifts during high water. Stream sluggish. Banks cut 5 to 15 feet in sandy soil. Two channels at medium and one at high stage.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 13.18 feet at 7 p. m. April 11 (discharge, 3,250 second-feet); channel dry October 1–7, January 4–6, and September 19–30, (discharge, 0).

1911–1917: Maximum stage recorded, 15.3 feet April 6, 1912 (discharge, 4,550 second-feet); minimum stage, channel dry July 6 to August 7, and October 14–18, 1911; September 9–15, 1913; September 8–10, 12–30, and October 1–7, 1916; January 4–6, 1917, and September 19–30, 1917.

ICE.—Stage-discharge relation seriously affected by ice. Data obtained is inadequate to estimate winter flow. Discharge not computed January 13 to March 26.

DIVERSIONS.—None.

REGULATION.—None of importance. Some flood water in spring is stored in coulees on tributaries for use in irrigating small tracts.

ACCURACY.—Stage-discharge relation permanent. Rating curve well defined between 80 and 2,000 second-feet. Gage read to quarter-tenths twice daily. Daily discharge obtained by applying mean daily gage height to rating table. Records good.

No discharge measurements were made during the year.

Daily discharge, in second-feet, of Little Missouri River near Alzada, Mont., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	0	5.2	9.0	1.0	.....	1,600	184	162	9.0	2.2	4.8
2	0	5.2	9.0	.8	.....	1,080	111	116	8.0	2.2	5.6
3	0	5.2	8.5	.5	.....	1,060	140	66	7.6	1.3	6.4
4	0	4.8	9.0	.0	.....	1,030	173	56	7.2	1.3	4.8
5	0	4.8	9.0	.0	.....	1,170	206	122	6.4	1.3	4.0
6	0	6.0	8.5	.0	.....	1,550	116	173	5.6	1.3	3.4
7	0	7.2	8.0	.7	.....	1,740	68	173	4.8	1.6	2.5
8	6.4	7.6	7.6	.5	.....	1,770	56	88	5.6	1.6	2.2
9	13	7.6	7.2	.6	.....	1,830	47	56	4.4	1.6	1.6
10	45	7.6	6.0	.7	.....	1,860	41	43	4.4	2.2	1.0
11	37	5.6	5.2	.7	.....	3,020	37	37	4.4	7.6	2.2
12	25	4.0	5.6	.6	.....	2,740	34	33	4.4	12	1.3
13	19	2.8	6.0	.....	.....	1,280	31	24	4.0	85	.8
14	16	4.0	6.0	.....	.....	1,030	25	20	5.2	20	.6
15	12	5.6	6.0	.....	.....	922	23	16	5.2	12	.5
16	9	6.0	6.8	.....	.....	550	22	14	4.8	9.0	.6
17	11	6.0	6.8	.....	.....	518	13	12	4.0	39	.4
18	10	6.4	6.8	.....	.....	430	20	11	4.0	17	.4
19	10	7.2	6.8	.....	.....	265	20	10	4.0	10	.0
20	10	14	6.4	.....	.....	217	25	14	4.8	19	.0
21	10	13	5.2	.....	.....	162	29	14	5.6	16	.0
22	9	12	4.8	.....	.....	140	31	14	5.6	9.0	.0
23	8	12	4.0	.....	.....	140	28	14	4.4	4.8	.0
24	7.6	11	3.1	.....	.....	162	36	12	4.4	4.0	.0
25	7.6	10	2.8	.....	.....	130	51	12	3.7	3.4	.6
26	8.0	10	2.6	.....	.....	162	51	11	2.8	2.8	.0
27	7.6	10	2.4	.....	120	96	45	22	2.8	2.5	.0
28	7.2	10	2.2	.....	128	109	41	19	3.1	1.6	.0
29	7.2	9.5	1.6	.....	173	306	49	12	3.7	1.3	.0
30	7.2	9.0	1.0	.....	860	352	49	11	3.1	1.0	.0
31	5.6	.....	1.0	.....	1,710	.....	184	.....	2.8	2.5	.....

Monthly discharge of Little Missouri River at Alzada, Mont., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	45	0.0	9.95	612
November	14	2.8	7.64	455
December	9.0	1.0	5.64	347
January 1–12	1.0	.0	.51	12.1
March 27–31	1,710	120	598	5,930
April	3,020	96	914	54,400
May	206	13	64.1	3,940
June	173	10	46.2	2,750
July	9.0	2.8	4.83	297
August	85	1.0	9.55	587
September	6.4	.0	1.44	85.7

KNIFE RIVER BASIN.

KNIFE RIVER NEAR BRONCHO, N. DAK.

LOCATION.—In SE. ¼ sec. 4, T. 142 N., R. 90 W., at ranch half a mile below mouth of Elm Creek, 15 miles above Spring Creek, and 6 miles from Broncho, in Mercer County.

DRAINAGE AREA.—1,260 square miles; drainage area at original location 2 miles downstream, probably 5 square miles greater.

RECORDS AVAILABLE.—May 29, 1903, to September 30, 1917.

GAGE.—Chain on cantilever timber on left bank near observer's house; datum unchanged since March 23, 1905. Gage read by C. D. Smith.

DISCHARGE MEASUREMENTS.—Made from cable 500 feet below gage or by wading.

CHANNEL AND CONTROL.—Stream bed below gage large gravel and stones, nearly permanent. Channel narrow with steep banks which are not overflowed at gage heights less than 20 feet.

EXTREMES OF DISCHARGE.—Maximum stage during year, 17.0 feet March 30, caused by ice jam; maximum discharge, 1,480 second-feet, March 31; minimum stage, 3.3 feet September 10 (discharge, 4 second-feet); river reported dry September 6–8, 1905, and September 18–19, 1908.

ICE.—Stage-discharge relation seriously affected by ice and gage records discontinued during part of winter.

ACCURACY.—Stage-discharge relation practically permanent during the year, except as affected by ice. Rating curve fairly well defined below 2,000 second-feet. Gage read to tenths once daily. Daily discharge ascertained by applying daily gage height to rating table. Records good. Indirect method used March 27 to April 9, because of ice. Records fair.

Discharge measurements of Knife River near Broncho, N. Dak., during the year ending Sept. 30, 1917.

[Made by V. H. Sprague.]

Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*
Mar. 31	[a]16.71	1,587
July 16	3.49	10.2

[a] Backwater from ice.

Daily discharge, in second-feet, of Knife River near Broncho, N. Dak., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	11	16	.....	1,320	124	27	21	11	4
2	11	16	.....	1,210	90	27	16	7	4
3	21	16	.....	1,100	80	27	16	7	4
4	21	16	.....	712	62	27	16	7	4
5	21	16	.....	627	62	27	16	7	4
6	21	16	.....	683	54	27	16	7	4
7	21	16	.....	925	54	33	16	7	4
8	21	16	.....	1,100	47	33	16	7	4
9	16	16	.....	655	47	33	16	7	4
10	16	16	.....	655	47	47	16	7	4
11	16	.....	.....	925	47	44	16	7	4
12	16	.....	.....	1,320	40	40	16	7	4
13	16	.....	.....	958	40	40	16	7	4
14	16	.....	.....	296	40	33	16	7	4
15	16	.....	.....	354	40	33	11	7	4
16	16	.....	.....	278	40	27	11	7	4
17	16	.....	.....	164	40	27	7	7	4
18	16	.....	.....	179	40	27	7	7	4
19	16	.....	.....	164	33	21	7	7	4
20	16	.....	.....	315	33	21	7	7	4
21	16	.....	.....	296	33	21	7	7	4
22	16	.....	.....	278	33	27	7	7	4
23	21	.....	.....	226	33	27	7	7	4
24	21	.....	.....	194	33	27	7	4	4
25	21	.....	.....	179	33	27	7	4	4
26	21	.....	.....	210	33	27	4	4	4
27	16	.....	100	243	33	33	4	4	4
28	16	.....	627	226	33	27	4	4	4
29	16	.....	741	194	27	27	4	4	4
30	16	.....	1,100	179	27	21	4	4	4
31	16	.....	1,480	.....	27	.....	11	4	.....

NOTE.—After Nov. 10, the discharge decreased gradually and during February and the first three weeks in March it was probably only a few second-feet.

Monthly discharge of Knife River near Broncho, N. Dak., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	21	11	17.3	1,060
November 1–10	16	16	16	317
April	1,320	164	539	32,100
May	124	27	45.3	2,790
June	47	21	29.5	1,760
July	21	4	11.1	682
August	11	4	6.35	390
September	4	4	4.0	238

NOTE.—See footnote to daily discharge table.

HEART RIVER BASIN.

HEART RIVER NEAR RICHARDTON, N. DAK.

LOCATION.—In sec. 21, T. 138 N., R. 92 W., opposite residence of W. F. Church, 1 mile below highway bridge and 11 miles south of Richardton.

DRAINAGE AREA.—1,250 square miles.

RECORDS AVAILABLE.—May 18, 1903, to September 30, 1917.

GAGE.—Chain on cantilever timber opposite observer's house, on right bank of river. Auxiliary chain gage on highway bridge 1 mile above observer's house, used March 23 to June 1, 1917, because of damage to regular gage. The two gage datums are so related that readings at the bridge are approximately 10.0 feet less than on the gage regularly used.

DISCHARGE MEASUREMENTS.—At high stages from bridge; at ordinary low stages by wading.

CHANNEL AND CONTROL.—Channel fairly permanent, but control sometimes changed considerably during part of year by the building of dams by beavers a quarter of a mile below gage.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 33.7 feet April 1 (discharge, 1,850 second-feet); minimum stage, 25.2 feet August 25 (discharge, 0.4 second-foot).

1903–1917: Maximum stage recorded, 25.9 feet from chain gage at highway bridge June 10, 1906 (discharge, 8,020 second-feet); river reported dry July 26 to August 11, August 20–23, 1903, September 1–19, 1905, July 22–27, 1914.

ICE.—Stage-discharge relation seriously affected by ice; flow estimated from observer's reports and gage heights and weather records. Winter flow very small.

REGULATION AND DIVERSIONS.—No storage or diversions appreciably affecting the discharge.

ACCURACY.—Stage-discharge relation affected by dam built by beavers. Rating curve poorly defined. Gage read to half-tenths once daily. Discharge determined by shifting-control method. Records poor.

Discharge measurements of Heart River near Richardton, N. Dak., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*
Mar. 30	V. H. Sprague	33.48	1,561
July 16	do	24.98	7.7
Aug. 28	E. F. Chandler	25.24	.4

Daily discharge, in second-feet, of Heart River near Richardton, N. Dak., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	24	17	.....	1,850	226	41	11	2.5	0.6
2	28	20	.....	1,850	138	36	11	1.6	.6
3	24	17	.....	1,850	138	41	14	1.6	.6
4	24	14	.....	1,670	138	41	14	2	.6
5	28	14	.....	1,470	132	45	20	1.6	.6
6	24	14	.....	1,500	152	50	17	.8	.8
7	24	14	.....	1,470	113	65	17	.8	.8
8	28	17	.....	1,410	102	60	24	1.3	.8
9	28	17	.....	1,560	102	55	24	1.3	.8
10	24	14	.....	1,210	102	55	28	1.3	1.0
11	24	14	.....	1,150	102	41	20	.8	1.0
12	24	.....	.....	940	91	32	17	1.0	1.6
13	24	.....	.....	651	91	36	14	1.3	1.3
14	24	.....	.....	485	91	36	11	1.0	1.6
15	24	.....	.....	409	80	32	8	1.0	2
16	24	.....	.....	372	70	28	8	1.0	1.6
17	24	.....	.....	466	70	24	8	1.0	2
18	24	.....	.....	409	70	24	11	.8	2
19	20	.....	.....	354	50	24	11	.6	2
20	24	.....	.....	320	50	24	11	.6	2
21	20	.....	.....	288	70	17	6	.5	2
22	24	.....	.....	320	60	24	3	.5	2
23	20	.....	226	320	60	28	3	.5	2
24	17	.....	256	304	60	28	3	.5	2.5
25	17	.....	372	288	50	41	2.5	.4	2.5
26	17	.....	409	272	50	36	2.5	.4	2.5
27	17	.....	545	337	41	24	4.5	.4	2.5
28	17	.....	810	337	41	24	3	.4	2
29	17	.....	940	288	41	24	3	.4	2
30	17	.....	1,640	256	41	17	2.5	.4	2
31	20	.....	1,610	.....	41	.....	4.5	.5	.....

NOTE.—After Nov. 11, discharge decreased gradually and during February and first 3 weeks in March amounted to only a few second-feet.

Monthly discharge of Heart River near Richardton, N. Dak., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	28	17	22.4	1,380
April	1,850	256	814	48,400
May	226	41	85.9	5,280
June	65	17	35.1	2,090
July	28	2.5	10.9	670
August	2.5	.4	.90	55
September	2.5	.6	1.54	92

CANNONBALL RIVER BASIN.

CANNONBALL RIVER NEAR STEVENSON, N. DAK.

LOCATION.—At boundary of Standing Rock Indian Reservation in NW. ¼, sec. 21, T. 133 N., R. 82 W., 60 rods above house of observer, F. Bingenheimer; 2 miles southeast of Stevenson schoolhouse, 4 miles south of Timmer, N. Dak., and 4 miles above mouth of Dogtooth Creek. From 1911 to 1915 records were maintained at M. H. Burdick's, 1 mile farther upstream.

DRAINAGE AREA.—3,650 square miles.

RECORDS AVAILABLE.—June 10, 1903, November 30, 1908; August 9, 1911, to September 30, 1917.

GAGE.—Chain gage on projecting cantilever timber at left bank. Datum of the gage is precisely the same as the datum of the gage maintained at the same point from 1903 to 1910. Read by F. Bingenheimer.

DISCHARGE MEASUREMENTS.—At low and medium stages made by wading at rapids a few rods below observer's house; at medium and high stages measurements are made by use of car and cable 20 rods above the gage.

CHANNEL AND CONTROL.—At the rapids at the ford 20 rods below the gage the bed is of stones and small boulders. Control has not changed considerably.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 9.4 feet April 5, caused by ice jams; maximum discharge, 1,880 second-feet April 13; minimum stage, 2.5 feet September 5 (discharge, 2 second-feet).

1903–1908 and 1911–1918: Maximum stage recorded, 21.05 feet (equivalent to 11.05 feet at present location) April 2, 1912 (discharge, 6,560 second-feet); no flow during periods each year 1904–1908 and 1913.

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

REGULATION.—No dams or diversions appreciably affect the flow.

ACCURACY.—Stage-discharge relation nearly permanent. Rating curve fairly well defined. Gage read to half-tenths daily. Daily discharge ascertained by applying daily gage height to rating table; indirect method used March 27 to April 10 because of ice. Records fair.

Discharge measurements of Cannonball River near Stevenson, N. Dak., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Oct. 24	T. M. Wardwell	2.90	13.1	June 20	Alf Hulteng	3.29	71
Apr. 12	L. B. Dale	6.45	1,487	July 25	E. F. Chandler	2.76	7.4
May 22	Alf Hulteng	3.58	92	Aug 25	....do	2.60	2.9

Daily discharge, in second-feet, of Cannonball River near Stevenson, N. Dak., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	8	14	.....	590	302	71	47	5	2
2	8	14	.....	770	222	62	47	3	2
3	8	14	.....	900	190	54	34	2	2
4	8	14	.....	900	190	47	34	2	2
5	8	23	.....	1,030	222	80	34	2	2
6	8	23	.....	1,450	190	100	28	2	2
7	8	23	.....	535	161	90	28	2	2
8	8	23	.....	770	161	80	23	2	2
9	8	23	.....	1,170	161	71	23	2	2
10	8	23	.....	1,520	134	71	23	2	2
11	8	23	.....	1,730	111	134	23	2	2
12	8	.....	.....	1,730	161	122	14	2	2
13	8	.....	.....	1,880	134	80	14	2	2
14	8	.....	.....	1,880	134	71	14	2	23
15	8	.....	.....	1,730	90	62	11	2	8
16	8	.....	.....	1,450	134	54	8	2.5	6
17	8	.....	.....	1,170	111	100	6	3	5
18	8	.....	.....	1,060	111	80	6	3	4
19	8	.....	.....	932	90	62	6	8	3
20	8	.....	.....	802	111	62	5	8	3
21	14	.....	.....	740	134	62	5	3	3
22	14	.....	.....	680	111	80	5	3	3
23	14	.....	.....	620	90	62	4	3	3
24	14	.....	.....	620	111	80	4	2.5	3
25	14	.....	.....	562	111	62	5	3	3
26	14	.....	.....	508	71	62	5	2.5	2.5
27	14	.....	147	452	90	62	5	2.5	2.5
28	14	.....	325	350	80	62	5	2	2.5
29	14	.....	325	350	80	54	14	2	2
30	14	.....	325	350	80	47	34	2	2
31	14	.....	535	.....	90	.....	47	2	.....

Monthly discharge of Cannonball River near Stevenson, N. Dak., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	14	8	10.1	623
April	1,880	350	974	58,000
May	302	71	134	8,240
June	134	47	72.9	4,340
July	47	4	18.1	1,110
August	8	2	2.77	170
September	23	2	3.48	207

GRAND RIVER BASIN.

NORTH BRANCH OF GRAND RIVER AT HALEY, N. DAK.

LOCATION.—At highway bridge near northeast corner of sec. 36, T. 129 N., R. 100 W., about 20 rods south of post office at Haley, in Bowman County.

DRAINAGE AREA.—500 square miles.

RECORDS AVAILABLE.—May 17, 1908, to September 30, 1917.

GAGE.—Stage obtained by measuring distance from bench mark on highway bridge to water surface by means of a metallic tape weighted at the end. From 1908 to 1911 a vertical staff gage 100 feet above the present bridge was used. Gage read by Wesley Nelson.

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

CHANNEL AND CONTROL.—Bed of stream gravel and sand; fairly permanen .

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 6.2 feet April 6, obstructed by ice; maximum discharge, 602 second-feet April 9; no flow June 25–28.

1908–1917: Maximum stage recorded, 9.85 feet June 13, 1915 (discharge, 3,500 second-feet); no flow June 25–28, 1917.

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

REGULATION.—Flow not appreciably affected by any diversions or dams above station.

ACCURACY.—Stage-discharge relation presumably nearly permanent, except when affected by ice. Gage read daily during floods and twice weekly through remainder of season, to half-tenths. Records roughly approximate.

The following discharge measurement was made by E. F. Chandler:

August 23, 1917: Gage height, 0.86 foot; discharge, 0.2 second-foot.

Daily discharge, in second-feet, of North Branch of Grand River at Haley, N. Dak., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Apr.	May.	June.	July.	Aug.	Sept.
1	1.3	1.3	.....	10.2	20.4	0.4	0.2	0.2
2	1.3	1.3	.....	9.5	22.5	.5	.2	.2
3	1.3	1.3	.....	8.8	15.2	.6	.2	.2
4	1.3	1.3	.....	8	8	.5	.2	.2
5	1.3	.....	.....	8	7	.4	.2	.2
6	1.3	.....	.....	8	6	.2	.2	.2
7	1.3	.....	.....	8	5	.3	.4	.2
8	1.3	.....	.....	8	4.6	.4	.6	.2
9	1.3	.....	602	8	4.2	.5	.6	.2
10	1.3	.....	549	8	3.8	.6	.6	.2
11	1.3	.....	424	8	3.4	.6	.5	.2
12	1.3	.....	300	7.2	3.4	.6	.4	.2
13	1.3	.....	244	6.5	3.4	.6	.3	.2
14	1.3	.....	187	5.8	3.4	.5	.2	.2
15	1.3	.....	148	5	3.4	.4	.2	.2
16	1.3	.....	108	4.4	2.7	.3	.2	.2
17	1.3	.....	75	3.9	2.0	.2	.2	.2
18	1.3	.....	41	3.4	1.3	.2	.2	.2
19	1.3	.....	8	3.4	1.6	.2	.2	.2
20	1.3	.....	10	3.4	1.8	.2	.2	.2
21	1.3	.....	12	3.4	2.0	.2	.2	.2
22	1.3	.....	14	3.4	2.2	.2	.2	.2
23	1.3	.....	16	9.8	1.5	.2	.2	.2
24	1.3	.....	16	16.2	.8	.2	.2	.2
25	1.3	.....	16	22.5	0	.2	.2	.2
26	1.3	.....	16	22.5	0	.2	.2	.2
27	1.3	.....	16	22.5	0	.2	.2	.2
28	1.3	.....	14	22.5	0	.2	.2	.2
29	1.3	.....	13	19.2	.1	.2	.2	.2
30	1.3	.....	11	16	.3	.2	.2	.2
31	1.3	.....	.....	18.2	.....	.2	.2	.....

Monthly discharge of North Fork of Grand River at Haley, N. Dak., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	1.3	1.3	1.3	80
May	22.5	3.4	10.1	618
June	22.5	.0	4.3	258
July	.9	.2	.3	21
August	.9	.2	.3	16
September	.2	.2	.2	12

GRAND RIVER NEAR WAKPALA, S. DAK.

LOCATION.—In SW. ¼ sec. 9, T. 19 N., R. 29 E., in Standing Rock Indian Reservation, at steel highway bridge 4 miles south of Wakpala, Carson County, a station on Chicago, Milwaukee & St. Paul Railway.

DRAINAGE AREA.—5,410 square miles (revised measurement).

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

GAGE.—Chain gage on foot guardrail at downstream side of highway bridge; read by James Soft.

DISCHARGE MEASUREMENTS.—Made from highway bridge or by wading at ford 40 rods below bridge.

CHANNEL AND CONTROL.—Bed composed of soft silt and quicksand; shifting.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 12.0 feet April 1 (discharge, about 2,000 second-feet); minimum stage recorded, 3.9 feet September 7 (discharge, 2 second-feet).

1911–1917: Maximum stage recorded, 18.0 feet June 17, 1915 (discharge, 7,130 second-feet); minimum discharge, 0.1 second-foot, September 13–15, and September 21 to October 1, 1913.

ICE.—Stage-discharge relation seriously affected by ice, and observations discontinued during winter.

DIVERSIONS AND REGULATION.—No diversions or storage reservoirs above are large enough to noticeably affect the flow.

ACCURACY.—Stage-discharge relation not permanent. Gage read to tenths about three times a week. Discharge determined by shifting-control method. Records roughly approximate.

Discharge measurements of Grand River near Wakpala, S. Dak., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Oct. 23	T. M. Wardwell	4.50	32	June 19	A. Hulteng	4.91	99
Apr. 10	Lloyd B. Dale	8.95	1,910	July 24	E. F. Chandler	4.19	18.8
May 21	A. Hulteng	7.48	931	Aug. 22	....do	4.71	.....

Daily discharge, in second-feet, of Grand River near Wakpala, S. Dak., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Apr.	May.	June.	July.	Aug.	Sept.
1	21	23	2,000	436	105	130	30	2
2	21	23	1,620	363	130	130	25	2
3	21	23	1,240	290	130	130	20	2
4	21	23	860	250	130	130	15	2
5	13	23	630	237	130	138	10	2
6	13	22	657	226	155	146	4	2
7	13	22	685	215	155	155	4	2
8	13	22	1,080	185	185	185	4	2
9	13	22	1,480	157	215	215	4	2
10	13	21	1,880	130	200	189	4	4
11	14	21	1,840	105	185	163	4	4
12	14	.....	1,800	85	170	137	4	4
13	14	.....	1,760	95	155	111	4	4
14	14	.....	1,760	105	130	85	1,040	5
15	14	.....	1,730	95	117	92	1,040	6
16	14	.....	1,700	85	105	99	765	6
17	14	.....	1,610	85	105	105	490	6
18	22	.....	1,520	85	105	95	215	6
19	22	.....	1,360	85	105	85	140	6
20	23	.....	1,200	532	105	75	65	6
21	23	.....	1,040	980	105	65	57	6
22	23	.....	800	420	105	65	50	6
23	23	.....	780	317	105	65	34	6
24	23	.....	760	215	105	15	19	6
25	23	.....	740	172	105	50	4	6
26	23	.....	740	130	105	85	4	6
27	23	.....	740	130	114	85	4	6
28	23	.....	685	130	122	85	4	6
29	23	.....	630	130	130	67	4	6
30	23	.....	520	130	130	51	3	6
31	23	.....	.....	117	.....	35	2	.....

Monthly discharge of Grand River near Wakpala, S. Dak., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	23	13	18.9	1,150
April	2,000	520	1,190	71,100
May	980	85	217	13,300
June	215	105	131	7,820
July	215	15	105	6,470
August	1,040	2	131	8,080
September	6	2	4.5	268

CHEYENNE RIVER BASIN.

CHEYENNE RIVER NEAR HOT SPRINGS,[1] S. DAK.

LOCATION.—In sec. 9, T. 9 S., R. 5 E., 1 mile above dam site of proposed Angostura irrigation project, 5 miles south of Cascade Springs, and 11 miles south of Hot Springs, Fall River County. Nearest tributary, Cascade creek, enters 2½ miles above.

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—September 11, 1914, to September 30, 1917. Station maintained at Edgemont June 19, 1903, to November 30, 1906, but flow is not directly comparable, as a number of small tributaries intervene.

GAGE.—Inclined slope gage on right bank one-third of a mile below Noerenberg's fruit farm; read by Fred Noerenberg. Friez water-stage recorder used prior to April 2, 1915, but abandoned, as stream carries too much silt during flood.

DISCHARGE MEASUREMENTS.—Made from cable 75 feet below gage or by wading.

CHANNEL AND CONTROL.—Bed composed of compacted gravel on which silt is deposited; shifts frequently. Principal control a short distance downstream; shifts during severe floods. Right bank subject to overflow for distance of 100 feet at stage of 14 feet.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 10.80 feet at 11 p. m. May 22 (discharge, 16,100 second-feet); minimum stage, 0.40 foot on September 6 (discharge, 10 second-feet).

ICE.—Spring water from Cascade creek prevents formation of ice, except for brief periods.

DIVERSIONS.—Permits granted for diversions amounting to 93.4 second-feet from Cheyenne River above station, and 43.4 second-feet from Cascade creek.

REGULATION.—None.

ACCURACY.—Stage-discharge relation not permanent; affected by ice for short periods during winter. Rating curve well defined between 20 and 20,000 second-feet. Gage read to hundredths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table, except for period May 24 to September 30, when discharge was computed by the indirect method for shifting control. Records good, except for periods affected by ice, when they are fair.

Discharge measurements of Cheyenne River near Hot Springs, S. Dak., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Dec. 31	Fred Noerenberg	0.83	27.2	July 27	P. V. Hodges	0.68	36.4
Apr. 20	do	3.73	1,500	Aug. 29	Fred Noerenberg	.71	26.2
May 23	do	4.64	2,660				

[1] Formerly Cheyenne River near Cascade Springs, S. Dak.

Daily discharge, in second-feet, of Cheyenne River near Hot Springs, S. Dak., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	27	49	34	24	20	349	3,270	953	1,680	166	18	18
2	32	38	32	23	20	98	2,290	1,680	1,420	112	18	17
3	34	38	29	23	21	49	1,110	3,270	916	90	18	14
4	38	36	29	22	21	38	614	3,730	3,500	76	14	14
5	38	35	29	22	22	38	530	1,910	6,860	58	24	12
6	37	35	39	22	22	62	586	1,190	3,500	52	18	10
7	36	36	34	22	20	62	530	806	1,280	47	24	11
8	38	38	34	22	20	49	476	476	916	44	32	14
9	45	38	34	22	20	62	586	374	706	125	44	16
10	45	40	34	21	20	62	398	302	502	125	50	17
11	45	44	34	21	20	88	530	222	398	36	53	20
12	41	49	32	20	21	62	614	153	349	20	130	20
13	38	49	32	20	22	38	644	186	330	16	28	17
14	38	49	31	20	22	34	586	176	254	16	18	17
15	35	49	30	22	26	49	557	133	207	26	16	16
16	35	44	29	24	258	38	502	92	156	18	14	22
17	38	40	26	26	122	29	449	88	150	12	18	49
18	38	38	24	26	150	22	772	59	166	46	41	32
19	38	36	22	26	218	38	614	75	298	18	250	26
20	40	35	22	22	258	62	1,370	2,700	182	14	1,090	22
21	41	35	22	23	182	122	878	5,230	189	12	662	22
22	44	34	22	25	122	218	557	13,900	144	11	211	20
23	62	49	22	26	78	98	398	3,890	125	11	105	20
24	78	70	22	28	70	349	246	1,520	321	11	105	35
25	70	49	22	29	78	1,370	176	1,240	298	11	67	56
26	62	44	22	29	200	2,290	204	2,360	182	31	34	49
27	62	40	23	26	258	1,570	238	5,320	112	36	29	41
28	78	38	23	22	738	1,280	258	4,050	330	24	26	22
29	78	36	23	20	.....	3,120	211	1,570	298	36	26	20
30	62	35	24	18	.....	4,050	238	1,370	254	20	26	20
31	56	.....	24	18	.....	3,120	.....	1,680	.....	16	20	.....

NOTE.—Nov. 13–14, Dec. 13–15, 20–22, 26–30, Jan. 13–18, 21–24, 31–Feb. 4, stage-discharge relation affected by ice. Discharge based on temperature and gage-height record, discharge measurements, and observer's notes.

Monthly discharge of Cheyenne River near Hot Springs, S. Dak., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	78	27	46.7	2,870
November	70	34	41.5	2,470
December	34	22	27.4	1,680
January	29	18	23.0	1,410
February	738	20	109	6,050
March	4,050	22	610	37,500
April	3,270	176	681	40,500
May	13,900	59	1,960	121,000
June	6,860	112	867	51,600
July	166	11	43.1	2,650
August	1,090	14	104	6,400
September	56	10	23.0	1,370
The year	13,900	10	380	276,000

RAPID CREEK AT BIG BEND, S. DAK.

LOCATION.—In NW. ¼ sec. 8, T. 1 N., R. 6 E., at Big Bend, in Pennington County. Nearest tributary, Deer Creek, enters 2½ miles upstream.

DRAINAGE AREA.—332 square miles (measured on topographic map).

RECORDS AVAILABLE.—March 23, 1915, to September 30, 1917.

GAGE.—Vertical staff just below tailrace of Dakota Power Co.; read by power-house operator.

DISCHARGE MEASUREMENTS.—Medium and low stage measurements by wading.

CHANNEL AND CONTROL.—Shifts at long intervals.

ICE.—Stage-discharge relation affected by ice during some winters.

DIVERSIONS.—Dakota Power Co. diverts water above station but returns it just above gage.

COOPERATION.—Station maintained by Dakota Power Co. Records furnished through courtesy of United States Forest Service.

Daily discharge, in second-feet, of Rapid Creek at Big Bend, S. Dak., for the period Mar. 23, 1915, to Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1915.												
1	.....	.....	.....	.....	.....	.....	30	130	115	204	312	340
2	.....	.....	.....	.....	.....	.....	28	178	149	204	328	311
3	.....	.....	.....	.....	.....	.....	35	328	166	183	295	295
4	.....	.....	.....	.....	.....	.....	47	270	198	173	267	254
5	.....	.....	.....	.....	.....	.....	59	257	236	160	248	264
6	.....	.....	.....	.....	.....	.....	71	227	210	145	218	242
7	.....	.....	.....	.....	.....	.....	81	204	178	153	233	242
8	.....	.....	.....	.....	.....	.....	83	212	166	156	218	224
9	.....	.....	.....	.....	.....	.....	89	180	160	136	233	224
10	.....	.....	.....	.....	.....	.....	109	178	165	138	233	198
11	.....	.....	.....	.....	.....	.....	92	183	185	131	242	190
12	.....	.....	.....	.....	.....	.....	83	180	185	142	248	188
13	.....	.....	.....	.....	.....	.....	99	162	198	145	295	210
14	.....	.....	.....	.....	.....	.....	136	156	178	147	233	185
15	.....	.....	.....	.....	.....	.....	145	151	164	125	306	167
16	.....	.....	.....	.....	.....	.....	156	143	173	193	378	149
17	.....	.....	.....	.....	.....	.....	185	149	173	273	368	158
18	.....	.....	.....	.....	.....	.....	156	145	233	227	439	142
19	.....	.....	.....	.....	.....	.....	128	128	344	185	446	133
20	.....	.....	.....	.....	.....	.....	102	130	395	193	378	136
21	.....	.....	.....	.....	.....	.....	109	130	361	193	429	133
22	.....	.....	.....	.....	.....	.....	91	125	321	178	395	112
23	.....	.....	.....	.....	.....	22	95	118	308	156	337	112
24	.....	.....	.....	.....	.....	37	102	104	295	149	318	114
25	.....	.....	.....	.....	.....	17	105	142	273	166	328	114
26	.....	.....	.....	.....	.....	26	91	142	236	248	616	120
27	.....	.....	.....	.....	.....	26	88	120	233	218	531	138
28	.....	.....	.....	.....	.....	30	89	128	218	212	497	149
29	.....	.....	.....	.....	.....	30	73	120	207	173	395	131
30	.....	.....	.....	.....	.....	30	84	114	204	251	405	125
31	.....	.....	.....	.....	.....	31	.....	117	.....	295	368	.....
1915–16.												
1	124	73	43	.....	.....	.....	81	119	.....	122	75	69
2	122	77	52	.....	.....	.....	79	119	.....	121	67	58
3	112	72	60	.....	.....	.....	67	111	.....	111	63	49
4	122	72	61	.....	.....	.....	69	108	.....	108	69	53
5	114	69	79	.....	.....	.....	70	111	.....	114	71	45
6	111	73	69	.....	.....	.....	71	108	.....	97	61	44
7	108	83	41	.....	.....	.....	63	95	.....	95	75	41
8	104	83	74	.....	.....	.....	46	90	.....	83	67	46
9	102	74	66	.....	.....	.....	69	87	.....	91	58	48
10	97	68	65	.....	.....	.....	83	79	.....	83	58	44
11	101	61	39	.....	.....	.....	81	87	.....	117	62	46
12	95	61	56	.....	.....	.....	98	91	.....	104	66	46
13	92	55	59	.....	.....	.....	95	101	.....	94	57	50
14	89	49	59	.....	.....	.....	90	104	.....	91	64	50
15	102	43	56	.....	.....	55	92	112	.....	83	64	48
16	115	37	52	.....	.....	66	92	117	.....	91	62	44
17	94	66	35	.....	.....	84	92	117	.....	101	56	51
18	102	65	43	.....	.....	87	95	124	.....	100	55	46
19	92	65	29	.....	.....	92	117	124	.....	91	50	45
20	102	67	33	.....	.....	90	122	138	.....	81	51	47
21	83	37	38	.....	.....	98	129	176	.....	81	64	46
22	83	60	57	.....	.....	104	111	180	.....	76	78	48
23	83	68	50	.....	.....	101	117	191	.....	84	57	46
24	95	65	61	.....	.....	91	129	204	.....	69	47	39
25	85	66	66	.....	.....	46	116	204	.....	68	51	48
26	77	60	68	.....	.....	58	114	187	.....	69	53	46
27	79	47	50	.....	.....	95	109	180	.....	63	56	47
28	69	42	50	.....	.....	95	114	182	.....	61	58	51
29	60	34	50	.....	.....	84	109	173	.....	76	47	46
30	73	42	50	.....	.....	79	106	173	.....	72	76	45
31	73	.....	48	.....	.....	62	.....	159	.....	75	72	.....

Daily discharge, in second-feet, of Rapid Creek at Big Bend, S. Dak., for the period Mar. 23, 1915, to Sept. 30, 1917—Continued.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1916–17.												
1	46	54	.....	34	26	27	32	78	247	100	49	44
2	52	60	.....	34	26	28	33	82	240	102	51	46
3	44	49	.....	34	27	27	40	83	224	93	45	46
4	46	60	.....	35	28	27	22	78	270	146	49	44
5	52	55	.....	36	28	28	22	92	270	92	40	41
6	44	60	.....	36	29	28	22	94	247	89	53	43
7	53	54	.....	37	28	30	21	102	218	96	70	40
8	50	39	.....	37	29	30	20	102	216	86	61	41
9	60	52	.....	37	29	29	33	96	200	82	60	42
10	51	56	.....	36	28	29	58	95	205	72	52	40
11	48	40	.....	35	28	28	48	102	198	66	51	39
12	51	32	.....	35	28	28	40	96	184	72	58	40
13	56	26	.....	33	28	28	50	120	188	68	56	35
14	49	26	.....	33	28	28	51	125	168	76	50	34
15	54	46	.....	33	28	28	45	130	166	71	58	38
16	50	58	.....	32	29	28	38	141	144	70	56	35
17	54	60	.....	34	28	28	43	144	152	64	54	46
18	48	84	.....	34	28	28	57	136	144	57	67	47
19	60	60	.....	36	28	30	72	132	153	57	51	47
20	45	71	.....	37	28	30	57	178	138	62	68	47
21	48	55	.....	35	28	30	60	244	164	54	72	45
22	60	46	.....	30	28	30	70	210	141	40	60	40
23	57	60	.....	32	28	29	74	210	144	52	51	40
24	52	35	.....	30	28	30	77	192	138	50	48	34
25	49	46	.....	31	28	30	85	198	132	53	43	40
26	56	62	.....	31	28	29	72	240	126	56	49	40
27	56	66	.....	31	28	29	75	244	128	57	46	36
28	56	56	.....	31	27	29	67	226	132	44	45	39
29	54	47	.....	32	.....	26	65	240	124	30	45	37
30	56	38	.....	31	.....	25	64	255	112	46	48	39
31	54	.....	.....	27	.....	28	.....	255	.....	49	47	.....

NOTE.—No gage-height record, Apr. 4–5, Aug. 1, 15, Sept. 1 and 15, 1915; discharge interpolated. Discharge Dec. 13 and 29, 1915, estimated because of ice.

Monthly discharge of Rapid Creek at Big Bend, S. Dak., for the period Mar. 23, 1915, to Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
1915.				
March 23–31	37	17	27.7	494
April	185	28	94.7	5,640
May	328	104	163	10,000
June	395	115	221	13,200
July	295	125	182	11,200
August	616	218	340	20,900
September	340	112	183	10,900
The period	.....	.....	.....	72,300
1915–16.				
October	124	60	95.5	5,870
November	83	34	61.1	3,640
December	79	29	53.8	3,310
January	.....	.....	49	3,010
February	.....	.....	52	2,990
March	104	.....	69.6	4,280
April	129	46	94.2	5,610
May	204	79	134	8,240
June	.....	.....	153	9,100
July	122	61	89.4	5,500
August	78	47	61.6	3,790
September	69	39	47.7	2,840
The year	.....	.....	80.1	58,200

Monthly discharge of Rapid Creek at Big Bend, S. Dak., for the period Mar. 23, 1915, to Sept. 30, 1917—Continued.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
1916–17.				
October	60	44	52.0	3,200
November	84	26	51.8	3,080
January	37	27	33.5	2,060
February	29	26	27.9	1,550
March	30	25	28.5	1,750
April	85	20	50.4	3,000
May	255	78	152	9,350
June	270	112	177	10,500
July	146	30	69.4	4,270
August	72	40	53.3	3,280
September	47	34	40.8	2,430

NOTE.—Discharge Jan. 1 to Mar. 14, 1916, estimated because of ice. No gage-height record June 1-30, 1916; discharge estimated from comparison with Rapid Creek at Rapid City.

BELLE FOURCHE RIVER NEAR BELLE FOURCHE, S. DAK.

LOCATION.—In sec. 2, T. 8 N., R. 2 E., at diversion dam of Belle Fourche irrigation project, 1½ miles below Belle Fourche, in Butte County.

DRAINAGE AREA.—4,270 square miles.

RECORDS AVAILABLE.—May 10 to November 30, 1906; January 1, 1912, to September 30, 1917. May 26, 1903, to June 23, 1906, for station at the west outskirts of Belle Fourche; the records at these points are not directly comparable, as Redwater River enters between the two stations, and water is diverted from Belle Fourche River.

GAGE.—Inclined staff 100 feet from crest of diversion dam, and a gage in canal. See "Computation of discharge."

COMPUTATION OF DISCHARGE.—The following information was supplied by the United States Reclamation Service:

The records of daily discharge represent the entire flow of the river at the diversion dam and have been corrected for water diverted through Inlet canal and passed through the sluice gages. The diversion dam acts as a weir; the crest is 400 feet long; the gage is about 100 feet from the crest and is read twice daily. Careful discharge measurements were made in the river above and below the dam before the coefficient was established, and the discharge rating table as originally computed has not been changed. The quantity diverted is determined at a gaging station maintained on Inlet canal, and the rating curve is checked by frequent discharge measurements. The sluice gates are seldom used and the flow through them is estimated.

DIVERSIONS.—In that part of the drainage area in Wyoming there were, prior to July 1, 1914, adjudicated diversions of 25 second-feet from Belle Fourche River and 237 second-feet from tributaries. In South Dakota there are authorized diversions of 102 second-feet from Belle Fourche River above the gaging station and approximately 2,500 second-feet from tributaries; below the station there are authorized diversions of 3,102 second-feet from Belle Fourche River.

ACCURACY.—The United States Reclamation Service considers the records fair.

COOPERATION.—Complete records furnished and stations maintained by United States Reclamation Service.

Daily discharge, in second-feet, of Belle Fourche River near Belle Fourche, S. Dak., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	177	245	115	206	173	235	2,500	483	477	50	9	25
2	177	245	115	215	173	235	3,680	465	597	52	9	30
3	177	245	115	218	228	179	2,920	465	620	50	9	55
4	180	245	115	223	213	179	1,700	500	597	50	9	90
5	180	245	115	223	229	238	1,300	483	717	48	10	40
6	230	245	115	231	238	238	2,420	483	730	52	11	52
7	275	245	115	237	237	237	5,170	450	550	49	12	60
8	293	140	115	238	237	237	2,640	435	427	44	12	58
9	275	142	125	238	235	237	2,210	435	427	58	13	48
10	230	172	125	238	235	237	5,400	405	322	34	92	42
11	200	200	125	238	235	237	1,980	405	418	32	20	78
12	185	172	125	238	235	237	1,640	390	405	31	59	61
13	185	230	125	179	235	237	1,420	366	295	36	49	63
14	185	230	125	206	235	237	1,320	470	295	30	88	52
15	185	230	125	206	235	237	1,240	470	290	30	60	88
16	185	200	125	188	235	237	1,150	470	215	30	44	100
17	185	125	125	188	235	237	840	530	190	35	40	149
18	210	125	125	233	208	240	770	530	180	33	35	35
19	245	117	125	238	181	241	630	530	155	31	115	135
20	245	117	125	238	235	225	490	530	155	26	61	138
21	245	117	125	240	238	331	480	550	155	25	35	147
22	245	117	125	131	235	1,300	465	457	155	25	25	135
23	245	117	125	215	235	810	450	392	140	17	27	150
24	245	117	125	229	235	1,270	450	982	140	15	27	143
25	245	117	125	240	235	934	465	982	125	11	29	143
26	245	117	125	238	235	407	465	890	125	12	26	145
27	245	117	125	238	235	344	465	575	112	13	26	182
28	245	117	125	237	235	344	613	547	112	9	23	136
29	245	117	125	238	.....	565	965	487	112	9	33	142
30	245	117	125	206	.....	1,480	615	547	112	8	31	165
31	245	.....	125	206	.....	1,220	.....	547	.....	12	26	.....

NOTE.—Figures have been changed slightly to conform to computation rules of the U. S. Geol. Survey.

Monthly discharge of Belle Fourche River near Belle Fourche, S. Dak., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	293	177	223	13,700
November	245	117	170	10,100
December	125	115	122	7,500
January	240	131	221	13,600
February	238	173	227	12,600
March	1,480	179	439	27,000
April	5,400	450	1,560	92,800
May	982	366	524	32,200
June	730	112	312	18,600
July	58	8	30.9	1,900
August	115	9	34.4	2,120
September	182	25	99.6	5,930
The year	5,400	8	329	238,000

WHITE RIVER BASIN.

WHITE RIVER NEAR INTERIOR, S. DAK.

LOCATION.—Near southwest corner of sec. 7, T. 4 S., R. 18 E., at boundary of Pine Ridge Indian Reservation, at steel highway bridge 3 miles southwest of Interior, on line between Jackson and Pennington counties.

DRAINAGE AREA.—4,090 square miles.

RECORDS AVAILABLE.—August 24, 1911, to September 30, 1917; June 24, 1904, to November 30, 1906, at the original station in sec. 10, T. 4 S., R. 18 E.

GAGE.—A vertical staff attached to downstream side of first pier at left end of highway bridge; read by George Carlbom.

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

CHANNEL AND CONTROL.—Silt and sand, changing gradually.

EXTREMES OF DISCHARGE.—Maximum stage during year, 11.8 feet at 5 p. m. March 23, caused by ice jams; maximum discharge, at 7.7 feet March 30 (discharge, 3,260 second-feet); minimum stage, 3.2 feet August 5 and September 8–13 (discharge, 8 second-feet).

1914–1906 and 1911–1917: Maximum stage recorded, 16 feet March 8, 1905 (discharge, 16,500 second-feet); channel reported dry July 13–15, 19–29, September 26 to October 4, 1914.

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

DIVERSIONS AND REGULATION.—No diversions or storage reservoirs above are sufficiently great to noticeably affect the flow.

ACCURACY.—Stage-discharge relation changed slightly. Rating curves used October 1 to November 11 and March 28 to September 30 fairly well defined. Gage read to half-tenths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table. Records fair.

Discharge measurements of White River near Interior, S. Dak., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Oct. 21	T. M. Wardwell	3.72	57	June 17	Alf Hulteng	4.10	156
Apr. 8	L. B. Dale	4.59	262	July 22	E. F. Chandler	3.62	41.8
May 19	Alf Hulteng	4.18	136	Aug. 18	....do	3.44	16.8

Daily discharge, in second-feet, of White River near Interior, S. Dak., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	42	108	.....	1,100	890	505	90	18	12
2	42	94	.....	1,030	610	530	116	18	12
3	42	40	.....	1,100	1,100	457	146	18	12
4	42	94	.....	1,030	1,180	300	146	18	12
5	42	81	.....	890	890	390	116	8	12
6	56	81	.....	640	760	435	103	28	12
7	59	81	.....	368	345	322	90	34	12
8	59	81	.....	345	530	480	68	90	8
9	42	81	.....	300	435	480	68	59	8
10	42	81	.....	279	210	368	50	31	8
11	42	42	.....	292	210	279	50	26	8
12	42	.....	.....	300	258	226	50	26	8
13	42	.....	.....	279	890	226	50	36	8
14	42	.....	.....	258	1,260	146	50	36	18
15	81	.....	.....	345	505	146	59	26	31
16	59	.....	.....	390	300	146	59	36	22
17	59	.....	.....	1,350	146	90	59	31	26
18	42	.....	.....	1,350	180	90	59	26	480
19	59	.....	.....	2,500	146	90	59	18	457
20	81	.....	.....	1,030	890	90	59	18	180
21	81	.....	.....	258	1,980	90	59	18	131
22	81	.....	.....	368	2,360	90	15	26	59
23	81	.....	.....	300	1,540	90	90	43	59
24	81	.....	.....	368	1,540	116	43	43	68
25	94	.....	.....	322	2,500	116	26	36	90
26	94	.....	.....	300	2,790	116	26	18	79
27	94	.....	.....	345	1,540	116	18	18	54
28	94	.....	1,980	1,030	1,540	198	18	18	39
29	81	.....	3,260	1,030	1,100	131	18	18	36
30	94	.....	3,260	1,180	760	90	18	15	31
31	94	.....	1,540	.....	700	.....	18	12	.....

Monthly discharge of White River near Interior, S. Dak., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	94	42	65.0	3,940
April	2,500	258	689	41,000
May	2,790	146	970	59,760
June	530	90	232	13,800
July	146	15	61.2	3,760
August	90	8	27.9	1,720
September	480	8	66.4	3,950

WHITE RIVER NEAR WESTOVER, S. DAK.

LOCATION.—In sec. 32, T. 3 S., R. 29 E., at boundary of Rosebud Indian Reservation, at steel highway bridge near Westover, 2 miles below mouth of South Fork of White River, 12 miles south and slightly east of Murdo, on Chicago, Milwaukee & St. Paul Railway.

DRAINAGE AREA.—7,850 square miles.

RECORDS AVAILABLE.—August 25, 1911, to September 30, 1917.

GAGE.—Chain gage attached to steel highway bridge; read by E. F. Sterner. Vertical staff gage with same datum as chain gage is bolted to concrete abutment of bridge, left bank. During 1911 the gage was a vertical staff on the left bank about 40 rods downstream from the present location, and its datum was such as to make readings about 2 feet greater than from the present gage.

DISCHARGE MEASUREMENTS.—Made from the highway bridge.

CHANNEL AND CONTROL.—Sand, silt, and quicksand; scours and shifts suddenly.

EXTREMES OF DISCHARGE.—Maximum stage during year, 15.1 feet at 8 p. m. March 22 (stage-discharge relation affected by ice); minimum stage, 6.2 feet July 30 (discharge, 85 second-feet).

1911–1915: Maximum stage recorded, 13 feet April 4, 1915 (discharge, 15,200 second-feet); minimum stage, 5.3 feet October 15, 1911 (discharge, 14 second-feet).

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

DIVERSIONS AND REGULATIONS.—No diversions or storage reservoirs above large enough to noticeably affect flow.

ACCURACY.—Stage-discharge relation not permanent. Gage read to half-tenths once daily. Discharge determined by shifting-control method. Records fair.

Discharge measurements of White River near Westover, S. Dak., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Oct. 20	T. M. Wardwell	6.71	176	June 16	Alf Hulteng	7.31	463
Apr. 7	L. B. Dale	8.44	1,386	July 21	E. F. Chandler	6.57	130
May 18	Alf Hulteng	7.58	747	Aug. 21	....do	6.53	124

Daily discharge, in second-feet, of White River near Westover, S. Dak., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	97	200	.....	3,310	1,900	2,060	262	105	95
2	97	200	.....	2,920	1,610	1,750	250	110	95
3	103	200	.....	2,060	1,540	1,750	240	118	95
4	103	200	.....	1,750	1,470	2,390	215	105	95
5	105	200	.....	1,540	2,920	1,980	215	100	95
6	107	200	.....	1,470	2,300	1,680	232	118	95
7	117	200	.....	1,470	1,680	1,400	335	118	95
8	117	200	.....	1,140	1,260	1,400	270	118	95
9	125	172	.....	740	1,140	1,260	232	110	95
10	132	172	.....	650	1,010	1,260	232	105	95
11	132	140	.....	610	695	1,140	200	118	95
12	132	125	.....	535	549	1,140	191	118	95
13	132	125	.....	500	500	895	160	132	95
14	137	125	.....	500	412	695	150	130	95
15	140	125	.....	458	385	594	150	118	103
16	150	.....	.....	470	2,220	500	140	118	100
17	160	.....	.....	740	1,070	482	140	118	97
18	160	.....	.....	1,540	740	412	140	118	95
19	160	.....	.....	2,220	650	396	140	150	95
20	172	.....	.....	1,750	570	385	140	120	95
21	172	.....	.....	1,680	650	360	125	118	160
22	172	.....	.....	1,900	2,390	345	135	118	470
23	172	.....	.....	1,540	3,110	335	140	115	270
24	172	.....	.....	1,010	2,740	312	125	107	200
25	185	.....	.....	790	2,920	312	110	103	180
26	200	.....	.....	610	7,900	312	105	97	160
27	200	.....	.....	570	8,250	312	95	95	156
28	200	.....	3,770	610	4,610	299	95	95	140
29	200	.....	3,310	535	3,110	312	87	95	140
30	200	.....	3,770	2,480	2,560	312	85	107	140
31	200	.....	4,310	.....	2,560	.....	97	97	.....

NOTE.—Ice effect Nov. 16 to Mar. 27; data inadequate for determination of discharge.

Monthly discharge of White River near Westover, S. Dak., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	200	97	150	9,300
April	3,310	458	1,270	75,600
May	8,250	385	2,110	130,000
June	2,390	299	893	53,100
July	335	85	169	10,400
August	150	95	113	6,930
September	470	95	131	7,800

SOUTH FORK OF WHITE RIVER NEAR WESTOVER, S. DAK.

LOCATION.—In NE. ¼ sec. 15, T. 43 N., R. 28 W., on Rosebud Indian Reservation, near house of observer, Mrs. C. H. Kendall, 2 miles above mouth of stream, 4 miles south of Westover, and 16 miles south of Murdo.

DRAINAGE AREA.—1,590 square miles.

RECORDS AVAILABLE.—June 26, 1912, to September 30, 1917.

GAGE.—Chain gage on projecting timber, on right bank 5 rods below cable. In 1912 and 1913, vertical staff gages at the same datum and nearly the same location were used.

DISCHARGE MEASUREMENTS.—Made from cable or by wading.

CHANNEL AND CONTROL.—Sandy and shifting.

EXTREMES OF DISCHARGE.—Maximum stage during year, 7.1 feet at 6 p. m., March 22, caused by ice jam; minimum discharge, 30 second-feet, September 30.

1912–1917: Maximum discharge recorded at 2.75 feet April 7, 1915 (discharge, 2,780 second-feet); minimum discharge, 20 second-feet, October 21, 1914.

ICE.—Stage-discharge relation seriously affected by ice; flow estimated from observer's reports and records of temperature and precipitation.

DIVERSIONS AND REGULATION.—No known diversions or storage reservoirs above are large enough to noticeably affect the flow.

ACCURACY.—Stage-discharge relation not permanent. Gage read daily to half-tenths. Discharge determined by shifting-control method. Records roughly approximate.

Discharge measurements of South Fork of White River near Westover, S. Dak., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Oct. 20	T. M. Wardwell	2.24	125	July 21	E. F. Chandler	1.92	75
Apr. 6	L. B. Dale	1.64	420	Aug. 20	do	1.85	61
May 18	Alf Hulteng	1.98	271	21	do	1.90	74
June 16	do	2.09	242				

Daily discharge, in second-feet, of South Fork of White River, near Westover, S. Dak., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	55	124	.....	730	344	236	81	48	62
2	62	124	.....	730	428	203	81	48	62
3	62	124	.....	570	428	176	81	48	62
4	62	148	.....	520	428	148	90	48	48
5	62	148	.....	453	386	148	100	74	48
6	48	148	.....	386	344	148	90	100	48
7	48	148	.....	386	306	148	81	110	48
8	74	148	.....	365	306	269	81	100	56
9	100	148	.....	344	306	176	81	100	59
10	81	148	.....	306	216	150	62	124	34
11	81	124	.....	269	216	124	62	148	34
12	81	124	.....	269	203	124	62	114	34
13	81	100	.....	269	220	124	62	81	42
14	81	.....	.....	306	236	124	62	81	48
15	81	.....	.....	288	203	124	62	62	42
16	81	.....	.....	269	223	236	62	48	42
17	48	.....	.....	269	203	148	62	48	42
18	64	.....	.....	344	203	124	62	48	48
19	81	.....	.....	520	203	124	62	48	62
20	119	.....	.....	474	236	124	62	48	34
21	81	.....	.....	520	203	112	62	73	34
22	96	.....	.....	474	203	100	81	62	34
23	110	.....	.....	428	203	81	62	62	34
24	100	.....	.....	386	203	90	48	62	34
25	100	.....	.....	428	570	100	48	62	34
26	100	.....	.....	361	1,500	100	48	62	34
27	100	.....	1,260	284	520	100	48	62	34
28	100	.....	730	428	176	100	48	62	34
29	112	.....	850	386	176	100	48	62	34
30	124	.....	850	344	176	100	48	62	30
31	124	.....	730	.....	206	.....	48	62	.....

Monthly discharge of South Fork of White River near Westover, S. Dak., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	124	48	83.8	5,160
April	730	269	404	24,000
May	1,500	176	315	19,400
June	269	81	139	8,250
July	100	48	65.7	4,040
August	148	48	71.6	4,400
September	62	30	43.0	2,560

PLATTE RIVER BASIN.

NORTH PLATTE RIVER NEAR NORTHGATE, COLO.

LOCATION.—In sec. 11, T. 11 N., R. 80 W., at highway bridge on interstate highway 6 miles south of Colorado-Wyoming line and 6 miles northwest of Northgate, in Jackson County. Three small tributaries—Camp, Threemile, and Sixmile creeks—enter North Platte River between station and State line. These have very little flow except spring run-off.

DRAINAGE AREA.—1,440 square miles (measured on Colorado typographic map, scale 1:500,000).

RECORDS AVAILABLE.—May 23, 1915, to September 30, 1917.

GAGE.—Chain gage installed on downstream side of bridge May 13, 1916; read by Mrs. H. L. McCasland. Original gage was a staff gage on middle pier of bridge at same datum.

DISCHARGE MEASUREMENTS.—Made from two-span bridge or by wading.

CHANNEL AND CONTROL.—Bed composed of sand, gravel, and small boulders. Principal control of 200 feet downstream at small rapids; shifts occasionally. Banks not subject to overflow.

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

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 6.0 feet on May 18 (discharge, 4,840 second-feet); minimum discharge occurred during winter.

DIVERSIONS.—There are court decrees for diversions of 3,060 second-feet from North Platte River and tributaries in Colorado. During 1917 Michigan ditch diverted 713 acre-feet from a tributary of the North Platte to the Cache la Poudre drainage basin between July 1 and September 8, 1917.

REGULATION.—None.

ACCURACY.—Stage-discharge relation not permanent; affected by ice during winter. Rating curve used October 1 to May 31, 1917, and curve used June 1 to September 30 are both fairly well defined between 200 and 3,500 second-feet. Gage read to quarter-tenths twice daily. Daily discharge ascertained by applying mean daily gage heights to rating table, except for periods July 8 to 21, July 23 to August 9, and September 23 to 30, when there was no gage-height record and discharge was based on comparative hydrograph of North Platte at Saratoga. Records good, except for periods of missing gage heights and for discharges above 3,500 second-feet when they are fair.

Discharge measurements of North Platte River near Northgate, Colo., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Oct. 21	H. K. Smith	1.96	407	Aug. 11	Robert Follansbee	2.25	500
June 15	Robert Follansbee	4.92	3,350	Sept. 18	S. B. Soulé	1.68	208
July 22	S. B. Soulé	3.17	1,310				

Daily discharge, in second-feet, of North Platte River near Northgate, Colo., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Apr.	May.	June.	July.	Aug.	Sept.
1	260	298	.....	1,300	2,220	3,590	875	275
2	269	260	.....	1,250	2,110	3,590	820	250
3	293	274	.....	1,250	1,780	3,460	755	226
4	303	274	.....	1,250	1,670	3,460	705	212
5	325	269	.....	1,150	2,000	3,330	640	203
6	325	232	.....	1,050	2,000	2,940	600	208
7	325	184	.....	1,050	1,670	2,820	550	235
8	330	180	.....	1,050	1,780	2,720	520	260
9	381	.....	.....	1,150	2,000	2,530	510	226
10	387	.....	.....	1,350	2,700	2,420	505	221
11	358	.....	.....	1,400	3,200	2,300	505	212
12	341	.....	.....	1,560	2,700	2,180	470	230
13	325	.....	.....	1,780	2,940	2,040	470	230
14	298	.....	.....	2,010	3,330	1,910	505	230
15	330	.....	.....	2,970	3,460	1,820	470	212
16	341	.....	.....	3,680	3,460	1,660	470	208
17	330	.....	.....	4,460	3,720	1,570	470	194
18	325	.....	.....	4,840	4,110	1,440	400	172
19	309	.....	1,890	4,840	4,240	1,380	400	167
20	309	.....	1,780	4,580	4,500	1,360	400	167
21	325	.....	1,450	4,460	4,370	1,340	370	162
22	438	.....	2,010	3,940	4,240	1,310	340	162
23	462	.....	2,850	3,160	4,110	1,230	310	165
24	432	.....	3,350	2,730	4,110	1,170	280	165
25	352	.....	3,350	2,610	4,110	1,110	260	180
26	352	.....	3,090	2,490	4,110	1,050	230	180
27	341	.....	2,970	2,490	3,980	985	226	190
28	320	.....	2,250	2,130	3,850	935	245	190
29	303	.....	1,890	2,010	3,720	920	284	190
30	298	.....	1,350	1,890	3,590	905	322	190
31	298	.....	.....	2,130	.....	899	304	.....

NOTE.—May 16-31, Sept. 1-22, discharge computed by indirect method for shifting control.

Monthly discharge of North Platte River near Northgate, Colo., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	462	260	335	20,600
November 1-8	298	180	246	3,900
April 19-30	3,350	1,350	2,350	55,900
May	4,840	1,050	2,390	147,000
June	4,500	1,670	3,190	190,000
July	3,590	890	1,950	120,000
August	875	226	458	28,200
September	275	162	204	12,100

NORTH PLATTE RIVER AT SARATOGA, WYO.

LOCATION.—At highway bridge at Saratoga, Carbon County. Nearest tributary, Spring Creek, enters 2 miles above.

DRAINAGE AREA.—2,880 square miles (measured on base map of Wyoming; scale, 1:500,000).

RECORDS AVAILABLE.—June 9, 1903, to October 31, 1906; April 1 to December 17, 1909; April 27, 1911, to October 31, 1912; April 1, 1915, to September 30,1917. State engineer maintained station at this point during 1913 and 1914.

GAGE.—Chain gage on upstream side of bridge; read by Miss Nora Doggett and Miss Carrie Priquet. Original gage read prior to 1911 was vertical staff 100 yards below bridge. No determined relation between gages.

DISCHARGE MEASUREMENTS.—Made from two-span highway bridge or by wading near control.

CHANNEL AND CONTROL.—Bed composed of coarse gravel and small boulders. Control at rapids 500 feet downstream; fairly permanent. Banks not subject to overflow.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 10.4 at 7 a. m. June 20 and 9 a. m. June 23 (discharge, 13,800 second-feet); minimum discharge 262 second-feet, January 19–24.

ICE.—Stage-discharge relation seriously affected by ice; flow estimated from discharge measurements, observer's notes, and temperature records.

DIVERSIONS.—Prior to December 31, 1916, there were adjudicated diversions of 83 second-feet from the North Platte between Saratoga and State line.

REGULATION.—None.

ACCURACY.—Stage-discharge relation practically permanent; affected by ice during winter. Rating curve well defined between 250 and 12,000 second-feet. Gage read to hundredths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table. Records excellent, except during period affected by ice when they are good.

Discharge measurements of North Platte River at Saratoga, Wyo., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Oct. 24	H. K. Smith	4.55	734	May 16	H. W. Fear	7.69	7,840
Dec. 11	P. V. Hodges	[a] 4.40	359	June 14	Robert Follansbee	9.22	10,500
Jan. 10	H. K. Smith	[a] 4.38	359	July 20	S. B. Soulé	6.21	3,260
Feb. 11	do	[a] 4.23	299	Sept. 20	do	4.10	404

[a] Stage-discharge relation affected by ice.

Daily discharge, in second-feet, of North Platte River at Saratoga, Wyo., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	471	536	362	298	278	298	691	2,030	6,150	10,700	2,030	536
2	471	536	362	317	278	298	609	2,030	5,900	9,650	1,700	536
3	572	536	340	340	298	298	536	2,030	5,650	8,900	1,540	536
4	650	536	340	340	298	317	650	1,860	6,150	8,650	1,460	471
5	650	536	340	340	298	362	504	1,780	6,400	7,900	1,460	471
6	609	536	340	340	298	362	471	1,780	6,150	7,900	1,460	504
7	738	504	340	358	298	372	471	1,780	6,150	7,650	1,320	536
8	1,120	442	340	358	298	393	572	1,780	6,900	7,400	1,180	536
9	887	398	353	358	298	377	784	1,860	8,400	7,150	1,060	504
10	836	471	353	359	298	377	1,320	2,030	10,400	7,150	943	471
11	784	442	359	340	299	372	1,250	2,200	11,200	6,650	908	471
12	738	272	362	298	298	367	1,700	2,750	10,900	6,150	872	471
13	650	278	362	278	298	362	2,200	3,340	10,400	5,160	836	504
14	609	298	362	278	298	388	2,560	4,450	10,400	4,680	836	536
15	572	309	362	278	278	367	2,200	5,400	11,200	4,220	887	536
16	609	317	362	278	278	382	2,290	6,900	12,000	3,770	887	536
17	609	326	340	278	278	362	3,140	8,150	12,800	3,340	887	504
18	650	335	317	278	278	353	3,340	9,150	13,300	2,940	836	471
19	650	340	317	262	278	382	3,140	9,650	13,500	2,940	784	442
20	650	326	317	262	278	382	2,380	9,650	13,800	3,340	784	415
21	650	317	298	262	298	408	2,200	9,150	13,300	2,940	784	403
22	738	317	298	262	298	362	2,560	8,150	13,500	2,940	784	413
23	784	326	317	262	298	388	3,550	9,650	13,800	2,560	738	403
24	738	335	317	262	317	353	4,220	6,650	13,300	2,560	650	393
25	738	340	317	278	317	393	4,680	6,650	13,500	2,380	572	413
26	738	340	298	317	317	382	4,680	6,900	13,000	2,560	536	413
27	691	340	278	317	317	388	4,450	6,150	12,800	2,380	536	442
28	691	362	278	298	298	353	3,550	5,650	11,700	2,200	536	442
29	650	362	278	298	.....	362	2,560	5,650	11,200	2,200	536	471
30	650	362	278	298	.....	413	2,290	5,650	11,700	2,200	536	442
31	572	.....	278	278	.....	738	.....	6,150	.....	2,200	536	.....

NOTE.—Nov. 13–Mar. 6, and Mar. 13 stage-discharge relation affected by ice. Discharge based on temperature and gage-height record, discharge measurements, and observer's notes. Aug. 11–12, Sept. 23, no gage-height record. Discharge interpolated.

Monthly discharge of North Platte River at Saratoga, Wyo., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	1,120	471	683	42,000
November	536	272	389	23,100
December	362	278	328	20,200
January	359	262	302	18,600
February	317	278	295	16,400
March	738	298	378	23,200
April	4,680	471	2,180	130,000
May	9,650	1,780	5,060	311,000
June	13,800	5,650	10,500	625,000
July	10,700	2,200	4,950	304,000
August	2,030	536	949	58,400
September	536	393	474	28,200
The year	13,800	262	2,210	1,600,000

NORTH PLATTE RIVER ABOVE PATHFINDER, WYO.

LOCATION.—In sec. 27, T. 26 N., R. 84 W., 900 feet below mouth of Lost Creek and three-quarters of a mile below mouth of Black Canyon, Carbon County. Backwater from Pathfinder reservoir reaches within 2½ miles of station.

DRAINAGE AREA.—7,410 square miles (measured on base map of Wyoming; scale, 1:500,000).

RECORDS AVAILABLE.—October 7, 1913, to September 30, 1917.

GAGE.—Friez water-stage recorder on right bank 900 feet below Lost Creek.

DISCHARGE MEASUREMENTS.—Made from cable at gage.

CHANNEL AND CONTROL.—Bed composed of small boulders. Gage at lower end of pool 600 feet long. Control located at rapids and is practically permanent. Banks high and not subject to overflow.

EXTREMES OF DISCHARGE.—Maximum stage during year from water-stage recorder, 6.2 feet at 2 p. m. June 26 (discharge, 18,800 second-feet); minimum discharge occurs during winter when observations are discontinued.

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

DIVERSIONS.—Prior to December 31, 1916, there were adjudicated diversions of 84 second-feet from North Platte River between Saratoga and the station above Pathfinder.

REGULATION.—None.

ACCURACY.—Stage-discharge relation practically permanent; affected by ice during winter. Rating curve well defined between 300 and 17,000 second-feet. The operation of the water-stage recorder was satisfactory except for short intervals as explained in footnotes. Daily discharge ascertained by applying mean daily gage heights, determined by inspecting gage-height graph, to rating table. Records excellent, except for days of missing gage-heights, when they are fair.

Discharge measurements of North Platte River above Pathfinder, Wyo., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Apr. 11	P. V. Hodges	3.84	6,030	July 24	S. B. Soulé	2.76	2,850
June 12	H. K. Smith	5.61	15,500				

Daily discharge, in second-feet, of North Platte River above Pathfinder, Wyo., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	550	864	.....	2,500	3,300	9,380	15,600	2,400	800
2	550	820	.....	2,230	3,180	9,120	14,400	2,320	800
3	600	810	.....	1,850	3,060	8,360	13,600	2,130	760
4	640	800	.....	1,650	2,950	8,360	12,100	1,920	711
5	700	780	.....	1,470	2,950	8,610	11,000	1,750	684
6	690	740	.....	1,320	2,910	9,120	10,200	1,650	675
7	820	720	.....	1,360	2,860	8,860	10,200	1,580	657
8	897	693	.....	1,500	2,730	8,360	10,200	1,480	693
9	1,250	566	.....	2,000	2,690	9,120	9,900	1,350	700
10	1,140	438	.....	4,000	2,770	11,300	9,640	1,260	695
11	1,090	255	.....	5,910	2,950	13,600	9,380	1,190	665
12	1,100	.....	.....	5,800	3,180	15,300	8,860	1,180	630
13	1,120	.....	.....	7,600	3,670	15,300	8,110	1,150	625
14	930	.....	.....	9,380	4,510	14,700	7,170	1,120	625
15	864	.....	.....	9,800	5,530	14,100	6,110	1,090	648
16	810	.....	.....	8,000	7,400	14,400	5,350	1,060	665
17	770	.....	.....	8,100	9,380	15,300	4,830	1,080	665
18	780	240	.....	8,950	10,700	16,200	4,210	1,100	665
19	831	.....	.....	6,000	11,800	17,100	3,800	1,100	640
20	864	.....	.....	3,600	12,700	18,000	3,540	1,060	570
21	853	.....	.....	3,540	12,700	18,300	3,800	1,010	545
22	842	.....	.....	4,400	12,400	18,300	3,540	978	515
23	908	.....	.....	6,000	11,500	18,300	3,420	954	515
24	990	.....	.....	7,400	10,400	18,300	3,180	908	530
25	978	.....	.....	9,000	9,380	18,300	2,950	864	515
26	897	.....	.....	8,300	9,640	18,300	2,770	810	495
27	978	.....	.....	7,200	10,200	18,000	2,710	875	510
28	1,010	.....	.....	5,910	9,640	17,700	2,730	853	515
29	1,000	.....	.....	4,830	8,610	16,800	2,650	790	529
30	1,000	.....	.....	3,800	8,110	15,900	2,440	770	540
31	908	.....	2,560	.....	8,610	.....	2,420	770	.....

NOTE.—Oct. 1–6, Apr. 8–10, 12–13, 15–20, 22–27, Sept. 9–14, 16–21, 23–28, 30, no gage-height record as water-stage recorder was out of order. Discharge based on comparative hydrograph of North Platte at Saratoga.

Monthly discharge of North Platte River above Pathfinder, Wyo., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	1,250	550	883	54,300
November 1-11	864	.....	681	14,900
April	9,800	1,320	5,110	304,000
May	12,700	2,690	6,850	421,000
June	18,300	8,360	14,100	839,000
July	15,600	2,420	6,800	418,000
August	2,400	770	1,240	76,200
September	800	495	626	37,200

NORTH PLATTE RIVER AT PATHFINDER, WYO.

LOCATION.—In sec. 24, T. 29 N., R. 84 W., a quarter of a mile below Pathfinder dam and one-third of a mile below old post office of Pathfinder, Natrona County. Nearest tributary, Canyon Creek, enters 2 miles above, in the reservoir.

DRAINAGE AREA.—10,700 square miles (measured on base map of Wyoming; scale, 1:500,000).

RECORDS AVAILABLE.—May 9, 1905, to September 30, 1917.

GAGE.—Chain gage on left bank a quarter of a mile below Pathfinder dam; read by J. C. Austin.

DISCHARGE MEASUREMENTS.—Made from cable 50 feet above gage.

EXTREMES OF DISCHARGE.—No data.

WINTER FLOW.—Stage-discharge relation not seriously affected by ice.

DIVERSIONS.—Prior to December 31, 1916, there were adjudicated diversions of 371 second-feet from tributaries entering the North Platte between the station above Pathfinder and this station. Near Whalen, 150 miles below, the water from Pathfinder reservoir is diverted by Interstate canal and used to irrigate land in Nebraska and Wyoming.

REGULATION.—The Pathfinder dam forms a reservoir 1,025,000 acre-feet in capacity, which materially changes the natural run-off of the river.

COOPERATION.—Records furnished by United States Reclamation Service.

Daily discharge, in second-feet, of North Platte River at Pathfinder, Wyo., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	750	5	5	5	5	5	5	1,000	5,350	17,400	5,550	5,110
2	780	5	5	5	5	5	5	1,000	6,400	16,700	4,240	5,110
3	780	5	5	5	5	5	5	1,000	7,450	15,900	4,060	5,110
4	800	5	5	5	5	5	5	1,000	8,270	15,200	4,060	5,110
5	800	5	5	5	5	5	5	1,000	6,700	14,100	4,480	5,110
6	800	5	5	5	5	5	5	1,000	7,300	13,100	4,560	5,110
7	660	5	5	5	5	5	5	1,000	8,200	12,100	5,730	5,140
8	750	5	5	5	5	5	5	1,000	8,670	11,400	5,730	5,110
9	850	5	5	5	5	5	5	1,000	8,860	10,800	5,730	5,110
10	955	5	5	5	5	5	5	1,000	9,320	10,400	5,730	5,110
11	1,290	5	5	5	5	5	5	1,580	10,200	10,200	4,380	4,240
12	1,290	5	5	5	5	5	5	2,000	11,600	9,820	4,060	4,040
13	230	5	5	5	5	5	5	2,050	13,200	9,400	4,060	4,040
14	5	5	5	5	5	5	5	2,050	14,400	8,860	4,060	4,180
15	5	5	5	5	5	5	5	2,120	15,000	8,230	4,060	4,060
16	5	5	5	5	5	5	5	2,020	14,800	8,490	4,060	4,060
17	5	5	5	5	5	5	5	2,060	15,000	8,410	4,060	4,060
18	5	5	5	5	5	5	5	2,020	15,200	8,350	4,060	4,060
19	5	5	5	5	5	5	5	2,040	16,000	8,200	4,060	4,060
20	5	5	5	5	5	5	5	2,060	16,900	8,090	4,060	4,060
21	5	5	5	5	5	5	5	2,020	17,800	7,780	4,060	3,200
22	5	5	5	5	5	5	5	480	18,300	5,620	4,060	3,070
23	5	5	5	5	5	5	5	10	18,600	4,760	4,140	3,070
24	5	5	5	5	5	5	800	10	18,800	4,560	4,060	3,120
25	5	5	5	5	5	5	960	10	18,900	4,540	4,060	3,070
26	5	5	5	5	5	5	1,020	10	18,900	4,760	4,060	3,070
27	5	5	5	5	5	5	1,020	10	18,900	4,680	4,060	3,070
28	5	5	5	5	5	5	1,020	20	18,800	4,590	4,850	2,260
29	5	5	5	5	.....	5	990	1,970	18,600	4,560	5,130	2,140
30	5	5	5	5	.....	5	990	3,030	18,100	4,560	5,110	2,140
31	5	.....	5	5	.....	5	.....	4,120	.....	4,560	5,110	.....

NOTE.—Figures have been changed slightly to conform to computation rules of United States Geological Survey.

Monthly discharge of North Platte River at Pathfinder, Wyo., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	1,290	5	349	21,500
November	5	5	5	298
December	5	5	5	307
January	5	5	5	307
February	5	5	5	278
March	5	5	5	307
April	1,020	5	230	13,700
May	4,120	10	1,340	82,400
June	18,900	5,350	13,500	803,000
July	17,400	4,540	9,040	556,000
August	5,730	4,060	4,500	277,000
September	5,140	2,140	4,010	239,000
The year	18,900	5	2,750	1,990,000

NORTH PLATTE RIVER NEAR CASPER, WYO.

LOCATION.—In sec. 31, T. 32 N., R. 81 W., at highway bridge at Speas ranch, half a mile below Bessemer Canyon, in Natrona County. Nearest tributary, Bates Creek, enters 3 miles upstream.

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—April 9 to September 30, 1917.

GAGE.—Vertical staff.

DISCHARGE MEASUREMENTS.—Made from bridge.

CHANNEL AND CONTROL.—Channel apparently permanent. Control below bridge.

DIVERSIONS.—Prior to December 31, 1916, there were no approved diversions from North Platte River between station and Pathfinder reservoir.

REGULATION.—(See North Platte at Pathfinder.)

COOPERATION.—Complete records furnished by United States Reclamation Service.

Daily discharge, in second-feet, of North Platte River near Casper, Wyo., for the year ending Sept. 30, 1917.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Day.	Apr.	May.	June.	July.	Aug.	Sept.
1	.....	1,170	5,380	17,300	4,180	4,750	16	460	2,420	14,900	8,980	4,140	4,110
2	.....	1,180	6,580	16,900	4,250	4,730	17	430	2,440	15,700	8,810	4,100	3,990
3	.....	1,180	7,660	16,700	4,180	4,780	18	420	2,380	16,500	8,540	4,160	3,970
4	.....	1,160	8,160	15,200	4,270	4,780	19	430	2,330	16,800	8,500	4,100	3,970
5	.....	1,160	6,930	14,400	4,650	4,750	20	400	2,380	17,500	8,100	3,920	3,910
6	.....	1,170	7,980	13,200	4,880	4,370	21	390	2,360	18,100	7,440	4,060	3,210
7	.....	1,160	8,670	11,800	5,370	4,870	22	375	770	17,900	5,800	4,110	3,170
8	.....	1,140	9,160	11,300	5,430	4,720	23	540	530	18,900	5,260	4,140	3,090
9	560	1,160	9,160	10,800	5,430	4,720	24	1,020	510	19,200	4,650	4,060	3,280
10	600	1,140	9,500	10,600	5,370	4,400	25	1,260	530	19,200	5,010	4,040	3,170
11	470	1,440	10,500	10,400	4,270	4,690	26	1,300	570	19,200	5,070	4,100	3,160
12	500	2,020	11,600	9,950	4,230	4,140	27	1,250	530	19,200	4,730	4,100	3,140
13	540	2,150	12,400	9,420	4,160	3,990	28	1,180	500	19,200	4,310	4,160	2,410
14	530	2,240	13,200	9,280	4,160	4,140	29	1,180	2,150	18,900	4,720	4,750	2,390
15	500	2,410	14,000	8,810	4,160	3,990	30	1,150	3,290	18,500	4,750	4,850	2,390
							31	.....	4,210	.....	4,930	4,750	.....

Monthly discharge of North Platte River near Casper, Wyo., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
April 9-30	1,300	375	704	30,700
May	4,210	500	1,610	99,000
June	19,200	5,380	13,700	815,000
July	17,300	4,310	9,200	566,000
August	5,430	3,920	4,400	271,000
September	4,870	2,390	3,910	233,000
The period				2,010,000

NOTE.—Figures have been changed slightly to conform to computation rules of United States Geological Survey.

NORTH PLATTE RIVER AT McKINLEY, WYO.

LOCATION.—About in sec. 21, T. 31 N., R. 69 W., at highway bridge at McKinley, in Converse County. Nearest tributary, Elkhorn Creek, enters several miles below.

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—April 1 to September 30, 1917.

GAGE.—Vertical staff.

DISCHARGE MEASUREMENTS.—Made from bridge.

DIVERSIONS.—Prior to December 31, 1916, adjudicated diversions of 53 second-feet from North Platte River between Casper station and McKinley.

REGULATION.—(See North Platte River at Pathfinder.)

COOPERATION.—Complete records furnished by United States Reclamation Service.

Daily discharge, in second-feet, of North Platte River at McKinley, Wyo., for the year ending Sept. 30, 1917.

Day.	Apr.	May.	June.	July.	Aug.	Sept.
1	2,330	2,040	7,200	19,200	5,010	4,820
2	1,920	2,180	7,860	18,400	4,770	4,820
3	1,920	2,180	8,720	16,000	4,770	4,820
4	1,800	2,180	11,100	15,600	4,770	4,650
5	1,800	2,180	12,000	15,200	4,340	4,650
6	1,920	2,180	10,300	14,600	4,340	4,650
7	1,920	2,180	9,950	13,600	4,770	4,650
8	2,040	2,180	10,300	12,900	5,540	4,200
9	2,040	2,180	10,700	12,600	5,540	4,650
10	2,040	2,180	10,700	12,200	5,540	4,650
11	1,920	2,330	11,100	12,200	5,540	4,650
12	1,690	2,810	12,000	11,600	4,770	4,650
13	1,560	3,700	12,500	11,600	4,340	4,200
14	1,560	3,910	13,200	11,600	4,340	4,200
15	1,380	4,340	13,900	11,600	4,140	4,200
16	1,380	4,770	14,600	11,600	4,140	4,200
17	1,290	5,540	15,600	9,900	4,140	4,200
18	1,290	4,770	16,000	8,520	4,140	4,050
19	1,380	4,560	16,000	7,100	4,140	4,050
20	1,380	6,520	16,700	5,940	4,340	4,050
21	1,290	6,880	17,100	5,680	4,140	4,050
22	1,470	6,160	17,400	5,300	4,140	3,940
23	1,560	4,650	19,200	5,540	4,050	3,610
24	2,040	4,050	19,500	5,010	4,200	3,520
25	2,490	3,940	19,900	5,010	4,200	3,440
26	2,810	5,200	19,900	5,010	4,340	3,440
27	2,640	5,000	20,300	5,010	4,200	3,440
28	2,490	5,000	19,900	5,010	4,050	3,350
29	2,180	5,440	19,900	5,260	4,200	3,350
30	2,330	5,440	19,500	5,260	4,820	3,350
31	.....	6,830	.....	5,010	4,820	.....

Monthly discharge of North Platte River at McKinley, Wyo., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
April	2,810	1,290	1,860	111,000
May	6,880	2,040	3,980	245,000
June	20,300	7,200	14,400	857,000
July	19,200	5,010	9,970	613,000
August	5,540	4,050	4,530	279,000
September	4,820	3,350	4,150	247,000
The period	.....	.....	.....	2,350,000

NOTE.—Figures have been changed slightly to conform to computation rules of United States Geological Survey.

NORTH PLATTE RIVER ABOVE AND BELOW WHALEN, WYO.

LOCATION.—In sec. 11, T. 26 N., R. 65 W., at diversion dam at Whalen, Goshen County. Nearest important tributary is Cottonwood Canyon Creek, an intermittent stream, which enters 1½ miles below.

DRAINAGE AREA.—16,300 square miles (measured on base map of Wyoming; scale, 1:500,000).

RECORDS AVAILABLE.—May 1, 1909, to September 30, 1917. Prior to October 1, 1916, the combined flow of the river and Interstate canal was given, and in addition, the flow through the Interstate canal. Beginning October 1, 1916, the flow above Whalen is given, which represents the flow of river and Interstate canal combined. The flow below Whalen represents the flow in the river passing the dam (overfall weir) below the Interstate canal diversion. The difference in the two records represents the amount diverted.

GAGE.—To determine the flow over the weir a vertical staff is used, its zero being at the weir crest. The discharge is then computed by a weir formula. There are also four sluice gates in the dam, through which the discharge is computed. In the river, 75 feet downstream from the weir gage, is another, with zero 10 feet lower. The second gage is only used in computing the discharge through the gates when the openings are submerged. The discharge through the head gates of the canal is computed from the nine gate openings. A vertical staff located in the canal 1,000 feet below the head gates is used in computing the discharge when the head-gate openings are submerged.

DISCHARGE MEASUREMENTS.—Made from cable 1 mile below weir in order to check the coefficients used in the discharge computations.

DIVERSIONS.—Prior to December 31, 1916, there were adjudicated diversions from North Platte River of 32 second-feet between McKinley and the Whalen gaging station, exclusive of the diversion by the United States Reclamation Service. Between Whalen and the State line there are adjudicated diversions of 240 second-feet.

REGULATION.—Records show the flow as regulated by Pathfinder reservoir, which stores water for use in the Interstate canal.

COOPERATION.—Records furnished by United States Reclamation Service.

Daily discharge, in second-feet, of North Platte River above Whalen, Wyo., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	2,060	242	275	150	170	500	2,110	2,160	8,800	19,700	4,660	4,980
2	1,650	234	290	150	180	500	1,940	2,240	9,420	19,000	4,720	5,000
3	1,460	234	280	150	170	525	1,480	2,320	9,680	18,100	5,540	5,010
4	1,510	233	270	150	160	550	828	2,260	10,600	17,500	4,380	5,000
5	1,530	230	280	160	160	550	794	2,290	13,100	16,600	4,360	5,000
6	1,510	227	280	170	160	550	590	2,480	13,700	15,600	4,360	5,000
7	1,440	223	190	170	160	575	515	2,360	10,900	13,800	4,700	5,080
8	1,360	184	190	170	160	575	400	2,300	11,000	12,600	4,720	5,040
9	1,370	193	170	170	170	575	550	2,280	11,500	11,300	5,420	5,460
10	1,300	165	180	170	170	575	488	2,270	11,600	10,500	5,420	5,010
11	1,210	143	170	180	175	575	564	2,240	11,700	10,000	5,480	5,010
12	1,210	148	180	170	180	575	629	2,340	12,000	9,660	5,420	5,010
13	1,270	148	190	180	180	575	737	2,630	12,800	9,400	4,480	4,290
14	1,540	80	190	180	180	590	884	3,920	14,400	9,120	4,380	4,150
15	1,210	93	180	170	190	600	880	4,460	15,600	8,800	4,260	4,160
16	1,110	93	180	180	190	600	936	5,170	16,200	8,500	4,240	4,180
17	1,020	124	190	180	190	600	850	6,050	16,800	8,460	4,220	4,160
18	856	178	190	190	200	600	950	6,350	17,400	8,360	4,240	4,140
19	888	277	200	190	200	600	900	5,760	17,200	8,480	4,240	4,140
20	692	277	190	190	200	600	1,110	6,350	16,800	8,220	4,410	4,100
21	500	277	180	180	220	600	1,670	6,830	17,600	7,950	4,400	3,990
22	500	277	180	140	240	600	1,380	7,690	18,600	7,820	4,230	3,780
23	500	302	170	150	250	600	1,940	6,830	19,600	7,430	4,170	3,640
24	573	327	170	160	270	650	2,110	5,780	20,000	5,450	4,190	3,290
25	550	405	170	160	300	650	2,460	4,770	20,300	5,220	4,190	3,230
26	548	377	160	170	350	750	2,880	5,660	20,600	4,860	4,180	3,340
27	450	321	150	170	450	800	3,030	7,480	20,800	4,810	4,160	3,370
28	346	293	150	180	450	850	2,840	6,900	21,000	4,910	4,200	3,300
29	340	247	150	190	.....	1,040	2,520	7,320	21,000	4,810	4,230	3,240
30	325	233	140	190	.....	1,580	2,220	7,760	20,700	4,960	4,730	2,900
31	280	.....	150	190	.....	1,550	.....	7,600	.....	4,860	5,010	.....

Daily discharge, in second-feet, of North Platte below Whalen, Wyo., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	1,610	242	275	150	170	500	2,110	1,540	7,940	18,200	3,040	3,350
2	1,380	234	290	150	180	500	1,940	1,550	8,560	17,500	3,100	3,360
3	1,460	234	280	150	170	525	1,480	1,540	8,830	16,600	3,910	3,380
4	1,510	233	270	150	160	550	828	1,490	9,700	16,000	2,760	3,360
5	1,530	230	280	160	160	550	794	1,510	12,300	15,000	2,740	3,360
6	1,510	227	280	170	160	550	590	1,660	12,800	14,100	2,740	3,360
7	1,440	223	190	170	160	575	515	1,540	10,000	12,300	3,070	3,800
8	1,360	184	190	170	160	575	400	1,490	10,400	11,000	3,100	3,700
9	1,370	193	170	170	170	575	550	1,460	10,900	9,780	3,800	4,070
10	1,300	165	180	170	170	575	488	1,440	11,000	8,940	3,800	3,620
11	1,210	143	170	180	175	575	564	1,410	11,000	8,470	3,850	3,520
12	1,210	148	180	170	180	575	629	1,490	11,300	8,110	3,800	3,520
13	1,270	148	190	180	180	575	737	1,780	12,100	7,850	2,860	2,800
14	1,320	80	190	180	180	590	884	3,040	13,700	7,560	2,760	2,660
15	1,210	93	180	170	190	600	880	3,550	14,600	7,240	2,640	2,660
16	1,110	93	180	180	190	600	936	4,250	15,000	6,940	2,610	2,680
17	1,020	124	190	180	190	600	850	5,120	16,000	6,900	2,600	2,680
18	856	178	190	190	200	600	950	5,400	16,800	6,800	2,620	2,740
19	708	277	200	190	200	600	900	4,810	16,500	6,900	2,610	2,740
20	277	277	190	190	200	600	1,110	5,400	15,600	6,620	3,010	2,740
21	0	277	180	180	220	600	1,670	5,880	16,300	6,350	2,880	2,590
22	0	277	180	140	240	600	1,380	6,740	17,200	6,220	2,660	2,490
23	0	302	170	150	250	600	1,410	5,880	18,200	5,830	2,600	2,380
24	183	327	170	160	270	650	1,510	4,830	18,600	3,850	2,580	2,030
25	265	405	170	160	300	650	1,780	3,850	18,900	3,620	2,580	2,030
26	548	377	160	170	350	750	2,380	4,810	19,100	3,260	2,570	2,140
27	450	321	150	170	450	800	2,490	6,620	19,300	3,210	2,530	2,170
28	346	293	150	180	450	850	2,310	6,050	19,500	3,310	2,570	2,100
29	340	247	150	190	.....	1,040	1,960	6,470	19,500	3,210	2,600	2,290
30	325	233	140	190	.....	1,580	1,630	6,900	19,100	3,330	3,100	1,960
31	280	.....	150	190	.....	1,550	.....	6,740	.....	3,230	3,380	.....

NOTE.—Figures have been changed slightly to conform to computation rules of the United States Geological Survey.

Monthly discharge of North Platte River above Whalen, Wyo., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	2,060	280	1,000	61,500
November	405	80	226	13,400
December	290	140	195	12,000
January	190	140	171	10,500
February	450	160	217	12,100
March	1,580	500	679	41,800
April	3,030	400	1,370	81,500
May	7,760	2,160	4,610	283,000
June	21,000	8,800	15,400	916,000
July	19,700	4,810	9,900	609,000
August	5,540	4,160	4,560	280,000
September	5,460	2,900	4,270	254,000
The year	21,000	80	3,560	2,570,000

Monthly discharge of North Platte River below Whalen, Wyo., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	1,610	0	884	54,400
November	405	80	226	13,400
December	290	140	195	12,000
January	190	140	171	10,500
February	450	160	216	12,100
March	1,580	500	679	41,800
April	2,490	400	1,220	72,600
May	6,900	1,410	3,750	231,000
June	19,500	7,940	14,400	857,000
July	18,200	3,210	8,330	512,000
August	3,850	2,530	2,950	181,000
September	4,070	1,960	2,880	171,000
The year	19,500	0	3,000	2,170,000

BIG CREEK NEAR BIG CREEK, WYO.

LOCATION.—In sec. 32, T. 13 N., R. 81 W., at Big Creek ranger station, 2 miles west of Big Creek post office, Carbon County. No important tributary within several miles.

DRAINAGE AREA.—123 square miles (measured on base map of Wyoming; scale, 1:500,000).

RECORDS AVAILABLE.—May 7, 1911, to June 30, 1912; April 4, 1915, to September 18, 1917. State engineer maintained station at this point during 1913 and 1914.

GAGE.—Vertical staff on left bank 50 feet from ranger station; read by J. C. Peryam. Prior to April 29, 1915, gage was placed 1 foot farther out in the stream and gave readings slightly different although referred to same datum.

DISCHARGE MEASUREMENTS.—Made from bridge a quarter of a mile below gage or by wading at gage.

CHANNEL AND CONTROL.—Bed composed of coarse gravel and small boulders. Control at gage, which is on riffle; permanent during 1917. Right bank subject to overflow at stage of 4.2 feet; left bank high. Stage of zero flow, 0.6 foot.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 4.1 feet at 7 p. m., July 1 (discharge, 985 second-feet); minimum discharge probably occurs during winter.

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

DIVERSIONS.—Prior to December 31, 1916, there were no adjudicated diversions from Big Creek above the station in Wyoming, but below the diversions amount to 100 second-feet. In Colorado the Independence ditch diverts from Big Lake to the North Platte drainage basin approximately 80 second-feet, usually from June 10 to July 10 each year. Storage filing for 27,548 acre-feet in Big Lake which supplies Independence ditch.

ACCURACY.—Stage-discharge relation practically permanent; affected by ice during winter. Rating curve well defined between 30 and 900 second-feet. Gage read to hundredths once or twice daily. Daily discharge ascertained by applying one daily gage reading or the mean of two daily gage readings to rating table. Records good, but fragmentary, owing to absence of observer.

Discharge measurements of Big Creek near Big Creek, Wyo., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Oct. 21	H. K. Smith	1.74	60	July 22	S. B. Soulé	2.57	281
June 15	Robert Follansbee	3.69	774	Sept. 18	do	1.56	35.7

Daily discharge, in second-feet, of Big Creek near Big Creek, Wyo., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	May.	June.	July.	Aug.	Sept.
1	37	34	.....	.....	985	164	.....
2	36	31	49	.....	885	151	.....
3	51	30	.....	.....	.....	128	.....
4	51	34	.....	.....	.....	132	.....
5	33	33	.....	478	.....	122	.....
6	34	30	52	500	.....	110	.....
7	44	30	49	545	.....	120	.....
8	55	.....	49	692	735	110	.....
9	51	.....	52	838	685	106	.....
10	52	.....	65	985	635	104	.....
11	52	.....	88	885	635	92	.....
12	47	.....	120	835	635	.....	.....
13	42	.....	196	785	.....	.....	.....
14	42	.....	370	835	.....	82	.....
15	42	.....	410	785	410	88	.....
16	42	.....	545	432	350	.....	.....
17	41	.....	522	.....	350	.....	.....
18	41	.....	522	.....	330	.....	37
19	48	.....	522	.....	330	.....	.....
20	58	.....	478	.....	.....	.....	.....
21	60	.....	330	.....	.....	.....	.....
22	48	.....	330	.....	284	74	.....
23	49	.....	370	.....	.....	57	.....
24	55	.....	410	.....	.....	.....	.....
25	58	.....	330	.....	.....	.....	.....
26	47	.....	312	.....	.....	.....	.....
27	41	.....	330	.....	.....	.....	.....
28	41	.....	432	.....	.....	.....	.....
29	39	.....	421	.....	.....	.....	.....
30	39	.....	410	.....	.....	.....	.....
31	36	.....	.....	.....	.....	.....	.....

Monthly discharge of Big Creek near Big Creek, Wyo., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	60	33	45.5	2,800
November 1–7	34	30	31.7	440

FRENCH CREEK NEAR FRENCH, WYO.

LOCATION.—In sec. 4, T. 14 N., R. 81 W., at Jenkins ranch, 3½ miles southeast of French, Carbon County. No tributary between station and mouth 2 miles below.

DRAINAGE AREA.—64 square miles (measured on base map of Wyoming; scale, 1:500,000).

RECORDS AVAILABLE.—April 30, 1911, to October 31, 1912; April 1, 1915, to September 30, 1917, when station was discontinued. State engineer maintained station at this point 1913 and 1914.

187043°—21—W S P 456——12

GAGE.—Vertical staff on downstream end of heavy rock-filled crib on left bank, a quarter of a mile above head gate of French Creek Irrigation & Development Co's. canal; read by J. W. Jenkins and Miss Pearl Jenkins.

DISCHARGE MEASUREMENTS.—Made from cable 75 feet above gage or by wading.

CHANNEL AND CONTROL.—Bed composed of small boulders; control 30 feet downstream; shifting occasionally. Banks not subject to overflow.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 4.1 feet at 6 p. m. June 24 (discharge, 1,240 second-feet); minimum stage occurs during winter.

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

DIVERSIONS.—Prior to December 31, 1916, there were no adjudicated diversions from French Creek above station, but below station there are diversions of 4 second-feet. From North French Creek there are adjudicated diversions of 6 second-feet.

REGULATION.—None.

ACCURACY.—Stage-discharge relation not permanent; affected by ice during winter. Rating curve used October 1 to November 11 well defined between 20 and 300 second-feet. Curve used March 16 to September 30 not well defined. Gage read to hundredths twice daily. Daily discharge ascertained by applying the mean daily gage height to rating table. Records good up to 600 second-feet, above which they are fair.

Discharge measurements of French Creek near French, Wyo., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*
Oct. 22	H. K. Smith	1.35	21.9
July 23	S. B. Soulé	2.33	180
Sept. 19	do	1.46	30.6

Daily discharge, in second-feet, of French Creek near French, Wyo., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	17	20	.....	17	24	131	755	115	41
2	22	20	.....	19	23	131	658	103	40
3	27	20	.....	19	24	141	592	96	40
4	27	18	.....	20	24	155	560	91	38
5	27	18	.....	17	24	160	625	90	40
6	27	17	.....	14	25	152	592	85	42
7	37	17	.....	14	25	152	560	81	42
8	36	17	.....	14	25	220	530	74	40
9	29	17	.....	17	26	310	500	71	38
10	26	17	.....	17	28	385	440	71	34
11	25	17	.....	19	41	360	412	73	38
12	24	.....	.....	21	42	360	385	68	40
13	23	.....	.....	20	56	360	360	66	38
14	22	.....	.....	20	83	385	360	66	35
15	21	.....	.....	17	111	440	310	66	33
16	21	.....	18	17	141	530	262	68	32
17	20	.....	18	17	160	592	240	65	31
18	20	.....	18	17	170	690	220	66	30
19	20	.....	18	16	170	790	220	65	28
20	24	.....	17	17	185	825	240	63	28
21	24	.....	14	20	165	895	197	62	28
22	22	.....	14	27	141	965	188	59	27
23	20	.....	12	34	148	965	176	55	27
24	20	.....	12	39	155	965	170	52	27
25	23	.....	11	40	155	1,040	168	50	27
26	24	.....	12	39	137	965	165	44	30
27	24	.....	12	33	121	895	148	71	29
28	22	.....	12	31	127	825	139	62	28
29	20	.....	16	29	133	895	139	48	28
30	20	.....	17	28	143	825	143	46	28
31	20	.....	17	.....	152	.....	139	42	.....

Monthly discharge of French Creek near French, Wyo., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	37	17	23.7	1,460
November 1–11	20	17	18.0	393
March 16–31	18	11	14.9	473
April	40	14	22.3	1,330
May	185	23	96.3	5,920
June	1,040	131	550	32,700
July	755	139	342	21,000
August	115	42	68.8	4,230
September	42	27	33.6	2,000

ENCAMPMENT RIVER AT ENCAMPMENT, WYO.

LOCATION.—In sec. 6, T. 14 N., R. 83 W., at lower end of smelter grounds at Encampment, Carbon County. Nearest tributary, North Fork, enters 1 mile above.

DRAINAGE AREA.—219 square miles (measured on base map of Wyoming; scale, 1,500,000).

RECORDS AVAILABLE.—May 2, 1911, to October 31, 1912; May 29, 1915, to September 30, 1917. State engineer maintained station at this point during 1913 and 1914.

GAGE.—Chain gage on left bank at tailing flume which crosses the river; read by Earl Waite. Prior to June 6, 1912, gage was 175 feet farther downstream, and although referred to same datum, read approximately 1 foot lower, owing to the slope of the river.

DISCHARGE MEASUREMENTS.—Made from cable 125 feet below gage or by wading.

CHANNEL AND CONTROL.—Channel composed of gravel and small boulders which shifted after the high water of 1917. Control is not well defined, though there are small rapids 200 feet downstream.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 8.9 feet at 6.30 p. m. June 23 (discharge, 4,490 second-feet); minimum discharge occurs during winter.

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

DIVERSIONS.—Three large irrigation ditches divert water at a point 1 mile above station. The smelter company has a pipe line which diverts water above the station, but as the tailrace of the power plant, which the pipe line supplies is just above station, the amount diverted passes the gage. Water is also diverted below station. Prior to December 31, 1916, there were adjudicated diversions from Encampment River amounting to 76 second-feet.

REGULATION.—None.

ACCURACY.—Stage-discharge relation shifted during high water of 1917. Affected by ice during winter. Rating curve used October 1 to July 21 well defined between 40 and 3,500 second-feet; curve used July 22 to September 30 well defined between 50 and 800 second-feet. Gage read to quarter-tenths twice daily. Daily discharge ascertained by applying the mean daily gage height to rating table. Records good, except for period June 15 to July 21 when, on account of shifting of stage-discharge relation, the records are only fair.

Discharge measurements of Encampment River at Encampment, Wyo., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*
June 14	Robert Follansbee	7.61	2,480
July 22	S. B. Soulé	5.45	539
Sept. 17	do	4.00	59

Daily discharge, in second-feet, of Encampment River at Encampment, Wyo., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Apr.	May.	June.	July.	Aug.	Sept.
1	72	123	.....	166	805	1,810	296	62
2	76	114	.....	166	840	1,680	240	62
3	121	101	.....	160	1,260	1,580	194	59
4	190	93	.....	144	1,010	1,590	188	53
5	163	86	.....	133	920	1,590	210	57
6	184	73	.....	133	1,010	1,480	182	59
7	220	63	.....	157	1,060	1,670	171	67
8	290	61	.....	166	1,310	1,860	154	77
9	420	59	.....	163	2,600	1,620	165	79
10	580	55	.....	166	3,950	1,520	133	82
11	525	.....	.....	190	3,500	1,290	126	75
12	398	.....	.....	205	3,050	1,190	110	65
13	310	.....	.....	220	2,750	1,100	110	62
14	220	.....	.....	272	2,900	1,020	126	65
15	205	.....	133	375	3,820	856	112	61
16	184	.....	114	470	3,080	791	112	62
17	166	.....	107	580	2,930	728	97	61
18	136	.....	89	840	3,240	670	128	75
19	136	.....	105	1,200	3,260	616	116	59
20	109	.....	126	1,200	3,560	983	116	62
21	91	.....	146	1,100	3,420	688	106	62
22	89	.....	155	1,100	4,040	600	86	67
23	89	.....	190	1,010	4,340	515	79	62
24	86	.....	238	1,010	3,750	515	84	47
25	79	.....	255	920	3,170	770	89	49
26	75	.....	255	840	3,170	515	95	53
27	75	.....	290	805	2,880	490	79	59
28	73	.....	255	770	2,600	442	79	53
29	81	.....	184	700	2,320	419	77	49
30	91	.....	160	735	2,050	419	75	47
31	105	.....	.....	805	.....	375	72	.....

NOTE.—June 15 to July 21, discharge computed by the indirect method for shifting control.

Monthly discharge of Encampment River at Encampment, Wyo., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	580	72	182	11,200
November 1-10	123	55	82.8	1,640
April 15-30	290	89	175	5,550
May	1,200	133	545	33,500
June	4,340	805	2,620	156,000
July	1,860	375	1,010	62,100
August	296	72	129	7,930
September	82	47	61.7	3,670

JACK CREEK AT MATHESON RANCH, NEAR SARATOGA, WYO.

LOCATION.—About sec. 36, T. 17 N., R. 86 W., at Matheson ranch, 14 miles southwest of Saratoga, in Carbon County. Nearest tributary, North Jack Creek, enters some distance below.

DRAINAGE AREA.—32 square miles (measured on base map of Wyoming; scale, 1:500,000).

RECORDS AVAILABLE.—August 23, 1913, to September 19, 1917.

GAGE.—Vertical staff at left abutment of wagon bridge 1,000 feet below ranch house; read by Miss Kathleen Montgomery. Gage originally 200 feet above present site; moved 800 feet farther upstream August 15, 1915 and used until June 13, 1917. No definite relation between readings on various gages.

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

CHANNEL AND CONTROL.—Channel composed of mud; control 100 feet downstream at small rapids which was practically permanent during 1917. Banks are overflowed at stage of 4.0 feet.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 4.3 feet June 11 (discharge, 260 second-feet); minimum discharge probably occurs during winter.

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

DIVERSIONS.—Prior to December 31, 1916, there were adjudicated diversions of 9 second-feet from Jack Creek above station and 93 second-feet below.

REGULATION.—None.

ACCURACY.—Stage-discharge relation practically permanent; affected by ice during winter. Rating curve used October 1 to June 12 well defined between 5 and 100 second-feet; curve used June 13 to September 30 fairly well defined between 10 and 220 second-feet. Gage read to hundredths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table. Records good.

Discharge measurements of Jack Creek at Matheson ranch, near Saratoga, Wyo., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Oct. 23	H. K. Smith	1.78	8.4	July 20	S. B. Soulé	[b]1.82	48
May 17	H. W. Fear	3.63	156	Sept. 19	do	[c].72	6.1
June 13	Robert Follansbee	[a]3.69	208				

[a] Old gage read 3.98 feet. [b] Stage at old gage, 2.60 feet. [c] Stage at old gage, 1.63 feet.

NOTE.—On June 13, 1917, gage was moved 1,000 feet downstream to the new highway bridge.

Daily discharge, in second-feet, of Jack Creek at Matheson ranch, near Saratoga, Wyo., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Apr.	May.	June.	July.	Aug.
1	7	8	.....	.....	91	190	33
2	7	7	.....	.....	91	180	31
3	8	9	.....	.....	119	180	25
4	11	8	.....	.....	119	190	16
5	11	10	.....	.....	113	180	19
6	9	10	.....	10	125	175	18
7	17	9	.....	9	132	180	16
8	17	.....	.....	10	181	109	16
9	12	.....	.....	10	174	113	.....
10	11	.....	.....	9	196	109	.....
11	14	.....	.....	14	212	105	.....
12	10	.....	.....	12	244	93	.....
13	11	.....	.....	28	210	97	.....
14	9	.....	.....	34	240	85	.....
15	11	.....	47	62	240	76	.....
16	9	.....	32	132	240	70	.....
17	12	.....	23	145	240	47	.....
18	12	.....	18	152	240	47	.....
19	11	.....	25	166	260	39	.....
20	14	.....	21	196	260	40	.....
21	11	.....	20	196	260	38	.....
22	13	.....	19	196	240	35	.....
23	11	.....	23	196	250	33	.....
24	10	.....	20	138	240	29	.....
25	11	.....	25	138	240	31	.....
26	10	.....	.....	145	230	29	.....
27	10	.....	.....	196	230	27	.....
28	10	.....	.....	196	210	23	.....
29	10	.....	.....	132	210	27	.....
30	11	.....	.....	113	210	38	.....
31	8	.....	.....	96	.....	31	.....

Monthly discharge of Jack Creek at Matheson ranch, near Saratoga, Wyo., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	17	7	10.9	670
November 1–7	10	7	8.7	121
April 15–25	47	18	24.8	541
May 6–31	196	9	105	5,420
June	260	91	202	12,000
July	190	23	85.4	5,250
August 1–8	33	16	21.8	346

MEDICINE BOW RIVER NEAR MEDICINE BOW, WYO.

LOCATION.—In sec. 7, T. 20 N., R. 79 W., at private bridge at Johnson's ranch, 14 miles southwest of Medicine Bow, Carbon County. Nearest tributary, Wagonhound Creek, enters 3 miles below.

DRAINAGE AREA.—178 square miles (measured on base map of Wyoming; scale, 1:500,000).

RECORDS AVAILABLE.—June 4, 1911, to November 30, 1912; May 5, 1915, to November 3, 1917. State engineer maintained station at this point during 1913 and 1914.

GAGE.—Vertical staff on downstream side of left abutment; read by Mrs. S. W. Johnson. Gage used during 1911 and 1912 was 600 feet upstream and referred to different datum.

DISCHARGE MEASUREMENTS.—Made from bridge or by wading.

CHANNEL AND CONTROL.—Bed composed of gravel. Control 75 feet downstream at riffle composed of gravel and small boulders well compacted; shifts occasionally. Banks not subject to overflow.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 5.4 feet at 7.30 a. m. June 23 (discharge, 2,810 second-feet); minimum discharge probably occurs during winter.

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

DIVERSIONS.—Prior to December 31, 1916, there were adjudicated diversions of 207 second-feet from Medicine Bow River above station and 67 second-feet below.

REGULATION.—None.

ACCURACY.—Stage-discharge relation changed during winter. Rating curve used October 1 to November 11 well defined below 500 second-feet; curve used April 15 to November 3 well defined below 1,300 second-feet. Gage read to hundredths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table. Records excellent up to 1,300 second-feet; above this they are fair.

Discharge measurements of Medicine Bow River near Medicine Bow, Wyo., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
June 17	Robert Follansbee	3.68	943	July 25	S. B. Soulé	2.04	92
28	H. K. Smith	3.87	1,230	Sept. 16	do	1.50	10.1

Daily discharge, in second-feet, of Medicine Bow River near Medicine Bow, Wyo., for the period Oct. 1, 1916, to Nov. 3, 1917.

Day.	Oct.	Nov.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	3	35	.....	54	355	922	51	9	3.6	22
2	3	32	.....	60	322	760	48	8	3.6	22
3	3	28	.....	65	241	645	32	8	3.6	22
4	6	27	.....	68	260	645	23	7	2.8	.....
5	13	27	.....	68	300	645	23	7	4.4	.....
6	16	25	.....	68	345	682	21	9	6.8	.....
7	16	25	.....	78	395	610	22	10	8.4	.....
8	15	24	.....	87	450	575	23	14	10	.....
9	20	24	.....	91	450	645	21	11	10	.....
10	21	22	.....	98	575	645	20	8	10	.....
11	24	21	.....	104	800	422	21	8	10	.....
12	24	.....	.....	113	510	395	21	9	10	.....
13	16	.....	.....	146	450	370	21	8	10	.....
14	15	.....	.....	174	610	300	18	8	10	.....
15	15	.....	83	206	610	264	21	8	11	.....
16	15	.....	78	241	720	215	20	10	11	.....
17	15	.....	91	260	922	209	22	10	12	.....
18	16	.....	91	268	1,100	143	28	9	12	.....
19	19	.....	72	260	1,880	143	29	8	14	.....
20	19	.....	68	309	2,100	154	29	8	15	.....
21	21	.....	65	322	2,330	162	32	7	16	.....
22	21	.....	72	292	2,330	118	28	7	16	.....
23	25	.....	137	268	2,810	110	21	6	17	.....
24	27	.....	132	292	2,100	104	16	5	17	.....
25	28	.....	146	322	1,450	98	12	7	20	.....
26	31	.....	120	355	1,880	91	20	10	20	.....
27	32	.....	98	260	1,060	91	30	10	20	.....
28	25	.....	87	230	1,010	76	20	9	20	.....
29	28	.....	72	268	965	76	15	7	20	.....
30	31	.....	51	300	1,060	76	12	5	20	.....
31	35	.....	.....	322	.....	72	10	.....	20	.....

Monthly discharge of Medicine Bow River near Medicine Bow, Wyo., for the period Oct. 1, 1916, to Oct. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	35	3	19.3	1,190
November 1–11	35	21	26.4	576
April 15–30	146	51	91.4	2,900
May	355	54	195	12,000
June	2,810	241	1,010	60,100
July	922	72	338	20,800
August	51	10	23.5	1,440
September	14	5	8.3	494
October	20	2.8	12.4	762

ROCK CREEK NEAR ARLINGTON, WYO.

LOCATION.—In sec. 25, T. 19 N., R. 79 W., at highway bridge 1½ miles above Arlington, Carbon County. Nearest tributary, Overland Creek, enters half a mile above. Prior to January 12, 1916, station was at Arlington, 1½ miles downstream. Flow at two points practically the same.

DRAINAGE AREA.—70 square miles (measured on base map of Wyoming; scale, 1:500,000).

RECORDS AVAILABLE.—April 22, 1911, to September 30, 1917.

GAGE.—Bristol water-stage recorder on left bank just below bridge.

DISCHARGE MEASUREMENTS.—Made from bridge or by wading.

CHANNEL AND CONTROL.—Bed rough and composed of coarse gravel and small boulders. Control not well defined. Banks high and not subject to overflow.

EXTREMES OF DISCHARGE.—Maximum stage during year from water-stage recorder 4.6 feet at 6 p. m. June 21 (discharge, 1,100 second-feet); minimum discharge, 4 second-feet on January 22 and 23.

ICE.—Stage-discharge relation seriously affected by ice; flow estimated from discharge measurements, observer's notes, and temperature records.

DIVERSIONS.—Prior to December 31, 1916, there were adjudicated permits for diversion of approximately 4 second-feet from Rock Creek above and 209 second-feet below the station.

REGULATION.—None.

ACCURACY.—Stage-discharge relation shifting during year; shifting-control method used. Gage heights from continuous record. Daily discharge ascertained by applying to rating table mean daily gage height obtained by inspection. Records fair.

Discharge measurements of Rock Creek near Arlington, Wyo., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Oct. 14	M. W. Gordon	0.96	21.5	Mar. 22	Ed. Lanning	0.93	10.1
Dec. 9	Ed. Lanning	1.08	13.9	Apr. 5	do	.94	17.2
22	do	1.1	9.26	May 11	do	.95	19.1
Jan. 10	do	1.15	15.5	July 8	do	2.90	450
Feb. 16	do	1.04	12.2	26	S. B. Soulé	1.60	137
Mar. 1	do	.83	6.03	Aug. 27	M. W. Gordon	.93	21.4
14	do	.90	9.30				

Daily discharge, in second-feet, of Rock Creek near, Arlington, Wyo., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	20	16	25	8	8	6	18	18	67	509	92	14
2	19	16	25	10	10	6	16	18	92	490	74	15
3	18	19	24	12	11	7	16	18	106	490	67	14
4	18	20	22	14	12	10	16	18	127	490	56	13
5	19	21	21	15	13	11	17	13	131	490	50	14
6	23	22	22	15	13	12	18	12	138	490	48	20
7	30	21	18	15	13	12	18	13	154	490	45	23
8	31	20	16	15	13	12	21	13	178	452	44	19
9	27	19	14	15	13	12	27	13	271	441	41	18
10	26	18	14	16	13	12	27	13	380	387	40	16
11	27	16	14	15	13	11	23	17	351	395	39	17
12	25	16	14	13	13	10	21	18	300	265	34	18
13	24	15	14	11	13	9	24	18	265	247	32	19
14	23	14	15	9	12	9	30	22	309	230	29	20
15	23	15	15	8	12	9	35	36	433	208	26	20
16	23	16	15	7	12	8	27	42	737	200	26	19
17	22	16	16	7	11	9	27	51	832	170	27	18
18	22	18	16	6	10	10	25	68	870	149	28	18
19	21	18	15	5	9	10	19	74	940	172	27	19
20	21	19	13	5	9	10	19	82	946	200	28	19
21	22	19	11	5	10	10	18	68	965	182	25	19
22	23	19	9	4	11	10	18	59	1,000	158	24	20
23	23	20	10	4	11	10	18	65	813	165	23	21
24	24	20	11	5	11	10	18	72	699	147	20	21
25	21	20	10	6	12	10	18	70	661	142	20	21
26	20	22	9	8	10	9	18	58	623	133	21	23
27	20	23	8	8	9	12	18	51	661	127	21	27
28	20	23	7	9	8	16	18	58	699	116	18	24
29	20	24	7	10	.....	20	18	58	642	116	18	27
30	19	25	6	10	.....	25	18	62	623	108	18	35
31	19	.....	6	9	.....	23	.....	58	.....	106	14	.....

NOTE.—Stage-discharge relation affected by ice Nov. 8–28, Dec. 8 to Mar. 27, Apr. 2–6; discharge based on measurements, gage heights, and temperature records. No gage heights Oct. 15–19, Apr. 22 to May 3, Sept. 18 and 19; discharge interpolated.

Monthly discharge of Rock Creek near Arlington, Wyo., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	31	18	22.4	1,380
November	25	14	19.0	1,130
December	25	6	14.3	879
January	16	4	9.7	596
February	13	8	11.2	622
March	25	6	11.3	695
April	35	16	20.8	1,240
May	82	12	40.5	2,490
June	1,000	67	501.	29,800
July	509	106	273.	16,800
August	92	14	34.7	2,130
September	35	13	19.7	1,170
The year	1,000	4	81.4	58,900

DEEP CREEK NEAR ARLINGTON, WYO.

LOCATION.—In sec. 16, T. 17 N., R. 79 W., at outlet of Sand Lake, 12 miles northwest of Arlington, in Carbon County, at an elevation of 10,100 feet. No tributary within several miles.

DRAINAGE AREA.—3.7 square miles (measured on topographic map).

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

GAGE.—Bristol water-stage recorder on left bank just below lake outlet. Prior to October 8, 1915, gage was 160 feet upstream, and referred to different datum.

DISCHARGE MEASUREMENTS.—Made by wading.

CHANNEL AND CONTROL.—Bed composed of coarse gravel well compacted; no well-defined control.

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

EXTREMES OF DISCHARGE.—Maximum stage for year from gage-height graph, 3.93 feet at 7 p. m. June 29 (discharge, 116 second-feet); minimum stage, 0.72 foot at 6 p. m. September 12 (discharge, 0.2 second-foot).

DIVERSIONS.—No diversions above.

REGULATION.—Flow regulated naturally by Sand Lake which has an approximate area of 95 acres.

ACCURACY.—Stage-discharge relation practically permanent; not affected by ice. Rating curve well defined below 40 second-feet but not well defined above 40 second-feet. Operation of water-stage recorder satisfactory except for short periods as shown in the footnote to daily-discharge table. Daily discharge ascertained by applying to rating table mean daily gage height determined by inspecting gage-height graph. Records good below 40 second-feet; fair above.

COOPERATION.—Field data furnished by Rock Creek Conservation Co.

Discharge measurements of Deep Creek near Arlington, Wyo., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Oct. 12	M. W. Gordon	1.18	2.60	July 14	M. W. Gordon	2.30	36.0
Dec. 3	do	.8	.27	27	S. B. Soulé	1.74	14.6
June 14	do	1.65	13.6	27	do	1.74	14.7

Daily discharge, in second-feet, of Deep Creek near Arlington, Wyo., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	0.9	0.7	0.3	.....	0.4	0.4	0.4	0.6	1.1	80	10	0.6
2	1.0	.7	.3	.....	.4	.4	.5	.8	1.2	80	9.2	.6
3	.9	.8	.3	.....	.4	.4	.4	1.2	1.4	80	11.0	.6
4	.9	.9	.4	.....	.4	.4	.4	1.4	1.6	85	10.0	.6
5	1.0	.8	.3	.....	.4	.3	.4	1.2	1.8	90	7.2	.6
6	1.0	.8	.3	.....	.4	.3	.4	.8	2.4	90	5.4	.6
7	1.2	.7	.4	.....	.4	.3	.4	.8	2.5	80	4.0	.6
8	1.4	.7	.3	.....	.4	.3	.4	.8	2.8	58	3.7	.4
9	1.6	.8	.3	.....	.4	.3	.4	.8	4.0	65	2.2	.3
10	1.8	.9	.3	.....	.4	.3	.5	.7	4.4	60	1.5	.2
11	2.0	.8	.3	.....	.4	.3	.4	.7	5.6	60	1.1	.2
12	2.3	.8	.3	.....	.4	.4	.5	.7	7.8	60	.8	.2
13	2.1	.9	.3	.....	.4	.3	.6	.7	9.8	62	.4	.2
14	1.9	1.0	.3	.....	.4	.3	.6	.8	15	40	.4	.2
15	1.9	1.0	.3	.....	.4	.3	.5	.7	17	45	.3	.3
16	1.9	.8	.3	.....	.5	.3	.3	.9	18	31	.4	.3
17	1.7	.8	.3	.....	.6	.3	.3	1.0	23	27	.4	.4
18	1.4	.8	.3	.....	.6	.3	.7	1.0	38	24	.5	.3
19	1.4	.8	.3	.....	.6	.4	1.4	1.1	80	24	.7	.3
20	1.4	.7	.3	.....	.6	.3	1.5	1.1	80	22	.9	.3
21	1.3	.7	.3	.....	.6	.3	1.0	1.2	90	23	.9	.3
22	1.2	.6	.3	.....	.6	.2	.8	1.1	85	20	.7	.3
23	1.2	.6	.3	.....	.5	.2	1.2	1.0	85	20	.4	.3
24	1.1	.6	.3	.....	.6	.3	.8	1.1	90	13	.3	.4
25	1.0	.5	.....	.....	.6	.3	.5	1.0	90	12	.3	.4
26	1.1	.5	.....	.....	.6	.2	.6	1.0	90	11	.3	.3
27	1.0	.5	.....	.....	.6	.2	.9	1.3	90	12	.3	.3
28	.9	.4	.....	.....	.5	.2	1.0	1.4	90	11	.3	.3
29	.9	.4	.....	0.4	.....	.5	1.0	1.4	100	10	.3	.3
30	.7	.4	.....	.4	.....	.4	.7	1.2	95	10	.4	.3
31	.8	.....	.....	.4	.....	.4	.....	1.2	.....	12	.5	.....

NOTE.—Oct. 7-11, water-stage recorder out of order; discharge interpolated. Dec. 25 to Jan. 28 recorder not running; discharge estimated.

Monthly discharge of Deep Creek near Arlington, Wyo., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	2.3	0.7	1.32	81.2
November	1.0	.4	.71	42.2
December	.4	.3	.30	18.4
January	.....	.....	.30	18.4
February	.6	.4	.48	26.7
March	.5	.2	.32	19.7
April	1.5	.3	.65	38.7
May	1.4	.6	.99	60.9
June	100	1.1	40.7	2,420
July	90	10	42.5	2,610
August	11	.3	2.41	148
September	.6	.2	.37	22.0
The year	100	.2	7.62	5,510

MUDDY CREEK NEAR SHIRLEY, WYO.

LOCATION.—In sec. 14, T. 26 N., R. 80 W., at highway bridge near Point of Rocks, 6 miles east of Shirley, in Carbon County. Nearest tributary enters 4 miles above.

DRAINAGE AREA.—67 square miles (measured on base map of Wyoming; scale, 1:500,000).

RECORDS AVAILABLE.—May 6, 1915, to April 15, 1917, when station was discontinued.

GAGE.—Vertical staff on downstream side of left abutment of bridge.

DISCHARGE MEASUREMENTS.—Made from single-span bridge or by wading.

CHANNEL AND CONTROL.—Bed composed of earth; channel very winding and current sluggish, owing to slight slope (0.0011 foot). Principal control practically at gage during low and medium stages, but during high water is at first bend downstream. Left bank subject to overflow at stage about 3.5 feet. Right bank is overflowed at stage 6.6 feet.

DIVERSIONS.—Prior to December 31, 1916, there were adjudicated diversions of 3.2 second-feet from Muddy Creek above station, and 4.8 second-feet below.

REGULATION.—None.

ACCURACY.—Owing to ice gorging in spring during principal high water, records only fair.

COOPERATION.—Assistance furnished by F. H. Richard.

Discharge measurements of Muddy Creek near Shirley, Wyo., during the year ending Sept. 30, 1917.

[Made by H. K. Smith.]

Date.	Discharge.	Date.	Discharge.	Date.	Discharge.
	Sec.-ft.		*Sec.-ft.*		*Sec.-ft.*
Apr. 8	14.1	Apr. 11	54	Apr. 13	54
8	15.0	11	75	14	27.3
9	107	12	45.8	15	21.8
10	86				

Daily discharge, in second-feet, of Muddy Creek near Shirley, Wyo., for the year ending Sept. 30, 1917.

Apr. 8	15.0	Apr. 11	64.4	Apr. 14	27.3
9	122	12	45.8	15	21.8
10	109	13	53.7		

NOTE.—Mean discharge Apr. 8 to 15, 57.4 second-feet; run-off for period, 911 acre-feet.

SAGE CREEK ABOVE PATHFINDER, WYO.

LOCATION.—In sec. 3, T. 26 N., R. 84 W., at footbridge at Vivion's ranch, 25 miles above Pathfinder dam, Carbon County. No tributary between station and mouth 2 miles below.

DRAINAGE AREA.—182 square miles (measured on base map of Wyoming; scale, 1:500,000 map).

RECORDS AVAILABLE.—March 20, 1915, to September 30, 1917.

GAGE.—Vertical staff 5 feet above footbridge at left bank; read by Mrs. Lewis Stillway and J. S. Wolf.

DISCHARGE MEASUREMENTS.—Made from footbridge or by wading.

CHANNEL AND CONTROL.—Bed composed of boulders embedded in sand. Control a short distance below bridge at riffle, which is permanent. Banks will be overflowed at stage of 6.5 feet. Stage of zero flow, 0.9 foot.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 3.9 feet at 6 a. m. April 24 (discharge, 336 second-feet); minimum stage, 1.12 feet at 6 a. m. July 19 (discharge 0.6 second-foot).

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

DIVERSIONS.—Prior to December 31, 1916, there were adjudicated diversions of 16 second-feet from Sage Creek, all above the station.

REGULATION.—None.

ACCURACY.—Stage-discharge relation practically permanent; affected by ice during winter. Rating curve well defined below 220 second-feet. Gage read to hundredths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table. Records good.

Discharge measurements of Sage Creek above Pathfinder, Wyo., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Apr. 10	P. V. Hodges	2.57	80	May 14	H. W. Fear	3.20	196
11	do	2.81	119	July 25	S. B. Soulé	1.16	.72

Daily discharge, in second-feet, of Sage Creek above Pathfinder, Wyo., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	1.1	8.4		14	39	100	3.8	0.8	1.0
2	1.2	7.5		15	36	92	3.3	.8	2.0
3	1.4	7.5		16	31	109	3.1	.8	2.2
4	1.6	8.4		18	36	156	3.1	.8	2.1
5	2.2	8.4		13	44	146	2.8	.8	2.0
6	2.7	7.5		12	42	100	2.6	.8	2.8
7	3.5	6.9		11	37	100	2.5	.8	2.8
8	4.4	6.3		53	32	109	2.3	.8	2.8
9	4.4	7.5		84	39	118	2.1	.8	2.8
10	4.4	7.5		109	53	146	1.8	.8	2.8
11	3.0	8.1		118	78	127	1.9	.8	2.8
12	3.0	8.1		156	118	109	1.8	.8	2.8
13	2.9	8.1		236	166	82	1.6	.8	2.8
14	2.9	8.1		176	196	80	1.5	.8	2.8
15	3.0	8.1		158	216	72	1.3	.8	2.8
16	3.0	8.4		84	236	70	1.2	.8	2.8
17	3.1	9		100	226	72	1.1	.8	2.8
18	3.3	9		109	196	67	.9	.8	2.8
19	4.4	9		100	176	61	.7	.9	2.8
20	6.6	9		100	196	61	.9	.9	3.0
21	7.2	9.4		92	176	50	.8	.9	3.0
22	6.6	9.8		136	136	45	.8	.9	3.0
23	6.9	10		216	92	37	.8	.9	3.0
24	7.2	10		246	118	31	.8	.9	3.0
25	7.8	10	24	118	127	24	.8	.9	3.0
26	8.4		24	118	118	21	.8	.9	1.8
27	9.0		25	84	100	18	.8	.9	1.8
28	9.0		92	42	100	13	.8	.9	1.8
29	9.0		52	42	109	14	.8	.9	1.8
30	9.0		46	42	146	8.4	.8	1.0	1.8
31	8.7		22		127		.8	1.0	

Monthly discharge of Sage Creek above Pathfinder, Wyo., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	9.0	1.1	4.87	299
November 1–25	10	6.3	8.40	417
March 25–31	92	22	40.7	565
April	246	11	93.9	5,590
May	236	31	114	7,010
June	156	8.4	74.6	4,440
July	3.8	.7	1.58	97
August	1.0	.8	.85	52
September	3.0	1.0	2.52	150

DEWEESE CREEK NEAR ALCOVA, WYO.

LOCATION.—In sec. 18, T. 27 N., R. 84 W., at Weaver's ranch, near entrance of creek into Pathfinder Reservoir, in Carbon County.

DRAINAGE AREA.—41 square miles (measured on base map of Wyoming; scale, 1:500,000).

RECORDS AVAILABLE.—March 4 to September 30, 1917.

DIVERSIONS.—Prior to December 31, 1916, there were adjudicated diversions of 4.4 second-feet from Deweese Creek above station.

COOPERATION.—Complete records furnished by United States Reclamation Service.

Daily discharge, in second-feet, of Deweese Creek near Alcova, Wyo., for the year ending Sept. 30, 1917.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	.....	14.0	2.0	32	14	0.2	0.6
2	.....	5.5	2.7	38	14	.2	.6
3	.....	1.0	2.7	33	14	.2	.6
4	0.2	2.7	2.7	33	14	.3	.6
5	.2	5.3	2.7	33	14	.3	.6
6	.2	7.6	2.0	33	8.8	.4	.6
7	.2	10	1.5	33	4.3	.4	.6
8	.3	13	1.5	33	1.5	.4	.6
9	.3	13	1.5	33	.4	.4	.6
10	.4	13	1.5	33	.1	.5	.6
11	.4	13	1.5	33	.1	.5	.6
12	.3	13	1.5	33	.1	.5	.6
13	.3	13	1.5	33	.1	.5	.6
14	.3	13	1.5	33	.1	.6	.6
15	.3	13	2.0	20	.1	.6	.6
16	.2	13	2.0	18	.1	.6	.6
17	.2	14	3.4	18	.1	.6	.6
18	.2	14	6.6	18	.1	.6	.6
19	.2	2.7	8.8	18	.1	.6	.6
20	.2	2.7	13	18	.1	.6	.6
21	.3	2.7	15	18	.1	.6	.5
22	.4	2.7	19	18	.2	.6	.5
23	.6	2.7	21	18	.2	.6	.5
24	1.0	2.7	26	18	.2	.6	.5
25	2.7	2.7	26	18	.2	.6	.4
26	6.6	2.7	26	16	.2	.6	.4
27	10	2.7	27	16	.2	.6	.4
28	14	2	27	16	.2	.6	.4
29	14	2	27	14	.2	.6	.4
30	14	2	27	14	.2	.6	.4
31	14	.....	30	.....	.2	.6	.....

NOTE.—Figures have been changed slightly to conform to computation rules of the United States Geological Survey.

Monthly discharge of Deweese Creek near Alcova, Wyo., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
March 4–31	14	0.2	2.93	163
April	14	1.0	7.38	439
May	30	1.5	10.8	664
June	38	14	24.7	1,470
July	14	.1	2.85	175
August	.6	.2	.50	30.7
September	.6	.4	.55	32.7
The period	.....	.....	.....	2,970

SAND CREEK NEAR ALCOVA, WYO.

LOCATION.—About sec. 25, T. 28 N., R. 85 W., at Weaver's ranch, 20 miles southwest of Alcova, in Carbon County. No tributary between station and Pathfinder reservoir, flow line of which is half a mile below.

DRAINAGE AREA.—70 square miles (measured on base map of Wyoming; scale, 1:500,000 map).

RECORDS AVAILABLE.—April 1, 1915, to September 9, 1917.

GAGE.—Vertical staff read by Clarence Burtch.

DIVERSIONS.—Prior to December 31, 1916, there were adjudicated diversions of 28 second-feet from Sand Creek, all above the station.

REGULATION.—None.

COOPERATION.—Complete records furnished by United States Reclamation Service.

Daily discharge, in second-feet, of Sand Creek near Alcova, Wyo., for the year ending Sept. 30, 1917.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Day.	Apr.	May.	June.	July.	Aug.	Sept.
1	.....	11.0	30	0.9	0.1	0.3	16	11	0.5	16	0.0	0.1	0.5
2	.....	11.0	30	.9	.1	.4	17	11	.5	22	.0	.1	.5
3	.....	16.0	30	.2	.1	.4	18	11	.5	22	.0	.1	.5
4	.....	22.0	27	.2	.1	.4	19	11	.5	16	.0	.1	.5
5	.....	27.0	27	.2	.2	.4	20	11	.5	16	.0	.1	.5
6	.....	27.0	27	.2	.2	.4	21	11	.5	16	.0	.1	.5
7	.....	27.0	27	.1	.2	.4	22	11	.5	16	.0	.1	.5
8	22	2.5	27	.1	.2	.4	23	5.4	27	16	.0	.1	.5
9	22	.0	27	.0	.2	.5	24	5.4	27	16	.0	.1	.5
10	22	.5	27	.0	.2	.5	25	5.4	27	11	.0	.1	.5
11	22	.5	27	.0	.2	.5	26	5.4	27	2.5	.1	.2	.5
12	11	.5	27	.0	.2	.5	27	5.4	27	2.5	.1	.2	.5
13	11	.5	27	.0	.2	.5	28	5.4	27	2.5	.1	.2	.5
14	11	.5	27	.0	.1	.5	29	5.4	27	2.5	.1	.3	.5
15	11	.5	27	.0	.1	.5	30	11	27	2.5	.1	.3	.5
							31	.....	27	.....	.1	.3	.....

Monthly discharge of Sand Creek near Alcova, Wyo., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
April 8-30	22	5.4	11.2	511
May	27	.0	12.7	781
June	30	2.5	19.8	1,180
July	.9	.0	.11	6.8
August	.3	.1	.16	9.8
September	.5	.3	.47	28.0
The period	.....	.....	.....	2,520

NOTE.—Figures have been changed slightly to conform to computation rules of United States Geological Survey.

SWEETWATER RIVER NEAR ALCOVA, WYO.

LOCATION.—In sec. 17, T. 29 N., R. 86 W., at Schoonmaker's ranch, 27 miles west of Alcova, in Natrona County. Backwater from Pathfinder reservoir comes to a point 5 miles below. Nearest tributary, Dry Creek, enters 6 miles below.

DRAINAGE AREA.—2,270 square miles (measured on base map of Wyoming; scale, 1:500,000).

RECORDS AVAILABLE.—August 28, 1913, to September 30, 1917.

GAGE.—Vertical staff on left bank at old bridge abutment 200 feet above footbridge; read by H. D. Schoonmaker.

DISCHARGE MEASUREMENTS.—Made from footbridge or by wading.

CHANNEL AND CONTROL.—Bed composed of gravel. Control 25 feet downstream at small rapids which change during high water. Banks high and not subject to overflow.

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

DIVERSIONS.—Prior to December 31, 1916, there were adjudicated diversions of 102 second-feet from Sweetwater River, above station. The original diversions below the station have been done away with by the Pathfinder reservoir.

REGULATION.—None.

COOPERATION.—Complete records furnished by United States Reclamation Service.

Daily discharge, in second feet, of Sweetwater River near Alcova, Wyo., for the year ending Sept. 30, 1917.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	.....	237	380	988	1,030	90	67
2	.....	257	315	950	930	82	65
3	.....	338	310	910	894	79	65
4	.....	338	355	912	843	74	65
5	.....	310	315	908	713	70	67
6	.....	70	310	937	620	70	66
7	.....	65	310	882	570	69	60
8	.....	85	238	865	523	68	60
9	.....	103	257	848	498	70	60
10	.....	96	272	880	500	70	60
11	.....	108	298	992	469	70	60
12	.....	157	345	972	404	76	60
13	.....	605	468	972	392	75	60
14	.....	860	655	1,180	333	79	60
15	.....	882	810	1,250	277	78	60
16	.....	607	988	1,280	273	76	60
17	.....	445	1,110	1,310	225	76	60
18	.....	275	1,180	1,310	186	76	60
19	.....	245	1,280	1,320	165	79	60
20	.....	132	1,350	1,320	142	79	60
21	.....	148	1,280	1,320	138	79	60
22	.....	140	1,240	1,350	134	79	60
23	.....	148	1,250	1,350	126	79	57
24	.....	237	1,260	1,290	122	79	55
25	.....	463	1,180	1,240	113	79	55
26	.....	592	1,060	1,250	105	79	54
27	.....	785	685	1,250	105	64	53
28	.....	773	707	1,200	102	63	53
29	.....	655	880	1,180	94	65	53
30	250	545	972	1,120	92	63	53
31	220	.....	985	.....	91	64	.....

NOTE.—Figures have been changed slightly to conform to computation rules of United States Geological Survey.

Monthly discharge of Sweetwater River near Alcova, Wyo., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
April	882	65	357	21,200
May	1,350	238	743	45,700
June	1,350	843	1,120	66,600
July	1,030	91	362	22,300
August	90	63	74.2	4,560
September	67	53	59.6	3,550
The period	.....	.....	.....	164,000

HORSE CREEK NEAR ALCOVA, WYO.

LOCATION.—About in sec. 22, T. 30 N., R. 85 W., at highway bridge near Bothwell's ranch, 16 miles west of Alcova, in Natrona County. No tributary between station and Pathfinder reservoir, flow line of which is half a mile below gage.

DRAINAGE AREA.—119 square miles (measured on base map of Wyoming; scale, 1:500,000).

RECORDS AVAILABLE.—March 23, 1915, to September 30, 1917.

GAGE.—Vertical staff on right bank at lower side of bridge; read by Thomas Igoe.

DISCHARGE MEASUREMENTS.—Made from single-span bridge or by wading.

CHANNEL AND CONTROL.—Bed composed of coarse gravel. Control a short distance below gage.

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

DIVERSIONS.—Prior to December 31, 1916, there were adjudicated diversions of 11 second-feet from Horse Creek.

REGULATION.—None.

COOPERATION.—Complete records furnished by United States Reclamation Service.

Daily discharge, in second-feet, of Horse Creek near Alcova, Wyo., for the year ending Sept. 30, 1917.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	.....	31	7.0	0.3	0.4	0.60	0.70
2	.....	31	.7	.3	.4	.60	.70
3	.....	16	.7	.3	.4	.60	.70
4	.....	22	.7	.3	.4	.60	.70
5	.....	13	.7	.3	.4	.60	.70
6	.....	13	.7	.3	.4	.60	.70
7	.....	16	.7	.3	.45	.60	.70
8	.....	16	.7	.3	.45	.60	.70
9	.....	62	.7	.3	.45	.60	.70
10	.....	42	.7	.3	.45	.60	.70
11	.....	31	.7	.3	.45	.60	.70
12	.....	19	.7	.3	.50	.60	.70
13	.....	25	.7	.3	.50	.60	.70
14	.....	10	.7	.3	.50	.60	.70
15	.....	16	.7	.3	.50	.65	.70
16	.....	20	.5	.3	.50	.65	.70
17	.....	13	.5	.3	.50	.65	.70
18	.....	7	.5	.3	.50	.65	.70
19	.....	1	.5	.3	.50	.65	.70
20	.....	.8	.3	.3	.50	.65	.70
21	10	.7	.2	.3	.50	.65	.70
22	10	.7	.3	.3	.50	.65	.70
23	10	.7	.3	.3	.50	.65	.70
24	13	.7	.3	.3	.50	.65	.70
25	31	.7	.3	.3	.50	.65	.70
26	10	.7	.3	.3	.50	.65	.70
27	10	.7	.3	.4	.55	.70	.70
28	42	.7	.3	.4	.60	.70	.70
29	56	1.0	.3	.4	.60	.70	.70
30	119	1.0	.3	.4	.60	.70	.70
31	95	.....	.3	.....	.60	.70	.....

Monthly discharge of Horse Creek near Alcova, Wyo., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
March 21-31	119	10	36.9	805
April	62	.7	12.7	815
May	7	.2	.72	44.3
June	.4	.3	.31	18.4
July	.60	.4	.49	30.1
August	.70	.60	.64	39.4
September	.70	.70	.70	41.7
The period				1,790

NOTE.—Figures have been changed slightly to conform to computation rules of United States Geological Survey.

CANYON CREEK NEAR ALCOVA, WYO.

LOCATION.—About in sec. 2, T. 28 N., R. 84 W., at Irvine's ranch, 12 miles southwest of Alcova, Carbon County. No tributary between station and Pathfinder reservoir, the flow line of which is 1 mile below gage.

DRAINAGE AREA.—54 square miles (measured on base map of Wyoming; scale, 1:500,000).

RECORDS AVAILABLE.—April 1, 1915, to September 30, 1917.

GAGE.—Vertical staff; read by F. J. Irvine.

DIVERSIONS.—Prior to December 31, 1916, there were adjudicated diversions of 3.9 second-feet from Canyon Creek, and 13 second-feet from tributaries entering above.

REGULATION.—None.

COOPERATION.—Complete records furnished by United States Reclamation Service.

Daily discharge, in second-feet, of Canyon Creek near Alcova, Wyo., for the year ending Sept. 30, 1917.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	6.1	20	8.3	14	0.1	0.0	0.1
2	6.1	18	8.0	11	.1	.0	.1
3	4.5	8.9	9.9	24	.1	.1	.3
4	4.8	8	7.1	24	.1	.1	.3
5	5.8	9.9	9.9	20	.1	.1	.3
6	4.5	10	7.1	17	.1	.1	.4
7	4.5	9.9	6.1	13	.1	.1	.4
8	3.9	22	7.6	11	.2	.1	.4
9	3.5	68	8.3	9.9	.3	.1	.4
10	3.2	50	7.1	8.3	.3	.1	.4
11	4.5	35	9	7.1	.3	.1	.4
12	3.2	77	15	29	.2	.1	.4
13	3.7	68	20	5.8	.3	.2	.5
14	3.9	40	27	4.5	.2	.2	.4
15	3.2	42	35	2.1	.2	.2	.4
16	3.9	32	40	1.4	.2	.2	.4
17	3.7	24	31	.7	.2	.2	.5
18	3.2	27	27	.7	.3	.3	.4
19	4.5	22	23	.5	.3	.2	.4
20	3.2	15	26	.6	.3	.1	.4
21	3	23	24	.6	.3	.1	.4
22	4.5	35	11	.6	.3	.1	.4
23	3	51	8	5	3	.1	.4
24	3.9	58	15	.5	.3	.1	.4
25	3.9	25	22	4	.3	.1	.4
26	3	26	21	.4	.1	.2	.4
27	3.5	18	20	.4	.1	.3	.4
28	18	14	20	.3	.1	.3	.4
29	52	9.5	18	1	.1	.3	.4
30	30	15.	22	.1	1	.3	.4
31	22		16		.0	.3	

Monthly discharge of Canyon Creek near Alcova, Wyo., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
March	52	3	7.44	457
April	77	8	29.4	1,750
May	40	6.1	17.1	1,050
June	29	.1	6.95	414
July	.3	.0	.19	11.7
August	.3	.0	.15	9.2
September	.5	.1	.38	22.6
The period				3,710

NOTE.—Figures have been changed slightly to conform to computation rules of United States Geological Survey

BATES CREEK NEAR CASPER, WYO.

LOCATION.—Approximately in sec. 12, T. 31 N., R. 82 W., near mouth of creek 21 miles southwest of Casper, in Natrona County.

DRAINAGE AREA.—383 square miles (measured on base map of Wyoming; scale, 1:500,000).

RECORDS AVAILABLE.—April 10, 1916, to August 31, 1917.

DIVERSIONS.—Prior to December 31, 1916, there were adjudicated diversions of 72 second-feet from Bates Creek, all above the station.

COOPERATION.—Complete records furnished by United States Reclamation Service.

Daily discharge, in second-feet, of Bates Creek near Casper, Wyo., for the year ending Sept. 30, 1917.

Day.	Apr.	May.	June.	July.	Aug.	Day.	Apr.	May.	June.	July.	Aug.
1	8	31	114	0.3	0.3	16	114	181	17	0.3	0.0
2	8	24	114	4.0	.3	17	181	152	44	.3	.0
3	12	24	114	.2	.3	18	84	114	114	.3	.0
4	8	31	114	.2	.3	19	114	114	12	.3	.0
5	8	40	84	.2	.3	20	181	114	8	.3	.0
6	40	84	64	.2	.3	21	329	181	4	.3	.0
7	24	181	40	.2	.3	22	161	181	.3	.3	.0
8	17	84	31	.3	.3	23	140	114	1	.3	.0
9	12	114	31	.3	.3	24	181	84	1	.3	.0
10	157	181	31	.5	.3	25	310	84	1	.3	.0
11	84	114	31	4.0	.3	26	371	152	1	.3	.0
12	114	114	114	.3	.0	27	181	133	.8	.3	.0
13	157	114	24	.3	.0	28	140	114	.8	.3	.0
14	158	114	24	.3	.0	29	64	152	.7	.3	.0
15	134	114	24	.3	.0	30	40	152	.7	.3	.0
						31		152		.3	.0

Monthly discharge of Bates Creek near Casper, Wyo., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
April	371	8	118	7,020
May	181	24	114	7,010
June	114	.3	38.7	2,300
July	4	.2	.53	32.6
August	.3	.0	.11	6.8
The period				16,400

NOTE.—Figures have been changed slightly to conform to computation rules of United States Geological Survey.

DEER CREEK AT GLENROCK, WYO.

LOCATION.—In sec. 4, T. 33 N., R. 75 W., near mouth of creek at Glenrock, in Converse County.

DRAINAGE AREA.—63 square miles (measured on base map of Wyoming; scale, 1:500,000).

RECORDS AVAILABLE.—April 11, 1916, to September 30, 1917.

DIVERSIONS.—Prior to December 31, 1916, there were adjudicated diversions of 48 second-feet from Deer Creek, all above the station.

COOPERATION.—Complete records furnished by United States Reclamation Service.

Daily discharge, in second-feet, of Deer Creek at Glenrock, Wyo., for the year ending Sept. 30, 1917.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Day.	Apr.	May.	June.	July.	Aug.	Sept.
1....	650	291	603	73	3	4	16....	510	1,350	125	7	2	5
2....	380	166	560	66	3	4	17....	382	1,150	125	5	2	5
3....	435	166	570	59	3	4	18....	328	1,050	125	5	2	5
4....	418	166	525	52	3	4	19....	290	982	119	5	2	5
5....	247	166	522	44	3	4	20....	266	945	117	5	2	5
6....	332	166	496	34	2	4	21....	226	857	117	4	2	5
7....	343	180	485	31	2	4	22....	835	733	113	4	3	5
8....	205	180	466	28	2	4	23....	1,110	604	103	4	3	5
9....	205	205	455	25	2	4	24....	1,090	626	95	4	3	5
10....	247	215	422	22	2	4	25....	1,090	693	95	4	3	5
11....	247	457	266	19	2	5	26....	1,070	814	85	4	3	5
12....	247	626	253	16	2	5	27....	1,010	877	94	4	3	5
13....	422	814	247	13	2	5	28....	967	712	85	4	3	5
14....	555	900	191	11	2	5	29....	626	647	80	3	3	5
15....	430	1,350	160	19	2	5	30....	877	647	80	3	3	5
							31....	.....	625	.....	3	3	.....

NOTE.—Figures have been changed slightly to conform to computation rules of United States Geological Survey.

Monthly discharge of Deer Creek at Glenrock, Wyo., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
April	1,110	205	535	31,800
May	1,350	166	625	38,400
June	603	80	259	15,400
July	73	3	18.7	1,150
August	3	2	2.5	152
September	5	4	4.7	278
The period	.....	.....	.....	87,200

BOXELDER CREEK NEAR CAREYHURST, WYO.

LOCATION.—Approximately in sec. 7, T. 33 N., R. 73 W., near moutn of creek, 1½ miles east of Careyhurst, in Converse County.

DRAINAGE AREA.—193 square miles (measured on base map of Wyoming; scale, 1:500,000).

RECORDS AVAILABLE.—May 17 to October 31, 1911; April 9, 1916, to September 30, 1917.

DIVERSIONS.—Prior to December 31, 1916, there were adjudicated diversions of 80 second-feet from Boxelder Creek, all above the station.

COOPERATION.—Complete records furnished by United States Reclamation Service.

Daily discharge, in second-feet, of Boxelder Creek near Careyhurst, Wyo., for the year ending Sept. 30, 1917.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Day.	Apr.	May.	June.	July.	Aug.	Sept.
1	21	135	742	25	4	3	16	90	920	283	9	4	3
2	29	116	664	17	4	3	17	70	957	272	9	3	3
3	29	126	588	9	4	3	18	70	640	220	9	3	3
4	25	116	857	9	4	3	19	75	588	183	9	3	4
5	25	155	870	9	4	3	20	70	742	170	9	3	4
6	27	135	588	9	4	3	21	98	995	146	9	3	4
7	28	116	602	9	4	3	22	126	742	135	9	3	4
8	29	135	588	9	4	3	23	272	664	135	9	3	4
9	40	107	588	9	4	3	24	423	690	108	9	3	4
10	45	135	588	9	4	3	25	298	754	75	9	3	4
11	45	146	640	9	4	3	26	220	1,150	62	9	3	4
12	63	309	538	9	4	3	27	98	895	56	9	3	4
13	183	398	385	9	4	3	28	70	1,050	56	9	3	4
14	146	538	410	9	4	3	29	155	995	50	9	3	4
15	126	690	322	9	4	3	30	135	920	29	9	3	4
							31	.....	844	.....	4	3	.....

Monthly discharge of Boxelder Creek near Careyhurst, Wyo., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
April	423	21	104	6,190
May	1,150	107	545	33,500
June	870	29	365	21,700
July	25	4	9.6	591
August	4	3	3.5	216
September	4	3	3.4	202
The period				62,400

NOTE.—Figures have been changed slightly to conform to computation rules of the United States Geological Survey.

WAGON HOUND CREEK NEAR LA BONTE, WYO.

LOCATION.—Approximately in sec. 16, T. 31 N., R. 71 W., near mouth of creek, at Eastman's ranch, 3 miles east of La Bonte, in Converse County.

DRAINAGE AREA.—145 square miles (measured on base map of Wyoming; scale, 1:500,000).

RECORDS AVAILABLE.—April 11, 1916, to September 30, 1917.

DIVERSIONS.—Prior to December 31, 1916, there were adjudicated diversions of 24 second-feet from Wagon Hound Creek, all above station.

COOPERATION.—Complete records furnished by United States Reclamation Service.

Daily discharge, in second-feet, of Wagon Hound Creek near La Bonte, Wyo., for the year ending Sept. 30, 1917.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Day.	Apr.	May.	June.	July.	Aug.	Sept.
1	.....	108	221	3.0	0.2	0.2	16	.....	136	25	1.0	0.2	0.2
2	.....	121	194	3.0	.2	.2	17	48	207	23	1.0	.2	.2
3	.....	136	179	3.0	.2	.2	18	48	108	23	1.0	.2	.2
4	.....	108	165	3.0	.2	.2	19	92	179	17	1.0	.2	.2
5	.....	121	150	3.0	.2	.2	20	92	342	13	1.0	.2	.2
6	.....	108	136	3.0	.2	.2	21	92	248	13	1.0	.2	.2
7	.....	121	121	3.0	.2	.2	22	108	289	9	1.0	.2	.2
8	.....	108	108	1.0	.2	.2	23	136	248	9	1.0	.2	.2
9	.....	92	92	1.0	.2	.2	24	165	221	9	1.0	.2	.2
10	.....	136	92	1.0	.2	.2	25	108	330	9	1.0	.2	.2
11	.....	150	82	1.0	.2	.2	26	150	342	6	1.0	.2	.2
12	.....	150	69	1.0	.2	.2	27	121	275	6	1.0	.2	.2
13	.....	303	59	1.0	.2	.2	28	136	289	6	1.0	.2	.2
14	.....	179	48	1.0	.2	.2	29	108	261	3	1.0	.2	.2
15	.....	194	35	1.0	.2	.2	30	121	248	3	1.0	.2	.2
							31	.....	248	.....	1.0	.2	.....

Monthly dischargeof Wagon Hound Creek near La Bonte, Wyo., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
April 17-30	165	48	109	3,020
May	342	92	197	12,100
June	221	3	64.2	3,820
July	3.0	1.0	1.45	89
August	.2	.2	.20	12.3
September	.2	.2	.20	11.9
The period				19,100

NOTE.—Figures have been changed slightly to comform to computation rules of the United States Geological Survey.

LA BONTE CREEK NEAR LA BONTE, WYO.

LOCATION.—Approximately in sec. 15, T. 31 N., R. 71 W., at Soden's ranch, near mouth of creek, 2 miles east of La Bonte, in Converse County.

DRAINAGE AREA.—270 square miles (measured on base map of Wyoming; scale, 1:500,000).

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

DIVERSIONS.—Prior to December 31, 1916, there were adjudicated diversions of 34 second-feet from La Bonte Creek, all above station.

COOPERATION.—Complete records furnished by United States Reclamation Service.

Daily discharge, in second-feet, of La Bonte Creek near La Bonte, Wyo., for the year ending Sept. 30, 1917.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Day.	Apr.	May.	June.	July.	Aug.	Sept.
1	.....	242	1,110	29	0	0	16	136	978	275	3	0	1
2	.....	270	1,120	29	0	0	17	131	945	265	2	0	0
3	.....	332	925	23	0	0	18	187	806	202	2	0	0
4	.....	390	1,020	15	0	0	19	250	873	173	2	0	0
5	.....	360	953	13	0	0	20	225	1,300	156	2	1	0
6	37	303	821	12	0	0	21	292	1,260	136	2	1	0
7	37	335	715	10	0	0	22	375	1,090	131	2	1	0
8	37	335	695	8	0	0	23	465	828	111	2	1	0
9	67	332	657	5	0	1	24	635	473	94	2	1	0
10	124	292	640	4	0	1	25	497	998	77	2	1	0
11	107	345	591	3	0	1	26	475	1,730	63	1	1	0
12	120	498	490	3	0	1	27	355	1,530	57	1	1	0
13	240	437	441	3	0	1	28	292	1,750	53	4	1	0
14	225	718	368	3	0	1	29	263	1,580	41	0	0	0
15	166	855	324	3	0	1	30	247	1,530	36	0	0	0
							31	.....	1,210	.....	0	0	.....

NOTE.—Figures have been changed slightly to conform to computation rules of the United States Geological Survey.

Monthly discharge of La Bonte Creek near La Bonte, Wyo., fort he year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
April 6-30	635	37	239	11,900
May	1,750	242	805	49,500
June	1,120	36	425	25,300
July	29	0	6.1	375
August	1	0	.3	18.4
September	1	0	.3	17.9
The period				87,100

HORSESHOE CREEK NEAR GLENDO, WYO.

LOCATION.—Approximately in sec. 26, T. 29 N., R. 68 W., at Hauf's ranch, near mouth of creek, 4 miles southeast of Glendo, in Platte County.

DRAINAGE AREA.—203 square miles (measured on base map of Wyoming; scale, 1:500,000).

RECORDS AVAILABLE.—April 16, 1916, to September 2, 1917.

DIVERSIONS.—Prior to December 31, 1916, there were adjudicated diversions of 81 second-feet from Horseshoe Creek, all above station.

COOPERATION.—Complete records furnished by United States Reclamation Service.

Daily discharge, in second-feet, of Horseshoe Creek near Glendo, Wyo., for the year ending Sept. 30, 1917.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Day.	Apr.	May.	June.	July.	Aug.	Sept.
1....	28	157	943	45	9	2	16....	123	425	334	21	4	2
2....	24	123	842	36	9	2	17....	194	438	293	21	4	2
3....	24	175	842	36	9	2	18....	194	395	273	18	4	2
4....	24	212	812	36	9	2	19....	194	374	253	18	3	2
5....	24	253	748	36	6	2	20....	212	487	212	16	3	2
6....	24	212	642	36	6	2	21....	212	623	175	16	3	2
7....	28	212	540	28	6	2	22....	212	580	139	16	3	2
8....	35	212	457	28	6	2	23....	232	540	73	16	3	2
9....	45	212	374	28	6	2	24....	232	540	73	16	3	2
10....	45	232	374	28	5	2	25....	212	642	73	14	3	2
11....	45	253	374	28	5	2	26....	212	748	232	14	2	2
12....	53	273	354	27	5	2	27....	194	842	54	14	2	2
13....	53	293	354	27	5	2	28....	184	943	54	12	2	2
14....	65	318	354	27	4	2	29....	175	943	45	12	2	2
15....	65	364	334	21	4	2	30....	175	1,040	45	12	2	2
							31....	.....	1,040	.....	12	2	.....

Monthly discharge of Horseshoe Creek near Glendo, Wyo., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
April	232	24	118	7,020
May	1,040	123	455	28,000
June	943	45	356	21,200
July	45	12	23.1	1,420
August	9	2	4.5	277
September	2	2	2.0	119
The period				58,000

NOTE.—Figures have been changed slightly to conform to computation rules of the United State Geological Survey.

COTTONWOOD CREEK NEAR WENDOVER, WYO.

LOCATION.—Approximately in sec. 16, T. 27 N., R. 67 W., near mouth of creek, 1½ miles south of Wendover, in Platte County.

DRAINAGE AREA.—150 square miles (measured on base map of Wyoming; scale, 1:500,000).

RECORDS AVAILABLE.—April 19, 1916, to September 30, 1917.

DIVERSIONS.—Prior to December 31, 1916, there were adjudicated diversions of 32 second-feet from Cottonwood Creek, all above station.

COOPERATION.—Complete records furnished by United States Reclamation Service.

Daily discharge, in second-feet, of Cottonwood Creek near Wendover, Wyo., for the year ending Sept. 30, 1917.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Day.	Apr.	May.	June.	July.	Aug.	Sept.
1	.....	24	340	18	2.0	2.2	16	4.6	139	38	4.4	2.4	2.4
2	.....	27	321	18	2.0	2.2	17	4.6	122	36	3.4	2.4	2.4
3	.....	28	250	7.4	1.8	2.4	18	5.0	122	36	3.4	1.8	2.4
4	.....	38	246	7.4	1.8	2.4	19	5.0	73	36	3.4	1.8	2.4
5	4.4	64	209	6.0	2.2	2.4	20	6.4	137	36	3.4	1.8	2.4
6	4.4	64	209	6.0	2.4	2.4	21	6.0	137	21	3.4	1.8	2.4
7	4.4	62	182	5.0	2.4	2.4	22	6.0	137	21	3.4	1.8	2.4
8	4.4	62	172	4.4	2.4	2.4	23	8.4	135	17	3.4	1.8	2.4
9	4.4	52	162	4.4	2.4	2.4	24	15.5	135	12	3.4	1.8	3.0
10	4.4	52	148	4.4	2.4	2.4	25	22.4	302	11	3.4	1.8	3.0
11	4.4	52	148	4.4	2.4	2.4	26	22.4	445	11	3.4	1.8	3.0
12	4.4	69	120	4.4	2.4	2.4	27	22.4	419	255	3.4	1.8	3.0
13	4.4	96	110	4.4	2.4	2.4	28	21.5	368	38	3.4	1.8	3.0
14	4.6	116	87	4.4	2.4	2.4	29	21.5	364	28	2.0	2.2	3.0
15	4.6	139	52	4.4	2.4	2.4	30	22.8	368	20	2.0	2.2	3.0
							31	.....	354	.....	2.0	2.2	.....

Monthly discharge of Cottonwood Creek near Wendover, Wyo., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
April 5-30	22.8	4.4	9.36	482
May	445	24	152	9,350
June	340	11	112	6,660
July	18	2.0	4.97	306
August	2.4	1.8	2.10	129
September	3.0	2.2	2.53	151
The period	.....	.....	.....	17,100

NOTE.—Figures have been changed slightly to conform with computation rules of the United States Geological Survey.

LARAMIE RIVER NEAR JELM, WYO.

LOCATION.—In sec. 15, T. 12 N., R. 77 W., at highway bridge at Boswell's ranch a quarter of a mile below Colorado-Wyoming line, 4 miles south of Jelm, in Albany County.

DRAINAGE AREA.—293 square miles (measured on base map of Wyoming; scale, 1:500,000).

RECORDS AVAILABLE.—May 7, 1911, to September 30, 1917. From June 22, 1904, to October 31, 1905, a station was maintained at Decker's ranch, half a mile south of the State line. The records at the two stations are comparable, as no large tributaries or diversions intervene.

GAGE.—Bristol water-stage recorder on downstream side of right bridge abutment.

DISCHARGE MEASUREMENTS.—Made from two-span bridge or by wading.

CHANNEL AND CONTROL.—Channel composed of gravel; control a short distance downstream, slightly shifting. Left bank is overflowed at gage height 3.0 feet. Flow passes through three well-defined, high-stage channels.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 3.92 feet at 8.30 a. m. June 23 (discharge, 3,390 second-feet); minimum discharge occurs during winter.

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

DIVERSIONS.—Court decrees for diversions of 349 second-feet from Laramie River above station and 800 second-feet from tributaries. Of this amount 688 second-

feet are for diversion into the Cache La Poudre drainage basin. During 1917, 11,502 acre-feet were diverted between July 3 and December 1. Also a conditional decree not exceeding 1,235 second-feet into the Cache La Poudre basin through the Laramie-Poudre tunnel. During 1917 tunnel diverted 392 acre-feet between August 4 and 25.

REGULATION.—None.

COOPERATION.—Station maintained in cooperation with the State engineer of Colorado, and records published as furnished by that office. Check measurements made by engineers of the United States Geological Survey.

ACCURACY.—Stage-discharge relation changed slightly during period when gage was not read. Rating curve used October 1–14 well defined between 40 and 200 second-feet; curve used April 24 to September 30 well defined between 40 and 3,000 second-feet. The operation of the water-stage recorder was satisfactory. Daily discharge ascertained by applying to rating table mean daily gage height determined by inspecting the gage-height graph. Records only fair because of the small scale of the Bristol gage-height graph.

Discharge measurements of Laramie River near Jelm, Wyo., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
May 18	H. W. Fear	2.90	994	Aug. 14	J. H. Baily	1.40	147
June 18	Robert Follansbee	3.75	2,870	29	do	1.28	121
July 1	W. A. Whitney	3.64	2,330				

Daily discharge, in second-feet, of Laramie River near Jelm, Wyo., for the year ending Sept. 30, 1917.

Day.	Oct.	Apr.	May.	June.	July.	Aug.	Sept.
1	80	.....	154	512	2,300	305	93
2	100	.....	141	512	2,020	288	93
3	110	.....	154	576	1,780	269	93
4	110	.....	128	728	1,480	269	93
5	80	.....	116	648	1,480	232	93
6	110	.....	116	818	1,480	218	93
7	110	.....	116	818	1,390	202	93
8	110	.....	104	970	1,310	202	93
9	100	.....	128	2,160	1,090	186	93
10	100	.....	141	2,460	1,090	222	93
11	80	.....	168	2,620	1,680	205	93
12	80	.....	183	2,160	1,090	146	82
13	90	.....	199	1,900	818	146	82
14	80	.....	309	1,900	728	146	82
15	.....	.....	512	2,300	685	146	82
16	.....	.....	770	2,460	583	136	82
17	.....	.....	970	2,300	518	111	82
18	.....	.....	1,030	2,800	432	100	82
19	.....	.....	1,030	2,460	487	111	82
20	.....	.....	1,030	2,460	493	136	82
21	.....	.....	1,090	2,620	437	149	72
22	.....	.....	918	2,800	386	149	72
23	.....	.....	770	2,970	339	149	72
24	.....	215	648	2,800	470	149	72
25	.....	199	576	2,970	416	149	72
26	.....	183	512	2,970	470	151	62
27	.....	154	454	2,620	391	166	62
28	.....	168	512	2,300	367	166	62
29	.....	141	512	2,160	284	114	62
30	.....	154	481	2,300	305	114	62
31	.....	.....	610	.....	371	91	.....

NOTE.—July 16–Sept. 30, discharge computed by shifting-control method.

Monthly discharge of Laramie River near Jelm, Wyo., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October 1-14	110	80	95.7	2,660
April 24-30	215	141	173	2,400
May	1,090	104	470	28,900
June	2,970	512	2,000	119,000
July	2,300	284	876	53,900
August	305	91	172	10,600
September	93	62	81.0	4,820

LARAMIE RIVER AND PIONEER CANAL NEAR WOODS, WYO.

LOCATION.—In sec. 36, T. 14 N., R. 77 W., at diversion dam for Pioneer canal, 2 miles above Woods post office, Albany County. Nearest important tributary, Fox Creek, enters 3 miles above.

DRAINAGE AREA.—409 square miles (measured on base map of Wyoming; scale, 1:500,000.)

RECORDS AVAILABLE.—April 16, 1912, to September 12, 1917. From 1895 to 1900, and from May 7 to November 11, 1911, a station was maintained at Woods Landing in sec. 11, T. 13 N., R. 77 W. The records are not directly comparable, as Fox Creek enters between and a few small ditches divert water.

GAGE.—Bristol water-stage recorder with its datum at the crest of dam, was moved September 23, 1915, to upper wing wall of head gates, and although actually above canal intake, it still indicates flow over dam as it is the pool formed by diversion dam. Gage originally at left end of dam just below Pioneer canal head gates. Chain gage in Pioneer canal is at Johnson Bridge, 1½ miles below intake; read by Wesley Johnson.

DISCHARGE MEASUREMENTS.—Made from cable 2,000 feet above dam. Measurement of Pioneer canal made at Johnson Bridge and this quantity is subtracted from flow at cable to determine flow at diversion dam.

CHANNEL AND CONTROL.—Channel at gage is pool formed by concrete diversion dam about 2 feet high. Control is dam itself and is permanent. Banks high and will not overflow. Stage of zero flow is 0.00 foot. Bed of canal composed of shale which changes somewhat; control at concrete drop 1 mile downstream.

EXTREMES OF DISCHARGE.—Laramie River: Maximum stage during year from water-stage recorder, 4.4 feet from 8 a. m. to noon June 23 (discharge, 3,310 second-feet); minimum stage recorded (mean for day), 0.08 foot November 6 (discharge, 12 second-feet).

Pioneer canal: Maximum stage recorded, 5.8 feet at 9.20 a. m. June 19 (discharge, 818 second-feet); minimum discharge of about 2 second-feet occurs during winter when gates are closed.

ICE.—Stage-discharge relation seldom affected by ice as crest of dam is kept free from ice.

DIVERSIONS.—By decree of district court dated December 27, 1912, there were adjudicated diversions of about 10 second-feet from Laramie River between the State line and Pioneer dam, exclusive of the Pioneer canal, which has decrees for 282 second-feet.

REGULATION.—None, as pond above dam is too small to have any appreciable effect on flow. Whenever canal head gates are closed the discharge over dam increases.

ACCURACY.—Laramie River station: Stage-discharge relation practically permanent; slightly affected by ice. Rating curve is well defined between 20 and 1,800 second-feet. Operation of the water-stage recorder was satisfactory throughout

the year. Daily discharge ascertained by applying to rating table mean daily gage height determined by inspecting gage-height graph.

Pioneer canal station: Stage-discharge relation slightly shifting. Rating curve used October 1 to November 9 well defined between 20 and 100 second-feet, and curve used April 25 to September 30 well defined between 10 and 1,000 second-feet. Gage read to quarter-tenths once or twice daily. Daily discharge ascertained by applying the one daily gage height or the mean of two daily gage heights to the rating table. Records are good except for periods of missing gage height, when they are fair.

Discharge measurements of Laramie River near Woods, Wyo., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Oct. 18	H. K. Smith	0.26	40.5	July 28	S. B. Soulé	1.02	345
Jan. 8	do	.32	61	Sept. 13	do	.40	76
May 19	H. W. Fear	2.46	1,530				

Daily discharge, in second-feet, of Laramie River near Woods, Wyo., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	42	15	81	58	60	42	65	131	720	1,700	222	76
2	46	15	81	60	58	46	60	128	720	1,470	208	68
3	55	15	84	63	58	51	55	111	624	1,250	185	63
4	55	15	81	68	55	53	55	114	448	1,000	165	55
5	55	15	81	71	55	51	58	131	522	928	153	63
6	65	12	73	65	51	44	55	105	484	1,100	128	63
7	68	12	68	60	51	37	60	102	378	1,160	121	71
8	63	12	68	63	55	44	71	93	600	1,140	111	68
9	60	12	73	58	63	48	78	102	1,120	1,060	96	51
10	55	87	65	58	60	46	84	99	2,010	1,040	118	51
11	53	87	60	63	55	44	105	111	2,320	1,340	105	55
12	53	87	63	63	55	42	131	142	2,100	1,130	96	55
13	55	87	60	60	53	37	177	185	2,010	880	96	68
14	55	87	68	55	53	40	177	333	1,960	760	93	68
15	44	87	76	53	55	42	145	499	2,010	680	96	76
16	33	87	68	44	58	44	128	816	2,240	568	102	68
17	44	96	68	44	55	44	145	1,120	2,420	484	102	60
18	48	96	73	46	55	44	145	1,340	2,370	448	90	55
19	42	90	65	51	53	40	138	1,420	2,320	499	90	55
20	35	84	60	53	48	35	111	920	2,280	522	165	44
21	35	81	63	53	44	35	114	680	2,320	448	165	44
22	35	81	68	54	51	37	128	507	2,640	412	165	44
23	33	81	71	56	53	42	157	448	2,910	378	153	37
24	29	87	68	57	53	42	190	484	2,550	412	153	35
25	28	90	68	58	51	41	185	522	2,460	412	145	33
26	29	87	68	58	40	40	208	448	2,280	345	145	33
27	28	81	63	60	35	33	194	412	2,140	284	128	46
28	26	81	63	58	40	33	149	560	1,920	284	128	60
29	20	81	65	58	.....	43	138	640	1,780	258	96	68
30	20	81	63	55	.....	53	134	680	1,830	258	96	55
31	15	.....	60	55	.....	68	.....	816	.....	231	81	.....

NOTE.—Jan. 22-24, Mar. 25, 29, stage-discharge relation affected by ice; discharge interpolated. Nov. 7-14, Apr. 30-May 1, 28-29, July 27-31, no gage-height record as water-stage recorder was out of order; discharge estimated.

Monthly discharge of Laramie River near Woods, Wyo., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	68	15	42.7	2,630
November	96	12	64.3	3,830
December	84	60	68.9	4,240
January	71	44	57.4	3,530
February	63	35	52.6	2,920
March	68	33	43.3	2,660
April	208	55	121	7,200
May	1,420	93	458	28,200
June	2,910	378	1,750	104,000
July	170	231	738	45,400
August	222	81	129	7,930
September	76	33	56.3	3,350
The year	2,910	12	298	216,000

NOTE.—The above tables do not include the discharge of Pioneer canal, which diverts water from the pool in which the gage is located.

Discharge measurements of Pioneer canal near Woods, Wyo., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
May 19	H. W. Fear	2.14	136	July 28	S. B. Soulé	1.96	106
June 18	Robert Follansbee	5.79	802	Sept. 13	do	.79	12.6

Daily discharge, in second-feet, of Pioneer canal near Woods, Wyo., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Apr.	May.	June.	July.	Aug.	Sept.
1	47	70	.....	40	119	657	101	15
2	47	70	.....	46	119	606	92	14
3	48	70	.....	52	508	126	87	13
4	48	70	.....	58	581	126	87	13
5	48	70	.....	64	606	126	87	13
6	49	70	.....	69	606	126	87	13
7	49	70	.....	72	631	126	82	20
8	49	70	.....	76	683	126	78	16
9	52	70	.....	80	736	126	78	13
10	55	.....	.....	84	581	126	78	13
11	58	.....	.....	87	556	126	78	13
12	61	.....	.....	92	606	126	71	13
13	64	.....	.....	97	631	126	64	13
14	66	.....	.....	102	631	126	60	13
15	68	.....	.....	107	709	126	60	13
16	70	.....	.....	112	736	126	60	13
17	70	.....	.....	117	485	126	60	13
18	70	.....	.....	122	790	126	60	13
19	70	.....	.....	126	818	126	78	13
20	70	.....	.....	252	657	126	19	13
21	70	.....	.....	295	736	121	16	13
22	70	.....	.....	295	790	121	16	13
23	70	.....	.....	310	508	116	16	13
24	70	.....	.....	380	581	121	16	13
25	70	.....	5	136	606	121	16	13
26	70	.....	10	380	683	116	14	13
27	70	.....	16	295	709	111	16	13
28	70	.....	22	280	709	111	16	13
29	70	.....	28	420	709	106	16	13
30	70	.....	34	119	736	106	16	13
31	70	.....	.....	119	.....	111	16	.....

NOTE.—Nov. 10–Apr. 24 gates closed; discharge estimated at 2 second-feet. Oct. 1–7, 9–15, 17–23, 25–31, Nov. 2–9, Apr. 26–May 5, 7–10, 12–18, July 3–13, Sept. 1–3, 9–12, 14–30 discharge estimated, as gage was not read.

Monthly discharge of Pioneer canal near Woods, Wyo., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	70	47	62.2	3,820
November	70	2	22.4	1,330
December	.....	.....	2	123
January	.....	.....	2	123
February	.....	.....	2	111
March	.....	.....	2	123
April	34	2	5.4	321
May	420	40	158	9,720
June	818	119	619	36,800
July	657	106	155	9,530
August	101	14	52.9	3,250
September	20	13	13.4	797
The year	818	.....	91.2	66,000

Combined monthly discharge of Laramie River and Pioneer canal near Woods, Wyo., for, the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	121	85	105	6,460
November	98	82	86.7	5,160
December	86	62	70.9	4,360
January	73	46	59.4	3,650
February	65	37	54.6	3,030
March	70	35	45.3	2,790
April	218	57	126	7,500
May	1,550	163	616	37,900
June	3,420	839	2,370	141,000
July	2,360	342	893	54,900
August	323	97	182	11,200
September	91	46	69.7	4,150
The year	3,420	35	389	282,000

LARAMIE RIVER AT TWO RIVERS, WYO.

LOCATION.—In sec. 5, T. 17 N., R. 74 W., at highway bridge at Two Rivers, Albany County. Nearest tributary, Little Laramie River, enters a quarter of a mile below.

DRAINAGE AREA.—1,290 square miles (measured on base map of Wyoming; scale 1:500,000).

RECORDS AVAILABLE.—May 6, 1911, to October 31, 1912; October 1, 1913, to August 15, 1917. Station maintained by State engineer during 1913 and 1914.

GAGE.—Bristol water-stage recorder on left bank just above bridge. Gage used since 1915 was referred to datum 0.74 foot higher than that of 1912. Gage on left bank 400 feet above bridge used during 1913 and 1914.

DISCHARGE MEASUREMENTS.—Made from bridge or by wading.

CHANNEL AND CONTROL.—Bed composed of sand and gravel, and is shifting; no well-defined control. Banks are high and not subject to overflow.

EXTREMES OF DISCHARGE.—Maximum from water-stage recorder, 6.35 feet on June 22, 25, and 26 (discharge, 2,560 second-feet); minimum probably occurs during winter.

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

DIVERSIONS.—By decree of district court dated December 27, 1912, there were adjudicated diversions of 414 second-feet from Laramie River between this and the station near Woods.

REGULATION.—None.

ACCURACY.—Stage-discharge relation slightly shifting; affected by ice during winter. Rating curve well defined between 20 and 2,600 second-feet. The operation of the water-stage recorder was satisfactory except for a few days, as explained in footnote. Daily discharge ascertained by applying to the rating table the mean daily gage heights determined by inspecting gage-height graph, except for periods April 16 to June 15 and June 23 to August 15, when discharge was computed by indirect method for shifting control. Records good.

Discharge measurements of Laramie River at Two Rivers, Wyo., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Apr. 20	H. K. Smith	1.87	210	July 29	S. B. Soulé	2.50	332
June 21	Robert Follansbee	6.25	2,480	Sept. 15	do	1.12	62

Daily discharge, in second-feet, of Laramie River at Two Rivers, Wyo., for the year ending Sept. 30, 1917.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Day.	Apr.	May.	June.	July.	Aug.	Sept.
1	.....	193	1,140	1,940	289	.....	16	228	232	2,330	800	.....	62
2	.....	203	1,320	1,870	276	.....	17	206	352	2,300	686	.....	62
3	.....	226	1,290	1,830	263	.....	18	228	566	2,330	600	.....	61
4	.....	223	1,160	1,720	228	.....	19	239	726	2,440	526	.....	60
5	.....	212	961	1,450	217	.....	20	239	868	2,520	509	.....	56
6	.....	201	884	1,160	195	.....	21	228	1,050	2,520	526	.....	54
7	.....	191	884	1,040	174	.....	22	195	1,080	2,560	492	.....	50
8	.....	178	884	1,130	164	.....	23	195	1,000	2,480	424	.....	48
9	.....	164	853	1,160	158	.....	24	195	843	2,480	361	.....	.....
10	.....	151	956	1,100	153	.....	25	228	748	2,550	331	.....	.....
11	.....	149	1,220	1,190	147	.....	26	251	889	2,550	361	.....	.....
12	.....	140	1,540	1,280	147	.....	27	249	1,170	2,510	361	.....	.....
13	.....	140	1,960	1,370	144	.....	28	226	1,110	2,430	376	.....	.....
14	.....	149	2,420	1,210	135	.....	29	237	940	2,240	346	.....	.....
15	.....	178	2,380	924	129	62	30	214	814	2,130	331	.....	.....
							31	.....	940	.....	302	.....	.....

NOTE.—May 8–9, July 11–12, no gage-height record, as water-stage recorder was out of order; discharge interpolated.

Monthly discharge of Laramie River at Two Rivers, Wyo., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
April 16–30	251	195	224	6,660
May	1,170	140	517	31,800
June	2,560	853	1,870	111,000
July	1,940	302	894	55,000
August 1–15	289	129	188	5,590

LARAMIE RIVER NEAR LOOKOUT, WYO.

LOCATION.—About sec. 33, T. 21 N., R. 74 W., at steel highway bridge 9 miles northeast of Lookout, Albany County. No important tributary between station and Wheatland reservoir No. 2, a short distance downstream.

DRAINAGE AREA.—2,100 square miles (measured on base map of Wyoming; scale, 1:500,000).

RECORDS AVAILABLE.—April 22, 1915, to August 30, 1917. State engineer maintained station at this point during 1913 and 1914.

GAGE.—Bristol water-stage recorder on upstream side of right bridge abutment.

DISCHARGE MEASUREMENTS.—Made from single-span bridge or by wading.

CHANNEL AND CONTROL.—Bed composed of sand and silt. Control a short distance downstream; shifts slightly at intervals; practically permanent during 1917.

EXTREMES OF DISCHARGE.—Maximum stage during year occurred June 26, at a time when recording gage was not in operation; discharge as estimated from flow at other Laramie River stations, 3,100 second-feet. Minimum discharge probably occurs during winter.

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

DIVERSIONS.—By decree of district court dated December 27, 1912, there were adjudicated diversions of 211 second-feet from Laramie River between Two Rivers and Lookout station.

REGULATION.—None.

ACCURACY.—Stage-discharge relation practically permanent; affected by ice during winter. Rating curve used October 1 to 22 well defined between 20 and 100 second-feet; curve used April 17 to September 30 well defined between 20 and 2,800 second-feet. Operation of the water-stage recorder fairly satisfactory except for intervals as explained in footnote. Daily discharge ascertained by applying to the rating tables mean daily gage heights determined by inspecting gage-height graph. Records good, except during periods when there was no gage-height record, when they are fair.

Discharge measurements of Laramie River near Lookout, Wyo., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*
June 19	Robert Follansbee	5.56	2,580
July 30	S. B. Soulé	2.70	467
Sept. 14	....do	1.59	72

Daily discharge, in second-feet, of Laramie River near Lookout, Wyo., for the year ending Sept. 30, 1917.

Day.	Oct.	Apr.	May.	June.	July.	Aug.	Day.	Oct.	Apr.	May.	June.	July.	Aug.
1	34	.....	384	1,230	2,150	430	16	27	.....	244	2,380	1,160	140
2	34	.....	361	1,160	2,200	384	17	27	1,460	280	2,290	1,010	140
3	34	.....	430	1,080	2,120	361	18	27	1,160	406	2,290	806	140
4	34	.....	505	1,010	2,040	300	19	34	1,620	589	2,470	679	140
5	34	.....	454	940	1,780	280	20	42	1,300	806	2,580	618	178
6	34	.....	406	872	1,540	262	21	34	872	940	2,520	618	194
7	34	.....	361	806	1,300	224	22	20	702	1,230	2,450	648	53
8	34	.....	340	872	1,380	210	23	.....	532	1,300	2,400	589	73
9	34	.....	300	872	1,540	194	24	.....	361	1,080	2,600	532	91
10	34	.....	280	940	1,540	172	25	.....	361	940	3,000	480	77
11	34	.....	262	1,080	1,540	166	26	.....	384	940	3,100	454	84
12	34	.....	244	1,460	1,540	166	27	.....	742	1,080	2,800	532	108
13	34	.....	244	1,700	1,950	154	28	.....	1,860	1,380	2,600	532	77
14	34	.....	244	2,120	1,950	157	29	.....	1,620	1,380	2,500	480	57
15	20	.....	244	2,470	1,460	145	30	.....	940	1,380	2,350	430	50
							31	.....	.....	1,300	.....	454	50

NOTE.—Oct. 2-10, Apr. 22-23, June 20-July 2, no gage-height record, because water-stage recorder was out of order. Discharge interpolated Oct. 2-10, Apr. 22-23, and based on comparative hydrograph of Laramie River near Woods June 20-July 2.

Monthly discharge of Laramie River near Lookout, Wyo., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October 1–22	42	20	32.1	1,400
April 17–30	1,860	361	994	27,600
May	1,380	244	656	40,300
June	3,100	806	1,900	113,000
July	2,200	430	1,120	68,900
August	430	50	170	10,500

LARAMIE RIVER BELOW McGILL, WYO.

LOCATION.—In sec. 33, T. 23 N., R. 73 W., at J. T. Dodge's ranch, 8 miles below McGill, Albany County. No tributary between station and outlet of Wheatland reservoir No. 2.

DRAINAGE AREA.—2,230 square miles (measured on base map of Wyoming; scale, 1:500,000).

RECORDS AVAILABLE.—May 4, 1916, to September 13, 1917.

GAGE.—Bristol recording gage referred to vertical staff on left abutment of private bridge; read by Mrs. Mary E. Dodge.

DISCHARGE MEASUREMENTS.—Made from single-span bridge or by wading.

CHANNEL AND CONTROL.—Channel composed of coarse gravel; control at small rapids 100 feet downstream, which are apparently permanent.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 5.6 feet June 26–30 (discharge, 2,860 second-feet); minimum stage occurs during winter, when flow is practically zero due to storage in Wheatland reservoir.

ICE.—No data.

DIVERSIONS.—One small diversion between station and that near Lookout (see "Regulation").

REGULATION.—Flow shows effect of storage in Wheatland reservoir, which has an adjudicated decree for 633 second-feet and a storage capacity of about 110,000 acre-feet. Flow entirely regulated by reservoir, as river passes through it.

ACCURACY.—Stage-discharge relation practically permanent. Rating curve well defined up to 2,600 second-feet. Operation of water-stage recorder fairly satisfactory. Daily discharge ascertained by applying to rating table the mean daily gage height determined by inspecting gage-height graph. Records good.

Discharge measurements of Laramie River below McGill, Wyo., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*
June 19	Robert Follansbee	4.70	2,140
July 30	S. B. Soule	2.68	739
Sept. 14	....do	1.58	176

Daily discharge, in second-feet, of Laramie River below McGill, Wyo., for the year ending Sept. 30, 1917.

Day.	May.	June.	July.	Aug.	Sept.	Day.	May.	June.	July.	Aug.	Sept.
1			2,700	670	408	16		1,860	1,780	610	
2			2,540	670	380	17	47	2,000	1,700	610	
3			2,160	670	380	18	48	2,080	1,630	610	
4			2,160	670	380	19	50	2,230	1,490	580	
5			1,860	670	380	20	50	2,300	1,420	520	
6			1,630	640	323	21	48	2,380	1,350	520	
7			1,420	640	265	22	45	2,540	1,350	490	
8			1,350	640	285	23	38	2,700	1,350	490	
9			1,420	640	228	24	36	2,780	1,280	490	
10		930	1,630	640	195	25	42	2,780	1,350	520	
11		898	1,700	640	195	26	50	2,860	1,350	490	
12		865	1,780	640	166	27	50	2,860	1,280	462	
13		1,280	1,780	640	141	28		2,860	1,280	435	
14		1,490	1,780	640		29		2,860	1,280	380	
15		1,630	1,860	640		30		2,860	768	380	
						31			720	380	

Monthly discharge of Laramie River below McGill, Wyo., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
May 17–27	50	36	45.8	999
June 10–30	2,860	865	2,140	89,100
July	2,700	720	1,590	97,800
August	670	380	572	35,200
September 1–13	408	141	287	7,400

LARAMIE RIVER AT FORT LARAMIE, WYO.

LOCATION.—At highway bridge in sec. 28, T. 26 N., R. 64 W., at Fort Laramie, in Goshen County. No important tributary between station and mouth, 1½ miles below.

DRAINAGE AREA.—4,580 square miles (measured on base map of Wyoming; scale, 1:500,000).

RECORDS AVAILABLE.—April 4, 1915, to September 30, 1917.

GAGE.—Vertical staff.

DISCHARGE MEASUREMENTS.—Made from highway bridge.

CHANNEL AND CONTROL.—No data.

EXTREMES OF DISCHARGE.—Data not available.

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

DIVERSIONS.—By decree of district court dated December 27, 1912, there are adjudicated diversions of 61 second-feet between station below McGill and Fort Laramie.

REGULATION.—(See Laramie River below McGill.)

COOPERATION.—Complete records furnished by United States Reclamation Service.

Daily discharge, in second-feet, of Laramie River at Fort Laramie, Wyo., for the year ending Sept. 30, 1917.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Day.	Apr.	May.	June.	July.	Aug.	Sept.
1....	35	292	3,560	3,260	240	110	16....	230	1,340	2,390	1,640	220	106
2....	43	318	3,560	3,200	220	110	17....	220	1,420	2,390	1,500	175	69
3....	75	292	3,700	2,980	220	108	18....	175	1,480	2,540	1,340	130	64
4....	60	340	3,560	2,840	175	105	19....	216	1,280	2,540	1,120	130	60
5....	43	380	4,000	2,690	175	96	20....	200	1,500	2,390	900	150	60
6....	35	398	4,280	1,710	780	92	21....	175	1,840	2,390	692	160	83
7....	28	420	4,140	1,500	292	89	22....	160	2,120	2,390	600	132	92
8....	24	410	4,000	1,280	268	89	23....	212	2,060	2,390	518	108	92
9....	20	448	3,840	1,500	268	92	24....	370	1,640	2,540	445	100	92
10....	20	465	3,560	800	240	92	25....	620	1,870	2,690	692	89	96
11....	20	388	3,200	924	220	92	26....	448	2,140	2,840	1,050	79	78
12....	268	465	2,090	924	220	92	27....	420	2,760	3,200	780	79	69
13....	248	692	1,640	986	175	92	28....	350	2,980	3,700	518	89	83
14....	340	900	1,790	986	150	118	29....	270	3,050	3,260	345	108	83
15....	400	1,050	2,100	1,640	195	118	30....	292	3,200	3,260	320	160	96
							31....	.....	3,490	.....	270	130	.....

NOTE.—Figures have been changed slightly to conform to computation rules of United States Geological Survey.

Monthly discharge of Laramie River at Fort Laramie, Wyo., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
April	620	20	201	12,000
May	3,490	292	1,340	82,000
June	4,280	1,640	3,000	179,000
July	3,260	270	1,290	79,300
August	780	79	190	11,700
September	118	60	90.6	5,390
The period	.....	.....	.....	370,000

LITTLE LARAMIE RIVER NEAR FILMORE, WYO.

LOCATION.—In sec. 9, T. 15 N., R. 77 W., at private bridge at May's ranch, 1½ miles south of Filmore, Albany County. No important tributary between station and junction of North, Middle, and South forks, 4 miles above.

DRAINAGE AREA.—155 square miles (measured on base map of Wyoming; scale, 1:500,000).

RECORDS AVAILABLE.—July 5, 1902, to August 15, 1903; May 14, 1911, to October 31, 1912; April 1, 1915, to September 30, 1917. State engineer maintained station at this point during 1913 and 1914.

GAGE.—Vertical staff on downstream side of left bridge abutment; read by Claude May. Gage used since April 1, 1915, was referred to datum 0.21 foot lower than gage, at same location, used during 1911 and 1912.

DISCHARGE MEASUREMENTS.—Made from single-span bridge or by wading.

CHANNEL AND CONTROL.—Channel composed of coarse gravel and small boulders; shifted slightly during 1917. No well-defined control. During high water there is flow through channel around right end of bridge.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 4.7 feet at 7 a. m. June 23 and 5 a. m. June 25 (discharge, 1,920 second-feet); minimum stage probably occurs during winter.

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

DIVERSIONS.—Prior to December 31, 1916, there were adjudicated diversions of 43 second-feet from the Little Laramie above station, and 255 second-feet from tributaries entering above.

REGULATION.—None.

ACCURACY.—Stage-discharge relation not permanent; affected by ice during winter. Rating curve used October 1 to November 7 fairly well defined between 20 and 200 second-feet; curve used April 15 to July 31 well defined between 20 and 1,800 second-feet; shifting-control method used August 1 to September 30. Gage read to hundredths twice daily. Daily discharge ascertained by applying mean daily gage height to the rating table. Records good.

Discharge measurements of Little Laramie River near Filmore, Wyo., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
May 18	H. W. Fear	2.04	231	July 28	S. B. Soulé	2.04	233
June 20	Robert Follansbee	4.42	1,700	Sept. 13	do	1.00	38.0

Daily discharge, in second-feet, of Little Laramie River near Filmore, Wyo., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Apr.	May.	June.	July.	Aug.	Sept.
1	20	19	.....	63	323	1,220	192	52
2	19	19	.....	76	268	1,070	157	50
3	21	19	.....	77	251	930	146	47
4	26	19	.....	80	285	930	136	46
5	27	19	.....	80	323	930	146	46
6	26	19	.....	54	323	930	136	48
7	26	18	.....	68	344	930	117	56
8	37	.....	.....	67	651	832	108	50
9	30	.....	.....	87	770	800	99	44
10	30	.....	.....	94	1,070	740	107	41
11	31	.....	.....	148	1,140	865	99	42
12	27	.....	.....	159	1,000	770	99	44
13	28	.....	.....	128	930	566	91	37
14	26	.....	.....	138	930	512	91	36
15	26	.....	66	170	1,140	460	91	36
16	25	.....	56	208	1,370	411	91	37
17	23	.....	75	236	1,520	388	90	37
18	23	.....	80	251	1,680	365	90	34
19	25	.....	79	268	1,680	365	90	32
20	27	.....	56	388	1,680	460	90	32
21	29	.....	75	365	1,680	365	76	32
22	29	.....	80	268	1,680	323	68	31
23	32	.....	87	236	1,840	323	68	30
24	38	.....	102	251	1,600	323	62	30
25	41	.....	87	285	1,680	388	60	31
26	47	.....	102	285	1,600	323	56	34
27	39	.....	87	268	1,520	285	74	34
28	28	.....	48	251	1,370	268	74	34
29	26	.....	43	251	1,370	236	70	33
30	23	.....	44	268	1,760	208	59	31
31	20	.....	.....	365	.....	208	53	.....

NOTE.—Oct. 19–21, stage-discharge relation affected by anchor ice; discharge interpolated.

Monthly discharge of Little Laramie River near Filmore, Wyo., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	47	19	28.2	1,730
November 1–7	19	18	18.9	262
April 15–30	102	43	72.9	2,310
May	388	54	191	11,700
June	1,840	251	1,130	67,200
July	1,220	208	572	35,200
August	192	53	96.3	5,920
September	56	30	38.9	2,310

LITTLE LARAMIE RIVER AT TWO RIVERS, WYO.

LOCATION.—On line between secs. 5 and 6, T. 17 N., R. 74 W., at highway bridge half a mile south of Two Rivers, Albany County. No tributary between station and mouth, half a mile below.

DRAINAGE AREA.—310 square miles (measured on base map of Wyoming; scale, 1:500,000).

RECORDS AVAILABLE.—May 6, 1911, to October 31, 1912; October 1, 1913, to August 18, 1917. State engineer maintained station at this point during 1913 and 1914.

GAGE.—Bristol water-stage recorder at bridge. Gage used during 1913 and 1914 was 400 feet downstream and referred to different datum.

DISCHARGE MEASUREMENTS.—Made from bridge or by wading.

CHANNEL AND CONTROL.—Bed composed of sand and gravel which is fairly permanent. Control not well defined. Banks not likely to be overflowed, except during extremely high water.

EXTREMES OF DISCHARGE.—Maximum stage during year from water-stage recorder, 6.0 feet at noon June 25 (discharge, 1,390 second-feet); minimum discharge occurs during irrigation season when there is little or no flow for extended periods.

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

DIVERSIONS.—Prior to December 31, 1916, there were adjudicated diversions from Little Laramie River of 422 second-feet between station near Filmore and this station; none below station.

REGULATION.—None.

ACCURACY.—Stage-discharge relation practically permanent; affected by ice during winter. Rating curve well defined below 1,200 second-feet. The operation of the water-stage recorder was satisfactory. Daily discharge ascertained by applying to the rating table the mean daily gage-height determined by inspecting the gage-height graph. Records good.

Discharge measurements of Little Laramie River at Two Rivers, Wyo., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Apr. 30	H. K. Smith	2.96	111	July 29	S. B. Soulé	3.00	117
June 21	Robert Follansbee	5.51	1,140	Sept. 15	do	1.43	1.7

Daily discharge, in second-feet, of Little Laramie River at Two Rivers, Wyo., for the year ending Sept. 30, 1917.

Day.	Apr.	May.	June.	July.	Aug.	Day.	Apr.	May.	June.	July.	Aug.
1	.....	138	360	772	105	16	98	66	525	360	15
2	.....	150	302	750	84	17	98	60	682	302	14
3	.....	176	204	570	66	18	91	55	795	285	16
4	.....	189	112	400	55	19	98	55	915	251	.....
5	.....	189	78	285	45	20	98	84	1,060	251	.....
6	.....	150	78	251	41	21	112	285	1,120	268	.....
7	.....	112	78	460	37	22	105	440	1,120	285	.....
8	.....	105	98	592	30	23	91	219	1,090	235	.....
9	.....	98	150	592	29	24	78	150	1,190	204	.....
10	.....	91	285	548	27	25	78	150	1,220	204	.....
11	.....	84	502	592	25	26	78	440	1,160	219	.....
12	.....	98	728	940	23	27	55	592	1,160	219	.....
13	.....	98	795	890	22	28	60	285	1,090	176	.....
14	.....	84	705	525	18	29	105	150	984	129	.....
15	.....	66	480	420	16	30	105	162	878	129	.....
						31	.....	268	.....	138	.....

Monthly discharge of Little Laramie River at Two Rivers, Wyo., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
April 16–30	112	55	90.0	2,680
May	592	55	171	10,500
June	1,220	78	665	39,600
July	940	129	395	24,300
August 1–18	105	14	37.1	1,320
September 15–22	2	1	1.5	24

NORTH LARAMIE RIVER NEAR WHEATLAND, WYO.

LOCATION.—In sec. 2, T. 25 N., R. 70 W., a quarter of a mile above head gate of North Laramie Land Co.'s ditch and 18 miles northwest of Wheatland, Platte County. No important tributary within 10 miles of station.

DRAINAGE AREA.—366 square miles (measured on base map of Wyoming; scale, 1:500,000).

RECORDS AVAILABLE.—November 6, 1914, to September 30, 1917.

GAGE.—Bristol water-stage recorder at left bank on vertical cliff just below proposed dam site.

DISCHARGE MEASUREMENTS.—Made from cable near gage or by wading.

CHANNEL AND CONTROL.—Channel of sand and gravel. Control 40 feet downstream at rapids which shifted slightly during 1917.

EXTREMES OF DISCHARGE.—Maximum stage during year from water-stage recorder, 4.05 feet June 2 (discharge, 1,270 second-feet); minimum stage probably occurred during winter.

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

DIVERSIONS.—Prior to December 31, 1916, there were adjudicated diversions of 37 second-feet from North Laramie River, above station, and 27 second-feet below.

REGULATION.—None.

ACCURACY.—Stage-discharge relation shifts between narrow limits; affected by ice during winter. Rating curve well defined below 1,000 second-feet. Operation of the water-stage recorder was fairly satisfactory except for short intervals as explained in footnote to daily-discharge table. Daily discharge ascertained by applying to rating table the mean daily gage height determined by inspecting gage-height graph, except for periods March 7 to April 20 and June 1 to September 5, when discharge was determined by shifting-control method. Records good up to 1,000 second-feet, above which they are fair.

Discharge measurements of North Laramie River near Wheatland, Wyo., during the year ending Sept. 30, 1917.

[Made by P. V. Hodges.]

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	Feet.	*Sec.-Ft.*		*Feet.*	*Sec.-ft.*		*Feet.*	*Sec.-ft.*
Mar. 31	1.02	22.9	May 23	3.45	849	Sept. 12	0.91	16.4
May 1	1.92	170	Aug. 6	1.02	27.2			

Daily discharge, in second-feet, of North Laramie River near Wheatland, Wyo., for the year ending Sept. 30, 1917.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	.....	43	153	1,190	172	29	20
2	.....	44	141	1,270	160	29	17
3	.....	30	190	1,030	160	29	20
4	.....	29	230	1,110	160	29	20
5	.....	37	260	1,110	137	29	20
6	.....	37	245	958	137	29	20
7	11	29	260	854	126	29	16
8	11	39	245	789	115	25	16
9	15	111	215	724	105	25	16
10	15	299	202	659	105	25	16
11	15	319	275	576	105	25	16
12	11	376	400	496	105	25	16
13	10	560	465	388	105	22	16
14	10	396	592	330	105	22	16
15	13	302	848	348	105	25	16
16	.....	212	950	330	95	25	16
17	.....	188	950	296	86	25	16
18	.....	163	880	281	86	25	16
19	.....	163	815	266	86	29	16
20	.....	151	1,100	251	78	25	16
21	.....	178	1,100	254	70	25	16
22	.....	245	880	254	56	25	16
23	.....	400	815	239	56	25	14
24	.....	510	950	224	44	25	12
25	.....	322	950	224	34	25	20
26	.....	275	1,260	210	29	24	16
27	15	215	1,100	224	29	24	16
28	13	141	1,100	224	25	24	16
29	18	141	1,100	224	25	24	16
30	25	141	1,260	198	29	20	16
31	22	.....	1,180	.....	22	20	.....

NOTE.—Sept. 8–11, no gage-height record, as water-stage recorder was out of order; discharge interpolated.

Monthly discharge of North Laramie River near Wheatland, Wyo., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
April	560	29	203	12,100
May	1,260	141	681	41,900
June	1,270	198	518	30,800
July	172	22	88.8	5,460
August	29	20	25.4	1,560
September	20	12	16.6	988

CHUGWATER CREEK AT CHUGWATER, WYO.

LOCATION.—In sec. 31, T. 21 N., R. 66 W., 300 feet above highway bridge half a mile from railroad station at Chugwater, Platte County. No tributary within several miles.

DRAINAGE AREA.—359 square miles (measured on base map of Wyoming; scale, 1:500,000).

RECORDS AVAILABLE.—May 22, 1911, to November 6, 1912; January 1, 1915, to September 30, 1917. State engineer maintained station at this point during 1913 and 1914.

GAGE.—Chain gage on left bank 300 feet above bridge, installed April 6, 1916, at same datum and location as vertical staff previously used; read by Artie Allen. Prior to February 6, 1912, gage was on bridge and referred to different datum.

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

CHANNEL AND CONTROL.—Bed composed of sand which shifted considerably during 1917. Control not well defined. Banks high and not subject to overflow.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 3.4 feet at 4 p. m. June 1 (discharge, 280 second-feet); minimum stage, 1.06 feet on January 26, 27, 29–31 (discharge, 2.6 second-feet).

ICE.—Stage-discharge relation not affected by ice, except for short periods.

DIVERSIONS.—Prior to December 31, 1916, there were adjudicated diversions from Chugwater Creek of 73 second-feet above station, and 98 second-feet below.

REGULATION.—None.

ACCURACY.—Stage-discharge relation not permanent; not affected by ice during winter. Rating curve used October 1 to December 31 fairly well defined below 200 second-feet, and curve used June 2 to September 30 is faily well defined between 10 and 250 second-feet; shifting-control method used January 1 to June 1. Gage read to hundredths twice daily. Daily discharge ascertained by applying the mean daily gage height to rating table. Records good, except for period May 24 to June 4, when they are only fair because of a decided shift.

Discharge measurements of Chugwater Creek at Chugwater, Wyo., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Jan. 25	H. K. Smith	1.08	2.8	Aug. 7	P. V. Hodges	1.10	15.1
Apr. 30	P. V. Hodges	2.38	66	7	....do	1.10	15.2
May 24	....do	3.06	143	Sept. 11	....do	1.17	19.4
June 5	....do	3.28	230				

Daily discharge, in second-feet, of Chugwater Creek at Chugwater, Wyo., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	3.0	3.5	3.7	3.5	2.7	5.9	18	67	275	29	23	24
2	3.0	3.5	3.9	3.7	2.7	6.0	16	67	258	26	14	20
3	4.0	3.5	4.8	3.7	2.7	6.6	28	67	245	39	14	19
4	5.1	3.5	5.8	3.7	2.8	5.6	21	63	245	29	20	15
5	5.1	3.5	6.3	3.5	2.8	6.0	24	54	245	26	36	15
6	5.1	3.5	7.6	3.5	3.1	8.8	23	59	233	22	20	16
7	5.1	3.5	3.7	3.5	3.1	6.6	20	59	209	22	15	16
8	3.4	3.5	4.4	3.7	3.1	5.3	18	59	209	20	16	17
9	3.4	3.5	3.9	3.5	3.2	6.8	19	51	197	19	15	22
10	3.4	3.5	3.9	3.0	3.0	8.8	24	51	197	17	12	18
11	3.4	3.5	4.6	3.1	3.1	9.4	32	51	173	19	13	20
12	3.5	3.5	4.0	3.0	3.1	7.8	40	48	149	19	13	18
13	3.5	3.5	4.4	3.0	3.1	7.6	39	52	126	16	14	26
14	3.5	3.5	4.6	3.0	3.5	9.1	39	61	120	12	27	21
15	3.5	3.5	4.4	3.0	4.6	10.7	47	86	110	12	20	20
16	3.5	3.5	4.4	3.0	3.9	5.1	47	118	100	11	20	22
17	3.5	3.5	4.6	2.7	3.9	5.6	47	157	90	11	16	16
18	3.7	3.5	4.4	2.8	3.9	8.1	43	181	85	11	20	20
19	3.7	3.5	4.0	2.8	3.9	11.9	55	147	76	10	20	17
20	3.5	3.5	4.0	2.8	4.2	9.1	59	147	67	11	22	20
21	3.5	3.5	4.0	2.8	4.6	9.1	50	172	58	11	19	17
22	3.5	3.4	4.2	2.8	5.3	11.6	46	172	54	12	22	20
23	3.5	3.4	4.0	2.8	5.8	7.6	46	148	54	10	22	20
24	3.5	3.4	4.0	2.7	6.8	10.0	55	148	50	12	22	16
25	3.5	3.4	4.0	2.8	11.3	11.0	82	148	48	17	23	17
26	3.5	3.4	4.2	2.6	8.4	12	92	205	44	26	20	16
27	3.5	3.9	3.9	2.6	7.3	13	97	227	40	23	19	20
28	3.5	4.0	4.0	2.7	5.8	14	82	213	41	26	20	20
29	3.5	3.9	4.0	2.6	.....	15	67	208	35	23	22	15
30	3.5	3.9	3.9	2.6	.....	16	67	229	31	20	24	20
31	3.5	.....	3.5	2.6	.....	17	.....	263	.....	23	22	.....

Monthly discharge of Chugwater Creek at Chugwater, Wyo., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	5.1	3.0	3.69	227
November	4.0	3.4	3.54	211
December	7.6	3.5	4.36	268
January	3.7	2.6	3.04	187
February	11.3	2.7	4.35	242
March	17.0	5.1	9.26	569
April	97	16	44.8	2,670
May	263	48	122	7,500
June	275	31	129	7,680
July	39	10	18.8	1,160
August	36	12	19.5	1,200
September	26	15	18.8	1,120
The year	275	2.6	31.8	23,000

HORSE CREEK NEAR LA GRANGE, WYO.

LOCATION.—In SW. ¼ SW. ¼ sec. 34, T. 20 N., R. 61 W., 2 miles southeast of Wye-Cross ranch and 1½ miles northwest of La Grange, Goshen County. Nearest tributary, Bear Creek, enters 2 miles below.

DRAINAGE AREA.—683 square miles (measured on base map of Wyoming; scale, 1:500,000).

RECORDS AVAILABLE.—November 1, 1915, to September 30, 1917. From December 1, 1911, to December 31, 1912, fragmentary records are available at a point 1¼ miles downstream.

GAGE.—Gurley water-stage recorder on left bank.

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

CHANNEL AND CONTROL.—Bed composed of coarse gravel which may shift. Control just below station at small rapids; practically permanent during 1917.

EXTREMES OF DISCHARGE.—Maximum stage during year from water-stage recorder, 3.2 feet at 1 a. m. June 3 (discharge, 345 second-feet); minimum stage from water-stage recorder, 0.85 foot on October 1, 2, and 3 (discharge, 9 second-feet).

ICE.—Stage-discharge relation not seriously affected by ice except during short periods.

DIVERSIONS.—Prior to December 31, 1916, there were adjudicated permits for diversions of 1,163 second-feet from Horse Creek above station, and 71 second-feet below. In addition, there were permits for 2,067 acre-feet storage above, and 5,202 acre-feet below station.

REGULATION.—None.

ACCURACY.—Stage-discharge relation practically permanent; affected by snow and ice for short periods during winter. Rating curve well defined between 6 and 280 second-feet. Operation of the water-stage recorder was satisfactory throughout year, except for short periods indicated by breaks in record, as shown in footnote to daily-discharge table. Daily discharge ascertained by applying to rating table mean daily gage height determined by inspecting gage-height graph. Records excellent, except for periods affected by ice when they are fair.

Discharge measurements of Horse Creek near La Grange, Wyo., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Nov. 25	Robert Follansbee	1.10	20.6	June 5	P. V. Hodges	2.67	218
Feb. 28	H. K. Smith	1.28	38.9	Sept. 24	Robert Follansbee	1.29	32.8
June 5	P. V. Hodges	2.83	254				

Daily discharge, in second-feet, of Horse Creek near La Grange, Wyo., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	9	18	33	27	48	41	59	25	320	39	14	36
2	9	18	35	28	39	48	51	32	332	37	12	35
3	9	18	33	29	31	47	41	36	320	37	10	34
4	9	18	33	29	23	49	32	31	269	37	9	34
5	9	18	32	30	22	40	32	21	246	34	12	35
6	9	18	32	32	23	44	30	17	244	30	21	38
7	10	17	26	32	26	49	29	16	222	29	20	39
8	10	18	23	33	27	54	28	14	209	27	20	40
9	11	18	24	34	30	58	27	14	182	27	20	57
10	11	18	28	32	38	62	27	14	154	26	20	55
11	12	14	31	35	39	69	32	14	145	18	21	54
12	14	17	29	35	41	49	32	12	139	14	20	56
13	21	20	29	32	46	55	29	13	133	14	21	53
14	22	23	34	29	43	57	25	14	118	14	21	43
15	23	26	37	27	43	49	23	14	91	15	22	42
16	24	29	32	22	50	38	24	16	72	15	22	41
17	23	33	27	24	45	28	24	29	68	16	21	41
18	21	37	28	26	43	34	24	29	62	17	21	41
19	22	34	33	28	41	66	24	32	57	17	21	41
20	21	30	32	30	41	80	26	53	41	18	22	40
21	23	29	32	29	45	73	37	78	29	17	23	38
22	23	29	33	28	47	74	32	88	22	18	24	37
23	24	32	31	26	52	60	21	104	17	17	23	35
24	24	35	31	24	51	64	17	102	18	17	22	34
25	23	30	30	22	76	64	16	99	17	17	24	36
26	23	34	29	21	77	57	14	129	28	16	25	38
27	23	34	30	20	75	63	15	179	78	17	27	38
28	22	32	26	23	50	72	17	276	62	16	27	36
29	21	25	25	26	.....	69	18	308	60	14	37	35
30	20	27	26	31	.....	68	20	295	47	13	41	37
31	20	.....	26	35	.....	64	.....	320	.....	16	38	.....

NOTE.—Nov. 12–17, Jan. 17–19, 22–26, no gage-height record as water-stage recorder was out of order; discharge interpolated. Dec. 15, 17–18, 20–30, Jan. 4–5, 13–16, 21, Mar. 6–9, and 16, stage-discharge relation affected by snow and ice; discharge based on temperature and gage-height record and observer's notes.

Monthly discharge of Horse Creek near La Grange, Wyo., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	24	9	17.6	1,080
November	37	14	25.0	1,490
December	37	23	30.0	1,840
January	35	20	28.4	1,750
February	77	22	43.3	2,400
March	80	28	56.3	3,460
April	59	14	27.5	1,640
May	320	12	78.2	4,810
June	332	17	127	7,560
July	39	13	21.3	1,310
August	41	9	22.0	1,350
September	57	34	40.6	2,420
The year	332	9	42.9	31,100

SOUTH PLATTE RIVER AT SOUTH PLATTE, COLO.

LOCATION.—In sec. 25, T. 7 S., R. 70 W., 375 feet below point where North Fork of South Platte enters, at South Platte, Jefferson County. No tributary between forks and station.

DRAINAGE AREA.—2,610 square miles (measured on map in Hayden's atlas).

RECORDS AVAILABLE.—March 28, 1902, to September 30, 1917. Records at Platte Canyon and at Deansbury, a few miles below, extend back to 1887, with the exception of 1893 and 1894. The earlier records, 1887–1892, were taken by the State engineer, and records from 1895 to 1896 were taken under direction of the Denver Power & Irrigation Co.

GAGE.—Bristol water-stage recorder on right bank 375 feet below forks; in use since March 14, 1910. From March 28, 1902, to May 7, 1905, the gage was at the highway bridge. On May 7, 1905, gage was moved to its present site 150 feet below bridge. Datum of new gage probably somewhat different. Recording gage is referred to datum of gage established in 1905.

DISCHARGE MEASUREMENTS.—Made from cable near gage or by wading.

CHANNEL AND CONTROL.—Bed composed of coarse sand and fine gravel; shifts. Control 35 feet downstream at well-defined rapids; shifts considerably at times. Banks high and not subject to overflow.

EXTREMES OF DISCHARGE.—Maximum stage during year from water-stage recorder, 5.4 feet at 8.30 a. m., June 20 (discharge, 2,050 second-feet); minimum discharge occurs during winter.

ICE.—Stage-discharge relation seriously affected by ice; monthly mean discharge estimated from records obtained few miles below by Denver Union Water Co.

DIVERSIONS.—No water is diverted between this station and that on the North Fork at South Platte. Above the station there are court decrees for 85,600 and 80,000 acre-feet for Antero and Cheesman reservoirs, respectively, all of which passes the gage before being diverted. In addition to the reservoir decrees, there are decrees for diversions of 1,075 second-feet from South Platte River above station, and 3,326 second-feet from tributaries entering above. Also a decree for storage of 46,000 acre-feet in reservoir located on tributary entering above station.

REGULATION.—Flow regulated to certain extent by Antero and Cheesman reservoirs on the South Platte, 60 and 15 miles, respectively, above the forks.

ACCURACY.—Stage-discharge relation slightly shifting; affected by ice during winter. Rating curve used October 1 to 30 well defined between 75 and 800 second-feet; curve used April 1 to September 30 well defined between 100 and 1,600 second-feet. Water-stage recorder gave satisfactory results except for short periods as explained in the footnotes. Daily discharge ascertained by applying to rating table the mean daily gage height determined by inspecting gage-height graph. Records for October and April to September are good.

Discharge measurements of South Platte River at South Platte, Colo., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Nov. 6	Robert Follansbee	1.68	113	Apr. 24	P. V. Hodges	2.06	267
Dec. 16	P. V. Hodges	2.10	184	May 26	H. W. Fear	4.08	1,250
Jan. 25	Do	3.50	120	June 27	Robert Follansbee	4.44	1,400
Feb. 28	Do	1.49	106	July 26	H. W. Fear	4.36	1,440
Apr. 19	Smith and Hodges	1.73	165	Aug. 16	Robert Follansbee	3.62	948
20	Do	1.52	147				

Daily discharge, in second-feet, of South Platte River at South Platte, Colo., for the year ending Sept. 30, 1917.

Day.	Oct.	Apr.	May.	June.	July.	Aug.	Sept.
1	121	200	210	1,060	1,150	875	600
2	110	150	210	1,090	1,090	775	568
3	110	169	225	1,180	1,010	650	546
4	110	121	225	1,240	982	600	474
5	98	142	258	1,210	928	650	377
6	492	142	225	1,090	900	600	437
7	738	151	240	1,040	850	750	449
8	146	108	258	1,060	875	750	465
9	121	185	225	1,120	982	675	470
10	134	204	240	1,330	1,300	750	457
11	121	166	258	1,390	1,600	850	457
12	110	175	292	1,360	1,420	850	425
13	121	175	328	1,480	1,210	850	417
14	121	180	385	1,510	1,040	850	425
15	173	180	700	1,630	850	875	377
16	121	180	825	1,660	800	875	338
17	146	190	875	1,790	750	928	268
18	160	210	955	1,860	775	955	244
19	146	165	955	1,860	760	928	190
20	134	147	1,040	1,920	760	775	177
21	134	177	1,120	1,790	1,140	700	204
22	146	204	1,290	1,790	1,080	600	234
23	134	240	1,240	1,790	1,060	650	234
24	121	258	1,210	1,660	900	650	190
25	60	258	1,240	1,660	1,010	650	190
26	110	289	1,190	1,540	1,300	625	185
27	110	268	1,120	1,480	1,480	600	180
28	110	240	1,100	1,360	1,540	650	185
29	103	210	1,090	1,300	1,330	650	190
30	88	196	1,040	1,240	1,180	675	195
31	74	.....	1,010	.....	1,060	650	.....

NOTE.—April 1–2, 12–20, July 19–23, Sept. 25–30, no gage-height record, as water-stage recorder was out of order. Discharge based on comparative hydrograph of South Platte River at Platte Canyon intake.

Monthly discharge of South Platte River at South Platte, Colo., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	738	74	152	9,350
November	.....	.....	132	7,860
December	.....	.....	138	8,480
January	.....	.....	144	8,850
February	.....	.....	114	6,330
March	.....	.....	101	6,210
April	289	108	189	11,200
May	1,290	210	696	42,800
June	1,920	1,040	1,450	86,300
July	1,600	760	1,070	65,800
August	955	600	739	45,400
September	600	177	338	20,100
The year	1,920	.....	440	319,000

NOTE.—Monthly estimates for November, December, January, February, and March taken from records of Union Water Co.

TARRYALL CREEK NEAR JEFFERSON, COLO.

LOCATION.—In sec. 6, T. 9 S., R. 74 W., at Robbins ranch, 10 miles southwest of Jefferson, Park County. Rock Creek enters half a mile below.

DRAINAGE AREA.—223 square miles (measured on Forest atlas).

RECORDS AVAILABLE.—June 27, 1912, to October 27, 1917. From October 18, 1910, to June 28, 1911, a station was maintained within a quarter of a mile of present site. Relation between the present gage and that used 1910–11 not known.

GAGE.—Vertical staff installed April 22, 1916, on left bank 60 feet above and at same datum as old vertical on left bank opposite ranch house. Difference in gage heights of about 0.4 foot as read on new and old gages is due to fall in stream between them; read by Miss Mary Robbins.

DISCHARGE MEASUREMENTS.—Made from footbridge 400 feet below gage or by wading.

CHANNEL AND CONTROL.—Bed composed of fine gravel. Principal control 150 feet downstream at gravel bar; practically permanent during 1917. Banks subject to overflow at stage of 2.8 feet, and at 3.0 feet the entire bottom for a width of 500 feet is flooded.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 4.1 feet at 7:15 p. m. July 9 (discharge, 1,320 second-feet); minimum stage, 0.45 foot October 3, 1917. (Discharge, 1.0 second-foot.)

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

DIVERSIONS.—There are court decrees for diversions of 314 second-feet from Tarryall Creek above and 220 second-feet below station. The Tarryall Canal and Reservoir Co. has a provisional decree for storage of 68,000 acre-feet from Tarryall and tributaries above station, and a decree for a supply diversion (not yet made) amounting to 450 second-feet. There are decrees for diversions of 926 second-feet from tributaries entering above station. The Boreas ditch diverts a small amount of water from the headwaters of Blue River to Tarryall Creek at its headwaters.

REGULATION.—None.

ACCURACY.—Stage-discharge relation practically permanent; affected by ice during winter. Rating curves well defined between 10 and 350 second-feet; not well defined above 350 second-feet. Gage read to quarter-tenths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table. Records good up to 350 second-feet, above which they are fair.

Discharge measurements of Tarryall Creek near Jefferson, Colo., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
May 24	H. W. Fear	1.04	37.5	June 25	Robert Follansbee	1.81	206
25	do	.91	23.1	July 23	H. W. Fear	1.27	89

Daily discharge, in second-feet, of Tarryall Creek near Jefferson, Colo., for the period Oct. 1, 1916, to Oct. 27, 1917.

Day.	Oct.	Nov.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.
1	15	26	.....	30	137	181	105	28	5.0
2	16	25	.....	39	105	159	105	22	3.0
3	13	24	.....	51	32	137	111	35	1.0
4	16	24	.....	53	12	137	111	25	2.2
5	12	26	.....	39	10	126	148	20	3.8
6	16	25	.....	32	7	137	126	18	5.0
7	13	25	.....	34	13	137	137	39	5.0
8	7	20	.....	34	10	400	137	95	5.0
9	13	23	.....	25	10	1,320	115	35	5.4
10	16	24	.....	85	12	480	115	32	6.2
11	10	25	.....	216	28	238	111	28	3.0
12	8	.....	.....	159	45	170	91	18	2.7
13	9	.....	.....	148	85	137	111	18	3.8
14	12	.....	.....	69	137	89	111	25	3.0
15	32	.....	.....	34	216	73	126	13	3.0
16	36	.....	126	39	250	95	148	22	3.0
17	46	.....	105	34	250	109	216	13	2.7
18	52	.....	99	28	250	181	238	13	3.0
19	54	.....	101	31	250	238	216	13	2.7
20	51	.....	53	113	273	170	181	13	2.7
21	38	.....	73	216	296	148	65	12	3.0
22	58	.....	85	59	238	148	111	10	6.2
23	37	.....	87	53	204	99	119	8	8.2
24	29	.....	77	35	204	159	99	7	10
25	41	.....	79	22	181	216	32	10	12
26	46	.....	81	12	204	411	51	8	15
27	37	.....	53	10	204	273	45	8	20
28	51	.....	37	12	181	115	59	10	.....
29	36	.....	23	18	159	126	51	10	.....
30	32	.....	41	12	159	137	45	10	.....
31	19	.....	.....	20	.....	148	39	.....	.....

Monthly discharge of Tarryall Creek near Jefferson, Colo., for the period Oct. 1, 1916, to Oct. 27, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	58	7	28.1	1,730
November 1–11	26	20	24.3	530
April 16–30	126	23	74.7	2,220
May	216	10	56.8	3,490
June	296	7	139	8,270
July	1,320	73	216	13,300
August	238	32	112	6,890
September	95	7	20.6	1,230
October 1–27	20	1.0	5.39	289

NORTH FORK OF SOUTH PLATTE RIVER AT GRANT, COLO.

LOCATION.—In sec. 9, T. 7 S., R. 74 W., at Grant, Park County, 250 feet above mouth of Geneva Creek.

DRAINAGE AREA.—51 square miles (measured on Forest atlas).

RECORDS AVAILABLE.—July 18, 1910, to September 30, 1917.

GAGE.—Vertical staff on left bank 250 feet above mouth of Geneva Creek; read by Mrs. M. McFarland.

DISCHARGE MEASUREMENTS.—Made by wading.

CHANNEL AND CONTROL.—Bed composed of gravel. Principal control about 20 feet below gage at small rapids; shifted during 1917.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 3.18 feet at 6 p.m. June 10 (discharge, 233 second-feet); minimum discharge occurs during winter.

ICE.—Stage-discharge relation serioulsy affected by ice; observations discontinued during winter; discharge measurements made monthly.

DIVERSIONS.—There are court decrees for diversions of 5.5 second-feet from the North Fork above station and 24 second-feet from tributaries entering above.

REGULATION.—None.

ACCURACY.—Stage-discharge relation not permanent; affected by ice during winter. Rating curve fairly well defined below 160 second-feet. Gage read to hundredths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table, except for period April 1 to September 30, when discharge is computed by shifting-control method. Records fair.

Discharge measurements of North Fork of South Platte River at Grant, Colo., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Nov. 9	P. V. Hodges	*a* 1.88	10.5	May 11	H. W. Fear	1.68	15.0
Dec. 15	do	*a* 2.30	8.6	July 24	do	2.05	63
Jan. 24	do	*a* 2.50	5.6	25	do	2.04	62
Feb. 26	do		5.8	Aug. 15	Robert Follansbee	1.78	29.3

a Stage-discharge relation affected by ice.

Daily discharge, in second-feet, of North Fork of South Platte River at Grant, Colo., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Apr.	May.	June.	July.	Aug.	Sept.
1	9	7	0.5	13	75	129	50	17
2	9	7	.4	14	84	122	46	16
3	8	7	.4	11	86	122	44	13
4	7	11	.6	11	88	107	41	14
5	7	9	.8	11	95	107	40	15
6	9	7	.4	20	95	100	38	13
7	12	7	.4	19	96	93	38	14
8	8	8	11	17	132	100	31	13
9	11	10	14	20	148	122	34	13
10	7	.....	13	17	218	107	31	13
11	7	.....	12	15	218	100	31	12
12	7	.....	11	20	202	92	29	12
13	7	.....	11	28	220	88	35	12
14	7	.....	11	42	186	82	29	14
15	9	.....	8.2	50	195	64	26	13
16	11	.....	8.2	53	195	68	28	12
17	12	.....	7.0	68	195	70	26	12
18	11	.....	8.8	79	195	68	26	11
19	6	.....	7.0	86	186	68	26	11
20	7	.....	7.0	76	177	67	25	11
21	8	.....	12	79	177	65	23	11
22	9	.....	22	73	161	62	22	10
23	9	.....	26	67	161	61	22	9
24	9	.....	23	69	161	61	22	9
25	9	.....	22	70	161	76	20	8
26	9	.....	21	69	153	70	19	8
27	8	.....	20	57	145	61	19	8
28	8	.....	14	69	145	55	20	8
29	8	.....	15	68	145	57	19	8
30	7	.....	26	69	129	62	19	8
31	7	.....	.....	73	.....	54	17	.....

Monthly discharge of North Fork of South Platte River at Grant, Colo., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	12	6	8.45	520
November 1–9	11	7	8.11	145
April	26	.4	11.1	660
May	86	11	46.2	2,840
June	220	75	154	9,160
July	129	54	82.6	5,080
August	50	17	28.9	1,780
September	17	8	11.6	690

NORTH FORK OF SOUTH PLATTE RIVER AT SOUTH PLATTE, COLO.

LOCATION.—In sec. 25, T. 3 S., R. 70 W., one-third of a mile above railroad station at South Platte, Jefferson County. No tributary between station and mouth at South Platte.

DRAINAGE AREA.—449 square miles (measured on map in Hayden's atlas).

RECORDS AVAILABLE.—January 4, 1909, to September 30, 1910; April 1, 1913, to September 30, 1917.

GAGE.—Inclined staff on left bank one-third of a mile above railroad station; read by Mrs. Mata Wallbrecht.

DISCHARGE MEASUREMENTS.—Made from cable 300 feet above gage or by wading.

CHANNEL AND CONTROL.—Bed composed of gravel and sand. Principal control a short distance below gage; shifting between narrow limits. Banks not subject to much overflow.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 4.8 feet at 8 a. m. June 18 (discharge, 1,300 second-feet); minimum discharge occurs during winter.

ICE.—Stage-discharge relation seriously affected by ice; daily discharge not determined because of insufficient data.

DIVERSIONS.—There are court decrees for diversion of 20 second-feet from North Fork between Grant and South Platte, and 62 second-feet from intervening tributaries, exclusive of Geneva Creek. Small quantities of water are also diverted at various times for several small ice and fish ponds.

REGULATION.—None.

ACCURACY.—Stage-discharge relation slightly shifting; affected by ice during winter. Rating curve used October 1 to November 10 well defined between 25 and 200 second-feet; curve used March 25 to September 30 well defined between 60 and 900 second-feet. Gage read to half-tenths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table; shifting-control method used October 1 to November 10. Records fair, October 1 to November 10; good, March 25 to September 30.

Discharge measurements of North Fork of South Platte River at South Platte, Colo., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Nov. 6	Robert Follansbee	1.82	61	May 26	H. W. Fear	3.28	498
Dec. 16	P. V. Hodges	[a] 2.30	50	June 27	Robert Follansbee	3.95	840
Jan. 25	do		38	July 25	H. W. Fear	2.90	376
Feb. 28	do	[a] 2.25	45.5	Aug. 16	Robert Follansbee	2.30	167
Apr. 19	Smith and Hodges	1.98	104				

[a] Stage-discharge relation affected by ice.

Daily discharge, in second-feet, of North Fork of South Platte River at South Platte, Colo., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	82	66	.....	65	136	552	620	260	102
2	82	66	.....	30	124	552	575	230	120
3	82	59	.....	65	136	552	575	230	106
4	82	55	.....	35	136	575	485	202	92
5	85	61	.....	65	148	645	508	230	92
6	80	56	.....	78	120	575	485	230	92
7	85	43	.....	58	148	575	485	174	102
8	70	33	.....	76	161	575	530	174	98
9	87	30	.....	88	148	620	530	174	102
10	87	17	.....	98	161	820	645	174	92
11	87	.....	.....	88	161	948	530	174	86
12	76	.....	.....	78	174	895	440	188	82
13	72	.....	.....	98	202	920	420	202	82
14	76	.....	.....	88	230	975	400	188	86
15	136	.....	.....	94	342	1,030	360	202	102
16	98	.....	.....	78	360	1,060	360	188	92
17	123	.....	.....	82	485	1,140	325	202	82
18	102	.....	.....	98	530	1,140	308	188	82
19	100	.....	.....	98	508	1,110	325	174	82
20	85	.....	.....	74	552	1,110	342	174	82
21	85	.....	.....	102	530	1,000	290	148	82
22	85	.....	.....	120	530	948	290	148	82
23	98	.....	.....	148	485	948	290	148	82
24	80	.....	.....	148	530	870	290	148	78
25	94	.....	82	174	530	845	400	136	72
26	100	.....	52	202	530	820	325	174	78
27	100	.....	40	174	530	795	400	174	86
28	100	.....	78	136	508	695	308	148	78
29	91	.....	82	120	485	695	290	148	67
30	76	.....	124	106	485	670	290	136	67
31	76	.....	120	.....	530	.....	308	120	.....

Monthly discharge of North Fork of South Platte River at South Platte, Colo., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	136	70	89.1	5,480
November 1-10	66	17	48.6	964
March 25-31	124	40	82.6	1,150
April	202	30	98.8	5,880
May	552	120	343	21,100
June	1,140	552	822	48,900
July	645	290	411	25,300
August	260	120	180	11,100
September	120	67	87.6	5,210

GENEVA CREEK AT GRANT, COLO.

LOCATION.—In sec. 9, T. 7 S., R. 74 W., just below highway bridge at Grant, Park County, 300 feet above mouth of creek.

DRAINAGE AREA.—74 square miles (measured on map in Forest atlas).

RECORDS AVAILABLE.—November 3, 1911, to September 30, 1917. From July 5, 1908, to November 3, 1911, a station was maintained at Sullivan's ranch 3 miles above Grant. Except during the spring run-off, the flow at the two points is practically the same.

GAGE.—Vertical staff on right bank just below bridge; temporary vertical staff on downstream side of left abutment used November 8, 1916, to May 5, 1917; read by Mrs. M. McFarland.

DISCHARGE MEASUREMENTS.—Made from single-span bridge or by wading.

CHANNEL AND CONTROL.—Bed composed of coarse gravel. Principal control 50 feet downstream at gravel bar; shifted during high water of 1917. Banks not subject to overflow.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 3.1 feet at 6 p. m. June 17 (discharge, 546 second-feet); minimum discharge of 10 second-feet occurred in February, March, and April.

ICE.—Stage-discharge relation seriously affected by ice; flow estimated from discharge measurements, observer's notes, and records of temperature.

DIVERSIONS.—There is a court decree for diversions of 1 second-foot from Geneva Creek above station, and a temporary reservoir decree for 1,490 acre-feet from Geneva and Kerby creeks.

REGULATION.—None.

ACCURACY.—Stage-discharge relation not permanent; affected by ice during winter. Rating curve well defined between 10 and 350 second-feet. Gage read to hundredths twice daily. Daily discharge ascertained by applying to rating table the mean daily gage height, except for period June 10 to August 7, when discharge is computed by shifting-control method. Records excellent, except for high water and period when stage-discharge relation is affected by ice, when they are fair.

Discharge measurements of Geneva Creek at Grant, Colo., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Nov. 8	P. V. Hodges	1.00	18.3	May 10	H. W. Fear	1.16	28.8
9	do	1.06	22.0	June 25	Robert Follansbee	2.54	319
Dec. 15	do	[a] 1.22	21.1	July 25	H. W. Fear	1.93	172
Jan. 23	do	[a] 1.28	11.4	Aug. 15	Robert Follansbee	1.54	68
Feb. 26	do	.80	11.7				

[a] Stage-discharge relation affected by ice.

Daily discharge, in second-feet, of Geneva Creek at Grant, Colo., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	30	23	28	18	11	10	12	17	76	301	121	37
2	30	23	25	18	10	10	11	19	86	266	104	33
3	30	25	16	18	10	10	11	16	89	252	106	32
4	30	24	15	18	11	10	14	14	116	219	97	33
5	28	24	15	18	11	10	17	13	18	222	95	34
6	28	22	14	18	11	10	10	16	106	191	87	32
7	28	20	13	18	11	11	14	22	106	209	78	33
8	27	18	13	18	11	12	11	23	132	262	72	31
9	28	22	12	18	11	12	12	19	167	280	70	30
10	27	21	13	18	11	12	14	20	283	301	72	30
11	27	21	13	18	11	12	13	23	280	252	68	30
12	27	19	15	17	11	12	12	23	298	219	70	30
13	27	18	17	15	11	12	14	34	266	200	68	30
14	27	12	18	13	11	12	14	56	400	185	68	30
15	23	13	21	13	10	12	13	76	495	206	68	30
16	30	16	21	15	12	12	13	95	472	159	72	30
17	30	17	21	16	11	28	12	116	487	153	68	28
18	35	18	21	16	11	24	15	132	468	156	61	28
19	23	19	21	16	12	16	13	109	464	173	62	27
20	29	21	21	15	11	15	14	66	442	156	61	27
21	29	24	21	13	11	12	15	82	423	148	56	27
22	28	24	21	12	10	12	27	70	400	159	53	26
23	30	25	21	12	10	10	23	72	381	156	55	25
24	32	28	21	12	10	13	35	82	415	182	48	25
25	19	35	21	12	10	10	25	76	396	182	46	25
26	18	37	18	12	10	10	27	72	345	173	44	25
27	18	35	17	11	10	10	24	82	345	170	46	25
28	19	31	17	11	10	11	17	78	330	153	46	25
29	20	31	18	11	.....	12	19	74	312	148	45	25
30	21	37	18	11	.....	12	19	74	298	145	45	24
31	22	.....	18	11	.....	14	.....	73	.....	137	40	.....

NOTE.—Oct. 27–31, no gage-height record; discharge interpolated. Nov. 9–20, 22, 24, 27, Dec. 1, 6–Feb. 13, 28–Mar. 12 stage-discharge relation affected by ice; discharge based on temperature and gage-height records, discharge measurements, and observer's notes.

Monthly discharge of Geneva Creek at Grant, Colo., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	35	18	26.5	1,630
November	37	12	23.4	1,390
December	28	12	18.2	1,120
January	18	11	14.9	916
February	12	10	10.7	594
March	28	10	12.5	769
April	35	10	16.3	970
May	132	13	56.3	3,460
June	495	76	300	17,900
July	301	137	197	12,100
August	121	40	67.5	4,150
September	37	24	28.9	1,720
The year	495	10	64.5	46,700

CLEAR CREEK NEAR GOLDEN, COLO.

LOCATION.—In sec. 6, T. 4 S., R. 70 W., 1,000 feet below head gates of Golden ditch and 2 miles above Golden, in Jefferson County. Only important tributary between station and mouth, Ralston Creek, enters 12 miles below.

DRAINAGE AREA.—Approximately 380 square miles.

RECORDS AVAILABLE.—December 4, 1908, to December 31, 1909; June 8 to September 24, 1911; January 29, 1912, to September 30, 1917.

GAGE.—Lallie water-stage recorder on left bank 1,000 feet below head of Golden ditch.

DISCHARGE MEASUREMENTS.—Made from cable near gage or by wading.

CHANNEL AND CONTROL.—Bed composed of coarse gravel and small boulders. Principal control 25 feet downstream at rapids; shifts occasionally. Creek flows in canyon; banks not subject to overflow.

EXTREMES OF DISCHARGE.—Maximum stage during year from water-stage recorder, 4.8 feet at 4 a. m. June 18 (discharge, 1,670 second-feet); minimum discharge occurs during winter.

ICE.—Stage-discharge relation seriously affected by ice; observations discontinued during winter, except for occasional discharge measurements.

DIVERSIONS.—There is a court decree for a diversion of 53 second-feet from the headwaters of Fraser River to the West Fork of Clear Creek, and approximately 570 acre-feet were diverted in 1917 between July 7 and August 25. Above the Golden station there is a court decree for a diversion of 26 second-feet by the Golden ditch. The diversion by this ditch past the Clear Creek gaging station was about 6,000 acre-feet for 1917.

REGULATION.—None.

ACCURACY.—Stage-discharge relation not permanent; affected by ice during winter. Rating curve used October 1 to November 7 well defined between 50 and 600 second-feet; curve used March 29 to September 30 well defined between 40 and 1,000 second-feet. Operation of the water-stage recorder was satisfactory. Daily discharge ascertained by applying to rating table the mean daily gage height determined by inspecting gage-height graph, except for periods October 1 to November 7, and March 29 to July 31, when discharge was computed by indirect method for shifting control. Records good.

187043°—20—WSP 456——15

Discharge measurements of Clear Creek near Golden, Colo., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Dec. 28	Fear and Hodges	a 1.50	51	July 9	Fear and Follansbee	3.62	891
Jan. 30	Hodges and Smith	a 1.12	60	19	P. V. Hodges	2.94	643
Mar. 5	do	.95	45.1	Aug. 15	do	2.03	256
Apr. 25	H. W. Fear	1.31	112	22	Hodges and Fear	1.84	204
25	do	1.28	100	22	do	1.85	209

a Stage-discharge relation affected by ice.

Daily discharge, in second-feet, of Clear Creek near Golden, Colo., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	110	91	45	45	45	75	115	426	1,180	442	144
2	121	123	45	45	35	60	116	442	1,090	406	132
3	118	125	45	45	35	52	115	474	1,000	376	120
4	116	93	45	45	40	40	107	538	971	362	120
5	112	94	45	45	45	50	122	574	944	341	118
6	175	86	45	55	40	61	111	551	938	334	104
7	152	81	55	55	35	64	118	528	883	327	104
8	90	.....	60	60	45	71	118	569	938	299	106
9	89	.....	55	60	55	76	107	636	910	282	102
10	94	.....	60	60	60	82	128	810	976	282	109
11	93	.....	65	55	45	79	140	938	932	236	102
12	102	.....	50	55	40	76	152	910	861	243	96
13	108	.....	45	50	40	88	175	993	820	254	99
14	107	.....	45	45	50	78	232	1,040	780	274	102
15	135	.....	45	45	60	67	316	1,130	735	254	100
16	125	.....	45	50	45	86	387	1,270	690	257	97
17	144	.....	45	50	50	88	457	1,330	650	250	92
18	150	.....	50	50	50	97	528	1,450	636	278	92
19	150	.....	50	50	55	86	502	1,450	646	268	96
20	143	.....	50	45	55	54	520	1,300	720	243	91
21	136	.....	45	50	60	59	492	1,440	623	212	86
22	129	.....	40	60	60	76	470	1,350	574	197	91
23	125	.....	40	60	45	107	442	1,440	596	209	83
24	121	.....	40	60	40	124	450	1,440	665	212	78
25	112	.....	45	55	40	124	470	1,440	685	206	83
26	112	.....	45	50	35	138	438	1,370	685	218	78
27	109	.....	50	55	40	144	426	1,340	636	209	80
28	121	.....	50	50	75	113	430	1,280	546	229	82
29	195	.....	50	.....	106	115	410	1,300	515	200	82
30	125	.....	60	.....	106	115	410	1,240	510	172	83
31	133	.....	50	.....	85	.....	434	.....	492	150	.....

NOTE.—Records of daily discharge Jan. 1 to Mar. 28 furnished by the Farmers Reservoir & Irrigation Co.

Monthly discharge of Clear Creek near Golden, Colo., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	195	89	124	7,620
November	.....	.....	63.9	3,800
December	.....	.....	49.5	3,040
January	.....	.....	48.5	2,980
February	.....	.....	51.8	2,880
March	.....	.....	52.2	3,210
April	144	40	84.8	5,050
May	528	107	304	18,700
June	1,450	426	1,030	61,300
July	1,180	492	769	47,300
August	442	150	265	16,300
September	144	78	98.4	5,860
The year	1,450	.....	246	178,000

NOTE.—Determination of discharge for November and December based on temperature records and discharge measurement.

NORTH BOULDER CREEK AT SILVER LAKE, COLO.

LOCATION.—In NW. ¼ sec. 28, T. 1 N., R. 73 W., at outlet of Silver Lake, in Colorado National Forest.

DRAINAGE AREA.—8.7 square miles (measured by special survey).

RECORDS AVAILABLE.—August 20, 1913, to September 30, 1917.

GAGE.—Friez water-stage recorder which indicates head on the weir.

DISCHARGE MEASUREMENTS.—Made by means of standard sharp-crested weir 10 feet long having a low-water section 5 feet long.

DIVERSIONS.—None above station.

REGULATION.—Winter flow increased by storage in Silver Lake (capacity, 1,900 acre-feet).

COOPERATION.—Complete records furnished by city engineer of Boulder.

Daily discharge, in second-feet, of North Boulder Creek at Silver Lake, Colo., for the period Aug. 20, 1913, to Sept. 30, 1917.

Day.	Aug.	Sept.	Day.	Aug.	Sept.	Day.	Aug.	Sept.
1913.			1913.			1913.		
1	.....	23.8	11	.....	34.4	21	25.2	15.7
2	.....	26.1	12	.....	35.8	22	24.9	15.5
3	.....	31.0	13	.....	35.0	23	24.6	15.4
4	.....	39.8	14	.....	32.4	24	24.9	15.1
5	.....	56.2	15	.....	26.2	25	25.3	14.7
6	.....	62.8	16	.....	25.8	26	24.9	13.6
7	.....	57.8	17	.....	25.8	27	24.3	12.7
8	.....	56.8	18	.....	25.7	28	23.9	12.4
9	.....	52.9	19	.....	21.6	29	23.6	12.2
10	.....	39.8	20	25.5	17.0	30	23.4	12.2
						31	22.2	.....

Daily discharge, in second-feet, of North Boulder Creek at Silver Lake, Colo., for the period Aug. 21, 1913, to Sept. 30, 1914.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1913–14.												
1	12.2	8.19	6.30	4.91	3.43	3.01	6.20	3.40	95.4	76.2	89.7	29.8
2	12.1	8.38	6.30	4.91	3.51	3.01	3.30	3.30	173	74.4	84.3	29.3
3	12.0	8.29	3.49	4.31	3.30	3.01	3.10	3.06	192	73.9	78.1	28.2
4	12.1	8.38	3.61	3.70	3.21	3.01	3.10	2.96	145	73.9	72.1	27.2
5	10.5	8.29	3.75	3.70	3.21	3.10	3.10	2.96	118	79.6	66.6	26.0
6	11.3	7.89	4.00	3.70	3.10	3.10	3.10	3.06	104	79.2	60.9	24.9
7	11.9	7.69	4.20	3.70	3.10	3.10	3.20	3.20	89.0	81.2	51.5	24.3
8	12.0	7.59	4.20	3.70	3.21	3.10	3.20	3.30	76.0	79.0	50.5	20.8
9	11.8	7.48	4.40	3.70	3.40	3.01	3.20	3.57	70.5	78.0	48.7	20.8
10	11.0	7.38	4.62	3.40	3.70	3.01	3.20	3.84	70.5	80.5	46.3	20.9
11	3.40	7.29	4.70	3.40	3.70	3.10	3.10	4.11	75.8	86.0	31.8	20.9
12	9.58	7.29	4.80	3.30	3.80	3.10	3.10	4.40	98.8	88.6	33.4	21.1
13	9.68	7.29	4.61	3.30	3.70	3.10	3.01	4.70	108	88.4	43.0	21.6
14	9.68	7.29	4.31	3.40	3.80	3.10	3.01	5.00	122	87.4	43.0	16.0
15	9.49	7.20	4.31	3.40	3.80	3.10	3.01	5.26	128	85.8	43.0	7.20
16	9.19	6.98	4.26	3.30	3.80	3.20	3.01	6.40	116	85.0	41.3	7.10
17	8.89	6.90	4.21	3.21	3.80	3.20	3.01	10.2	112	93.1	39.3	17.0
18	8.79	6.81	4.11	3.21	3.80	3.20	3.10	13.6	111	83.4	37.2	22.0
19	8.79	6.81	4.00	3.20	3.80	3.20	3.10	17.0	126	80.0	35.3	21.9
20	8.79	6.81	3.96	3.30	3.80	3.30	4.40	39.0	130	76.0	34.4	17.8
21	8.79	6.69	3.90	3.40	3.80	3.30	4.40	38.5	130	75.7	34.1	16.8
22	8.59	6.64	3.90	3.40	3.80	3.30	4.40	39.2	114	83.4	33.9	13.0
23	8.59	6.60	3.88	3.70	3.80	3.30	4.40	50.0	103	84.9	33.6	15.6
24	8.59	6.60	3.80	3.30	3.80	3.30	5.20	50.9	98.5	80.6	32.2	15.8
25	8.68	6.49	3.75	3.30	3.80	3.30	3.40	50.8	93.5	76.2	30.5	16.2
26	8.68	6.49	3.70	3.40	3.80	3.30	3.40	50.1	85.7	69.6	29.8	11.1
27	8.50	6.49	4.40	3.40	3.80	3.30	3.40	53.4	79.5	65.2	29.4	9.80
28	8.29	6.49	5.00	3.40	3.20	3.30	3.40	73.0	76.3	57.7	26.5	9.80
29	8.19	6.49	5.04	3.40	.....	3.30	3.40	67.4	75.7	57.3	26.1	9.80
30	8.19	6.49	5.04	3.51	.....	3.30	3.40	64.0	76.8	78.1	25.5	9.19
31	8.19	.....	4.96	3.51	.....	3.30	.....	63.7	.....	93.1	25.1	.....
1914–15.												
1	8.59	4.11	5.80	5.4	5.25	4.7	6.6	10.6	34.2	85.6	49.4	30.1
2	8.59	2.40	5.76	5.2	5.2	4.7	6.65	10.4	34.8	86.0	46.7	29.1
3	5.15	5.41	5.71	5.1	5.2	4.7	6.7	10.2	14.1	87.6	44.4	28.2
4	2.01	6.21	5.71	5.05	5.2	4.7	6.8	10.4	8.8	81.8	42.9	28.8
5	6.30	6.10	5.65	5.0	5.2	6.2	6.9	10.6	9.8	80.1	41.6	29.6
6	6.90	5.60	5.60	5.0	5.55	6.3	6.9	9.9	10.8	82.2	41.0	29.4
7	6.90	5.50	5.60	5.0	6.05	6.35	6.9	9.3	12.0	80.8	41.9	26.3
8	8.89	5.50	5.60	5.0	6.25	6.4	6.85	13.9	12.5	79.2	44.6	29.1
9	8.45	5.50	5.60	5.1	6.35	6.6	6.8	14.3	24.6	75.2	47.9	11.8
10	6.99	4.91	5.60	5.2	6.4	7.0	6.8	13.7	36.9	75.5	50.2	13.9
11	6.80	4.91	5.60	5.2	6.45	7.3	10.5	13.4	55.8	81.7	48.5	17.4
12	6.80	4.91	5.60	5.15	6.5	7.6	10.1	14.4	67.6	88.8	46.6	21.6
13	6.99	5.00	5.65	5.1	4.8	7.0	10.8	16.3	59.4	93.8	44.6	26.1
14	6.99	5.11	5.71	5.1	4.95	7.0	10.6	18.2	55.2	94.7	44.6	24.0
15	6.99	5.20	5.71	5.1	5.0	7.05	10.5	25.8	51.1	93.2	45.6	23.7
16	6.99	5.20	5.71	5.1	5.0	7.15	10.2	25.0	45.2	89.4	44.6	22.7
17	6.99	5.20	5.71	5.15	5.0	7.5	10.0	24.3	48.8	84.2	42.6	22.1
18	6.00	5.11	5.71	5.2	5.0	7.1	9.8	22.0	52.5	78.3	40.8	22.4
19	4.71	5.20	5.76	5.2	5.0	7.1	9.7	18.0	58.7	61.1	39.8	20.3
20	4.71	5.30	6.40	5.15	4.85	7.2	9.4	14.5	67.7	65.8	38.6	24.4
21	4.71	5.56	5.50	5.1	4.7	7.3	9.2	11.7	89.8	63.5	35.6	25.6
22	4.96	5.71	5.56	5.15	4.65	7.05	9.2	10.6	107	60.7	33.1	25.1
23	5.15	5.80	5.60	5.2	4.65	7.1	9.2	11.3	128	53.0	32.2	31.2
24	5.30	5.90	5.41	5.2	4.7	7.0	9.2	14.4	131	55.9	31.5	34.4
25	5.41	5.90	5.20	5.2	4.7	6.8	8.7	17.6	125	55.9	30.3	36.0
26	5.44	5.90	5.20	5.2	4.7	6.8	8.4	18.2	109	55.9	29.0	34.4
27	5.56	5.85	5.20	5.2	4.7	6.8	8.45	17.5	100	55.9	30.0	36.0
28	5.74	5.80	5.20	5.25	4.7	6.8	8.7	16.9	92.4	53.1	36.0	36.0
29	6.00	5.80	5.26	5.3	.....	6.8	9.6	13.4	88.4	51.5	34.7	36.0
30	6.10	5.80	5.30	5.3	.....	6.8	10.4	23.7	86.8	51.4	33.2	32.2
31	5.56	.....	5.41	5.3	.....	6.6	.....	28.9	.....	50.3	31.3	.....

Daily discharge, in second-feet, of North Boulder Creek at Silver Lake, Colo., for the period Aug. 20, 1913, to Sept. 30, 1917—Continued.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1915–16.												
1	28.2	8.8	5.8	4.8	6.5	5.3	2.2	4.3	19.6	53.5	46.8	16.8
2	25.1	5.0	5.8	4.7	7.5	5.3	2.2	4.3	19.0	47.6	45.4	15.8
3	22.3	5.3	5.9	4.6	7.4	5.3	2.3	4.3	18.6	49.2	41.5	14.8
4	15.7	5.3	5.7	4.6	7.2	5.3	2.5	4.3	20.0	49.0	39.0	14.6
5	15.4	5.2	5.0	4.9	7.1	5.25	3.8	4.3	21.0	47.0	37.5	17.7
6	15.4	7.73	5.0	4.9	5.4	5.0	3.7	4.3	19.1	47.0	36.8	18.2
7	15.3	9.5	5.0	4.8	6.15	3.1	3.6	3.7	18.4	47.4	36.8	16.7
8	15.1	7.8	5.0	4.7	5.71	3.8	3.4	3.25	19.8	46.2	36.8	16.2
9	12.7	7.5	5.0	4.8	5.2	4.0	3.25	3.1	22.1	47.4	37.0	16.6
10	8.9	7.1	4.8	4.9	4.45	4.0	3.25	1.8	23.2	51.0	36.7	18.0
11	8.9	6.8	4.9	5.0	4.3	3.85	4.0	1.2	23.2	54.4	36.0	18.7
12	8.9	6.5	4.7	5.0	5.15	3.75	3.8	8.4	24.8	52.4	35.0	18.3
13	9.4	9.1	4.7	4.9	6.45	3.6	4.0	18.6	30.0	46.4	34.0	18.8
14	11.2	6.2	4.7	4.9	5.21	3.6	4.0	12.2	35.9	43.2	33.4	16.0
15	9.8	6.2	4.7	4.1	4.8	3.55	4.0	11.7	40.0	41.8	33.0	14.0
16	9.9	6.1	4.8	6.7	5.2	3.45	3.8	9.8	43.6	41.0	32.5	12.8
17	10.0	6.1	4.9	9.3	5.1	3.3	3.8	7.2	47.2	41.0	32.3	11.8
18	9.9	6.1	4.6	7.3	5.0	3.2	3.8	7.2	50.0	40.8	31.2	11.0
19	9.8	5.8	4.6	6.3	4.8	3.0	3.7	7.6	51.6	39.7	29.2	10.2
20	9.7	6.2	4.6	5.8	4.65	2.9	3.7	8.8	53.2	39.5	28.0	9.95
21	9.6	6.7	4.7	5.8	4.6	3.05	3.6	9.4	54.6	39.0	26.5	9.35
22	9.6	6.2	4.6	5.4	4.6	3.05	3.6	8.8	52.6	37.5	24.7	8.55
23	9.2	5.8	5.2	5.4	4.6	2.9	3.6	8.2	49.2	35.8	23.6	8.50
24	6.5	5.7	5.5	5.3	4.55	2.8	3.6	7.8	46.4	34.9	22.1	8.8
25	5.2	5.7	3.9	5.3	4.5	2.8	3.7	8.8	45.0	34.6	21.0	8.9
26	6.8	5.8	4.8	5.3	4.5	2.4	3.7	11.5	46.4	34.4	21.0	8.4
27	5	6	5.0	5.2	4.5	1.85	3.8	12.8	49.0	35.2	20.6	7.6
28	5	6	5.6	5.0	4.55	1.7	4.0	13.4	52.0	35.4	19.6	6.85
29	5	5.9	4.6	5.0	5.0	1.75	4.0	13.9	55.4	36.3	18.6	6.55
30	5	5.8	4.6	5.6	.....	2.0	4.2	16.0	57.2	40.1	18.0	7.6
31	6	.....	4.6	6.5	.....	2.25	.....	16.6	.....	44.2	17.4	.....
1916–17.												
1	5.55	8.70	5.65	5.2	6.6	7.8	1.8	1.9	2.0	101	99.4	24.2
2	5.75	8.60	5.2	5.2	6.6	7.7	1.8	1.8	1.3	105	87.5	23.4
3	6.05	5.05	4.0	4.8	6.5	7.7	1.8	1.8	3.0	100	76.2	23.4
4	6.45	6.05	4.0	4.8	6.3	7.4	1.8	1.8	9.0	91.0	43.0	23.2
5	9.3	6.80	4.3	4.7	6.2	7.3	1.8	1.7	11.3	81.4	48.0	23.2
6	12.9	7.20	4.3	4.7	6.2	7.3	1.7	1.7	15.0	79.4	50.0	26.2
7	7.15	7.40	4.3	4.7	6.2	7.1	1.7	1.8	18.0	78.8	50.8	26.2
8	7.0	7.90	4.0	4.8	4.6	7.1	1.7	1.8	21.2	65.0	48.0	25.2
9	8.2	8.15	3.7	4.8	4.6	7.1	1.7	1.9	26.0	91.6	48.0	25.2
10	8.2	7.85	5.8	4.8	6.0	7.1	1.6	1.9	36.3	90.8	50.8	23.4
11	8.2	7.40	4.95	4.9	6.3	7.1	1.6	1.9	27.0	91.6	51.6	23.4
12	8.2	7.20	4.7	5.0	6.2	7.0	1.6	2.2	29.8	96.4	56.6	23.4
13	8.25	7.30	4.7	5.0	6.5	7.1	1.6	2.2	24.4	96.0	55.4	23.4
14	6.2	7.25	4.7	5.7	6.7	7.1	1.6	2.3	38.0	96.0	53.8	23.4
15	3.8	7.00	6.3	6.3	7.0	7.1	1.6	2.7	40.2	84.4	53.8	18.6
16	3.7	6.90	6.4	6.7	7.4	7.1	1.5	3.4	42.8	80.6	38.7	19.0
17	2.2	6.85	5.55	6.8	7.0	7.1	1.5	8.0	44.5	75.0	38.7	19.0
18	1.3	6.80	4.7	6.9	6.9	6.3	1.5	15.0	44.5	68.6	40.7	19.0
19	2.8	6.80	6.4	7.6	7.3	6.2	1.5	60.0	44.5	66.8	34.5	12.5
20	3.3	6.80	6.1	7.8	7.3	6.2	1.5	33.0	44.4	58.8	33.2	12.5
21	4.2	6.85	5.8	7.9	7.2	6.3	1.5	16.6	48.0	58.8	33.2	12.4
22	3.9	6.90	5.8	8.3	7.2	5.8	1.5	12.8	51.6	55.0	31.7	12.4
23	3.15	6.70	5.8	8.3	7.2	5.5	1.5	9.6	55.5	51.6	31.2	12.4
24	3.85	6.40	5.8	8.0	7.2	5.4	1.5	4.0	70.5	52.6	31.2	12.4
25	9.0	6.30	5.8	8.1	7.2	5.0	1.6	2.3	105	54.0	30.0	12.4
26	11.8	6.30	5.7	8.2	7.2	4.6	1.7	1.5	105	55.2	26.2	12.4
27	11.0	6.25	5.5	8.1	7.7	3.8	1.7	2.0	98.8	56.5	26.2	12.4
28	10.4	6.00	5.5	7.2	7.8	1.8	1.7	2.0	98.2	58.2	24.2	12.4
29	9.75	5.90	5.5	7.2	.....	1.8	1.7	2.0	97.6	77.4	24.2	12.4
30	9.2	5.90	5.5	7.0	.....	1.8	2.5	2.0	97.6	83.0	24.2	12.4
31	8.9	.....	5.5	6.9	.....	1.8	.....	2.0	.....	101	24.2	.....

Monthly discharge of North Boulder Creek at Silver Lake, Colo., for the period Aug. 20, 1913, to Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
1913.				
August 20–31	25.5	22.2	24.4	581
September	62.8	12.2	28.9	1,720
1913–14.				
October	12.2	3.40	9.56	588
November	8.38	6.49	7.19	428
December	6.30	3.49	4.37	269
January	4.91	3.20	3.56	219
February	3.80	3.10	3.60	200
March	3.30	3.01	3.17	195
April	6.20	3.01	3.51	209
May	73.0	2.96	24.0	1,480
June	192	70.5	106	6,310
July	93.1	57.3	78.9	4,850
August	89.7	25.1	43.8	2,690
September	29.8	7.10	18.4	1,090
The year	192	2.96	25.5	18,500
1914–15.				
October	8.89	2.01	6.22	382
November	6.21	2.40	5.35	318
December	6.40	5.20	5.58	343
January	5.4	5.0	5.16	317
February	6.5	4.65	5.24	291
March	7.6	4.7	6.63	408
April	10.8	6.6	8.68	516
May	28.9	9.3	15.8	972
June	131	8.8	60.6	3,610
July	94.7	50.3	72.6	4,460
August	50.2	29.0	40.1	2,470
September	36.0	11.8	26.9	1,600
The year	131	2.01	21.6	15,700
1915–16.				
October	28.2	5.0	11.1	682
November	9.5	5.0	6.46	384
December	5.9	3.9	4.95	304
January	9.3	4.1	5.38	331
February	7.4	4.3	5.33	307
March	5.3	1.7	3.45	212
April	4.2	2.2	3.55	211
May	18.6	1.2	8.31	511
June	57.2	18.4	36.9	2,200
July	54.4	34.4	43.0	2,640
August	46.8	17.4	30.7	1,890
September	18.8	6.55	12.9	768
The year	57.2	1.2	14.3	10,400
1916–17.				
October	12.9	1.3	6.76	416
November	8.7	5.05	6.92	412
December	6.4	3.7	5.22	321
January	8.3	4.7	6.33	389
February	7.8	4.6	6.68	371
March	7.8	1.8	5.98	368
April	2.5	1.5	1.66	99
May	60.0	1.5	6.65	409
June	105	1.3	38.7	2,300
July	105	51.6	77.5	4,770
August	99.4	24.2	44.1	2,710
September	26.2	12.4	18.7	1,110
The year	105	1.3	18.9	13,700

SOUTH BOULDER CREEK NEAR ROLLINSVILLE, COLO.

LOCATION.—In sec. 35, T. 1 S., R. 73 W., 1 mile west of Rollinsville, Gilpin County. Nearest important tributary, Jenny Creek, enters 3 miles above.

DRAINAGE AREA.—39 square miles (measured on topographic maps).

RECORDS AVAILABLE.—September 10, 1910, to September 30, 1917.

GAGE.—Vertical staff spiked to tree on left bank, 500 feet above bridge, used since June 2, 1916; vertical staff on downstream side of right abutment used May 8 to June 1, 1916; vertical staff on upstream side of right abutment used prior to May 8, 1916; read by Miss Grace Grant.

DISCHARGE MEASUREMENTS.—Made from two-span bridge or by wading.

CHANNEL AND CONTROL.—Bed composed of coarse gravel and small boulders. Control not well defined; shifts occasionally. Banks not subject to overflow.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 2.38 feet at 5 p. m. June 22 (discharge, 432 second-feet); minimum discharge occurs during winter.

ICE.—Stage-discharge relation affected by ice for short periods.

DIVERSIONS.—No court decrees for diversion above station.

REGULATION.—None.

ACCURACY.—Stage-discharge relation slightly shifting; affected by ice during winter. Rating curve used October 1 to December 31 well defined between 15 and 300 second-feet; curve used April 15 to September 30 well defiend between 10 and 350 second-feet. Gage read to quarter-tenths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table. Records good.

Discharge measurements of South Boulder Creek near Rollinsville, Colo., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Dec. 29	J. H. Keep	[a] 0.92	11.9	June 30	Robert Follansbee	1.98	275
Feb. 21	....do....	[a] 1.10	7.5	Aug. 17	S. B. Soulé	1.22	37.9

[a] Stage-discharge relation affected by ice.

Daily discharge, in second-feet, of South Boulder Creek near Rollinsville, Colo., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Apr.	May.	June.	July.	Aug.	Sept.
1	17	19	14	.....	31	105	300	90	22
2	17	19	13	.....	31	102	260	72	22
3	17	19	13	.....	28	109	240	63	22
4	17	19	14	.....	22	170	240	63	17
5	17	18	14	.....	23	170	222	44	13
6	17	17	14	.....	25	166	222	44	13
7	17	17	14	.....	23	170	205	41	13
8	17	15	14	.....	23	170	205	36	13
9	17	15	14	.....	23	300	222	32	14
10	17	16	14	.....	23	320	222	31	14
11	17	16	14	.....	32	300	222	34	14
12	17	14	14	.....	41	320	188	32	14
13	17	13	14	.....	51	320	156	32	14
14	17	14	13	.....	122	320	156	32	14
15	15	15	14	16	170	360	135	36	14
16	20	16	14	17	222	360	122	36	14
17	25	17	14	17	260	400	115	41	14
18	21	17	14	23	280	360	115	32	13
19	20	17	14	17	222	340	115	31	13
20	21	17	14	20	188	360	115	31	13
21	19	17	14	23	138	360	122	31	10
22	23	15	14	32	115	400	115	28	10
23	21	15	14	34	115	400	102	27	10
24	21	14	14	41	115	380	118	27	10
25	21	14	14	34	118	340	115	22	10
26	21	14	14	37	115	320	212	22	13
27	21	14	14	32	102	300	205	22	10
28	21	14	14	31	102	300	115	22	10
29	21	14	12	31	105	300	128	23	8
30	20	13	12	31	105	300	118	23	6
31	20	.....	12	.....	105	.....	102	22	.....

NOTE.—Stage-discharge relation affected by ice Nov. 8–16, Dec. 29–31; discharge based on temperature and gage-height record, discharge measurements, and observer's notes.

Monthly discharge of South Boulder Creek near Rollinsville, Colo., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	25	15	19.0	1,170
November	19	13	15.8	940
December	14	12	13.7	842
April 15–30	41	16	27.2	863
May	280	22	99.2	6,100
June	400	102	287	17,100
July	300	102	169	10,400
August	90	22	36.2	2,230
September	22	6	13.2	786

BIG THOMPSON CREEK NEAR DRAKE, COLO.

LOCATION.—In sec. 2, T. 5 N., R. 71 W., at highway bridge No. 7 in Big Thompson Canyon, 200 yards below Loveland dam and 1½ miles east of Drake, in Larimer County. Nearest tributary, North Fork, enters at Drake.

DRAINAGE AREA.—274 square miles (measured on topographic map).

RECORDS.—September 18–30, 1917.

GAGE.—Bristol pressure gage attached to left bridge abutment.

DISCHARGE MEASUREMENTS.—Made from single-span bridge.

CHANNEL AND CONTROL.—Channel is pool in which several feet of silt are deposited and scoured out; control 50 feet downstream at rapids of compact gravel; practically permanent during 1917. Banks not subject to overflow.

ICE.—Stage-discharge relation seriously affected by ice. Winter measurements made at section half a mile upstream.

DIVERSIONS.—Court decrees for diversion of 23 second-feet from river above station and 2,277 second-feet below, also decrees for storage of 81,000 acre-feet below station.

REGULATION.—Alternate melting and freezing of mountain snows during spring causes diurnal fluctuation. No artificial regulation.

ACCURACY.—Stage-discharge relation practically permanent; affected by ice during winter. Rating curve well defined between 25 and 650 second-feet. Water-stage recorder gave satisfactory results. Daily discharge ascertained by applying to the rating table mean daily gage height determined by inspecting gage-height graph. Records good.

COOPERATION.—Field data furnished by city of Loveland. Discharge measurement also made by United States Geological Survey.

Discharge measurements of Big Thompson Creek near Drake, Colo., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Inches.	*Sec.-ft.*			*Inches.*	*Sec.-ft.*
Feb. 20	Hodges and Bice		23.8	Apr. 21	E. S. Bice	17	89
26	E. S. Bice		25.5	July 24	do	35	629
Mar. 9	do		22.4	Aug. 18	do	25	230
23	do		26.1	30	do	21.5	178

Daily discharge, in second-feet, of Big Thompson Creek near Drake, Colo., for the period Sept. 18–30, 1917.

Sept. 18	106	Sept. 23	80	Sept. 27	76
19	98	24	80	28	72
20	93	25	89	29	61
21	89	26	80	30	61
22	85				

KANSAS RIVER BASIN.

REPUBLICAN RIVER AT WAKEFIELD, KANS.

LOCATION.—In NE. ¼ sec. 5, T. 10 S., R. 4 E., at highway bridge 1,000 feet north of Union Pacific Railroad station at Wakefield, Clay County.

DRAINAGE AREA.—Not determined.

RECORDS AVAILABLE.—June 21 to September 30, 1917.

GAGE.—Chain gage bolted to upstream guard timber of highway bridge in center of middle span.

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

CHANNEL AND CONTROL.—Bed is sandy and shifting. The river is confined within fairly high banks that are fairly clean of vegetation. At high water the river overflows on left bank and spreads out over entire valley floor a distance of from 2 to 3 miles in width. The right bank is high and is not overflowed at the gage.

EXTREMES OF STAGE.—Maximum stage recorded during the period, 3.4 feet on June 21, 1917; minimum stage, 1.65 feet on September 12 and 17, 1917.

During the flood of June, 1915, the river rose to within a few feet of the bridge floor, which is approximately gage height, 22½ feet, and flooded out the entire valley. Flood stage occurs at 12 feet gage height.

ICE.—Stage-discharge relation affected by ice.

REGULATION.—Flow is affected by regulation by a dam at Clay Center.

ACCURACY.—Gage heights are means of two daily readings.

Data inadequate for determination of discharge.

Discharge measurements of Republican River at Wakefield, Kans., during the year ending Sept. 30, 1917.

[Made by R. C. Rice.]

Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*
June 21	3.38	750
July 26	2.04	84
Sept. 5	1.78	55

Daily gage height, in feet, of Republican River at Wakefield, Kans., for the year ending Sept. 30, 1917.

[S. R. Winsor, observer.]

Day.	June.	July.	Aug.	Sept.	Day.	June.	July.	Aug.	Sept.
1		3.0	2.0	2.1	16		2.45	2.4	1.75
2		2.9	1.95	2.15	17		2.5	2.2	1.65
3		2.9	1.9	1.85	18		2.45	2.1	1.85
4		2.85	1.8	1.95	19		2.4	2.05	1.75
5		2.85	2.35	1.9	20		2.4	2.35	1.95
6		2.75	2.15	1.95	21	3.4	2.35	2.2	2.65
7		2.8	2.85	1.95	22	3.3	2.3	2.25	2.5
8		2.7	3.05	1.95	23	3.3	2.3	2.3	2.4
9		2.7	2.8	2.0	24	3.25	2.25	2.3	2.6
10		2.65	3.05	1.7	25	3.2	2.3	2.15	2.65
11		2.6	3.5	1.85	26	3.1	2.3	2.2	2.65
12		2.5	2.7	1.65	27	3.1	2.2	2.2	2.7
13		2.55	2.55	1.8	28	3.05	2.3	2.15	2.75
14		2.5	2.4	1.85	29	3.05	2.35	2.15	4.0
15		2.4	2.45	1.8	30	3.1	1.9	2.05	3.6
					31		2.05	2.0	

KANSAS RIVER AT OGDEN, KANS.

LOCATION.—In SE. ¼ sec. 12, T. 11 S., R. 6 E., at highway bridge three-fourths of a mile southeast of Ogden, Riley County, Kans. Sevenmile Creek enters from north a quarter of a mile upstream; Clark Creek enters from south 2 miles upstream. Smoky Hill and Republican rivers unite near Junction City, 6 miles by direct line (10 miles by river) upstream, to form Kansas River. Camp Funston is at Ogden Flats, along Kansas River 1½ miles upstream.

DRAINAGE AREA.—Not determined.

RECORDS AVAILABLE.—June 19 to September 30, 1917.

GAGE.—Chain gage bolted to upstream landrail of highway bridge in center of span next to right bank; read by Arthur Estes.

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

CHANNEL AND CONTROL.—Bed composed of sand; control shifting. Stone jetty on right bank about 50 feet downstream from bridge partially controls flow at low water. There are old bridge members in channel below bridge, which are the remains of an old bridge that was washed out.

EXTREMES OF STAGE.—Maximum stage recorded during period, 9.7 feet on August 17, 1917; minimum stage, 3.8 feet on August 2, 1917. Flood stage occurs at about 21 feet.

ICE.—Discharge affected by ice.

REGULATION.—Flow affected somewhat by mill and power regulation on the tributaries of Kansas River.

ACCURACY.—Gage heights are means of two daily readings.

Data inadequate for determination of discharge.

Discharge measurements of Kansas River at Ogden, Kans., during the year ending Sept. 30, 1917.

[Made by R. C. Rice.]

Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*
June 19	6.34	1,660
July 25	4.23	354
Sept. 3	5.13	709

Daily gage height, in feet, of Kansas River at Ogden, Kans., for the year ending Sept. 30, 1917.

Day.	June.	July.	Aug.	Sept.	Day.	June.	July.	Aug.	Sept.
1		5.45	4.0	5.45	16		4.7	9.15	4.4
2		5.4	3.8	5.3	17		4.5	9.7	4.5
3		5.4	4.0	5.2	18		4.5	9.2	4.45
4		5.0	4.1	5.15	19	6.35	4.75	8.85	4.55
5		5.15	4.05	5.2	20	6.3	4.6	9.0	4.45
6		5.15	4.1	5.15	21	6.15	4.45	8.6	4.3
7		5.0	5.1	4.7	22	6.6	4.4	7.7	4.7
8		5.1	5.3	4.55	23	5.95	4.4	7.0	4.75
9		4.95	6.05	4.8	24	5.9	4.35	7.05	4.95
10		5.1	5.9	4.9	25	5.7	4.45	6.5	4.85
11		4.9	6.05	4.55	26	5.65	4.4	6.1	5.7
12		4.9	7.15	4.75	27	5.6	4.35	6.5	5.35
13		4.8	6.6	4.65	28	5.6	4.35	6.5	5.15
14		4.6	5.95	4.55	29	5.55	4.2	6.1	5.1
15		4.65	6.9	4.5	30	5.35	3.9	5.8	5.95
					31		4.05	5.65	

KANSAS RIVER AT TOPEKA, KANS.

LOCATION.—At Chicago, Rock Island & Pacific Railroad bridge 2,100 feet upstream from Melan arch highway bridge, at Topeka, Shawnee County. Soldier Creek enters about 1½ miles downstream.

DRAINAGE AREA.—Not determined.

RECORDS AVAILABLE.—April 24 to August 31, 1904, and June 12 to September 30, 1917.

GAGE.—Chain gage bolted to floor beam of second span of railroad bridge, 235 feet out from right abutment on the downstream side; read by T. H. Beeson. Gage set to read the same as the United States Weather Bureau chain gage on Melan arch bridge on June 12, 1917, when the stage there read 9.1 feet, at 1.40 p. m. In 1904 a station was maintained at this point for flood observations. A staff gage was painted on one of the piers of the railroad bridge at an arbitrary datum.

DISCHARGE MEASUREMENTS.—Made from downstream side of railroad bridge.

CHANNEL AND CONTROL.—Bed composed of sand and silt; the Melan arch bridge and old bridge piles and riprapping under and upstream from it act as an artificial control for the stage-discharge relation. Banks are levied upstream and downstream so that the stream is confined for all stages.

EXTREMES OF DISCHARGE.—Maximum stage recorded during period, 9.4 feet on June 12, 1917 (discharge, 12,400 second-feet); minimum stage, 4.3 feet on August 4 and 5, 1917 (discharge, 1,010 second-feet).

ICE.—Discharge affected by ice. Flow from outfall sewers entering Kansas River 500 feet upstream from the Melan arch bridge usually keeps the main channel open at that point.

REGULATION.—None, except slight effect of power regulation on tributaries upstream.

ACCURACY.—Stage-discharge relation not permanent. Rating curves used June 12 to September 9 and September 10–30 fairly well defined. Gage read to half-tenths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table. Records good.

Discharge measurements of Kansas River at Topeka, Kans., during the year ending Sept. 30, 1917.

[Made by R. C. Rice.]

Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*
June 13	9.53	12,900
26	6.07	3,050
Aug. 17	7.21	5,390

Daily gage height, in feet, of Kansas River at Topeka, Kans., for the year ending Sept. 30, 1917.

Day.	June.	July.	Aug.	Sept.	Day.	June.	July.	Aug.	Sept.
1	.....	5.8	4.45	5.35	16	7.5	5.05	6.85	5.0
2	.....	5.8	4.5	5.3	17	7.2	5.0	7.2	4.95
3	.....	5.9	4.4	5.15	18	7.0	5.0	8.35	4.8
4	.....	5.8	4.3	5.0	19	6.8	4.9	6.9	4.8
5	.....	5.75	4.3	4.85	20	6.65	4.85	7.65	4.8
6	.....	5.6	4.35	4.75	21	6.5	4.9	7.65	4.6
7	.....	5.6	4.4	4.8	22	6.4	4.8	7.75	4.55
8	.....	5.55	5.8	4.8	23	6.3	4.8	7.2	4.7
9	.....	5.5	6.15	4.8	24	6.2	4.7	6.5	4.9
10	.....	5.3	5.9	7.45	25	6.1	4.95	6.4	4.8
11	.....	5.3	6.2	6.55	26	6.1	5.0	6.4	5.25
12	9.4	5.3	6.45	6.1	27	6.0	4.85	6.1	5.2
13	9.4	5.25	6.7	5.65	28	6.0	4.7	5.9	5.35
14	8.75	5.15	7.0	5.35	29	5.9	4.5	5.9	4.95
15	7.75	5.1	8.0	5.1	30	5.85	4.45	5.8	4.85
					31	.....	4.55	5.5	.....

Daily discharge, in second-feet, of Kansas River at Topeka, Kans., for the year ending Sept. 30, 1917.

Day.	June.	July.	Aug.	Sept.	Day.	June.	July.	Aug.	Sept.
1	.....	2,710	1,130	2,110	16	6,240	1,750	4,620	2,100
2	.....	2,710	1,170	2,050	17	5,430	1,690	5,430	2,040
3	.....	2,850	1,090	1,870	18	4,950	1,690	8,860	1,860
4	.....	2,710	1,010	1,690	19	4,510	1,580	4,730	1,860
5	.....	2,640	1,010	1,520	20	4,190	1,520	6,670	1,860
6	.....	2,430	1,050	1,420	21	3,890	1,580	6,670	1,640
7	.....	2,430	1,090	1,470	22	3,710	1,470	6,970	1,590
8	.....	2,360	2,710	1,470	23	3,530	1,470	5,430	1,750
9	.....	2,300	3,260	1,470	24	3,350	1,360	3,890	1,980
10	.....	2,050	2,850	6,390	25	3,170	1,640	3,710	1,860
11	.....	2,050	3,350	4,410	26	3,170	1,690	3,710	2,420
12	12,400	2,050	3,800	3,660	27	3,010	1,520	3,170	2,350
13	12,400	1,990	4,290	2,980	28	3,010	1,360	2,850	2,550
14	10,200	1,870	4,950	2,550	29	2,850	1,170	2,850	2,040
15	6,970	1,810	7,740	2,220	30	2,780	1,130	2,710	1,920
					31	.....	1,220	2,300	.....

Monthly discharge of Kansas River at Topeka, Kans., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
June 12-30	12,400	2,780	5,250	198,000
July	2,850	1,130	1,900	117,000
August	8,860	1,010	3,710	228,000
September	6,390	1,470	2,240	133,000

KANSAS RIVER AT BONNER SPRINGS, KANS.

LOCATION.—In NW. ¼ sec. 32, T. 11 S., R. 23 E., at highway bridge at Bonner Springs, Wyandotte County. Wolf Creek enters from north just above Atchison, Topeka & Santa Fe Railway bridge, half a mile upstream. Station is 18 miles by river above Kansas City, Mo., and above backwater influence of Missouri River.

DRAINAGE AREA.—Not determined.

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

GAGE.—Chain gage bolted to upstream landrail of highway bridge in center of second span from left bank; read by M. E. Kenton.

DISCHARGE MEASUREMENT.—Made from downstream side of highway bridge.

CHANNEL AND CONTROL.—Bed composed of sand and gravel; control shifts at high water. Right bank subject to overflow at high stages; left bank high and fairly steep.

EXTREMES OF STAGE.—Maximum stage recorded during the period, 7.0 feet on August 16, 1917; minimum stage, 3.95 feet on September 23 and 24, 1917.

ICE.—Stage-discharge relation affected by ice.

REGULATION.—Flow affected somewhat by mill operation at Lawrence.

ACCURACY.—Gage heights are means of two daily readings.

Data inadequate for determination of discharge.

The following measurement was made by R. C. Rice:

July 8, 1917: Gage height, 4.90 feet; discharge, 2,480 second-feet.

Daily gage height, in feet, of Kansas River at Bonner Springs, Kans., for the year ending Sept. 30, 1917.

Day.	July.	Aug.	Sept.	Day.	July.	Aug.	Sept.	Day.	July.	Aug.	Sept.
1	.....	4.15	4.75	11	4.75	5.55	5.8	21	4.35	6.6	4.1
2	.....	4.05	4.6	12	4.65	5.4	5.7	22	4.3	6.5	4.0
3	.....	4.0	4.5	13	4.65	5.5	5.2	23	4.3	6.55	3.95
4	.....	4.0	4.45	14	4.6	6.35	5.0	24	4.3	6.1	3.95
5	.....	4.05	4.3	15	4.6	6.7	4.7	25	4.3	5.6	4.15
6	.....	4.0	4.2	16	4.5	7.0	4.5	26	4.3	5.45	5.25
7	.....	4.05	4.15	17	4.5	6.05	4.35	27	4.4	5.45	5.5
8	4.9	4.1	4.15	18	4.45	6.2	4.3	28	4.4	5.1	5.0
9	4.9	5.0	4.7	19	4.3	6.95	4.15	29	4.3	4.9	4.7
10	4.85	5.75	5.0	20	4.35	6.6	4.1	30	4.2	4.9	4.5
								31	4.2	4.9	.....

MISCELLANEOUS MEASUREMENTS.

Measurements of the flow of streams in the Missouri River basin at points other than gaging stations are recorded in the following table:

Miscellaneous measurements in Missouri River drainage basin during the year ending Sept. 30, 1917.

Date.	Stream.	Tributary to, or diverts from—	Locality.	Gage height.	Discharge.
				Feet.	*Sec.-ft.*
May 9	Big Hole River	Jefferson River	Divide, Mont	4.54	2,880
Aug. 25	City ditch (Helena, Mont.).	Tenmile Creek	Moose Creek ranger station, Mont.	4.22	3.2
13	Birch Creek	Two Medicine River.	Fischer's ranch, near Valier, Mont.		64
June 22	Eldorado ditch	Left bank of Teton River.[a]	Crossing of highway between Strabane and Chouteau, Mont.		83
22	Monkman ditch	do	do		1.2
22	Farmer's ditch	do	do		119
22	Cashman ditch	do	do		7.0
22	Burton ditch	do	do		66
Oct. 24	Dogtooth Creek	Cannonball River.	Sec. 4, T. 134 N., R. 82 W., at Timmer, N. Dak., one-fourth mile below mouth of Louise Creek.		2.5
May 23	do	do	do		14.0
July 26	do	do	do		[b] 1.8
Aug. 27	do	do	do		[b] .9
Oct. 23	Oak Creek	Missouri River	Sec. 27, T. 20 N., R. 29 E., at Wakpala, S. Dak.		5.9
June 19	do	do	do		[b] 1.0
July 24	do	do	do		[b] .2
Aug. 20	do	do	do		.0
24	Little Missouri River	do	Highway bridge at Marmarth, S. Dak.	[c] 24.40	11.8
May 15	Greybull River	Big Horn River	Meeteetse, Wyo	3.20	2,350
June 24	do	do	do	3.12	3,080
July 19	Clear Creek	Powder River	Above Piney Creek at Ucross, Wyo.		75
18	do	do	Clearmont, Wyo	2.0	64
24	do	do	do		91
June 15	Camp Creek	North Platte River.	Mouth, sec. 11, T. 11 N., R. 80 W., Colo.		[a] 50
15	Threemile Creek	do	Mouth, sec. 25, T. 12 N., R. 80 W., Colo.		[a] 5
Oct. 24	Cedar Creek	do	Sec. 28, T. 17 N., R. 83 W., Wyo.		2 4
24	South Spring	do	Sec. 31, T. 16 N., R. 84 W., Wyo.		16
11	North Platte River	Platte River	Pathfinder, Wyo	3.10	1,180
30	Bear Creek	South Platte River	Morrison, Colo		28

[a] Canals divert from Teton River and head on north bank between Strabane and Chouteau; canals listed in downstream order, beginning at Strabane.
[b] Estimated.
[c] Distance from reference point to water surface.

INDEX.

STREAM-GAGING STATIONS

AND

PUBLICATIONS RELATING TO WATER RESOURCES

PART VI. MISSOURI RIVER BASIN

STREAM-GAGING STATIONS AND PUBLICATIONS RELATING TO WATER RESOURCES.

INTRODUCTION.

Investigation of water resources by the United States Geological Survey has consisted in large part of measurements of the volume of flow of streams and studies of the conditions affecting that flow, but it has comprised also investigation of such closely allied subjects as irrigation, water storage, water powers, underground waters, and quality of waters. Most of the results of these investigations have been published in the series of water-supply papers, but some have appeared in the monographs, bulletins, professional papers, and annual reports.

The results of stream-flow measurements are now published annually in 12 parts, each part covering an area whose boundaries coincide with natural drainage features as indicated below:

Part I. North Atlantic basins.
II. South Atlantic and eastern Gulf of Mexico basins.
III. Ohio River basin.
IV. St. Lawrence River basin.
V. Upper Mississippi River and Hudson Bay basins.
VI. Missouri River basin.
VII. Lower Mississippi River basin.
VIII. Western Gulf of Mexico basins.
IX. Colorado River basin.
X. Great basin.
XI. Pacific basins in California.
XII. North Pacific slope basins, in three volumes:
A, Pacific slope basins in Washington and upper Columbia River basin.
B, Snake River basin.
C, Lower Columbia River basin and Pacific slope basins in Oregon.

HOW GOVERNMENT REPORTS MAY BE OBTAINED OR CONSULTED.

Water-supply papers and other publications of the United States Geological Survey containing data in regard to the water resources of the United States may be obtained or consulted as indicated below:

1. Copies may be obtained free of charge by applying to the Director of the Geological Survey, Washington, D. C. The edition printed for free distribution is, however, small and is soon exhausted.

2. Copies may be purchased at nominal cost from the Superintendent of Documents, Government Printing Office, Washington, D. C., who will on application furnish lists, giving prices.

3. Sets of the reports may be consulted in the libraries of the principal cities of the United States.

4. Complete sets are available for consultation in the local office of the water-resources branch of the Geological Survey, as follows:

Boston, Mass., 2500 Customhouse.
Albany, N. Y., Room 704 Journal Building.
Harrisburg, Pa., Care of Water Supply Commission.
Asheville, N. C., 32–35 Broadway.
Chattanooga, Tenn., Temple Court Building.
Madison, Wis., care of Railroad Commission of Wisconsin.
Chicago, Ill., 1404 Kimball Building.
Ames, Iowa, care of State Highway Commission.
Topeka, Kans., 23 Federal Building.
Helena, Mont., Montana National Bank Building.
Denver, Colo., 403 New Post Office Building.
Salt Lake City, Utah, 421 Federal Building.
Boise, Idaho, 615 Idaho Building.
Idaho Falls, Idaho, 228 Federal Building.
Tacoma, Wash., 406 Federal Building.
Portland, Oreg., 606 Post Office Building.
San Francisco, Calif., 328 Customhouse.
Los Angeles, Calif., 619 Federal Building.
Austin, Tex., Capitol Building.
Honolulu, Hawaii, 14 Capitol Building.

A list of the Geological Survey's publications may be obtained by applying to the Director, United States Geological Survey, Washington, D. C.

STREAM-FLOW REPORTS.

Stream-flow records have been obtained at more than 4,240 points in the United States, and the data obtained have been published in the reports tabulated below:

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

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

Report.	Character of data.	Year.
10th A, pt. 2	Descriptive information only	
11th A, pt. 2	Monthly discharge and descriptive information.	1884 to Sept., 1890.
12th A, pt. 2	....do	1884 to June 30, 1891.
13th A, pt. 3	Mean discharge in second-feet	1884 to Dec. 31, 1892.
14th A, pt. 2	Monthly discharge (long-time records, 1871 to 1893)	1888 to Dec. 31, 1893.
B 131	Descriptions, measurements, gage heights, and ratings	1893 and 1894.
16th A, pt. 2	Descriptive information only	
B 140	Descriptions, measurements, gage heights, ratings, and monthly discharge (also many data covering earlier years).	1895.
W 11	Gage heights (also gage heights for earlier years)	1896.
18th A, pt. 4	Descriptions, measurements, ratings, and monthly discharge (also simular data for some earlier years).	1895 and 1896.
W 15	Descriptions, measurements, and gage heights, eastern United States, eastern Mississippi River, and Missouri River above junction with Kansas.	1897.

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

Report.	Character of data.	Year.
W 16	Descriptions, measurements, and gage heights, western Mississippi River below junction of Missouri and Platte, and western United States.	1897.
19th A, pt. 4	Descriptions, measurements, ratings, and monthly discharge (also some long-time records).	1897.
W 27	Measurements, ratings, and gage heights, eastern United States, eastern Mississippi River, and Missouri River.	1898.
W 28	Measurements, ratings, and gage heights, Arkansas River, and western United States.	1898.
20th A, pt. 4	Monthly discharge (also for many earlier years)	1898.
W 35 to 39	Descriptions, measurements, gage heights, and ratings	1899.
21st A, pt. 4	Monthly discharge	1899.
W 47 to 52	Descriptions, measurements, gage heights, and ratings	1900.
22d A, pt. 4	Monthly discharge	1900.
W 65, 66	Descriptions, measurements, gage heights, and ratings	1901.
W 75	Monthly discharge	1901.
W 82 to 85	Complete data	1902.
W 97 to 100	....do	1903.
W 124 to 135	....do	1904.
W 165 to 178	....do	1905.
W 201 to 214	....do	1906.
W 241 to 252	....do	1907–8.
W 261 to 272	....do	1909.
W 281 to 292	....do	1910.
W 301 to 312	....do	1911.
W 321 to 332	....do	1912.
W 351 to 362	....do	1913.
W 381 to 394	....do	1914.
W 401 to 414	....do	1915.
W 431 to 444	....do	1916.
W 451 to 464	....do	1917.

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, and miscellaneous measurements at many points other than regular gaging stations have been made each year. An index of the reports containing records obtained prior to 1904 has been published in Water-Supply Paper 119.

The following table gives by years and drainage basins the numbers of the papers on surface-water supply published from 1899 to 1917. The data for any particular station will in general be found in the reports covering the years during which the station was maintained. For example, data from 1902 to 1917, for any station in the area covered by Part III are published in Water-Supply Papers 83, 98, 128, 169, 205, 243, 263, 283, 303, 323, 353, 383, 403, 433, and 453, which contain records for the Ohio River basin for those years.

Numbers of water-supply papers containing results of stream measurements, 1899–1917.

Year.	I North Atlantic slope basins (St. John River to York River).	II South Atlantic and eastern Gulf of Mexico (James River to the Mississippi).	III Ohio River basin.	IV St. Lawrence River and Great Lakes basins.	V Hudson Bay and upper Mississippi River basins.	VI Missouri River basin.	VII Lower Mississippi River basin.	VIII Western Gulf of Mexico basins.	IX Colorado River basin.	X Great Basin.	XI Pacific slope basins in California.	XII North Pacific slope basins.		
												Pacific slope basins in Washington and upper Columbia River.	Snake River basin.	Lower Columbia River and Pacific slope basin in Oregon.
1899 [a]	35	[b] 35, 36	36	36	36	[c] 36, 37	37	37	[d] 37, 38	38, [e] 39	38, [f] 39	38	38	38
1900 [g]	47, [h] 48	48	48, [i] 49	49	49	49, [j] 50	50	50	50	51	51	51	51	51
1901	65, 75	65, 75	65, 75	65, 75	[k] 65, 66, 75	66, 75	[k] 65, 66, 75	66, 75	66, 75	66, 75	66, 75	66, 75	66, 75	66, 75
1902	82	[b] 82, 83	83	[l] 82, 83	[k] 83, 85	84	[k] 83, 84	84	85	85	85	85	85	85
1903	97	[b] 97, 98	98	97	[k] 98, 99, [m] 100	99	[k] 98, 99	99	100	100	100	100	100	100
1904	[n] 124, [o] 125, [p] 126	[p] 126, 127	128	129	[k] 128, 130	130, [q] 131	[k] 128, 131	132	133	133, [r] 134	134	135	135	135
1905	[n] 165, [o] 166, [p] 167	[p] 167, 168	169	170	171	172	[k] 169, 173	174	175, [s] 177	176, [r] 177	177	178	178	177, 178
1906	[n] 201, [o] 202, [p] 203	[p] 203, 204	205	206	207	208	[k] 205, 209	210	211	212, [r] 213	213	214	214	214
1907–8	241	242	243	244	245	246	247	248	249	250, [r] 251	251	252	252	252
1909	261	262	263	264	265	266	267	268	269	270, [r] 271	271	272	272	272
1910	281	282	283	284	285	286	287	288	289	290	291	292	292	292
1911	301	302	303	304	305	306	307	308	309	310	311	312	312	312
1912	321	322	323	324	325	326	327	328	329	330	331	332–A	332–B	332–C
1913	351	352	353	354	355	356	357	358	359	360	361	362–A	362–B	362–C
1914	381	382	383	385	385	386	387	388	389	390	391	392	393	394
1915	401	402	403	404	405	406	407	408	409	410	411	412	413	414
1916	431	432	433	434	435	436	437	438	439	440	441	442	443	444
1917	451	452	453	454	455	456	457	458	459	460	461	462	463	464

[a] Rating tables and index to Water-Supply Papers 35–39 contained in Water-Supply Paper 39. Tables of monthly discharge for 1899 in Twenty-first Annual Report, Part IV.
[b] James River only.
[c] Gallatin River.
[d] Green and Gunnison rivers and Grand River above junction with Gunnison.
[e] Mohave River only.
[f] Kings and Kern rivers and south Pacific slope basins.
[g] Rating tables and index to Water-Supply Papers 47–52 and data on precipitation, wells, and irrigation in California and Utah contained in Water-Supply Paper 52. Tables of monthly discharge for 1900 in Twenty-second Annual Report, Part IV.
[h] Wissahickon and Schuylkill rivers to James River.
[i] Scioto River.
[j] Loup and Platte rivers near Columbus, Nebr., and all tributaries below junction with Platte.
[k] Tributaries of Mississippi from east.
[l] Lake Ontario and tributaries to St. Lawrence River proper.
[m] Hudson Bay only.
[n] New England rivers only.
[o] Hudson River to Delaware River, inclusive.
[p] Susquehanna River to Yadkin River, inclusive.
[q] Platte and Kansas rivers.
[r] Great Basin in California, except Truckee and Carson river basins.
[s] Below junction with Gila.
[t] Rogue, Umpqua, and Siletz rivers only.

In these papers and in the following lists the stations are arranged in downstream order. The main stem of any river is determined by measuring or estimating its drainage area—that is, the headwater stream having the largest drainage area is considered the continuation of the main stream, and local changes in name and lake surface are disregarded. All stations from the source to the mouth of the main stem of the river are presented first, and the tributaries in regular order from source to mouth follow, the streams in each tributary basin being listed before those of the next basin below.

In exception to this rule the records for Mississippi River are given in four parts, as indicated on page III, and the records for large lakes are presented in order of streams around the rim of the lake.

PART VI. MISSOURI RIVER BASIN.

PRINCIPAL STREAMS.

The principal streams in the Missouri River basin are Red Rock Creek and Beaverhead and Jefferson rivers, which may be considered a continuous river forming the head of the Missouri; and, below the mouth of the Jefferson, Madison, Gallatin, Prickly Pear, Little Prickly Pear, Dearborn, Sun, Marias, Judith, Musselshell, Milk, Yellowstone, Muddy, Little Missouri, Cheyenne, Niobrara, Platte (including North Platte and South Platte), Kansas, Osage (Marias des Cygnes), and Gasconade rivers. These streams drain wholly or in part the States of Colorado, Iowa, Kansas, Minnesota, Missouri, Montana, Nebraska, North Dakota, South Dakota, and Wyoming.

In addition to the annotated list of publications relating specifically to the section, these pages contain a similar list of reports that are of general interest in many sections and cover a wide range of hydrologic subjects, and also brief references to reports published by State and other organizations. (See p. XXVIII.)

GAGING STATIONS.

NOTE.—Dash after a date indicates that station was being maintained September 30, 1917; period after a date indicates discontinuance. Tributaries are shown by indention.

Red Rock Creek (head of Missouri River) above Red Rock reservoir, near Monida, Mont., 1911; 1914–15.
Red Rock Creek below Red Rock reservoir, near Monida, Mont., 1911–
Red Rock Creek at Lima, Mont., 1907–1911.
Red Rock Creek at Red Rock, Mont., 1890.
Beaverhead River (continuation of Red Rock Creek) at Barratts, Mont., 1907–
Beaverhead River at Dillon, Mont., 1907.
Jefferson River (continuation of Red Rock-Beaverhead River) near Silverstar, Mont., 1910–1916.
Jefferson River at Sappington, Mont., 1894–1905.
Missouri River at Toston, Mont., 1890; 1910–1916.
Missouri River near Townsend, Mont., 1891–1901; 1903–4.
Missouri River at Canyon Ferry, Mont., 1889.
Missouri River near Craig, Mont., 1890–1892.
Missouri River at Cascade, Mont., 1902–1915.
Missouri River at Great Falls, Mont., 1897–1905.
Missouri River at Fort Benton, Mont., 1910–
Missouri River near Williston, N. Dak., 1905–1907.
Missouri River at Mannhaven, N. Dak., 1904.
Missouri River at Washburn, N. Dak., 1905.
Missouri River at Bismarck, N. Dak., 1904–5.
Missouri River at Kansas City, Mo., 1905–6.

Missouri River tributaries:
- Passamari River [Ruby Creek] near Alder, Mont., 1911–1914.
- Bighole River near Dewey, Mont., 1910–1913.
- Big pipestone Creek near Whitehall, Mont., 1910–11.
- Whitetail Creek near Whitehall, Mont., 1911.
  - Little Whitetail Creek near Whitehall, Mont., 1911.
- Boulder River.
  - Muskrat Creek near Boulder, Mont., 1912–1914.
- Gibbon River (head of Madison River) near Yellowstone, Mont., 1913–1916.
- Madison River near Yellowstone, Mont., 1913–
- Madison River near Norris, Mont., 1897–1905; 1910.
- Madison River near Red Bluff, Mont., 1890–1894; 1897–1902.
- Madison River near Three Forks, Mont., 1893–1897.
- Gallatin River near Salesville, Mont., 1895–1905; 1910–1913.
- Gallatin River near Bozeman, Mont., 1889–1891.
- Gallatin River at Logan, Mont., 1893–1905.
  - Middle Creek near Bozeman, Mont., 1895–96; 1898–1900; 1902–3.
- Crow Creek near Townsend, Mont., 1912–13.
- Crow Creek near Radersburg, Mont., 1901.
- Deep Creek near Townsend, Mont., 1910–1915.
- Prickly Pear Creek near Clancy, Mont., 1908–1916.
- Prickly Pear Creek at East Helena, Mont., 1908–1913.
  - Lump Gulch Creek near Clancy, Mont., 1908–1913.
  - Tenmile Creek near Rimini, Mont., 1915–
  - Tenmile Creek near Helena, Mont., 1908–
    - Sevenmile Creek at Birdseye, Mont., 1908–1913.
- Little Prickly Pear Creek near Marysville, Mont., 1909–1911; 1913–
- Little Prickly Pear Creek near Cayon Creek, Mont., 1909–1911; 1913–
  - Lost Horse Creek near Marysville, Mont., 1909–1911.
  - Marsh Creek near Marysville, Mont., 1909–1911.
  - Deadman Creek near Marysville, Mont., 1909–1911.
- Dearborn River near Clemons, Mont., 1908–1911.
  - Falls Creek near Clemons, Mont., 1908–1911.
- Smith River at Truly, Mont., 1905–1907.
- Sun River, North Fork of North Fork (head of Sun River), near Augusta, Mont., 1911–12.
- Sun River, North Fork, near Augusta,[1] Mont., 1889–90; 1903–
- Sun River at Fort Shaw, Mont., 1912–
- Sun River at Sun River, Mont., 1905–1912.
- Sun River near Great Falls, Mont., 1897.
  - South Fork of North Fork of Sun River near Augusta, Mont., 1911–12.
  - Floweree Big canal near Fort Shaw, Mont., 1912.
  - Willow Creek near Augusta, Mont., 1905–1911; 1912–
  - South Fork of Sun River at Augusta, Mont., 1904–
    - Smith Creek near Augusta, Mont., 1906–1912.
      - Ford Creek near Augusta, Mont., 1906–1912.
  - Crown Butte canal at Riebling, Mont., 1912.
  - Crown Butte canal near Simms, Mont., 1912.
  - Sun River canal near Sun River, Mont., 1912.
  - Sun River canal at Vaughn, Mont., 1912.

[1] Records for 1889–90 published at Sun River above Augusta, Mont.

Missouri River tributaries—Continued.
Milk River tributaries—Continued.
Lodge Creek[1] at Chinook, Mont., 1906–1908.
Reser ditch near Chinook, Mont., 1905–6.
West Fork ditch near Chinook, Mont., 1905–6.
Battle Creek at international boundary, 1917–
Battle Creek[2] near Chinook, Mont., 1905–
Cook canal near Chinook, Mont., 1905–
Matheson canal near Chinook, Mont., 1905–
Paradise Valley canal near Chinook, Mont., 1903–
Harlem canal near Zurich, Mont., 1903–
Agency ditch near Harlem, Mont., 1905–
Frenchman Creek near international boundary, 1917–
Beaver Creek near Malta, Mont., 1917–
Beaver Creek overflow near Bowdoin, Mont., 1903–1906; 1908–1912.
Beaver Creek near Saco (Ashfield), Mont., 1903–1906; 1908–1912.
Rock Creek near Hinsdale, Mont., 1905–1907; 1912–
Rock Creek canal near Hinsdale, Mont., 1905–1907.
Porcupine Creek at Nashua, Mont., 1908–
Little Porcupine Creek near Frazer, Mont., 1908–1916.
Wolf Creek near Wolf Point, Mont., 1908–1914.
Wolf Point ditch at Wolf Point, Mont., 1909.
Poplar River near Poplar, Mont., 1908–
Big Muddy Creek near Culbertson, Mont., 1908–
Yellowstone River near Canyon Hotel, Yellowstone National Park, 1913–
Yellowstone River at Corwin Springs, Mont., 1910–
Yellowstone River near Horr, Mont., 1889–1893.
Yellowstone River at Livingston, Mont., 1897–1905.
Yellowstone River at Billings, Mont., 1904–5.
Yellowstone River at Huntley, Mont., 1907–1916.
Yellowstone River at Junction, Mont., 1906–7.
Yellowstone River near Glendive, Mont., 1897–1910.
Yellowstone River at Intake, Mont., 1911–
Big Timber Creek, North Fork (head of Big Timber Creek), near Big Timber, Mont., 1907–1911.
Big Timber Creek near Big Timber, Mont., 1912–
South Fork of Big Timber Creek near Big Timber, Mont., 1907–1911.
Boulder River near Contact, Mont., 1910–1916.
Boulder River near McLeod, Mont., 1912–1914.
East Fork of Boulder River near McLeod, Mont., 1907–1909.
West Fork of Boulder River near Bruffeys, Mont., 1904–1910.
West Fork of Boulder River at McLeod, Mont., 1907–1914.
Sweetgrass Creek above Melville, Mont., 1907–
Sweetgrass Creek below Melville, Mont., 1907–
Stillwater River near Nye, Mont., 1911–1913.
Stillwater River near Absarokee, Mont., 1910–1914.
Woodbine Creek near Nye, Mont., 1911–1913.
Rosebud Creek at Absarokee, Mont., 1910–1914.
Clark Fork at Fromberg, Mont., 1905–1913.
Pryor Creek at Coburn, Mont., 1911–
Pryor Creek at Huntley, Mont., 1904–1916.
Wind River (head of Big Horn River) at Dubois, Wyo., 1910–1912.
Wind River near Wind River, Wyo., 1909.

[1] Formerly called West Fork of Milk River. [2] Formerly called North Fork of Milk River.

Missouri River tributaries—Continued.
Yellowstone River tributaries—Continued.
Powder River tributaries—Continued.
Clear Creek near Arvada, Wyo., 1915–
Piney Creek at Kearney, Wyo., 1902–1906; 1911–12; 1915–1917.
Piney Creek at Ucross, Wyo., 1917–
Cruez ditch near Story, Wyo., 1903.
Muddy River near Williston, N. Dak., 1904–1909.
Little Missouri at Alzada, Mont., 1904–1906.
Little Missouri River near Alzada, Mont., 1911–
Little Missouri River at Camp Crook, S. Dak., 1903–1906.
Little Missouri River at Medora, N. Dak., 1903–1908.
Knife River near Broncho, N. Dak., 1903–
Painted Woods Creek near Washburn, N. Dak., 1909–10.
Turtle Creek near Washburn, N. Dak., 1909–10.
Heart River near Richardton, N. Dak., 1903–
Apple Creek near Bismarck, N. Dak., 1905.
Cannonball River at Stevenson, N. Dak., 1903–1908; 1911–
Grand River, North Branch (head of Grand River), at Haley, N. Dak., 1908–1917.
Grand River near Seim, S. Dak., 1904–1906.
Grand River near Wakpala, S. Dak., 1911–
Moreau [Owl] River near Bixby, S. Dak., 1904–1906.
Cheyenne River at Edgemont, S. Dak., 1903–1906.
Cheyenne River near Hot Springs [Cascade Springs], S. Dak., 1914–
Cheyenne River near Wasta, S. Dak., 1914–15.
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., 1903–1905.
Rapid Creek at Big Bend, S. Dak., 1915–1917.
Rapid Creek at Rapid, S. Dak., 1903–1906.
Boxelder 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; 1912–
Redwater River near Minnesela, S. Dak., 1903.
Redwater River at Belle Fourche, S. Dak., 1903–1906.
Spearfish Creek near Spearfish, S. Dak., 1903–1906.
Redwater ditch at Minnesela, S. Dak., 1904–1906.
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 Crawford, Nebr., 1897.
White River near Interior, S. Dak., 1904–1906; 1911–
White River near Westover, S. Dak., 1911–
South Fork of White River near Westover, S. Dak., 1912–
Niobrara River near Valentine (Fort Niobrara), Nebr., 1897; 1899; 1901–1906.
Niobrara River near Spencer, Nebr., 1908.
Niobrara River near Lynch, Nebr., 1913–1915.
Niobrara River at Niobrara, Nebr., 1902; 1910–1913.
Red Deer Lake (on Plum Creek) near Woodlake, Nebr., 1904–5.
James River near Lamoure, N. Dak., 1903.

[1] Formerly North Platte River and Interstate canal at Whalen, Wyo.

Missouri River tributaries—Continued.
Platte River tributaries—Continued.
Jack Creek at Burdick's ranch, near Saratoga, Wyo., 1911–12.
Pass Creek near Walcott, Wyo., 1911.
Medicine Bow River near Medicine Bow, Wyo., 1901; 1911–12; 1915–1917.
Rock Creek near Arlington, Wyo., 1911–
Rock Creek near Rock River, Wyo., 1911–12.
Deep Creek near Arlington, Wyo., 1914–
Little Medicine Bow River:
Muddy Creek near Shirley, Wyo., 1915–1917.
Sage Creek above Pathfinder reservoir, Wyo., 1915–
Deweese Creek near Alcova, Wyo., 1917–
Sand Creek above Alcova, Wyo., 1915–
Sweetwater River near Splitrock, Wyo., 1902–3.
Sweetwater River near Alcova, Wyo., 1913–
Horse Creek near Alcova, Wyo., 1915–
Canyon Creek near Alcova, Wyo., 1915–
Bates Creek near Casper, Wyo., 1916–
Deer Creek at Glenrock, Wyo., 1916–
Boxelder Creek near Careyhurst, Wyo., 1911; 1916–
La Prele Creek near Fetterman, Wyo., 1916.
Wagon Hound Creek near La Bonte, Wyo., 1916–
La Bonte Creek near La Bonte, Wyo., 1916–
Horseshoe Creek near Glendo, Wyo., 1916–
Cottonwood Creek near Wendover, Wyo., 1916–
Laramie River at Glendevey, Colo., 1904–5; 1910–1913; 1916.
Laramie River near Jelm, Wyo., 1904–5; 1911–
Laramie River near Woods Landing, Wyo., 1895–1900; 1911.
Laramie River and Pioneer canal near Woods, Wyo., 1912; 1914–
Laramie River at Two Rivers, Wyo., 1911–
Laramie River near Lookout, Wyo., 1915–1917.
Laramie River at McGill, Wyo., 1915.
Laramie River below McGill, Wyo., 1916–1917.
Laramie River near Wheatland, Wyo., 1912; 1915–16.
Laramie River near Uva, Wyo., 1895–1900; 1903.
Laramie River at Fort Laramie, Wyo., 1915–
McIntyre Creek near Gleneyre, Colo., 1904–5.
Little Laramie River near Hatton, Wyo., 1902–3.
Little Laramie River near Filmore, Wyo., 1911–12; 1915–
Little Laramie River near Laramie, Wyo., 1903.
Little Laramie River at Two Rivers, Wyo., 1911–
Sibylee Creek near Wheatland, Wyo., 1912; 1915–16.
North Laramie River near Wheatland, Wyo., 1912; 1914–
North Laramie River at Uva, Wyo., 1911–12.
Chugwater Creek at Chugwater, Wyo., 1911–12; 1915–
Horse Creek near Little Horse Creek, Wyo., 1911–12.
Horse Creek near La Grange, Wyo., 1911–12; 1915–
Birdwood Creek near Sutherland, Nebr., 1913–1915.
South Platte River at Lake George, Colo., 1910–1915.
South Platte River at Cheeseman Lake, Colo., 1899; 1901.
South Platte River above North Fork, at South Platte, Colo., 1905–1912.
South Platte River at South Platte, Colo., 1902–
South Platte River near Deansbury (Platte Canyon), Colo., 1887–1892; 1895–1900; 1903.

[1] Published only in Water-Supply Paper 74.
[2] Published as "North Boulder Creek above Boulder" in Thirteenth Ann. Rept., pt. 3.

Missouri River tributaries—Continued.
Platte River tributaries—Continued.
Middle Loup River (head of Loup River) near St. Paul, Nebr., 1895; 1897; 1899; 1903.
Loup River at Columbus, Nebr., 1894–1915.
North Loupe River near St. Paul, Nebr., 1895; 1897; 1899; 1903.
Elkhorn River at Norfolk, Nebr., 1896–1903.
Elkhorn River at Arlington, Nebr., 1899–1903; 1913–1915.
Elkhorn River at Waterloo, Nebr., 1911–1913.
Republican River, North Fork (head of Kansas River), near Haigler, Nebr., 1896.
Republican River, North Fork, near Benkelman, Nebr., 1894–95; 1903–1906.
Republican River at Culbertson, Nebr., 1913–1915.
Republican River at Bostwick, Nebr., 1904–1915.
Republican River near Superior, Nebr., 1896–1903.
Republican River at Wakefield, Kans., 1917–
Republican River at Junction, Kans., 1895–1905.
Kansas River at Ogden, Kans., 1917–
Kansas River near St. George, Kans., 1904.
Kansas River at Topeka, Kans., 1904; 1917–
Kansas River at Lecompton, Kans., 1899–1906.
Kansas River near Lawrence, Kans., 1895–1899.
Kansas River at Bonner Springs, Kans., 1917–
South Fork of Republican River at Benkelman, Nebr., 1894–95; 1903–1906.
Frenchman Creek near Wauneta, Nebr., 1895–96.
Frenchman Creek near Palisade, Nebr., 1894–1896.
Frenchman Creek at Culbertson, Nebr., 1913–1915.
Smoky Hill River at Ellsworth, Kans., 1895–1905.
Smoky Hill River at Solomon, Kans., 1904.
Beaver (Ladder) Creek near Scott City, Kans., 1904–5.
Saline River near Beverly, Kans., 1895–1897.
Saline River near Salina, Kans., 1897–1903.
Solomon River at Beloit, Kans., 1895–1897.
Solomon River near Niles, Kans., 1897–1903.
Big Blue River (head of Blue River) at Beatrice, Nebr., 1910–1915.
Blue River at Manhattan, Kans., 1895–1905.
Little Blue River at Blue Bluff, Nebr., 1912.
Little Blue River near Fairbury, Nebr., 1908–1915.
Osage (Marias des Cygnes) River at Ottawa, Kans., 1902–1905.
Gasconade River at Arlington, Mo., 1903–1906.
Piney Fork of Gasconade River near Houston, Mo., 1908–9.
Piney Fork of Gasconade River near Hooker, Mo., 1903. (Also called Big Piney Creek.)
Little Piney Creek near Arlington, Mo., 1903.

REPORTS ON WATER RESOURCES OF THE MISSOURI RIVER BASIN.

PUBLICATIONS OF UNITED STATES GEOLOGICAL SURVEY

WATER-SUPPLY PAPERS.

Water-supply papers are distributed free by the Geological Survey as long as its stock lasts. An asterisk (*) indicates that this stock has been exhausted. Many of the papers marked in this way may, however, be purchased (at price noted) from the SUPERINTENDENT OF DOCUMENTS, WASHINGTON, D. C. Omission of the price indicates that the report is not obtainable from Government sources. Water supply papers are of octavo size.

*5. Irrigation practice on the Great Plains, by E. B. Cowgill. 1897. 39 pp., 12 pls. 10c.

Describes reservoirs for storm and pumped waters, ditching, methods of distributing water, cultivation and subirrigation, duty of water, and winter irrigation.

*9. Irrigation near Greeley, Colo., by David Boyd. 1897. 90 pp., 21 pls.

Treats of topography, rainfall, and water supply in the valley of Cache la Poudre River, a tributary of the South Platte; describes the canals and reservoir system, construction and operation of canals, and agricultural practice; discusses also the legislative and judicial control of the waters; speaks of the use of the underground water, effect of alkali waters on soil, pumping of underground waters, and artesian wells.

*12. Underground waters of a portion of southeastern Nebraska, by N. H. Darton. 1898. 56 pp., 21 pls.

Discusses physiography, geology, underground waters of moderate depth, and water horizons in Lancaster, Seward, northern Saline, York, Fillmore, Hamilton, Clay, Hall, Adams, Buffalo, Kearney, Phelps, northern Gosper, and eastern and central Dawson counties; reviews briefly the prospects for obtaining deeper-seated waters.

*23. Water-right problems of the Big Horn Mountains, by Elwood Mead. 1899. 62 pp., 7 pls. 10c.

Discusses water divisions, districts, appropriations, reservoirs, and administrative questions.

*29. Wells and windmills in Nebraska, by E. H. Barbour. 1899. 85 pp., 27 pls. 15c.

Describes home-made windmills; discusses briefly action of water underground, transmission and storage of windmill power, precipitation, surface waters for irrigation, supply for cities and towns, salt water, and blowing wells.

*34. Geology and water resources of a portion of southeastern South Dakota, by J. E. Todd. 1900. 34 pp., 10 pls. 10c.

Describes areas in Turner, Hutchinson, Bonhomme, Yankton, and Clay counties, including typical sections of the valleys of James and Vermilion rivers.

*44. Profiles of rivers in the United States, by Henry Gannett. 1901. 100 pp., 11 pls.

Gives elevations and distances along rivers of the United States, including Missouri, Jefferson, Bighole, Beaverhead, Madison, Gallatin, Osage, Kansas, Republican, Platte, Yellowstone, Milk, and James rivers; also brief descriptions of many of the streams. Arrangement geographic. Many river profiles are scattered through other reports on surface waters in various parts of the United States.

*57. Preliminary list of deep borings in the United States, Part I (Alabama-Montana), by N. H. Darton. 1902. 60 pp. 5c.

*61. Preliminary list of deep borings in the United States, Part II (Nebraska-Wyoming), by N. H. Darton. 1902. 67 pp. 5c.

A second, revised, edition was published in 1905 as Water-Supply Paper 149 (q. v.).

*70. Geology and water resources of the Patrick and Goshen Hole quadrangles, in eastern Wyoming and western Nebraska, by G. I. Adams. 1902. 50 pp., 11 pls. 15c.

Describes the geologic formation, surface features, water supply (surface and underground, irrigation, and agricultural products of a part of the Great Plains; discusses settlement and occupancy of public lands, and in an appendix gives the text of the "desert-lands" act, the Carey act, and an act for the construction of reservoirs on public lands for the watering of stock.

74. Water resources of the State of Colorado, by A. L. Fellows. 1902. 151 pp., 14 pls. 25c.

Discusses under South Platte, Arkansas, Rio Grande, San Juan, Grand, and Green River irrigation divisions, drainage, and irrigation, and gives records of stream flow.

90. Geology and water resources of part of the lower James River Valley, South Dakota, by J. E. Todd and C. M. Hall. 1904. 47 pp., 23 pls. 35c.

Describes topography, geologic formations, and surface and underground waters of Davison, Hanson, Sanborn, Beadle, and Miner counties, and portions of Kingsbury, Jerauld, Aurora, and McCook counties, S. Dak.

93. Proceedings of first conference of engineers of the Reclamation Service, with accompanying papers, compiled by F. H. Newell, chief engineer. 1904. 361 pp. 25. [Inquiries concerning this report should be addressed to the Reclamation Service.] Contains:

Irrigation in North Dakota by pumping, by F. A. Wilder. Discusses the use of lignite as a fuel for the operation of farm engines.

South Dakota investigations, by Raymond F. Walter. Mentions surveys of reservoir sites on creeks north of Rapid City and the water supply of the Belle Fourche project.

Work on North Platte River in Wyoming, by John E. Field.

Investigations in Wyoming, by Jeremiah Ahern. Describes the Lake De Smet and the Shoshone projects.

Reclamation and water storage in Nebraska, by O. V. P. Stout. Describes North Platte River and discusses its possible use for irrigation. Gives tables showing monthly discharge of the river from 1895 to 1902 and the volume of storage necessary to insure water to meet possible demands. Describes also Frenchman, Loup, and Niobrara rivers.

96. Destructive floods in the United States in 1903, by E. C. Murphy. 1904. 81 pp., 13 pls. 15c.

Gives notes on early floods in Mississippi Valley, and describes floods on Kansas River and its tributaries (Blue, Republican, Solomon, Saline, and Smoky Hill rivers); gives an account of the losses and suggests methods of flood prevention; contains also discharge tables and compares flood and ordinary data.

102. Contributions to the hydrology of eastern United States, 1903; M. L. Fuller, geologist in charge. 1904. 522 pp. 30c.

Contains brief reports on wells and springs of Minnesota and Missouri. The reports comprise tabulated well records giving information as to location, owner, depth, yield, head, etc., supplemented by notes as to elevation above sea, materials penetrated, temperature, use and quality; many miscellaneous analyses.

*103. A review of the laws forbidding pollution of inland waters in the United States, by E. B. Goodell. 1904. 120 pp. Superseded by 152.

Cites statutory restriction of water pollution.

*110. Contributions to the hydrology of eastern United States, 1904; M. L. Fuller, geologist in charge. 1905. 211 pp., 5 pls. 10c.

Contains a brief report on the "Spring system of the Decaturville dome, Camden County, Mo.," by E. M. Shepard. Some of these springs are of immense size and present many points of interest.

*114. Underground waters of eastern United States; M. L. Fuller, geologist in charge. 1905. 285 pp., 18 pls. 25c.

Contains brief reports as follows:

Missouri, by E. M. Shepard.

Iowa, by W. H. Norton.

Each of these reports describes briefly the topography of the area, the relation of the geology to the water supplies, and gives list of pertinent publications; lists also principal mineral springs.

117. The lignite of North Dakota and its relation to irrigation, by F. A. Wilder. 1905. 59 pp., 8 pls. 10c.

Describes the thickness, extent, variations, and fuel value of the lignite and its use for pumping water, the area, soils, and lignite of the river flats, and the status of irrigation in the State.

*122. Relation of the law to underground waters, by D. W. Johnson. 1905. 55 pp. 5c.

Cites legislative acts relating to ground waters in Colorado, Nebraska, South Dakota, and Wyoming.

146. Proceedings of second conference of engineers of the Reclamation Service, with accompanying papers, compiled by F. H. Newell, chief engineer. 1905. 267 pp. 15c. [Inquiries concerning this report should be addressed to the Reclamation Service.]

Contains brief account of the organization of the hydrographic (water-resources) branch and the Reclamation Service, reports of conferences and committees, circulars of instruction, and many brief reports on subjects closely related to reclamation, and a bibliography of technical papers by members of the service.

A brief report on "Irrigation development in North Dakota," by H. A. Storrs. Discusses the feasibility of pumping water from the Missouri to irrigate bench lands along its banks.

147. Destructive floods in United States in 1904, by E. C. Murphy and others. 1905. 206 pp., 18 pls. 15c. Contains:

Belle Fourche River flood, South Dakota, from report of R. F. Walter. Describes floods on Belle Fourche River (tributary to the Missouri through Cheyenne River) and on Cache la Poudre River and Crow Creek (tributaries of the South Platte).

*149. Preliminary list of deep borings in United States, second edition, with additions, by N. H. Darton. 1905. 175 pp. 10c.

Gives, by States (and within the States by counties), location, depth, diameter, yield, height of water, and other available information, concerning wells 400 feet or more in depth; includes all wells listed in Water-Supply Papers 57 to 61; mentions also principal publications relating to deep borings.

*152. A review of the laws forbidding pollution of inland waters in the United States (second edition), by E. B. Goodell. 1905. 149 pp. 10c.

Cites statutory restrictions of water pollution in Colorado, Iowa, Kansas, Minnesota, Missouri Nebraska, North and South Dakota, and Wyoming.

*162. Destructive floods in the United States in 1905, with a discussion of flood discharge and frequency and an index to flood literature, by E. C. Murphy and others. 1906. 105 pp., 4 pls. 15c.

Gives accounts of floods in eastern Missouri and South Dakota, and estimates of floods discharge and frequency on Kansas, Loup, and Platte rivers; contains also index to literature on floods in American streams.

*184. The underflow of the South Platte Valley, by C. S. Slichter and H. C. Wolff. 1906. 42 pp. 5c.

Describes investigations of velocity, direction, quantity of underflow, and the underflow ditch at Ogalalla, Nebr., gives chemical analyses of the water, and discusses disadvantages of underflow canals; describes also the investigation at North Platte, Nebr., and gives suggestions for construction of small pumping plants.

*195. Underground waters of Missouri, their geology and utilization, by E. M. Shepard. 1907. 224 pp., 6 pls. 30c.

Describes the topography and geology of the State, the waters of the various formations, and discusses the water supplies by districts and counties; gives statistics of city water supplies, analyses of waters, and many well records.

*215. Geology and water resources of a portion of the Missouri River valley in northeastern Nebraska, by G. E. Condra. 1908. 59 pp., 11 pls. 40c.

Describes topography, rock formation, mineral resources, streams, springs, shallow and artesian wells, soils, crops, and timber, in Boyd, Knox, Cedar, Dixon, and Dakota counties, and part of Holt County.

*216. Geology and water resources of the Republican River valley and adjacent areas, Nebraska, by G. E. Condra. 1907. 71 pp., 13 pls. 15c.

Describes topographic, drainage, temperature, rainfall, winds, rock systems, surface and underground waters, water powers, soils, crops, and timbers of Dundy, Hitchcock, Redwillow, Furnas, Harlan, Franklin, Webster, Nuckolls, Thayer, and Jefferson counties.

221. Geology and water resources of the Great Falls region, Montana, by C. A. Fisher. 1909. 89 pp., 7 pls. 20c.

Describes the topographic features, geologic formation, streams, lakes, swamps, springs, and artesian wells of a portion of the Great Plains in Cascade, Teton, Fergus, Chouteau, and Lewis and Clark counties; discusses the chemical character of the waters (analyses), water powers, irrigation, temperature, rainfall, and agriculture, and gives details of water supplies by districts.

*227. Geology and underground waters of South Dakota, by N. H. Darton. 1909. 156 pp., 15 pls. 40c.

Describes physical features, geologic formations, water horizons, and, by counties, deep wells and well prospects; gives notes on construction and management of artesian wells.

*230. Surface water supply of Nebraska, by J. C. Stevens. 1909. 251 pp., 6 pls. 35c.

Discusses relation of rainfall to run-off and evaporation and seepage near Kearney; describes the river basins, and gives results of observations at gaging stations.

236. The quality of surface waters in the United States, Part I, Analyses of waters east of one hundredth meridian, by R. B. Dole. 1909. 123 pp. 10c.

Describes collection of samples, methods of examinations, preparation of solutions, accuracy of estimates, and expression of analytical results; gives results of analyses of waters of Missouri, North Platte, and Platte rivers.

*258. Underground-water papers, 1910, by M. L. Fuller, F. G. Clapp, G. C. Matson, Samuel Sanford, and H. C. Wolff. 1911. 123 pp., 2 pls. 15c.

Contains brief report entitled "The utilization of the underflow near St. Francis, Kans.," by H. C. Wolff; discusses the water-bearing material, velocity, amount, rate of movement, and quality of the waters; arrangement and method of sinking the wells selection and installation of pumps, engines and cost of pumping, storage reservoirs, and loss by evaporation.

273. Quality of the water supplies of Kansas, by H. N. Parker, with a preliminary report on stream pollution by mine waters in southeastern Kansas, by E. H. S. Bailey. 1911. 375 pp., 1 pl. 30c.

Describes the topographic and geologic features of the State and the artesian basins; discusses the significance of mineral constituents and classification of waters; gives details concerning quality of underground water by counties and surface water by drainage basins.

274. Some stream waters of the western United States, with chapters on sediment carried by the Rio Grande and the industrial application of water analyses, by Herman Stabler. 1911. 188 pp. 15c.

Describes collection of samples, plan of analytical work, and methods of analysis; discusses soap-consuming power of waters, water softening, boiler waters, and water for irrigation; gives results of analyses of samples of water from streams in Missouri River basin.

293. Underground water resources of Iowa, by W. H. Norton, W. S. Hendrixson, H. E. Simpson, O. E. Meinzer, and others. 1912. 994 pp., 18 pls. 70c.

Describes the relief, drainage, temperature, and precipitation of the State and the geologic formations; discusses the geologic occurrence of underground waters, artesian phenomena and yield of artesian wells, the chemical composition of underground waters, municipal, domestic, and industrial water supplies, and mineral waters; gives details concerning topography, geology, underground waters, and city and village supplies by districts and counties.

345. Contributions to the hydrology of the United States, 1914; N. C. Grover, chief hydraulic engineer. 1915. 225 pp., 17 pls. 30c. Contains:

*(g) The water resources of Butte, Mont., by O. E. Meinzer (pp. 79–125, pls. 7–8.)

364. Water analyses from the laboratory of the United States Geological Survey, tabulated by F. W. Clarke, chief chemist. 1914. 40 pp.

Contains analyses from spring and well waters from Missouri, Wyoming, Yellowstone National Park, Montana, and Colorado, and of mine waters from Butte, Mont.

367. Profile surveys of Missouri River from Great Falls to Three Forks, Montana, prepared under the direction of R. B. Marshall, chief geographer. 1914. 8 pp., 1 pl. (13 sheets). 50c.

Gives a brief description of the general features of the Missouri River basin, a list of the gaging stations that have been maintained between Three Forks and Great Falls, and of the publications containing the results of stream-flow measurements.

*425. Contributions to the hydrology of the United States, 1917; N. C. Grover, chief hydraulic engineer. 1918. Contains:

*(*b*) Ground water for irrigation in Lodgepole Valley, Wyo.-Nebr., by O. E. Meinzer (pp. 37–69, pls. 4–6). Describes the physiography and geology of Lodgepole Valley and the adjacent region and the water in the alluvial gravel and in the Tertiary and Cretaceous formations; discusses irrigation with ground water; gives well data and analyses of 20 wells waters and 2 samples from Lodgepole Creek; contains maps showing the geology and the depths to the water table; also includes data on the cost of pumping for irrigation in western Nebraska, by H. C. Diesem, U. S. Department of Agriculture.

428. Artesian water in the vicinity of the Black Hills, S. Dak., by N. H. Darton. 1918. 64 pp., 13 pls.

Describes the geology and artesian-water conditions in areas covered in previous reports but in the light of additional data. Discusses the artesian prospects of the Dakota, Minnelusa, and Deadwood sandstones. Contains a map showing the geology and the depths to the water-bearing sandstones.

ANNUAL REPORTS.

Each of the papers contained in the annual reports was also issued in separate form.

Annual reports are distributed free by the Geological Survey as long as its stock lasts. An asterisk (*) indicates that this stock has been exhausted. Many of the papers so marked, however, may be purchased from the SUPERINTENDENT OF DOCUMENTS, WASHINGTON, D. C.

*Tenth Annual Report of the United States Geological Survey, 1888–89; J. W. Powell, Director. 1890. 2 parts. *Pt. II. Irrigation, viii, 123 pp. 35c.

Makes a preliminary report on the organization and prosecution of the survey of the arid lands for purposes of irrigation; includes an account of the methods of topographic and hydraulic work, the segregation work on reservoir sites and irrigable lands, field and office methods, and brief descriptions of the topography of some of the river basins.

Eleventh Annual Report of the United States Geological Survey, 1889–90; J. W. Powell, Director. 1891. 2 parts. Pt. II. Irrigation, xiv, 395 pp., 30 plates and maps. $1.25. Contains:

*Hydrography, pp. 1–110. Discusses scope of work, methods of stream measurements, rainfall, and evaporation, and describes the more important streams.

*Engineering, pp. 111–200. Defines the scope of the work and gives an account of the surveys in the Sun River basin and in the Arkansas, Rio Grande, California, Lahontan, Utah, and Snake River divisions.

*The arid lands, pp. 201–289. Includes statement of the Director to the House Committee on Irrigation, extracts from the constitutions of States relating to irrigation, and a report on artesian irrigation on the Great Plains, including a discussion of the general considerations affecting artesian water supply, the economic limit to the utilization of artesian water for irrigation, irrigation by artesian wells in various countries, and the geologic conditions and statistics of artesian wells on the Great Plains.

*Topography, pp. 291–343. Comprises reports of the topographic surveys in California, Nevada, Colorado, Idaho, Montana, and New Mexico, and a report on reservoir sites.

*Irrigation literature, pp. 345–388. Gives a list of books and pamphlets on irrigation and allied subjects, mainly contained in the library of the United States Geological Survey.

*Twelfth Annual Report of the United States Geological Survey, 1890–91; J. W. Powell, Director. 1891. 2 parts. *Pt. II. Irrigation, xviii, 576 pp., 93 pls. $2.00. Contains:

*Report upon the location and survey of reservoir sites during the fiscal year ended June 30, 1891, by A. H. Thompson, pp. 1–212, pls. 54–57. Describes reservoir sites in Meagher, Lewis and Clark, Beaverhead, Madison, Chouteau, Cascade, and Fergus counties, Mont., and for each site gives the location, brief description of the drainage basin, height of dam, capacity of reservoir, and the area of segregated land.

*Hydrography of the arid regions, by F. H. Newell, pp. 213–361, pls. 58–106. Discusses the available water supply of the arid regions, the duty of water, flood waters, relation of rainfall to river flow; classifies the drainage basins; and describes the rivers of the Missouri, Arkansas, Rio Grande, Colorado, Sacramento, and San Joaquin basins, and the principal streams of the Great Basin in Nevada and Utah and the Snake River basin.

Thirteenth Annual Report of the United States Geological Survey, 1891–92; J. W. Powell, Director. 1892. (Pts. II and III, 1893.) 3 parts. *Pt. III. Irrigation, xi, 486 pp., 77 pls. $1.85. Contains:

*Water supply for irrigation, by F. H. Newell, pp. 1–99, pls. 108–110. Discusses areas irrigated and irrigable, fluctuations in rivers and lakes, cost and value of water supply, and describes the location and area, topography, land classification, extent of irrigation, precipitation, and water measurements on the Missouri and its tributaries.

*Engineering results of irrigation survey, by H. M. Wilson, pp. 351–427, pls. 147–182. Describes the reservoirs, canal lines, areas of lands reclaimable, and estimated revenue from irrigation works on the Sun River system, Montana.

Sixteenth Annual Report of the United States Geological Survey, 1894–95; Charles D. Walcott, Director. 1896. (Pts. II, III, and IV, 1895.) 4 parts. *Pt. II. Papers of an economic character, xix, 598 pp., 42 pls. $1.25. Contains:

The public lands and their water supply, by F. H. Newell, pp. 457–533, pls. 35–39. Describes the general character of the public lands, the lands disposed of (railroad, grant, and swamp lands, and private, miscellaneous entries), lands reserved (Indian, forest, and military reservations), the vacant lands, and the rate of disposal of vacant lands; discusses the streams, wells, and reservoirs as sources of water supply; gives details for each State.

*Water resources of a portion of the Great Plains, by Robert Hay, pp. 535–588, pls. 40–42. Describes an area comprising between 5,000 and 6,000 square miles and including parts of three counties of Kansas, five counties of Nebraska, and six of Colorado, drained to the Missouri through Platte and Kansas rivers; discusses the lakes, streams, and springs of the area, the underflow of the river bottoms, and the water-bearing strata under the higher lands; treats also of the sources of the water supply, rainfall, rate of percolation, and volume; valley, upland, and deep wells; waterless wells, artesian flow, and blowing wells; and the temperature of the well waters; describes briefly the topography and geology of the region and the utilization of the water supply.

Seventeenth Annual Report of the United States Geological Survey, 1895–96; Charles D. Walcott, Director. 1896. 3 parts in 4 vols. *Pt. II. Economic geology and hydrography, xxv, 864 pp., 113 pls. $2.35. Contains:

Preliminary report on artesian waters of a portion of the Dakotas, by N. H. Darton, pp. 603–694, pls. 69–107. Gives an outline of the geologic relations; describes the water horizons and the extent of the artesian water, and gives details concerning wells and prospects by counties; discusses the origin, amount, pressure, head, and composition of the artesian water, the use of artesian water for power, and gives details concerning artesian irrigation by counties; contains also remarks on the construction and management of artesian wells.

Eighteenth Annual Report of the United States Geological Survey, 1896–97; Charles D. Walcott, Director. 1897. (Pts. II and III, 1898.) 5 parts in 6 vols. *Pt. IV. Hydrography, x, 756 pp., 102 pls. $1.75. Contains:

*New development in well boring and irrigation in eastern South Dakota, 1896, by N. H. Darton, pp. 561–615, pls. 38–47. Discusses progress in well sinking and irrigation by artesian waters in 1896 in Aurora, Beadle, Bonhomme, Brule, Buffalo, Charles Mix, Davison, Douglas Hanson, Hutchinson, Jerauld, Sanborn, Spink, and Yankton counties, South Dakota, and in areas west of the Missouri River; treats also of the temperature and volume of flow of the deeper artesian waters and gives chemical analyses of waters from Missouri River and from artesian wells in the Sanborn basin.

*Reservoirs for irrigation, by J. D. Schuyler, pp. 617–740, pls. 48–102. Describes reservoir sites on Goose Creek, Tarryall Creek, and South Fork of South Platte River in Colorado; gives tables of reservoir capacity and areas.

Nineteenth Annual Report of the United States Geological Survey, 1897–98; Charles D. Walcott, Director. 1898. (Pts. II, III, IV, and V, 1899.) 6 parts in 7 vols. and separate case for maps with Pt. V. *Pt. IV, Hydrography, viii, 814 pp., 118 pls. $1.85. Contains:

*Preliminary report on the geology and water resources of Nebraska west of the one hundred and third meridian, by N. H. Darton, pp. 719–785, pls. 74–118. Describes topography and drainage of the area, the general geology of Nebraska, and the geology of the area covered by the report; the water horizons, and deep-seated waters; discusses springs, streams, irrigation, climate, and timber, and gives list of elevations.

——— *Pt. V, Forest reserves, pp. xvii–400, 110 pls. (16 maps in separate case, paper, 75c.; cloth, $1.00.) $1.25. Contains:

*Black Hills Forest Reserve, by H. S. Graves, pp. 67–164, pls. 14–36.

*Big Horn Forest Reserve, by F. E. Town, pp. 165–190, pls. 37–42.

Yellowstone Park Forest Reserve, southern part, from notes by T. S. Brandegee, pp. 213–216.

These reports contain many descriptions of the streams of the forest reserves.

Twentieth Annual Report of the United States Geological Survey, 1898–99; Charles D. Walcott, Director. 1899. (Pts. II, III, IV, V, and VII, 1900.) 7 parts in 8 vols. and separate case for maps with Pt. V. *Pt. V, Forest reserves, xix, 498 pp., 159 pl., 8 maps in separate case. $2.80. Contains:

*Pikes Peak, Plum Creek, and South Platte reserves, by J. G. Jack, pp. 39–115, pls. 8–47. Describes briefly the drainage of the forest reserves.

Twenty-first Annual Report of the United States Geological Survey, 1899–1900; Charles D. Walcott, Director. 1900. (Pts. III, IV, VI, VI continued, and VII, 1901.) 7 parts in 8 vols., and separate case for maps with Pt. V. *Pt. IV, Hydrography, 768 pp., 156 pls. $2.25. Contains:

*Preliminary description of the geology and water resources of the southern half of the Black Hills and adjoining regions in South Dakota and Wyoming, by N. H. Darton, pp. 489–599, pls. 58–112. Describes the topography and geology of an area comprisong about 5,500 square miles in southwestern corner of South Dakota, and the adjoining portion of Wyoming. Discusses the geologic formations and their contained waters, the deep borings at Edgemont and other places, the surface waters (Cheyenne and Fall River, Beaver, Lame Johnny, French, Battle Spring, Hat, Cascade, Stockade Beaver, and Beaver Creeks), and irrigation, the soils, mineral resources, climate, temperature, and timber.

*The High Plains and their utilization, by W. D. Johnson, pp. 601–741, pls. 113–146. Describes the area lying in an irregular belt about midway across the long eastward slope of the Great Plains and including parts of Wyoming, Colorado, Nebraska, Kansas, New Mexico, Oklahoma, and Texas; discusses the origin and structure of the High Plains, the precipitation, temperature, and other factors of climate, experiments with irrigation, and the use of mountain streams, local storm-water storage, and artesian waters. Concluded in the Twenty-second Annual Report, Pt. IV, pp. 631–669, pls. 51–65.

———— *Pt. V, Forest reserves, 711 pp., 143 pls., 39 maps in separate case. $3.85. Contains:

*Lewis and Clarke Forest Reserve, Mont., by H. B. Ayres, pp. 27–80, pls. 2–32. Briefly describes the valleys of the streams.

BULLETINS.

An asterisk (*) indicates that the Geological Survey's stock of the paper is exhausted. Many of the papers so marked may be purchased from the SUPERINTENDENT OF DOCUMENTS, Washington, D. C.

*47. Analyses of waters of the Yellowstone National Park, with an account of the methods of analysis employed, by F. A. Gooch and J. E. Whitfield. 1888. 84 pp.

Describes methods used in analyzing natural waters and contains analyses of 43 geyser, spring, and surface waters in Yellowstone National Park.

*264. Record of deep-well drilling for 1904, by M. L. Fuller, E. F. Lines, and A. C. Veatch. 1905. 106 pp. 10c.

Discusses the importance of accurate well records to the driller, to owners of oil, gas, and water wells, and to the geologist; describes the general methods of work; gives tabulated records of wells in Kansas and Missouri, and detailed records of wells in Greeley County, Kansas, and Randolph County, Missouri. These wells were selected because they give definite stratigraphic information.

265. Geology of the Boulder district, Colo., by N. M. Fenneman. 1905. 101 pp., 5 pls. 15c.

Describes the geology of a rectangular area 16 miles north and south by 9 miles east and west, in the southwestern part of which is situated the city of Boulder. Discusses briefly (pp. 67–69) the flowing wells and water-bearing formations, including the Dakota sandstone. Contains a geologic map of the area.

*298. Record of deep-well drilling for 1905, by M. L. Fuller and Samuel Sanford. 1906. 299 pp. 25c.

Gives an account of progress in the collection of well records and samples; contains tabulated records of wells in Colorado, Iowa, Kansas, Minnesota, Missouri, Montana, Nebraska, North Dakota, South Dakota, and Wyoming, and detailed records of wells in Geary and Wyandotte counties, Kansas; Jackson County, Missouri; Teton County, Montana; and Beadle and Miner counties, South Dakota. The wells of which detailed sections are given were selected because they afford valuable stratigraphic information.

*364. Geology and mineral resources of the Laramie basin, Wyo. (a preliminary report, by N. H. Darton and C. E. Siebenthal. 1909. 81 pp., 8 pls. 20c.

Describes the geology and contains a geologic map. Includes a section on ground water (pp. 67–78), in which are given well data and 6 water analyses. A part of the area is covered by Geologic Folio 173, which also contains information on ground water.

*395. Radioactivity of the thremal waters of Yellowstone National Park, by Herman Schlundt and R. B. Moore. 1909. 35 pp., 4 pls. 10c.

Describes the apparatus and methods used and presents and discusses the results of the experiments.

*471. Contributions to economic geology, 1910, Part II, Mineral fuels; M. R. Campbell, geologist in charge. 1912. 663 pp., 62 pls. $1.05.

Issued also in separate chapters. The following paper contains information on ground water:

*(*a*) The Powder River oil field, Wyo., by C. H. Wegemann (pp. 56–75). Describes the geology and contains a geologic map of a quadrangular area which includes Tps. 40–42 N., R. 81 W., and portions of adjoining townships. Contains brief notes on water supplies, including water-bearing formations (pp. 59, 59).

*575. Geology of the Standing Rock and Cheyenne River Indian reservations, North and South Dakota, by W. R. Calvert, A. L. Beekly, V. H. Barnett, and M. A. Pishel. 1914. 49 pp., 8 pls. 15c.

Covers an area lying west of Missouri River, north of Cheyenne River, and south of Cannonball River, and extending westward to 102d meridian. Describes the geology and contains a geologic map of the area. Includes a brief discussion of the water in the Dakota and Fox hills sandstones and in other formations (pp. 24–25).

*621. Contributions to economic geology, 1915, Part II, Mineral fuels; M. R. Campbell and David White, geologists in charge. 1916. 375 pp., 25 pls. 60c.

Issued also in separate chapters. The following chapter contains information on ground water:

*(*l*) Oiland gas near Basin, Big Horn County, Wyo., by C. T. Lupton (pp. 157–190, Pl. XVII), describes the geology and contains a geologic map of parts of Tps. 50–52 N., Rs. 92 and 93 W. Includes a brief description of the water supplies and of the water-bearing sand with a table giving percentages of oil and gas wells that obtained water in each of these sand strata (pp. 164–166) It also includes well records that contain some data in regard to water (pp. 186–189).

627. The lignite field of northwestern South Dakota, by D. E. Winchester, C. J. Hares, E. R. Lloyd, and E. M. Parks. 1916. 169 pp., 11 pls. 25c.

Describes the geology and contains geologic maps of Harding and Perkins counties. Describes the drainage and water supply and contains a small amount of data on deep well not given in Water-Supply Paper 227.

*641. Contributions to economic geology, 1916, Part II, Mineral fuels; David White, G. H. Ashley, and M. R. Campbell, geologists in charge.

Issued also in separate chapters. The following chapter contains information on ground water:

*(*i*) Anticlines in central Wyoming, by C. J. Hares (pp. 233–280, Pl. XVIII). Covers nearly 5,000 square miles in Natrona and Fremont counties, west of Casper and southeast of Lander. Contains, on pages 235 and 236, a brief discussion of the water supply, including statements regarding various hot springs, springs of large size, sulphur springs, and other mineral springs; also a statement regarding water-bearing formations and artesian prospects. Includes a geologic map.

647. The Bull Mountain coal fields, Musselshell and Yellowstone counties, Mont.; by L. H. Woolsey, R. W. Richards, and C. T. Lupton. 1917. 218 pp., 36 pls.

Gives detailed data regarding water supplies, including ground water, for the following townships: Tps. 5–8 N., R. 24 E.; Tps. 5–8 N., R. 25 E.; Tps. 5–8 N., R. 26 E.; Tps. 5–9 N., R. 27 E.; Tps. 5–9 N., R. 28 E.; Tps. 5–9 N., R. 29 E.; Tps. 5–9 N., R. 30 E.; Tps. 5–9 N., R. 31 E.; T. 8 N., R. 32 E.

656. Anticlines in the southern part of the Big Horn Basin, Wyo., a preliminary report on the occurrence of oil, by D. F. Hewett and C. T. Lupton. 1917. 192 pp., 32 pls. 35c.

Covers a large region in northwestern Wyoming, west of the Big Horn Mountains. Gives detailed data regarding surface waters, springs, wells, and ground-water prospects in the numerous anticlinal areas described in the report. See pages 15, 16, 56–188. Includes a geologic map and section.

PROFESSIONAL PAPERS.

Professional papers are distributed free by the Geological Survey as long as its stock lasts. An asterisk (*) indicates that this stock has been exhausted. Many of the papers marked with an asterisk may, however, be purchased from the SUPERINTENDENT OF DOCUMENTS, WASHINGTON, D. C. Professional papers are of quarto size.

*17. Preliminary report on the geology and water resources of Nebraska west of the one hundred and third meridian, by N. H. Darton. 1903. 69 pp., 43 pls. 50c.

Describes topography and general geology of Nebraska, the streams, springs, and deep-seated waters, and irrigation; gives list of elevations.

*32. Preliminary report on the geology and underground water resources of the central Great Plains, by N. H. Darton. 1905. 433 pp., 72 pls. $1.80.

Describes topography, drainage, stratigraphy, historical geology, and the water horizons: discusses deep wells and prospects (by counties and towns) in South Dakota (see Water-Supply Paper 227), Nebraska, central and western Kansas, eastern Colorado, and eastern Wyoming; discusses also the occurrence of coal, petroleum, and natural gas, salt, gypsum, gold, iron ore, and other minerals.

*53. Geology and water resources of the Big Horn basin, Wyoming, by C. A. Fisher. 1906. 72 pp., 16 pls.

Describes the topography of the region, the stratigraphic, structural, and historical geology, and the underground waters, coal, oil, and gas, building stone, and other mineral resources; discusses briefly irrigation and mineral waters.

*65. Geology and water resources of the northern portion of the Black Hills and adjoining regions in South Dakota and Wyoming, by N. H. Darton. 1909. 105 pp., 24 pls. 40c.

Describes the topography of the region and the stratigraphic, structural, and historical geology of the sedimentary rocks; discusses their mineral resources, including underground water, coal, gypsum, etc.; contains also information concerning the surface waters.

MONOGRAPHS.

Monographs are of quarto size. They are not distributed free, but may be obtained from the Geological Survey or from the SUPERINTENDENT OF DOCUMENTS, WASHINGTON, D. C., at the prices indicated. An asterisk (*) indicates that the Survey's stock of the paper is exhausted.

25. The glacial Lake Agassiz, by Warren Upham. 1896. 658 pp., 38 pls. $1.70.

Contains a chapter (pp. 523–582) on "Artesian and common wells of the Red River Valley," which discusses the sources of artesian water, the fresh waters in the drift sheets, the saline and alkaline waters in the Dakota sandstone, and the use of artesian water for irrigation; contains analyses of waters from wells, streams, and lakes in Red River Valley and the adjoining region; and gives notes on wells in Clay, Kittson, Marshall, Norman, Polk, Traverse, and Wilkin counties, in Minnesota; in Cass, Grand Forks, Pembina, Richland, Traill, and Walsh counties, in North Dakota; and in a part of the area covered by Lake Agassiz, in Manitoba. The monograph includes numerous maps relating to the Pleistocene geology of the region and a map (Pl. XXXVII) showing the distribution and depths of artesian wells in glacial drift and bedrock.

*27. Geology of the Denver Basin in Colorado, by S. F. Emmons, Whitman Cross, and G. H. Eldridge. 1896. 556 pp., 31 pls. $1.50.

Contains a discussion of the water in the Pleistocene deposits (pp. 272, 273) and a section on artesian wells (pp. 401–465). Discusses the history of artesian-water developments in Colorado, the water-bearing horizons, the artesian structure, the quantity of artesian water, and the yield and decrease in yield of flowing wells. Includes three analyses of well waters and maps showing the geology of the region and the original area of artesian flow.

GEOLOGIC FOLIOS.

Under the plan adopted for the preparation of a geologic map of the United States the entire area is divided into small quadrangles, bounded by certain meridians and parallels, and these quadrangles, which number several thousand, are separately

surveyed and mapped.[1] The unit of survey is also the unit of publication, and the maps and description of each quadrangle are issued in the form of a folio. When all the folios are completed they will constitute the Geologic Atlas of the United States.

A folio is designated by the name of the principal town or of a prominent natural feature within the quadrangle. Each folio includes maps showing the topography, geology, underground structure, and mineral deposits of the area mapped and several pages of descriptive text. The text explains the maps and describes the topographic and geologic features of the country and its mineral products. The topographic map shows roads, railroads, waterways, and, by contour lines, the shapes of the hills and valleys and the height above sea level of all points in the quadrangle. The areal-geology map shows the distribution of the various rocks at the surface. The structural-geology map shows the relations of the rocks to one another underground. The economic-geology map indicates the location of mineral deposits that are commercially valuable. The artesian-water map shows the depth to underground-water horizons. Economic-geology and artesian-water maps are included in folios if the conditions in the areas mapped warrant their publication. The folios are of special interest to students of geography and geology and are valuable as guides in the development and utilization of mineral resources.

The folios numbered from 1 to 163, inclusive, are published in only one form (18 by 22 inches), called the library edition. Some of the folios that bear numbers higher than 163 are published also in an octavo edition (6 by 9 inches). Owing to a fire in the Geological Survey building May 18, 1913, the stock of geologic folios was more or less damaged by fire and water, but 80 or 90 per cent of the folios are usable. They will be sold at the uniform price of 5 cents each, with no reduction for wholesale orders. This rate applies to folios in stock from 1 to 184, inclusive (except reprints), also to the library edition of folio 186. The library edition of folios 185, 187, and higher numbers sells for 25 cents a copy, except that some folios which contain an unusually large amount of matter sell at higher prices. The octavo edition of folio 185 and higher numbers sells for 50 cents a copy, except folio 193, which sells for 75 cents a copy. A discount of 40 per cent is allowed on an order for folios or for folios togerher with topographic maps amounting to $5 or more at the retail rate.

All the folios contain descriptions of the drainage of the quadrangles. The folios in the following list contain also brief discussions of the underground waters in connection with the economic resources of the areas and more or less information concerning the utilization of the water resources.

*24. Three Forks, Montana.
*55. Fort Benton, Montana.
*56. Little Belt Mountains, Montana.
85. Oelrichs, South Dakota–Nebraska. 5c.
87. Camp Clark, Nebraska. 5c.
88. Scotts Bluff, Nebraska. 5c.
96. Olivet, South Dakota. 5c.
97. Parker, South Dakota. 5c.
99. Mitchell, South Dakota. 5c.
100. Alexandria, South Dakota. 5c.
*107. Newcastle, Wyoming–South Dakota. 5c.
108. Edgemont, South Dakota–Nebraska. 5c.
113. Huron, South Dakota. 5c.
114. De Smet, South Dakota. 5c.
117. Castleton-Fargo, North Dakota–Minnesota. 5c.

[1] Index maps showing areas in the Missouri River basin covered by typographic maps and by geologic folios will be mailed on receipt of request addressed to the Director, U. S. Geological Survey, Washington, D. C.

*127. Sundance, Wyoming-South Dakota.
*128. Aladdin, Wyoming-South Dakota-Montana. 5c.
*141. Bald Mountain-Dayton, Wyoming. 5c.
*142. Cloud Peak-Fort McKinney, Wyoming. 5c.
*150. Devils Tower, Wyoming.
156. Elk Point, South Dakota-Nebraska-Iowa. 5c.
165. Aberdeen-Redfield[1] (Northville, Aberdeen, Redfield, and Byron quadrangles), South Dakota. 5c.
168. Jamestown-Tower[1] (Jamestown, Eckleson, and Tower quadrangles), North Dakota. 5c.
181. Bismarck,[1] North Dakota. 5c.
196. Philipsburg, Montana. 25c.
206. Leavenworth, Smithville, Missouri-Kansas. 25c.

MISCELLANEOUS REPORTS.

Other Federal bureaus and State and other organizations have from time to time published reports relating to the water resources of the various sections of the country. Notable among those pertaining to the Missouri River basin are the reports of the Chief of Engineers, United States Army, of the State geologist of Kansas, the State Drainage Commission of Minnesota, the Commission on Conservation of the State of Montana, the State Board of Irrigation of Nebraska, the superintendent of the Department of Irrigation, Forestry, Fish, and Game of North Dakota, and the State Engineer of Wyoming. The following reports deserve special mention:

The Missouri River and its utmost source, by J. V. Brower. St. Paul, 1896.

Geological report of the exploration of the Yellowstone and Missouri rivers, by F. V. Hayden. Washington, 1869.

Preliminary examination of reservoir sites in Wyoming and Colorado: 55th Cong., 2d session, House Doc. 141.

Report of the Commission appointed by his excellency the governor of the State of Colorado to revise the laws of the State [of Colorado] regulating the appropriation, distribution, and use of water. Denver, 1890.

Some aspects of irrigation development in Colorado, by G. G. Anderson; Colorado Sci. Soc. Proc., vol. 9, 1909.

Special report on well waters in Kansas, by Erasmus Haworth; Kansas Univ. Geol. Survey Bull. 1.

Report of Board of Irrigation Survey and Experiment [Kansas] for 1895–96. Topeka, 1897.

Water supplies of Kansas, by C. A. Haskins and C. C. Young; Univ. of Kansas Bull. 5, vol. 16, 1915.

Report of the commission on conservation [State of Montana] on bills relating to public lands, water rights, and the protection and preservation of the forests. Helena, 1911.

Irrigation laws of the State of Wyoming; compiled in the office of the State engineer.

[1] Issued in two editions—library and octavo. Specify edition desired.

GEOLOGICAL SURVEY HYDROLOGIC REPORTS OF GENERAL INTEREST.

The following list comprises reports which are not readily classifiable by drainage basins and which cover a wide range of hydrologic investigations:

WATER-SUPPLY PAPERS.

*1. Pumping water for irrigation, by H. M. Wilson. 1896. 57 pp., 9 pls.

Describes pumps and motive powers, windmills, water wheels, and various kinds of engines; also storage reservoirs to retain pumped water until needed for irrigation.

*3. Sewage irrigation, by G. W. Rafter. 1897. 100 pp., 4 pls. (See Water-Supply Paper 22.) 10c.

Discusses methods of sewage disposal by intermittent filtration and by irrigation; describes utilization of sewage in Germany, England, and France, and sewage purification in the United States.

*8. Windmills for irrigation, by E. C. Murphy. 1897. 49 pp., 8 pls. 10c.

Gives results of experimental tests of windmills during the summer of 1896 in the vicinity of Garden, Kans.; describes instruments and methods and draws conclusions.

*14. New tests of certain pumps and water lifts used in irrigation, by O. P. Hood. 1898. 91 pp., 1 pl. 10c.

Discusses efficiency of pumps and waterlifts of various types.

*20. Experiments with windmills, by T. O. Perry. 1899. 97 pp., 12 pls. 15c.

Includes tables and descriptions of wind wheels, makes comparisons of wheels of several types, and discusses results.

*22. Sewage irrigation, Part II, by G. W. Rafter. 1899. 100 pp., 7 pls. 15c.

Gives résumé of Water-Supply Paper No. 3; discusses pollution of certain streams, experiments on purification of factory wastes in Massachusetts, value of commercial fertilizers, and describes American sewage-disposal plants by States; contains bibliography of publications relating to sewage utilization and disposal.

*41. The windmill, its efficiency and economic use, Part I, by E. C. Murphy. 1901. 72 pp., 14 pls.

*42. The windmill, its efficiency and economic use, Part II, by E. C. Murphy. 1901. 75 pp., 2 pls. 10c.

Nos. 41 and 42 give details of results of experimental tests with windmills of various types.

*43. Conveyance of water in irrigation canals, flumes, and pipes, by Samuel Fortier. 1901. 86 pp., 15 pls. 15c.

*56. Methods of stream measurements. 1901. 51 pp., 12 pls. 15c.

Describes the methods used by the Survey in 1901–2. (See also Nos. 64, 94, and 95.)

*64. Accuracy of stream measurements, by E. C. Murphy. 1902. 99 pp., 4 pls. (See No. 95.) 10c.

Describes methods of measuring velocity of water and of measuring and computing stream flow, and compares results obtained with the different instruments and methods; describes also experiments and results at the Cornell University hydraulic laboratory. A second, enlarged, edition published as Water-Supply Paper 95.

*67. The motions of underground waters, by C. S. Slichter. 1902. 106 pp., 8 pls. 15c.

Discusses origin, depth, and amount of underground waters; permeability of rocks and porosity of sois; causes, rates, and laws of motions of underground water; surface and deep zones of flow, and recovery of waters by open wells and artesian and deep wells; treats of the shape and position of the water table; gives simple methods of measuring yield of flowing wells; describes artesian wells at Savannah, Ga.

72. Sewage pollution in the metropolitan area near New York City and its effect on inland water resources, by M. O. Leighton. 1902. 75 pp., 8 pls. 10c.

Defines "normal" and "polluted" waters and discusses the damage resulting from pollution.

*80. The relation of rainfall to run-off, by G. W. Rafter. 1903. 104 pp. 10c.

Treats of measurements of rainfall and laws of measurements of stream flow; gives formulas for rainfall, run-off, and evaporation; discusses effect of forests on rainfall and run-off.

87. Irrigation in India (second edition), by H. M. Wilson. 1903. 238 pp., 27 pls. 25c.

First edition was published in Part II of the Twelfth Annual Report.

93. Proceedings of first conference of engineers of the Reclamation Service, with accompanying papers, compiled by F. H. Newell, chief engineer. 1904. 361 pp. 25c.

Contains, in addition to an account of the organization of the hydrographic [water-resources] branch of the United States Geological Survey, and the report of the conference, the following papers of more or less general interest:

Limits of an irrigation project, by D. W. Ross.
Relation of Federal and State laws to irrigation, by Morris Bien.
Electrical transmission of power for pumping, by H. A. Storrs.
Correct design and stability of high masonry dams, by Geo. Y. Wisner.
Irrigation surveys and the use of the plane table, by J. B. Lippincott.
The use of alkaline waters for irrigation, by Thomas H. Means.

*94. Hydrographic manual of the United States Geological Survey, prepared by E. C. Murphy, J. C. Hoyt, and G. B. Hollister. 1904. 76 pp., 3 pls. 10c.

Gives instruction for field and office work relating to measurements of stream flow by current meters. (See also No. 95.)

*95. Accuracy of stream measurements (second, enlarged, edition), by E. C. Murphy. 1904. 169 pp., 6 pls.

Describes methods of measuring and computing stream flow and compares results derived from different instruments and methods. (See also No. 94.)

*103. A review of the laws forbidding pollution of inland waters in the United States, by E. B. Goodell. 1904. 120 pp. (See No. 152.)

Explains the legal principles under which antipollution statutes become operative, quotes court decisions to show authority for various deductions, and classifies according to scope the statutes enacted in the different States.

*110. Contributions to the hydrology of eastern United States, 1904; M. L. Fuller, geologist in charge. 1905. 211 pp., 5 pls. 10c.

Contains the following reports of general interest. The scope of each paper is indicated by its title.

Description of underflow meter used in measuring the velocity and direction of underground water, by Charles S. Slichter.

The California or "stovepipe" method of well construction, by Charles S. Slichter.

Approximate methods of measuring the yield of flowing wells, by Charles S. Slichter.

Corrections necessary in accurate determinations of flow from vertical well casings, from notes furnished by A. N. Talbot.

Experiment relating to problems of well contamination at Quitman, Ga., by S. W. McCallie.

113. The disposal of strawboard and oil-well wastes, by R. L. Sackett and Isaiah Bowman. 1905. 52 pp., 4 pls. 5c.

The first paper discusses the pollution of streams by sewage and by trade wastes, describes the manufacture of strawboard, and gives results of various experiments in disposing of the waste. The second paper describes briefly the topography, drainage, and geology of the region about Marion, Ind., and the contamination of rock wells and of streams by waste oil and brine.

*114. Underground waters of eastern United States; M. L. Fuller, geologist in charge. 1905. 285 pp., 18 pls. 25c.

Contains report on "Occurrence of underground waters," by M. L. Fuller, discussing sources, amount, and temperature of waters, permeability and storage capacity of rocks, water-bearing formations, recovery of water by springs, wells, and pumps, essential condition of artesian flows, and general conditions affecting underground waters in eastern United States.

119. Index to the hydrographic progress reports of the United States Geological Survey, 1888 to 1903, by J. C. Hoyt and B. D. Wood. 1905. 253 pp. 15c.
Scope indicated by title.

120. Bibliographic review and index of papers relating to underground waters published by the United States Geological Survey, 1879–1904, by M. L. Fuller. 1905. 128 pp. 10c.
Scope indicated by title.

*122. Relation of the law to underground waters, by D. W. Johnson. 1905. 55 pp. 5c.
Defines and classifies underground waters, gives common-law rules relating to their use, and cites State legislative acts affecting them.

140. Field measurements of the rate of movement of underground waters, by C. S. Slichter. 1905. 122 pp., 15 pls. 15c.
Discusses the capacity of sand to transmit water, describes measurements of underflow in Rio Hondo, San Gabriel, and Mohave River valleys, Calif., and on Long Island, N. Y., gives results of tests of wells and pumping plants, and describes stovepipe method of well construction.

143. Experiments on steel-concrete pipes on a working scale, by J. H. Quinton. 1905. 61 pp., 4 pls.
Scope indicated by title.

145. Contributions to the hydrology of eastern United States, 1905; M. L. Fuller, geologist in charge. 1905. 220 pp., 6 pls. 10c.
Contains brief reports of general interest as follows:
Drainage of ponds into drilled wells, by Robert E. Horton. Discusses efficiency, cost, and capacity of drainage wells, and gives statistics of such wells in southern Michigan.
Construction of so-called fountain and geyser springs, by Myron L. Fuller.
A convenient gage for determining low artesian heads, by Myron L. Fuller.

146. Proceedings of second conference of engineers of the Reclamation Service, with accompanying papers, compiled by F. H. Newell, chief engineer. 1905. 267 pp. 15c.
Contains brief account of the organization of the hydrographic [water-resources] branch and the Reclamation Service, reports of conferences and committees, circulars of instruction, and many brief reports on subjects closely related to reclamation, and a bibliography of technical papers by members of the service. Of the papers read at the conference those listed below (scope indicated by title) are of more or less general interest.
Proposed State code of water laws, by Morris Bien.
Power engineering applied to irrigation problems, by O. H. Ensign.
Estimates on tunneling in irrigation projects, by A. L. Fellows.
Collection of stream-gaging data, by N. C. Grover.
Diamond-drill methods, by G. A. Hammond.
Mean-velocity and area curves, by F. W. Hanna.
Importance of general hydrographic data concerning basins of streams gaged, by R. E. Horton.
Effect of aquatic vegetation on stream flow, by R. E. Horton.
Sanitary regulations governing construction camps, by M. O. Leighton.
Necessity of draining irrigated land, by Thos. H. Means.
Alkali soils, by Thos. H. Means.
Cost of stream-gaging work, by E. C. Murphy.
Equipment of a cable gaging station, by E. C. Murphy.
Silting of reservoirs, by W. M. Reed.
Farm-unit classification, by D. W. Ross.
Cost of power for pumping irrigating water, by H. A. Storrs.
Record of flow at current-meter gaging stations during the frozen season, by F. H. Tillinghast.

147. Destructive floods in United States in 1904, by E. C. Murphy and others. 1905. 206 pp., 18 pls. 15c.
Contains a brief account of "A method of computing cross-section area of waterways," including formulas for maximum discharge and area of cross section.

*150. Weir experiments, coefficients, and formulas, by R. E. Horton. 1906. 189 pp., 38 pls. (See Water-Supply Paper 200.) 15c.
Scope indicated by title.

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151. Field assay of water, by M. O. Leighton. 1905. 77 pp., 4 pls. 10c.

Discusses methods, instruments, and reagents used in determining turbidity, color, iron chlorides, and hardness in connection with the studies of the quality of water in various parts of the United States.

*152. A review of the laws forbidding pollution of inland waters in the United States (second edition), by E. B. Goodell. 1905. 149 pp. 10c.

Scope indicated by title.

*160. Underground water papers, 1906; M. L. Fuller, geologist in charge. 1906. 104 pp., 1 pl.

Gives account of work in 1905; lists of publications relating to underground waters, and contains the following brief reports of general interest.

Significance of the term "artesian," by Myron L. Fuller.
Representation of wells and springs on maps, by Myron L. Fuller.
Total amount of free water in the earth's crust, by Myron L. Fuller.
Use of fluorescein in the study of underground waters, by R. B. Dole.
Problems of water contamination, by Isaiah Bowman.
Instances of improvement of water in wells, by Myron L. Fuller.

*162. Destructive floods in the United States in 1905, with a discussion of flood discharge and frequency and an index to flood literature, by E. C. Murphy and others. 1906. 105 pp., 4 pls. 15c.

*163. Bibliographic review and index of underground-water literature published in the United States in 1905, by M. L. Fuller, F. G. Clapp, and B. L. Johnson. 1906. 130 pp. 15c.

Scope indicated by title.

*179. Prevention of stream pollution by distillery refuse, based on investigations at Lynchburg, Ohio, by Herman Stabler. 1906. 34 pp., 1 pl. 10c.

Describes grain distillation, treatment of slop, sources, character, and effects of effluents on streams; discusses filtration, precipitation, fermentation, and evaporation methods of disposal of wastes without pollution.

*180. Turbine water-wheel tests and power tables, by R. E. Horton. 1906. 134 pp., 2 pls. 20c.

Scope indicated by title.

*185. Investigations on the purification of Boston sewage, * * * with a history of the sewage-disposal problem, by C.-E. E. Winslow and E. B. Phelps. 1906. 163 pp. 25c.

Discusses composition, disposal, purification, and treatment of sewages and recent tendencies in sewage-disposal practice in England, Germany, and the United States; describes character of crude sewage at Boston, removal of suspended matter, treatment in septic tanks, and purification by intermittent sand filtration and in beds of coarse material; gives bibliography.

*186. Stream pollution by acid-iron wastes, a report based on investigations made at Shelby, Ohio, by Herman Stabler. 1906. 36 pp., 1 pl.

Gives history of pollution by acid-iron wastes at Shelby, Ohio, and resulting litigation; discusses effect of acid-iron liquors on sewage-purification processes, recovery of copperas from acid-iron wastes, and other processes for removal of pickling liquor.

*187. Determination of stream flow during the frozen season, by H. K. Barrows and R. E. Horton. 1907. 93 pp., 1 pl. 15c.

Scope indicated by title.

*189. The prevention of stream pollution by strawboard waste, by E. B. Phelps. 1906. 29 pp., 2 pls. 5c.

Describes manufacture of strawboard, present and proposed methods of disposal of waste liquors, laboratory investigations of precipitation and sedimentation, and field studies of amounts and character of water used, raw material and finished product, and mechanical filtration.

*194. Pollution of Illinois and Mississippi rivers by Chicago sewage (a digest of the testimony taken in the case of the State of Missouri *v.* the State of Illinois and the Sanitary District of Chicago), by M. O. Leighton. 1907. 369 pp., 2 pls. 40c.

Scope indicated by amplification of title.

*200. Weir experiments, coefficients, and formulas, revision of paper No. 150, by R. E. Horton. 1907. 195 pp., 38 pls. 35c.

Scope indicated by title.

*226. The pollution of streams by sulphite-pulp waste, a study of possible remedies, by E. B. Phelps. 1909. 37 pp., 1 pl. 10c.

Describes manufacture of sulphite pulp, the waste liquors, and the experimental work leading to suggestions as to methods of preventing stream pollution.

*229. The disinfection of sewage and sewage filter effluents, with a chapter on the putrescibility and stability of sewage effluents, by E. B. Phelps. 1909. 91 pp., 1 pl. 15c.

Scope indicated by title.

*234. Papers on the conservation of water resources. 1909. 96 pp., 2 pls. 15c.

Contains the following papers, whose scope is indicated by their titles: Distribution of rainfall by Henry Gannett; Floods, by M. O. Leighton; Developed water powers, compiled under the direction of W. M. Steuart, with discussion by M. O. Leighton; Undeveloped water powers, by M. O. Leighton; Irrigation, by F. H. Newell; Underground waters, by W. C. Mendenhall; Denudation, by R. B. Dole and Herman Stabler; Control of catchment areas, by H. N. Parker.

*235. The purification of some textile and other factory wastes, by Herman Stabler and G. H. Pratt. 1909. 76 pp. 10c.

Discusses waste waters from wool scouring, bleaching and dyeing cotton yarn, bleaching cotton piece goods, and manufacture of oleomargarine, fertilizer, and glue.

236. The quality of surface waters in the United States, Part I, Analyses of waters east of the one-hundredth meridian, by R. B. Dole. 1909. 123 pp. 10c.

Describes collection of samples, methods of examination, preparation of solutions, accuracy of estimates, and expression of analytical results.

238. The public utility of water powers and their governmental regulation, by René Tavernier and M. O. Leighton. 1910. 161 pp. 15c.

Discusses hydraulic power and irrigation, French, Italian, and Swiss legislation relative to the development of water powers, and laws proposed in the French Parliament; reviews work of bureau of hydraulics and agricultural improvement of the French department of agriculture and gives résumé of Federal and State water-power legislation in the United States.

*255. Underground waters for farm use, by M. L. Fuller. 1910. 58 pp., 17 pls. 15c.

Discusses rocks as sources of water supply and the relative safety of supplies from different materials; springs, and their protection; open or dug deep wells, their location, yield, relative cost, protection, and safety; advantages and disadvantages of cisterns and combination wells and cisterns.

*257. Well-drilling methods, by Isaiah Bowman. 1911. 139 pp., 4 pls. 15c.

Discusses amount, distribution, and disposal of rainfall, water-bearing rocks, amount of underground water, artesian conditions, and oil and gas bearing formations; gives history of wel drilling in Asia, Europe, and the United States; describes in detail the various methods and the machinery used; discusses loss of tools and geologic difficulties; contamination of well waters and methods of prevention; tests of capacity and measurement of depth; and cost of sinking wells.

*258. Underground-water papers, 1910, by M. L. Fuller, F. G. Clapp, G. C. Matson, Samuel Sanford, and H. C. Wolff. 1911. 123 pp., 2 pls. 15c.

Contains the following papers (scope indicated by titles) of general interest:
Drainage by wells, by M. L. Fuller.
Freezing of wells and related phenomena, by M. L. Fuller.
Pollution of underground waters in limestone, by G. C. Matson.
Protection of shallow wells in sandy deposits, by M. L. Fuller.
Magnetic wells, by M. L. Fuller.

274. Some stream waters of the western United States, with chapters on sediment carried by the Rio Grande and the industrial application of water analyses, by Herman Stabler. 1911. 188 pp. 15c.

Describes collection of samples, plan of analytical work and methods of analyses; discusses soap-consuming power of waters, water softening, boiler waters, and water for irrigation; gives results of analyses of waters of the Rio Grande and of Pecos, Gallinas, and Hondo rivers.

*315. The purification of public water supplies, by G. A. Johnson. 1913. 84 pp., 8 pls. 10c.

Discusses ground, lake, and river waters as public supplies, development of waterworks systems in the United States, water consumption, and typhoid fever; describes methods of filtration and sterilization of water, and municipal water softening.

334. The Ohio Valley flood of March–April, 1913 (including comparisons with some earlier floods), by A. H. Horton and H. J. Jackson. 1913. 96 pp., 22 pls. 20c.

Although relating specifically to floods in the Ohio Valley, this report discusses also the causes of floods and the prevention of damage by floods.

337. The effects of ice on stream flow, by William Glenn Hoyt. 1913. 76 pp., 7 pls. 15c.

Discusses methods of measuring the winter flow of streams.

345. Contributions to the hydrology of the United States, 1914. N. G. Grover, chief hydraulic engineer. 1915. 225 pp., 17 pls. 30c.

*(e) A method of determining the daily discharge of rivers of variable slope, by M. R. Hall, W. E. Hall, and C. H. Pierce, pp. 53–65. Scope indicated by title.

364. Water and analyses from the laboratory of the United States Geological Survey, tabulated by F. W. Clarke, chief chemist. 1914. 40 pp. 5c.

Contains analyses of waters from rivers, lakes, wells, and springs in various parts of the United States, including analyses of the geyser water of Yellowstone National Park, Hot springs in Montana, brines from Death Valley, water from the Gulf of Mexico, and mine waters from Tennessee, Michigan, Missouri, and Oklahoma, Montana, Colorado and Utah, Nevada and Arizona, and California.

371. Equipment for current-meter gaging stations, by G. J. Lyon. 1915. 64 pp., 37 pls. 20c.

Describes methods of installing automatic and other gages and of constructing gage wells, shelters, and structures for making discharge measurements and artificial controls.

375. Contributions to the hydrology of the United States, 1915. N. C. Grover, chief hydraulic engineer. 1916. 181 pp., 9 pls. 15c.

Contains three papers presented at the conference of engineers of the water-resources branch in December, 1914, as follows:

*(c) Relation of stream gaging to the science of hydraulics, by C. H. Pierce and R. W. Davenport, pp. 77–84.

(e) A method of correcting river discharge for a changing stage, by B. E. Jones, pp. 117–130.

(f) Conditions requiring the use of automatic gages in obtaining records of stream flow, by C. H. Pierce, pp. 131–139.

*400. Contributions to the hydrology of the United States, 1916. N. G. Grover, chief hydraulic engineer.

(a) The people's interest in water-power resources, by G. O. Smith, pp. 1–8.

*(c) The measurement of silt-laden streams, by Raymond C. Pierce, pp. 39–51.

(d) Accuracy of stream-flow data, by N. C. Grover and J. C. Hoyt, pp. 53–59.

416. The divining rod, a history of water witching, with a bibliography, by Arthur J. Ellis. 1917. 59 pp. 10c.

A brief paper published "merely to furnish a reply to the numerous inquiries that are continually being received from all parts of the country" as to the efficacy of the divining rod for locating underground water.

*425. Contributions to the hydrology of the United States, 1917. N. C. Grover, chief hydraulic engineer. 1918. Contains:

*(c) Hydraulic conversion tables and convenient equivalents, pp. 71–94. 1917.

427. Bibliography and index of the publications of the United States Geological Survey relating to ground water, by O. E. Meinzer. 1918. 169 pp., 1 pl.

Includes publications prepared, in whole or in part, by the Geological Survey that treat any phase of the subject of ground water or any subject directly applicable to ground water. Illustrated by map showing reports that cover specific areas more or less thoroughly.

ANNUAL REPORTS.

*Fifth Annual Report of the United States Geological Survey, 1883–84, J. W. Powell, Director. 1885. xxxvi, 469 pp., 58 pls. $2.25. Contains:

The requisite and qualifying conditions of artesian wells, by T. C. Chamberlin, pp. 125–173, pl. 21. Scope indicated by title.

*Twelfth Annual Report of the United States Geological Survey, 1890–91, J. W. Powell, Director. 1891. 2 parts. *Part II, Irrigation, xviii, 576 pp., 93 pls. $2. Contains:

*Irrigation in India, by H. M. Wilson, pp. 363–561, pls. 107–146. (See Water-Supply Paper 87.)

Thirteenth Annual Report of the United States Geological Survey, 1891–92, J. W. Powell, Director. 1892. (Parts II and III, 1893.) 3 parts. *Part III, Irrigation, xi, 486 pp., 77 pls. $1.85. Contains:

*American irrigation engineering, by H. M. Wilson, pp. 101–349, pls. 111–146. Discusses the economical aspects of irrigation, alkaline drainage, silt, and sedimentation; gives brief history of legislation; describes perennial canals in Idaho-California, Wyoming, and Arizona; discusses water storage at reservoirs of the California and other projects, subsurface sources of supply, pumping and subirrigation.

Fourteenth Annual Report of the United States Geological Survey, 1892–93, J. W. Powell, Director. 1893. (Part II, 1894.) 2 parts. *Part II, Accompanying papers, xx, 597 pp., 73 pls. $2.10. Contains:

*Natural mineral waters of the United States, by A. C. Peale, pp. 49–88, pls. 3 and 4. Discusses the origin and flow of mineral springs, the source of mineralization, thermal springs, the chemical composition and analysis of spring waters, geographic distribution, and the utilization of mineral waters; gives a list of American mineral spring resorts; contains also some analyses.

Nineteenth Annual Report of the United States Geological Survey, 1897–98, Charles D. Walcott, Director. 1898. (Parts II, III, and V, 1899.) 6 parts in 7 vols. and separate case for maps with Part V. *Part II, Papers chiefly of a theoretic nature, v. 958 pp., 172 pls. $2.65. Contains:

*Principles and conditions of the movements of ground water, by F. H. King, pp. 59–294, pls. 6–16. Discusses the amount of water stored in sandstone, in soil, and in other rocks, the depth to which ground water penetrates; gravitational, thermal, and capillary movements of ground waters, and the configuration of the ground-water surface; gives the results of experimental investigations on the flow of air and water through a rigid, porous medium and through sands, sandstones, and silts; discusses results obtained by other investigators, and summarizes results of observations; discusses also rate of flow of water through sand and rock, the growth of rivers, rate of filtration through soil, interference of wells, etc.

*Theoretical investigation of the motion of ground waters, by C. S. Slichter, pp. 295–384, pl. 17. Scope indicated by title.

Twentieth Annual Report of the United States Geological Survey, 1898–99, Charles D. Walcott, Director. 1899. (Parts II, III, IV, V, and VII, 1900.) 7 parts in 8 vols. and separate case for maps with Part V. *Part IV, Hydrography, vii, 660 pp., 75 pls. $1.40. Contains:

*Hydrography of Nicaragua, by A. P. Davis, pp. 563–637, pls. 64–75. Describes the topographic features of the boundary, the Lake Basin, and Rio San Juan; gives a brief résumé of the boundary dispute; discusses rainfall, temperature, and relative humidity, evaporation, resources and productions, the ship-railway and canal projects; gives the history of the investigations by the Canal Commission, and results of measurements on the Rio Grande, on streams tributary to Lake Nicaragua, and on Rio San Jaun and its tributaries.

Twenty-second Annual Report of the United States Geological Survey, 1900–1901; Charles D. Walcott, Director. 1901. (Parts III and IV, 1902.) 4 parts. Part IV, Hydrography, 690 pp., 65 pls. $2.20. Contains:

*Hydrography of the American Isthmus, by A. P. Davis, pp. 507–630, pls. 37–50. Describes the physiography, temperature, rainfall, and winds of Central America; discussed the hydrography of the Nicaragua canal route and the Panama canal route; gives estimated monthly discharge of many of the streams, and rainfall and evaporation tables for various points.

PROFESSIONAL PAPERS.

*72. Denudation and erosion in the southern Appalachian region and the Monongahela basin, by L. C. Glenn. 1911. 137 pp., 21 pls. 35c.

Describes the relation of agriculture, lumbering, mining, and power development to erosion and denudation, and the nature, effects, and remedies of erosion; gives details of conditions in Holston, Nolichucky, French Broad, Little Tennessee, and Hiwassee river basins, along Tennessee River proper, and in the basins of the Coosa-Alabama system, Chattahoochee, Savannah, Saluda, Broad, Catawba, Yadkin, New, and Monongahela rivers.

*86. The transportation of débris by running water, by G. K. Gilbert, based on experiments made with the assistance of E. C. Murphy. 1914. 263 pp., 3 pls. 70c.

The results of an investigation which was carried on in a specially equipped laboratory at Berkeley, Calif., and was undertaken for the purpose of learning "the laws which control the movement of bed load, and specially to determine how the quantity of load is related to the stream's slope and discharge and to the degree of comminution of the débris."

A highly technical report.

105. Hydraulic mining débris in the Sierra Nevada, by G. K. Gilbert. 154 pp., 34 pls. 1917.

Presents the results of an investigation undertaken by the United States Geological Survey in response to a memorial from the California Miners' Association asking that a particular study be made of portions of the Sacramento and San Joaquin valleys affected by detritus from torrential streams. The report deals largely with geologic and physiographic aspects of the subject, traces the physical effects, past and future, of the hydraulic mining of earlier decades, the similar effects which certain other industries induce through stimulation of the erosion of the soil, and the influence of the restriction of the area of inundation by the construction of levees. Suggests cooperation by several interests for the control of the streams now carrying heavy loads of débris.

BULLETINS.

*32. Lists and analyses of the mineral springs of the United States (a preliminary study), by A. C. Peale. 1886. 235 pp.

Defines mineral waters, lists the springs by States, and gives tables of analyses so far as available.

*319. Summary of the controlling factors of artesian flows, by Myron L. Fuller. 1908. 44 pp., 7 pls. 10c.

Describes underground reservoirs, the sources of underground waters, the confining agents, the primary and modifying factors of artesian circulation, the essential and modifying factors of artesian flow, and typical artesian systems.

479. The geochemical interpretation of water analyses, by Chase Palmer. 1911. 31 pp. 5c.

Discusses the expression of chemical analyses, the chemical character of water and the properties of natural water; gives a classification of water based on property values and reacting values, and discusses the character of the waters of certain rivers as interpreted directly from the results of analyses; discusses also the relation of water properties to geologic formations, silica in river water, and the character of the water of the Mississippi and the Great Lakes and St. Lawrence River as indicated by chemical analyses.

INDEX BY AREAS AND SUBJECTS.

[A=Annual Report; M=Monograph; B=Bulletin; P=Professional Paper; W=Water-Supply Paper; G F=Geologic folio.]

[1] Many of the reports contain brief subject bibliographies. See abstracts.

[2] Many analyses of river, spring, and well waters are scattered through publications as noted in abstracts.

INDEX OF STREAMS.