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SURFACE WATER SUPPLY OF THE
UNITED STATES
1916

PART VI. MISSOURI RIVER BASIN

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



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SURFACE WATER SUPPLY OF MISSOURI RIVER BASIN, 1916.

AUTHORIZATION AND SCOPE OF WORK.

This volume is one of a series of 14 reports presenting results of measurements of flow made on streams in the United States during the year ending September 30, 1916.

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, 1895-1917.

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

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 14.

Measurements of stream flow have been made at about 4,100 points in the United States and also at many points in Alaska and the Hawaiian Islands. In July, 1916, 1,290 gaging stations were being maintained by the Survey and the cooperating organizations. Many miscellaneous discharge measurements are made at other points. In con-

nection 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 of 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 by the use of the factors given in the tables of convenient equivalents (p. 9).

“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 of 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.

CONVENIENT EQUIVALENTS.

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

Table for converting discharge in second-feet per square mile into run-off in depth in inches over the area.

Discharge (second-feet per square mile).	Run-off (depth in inches).				
	1 day.	28 days.	29 days.	30 days.	31 days.
1.....	0.03719	1.041	1.079	1.116	1.153
2.....	.07438	2.083	2.157	2.231	2.306
3.....	.11157	3.124	3.236	3.347	3.459
4.....	.14876	4.165	4.314	4.463	4.612
5.....	.18595	5.207	5.393	5.578	5.764
6.....	.22314	6.248	6.471	6.694	6.917
7.....	.26033	7.289	7.550	7.810	8.070
8.....	.29752	8.331	8.628	8.926	9.223
9.....	.33471	9.372	9.707	10.041	10.376

NOTE.—For part of a month multiply the run-off for 1 day by the number of days.

Table for converting discharge in second-feet into run-off in acre-feet.

Discharge (second-feet).	Run-off (acre-feet).				
	1 day.	28 days.	29 days.	30 days.	31 days.
1.....	1.983	55.54	57.52	59.50	61.49
2.....	3.967	111.1	115.0	119.0	123.0
3.....	5.950	166.6	172.6	178.5	184.5
4.....	7.934	222.1	230.1	238.0	246.0
5.....	9.917	277.7	287.6	297.5	307.4
6.....	11.90	333.2	345.1	357.0	368.9
7.....	13.88	388.8	402.6	416.5	430.4
8.....	15.87	444.3	460.2	476.0	491.9
9.....	17.85	499.8	517.7	535.5	553.4

NOTE.—For part of a month multiply the run-off for 1 day by the number of days.

Table for converting discharge in second-feet into run-off in millions of cubic feet.

Discharge (second-feet).	Run-off (depth in inches).				
	1 day.	28 days.	29 days.	30 days.	31 days.
1.....	0.0864	2.419	2.506	2.592	2.678
2.....	.1728	4.838	5.012	5.184	5.356
3.....	.2592	7.257	7.518	7.776	8.034
4.....	.3456	9.676	10.02	10.37	10.71
5.....	.4320	12.10	12.53	12.96	13.39
6.....	.5184	14.51	15.04	15.55	16.07
7.....	.6048	16.93	17.54	18.14	18.75
8.....	.6912	19.35	20.05	20.74	21.42
9.....	.7776	21.77	22.55	23.33	24.10

NOTE.—For part of a month multiply the run-off for 1 day by the number of days.

Table for converting discharge in second-feet into run-off in millions of gallons.

Discharge (second-feet)	Run-off (depth in inches).				
	1 day.	28 days.	29 days.	30 days.	31 days.
1.....	0.6463	18.10	18.74	19.39	20.04
2.....	1.293	36.20	37.48	38.78	40.08
3.....	1.939	54.30	56.22	58.17	60.12
4.....	2.585	72.40	74.96	77.56	80.16
5.....	3.232	90.50	93.70	96.95	100.2
6.....	3.878	108.6	112.4	116.3	120.2
7.....	4.524	126.7	131.2	135.7	140.3
8.....	5.171	144.8	149.9	155.1	160.3
9.....	5.817	162.9	168.7	174.5	180.4

NOTE.—For part of a month multiply the run-off for 1 day by the number of days.

Table for converting velocity in feet per second into velocity in miles per hour.

[1 foot per second=0.681818 miles per hour, or two-thirds mile per hour, very nearly; 1 mile per hour=1.4666 feet per second. In computing the table the figures 0.68182 and 1.4667 were used.]

Feet per second (units).	Miles per hour for tenths of foot per second.									
	0	1	2	3	4	5	6	7	8	9
0.....	0.000	0.068	0.136	0.205	0.273	0.341	0.499	0.477	0.545	0.614
1.....	.682	.750	.818	.886	.955	1.02	1.09	1.16	1.23	1.30
2.....	1.36	1.43	1.50	1.57	1.64	1.70	1.77	1.84	1.91	1.98
3.....	2.05	2.11	2.18	2.25	2.32	2.39	2.45	2.52	2.59	2.66
4.....	2.73	2.80	2.86	2.93	3.00	3.07	3.14	3.20	3.27	3.34
5.....	3.41	3.48	3.55	3.61	3.68	3.75	3.82	3.89	3.95	4.02
6.....	4.09	4.16	4.23	4.30	4.36	4.43	4.50	4.57	4.64	4.70
7.....	4.77	4.84	4.91	4.98	5.05	5.11	5.18	5.25	5.32	5.39
8.....	5.45	5.52	5.59	5.66	5.73	5.80	5.86	5.93	6.00	6.07
9.....	6.14	6.20	6.27	6.34	6.41	6.48	6.55	6.61	6.68	6.75

Table for converting discharge in second-feet into theoretical horsepower per foot of fall.

[1 second-foot=0.1136 theoretical horsepower per foot of fall. Weight of 1 cubic foot of water=62.5 pounds.]

Tens.	Units.									
	0	1	2	3	4	5	6	7	8	9
0.....	0.00	0.114	0.227	0.341	0.454	0.568	0.682	0.795	0.909	1.02
1.....	1.14	1.25	1.36	1.48	1.59	1.70	1.82	1.93	2.04	2.16
2.....	2.27	2.39	2.50	2.61	2.73	2.84	2.95	3.07	3.18	3.29
3.....	3.41	3.52	3.64	3.75	3.86	3.98	4.09	4.20	4.32	4.43
4.....	4.54	4.66	4.77	4.88	5.00	5.11	5.23	5.34	5.45	5.57
5.....	5.68	5.79	5.91	6.02	6.13	6.25	6.36	6.48	6.59	6.70
6.....	6.82	6.93	7.04	7.16	7.27	7.38	7.50	7.61	7.72	7.84
7.....	7.95	8.07	8.18	8.29	8.41	8.52	8.63	8.75	8.86	8.97
8.....	9.09	9.20	9.32	9.43	9.54	9.66	9.77	9.88	10.0	10.1
9.....	10.2	10.3	10.5	10.6	10.7	10.8	10.9	11.0	11.1	11.2

1 second-foot equals 40 California miner's inches (law of Mar. 23, 1901).

1 second-foot equals 38.4 Colorado miner's inches.

1 second-foot equals 40 Arizona miner's inches.

1 second-foot equals 7.48 United States gallons per second; equals 448.8 gallons per minute; equals 646,317 gallons for one day.

1 second-foot for one year (365 days) covers 1 square mile 1.131 feet, or 13.572 inches deep.

1 second-foot for one year (365 days) equals 31,536,000 cubic feet.

1 second-foot equals about 1 acre-inch per hour.

- 1 second-foot for one year (365 days) equals 724 acre-feet.
 1 second-foot for one day equals 86,400 cubic feet.
 1,000,000,000 (1 United States billion) cubic feet equals 11,570 second-feet for one day.
 1,000,000,000 cubic feet equals 414 second-feet for one 28-day month.
 1,000,000,000 cubic feet equals 399 second-feet for one 29-day month.
 1,000,000,000 cubic feet equals 386 second-feet for one 30-day month.
 1,000,000,000 cubic feet equals 373 second-feet for one 31-day month.
 100 California miner's inches equals 18.7 United States gallons per second.
 100 California miner's inches for one day equals 4.96 acre-feet.
 100 Colorado miner's inches equals 2.60 second-feet.
 100 Colorado miner's inches equals 19.5 United States gallons per second.
 100 Colorado miner's inches for one day equals 5.17 acre-feet.
 100 United States gallons per minute equals 0.223 second-foot.
 100 United States gallons per minute for one day equals 0.442 acre-foot.
 1,000,000 United States gallons per day equals 1.55 second-feet.
 1,000,000 United States gallons equals 3.07 acre-feet.
 1,000,000 cubic feet equals 22.95 acre-feet.
 1 acre-foot equals 325,850 gallons.
 1 inch deep on 1 square mile equals 2,323,200 cubic feet.
 1 inch deep on 1 square mile equals 0.0737 second-foot per year.
 1 foot equals 0.3048 meter.
 1 mile equals 1.60935 kilometers.
 1 mile equals 5,280 feet.
 1 acre equals 0.4047 hectare.
 1 acre equals 43,560 square feet.
 1 acre equals 209 feet square, nearly.
 1 square mile equals 2.59 square kilometers.
 1 cubic foot equals 0.0283 cubic meter.
 1 cubic foot of water weighs 62.5 pounds.
 1 cubic meter per minute equals 0.5886 second-foot.
 1 horsepower equals 550 foot-pounds per second.
 1 horsepower equals 76.0 kilogram-meters per second.
 1 horsepower equals 746 watts.
 1 horsepower equals 1 second-foot falling 8.80 feet.
 1½ horsepower equals about 1 kilowatt.

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

EXPLANATION OF DATA.

The data presented in this report cover the year beginning October 1, 1915, and ending September 30, 1916. 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.

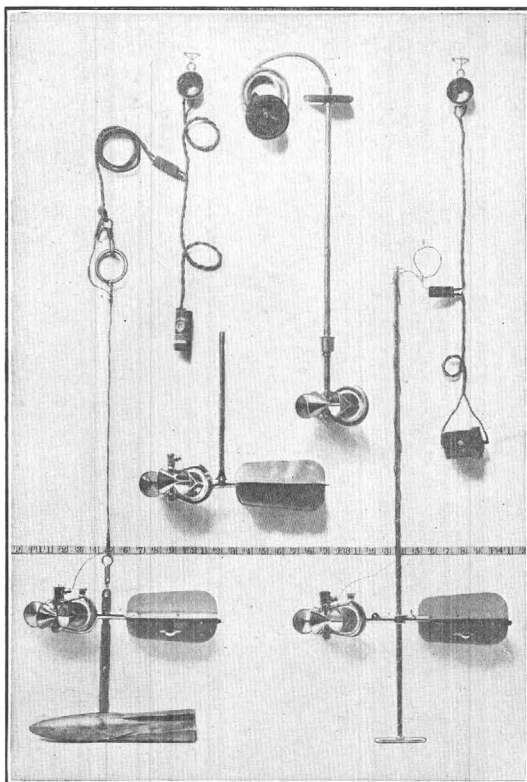
The data presented for each gaging station in the area covered by this report comprise a description of the station, a table giving results of discharge measurements, a table showing the daily discharge of the stream, and a table of monthly and yearly discharge and run-off.

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

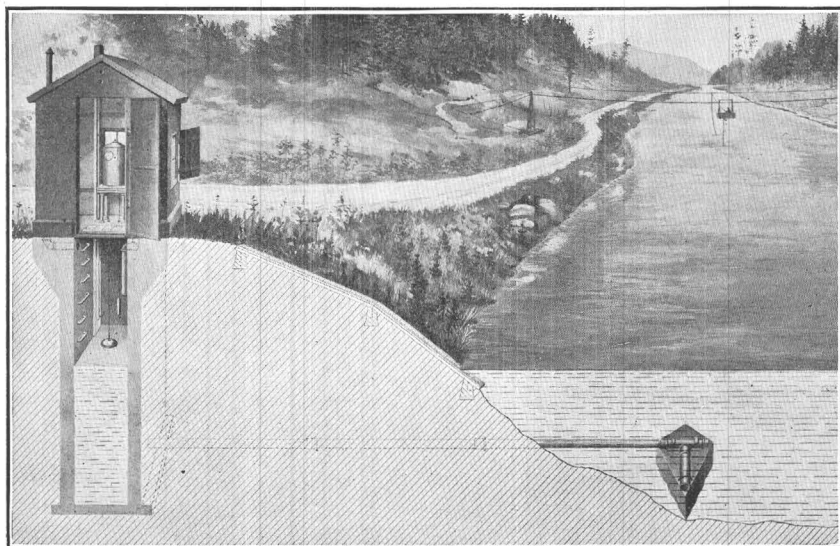
The description of the station gives, in addition to statements regarding location and equipment, information in regard to any conditions that may affect the constancy of the stage-discharge relation, covering such subjects as the occurrence of ice, the use of the stream for log driving, shifting of 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.

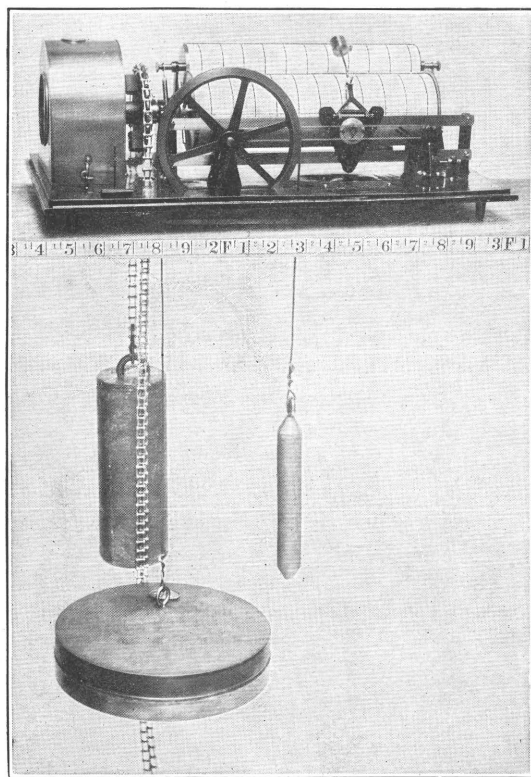
In the table of monthly discharge the column headed "Maximum" gives the mean flow for the day when the mean gage height was highest. As the gage height is the mean for the day it does not indicate correctly the stage when the water surface was at crest height, and the corresponding discharge was consequently larger than given in the maximum column. Likewise, in the column headed "Mini-



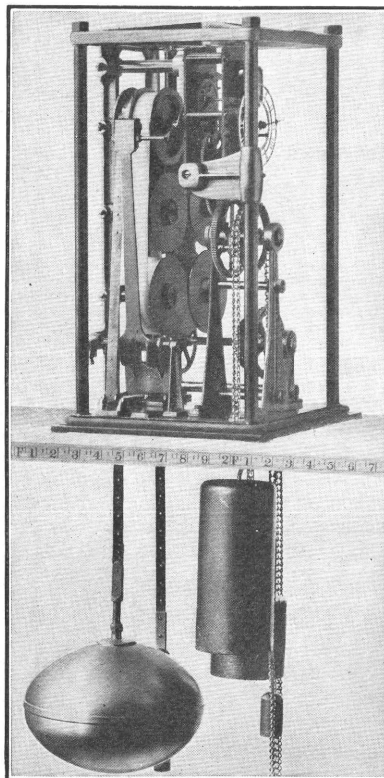
A. PRICE CURRENT METERS.



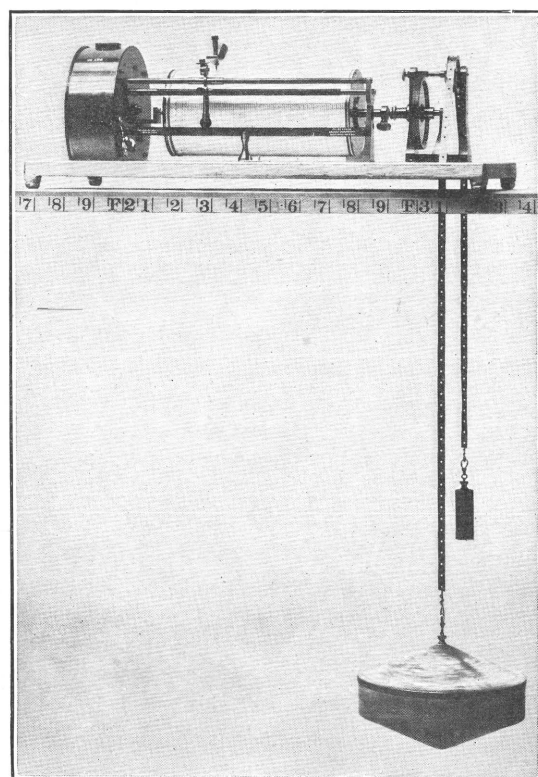
B. TYPICAL GAGING STATION.



A. STEVENS.



B. GURLEY PRINTING.



C. FRIEZ.

WATER-STAGE RECORDERS.

mum" 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 or 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 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.

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.

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., on Sweetwater River near Alcova, Wyo., and on Sage Creek above Pathfinder, and also furnished complete records for certain stations, as acknowledged in connection with the descriptions of those stations.

The Hawk Springs Development Co., through Mr. J. A. Whiting, furnished record of gage heights and provided the transportation necessary to obtain data for the station on Horse Creek near Lagrange. Messrs. Johnson and Crownberg 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, Wyo. The Wyoming Irrigation Co. furnished gage-height records for Shell Creek at Shell, Wyo. The Rock Creek Conservation Co. furnished field data for stations on Rock and Deep creeks near Arlington, Wyo., and also transportation for Survey engineers.

The State engineer of Colorado paid the gage observers at the stations on the South Platte at South Platte, on the North Fork of the South Platte at Grant and at South Platte, and on 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 Black Hills Angostura Irrigation Co. paid the salary of the gage observer at the station on Cheyenne River near Hot Springs.

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 B. E. Jones, E. F. Chandler, A. H. Tuttle, and Mrs. A. H. Blom, 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 R. H. Fletcher, W. R. King, P. V. Hodges, H. K. Smith, J. H. Baily, and Miss Jane Hanna.

Data for three 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 H. J. Dean, C. G. Paulsen, and E. Hazel Hauge.

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.—About 560 square miles.

RECORDS AVAILABLE.—July 22, 1911, to September 30, 1916; 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 twice daily by P. V. Maxwell. Float gage in concrete well used in 1912 and 1913. During 1911 a temporary vertical staff on the left bank about 300 yards below the dam was read. Gage heights beginning with those for 1912 indicate head on crest of 40-foot weir about 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 extreme 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, 2.96 feet at 7 a. m. and 6 p. m. April 30 (discharge obtained by indirect method, 1,170 second-feet); minimum stage recorded, 0.28 feet January 16, 17, 18 (discharge, 23 second-feet).

1911-1916: 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 relation not affected by ice.

DIVERSIONS.—None.

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

ACCURACY.—Stage discharge relation changed by high water of April and May.

Rating curve used to May 1 well defined; rating curve used after May 1 well defined between 200 and 500 second-feet. Gage read to hundredths twice daily.

Daily discharge ascertained by applying mean daily gage heights to rating tables October 1 to April 22 and May 2 to September 30; April 23 to May 1 by indirect method. Results good.

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

Discharge measurements of Red Rock Creek below Red Rock reservoir, near Monida, Mont., during the year ending Sept. 30, 1916.

Date.	Made by—	Gage height.	Discharge.
		<i>Feet.</i>	<i>Sec.-ft.</i>
Oct. 1	Heidel and Maxwell.....	1.40	286
June 23	do.....	1.70	456

Daily discharge, in second-feet, of Red Rock Creek below Red Rock reservoir, near Monida, Mont., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1.....	280	70	25	25	25	25	26	1,170	576	445	155	138
2.....	154	70	25	25	25	25	25	1,140	548	445	152	133
3.....	68	70	25	25	25	25	25	1,110	548	407	149	133
4.....	68	70	25	25	25	25	25	1,110	548	376	147	133
5.....	68	70	25	25	25	25	25	1,110	537	376	141	133
6.....	68	70	25	25	25	25	25	1,050	537	337	141	133
7.....	68	70	25	25	25	25	25	1,020	470	332	138	128
8.....	68	70	25	25	25	25	26	1,020	422	332	136	128
9.....	68	70	25	25	25	25	26	925	422	332	136	128
10.....	68	70	25	25	25	25	26	895	422	332	131	128
11.....	68	70	25	25	25	25	26	717	422	332	131	128
12.....	68	70	25	25	25	25	26	717	422	291	128	128
13.....	68	70	25	25	25	25	26	648	436	291	128	128
14.....	68	70	25	25	25	25	65	603	436	271	128	128
15.....	68	70	25	25	25	25	124	603	436	252	128	256
16.....	68	46	25	23	25	25	248	603	436	271	128	332
17.....	68	25	25	23	25	25	352	603	436	271	125	376
18.....	68	25	25	23	25	25	396	603	436	264	125	398
19.....	68	25	25	25	25	25	418	603	440	252	123	445
20.....	68	25	25	25	25	25	510	603	445	252	123	470
21.....	68	25	25	25	25	25	668	548	440	252	136	485
22.....	68	25	25	25	25	25	805	495	436	227	149	506
23.....	68	25	25	25	25	25	876	495	440	200	149	372
24.....	68	25	25	25	25	25	927	495	445	155	149	252
25.....	68	25	25	25	25	25	967	495	445	155	149	252
26.....	68	25	25	25	25	25	1,010	522	445	155	141	252
27.....	68	25	25	25	25	25	1,080	548	445	155	141	252
28.....	68	25	25	25	25	25	1,100	548	445	155	138	252
29.....	68	25	25	25	25	25	1,130	576	445	155	138	252
30.....	70	25	25	25	.....	25	1,170	576	445	155	138	252
31.....	70	.....	25	25	.....	26	.....	576	.....	155	138	.....

NOTE.—April 24 to May 10, 1916, water passed around weir; estimated by observer as follows:

	Second-feet.		Second-feet.
Apr. 24.....	7.5	May 1-5.....	30
Apr. 25.....	8.8	May 6-8.....	25
Apr. 26.....	12.5	May 9.....	12.5
Apr. 27-28.....	25	May 10.....	10
Apr. 29-30.....	30		

Monthly discharge of Red Rock Creek below Red Rock reservoir, near Monida, Mont., for the year ending Sept. 30, 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
October.....	280	68	77.7	4,780
November.....	70	25	48.2	2,870
December.....	25	25	25.0	1,540
January.....	25	23	24.8	1,520
February.....	25	25	25.0	1,440
March.....	26	25	25.0	1,540
April.....	1,170	25	406	24,200
May.....	1,170	495	733	45,100
June.....	576	422	460	27,400
July.....	445	155	270	16,600
August.....	155	123	137	8,420
September.....	506	126	241	14,300
The year.....	1,170	25	206	150,000

BEAVERHEAD RIVER AT BARRATTS, MONT.

LOCATION.—In SW. $\frac{1}{4}$ SW. $\frac{1}{4}$ sec. 20, T. 8 S., R. 9 W., at highway bridge 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 AREA.—Not measured.

RECORDS AVAILABLE.—August 12, 1907, to September 30, 1916.

GAGE.—Chain gage on downstream side of bridge; read 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 year, 4.2 feet at 3.50 p. m., June 22 (discharge, 2,150 second-feet); minimum stage, 0.90 foot, September 1-7 (discharge, 222 second-feet).

1907-1916: Maximum stage recorded, 6.0 feet, June 19 and 20, 1908 (discharge, 3,640 second-feet); minimum stage, 0.42 foot, June 23, 1910 (discharge, 114 second-feet).

ICE.—Stage-discharge relation at times affected by ice.

DIVERSIONS.—Numerous diversions are made above the 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. The Union Electric Co., of Dillon, has a canal, with a carrying capacity of 6,000 inches.

REGULATION.—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 unchanged during year. Rating curve fairly well defined. Gage read to half tenths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table. Records good.

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

June 22, 1916: Gage height, 3.97 feet; discharge, 1,990 second-feet.

Daily discharge, in second-feet, of Beaverhead River at Barratts, Mont., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1.....	567	420	332	332	332	256	444	1,280	961	1,020	332	222
2.....	567	420	332	332	332	292	467	1,340	900	1,020	354	222
3.....	567	444	354	332	332	256	444	1,340	840	1,080	332	222
4.....	567	467	375	332	332	256	420	1,340	840	1,340	332	222
5.....	516	467	375	332	354	274	420	1,400	840	1,340	332	222
6.....	516	467	375	332	332	292	420	1,470	900	1,080	332	222
7.....	492	467	398	332	332	292	398	1,540	900	961	332	222
8.....	420	467	375	332	312	354	420	1,470	961	782	332	256
9.....	420	444	375	332	292	516	444	1,470	1,020	726	332	256
10.....	420	420	332	332	292	900	467	1,470	1,080	619	332	292
11.....	398	398	332	332	274	840	492	1,400	1,210	593	332	292
12.....	398	420	332	332	292	726	699	1,340	1,210	567	312	332
13.....	420	420	332	332	292	567	567	1,280	1,080	567	312	332
14.....	420	420	354	332	332	467	516	1,210	1,080	516	312	332
15.....	420	420	354	332	332	444	542	1,080	1,080	516	332	332
16.....	420	420	332	.....	292	420	542	1,020	1,020	516	332	332
17.....	444	420	332	.....	274	516	619	961	1,020	516	332	332
18.....	420	420	332	.....	292	619	672	900	1,020	467	332	354
19.....	420	420	332	.....	292	726	672	961	1,150	467	332	354
20.....	420	420	354	.....	292	840	699	1,020	1,470	467	332	375
21.....	420	420	332	.....	274	726	726	961	1,800	420	332	375
22.....	420	420	332	.....	274	699	840	840	2,010	420	312	375
23.....	398	420	332	.....	274	646	840	840	1,730	420	292	375
24.....	398	420	312	.....	274	567	900	840	1,470	375	292	420
25.....	420	354	332	.....	256	492	961	900	1,470	375	274	420
26.....	420	375	332	.....	256	492	1,020	961	1,340	398	256	444
27.....	444	354	332	354	256	492	1,150	1,150	1,080	375	274	420
28.....	444	332	312	354	256	467	1,210	1,080	1,080	375	256	420
29.....	420	332	332	332	256	467	1,280	1,020	1,080	332	256	467
30.....	420	332	332	332	.....	467	1,280	1,020	1,080	332	256	467
31.....	420	.....	332	312	.....	444	.....	961	.....	332	238	.....

NOTE.—Discharge Jan. 2-15 determined from gage heights as estimated by observer because of effect of ice at gage. No gage height record Jan. 16-26.

Monthly discharge of Beaverhead River at Barratts, Mont., for the year ending Sept. 30, 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
October.....	567	398	447	27,500
November.....	467	332	414	24,600
December.....	398	312	343	21,100
January.....	354	256	296	17,000
February.....	900	256	510	31,400
March.....	1,280	398	686	40,800
April.....	1,540	840	1,160	71,300
May.....	2,010	840	1,160	69,000
June.....	1,340	332	623	38,300
July.....	354	238	311	19,100
August.....	467	222	330	19,600
September.....				

JEFFERSON RIVER NEAR SILVERSTAR, MONT.

LOCATION.—In sec. 23, T. 2 S., R. 6 W., at highway bridge at Barkell's ranch, in Madison County, on road from Silverstar to Iron Rod, a station on Ruby Valley branch of Northern Pacific Railway, about 5 miles below junction of Beaverhead and Bighole rivers.

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—August 11, 1910, to September 30, 1916, when station was discontinued.

GAGE.—Vertical staff nailed to downstream side of rock-filled timber crib placed around two concrete piers at center of bridge; read by C. A. Barkell.

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

CHANNEL AND CONTROL.—Bed gravel; practically permanent. Banks of medium height, covered with brush, and subject to overflow during extreme floods.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 7.75 feet at 8 a. m. and 5 p. m. June 23 (discharge, 13,500 second-feet); minimum stage 2.0 feet at 5 p. m. August 11, and at 8 a. m. and 5 p. m. August 12 (discharge, 465 second-feet).

1910-1916: Maximum stage recorded, 8.8, June 15, 1913 (discharge, 16,500 second-feet); minimum stage, 1.7 feet August 22, 1910 (discharge, 320 second-feet).

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

DIVERSIONS.—Numerous irrigating ditches divert water above and below station.

REGULATION.—Flow regulated by two dams: One on Red Rock Creek, near Monida, stores water for irrigation, and one on Bighole River, near Divide, is used for power development.

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

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

June 20, 1916: Gage height, 7.4 feet; discharge, 12,100 second-feet.

Daily discharge, in second-feet, of Jefferson River near Silverstar, Mont., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1.	1,830	1,660	-----	2,570	5,480	4,090	10,600	1,080	1,500
2.	1,830	1,660	-----	2,370	6,220	4,090	10,000	1,080	1,500
3.	1,830	1,500	-----	2,180	6,470	4,090	10,000	965	1,660
4.	1,740	1,350	-----	2,180	6,730	4,320	9,730	965	1,830
5.	1,660	1,350	-----	2,180	6,730	4,550	9,450	765	1,830
6.	1,830	1,350	-----	2,470	6,730	4,550	9,450	678	2,000
7.	1,830	1,350	-----	2,370	6,990	4,550	9,170	678	2,000
8.	1,830	1,350	-----	2,180	6,990	4,780	9,170	678	2,000
9.	1,830	1,500	-----	2,370	6,220	5,010	8,340	599	1,830
10.	1,830	1,660	-----	2,370	5,480	5,720	8,070	599	1,830
11.	2,000	-----	-----	2,280	5,010	6,470	7,260	496	1,660
12.	2,000	-----	-----	2,990	4,780	6,990	6,730	465	1,660
13.	2,000	-----	-----	3,200	4,090	6,990	5,970	599	1,830
14.	2,090	-----	-----	3,420	4,090	7,260	5,480	765	1,830
15.	2,180	-----	-----	3,640	4,320	8,340	4,550	765	1,830
16.	2,180	-----	-----	2,280	4,550	9,170	8,860	965	1,830
17.	2,000	-----	-----	2,370	4,550	9,170	8,860	1,080	1,830
18.	1,920	-----	-----	2,280	4,320	9,450	8,420	1,210	2,000
19.	1,830	-----	2,370	2,990	4,320	10,600	2,990	1,500	2,000
20.	1,830	-----	2,370	3,200	4,320	12,300	2,780	1,500	2,000
21.	1,830	-----	2,470	3,420	4,320	12,600	2,570	1,500	1,830
22.	2,000	-----	2,370	3,640	4,550	13,200	2,180	1,660	1,830
23.	2,000	-----	2,370	3,640	4,550	13,500	1,920	1,660	1,830
24.	2,000	-----	2,180	3,860	4,320	12,000	1,830	1,350	1,920
25.	2,000	-----	2,000	4,090	4,320	11,400	1,500	1,350	2,090
26.	1,830	-----	2,180	4,550	4,320	11,200	1,660	1,350	2,180
27.	1,920	-----	2,280	4,780	4,320	10,900	1,350	1,350	2,090
28.	2,000	-----	2,570	4,780	4,320	11,200	1,350	1,280	2,000
29.	1,830	-----	2,780	5,240	4,550	11,200	1,350	1,350	2,180
30.	2,000	-----	2,780	5,480	4,320	10,600	1,210	1,500	2,180
31.	1,660	-----	2,780	-----	4,090	-----	1,080	1,500	-----

NOTE.—Stage-discharge relation affected by ice Nov. 11 to Mar. 18. No gage-height record Dec. 30 to Mar. 17.

Monthly discharge of Jefferson River near Silverstar, Mont., for the year ending Sept. 30, 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
October.....	2,180	1,660	1,900	117,000
Nov. 1-10.....	1,660	1,350	1,470	29,200
Mar. 19-31.....	2,780	2,000	2,420	62,400
April.....	5,480	2,180	3,180	189,000
May.....	6,990	4,090	5,040	310,000
June.....	13,500	4,090	8,340	496,000
July.....	10,600	1,080	5,130	315,000
August.....	1,660	465	1,070	65,800
September.....	2,180	1,500	1,890	112,000

MISSOURI RIVER AT TOSTON, MONT.

LOCATION.—In SW. $\frac{1}{4}$ sec. 23, T. 5 N., R. 2 E., at highway bridge crossing Missouri River at Toston, Broadwater County, about 25 miles below junction of Gallatin, Jefferson, and Madison rivers. Only large tributary between gaging station and headwater forks is Sixteenmile Creek.

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—April 5, 1910, to December 20, 1916, when station was discontinued.

GAGE.—Chain gage attached to downstream side of bridge, about 30 feet from first pier from right bank; read by W. B. Lorentz.

DISCHARGE MEASUREMENTS.—Made from cable just above bridge.

CHANNEL AND CONTROL.—Rocky; practically permanent.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 10.0 feet January 4 (stage-discharge relation affected by ice gorge); maximum stage recorded during open-water periods, 8.15 feet at 8 p. m. June 21 (discharge, 23,500 second-feet); minimum stage recorded, 2.1 feet at 5 p. m. December 31 (discharge, 1,560 second-feet).

1910-1916: Maximum stage recorded, 9.4 feet June 1, 1913 (discharge, 29,800 second-feet); minimum stage recorded February 10, 1914 (discharge estimated at 1,100 second-feet).

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

DIVERSIONS.—Numerous diversions from tributaries above station.

REGULATION.—Low-water flow partly regulated by Hebgen reservoir on Madison River.

ACCURACY.—Stage-discharge relation permanent for open channel; seriously affected by ice January 1 to March 10. Rating curve fairly well defined. Gage read to half tenths twice daily. Daily discharge ascertained by applying mean daily gage heights to rating table. Records fair.

No discharge measurements were made at this station during the year.

308 report gives 14,470 sq miles at Toston

Daily discharge, in second-feet, of Missouri River at Toston, Mont., for the period Oct. 1, 1915, to Dec. 20, 1916.

Day.	Oct.	Nov.	Dec.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1915-16.										
1.....	5,580	3,950	3,950	.....	5,230	9,130	10,400	19,400	5,230	4,560
2.....	5,230	3,950	3,950	.....	5,580	9,560	10,400	20,400	4,890	4,250
3.....	5,230	4,250	4,250	.....	5,940	9,130	9,990	20,400	4,560	4,560
4.....	5,230	4,250	4,560	.....	5,580	9,130	10,400	19,400	4,890	4,250
5.....	4,890	4,560	4,250	.....	5,580	8,710	10,800	18,400	4,250	3,950
6.....	4,890	4,250	4,250	.....	5,580	9,990	11,700	19,400	4,560	5,230
7.....	4,560	4,250	4,250	.....	5,230	12,200	11,300	18,400	4,250	4,900
8.....	4,560	3,950	4,250	.....	5,230	12,600	11,300	16,400	4,250	4,560
9.....	4,250	3,950	4,250	.....	5,230	13,500	11,700	15,400	4,560	4,250
10.....	4,560	3,950	4,250	.....	5,580	13,100	12,600	15,400	4,250	5,230
11.....	4,560	4,250	4,100	11,300	5,580	12,600	14,500	15,000	4,560	4,560
12.....	4,250	4,950	3,950	10,800	6,690	12,200	15,000	13,500	4,560	4,560
13.....	3,950	3,950	3,950	9,130	7,480	11,300	15,400	13,100	4,560	4,560
14.....	3,950	3,950	4,560	8,300	7,480	11,300	14,500	11,300	4,560	4,560
15.....	4,250	3,950	4,560	7,080	7,080	10,800	14,500	10,800	4,560	4,890
16.....	3,950	4,250	4,250	7,080	7,480	9,990	15,000	10,800	4,560	4,250
17.....	3,950	4,250	4,250	6,690	7,480	9,560	17,400	9,990	4,560	4,250
18.....	3,950	4,250	3,950	7,480	7,480	9,130	18,400	9,130	4,560	4,250
19.....	3,950	4,560	3,660	7,480	7,480	9,130	20,900	9,130	4,560	4,250
20.....	3,950	4,560	3,660	7,480	7,480	9,130	22,400	8,300	4,560	4,560
21.....	3,950	4,560	3,950	7,480	7,480	9,560	23,000	7,480	4,250	4,250
22.....	3,660	4,560	3,660	6,690	6,690	10,400	22,400	6,690	4,250	3,950
23.....	3,660	4,560	4,560	7,480	6,690	9,990	22,400	5,940	4,250	3,660
24.....	3,660	5,230	3,950	7,080	6,690	9,990	20,900	5,230	4,560	3,950
25.....	3,660	5,230	3,600	6,690	7,080	9,990	19,400	4,890	4,560	3,950
26.....	3,660	4,560	3,240	5,940	7,480	10,400	18,400	5,580	4,890	3,950
27.....	3,660	3,950	3,660	6,690	8,710	9,990	17,400	5,230	4,560	3,950
28.....	3,950	4,250	3,950	6,690	9,130	9,990	17,400	5,230	4,250	3,950
29.....	4,560	3,660	2,850	6,310	10,400	9,560	17,900	5,230	4,560	3,950
30.....	4,250	3,950	1,820	5,230	9,990	9,990	19,400	5,230	4,560	3,660
31.....	4,250	.....	1,640	5,580	.....	9,990	.....	5,230	4,560	.....

Day.	Oct.	Nov.	Dec.	Day.	Oct.	Nov.	Dec.	Day.	Oct.	Nov.	Dec.
1916.				1916.				1916.			
1.....	3,660	4,560	4,560	11.....	4,560	4,560	4,250	21.....	4,560	3,950	.....
2.....	3,660	4,560	4,400	12.....	4,560	2,600	3,660	22.....	5,230	4,560	.....
3.....	4,560	4,560	4,250	13.....	4,560	1,820	3,950	23.....	4,560	3,950	.....
4.....	4,560	4,250	4,560	14.....	4,250	2,850	3,660	24.....	4,560	4,250	.....
5.....	4,250	4,560	4,890	15.....	4,560	4,560	4,250	25.....	4,890	4,250	.....
6.....	4,250	4,560	4,250	16.....	4,250	3,950	3,950	26.....	4,560	4,560	.....
7.....	4,560	4,250	4,250	17.....	4,250	3,660	4,560	27.....	4,890	4,560	.....
8.....	4,560	4,560	3,950	18.....	4,560	3,660	4,250	28.....	4,560	4,560	.....
9.....	4,560	4,560	3,950	19.....	4,250	4,560	4,560	29.....	4,560	4,560	.....
10.....	4,560	4,560	3,950	20.....	4,560	4,560	4,560	30.....	4,560	3,950	.....
								31.....	5,230	.....	.....

NOTE.—Stage-discharge relation affected by ice Jan. 1 to Mar. 10 and Dec. 21-25, 1916; gage read but discharge not determined. On Dec. 25 channel was blocked solid with ice as high as bridge; water reached stage of 9 feet, was turned from channel, and overflowed surrounding ranch lands.

Monthly discharge of Missouri River at Toston, Mont., for the period Oct. 1, 1915, to Dec. 20, 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
1915-16.				
October.....	5,580	3,660	4,280	263,000
November.....	5,230	3,660	4,260	253,000
December.....	4,560	1,640	3,890	239,000
March 11-31.....	11,300	5,230	7,370	307,000
April.....	10,400	5,230	6,890	410,000
May.....	13,500	8,710	10,400	640,000
June.....	23,000	9,990	15,900	946,000
July.....	20,400	4,890	11,500	707,000
August.....	5,230	4,250	4,530	279,000
September.....	5,230	3,660	4,320	257,000
1916.				
October.....	5,230	3,660	4,510	277,000
November.....	4,560	1,820	4,160	248,000
December 1-20.....	4,890	3,660	4,230	168,000

MISSOURI RIVER AT FORT BENTON, MONT.

LOCATION.—In NE. $\frac{1}{4}$ sec. 26, T. 24 N., R. 8 E., at public highway bridge at Fort Benton, Chouteau 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, 1916, United States Geological Survey records for parts of years.

GAGE.—A Mott gage installed April 11, 1907, on upstream side of bridge; gage heights for 1911-1915 are referred to the datum used by the United States Army Engineers from 1881 to 1890, which is 0.43 foot higher than that used by the United States Geological Survey in 1910.

DISCHARGE MEASUREMENTS.—Made from downstream side of bridge.

CHANNEL AND CONTROL.—Practically permanent except in flood.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 9.25 feet at 8 a. m. June 23 (discharge, 50,600 second-feet); minimum stage recorded, 0.55 foot at 4.30 p. m. December 15 (discharge, 4, 120 second-feet).

1881-1916: Maximum stage recorded, 9.25 feet June 23, 1916 (discharge, 50,600 second-feet); maximum stage recorded by United States Weather Bureau, 15.3 feet June 7, 1908 (discharge not determined); minimum 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 determined). Open-season records only; flow may have been lower during winter months.

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

DIVERSIONS.—Numerous above gage.

REGULATION.—Low-water flow regulated by operation of power plants above station.

ACCURACY.—Stage-discharge relation practically permanent for year except when seriously affected by ice, December 4-7 and January 4 to March 7. Rating curve well defined above 3,500 second-feet. Gage read to hundredths twice daily. Discharge ascertained by applying mean daily gage height to rating table. Gage read but data inadequate for determining flow for period of ice affect. Records fair.

Discharge measurements of Missouri River at Fort Benton, Mont., during the year ending Sept. 30, 1916.

[Made by A. H. Tuttle.]

Date.	Gage height.	Dis-charge.
	<i>Feet.</i>	<i>Sec.-ft.</i>
Apr. 22.....	2.61	10,800
July 27.....	2.05	9,105
Aug. 23.....	1.36	7,360

Daily discharge, in second-feet, of Missouri River at Fort Benton, Mont., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Dec.	Jan.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1.....	7,400	5,700	6,700	4,500		6,700	14,000	22,300		9,600	6,000
2.....	8,800	5,900	5,650	4,750		6,700	15,000	22,300		8,800	6,000
3.....	8,800	6,100	6,000	5,000		7,050	15,500	22,900		8,800	6,000
4.....	9,600	6,300	5,800			7,050	16,000	22,900		8,450	5,650
5.....	10,000	6,500	5,600			7,400	17,000	22,900		8,100	6,000
6.....											
7.....	9,600	6,700	5,400			8,450	18,500	24,100		8,100	6,000
8.....	8,800	6,700	5,200			8,450	18,500	23,500		8,100	6,000
9.....	8,100	6,700	5,000			8,450	18,500	22,900		7,750	6,000
10.....	8,100	6,000	5,300		8,450	8,450	18,500	22,900	21,200	7,400	6,000
11.....	8,800	6,000	5,650		9,600	8,450	20,600	23,500	19,600	7,400	6,000
12.....											
13.....	8,100	6,350	5,650		9,600		21,200	23,500	19,000	7,050	6,000
14.....	7,400	6,700	5,300		17,000		20,100	23,500	18,000	7,050	6,000
15.....	7,400	6,350	5,300		20,100		19,000	23,500	17,000	7,050	6,000
16.....	7,400	6,000	4,500		17,000		17,000	24,100	16,000	7,050	6,000
17.....	7,400	6,000	4,250		16,500		17,000	25,300	16,500	7,050	6,000
18.....											
19.....	7,050	6,700	5,300		16,000		17,000	27,100	16,000	7,400	6,000
20.....	6,700	7,050	5,300		15,500		16,500	30,100	15,500	7,400	6,000
21.....	6,700	7,050	4,750		15,000		15,500	35,500	14,500	7,050	6,000
22.....	6,350	7,400	4,750		15,000		14,500	35,500	14,000	7,050	6,000
23.....	6,000	7,750	4,250		13,500		14,000	35,500	13,500	7,050	6,000
24.....											
25.....	6,350	7,580	5,300		12,500		14,000	36,800	13,500	7,050	6,000
26.....	6,000	7,400	6,350		12,500	11,200	14,000	43,300	13,000	6,700	6,000
27.....	5,650	6,700	6,000		12,500	11,200	14,500	48,900	12,500	6,700	6,000
28.....	5,300	6,700	5,650		12,000	11,200	13,500	45,400	11,600	6,350	
29.....	5,300	6,350	5,000		10,000	10,400	15,500	44,700	11,200	6,350	
30.....											
31.....	4,750	7,050	4,500		10,400	10,400	17,500	44,000	10,400	6,350	
32.....	4,750	7,050	5,300		10,400	10,400	19,000	43,300	9,600	6,350	
33.....	5,300	5,650	4,750		10,000	11,600	21,200	41,400	8,800	6,350	
34.....	5,650	6,700	4,750		10,000	13,500	21,200	40,000	8,800	6,000	
35.....	5,300	5,300	5,000		9,200	14,000	21,800	39,400	10,800	6,000	
36.....	5,500		4,750		7,400		21,800		10,800	6,000	

NOTE.—Mott gage broken and no readings taken Apr. 11-21 and after Sept. 23. No readings July 1-7. Discharge interpolated for following days: Oct. 31 to Nov. 5 and Nov. 21, owing to lack of gage readings; Dec. 4-7, owing to backwater from ice.

Monthly discharge of Missouri River at Fort Benton, Mont., for the year ending Sept. 30, 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
October.....	10,000	4,750	7,040	433,000
November.....	7,750	5,300	6,550	390,000
December.....	6,700	4,250	5,260	323,000
March 9-31.....	20,100	7,400	12,600	575,000
April 1-10 and 22-30.....	14,000	6,700	9,530	359,000
May.....	21,800	13,500	17,300	1,060,000
June.....	48,900	22,300	31,400	1,870,000
July 9-31.....	21,200	8,800	14,000	639,000
August.....	9,600	6,000	7,220	444,000
September 1-23.....	6,000	5,650	5,980	273,000

MADISON RIVER BASIN.

GIBBON RIVER NEAR YELLOWSTONE, MONT.

LOCATION.—In sec. 6, T. 14 S., R. 8 E. Montana meridian, about 500 feet northeast of Wylie-Gibbon lunch station, 2 miles below Gibbon Falls, 4 miles above confluence of Gibbon with Firehole River to form Madison River, and 16 miles east of Yellowstone and west boundary of Yellowstone Park.

DRAINAGE AREA.—117 square miles (measured on topographic maps).

RECORDS AVAILABLE.—June 22, 1913, to September 30, 1916, when station was discontinued.

GAGE.—Vertical staff on left bank about 50 feet below concrete highway bridge; read by J. J. Dalton, a private stationed at the Fountain soldier station. Present gage used since September 14, 1913. Original gage, used June 22 to August 30, 1913, was vertical staff attached to downstream side of left abutment of old highway bridge, about 40 feet above site of present gage. A temporary gage installed by observer at site of present gage was read August 31 to September 14, 1913; readings on temporary gage have been reduced to datum of permanent gage.

DISCHARGE MEASUREMENTS.—Made by wading at low and medium stages at a solid rock section about 30 feet above highway bridge.

CHANNEL AND CONTROL.—One channel at all stages. Bed of stream rocky and rough. Control consists largely of solid rock and is practically permanent. Little aquatic growth in stream near gage at any time. Control for present gage not the same as that for original gage; relation of the rating curves for the two gages not known.

ICE.—Stage-discharge relation not seriously affected by ice, as river is fed largely from geysers and hot springs; open-channel rating curve assumed applicable.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 3.8 feet at 2 p. m. June 21 (discharge not determined); minimum stage recorded, 1.4 feet October 30, November 1 and 27 (discharge, 72 second-feet). 1913-1916: Maximum stage recorded, 3.8 feet at 2 p. m., June 21, 1916 (discharge not determined); minimum stage recorded 1.3 feet March 10, 13, 17, 1915 (discharge 62 second-feet).

DIVERSIONS.—None.

REGULATION.—None.

ACCURACY.—Stage-discharge relation believed to have remained permanent throughout the year. Rating curve fairly well defined between 63 and 188 second-feet but not defined for higher stages. Gage read to half tenths once daily during summer months and during rest of year at intervals varying from three to five days. Discharge, except May 3 to July 8, ascertained by applying daily gage height to the rating table and interpolating for days on which gage was not read; May 3 to July 8 stage was above 2 feet and discharge was not determined. Record good July to September and fair October to May.

Discharge measurements of Gibbon River near Yellowstone, Mont., during the period Oct. 1, 1915, to Oct. 11, 1916.

Date.	Made by—	Gage height.	Dis-charge.
1916.		Feet.	Sec.-ft.
Aug. 3	Baldwin and Hoyt.....	1.80	139
Oct. 11	C. G. Paulsen.....	1.70	119

Daily discharge, in second-feet, of Gibbon River near Yellowstone, Mont., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	July.	Aug.	Sept.
1.....	a87	72	a80	78	a90	92	a100	a162	162	109	109
2.....	a89	a73	a81	a94	92	a92	a100	a156	139	118	118
3.....	92	a74	a82	109	a92	a92	100	150	139	109	109
4.....	a88	a76	84	a114	a92	92	a104	108	139	100	100
5.....	84	a77	a84	118	92	a92	a108	108	162	100	100
6.....	a84	78	a84	a115	a92	a92	a111	111	162	100	100
7.....	84	a78	84	a112	a92	a92	a115	115	162	100	100
8.....	a84	a78	a82	109	a92	92	118	118	162	109	109
9.....	84	78	a81	a106	92	a97	a132	132	188	139	109
10.....	84	a80	a80	a103	a95	a104	a146	146	188	139	100
11.....	a87	a81	78	100	a97	109	a161	161	188	139	100
12.....	a89	a82	a80	a100	100	a109	175	175	162	139	108
13.....	92	84	a81	a100	a103	a109	a159	159	162	128	100
14.....	a92	a84	a82	100	a106	a109	a144	144	162	118	100
15.....	a92	a84	84	100	109	109	128	128	150	118	100
16.....	92	a84	a84	a97	a104	a112	a126	126	162	118	100
17.....	a89	84	a84	a95	100	a115	a123	123	162	139	100
18.....	a87	a84	84	92	a100	118	a120	120	150	128	100
19.....	84	a84	a84	a90	100	a125	118	118	150	139	100
20.....	a82	84	a84	a88	a98	a132	a115	115	139	128	100
21.....	a81	a81	a84	a86	a96	139	a112	112	139	118	100
22.....	a80	78	84	84	a94	a150	109	109	139	118	100
23.....	78	a77	a87	a84	92	162	a117	117	139	118	109
24.....	a78	a76	a89	a84	a89	a156	a124	124	a139	118	a109
25.....	a78	a74	92	84	a87	150	a131	131	a139	118	109
26.....	a78	a73	a87	a84	84	a130	139	139	139	118	a104
27.....	78	72	a83	a84	a86	109	a151	151	139	118	100
28.....	a76	a74	78	a84	a88	a106	a163	163	139	118	a106
29.....	a74	a76	a78	84	a90	a103	175	175	162	128	a112
30.....	72	78	a78	a86	.....	100	a169	169	162	118	118
31.....	a72	.....	a78	a88	.....	a100	.....	.....	162	109	.....

a Gage not read; discharge interpolated or estimated.

Monthly discharge of Gibbon River near Yellowstone, Mont., for the year ending Sept. 30, 1916.

[Drainage area, 117 square miles]

Month.	Discharge in second-feet.				Run-off.	
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.
October.....	92	72	83.6	0.715	0.82	5,140
November.....	84	72	78.6	.672	.75	4,680
December.....	92	78	82.7	.707	.82	5,080
January.....	118	78	95.2	.814	.94	5,850
February.....	109	84	94.6	.809	.87	5,440
March.....	162	92	113	.966	1.11	6,950
April.....	175	100	130	1.11	1.24	7,740
July 9-31.....	188	139	155	1.32	1.13	7,070
August.....	162	109	132	1.13	1.30	8,120
September.....	118	100	104	.889	.99	6,190

MADISON RIVER NEAR YELLOWSTONE, MONT.

LOCATION.—In (approximately) 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, and almost immediately in front of Riverside soldier station; about 4 miles east of Yellowstone and west boundary of Yellowstone National Park. Gibbon and Firehole rivers unite to form the Madison about 8 miles upstream.

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

RECORDS AVAILABLE.—June 16, 1913, to September 30, 1916.

GAGE.—Vertical staff on left bank; read by Sergeant Higinbotham, attached to the Riverside soldier station.

DISCHARGE MEASUREMENTS.—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 believed to be permanent. Aquatic growth is present during greater part of year and during summer months 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 water from numerous hot springs and geysers.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 2.5 feet at 6 p. m., June 13 (discharge 1,770 second-feet); minimum stage recorded, 1.3 feet on numerous days from October to March (discharge 420 second-feet).

1913-1916: Maximum stage recorded 2.5 feet at 6 p. m. June 13, 1916 (discharge 1,770 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 believed permanent throughout the year except June 22 to August 10, when it was affected by growth of aquatic plants. Rating curve used October 1 to June 21 and August 11 to September 30 well defined below 1,400 second-feet; curve used July 4-29, well defined. Gage read once daily to half tenths. Discharge ascertained by applying daily gage height to rating tables except June 22 to July 3 and July 30 to August 10, for which periods shifting-control method was used. Records good.

Discharge measurements of Madison River near Yellowstone, Mont., during the year ending Sept. 30, 1916.

Date.	Made by—	Gage height.	Discharge.
		<i>Feet.</i>	<i>Sec.-ft.</i>
July 27	Baldwin and Hoyt.....	1.51	568
Aug. 3	do.....	1.46	543
Sept. 19	C. G. Paulsen.....	1.40	521

PRICKLY PEAR CREEK BASIN.

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Daily discharge, in second-feet, of Madison River near Yellowstone, Mont., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1.....	471	420	420	471	420	420	471	728	994	1,050	574	522
2.....	471	420	420	471	420	420	471	728	1,050	1,100	518	522
3.....	471	420	420	522	420	420	471	676	994	1,210	529	543
4.....	420	420	471	522	420	420	471	676	1,110	923	541	522
5.....	420	420	471	471	420	471	471	832	1,220	923	541	522
6.....	420	428	471	471	471	471	471	939	1,340	923	605	522
7.....	420	436	471	471	471	471	471	1,050	1,220	923	553	522
8.....	420	444	471	471	471	471	471	1,050	1,310	869	666	522
9.....	420	453	471	471	471	471	522	939	1,400	816	615	522
10.....	420	462	471	471	471	471	522	939	1,520	816	615	574
11.....	420	471	471	420	420	471	522	886	1,580	764	574	574
12.....	420	471	471	420	420	471	625	832	1,160	764	574	574
13.....	471	471	471	420	471	471	574	832	1,770	712	574	522
14.....	471	420	471	420	420	471	574	780	1,280	712	574	522
15.....	471	420	471	420	420	471	574	780	1,400	712	574	522
16.....	522	420	420	420	420	471	574	728	1,460	712	574	522
17.....	471	420	420	420	420	471	625	780	1,400	661	574	522
18.....	471	420	420	471	420	471	574	780	1,520	661	574	471
19.....	471	420	420	471	420	522	574	780	1,520	610	574	522
20.....	471	471	420	471	420	574	574	832	1,580	610	574	522
21.....	420	471	420	471	420	574	574	939	1,640	610	522	522
22.....	420	471	471	471	420	574	574	939	1,390	610	522	522
23.....	420	471	471	471	420	574	625	886	1,210	610	522	522
24.....	426	471	471	471	420	522	625	994	1,080	558	522	522
25.....	433	471	471	471	420	522	728	939	1,030	558	522	522
26.....	439	420	471	471	420	522	728	939	1,070	558	522	522
27.....	446	420	471	420	420	522	728	886	1,070	558	522	522
28.....	452	471	471	420	420	522	728	939	1,120	558	522	522
29.....	458	420	471	420	420	522	728	939	1,120	610	522	522
30.....	464	420	471	420	.....	471	728	994	1,050	563	522	522
31.....	471	.....	471	420	.....	471	.....	1,110	.....	563	522	.....

NOTE.—Discharge interpolated, for lack of gage readings, Oct. 24-30, Nov. 6-10, 23, June 5, 8, Sept. 21, and 22.

Monthly discharge of Madison River near Yellowstone, Mont., for the year ending Sept. 30, 1916.

[Drainage area, 410 square miles].

Month.	Discharge in second-feet.				Run-off.	
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.
October.....	522	420	447	1.09	1.26	27,500
November.....	471	420	441	1.08	1.20	26,200
December.....	471	420	456	1.11	1.28	28,000
January.....	522	420	455	1.11	1.28	28,000
February.....	471	420	431	1.05	1.13	24,800
March.....	574	420	489	1.19	1.37	30,100
April.....	728	471	579	1.41	1.57	34,500
May.....	1,110	676	873	2.13	2.46	53,700
June.....	1,770	994	1,290	3.15	3.51	76,800
July.....	1,210	558	736	1.80	2.08	45,300
August.....	666	518	556	1.36	1.57	34,200
September.....	574	471	526	1.28	1.43	31,300
The year.....	1,770	420	606	1.48	20.14	440,000

PRICKLY PEAR CREEK BASIN.

PRICKLY PEAR CREEK NEAR CLANCY, MONT.

LOCATION.—In sec. 34, T. 9 N., R. 3 W., at private wagon bridge back of ranch buildings on Stafford ranch, about a mile below Clancy and just below mouth of Lump Gulch Creek, in Jefferson County.

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—July 12, 1910, to September 30, 1916, when station was discontinued; July 15, 1908, to June 30, 1909, at old site, about a mile below; same quantity of water passes both sites.

GAGE.—Staff gage nailed to downstream side of right abutment to wagon bridge; read by Miss Thane Haab.

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

CHANNEL AND CONTROL.—Bed of stream gravel and sand; slightly shifting. Banks subject to overflow at high stages.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 3.9 feet at 5 p. m. June 28 (discharge, 441 second-feet); minimum stage recorded, 1.5 feet March 30 and August 28 to September 2 (discharge, 38 second-feet).

1909-1916: Maximum stage recorded, 4.0 feet June 17, 1915 (discharge, 465 second-feet); minimum stage recorded, 1.4 feet August 4-26, 1910 (discharge, 12 second-feet).

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

DIVERSIONS.—There are a few small diversions above station; flow appropriated and used for irrigation below station.

REGULATION.—None.

ACCURACY.—Stage-discharge relation permanent except as affected by ice. Rating curve well defined between 23 and 450 second-feet. Gage read to half tenths twice daily. Discharge ascertained by applying mean daily gage height to rating table. Records fair.

The following discharge measurement was made by W. A. Lamb:

June 17, 1916: Gage height, 2.44 feet; discharge, 159 second-feet.

Daily discharge, in second-feet, of Prickly Pear Creek near Clancy, Mont., for the year ending Sept 30, 1916.

Day.	Oct.	Nov.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1.....	71	48	.....	59	108	164	246	71	38
2.....	77	48	.....	59	102	211	228	71	38
3.....	77	48	.....	59	89	203	211	59	59
4.....	71	48	.....	59	95	228	179	59	61
5.....	71	48	.....	59	121	195	164	59	65
6.....	71	48	.....	59	135	164	164	59	65
7.....	77	48	.....	59	108	149	149	59	59
8.....	71	48	.....	59	135	164	149	59	59
9.....	71	48	.....	61	142	179	179	59	48
10.....	65	48	.....	61	135	195	164	71	59
11.....	65	48	.....	89	142	179	149	71	71
12.....	59	65	121	89	108	164	149	71	59
13.....	59	71	83	95	102	149	142	59	59
14.....	59	65	61	77	102	164	121	59	59
15.....	59	54	65	71	95	156	121	71	59
16.....	59	48	83	71	95	149	95	65	59
17.....	59	48	71	71	108	156	95	65	48
18.....	59	48	77	83	95	149	102	59	48
19.....	59	48	77	77	102	164	95	59	48
20.....	59	48	83	71	149	195	95	59	48
21.....	59	50	83	71	121	285	95	50	48
22.....	59	50	77	83	108	228	95	48	43
23.....	59	48	71	71	95	228	95	48	43
24.....	59	48	69	83	128	265	83	48	48
25.....	59	48	57	71	95	265	71	48	48
26.....	59	48	61	71	95	285	71	43	48
27.....	59	48	59	71	108	265	71	43	48
28.....	54	.....	50	108	164	395	77	38	48
29.....	50	.....	48	95	149	328	71	38	48
30.....	48	.....	38	89	228	328	71	38	48
31.....	48	.....	48	.....	195	.....	71	38	.....

NOTE.—No gage readings Nov. 28 to Mar. 11.

Monthly discharge of Prickly Pear Creek near Clancy, Mont., for the year ending Sept. 30, 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
October.....	77	48	62.3	3,830
November 1-27.....	71	48	50.5	2,700
March 12-31.....	121	38	69.1	2,740
April.....	108	59	73.4	4,370
May.....	228	89	121	7,440
June.....	395	149	212	12,600
July.....	246	71	125	7,690
August.....	71	38	56.3	3,460
September.....	71	38	52.6	3,130

TENMILE CREEK NEAR RIMINI, MONT.

LOCATION.—In NE. $\frac{1}{4}$ sec. 20, T. 9 N., R. 5 W., opposite Moose Creek ranger station, 500 feet above Moose Creek, 3 miles north of Rimini, in Lewis and Clark County,

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—March 13, 1915, to September 30, 1916.

GAGE.—Friez water-stage recorder on left bank opposite ranger station; observer W. J. Derrick, a forest ranger.

DISCHARGE MEASUREMENTS.—Made by wading just below gage.

CHANNEL AND CONTROL.—Gravel and boulders; slightly shifting. Left bank high and steep; composed of loose material; subject to erosion but not to overflow; right bank sloping and subject to overflow.

EXTREMES OF DISCHARGE.—Maximum stage recorded during the year, 3.72 feet at 2 p. m. June 28 (discharge, 330 second-feet); minimum stage reported, 1.32 feet September 1 (discharge, 1.9 second-feet).

1915-1916: Maximum stage, 4.18 feet at 5 p. m. June 16, 1915 (discharge, 536 second-feet); minimum stage, 1.32 feet September 1, 1916 (discharge, 1.9 second feet).

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

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

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

ACCURACY.—Stage-discharge relation not permanent; affected by ice in winter and by shift of control. Used three fairly well defined rating curves, applicable October 1-14, October 15 to August 1, and August 2 to September 9. Mean daily gage heights, except during periods of large diurnal fluctuation, obtained from Friez water-stage recorder by inspection. Discharge ascertained by applying to rating table mean daily gage height, except for periods of large diurnal fluctuation, for which the discharge is the weighted mean obtained by using discharge for periods of different lengths for different days, in accordance with the fluctuations in stage. Records fair.

Discharge measurements of Tenmile Creek near Rimini, Mont., during the year ending Sept. 30, 1916.

Date.	Made by—	Gage height.	Dis-charge.	Date.	Made by—	Gage height.	Dis-charge.
		<i>Feet.</i>	<i>Sec.-ft.</i>			<i>Feet.</i>	<i>Sec.-ft.</i>
Nov. 20	B. E. Jones.....	1.59	6.3	Apr. 1	W. A. Lamb.....	1.88	14.3
Dec. 29	W. A. Lamb.....	1.50	4.9	May 13	.....do.....	2.75	90
Jan. 5	.....do.....	1.48	4.3	June 6	.....do.....	3.24	172
Feb. 19	B. E. Jones.....	1.41	4.4	Aug. 31	.....do.....	1.36	2.4
Feb. 12	W. A. Lamb.....	1.32	3.8				

^a Stage-discharge relation affected by ice.

Daily discharge in second-feet, of Tenmile Creek near Rimini, Mont., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1.	9.0	8.2					14.3	79	177	172	13.2	2.3
2.	9.0	8.2					14.3	78	164	148	10.8	2.4
3.	8.7	8.5					15.0	89	179	143	10.0	21.5
4.	8.4	8.5					14.3	114	214	122	9.5	12.2
5.	7.8	8.5		a 4.3			14.3	134	209	110	9.0	10.0
6.	7.8	8.5					14.0	173	209	100	8.7	10.2
7.	6.9	7.2					14.9	180	209	92	8.4	9.5
8.	6.6	5.8					17.3	152	204	85	8.1	8.1
9.	6.9						17.8	143	229	104	7.8	3.0
10.	7.2						20.0	130	205	92	7.6	
11.	7.2						37	117	173	73	7.4	
12.	7.2				a 3.8		44	104	156	66	7.2	
13.	7.2						38	92	158	60	7.2	
14.	7.2						44	88	173	56	7.2	
15.	7.6						51	86	192	51	6.9	
16.	6.3						52	92	187	46	6.9	
17.	6.3						53	92	166	55	8.1	
18.	6.2					18.6	51	95	154	54	8.5	
19.	6.2			a 4.4		20.3	48	114	130	42	8.3	
20.	6.1	a 6.3				25.0	45	139	122	37	7.8	
21.	6.0					23.5	46	140	112	33	7.3	
22.	5.3					21.9	52	141	117	29	6.8	
23.	4.8					19.5	51	142	132	25	6.3	
24.	4.5					19.0	50	143	154	24	5.8	
25.	4.5					18.6	64	144	190	23.5	5.3	
26.	4.5					17.1	66	146	209	22.5	4.8	
27.	4.8					17.8	102	148	172	22.0	4.3	
28.	5.8					16.6	111	144	245	23.0	3.8	
29.	6.3		a 4.9			14.6	96	164	241	20.5	3.3	
30.	7.8					14.6	80	186	209	18.0	2.8	
31.	7.8					14.3		173		15.6	2.4	

a Discharge determined by current-meter measurement.

NOTE.—Discharge for following days interpolated, owing to lack of records or imperfect records: Oct. 17-20; Nov. 7; Apr. 16; May 10-12, 21-26; July 29-31; Aug. 1, 6-11, and 21-30.

Monthly discharge of Tenmile Creek near Rimini, Mont., for the year ending Sept. 30, 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
October	9	4.5	6.71	413
March 18-31	25	14.3	18.7	519
April	111	14.0	44.6	2,650
May	186	78	128	7,870
June	245	112	180	10,700
July	172	15.6	63.4	3,900
August	13.2	2.4	7.15	440
September 1-9	21.5	2.3	8.80	157

TENMILE CREEK NEAR HELENA, MONT.

LOCATION.—In SW. $\frac{1}{4}$ SE. $\frac{1}{4}$ 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, 1916.

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 coarse gravel and boulders; shifting occasionally.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 5.45 feet March 9 (discharge, 668 second-feet); minimum stage recorded, 1.70 feet February 9 and 10. (Discharge from current-meter measurement of February 9, 3.2 second-feet.)

1908-1916: Maximum stage recorded March 9, 1916; minimum stage recorded, 1.15 feet August 5 to September 10, 1910 (discharge, 0.15 second-foot).

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

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

REGULATION.—None.

ACCURACY.—Stage-discharge relation not permanent; affected by ice and by shifting control. Rating curves used applicable as follows: October 1 to November 21, fairly well defined between 5 and 90 second-feet; November 22 to February 14, see footnote to table of daily discharge; February 15 to June 2, well defined between 4 and 80 second-feet; June 3 to September 30, fairly well defined between 10 and 300 second-feet. Gage read to half tenths once daily; accuracy of readings taken by substitute gage reader November 12 to December 30 and April 10-15, doubtful. Discharge ascertained by applying mean daily gage height to rating table. Records good except for short periods when stage-discharge relation was affected by ice or shifts in control, for which they are fair.

Discharge measurements of Tenmile Creek near Helena, Mont., during the year ending Sept. 30, 1916.

Date.	Made by—	Gage height.	Dis-charge.	Date.	Made by—	Gage height.	Dis-charge.
		<i>Feet.</i>	<i>Sec.-ft.</i>			<i>Feet.</i>	<i>Sec.-ft.</i>
Nov. 27	B. E. Jones.....	2.10	10.1	Feb. 9	B. E. Jones.....	a 1.70	3.2
Dec. 22	do.....	2.26	17.9	Apr. 18	W. A. Lamb.....	2.82	67
30	W. A. Lamb.....	a 2.16	4.4	June 6	do.....	3.83	258
Jan. 5	do.....	a 2.01	6.8	Aug. 31	A. H. Tuttle.....	1.92	7.9
19	B. E. Jones.....	a 1.83	4.3				

a Stage-discharge relation affected by ice.

Daily discharge, in second-feet, of Tenmile Creek near Helena, Mont., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1.....	10	8	.....	10.1	20	123	265	303	33	9.0
2.....	10	8	.....	10.1	20	141	265	275	30	9.0
3.....	10	8	.....	12.2	20	141	262	262	30	10.5
4.....	13	8	.....	12.2	20	159	262	262	30	15.0
5.....	13	8	.....	12.2	20	168	262	214	26	15.0
6.....	13	8	.....	12.2	20	178	262	183	26	17.5
7.....	13	8	.....	12.2	20	199	262	173	23	17.5
8.....	16	8	.....	30	20	178	275	163	23	17.5
9.....	16	8	.....	668	20	178	275	145	23	17.5
10.....	16	8	.....	114	20	159	275	145	23	17.5
11.....	13	8	.....	34	23	150	275	136	23	17.5
12.....	13	8	.....	30	23	150	249	128	23	12.8
13.....	10	8	.....	30	23	132	237	128	23	10.5
14.....	10	8	.....	30	30	106	237	112	23	10.5
15.....	10	8	5.1	30	30	106	225	112	20	10.5
16.....	10	8	8.7	30	48	114	225	97	20	12.8
17.....	10	8	30	26	59	114	203	83	20	10.5
18.....	10	8	23	26	66	123	183	83	20	10.5
19.....	10	8	23	34	64	132	183	77	17.5	10.5
20.....	10	8	20	34	58	159	183	66	15.0	10.5
21.....	10	8	17.2	34	53	159	183	60	15.0	9.0
22.....	10	.....	12.2	34	53	159	193	50	15.0	9.0
23.....	10	.....	10.1	30	64	168	203	50	15.0	9.0
24.....	10	.....	10.1	30	64	168	203	50	12.8	9.0
25.....	10	.....	10.1	23	76	168	193	46	12.8	9.0
26.....	8	.....	10.1	23	123	168	193	41	12.8	10.5
27.....	8	.....	10.1	23	123	168	275	37	12.8	10.5
28.....	8	.....	10.1	23	123	178	438	33	10.5	15.0
29.....	8	.....	10.1	20	123	199	486	41	10.5	15.0
30.....	8	.....	.....	20	123	242	454	37	10.5	12.8
31.....	8	.....	.....	20	.....	265	.....	33	9.0	.....

NOTE.—Discharge estimated because of ice from gage heights, observer's notes, discharge measurements, and weather records, as follows: Nov. 22-30, 10 second-feet; Dec. 1-10, 12 second-feet; Dec. 11-20, 9 second-feet; Dec. 21-25, 16 second-feet; Dec. 26-31, 7 second-feet; Jan. 1-5, 7 second-feet; Jan. 6-15, 6 second-feet; Jan. 16-25, 4.5 second-feet; Jan. 26-31, 4 second-feet; Feb. 1-14, 3.5 second-feet.

Monthly discharge of Tenmile Creek near Helena, Mont., for the year ending Sept. 30, 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
October.....	16	8	10.8	664
November.....			8.6	512
December.....			10.7	658
January.....			5.29	325
February.....	30		8.93	514
March.....	668	10.1	47.7	2,930
April.....	123	20	51.6	3,070
May.....	265	106	160	9,840
June.....	486	183	256	15,200
July.....	303	33	117	7,190
August.....	33	9.0	19.6	1,210
September.....	17.5	9.0	12.4	738
The year.....	668		59.1	42,900

LITTLE PRICKLY PEAR CREEK BASIN.

LITTLE PRICKLY PEAR CREEK NEAR MARYSVILLE, MONT.

LOCATION.—At highway bridge on ranch of Casper Traufer, one-fourth 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, 1916, at present site; April 12 to May 23, 1913, about one-fourth mile above present site; May 18, 1909, to December 31, 1911, at station formerly maintained above mouth of Deadman Creek.

GAGES.—Vertical staff spiked to upstream side of left abutment of highway bridge; read by Casper Traufer. April 12 to May 23, 1913, vertical staff about one-fourth 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, one-half mile above the mouth of Deadman Creek.

DISCHARGE MEASUREMENTS.—Made from bridge or by wading.

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

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 2.55 feet at 6 p. m. June 5 (discharge 204 second-feet); minimum stage, 0.90 foot February 20 to March 8 (discharge 6 second-feet).

1909–1911 and 1913–1916: Maximum stage recorded, 3.2 feet May 28, 1913 (discharge 315 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 take water from the stream, practically the entire normal flow being appropriated.

REGULATION.—None.

ACCURACY.—Stage-discharge relation changed probably during the high water in June. Rating curve used Oct. 1 to June 5 fairly well defined; curve used after that date well defined below 150 second-feet. Gage read to half tenths once daily except March 10 to August 1, when it was read twice daily. Daily discharge ascertained by applying mean daily gage height to rating tables. Records good.

Discharge measurements of Little Prickly Pear Creek near Marysville, Mont., during the year ending Sept. 30, 1916.

Date.	Made by—	Gage height.	Dis-charge.
		<i>Feet.</i>	<i>Sec.-ft.</i>
May 29	C. S. Heidel.....	1.92	103
June 26	Lamb and Heidel.....	2.00	108
Sept. 27	Heidel and Lamb.....	1.20	19.0

Daily discharge, in second-feet, of Little Prickly Pear Creek near Marysville, Mont., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Dec.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1.....	18	18	11	.....	6	25	73	172	132	35	19
2.....	18	18	11	.....	6	25	63	156	124	35	19
3.....	18	18	11	.....	6	25	63	156	124	35	26
4.....	18	18	11	.....	6	25	69	180	116	35	22
5.....	18	18	11	.....	6	25	102	196	108	35	19
6.....	18	18	11	.....	6	25	132	174	93	30	19
7.....	18	18	11	.....	6	25	140	157	90	30	19
8.....	18	18	11	.....	6	27	124	140	79	30	19
9.....	18	18	11	.....	11	29	102	140	93	30	19
10.....	18	14	11	.....	42	31	91	140	82	26	19
11.....	18	14	11	.....	40	40	78	132	76	26	19
12.....	18	14	11	.....	35	47	73	124	69	26	19
13.....	18	14	11	.....	31	47	65	108	66	26	19
14.....	18	14	11	.....	25	52	63	108	64	26	19
15.....	18	14	11	.....	25	52	61	108	56	26	19
16.....	18	14	11	.....	29	52	54	108	52	26	19
17.....	18	14	11	.....	29	61	52	108	49	26	19
18.....	18	14	11	.....	29	63	52	108	49	26	19
19.....	18	14	11	.....	33	58	52	108	49	26	16
20.....	18	14	11	.....	6	35	52	108	49	26	16
21.....	18	14	11	6	38	52	58	124	46	26	16
22.....	18	11	11	6	33	52	63	124	44	22	16
23.....	18	11	11	6	31	52	63	108	42	22	16
24.....	18	11	11	6	29	52	65	100	40	22	16
25.....	18	11	11	6	25	54	69	108	40	22	16
26.....	18	11	11	6	27	61	69	108	40	19	16
27.....	18	11	11	6	29	73	69	108	40	19	18
28.....	18	11	11	6	29	82	82	108	40	19	19
29.....	18	11	11	6	25	82	102	124	40	19	19
30.....	18	11	.....	.....	25	78	132	124	40	19	19
31.....	18	.....	.....	.....	25	.....	164	.....	35	19	.....

NOTE.—No gage-height record Dec. 30 to Feb. 19.

Monthly discharge of Little Prickly Pear Creek near Marysville, Mont., for the year ending Sept. 30, 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
October.....	18	18	18.0	1,110
November.....	18	11	14.3	851
December 1-29.....	11	11	11.0	633
February 20-29.....	6	6	6.0	119
March.....	42	6	23.5	1,440
April.....	82	25	47.5	2,830
May.....	164	52	80.5	4,950
June.....	196	100	129	7,680
July.....	132	35	66.7	4,100
August.....	35	19	26.1	1,600
September.....	26	16	18.5	1,100

LITTLE PRICKLY PEAR NEAR CANYON CREEK, MONT.

LOCATION.—In NW. $\frac{1}{4}$ sec. 9, T. 12 N., R. 5 W., near ford on Carbis ranch, below mouth of Canyon Creek, about $1\frac{1}{4}$ 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; April 12, 1913, to September 30, 1916.

GAGE.—Vertical staff attached to tree on right bank about 40 feet above ford; read by E. D. Carbis.

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

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

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 4.2 feet, June 30 (discharge 395 second-feet); minimum stage, 1.9 feet September 2 (discharge 16 second-feet).

1909-1911 and 1913-1916: 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; practically all of low-water flow appropriated.

REGULATION.—None.

ACCURACY.—Stage-discharge relation affected by ice and by shifting control. Rating curve used October 1 to May 20 and June 10-29, fairly well defined; curve used June 30 to September 30 poorly defined. Gage read to half tenths once daily. Discharge ascertained by applying daily gage height to rating tables, except May 21 to June 9 for which it was determined by shifting-control method. Records fair.

Discharge measurements of Little Prickly Pear Creek near Canyon Creek, Mont., during the year ending Sept. 30, 1916.

Date.	Made by—	Gage height.	Discharge.
		<i>Feet.</i>	<i>Sec.-ft.</i>
May 29	C. S. Heidel.....	3.40	197
June 28	Lamb and Heidel.....	3.70	228
Sept. 27	.....do.....	2.17	32.6

Daily discharge, in second-feet, of Little Prickly Pear Creek near Canyon Creek, Mont., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Dec.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1.....	37	30	30	.....	30	63	211	228	357	27	21
2.....	37	30	30	.....	30	63	211	226	324	27	16
3.....	45	24	30	.....	30	63	192	222	271	30	34
4.....	37	24	30	.....	30	63	192	202	227	34	34
5.....	37	18	30	.....	30	74	173	200	207	34	38
6.....	37	18	30	.....	30	74	173	217	188	34	42
7.....	37	18	30	.....	30	74	192	234	188	27	34
8.....	37	18	30	.....	37	74	192	272	179	30	34
9.....	37	18	30	.....	63	74	230	296	227	30	42
10.....	37	18	30	.....	111	74	230	320	271	21	42
11.....	37	18	30	.....	211	86	230	320	188	21	38
12.....	37	18	30	.....	211	86	230	250	137	27	42
13.....	37	18	24	45	173	86	230	192	122	27	42
14.....	37	18	24	53	173	86	230	192	122	21	46
15.....	37	18	24	63	155	111	230	155	107	24	38
16.....	37	18	24	63	155	111	230	125	81	24	27
17.....	37	24	18	74	63	111	230	125	122	24	27
18.....	30	24	18	98	63	111	230	125	122	21	34
19.....	30	24	18	98	63	111	230	125	107	21	34
20.....	24	24	18	98	63	125	230	139	81	21	34
21.....	18	24	.....	74	63	125	217	139	81	21	30
22.....	18	24	.....	74	63	125	219	155	70	24	27
23.....	18	24	.....	63	63	125	182	155	60	27	30
24.....	18	27	.....	63	63	111	186	155	51	21	34
25.....	24	27	.....	63	63	111	200	155	51	21	34
26.....	24	30	.....	45	63	111	192	230	46	30	34
27.....	30	37	.....	30	63	139	194	202	42	27	38
28.....	30	30	.....	30	63	155	196	333	34	21	42
29.....	18	30	.....	30	53	192	198	346	38	21	38
30.....	30	30	.....	.....	53	211	215	395	34	24	34
31.....	30	.....	.....	.....	49	.....	211	.....	34	24	.....

NOTE.—Gage read Dec. 21 to Jan. 15, but data inadequate for determination of flow because of ice. No gage-height record Jan. 16 to Feb. 12.

Monthly discharge of Little Prickly Pear Creek near Canyon Creek, Mont., for the year ending Sept. 30, 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
October.....	45	18	31.6	1,940
November.....	37	18	23.4	1,390
December 1-20.....	30	18	26.4	1,050
February 13-29.....	98	30	62.6	2,110
March.....	211	30	77.7	4,780
April.....	211	63	104	6,180
May.....	230	173	210	12,900
June.....	395	125	214	12,700
July.....	357	34	134	8,240
August.....	34	21	25.4	1,560
September.....	46	16	34.7	2,060

SUN RIVER BASIN.

NORTH FORK OF SUN RIVER NEAR AUGUSTA, MONT.

LOCATION.—At Sun River diversion dam, 18 miles northwest of Augusta, Teton County.

DRAINAGE AREA.—Not measured.

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

GAGE.—Sloping staff gage on right abutment of Sun River diversion dam; read by employees of the Reclamation Service; a Stevens water-stage recorder was in operation part of the year. Gage read October 31, 1903, to December 31, 1915, was an over-hanging chain gage on the left bank below the ranch buildings of the Henningson Company; that used from August 5, 1889, to December 31, 1890, was also near this point.

DISCHARGE MEASUREMENTS.—Made from footbridge about a half mile below dam.

CHANNEL AND CONTROL.—Control is crest of the 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 the year, 11.4 feet June 21 (discharge, 32,300 second-feet); minimum stage recorded 0.4 foot February 28 to March 2, 1916 (discharge, 152 second-feet).

1889–1890, and 1903–1916: Maximum stage recorded June 21, 1916; minimum stage recorded, zero, April 7 and 8, 1915 (discharge, 15 second-feet).

ICE.—Stage-discharge relation not seriously affected by ice.

DIVERSIONS.—None.

REGULATION.—None.

ACCURACY.—Stage-discharge relation permanent during year except for old station at Henningson ranch, where it was affected by ice December 18–31. Rating curve used October 1 to December 17 for records obtained at Henningson ranch fairly well defined; curve used January 1 to September 30, for records obtained at present site, well defined. Discharge ascertained by applying mean daily gage height to rating tables. Records good.

Discharge measurements of North Fork of Sun River near Augusta, Mont., during the year ending Sept. 30, 1916.

[Made by W. A. Lamb.]

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	<i>Feet.</i>	<i>Sec.-ft.</i>		<i>Feet.</i>	<i>Sec.-ft.</i>
June 20.....	5.52	10,400	Aug. 11.....	1.18	862
July 12.....	3.32	4,350	Sept. 23.....	.73	440

Daily discharge, in second-feet, of North Fork of Sun River near Augusta, Mont., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1.....	472	418	305	217	217	152	372	1,680	2,500	8,710	1,160	461
2.....	472	472	305	217	217	152	372	1,840	2,500	10,200	1,130	461
3.....	472	445	330	217	217	217	372	1,840	2,680	8,790	1,070	659
4.....	472	445	315	217	217	254	372	2,680	2,680	7,050	1,070	1,260
5.....	472	472	330	217	217	291	372	4,230	2,860	6,920	1,030	659
6.....	500	445	330	217	217	291	557	4,890	3,820	6,180	944	608
7.....	472	445	357	217	217	372	883	5,820	3,820	6,550	907	557
8.....	472	445	384	217	217	372	883	3,820	4,230	7,180	907	461
9.....	472	445	357	217	217	416	883	3,230	5,350	6,550	980	461
10.....	472	445	384	217	217	416	883	2,680	5,580	5,870	944	461
11.....	472	445	357	217	217	461	883	2,160	4,230	5,460	883	461
12.....	472	472	305	217	217	461	883	2,000	4,450	4,670	883	461
13.....	472	472	357	217	291	461	883	1,760	4,020	4,410	860	509
14.....	500	500	330	217	291	461	883	1,600	4,670	4,340	825	557
15.....	472	418	280	217	372	461	1,000	1,530	6,550	3,520	790	480
16.....	472	418	216	217	372	461	1,390	1,530	8,790	3,420	745	461
17.....	472	384	216	217	372	461	1,130	1,600	9,730	3,270	659	461
18.....	472	357	216	217	461	461	1,130	1,760	9,940	2,900	659	461
19.....	472	357	210	217	372	461	1,000	2,160	12,800	2,500	659	461
20.....	472	418	210	217	217	461	1,000	2,680	12,800	2,240	659	461
21.....	472	384	.....	217	217	461	883	2,770	25,000	2,130	659	461
22.....	472	357	.....	217	217	461	883	2,860	14,500	2,030	659	461
23.....	472	384	.....	217	217	461	883	2,330	10,100	1,840	608	461
24.....	472	418	.....	217	217	461	883	2,160	9,440	1,680	608	461
25.....	472	445	.....	217	217	461	1,130	2,000	9,210	1,650	608	461
26.....	445	357	.....	217	217	461	1,680	1,840	9,270	1,680	608	461
27.....	445	330	.....	217	217	372	2,330	2,000	9,360	1,600	608	461
28.....	445	280	.....	217	152	372	2,860	2,160	11,100	1,530	557	461
29.....	445	267	.....	217	152	372	2,160	2,160	12,900	1,360	557	461
30.....	418	280	.....	217	.....	372	1,840	2,330	10,400	1,230	557	461
31.....	445	.....	.....	217	.....	372	.....	2,420	.....	1,200	461	.....

NOTE.—Discharge from Oct. 1 to Dec. 31 determined from gage-height record for chain gage at Henningson ranch, where flow is practically the same as at present site. Discharge Dec. 21–31 estimated at 210 second-feet.

Monthly discharge of North Fork of Sun River near Augusta, Mont., for the year ending Sept. 30, 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
October.....	500	418	468	28,800
November.....	500	267	407	24,200
December.....	384	.....	271	16,700
January.....	.....	217	217	13,300
February.....	461	152	247	14,200
March.....	461	152	393	24,200
April.....	2,860	372	1,060	63,100
May.....	5,820	1,530	2,470	132,000
June.....	25,000	2,500	7,840	467,000
July.....	10,200	1,200	4,150	255,000
August.....	1,160	461	782	48,100
September.....	1,260	461	514	30,600
The year.....	25,000	152	1,570	1,140,000

NOTE.—See footnote to table of daily discharge.

SUN RIVER AT FORT SHAW, MONT.

LOCATION.—In SW. $\frac{1}{4}$ sec. 1, T. 20 N., R. 2 W., just above highway bridge at Fort Shaw, Cascade County.

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—May 16, 1912, to September 30, 1916. 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.—Staff gage installed September 1, 1913, on right bank about 400 feet above highway bridge; read by C. G. Peterson, an employee of the United States Reclamation Service; stage prior to September 1, 1913, measured by chain gage fastened to footbridge near right bank and 1,000 feet downstream. Gages referred to different datums.

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

CHANNEL AND CONTROL.—Bed of stream, gravel and rock; fairly permanent; shifting only at extremely high stages. A ledge about 150 feet below the gage forms principal low-water control. Banks high and not subject to overflow.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 10.4 feet at 6 a. m. June 22 (discharge, 17,500 second-feet); minimum stage recorded, 2.08 feet December 20 (discharge, 240 second-feet by current-meter measurement of same date; stage-discharge relation affected by ice; a lower discharge probably occurred during winter season).

1905–1916: 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), and 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 seriously affected by ice. Observer's notes relative to ice very meager.

DIVERSIONS.—There are 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 the irrigation season.

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

ACCURACY.—Stage-discharge relation fairly permanent except for a considerable change caused by flood in June; seriously affected by ice. Rating curve used October 1 to June 21, well defined between 400 and 3,000 second-feet and fairly well defined to 11,000 second-feet; curve used June 22 to September 30, well defined below 1,500 second-feet. Gage read to tenths (occasional readings to half-tenths) twice daily. Discharge ascertained by applying mean daily gage height to rating table. Records good.

Discharge measurements of Sun River at Fort Shaw, Mont., during the year ending Sept. 30, 1916.

[Made by W. A. Lamb.]

Date.	Gage height.	Dis-charge.	Date.	Gage height.	Dis-charge.	Date.	Gage height.	Dis-charge.
	<i>Feet.</i>	<i>Sec.-ft.</i>		<i>Feet.</i>	<i>Sec.-ft.</i>		<i>Feet.</i>	<i>Sec.-ft.</i>
Oct. 8.....	2.43	639	May 26.....	3.62	2,240	Sept. 23.....	2.00	982
Dec. 20.....	2.08	240	June 20.....	7.90	10,300	Nov. 6.....	1.70	590
Apr. 20.....	2.90	1,130	Aug. 12.....	2.04	1,070			

a Stage-discharge relation affected by ice.

Daily discharge, in second-feet, of Sun River at Fort Shaw, Mont., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Dec.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1.	710	710	610		330	510	1,760	3,020	10,100	1,700	590
2.	560	710	610		270	491	1,530	3,020	9,640	1,670	590
3.	610	660	510		330	472	1,760	3,020	11,502	1,400	652
4.	610	660	510		398	453	2,420	2,380	9,430	1,400	782
5.	660	610	462		415	453	3,380	4,820	7,440	1,260	850
6.	710	660	415		415	453	4,460	4,640	6,870	1,020	850
7.	660	660	415		415	434	5,550	3,920	7,060	985	782
8.	710	610	372		610	434	4,280	4,100	8,020	985	715
9.	560	660	372		1,030	415	3,380	5,000	7,630	985	652
10.	610	560	372		1,600	434	2,840	5,180	7,630	1,050	782
11.	660	610	372		1,260	570	2,380	4,820	6,680	1,020	782
12.	710	610	372		1,030	710	1,920	4,280	6,110	985	1,020
13.	560	560	330		920	920	1,760	3,920	5,730	985	1,330
14.	610	660	372		815	1,030	1,680	4,280	4,970	985	1,260
15.	610	610	330		710	1,260	1,600	5,550	4,610	985	1,260
16.	610	660	320	4,280	660	1,260	1,460	7,100	4,250	985	1,090
17.	610	660	300	3,200	610	1,200	1,390	8,100	4,250	850	1,020
18.	610	610	280	2,180	660	1,140	1,530	8,900	4,250	918	1,020
19.	560	660	260	868	660	1,080	1,840	8,900	3,890	985	1,020
20.	610	610	240	868	610	1,080	2,330	10,300	3,260	918	1,020
21.	560	610		762	868	975	2,500	14,400	3,010	850	1,050
22.	610	610		782	815	920	2,500	17,000	2,840	850	985
23.	610	560		660	710	920	2,160	13,500	2,670	850	985
24.	610	610		660	660	920	2,160	10,900	2,500	850	782
25.	660	560		660	610	1,090	2,160	10,100	2,420	652	590
26.	610	610		660	610	1,260	2,000	10,100	2,330	590	590
27.	660	610		610	610	2,000	2,160	10,300	2,330	474	532
28.	660	560		610	590	2,670	2,500	11,300	2,160	474	590
29.	610	610		415	530	2,670	2,670	12,600	2,080	474	590
30.	660	560			510	1,840	2,840	12,400	2,000	474	590
31.	660				491		2,840		1,850	532	

NOTE.—Stage-discharge relation affected by ice Dec. 9-10, and Dec. 16 to Feb. 15. Discharge Dec. 9 and 10, interpolated; Dec. 16-20, from discharge measurement of Dec. 20; Dec. 21-31, mean discharge estimated 220 second-feet, on basis of temperature records and measurement of Dec. 20. Data inadequate for determination of discharge, Jan. 1 to Feb. 15, owing to effect of ice.

Monthly discharge of Sun River at Fort Shaw, Mont., for the year ending Sept. 30, 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
October.....	710	560	628	38,600
November.....	710	560	622	37,000
December.....	610		330	20,300
February 16-29.....	4,280	415	1,230	34,200
March.....	1,600	270	669	41,100
April.....	2,670	415	1,000	59,500
May.....	5,550	1,390	2,440	150,000
June.....	17,000	3,020	7,630	454,000
July.....	11,500	1,850	5,150	317,000
August.....	1,700	474	938	57,700
September.....	1,330	532	845	80,300

WILLOW CREEK NEAR AUGUSTA, MONT.

LOCATION.—In NW. $\frac{1}{4}$ SW. $\frac{1}{4}$ sec. 26, T. 21 N., R. 7 W., at Clark Co.'s ranch, just below mouth of Little Willow Creek and about 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, 1916.

GAGE.—Chain 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, 10.8 feet June 23 (discharge, 1,150 second-feet); minimum stage recorded, 0.60 foot January 31 and February 1-14 (discharge, 6.3 second-feet).

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

ICE.—Probably no ice forms at this station, as a large spring enters the creek just above gage, but record of winter flow should be used with caution. February 15-17 stage-discharge relation seriously affected by ice gorge; flow not computed.

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, about 2 miles below station, forms a reservoir with a capacity of 84,320 acre-feet, for use on the Fort Shaw unit of the Sun River project. In addition to the 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 shifting control, and occasionally slightly affected by ice. Used rating curves applicable as follows: October 1 to February 14, fairly well defined; February 18 to June 23, well defined between 30 and 100 second-feet, and fairly well above 100; July 1 to September 30, well defined between 25 and 700 second-feet. Gage read to half tenths once daily. Discharge ascertained by applying daily gage heights to rating tables except June 21, 22, and 26-30, for which it was determined by comparison with records of flow for station at Chouteau. Records fair October 1 to February 17; good for rest of year.

Discharge measurements of Willow Creek near Augusta, Mont., during the year ending Sept. 30, 1916.

[Made by W. A. Lamb.]

Date.	Gage height.	Dis-charge.	Date.	Gage height.	Dis-charge.	Date.	Gage height.	Dis-charge.
	<i>Feet.</i>	<i>Sec.-ft.</i>		<i>Feet.</i>	<i>Sec.-ft.</i>		<i>Feet.</i>	<i>Sec.-ft.</i>
Oct. 7.....	1.38	28.4	June 18.....	3.70	187	Aug. 11.....	1.80	64
Dec. 18.....	.80	9.3	25.....	7.65	642	Sept. 24.....	.91	28
Apr. 20.....	1.75	37.7	July 12.....	3.89	212			

Daily discharge, in second-feet, of Willow Creek near Augusta, Mont., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1.....	29	21	14	9.4	6.3	14	28	46	195	460	76	36
2.....	27	21	13	9.4	6.3	13	28	43	195	558	69	38
3.....	27	21	13	9.4	6.3	13	28	49	195	496	64	59
4.....	27	21	17	9.4	6.3	16	26	55	215	388	66	44
5.....	27	21	17	9.4	6.3	18	23	58	255	342	69	38
6.....	27	21	10	9.4	6.3	18	26	65	235	298	66	36
7.....	29	21	17	9.4	6.3	16	28	72	225	320	64	36
8.....	29	21	14	9.4	6.3	20	30	65	215	342	62	34
9.....	29	17	19	9.4	6.3	76	32	58	215	320	64	38
10.....	27	16	17	9.4	6.3	125	35	55	215	257	64	36
11.....	27	14	17	9.4	6.3	76	38	55	109	220	64	36
12.....	27	14	14	8.4	6.3	55	40	52	101	202	59	34
13.....	27	14	11	9.4	6.3	46	40	49	93	176	56	32
14.....	25	13	14	9.4	6.3	35	43	46	86	168	54	32
15.....	25	16	14	9.4	.....	30	46	46	86	160	50	32
16.....	25	17	11	7.8	.....	28	43	46	125	152	46	31
17.....	23	17	10	7.8	.....	28	43	43	176	176	66	31
18.....	23	17	9.4	7.8	121	30	40	43	185	168	59	31
19.....	23	17	11	7.8	58	32	40	46	195	137	48	30
20.....	23	17	11	7.8	40	40	43	49	255	123	46	30
21.....	23	19	14	7.8	23	40	38	49	900	116	46	30
22.....	21	21	14	7.8	23	30	35	49	1,000	109	42	30
23.....	21	23	16	7.8	23	30	32	49	1,150	103	42	30
24.....	23	25	11	7.8	23	28	35	55	880	97	40	28
25.....	23	14	11	7.8	23	26	35	52	642	97	40	28
26.....	23	13	14	7.8	20	26	40	72	540	97	40	28
27.....	21	16	13	7.8	20	32	46	125	470	97	38	32
28.....	21	14	11	7.0	20	28	55	141	550	91	36	30
29.....	21	14	11	7.0	18	26	52	141	400	97	36	28
30.....	21	14	10	7.0	.....	23	49	158	800	97	34	28
31.....	21	.....	9.4	6.3	.....	24	.....	141	.....	85	34	.....

NOTE.—Discharge, Feb. 15-17, not computed on account of ice gorge below gage; stage rose to 8.1 feet on Feb. 15. Discharge, June 24, interpolated.

Monthly discharge of Willow Creek near Augusta, Mont., for the year ending Sept. 30, 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
October.....	29	21	24.7	1,520
November.....	25	13	17.7	1,050
December.....	19	9.4	13.2	812
January.....	9.4	6.3	8.45	520
March.....	125	13	33.6	2,070
April.....	55	23	37.2	2,210
May.....	158	43	66.9	4,110
June.....	1,150	86	363	21,600
July.....	558	85	211	13,000
August.....	76	34	52.9	3,250
September.....	59	28	33.5	1,990

SOUTH FORK OF SUN-RIVER AT AUGUSTA, MONT.

LOCATION.—In NW. $\frac{1}{4}$ SE. $\frac{1}{4}$ sec. 17, T. 20 N., R. 6 W., at highway bridge on road from Augusta to Craig, about half a mile from Augusta, in Lewis and Clark County.

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—December 2, 1904, to September 30, 1916.

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 1916 referred to the 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 mile above the gage and there are two to four channels. Stage-discharge relation subject to change at high stages.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 4.4 feet June 22 (discharge, 1,910 second-feet); minimum stage recorded, 2.5 feet December 19 (discharge measurement, 19 second-feet).

1905-1916: Maximum stage recorded, 6.2 feet June 2, 1908 (discharge, 4,300 second-feet); minimum "dry" July 28-30, 1910.

ICE.—Stage-discharge relation seriously affected by i. e.

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 causes small diurnal fluctuation during spring months.

ACCURACY.—Stage-discharge relation not permanent; affected by shifting control.

Gage read to half tenths once daily. Used three rating curves applicable as follows: October 1 to March 4, fairly well defined below 500 second-feet; March 5 to June 5, poorly defined; and June 6 to September 30, well defined between 50 and 1,600 second-feet. Discharge ascertained by applying daily gage height to rating tables. Records good.

Discharge measurements of South Fork of Sun River at Augusta, Mont., during the year ending Sept. 30, 1916.

[Made by W. A. Lamb.]

Date.	Gage height.	Dis-charge.	Date.	Gage height.	Dis-charge.	Date.	Gage height.	Dis-charge.
	<i>Feet.</i>	<i>Sec.-ft.</i>		<i>Feet.</i>	<i>Sec.-ft.</i>		<i>Feet.</i>	<i>Sec.-ft.</i>
Oct. 7.....	1.35	82	June 18.....	3.20	588	Aug. 11.....	2.25	118
Dec. 19.....	2.50	19.2	25.....	3.85	1,250	Sept. 14.....	2.10	75
Apr. 20.....	1.82	177	July 12.....	3.00	417			

^a Stage-discharge relation affected by backwater from dam across channel and ice.

Daily discharge, in second-feet, of South Fork of Sun River at Augusta, Mont., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1.....	88	62	120	98	190	1,160	756	157	55
2.....	88	62	133	98	190	965	756	157	55
3.....	88	62	148	98	190	1,010	756	157	88
4.....	88	62	242	98	207	1,360	611	157	76
5.....	79	62	1,360	98	207	1,460	566	157	76
6.....	79	62	790	98	246	806	1,010	114	76
7.....	79	62	790	98	386	756	453	114	76
8.....	79	62	565	111	246	756	806	114	76
9.....	79	62	790	111	207	806	656	114	76
10.....	79	70	336	140	207	856	566	114	76
11.....	79	79	172	140	207	756	453	114	76
12.....	79	79	172	140	172	656	453	114	76
13.....	79	79	172	140	172	488	420	100	76
14.....	79	79	172	156	172	420	363	100	76
15.....	79	79	140	156	172	488	338	100	76
16.....	79	79	98	156	156	566	338	100	76
17.....	79	79	98	156	156	611	313	100	76
18.....	79	79	85	156	140	566	313	114	76
19.....	79	54	98	172	140	488	313	114	66
20.....	79	47	98	190	140	706	313	100	66
21.....	79	40	126	172	140	1,670	290	88	66
22.....	79	40	126	156	140	1,910	248	88	66
23.....	70	40	126	156	140	1,310	227	76	66
24.....	70	40	111	156	172	1,190	227	76	66
25.....	70	40	98	156	190	1,250	208	76	55
26.....	62	40	98	156	246	1,250	208	76	55
27.....	62	40	98	156	268	1,070	208	76	76
28.....	62	40	98	172	440	1,190	208	76	76
29.....	62	40	98	172	500	1,130	208	55	76
30.....	62	40	98	207	672	908	174	55	66
31.....	62	.....	98	.....	672	.....	174	55	.....

NOTE.—Discharge Nov. 14-17 interpolated on account of ice; Nov. 22-30 estimated at 40 second-feet.

Monthly discharge of South Fork of Sun River at Augusta, Mont., for the year ending Sept. 30, 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
October.....	88	62	76.0	4,670
November.....	79	.....	58.7	3,490
March.....	1,360	85	250	15,400
April.....	207	98	142	8,450
May.....	672	140	241	14,800
June.....	1,910	420	952	56,600
July.....	1,010	174	417	25,600
August.....	157	55	103	6,330
September.....	88	55	71.3	4,240

MARIAS RIVER BASIN.

TWO MEDICINE RIVER AT FAMILY, MONT.

LOCATION.—In NE. $\frac{1}{4}$ sec. 2, T. 31 N., R. 9 W., at Holy Family Mission, in Teton County, 16 miles southeast of Browning and about 6 miles above mouth of Badger Creek, the nearest tributary.

DRAINAGE AREA.—368 square miles.

RECORDS AVAILABLE.—April, 1907, to September 30, 1916.

GAGE.—Overhanging chain gage installed July 15, 1916, on left bank about 150 feet below barn belonging to Holy Family Mission; read by John Gobert. 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 1.00 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 about 3 miles above the mission.

CHANNEL AND CONTROL.—Gravel; shifting. Both banks high and not subject to overflow except at extreme floods.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 7.5 feet at 6 a. m. June 21 (discharge about 4,500 second-feet; gage height uncertain); minimum stage recorded, 1.45 feet December 18 and 19 (discharge, 44 second-feet); low flow may have occurred in January.

1907-1916: 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 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.

DIVERSION.—Water diverted about 2 miles above gage by ditch which supplies about 100 acres on farm at the Holy Family Mission. From May 18 to September 8 a total diversion 5,824 acre-feet was made by the United States Reclamation Service above the station to irrigate lands in the vicinity of Seville on the Black-foot Indian Reservation.

REGULATION.—None.

ACCURACY.—Stage-discharge relation not permanent; affected by shifting control and seriously by ice. Rating curves used as follows: October to December 29, poorly defined; February 18 to May 7, fairly well defined; July 4 to September 30, fairly well defined below 1,100 second-feet. Gage read to quarter-tenths twice daily. No gage-height record May 8–15; record May 16 to July 13 questionable, as it was obtained from several gages set by observer at unknown datum, being washed away before their elevations were obtained. Discharge ascertained by applying mean daily gage heights to rating table except May 8 to July 3, which was determined from gage heights and by comparison with record for Badger Creek, using discharge measurements of May 19 and June 7. Gage read but data inadequate for determination of flow for period of ice effect. Records fair except those for period May 8 to July 3, which are poor.

Discharge measurements of Two Medicine River at Family, Mont., during the year ending Sept. 30, 1916.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		<i>Feet.</i>	<i>Sec.-ft.</i>			<i>Feet.</i>	<i>Sec.-ft.</i>
Nov. 23	W. A. Lamb.....	2.37	179	June 7 ^a	A. H. Tuttle.....	c 4.80	1,710
Jan. 26 ^b	do.....	1.93	74	July 15 ^b	W. A. Lamb.....	4.21	868
Mar. 10	do.....	3.36	447	Aug. 15	do.....	2.85	190
Apr. 28 ^c	do.....	4.35	1,200	Sept. 18	do.....	2.74	146
May 19 ^c	do.....	c 4.20	1,010				

^a Stream frozen over at gage; ice cover about 2 inches thick. Control about one-third open in middle.

^b Measured from wagon bridge 3 miles above gage.

^c Gage height uncertain owing to changes in location and datum of gage.

Daily discharge, in second-feet, of Two Medicine River at Family, Mont., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Dec.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1.....	205	263	138	.....	140	382	860	1,430	2,000	274	148
2.....	205	263	129	.....	196	364	820	1,440	2,000	256	160
3.....	218	263	158	.....	236	346	900	1,400	1,960	225	184
4.....	232	247	138	.....	209	364	1,470	1,500	1,900	225	184
5.....	205	218	129	.....	196	312	1,990	2,040	1,760	197	420
6.....	232	331	138	.....	161	329	2,280	1,740	1,580	197	471
7.....	263	296	138	.....	150	364	2,280	1,710	1,530	211	471
8.....	263	296	138	.....	161	463	2,000	1,760	1,440	172	396
9.....	263	263	158	.....	209	534	1,750	1,950	1,440	211	330
10.....	247	232	129	.....	678	509	1,500	2,100	1,440	240	352
11.....	218	218	120	.....	1,020	1,140	1,150	1,950	1,350	256	291
12.....	232	192	138	.....	1,390	820	1,000	1,770	1,260	256	256
13.....	247	169	104	.....	940	588	900	1,740	1,180	240	225
14.....	263	129	120	.....	236	820	800	1,650	1,090	240	240
15.....	263	148	97	.....	560	1,060	750	2,000	891	197	197
16.....	263	180	78	.....	486	900	712	2,240	852	211	197
17.....	247	180	66	.....	509	746	746	2,040	779	172	172
18.....	205	158	44	.....	509	712	900	2,260	710	197	184
19.....	218	158	44	1,140	509	712	1,140	2,150	614	197	149
20.....	247	279	72	560	382	616	1,140	4,240	526	225	149
21.....	232	180	90	463	940	616	1,220	4,300	471	225	149
22.....	232	158	78	382	678	678	1,140	4,080	373	197	149
23.....	232	169	104	442	534	486	980	2,890	373	211	128
24.....	232	205	78	312	486	509	940	1,980	330	197	128
25.....	205	148	72	364	421	647	1,020	1,980	310	172	128
26.....	218	138	104	250	442	860	900	1,950	291	172	128
27.....	247	138	120	280	312	1,100	1,160	1,950	310	172	128
28.....	232	148	104	222	296	1,340	1,410	2,000	291	172	149
29.....	232	138	104	121	486	1,020	1,510	2,050	330	184	160
30.....	218	129	97	.....	421	900	1,350	2,050	225	172	160
31.....	218	.....	90	.....	421	.....	1,410	.....	256	160	.....

Monthly discharge of Two Medicine River at Family, Mont., for the year ending Sept. 30, 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
October.....	263	205	233	14,300
November.....	331	129	201	12,000
December.....	158	44	107	6,580
February 18-29.....	1,140	121	460	10,900
March.....	1,390	140	462	28,400
April.....	1,340	312	675	40,200
May.....	2,280	712	1,230	75,600
June.....	4,300	1,400	2,140	127,000
July.....	2,000	225	963	59,200
August.....	274	160	208	12,800
September.....	471	128	219	13,000

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 11, 1908; April 23, 1911, to September 30, 1916.

GAGES.—Chain gage on downstream side of bridge. April 4, 1902, to January 11, 1908; chain gage on highway bridge, about 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.

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

CHANNEL AND CONTROL.—Gravel and boulders; shifts. Left bank steep and high; not subject to overflow. Right bank gently sloping; subject to overflow at extreme high stages.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 13.5 feet at 11 a. m. June 22 (discharge, determined from extension of rating curve, 15,600 second-feet); minimum stage recorded, 3.5 feet November 13 (discharge 370 second-feet).

1902-1907 and 1911-1916: 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; observations discontinued during winter.

DIVERSIONS.—Water for Valier-Montana Land & Water Co.'s Cary project and for Blackfeet project of the United States Reclamation Service is diverted above this station; also a number of smaller diversions.

REGULATION.—None.

ACCURACY.—Stage discharge relation not permanent, affected by shifting control. Three rating curves used, applicable as follows: October 1 to November 14 fairly well defined for medium and low stages; March 15 to June 23 well defined below 3,650 second-feet and extended above that point; June 24 to September 30, poorly defined. Gage read to tenths once daily. Discharge ascertained by applying daily gage height to rating tables. Records good March 16 to June 23; fair for rest of year.

Discharge measurement of Marias River near Shelby, Mont., during the year ending Sept. 30, 1916.

Date.	Made by—	Gage height.	Dis-charge.
Apr. 28	W. A. Lamb	Feet.	Sec.-ft.
May 26	A. H. Tuttle	4.98	2,220
July 14	W. A. Lamb	4.95	2,240
		5.50	3,150

Daily discharge, in second-feet of Marias River near Shelby, Mont., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	581	581		935	1,780	2,790	6,780	1,160	1,700
2	581	581		1,120	1,440	2,930	6,630	1,160	1,560
3	518	581		1,120	1,660	2,930	5,790	1,060	1,480
4	581	581		1,020	1,900	4,590	5,510	1,060	1,260
5	518	616		1,020	2,790	4,750	4,950	960	960
6	650	650		1,020	3,500	4,750	4,530	960	870
7	581	581		1,120	3,210	3,950	4,250	1,060	700
8	518	581		1,120	2,270	3,210	4,530	870	700
9	650	650		1,120	1,780	2,790	4,390	870	780
10	518	650		1,120	1,550	2,400	4,250	780	700
11	581	518		1,120	1,440	3,800	3,830	700	780
12	518	462		1,120	1,440	4,110	3,550	870	700
13	581	370		1,440	1,550	3,650	3,410	960	620
14	581			1,330	1,660	3,800	3,130	960	620
15	581			1,220	1,550	3,950	3,130	960	620
16	581			1,330	1,550	4,110	2,990	960	620
17	581			1,440	1,440	4,110	2,710	870	700
18	518		1,120	1,440	1,550	5,400	2,710	870	620
19	581		1,440	1,330	1,660	5,570	2,580	870	620
20	650		1,440	1,220	1,780	6,630	2,450	870	550
21	650		1,440	1,120	1,780	9,620	2,190	870	550
22	581		1,550	1,120	1,900	15,600	2,660	780	620
23	650		1,660	1,120	2,140	14,000	1,940	780	620
24	650		1,660	1,220	2,140	9,460	1,940	780	550
25	650		1,660	1,220	2,270	8,500	1,820	780	550
26	581		1,220	1,220	2,270	7,540	1,700	780	620
27	518		1,220	1,330	2,270	7,540	1,590	780	620
28	518		1,120	2,140	2,270	7,380	1,590	960	550
29	581		1,120	2,270	2,400	7,230	1,370	1,260	550
30	581		1,120	1,660	2,660	7,230	1,260	1,480	550
31	518		1,020		2,660		1,260	1,700	

NOTE.—Gage read to Dec. 4, but data inadequate for determination of flow owing to effect of ice. Gage not read Dec. 5 to Mar. 17. Discharge, June 25, interpolated.

Monthly discharge of Marias River near Shelby, Mont., for the year ending Sept. 30, 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
October	650	518	578	35,500
November 1-13	650	370	569	14,700
March 18-31	1,660	1,020	1,340	37,200
April	2,270	935	1,270	175,600
May	3,500	1,440	2,010	124,000
June	15,600	2,400	5,810	348,000
July	6,780	1,260	3,259	200,000
August	1,700	700	961	59,100
September	1,700	550	766	45,600

BADGER CREEK NEAR FAMILY, MONT.

LOCATION.—In NE. $\frac{1}{4}$ sec. 19, T. 31 N., R. 8 W., near road crossing 4 miles east of Family, in Teton County.

DRAINAGE AREA.—224 square miles.

RECORDS AVAILABLE.—April 20, 1907, to September 30, 1916.

GAGE.—Chain; read to May 13, 1916, by O. J. Racine, and thereafter by Mrs. Claudia Acord. The original staff gage, established April 20, 1907, and bench marks, were washed out in June, 1908, and a new gage was established July 22, 1908, about 400 feet farther upstream and at a different datum; as the bench mark was destroyed the relation between the two gages could not be determined. Gage was again washed out May 25, 1909, and was reset at a different datum, on right bank, and 400 feet below old Piegan Mission crossing.

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

CHANNEL AND CONTROL.—Slightly shifting; two channels at both medium and low stages; at high stages stream flows in several channels. Banks low and subject to overflow above gage.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 6.7 feet at 9 a. m. June 21 (discharge, 1,650 second-feet); minimum open-water stage recorded, 3.88 feet at 6.20 p. m. October 1 (discharge, 171 second-feet.)

1907-1916: Maximum stage recorded, 5.85 feet May 27, 1913 (discharge, 1,780 second-feet); minimum, 3.45 feet September 25, 28, and 30, 1914 (discharge, 92 second-feet); records for open-water season only; mean discharge for February, 1911, estimated at 25 second-feet.

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

DIVERSIONS.—The United States Reclamation Service proposes to divert the natural flow of Badger Creek to irrigate land in the eastern part of the Blackfeet Indian Reservation north of Birch Creek. A small amount of water was diverted in 1916 above the gage.

REGULATION.—None.

ACCURACY.—Stage-discharge relation not permanent; affected by shifting control.

Rating curves used applicable as follows: October 1 to December 1, and March 24 to May 7, fairly well defined; June 22 to September 30, well defined. Gage read to quarter tenths once daily until May 13 and twice daily thereafter. Discharge ascertained by applying mean daily gage height to rating tables; shifting-control method used May 8 to June 21. Records good.

Discharge measurements of Badger Creek near Family, Mont., during the year ending Sept. 30, 1916.

[Made by W. A. Lamb.]

Date.	Gage height.	Discharge.	Date	Gage height.	Discharge.
	<i>Feet.</i>	<i>Sec.-ft.</i>		<i>Feet.</i>	<i>Sec.-ft.</i>
Apr. 28.....	a 4.90	602	Aug. 15.....	4.45	252
May 19.....	a 4.97	596	Sept. 18.....	4.31	180
July 15.....	a 5.09	613			

a Made by wading at ford 1 mile above gage.

Daily discharge, in second-feet, of Badger Creek, near Family, Mont., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Dec.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1.....	171	180	188	.....	265	426	692	1,030	381	202
2.....	175	180	180	.....	265	400	724	1,060	327	225
3.....	175	188	180	.....	265	400	756	1,030	327	250
4.....	175	195	180	.....	285	562	1,010	968	327	327
5.....	180	195	.....	.....	285	740	1,140	903	327	327
6.....	175	188	.....	.....	305	800	948	839	327	275
7.....	175	195	.....	.....	285	800	852	871	301	225
8.....	175	188	.....	.....	305	769	916	903	327	225
9.....	175	188	.....	.....	305	605	1,050	807	354	225
10.....	188	188	.....	.....	305	598	1,050	807	327	275
11.....	180	188	.....	.....	305	531	884	743	301	225
12.....	180	195	.....	.....	305	531	884	743	275	225
13.....	175	195	.....	.....	305	466	884	679	275	225
14.....	175	195	.....	.....	328	354	948	617	275	225
15.....	180	188	.....	.....	328	349	948	617	250	202
16.....	175	188	.....	.....	305	349	1,140	617	250	180
17.....	180	188	.....	.....	328	398	1,140	586	275	180
18.....	188	180	.....	.....	350	478	1,080	555	275	180
19.....	188	180	.....	.....	328	598	1,140	525	275	.....
20.....	188	180	.....	.....	350	567	1,080	495	275	.....
21.....	180	180	.....	.....	350	629	1,520	495	225	.....
22.....	188	175	.....	.....	350	598	1,200	466	225	.....
23.....	188	175	.....	.....	400	507	1,100	437	225	.....
24.....	188	180	.....	215	400	449	1,030	437	225	.....
25.....	188	180	.....	200	452	449	1,030	437	225	.....
26.....	188	175	.....	230	452	449	1,000	437	327	.....
27.....	188	175	.....	230	506	537	1,000	466	250	.....
28.....	188	180	.....	265	591	629	1,060	437	225	.....
29.....	180	188	.....	265	506	692	1,100	381	202	.....
30.....	180	180	.....	265	452	692	1,030	381	202	.....
31.....	180	.....	.....	265	.....	629	.....	381	202	.....

NOTE.—Discharge Dec. 2-4 estimated on account of backwater from ice; Sept. 17, interpolated.

Monthly discharge of Badger Creek near Family, Mont., for the year ending Sept. 30, 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
October.....	188	171	181	11,100
November.....	195	175	185	11,000
December 1-4.....	188	180	182	1,440
March 24-31.....	265	200	242	3,840
April.....	591	265	352	20,900
May.....	800	349	548	33,700
June.....	1,520	692	1,010	60,100
July.....	1,060	381	650	40,000
August.....	381	202	277	17,000
September 1-18.....	327	180	233	8,320

BIRCH CREEK AT SWIFT DAM, NEAR DUPUYER, MONT.

LOCATION.—At Swift dam, on south boundary of Blackfeet Indian Reservation, Teton County, about 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.—About 120 square miles.

RECORDS AVAILABLE.—March 26, 1913, to September 30, 1916.

GAGES.—Vertical iron staff on right bank, about 800 feet below dam, used for determining flow through valves in dam. Discharge over spillway determined from readings of inclined staff gage near lower end and on left side of spillway channel. Gages read by H. C. Stalzer. Prior to July 11, 1915, a vertical wooden staff on right bank, one-fourth mile below dam, was used for all readings except June 5 to July 16, 1913, when a vertical staff on left bank immediately below dam was read to obtain high-water records.

DISCHARGE MEASUREMENTS.—Discharge through valves measured by wading at gage or from foot bridge about 300 feet above gage. Spillway discharge determined by wading on lip of spillway, from foot bridge, or by floats near gage.

CHANNEL AND CONTROL.—Bed of channel conveying flow from valves clean, coarse gravel and boulders. Right bank at gage high and not subject to overflow; left bank high and subject to overflow only if floods should break across from spillway channel and flow into this one; right bank subject to overflow about 200 feet below gage during high water. Control for discharge below 500 second-feet is riffle about 100 feet below gage, which has not shifted since gage was located at present site.

Spillway channel, cement-lined channel ending at solid limestone ledge which is crest of falls. Not liable to change.

EXTREMES OF DISCHARGE.—Maximum stage (for flow from valves) recorded during year, 3.45 feet at 8 a. m. and 6 p. m. June 21, and at 8 a. m. June 22 (discharge 565 second-feet); maximum stage (from spillway) recorded during year, 12.94 feet at 5 a. m. June 21 (discharge 4,710 second-feet). Combined maximum discharge 5,275 second-feet. Minimum stage, 1.52 feet at 12.20 p. m. December 11, and at 8 a. m. and 5.30 p. m. December 12 (discharge 5 second-feet).

1913-1916: Maximum discharge 5,275 second-feet at 5 a. m. June 21, 1916; minimum discharge 0.9 second-foot March 6, 1915.

ICE.—The presence of ice seldom affects the winter flow at this station.

DIVERSIONS.—Two small irrigation ditches divert between station and dam. Acre-feet in storage at end of each month was as follows: September (1915) 26,670, October, 24,350; November, 24,635; December, 25,040; January, 25,770; February; 25,080; March, 13,550; April, 13,860; May, 20,960; June 30,120; July, 26,750; August, 17,720; September, 7,060.

REGULATION.—Dam is used to store flood and winter flow, and during dry periods will release no more water than is required by the canal system of the Valier Carey project in addition to amount required by prior rights.

DETERMINATION OF DISCHARGE.—Discharge through valves in mouth of tunnel at south end of dam flows down main channel of creek past the vertical iron staff gage on right bank. Readings from this gage indicate flow through valves not diverted between dam and gage. Flow over spillway passes down artificial channel and joins creek about one-fourth mile below dam. Readings from inclined gage near lower end of this channel indicate total flow from reservoir not passing through valves. Total mean daily discharge obtained by adding flow passing the two gages.

ACCURACY.—Stage-discharge relation permanent for both gages. Rating curve for gage in channel conveying flow from valves well defined; for gage in spillway channel fairly-well defined below 3,000 second-feet and approximate above 3,000 second-feet. Gage in channel from valves read to hundredths twice daily. Gage in spillway channel read to tenths twice daily except June 16-17 and 20-24, when from 3 to 10 readings were taken daily. Daily discharge for channel from valves ascertained by applying to rating table mean daily gage heights obtained by weighting observed gage heights according to observer's notes for days on which gate openings were changed; daily discharge for spillway channel ascertained by applying mean daily gage height to rating table except for June 16-17 and 20-24, when the mean discharge between two consecutive readings was applied to the time interval between those readings. Records of flow through valves good; for spillway channel fair except June 21, for which computed discharge is roughly approximate.

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

Discharge measurements of Birch Creek, showing flow through valves at Swift dam, near Dupuyer, Mont., during the year ending Sept. 30, 1916.

Date.	Made by—	Gage height.	Dis-charge.	Date.	Made by—	Gage height.	Dis-charge.
		<i>Feet.</i>	<i>Sec.-ft.</i>			<i>Feet.</i>	<i>Sec.-ft.</i>
Oct. 1	Chadwick ^a and Him- melstein ^a	2.50	118	Apr. 20	Chadwick and Atwood.	2.10	69
Nov. 4	Heidel and Atwood ^a	2.15	64	May 9	Heidel and Atwood....	2.69	178
Dec. 11	H. M. Chadwick.....	1.52	4.9	June 2	Atwood and Hall ^a	3.15	374
Feb. 17	Chadwick and Atwood.....	2.57	139	July 17	Atwood and Chadwick.	3.35	495
Apr. 8	Atwood and Himmel- stein.....	2.89	241	July 30	Heidel and Atwood....	3.35	487
				Aug. 31	Atwood and Sage ^a	3.18	328
					Heidel and Atwood....	3.00	281

^a Employee of Valier-Montana Land & Water Co.

Discharge measurements of Birch Creek, showing flow over spillway at Swift dam, near Dupuyer, Mont., during the year ending Sept. 30, 1916.

Date.	Made by—	Gage height.	Dis-charge.	Date.	Made by—	Gage height.	Dis-charge.
		<i>Feet.</i>	<i>Sec.-ft.</i>			<i>Feet.</i>	<i>Sec.-ft.</i>
June 17	Atwood and Chad- wick.....	2.90	^b 591	June 23	Atwood and Stalzer ^a ..	4.80	^c 1,160
21	Chadwick and Hall ^a ...	12.44	^d 4,620	24	Atwood and Chadwick.	4.80	^c 998
21	Atwood and Chadwick.	10.44	^e 3,480	July 1	Heidel and Atwood....	2.30	461
				18	Atwood and Stalzer...	.15	^c 2.6

^a Employee of Valier-Montana Land & Water Co.

^b Measured by wading on lip of spillway.

^c Float measurement.

^d Discharge obtained by assuming flow in concrete-lined portion of the section to be the same as though running full and applying a coefficient of 0.6 to the maximum float velocity of 25 feet per second to obtain velocity of section above the concrete.

^e A coefficient of 0.6 was applied to the maximum float velocity of 20 feet per second and discharge obtained as noted for first measurement of this date.

Daily discharge, in second-feet, of Birch Creek at Swift dam, near Dupuyer, Mont., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1.....	124	95	63	57	110	275	283	159	360	963	365	286
2.....	124	77	61	57	79	275	283	175	360	1,010	390	286
3.....	124	64	63	57	57	275	283	175	360	981	360	286
4.....	124	64	63	57	57	275	283	175	360	874	360	286
5.....	124	63	63	57	87	275	283	175	360	867	360	286
6.....	121	63	63	55	57	275	256	173	360	632	365	286
7.....	124	63	63	79	64	275	252	175	420	623	376	286
8.....	138	63	61	71	64	291	248	175	426	676	376	286
9.....	187	63	63	71	64	309	216	175	605	703	365	286
10.....	187	64	54	71	57	309	130	175	605	609	360	286
11.....	210	64	5	68	57	309	52	173	605	599	360	286
12.....	248	63	5	57	67	309	52	175	605	590	360	286
13.....	248	64	9	57	96	309	55	175	526	558	376	286
14.....	244	63	15	57	106	286	57	175	511	506	376	282
15.....	244	63	32	57	106	286	57	173	489	501	365	278
16.....	241	63	46	57	124	286	57	173	645	497	360	278
17.....	241	63	55	57	140	286	64	173	1,070	493	360	278
18.....	241	63	57	57	213	286	63	173	1,130	489	360	278
19.....	244	63	57	57	230	286	60	173	1,160	421	365	278
20.....	241	63	57	64	230	286	58	175	2,500	388	376	278
21.....	241	63	57	64	230	282	64	175	4,620	388	376	278
22.....	241	63	57	64	248	278	87	175	2,620	360	365	278
23.....	238	63	57	60	267	278	87	181	1,780	332	360	275
24.....	200	63	57	57	267	275	87	181	1,530	332	343	275
25.....	167	61	57	110	271	271	87	181	1,430	343	332	275
26.....	148	61	57	117	275	271	98	181	1,380	343	309	275
27.....	115	61	57	117	275	271	128	194	1,330	332	309	271
28.....	96	61	57	110	275	271	136	323	1,300	343	309	267
29.....	95	61	57	106	275	263	146	360	1,270	360	309	267
30.....	95	61	57	106	275	263	153	360	988	360	285	267
31.....	95	-----	57	117	-----	263	-----	360	-----	365	286	-----

NOTE.—The above table shows total flow through valves and over spillway. There was no flow over spillway except during period June 13 to July 22.

Monthly discharge of Birch Creek at Swift dam, near Dupuyer, Mont., for the year ending Sept. 30, 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
October.....	248	95	178	10,900
November.....	95	61	64.3	3,830
December.....	63	5	51.0	3,140
January.....	117	55	72.5	4,460
February.....	275	57	152	8,740
March.....	309	263	282	17,300
April.....	263	52	136	8,090
May.....	360	159	198	12,200
June.....	4,620	369	1,060	63,100
July.....	1,010	332	537	33,000
August.....	378	286	352	21,600
September.....	286	267	280	16,700
The year.....	4,620	5	279	203,000

NOTE.—The above table shows total flow through valves and over spillway.

BIRCH CREEK NEAR DUPUYER, MONT.

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

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

RECORDS AVAILABLE.—July 25, 1907, to September 30, 1916.

GAGE.—Inclined staff on right bank, nearly one-half mile due west of the ranch buildings; read until December 31, 1915; beginning January 1, 1916, a vertical 1-inch square steel bar, marked to tenths, about 1,000 feet downstream, was used but this was washed out June 21; observer set a temporary gage at approximately the same location June 23, which was replaced by new vertical steel staff at same section July 5 and referred to approximately the same datum. Read by John Ryan. Gage previously used as follows: A chain gage on right bank about 250 feet below inclined staff July 25, 1907, until June, 1908, when it was washed out; a temporary staff 200 feet below old chain gage July 23 to October 1, 1908, when a new chain gage was installed on right bank one-fourth mile above old site; chain gage used until December 31, 1913; inclined staff with datum unchanged January 1, 1914, to December 31, 1915. No relation determined between gage datums for the different sections.

DISCHARGE MEASUREMENTS.—Made by wading or from cable. Cable originally was established about 100 feet below inclined gage but was moved downstream to 75 feet below new vertical steel staff; washed out June 21, 1916.

CHANNEL AND CONTROL.—Rock and gravel at inclined gage. Principal control is riffle about 100 feet below; shifting. Large clean gravel at site of present gage; control is gravel bar about 250 feet below gage. Banks of medium height, covered with brush, and subject to overflow.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 10.0 feet June 21, determined by leveling from high-water marks (discharge estimated 5,000 second-feet by comparison with flow at Swift dam); minimum discharge during open-water period 80 second-feet November 5-8 and April 19 and 21.

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

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

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; about 12 miles upstream from station.

ACCURACY.—Stage-discharge relation fairly permanent at old site October 1 to November 10; affected by ice November 11 to February 22; practically unchanged at new location December 7 to June 18; changing after June 18. Rating curves used October 1 to November 10 and February 23 to June 9 well defined. Gage read to hundredths once daily. Daily discharge ascertained by applying daily gage height to rating tables, except June 10 to July 4, which was estimated by comparison with records of flow at Swift dam and July 5 to September 30, which was obtained by shifting-control method. Gage read but data inadequate to warrant determinations of flow for period of ice effect. Results obtained by the use of rating tables, good; other results fair.

Discharge measurements of Birch Creek near Dupuyer, Mont., during the year ending Sept. 30, 1916.

Date.	Made by—	Gage height.	Dis-charge.	Date.	Made by—	Gage height.	Dis-charge.
		<i>Feet.</i>	<i>Sec.-ft.</i>			<i>Feet.</i>	<i>Sec.-ft.</i>
Oct. 22	McHugh and Atwood	3.77	252	June 9	Chadwick and Spier ^a ..	4.75	448
Nov. 4	Heidel and Atwood....	3.27	83	18	Atwood and Himmelstein ^a	5.84	1,090
Dec. 7	Chadwick and Larsons ^b	3.53	74	Aug. 30	Atwood and Heidel....	4.69	319
Mar. 28	Chadwick and Minkler ^c	4.40	296				
May 9	Heidel and Atwood....	4.10	194				

^a Employee of engineering department of the Valier-Montana Land & Water Co.

^b Gage height obtained from new gage; old gage read 3.48 feet.

^c Stage-discharge relation affected by ice.

Daily discharge, in second-feet, of Birch Creek near Dupuyer, Mont., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1.....	117	104	.....	293	293	143	446	1,130	442	313
2.....	120	104	.....	353	293	167	446	1,160	437	320
3.....	120	104	.....	332	293	167	446	1,130	428	340
4.....	117	84	.....	328	290	167	437	1,020	418	320
5.....	120	80	.....	316	290	170	446	880	416	320
6.....	123	80	.....	293	290	175	461	816	416	316
7.....	120	80	.....	293	290	181	461	816	414	309
8.....	120	80	.....	293	279	189	470	874	418	313
9.....	143	82	.....	301	279	195	508	874	418	305
10.....	157	84	.....	332	102	195	670	874	428	297
11.....	157	.....	.....	305	90	195	670	804	414	297
12.....	236	.....	.....	332	85	195	670	749	410	297
13.....	236	.....	.....	332	85	195	630	691	400	293
14.....	240	.....	.....	332	84	195	570	685	387	293
15.....	240	.....	.....	313	84	195	550	685	387	297
16.....	240	.....	.....	309	84	195	710	685	387	297
17.....	240	.....	.....	309	82	195	1,100	669	382	286
18.....	244	.....	.....	313	82	195	1,150	658	382	286
19.....	244	.....	.....	313	80	189	1,200	658	382	283
20.....	244	.....	.....	313	78	189	2,600	652	382	272
21.....	244	.....	.....	313	80	181	5,000	652	378	272
22.....	244	.....	.....	313	85	181	3,000	625	378	268
23.....	244	.....	.....	309	85	181	2,350	499	374	264
24.....	244	.....	.....	374	305	201	1,680	451	374	264
25.....	244	.....	.....	301	293	85	227	1,580	451	374
26.....	153	.....	.....	293	85	244	1,530	470	374	264
27.....	128	.....	.....	293	121	279	1,480	470	365	264
28.....	107	.....	.....	332	293	123	279	1,450	451	365
29.....	107	.....	.....	293	297	123	357	1,420	446	357
30.....	104	.....	.....	297	133	423	1,130	446	320	264
31.....	104	.....	.....	293	.....	423	.....	446	313	.....

Monthly discharge of Birch Creek near Dupuyer, Mont., for the year ending Sept. 30, 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
October.....	244	104	177	10,900
November 1-10.....	104	80	88.2	1,750
February 23-29.....	642	293	361	5,010
March.....	353	293	310	19,100
April.....	293	78	151	8,980
May.....	423	143	215	13,200
June.....	5,000	437	1,180	70,200
July.....	1,160	446	707	43,500
August.....	442	313	391	24,000
September.....	340	264	290	17,300

a Estimated by comparison with record obtained at Swift Dam.

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

LOCATION.—In NW. $\frac{1}{4}$ 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, 1916.

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.—Bed composed of cobblestones and gravel; shifts at extreme floods. Channel occasionally obstructed by growth of aquatic plants in summer.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 5.10 feet July 2 (discharge 930 second-feet); minimum stage recorded was 2.15 feet December 21, 1915. Stage-discharge relation affected by ice.

1914-1916: Maximum stage occurred June 19-21, 1916, after gage was washed away (stage and discharge unknown); maximum stage recorded 5.10 feet July 2, 1916 (discharge 930 second-feet); minimum stage 1.67 feet (or less) October 18-24, 1914, March 28 to April 5 and April 8-30, 1915 (discharge, 0 second-feet).

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

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 changed during flood of June 19-21; affected by ice November 11 to February 24; fairly permanent at other times. Rating curve used October 1 to November 10 and February 25 to June 18 well defined between 107 and 250 second-feet; curve used July 1 to September 30 well defined between 25 and 350 second-feet. Gage read to hundredths once daily. Discharge ascertained by applying daily gage height to rating table. Gage read but data insufficient for determinations of flow during period of ice effect. Records below 400 second-feet good; above that, fair.

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

Discharge measurements of Birch Creek at Nelson's ranch near Dupuyer, Mont., during the year ending Sept. 30, 1916.

Date.	Made by—	Gage height.	Dis-charge.	Date.	Made by—	Gage height.	Dis-charge.
		<i>Feet.</i>	<i>Sec.-ft.</i>			<i>Feet.</i>	<i>Sec.-ft.</i>
Oct. 22	McHugh ^a and Atwood ^a	3.10	209	Feb. 16	Chadwick and Atwood.	5.13	205
Nov. 3	Heidel and Atwood....	2.65	96	May 3	Heidel and Himmel-stein ^a		
Dec. 7	Chadwick ^a and Lar-son ^a	2.69	77	Aug. 30	Atwood and Heidel....	2.85	136
						3.90	292

^a Employee of engineering department of Valier-Montana Land & Water Co.

^b Stage-discharge relation seriously affected by ice.

Daily discharge, in second-feet, of Birch Creek at Nelson's ranch, near Dupuyer, Mont., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1.....	42	76		282	286	146	423	875	336	280
2.....	43	76		290	282	178	423	930	336	285
3.....	44	94		301	282	140	423	902	336	312
4.....	42	73		290	275	140	414	765	336	289
5.....	43	71		286	275	146	423	710	336	289
6.....	44	71		275	275	153	431	655	336	289
7.....	94	71		275	275	156	431	655	336	280
8.....	94	71		275	264	156	423	710	336	280
9.....	118	73		290	264	156	452	710	336	274
10.....	130	74		309	107	156	479	710	336	268
11.....	130			309	94	159	501	655	336	268
12.....	206			328	85	162	501	600	336	268
13.....	210			309	78	162	501	572	327	268
14.....	216			309	78	162	501	572	312	268
15.....	216			301	78	162	501	572	312	268
16.....	216			297	76	194	501	572	308	268
17.....	216			297	74	203	795	562	298	259
18.....	219			301	74	203	843	545	294	259
19.....	219			301	73	197		545	294	255
20.....	219			301	71	197		545	289	255
21.....	219			301	78	197		545	289	255
22.....	216			301	85	197		545	289	255
23.....	216			297	85	197		386	289	255
24.....	216			294	85	184		336	289	255
25.....	216		286	290	85	197		336	289	255
26.....	146		257	290	85	213		336	289	255
27.....	107		275	290	118	243		336	289	255
28.....	80		301	290	121	243		336	289	255
29.....	80		290	290	121	332		336	289	255
30.....	78			290	134	393		336	285	255
31.....	76			286		402		336	280	

NOTE.—Gage not read; discharge interpolated Apr. 30, July 9, Aug. 5, 6, and Sept. 9.

Monthly discharge of Birch Creek at Nelson's ranch, near Dupuyer, Mont., for the year ending Sept. 30, 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
October.....	219	42	142	8,730
November 1-10.....	94	71	75.0	1,490
February 25-29.....	301	257	282	2,800
March.....	328	275	295	18,100
April.....	286	71	145	8,630
May.....	402	140	198	12,200
June 1-18.....	843	414	498	17,800
July.....	930	336	565	34,700
August.....	336	280	311	19,100
September.....	312	255	268	15,900

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

LOCATION.—In NW. $\frac{1}{4}$ sec. 12, T. 29 N., R. 8 W., at Hall's ranch, about 4 miles below headworks of B canal of Valier Carey project and about 10 miles northwest of Dupuyer, Teton County.

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—May 16, 1913, to June 16, 1916.

GAGE.—Vertical staff on left bank about 400 feet below a ford leading to ranch buildings, which are one-half mile away; read by Radford Angell. Gage used prior to June 27, 1915, a vertical staff on left bank about 400 feet below present site, referred to a different datum and was abandoned because of variable amount of backwater due to operation of an irrigation ditch.

DISCHARGE MEASUREMENTS.—Made by wading.

CHANNEL AND CONTROL.—At ordinary stages a bar or ridge producing riffle about 100 feet below the new gage is principal control.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 2.55 feet June 16 (discharge, 536 second-feet); minimum stage, 0.98 foot December 17-18 (stage-discharge relation affected by ice; flow not computed).

1913-1916: Maximum stage recorded, 3.3 feet (old gage) May 28, 1913 (discharge, 910 second-feet); minimum stage, 0.10 foot (old gage) May 3, 1914 (discharge, 1.0 second-foot.)

ICE.—Stage-discharge relation seriously affected by ice after November 10; data insufficient to warrant estimates of flow.

DIVERSIONS.—A large part of the flow is diverted above the station.

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

ACCURACY.—Stage-discharge relation not permanent; affected by ice and by shift in control. Rating curve used October 1 to November 10 well defined; curve used May 3 to June 16, poorly defined. Gage read once daily to hundredths. Discharge ascertained by applying daily gage heights to rating table. Gage read but data inadequate for determination of flow for period of ice effect. No record February 15 to May 2 and June 17 to September 30. Records October 1 to November 10 good; May 3 to June 16 poor.

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

Discharge measurements of Birch Creek at Hall's ranch, near Dupuyer, Mont., during the year ending Sept. 30, 1916.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		<i>Feet.</i>	<i>Sec.-ft.</i>			<i>Feet.</i>	<i>Sec.-ft.</i>
Oct. 21	McHugh ^a and Atwood ^a .	1.99	206	Dec. 6	Chadwick ^a and Larson ^a	1.51	72
Nov. 3	Heidel and Atwood.....	1.65	94	May 3	Heidel and Himmelstein ^a	1.78	149
Dec. 1	Chadwick ^a and Larson ^a	^b 1.78	75				

^a Employee of engineering department of Valier-Montana Land & Water Co.

^b Stage-discharge relation affected by ice.

Daily discharge, in second-feet, of Birch Creek at Hall's ranch, near Dupuyer, Mont., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	May.	June.	Day.	Oct.	Nov.	May.	June.
1.....	50	83	-----	400	16.....	202	-----	159	536
2.....	50	83	-----	412	17.....	210	-----	203	-----
3.....	52	94	149	423	18.....	206	-----	194	-----
4.....	50	79	152	435	19.....	210	-----	194	-----
5.....	54	77	155	446	20.....	210	-----	194	-----
6.....	54	74	155	446	21.....	210	-----	194	-----
7.....	92	74	163	435	22.....	210	-----	194	-----
8.....	92	74	159	476	23.....	206	-----	194	-----
9.....	112	74	159	446	24.....	206	-----	171	-----
10.....	120	74	163	505	25.....	202	-----	220	-----
11.....	117	-----	163	505	26.....	144	-----	228	-----
12.....	190	-----	167	511	27.....	114	-----	233	-----
13.....	198	-----	163	523	28.....	90	-----	256	-----
14.....	198	-----	167	505	29.....	83	-----	325	-----
15.....	202	-----	163	505	30.....	83	-----	400	-----
					31.....	81	-----	389	-----

Monthly discharge of Birch Creek at Hall's ranch, near Dupuyer, Mont., for the year ending Sept. 30, 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
October.....	210	50	139	8,550
November 1-10.....	94	74	73.6	1,560
May 3-31.....	400	149	201	11,600
June 1-16.....	536	400	469	14,900

BIRCH CREEK AT ROBARE, MONT.

LOCATION.—In N. $\frac{1}{2}$ sec. 31, T. 30 N., R. 7 W., near former post office of Robare, 10 miles north of Dupuyer and 14 miles west of Valier, in Teton County.

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—June 4, 1914, to September 30, 1916.

GAGE.—Inclined staff gage on right bank one-half mile downstream from old post office at Robare; read by Radford Angell. Vertical steel staff graduated to tenths set July 1, 1916, for high water.

DISCHARGE MEASUREMENTS.—Made by wading.

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, 4.11 feet June 17 (discharge, 1,010 second-feet); minimum stage recorded, 2.36 feet October 1 and 2 (discharge, 37 second-feet).

1914-1916: 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-feet).

ICE.—Stage-discharge relation affected by ice from November 30 to March 12.

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

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

ACCURACY.—Stage-discharge relation changed during the high water of June 18. The rating curves are fairly well defined except at high stages. Gage read to hundredths once daily. Daily discharge obtained by applying daily gage heights to rating table. Gage read but data inadequate to warrant computation of flow for period of ice effect. Results 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, 1916.

Date.	Made by—	Gage height.	Dis-charge.	Date.	Made by—	Gage height.	Dis-charge.
Oct. 21	McHugh ^a and Atwood ^a	Feet. 3.10	Sec.-ft. 177	Dec. 6	Chadwick ^a and Larson ^a	Feet. 2.60	Sec.-ft. 61
Nov. 3	Heidel and Atwood..	2.70	87	Mar. 28	Chadwick and Minkler ^a	3.27	251

^a Employee 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, 1916.

Day.	Oct.	Nov.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1.....	37	80	.....	251	118	334	745	314	297
2.....	37	69	.....	242	137	341	770	306	297
3.....	42	91	.....	238	120	348	736	301	327
4.....	39	73	.....	228	120	360	845	297	297
5.....	42	72	.....	224	122	367	815	297	297
6.....	42	59	.....	224	125	374	790	301	289
7.....	75	75	.....	228	129	360	785	301	285
8.....	89	81	.....	228	124	402	805	297	289
9.....	114	69	.....	220	129	380	790	314	293
10.....	162	69	.....	98	127	425	790	318	297
11.....	116	109	.....	85	129	432	745	297	293
12.....	168	109	.....	78	132	425	452	306	293
13.....	171	85	388	73	129	440	452	306	297
14.....	174	75	322	70	132	440	444	297	289
15.....	174	66	322	70	134	440	444	297	289
16.....	177	77	354	70	132	455	452	297	281
17.....	184	75	354	72	156	1,010	520	293	285
18.....	184	69	266	67	156	.....	466	293	285
19.....	184	69	242	67	156	.....	448	297	285
20.....	187	92	266	66	159	.....	439	297	276
21.....	187	92	266	64	162	.....	430	301	268
22.....	184	92	251	77	153	.....	439	297	268
23.....	184	89	242	77	145	.....	349	293	264
24.....	184	77	251	77	127	.....	340	289	264
25.....	187	92	242	75	132	.....	318	289	268
26.....	137	85	242	77	174	.....	331	297	264
27.....	116	85	242	98	171	.....	327	297	268
28.....	85	69	246	109	184	.....	323	297	268
29.....	81	69	250	114	251	.....	314	293	264
30.....	78	.....	246	114	322	.....	318	293	264
31.....	78	.....	238	.....	322	.....	310	293	.....

NOTE.—Gage out June 18-30. Discharge not determined.

Monthly discharge of Birch Creek at Robare, Mont., for the year ending Sept. 30, 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
October.....	187	37	126	7,750
November 1-29.....	109	59	79.8	4,590
March 13-31.....	388	238	276	10,400
April.....	251	64	126	7,500
May.....	322	118	155	9,530
June 1-17.....	1,010	334	431	14,500
July.....	845	310	533	32,800
August.....	318	289	299	18,400
September.....	327	264	283	16,800

DUPUYER CREEK NEAR VALIER, MONT.

LOCATION.—In NE. $\frac{1}{4}$ NW. $\frac{1}{4}$ 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; about 6 miles below mouth of Sheep Creek and 11 miles southwest of Valier, Teton County, the nearest railway point.

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—July 17, 1912, to September 30, 1916.

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. Measuring section obstructed during the late summer and fall by growth of algae.

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.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year 6.5 feet on June 21, determined by level from flood marks (discharge 2,180 second-feet); minimum stage 2.64 feet November 6 (discharge 27 second-feet).

1912-1916: Maximum stage recorded 6.5 feet 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.

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 by high water of June 21-22; affected by ice November 10 to March 17. Rating curve used to June 20 well defined; curve used after that date well defined between 50 and 1,800 second-feet. Gage read to hundredths once daily. Daily discharge ascertained by applying daily gage height to rating tables. Data inadequate for determination of discharge during period of ice effect. Records good.

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

Discharge measurements of Dupuyer Creek near Valier, Mont., during the year ending Sept. 30, 1916.

Date.	Made by—	Gage height.	Dis-charge.	Date.	Made by—	Gage height.	Dis-charge.
		Feet.	Sec-ft.			Feet.	Sec-ft.
Oct. 26	McHugh and Atwood	2.79	41.2	June 23	Chadwick and Him-		
Nov. 5	Heidel and Atwood	2.75	37.7		melstein	5.95	1,680
Dec. 8	H. M. Chadwick	3.28	45.1	30	Heidel and Chadwick	4.99	4890
Feb. 19	Atwood and Chadwick	5.27	247	July 5	Heidel and Atwood	4.15	401
Mar. 24	H. M. Chadwick	2.95	57	17	H. M. Chadwick	3.55	181
Apr. 28	Atwood and Heidel	2.92	61	29	do	3.31	123
May 27	H. M. Chadwick	3.56	227	Aug. 28	Heidel and Atwood	2.96	59
June 8	do	3.65	244				

a Employee of engineering department, Valier-Montana Land & Water Co.

b Stage-discharge relation affected by ice.

c Measurement of water flowing over ice which was 3 feet thick. Water under ice could not be measured.

d 844 second-feet measured from steel bridge 5 miles below gage; 46 second-feet was being diverted by "D" Canal.

Daily discharge, in second-feet, of Dupuyer Creek near Valier, Mont., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	56	42		60	65	214	638	115	55
2	49	38		56	73	222	552	110	65
3	49	39		59	70	214	525	104	85
4	49	32		56	65	234	452	100	133
5	50	38		53	70	315	406	92	81
6	49	27		62	77	355	362	90	71
7	56	32		57	73	315	340	85	68
8	54	33		59	92	278	500	85	61
9	56	44		59	82	278	452	143	62
10	57			57	79	315	340	135	05
11	54			52	75	234	282	110	58
12	50			57	75	234	246	98	55
13	50			57	71	202	228	90	58
14	54			59	70	202	213	85	65
15	56			59	70	198	198	78	58
16	53			59	71	234	184	73	57
17	53			54	71	234	184	73	56
18	47		109	57	65	234	228	119	52
19	44		109	57	62	234	173	85	50
20	38		90	57	57	256	178	73	50
21	49		94	56	68	2,180	165	68	48
22	44		82	54	65	1,950	150	67	47
23	44		73	56	59	1,720	145	64	45
24	47		65	53	70	1,150	145	60	47
25	44		92	49	82	898	126	61	45
26	44		125	49	102	762	140	90	44
27	44		113	54	210	730	150	73	48
28	38		73	57	315	1,210	143	62	50
29	38		82	65	278	1,210	123	68	47
30	44		56	68	234	898	121	58	45
31	45		65		214		117	56	

NOTE.—Discharge, June 22, interpolated.

Monthly discharge of Dupuyer Creek near Valier, Mont., for the year ending Sept. 30, 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
October	57	38	48.5	2,980
November 1-9	44	27	36.1	644
March 18-31	125	56	87.7	2,440
April	68	49	56.9	3,390
May	315	57	101	6,210
June	2,180	198	590	35,100
July	638	117	265	16,300
August	143	56	86.1	5,290
September	133	44	59.0	3,510

CUT BANK CREEK AT CUT BANK, MONT.

LOCATION.—In SW. $\frac{1}{4}$ SW. $\frac{1}{4}$ 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, 1916.

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

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

CHANNEL AND CONTROL.—Rock and gravel bar about 200 feet below gage forms principal control; shifts only slightly. 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, 6.65 feet at 6 p. m. June 22 (discharge, 1,760 second-feet); minimum stage recorded, 4.10 feet September 29 (discharge, 51 second-feet).

1905-1916: 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 the 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 not permanent. Rating curves used October 1 to November 10, March 14 to May 8, and July 22 to September 30, well defined. Gage read to quarter tenths twice daily. Discharge ascertained by applying to rating table mean daily gage height except November 11-30, for which it was estimated from flow on November 10 and the discharge measurement November 29; discharge May 9 to July 21 determined by shifting-control method. Records good for periods for which rating tables were used; fair for other periods.

Discharge measurements of Cut Bank Creek at Cut Bank, Mont., during the year ending Sept. 30, 1916.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		<i>Feet.</i>	<i>Sec.-ft.</i>			<i>Feet.</i>	<i>Sec.-ft.</i>
Nov. 29	W. A. Lamb.....	^a 4.45	33	June 13	A. H. Tuttle.....	5.05	636
Jan. 27	.....do.....	^b 5.50	5.1	July 14	W. A. Lamb.....	4.96	486
Mar. 14	.....do.....	5.18	576	Aug. 14	.....do.....	4.43	152
May 20	.....do.....	4.66	309	Sept. 15	.....do.....	4.34	124

^a Measurement made from ice cover 300 feet below gage; ice about 0.6 foot thick.

^b Stage-discharge relation seriously affected by ice; ice about 2.0 feet thick. Temperature, 42° below zero.

Daily discharge, in second-feet, of Cut Bank Creek, at Cut Bank, Mont., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1.....	79	97	.....	133	230	496	992	174	103
2.....	79	97	.....	162	230	470	912	149	122
3.....	97	97	.....	140	221	438	824	140	133
4.....	97	97	.....	122	192	502	824	133	206
5.....	103	97	.....	122	272	508	816	122	192
6.....	97	97	.....	103	400	721	816	122	174
7.....	88	103	.....	103	463	664	729	110	192
8.....	79	97	.....	103	528	515	654	103	221
9.....	79	88	.....	122	463	548	646	206	240
10.....	97	103	.....	140	376	736	610	221	230
11.....	103	99	.....	162	345	776	569	221	206
12.....	97	96	.....	183	293	668	569	221	183
13.....	79	92	.....	221	288	632	496	206	149
14.....	79	88	596	221	261	668	457	183	133
15.....	79	84	432	174	286	661	425	183	110
16.....	88	80	432	183	251	816	388	162	103
17.....	97	76	339	174	240	968	357	149	103
18.....	97	72	282	174	246	1,010	351	140	88
19.....	97	68	256	192	266	1,040	322	133	88
20.....	110	64	282	183	310	1,040	288	122	73
21.....	110	60	282	149	310	1,120	288	110	73
22.....	103	56	310	149	345	1,610	256	103	73
23.....	97	52	272	140	345	1,440	240	103	73
24.....	97	48	221	149	351	1,020	221	110	73
25.....	110	45	183	133	351	936	192	122	69
26.....	110	42	174	133	413	936	192	122	62
27.....	110	39	183	149	388	928	240	133	62
28.....	103	36	183	174	419	928	230	133	62
29.....	97	33	162	240	425	1,040	206	122	51
30.....	97	30	183	256	522	1,080	192	110	62
31.....	97	.....	110	.....	528	.....	183	103	.....

Monthly discharge of Cut Bank Creek at Cut Bank, Mont., for the year ending Sept. 30, 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
October.....	110	79	95.2	5,850
November.....	103	30	75.1	4,470
March 14-31.....	596	110	271	9,680
April.....	256	103	160	9,520
May.....	528	192	340	20,900
June.....	1,610	438	880	49,400
July.....	992	183	467	28,700
August.....	221	103	144	8,850
September.....	240	51	124	7,380

TETON RIVER AT STRABANE, MONT.

LOCATION.—In SE. $\frac{1}{4}$ sec. 35, T. 25 N., R. 7 W., on highway bridge at Peeble's ranch at Strabane, Teton County, 16 miles above Chouteau.

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—November 26, 1904, to December 31, 1906; January 16, 1908, to September 30, 1916.

GAGE.—Chain gage on upstream side of bridge, half a mile north of ranch buildings; read by James Peebles, jr. Original gage was staff spiked to post on left bank about 40 feet above the head of Kroff's irrigation ditch; March 9, 1905, gage was moved by observer 250 feet upstream to avoid the effect of a dam erected at head of ditch below; May 8, 1905, when gage was checked from bench marks, it was found that datum had been raised 0.78 foot in the moving, but the difference between level of water surface at old and new sites was but 0.10 foot; gage datum was lowered on this date 0.20 foot. May 8, 1906, gage was moved $1\frac{1}{2}$ miles upstream to Mr. Bjornstad's new ranch and set at an entirely different datum. Station discontinued during 1907, and reestablished June 16, 1908, by installing an overhanging chain gage on left bank near site of gage used during 1906; relation between gage readings not known. This gage was operated until March 23, 1911, when it was moved to present site.

DISCHARGE MEASUREMENTS.—Made by wading or from bridge.

CHANNEL AND CONTROL.—Shifts occasionally; several channels at all stages, but records show total flow; beds of all channels of course gravel; water at times overflows into channels on both sides of main stream.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year 7.8 feet at 4 p. m. June 21 (discharge, 3,810 second-feet); minimum stage 3.04 feet at 11 a. m. and 4 p. m. January 13, and at 11 a. m. January 21 (discharge, 13 second-feet).

1908-1916: Maximum stage recorded 7.8 feet June 21, 1916 (discharge, 3,810 second-feet); minimum stage 3.04 feet January 13 and 21, 1916 (discharge, 13 second-feet).

ICE.—Current swift; stage-discharge relation not affected by ice.

DIVERSIONS.—Numerous diversions for irrigation, most of them below station. A large canal diverting water for the Teton Cooperative Reservoir Co., developing a Carey Act project, heads about a mile above gage.

ACCURACY.—Stage-discharge relation practically permanent during year. Rating curve well defined below 2,000 second-feet. Gage read to hundredths twice daily. Discharge ascertained by applying mean daily gage height to rating table. Records good.

Discharge measurements of Teton River at Strabane, Mont., during the year ending Sept. 30, 1916.

Date.	Made by—	Gage height.	Dis-charge.	Date.	Made by—	Gage height.	Dis-charge.
		<i>Feet.</i>	<i>Sec.-ft.</i>			<i>Feet.</i>	<i>Sec.-ft.</i>
Oct. 29	C. S. Heidel.....	3.83	92	July 12	C. S. Heidel.....	5.69	797
Apr. 25	do.....	3.79	88	Aug. 13	W. A. Lamb.....	4.59	239
June 24	W. A. Lamb.....	6.45	1,630	Sept. 1	C. S. Heidel.....	4.28	167
July 2	C. S. Heidel.....	6.37	1,530				

Daily discharge, in second-feet, of Teton River, Strabane, Mont., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1.....	109	96	69	50	14	43	62	136	154	1,990	290	174
2.....	113	92	69	43	14	44	62	128	154	1,710	290	174
3.....	109	92	69	16	14	45	64	136	208	1,440	274	174
4.....	109	93	68	16	14	46	64	154	290	1,140	260	174
5.....	109	93	68	16	14	46	63	196	340	1,090	260	174
6.....	111	92	66	16	14	48	62	233	322	1,040	260	174
7.....	109	89	66	16	14	49	62	233	290	1,040	260	174
8.....	106	89	65	15	14	50	64	208	305	1,260	260	174
9.....	106	86	65	14	14	52	64	196	340	1,090	260	164
10.....	106	85	66	14	14	81	70	154	322	1,040	260	164
11.....	106	81	66	14	14	82	76	145	305	942	260	154
12.....	106	79	65	14	16	77	76	136	322	850	260	154
13.....	103	76	65	13	22	75	75	136	402	725	246	154
14.....	103	76	64	14	29	75	75	128	425	725	233	154
15.....	103	77	63	15	46	70	79	119	425	690	233	154
16.....	103	77	63	17	100	65	84	111	590	622	233	145
17.....	102	76	60	18	96	64	89	105	690	622	233	136
18.....	100	76	57	19	82	66	89	103	725	622	233	136
19.....	97	77	54	18	69	66	86	106	895	502	233	128
20.....	99	77	57	15	66	70	86	106	1,320	425	220	136
21.....	97	77	57	13	63	74	86	105	3,450	425	220	128
22.....	97	76	57	14	62	74	86	119	2,760	425	196	128
23.....	96	76	57	14	57	72	86	119	1,710	425	185	128
24.....	96	79	56	15	52	71	86	128	1,570	402	185	136
25.....	97	80	54	16	52	70	86	119	1,320	402	174	136
26.....	96	79	54	16	50	69	86	119	1,440	402	185	136
27.....	97	76	54	14	45	65	88	128	1,640	402	174	136
28.....	97	76	56	14	43	62	92	136	1,990	380	174	136
29.....	93	74	57	14	42	64	116	136	2,140	380	174	136
30.....	95	70	57	13	.....	64	136	136	2,140	340	174	136
31.....	99	.....	57	13	.....	64	.....	154	.....	305	164	.....

NOTE.—Engineer for the Teton Cooperative Reservoir Co. estimated that the company's canal was diverting about 200 second-feet from June 12 to 17.

Monthly discharge of Teton River at Strabane, Mont., for the year ending Sept. 30, 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
October.....	113	93	102	6,270
November.....	96	70	81.4	4,840
December.....	69	54	61.3	3,770
January.....	50	13	17.1	1,050
February.....	100	14	39.5	2,270
March.....	82	43	63.3	3,890
April.....	136	62	80.0	4,760
May.....	233	103	141	8,670
June.....	3,450	154	966	57,500
July.....	1,990	305	769	47,300
August.....	290	164	228	14,000
September.....	174	128	150	8,930
The year.....	3,460	13	225	163,000

TETON RIVER NEAR CHOUTEAU, MONT.

LOCATION.—On south line of SW. $\frac{1}{4}$ sec. 25, T. 24 N., R. 5 W., at highway bridge about $1\frac{1}{2}$ 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, 1916.

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 hand rail 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 must be deducted.

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

EXTREMES OF DISCHARGE.—Maximum stage during year 8.7 feet June 21, estimated from flood marks (discharge not determinable); minimum stage recorded 2.75 feet April 11 (discharge 37 second-feet).

1904-1906, 1913, and 1915-16: Maximum stage recorded, 8.7 feet June 21, 1916 determined from flood marks (discharge not determined); minimum stage recorded August 9-16, 20, 1913 (discharge 1 second-foot). 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.

REGULATION.—Low flow during summer caused by diversions.

ACCURACY.—Stage-discharge relation changed slightly during winter period and greatly during high water in June. Rating curve used October 1 to December 27, and March 12 to June 7, fairly well defined; July 8 to September 30, fairly well defined. Gage read to hundredths to June 7, and to half tenths July 8 to September 30. Gage read daily except as noted in footnote to daily discharge table. Daily discharge ascertained by applying daily gage height to rating tables, 0.04 foot being added to gage heights October 1 to December 27, before entering table and 0.05 foot March 12 to June 7 in order to make ratings agree with measurements made October 29 and April 25. Records fair.

Discharge measurements of Teton River near Chouteau, Mont., during the year ending Sept. 30, 1916.

Date.	Made by—	Gage height.	Dis-charge.	Date.	Made by—	Gage height.	Dis-charge.
		<i>Feet.</i>	<i>Sec.-ft.</i>			<i>Feet.</i>	<i>Sec.-ft.</i>
Oct. 29	C. S. Heidel.....	2.95	55	Aug. 13	W. A. Lamb.....	5.12	153
Apr. 25	.....do.....	2.76	38.1	Sept. 1	C. S. Heidel.....	4.76	70
July 12	.....do.....	6.2	21,230	23	W. A. Lamb.....	4.69	53
July 14	W. A. Lamb.....	6.15	61,120				

^a Measured below mouth of Deep Creek. Subtract 478 second-feet, the flow of the creek, to obtain an estimate of the flow past gage.

^b Includes flow of Deep Creek (378 second-feet).

Daily discharge, in second-feet, of Teton River near Chouteau, Mont., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Dec.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1.....	55	58	58	.....	51	42	178	.....	215	75
2.....	47	60	60	.....	51	44	153	.....	198	75
3.....	45	60	60	.....	48	46	166	.....	181	75
4.....	45	58	58	.....	46	46	178	.....	198	75
5.....	52	58	58	.....	46	46	205	.....	215	75
6.....	55	60	58	.....	42	49	212	.....	206	75
7.....	60	58	58	.....	42	51	220	.....	198	75
8.....	58	59	55	.....	40	62	.....	990	190	75
9.....	60	60	55	.....	40	79	.....	690	182	97
10.....	60	60	55	.....	40	102	.....	1,070	174	97
11.....	64	63	55	.....	37	107	.....	835	166	97
12.....	66	66	55	62	40	120	.....	760	158	86
13.....	66	66	55	62	42	137	.....	760	150	75
14.....	60	66	55	73	42	142	.....	725	150	80
15.....	64	64	52	73	42	153	.....	690	150	86
16.....	60	60	55	73	44	158	.....	690	150	86
17.....	60	60	52	62	42	166	.....	655	150	75
18.....	56	63	50	62	42	150	.....	620	215	66
19.....	58	60	52	62	42	134	.....	550	215	56
20.....	58	59	53	62	42	118	.....	526	254	56
21.....	60	58	54	67	42	102	.....	503	215	56
22.....	60	58	54	67	42	102	.....	480	150	56
23.....	62	60	55	62	42	100	.....	480	150	56
24.....	60	63	52	62	42	125	.....	448	136	56
25.....	58	62	52	62	42	150	.....	416	122	56
26.....	58	60	50	56	42	300	.....	387	122	56
27.....	58	60	50	51	42	220	.....	358	98	56
28.....	58	60	.....	51	42	178	.....	329	75	56
29.....	55	60	.....	51	42	166	.....	300	75	56
30.....	56	58	.....	51	42	146	.....	281	75	56
31.....	58	.....	.....	56	.....	142	.....	253	75	.....

NOTE.—Discharge interpolated for lack of gage readings Nov. 8, 20, 25; Dec. 20-22; Apr. 19-20; May 18-20; June 6; July 17, 20, 21, 24, 26-28, 30, 31; Aug. 2, 4, 6-12, 16, 24, 27, 30, 31; Sept. 4, 6, 10, 12, 14, 18, 20-22, 25, 27, 29. Discharge May 23-26 estimated from observer's notes and by comparison with record of flow at near-by stations. No gage-height record Dec. 28 to Mar. 11, June 8-22, 25-30, July 1-2, 4-5 and 7.

Monthly discharge of Teton River near Chouteau, Mont., for the year ending Sept. 30, 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
October.....	66	45	57.8	3,550
November.....	66	58	60.6	3,610
December 1-27.....	60	50	54.7	2,930
March 12-31.....	73	51	61.4	2,440
April.....	51	37	42.7	2,540
May.....	.....	42	119	7,320
June 1-7.....	220	153	187	2,600
July 8-31.....	1,070	.....	575	27,400
August.....	254	75	162	9,960
September.....	97	56	70.6	4,200

DEEP CREEK NEAR CHOUTEAU, MONT.

LOCATION.—In SW. $\frac{1}{4}$ NW. $\frac{1}{4}$ 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, 1916.

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.—Bed composed of gravel. Bar of gravel about 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, 10.5 feet, at 7 a. m. June 21 (discharge, determined from extension of rating curve, 3,050 second-feet); minimum stage recorded, 5.5 feet, November 11, and December 21, (discharge 24 second-feet).

1911-1916: Maximum stage recorded, 10.5 feet 7 a. m., June 21, 1916 (discharge determined 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; observations discontinued during winter months.

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

REGULATION.—None.

ACCURACY.—Stage-discharge relation practically permanent. Rating curve well defined below 700 second-feet. Gage read to half tenths once daily. Discharge ascertained by applying daily gage height to rating table. Records good except those for periods in which stage-discharge relation was affected by ice, which are fair.

Discharge measurements of Deep Creek near Chouteau, Mont., during the year ending Sept. 30, 1916.

[Made by W. A. Lamb.]

Date.	Gage height.	Dis-charge.	Date.	Gage height.	Dis-charge.	Date.	Gage height.	Dis-charge.
	<i>Feet.</i>	<i>Sec.-ft.</i>		<i>Feet.</i>	<i>Sec.-ft.</i>		<i>Feet.</i>	<i>Sec.-ft.</i>
Oct. 9.....	5.75	49.0	June 25.....	8.21	21, 280	Aug. 12.....	6.11	116
Apr. 21.....	5.80	59.	July 13.....	6.91	360.	Sept. 23.....	5.74	54.

^a Velocity determined by means of floats and coefficient of 0.85 used to reduce to mean velocity.

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Daily discharge, in second-feet, of Deep Creek near Chouteau, Mont., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Dec.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	54	38	44		51	51	86	227	1,210	155	67
2	54	38	38		51	51	96	244	980	155	58
3	47	38	38		51	51	96	227	1,450	130	107
4	47	38	38		28	51	96	260	1,060	130	182
5	47	38	38		28	51	123	316	770	118	130
6	50	38	35		33	51	142	356	676	118	107
7	50	38	38		33	51	168	296	617	130	76
8	54	38	38		33	51	196	278	1,530	107	86
9	52	33	33		260	51	168	278	1,230	130	67
10	51	33	33		316	51	155	316	738	142	118
11	51	24	28		260	51	130	296	560	142	107
12	51	27	33		196	76	118	260	478	130	76
13	51	30	33		196	67	118	244	402	118	76
14	47	33	33		86	58	107	244	378	155	76
15	44	33	33		58	58	107	200	335	107	86
16	44	38	33		76	67	107	316	316	96	76
17	44	33	28		67	67	96	378	278	96	58
18	44	33	33		67	67	96	426	426	168	67
19	44	38	33		76	67	86	402	296	130	51
20	44	38	33		76	58	96	452	260	107	
21	44	38	24		67	58	118	3,050	227	107	51
22	44	38	33		67	58	118	2,410	212	86	58
23	44	44	33		58	58	107	1,770	196	76	51
24	42	51	33		58	58	118	1,370	196	76	51
25	42	51	33		58	58	212	1,210	182	76	58
26	42	44	33		58	51	452	1,130	168	118	58
27	42	46		51	51	58	426	1,130	196	96	58
28	38	48		51	51	76	532	1,290	316	76	76
29	38	51		51	51	96	316	1,530	260	76	58
30	38	51			51	96	278	1,610	212	67	67
31	38				51		244		182	58	

NOTE.—Discharge for following days interpolated because of ice effect: Nov. 12, 13, 27, 28, Dec. 19, 24–26, Mar. 1 and 2. Gage not read Dec. 27 to Feb. 26. Discharge Dec. 27–31, estimated 30 second-feet. Discharge June 22 interpolated; gage not read.

Monthly discharge of Deep Creek near Chouteau, Mont., for the year ending Sept. 30, 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
October	54	38	45.9	2,820
November	51	24	38.6	2,300
December	44	24	33.3	2,050
January 27–29	51	51	51.0	303
March	316	28	85.9	5,280
April	96	51	60.4	3,590
May	532	86	171	10,500
June	3,050	227	753	44,800
July	1,530	168	529	32,500
August	168	58	112	6,890
September	182	51	77.2	4,590

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, 1916.

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

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

CHANNEL AND CONTROL.—A gravel bar 30 feet below the gage is the control; slightly shifting. Banks about 4 feet high; subject to overflow only at extreme flood stages.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 6.60 feet at 5.30 p. m. June 21 (discharge 880 second-feet); minimum stage, 1.54 feet at 3 p. m. November 10 (discharge, 9 second-feet).

1912-1916: 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 diversions above the station, mostly to water hay land; very little water used except during very dry periods.

REGULATION.—None.

ACCURACY.—Stage-discharge relation not permanent; affected by growth of moss and weeds during summer and seriously affected by ice during winter. Two fairly well defined rating curves used, one applicable October 1 to December 20, the other March 12 to July 18 and September 15-30. Gage read to quarter tenths once daily. Discharge ascertained by applying daily gage height to rating tables, except for period July 19 to September 4, for which it was obtained by shifting-control method. Records fair.

Discharge measurements of Willow Creek near Chouteau, Mont., during the year ending Sept. 30, 1916.

[Made by W. A. Lamb.]

Date.	Gage height.	Dis-charge.	Date.	Gage height.	Dis-charge.	Date.	Gage height.	Dis-charge.
	<i>Feet.</i>	<i>Sec.-ft.</i>		<i>Feet.</i>	<i>Sec.-ft.</i>		<i>Feet.</i>	<i>Sec.-ft.</i>
Oct. 9.....	1.71	18.5	June 24.....	4.24	386.	Aug. 13.....	2.04	a 31.6
Apr. 21.....	1.87	24.4	July 13.....	2.45	86	Sept. 23.....	1.66	12.9

a Moss on control.

Daily discharge in second-feet, of Willow Creek near Chouteau, Mont., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Dec.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1.....	16	10	13	.....	26	34	113	305	40	24
2.....	14	10	13	.....	30	32	100	233	26	35
3.....	14	12	13	.....	26	30	93	206	21	60
4.....	13	12	13	.....	26	34	100	133	26	57
5.....	14	13	13	.....	29	30	106	142	32	46
6.....	16	13	13	.....	26	30	93	135	33	36
7.....	16	12	13	.....	26	34	86	128	33	29
8.....	18	12	13	.....	24	39	73	190	25	18
9.....	19	10	13	.....	29	34	73	174	29	29
10.....	19	9	13	.....	26	30	70	166	37	33
11.....	18	10	13	.....	30	34	67	150	41	29
12.....	16	13	12	113	34	30	61	128	36	29
13.....	16	13	12	128	32	30	58	86	32	33
14.....	16	13	12	86	30	29	55	74	30	28
15.....	16	12	10	73	30	26	52	74	26	23
16.....	16	12	10	61	30	30	49	80	25	23
17.....	16	12	12	49	30	34	41	74	37	20
18.....	14	13	12	44	30	30	49	70	33	17
19.....	14	12	13	39	29	26	61	62	23	16
20.....	14	12	13	39	26	23	206	57	25	16
21.....	13	13	.....	49	26	20	880	46	26	14
22.....	13	13	.....	39	26	17	858	40	22	13
23.....	13	13	.....	30	24	17	600	37	19	13
24.....	13	19	.....	34	23	30	381	35	16	17
25.....	13	18	.....	30	20	72	343	33	19	12
26.....	13	18	.....	30	17	113	287	33	23	14
27.....	12	16	.....	30	17	174	251	57	20	17
28.....	12	14	.....	30	20	182	305	102	18	20
29.....	12	13	.....	30	23	174	224	96	17	23
30.....	12	13	.....	23	30	158	498	81	18	23
31.....	10	.....	.....	23	.....	142	.....	56	20	.....

NOTE.—Discharge Dec. 21-31 estimated, because of ice, at 12 second-feet. Gage not read Jan. 1 to Mar. 11.

Monthly discharge of Willow Creek near Chouteau, Mont., for the year ending Sept. 30, 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
October.....	19	10	14.5	892
November.....	19	9	12.8	762
December.....	13	10	12.3	756
March 12-31.....	128	23	49.0	1,940
April.....	34	17	26.5	1,580
May.....	182	17	55.4	3,410
June.....	880	41	208	12,400
July.....	305	33	105	6,460
August.....	41	16	26.9	1,650
September.....	60	12	25.6	1,520

MUDDY CREEK NEAR BYNUM, MONT.

LOCATION.—In NW. $\frac{1}{4}$ SE. $\frac{1}{4}$ sec. 22, T. 26 N., R. 6 W., 400 feet above mouth of Blackleaf Creek and about 2 miles above Bynum, in Teton County.

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—May 24, 1912, to September 30, 1916.

GAGE.—Vertical staff on right bank; read by George Miller. A temporary vertical staff about 20 feet downstream was used June 23 to July 20, 1916, to replace regular gage, which had been washed out; July 21 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 during year, 6.9 feet June 21, determined by leveling from flood marks (discharge, determined from extension of rating curve, 976 second-feet); minimum stage recorded, 2.25 feet October 29-31 and November 7-9 (discharge 0.5 second-foot).

1912-1916: Maximum stage recorded June 21, 1916; channel dry August 18, 23, 24, 31; September 1-3, 10, 29; and October 7, 1912.

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

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

REGULATION.—None.

ACCURACY.—Stage-discharge relation practically permanent during year. Rating curve used October 1 to November 26 fairly well defined; curve used March 24 to September 30 well defined below 600 second-feet. Gage read to quarter tenths once daily; during high water read oftener. 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, 1916.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		<i>Feet.</i>	<i>Sec.-ft.</i>			<i>Feet.</i>	<i>Sec.-ft.</i>
Oct. 29	C. S. Heidel.....	2.27	1.0	July 12	C. S. Heidel.....	3.32	62
Apr. 25	.....do.....	2.41	2.5	Aug. 13	W. A. Lamb.....	2.63	9.6
June 23	W. A. Lamb.....	5.30	500	Sept. 1	C. S. Heidel.....	2.50	3.7
July 2	C. S. Heidel.....	4.00	172				

Daily discharge, in second-feet, of Muddy Creek near Bynum, Mont., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1.....	1.0	0.8	-----	8.0	2.0	14	192	13	3.6
2.....	1.0	.8	-----	8.0	2.4	13	172	13	3.6
3.....	1.0	.8	-----	7.2	2.0	10	333	12	10
4.....	1.0	.8	-----	4.8	2.0	9.0	153	8.0	32
5.....	1.0	.8	-----	4.8	2.0	9.0	102	8.0	16
6.....	1.0	.8	-----	4.0	2.0	12	87	8.0	10
7.....	1.0	.5	-----	4.0	2.0	14	87	19	10
8.....	1.0	.5	-----	3.6	2.0	13	118	14	6.0
9.....	1.0	.5	-----	3.6	2.0	12	202	13	4.8
10.....	1.0	1.0	-----	3.6	1.7	14	102	22	4.8
11.....	1.0	1.0	-----	4.0	2.0	13	80	20	7.2
12.....	1.0	1.0	-----	3.6	2.0	12	62	14	4.8
13.....	1.0	1.0	-----	3.6	2.0	10	55	10	4.0
14.....	1.0	1.0	-----	3.6	2.0	9.0	50	9.0	4.0
15.....	1.0	1.0	-----	3.0	2.0	8.0	45	7.2	4.8
16.....	1.0	1.0	-----	3.0	2.0	8.0	36	6.0	4.8
17.....	.8	1.0	-----	3.6	2.0	10	32	4.0	4.0
18.....	.8	1.0	-----	3.6	2.0	12	50	8.0	3.6
19.....	.8	1.0	-----	3.6	2.0	12	45	18	3.6
20.....	.8	1.0	-----	3.6	2.0	18	34	12	3.6
21.....	.8	1.0	-----	3.6	2.0	976	25	10	3.6
22.....	.8	1.0	-----	3.6	1.7	946	22	4.0	3.6
23.....	.8	1.0	-----	3.6	2.0	706	19	4.0	3.0
24.....	.8	1.0	4.0	3.6	2.4	360	18	3.6	3.0
25.....	.8	1.0	4.8	2.2	3.6	360	16	3.6	3.0
26.....	.8	1.0	6.0	2.4	12	307	16	6.0	2.0
27.....	.8	-----	4.0	2.4	102	307	32	4.0	2.4
28.....	.8	-----	4.0	2.4	102	444	28	4.0	3.6
29.....	.5	-----	4.0	2.0	33	766	25	4.0	4.0
30.....	.5	-----	4.8	2.0	26	360	19	4.0	4.0
31.....	.5	-----	6.0	-----	18	-----	18	3.6	-----

NOTE.—Gage out June 21–22; discharge estimated from high-water marks and extension of rating curve. Stage-discharge relation seriously affected by ice Nov. 27 to Dec. 4; data inadequate for determination of discharge. Gage not read Dec. 5 to Mar. 23.

Monthly discharge of Muddy Creek near Bynum, Mont., for the year ending Sept. 30, 1919.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
October.....	1.0	0.5	0.87	53
November 1–26.....	1.0	0.5	.90	46
March 24–31.....	6.0	4.0	4.70	75
April.....	8.0	2.0	3.82	227
May.....	102	1.7	11.1	682
June.....	976	8.0	192	11,400
July.....	333	16	73.4	4,510
August.....	22	3.6	9.32	573
September.....	32	2.0	5.91	352

α Crest stage; discharge determined from elevation of high-water marks and extension of rating curve.

BLACKLEAF CREEK NEAR BYNUM, MONT.

LOCATION.—In NW. $\frac{1}{4}$ SE. $\frac{1}{4}$ sec. 22, T. 26 N., R. 6 W., about 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, 1916.

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

DISCHARGE MEASUREMENTS.—Made by wading near gage.

CHANNEL AND CONTROL.—Banks fairly high; overflow not probable. Stream bed fine sand and gravel; shifts occasionally.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 5.85 feet June 21, determined by leveling from flood marks (discharge, determined from extension of rating curve, 600 second-feet); minimum stage recorded 2.02 feet March 26–27 (discharge 4.5 second-feet).

1912–1916: Maximum stage recorded June 21, 1916; channel “dry” July 21 to October 3, 1914.

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

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

REGULATION.—None.

ACCURACY.—Stage-discharge relation not permanent, as channel shifts occasionally. Rating curves used as follows: October 1 to December 4, fairly well defined; March 24 to June 20, fairly well defined; June 21 to September 30, well defined below 400 second-feet. Gage read to quarter tenths twice daily during periods of changing stage and high water, and once daily during periods of nearly uniform flow. Daily discharge ascertained by applying mean daily gage height to rating table. Record fair October 1 to December 4, March 24 to June 20, and good June 21 to September 30.

Discharge measurements of Blackleaf Creek near Bynum, Mont., during the year ending Sept. 30, 1916.

Date.	Made by—	Gage height.	Dis-charge.	Date.	Made by—	Gage height.	Dis-charge.
		<i>Feet.</i>	<i>Sec.-ft.</i>			<i>Feet.</i>	<i>Sec.-ft.</i>
Oct. 29	C. S. Heidel.....	2.00	5.0	July 12	C. S. Heidel.....	3.86	49.7
Apr. 25	.....do.....	2.12	6.3	Aug. 13	W. A. Lamb.....	3.50	19.7
June 23	W. A. Lamb.....	5.14	342	Sept. 1	C. S. Heidel.....	3.31	8.8
July 2	C. S. Heidel.....	4.34	119.				

Daily discharge, in second-feet, of Blackleaf Creek near Bynum, Mont., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Dec.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1.....	8.8	6.5	7.4	.....	10.	8.6	43	137	28	8.5
2.....	7.4	7.4	8	.....	9.5	13	37	122	26	10
3.....	8.0	7.4	11	.....	9.5	12	32	236	23	18
4.....	10	8.0	11	.....	8.9	9.2	31	124	21	47
5.....	8.8	8.0	.....	.....	7.1	7.7	27	81	21	27
6.....	8.8	7.4	.....	.....	7.1	6.8	25	72	19	18
7.....	11	7.4	.....	.....	7.1	12	25	62	17	16
8.....	12	6.5	.....	.....	7.1	6.8	23	96	16	13
9.....	11	5.6	.....	.....	7.1	6.2	21	168	35	12
10.....	8.0	8.8	.....	.....	7.1	5.8	21	91	36	12
11.....	8.8	10	.....	.....	8.9	6.2	21	63	28	10
12.....	8.8	10	.....	.....	10	6.8	19	50	27	12
13.....	8.0	11	.....	.....	8.9	6.8	17	42	24	18
14.....	8.0	11	.....	.....	8.9	6.8	15	39	20	22
15.....	8.0	10	.....	.....	8.0	8.6	14	33	16	24
16.....	8.0	10	.....	.....	7.1	8.6	13	32	12	20
17.....	7.4	6.5	.....	.....	7.4	8.6	12	30	9.5	18
18.....	6.5	5.6	.....	.....	7.4	7.7	12	50	18	16
19.....	7.4	10	.....	.....	7.4	6.8	12	48	22	15
20.....	6.5	10	.....	.....	7.4	6.2	18	33	15	13
21.....	5.6	7.4	.....	.....	7.4	5.8	600	28	12	12
22.....	5.6	7.4	.....	.....	7.4	5.8	580	24	10	12
23.....	5.6	6.5	.....	.....	7.4	5.8	450	28	9.5	12
24.....	5.6	6.5	.....	8.0	7.4	7.7	207	33	8.0	12
25.....	5.6	5.6	.....	6.0	7.1	11	180	28	6.8	12
26.....	5.6	5.6	.....	4.5	7.1	19	168	30	60	10
27.....	5.6	8.0	.....	4.5	7.1	134	144	40	38	12
28.....	5.6	7.4	.....	7.1	7.1	134	504	39	22	15
29.....	5.0	6.5	.....	7.1	7.1	69	580	39	13	18
30.....	5.0	7.4	.....	8.0	8.0	53	266	23	13	15
31.....	5.6	.....	.....	8.9	.....	44	.....	30	10	.....

NOTE.—Discharge, June 21, 22, and 29, determined from high water marks; June 23, by average estimated flow for the morning, when stage was too high for the observer to cross river, with that corresponding to gage reading in afternoon. Gage not read Dec. 5 to Mar. 23.

Monthly discharge of Blackleaf Creek near Bynum, Mont., for the year ending Sept. 30, 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
October.....	12	5.0	7.47	459
November.....	11	5.6	7.85	467
December 1-4.....	11	7.4	9.35	74
March 24-31.....	8.9	4.5	6.76	107
April.....	10	7.1	7.83	466
May.....	134	5.8	21.0	1,290
June.....	600	12	137	8,150
July.....	236	24	63.3	3,890
August.....	60	6.8	20.5	1,260
September.....	47	8.5	16.0	952

^a Crest stage; estimated from elevation of high-water marks and extension of rating curve.

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, 1916.

GAGES.—Chain gage on upstream side of public highway bridge; read by W. G. Yamamoto. Before October, 1908, a staff gage fastened to the center of old highway bridge; April 10, 1919, a temporary staff gage was installed which read 0.73 foot high and which 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 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 forced to pass under bridge as wagon road is filled and graded almost to the level of bridge floor.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 2.74 feet at 6.40 a. m. June 22 (discharge, 1,240 second-feet); minimum stage 0.33 foot at 6.40 a. m. and 6.30 p. m. September 4 (discharge 25 second-feet).

1907-1916: Maximum stage recorded, 4.85 feet, May 30-31, 1908 (discharge 2,940 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 the Musselshell above station.

REGULATION.—None.

ACCURACY.—Stage-discharge relation unchanged during year. Rating curve well defined above 40 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 Musselshell River at Harlowton, Mont., during the year ending Sept. 30, 1916.

[Made by C. S. Heidel.]

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	<i>Feet.</i>	<i>Sec.-ft.</i>		<i>Feet.</i>	<i>Sec.-ft.</i>
Oct. 8.....	1.18	203	July 25.....	0.79	85
June 1.....	2.11	722	Sept. 23.....	.56	47.7

Daily discharge, in second-feet, of Musselshell River at Harlowton, Mont., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1.....	226	142	.....	170	305	715	680	64	27
2.....	221	142	.....	177	278	750	645	52	27
3.....	217	142	.....	185	250	715	645	49	27
4.....	217	142	.....	174	256	680	612	46	25
5.....	217	142	.....	163	296	715	549	42	27
6.....	217	142	.....	139	353	860	458	46	29
7.....	213	142	.....	136	458	750	4' 0	51	33
8.....	209	176	.....	136	612	715	373	52	34
9.....	209	124	.....	139	549	715	329	51	37
10.....	213	112	.....	149	518	822	378	47	39
11.....	217	107	.....	174	458	900	329	46	41
12.....	209	100	.....	201	430	785	282	45	41
13.....	197	100	.....	287	430	715	226	45	42
14.....	197	100	.....	234	430	645	193	45	43
15.....	185	100	.....	243	403	645	170	45	47
16.....	181	100	.....	274	378	680	160	43	47
17.....	174	.....	.....	256	353	715	146	42	47
18.....	170	.....	.....	247	353	715	133	42	47
19.....	160	.....	329	230	353	785	124	42	43
20.....	160	.....	329	226	378	822	110	39	43
21.....	149	.....	353	217	430	1,060	107	38	46
22.....	146	.....	353	226	488	1,200	107	36	47
23.....	142	.....	292	226	458	1,020	100	34	47
24.....	142	.....	234	213	458	900	95	32	47
25.....	142	.....	197	209	715	822	86	33	47
26.....	142	.....	170	217	680	822	82	34	47
27.....	142	.....	156	217	549	822	72	33	48
28.....	142	.....	160	263	518	860	70	32	51
29.....	142	.....	181	323	549	940	74	29	51
30.....	142	.....	177	329	580	900	70	29	53
31.....	142	.....	166	.....	645	.....	65	27	.....

NOTE.—Stage-discharge relation seriously affected by ice Nov. 17 to Dec. 25. No gage-height record Dec. 26 to Mar. 18.

Monthly discharge of Musselshell River at Harlowton, Mont., for the year ending Sept. 30, 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
October.....	226	142	180	11,100
November 1-16.....	142	100	123	3,900
March 19-31.....	353	156	238	6,140
April.....	329	136	213	12,700
May.....	715	256	449	27,600
June.....	1,200	645	806	48,000
July.....	680	65	255	15,700
August.....	64	27	41.6	2,560
September.....	53	25	41.0	2,440

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.—Not measured.

RECORDS AVAILABLE.—May 1, 1911, to September 30, 1916.

GAGE.—Vertical staff just below the 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 stream bed during summer; control shifts.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 5.3 feet June 29 (discharge, 180 second-feet); minimum stage 2.3 feet August 8–12, 14, and September 1–2 (discharge, 21 second-feet).

1911–1916: Maximum stage recorded, 7.6 feet June 13, 1913 (discharge, 307 second-feet); minimum stage, 2.1 feet September 3–4, 1912 (discharge, 1.0 second-foot).

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

DIVERSIONS.—Numerous above gage.

REGULATION.—None.

ACCURACY.—Stage-discharge relation changed by ice during the winter. Rating curve used October and November well defined; curve used March 20 to September 30 well defined below 100 second-feet. Gage read once daily to tenths.

Discharge ascertained by applying daily gage height to rating table. Records good.

Discharge measurements of Flatwillow Creek near Flatwillow, Mont., during the year ending Sept. 30, 1916.

[Made by C. S. Heidel.]

Date.	Gage height.	Dis-charge.	Date.	Gage height.	Dis-charge.
	<i>Feet.</i>	<i>Sec.-ft.</i>		<i>Feet.</i>	<i>Sec.-ft.</i>
Oct. 7.....	3.24	52	July 26.....	2.99	48.4
June 2.....	3.41	68	Sept. 22.....	2.41	24.9

Daily discharge, in second-feet, of Flatwillow Creek near Flatwillow, Mont., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1.....	50	50	.....	46	38	67	128	32	21
2.....	50	50	.....	46	38	67	122	32	21
3.....	55	50	.....	46	38	67	110	32	22
4.....	55	55	.....	46	38	77	93	32	22
5.....	53	53	.....	44	36	72	88	28	26
6.....	55	55	.....	42	30	67	88	24	24
7.....	55	55	.....	42	30	67	88	22	26
8.....	55	50	.....	42	30	67	77	21	24
9.....	55	50	.....	38	30	72	67	21	28
10.....	53	50	.....	40	32	82	67	21	30
11.....	55	50	.....	42	30	77	82	21	28
12.....	55	50	.....	46	26	77	77	21	32
13.....	55	50	.....	46	38	77	72	22	34
14.....	55	50	.....	46	38	77	72	21	28
15.....	53	50	.....	49	40	58	67	24	30
16.....	55	50	.....	46	34	38	67	28	28
17.....	55	50	.....	46	34	40	67	30	28
18.....	55	50	.....	42	34	46	67	28	26
19.....	55	50	.....	42	30	58	67	28	28
20.....	48	48	67	44	32	77	60	28	26
21.....	50	50	60	42	30	140	58	28	26
22.....	50	80	60	42	30	98	58	28	24
23.....	50	55	56	42	30	98	51	30	26
24.....	50	62	56	38	34	88	53	28	22
25.....	48	57	53	40	58	93	51	28	24
26.....	50	50	51	38	67	88	49	26	24
27.....	50	50	51	38	56	110	46	26	28
28.....	50	50	51	38	56	160	49	26	26
29.....	50	50	46	38	60	180	44	28	28
30.....	48	50	49	40	62	134	40	26	28
31.....	50	.....	46	.....	60	.....	36	22	.....

NOTE.—Discharge Nov. 8–17 and 28–30 estimated because of ice. Considerable run-off during February and the first half of March; water flowed on top of ice. Data inadequate for determination of discharge, Dec. 1 to Mar. 19.

Monthly discharge of Flatwillow Creek near Flatwillow, Mont., for the year ending Sept. 30, 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
October.....	55	48	52.4	3,220
November.....			51.3	3,050
March 20-31.....	67	46	53.8	1,280
April.....	49	38	42.6	2,530
May.....	67	26	39.3	2,420
June.....	180	38	84.0	5,000
July.....	128	36	69.7	4,290
August.....	32	21	26.2	1,610
September.....	34	21	26.3	1,560

MILK RIVER BASIN.

SOUTH FORK OF MILK RIVER NEAR BROWNING, MONT.

LOCATION.—In SW. $\frac{1}{4}$ sec. 29, T. 37 N., R. 9 W., at Richard Croff's ranch, just above Kennedy Coulee, in Teton County, 6 miles south of international boundary and about 30 miles northeast of Browning.

DRAINAGE AREA.—288 square miles.

RECORDS AVAILABLE.—April 28, 1905, to September 30, 1916.

GAGE.—Stevens water-stage recorder installed April 12, 1913, on left bank opposite the house of the observer, Wm. Welch; April 28 to May 8, 1905, a staff; May 8, 1905, to April 13, 1913, an overhanging chain gage. Datum unchanged.

DISCHARGE MEASUREMENTS.—Made from cable 150 feet above 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 high and not subject to overflow except at extremely high stages.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 8.6 feet February 16 (discharge, 2,840 second-feet); minimum stage, 2.60 feet, January 17 and 26 (discharge, 19 second-feet).

1905-1916: 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 not permanent; affected by aquatic growth in channel and ice. Rating curves used as follows: October 1 to November 10, fairly well defined; November 27 to March 11, fairly well defined between 50 and 170 second-feet; April 2 to June 2 and July 1 to September 30, well defined between 40 and 1,520 second-feet. Stage-discharge relation November 11, 12 and 29, affected by ice; assumed not affected rest of season, the assumption being based on comparison with records of flow of other streams, study of hydrographs and weather records. Chain gage read twice daily to hundredths October 1 to November 12, once daily to half tenths, November 27 to March 10, July 8-18, and September 20-30; stage during rest of year ascertained from recordergraph by inspection. Daily discharge ascertained by applying mean daily gage height to rating table except for periods during which stage-discharge relation was affected by shifting control, or ice, or days of considerable fluctuation. Records good.

COOPERATION.—Station maintained in cooperation with the Irrigation Branch, Department of the Interior, Canada.

Discharge measurements of South Fork of Milk River near Browning, Mont., during the year ending Sept. 30, 1916.

Date.	Made by—	Gage height.	Dis-charge.	Date.	Made by—	Gage height.	Dis-charge.
		<i>Fect.</i>	<i>Sec.-ft.</i>			<i>Fect.</i>	<i>Sec.-ft.</i>
Oct. 8	V. A. Newhall ^a	3.31	104	June 1	S. H. Frame.....	4.25	395
Nov. 11	W. H. Storey ^a	3.09	64	11	A. H. Tuttle.....	4.45	411
27	W. A. Lamb.....	2.91	52	21	S. H. Frame.....	4.38	433
Dec. 7	W. H. Storey.....	2.93	59	27	do.....	4.35	468
Mar. 11	W. A. Lamb.....	6.25	1,430	July 19	W. A. Lamb.....	3.35	146
17	S. H. Frame ^a	3.86	229	27	W. A. Burton ^a	3.15	95
Apr. 7	do.....	3.47	157	Aug. 22	W. A. Lamb.....	3.01	77
26	do.....	3.41	150	Sept. 6	S. H. Frame.....	3.22	113
26	W. A. Lamb.....	3.45	156	19	W. A. Lamb.....	2.83	52
May 24	Tuttle and Lamb.....	3.70	225	28	S. H. Frame.....	2.88	53

^a Engineer, Irrigation Branch, Department of the Interior, Canada.

^b Stage-discharge relation affected by ice.

Daily discharge, in second-feet, of South Fork of Milk River near Browning, Mont., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1.....	67	60	52	28	28	75	220	194	419	467	85	59
2.....	68	62	52	24	28	75	257	266	509	338	72	59
3.....	88	64	52	28	28	75	225	251	334	314	65	95
4.....	97	66	57	28	34	83	184	239	266	304	60	279
5.....	99	66	62	28	34	75	165	242	266	269	56	202
6.....	94	67	67	28	28	75	147	239	338	242	56	112
7.....	104	51	56	28	28	75	158	234	266	217	55	87
8.....	101	39	60	28	24	111	174	234	223	217	53	77
9.....	97	42	60	28	28	900	201	207	201	217	84	71
10.....	101	50	52	28	28	1,640	214	201	291	191	222	70
11.....	91	64	52	28	28	1,520	217	186	381	167	167	68
12.....	96	63	52	28	34	1,300	242	184	334	179	121	66
13.....	91	62	52	28	34	777	234	184	251	145	100	65
14.....	90	61	52	28	34	568	204	186	231	145	107	58
15.....	102	60	52	28	39	448	217	191	217	145	100	62
16.....	97	60	39	24	2,840	346	251	194	223	125	80	59
17.....	88	59	39	19	1,880	308	214	186	228	145	74	58
18.....	80	58	28	24	1,260	293	196	174	239	145	104	53
19.....	70	57	28	28	792	281	196	165	257	135	147	49
20.....	61	56	34	28	1,230	314	189	160	359	116	111	48
21.....	70	55	28	28	900	355	177	158	431	109	92	47
22.....	70	55	34	28	359	314	177	156	545	102	77	47
23.....	64	54	34	24	359	234	174	158	616	100	74	46
24.....	64	53	34	24	359	199	181	196	439	98	68	45
25.....	61	52	39	24	341	191	174	260	359	97	65	49
26.....	61	52	34	19	275	186	152	322	381	97	64	49
27.....	60	52	34	24	92	207	169	616	460	120	71	53
28.....	70	52	28	28	92	212	204	626	484	154	70	56
29.....	67	52	28	28	83	189	212	484	536	112	65	58
30.....	61	52	28	34	-----	179	201	592	670	100	64	59
31.....	61	-----	28	28	-----	174	-----	451	-----	93	60	-----

NOTE.—Discharge Mar. 12 to Apr. 1 and June 3-30, computed by shifting-control method. Discharge Mar. 12, 13, 15-18, May 26, 27, 29, June 28, 29, July 1, Aug. 9, 10, and Sept. 3-5, ascertained by weighting the results obtained by applying gage heights for parts of days to rating table. Discharge estimated, because of ice, Nov. 11, 12, and 29, and interpolated because of missing gage heights Nov. 2-5, 13-26, Dec. 4, 5, 30, 31, Jan. 5-10, July 8, Sept. 20-23, 26, 27, and 28. See "Accuracy" in description of station.

Monthly discharge of South Fork of Milk River near Browning, Mont., for the year ending Sept. 30, 1916.

[Drainage area, 288 square miles.]

Month.	Discharge in second-feet.				Run-off.	
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.
October.....	104	60	80.4	0.279	0.32	4,940
November.....	67	39	56.5	.196	.22	3,360
December.....	67	28	43.5	.151	.17	2,660
January.....	34	19	26.7	.093	.11	1,640
February.....	2,840	24	390	1.35	1.46	22,400
March.....	1,640	75	380	1.32	1.52	23,400
April.....	257	147	198	.688	.77	11,800
May.....	626	156	262	.910	1.05	16,100
June.....	670	201	358	1.24	1.38	21,300
July.....	467	93	174	.604	.70	10,700
August.....	222	53	86.7	.301	.35	5,330
September.....	279	45	73.5	.255	.28	4,370
The year.....	2,840	19	176	.611	8.33	128,000

MILK RIVER AT INTERNATIONAL BOUNDARY.

LOCATION.—In SE. $\frac{1}{4}$ sec. 3, T. 1, R. 5 W. fourth meridian, Alberta, Canada, at international boundary, 30 miles north of Rudyard, in Hill County, Mont., the nearest railroad station.

DRAINAGE AREA.—2,514 square miles (measured by Irrigation Branch, Department of the Interior, Canada.)

RECORDS AVAILABLE.—April 1, 1913, to September 30, 1916. From August 7, 1909, to April 1, 1913, station was maintained by Canada.

GAGE.—Gurley printing water-stage recorder on left bank, installed August 13, 1913. At the station maintained by Canada readings were obtained from a staff gage on the right bank about 1,000 feet above site of present gage. Gage read by Frank Galloway.

DISCHARGE MEASUREMENTS.—Made from cable about 1,000 feet above gage, or by wading near the gage.

CHANNEL AND CONTROL.—Bed of stream sandy; shifting. Banks high above and below gage; not subject to overflow at ordinary high stages.

EXTREMES OF DISCHARGE.—Maximum discharge during year estimated at 3,500 second-feet, July 3; minimum discharge estimated at 18 second-feet January 1 to February 14.

1909–1916: Maximum discharge estimated at 3,500 second-feet July 3, 1916; channel reported dry August 3–17, 22, 23, 1914.

ICE.—Stage-discharge relation seriously affected by ice; flow estimated from discharge measurements, weather records and observer's notes, and flow at near-by stations.

DIVERSIONS.—None.

REGULATION.—None.

ACCURACY.—Stage-discharge relation not permanent because of shifting control and effect of ice. Numerous discharge measurements necessary to determine the flow; 19 measurements made during the year ending September 30, 1916. Two rating curves, each well defined except at high stages, were used, one applicable April 17 to May 5 and September 7–13, the other applicable June 15 to September 6. Discharge March 14–28 based on measurements and gage heights referred to gage at cable. Mean daily gage height October 1 to December 25, and March 29 to September 30 obtained by averaging gage heights registered every 15 minutes by Gurley weight-driven recorder. Gage heights January 2 to February 22, and March 14 were read on outside staff gage at recorder; gage heights March 15–28 were

read on staff gage at cable. No readings obtained December 26 to January, 1 and February 23 to March 13. Gage read to hundredths at low stages and to half tenths at high stages. Stage-discharge relation affected by ice November 11 to March 13. Daily discharge ascertained by applying mean daily gage height to rating tables except for periods during which stage-discharge relation was affected by ice or shifting control. Record good except for winter months.

COOPERATION.—Station maintained in cooperation with and computations made by the Irrigation Branch, Department of the Interior, Canada.

Discharge measurements of Milk River at international boundary during the year ending Sept. 30, 1916.

Date.	Made by—	Gage height.	Dis-charge.	Date.	Made by—	Gage height.	Dis-charge.
		<i>Feet.</i>	<i>Sec.-ft.</i>			<i>Feet.</i>	<i>Sec.-ft.</i>
Oct. 8	W. H. Story ^a	3.70	228	May 12	A. H. Tuttle.....	3.54	287
27	do.....	3.61	177	17	H. W. Rowley.....	3.50	248
Nov. 22	W. A. Lamb.....	b 3.75	90	June 12	do.....	4.37	722
Mar. 14	L. J. Gleeson ^c	6.64	2,064	14	A. H. Tuttle.....	4.81	939
15	W. A. Lamb.....	c 5.51	1,190	July 7	H. W. Rowley.....	4.41	686
23	L. J. Gleeson.....	d 4.20	766	28	do.....	3.49	228
31	do.....	e 3.69	413	Aug. 17	do.....	3.54	251
Apr. 12	do.....	3.68	392	Sept. 7	W. A. Lamb.....	4.67	971
30	W. A. Lamb.....	3.36	231	13	H. W. Rowley.....	3.39	255
May 5	H. W. Rowley ^a	3.50	297				

^a Engineer, Irrigation Branch, Department of Interior, Canada.

^b Stage-discharge relation affected by ice.

^c Staff gage at cable read 4.61 feet.

^d Staff gage at cable read 3.68 feet.

^e Staff gage at cable read 3.03 feet.

Daily discharge, in second-feet, of Milk River at international boundary for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Dec.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1.....	166	136	65	.....	344	289	1,130	1,100	258	155
2.....	166	143	63	.....	314	354	1,060	1,370	196	155
3.....	187	151	62	.....	274	375	915	3,500	170	151
4.....	189	153	62	.....	354	319	946	2,000	162	341
5.....	187	153	61	.....	454	339	1,000	1,200	158	322
6.....	189	156	59	.....	503	446	871	800	148	360
7.....	212	153	57	.....	484	355	784	688	158	973
8.....	230	153	55	.....	465	346	706	623	415	709
9.....	239	147	53	.....	447	346	883	1,480	254	530
10.....	224	136	51	.....	428	331	803	1,000	258	412
11.....	248	132	49	.....	410	317	927	706	410	344
12.....	252	128	48	.....	391	303	748	594	553	274
13.....	233	124	47	.....	391	267	688	505	527	240
14.....	212	120	45	2,060	391	258	896	415	390	232
15.....	215	116	40	1,190	391	237	712	336	303	232
16.....	224	112	39	984	391	245	589	478	258	232
17.....	224	108	39	826	391	245	555	462	245	216
18.....	221	104	37	866	406	245	510	312	317	237
19.....	213	101	37	825	412	245	532	317	289	216
20.....	205	98	35	784	406	271	425	312	258	188
21.....	192	94	38	744	433	237	415	289	241	166
22.....	180	90	33	816	385	204	688	294	276	162
23.....	164	88	29	766	339	204	700	271	327	151
24.....	162	86	27	706	375	204	803	224	312	144
25.....	162	84	25	602	370	635	865	208	241	137
26.....	164	81	25	520	375	852	877	216	196	124
27.....	162	79	25	408	339	946	764	220	181	131
28.....	151	77	25	356	309	915	641	241	166	127
29.....	145	73	25	296	289	1,060	670	241	158	120
30.....	137	72	25	396	245	1,160	896	280	155	131
31.....	136	.....	25	384	.....	1,070	.....	346	151	.....

NOTE.—Discharge computed by indirect method for shifting control Oct. 1 to Nov. 10, Mar. 29 to Apr. 16, and May 6 to June 14. Discharge estimated because of ice from study of gage heights, weather records, and flow at near-by stations as follows: Nov. 14 to Dec. 31, as in table; Jan. 1-31, 18 second-feet; Feb. 1-14, 18 second-feet; Feb. 15-29, 2,160 second-feet; Mar. 1-13, 700 second-feet. Discharge interpolated Nov. 11-13, Mar. 19, 20, Apr. 7-11, 13-16, and estimated July 3-6. See Accuracy in description of station.

Monthly discharge of Milk River at international boundary for the year ending Sept. 30, 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
October.....	252	136	193	11,900
November.....	156	72	115	6,840
December.....	65	25	42.1	2,590
January.....			18.0	1,110
February.....			1,130	65,000
March.....			730	44,900
April.....	503	245	384	22,800
May.....	1,160	204	439	27,000
June.....	1,130	415	766	45,600
July.....	3,500	208	678	41,700
August.....	553	148	262	16,100
September.....	973	120	264	15,700
The year.....			415	301,000

NOTE.—See footnote to daily-discharge table.

MILK RIVER AT HAVRE, MONT.

LOCATION.—In SW. $\frac{1}{4}$ SW. $\frac{1}{4}$ sec. 4, T. 32 N., R. 16 E., at highway bridge at Havre, in Hill County.

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—May 15, 1898, to September 30, 1916.

GAGE.—Chain gage fastened to rail on downstream side of bridge; read by C. W. Ling United States Weather Bureau observer. Owing to shifting of river bed at low water the gage frequently has to be moved from one end of the bridge to the other, but it was not so moved during 1916; datum unchanged.

DISCHARGE MEASUREMENTS.—Made from bridge or by wading.

CHANNEL AND CONTROL.—Stream bed sand and earth; shifts greatly. Banks are overflowed at high stages.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 17.2 feet March 12 (discharge not determined); minimum discharge (measured) 7.5 second-feet January 29.

1898-1916: Maximum stage recorded, 17.2 feet March 12, 1916 (discharge not determined); channel reported "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; July 29 to August 22, 1914.

ICE.—From the last part of November to the first part of April the river at Havre is frozen over, and in portions of the cross section it is usually frozen to the bottom.

DIVERSIONS.—None.

REGULATION.—None.

ACCURACY.—Stage-discharge relation not permanent; affected by shifting control and, from November 11 to March 26, by ice. Rating curve used March 27 to April 23, poorly defined; that used March 4-25 and July 4 to September 30, well defined between 100 and 1,500 second-feet. Gage read once daily to tenths prior to September 4 and twice daily to hundredths after that date. Daily discharge ascertained by applying daily gage height to rating tables except for period during which stage-discharge relation was affected by shifting control or ice. Records fair.

*Discharge measurements of Milk River at Havre, Mont., during the year ending
Sept. 30, 1916.*

Date.	Made by—	Gage height.	Dis-charge.	Date.	Made by—	Gage height.	Dis-charge.
		<i>Feet.</i>	<i>Sec.-ft.</i>			<i>Feet.</i>	<i>Sec.-ft.</i>
Nov. 22	W. A. Lamb.....	a 6.10	54	May 27	A. H. Tuttle.....	8.13	1,090
Jan. 16	.....do.....	b 5.45	12.6	June 15	.....do.....	8.68	1,020
29	.....do.....	(c)	7.5	July 17	.....do.....	7.75	640
Mar. 17	.....do.....	d 9.98	1,060	27	.....do.....	8.49	1,100
Apr. 23	A. H. Tuttle.....	6.66	265	Aug. 23	.....do.....	6.81	270
May 4	.....do.....	7.03	356	Sept. 7	W. A. Lamb.....	7.64	619
12	.....do.....	6.75	249	12	.....do.....	7.20	428

a Stage-discharge relation affected by ice.

b Stage-discharge relation affected by ice. Measurement made from ice cover 400 feet below gage and below Havre sewer. Sewer discharging one or two second-feet.

c Stream frozen solid at gage. Measurement made from ice cover 200 feet below gage and below Havre sewer. Sewer discharging one or two second-feet.

d Stage-discharge relation affected by ice jam below gage.

*Daily discharge, in second-feet, of Milk River at Havre, Mont., for the year ending
Sept. 30, 1916.*

Day.	Oct.	Nov.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1.....	145	129	.....	381	316	1,310	1,240	419	213
2.....	145	129	.....	381	349	1,380	1,380	341	241
3.....	145	129	.....	381	275	1,020	2,220	461	188
4.....	145	129	.....	381	341	784	4,850	419	165
5.....	145	129	.....	381	272	1,090	2,130	341	241
6.....	145	129	.....	505	241	896	1,620	341	379
7.....	164	129	.....	421	241	784	1,460	341	593
8.....	164	129	.....	421	272	838	1,380	305	896
9.....	164	129	.....	343	241	593	1,460	1,780	639
10.....	164	129	.....	343	272	784	2,510	734	548
11.....	188	129	.....	421	272	784	1,460	504	461
12.....	217	122	.....	343	272	1,160	1,160	461	419
13.....	217	115	.....	381	305	896	1,090	419	341
14.....	188	108	.....	463	305	784	896	379	272
15.....	251	101	.....	421	272	1,020	896	548	288
16.....	217	94	.....	421	241	896	734	461	305
17.....	217	87	.....	463	241	686	639	461	256
18.....	188	80	.....	381	212	639	1,240	379	227
19.....	188	73	.....	381	213	593	784	379	241
20.....	188	66	.....	343	213	1,240	548	341	227
21.....	164	60	.....	550	213	548	593	305	176
22.....	164	54	.....	421	241	734	548	272	176
23.....	164	.....	.....	273	213	1,020	504	272	200
24.....	145	.....	.....	379	241	838	548	272	194
25.....	145	.....	.....	269	341	838	504	341	188
26.....	129	.....	.....	266	1,020	784	419	305	188
27.....	129	.....	550	295	1,090	948	1,090	305	200
28.....	129	.....	421	260	1,090	896	593	241	200
29.....	129	.....	421	256	1,020	784	461	241	165
30.....	129	.....	463	285	1,540	1,090	461	213	165
31.....	129	.....	381	.....	1,780	.....	440	241	.....

NOTE.—Shifting control method used Oct. 1 to Nov. 11, Apr. 24 to May 3, May 26 to July 3. Discharge interpolated Nov. 12-22, and estimated at 50 second-feet Nov. 23-30. No gage readings obtained Nov. 12-21, 23-30, Dec. 1 to Feb. 15, and Feb. 27 to Mar. 7. Chinook winds and ice jams in February and March caused rapid rises which reached stage of 15.9 feet on Feb. 21, 22 and 17.2 feet on Mar. 12.

Monthly discharge of Milk River at Havre, Mont., for the year ending Sept. 30, 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
October.....	251	129	166	10,200
November.....	129	.....	92.6	5,510
April.....	550	256	374	22,300
May.....	1,780	213	459	28,206
June.....	1,380	548	889	52,900
July.....	4,850	419	1,160	71,300
August.....	1,780	213	414	25,500
September.....	896	165	300	17,900

MILK RIVER AT MALTA, MONT.

LOCATION.—In NW. $\frac{1}{4}$ 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, 1916.

GAGE.—Chain fastened to handrail on downstream side of bridge; read by employees of the 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, 17.5 feet at 4 p. m. March 19 (discharge estimated from measurement of March 17 at 7,000 second-feet); minimum stage recorded, 1.01 feet April 23–29 (discharge 45 second-feet). Lower flow may have occurred during winter.

1902–1916: Maximum stage recorded, 19.75 feet, April 10, 1907 (discharge 11,200 second-feet); channel reported “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 seriously affected by ice; observations discontinued during winter.

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, about 17 miles above the 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, the combined capacity being 1,000 second-feet.

REGULATION.—Normal distribution of flow affected by storage in Nelson reservoir.

ACCURACY.—Stage-discharge relation fairly permanent for open channel but affected by ice during winter. Rating curves used as follows: October 1 to December 18, February 17–19, and March 23–31, well defined; April 1 to September 30, well defined below 300 second-feet and fairly well defined above; February 20 to March 22, curve drawn through measurements made February 25 and March 17 (effect of ice on stage-discharge relation practically constant during this period). Gage read to half tenths twice daily. Daily discharge ascertained by applying mean daily gage height to rating tables. Records good.

Discharge measurements of Milk River at Malta, Mont, during the year ending Sept. 30, 1916.

Date.	Made by—	Gage height.	Dis-charge.	Date.	Made by—	Gage height.	Dis-charge.
		<i>Feet.</i>	<i>Sec.-ft.</i>			<i>Feet.</i>	<i>Sec.-ft.</i>
Nov. 20	W. A. Lamb.....	a 1.79	130	May 19	A. H. Tuttle.....	1.14	56
Jan. 30	.....do.....	b 2.0	25	May 29	.....do.....	4.03	1,280
Feb. 25	.....do.....	c 12.11	3,580	July 24	.....do.....	3.22	740
Mar. 17	.....do.....	d 16.21	6,140	Aug. 17	.....do.....	2.91	568
Apr. 11	A. H. Tuttle.....	3.28	805	Aug. 22	.....do.....	2.54	375
May 2	.....do.....	2.20	255				

a Ice along bank, control open.

b Measured from ice cover at gage. Channel free from slush and anchor ice. Temperature 40 degrees below zero. No water under gage. Gage height estimated at 2.0 feet.

c Stage-discharge relation seriously affected by ice on control. Channel open 400 feet above and below gage.

d Stage-discharge relation seriously affected by ice gorge 400 feet below gage.

Daily discharge, in second-feet, of Milk River at Malta, Mont., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Dec.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1.....	210	225	106	.....	3, 140	4, 350	159	1, 900	4, 290	895	205
2.....	195	210	110	.....	3, 800	3, 380	177	2, 100	4, 290	825	190
3.....	195	210	127	.....	3, 060	2, 580	177	2, 320	4, 040	758	164
4.....	195	210	127	.....	2, 650	2, 040	177	2, 320	4, 040	692	164
5.....	195	195	120	.....	2, 450	1, 620	164	2, 180	4, 890	630	164
6.....	195	195	120	.....	2, 180	1, 340	164	2, 100	5, 400	520	137
7.....	195	195	120	.....	1, 820	1, 140	155	1, 900	5, 220	472	133
8.....	210	195	120	.....	1, 480	1, 070	155	1, 760	4, 880	448	159
9.....	225	195	120	.....	1, 340	825	111	1, 620	4, 230	426	220
10.....	225	195	120	.....	1, 280	825	114	1, 280	3, 260	385	346
11.....	225	184	120	.....	1, 620	758	106	1, 340	2, 780	346	545
12.....	225	127	120	.....	2, 250	692	106	1, 340	2, 720	385	660
13.....	225	132	120	.....	4, 200	630	79	1, 340	2, 720	630	520
14.....	241	132	120	.....	5, 000	600	72	1, 410	2, 240	660	426
15.....	257	132	120	.....	5, 250	572	52	1, 480	1, 820	572	385
16.....	257	132	120	.....	6, 000	572	52	1, 540	1, 760	520	346
17.....	291	144	120	254	6, 140	600	52	1, 680	1, 680	520	308
18.....	291	144	120	254	5, 900	572	52	1, 680	1, 680	495	272
19.....	291	144	.....	1, 960	6, 450	572	56	1, 620	1, 620	472	254
20.....	291	132	.....	2, 750	6, 400	520	56	1, 480	1, 340	426	220
21.....	307	132	.....	3, 450	4, 500	495	52	1, 280	1, 480	365	220
22.....	291	132	.....	3, 530	4, 270	495	48	1, 070	1, 410	346	220
23.....	291	132	.....	3, 450	4, 040	448	48	1, 210	1, 140	220	205
24.....	274	120	.....	3, 450	5, 220	346	48	1, 140	860	96	190
25.....	274	120	.....	3, 590	5, 830	220	57	1, 210	825	74	177
26.....	274	120	.....	3, 530	5, 340	83	123	1, 410	692	74	164
27.....	257	120	.....	3, 400	4, 410	56	91	1, 480	630	101	164
28.....	257	120	.....	3, 300	3, 380	45	164	1, 410	600	145	164
29.....	257	120	.....	2, 680	4, 040	45	1, 480	1, 900	660	190	143
30.....	257	120	.....	.....	4, 650	56	1, 900	4, 290	1, 140	220	143
31.....	241	.....	.....	.....	5, 220	.....	2, 040	.....	1, 140	205	.....

Monthly discharge of Milk River at Malta, Mont., for the year ending Sept. 30, 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
October.....	307	195	246	15, 100
November.....	225	120	155	9, 220
December 1-18.....	127	106	119	4, 250
February 17-29.....	3, 580	254	2, 740	70, 600
March.....	6, 450	1, 280	3, 980	245, 000
April.....	4, 350	45	918	54, 600
May.....	2, 040	48	267	16, 400
June.....	4, 290	1, 070	1, 690	101, 000
July.....	5, 400	600	2, 440	150, 000
August.....	895	74	423	26, 000
September.....	660	137	253	15, 100

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, 1916. Records were obtained at Hinsdale, 6 miles upstream, May 13, 1908, to November 13, 1914; discharge nearly the 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 by wading or from bridge at Vandalia, 2 miles below; distance along river probably 4 miles.

CHANNEL AND CONTROL.—Water surface in large pool below dam is controlled by a gravel bar which is drowned out at medium and high stages, when the river bed below forms the control.

EXTREMES OF STAGE.—During the ice jam of March 14-21, the water was over the abutment, approximate height on gage 32.0 feet (discharge not known). For open channel the maximum gage height was 30.0 feet at 4 p. m., March 24; minimum stage, 4.0 feet January 20 to February 22 (discharge, 114 second-feet).

1908-1916: Maximum stage recorded April 6, 1912 (discharge estimated at 24,200 second-feet); channel reported dry August 9-13, 1910.

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

DIVERSIONS.—During the irrigation season water is diverted from the main stream above station and from nearly all of its tributaries.

REGULATION.—Flow regulated to some extent by various diversion dams and by small reservoirs on tributaries.

ACCURACY.—Stage-discharge relation not permanent. Rating curves used as follows: October 1 to February 22, except November 20 to December 2, curve fairly well defined; April 6 to July 31, curve fairly well defined below 8,400 second-feet; August 1 to September 30, curve well defined between 80 and 600 second-feet. Stage-discharge relation affected by ice November 20 to December 2 and by debris in channel and ice jams from February 23 to April 5. Gage read twice daily to tenths. Determinations of mean daily gage height may be subject to error due to variations in sluice-gate openings. Gage readings closer than tenths are difficult to make. Daily discharge ascertained by applying mean daily gage height to rating tables except for periods during which stage-discharge relation was affected by ice or by debris in channel. Records fair.

Discharge measurements of Milk River near Vandalia, Mont., during the year ending Sept. 30, 1916.

Date.	Made by—	Gage height.	Dis-charge.	Date.	Made by—	Gage height.	Dis-charge.
Nov. 21	W. A. Lamb.....	Feet. 4.3	Sec.-ft. 154	May 18	A. H. Tuttle.....	Feet. 4.8	Sec.-ft. 267
Mar. 18	do.....	(a) 422	422	June 20 ^b	do.....	8.6	1,770
Apr. 12 ^b	A. H. Tuttle.....	21.0	8,320	July 25 ^b	do.....	7.8	1,440
30 ^b	do.....	5.95	668	Aug 21 ^b	do.....	5.6	437

^a Ice jam, gage submerged.

^b Measured at bridge at Vandalia.

Daily discharge, in second-feet, of Milk River near Vandalia, Mont., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1.....	267	428	145	147	114	-----	-----	272	2,430	7,390	1,820	269
2.....	253	428	145	147	114	-----	-----	330	2,430	8,090	1,290	300
3.....	253	362	147	147	114	-----	-----	460	2,430	7,450	1,040	300
4.....	297	297	147	147	114	-----	-----	495	2,430	5,960	994	300
5.....	297	297	147	147	114.	-----	-----	495	3,020	5,300	716	240
6.....	267	297	147	147	114	-----	9,020	495	3,020	6,070	606	240
7.....	213	267	147	147	114	-----	7,920	495	2,820	7,220	606	240
8.....	213	297	147	147	114	-----	6,870	495	2,480	8,260	570	213
9.....	253	297	147	147	114	-----	5,630	460	2,190	8,840	500	213
10.....	239	239	147	147	114	-----	5,090	460	1,950	7,800	500	226
11.....	267	213	147	147	114	-----	6,520	393	1,950	6,760	500	365
12.....	239	189	147	147	114	-----	8,500	300	1,720	5,630	500	432
13.....	213	189	147	147	114	-----	9,080	300	1,500	4,770	432	432
14.....	253	189	147	147	114	-----	10,400	216	1,500	4,250	432	500
15.....	267	189	147	147	114	-----	8,030	216	1,500	3,520	535	432
16.....	346	189	147	129	114	-----	5,960	32	1,630	2,720	570	398
17.....	428	189	147	129	114	-----	5,090	32	1,630	2,330	570	365
18.....	395	189	147	129	114	422	4,040	203	1,680	2,870	466	332
19.....	395	157	147	129	114	-----	2,970	190	1,680	1,830	432	332
20.....	395	155	147	114	114	-----	2,290	203	1,720	836	432	300
21.....	428	154	147	114	114	-----	1,950	203	1,860	1,370	432	269
22.....	428	145	147	114	114	-----	1,630	190	1,860	1,680	398	240
23.....	532	145	147	114	-----	-----	1,460	165	1,770	1,860	398	240
24.....	532	145	147	114	-----	-----	1,420	216	1,680	1,770	365	226
25.....	496	145	147	114	-----	-----	1,250	272	1,590	1,420	332	200
26.....	496	145	147	114	-----	-----	797	1,590	1,680	1,250	300	188
27.....	532	145	147	114	-----	-----	608	1,590	1,720	996	240	188
28.....	496	145	147	114	-----	-----	460	996	2,050	530	213	200
29.....	496	145	147	114	-----	-----	330	955	2,820	915	165	240
30.....	496	145	147	114	-----	-----	460	875	4,720	2,050	144	144
31.....	462	-----	147	114	-----	-----	-----	2,000	-----	2,140	200	-----

NOTE.—Discharge, Nov. 20 to Dec. 2, estimated because of ice. Ice jams and debris on control Feb. 23 to Apr. 5; discharge not determined. Gage readings not obtained Mar. 14-21, as water was backed over abutment by ice jam.

Monthly discharge of Milk River near Vandalia, Mont., for the year ending Sept. 30, 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
October.....	532	213	359	22,100
November.....	428	145	217	12,900
December.....	147	145	147	9,040
January.....	147	114	132	8,120
February 1-22.....	114	114	114	4,970
April 6-30.....	10,400	330	4,310	214,000
May.....	2,000	32	503	30,900
June.....	4,720	1,500	2,120	126,000
July.....	8,840	530	3,980	245,000
August.....	1,820	144	539	33,100
September.....	500	144	285	17,000

NORTH FORK OF MILK RIVER NEAR KIMBALL, ALBERTA.

LOCATION.—In NE. $\frac{1}{4}$ sec. 11, T. 1, R. 23 W. fourth meridian, Alberta, about 300 yards above road crossing at Peter's ranch, 18 miles east of Kimball, and about 2 miles north of international boundary.

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

RECORDS AVAILABLE.—January 1, 1913, to September 30, 1916. July 21, 1909, to December 31, 1912, station was maintained by Irrigation Branch, Department of the Interior, Canada, in NE. $\frac{1}{4}$ sec. 13, T. 1, R. 23 W. fourth meridian, about 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, inspected by William Wheeler.

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

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

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, due to ice jams, 7.35 feet February 17; maximum discharge, 405 second-feet at 7 a. m. June 28 (gage height 4.06 feet by water-stage recorder); minimum stage recorded, 1.97 feet December 7; minimum discharge, 5.0 second-feet February 12 (gage height 3.45 feet, stage-discharge relation affected by ice).

1909-1916: Maximum stage recorded, 3.9 feet (at station maintained by Canada; see paragraph on "Records available") July 27, 28, 1909 (discharge, 591 second-feet); minimum stage, 1.97 feet December 7, 1915; minimum discharge, that of February 12, 1916.

ICE.—Stage-discharge relation seriously affected by ice; flow estimated from discharge measurements, temperature records, and observer's notes.

DIVERSIONS.—The St. Mary canal intercepts the flow of several small streams in St. Mary basin and delivers the water to the North Fork of Milk River. According to engineers of the United States Reclamation Service, approximately 1,528 acre-feet of water was added to the flow of North Fork of Milk River above the gaging station from this source during 1916.

REGULATION.—None.

ACCURACY.—Stage-discharge relation changed during periods of high water and ice.

Rating curves used as follows: October 1 to November 10, well defined between 24 and 160 second-feet; April 26 to May 24 and June 27 to August 19, fairly well defined between 50 and 270 second-feet. Mean gage height for October 1 to December 19, April 6 to May 16, and May 31 to September 30 found by inspecting recorder graph. Outside staff gage read once daily to hundredths January 1 to April 5 and May 17-30. No gage heights obtained December 20-31. Daily

See W. 91

discharge ascertained by applying daily gage height to rating tables except for periods during which stage-discharge relation was affected by shifting control or ice. Records good.

COOPERATION.—Station maintained in cooperation with and computations made by the Irrigation Branch, Department of the Interior, Canada.

Discharge measurements of North Fork of Milk River near Kimball, Alberta, during the year ending Sept. 30, 1916.

Date.	Made by—	Gage height.	Dis-charge.	Date.	Made by—	Gage height.	Dis-charge.
		<i>Fect.</i>	<i>Sec.-ft.</i>			<i>Fect.</i>	<i>Sec.-ft.</i>
Oct. 8	V. A. Newhall <i>a</i>	2.34	84	June 11	A. H. Tuttle.....	2.90	182
Nov. 11	W. H. Storey <i>a</i>	2.43	39	21	S. H. Frame.....	2.44	103
Dec. 6	do.....	2.06	56	27	A. H. Tuttle.....	2.50	104
7	do.....	1.97	44	27	S. H. Frame.....	2.47	120
23	do.....	2.02	40	28	do.....	3.32	267
Jan. 11	do.....	3.09	32	July 19	W. A. Lamb.....	2.23	72
Feb. 11	V. A. Newhall.....	3.57	b 5.5	23	S. H. Frame.....	2.13	62
Mar. 2	do.....	3.11	36	Aug. 19	V. A. Newhall.....	2.38	92
16	S. H. Frame <i>a</i>	2.45	91	Sept. 5	S. H. Frame.....	2.38	101
Apr. 6	do.....	2.30	74	6	do.....	2.28	80
25	do.....	2.07	58	7	do.....	2.21	71
26	W. A. Lamb.....	2.10	55	7	do.....	2.27	73
May 24	Tuttle and Lamb.....	2.45	106	27	do.....	2.19	59
31	S. H. Frame.....	2.45	99	28	do.....	2.14	52
June 1	do.....	2.84	180				

a Engineer Irrigation Branch, Department of Interior, Canada.

b Discharge estimated.

Daily discharge, in second-feet, of North Fork of Milk River near Kimball, Alberta, for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1.....	59	65	36	34	18.3	36	81	74	158	102	56	78
2.....	59	65	46	34	16.6	36	80	88	145	93	56	78
3.....	89	65	51	34	15.0	37	83	74	96	96	56	170
4.....	90	66	54	33	13.6	40	63	63	84	86	57	230
5.....	86	66	58	33	12.0	43	57	62	149	78	61	122
6.....	86	67	56	33	10.4	46	74	56	159	76	58	82
7.....	89	66	43	33	9.0	51	80	55	102	74	58	78
8.....	92	65	43	33	8.0	64	81	53	88	78	64	75
9.....	78	66	40	32	7.0	83	90	51	84	78	158	72
10.....	75	58	36	32	6.1	104	96	47	148	71	137	74
11.....	80	39	36	32	5.5	123	90	47	169	64	104	67
12.....	87	38	35	32	5	144	100	53	101	64	83	68
13.....	81	37	35	32	10	164	103	55	84	66	100	67
14.....	80	46	35	32	80	189	91	56	82	64	95	79
15.....	87	48	34	31	150	154	73	50	75	60	74	75
16.....	76	58	33	31	700	91	86	61	73	57	70	70
17.....	71	50	35	31	600	82	85	51	71	64	82	65
18.....	67	56	38	31	400	58	82	50	68	76	154	63
19.....	65	58	36	30	200	80	81	49	80	74	83	61
20.....	65	36	36	31	180	102	73	50	88	70	80	59
21.....	65	34	36	32	170	100	66	48	100	64	80	59
22.....	65	32	38	34	160	76	68	45	110	62	79	57
23.....	65	34	40	35	150	62	65	70	125	58	77	57
24.....	64	50	40	34	140	54	61	106	80	62	82	55
25.....	64	35	40	32	115	53	58	166	90	66	86	50
26.....	64	46	40	30	80	61	56	225	94	74	87	51
27.....	65	46	40	29	55	68	128	178	108	104	83	58
28.....	65	46	39	27	45	57	130	140	241	78	82	53
29.....	65	42	38	25	38	48	55	158	214	61	82	52
30.....	66	39	36	22	.....	50	54	175	162	55	84	51
31.....	65	.....	35	20	.....	65	.....	99	.....	55	80	.....

NOTE.—Discharge Mar. 14 to Apr. 25, May 25 to June 26, and Aug. 25 to Sept. 30, computed by shifting-control method. Discharge Nov. 11 to Mar. 13, estimated, because of ice, from gage heights, discharge measurements, and weather records. Discharge interpolated May 25 and 29. See "Accuracy" in description of station.

Monthly discharge of North Fork of Milk River near Kimball, Alberta, for the year ending Sept. 30, 1916.

[Drainage area, 101 square miles.]

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
October.....	92	59	73.4	4,510
November.....	67	32	51.3	3,050
December.....	58	33	39.9	2,450
January.....	35	20	31.1	1,910
February.....	700	5.0	117	6,730
March.....	189	36	78	4,800
April.....	130	54	79.7	4,740
May.....	225	45	82.4	5,070
June.....	241	68	114	6,780
July.....	104	55	71.9	4,420
August.....	158	56	83.2	5,120
September.....	230	50	75.6	4,500
The year.....	700	5.0	74.6	54,100

FORT BELKNAP CANAL NEAR CHINOOK, MONT.

LOCATION.—In SE. $\frac{1}{4}$ sec. 20, T. 33 N., R. 18 E., at highway bridge half a mile below headgates of canal on Milk River 8 miles west of Chinook, in Blaine County.

RECORDS AVAILABLE.—June 21, 1903, to September 30, 1916.

GAGES.—Vertical staff on downstream side of first bent of piles from left bank; used since 1910; read by E. O. Walters. Gage previously used was a vertical staff, at a different datum, at the highway bridge one-fourth mile downstream. Both bridge and gage were washed out by high water of June, 1908, and new gage was installed June 27, 1908, at a different datum, within a few feet of site of old gage. Discharge is the same at all three sites.

DISCHARGE MEASUREMENTS.—Made by wading at section about 30 feet below gage.

CHANNEL AND CONTROL.—Channel soil, no definite control. Some backwater is caused by a check weir about half a mile below gage, and by aquatic plants that grow in the canal during summer. The water is muddy and deposits silt. Current uniformly sluggish at low stages.

ACCURACY.—Stage-discharge relation not permanent; affected by shifting control, backwater from checks half a mile below, and by growth of aquatic plants. Rating curves applicable as follows: April 6 to May 17, well defined; May 23 to June 10, and June 16 to July 1, poorly defined; July 19 to September 30, fairly well defined. Gage read to quarter-tenths once daily. Daily discharge ascertained by applying gage height to rating tables except for periods during which stage-discharge relation was affected by shifting control. Records fair.

The water in the Fort Belknap canal is diverted from the north bank of Milk River in the SE. $\frac{1}{4}$ sec. 20, T. 33 N., R. 18 E., to irrigate lands on the north side of the river. Most of that diverted is used, but it can be wasted into Lodge Creek, north of Chinook, about 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, 1916.

[Made by A. H. Tuttle.]

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	<i>Feet.</i>	<i>Sec.-ft.</i>		<i>Feet.</i>	<i>Sec.-ft.</i>		<i>Feet.</i>	<i>Sec.-ft.</i>
Apr. 24.....	1.82	26.5	May 28.....	2.12	35.9	July 19.....	1.65	7.8
May 13.....	2.12	41.5	June 16.....	2.50	40.0	Aug. 15.....	1.78	12.6

Daily discharge, in second-feet, of Fort Belknap canal near Chinook, Mont., for the year ending Sept. 30, 1916.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Day.	Apr.	May.	June.	July.	Aug.	Sept.
1.....		22	41	21	13	13	16....	6.2	49	39	1.4	9.5	9.5
2.....		18	47	11	13	13	17....	18	52	38	1.4	13	9.5
3.....		18	58	11	13	13	18....	20	63	35	6.2	15	8.0
4.....		26	58	11	13	13	19....	22	67	35	8.0	17	8.0
5.....		26	58	6.2	13	13	20....	24	65	43	6.5	19	8.0
6.....		28	58	2.8	13	25	21....	26	70	43	6.5	14	8.0
7.....		26	64	2.8	13	25	22....	26	63	38	9.5	9.5	8.0
8.....		30	61	2.8	13	25	23....	26	49	38	9.5	9.5	8.0
9.....		30	58	2.8	13	25	24....	26	46	38	13	9.5	8.0
10....		30	64	2.8	13	25	25....	26	46	30	17	11	8.0
11....		35	38	2.8	13	21	26....	26	46	30	17	11	8.0
12....		40	26	2.8	13	21	27....	26	46	30	9.5	13	8.0
13....		41	33	1.4	6.5	9.5	28....	26	38	30	9.5	13	8.0
14....		52	38	1.4	6.5	9.5	29....	26	41	22	9.5	13	8.0
15....		49	40	1.4	11	9.5	30....	22	41	22	13	13	8.0
							31....		47		13	13	

NOTE.—Head gates opened Apr. 16. Discharge May 18-22, June 11-15, and July 2-18 computed by shifting-control method.

Monthly discharge of Fort Belknap canal near Chinook, Mont., for the year ending Sept. 30, 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
April 16-30.....	26	6.2	23.1	687
May.....	70	18	41.9	2,580
June.....	64	22	41.8	2,490
July.....	21	1.4	7.56	465
August.....	19	6.5	12.4	762
September.....	25	8.0	12.8	762
The period.....				7,750

BATTLE CREEK NEAR CHINOOK, MONT.

LOCATION.—In sec. 3, T. 33 N., R. 19 E., 500 feet above new highway bridge about 4½ miles north of Chinook, in Blaine County.

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—April 22, 1905, to September 30, 1916.

GAGE.—Low-water gage is overhanging chain on the left bank, near the house of R. B. Snedecor and 500 feet above the highway bridge; high-water gage is vertical staff at same point. Gages read by Mrs. R. B. Snedecor.

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

CHANNEL AND CONTROL.—Bed of stream gravel and sand. Banks high; not subject to overflow. Low-water control is a sand bar below the gage; no definite point of control at high water.

EXCHANGE OF DISCHARGE.—Maximum stage recorded during year, 11.50 feet at 5 p. m. March 28 (discharge, determined from extension of rating curve, 3,860 second-feet); minimum stage recorded, 0.8 foot October 1-2, 26-28, 1915 (discharge, 23 second-feet).

1905-1916: Maximum stage recorded, 12.60 feet, June 8, 1906 (discharge, 4,600 second-feet); no flow 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.

ICE.—Discharge relation seriously affected by ice. Observations discontinued during the winter.

DIVERSIONS.—Fifteen ditches divert water from this creek in Canada before it crosses the boundary line. Three canals, which divert in the aggregate about 20 second-feet, take out above the station in the United States. Several small pumping plants, which supply water for irrigating the bottom land along the valley, also operate above the station. Below the station Matheson and Cook canals divert water (see pp. 88, 89) for irrigating land in Milk River Valley near the mouth of Battle Creek.

REGULATION.—None.

ACCURACY.—Stage-discharge relation not permanent; seriously affected by ice November 21 to March 12. Two rating curves used, one applicable October 1 to November 20, March 13 to April 14, and June 4 to September 30, well defined below 700 second-feet and poorly defined above; the other, applicable April 24 to June 3, well defined between 40 and 700 second-feet. Gage read to hundredths twice daily. Daily discharge ascertained by applying mean daily gage height to rating tables, except for periods during which stage-discharge relation was affected by shifting control, for which periods records are fair. Records obtained by use of rating tables good.

Discharge measurements of Battle Creek near Chinook, Mont., during the year ending Sept. 30, 1916.

Date.	Made by—	Gage height.	Dis-charge.	Date.	Made by—	Gage height.	Dis-charge.
		<i>Feet.</i>	<i>Sec.-ft.</i>			<i>Feet.</i>	<i>Sec.-ft.</i>
Apr. 13	A. H. Tuttle.....	2.05	172	July 26	A. H. Tuttle.....	1.28	69
24	.....do.....	1.62	102	Aug. 15	.....do.....	1.45	95
May 4	.....do.....	1.38	71	22	.....do.....	1.04	48.1
28	.....do.....	4.22	637	Sept. 10	Wm. A. Lamb.....	1.06	47.0
July 19	.....do.....	1.40	89				

Daily discharge, in second-feet, of Battle Creek near Chinook, Mont., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1.....	23	25	.....	1,350	73	554	235	109	46
2.....	23	25	.....	1,230	73	740	158	74	45
3.....	24	25	.....	640	73	920	207	59	45
4.....	25	25	.....	485	73	515	870	50	48
5.....	25	25	.....	319	68	364	255	47	51
6.....	25	28	.....	245	68	297	675	47	48
7.....	25	28	.....	216	68	255	545	43	46
8.....	25	28	.....	198	68	226	216	41	44
9.....	25	28	.....	181	68	319	158	80	47
10.....	25	28	.....	165	68	575	122	97	47
11.....	28	28	.....	150	68	255	109	85	45
12.....	30	28	.....	173	68	190	85	80	47
13.....	32	28	2,100	165	68	181	63	80	47
14.....	32	28	1,350	165	68	216	91	80	44
15.....	32	28	1,350	157	68	460	85	85	41
16.....	32	28	1,670	156	68	435	74	74	38
17.....	32	28	1,190	155	68	297	68	63	37
18.....	32	28	790	146	62	235	68	58	36
19.....	34	28	541	137	62	181	216	51	34
20.....	34	28	460	130	57	173	226	48	34
21.....	34	.....	2,190	128	57	158	150	46	33
22.....	37	.....	3,220	120	57	150	122	44	32
23.....	37	.....	2,780	113	57	143	103	41	32
24.....	31	.....	1,830	103	62	136	97	40	32
25.....	27	.....	1,510	97	123	129	80	44	32
26.....	23	.....	1,630	85	376	129	74	47	32
27.....	23	.....	3,220	79	670	150	74	46	32
28.....	23	.....	3,720	73	640	136	74	44	32
29.....	25	.....	2,780	73	502	136	80	41	33
30.....	25	.....	2,730	73	376	165	85	40	34
31.....	25	.....	1,830	.....	845	.....	122	42	.....

NOTE.—Discharge Apr. 15-23 determined by shifting-control method. No gage readings obtained Jan. 1 to Mar. 12.

Monthly discharge of Battle Creek near Chinook, Mont., for the year ending Sept. 30, 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
October.....	37	23	28.2	1,730
November 1-20.....	28	25	27.2	1,080
March 13-31.....	3,720	341	1,930	72,700
April.....	1,350	73	255	14,900
May.....	845	57	165	10,100
June.....	920	129	294	17,500
July.....	870	63	180	11,100
August.....	109	40	58.9	3,620
September.....	51	32	39.8	2,370

COOK CANAL NEAR CHINOOK, MONT.

LOCATION.—In N. $\frac{1}{2}$ sec. 30, T. 33 N., R. 20 E., about half a mile above small wooden highway bridge on road running parallel to Great Northern Railway, half a mile below headgates, and 3 miles east of Chinook, in Blaine County.

RECORDS AVAILABLE.—April 10, 1905, to September 30, 1916 (irrigation season only).

GAGE.—Vertical staff on left bank, about 1,000 feet above point at which canal turns and runs parallel with the road; read by Adam Jamison.

DISCHARGE MEASUREMENTS.—Made by wading where canal passes under the Great Northern Railway.

CHANNEL AND CONTROL.—Channel of earth; no well-defined control. Weeds grow along the bottom, causing backwater. Canal infested with beavers, whose dams are liable to cause backwater.

ACCURACY.—Stage-discharge relation not permanent, affected by shifting control and aquatic growth in channel. Gage read to hundredths once daily. Daily discharge obtained by shifting-control method throughout season. Standard rating curve fairly well defined below 30 second-feet. Records fair.

Cook Canal diverts water from Battle Creek in SE. $\frac{1}{4}$ sec. 19, T. 33 N., R. 20 E., to irrigate lands in Milk River valley on south side of river. Canal crosses Milk River in a flume. Water can be wasted into Milk River at this flume, which is about 2 miles below the gage. Little water is returned to the stream intentionally, but the flume often acts as a throttle when too much water is turned in at the headgate.

Discharge measurements of Cook canal near Chinook, Mont., during the year ending Sept. 30, 1916.

[Made by A. H. Tuttle.]

Date.	Gage height.	Dis-charge.	Date.	Gage height.	Dis-charge.	Date.	Gage height.	Dis-charge.
	<i>Feet.</i>	<i>Sec.-ft.</i>		<i>Feet.</i>	<i>Sec.-ft.</i>		<i>Feet.</i>	<i>Sec.-ft.</i>
Apr. 14.....		Dry.	May 28.....	1.44	3.1	June 16.....	3.15	21.5
May 3.....	2.37	15.5	June 16.....	3.15	21.3	July 19.....	1.90	7.3
May 14.....	3.30	28.1						

Daily discharge, in second-feet, of Cook canal near Chinook, Mont., for the year ending Sept. 30, 1916.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Day.	Mar.	Apr.	May.	June.	July.	Aug.
1.....			28	28	19	3.1	16.....			26	21	1.3	.....
2.....			16	2.8	21	3.0	17.....			25	18	1.2	.....
3.....			15	35	21	3.1	18.....			25	15	1.1	.....
4.....			16	6.4	21	4.3	19.....			26	18	7.3	.....
5.....			28	10	16	4.6	20.....			26	25	5.5	.....
6.....			32	11	13	4.3	21.....			28	21	3.1	.....
7.....			30	7.2	9.9	3.8	22.....			28	20	2.6	.....
8.....			28	6.5	5.8	2.2	23.....			28	28	3.5	.....
9.....			28	6.5	4.4	.5	24.....		13	28	32	4.5	.....
10.....			28	6.5	2.8	.5	25.....		16	22	30	2.5	.....
11.....			24	7.5	1.8	.5	26.....		31	16	29	2.2	.....
12.....			23	13	4.6	.....	27.....	18	32	10	27	2.1	.....
13.....			24	14	3.8	.....	28.....	33	30	3.1	25	1.8	.....
14.....			28	18	2.0	.....	29.....	19	28	1.3	23	1.2	.....
15.....			25	12	1.5	.....	30.....	9	28	1.1	20	.9	.....
							31.....	2	.....	20	.....	3.3	.....

NOTE.—Head gates open Mar. 27 to Apr. 1 and Apr. 24 to Aug. 11.

Monthly discharge of Cook canal near Chinook, Mont., for the year ending Sept. 30, 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
March 27-31.....	33	2	16.2	161
April.....	32	0	5.93	353
May.....	32	1.1	22.1	1,360
June.....	35	2.8	17.9	1,070
July.....	21	.9	6.18	380
August 1-11.....	4.6	.5	2.72	59
The period.....				3,380

MATHESON CANAL NEAR CHINOOK, MONT.

LOCATION.—In NW. $\frac{1}{4}$ sec. 29, T. 33 N., R. 20 E., at highway bridge over head gate of canal, one-fourth mile north of main road, and $3\frac{1}{2}$ miles east of Chinook, in Blaine County.

RECORDS AVAILABLE.—April 10, 1905, to September 30, 1916 (irrigation seasons only).

GAGE.—Vertical staff nailed to a post on the right bank, about 10 feet below head gate of canal; read by Adam Jamison.

DISCHARGE MEASUREMENTS.—Made by wading below gage.

CHANNEL AND CONTROL.—Bed of the canal is mud. No definite point of control. Weeds grow in the bottom of the canal during the summer months.

REGULATION.—Flow regulated by head gate; depends also on height of diversion dam. The dam was washed out in June, 1916, and was not replaced.

ACCURACY.—Stage-discharge relation probably permanent during June and July, 1916. Rating curves poorly defined. Gage read to hundredths once daily.

Daily discharge ascertained by applying gage height to rating table. Records poor.

Matheson canal diverts water from Battle Creek for the irrigation of lands on the north side of Milk River valley. Water can be wasted into a small tributary of Milk River. Practically all water diverted during 1916 was merely overflow from Battle Creek during the high stages.

The following discharge measurement was made by A. H. Tuttle:

June 16, 1916: Gage height, 3.50 feet; discharge, 0.9 second-foot.

Daily discharge, in second-feet, of Matheson canal near Chinook, Mont., for the year ending Sept. 30, 1916.

Day.	Mar.	June.	July.	Aug.	Day.	Mar.	June.	July.	Aug.
1.....		3.8	12.7	1.5	16.....		.8	.0	.....
2.....		8.9	2.7		17.....		.0	.0	.....
3.....		11.7	2.2		18.....		.0	.0	.....
4.....		5.7	1.7		19.....		.0	.0	.....
5.....		.6	1.6		20.....		5.0	.0	.....
6.....		.0	1.4		21.....		8.1	.0	.....
7.....		.0	2.2		22.....		8.1	.0	.....
8.....		.0	1.1		23.....		7.4	.0	.....
9.....		1.6	.5		24.....		7.0	.0	.....
10.....		1.7	.0		25.....		5.9	.0	.....
11.....		.6	.0		26.....		5.7	.0	.....
12.....		.5	.0		27.....	2.3	7.2	.7	.....
13.....		.5	.0		28.....	3.3	5.5	.6	.....
14.....		9.6	.0		29.....	4.3	8.5	1.1	.....
15.....		2.3	.0		30.....	1.6	5.9	2.3	.....
					31.....			1.0	.....

NOTE.—Canal dry Apr. 1 to May 31, 1916, June 7, 8, 17–19, July 10–26, and Aug. 2 to Sept. 30, 1916. Water in canal represents overflow from Battle Creek through gates, as canal was not used for irrigation during 1916.

Monthly discharge of Matheson canal near Chinook, Mont., for the year ending Sept. 30, 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
March 27–31.....	4.3	0	2.30	22.8
June.....	11.7	0	4.09	243
July.....	12.7	0	1.03	63.3

PARADISE VALLEY CANAL NEAR CHINOOK, MONT.

LOCATION.—In SW. $\frac{1}{4}$ sec. 35, T. 33 N., R. 20 E., about 300 feet below intake on Milk River, near house of Rudolph Friede, 6 miles southeast of Chinook, in Blaine County.

RECORDS AVAILABLE.—June, 1903, to September 30, 1916.

GAGE.—Vertical staff on left bank, 300 feet below head gate and 30 feet below Cook canal flume over Paradise Valley canal; read by Rudolph Friede, ditch rider.

DISCHARGE MEASUREMENTS.—Made by wading.

CHANNEL AND CONTROL.—Bed of canal earth; silt is deposited during the irrigation season. Weeds grow in the bottom of the canal during the summer months. A large slough into which the canal flows, a few hundred feet below the gage, may affect results, the height of the water in the slough possibly affecting the slope of the water surface at the gage.

REGULATION.—Flow partly regulated by intake gates which are low and permit overflow from river at high stages.

ACCURACY.—Stage-discharge relation not permanent, owing to silting up of canal by mud from river. Discharge measurements subject to some error due to difficulty in accurately determining the depth on account of soft mud in bottom. Rating curves fairly well defined April 26 to May 6, May 23 to July 7, and July 19–31. Gage read to hundredths twice daily. Discharge ascertained by applying mean gage height to rating tables or, for intervals between curves, by shifting-control method. Records fair.

Paradise Valley canal diverts water from the south bank of Milk River in the SW. $\frac{1}{4}$ sec. 35, T. 33 N., R. 20 E., for irrigation of lands on south side of river. No water is returned to the river.

Discharge measurements of Paradise Valley canal near Chinook, Mont., during the year ending Sept. 30, 1916.

[Made by A. H. Tuttle.]

Date.	Gage height.	Dis-charge.	Date.	Gage height.	Dis-charge.	Date.	Gage height.	Dis-charge.
	<i>Feet.</i>	<i>Sec.-ft.</i>		<i>Feet.</i>	<i>Sec.-ft.</i>		<i>Feet.</i>	<i>Sec.-ft.</i>
Apr. 14.....		(¹)	May 28.....	2.17	9.7	July 19.....	2.00	3.3
May 3.....	1.58	5.3	June 16.....	1.84	4.8	Aug 15.....		(¹)
14.....	1.78	7.3						

¹ Dry.

Daily discharge, in second-feet, of Paradise Valley canal near Chinook, Mont., for the year ending Sept. 30, 1916.

Day.	Apr.	May.	June.	July.	Day.	Apr.	May.	June.	July.
1.....		6.7	10.5	3.6	16.....		7.2	4.8	0.0
2.....		6.5	11.0	3.7	17.....		7.5	3.8	.0
3.....		5.5	11.2	4.1	18.....		7.8	2.9	.0
4.....		5.6	10.8	4.2	19.....		7.9	2.1	5.8
5.....		5.6	8.9	2.3	20.....		8.3	1.5	1.5
6.....		5.3	8.9	3.0	21.....		7.8	2.6	.0
7.....		4.4	9.3	3.1	22.....		7.3	1.1	.0
8.....		6.0	8.6	1.3	23.....		7.6	2.0	.0
9.....		6.2	8.9	1.0	24.....		8.2	2.9	.0
10.....		6.1	8.9	.8	25.....		9.1	2.2	.0
11.....		6.1	7.2	.7	26.....	0.4	11.7	2.2	.0
12.....		7.3	7.7	.3	27.....	7.6	7.8	2.8	2.9
13.....		8.0	7.6	.1	28.....	6.9	10.3	3.0	4.3
14.....		7.5	7.4	.0	29.....	6.7	8.4	5.0	.0
15.....		7.2	8.6	.1	30.....	8.2	10.0	3.8	.0
					31.....		10.3	.....	.0

NOTE.—No flow before April 26 and after July 31.

Monthly discharge of Paradise Valley canal near Chinook, Mont., for the year ending Sept. 30, 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
April 26-30.....	8.2	0.4	5.96	59
May.....	11.7	4.4	7.46	459
June.....	11.2	1.1	5.94	353
July.....	5.8	.0	1.38	85
The period.....				956

HARLEM CANAL NEAR ZURICH, MONT.

LOCATION.—In SW. $\frac{1}{4}$ sec. 33, T. 33 N., R. 21 E., 500 feet below head gates of canal $1\frac{1}{2}$ miles southeast of Zurich, in Blaine County.

RECORDS AVAILABLE.—June, 1903, to September 30, 1916.

GAGE.—Vertical staff nailed to tree on right bank about 500 feet below head gates; read by B. E. Hemphill.

DISCHARGE MEASUREMENTS.—Made by wading.

CHANNEL AND CONTROL.—Bed of canal is mud. No definite point of control. Checks several miles below the gage may cause some backwater at the higher stages. Weeds growing in the canal during the irrigation season also cause backwater, and much silt is deposited.

REGULATION.—Flow regulated by head gate 500 feet above gage.

ACCURACY.—Stage-discharge relation fairly permanent except for period April 7 to May 14. Fairly well defined rating curve used, applicable March 31 to April 26 and May 13 to July 8. Gage read to quarter-tenths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table; shifting-control method used April 27 to May 12. Records fair.

Harlem canal diverts water from north bank of Milk River in the SW. $\frac{1}{4}$ sec. 33, T. 33 N., R. 21 E., for irrigation of lands on north side of river near Harlem. Water can be wasted into Milk River, but most of that diverted is used.

Discharge measurements of Harlem canal near Zurich, Mont., during the year ending Sept. 30, 1916.

[Made by A. H. Tuttle.]

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	<i>Feet.</i>	<i>Sec.-ft.</i>		<i>Feet.</i>	<i>Sec.-ft.</i>
Apr. 25.....	3.25	48.7	May 14.....	3.24	47.3
May 3.....	3.60	57	June 16.....	2.48	24.7

Daily discharge, in second-feet, of Harlem canal near Zurich, Mont., for the year ending Sept. 30, 1916.

Day.	Mar.	Apr.	May.	June.	July.	Day.	Mar.	Apr.	May.	June.	July.
1.....		6.9	55	40	5.3	16.....		40	48	26	.....
2.....		26	61	40	4.0	17.....		46	48	3.3	.....
3.....		30	57	40	3.6	18.....		60	48	3.3	.....
4.....		19	57	40	3.8	19.....		55	48	10	.....
5.....		29	59	42	3.3	20.....		49	53	9.6	.....
6.....		20	58	33	3.6	21.....		48	53	9.5	.....
7.....		32	59	0	3.0	22.....		48	49	9.1	.....
8.....		30	55	30	2.4	23.....		50	51	9.4	.....
9.....		27	44	32	.....	24.....		51	52	9.6	.....
10.....		26	44	34	.....	25.....		44	44	8.8	.....
11.....		29	50	33	.....	26.....		36	37	8.9	.....
12.....		32	46	33	.....	27.....		47	36	8.7	.....
13.....		34	45	33	.....	28.....		59	36	6.9	.....
14.....		39	49	32	.....	29.....		54	31	6.3	.....
15.....		41	49	31	.....	30.....		53	32	6.5	.....
						31.....	8.2	.....	38	.....	.....

NOTE.—Head gates opened Mar. 31 and closed July 8.

Monthly discharge of Harlem canal near Zurich, Mont., for the year ending Sept. 30, 1918.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
April.....	60	6.9	38.7	2,300
May.....	61	31	48.1	2,960
June.....	42	0	21.0	1,250
July 1-8.....	5.3	2.4	3.62	57
The period.....				6,580

AGENCY DITCH NEAR HARLEM, MONT.

LOCATION.—In NW. $\frac{1}{4}$ SW. $\frac{1}{4}$ sec. 33, T. 32 N., R. 23 E., at spillway about 1,000 feet below highway bridge, and about half a mile below head gates, on Fort Belknap Reservation, 4 miles south of Harlem, in Blaine County.

RECORDS AVAILABLE.—July 14, 1905, to September 30, 1916. (Irrigation seasons only.)

GAGE.—Vertical staff on right bank, on downstream side of the check at the spillway. Read by Phil H. Marrion.

DISCHARGE MEASUREMENTS.—Made from highway bridge 1,000 feet above the gage

CHANNEL AND CONTROL.—Bed of ditch is mud and is subject to sudden changes when head on ditch is changed. A check about a mile below causes considerable backwater, which varies with the quantity of water diverted.

REGULATION.—Flow regulated at intake by head gates.

ACCURACY.—Stage-discharge relation affected by changes in channel and operation of check 1 mile below. Rating curves used as follows: April 6 to May 5, and June 5 to July 4, well defined between 18 and 110 second-feet; May 6–19, fairly well defined. Gage read to hundredths twice daily. Daily discharge ascertained by applying gage height to rating table except for period during which stage-discharge relation was affected by shifting control. Records good for period April 6 to May 5; fair for other periods.

Agency ditch takes water from the south bank of Milk River in sec. 32, T. 32 N., R. 23 E., for the irrigation of lands on the Fort Belknap Indian Reservation. Water not required for irrigation can be wasted into White Bear Creek, about 12 miles below head gate. The canal has been given a prior right by court decrees 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, 1916.

Date.	Made by—	Gage height.	Dis-charge.	Date.	Made by—	Gage height.	Dis-charge.
		Feet.	Sec.-ft.			Feet.	Sec.-ft.
May 2	Tuttle and Marrion	3.98	54	June 4	Phil. H. Marrion	4.15	63
May 19 ^b	A. H. Tuttle	4.19	44	21	Tuttle and Marrion	4.98	98
27	Phil. H. Marrion	3.55	51	21	Marrion and Tuttle	4.98	99
21	do.	5.10	110	July 1	Phil. H. Marrion	3.10	21.6

^a Engineer, United States Indian Service.

^b Check gate in place one mile below.

Daily discharge, in second-feet, of Agency ditch near Harlem, Mont., for the year ending Sept. 30, 1916.

Day.	Apr.	May.	June.	July.	Day.	Apr.	May.	June.	July.
1.....		56	86	22	16.....	59	47	0	.....
2.....		55	62	1	17.....	55	47	0	.....
3.....		59	63	1	18.....	47	45	0	.....
4.....		60	62	0	19.....	43	44	0	.....
5.....		60	0		20.....	0	64	90	.....
6.....	78	48	0		21.....	0	50	94	.....
7.....	75	50	78		22.....	66	57	96	.....
8.....	70	49	84		23.....	67	64	90	.....
9.....	67	52	86		24.....	73	70	95	.....
10.....	61	56	86		25.....	80	73	92	.....
11.....	53	53	0		26.....	63	78	90	.....
12.....	47	57	0		27.....	53	106	90	.....
13.....	51	53	0		28.....	57	128	98	.....
14.....	59	49	0		29.....	57	98	94	.....
15.....	60	49	0		30.....	57	86	62	.....
					31.....		92		.....

NOTE.—May 6–19 gage heights affected by backwater from check about a mile below gage; discharge determined from curve through one measurement made during this period. Discharge May 20 to June 4 determined by shifting-control method. No flow in canal before Apr. 6, on Apr. 20–21, June 5–6 and 11–19, and after July 3.

Monthly discharge of Agency ditch near Harlem, Mont., for the year ending Sept. 30, 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
April 6-30.....	80	0	55.9	2,770
May.....	128	44	63.1	3,880
June.....	98	0	53.3	3,170
July 1-4.....	22	0	6.0	48
The period.....				9,870

ROCK CREEK NEAR HINSDALE, MONT.

LOCATION.—In sec. 10, T. 31 N., R. 36 E., at Ottenstror's ranch, about 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, 1916. From July 5, 1905, to December 31, 1907, records 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.—Overhanging chain gage and staff gage on the left bank, back of John Ottenstror's house; chain gage reads to 16.0 feet; staff 16.0-24.0 feet. Gage read by Mrs. John Ottenstror.

DISCHARGE MEASUREMENTS.—Made by wading one-fourth mile below the gage at low and medium stages, and from a bridge 2 miles below at high stages.

CHANNEL AND CONTROL.—The water at the gage is deep and sluggish at low water. Control is a gravel bar a quarter of a mile below; under natural conditions it shifts a little at high water. Left bank is high and not subject to overflow at the gage; right bank fairly high, but subject to overflow at flood stages.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 20.6 feet at 2 p. m. April 13 (discharge, 4,220 second-feet); minimum discharge, 3.7 second-feet, November 21, 1915. Lower flow may have occurred during winter.

1906-1907 and 1912-1916: Maximum stage recorded, 18.40 feet June 9, 1906; measured by leveling from flood marks (discharge, determined from extension of rating curve, about 6,220 second-feet); no flow April 14 to May 2, 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.

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

DIVERSIONS.—There is no storage, but the normal summer flow is appropriated and used during the irrigation season.

REGULATION.—None.

ACCURACY.—Stage-discharge relation seriously affected by backwater from a beaver dam from October 1 to the time of spring flood, which carried the dam away; discharge for this period not determined; stage-discharge relation for other periods fairly permanent. Two rating curves, well defined at low and fairly well defined at high stages, were used, one applicable March 20 to June 3, the other June 18 to September 30. Gage read to nearest half tenths once daily. Discharge ascertained by applying gage height to rating table; shifting-control method used June 4-17. Records good except those for intermediate stages, which are fair, owing to possible reversal in curve between 7 and 18 feet.

Discharge measurements of Rock Creek near Hinsdale, Mont., during the year ending Sept. 30, 1916.

Date.	Made by—	Gage height.	Dis-charge.	Date.	Made by—	Gage height.	Dis-charge.
		<i>Feet.</i>	<i>Sec.-ft.</i>			<i>Feet.</i>	<i>Sec.-ft.</i>
Nov. 21 ^a	W. A. Lamb.....	6.70	3.7	May 29 ^b	A. H. Tuttle.....	6.50	175
Apr. 12 ^b	A. H. Tuttle.....	18.95	3,670	June 19	.....do.....	5.74	24.0
30	.....do.....	6.06	90	July 25	.....do.....	5.65	13.3
May 18	.....do.....	5.50	10.2	Aug. 21	.....do.....	5.55	7.4

^a Stage-discharge relation seriously affected by backwater from beaver dam on control 600 feet below gage and by ice.

^b Made from highway bridge $1\frac{1}{2}$ miles below gage.

Daily discharge, in second-feet, of Rock Creek near Hinsdale, Mont., for the year ending Sept. 30, 1916.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1.		3,790	106	154	1,720	79	7
2.		3,790	144	144	1,040	61	7
3.		3,790	135	106	350	52	7
4.		2,500	116	98	350	25	10
5.		2,000	116	77	350	19	40
6.		1,600	97	77	316	19	10
7.		1,304	88	75	294	19	10
8.		1,050	79	75	250	19	10
9.		1,450	70	74	1,180	19	10
10.		2,300	70	74	1,180	40	10
11.		3,070	62	91	294	61	10
12.		3,790	62	89	118	38	27
13.		4,160	54	77	98	14	44
14.		3,950	54	77	79	10	228
15.		3,600	46	66	70	10	119
16.		2,750	26	65	52	10	10
17.		2,000	16	63	19	10	10
18.		1,050 ^a	11	44	372	10	10
19.		860	11	25	206	10	10
20.	1,130	680	11	25	98	8	10
21.	1,750	560	20	31	70	7	10
22.	1,490	440	20	206	31	7	10
23.	1,240	350	20	696	14	6	10
24.	868	280	20	206	10	5	10
25.	600	220	315	173	14	5	10
26.	1,020	180	1,380	140	10	4	10
27.	1,780	160	624	118	10	4	10
28.	2,720	130	397	79	10	4	10
29.	2,780	110	174	1,350	10	4	10
30.	2,850	88	174	2,410	1,300	4	10
31.	3,200	.....	174	.....	640	7	.....

Monthly discharge of Rock Creek near Hinsdale, Mont., for the year ending Sept. 30, 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
March 20-31.....	3,200	600	1,790	42,600
April.....	4,160	88	1,730	108,000
May.....	1,380	11	151	9,280
June.....	2,410	25	233	13,900
July.....	1,720	10	340	20,900
August.....	79	4	19.0	1,170
September.....	228	7	22.3	1,330
The period.....	.....	.....	.....	192,000

PORCUPINE CREEK AT NASHUA, MONT.

LOCATION.—In NE. $\frac{1}{4}$ sec. 31, T. 28 N., R. 42 E., 500 feet above ford, one-fourth mile above highway bridge, three-eighths of a mile north of Nashua, in Valley County.

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—July 11, 1908, to September 30, 1916.

GAGE.—Vertical staff in three sections nailed to trees on the left bank. Read by Rosie Brocksmitth.

DISCHARGE MEASUREMENTS.—Made by wading near gage, or from bridge one-fourth mile below.

CHANNEL AND CONTROL.—Bed of the stream is of mud. Slight gravel bar forms the control at low stages, but as the creek rises the bar is soon drowned out and the control becomes indefinite.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 18.0 feet, April 11; measured by leveling from flood marks (discharge, determined from extension of rating curve 2,700 second-feet); minimum stage recorded, 3.0 feet, August 19 (discharge zero).

1909–1916: Maximum stage recorded April 11, 1916; channel reported dry, August 18 to September 4, 1909; May 27 to June 7, July 12–29, 1910; June 21 to September 5, 1911; August 1–31, 1913; August 19, 1916.

ICE.—Stage-discharge relation seriously affected by ice. Discharge very small. Observations discontinued during winter months.

DIVERSIONS.—None during 1916. A United States Reclamation Service canal, which will divert the entire flow during the irrigation season, is practically completed.

REGULATION.—None developed. A United States Reclamation Service reservoir on the middle fork of stream will partly regulate flood flow.

ACCURACY.—Stage-discharge relation not permanent; affected by shifting control and by ice. Rating curves used as follows: October 1 to December 9, well defined between 1 second-foot and 220 second-feet; March 21 to September 30, well defined below 60 second-feet and fairly well defined between 60 and 1,000 second-feet. Gage read to tenths once daily except December 10 to March 20, when stage-discharge relation was affected by ice. Daily discharge ascertained by applying gage height to rating table. Records good for medium and poor for low stages.

Discharge measurements of Porcupine Creek at Nashua, Mont., during the year ending Sept. 30, 1916.

[Made by A. H. Tuttle.]

Date.	Gage height.	Dis-charge.	Date.	Gage height.	Dis-charge.	Date.	Gage height.	Dis-charge.
Apr. 8.....	Feet. 14.12	Sec.-ft. 804	May 17.....	Feet. 4.02	Sec.-ft. 18.0	July 24.....	Feet. 3.84	Sec.-ft. 12.5
28.....	4.80	53	June 19.....	3.76	9.1	Aug. 20.....	3.21	.6

Daily discharge, in second-feet, of Porcupine Creek at Nashua, Mont., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Dec.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1.	0.5	0.5	1.3	-----	1,000	42	52	835	88	0.2
2.	.5	.5	1.3	-----	1,040	33	42	488	21	.2
3.	.5	.5	1.3	-----	1,030	33	42	386	17	.2
4.	.5	.5	1.3	-----	1,040	33	42	214	14	.2
5.	.1	.5	1.3	-----	1,020	29	33	88	11	.2
6.	.1	.5	1.3	-----	989	29	33	88	7.9	.2
7.	.1	.5	1.3	-----	905	29	33	52	5.5	.2
8.	.1	.5	1.3	-----	775	29	33	52	2.7	.2
9.	.1	1.3	1.3	-----	815	25	25	52	2.7	.2
10.	.1	.5	-----	-----	925	25	25	42	2.7	.6
11.	.1	.5	-----	-----	1,150	21	25	42	2.7	2.7
12.	.1	1.3	-----	-----	1,070	17	25	33	2.7	2.7
13.	.1	1.3	-----	-----	1,020	17	25	25	2.7	2.7
14.	.5	1.3	-----	-----	956	17	25	17	1.6	1.6
15.	.5	1.3	-----	-----	895	17	21	11	.6	1.6
16.	.5	1.3	-----	-----	700	17	21	5.5	.6	1.6
17.	.5	1.3	-----	-----	612	17	17	5.5	.2	1.6
18.	.5	1.3	-----	-----	540	14	17	646	.2	1.6
19.	.5	1.3	-----	-----	470	14	11	165	.0	1.6
20.	.5	1.3	-----	-----	402	14	11	165	.2	1.6
21.	.5	1.3	-----	11	306	33	11	102	.2	.6
22.	.5	1.3	-----	214	242	95	17	21	.2	1.6
23.	.5	1.3	-----	214	158	70	144	21	.2	1.6
24.	.5	1.3	-----	186	102	58	158	21	.2	1.6
25.	.5	1.3	-----	52	76	42	88	11	.2	1.6
26.	.5	1.3	-----	186	52	137	42	5.5	.2	1.6
27.	.5	1.3	-----	253	52	102	37	11	.6	1.6
28.	.5	1.3	-----	540	52	95	52	7.9	.6	1.6
29.	.5	1.3	-----	603	52	88	709	7.9	.6	1.6
30.	.5	1.3	-----	567	42	76	1,000	290	.2	1.6
31.	.5	-----	-----	628	-----	52	-----	137	.2	-----

Monthly discharge of Porcupine Creek at Nashua, Mont., for the year ending Sept. 30, 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
October.....	0.5	0.1	0.38	23
November.....	1.3	.5	1.03	61
December 1-9.....	1.3	1.3	1.30	23
March 21-31.....	628	11	314	6,850
April.....	1,150	42	616	36,700
May.....	137	14	42.6	2,620
June.....	1,000	11	93.9	5,500
July.....	835	5.5	131	8,060
August.....	88	.0	6.05	372
September.....	2.7	.2	1.22	73

LITTLE PORCUPINE CREEK BASIN.

LITTLE PORCUPINE CREEK AT FRAZER, MONT.

LOCATION.—In SE. $\frac{1}{4}$ NE. $\frac{1}{4}$ sec. 28, T. 27 N., R. 44 E., half a mile above intake o. reservoir, on Fort Peck Indian Reservation, and about half a mile north of Frazer, in Valley County.

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—July 13, 1908, to September 30, 1916. From 1908 to 1910 the records were obtained at a site $1\frac{1}{4}$ miles downstream, and from April 14, 1911, to May 10, 1913, at station one-fourth mile below present site.

GAGE.—Vertical staff gage, installed May 10, 1913, on left bank, back of the house of Wm. Ivey, by whom it is read. Gages previously used as follows: July 13, 1908, to September 30, 1910, a staff gage $1\frac{1}{2}$ miles downstream; April 14, 1911, to May 10, 1913, a staff gage one fourth mile below the present site. Flow at the three sites is practically the same.

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

CHANNEL AND CONTROL.—Principal control bar of small rocks and gravel on which moss and weeds grow. At high stages willows growing in the bed of the creek might cause small changes in stage-discharge relation.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 5.0 feet at 6.30 p. m. April 1 (discharge, from extension of rating curve, about 750 second-feet), no flow October to December and August 16 to September 30.

1909–1916: Maximum stage recorded, 5.0 feet April 1, 1916 (discharge, from extension of rating curve, about 750 second-feet); no flow every year in July, August or September.

ICE.—Stream is usually dry during winter months.

DIVERSIONS.—None above station. Entire flow is diverted half a mile below station.

REGULATION.—None.

ACCURACY.—Stage-discharge relation practically permanent during year. Rating curve well defined below 160 second-feet and extended above. Gage read to hundredths twice daily. Discharge ascertained by applying mean daily gage height to rating table. Records good except those below 160 second-feet which are roughly approximate.

Discharge measurements of Little Porcupine Creek at Frazer, Mont., during the year ending Sept. 30, 1916.

[Made by A. H. Tuttle.]

Date.	Gage height.	Dis-charge.	Date.	Gage height.	Dis-charge.	Date.	Gage height.	Dis-charge.
	<i>Feet.</i>	<i>Sec.-ft.</i>		<i>Feet.</i>	<i>Sec.-ft.</i>		<i>Feet.</i>	<i>Sec.-ft.</i>
Apr. 10.....	2.15	146	May 17.....	0.54	6.8	July 24.....	0.66	9.6
29.....	.76	13.1	June 19.....	.54	7.0	Aug. 20.....		.0

Daily discharge, in second-feet, of Little Porcupine Creek at Frazer, Mont., for the year ending Sept. 30, 1916.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Day.	Mar.	Apr.	May.	June.	July.	Aug.
1.....		725	11	16	225	6.3	16.....		79	6.8	7.6	5.6	0.0
2.....		652	11	14	113	5.1	17.....		63	6.3	7.3	5.3	
3.....		493	10.7	12	56	3.7	18.....		49	6.3	6.3	41	
4.....		430	9.6	11	37	3.4	19.....		35	6.3	6.3	74	
5.....		346	9.4	12	47	3.4	20.....		28	5.8	3.5	68	
6.....		225	8.8	13	21	3.7	21.....	37	24	12	6.6	27	
7.....		137	8.8	12	17	3.5	22.....	20	21	14	8.3	20	
8.....		79	7.8	8.3	14	3.4	23.....	16	20	14	11	13	
9.....		113	7.6	8.6	12	3.2	24.....	244	18	16	12	10.2	
10.....		179	7.3	9.4	11	2.9	25.....	264	17	22	12	8.3	
11.....		493	7.0	10.2	9.9	2.9	26.....	264	15	20	12	7.6	
12.....		605	6.8	9.1	8.3	2.3	27.....	304	13	30	14	6.0	
13.....		493	6.8	5.8	7.8	2.3	28.....	493	13	30	16	5.8	
14.....		225	7.3	6.8	6.3	2.2	29.....	472	12	23	19	7.3	
15.....		137	6.0	7.8	5.8	1.2	30.....	515	12	22	79	8.8	
							31.....	559		20		8.6	

NOTE.—Creek practically dry from Oct. 1, 1915, to spring break-up and after Aug. 16, 1916.

Monthly discharge of Little Porcupine Creek at Frazer, Mont., for the year ending Sept. 30, 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
October.....				0
November.....				0
December.....				0
March 21-31.....	559	16	290	6,330
April.....	725	12	192	11,400
May.....	30	5.8	12.3	756
June.....	79	3.5	12.6	750
July.....	225	5.3	29.3	1,800
August 1-16.....	6.3	.0	3.09	98
September.....			.0	0

POPLAR RIVER BASIN.

POPLAR RIVER NEAR POPLAR, MONT.

LOCATION.—In S. $\frac{1}{2}$ 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, 1916, at present site; August 15, 1908, to May 1, 1911, in the S. $\frac{1}{2}$ 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 the United States Reclamation Service Camp, in the NE. $\frac{1}{4}$ sec. 4, T. 29 N., R. 51 E., 18 miles north of Poplar.

GAGE.—Chain on left bank, opposite United States Reclamation Service camp; read by Frank Krauth and Art Pronovort, employees of the United States Reclamation Service.

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

CHANNEL AND CONTROL.—Gravel and clay; shifting slightly.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 14.2 feet at 3 p. m. April 13 (discharge, determined from extension of rating curve about 9,510 second-feet); minimum stage recorded, 3.92 feet September 5 (discharge 11 second-feet.)

1908-1916: Maximum stage recorded, 12.0 feet April 10, 1912, determined by leveling from flood marks (discharge determined from extension of rating curve, about 10,000 second-feet); minimum stage recorded, 2.2 feet, July 29 to August 14, 1910 (discharge, 2.0 second-feet).

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

DIVERSIONS.—Diversions for irrigation are made by the United States Reclamation Service above the station.

REGULATION.—None.

ACCURACY.—Stage-discharge relation permanent except during floods and in winter.

Rating curve used as follows: October 1 to November 10, well defined; March 28 to September 30, well defined between 20 and 1,800 second-feet, and extended beyond these limits. Gage read to quarter-tenths twice daily; oftener during flood stages. Discharge ascertained by applying mean daily gage height to rating table. Records of discharge between 20 and 3,000 second-feet good; others roughly approximate.

Discharge measurements of Poplar River near Poplar, Mont., during the year ending Sept. 30, 1916.

[Made by A. H. Tuttle.]

Date.	Gage height.	Dis-charge.	Date.	Gage height.	Dis-charge.	Date.	Gage height.	Dis-charge.
Apr. 7.....	<i>Feet.</i> 7.55	<i>Sec.-ft.</i> 1,600	May 16.....	<i>Feet.</i> 5.11	<i>Sec.-ft.</i> 218	July 22.....	<i>Feet.</i> 4.34	<i>Sec.-ft.</i> 46.8
27.....	6.19	611	June 18.....	4.75	115	Aug. 18.....	4.18	25.5

Daily discharge, in second-feet, of Poplar River near Poplar, Mont., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1.....	47	48	.....	7,170	505	256	324	62	18
2.....	48	48	.....	7,430	494	223	324	50	15
3.....	69	48	.....	7,040	441	207	306	47	15
4.....	195	48	.....	6,130	441	192	289	39	13
5.....	138	47	.....	4,340	400	178	272	36	41
6.....	125	47	.....	2,350	400	178	239	36	12
7.....	113	47	.....	1,620	385	175	192	36	13
8.....	125	46	.....	1,280	370	157	150	30	14
9.....	113	44	.....	1,280	356	150	134	30	15
10.....	113	41	.....	2,350	342	145	118	30	26
11.....	99	.....	.....	5,610	306	134	106	30	50
12.....	85	.....	.....	8,470	289	123	102	36	39
13.....	81	.....	.....	9,250	272	123	86	36	36
14.....	78	.....	.....	8,600	272	118	83	30	34
15.....	75	.....	.....	7,040	256	118	83	30	30
16.....	72	.....	.....	6,000	223	112	68	30	26
17.....	69	.....	.....	4,340	192	112	65	30	26
18.....	69	.....	.....	2,550	170	116	62	27	26
19.....	67	.....	.....	1,790	165	98	50	24	26
20.....	65	.....	.....	1,530	160	79	50	22	24
21.....	63	.....	.....	1,280	148	86	50	22	22
22.....	61	.....	.....	1,130	145	123	43	22	22
23.....	61	.....	.....	925	157	178	36	22	22
24.....	58	.....	.....	865	170	192	34	22	22
25.....	56	.....	.....	750	192	170	30	22	26
26.....	53	.....	.....	695	223	170	30	22	26
27.....	52	.....	.....	645	239	175	30	22	27
28.....	52	.....	7,040	550	256	207	34	18	30
29.....	52	.....	7,690	528	324	223	47	18	30
30.....	50	.....	6,520	505	306	272	62	18	30
31.....	49	.....	6,390	.....	289	.....	65	18	.....

Monthly discharge of Poplar River near Poplar, Mont., for the year ending Sept. 30, 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
October.....	195	47	79.1	4,860
November 1-10.....	48	41	46.4	920
March 28-31.....	7,690	6,390	6,910	54,800
April.....	9,250	505	3,470	206,000
May.....	505	145	286	17,600
June.....	272	79	160	9,520
July.....	324	30	115	7,070
August.....	62	18	29.6	1,820
September.....	50	11	24.2	1,440

BIG MUDDY CREEK BASIN.

BIG MUDDY CREEK NEAR CULBERTSON, MONT.

LOCATION.—In NE. $\frac{1}{4}$ 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 because of backwater from Missouri River.

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—July 19, 1909, to September 30, 1916, at present station; July 14, 1908, to July 19, 1909, at original station.

GAGE.—An inclined staff on the left bank near the house on Kraft's ranch; read by Thomas Shields until August 19, 1916; then by Jacob Kraft. This gage has been used since July 19, 1909; before that date a staff gage at Boyd's ranch, 8 miles downstream, was used.

DISCHARGE MEASUREMENTS.—Made by wading or from the bridge about 9 miles below the gage.

CHANNEL AND CONTROL.—Creek has small crooked channel, and mud banks, which are fairly high and seldom overflowed. Extreme low-water control consists of bar of gravel with a few small boulders; but as the stage increases the bar is drowned out and the control becomes indefinite. Weeds grow thick in the channel above the control during the summer months and cause backwater at gage.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 11.4 feet at 3 p. m. March 31 (discharge, 1,550 second-feet); minimum stage, 2.1 feet October 10, November 2 and 5 (discharge, 1 second-foot).

1909-1916: 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 January, February, October, November and December.

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 backwater from aquatic growth in channel during the last part of summer. Rating curves used as follows: October 1 to November 5, fairly well defined between 7 and 120 second-feet; March 26 to August 4, well defined between 80 and 1,400 second-feet; August 19 to September 30, well defined below 30 second-feet; August 5-18, interpolated. Gage read to tenths about every other day until August 4; to hundredths once daily after August 19. Discharge ascertained by applying gage height to rating table. Records good October to July; fair August and September.

Discharge measurements of Big Muddy Creek near Culbertson, Mont., during the year ending Sept. 30, 1916.

[Made by A. H. Tuttle.]

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	<i>Feet.</i>	<i>Sec.-ft.</i>		<i>Feet.</i>	<i>Sec.-ft.</i>		<i>Feet.</i>	<i>Sec.-ft.</i>
Apr. 9 ^a	10.73	1,360	May 15 ^a	4.72	204	July 20 ^a	3.56	98
26 ^a	7.42	636	June 17 ^a	3.30	84	Aug. 19 ^b	2.85	18

^a Measured at highway bridge 8 miles below gage.

^b Measurements made by wading at ford 300 feet below gage. Stage-discharge relation seriously affected by backwater caused by aquatic plants in channel.

Daily discharge, in second-feet, of Big Muddy Creek near Culbertson, Mont., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1.....	2	a 1	.....	1,430	378	142	362	a 46	6.2
2.....	a 2	1	.....	1,430	a 347	a 140	a 351	33	5.5
3.....	2	a 1	.....	a 1,430	316	a 137	a 340	a 31	4.8
4.....	a 2	a 1	.....	a 1,430	a 277	134	330	29	5.5
5.....	3	1	.....	1,430	238	a 122	a 284	28	5.5
6.....	a 3	.....	.....	1,430	a 232	110	238	27	5.5
7.....	3	.....	.....	1,390	226	a 100	a 190	26	5.5
8.....	3	.....	.....	a 1,380	a 214	89	142	25	4.8
9.....	3	.....	.....	1,360	202	a 75	a 134	24	4.0
10.....	1	.....	.....	a 1,360	a 186	61	126	24	5.5
11.....	2	.....	.....	1,360	170	a 61	a 118	23	7.0
12.....	2	.....	.....	a 1,360	a 170	61	110	22	6.2
13.....	a 2	.....	.....	1,360	170	a 55	a 103	21	5.5
14.....	2	.....	.....	1,410	a 186	50	96	20	6.2
15.....	3	.....	.....	a 1,400	202	a 60	a 89	20	7.0
16.....	a 3	.....	.....	1,390	a 188	a 71	82	19	9.0
17.....	a 5	.....	.....	1,390	a 174	82	a 72	19	11.0
18.....	5	.....	.....	a 1,390	160	a 82	61	18	13.0
19.....	a 5	.....	.....	1,390	150	82	a 80	18	12.0
20.....	5	.....	.....	a 1,360	a 150	a 104	100	20	11.0
21.....	5	.....	.....	1,340	a 150	126	a 115	16	10.0
22.....	a 4	.....	.....	a 1,240	150	a 134	130	13	9.0
23.....	3	.....	.....	1,150	a 150	142	a 122	12	9.0
24.....	a 3	.....	.....	1,060	150	a 151	114	10	7.0
25.....	3	.....	.....	a 847	a 150	a 160	a 107	9	7.0
26.....	a 3	.....	970	634	150	170	100	8	6.2
27.....	a 3	.....	1,220	a 594	a 150	214	a 84	7	7.0
28.....	a 3	.....	a 1,260	554	150	a 265	68	6.2	6.2
29.....	3	.....	1,310	496	a 146	316	a 64	5.5	6.2
30.....	2	.....	1,410	460	142	346	a 61	5.5	5.5
31.....	2	.....	1,550	.....	a 142	.....	58	6.2	.....

a Discharge interpolated.

Monthly discharge of Big Muddy Creek near Culbertson, Mont., for the year ending Sept. 30, 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
October.....	5	1	2.97	183
November 1-5.....	1	1	1.00	9.9
March 26-31.....	1,550	970	1,290	15,400
April.....	1,430	460	1,210	72,000
May.....	378	142	192	11,800
June.....	346	50	128	7,620
July.....	362	58	143	8,790
August.....	46	5.5	19.1	1,170
September.....	13	4.0	7.13	424

YELLOWSTONE RIVER BASIN.

YELLOWSTONE RIVER NEAR CANYON HOTEL,¹ YELLOWSTONE NATIONAL PARK.

LOCATION.—Approximately in secs. 9-16, T. 13 S., R. 10 E., Montana meridian, 30 feet east of stage road from Lake Yellowstone to Yellowstone Canyon, half a mile upstream from Upper Falls and Canyon soldier station, $1\frac{1}{2}$ miles south of Canyon Hotel, and about 13 miles below outlet of Lake Yellowstone.

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—June 22, 1913, to September 30, 1916.

¹ Formerly known as Yellowstone River at Canyon soldier station.

GAGE.—Vertical staff on left bank, one-eighth mile above Chittenden Bridge, read by privates or noncommissioned officers attached to the Canyon soldier station. Present gage used since September 13, 1913. Original gage, used June 22 to September 12, 1913, was of same type and at same site but set to a datum 1.03 feet higher than that of present gage; readings on original gage reduced to datum of present gage.

DISCHARGE MEASUREMENTS.—Made by wading at low stages at a gravel and boulder section 100 feet below the gage. High-stage measurements made from Fishing bridge, about 13 miles upstream, and the measured inflow of tributary streams between this point and the gage added.

CHANNEL AND CONTROL.—One channel at all stages. Bed of stream gravel and boulders. Rock control at head of rapids about 600 feet below gage; practically permanent. Water opposite and above gage, deep and sluggish. Aquatic growth affects stage-discharge relation during summer months.

ICE.—Stage-discharge relation affected by ice; gage readings discontinued during winter.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year 5.0 feet July 4–10 (discharge July 4–6, 6,470 second-feet); minimum stage recorded, 0.75 foot at 3.30 p. m. October 16 (discharge, 675 second-feet). Gage height and discharge lower during winter period.

1913–1916: Maximum stage recorded, 5.35 feet June 23 and 25, 1913 (discharge, 7,060 second-feet); minimum stage, 0.75 foot October 16, 1915 (discharge, 675 second-feet). Gage height and discharge lower during winter periods.

DIVERSIONS.—None above station.

REGULATION.—None.

ACCURACY.—Control believed to have remained permanent, but stage-discharge relation is affected by aquatic growth each summer, usually from July to September. Rating curve is fairly well defined, partly by measurements made from a cable during 1917. Gage read once daily to half tenths except during winter months. Discharge ascertained by applying daily gage height to rating table or by shifting-control method. Records fair.

The following discharge measurement was made by Baldwin and Hoyt: July 13, 1916: Gage height, 4.07 feet; discharge, 4,660 second-feet, no allowance being made for inflow between Fishing bridge and station.

Daily discharge, in second-feet, of Yellowstone River near Canyon Hotel, Yellowstone National Park, for the years ending Sept. 30, 1913–1916.

Day.	June.	July.	Aug.	Sept.	Day.	June.	July.	Aug.	Sept.
1913.					1913.				
1.		6,810	5,790	2,670	16.		6,130	3,790	1,860
2.		6,720	5,880	2,670	17.		5,960	3,710	1,760
3.		6,720	5,960	2,600	18.		5,700	3,630	1,670
4.		6,720	5,960	2,530	19.		5,540	3,630	1,580
5.		6,560	5,790	2,460	20.		5,540	3,560	1,490
6.		6,560	5,450	2,390	21.	6,900	5,450	3,480	1,500
7.		6,560	5,020	2,390	22.	6,900	5,200	3,400	1,560
8.		6,560	4,760	2,340	23.	7,060	5,280	3,260	1,570
9.		6,380	4,590	2,290	24.	6,980	5,020	3,180	1,570
10.		6,380	4,330	2,230	25.	7,060	5,110	3,100	1,630
11.		6,380	4,320	2,180	26.	6,980	5,200	3,030	1,630
12.		6,380	4,060	2,130	27.	6,900	5,360	2,880	1,640
13.		6,380	3,960	2,130	28.	6,900	5,200	2,810	1,640
14.		6,300	3,950	2,040	29.	6,900	5,200	2,740	1,650
15.		6,220	3,950	1,950	30.	6,810	5,960	2,740	1,650
					31.		5,790	2,740	.....

Daily discharge, in second-feet, of Yellowstone River near Canyon Hotel, Yellowstone National Park, for the years ending Sept. 30, 1913-1916—Continued.

Day.	Oct.	Nov.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1913-14.									
1.....	1,610	1,200	.....	.....	.....	3,060	4,300	2,850	1,290
2.....	1,610	1,200	.....	.....	.....	3,210	4,600	2,710	1,280
3.....	1,610	1,200	.....	.....	.....	3,510	4,280	2,710	1,260
4.....	1,560	1,200	.....	.....	.....	3,820	4,270	2,710	1,240
5.....	1,500	1,200	.....	.....	.....	4,140	4,410	2,710	1,220
6.....	1,500	1,200	.....	.....	.....	4,300	4,570	2,570	1,210
7.....	1,500	1,160	669	.....	.....	4,300	4,400	2,570	1,190
8.....	1,500	1,160	.....	.....	.....	4,300	4,380	2,430	1,170
9.....	1,560	1,160	.....	.....	1,350	4,300	4,540	2,430	1,160
10.....	1,560	1,110	.....	.....	1,250	4,300	4,360	2,300	1,140
11.....	1,500	1,110	.....	.....	.....	4,300	4,350	2,300	1,120
12.....	1,500	1,060	.....	.....	.....	4,300	4,330	2,300	1,100
13.....	1,450	1,020	.....	.....	.....	4,140	4,170	2,170	1,090
14.....	1,400	978	.....	.....	.....	4,140	4,160	2,170	1,070
15.....	1,400	935	.....	.....	.....	4,140	4,160	2,170	1,070
16.....	1,400	935	.....	.....	1,350	4,300	3,980	2,170	1,070
17.....	1,400	895	.....	.....	1,350	4,140	3,960	2,040	1,080
18.....	1,350	855	.....	.....	1,500	4,140	3,800	1,910	1,050
19.....	1,350	.....	.....	.....	1,610	4,140	3,790	1,790	1,060
20.....	1,350	.....	.....	.....	1,610	4,140	3,620	1,790	1,160
21.....	1,350	.....	.....	.....	1,720	4,620	3,620	1,790	1,260
22.....	1,300	.....	.....	.....	1,840	4,940	3,600	1,620	1,270
23.....	1,300	.....	.....	.....	1,960	4,940	3,450	1,510	1,280
24.....	1,300	.....	.....	.....	2,090	4,940	3,450	1,460	1,290
25.....	1,300	.....	.....	.....	2,220	4,940	3,300	1,460	1,300
26.....	1,300	.....	.....	.....	2,350	4,940	3,300	1,410	1,260
27.....	1,250	.....	.....	.....	2,350	4,780	3,150	1,440	1,270
28.....	1,250	.....	.....	.....	2,490	4,620	3,000	1,360	1,230
29.....	1,250	.....	.....	.....	2,630	4,460	3,000	1,360	1,240
30.....	1,200	.....	.....	.....	2,770	4,300	2,850	1,310	1,250
31.....	1,200	.....	.....	.....	2,910	.....	2,850	1,310	.....
1914-15.									
1.....	1,250	1,160	.....	.....	.....	1,350	1,610	2,740	1,480
2.....	1,300	1,160	.....	.....	.....	1,350	1,650	2,740	1,480
3.....	1,400	1,160	.....	.....	.....	1,350	1,650	2,740	1,480
4.....	1,300	1,160	.....	.....	.....	1,300	1,700	2,600	1,480
5.....	1,300	1,160	.....	.....	.....	1,300	1,760	2,600	1,430
6.....	1,300	1,160	.....	.....	.....	1,400	1,740	2,600	1,430
7.....	1,300	1,160	.....	.....	.....	1,450	1,800	2,460	1,430
8.....	1,250	1,160	.....	.....	.....	1,500	1,910	2,320	1,430
9.....	1,250	1,160	.....	.....	.....	1,720	1,910	2,320	1,430
10.....	1,250	1,160	.....	.....	.....	1,960	2,020	2,190	1,430
11.....	1,300	1,160	.....	.....	.....	1,960	2,160	2,190	1,430
12.....	1,300	1,160	.....	.....	.....	2,090	2,270	2,060	1,380
13.....	1,300	1,160	.....	.....	.....	1,840	2,270	2,060	1,330
14.....	1,300	1,160	.....	.....	1,250	1,780	2,390	1,940	1,330
15.....	1,250	1,160	.....	.....	1,300	1,780	2,390	1,940	1,140
16.....	1,250	1,160	.....	.....	1,250	1,780	2,520	1,940	1,140
17.....	1,250	1,110	.....	.....	1,300	1,720	2,520	1,820	1,140
18.....	1,250	.....	.....	.....	1,300	1,720	2,500	1,820	1,140
19.....	1,250	.....	.....	.....	1,300	1,720	2,640	1,820	1,100
20.....	1,250	.....	.....	.....	1,300	1,720	2,630	1,820	1,110
21.....	1,250	.....	.....	.....	1,300	1,660	2,770	1,820	1,120
22.....	1,250	.....	.....	.....	1,200	1,660	2,760	1,700	1,130
23.....	1,250	.....	.....	.....	1,350	1,660	2,760	1,700	1,140
24.....	1,250	.....	.....	.....	1,350	1,500	2,880	1,640	1,150
25.....	1,250	.....	.....	.....	1,400	1,500	2,880	1,590	1,150
26.....	1,250	.....	.....	.....	1,400	1,500	2,880	1,590	1,110
27.....	1,250	.....	.....	.....	1,400	1,560	2,740	1,480	1,120
28.....	1,250	.....	.....	.....	1,450	1,560	2,740	1,480	1,130
29.....	1,250	.....	.....	.....	1,450	1,560	2,740	1,480	1,140
30.....	1,200	.....	.....	.....	1,450	1,610	2,740	1,480	1,150
31.....	1,200	.....	.....	.....	1,400	.....	2,740	1,480	.....

Daily discharge, in second feet, of Yellowstone River near Canyon Hotel, Yellowstone National Park, for the years ending Sept. 30, 1913-1916—Continued.

Day.	Oct.	Nov.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1915-16.									
1.....	1,110					2,490	6,130	4,560	2,300
2.....	1,060					2,490	6,130	4,560	2,170
3.....	1,020					2,490	6,300	4,560	2,170
4.....	978					2,630	6,470	4,400	2,170
5.....	978					2,630	6,470	4,400	2,040
6.....	935					2,630	6,470	4,240	1,910
7.....	935					2,630	6,450	4,240	1,910
8.....	895					2,630	6,450	4,240	1,790
9.....	855					2,630	6,440	4,240	1,680
10.....	855					2,770	6,440	4,080	1,680
11.....	780					2,910	6,250	3,920	1,620
12.....	780					2,910	6,060	3,920	1,620
13.....	745					3,060	6,060	3,920	1,570
14.....	745					3,210	6,040	3,920	1,570
15.....	710					3,360	5,880	3,920	1,570
16.....	675					3,510	5,690	3,920	1,580
17.....						935	5,670	3,760	1,530
18.....						1,020	5,670	3,600	1,490
19.....						1,110	5,480	3,600	1,450
20.....						1,200	5,300	3,600	1,410
21.....						1,300	5,300	3,450	1,420
22.....						1,400	5,280	3,450	1,380
23.....						1,400	5,110	3,300	1,390
24.....						1,610	4,920	3,300	1,400
25.....						1,720	4,460	3,300	1,360
26.....						1,720	4,780	4,910	1,370
27.....						1,840	5,110	4,730	1,330
28.....						1,960	5,450	4,570	1,340
29.....						2,090	5,620	4,560	1,300
30.....						2,220	5,790	4,560	1,300
31.....						2,350	4,720	2,430	.....

Monthly discharge of Yellowstone River near Canyon Hotel, Yellowstone National Park, for the years ending Sept. 30, 1913-1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
1913.				
June 21-30.....	7,060	6,810	6,940	138,000
July.....	6,810	5,020	5,980	368,000
August.....	5,960	2,740	4,050	249,000
September.....	2,670	1,490	1,980	118,000
1913-14.				
October.....	1,610	1,200	1,410	86,700
November 1-18.....	1,200	855	1,090	38,900
May 9-31.....	2,910	.....	1,800	82,100
June.....	4,940	3,060	4,290	255,000
July.....	4,600	2,850	3,870	238,000
August.....	2,850	1,810	2,030	125,000
September.....	1,300	1,050	1,190	70,800
1914-15.				
October.....	1,400	1,200	1,270	78,100
November 1-17.....	1,180	1,110	1,160	39,100
May 14-31.....	1,450	1,200	1,340	47,800
June.....	2,090	1,300	1,620	96,400
July.....	2,880	1,610	2,340	144,000
August.....	2,740	1,480	2,010	124,000
September.....	1,480	1,100	1,270	75,600
1915-16.				
October 1-16.....	1,110	675	878	27,900
May 17-31.....	2,350	935	1,590	47,300
June.....	5,790	2,490	3,570	212,000
July.....	6,470	4,560	5,660	348,000
August.....	4,560	2,430	3,716	228,000
September.....	2,300	1,300	1,630	97,000

YELLOWSTONE RIVER AT CORWIN SPRINGS, MONT.

LOCATION.—In NE. $\frac{1}{4}$ 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, 1916.

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.

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; not subject to overflow.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 9.8 feet June 18 and 19 (discharge, 20,900 second-feet); minimum stage recorded, 0.6 foot January 1 (discharge, 830 second-feet).

1910-1916: 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). Estimates of daily flow were made for the winter of 1911-12 only. The estimated mean monthly flow for January and February, 1911, was 900 second-feet.

ICE.—Stage-discharge relation not seriously affected by ice except in extremely cold weather, largely because of high velocity of water.

DIVERSIONS.—No water diverted from the Yellowstone above station.

REGULATION.—None.

ACCURACY.—Stage-discharge relation permanent since station was established.

Rating curve well defined between 1,010 and 18,300 second-feet. Gage read to half tenths once daily. Discharge ascertained by applying daily gage heights to rating table. Records excellent.

The following discharge measurement was made by W. A. Lamb: August 4, 1916: Gage height, 4.70 feet; discharge, 5,970 second-feet.

Daily discharge, in second-feet, of Yellowstone River at Corwin Springs, Mont., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1.....	2,010	1,310	1,010	830	.....	960	1,310	2,560	5,800	18,300	6,730	3,060
2.....	1,900	1,310	1,900	910	.....	1,010	1,310	2,340	5,180	17,700	6,250	3,060
3.....	1,900	1,310	1,700	1,070	.....	1,010	1,310	2,340	4,980	18,600	6,020	3,060
4.....	1,900	1,310	1,800	910	.....	1,140	1,220	2,800	5,800	16,400	6,020	3,060
5.....	1,800	1,310	1,900	910	.....	1,070	1,220	4,240	8,760	14,600	5,800	2,800
6.....	1,700	1,220	1,140	910	.....	1,140	1,140	4,600	7,220	15,500	5,800	2,930
7.....	1,700	1,220	1,140	910	.....	1,010	1,220	7,470	6,970	15,800	5,800	2,800
8.....	1,700	1,220	1,140	910	.....	1,140	1,310	5,380	7,720	15,200	5,380	2,680
9.....	1,600	1,310	1,140	910	.....	1,140	1,310	6,490	9,030	15,500	5,280	2,680
10.....	1,600	1,220	1,070	910	910	1,140	1,310	5,380	11,300	14,900	5,180	2,560
11.....	1,500	1,140	1,010	910	910	1,220	1,400	4,420	9,870	13,400	5,180	2,560
12.....	1,500	1,220	1,070	.....	910	1,220	1,500	3,610	9,030	12,200	4,980	2,560
13.....	1,600	1,140	1,140	.....	910	1,310	1,310	3,610	9,590	12,800	4,980	2,560
14.....	1,600	1,220	1,070	.....	960	1,140	1,400	3,330	11,000	12,200	4,790	2,340
15.....	1,500	1,220	1,010	.....	1,010	1,220	1,700	3,060	13,700	11,600	4,600	2,340
16.....	1,500	1,310	1,010	.....	1,010	1,220	1,500	2,930	15,800	11,000	4,420	2,340
17.....	1,600	1,220	960	.....	1,010	1,310	1,600	3,060	18,600	10,400	4,240	2,230
18.....	1,500	1,220	910	.....	1,010	1,310	1,700	2,930	20,900	10,100	4,240	2,120
19.....	1,500	1,220	1,010	.....	1,010	1,310	1,600	3,330	20,900	9,870	4,070	2,120
20.....	1,500	1,140	1,140	.....	1,010	1,500	1,500	4,420	18,000	9,310	3,900	2,230
21.....	1,500	1,220	1,140	.....	1,070	1,500	1,500	4,980	16,100	9,310	3,900	2,230
22.....	1,500	1,140	1,070	.....	1,010	1,400	1,500	4,790	14,000	8,760	3,750	2,120
23.....	1,500	1,140	1,140	.....	1,070	1,500	1,500	4,420	12,500	8,490	3,610	2,120
24.....	1,700	1,140	960	.....	1,070	1,310	1,600	3,900	12,200	7,720	3,470	2,230
25.....	2,340	960	910	.....	1,140	1,310	1,900	3,900	12,500	7,220	3,330	2,120
26.....	1,500	1,010	910	.....	1,140	1,310	2,450	3,900	14,000	7,220	3,190	2,120
27.....	1,500	910	910	.....	1,010	1,220	3,190	3,610	15,800	6,970	3,060	2,120
28.....	1,500	1,010	910	.....	1,010	1,310	4,240	3,750	19,300	7,720	3,190	2,120
29.....	1,500	1,140	870	.....	.....	960	1,310	3,610	4,600	20,200	7,220	2,060
30.....	1,310	1,010	910	.....	.....	1,220	2,800	5,380	19,300	7,220	3,060	2,010
31.....	1,310	.....	870	.....	.....	1,310	.....	6,490	.....	6,970	3,060	.....

NOTE.—Discharge Jan. 12-31 and Feb. 1-9 estimated at 910 second-feet.

Monthly discharge of Yellowstone River at Corwin Springs, Mont., for the year ending Sept. 30, 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
October.....	2,340	1,310	1,620	99,600
November.....	1,310	910	1,180	70,200
December.....	1,900	870	1,120	68,900
January.....	1,070	830	913	56,100
February.....	1,140	.....	977	56,200
March.....	1,500	960	1,230	75,600
April.....	4,240	1,140	1,740	104,000
May.....	7,470	2,340	4,130	254,000
June.....	20,900	4,980	12,500	744,000
July.....	18,600	6,970	11,600	713,000
August.....	6,730	3,060	4,530	279,000
September.....	3,060	2,010	2,440	145,000
The year.....	20,900	.....	3,680	2,670,000

YELLOWSTONE RIVER AT HUNTLEY, MONT.

LOCATION.—In SW. $\frac{1}{4}$ sec. 24, T. 2 N., R. 27 E., at new steel highway bridge 1 mile below Huntley, in Yellowstone County, 1 mile below mouth of Pryor Creek.

DRAINAGE AREA.—12,000 square miles.

RECORDS AVAILABLE.—October 1, 1907, to November 12, 1916, when station was discontinued. For station at Junction, where discharge is practically the same as at Huntley, May 10, 1906, to December 31, 1907.

GAGE.—Chain fastened to bridge rail on downstream side; read by E. V. Carpenter, employee of the United States Reclamation Service.

DISCHARGE MEASUREMENTS.—Made from downstream side of bridge.

CHANNEL AND CONTROL.—Bed of channel composed of gravel; current very swift at all stages causing frequent shifts in stream bed. Banks high and not subject to overflow.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 12.5 feet June 30 (discharge, 58,100 second-feet); minimum stage recorded, 3.6 feet March 26 (discharge, 3,100 second-feet).

1906-1916: Maximum stage recorded, 12.5 feet June 30, 1916, (discharge, 58,100 second-feet); minimum stage recorded, 1.1 feet December 26-28, 1907 (discharge, 1,060 second-feet).

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

DIVERSIONS.—The Huntley canal, built by the United States Reclamation Service and supplying water for 29,000 acres, takes water from river about 2 miles above gaging station; normal capacity of canal 400 second-feet. Near Laurel are the headgates of the Billings Land & Irrigation Co.'s canal, which carries about 305 second-feet and irrigates 28,000 acres. Many small ditches take water from the tributaries of the Yellowstone but few from the river itself, owing to variation of stage and consequent difficulty of diversion.

REGULATION.—Yellowstone Lake furnishes some natural regulation.

ACCURACY.—Stage-discharge relation not permanent; affected by shifting control and seriously affected by ice in winter. Rating curves used as follows: October 1 to November 4, 1915, fairly well defined; March 1 to June 20 and July 1 to November 12, 1916, poorly defined. Gage read to quarter tenths once daily. Discharge ascertained by applying gage height to rating table; shifting-control method used June 21-30. Records only fair.

Discharge measurements of Yellowstone River at Huntley, Mont., during the year ending Sept. 30, 1916.

[Made by W. A. Lamb.

Date.	Gage height.	Dis-charge.
Mar. 23.....	<i>Fect.</i> 3.80	<i>Sec.-ft.</i> 3,640
Aug. 5.....	5.45	12,000

Daily discharge, in second-feet, of Yellowstone River at Huntley, Mont., for the period Oct. 1, 1915, to Nov. 12, 1916.

Day.	Oct.	Nov.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1915-16.									
1.....	5,030	3,760	13,600	3,370	5,090	10,700	55,000	13,900	5,860
2.....	5,030	3,520	13,600	3,500	4,200	10,700	54,300	13,400	5,530
3.....	5,030	3,520	13,600	3,920	4,790	10,300	52,900	12,400	5,530
4.....	5,030	3,520	13,100	3,640	5,390	11,200	48,000	11,900	5,530
5.....	5,030	.....	13,600	3,500	5,390	12,100	43,800	11,900	5,530
6.....	4,770	.....	13,100	3,370	6,370	14,800	41,700	11,900	5,530
7.....	4,510	.....	13,100	3,370	9,820	17,000	41,700	11,900	5,530
8.....	4,510	.....	12,600	3,370	15,800	18,000	42,400	11,400	5,530
9.....	4,510	.....	12,600	3,370	14,200	19,700	44,800	10,900	5,530
10.....	4,510	.....	12,100	3,500	13,100	20,900	46,600	10,900	5,530
11.....	4,510	.....	12,100	3,640	11,200	22,100	42,400	10,000	5,860
12.....	4,510	.....	11,200	3,500	10,300	24,000	39,600	9,580	6,200
13.....	4,510	.....	10,300	3,640	11,200	22,700	38,300	8,780	6,540
14.....	4,510	.....	9,820	3,640	9,390	21,500	36,200	8,380	6,200
15.....	4,510	.....	8,970	3,920	8,970	26,600	34,900	8,000	6,200
16.....	4,510	.....	8,970	4,200	8,970	33,600	33,500	8,000	6,200
17.....	4,510	.....	7,080	4,200	8,570	37,800	32,200	7,620	5,860
18.....	4,510	.....	6,030	4,200	8,180	44,800	30,200	7,620	5,860
19.....	4,510	.....	5,390	3,920	8,570	53,900	27,600	7,620	5,530
20.....	4,260	.....	4,790	3,920	9,390	56,000	25,600	7,250	5,530
21.....	4,010	.....	4,200	3,640	12,100	54,300	25,000	6,890	5,530
22.....	4,010	.....	3,500	3,640	14,200	49,100	23,000	6,890	5,530
23.....	4,010	.....	3,500	3,640	13,100	42,600	20,000	6,890	5,210
24.....	4,010	.....	3,240	3,640	11,600	34,900	18,900	6,540	5,210
25.....	4,010	.....	3,100	3,920	11,600	36,400	17,700	6,540	5,210
26.....	4,010	.....	3,100	4,200	11,200	37,500	16,600	6,200	5,210
27.....	3,760	.....	3,240	5,090	10,700	43,500	15,000	5,860	5,210
28.....	3,760	.....	3,370	6,370	10,700	50,300	15,000	5,860	4,910
29.....	3,760	.....	3,240	7,080	10,700	56,300	16,600	5,860	4,910
30.....	4,010	.....	3,370	6,370	10,700	58,100	15,000	5,860	4,910
31.....	3,760	.....	3,370	.....	10,700	.....	14,500	5,860	.....

Day.	Oct.	Nov.	Day.	Oct.	Nov.	Day.	Oct.	Nov.
1916.			1916.			1916.		
1.....	4,910	5,210	11.....	5,210	4,620	21.....	5,530	.....
2.....	4,910	5,210	12.....	5,210	4,620	22.....	5,530	.....
3.....	4,910	4,910	13.....	5,210	.....	23.....	5,530	.....
4.....	4,910	5,210	14.....	5,210	.....	24.....	5,530	.....
5.....	4,910	4,910	15.....	5,530	.....	25.....	5,530	.....
6.....	4,910	4,910	16.....	5,530	.....	26.....	5,530	.....
7.....	4,910	4,910	17.....	5,530	.....	27.....	5,530	.....
8.....	4,910	4,910	18.....	5,530	.....	28.....	5,530	.....
9.....	4,910	4,910	19.....	5,210	.....	29.....	5,530	.....
10.....	4,910	4,620	20.....	5,210	.....	30.....	5,210	.....
						31.....	5,210	.....

Monthly discharge of Yellowstone River at Hunley, Mont., for the period Oct. 1, 1915, to Nov. 12, 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
1915-16.				
October.....	5,030	3,760	4,380	269,000
November 1-4.....	3,760	3,520	3,580	28,400
March.....	13,600	3,100	8,160	502,000
April.....	7,080	3,370	4,040	240,000
May.....	15,800	4,200	9,880	608,000
June.....	58,100	10,300	31,700	1,890,000
July.....	55,000	14,500	32,500	2,000,000
August.....	13,900	5,860	8,790	540,000
September.....	6,540	4,910	5,590	332,000
1916.				
October.....	5,530	4,910	5,250	323,000
November 1-12.....	5,210	4,620	4,910	117,000

YELLOWSTONE RIVER AT INTAKE, MONT.

LOCATION.—In NW. $\frac{1}{4}$ 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, 1916; 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 the United States Reclamation Service.

DISCHARGE MEASUREMENTS.—Made from bridge at Glendive.

CHANNEL AND CONTROL.—Dam forming 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, 10.3 feet at 2.30 p. m. February 20 (stage-discharge relation affected by ice; discharge not computed); minimum stage recorded, 1.6 feet November 30 and December 1 and 2, 18 and 19 (discharge, 5,760 second-feet).

1903-1915: Maximum stage recorded, 10.1 feet July 4, 1912 (discharge, 112,000 second-feet); minimum stage recorded, 0.9 foot December 26-28, 1912 (discharge, 2,950 second-feet).

ICE.—Stage-discharge relation seriously affected by ice January 1 to March 10.

DIVERSIONS.—The Lower Yellowstone canal, which diverts water to irrigate 66,000 acres of land, heads at the north abutment of dam. There are also many diversions on the tributaries above the 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 January 1 to March 10, when ice froze to crest of dam. 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 reads to tenths twice daily. Discharge ascertained by applying mean daily gage height to rating table. Results good.

No discharge measurements were made during the year.

Daily discharge, in second-feet, of Yellowstone River at Intake, Mont., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Dec.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1.....	23,400	7,260	5,760	.....	8,940	14,400	18,600	83,000	23,400	7,800
2.....	19,500	7,260	5,760	.....	8,360	14,400	21,400	81,500	25,400	7,260
3.....	17,700	7,260	6,240	.....	8,360	12,900	23,400	78,400	23,400	6,740
4.....	16,800	7,260	6,240	.....	7,800	12,900	23,400	69,100	20,400	6,740
5.....	14,400	7,260	6,740	.....	8,360	12,200	23,400	72,200	29,600	6,740
6.....	13,600	7,260	6,740	.....	8,360	12,200	23,400	72,200	22,400	6,740
7.....	13,600	7,260	6,740	.....	8,940	12,200	23,400	61,400	23,400	6,240
8.....	13,600	7,800	6,740	.....	8,940	12,200	27,500	64,400	21,400	6,740
9.....	12,200	7,260	6,740	.....	8,940	12,900	30,800	58,200	21,400	6,740
10.....	11,500	6,740	6,240	.....	8,940	13,600	28,600	59,800	19,500	6,740
11.....	11,500	6,740	6,240	94,200	8,940	17,700	27,500	58,200	17,700	6,740
12.....	10,800	6,740	6,740	94,200	8,360	23,400	32,000	56,800	16,000	7,800
13.....	10,200	6,740	6,740	58,200	8,360	23,400	39,400	50,800	15,200	8,940
14.....	10,200	6,740	6,740	42,200	8,360	23,400	39,400	45,000	14,400	7,800
15.....	10,200	6,740	6,240	30,800	8,360	20,400	36,800	42,200	14,400	7,800
16.....	10,200	6,740	6,240	20,400	8,360	19,500	42,200	75,300	13,600	6,740
17.....	10,200	6,740	6,240	16,800	8,360	18,600	42,200	45,000	12,900	6,740
18.....	10,200	6,740	5,760	14,400	8,940	18,600	45,000	42,200	12,200	6,740
19.....	10,200	6,240	5,760	14,400	8,940	17,700	55,200	35,600	11,500	6,740
20.....	9,540	6,240	6,240	12,900	8,940	15,200	67,600	34,300	10,800	6,740
21.....	9,540	6,240	6,240	12,900	9,540	15,200	78,400	33,100	10,200	6,240
22.....	9,540	6,240	6,240	11,500	9,540	15,200	84,600	29,600	10,200	6,240
23.....	8,940	6,240	6,740	10,800	9,540	16,000	101,000	27,500	9,540	6,240
24.....	8,940	6,240	6,740	10,200	9,540	19,500	84,600	25,400	9,540	6,240
25.....	8,940	6,240	6,740	10,800	8,940	23,400	69,100	25,400	9,540	6,240
26.....	8,940	6,240	6,740	10,800	9,540	24,400	59,800	23,400	8,940	6,240
27.....	8,940	6,240	6,740	9,540	10,200	21,400	50,800	22,400	8,940	6,240
28.....	8,360	6,240	7,260	8,940	12,900	21,400	59,800	23,400	8,360	6,240
29.....	7,800	6,740	7,260	8,360	12,900	19,500	53,800	24,400	7,800	6,240
30.....	7,260	5,760	6,740	8,360	14,400	18,600	78,400	21,400	7,800	6,240
31.....	7,260	.....	6,240	8,940	.....	17,700	.....	25,400	7,800	.....

NOTE.—No determination of discharge, Jan. 1 to Mar. 10, owing to uncertainty concerning the extent to which stage-discharge relation was affected by ice.

Monthly discharge of Yellowstone River at Intake, Mont., for the year ending Sept. 30, 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
October.....	23,400	7,260	11,400	701,000
November.....	7,800	5,760	6,710	339,000
December.....	7,260	5,760	6,470	398,000
March 11-31.....	94,200	8,360	24,300	1,010,000
April.....	14,400	7,800	9,300	553,000
May.....	24,400	12,200	17,400	1,070,000
June.....	101,000	18,600	46,400	2,760,000
July.....	83,000	21,400	47,300	2,910,000
August.....	29,600	7,800	15,100	928,000
September.....	8,940	6,240	6,790	404,000

BIG TIMBER CREEK NEAR BIG TIMBER, MONT.

LOCATION.—In SE. $\frac{1}{4}$ sec. 5, T. 2 N., R. 14 E., at Webb's ranch, about 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, 1916.

GAGE.—Chain gage on left bank below lower barns, and about one-eighth mile below house at Webb's ranch; read by L. E. Webb.

DISCHARGE MEASUREMENTS.—Made by wading or from bridge about a mile below gage.

CHANNEL AND CONTROL.—Stream bed and banks both below and above the gage change at each high stage. Principal control is a bar that produces riffle extending diagonally across the creek from 30 to 40 feet below gage, and is moving gradually upstream.

EXTREMES OF DISCHARGE.—Maximum stage recorded, 4.65 feet June 20, (discharge 768 second-feet); minimum stage recorded 3.0 feet November 20–21 (discharge 12 second-feet).

1912–1916: 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.—Much water is diverted for irrigation above and below station.

REGULATION.—None.

ACCURACY.—Stage-discharge relation changed by high water during June, 1916.

Rating curve used before June 18 well defined below 400 second-feet, and poorly defined above; curve used after July 4 fairly well defined below 125 second-feet, and poorly defined above. Gage read to half-tenths once daily. Daily discharge ascertained by applying gage heights to rating tables, except for periods during which stage-discharge relation is affected by shifting control, or ice, as shown in footnote to daily-discharge table. Records good except for the high-water period of June, and the month of July.

Discharge measurements of Big Timber Creek near Big Timber, Mont., during the year ending Sept. 30, 1916.

[Made by C. S. Heidel.]

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	<i>Feet.</i>	<i>Sec.-ft.</i>		<i>Feet.</i>	<i>Sec.-ft.</i>		<i>Feet.</i>	<i>Sec.-ft.</i>
Oct. 21.....	3.22	37.1	May 24.....	3.70	130	June 27 ^a	3.92	527
Feb. 27.....	3.14	26.9	June 10 ^a	4.20	346	Aug. 3.....	3.76	102

^a Measured from bridge 1 mile below gage.

Daily discharge, in second-feet, of Big Timber Creek near Big Timber, Mont., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Dec.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1.....	56	29	.....	.....	48	83	146	400	126	42
2.....	56	29	.....	.....	48	74	130	400	112	35
3.....	48	29	.....	.....	42	74	105	430	100	35
4.....	48	29	.....	.....	48	74	105	300	100	35
5.....	48	29	.....	.....	64	83	200	257	88	35
6.....	48	29	23	.....	56	94	162	234	126	35
7.....	48	29	23	.....	56	200	146	234	112	35
8.....	48	23	23	.....	56	118	162	234	100	35
9.....	48	23	23	.....	56	94	200	282	88	29
10.....	42	23	23	.....	48	83	346	192	88	29
11.....	42	23	23	.....	56	83	376	199	88	35
12.....	42	23	.....	42	83	74	292	206	78	35
13.....	42	23	.....	48	83	48	319	212	78	35
14.....	42	23	.....	56	83	64	346	173	68	35
15.....	42	23	.....	35	83	64	435	156	68	35
16.....	42	23	.....	42	83	64	496	234	68	35
17.....	35	23	.....	42	83	64	593	234	68	35
18.....	35	23	.....	42	83	64	731	212	68	35
19.....	35	23	.....	48	83	83	731	192	59	29
20.....	35	12	.....	48	105	118	768	156	59	29
21.....	35	12	.....	48	64	118	528	173	59	23
22.....	35	29	.....	48	64	118	465	126	59	23
23.....	35	29	.....	74	56	105	435	140	50	23
24.....	35	42	.....	56	74	105	435	126	50	23
25.....	35	29	.....	48	64	105	435	126	50	23
26.....	35	29	.....	56	64	118	528	126	50	23
27.....	35	29	.....	64	83	105	527	140	42	23
28.....	29	28	.....	64	94	105	600	156	42	23
29.....	29	27	.....	64	83	118	500	173	42	23
30.....	23	26	.....	48	83	130	400	126	42	23
31.....	29	.....	.....	56	.....	130	.....	126	42	.....

NOTE.—Stage-discharge relation affected by ice Nov. 28 to Dec. 4, Dec. 12–13, and Mar. 1–11. Discharge interpolated Nov. 28–30 and July 11–12. June 18–26 discharge determined indirectly on basis of observer's notes and measurement of June 27; June 28 to July 4, on basis of observer's notes, and by comparison with daily discharge of Sweetgrass Creek above Melville. No gage-height record Dec. 14 to Feb. 29.

Monthly discharge of Big Timber Creek near Big Timber, Mont., for the year ending Sept. 30, 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
October.....	56	23	39.9	2,450
November.....	42	12	25.7	1,530
March 12-31.....	74	35	51.4	2,040
April.....	105	42	69.2	4,120
May.....	200	48	95.5	5,870
June.....	768	105	388	23,100
July.....	430	126	209	12,900
August.....	126	42	73.2	4,500
September.....	42	23	30.4	1,810

Boulder River near Contact, Mont.

LOCATION.—In SE. $\frac{1}{4}$ sec. 14, T. 3 S., R. 12 E., at private wagon bridge on ranch of G. W. Baker, $2\frac{1}{2}$ miles below Boulder Falls, and about 8 miles above McLeod post office, 4 miles from Contact, in Sweetgrass County.

DRAINAGE AREA.—234 square miles.

RECORDS AVAILABLE.—May 1, 1910, to September 16, 1916, when station was discontinued.

GAGE.—Vertical staff fastened to downstream side of left abutment of private wagon bridge near the barns on the ranch of G. W. Baker, by whom gage is read.

DISCHARGE MEASUREMENTS.—Made from bridge or by wading at a ford about 400 yards above gage.

CHANNEL AND CONTROL.—Stream bed rocky; shifts slightly. Right bank high and not subject to overflow; left bank low but is overflowed only in extreme floods.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 8.4 feet, 7 a. m. June 27 (discharge, 4,750 second-feet); minimum stage recorded, 2.25 feet November 15 (discharge, 78 second-feet).

1910-1916: Maximum stage recorded June 27, 1916; minimum stage recorded, 1.9 feet November 22-24, 1914, and March 21-24, 1915 (discharge, 20 second-feet).

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

DIVERSIONS.—Small ditch diverts for irrigation above station.

REGULATION.—None.

ACCURACY.—Stage-discharge relation fairly permanent. Rating curve fairly well defined. Gage read to half tenths twice daily. Discharge ascertained by applying mean daily gage height to rating table. Records only fair, owing to lack of discharge measurements.

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

October 22, 1916: Gage height, 2.59 feet; discharge, 152 second-feet.

Daily discharge, in second-feet, of Boulder River near Contact, Mont., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	May.	June.	July.	Aug.	Sept.
1.....	140	165	.....	435	3,450	590	265
2.....	140	165	.....	510	3,450	590	230
3.....	152	140	.....	485	3,550	535	265
4.....	180	140	.....	435	2,720	535	230
5.....	140	128	.....	485	2,630	510	230
6.....	165	128	.....	510	3,650	485	265
7.....	165	128	.....	485	2,900	435	248
8.....	165	128	.....	535	3,260	435	230
9.....	165	115	.....	618	2,990	390	230
10.....	140	102	.....	535	2,990	368	180
11.....	152	115	.....	765	2,540	435	195
12.....	152	90	.....	735	2,460	435	230
13.....	165	90	.....	1,260	2,380	535	230
14.....	165	90	.....	1,040	2,290	485	195
15.....	152	78	.....	1,260	2,120	460	165
16.....	165	.....	.....	1,330	1,980	435	165
17.....	165	.....	.....	1,880	1,850	435	.....
18.....	165	.....	.....	4,250	1,720	390	.....
19.....	165	.....	.....	4,450	1,580	368	.....
20.....	152	.....	.....	4,050	1,440	325	.....
21.....	165	.....	.....	3,850	1,310	325	.....
22.....	152	.....	.....	3,450	1,180	305	.....
23.....	152	.....	.....	3,080	1,040	265	.....
24.....	152	.....	.....	3,080	965	265	.....
25.....	128	.....	.....	3,080	895	230	.....
26.....	140	.....	.....	4,050	895	230	.....
27.....	140	.....	.....	4,450	830	265	.....
28.....	140	.....	.....	4,250	765	265	.....
29.....	152	.....	390	4,050	735	230	.....
30.....	140	.....	405	3,850	675	212	.....
31.....	152	.....	420	.....	645	265	.....

NOTE.—Discharge interpolated, for lack of gage readings, Oct. 31, May 30, 31, and July 16-22.

Monthly discharge of Boulder River near Contact, Mont., for the year ending Sept. 30, 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
October.....	180	128	154	9,470
November 1-15.....	165	78	120	3,570
June.....	4,450	435	2,110	126,000
July.....	3,650	645	2,000	123,000
August.....	590	212	388	23,900
September 1-16.....	265	165	222	7,050

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, Sweetgrass County.

DRAINAGE AREA.—About 63 square miles (measured on topographic map).

RECORDS AVAILABLE.—August 21, 1913, to September 30, 1916; May 5, 1907, to December 31, 1912, for station at C. M. Rein's ranch in SW. $\frac{1}{4}$ 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 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 composed of gravel and boulders; probably slightly shifting. Banks high; not subject to overflow.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 2.7 feet June 17 (discharge, 872 second-feet); minimum stage, 0.5 foot March 20–23 and April 12–21 (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).

1913–1916: 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 practically permanent during year. 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, 1916.

[Made by C. S. Heidel.]

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	<i>Feet.</i>	<i>Sec.-ft.</i>		<i>Feet.</i>	<i>Sec.-ft.</i>		<i>Feet.</i>	<i>Sec.-ft.</i>
Oct. 20.....	0.95	49.8	June 10.....	2.2	508	Aug. 3.....	1.32	131
May 24.....	1.24	107	27.....	2.3	579			

Daily discharge, in second-feet, of Sweetgrass Creek above Melville, Mont., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Dec.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1.....	80	37	27	-----	19	19	136	511	149	49
2.....	80	49	27	-----	16	23	136	578	149	49
3.....	80	49	27	-----	19	23	123	578	123	49
4.....	80	49	27	-----	16	23	149	511	136	49
5.....	80	49	27	-----	16	27	247	511	136	49
6.....	80	49	27	-----	16	27	210	393	149	49
7.....	80	49	27	-----	16	27	228	393	149	49
8.....	80	49	27	-----	16	37	210	393	136	49
9.....	80	49	27	-----	16	100	340	578	136	49
10.....	80	49	27	-----	16	80	511	450	123	49
11.....	80	49	27	-----	16	123	340	340	123	49
12.....	63	49	27	-----	13	123	210	340	123	49
13.....	63	49	27	-----	13	123	290	340	123	49
14.....	63	49	27	-----	13	123	340	290	112	49
15.....	63	37	27	-----	13	100	511	247	100	43
16.....	63	37	37	-----	13	100	578	210	100	43
17.....	63	37	37	-----	13	100	872	228	100	43
18.....	63	37	27	-----	13	100	650	247	100	37
19.....	63	37	27	16	13	123	797	247	90	37
20.....	56	37	27	13	13	100	578	210	90	37
21.....	63	37	37	13	13	100	578	178	80	37
22.....	63	37	37	13	19	100	511	178	80	37
23.....	63	37	37	13	19	100	450	178	80	37
24.....	63	37	37	16	19	112	511	178	80	37
25.....	63	27	27	16	19	123	450	178	80	37
26.....	49	27	27	16	19	123	511	178	80	37
27.....	49	27	27	16	19	123	578	164	80	37
28.....	49	27	27	16	19	123	650	164	80	37
29.....	37	27	27	16	19	136	578	164	80	37
30.....	37	27	27	16	19	136	511	164	56	37
31.....	37	-----	27	16	-----	136	-----	149	49	-----

NOTE.—No gage-height record Jan. 1 to Mar. 18.

Monthly discharge of Sweetgrass Creek above Melville, Mont., for the year ending Sept. 30, 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
October.....	80	37	64.9	3,990
November.....	49	27	40.2	2,390
December.....	37	27	28.9	1,780
March 19-31.....	16	13	15.1	389
April.....	19	13	16.1	958
May.....	136	19	90.7	5,580
June.....	372	123	426	25,300
July.....	578	149	305	18,800
August.....	149	49	106	6,520
September.....	49	37	43.2	2,570

SWEETGRASS CREEK BELOW MELVILLE, MONT.

LOCATION.—Near middle of south line of sec. 27, T. 4 N., R. 15 E., at McAllister's ranch, about one-fourth mile above head of intake canal of Big Timber Carey project, and 6 miles southeast of Melville, Sweetgrass County.

DRAINAGE AREA.—137 square miles (measured on topographic maps).

RECORDS AVAILABLE.—April 1, 1909, to September 30, 1916; May 4, 1907, to April 1, 1909, at Adam's ranch, 2½ miles downstream.

GAGE.—Overhanging chain gage on left bank about 100 feet west of McAllister's ranch house; read by Mrs. Swen Johnson.

DISCHARGE MEASUREMENTS.—Made by wading below gage or from highway bridge one-half mile above gage.

CHANNEL AND CONTROL.—Stream bed of clean gravel. Bar producing riffle about 300 feet around a bend below gage likely to shift. Right bank low; subject to overflow during high stages; left is a cut bank at the gage and not overflowed at that point, but is lower and may be overflowed about 200 feet below gage.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year 4.2 feet during high water in June, as estimated on June 27 from high-water marks (discharge determined from extension of rating curve, 1,700 second-feet); minimum stage recorded, 1.15 feet September 4 (discharge, 34 second-feet).

1909-1916: Maximum stage recorded June 27, 1916; minimum stage recorded, 1.0 foot, August 23-25, September 2-4 and 6, 1913 (discharge, 10 second-feet).

ICE.—Stage-discharge relation seriously affected by ice. Recently no one has lived on the ranch during the winter, and observers have not been available for reading gage even to the end of the open season or to begin as soon as the ice breaks.

DIVERSIONS.—There are adjudicated rights from Sweetgrass Creek exceeding 500 second-feet, and numerous ditches divert water both above and below the 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 fairly permanent during year. Rating curve fairly well defined. Gage read to half tenths daily when observer was home. Discharge obtained by applying gage heights to rating table. Records fair.

Discharge measurements of Sweetgrass Creek below Melville, Mont., during the year ending Sept. 30, 1916.

[Made by C. S. Heidel.]

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	<i>Feet.</i>	<i>Sec.-ft.</i>		<i>Feet.</i>	<i>Sec.-ft.</i>		<i>Feet.</i>	<i>Sec.-ft.</i>
Oct. 20	1.43	68	June 10.....	3.00	580	Aug 3.....	1.45	73
May 24.....	1.78	122	June 27.....	3.22	800			

Daily discharge, in second-feet, of Sweetgrass Creek below Melville, Mont., for the year ending Sept. 30, 1916.

Day.	May.	June.	July.	Aug.	Sept.	Day.	May.	June.	July.	Aug.	Sept.
1.....			614	84	38.	16.....			187	61	48
2.....		200	614	76	38	17.....			174	61	48
3.....		151	830	68	38	18.....			215	61	54
4.....		162	494	61	34	19.....			151	54	54
5.....		230	390	61	38	20.....			151	61	61
6.....		247	302	76	43	21.....			110	68	54
7.....		230	440	61	43	22.....			120	54	54
8.....			440	68	43	23.....			110	61	48
9.....			440	76	48	24.....	130		110	54	38
10.....		614	415	76	48	25.....	200		101	54	38
11.....			390	76	54	26.....	187		101	61	43
12.....			230	76	54	27.....	174	752	92	54	38
13.....			323	68	48	28.....	174	995	110	54	48
14.....			247	61	54	29.....	174	912	130	54	48
15.....			230	61	48	30.....		680	110	48	43
						31.....			92	43	.....

Monthly discharge of Sweetgrass Creek below Melville, Mont., for the year ending Sept. 30, 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
July.....	830	92	273	16,800
August.....	84	43	63.0	3,870
September.....	61	34	46.2	2,750
The period.....				23,400

PRYOR CREEK AT COBURN, MONT.

LOCATION.—In SE. $\frac{1}{4}$ 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, 1916.

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. Banks high and not subject to overflow except at extremely high stages. Current at gage is sluggish at low stages but of medium velocity at high stages.

EXTREMES OF DISCHARGE.—Maximum stages recorded during year, 7.01 feet at 6 p. m.

May 22 (discharge, 333 second-feet); minimum stage, 3.9 feet July 15–27, August 3–6 and 11–14 (discharge, 25 second-feet).

1911–1916: Maximum stage recorded, 9.9 feet, May 20, 1912 (discharge, 746 second-feet); 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 practically permanent. Rating curve well defined between 14 and 282 second-feet. Gage read to half tenths twice 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, 1916.

[Made by W. A. Lamb.]

Date.	Gage height.	Discharge.
	<i>Fect.</i>	<i>Sec.-ft.</i>
Mar. 23.....	4.39	67
May 31.....	5.05	136
Aug. 5.....	3.91	25.2

Daily discharge, in second-feet, of Pryor Creek at Coburn, Mont., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1.....	49	49	-----	83	78	133	49	36	40
2.....	49	49	-----	116	83	146	49	32	40
3.....	58	49	-----	219	83	199	44	25	32
4.....	88	49	-----	153	73	121	40	25	32
5.....	68	49	-----	99	68	140	40	25	32
6.....	49	49	-----	88	68	121	40	25	40
7.....	49	49	-----	88	73	121	40	28	40
8.....	49	49	-----	83	78	110	40	25	40
9.....	49	49	-----	68	78	110	32	28	40
10.....	49	49	-----	68	78	110	32	28	58
11.....	49	49	-----	68	78	104	32	25	49
12.....	49	49	-----	73	83	99	32	25	49
13.....	49	49	-----	68	121	99	32	25	49
14.....	49	49	-----	68	179	99	32	25	49
15.....	49	49	-----	68	219	88	25	25	49
16.....	49	49	-----	68	273	88	25	28	49
17.....	49	49	-----	73	238	88	25	32	49
18.....	49	49	-----	68	189	88	25	32	49
19.....	49	49	-----	68	121	83	25	32	40
20.....	49	49	-----	68	133	78	25	32	40
21.....	49	-----	-----	68	140	99	25	32	40
22.....	49	-----	-----	73	273	133	25	32	40
23.....	49	-----	68	68	273	110	25	40	40
24.....	49	-----	63	68	219	88	25	40	40
25.....	49	-----	73	68	255	88	25	40	40
26.....	49	-----	83	68	229	78	25	40	40
27.....	49	-----	83	73	179	68	25	40	40
28.....	49	-----	83	68	152	63	32	40	40
29.....	49	-----	78	68	146	58	58	40	40
30.....	49	-----	78	78	146	54	78	40	40
31.....	49	-----	78	-----	140	-----	54	40	-----

NOTE.—Gage not read Dec. 16 to Mar. 22. Stage-discharge relation affected by ice after Nov. 20.

Monthly discharge of Pryor Creek at Coburn, Mont., for the year ending Sept. 30, 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
October.....	88	49	51.2	3,150
November 1-20.....	49	49	49.0	1,940
March 23-31.....	83	68	76.3	1,360
April.....	219	68	82.0	4,880
May.....	273	68	147	9,040
June.....	199	54	102	6,070
July.....	78	25	34.9	2,150
August.....	40	25	31.7	1,950
September.....	58	32	42.2	2,510

PRYOR CREEK AT HUNTLEY, MONT.

LOCATION.—In SW. $\frac{1}{4}$ sec. 25, T. 2 N., R. 27 E., at steel highway bridge half a mile from railroad station at Huntley, in Yellowstone County.

DRAINAGE AREA.—800 square miles.

RECORDS AVAILABLE.—August 6, 1904, to December 30, 1916, when station was discontinued.

GAGE.—Chain, installed June 16, 1906, at highway bridge crossing the new channel, into which the creek was at that time turned by the United States Reclamation Service; read by E. V. Carpenter, E. C. Peterson, and George Ditz, employees of the United States Reclamation Service. From August 6, 1904, to June 16, 1906, observations were made from staff gage on right bank 200 feet south of Northern Pacific Railway station. The two gages are not set to the same datum.

DISCHARGE MEASUREMENTS.—Made by wading or from bridge to which gage is attached.

CHANNEL AND CONTROL.—Bed composed of clay and gravel; may change somewhat; banks steep and uniformly graded, clean, and not subject to overflow.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 8.85 feet February 18 (stage-discharge relation affected by ice; discharge not determined); minimum stage recorded, 1.10 feet July 25-26 (discharge, 13 second-feet).

1904-1916: Maximum open-water stage recorded, 7.2 feet July 3, 1912 (discharge, 1,560 second-feet); channel reported dry July 26-28, 1908.

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

DIVERSIONS.—Water sufficient to irrigate about 1,100 acres is diverted above station.

REGULATION.—None.

ACCURACY.—Stage-discharge relation not permanent; affected by ice and by shifting control. Rating curve used October 1 to November 4, 1915, fairly well defined; curve used March 16 to December 15, 1916, well defined between 20 and 200 second-feet. Gage read to quarter tenths before March 1, and to hundredths after that date, once daily. Discharge ascertained by applying daily gage height to rating table. No record November 5 to December 31, 1915; gage read but data inadequate for determination of flow January 1 to March 15, and December 11-30, 1916. Records fair.

Discharge measurements of Pryor Creek at Huntley, Mont., during the year ending Sept. 30, 1916.

[Made by W. A. Lamb.]

Date.	Gage height.	Dis- charge.
Mar. 23.....	<i>Feet.</i> 1.67	<i>Sec.-ft.</i> 76
May 31.....	2.17	152
Aug. 5.....	1.30	30.5

Daily discharge, in second-feet, of Pryor Creek at Huntley, Mont., for the period Oct. 1, 1915, to Dec. 10, 1916.

Day.	Oct.	Nov.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1915-16.									
1.....	282	36	.....	79	75	178	72	38	30
2.....	40	36	.....	188	75	168	69	35	30
3.....	40	36	.....	239	72	159	65	30	32
4.....	40	36	.....	198	69	141	65	30	32
5.....	40	.....	.....	141	68	124	62	28	33
6.....	40	.....	.....	108	65	124	61	26	35
7.....	40	.....	.....	100	68	141	58	28	35
8.....	40	.....	.....	93	69	124	56	30	35
9.....	40	.....	.....	93	72	124	52	32	37
10.....	40	.....	.....	86	68	116	51	32	38
11.....	40	.....	.....	86	65	116	46	35	40
12.....	40	.....	.....	79	69	116	40	35	40
13.....	40	.....	.....	65	72	108	35	35	42
14.....	40	.....	.....	76	159	108	33	33	44
15.....	40	.....	.....	79	260	100	30	33	44
16.....	40	.....	305	82	218	100	30	30	46
17.....	40	.....	260	86	178	96	28	30	46
18.....	38	.....	239	86	159	93	26	29	48
19.....	36	.....	198	82	159	86	23	28	46
20.....	36	.....	188	79	124	82	21	27	46
21.....	36	.....	168	76	198	79	17	26	44
22.....	36	.....	141	72	228	93	17	26	42
23.....	36	.....	93	69	218	105	17	24	40
24.....	38	.....	100	68	218	116	15	23	40
25.....	40	.....	79	69	218	108	13	22	42
26.....	40	.....	79	72	208	105	13	21	44
27.....	38	.....	86	75	198	100	17	23	44
28.....	36	.....	93	78	196	93	26	26	46
29.....	36	.....	86	79	188	86	124	26	46
30.....	36	.....	82	76	178	76	46	27	47
31.....	36	.....	79	.....	159	.....	42	28	.....

Day.	Oct.	Nov.	Dec.	Day.	Oct.	Nov.	Dec.	Day.	Oct.	Nov.	Dec.
1916.											
1.....	50	75	72	11.....	68	62	.....	21.....	108	75	.....
2.....	52	72	72	12.....	69	62	.....	22.....	105	72	.....
3.....	55	71	69	13.....	72	65	.....	23.....	100	72	.....
4.....	55	69	69	14.....	72	68	.....	24.....	98	69	.....
5.....	56	68	68	15.....	76	69	.....	25.....	93	68	.....
6.....	58	68	65	16.....	79	72	.....	26.....	89	65	.....
7.....	58	66	65	17.....	86	72	.....	27.....	83	68	.....
8.....	61	65	64	18.....	89	75	.....	28.....	79	68	.....
9.....	62	65	62	19.....	93	76	.....	29.....	79	69	.....
10.....	65	65	65	20.....	100	76	.....	30.....	76	72	.....
								31.....	75	.....	.....

Monthly discharge of Pryor Creek at Huntley, Mont., for the period Oct. 1, 1915, to Dec. 10, 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
1915-16.				
October.....	282	36	46.5	2,860
November 1-4.....	36	36	36.0	286
March 16-31.....	305	79	142	4,510
April.....	239	65	95.3	5,670
May.....	260	65	141	8,670
June.....	178	76	112	6,660
July.....	124	13	41.0	2,520
August.....	38	21	28.9	1,780
September.....	48	30	40.5	2,410
1916.				
October.....	108	50	76.2	4,690
November.....	76	62	69.3	4,120
December 1-10.....	72	62	67.1	1,380

WIND RIVER AT RIVERTON, WYO.

LOCATION.—In sec. 2, T. 1 S., R. 4 E., at highway bridge one mile east of Riverton, in Fremont County. Popo Agie River enters three-fourths 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, 1916. From May 14, 1906, to November 1, 1908, a station was maintained at Walker's ferry, about a mile above the present station. No streams enter between the sites; records directly comparable.

GAGE.—Chain gage on downstream side of first pier from left bank; read by Miss Edna Grider.

DISCHARGE MEASUREMENTS.—Made from bridge.

CHANNEL AND CONTROL.—Bed composed of sand and gravel, somewhat shifting. No well-defined control. Right bank subject to overflow at extremely high water.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 10.1 feet at 6.30 p. m. June 18, and 5 p. m. June 19 (discharge, 7,750 second-feet); minimum discharge occurs during winter months.

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

DIVERSIONS.—Water is diverted from Wind River and its tributaries to irrigate about 20,000 acres, an area which, under the Wyoming law allowing one second-foot for 70 acres, would require 286 second-feet.

REGULATION.—None.

ACCURACY.—Stage-discharge relation not permanent but shifts between narrow limits.

Rating curve well defined between 500 and 6,000 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 Wind River at Riverton, Wyo., during the year ending Sept. 30, 1916.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		<i>Feet.</i>	<i>Sec.-ft.</i>			<i>Feet.</i>	<i>Sec.-ft.</i>
Oct. 11	M. N. Grant, jr.....	5.59	979	May 8	R. H. Fletcher.....	7.05	2,370
Jan. 16	R. I. Meeker.....	45.95	266	June 15	H. K. Smith.....	8.60	4,760
Feb. 25	R. H. Fletcher.....	45.86	459	Sept. 1	P. V. Hodges.....	5.63	1,130

* Stage-discharge relation affected by ice.

Daily discharge, in second-feet, of Wind River at Riverton, Wyo., for the year ending Sept. 30, 1916.

Day.	Oct.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1.....	1,530	.....	422	1,090	2,570	5,160	2,850	1,010
2.....	1,440	.....	478	970	2,320	5,160	2,570	1,010
3.....	1,350	.....	498	930	2,090	5,160	2,320	1,010
4.....	1,260	.....	440	970	2,570	4,980	2,090	1,010
5.....	1,180	.....	440	1,340	3,600	4,450	2,090	1,010
6.....	1,260	.....	478	1,880	3,920	4,450	2,850	1,010
7.....	1,100	.....	440	2,200	3,290	4,450	2,710	990
8.....	960	.....	440	2,320	3,440	4,450	2,440	990
9.....	960	855	459	2,090	4,090	4,800	2,710	855
10.....	960	1,510	459	2,200	5,160	4,800	2,710	785
11.....	960	1,090	498	2,090	5,160	4,450	2,440	785
12.....	960	855	586	1,880	5,530	4,260	2,090	753
13.....	835	785	636	1,690	5,160	4,090	1,980	663
14.....	835	930	540	1,510	4,980	3,920	1,880	610
15.....	835	636	586	1,340	5,530	3,760	1,880	610
16.....	895	518	785	1,170	5,720	4,090	1,690	562
17.....	835	540	692	1,010	6,700	3,920	1,690	586
18.....	780	663	636	930	7,120	3,920	1,600	562
19.....	780	785	636	930	7,120	3,760	1,510	518
20.....	780	721	562	1,010	6,910	3,440	1,420	518
21.....	675	586	498	1,340	6,700	3,140	1,420	498
22.....	725	636	540	1,510	5,910	2,850	1,340	478
23.....	.....	562	498	1,340	4,450	2,850	1,170	478
24.....	.....	530	518	1,340	3,760	2,850	1,090	478
25.....	.....	498	586	1,340	3,600	2,710	1,010	478
26.....	.....	459	892	1,260	3,760	2,710	970	478
27.....	.....	440	1,340	1,260	4,450	3,140	970	478
28.....	.....	440	1,510	1,260	5,160	3,140	970	478
29.....	.....	518	1,690	1,260	5,910	3,140	970	478
30.....	.....	459	1,170	1,690	5,530	3,290	1,010	478
31.....	.....	422	.....	2,200	.....	2,850	1,010	.....

Monthly discharge of Wind River at Riverton, Wyo., for the year ending Sept. 30, 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
October 1-22.....	1,530	675	995	43,400
March 9-31.....	1,510	422	671	30,600
April.....	1,690	422	665	39,600
May.....	2,320	930	1,460	89,800
June.....	7,120	2,090	4,740	282,000
July.....	5,160	2,710	3,880	239,000
August.....	2,850	970	1,790	110,000
September.....	1,010	478	684	40,700

BIG HORN RIVER AT THERMOPOLIS, WYO.

LOCATION.—In sec. 19, T. 43 N., R. 95 W., at highway bridge between Thermopolis and Hot Springs, in 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, 1916. State engineer maintained station at this point during 1913 and 1914.

GAGE.—Chain gage on downstream handrail of bridge; installed May 4, 1916, at datum 1 foot lower than staff gage used previously; read by Mrs. H. E. Holdrege.

DISCHARGE MEASUREMENTS.—Made from two-span bridge.

CHANNEL AND CONTROL.—Bed composed of coarse gravel and small boulders. Control a short distance below gage; practically permanent during 1916. High-water control is canyon entrance half a mile down stream. Banks high and not subject to overflow.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 9.25 feet at 8 a. m.

June 21 (discharge, 13,000 second-feet); minimum discharge occurs during winter months.

ICE.—Warm springs keep river practically free from ice.

DIVERSIONS.—Prior to December 31, 1916, there were adjudicated diversions of 41 second-feet from Big Horn River above the station and 202 second-feet below.

In addition, an adjudicated permit of 336 second-feet for power above the station.

REGULATION.—None.

ACCURACY.—Stage-discharge relation not permanent but shifts between narrow limits; not seriously affected by ice during the year. Rating curve well defined between 900 and 12,000 second-feet but poorly defined below. Gage read to half-tenths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table. Records good.

Discharge measurements of Big Horn River at Thermopolis, Wyo., during the year ending Sept. 30, 1916.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		<i>Feet.</i>	<i>Sec.-ft.</i>			<i>Feet.</i>	<i>Sec.-ft.</i>
Oct. 12	M. N. Grant, Jr.....	a 1.70	1,730	June 12	H. K. Smith.....	6.58	8,310
Feb. 26	R. H. Fletcher.....	b 1.93	931	July 26	.....do.....	3.72	3,510
May 4	.....do.....	b 2.76	1,950				

a Refers to old datum, 1.0 foot higher than that established May 4, 1916.

b 1.0 foot added to observed gage heights to refer them to datum established May 4.

Daily discharge, in second-feet, of Big Horn River at Thermopolis, Wyo., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1.....	3,110	1,180	-----	800	1,280	3,190	3,360	8,300	3,020	1,180
2.....	2,700	1,180	-----	720	1,280	2,200	3,680	7,480	3,190	1,180
3.....	2,530	1,180	-----	720	1,180	1,880	3,520	7,150	3,190	1,080
4.....	2,360	1,180	-----	720	1,180	1,880	3,520	7,150	3,360	1,080
5.....	2,360	1,180	-----	720	1,280	1,740	3,850	6,820	3,520	1,180
6.....	2,280	1,180	-----	890	1,180	2,200	4,680	6,160	3,020	1,180
7.....	1,960	1,080	-----	1,390	1,180	2,860	6,160	6,160	3,190	1,180
8.....	1,880	980	-----	1,280	1,180	3,520	6,490	6,160	3,190	1,130
9.....	1,880	980	-----	1,280	1,130	3,850	5,170	6,000	3,190	1,080
10.....	1,880	980	-----	1,390	1,080	3,680	5,830	6,000	3,190	980
11.....	1,880	980	-----	1,620	980	3,680	7,150	6,160	3,020	980
12.....	1,810	980	-----	1,880	980	3,520	8,140	5,830	2,860	980
13.....	1,740	980	-----	1,620	1,180	3,190	8,140	5,500	2,530	980
14.....	1,740	800	-----	1,500	1,180	3,190	7,480	5,660	2,530	980
15.....	1,620	685	-----	1,500	1,180	2,860	7,480	5,170	2,200	935
16.....	1,620	600	-----	1,390	1,280	2,200	7,980	5,340	2,200	890
17.....	1,620	600	-----	1,280	1,280	2,040	8,800	5,170	2,040	800
18.....	1,500	560	-----	1,390	1,180	1,880	10,300	5,170	1,880	760
19.....	1,500	540	-----	1,390	1,180	1,880	11,800	5,000	1,740	760
20.....	1,500	540	980	1,740	1,180	1,880	12,400	5,000	1,740	760
21.....	1,390	485	980	1,740	1,180	1,880	12,400	4,510	1,740	720
22.....	1,280	485	890	1,620	1,180	2,360	11,400	4,510	1,620	720
23.....	1,280	440	800	1,500	1,180	2,530	9,790	4,180	1,620	720
24.....	1,280	440	800	1,500	1,180	2,360	6,980	3,910	1,390	685
25.....	1,280	440	800	1,500	1,180	2,360	5,830	3,630	1,280	685
26.....	1,340	440	800	1,390	1,180	2,200	5,340	3,360	1,280	685
27.....	1,390	440	800	1,390	1,500	2,200	5,500	3,360	1,280	720
28.....	1,280	440	890	1,390	1,880	2,040	6,320	3,360	1,280	720
29.....	1,280	440	845	1,180	3,190	1,880	7,480	3,360	1,280	720
30.....	1,280	440	-----	1,390	3,190	2,200	8,470	3,190	1,280	720
31.....	1,280	-----	-----	1,390	-----	2,530	-----	3,190	1,230	-----

NOTE.—Discharge Nov. 29, 30, and July 24, 25, estimated.

Monthly discharge of Big Horn River at Thermopolis, Wyo., for the year ending Sept. 30, 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
October.....	3,110	1,280	1,740	107,000
November.....	1,180	440	762	45,300
February 20-29.....	980	800	858	17,000
March.....	1,880	720	1,330	81,800
April.....	3,190	980	1,350	80,300
May.....	3,850	1,740	2,510	154,000
June.....	12,400	3,360	7,180	427,000
July.....	8,300	3,190	5,220	321,000
August.....	3,520	1,230	2,260	139,000
September.....	1,180	685	906	53,900

BIG HORN RIVER NEAR HARDIN, MONT.

LOCATION.—In SW. $\frac{1}{4}$ sec. 13, T. 1 S., R. 33 E., at bridge of Chicago, Burlington & Quincy Railroad on Crow Indian Reservation, about 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, 1916.

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 were 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, 9.05 feet, June 21 (discharge, 31,400 second-feet); minimum stage recorded, 2.65 feet December 3, 1915 (discharge, 1,520 second-feet).

1904-1916: Maximum stage recorded, 9.8 feet June 17, 1908 (discharge, 40,800 second-feet); minimum stage recorded, 2.0 feet November 11, 12, 1911 (discharge, 870 second-feet).

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

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, Wyoming, by the United States Reclamation Service, and many private ditches divert water from tributaries above the station.

REGULATION.—Shoshone reservoir above Cody controls the flow of Shoshone River, an important tributary of the Big Horn.

ACCURACY.—Stage-discharge relation not permanent during year. Three fairly well defined rating curves used, applicable as follows: October 1 to December 30, March 15 to June 21, and July 18 to September 30. Gage read to half tenths once daily except during periods of high water when it was read twice daily. Discharge ascertained by applying mean daily gage height to rating tables except for period June 22 to July 17, for which it was determined by shifting-control method and by hydrographic comparison with record of flow of Shoshone River at Corbett dam, Wyo. Records obtained by use of rating tables, good; others fair.

Discharge measurements of Big Horn River near Hardin, Mont., during the year ending Sept. 30, 1916.

[Made by W. A. Lamb.]

Date.	Gage height.	Discharge.
June 2.....	<i>Feet.</i>	<i>Sec.-ft.</i>
Aug. 7.....	5.00	7,220
	4.90	5,590

Daily discharge, in second-feet, of Big Horn River near Hardin, Mont., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Dec.	Mar.	Apr.	May.	June.	July	Aug.	Sept.
1.....	7,320	3,010	2,140	-----	2,660	4,220	6,300	20,100	6,920	2,040
2.....	6,550	2,890	1,770	-----	2,900	4,500	7,260	20,100	6,920	1,940
3.....	7,320	2,890	1,520	-----	3,030	4,360	7,260	19,400	6,220	2,040
4.....	10,800	2,770	1,770	-----	3,160	4,220	7,260	18,700	6,220	2,040
5.....	5,860	2,770	1,950	-----	2,780	3,680	7,260	18,000	5,560	2,140
6.....	5,860	2,660	2,340	-----	2,660	3,680	7,940	17,300	6,220	2,340
7.....	5,210	2,660	2,440	-----	2,540	4,220	9,080	16,600	5,560	2,340
8.....	5,210	2,660	2,550	-----	2,540	4,800	9,500	15,900	5,260	2,340
9.....	4,600	2,660	2,660	-----	2,540	5,400	9,500	15,200	5,560	2,340
10.....	4,600	2,770	2,660	-----	2,540	5,700	10,400	14,500	5,560	2,240
11.....	4,600	2,770	2,660	-----	2,540	6,620	13,600	13,900	5,260	2,140
12.....	4,310	2,770	2,770	-----	2,420	6,620	15,300	13,300	5,260	2,430
13.....	4,310	2,770	2,890	-----	2,420	6,940	15,800	12,700	5,260	2,340
14.....	4,030	3,250	2,770	-----	2,420	6,620	15,800	12,100	4,960	2,340
15.....	4,030	3,010	2,550	4,800	2,420	6,000	16,400	11,500	4,660	2,340
16.....	4,030	2,890	2,140	4,500	3,030	5,700	15,300	10,900	4,380	2,340
17.....	4,030	2,890	2,140	3,940	3,290	5,100	19,400	10,300	4,100	2,340
18.....	4,030	2,770	2,140	4,220	3,160	4,500	22,100	9,700	3,540	2,340
19.....	4,030	2,660	-----	3,940	3,030	4,220	25,000	11,900	3,540	2,340
20.....	3,760	2,550	-----	3,680	3,030	3,680	28,000	11,400	3,150	2,340
21.....	3,760	2,550	-----	4,220	3,160	4,220	31,000	10,500	3,020	2,340
22.....	3,500	2,550	-----	3,420	3,160	5,700	28,700	9,700	3,020	2,140
23.....	3,500	2,660	-----	3,420	3,160	5,400	26,900	9,280	3,020	2,140
24.....	3,500	2,770	-----	3,420	2,780	5,700	23,100	8,880	2,780	2,140
25.....	3,500	2,550	-----	3,290	2,660	5,700	18,300	8,460	2,560	2,140
26.....	3,500	2,660	-----	3,160	2,540	6,000	15,800	8,060	2,450	2,240
27.....	3,500	2,550	-----	3,160	2,540	5,400	14,700	7,680	2,450	2,240
28.....	3,250	2,550	-----	3,160	2,660	5,400	15,500	7,300	2,430	2,140
29.....	3,130	2,550	-----	3,030	3,420	5,100	18,100	7,300	2,220	2,140
30.....	3,130	2,140	-----	2,900	4,220	4,800	19,900	6,920	2,140	1,240
31.....	3,130	-----	-----	2,660	-----	5,400	-----	6,920	2,040	-----

NOTE.—Observer noted the presence of slush ice Dec. 1-6. Determination of discharge, Dec. 1-13, may be too large, owing to possible backwater from ice.

Monthly discharge of Big Horn River near Hardin, Mont., for the year ending Sept. 30, 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
October.....	10,800	3,130	4,580	282,000
November.....	3,250	2,140	2,720	162,000
December 1-18.....	2,890	1,520	2,330	83,200
March 15-31.....	4,800	2,660	3,580	121,000
April.....	4,220	2,420	2,860	170,000
May.....	6,940	3,680	5,150	317,000
June.....	31,000	8,300	16,000	952,000
July.....	20,100	6,920	12,400	762,000
August.....	6,920	2,040	4,270	263,000
September.....	2,430	1,940	2,230	133,000

POPO AGIE RIVER BELOW ARAPAHOE, WYO.^a

LOCATION.—In sec. 23, T. 1 S., R. 3 E., at highway bridge half a mile below Arapahoe, in Fremont County. Nearest tributary, Little Wind River, enters 200 yards above. Popo Agie River enters Wind River 6 miles below.

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, 1916.

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 extremely high water.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 6.2 feet at 6 p. m. June 19 (discharge, 4,400 second-feet); minimum stage recorded, 0.99 foot at 5.45 p. m. September 21 (discharge, 107 second-feet).

DIVERSIONS.—Between this station and that on Little Wind above Arapahoe prior to December 31, 1916, there were adjudicated diversions of 583 second-feet from the Popo Agie and its tributaries.

REGULATION.—None.

ACCURACY.—Stage-discharge relation not permanent, but shifts between very narrow limits; affected by ice during winter. Rating curve well defined between 100 and 7,000 second-feet. Gage read to hundredths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table. Records excellent, except those for October, November, and March, which are good.

Discharge measurements of Popo Agie River below Arapahoe, Wyo., during the year ending Sept. 30, 1916.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		<i>Feet.</i>	<i>Sec.-ft.</i>			<i>Feet.</i>	<i>Sec.-ft.</i>
Oct. 11	M. N. Grant, Jr.	2.40	594	June 14	H. K. Smith.	4.74	2,530
Jan. 15	R. I. Meeker.	^b 2.40	154	Aug. 31	Follansbee and Hodges	1.18	146
May 7	R. H. Fletcher.	3.76	1,760				

^a Formerly known as Little Wind River below Arapahoe, Wyo.

^b Stage discharge relation affected by ice.

Daily discharge, in second-feet, of Popo Agie River below Arapahoe, Wyo., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	1,000	344	.....	252	625	1,280	2,160	518	147
2	935	344	.....	235	625	1,130	2,160	469	149
3	870	344	.....	252	625	1,130	2,160	423	133
4	870	321	.....	252	598	1,440	1,960	380	129
5	806	321	.....	235	770	1,960	1,690	340	151
6	744	321	.....	235	1,130	2,160	1,600	380	129
7	744	300	.....	252	1,520	1,780	1,600	423	125
8	684	300	.....	235	1,360	1,870	1,520	380	125
9	655	300	.....	220	1,360	2,360	1,780	380	117
10	655	300	.....	204	1,360	2,760	1,780	423	121
11	626	280	.....	220	1,200	2,760	1,600	402	136
12	626	280	.....	284	1,130	2,560	1,440	380	149
13	570	280	.....	303	1,060	2,460	1,360	322	144
14	570	.....	.....	286	1,130	2,360	1,280	286	144
15	570	.....	.....	286	860	2,560	1,280	268	142
16	543	.....	.....	322	800	2,980	1,440	235	144
17	543	.....	.....	340	770	3,480	1,280	220	131
18	543	.....	340	340	711	3,930	1,280	190	125
19	516	.....	235	340	682	4,100	1,200	176	121
20	516	.....	220	340	800	3,770	990	164	115
21	516	.....	235	303	990	2,760	860	176	109
22	490	.....	360	286	1,060	2,560	800	176	111
23	464	.....	322	286	925	1,960	682	164	119
24	464	.....	268	303	860	1,600	682	151	117
25	439	.....	268	360	800	1,780	625	268	113
26	439	.....	268	446	740	1,870	682	164	109
27	414	.....	268	570	682	2,160	625	151	111
28	390	.....	303	711	682	2,560	625	151	117
29	390	.....	303	800	800	2,760	654	151	122
30	366	.....	268	682	925	2,460	625	147	109
31	366	.....	268	.....	1,130	.....	598	147	.....

Monthly discharge of Popo Agie River below Arapahoe, Wyo., for the year ending Sept. 30, 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
October.....	1,000	366	591	36,300
November 1-13.....	344	280	310	7,990
March 18-31.....	360	220	280	7,780
April.....	800	204	339	20,200
May.....	1,520	625	926	56,900
June.....	4,100	1,130	2,380	142,000
July.....	2,160	598	1,260	77,500
August.....	518	147	278	17,100
September.....	151	109	127	7,560

LITTLE POPO AGIE RIVER AT HUDSON, WYO.

LOCATION.—About sec. 12, T. 2 S., R. 2 E., at highway bridge three-eighths mile southwest of Hudson, in Fremont County. No tributary between station and mouth of river, half 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, 1916.

GAGE.—Vertical staff on center pier of bridge, installed August 25, 1915, at a datum 1 foot higher than that of original gage, a staff fastened to the right abutment of bridge 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 Miss Alice 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; shifting.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 3.65 feet at 5.30 p. m. June 19 (discharge 584 second-feet); minimum discharge occurs during winter months.

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

DIVERSIONS.—Prior to December 1, 1916, adjudicated diversions from Little Popo Agie River above the station amounted to 50 second-feet.

REGULATION.—None.

ACCURACY.—Stage-discharge relation changed during high water in May and June; apparently permanent for remainder of year. Rating curve used before the change in control, fairly well defined, curve used after change, well defined between 30 and 800 second-feet; applied indirectly October 1 to November 26, and May 6 to June 21. Gage read to hundredths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table; shifting control method used May 7 to June 13. Records good except those obtained by shifting-control method which are fair.

Discharge measurements of Little Popo Agie River at Hudson, Wyo., during the year ending Sept. 30, 1916.

Date.	Made by—	Gage height.	Discharge.
		<i>Fect.</i>	<i>Sec.-ft.</i>
Oct. 11	M. N. Grant, jr.	1.10	89
May 6	R. H. Fletcher	2.22	288
June 14	H. K. Smith	2.72	348
Aug. 31	Follansbee and Hodges	~.74	38.1

Daily discharge, in second-feet, of Little Popo Agie River at Hudson, Wyo., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Apr.	May.	June.	July.	Aug.	Sept.
1.....	110	79	83	192	222	272	48	40
2.....	117	78	78	212	212	261	55	41
3.....	110	82	86	202	232	261	46	41
4.....	110	78	86	202	264	261	42	42
5.....	103	79	82	222	328	222	42	41
6.....	103	78	84	296	306	204	46	40
7.....	96	78	88	362	264	196	44	41
8.....	96	78	80	362	285	204	42	41
9.....	90	78	78	384	350	241	37	39
10.....	90	77	77	362	396	241	37	39
11.....	90	71	90	339	419	196	37	41
12.....	88	59	110	317	396	187	36	42
13.....	84	72	110	296	396	178	37	42
14.....	85	78	103	285	393	154	37	42
15.....	85	85	110	254	393	154	38	42
16.....	88	84	103	222	466	170	39	42
17.....	88	79	117	202	517	146	35	46
18.....	88	84	117	192	517	132	37	46
19.....	88	90	124	183	543	132	37	45
20.....	86	90	117	192	517	112	38	42
21.....	84	78	117	243	417	100	37	42
22.....	83	78	110	254	370	82	38	42
23.....	83	77	110	243	303	72	38	42
24.....	82	78	117	232	241	82	39	44
25.....	80	76	132	212	261	72	39	42
26.....	80	67	156	192	282	61	39	43
27.....	80	.....	192	183	282	57	42	44
28.....	80	.....	222	192	325	48	41	44
29.....	80	.....	232	192	347	77	41	46
30.....	80	.....	212	192	325	77	42	46
31.....	80	.....	.....	212	.....	66	41	.....

Monthly discharge of Little Popo Agie River at Hudson, Wyo., for the year ending Sept. 30, 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
October.....	117	80	89.9	5,530
November 1-26.....	90	59	78.1	4,030
April.....	232	77	117	6,960
May.....	384	183	246	15,100
June.....	543	212	352	20,900
July.....	272	48	152	9,350
August.....	55	35	40.2	2,470
September.....	46	39	42.3	2,520

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, in Fremont County. Little Wind River enters Popo Agie River a quarter of a mile below.

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, 1916. May 11, 1906, to December 17, 1909, for station a short distance above present site; flow directly comparable.

GAGE.—Chain gage on upstream side of railroad bridge; read by R. H. Knox.

DISCHARGE MEASUREMENTS.—Made from single-span bridge or by wading.

CHANNEL AND CONTROL.—Bed composed of sand and gravel. Control a short distance downstream from gage; permanent during 1916. Banks high and not subject to overflow.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 5.1 feet at 5.45 p. m. June 19 (discharge, 1,870 second-feet); minimum stage, 1.58 feet at 7.20 a. m. September 29 (discharge, 24 second-feet).

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

DIVERSIONS.—Water is diverted from Little Wind River and tributaries to irrigate about 15,000 acres, an area which would require, under the Wyoming law allowing one second-foot for 70 acres, 214 second-feet.

REGULATION.—None.

ACCURACY.—Stage-discharge relation practically permanent except as affected by ice. Rating curve well defined between 40 and 3,000 second feet; extended beyond these limits. Gage read to quarter-tenths twice daily. Daily discharge ascertained by applying mean daily gage heights to rating table. Records excellent except those for October, November, and March, which are good.

Discharge measurements of Little Wind River above Arapahoe, Wyo., during the year ending Sept. 30, 1916.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		<i>Feet.</i>	<i>Sec.-ft.</i>			<i>Feet.</i>	<i>Sec.-ft.</i>
Oct. 11	M. N. Grant, Jr.....	2.85	213	May 7	R. H. Fletcher.....	3.45	501
Jan. 15	R. I. Meeker.....	2.82	47.8	June 14	H. K. Smith.....	4.07	874
Feb. 25	R. H. Fletcher.....	3.80	105	Aug. 31	P. V. Hodges.....	2.01	48.9

^a Stage-discharge relation affected by ice.

Daily discharge, in second-feet, of Little Wind River above Arapahoe, Wyo., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1.....	401	98	-----	72	120	445	955	230	49
2.....	390	94	-----	72	100	445	915	192	53
3.....	365	94	-----	74	110	445	915	160	49
4.....	340	86	-----	74	103	530	878	145	50
5.....	295	86	-----	74	118	730	765	132	46
6.....	272	86	-----	75	272	995	730	145	44
7.....	250	86	-----	75	365	765	695	160	42
8.....	242	86	-----	76	365	765	695	145	40
9.....	203	80	-----	73	318	955	765	160	39
10.....	175	80	-----	69	365	1,160	802	175	38
11.....	182	74	-----	65	295	1,160	765	175	40
12.....	175	74	-----	70	250	1,080	695	175	46
13.....	175	-----	-----	84	250	1,040	625	160	46
14.....	175	-----	-----	76	250	915	592	120	47
15.....	175	-----	-----	72	210	995	560	109	39
16.....	160	-----	-----	76	175	1,160	660	101	47
17.....	160	-----	-----	84	145	1,440	625	96	38
18.....	160	-----	-----	75	132	1,540	592	84	37
19.....	160	-----	-----	74	120	1,760	560	73	33
20.....	160	-----	86	72	145	1,650	500	70	31
21.....	160	-----	94	64	250	1,350	390	69	29
22.....	145	-----	132	52	210	1,160	365	69	28
23.....	145	-----	101	52	210	878	295	64	28
24.....	145	-----	98	50	175	660	295	60	28
25.....	132	-----	94	52	175	660	250	55	26
26.....	125	-----	86	62	160	730	295	51	25
27.....	120	-----	86	89	145	878	295	51	25
28.....	110	-----	86	120	120	1,080	295	51	25
29.....	105	-----	86	175	160	1,260	295	51	25
30.....	101	-----	86	145	272	1,160	250	51	25
31.....	101	-----	86	-----	365	-----	230	46	-----

Monthly discharge of Little Wind River above Arapahoe, Wyo., for the year ending Sept. 30, 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
October.....	401	101	194	11,900
November 1-12.....	98	74	85.3	2,030
March 20-31.....	132	86	93.4	2,220
April.....	175	50	78.1	4,650
May.....	365	100	208	12,800
June.....	1,760	445	993	59,100
July.....	955	230	566	34,800
August.....	230	46	110	6,760
September.....	53	25	37.3	2,220

OWL CREEK NEAR THERMOPOLIS, WYO.

LOCATION.—About sec. 16, T. 43 N., R. 95 W., at Whetstine's ranch, 6 miles north-west of Thermopolis, in 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 September 30, 1916. 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. Gage used from 1910 to 1912 was chain on upstream side of highway bridge one-quarter mile above present site. Relation between the gage readings not known.

DISCHARGE MEASUREMENTS.—Made from footbridge or by wading.

CHANNEL AND CONTROL.—Bed composed of compact gravel. Control 100 feet downstream from gage at small rapids; fairly permanent during 1916. Right bank not subject to overflow; left bank is overflowed at stage about 6.6 feet. Stage of zero flow 1.2 feet.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 3.79 feet at 12.30 p. m. June 18 (discharge, 184 second-feet); no flow, August 20 to September 16.

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

DIVERSIONS.—Prior to December 31, 1916, there were adjudicated diversions of 122 second-feet from Owl Creek above station and 65 second-feet below.

REGULATION.—None.

ACCURACY.—Stage-discharge relation practically permanent. Rating curve not well defined. Gage read to tenths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table. Records good except those for low water, which are roughly approximate.

Discharge measurements of Owl Creek near Thermopolis, Wyo., during the year ending Sept. 30, 1916.

Date.	Made by—	Gage height.	Dis-charge.	Date.	Made by—	Gage height.	Dis-charge.
		<i>Feet.</i>	<i>Sec.-ft.</i>			<i>Feet.</i>	<i>Sec.-ft.</i>
Oct. 13	M. N. Grant, jr.....	2.98	89	June 13	H. K. Smith.....	2.12	21.6
May 4	R. H. Fletcher.....	2.21	22.8	July 26	...do.....	1.50	a.6

a Estimated.

Daily discharge, in second-feet, of Owl Creek near Thermopolis, Wyo., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Apr.	Mar.	May.	June.	July.	Aug.	Sept.
1.....	96	59	.....	40	73	20	27	0.6	0.0
2.....	96	59	.....	27	58	24	47	.6	.0
3.....	96	59	.....	19	50	33	36	.6	.0
4.....	90	53	.....	16	31	54	27	.6	.0
5.....	90	53	.....	16	58	58	24	.6	.0
6.....	102	59	.....	16	90	58	31	.6	.0
7.....	96	59	.....	24	78	47	32	.6	.0
8.....	102	51	.....	30	50	24	16	.6	.0
9.....	90	51	.....	27	24	58	16	.6	.0
10.....	62	53	.....	24	14	58	19	.6	.0
11.....	62	51	.....	27	14	47	10	.6	.0
12.....	62	51	.....	30	14	16	14	.6	.0
13.....	78	51	.....	33	19	19	10	.6	.0
14.....	78	44	.....	33	24	22	12	.6	.0
15.....	68	50	.....	36	36	27	10	.6	.0
16.....	68	48	.....	36	30	68	16	.6	.0
17.....	68	51	.....	30	43	96	12	.6	.6
18.....	68	51	.....	24	58	90	10	.6	.6
19.....	68	51	.....	24	73	78	6	.6	.6
20.....	59	51	.....	27	54	77	.6	.0	.6
21.....	64	55	.....	24	33	58	.6	.0	.6
22.....	64	55	.....	27	30	64	.6	.0	.6
23.....	59	48	.....	33	16	19	.6	.0	.6
24.....	59	48	.....	40	14	8	.6	.0	1.0
25.....	59	44	.....	50	10	16	.6	.0	1.0
26.....	51	51	84	68	7	33	.6	.0	1.0
27.....	51	51	90	84	7	78	.6	.0	1.0
28.....	53	50	73	103	8	110	.6	.0	1.0
29.....	59	50	64	96	14	110	.6	.0	1.0
30.....	59	50	50	78	18	58	.6	.0	1.0
31.....	59	.....	47	.....	19	.....	.6	.0	.....

NOTE.—Discharge estimated Nov. 28-30. Water below gage July 20 to Aug. 19, and Sept. 17-30; discharge estimated from discharge measurements of July 26 and Oct. 3.

Monthly discharge of Owl Creek near Thermopolis, Wyo., for the year ending Sept. 30, 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
October.....	102	51	72.1	4,430
November.....	59	44	51.9	3,090
March 26-31.....	90	47	68.0	809
April.....	103	16	38.1	2,270
May.....	90	7	34.4	2,120
June.....	110	8	50.9	3,030
July.....	47	.6	12.3	756
August.....	.6	.0	.37	22.8
September.....	1.0	.0	.37	22.0

NO WOOD CREEK AT BONANZA, WYO.

LOCATION.—In sec. 13, T. 49 N., R. 91 W., at Bonanza, in 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, 1916.

GAGE.—Chain gage 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 by wading or from two-span highway bridge one-fourth mile below gage.

CHANNEL AND CONTROL.—Bed composed of gravel. Control 100 feet downstream from gage at small rapids, which shift slightly.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, ~~6.8~~ ^{7.5} feet on June 19 (discharge, ~~2,140~~ ^{3,780} second-feet); minimum stage, 2.16 feet September 6 and 7 (discharge, 67 second-feet).

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 for irrigation above station and 42 second-feet below.

REGULATION.—None.

ACCURACY.—Stage-discharge relation fairly permanent, except as affected by shifting control. Rating curve well defined between 100 and 3,000 second-feet. Gage read to half-tenths once daily. Daily discharge ascertained by applying gage height to rating table. Records good except those for October and November, which are fair.

Discharge measurements of No Wood Creek at Bonanza, Wyo., during the year ending Sept. 30, 1916.

Date.	Made by—	Gage height.	Dis-charge.	Date.	Made by—	Gage height.	Dis-charge.
		<i>Feet.</i>	<i>Sec.-ft.</i>			<i>Feet.</i>	<i>Sec.-ft.</i>
Oct. 15	M. N. Grant, jr.....	3.01	314	July 24	H. K. Smith.....	2.82	245
May 2	R. H. Fletcher.....	3.64	659	Sept. 22	do.....	2.42	127
June 11	H. K. Smith.....	6.24	2,570				

Daily discharge, in second-feet, of No Wood Creek at Bonanza, Wyo., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Apr.	May.	June.	July.	Aug.	Sept.
1.....	440	420	212	725	1,310	1,520	212	88
2.....	400	382	212	610	1,310	1,100	180	88
3.....	440	382	212	667	1,170	1,100	180	88
4.....	400	382	212	610	1,450	605	150	88
5.....	400	420	212	845	1,980	845	150	88
6.....	348	382	246	785	2,140	725	150	67
7.....	348	460	246	1,590	1,450	785	150	67
8.....	348	420	246	1,520	1,380	845	144	112
9.....	315	382	212	1,310	1,450	845	144	107
10.....	348	460	212	1,380	1,170	725	144	107
11.....	348	460	212	1,100	2,500	667	117	107
12.....	348	420	246	965	1,740	502	117	107
13.....	382	382	246	785	1,820	452	117	107
14.....	502	382	212	725	1,980	405	117	107
15.....	382	382	212	667	2,140	405	117	107
16.....	348	382	282	555	1,900	502	93	107
17.....	348	382	361	555	1,820	502	93	84
18.....	315	382	452	502	2,680	452	93	107
19.....	315	382	452	502	3,780	405	93	107
20.....	348	382	502	452	2,680	361	93	120
21.....	315	382	405	845	2,230	361	93	120
22.....	315	382	361	905	2,590	320	93	120
23.....	315	382	361	845	1,450	282	117	122
24.....	315	382	405	785	1,310	246	112	110
25.....	315	382	405	785	1,450	180	112	97
26.....	315	382	725	845	1,520	180	88	97
27.....	285	382	1,240	725	1,660	180	112	110
28.....	285	382	905	785	1,740	150	139	110
29.....	285	382	725	1,380	1,660	150	139	97
30.....	255	382	405	1,520	1,660	452	112	97
31.....	382	.....	.....	1,820	.....	320	112	.....

NOTE.—Shifting-control method used Oct. 1 to Nov. 14. Discharge Nov. 15-30 and Apr. 1 estimated because of ice.

Monthly discharge of No Wood Creek at Bonanza, Wyo., for the year ending Sept. 30, 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
October.....	502	255	349	21,500
November.....	460	382	395	23,500
April.....	1,240	212	378	22,500
May.....	1,820	502	906	55,700
June.....	3,780	1,170	1,840	109,000
July.....	1,520	150	544	33,400
August.....	212	88	125	7,690
September.....	122	67	101	6,010

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, in Washakie County. Nearest tributary, Canyon Creek, enters one-fourth 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, 1916.

GAGE.—Inclined staff on left bank, 800 feet above county bridge, opposite vertical rock cliff; read by Lynn Burke.

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

CHANNEL AND CONTROL.—Bed composed of coarse gravel and small boulders. Control is just below gage at rapids, which may shift. Right bank is vertical rock cliff; left bank subject to overflow at extremely high water.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 5.0 feet at 7 a. m. June 12 (discharge, 1,710 second-feet); minimum stage, 0.08 foot at 11 a. m. February 5 (discharge, 56 second-feet).

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 the station.

REGULATION.—None.

ACCURACY.—Stage-discharge relation practically permanent; not affected by ice during year. Rating curve well defined below 900 second-feet. Gage read to hundredths once daily except in periods of high water, when it is read twice daily. Daily discharge ascertained by applying mean daily gage height to rating table. Records good except those for winter period which are only fair, owing to possible effect of ice on stage-discharge relation.

Discharge measurements of Tensleep Creek near Tensleep, Wyo., during the year ending Sept. 30, 1916.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		<i>Feet.</i>	<i>Sec.-ft.</i>			<i>Feet.</i>	<i>Sec.-ft.</i>
Oct. 15	M. N. Grant, Jr.	0.61	126	July 24	H. K. Smith	0.68	144
May 1	R. H. Fletcher .....	.52	124	Sept. 26	.....do.....	.13	63
June 11	H. K. Smith	2.94	886				

Daily discharge, in second-feet, of Tensleep Creek near Tensleep, Wyo., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1.....	174	110	74	65	59	59	65	130	830	602	168	80
2.....	166	108	76	68	59	71	62	139	495	566	158	79
3.....	174	115	78	71	59	62	62	160	602	495	148	79
4.....	166	113	83	71	59	59	63	198	676	495	139	78
5.....	170	108	79	69	57	65	62	252	1,070	495	168	75
6.....	162	108	76	65	58	63	64	460	602	327	158	74
7.....	139	105	74	65	58	64	63	752	676	426	148	75
8.....	148	102	74	66	59	71	64	443	714	530	148	74
9.....	139	103	71	65	60	263	65	602	870	639	139	74
10.....	139	100	65	69	58	258	65	495	1,230	566	139	79
11.....	132	100	71	76	60	252	68	376	830	530	130	75
12.....	137	97	76	71	64	71	69	343	791	495	130	74
13.....	134	99	78	65	65	65	70	252	1,030	343	130	74
14.....	132	97	76	68	65	71	71	187	830	266	122	76
15.....	128	99	74	70	68	70	71	168	870	238	122	74
16.....	137	96	69	74	71	68	71	134	950	238	113	74
17.....	137	97	65	71	71	65	74	156	1,230	252	113	73
18.....	141	96	68	64	69	63	80	183	1,190	238	105	70
19.....	132	93	71	65	68	65	63	200	1,430	225	105	70
20.....	128	89	71	65	68	64	78	296	1,190	225	97	69
21.....	134	93	76	62	68	65	71	478	1,070	200	105	66
22.....	125	91	79	59	69	66	70	566	910	189	91	66
23.....	143	84	82	62	65	69	68	392	791	158	94	62
24.....	139	82	84	63	65	65	68	281	714	148	87	66
25.....	132	76	82	60	63	64	118	281	639	158	89	71
26.....	134	69	73	62	60	65	162	281	566	178	97	74
27.....	143	65	69	59	64	64	212	252	752	148	91	74
28.....	125	69	68	62	55	63	312	409	791	139	86	79
29.....	116	71	65	63	57	62	189	530	870	148	84	73
30.....	111	71	70	56	.....	63	148	676	752	281	82	70
31.....	116	.....	68	58	.....	63	.....	791	.....	189	82	.....

NOTE.—Discharge June 5, 11–12 determined from hydrograph comparison with flow of Paintrock Creek and No Wood Creek, as gage readings are apparently 1.0 foot in error.

Monthly discharge of Tensleep Creek near Tensleep, Wyo., for the year ending Sept. 30, 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
October.....	174	111	140	8,610
November.....	115	65	93.5	5,560
December.....	84	65	73.7	4,530
January.....	76	56	65.5	4,030
February.....	71	55	62.8	3,610
March.....	263	59	83.8	5,150
April.....	312	62	92.9	5,530
May.....	791	130	350	21,500
June.....	1,430	495	865	51,500
July.....	639	139	327	20,100
August.....	168	82	118	7,260
September.....	80	62	73.2	4,360
The year.....	1,430	55	195	142,000

PAINTROCK CREEK NEAR BONANZA, WYO.

LOCATION.—About sec. 19, T. 49 N., R. 90 W., at Paumer's ranch, $1\frac{1}{2}$ miles above Bonanza, in Big Horn County. No tributary between station and mouth, 1 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, 1916.

GAGE.—Vertical staff on right bank 300 feet below ranch house; read by Mrs. Wm. Paumer. From July 28, 1910, to October 31, 1912, there was a chain gage near house. Relation between two gages not known; high water changed channel between.

DISCHARGE MEASUREMENTS.—Made from cable 65 feet below gage or by wading.

CHANNEL AND CONTROL.—Bed composed of gravel. Control is at rapids composed of small boulders 150 feet below gage; somewhat shifting. Right bank is low and is overflowed at stage of 2 feet.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 4.75 feet at 8 a. m. June 19 (discharge, 2,670 second-feet) gage destroyed by high water during afternoon; minimum stage recorded, 1.0 foot August 22 (discharge, 9 second-feet).

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 the station.

REGULATION.—None.

ACCURACY.—Stage-discharge relation not permanent. Three fairly well defined rating curves used as follows: October 1 to November 24; March 12 to June 19; and July 2 to September 30. Gage read to hundredths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table. Records good except those for October, November, August, and September, which are fair.

Discharge measurements of Paintrock Creek near Bonanza, Wyo., during the year ending Sept. 10, 1916.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		<i>Feet.</i>	<i>Sec.-ft.</i>			<i>Feet.</i>	<i>Sec.-ft.</i>
Oct. 15	M. N. Grant, jr.....	1.52	114	July 24	H. K. Smith.....	1.57	89
May 2	R. H. Fletcher.....	1.51	100	Sept. 22	.....do.....	1.23	29.4
June 11	H. K. Smith.....	3.41	1,360				

Monthly discharge of Paintrock Creek near Bonanza, Wyo., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1.....	182	105	-----	53	109	708	650	80	19
2.....	182	105	-----	58	99	332	636	71	14
3.....	174	100	-----	59	92	346	397	52	14
4.....	167	100	-----	58	102	746	342	40	14
5.....	167	100	-----	56	208	950	270	38	16
6.....	167	100	-----	55	246	532	230	38	19
7.....	160	94	-----	53	498	404	230	38	24
8.....	157	94	-----	56	204	346	426	35	24
9.....	140	89	-----	56	374	746	368	24	14
10.....	140	89	-----	53	466	1,040	316	24	14
11.....	137	84	-----	53	319	1,320	270	24	14
12.....	131	84	106	53	228	825	212	24	14
13.....	128	84	96	56	170	950	201	24	14
14.....	122	84	77	56	140	865	198	19	14
15.....	116	84	53	56	106	908	191	14	14
16.....	110	80	53	56	96	950	234	14	18
17.....	110	80	77	56	70	1,520	208	14	24
18.....	110	80	86	59	63	1,620	194	12	24
19.....	116	84	58	63	66	2,620	174	12	31
20.....	122	84	64	63	114	1,500	128	12	31
21.....	122	84	63	63	180	1,080	114	10	31
22.....	128	84	59	64	160	1,370	102	9	28
23.....	128	84	58	53	140	720	99	24	24
24.....	128	87	56	73	114	430	87	24	24
25.....	128	84	53	119	228	520	75	24	24
26.....	128	84	56	122	188	600	77	24	28
27.....	122	84	56	125	152	680	55	38	28
28.....	116	84	56	137	184	770	63	38	30
29.....	110	84	55	137	346	690	223	38	32
30.....	105	84	53	119	785	690	177	31	38
31.....	105	-----	53	-----	825	-----	114	24	-----

NOTE.—Discharge Nov. 25-30 estimated because of ice. Gage washed out during afternoon of June 19; discharge, June 20 to July 1, estimated by comparison with records of flow of No Wood Creek at Bonanza.

Daily discharge, in second-feet, of Paintrock Creek near Bonanza, Wyo., for the year ending Sept. 30, 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
October.....	182	105	134	8,240
November.....	105	80	88.2	5,250
March 12-31.....	106	53	64.4	2,550
April.....	137	53	71.4	4,250
May.....	825	62	228	14,000
June.....	2,620	332	893	53,100
July.....	650	55	228	14,000
August.....	80	9	28.8	1,770
September.....	38	14	21.9	1,300

GREYBULL RIVER NEAR MEETEETSE, WYO.

LOCATION.—In sec. 13, T. 48 N., R. 101 W., at private bridge at Wilson's ranch, 4½ miles southwest of Meeteetse, in Park County. Rawhide Creek enters 1½ miles above and Iron Creek 1½ miles below.

DRAINAGE AREA.—680 square miles (measured on base map of Wyoming; scale, 1:500,000).

RECORDS AVAILABLE.—September 14, 1910, to October 31, 1912; June 6, 1915, to September 30, 1916.

GAGE.—Vertical staff on downstream side of right bridge abutment; read by Mrs. Katherine Wilson. Gage used from 1910 to 1912 was on center pier and was referred to datum 0.72 foot lower than that of present gage.

DISCHARGE MEASUREMENTS.—Made from two-span bridge or by wading.

CHANNEL AND CONTROL.—Bed composed of coarse gravel and small boulders. Control is 50 feet downstream from gage at site of an old bridge; badly shifting during 1916. Banks subject to overflow at stage of about 5 feet.

EXTREMES OF DISCHARGE.—Maximum stage not known; record incomplete. Minimum stage recorded, 0.6 foot on April 4 (discharge, 80 second-feet).

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

DIVERSIONS.—Prior to December 31, 1916, there were adjudicated diversions of 86 second-feet from Greybull River above station and 648 second-feet below.

REGULATION.—None.

ACCURACY.—Stage-discharge relation not permanent. Rating curve not well defined, shifting control method used after May 20. Gage read to half tenths once daily. Daily discharge ascertained by applying gage height to rating table. Records fair except those for last part of year which are roughly approximate.

Discharge measurements of Greybull River near Meeteetse, Wyo., during the year ending Sept. 30, 1916.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		<i>Feet.</i>	<i>Sec.-ft.</i>			<i>Feet.</i>	<i>Sec.-ft.</i>
Oct. 22	M. N. Grant, jr.	1.44	277	June 9	H. K. Smith.	2.66	1,250
Apr. 26	R. H. Fletcher.	1.50	334	July 21	do.	1.66	643
27	do.	1.86	483	Sept. 17	do. ....	.86	158

Daily discharge, in second-feet, of Greybull River near Meeteetse, Wyo., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1.....	455	202		115	253			548	
2.....	455	202		105	253			548	
3.....	485	202		88	237	688		517	
4.....	455	202		80	390	1,340		548	
5.....	428	202		88	462			615	
6.....	375	194		95	490			517	
7.....	350	185		95	688			615	
8.....	375	185		105	462			580	
9.....	400	168		115	462	1,250		490	
10.....	400			150	437			490	
11.....	350			237	346			490	
12.....	328			206	307			517	
13.....	328			150	288			490	
14.....	328			206	221			462	
15.....	305			270	237			462	
16.....	305			221	237			462	
17.....	305			191	253			462	158
18.....	282			206	270			462	156
19.....	282			191	326			390	156
20.....	282			138				462	156
21.....	282		138	138			658	462	156
22.....	260		126	150	762			462	156
23.....	260		115	150	615		548	437	156
24.....	240		126	191	615		548	437	156
25.....	220		163	253	412		548	462	156
26.....	240		115	326	462		580	462	156
27.....	240		115	412	490		548	437	183
28.....	220		115	517	517		885	437	169
29.....	220		115	326			688	437	169
30.....	220		105	326			615	437	156
31.....	202		95				548	437	

NOTE.—Discharge Nov. 6, Aug. 18 and 31, estimated. Shifting-control method used after May 20.

Monthly discharge of Greybull River near Meeteetse, Wyo., for the year ending Sept. 30, 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
October.....	485	202	319	19,600
November 1-9.....	202	168	194	3,460
March 21-31.....	163	95	121	2,640
April.....	517	80	195	11,600
August.....	615	390	485	29,800
September 17-30.....	183	156	160	4,440

WOOD RIVER NEAR MEETEETSE, WYO.

LOCATION.—Near line between secs. 22 and 27, T. 48 N., R. 101 W., 1,200 feet above mouth of Wood River and 7 miles southwest of Meeteetse, in 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, 1916.

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. Gage used from May 10, 1915, to April 24, 1916, was vertical staff at bridge but was referred to datum different from that of original gage.

DISCHARGE MEASUREMENTS.—Made from cable short distance below gage.

CHANNEL AND CONTROL.—Bed composed of boulders. Control at small rapids a short distance below gage; practically permanent during 1916. Right bank subject to overflow at extremely high water.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 3.85 feet at 5 p. m. June 18 (discharge, 888 second-feet); minimum stage recorded, 1.02 feet, March 24, 1916 (discharge, 43 second-feet); lower discharge probably occurred during winter months.

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, and 9 second-feet from tributaries.

REGULATION.—None.

ACCURACY.—Stage-discharge relation practically permanent. Rating curve fairly well defined between 80 and 500 second-feet. Gage read to half-tenths once daily. Daily discharge ascertained by applying gage height to rating table. Records good except those for low water, which are fair.

Discharge measurements of Wood River near Meeteetse, Wyo., during the year ending Sept. 30, 1916.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		<i>Feet.</i>	<i>Sec.-ft.</i>			<i>Feet.</i>	<i>Sec.-ft.</i>
Oct. 22	M. N. Grant, jr.....	1.60	135	June 9	H. K. Smith.....	2.81	452
Apr. 25	R. H. Fletcher.....	a 1.97	104	July 21	.....do.....	2.25	219
27	.....do.....	2.12	165	Sept. 17	.....do.....	1.80	82

a Old gage read 1.41 feet.

Daily discharge, in second-feet, of Wood River near Meeteetse, Wyo., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1.....	218	106	-----	56	107	321	321	175	84
2.....	218	97	-----	49	107	300	321	167	84
3.....	197	106	-----	49	107	279	300	155	84
4.....	197	106	-----	49	115	321	237	167	84
5.....	186	106	-----	56	163	384	258	175	84
6.....	176	106	-----	56	216	300	271	216	84
7.....	166	115	-----	49	245	258	279	167	84
8.....	176	89	-----	70	195	363	321	155	74
9.....	176	89	-----	56	195	531	321	144	74
10.....	156	89	-----	77	195	426	279	155	74
11.....	166	89	-----	92	155	405	237	138	66
12.....	156	97	101	77	155	363	229	130	69
13.....	156	89	110	77	138	447	229	120	69
14.....	146	97	84	84	120	405	203	112	66
15.....	146	97	119	101	138	447	203	107	66
16.....	135	97	101	84	127	531	195	107	66
17.....	135	97	92	84	127	573	195	102	66
18.....	135	97	70	77	138	867	203	88	66
19.....	135	97	63	84	195	699	175	94	66
20.....	135	89	63	84	405	531	163	107	66
21.....	135	89	56	77	363	615	183	94	74
22.....	135	81	56	70	363	363	175	88	66
23.....	135	89	49	70	300	321	175	84	66
24.....	115	89	43	77	279	300	175	84	66
25.....	115	89	63	92	279	321	138	80	66
26.....	125	81	63	120	279	405	144	84	66
27.....	115	81	63	155	279	489	195	94	66
28.....	125	97	56	195	279	573	216	94	74
29.....	115	81	49	138	279	468	237	94	74
30.....	115	81	56	115	405	321	195	84	74
31.....	115	-----	70	-----	384	-----	175	88	-----

Monthly discharge of Wood River near Meeteetse, Wyo., for the year ending Sept. 30, 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
October.....	218	115	150	9,220
November.....	115	81	93.8	5,580
March 12-31.....	119	43	71.4	2,830
April.....	195	49	84.0	5,000
May.....	405	107	220	13,500
June.....	867	258	431	25,600
July.....	321	138	224	13,800
August.....	216	80	121	7,440
September.....	84	66	72.3	4,300

SHELL CREEK AT SHELL, WYO.

LOCATION.—About sec. 26, T. 53 N., R. 91 W., 450 feet above headgate of Shell canal, three-fourths mile northeast of Shell, in Big Horn County. Nearest tributary, Trapper Creek, enters some 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, 1916. From July 1, 1911, to October 31, 1914, station was maintained by the Wyoming Irrigation Co. and records were published in reports of State engineer.

GAGE.—Vertical staff on right bank 450 feet above canal headgate; read by J. G. Tatlock.

DISCHARGE MEASUREMENTS.—Made from suspension footbridge at gage.

CHANNEL AND CONTROL.—Bed composed of gravel. Control is just below gage at gravel bar which shifts during high water. Banks not subject to overflow.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 7.5 feet at 5 a. m. June 10 (discharge, 1,360 second-feet); minimum stage recorded, 3.9 feet, November 20 and 28–30 (discharge, 58 second-feet); a less discharge probably occurred during winter months.

ICE.—No information; observations are discontinued during winter months.

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 on Shell Creek, 25 miles above Shell. Capacity of reservoir, 1,410 acre-feet.

ACCURACY.—Stage-discharge relation not permanent. Gage read to hundredths twice daily. Daily discharge ascertained by shifting-control method. Records fair.

COOPERATION.—Gage-height records furnished by Wyoming Irrigation Co.

Discharge measurements of Shell Creek at Shell, Wyo., during the year ending Sept. 30, 1916.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		<i>Feet.</i>	<i>Sec.-ft.</i>			<i>Feet.</i>	<i>Sec.-ft.</i>
Oct. 19	M. N. Grant, jr.....	4.10	75	June 10	H. K. Smith.....	7.20	1,200
Apr. 28	R. H. Fletcher.....	4.33	145	Sept. 21	.....do.....	4.20	77

Daily discharge, in second-feet, of Shell Creek at Shell, Wyo., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Apr.	May.	June.	July.	Aug.	Sept.
1.....	102	72	83	108	490	350	89	78
2.....	102	72	83	102	335	350	102	78
3.....	95	72	83	95	191	320	102	72
4.....	102	72	83	102	350	306	102	72
5.....	95	72	83	162	802	277	102	67
6.....	89	72	83	350	434	263	102	62
7.....	89	69	83	306	320	237	102	62
8.....	83	69	83	225	434	335	102	62
9.....	82	69	83	320	900	250	102	62
10.....	82	68	83	335	1,300	237	102	72
11.....	82	68	83	225	900	202	89	72
12.....	83	67	89	202	572	191	89	72
13.....	82	67	83	191	754	181	83	72
14.....	81	67	83	137	900	181	83	72
15.....	76	67	95	137	900	171	83	72
16.....	78	67	95	130	900	181	83	67
17.....	78	67	89	130	754	171	83	67
18.....	78	64	95	122	950	162	83	67
19.....	78	61	89	145	1,000	153	83	67
20.....	78	58	83	202	802	145	89	66
21.....	78	59	83	225	551	130	83	64
22.....	77	65	89	225	730	130	83	62
23.....	76	67	83	213	594	122	83	62
24.....	78	67	89	202	551	122	83	67
25.....	74	67	102	202	490	145	83	67
26.....	73	62	108	181	551	130	83	62
27.....	72	62	115	171	510	115	89	62
28.....	73	58	145	131	510	108	83	62
29.....	72	58	122	277	471	122	83	62
30.....	72	58	108	434	416	130	83	62
31.....	72	-----	-----	684	-----	102	83	-----

NOTE.—Discharge interpolated Oct. 5, 9, 10, 13, 17, 18, 22, 25, 26, Nov. 4, 5, 10–12, 18, 19, 24, Sept. 20 and 21.

Monthly discharge of Shell Creek at Shell, Wyo., for the year ending Sept. 30, 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
October.....	102	72	81.7	5,020
November.....	72	58	66.1	3,930
April.....	145	83	91.9	5,470
May.....	684	95	217	13,300
June.....	1,300	191	645	38,400
July.....	350	102	194	11,900
August.....	102	83	89.5	5,500
September.....	78	62	67.1	3,990

SHOSHONE RIVER NEAR ISHAWOOA, WYO.

LOCATION.—On line between secs. 26 and 27, T. 51 N., R. 104 W., at Coe's private bridge, $1\frac{1}{2}$ miles northeast of Ishawooa, in 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 23, 1915, to September 30, 1916.

GAGE.—Vertical staff on first right downstream piling of bridge; read by Miss Ina Spaulding.

DISCHARGE MEASUREMENTS.—Made from five-span pile bent bridge or by wading.

CHANNEL AND CONTROL.—Bed composed of boulders. Control not well defined; shifts during high water. Right bank not subject to overflow; left bank subject to overflow at high stages.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 5.9 feet at 5.30 p. m. June 18 (discharge, 4,760 second-feet); minimum stage recorded, 0.72 foot, November 13 and April 1 (discharge, 170 second-feet); a less discharge probably occurred during winter months.

ICE.—No information; observations discontinued during winter.

DIVERSIONS.—Prior to December 31, 1916, there were approved diversions of 26 second-feet from Shoshone River above station and 40 second-feet below.

REGULATION.—None.

ACCURACY.—Stage-discharge relation not permanent. Rating curve used from October 1 to September 17 fairly well defined between 140 and 1,700 second-feet; but poorly defined above 1,700 second-feet. Curve used September 18–30 fairly well defined between 140 and 700 second-feet. Gage read to hundredths once daily. Daily discharge ascertained by applying daily gage height to rating tables; shifting-control method used July 22 to September 17. Records fair.

Discharge measurements of Shoshone River near Ishawooa, Wyo., during the year ending Sept. 30, 1916.

Date.	Made by—	Gage height.	Dis-charge.	Date.	Made by—	Gage height.	Dis-charge.
		<i>Feet.</i>	<i>Sec.-ft.</i>			<i>Feet.</i>	<i>Sec.-ft.</i>
Oct. 20	M. N. Grant, jr.....	1.26	300	July 19	H. K. Smith.....	3.48	1,690
Apr. 23	R. H. Fletcher.....	1.06	253	Sept. 18	.....do.....	1.50	237
June 8	H. K. Smith.....	3.12	1,370				

Daily discharge, in second-feet, of Shoshone River near Ishawooa, Wyo., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1.....	601	251	.....	170	292	825	3,500	1,530	380
2.....	623	251	.....	196	485	765	4,060	1,450	377
3.....	601	251	.....	201	440	858	4,200	1,080	373
4.....	467	251	.....	196	579	1,300	2,840	1,010	350
5.....	449	251	.....	215	851	1,370	3,230	1,590	329
6.....	424	251	.....	201	1,160	1,020	3,360	1,130	325
7.....	377	257	.....	201	1,200	1,080	3,360	1,120	308
8.....	377	201	.....	205	890	1,530	3,640	1,050	289
9.....	384	201	.....	201	929	1,910	3,640	1,050	286
10.....	384	192	.....	225	825	2,020	2,970	974	283
11.....	400	192	.....	286	729	1,810	2,840	903	265
12.....	361	187	.....	274	741	2,020	2,970	832	262
13.....	361	170	.....	262	568	2,240	2,720	825	262
14.....	339	.....	.....	645	495	2,130	2,360	765	259
15.....	347	.....	.....	312	476	2,970	2,020	729	243
16.....	325	.....	.....	325	416	3,640	2,020	693	240
17.....	354	.....	.....	305	408	4,340	2,450	628	238
18.....	347	.....	.....	292	424	4,760	2,130	623	235
19.....	312	.....	235	286	495	4,340	1,710	562	235
20.....	305	.....	225	262	825	3,640	1,810	562	235
21.....	305	.....	215	251	765	3,360	1,810	505	235
22.....	305	.....	201	268	729	3,360	1,700	500	232
23.....	299	.....	210	251	568	1,810	1,510	449	232
24.....	318	.....	187	292	838	1,810	1,510	467	221
25.....	280	.....	192	416	623	2,360	1,420	462	214
26.....	280	.....	179	634	699	3,360	1,660	462	207
27.....	274	.....	183	825	535	4,480	1,410	436	235
28.....	274	.....	192	890	568	4,620	1,570	412	207
29.....	262	.....	187	612	729	4,340	1,940	408	207
30.....	262	.....	187	485	955	3,500	2,040	404	207
31.....	257	.....	179	.....	1,050	.....	1,300	380	.....

Monthly discharge of Shoshone River near Ishawooa, Wyo., for the year ending Sept. 30, 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
October.....	623	257	363	22,300
November 1-13.....	257	170	224	5,780
March 19-31.....	235	179	198	5,100
April.....	890	170	339	20,200
May.....	1,200	292	687	42,200
June.....	4,760	765	2,590	154,000
July.....	4,200	1,300	2,440	150,000
August.....	1,590	380	774	47,600
September.....	380	207	266	15,800

SHOSHONE RIVER AT CORBETT DAM, WYO.

LOCATION.—In NE. $\frac{1}{4}$ sec. 7, T. 53 N., R. 100 W., at Corbett diversion dam, 8 miles below Cody, in Big Horn County.

DRAINAGE AREA.—Not measured at this station; drainage area above Cody is 1,400 square miles. Sage Creek, the only important tributary that enters between this station and Cody, drains about 25 square miles.

RECORDS AVAILABLE.—April 20, 1908, to September 30, 1916.

GAGE.—Staff gage 40 feet upstream from the crest of the dam; readings represent height of water above crest. It is read once a day during the irrigation season and at irregular intervals during the winter by employees of the United States Reclamation Service.

DETERMINATION OF DISCHARGE.—Discharge computed by considering the dam as a weir and the sluice gates as submerged orifices. The following formula for dis-

charge over the crest was developed from measurements at Cody, Wyo.: $Q=3.50 BH^{1.58}$.

CHANNEL AND CONTROL.—The crest of the dam forms a permanent control. The dam is of reinforced concrete of the buttressed type, having on the upstream side a deck $2\frac{1}{2}$ feet thick, sloping 1 to 1, and supported by buttresses 2 feet thick spaced 14 feet on centers; it raises the low-water elevation of the river 10.2 feet; length between abutments, 400 feet.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 3.40 feet June 20 (discharge, 9,700 second-feet; discharge through Corbett tunnel, 533 second-feet; total, 10,200 second-feet); minimum stage recorded, 0.35 foot May 7 (discharge, 270 second-feet; discharge through Corbett tunnel, 255 second-feet; total, 525 second-feet).

1908-1916: Maximum stage recorded, 4.79 feet, July 4, 1909 (discharge, 15,400 second-feet); no flow October 21 to November 19, 1909.

ICE.—Stage-discharge relation not seriously affected by ice; open-channel rating curve assumed applicable. Records not complete enough for computing discharge.

DIVERSIONS.—Little water is diverted above this station.

REGULATION.—Shoshone reservoir, with a capacity of 456,000 acre-feet regulates the flow.

ACCURACY.—Stage-discharge relation practically permanent; rating curve fairly well defined; gage read to hundredths once daily; daily discharge ascertained by applying gage height to rating table and adding the daily flow through tunnels. Records good.

No discharge measurements were made during the year.

Daily discharge, in second-feet, of Shoshone River, including tunnels, at Corbett dam, Wyo., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1.....	808	717	.....	.....	.....	.....	.....	677	2,410	9,450	2,830	862
2.....	810	877	.....	.....	.....	.....	.....	660	2,210	9,470	2,660	812
3.....	812	710	.....	.....	.....	.....	.....	683	2,030	9,370	2,510	811
4.....	814	710	.....	.....	.....	.....	.....	661	2,230	8,750	2,370	915
5.....	816	723	.....	.....	.....	.....	.....	573	2,790	7,770	2,200	1,610
6.....	818	681	.....	.....	.....	.....	.....	553	3,070	7,810	2,640	1,570
7.....	818	622	.....	.....	.....	.....	.....	525	2,950	7,530	2,510	1,110
8.....	807	632	.....	.....	.....	.....	.....	638	2,830	7,680	2,220	1,130
9.....	796	692	.....	.....	.....	.....	.....	727	3,490	7,680	2,410	1,050
10.....	785	788	.....	.....	.....	.....	676	949	4,320	8,040	2,210	1,040
11.....	774	717	.....	.....	.....	.....	.....	657	1,440	7,900	2,070	1,060
12.....	763	1,400	.....	.....	.....	.....	.....	657	1,490	4,650	6,960	1,130
13.....	752	.....	.....	.....	.....	.....	.....	657	1,460	4,760	6,610	1,870
14.....	741	.....	.....	.....	.....	.....	.....	644	1,660	5,200	6,650	1,760
15.....	730	.....	.....	.....	.....	.....	.....	657	1,480	5,660	5,900	1,740
16.....	719	.....	.....	.....	.....	.....	.....	657	1,340	6,580	5,390	1,520
17.....	708	.....	.....	.....	.....	.....	.....	632	1,320	8,170	5,190	1,480
18.....	697	.....	.....	.....	.....	.....	.....	632	1,280	9,200	5,230	1,390
19.....	686	.....	.....	.....	.....	.....	.....	632	1,170	10,100	4,810	1,280
20.....	675	.....	.....	.....	.....	.....	.....	590	1,350	10,200	4,320	1,200
21.....	664	.....	.....	.....	.....	.....	.....	572	1,840	9,850	4,010	1,210
22.....	653	.....	647	.....	.....	.....	.....	690	1,920	8,360	3,770	1,220
23.....	642	.....	.....	.....	.....	.....	.....	670	1,950	6,660	3,540	1,000
24.....	631	.....	.....	630	.....	664	.....	643	1,880	5,430	3,420	880
25.....	620	.....	.....	.....	.....	.....	.....	643	1,950	5,410	3,320	1,020
26.....	609	.....	.....	.....	.....	.....	.....	709	1,920	5,380	3,140	919
27.....	657	.....	.....	.....	647	.....	.....	687	1,770	5,840	3,150	861
28.....	749	.....	.....	.....	.....	.....	.....	645	1,790	8,380	3,140	878
29.....	707	836	.....	.....	.....	.....	.....	638	1,780	10,100	3,250	967
30.....	717	836	.....	.....	.....	.....	.....	624	1,780	9,800	3,190	804
31.....	717	.....	.....	.....	.....	.....	.....	2,090	.....	3,520	869	.....

NOTE.—Discharge, Oct. 1-6, 8-27, Aug. 19, and Sept. 24-29, interpolated. Discharge estimated by U. S. Reclamation Service engineers as follows: Nov. 13-28, 800 second-feet; Dec. 1-21, 740 second-feet; and Dec. 23-31, 650 second-feet.

Monthly discharge of Shoshone River, including tunnels at Corbett dam, Wyo., for the year ending Sept. 30, 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
October.....	818	609	732	45,000
November.....	1,400	622	845	50,300
December.....			711	43,700
April 10-30.....	709	572	648	27,000
May.....	2,090	525	1,330	81,800
June.....	10,200	2,030	5,760	343,000
July.....	9,570	3,140	5,810	357,000
August.....	2,830	804	1,660	102,000
September.....	1,610	585	927	55,200

^a See footnote to daily-discharge table.

Daily discharge, in second-feet, of Corbett tunnel at Corbett dam, Wyo., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Apr.	May.	June.	July.	Aug.	Sept.
1.....		119		221	277	328	574	328
2.....		278		246	277	346	525	342
3.....		310		283	246	321	508	341
4.....		310		303	246	277	487	317
5.....		323		303	318	323	437	323
6.....		323		283	351	489	378	323
7.....		264		255	433	534	378	323
8.....		190		332	393	562	259	365
9.....		190		421	426	562	328	336
10.....		190	46	351	474	630	327	279
11.....		119	107	381	474	700	308	224
12.....		41	107	349	474	631	266	224
13.....			107	283	576	700	277	276
14.....			94	303	576	702	288	252
15.....			107	303	623	677	342	189
16.....			107	259	626	692	343	197
17.....			130	265	636	672	342	197
18.....			130	302	600	710	373	218
19.....			130	302	439	632	328	218
20.....			88	268	533	660	305	301
21.....			70	197	600	660	316	364
22.....			124	215	413	660	420	363
23.....			152	241	328	605	450	160
24.....			173	241	284	620	378	58
25.....			173	241	261	657	418	58
26.....			191	210	226	625	417	58
27.....	59		217	176	0	626	359	58
28.....	119		217	197	0	625	328	58
29.....	109		210	259	107	594	369	58
30.....	119		196	258	324	526	334	58
31.....	119			259		524	335	

NOTE.—Discharge record showing acre-feet per day furnished by United States Reclamation Service; converted into second-feet by engineers of United States Geological Survey.

Monthly discharge of Corbett tunnel at Corbett dam, Wyo., for the year ending Sept. 30, 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
October 27-31.....	119	59	105	1,040
November 1-12.....	323	41	221	5,260
April 10-30.....	217	46	137	5,710
May.....	421	176	274	16,800
June.....	636	0	385	22,900
July.....	710	277	576	35,400
August.....	574	259	371	22,800
September.....	365	58	229	13,600

SOAP CREEK NEAR ST. XAVIER, MONT.

LOCATION.—In sec. 20, T. 5 S., R. 32 E., at Henry Reed's ranch, about a mile above mouth of stream, 9 miles south of St. Xavier, in Big Horn County.

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—September 11, 1911, to September 30, 1916. April 25, 1914, to June 12, 1915, at Frank Annerer's ranch about half a mile above present site; September 11, 1911, to November 30, 1913, in W. $\frac{1}{2}$ NW. $\frac{1}{4}$ sec. 2, T. 6 S., R. 32 E., about one-fourth 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 one-fourth 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, about one-fourth mile above present site. After July 8, 1915, present gage was used.

DISCHARGE MEASUREMENTS.—Made by wading or from highway bridge about 1 mile upstream from gage.

CHANNEL AND CONTROL.—Bed of stream at principal control 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, 7.27 feet at 7.30 a. m. May 15 (discharge, 252 second-feet); minimum stage recorded, 2.86 feet October 25 (discharge, 13 second-feet).

1911-1916: Maximum stage recorded, 12.8 feet May 11, 1914, determined by leveling from flood marks (discharge, determined from extension of rating curve, about 438 second-feet); minimum stage recorded, 2.1 feet September 10, 1914 (discharge, 1 second-foot).

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

DIVERSIONS.—Soap Creek ditch diverts above station during summer for irrigation.

REGULATION.—None.

ACCURACY.—Stage-discharge relation not permanent; affected by shifting control and growth of aquatic plants in channel. Rating curves used as follows: October 1 to November 10 poorly defined; March 25 to June 1 well defined below 63 second-feet; August 8 to September 30 poorly defined. Gage read twice daily to hundredths. Discharge ascertained by applying mean daily gage height to rating table, except June 2 to August 7, for which shifting-control method was used. Records subject to considerable error.

Discharge measurements of Soap Creek near St. Xavier, Mont., during the year ending Sept. 30, 1916.

[Made by W. A. Lamb.]

Date.	Gage height.	Discharge.
	<i>Feet.</i>	<i>Sec.-ft.</i>
June 1.....	3.50	41.0
Aug. 6.....	2.98	17.5

Daily discharge, in second-feet, of Soap Creek near St. Xavier, Mont., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1.....	16	14	.....	34	46	40	16	18	17
2.....	16	13	.....	103	30	36	16	18	16
3.....	14	13	.....	151	30	32	16	18	17
4.....	26	14	.....	169	28	32	16	18	16
5.....	23	14	.....	73	28	31	16	18	16
6.....	17	14	.....	44	26	31	16	18	17
7.....	15	13	.....	56	26	29	17	18	16
8.....	15	15	.....	46	25	28	17	18	17
9.....	15	15	.....	40	38	28	17	18	17
10.....	16	16	.....	34	30	28	17	18	17
11.....	17	.....	.....	36	36	27	17	18	22
12.....	16	.....	.....	36	26	27	17	17	22
13.....	14	.....	.....	30	30	27	17	17	20
14.....	13	.....	.....	40	83	26	16	17	21
15.....	16	.....	.....	26	187	25	17	17	21
16.....	16	.....	.....	24	109	24	17	16	21
17.....	15	.....	.....	25	44	23	17	16	21
18.....	14	.....	.....	40	40	21	17	16	21
19.....	14	.....	.....	26	44	17	17	16	21
20.....	14	.....	.....	28	44	16	17	16	21
21.....	14	.....	.....	40	46	18	17	16	21
22.....	14	.....	.....	30	78	20	17	16	21
23.....	14	.....	.....	42	133	18	19	16	21
24.....	13	.....	.....	26	83	16	18	16	21
25.....	13	.....	24	30	63	18	18	16	21
26.....	14	.....	44	24	53	17	18	16	21
27.....	14	.....	44	22	44	17	18	16	21
28.....	14	.....	32	22	44	16	18	17	21
29.....	14	.....	34	30	38	17	18	17	21
30.....	14	.....	44	25	42	17	21	17	21
31.....	14	.....	48	.....	40	.....	20	17	.....

Monthly discharge of Soap Creek near St. Xavier, Mont., for the year ending Sept. 30, 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
October.....	26	13	15.3	941
November 1-10.....	16	13	14.3	284
March 25-31.....	48	24	38.6	536
April.....	169	22	45.1	2,680
May.....	187	25	52.1	3,200
June.....	40	16	24.1	1,430
July.....	21	16	17.3	1,060
August.....	18	16	17.0	1,050
September.....	22	16	19.6	1,170

ROTTENGRASS CREEK NEAR ST. XAVIER, MONT.

LOCATION.—In NW. $\frac{1}{4}$ sec. 6, T. 5 S., R. 23 E., about one-fourth 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, 1916.

GAGE.—Overhanging chain on left bank about one-fourth mile above crossing of Big Horn canal; read by Loren S. Stanley.

DISCHARGE MEASUREMENTS.—Made from footbridge about 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, determined by leveling from flood marks, 5.8 feet at 10 a. m., May 15 (discharge, 78 second-feet); minimum stage recorded, 2.8 feet at 4 p. m., August 14 (discharge, 2.5 second-feet).

1911–1916: Maximum stage recorded, 11.3 feet June 12, 1915; (discharge, 420 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 during winter.

DIVERSIONS.—None.

REGULATION.—None.

ACCURACY.—Stage-discharge relation not permanent. Rating curve used October 1 to November 27 fairly well defined; curve used June 2 to September 30 well defined below 100 second-feet. Gage read to tenths (occasionally to half tenths) once daily to June 1 and twice daily thereafter. Discharge ascertained by applying mean daily gage height to rating table; shifting-control method used March 25 to June 1. Records fair.

Discharge measurements of Rottengrass Creek near St. Xavier, Mont., during the year ending Sept. 30, 1916.

[Made by W. A. Lamb.]

Date.	Gage height.	Discharge.
	<i>Feet.</i>	<i>Sec.-feet.</i>
Mar. 25.....	3.56	12.4
June 1.....	5.14	53.8
Aug. 6.....	2.98	3.8

Daily discharge, in second-feet, of Rottengrass Creek near St. Xavier, Mont., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1.....	10	9	.....	68	23	55	6.0	5.0	6.0
2.....	10	10	.....	68	23	55	6.0	5.0	6.0
3.....	10	9	.....	68	23	55	6.0	5.0	6.3
4.....	10	9	.....	61	23	50	6.0	5.5	6.0
5.....	10	10	.....	56	22	50	6.0	5.0	5.5
6.....	10	9	.....	47	22	46	6.0	4.0	6.0
7.....	10	9	.....	40	22	46	6.0	4.0	5.0
8.....	10	10	.....	21	25	42	6.0	4.5	5.0
9.....	10	10	.....	66	28	34	6.0	5.0	6.0
10.....	10	10	.....	75	31	30	7.5	5.0	5.5
11.....	10	10	.....	65	31	28	19.0	5.0	5.0
12.....	10	10	.....	54	28	26	13.0	4.0	6.5
13.....	10	10	.....	38	28	26	7.0	3.6	7.0
14.....	9	10	.....	25	28	11	7.0	2.6	7.0
15.....	10	9	.....	18	58	11	7.0	3.2	7.0
16.....	10	9	.....	18	78	11	7.0	4.2	7.0
17.....	10	10	.....	18	68	11	7.0	5.5	7.0
18.....	10	10	.....	20	53	11	6.0	6.0	7.0
19.....	10	10	.....	18	30	11	5.0	6.2	7.0
20.....	11	10	.....	20	30	9.5	5.0	6.0	7.5
21.....	10	10	.....	20	52	9	5.0	6.0	7.0
22.....	9	10	.....	20	52	9	5.0	6.3	7.0
23.....	10	10	.....	20	52	9	5.5	7.0	7.0
24.....	10	10	.....	22	56	9	6.0	7.0	7.5
25.....	10	10	12	24	56	9	6.0	8.0	7.5
26.....	10	9	14	24	56	9	6.0	8.0	7.0
27.....	10	10	14	24	55	9	6.0	7.5	8.0
28.....	9	.....	21	24	55	9	7.0	7.5	7.0
29.....	9	.....	27	24	55	9	7.0	7.5	7.0
30.....	9	.....	37	24	55	9	6.0	8.0	7.0
31.....	9	.....	58	.....	55	.....	5.0	7.5	.....

NOTE.—Gage not read Nov. 28 to Mar. 24.

Monthly discharge of Rottengrass Creek near St. Xavier, Mont., for the year ending Sept. 30, 1916

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
October.....	11	9	9.8	603
November 1-27.....	10	9	9.7	519
March 25-31.....	58	12	26.1	362
April.....	75	18	36.3	2,160
May.....	78	22	41.1	2,530
June.....	55	9	23.6	1,400
July.....	19	5.0	6.74	414
August.....	8.0	2.6	5.63	346
September.....	8.0	5.0	6.58	392

LITTLE HORN RIVER NEAR WYOLA, MONT.

LOCATION.—In W. $\frac{1}{2}$ SW. $\frac{1}{4}$ sec. 28, T. 8 S., R. 35 E., one-fourth mile below proposed headworks of Little Horn canal No. 3 and about 16 miles above Lodgegrass Creek, 4 miles southwest of Wyola, in Big Horn County.

DRAINAGE AREA.—260 square miles.

RECORDS AVAILABLE.—September 7, 1911, to September 30, 1916.

GAGE.—Overhanging chain gage on right bank; read by C. C. Dillon to December 25, and by Ida M. Shipman after March 27, 1916.

DISCHARGE MEASUREMENTS.—Made from cable 75 feet below gage or by wading near cable.

CHANNEL AND CONTROL.—Stream bed composed of boulders and gravel; shifts occasionally during high stage. Left bank high and not subject to overflow; right bank high but subject to overflow about 100 feet below gage.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 6.3 feet at 4 p. m. June 18 (discharge, 950 second-feet); minimum stage, 4.25 feet, 5.30 p. m. March 31 (discharge, 91 second-feet).

1912-1916: Maximum stage recorded, 6.6 feet June 11, 1915 (discharge, 1,130 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 during winter. No notes on ice during November and December; records slightly affected, if at all.

DIVERSIONS.—Small amount diverted for irrigation.

REGULATION.—None.

ACCURACY.—Stage-discharge relation fairly permanent, affected by slight shifts of control at high stages. Rating curve well defined below 500 second-feet. Gage read twice daily to hundredths. Discharge ascertained by applying mean daily gage height to rating table. Records good.

Discharge measurements of Little Horn River near Wyola, Mont., during the year ending Sept. 30, 1916.

[Made by W. A. Lamb.]

Date.	Gage height.	Dis- charge.
	<i>Feet.</i>	<i>Sec.-ft.</i>
Mar. 27.....	4.30	102
June 2.....	5.23	391
Sept. 2.....	4.40	122

Daily discharge, in second-feet, of Little Horn River near Wyola, Mont., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Dec.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1.....	124	110	104	-----	100	154	396	442	156	122
2.....	124	110	104	-----	108	154	396	418	152	120
3.....	126	110	104	-----	100	142	396	418	147	122
4.....	127	108	104	-----	96	156	418	373	142	120
5.....	127	108	104	-----	100	166	516	331	138	118
6.....	124	108	104	-----	100	223	418	331	142	120
7.....	120	109	104	-----	98	274	418	292	142	122
8.....	120	110	104	-----	96	274	568	292	142	112
9.....	120	110	104	-----	104	292	675	292	131	110
10.....	122	112	110	-----	100	292	675	274	144	138
11.....	124	112	110	-----	100	274	594	256	142	131
12.....	124	110	107	-----	102	256	466	256	142	131
13.....	120	110	104	-----	100	256	491	223	142	131
14.....	120	111	104	-----	100	240	594	223	142	127
15.....	120	112	102	-----	110	193	621	223	142	122
16.....	120	112	102	-----	120	193	675	193	131	120
17.....	120	114	100	-----	116	193	675	193	120	120
18.....	120	116	100	-----	116	208	895	180	100	120
19.....	120	116	102	-----	120	223	895	180	142	116
20.....	120	116	104	-----	120	256	785	180	131	116
21.....	120	116	106	-----	120	274	675	180	135	114
22.....	120	116	110	-----	120	292	675	180	124	114
23.....	120	114	112	-----	124	331	621	166	124	114
24.....	120	112	112	-----	120	312	568	166	120	114
25.....	120	110	110	-----	124	292	516	166	120	116
26.....	104	110	-----	-----	131	292	466	166	131	120
27.....	104	110	-----	100	138	292	516	166	131	120
28.....	104	110	-----	98	142	292	466	166	112	122
29.....	108	110	-----	100	161	396	442	166	116	120
30.....	110	110	-----	98	154	396	418	166	120	120
31.....	110	-----	-----	93	-----	491	-----	166	120	-----

NOTE.—Gage not read discharge interpolated for following days: Oct. 3, 10, 17, 24, 31, Nov. 7, 14, 21, 28, Dec. 5, 12, 19, and Apr. 15.

Monthly discharge of Little Horn River near Wyola, Mont., for the year ending Sept. 30, 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
October.....	127	104	119	7,320
November.....	116	108	111	6,600
December 1-25.....	112	100	105	5,210
March 27-31.....	100	93	97.8	970
April.....	161	96	115	6,840
May.....	491	142	261	16,000
June.....	895	396	564	33,600
July.....	442	166	239	14,700
August.....	156	100	133	8,180
September.....	138	110	120	7,140

LITTLE HORN RIVER NEAR CROW AGENCY, MONT.

LOCATION.—In W. $\frac{1}{2}$ 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, 1916; March 24, 1905, to June 30, 1906, for station at Crow Agency, about 2 miles below the present station; Crow Agency ditch diverts water between the stations.

GAGE.—Chain gage on downstream side of railway bridge; read by Everett Keeler. 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, about 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, 6.65 feet at 6.30 p. m. June 20 (discharge, 1,360 second-feet); minimum stage, 4.30 feet August 24-31 and September 2-9 (discharge, 104 second-feet).

1905-6 and 1912-1916: Maximum stage recorded, 11.0 feet June 14, 1915 (estimated discharge, 3,600 second-feet); minimum stage, 1.8 feet September 25-29, 1905 (discharge, 60 second-feet).

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

DIVERSION.—Several small diversions for irrigation from main stream and tributaries above station.

REGULATION.—None.

ACCURACY.—Stage-discharge relation changed during winter period. Rating curve used before the change well defined between 84 and 1,050 second-feet; curve used after the change well defined between 100 and 1,000 second-feet. Gage read once daily to half tenths. Observer's readings in error occasionally. Discharge ascertained by applying gage height to rating table. Records fair.

Discharge measurements of Little Horn River near Crow Agency, Mont., during the year ending Sept. 30, 1916.

[Made by W. A. Lamb.]

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	<i>Feet.</i>	<i>Sec.-ft.</i>		<i>Feet.</i>	<i>Sec.-ft.</i>
Mar. 26.....	4.72	220	Aug. 6.....	4.60	187
June 1.....	6.03	925	Sept. 1.....	4.38	123

Daily discharge, in second-feet, of Little Horn River near Crow Agency, Mont., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1.....	240	190	.....	263	339	904	840	186	114
2.....	240	178	.....	263	386	970	840	186	104
3.....	240	178	.....	339	339	542	840	186	104
4.....	240	178	.....	339	339	570	840	186	104
5.....	240	166	.....	339	339	598	840	186	104
6.....	240	158	.....	295	339	598	488	186	104
7.....	198	190	.....	263	386	598	488	186	104
8.....	240	206	.....	263	542	627	436	186	104
9.....	240	232	.....	295	488	716	436	186	104
10.....	240	232	.....	275	488	840	436	186	129
11.....	240	240	.....	275	598	778	386	156	129
12.....	240	219	.....	255	542	904	386	156	129
13.....	240	198	.....	255	515	840	339	156	129
14.....	240	198	904	275	515	716	339	156	129
15.....	240	198	515	255	542	970	339	156	129
16.....	198	206	386	255	598	1,040	339	156	129
17.....	206	219	462	263	598	1,040	295	129	129
18.....	206	206	462	263	598	1,180	295	129	156
19.....	198	219	339	263	656	1,180	295	129	156
20.....	198	206	317	263	686	1,320	295	129	156
21.....	198	206	275	263	686	1,320	295	129	129
22.....	198	198	275	263	716	1,250	255	129	129
23.....	198	.....	275	263	904	1,040	255	129	129
24.....	190	.....	275	263	716	970	219	104	129
25.....	190	.....	263	263	716	970	219	104	129
26.....	190	.....	226	263	716	904	219	104	129
27.....	190	.....	263	287	716	840	219	104	129
28.....	178	.....	263	287	686	840	186	104	129
29.....	158	.....	263	339	598	840	186	104	129
30.....	178	.....	295	339	598	840	186	104	129
31.....	178	.....	255	.....	570	.....	186	104	.....

Monthly discharge of Little Horn River near Crow Agency, Mont., for the year ending Sept. 30, 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
October.....	240	158	213	13,100
November 1-22.....	240	158	201	8,770
March 14-31.....	904	226	351	12,500
April.....	339	255	280	16,700
May.....	904	339	563	34,600
June.....	1,320	542	892	53,100
July.....	840	186	394	24,200
August.....	186	104	146	8,980
September.....	156	104	125	7,440

LODGEGRASS CREEK AT LODGEGRASS, MONT.

LOCATION.—In S. $\frac{1}{2}$ sec. 13, T. 6 S., R. 35 E., 600 feet above Chicago, Burlington & Quincy Railroad bridge and one-fourth 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 to September 30, 1916, at present site; September 9, 1911, to December 28, 1915, at old site 6 miles upstream in S.W $\frac{1}{4}$ sec. 29, T. 6 S., R. 35 E., one-fourth mile above Lodgegrass ditch.

GAGE.—October 1 to December 4 an overhanging chain gage at old site 6 miles upstream; March 24 to September 30 overhanging wire gage on left bank at different datum.

DISCHARGE MEASUREMENTS.—Made from the railway bridge or by wading.

CHANNEL AND CONTROL.—Control is an outcrop of sandstone overlain with boulders and gravel; boulders and gravel likely to shift.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 3.60 feet June 20 (discharge, 355 second-feet); minimum stage, 1.80 feet September 9 and 13 (discharge, 11 second-feet).

1911-1916: 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.

DIVERSIONS.—Lodgegrass ditch diverts water for irrigation about 6 miles above present site. Old station was about one-fourth mile above headworks of this ditch; hence flow during irrigation season is not comparable to that at present site.

REGULATION.—None.

ACCURACY.—Stage-discharge relation not permanent; affected by occasional shift in control. Gage read once daily to quarter tenths. Rating curve used as follows: October 1 to December 4, gage at old site 6 miles upstream, fairly well defined; March 24 to June 20, fairly well defined; July 8 to September 30, poorly defined. Discharge ascertained by applying daily gage height to rating table; shifting-control method used June 21 to July 7. Records good.

Discharge measurements of Lodgegrass Creek at Lodgegrass, Mont., during the year ending Sept. 30, 1916.

[Made by W. A. Lamb.]

Date.	Gage height.	Dis- charge.
	<i>Feet.</i>	<i>Sec.-ft.</i>
Mar. 24.....	2.06	47.8
June 2.....	2.86	151
Sept. 1.....	1.86	15.4

Daily discharge, in second-feet, of Lodgegrass Creek at Lodgegrass, Mont., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Dec.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1.....	26	28	30	.....	71	69	150	156	28	15
2.....	24	27	30	.....	69	71	151	133	28	14
3.....	26	28	30	.....	93	83	133	128	28	14
4.....	39	28	30	.....	107	69	128	119	26	14
5.....	34	28	.....	.....	71	62	133	103	26	12
6.....	32	28	.....	.....	66	69	178	96	26	12
7.....	32	28	.....	.....	60	77	159	88	26	12
8.....	30	28	.....	.....	62	110	133	77	24	12
9.....	30	28	.....	.....	58	96	133	74	24	11
10.....	30	26	.....	.....	58	99	159	72	24	12
11.....	30	26	.....	.....	58	113	239	68	24	14
12.....	30	26	.....	.....	53	110	200	63	24	12
13.....	30	26	.....	.....	53	107	168	61	24	11
14.....	28	26	.....	.....	43	122	178	63	22	12
15.....	28	28	.....	.....	51	174	205	61	24	24
16.....	28	28	.....	.....	58	178	253	55	22	22
17.....	28	28	.....	.....	58	118	253	53	22	22
18.....	28	28	.....	.....	56	99	284	53	22	22
19.....	28	28	.....	.....	56	90	818	45	20	20
20.....	26	28	.....	.....	81	93	355	38	22	17
21.....	26	28	.....	.....	62	103	316	38	22	17
22.....	26	28	.....	.....	58	150	269	36	22	17
23.....	26	28	.....	.....	77	178	262	34	22	17
24.....	26	28	.....	48	71	138	179	34	20	17
25.....	26	30	.....	43	60	138	179	32	18	17
26.....	27	30	.....	43	56	125	168	32	18	17
27.....	28	30	.....	56	56	118	156	30	18	14
28.....	28	30	.....	53	60	110	168	32	17	14
29.....	28	30	.....	56	66	110	179	36	17	17
30.....	28	30	.....	58	69	122	174	36	17	14
31.....	27	.....	.....	58	.....	133	.....	32	14	.....

NOTE.—Records Oct. 1 to Dec. 4 show the flow at the old site 6 miles upstream. Data inadequate for determination of discharge Dec. 5-28; no gage-height record Dec. 29 to Mar. 23.

Monthly discharge of Lodgegrass Creek at Lodgegrass, Mont., for the year ending Sept. 30, 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
October.....	39	24	28.5	1,750
November.....	30	26	28.0	1,670
December 1-4.....	30	30	36.0	238
March 24-31.....	58	43	51.9	824
April.....	107	43	63.9	3,800
May.....	178	62	111	6,820
June.....	355	128	199	11,800
July.....	156	30	63.8	3,920
August.....	28	14	22.3	1,370
September.....	24	11	15.5	922

NOTE.—See footnote to daily-discharge table.

TONGUE RIVER AT CARNEYVILLE, WYO.

LOCATION.—In sec. 20, T. 57 N., R. 84 W., at highway bridge at Carneyville, in 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 September 30, 1916.

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, 6.75 feet at 6 p. m. June 19 (discharge, 2,050 second-feet); minimum stage, 2.85 feet August 18, 19, 23, and 24 (discharge, 84 second-feet).

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 so far as known.

ACCURACY.—Stage-discharge relation fairly permanent; shifts slightly at times.

Rating curve fairly well defined between 100 and 1,300 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 Tongue River at Carneyville, Wyo., during the year ending Sept. 30, 1916.

Date.	Made by—	Gage height.	Dis-charge.	Date.	Made by—	Gage height.	Dis-charge.
		<i>Feet.</i>	<i>Sec.-ft.</i>			<i>Feet.</i>	<i>Sec.-ft.</i>
Oct. 25	M. N. Grant, Jr.....	3.15	140	June 5	H. K. Smith.....	5.30	1,200
Apr. 21	R. H. Fletcher.....	3.43	225	July 17	.....do.....	3.50	263

Daily discharge, in second-feet, of Tongue River at Carneyville, Wyo., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1.....	154	133	.....	128	300	1,120	540	152	94
2.....	208	124	.....	138	300	905	540	147	94
3.....	208	133	.....	164	300	960	490	133	94
4.....	260	124	.....	164	256	960	465	147	94
5.....	196	124	.....	152	300	1,120	416	124	91
6.....	208	133	.....	128	540	1,070	393	128	94
7.....	182	133	.....	128	905	850	370	124	88
8.....	189	147	.....	116	690	905	346	128	88
9.....	168	133	.....	116	795	1,120	323	128	88
10.....	186	124	.....	128	690	1,420	323	124	94
11.....	178	133	.....	133	795	1,240	300	128	94
12.....	186	133	.....	152	690	1,070	300	128	88
13.....	186	133	.....	138	740	1,120	248	118	91
14.....	178	124	.....	164	795	1,180	240	112	94
15.....	157	124	94	181	590	1,180	240	105	93
16.....	157	133	118	181	540	1,070	248	94	105
17.....	147	133	133	232	490	1,180	252	91	94
18.....	154	147	124	244	346	1,300	248	84	94
19.....	154	133	133	278	540	1,600	236	84	98
20.....	154	133	158	244	690	1,300	224	88	105
21.....	154	147	138	202	905	1,240	188	91	105
22.....	154	158	152	188	905	960	181	94	105
23.....	154	158	152	198	850	905	181	84	112
24.....	140	158	138	209	795	850	158	84	112
25.....	152	158	128	256	795	795	175	91	112
26.....	133	128	128	346	690	850	166	88	116
27.....	147	133	122	416	740	795	152	94	110
28.....	133	108	128	540	690	795	133	105	116
29.....	133	112	138	465	795	740	209	105	118
30.....	133	112	138	323	1,070	690	181	105	120
31.....	133	.....	128	.....	1,020	.....	158	94	.....

NOTE.—Shifting control method used Oct. 1-24.

Monthly discharge of Tongue River at Carneyville, Wyo., for the year ending Sept. 30, 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
October.....	260	133	167	10, 300
November.....	158	108	134	7, 970
March 15-31.....	158	94	132	4, 450
April.....	540	116	215	12, 800
May.....	1, 070	256	663	40, 800
June.....	1, 600	690	1, 040	61, 900
July.....	540	133	278	17, 100
August.....	152	84	110	6, 760
September.....	120	88	100	5, 950

GOOSE CREEK AT SHERIDAN, WYO.

LOCATION.—At West Loucks Street Bridge, Sheridan, in Sheridan County. Nearest tributary, Little Goose Creek, enters a short distance below.

DRAINAGE AREA.—182 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, 1916; August 1, 1895, to August 2, 1897, below mouth of Little Goose Creek. State engineer maintained station at this point during 1913.

GAGE.—Vertical staff installed April 20, 1916, in inside face left abutment; read by Wm. Yeager. Original gage was vertical staff on pile pier of footbridge at City Park several hundred yards below present site. August 14, 1915, gage was moved to left abutment of footbridge, and referred to datum 1.00 foot higher.

DISCHARGE MEASUREMENTS.—Made from single-span bridge or by wading.

CHANNEL AND CONTROL.—Bed composed of gravel. Control is 100 feet downstream at small rapids which shift somewhat during high water.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 4.5 feet at 3 p. m. June 19 (discharge, 1,270 second-feet); minimum stage, 0.39 foot at 5 p. m. August 5 (discharge, 4 second-feet).

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

DIVERSIONS.—During irrigation season greater part of flow is diverted above station.

REGULATION.—None.

ACCURACY.—Stage-discharge relation not permanent; control shifted during high water. Rating curve used prior to April 20 fairly well defined below 600 second-feet; curve used after that date well defined below 800 second-feet. Gage read to hundredths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table. Records fair.

Discharge measurements of Goose Creek at Sheridan, Wyo., during the year ending Sept. 30, 1916.

Date.	Made by—	Gage height.	Dis-charge.	Date.	Made by—	Gage height.	Dis-charge.
		<i>Feet.</i>	<i>Sec.-ft.</i>			<i>Feet.</i>	<i>Sec.-ft.</i>
Oct. 25	M. N. Grant, jr.....	a 2.61	66	July 17	H. K. Smith.....	0.97	59
Apr. 20	R. H. Fletcher.....	1.41	74	Sept. 14	.....do.....	.58	13.0
June 5	H. K. Smith.....	3.21	694				

a Refers to gage installed Aug. 14, 1915.

Daily discharge, in second-feet, of Goose Creek at Sheridan, Wyo., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1.....	119	59	.....	43	120	489	317	12	9
2.....	136	57	.....	49	120	470	287	8	9
3.....	136	38	.....	34	120	462	170	7	8
4.....	136	63	.....	49	139	470	193	5	8
5.....	166	63	.....	43	159	647	159	5	8
6.....	160	63	.....	30	218	302	139	4	8
7.....	142	67	.....	40	332	434	130	8	8
8.....	154	71	.....	30	287	416	149	8	8
9.....	142	67	.....	42	332	527	149	6	6
10.....	133	75	.....	35	272	775	149	4	19
11.....	136	59	.....	46	287	775	149	5	12
12.....	154	49	.....	63	245	689	139	5	15
13.....	93	56	.....	56	218	647	112	6	12
14.....	84	75	.....	56	205	689	82	8	15
15.....	79	108	.....	56	193	689	74	7	16
16.....	77	108	.....	61	159	606	72	8	17
17.....	77	98	.....	63	159	775	59	7	15
18.....	75	108	35	66	149	910	43	7	15
19.....	71	111	30	69	181	1,180	40	7	15
20.....	71	142	39	73	205	1,140	27	7	15
21.....	69	61	59	80	258	820	22	6	18
22.....	63	173	46	80	287	732	20	6	20
23.....	63	163	43	88	258	566	16	6	20
24.....	59	127	35	96	258	272	15	7	17
25.....	61	114	30	96	272	245	9	6	17
26.....	57	75	40	96	272	245	8	7	16
27.....	57	103	33	112	348	364	6	7	18
28.....	56	114	30	149	258	398	5	8	20
29.....	56	75	35	120	317	416	15	8	23
30.....	56	75	25	130	381	398	15	8	23
31.....	59	.....	22	.....	508	.....	12	8	.....

NOTE.—Discharge Nov. 30 estimated because of ice; Apr. 18-19, interpolated. Shifting-control method used Apr. 20 to June 4.

Monthly discharge of Goose Creek at Sheridan, Wyo., for the year ending Sept. 30, 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
October.....	166	56	96.7	5,950
November.....	173	38	87.2	5,190
March 18-31.....	59	22	35.9	997
April.....	149	30	68.4	4,070
May.....	508	120	242	14,900
June.....	1,180	245	585	34,800
July.....	317	5	89.7	5,520
August.....	12	4	6.8	418
September.....	23	6	14.0	833

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, in 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.—Sept. 1, 1915, to Sept. 30, 1916.

GAGE.—Chain gage on upstream guard-rail of bridge since May 4, 1916; read by Miss Carrie Sorenson. Prior to May 4, 1916, gage was inclined staff 1 mile upstream, at K ranch.

DISCHARGE MEASUREMENTS.—Made from two-span highway bridge or by wading.

CHANNEL AND CONTROL.—Channel composed of silt and gravel. Control just above mouth of Clear Creek; during high water backwater from Clear Creek may reach gage, as fall between station and creek is only 2 feet.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 7.0 feet July 29 (discharge, 6,080 second-feet); minimum discharge estimated at 1 second-foot for Sept. 14-19.

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

DIVERSIONS.—Prior to December 31, 1916, there were adjudicated divisions of 9 second-feet from Powder River, above the station. Between the station and State line there were adjudicated diversions of 39 second-feet from Powder River.

REGULATION.—None.

ACCURACY.—Stage-discharge relation not permanent; control shifting at intervals. Rating curve well defined below 2,000 second-feet but poorly defined above. Gage read to hundredths once daily. Daily discharge ascertained by applying gage height to rating table. Records fair.

Discharge measurements of Powder River near Arvada, Wyo., during the period July 22, 1915 to Sept. 30, 1916.

Date.	Made by—	Gage height.	Dis-charge.	Date.	Made by—	Gage height.	Dis-charge.
1915.		<i>Feet.</i>	<i>Sec.-ft.</i>	1916.		<i>Feet.</i>	<i>Sec.-ft.</i>
July 22	R. H. Fletcher.....	3.00	346	Apr. 15	R. H. Fletcher.....	4.63	610
Aug. 13	.....do.....	2.99	283	June 3	H. K. Smith.....	4.71	807
Oct. 28	M. N. Grant, jr.....	a 2.98	277	July 14	.....do.....	4.16	367
				Sept. 13	.....do.....	2.51	b 1

^a Read on old gage; gage height referred to datum of gage installed May 4, 1916, is 4.03 feet.

^b Estimated.

NOTE.—Gage heights of measurements on and after April 15 refer to chain gage at bridge.

Daily discharge, in second-feet, of Powder River near Arvada, Wyo., for the period Sept. 1, 1915 to Sept. 30, 1916.

Day.	Sept.	Day.	Sept.	Day.	Sept.
1915.		1915.		1915.	
1.....	311	11.....	925	21.....	311
2.....	294	12.....	747	22.....	294
3.....	2,900	13.....	588	23.....	271
4.....	1,270	14.....	502	24.....	265
5.....	5,470	15.....	486	25.....	255
6.....	5,160	16.....	426	26.....	463
7.....	2,320	17.....	294	27.....	2,360
8.....	1,780	18.....	356	28.....	5,620
9.....	1,240	19.....	343	29.....	2,100
10.....	943	20.....	330	30.....	1,380

Daily discharge, in second-feet, of Powder River near Arvada, Wyo., for the period Sept. 1, 1915, to Sept. 30, 1916—Continued.

Day.	Oct.	Nov.	Apr.	May.	June.	July.	Aug.	Sept.
1915-16.								
1.....	1,020	265			712	242	316	
2.....	835	271			712	200	162	
3.....	662	277			712	159	143	
4.....	356	277		577	692	130	132	
5.....	580	282		500	762	119	4,740	
6.....	502	288		466	762	104	602	
7.....	426	294		433	664	124	1,680	
8.....	463	306		674	459	135	560	
9.....	294	300		875	485	91	305	
10.....	330	306		1,080	500	84	189	
11.....	356	343		875	530	76	189	
12.....	323	306		1,000	611	740	189	
13.....	317	294		850	552	378	189	1
14.....	330	288		712	522	354	189	1
15.....	323	282	674	664	478	305	189	1
16.....	317	250		560	466	305	182	1
17.....	306	240		500	452	305	182	1
18.....	356			466	402	305	182	1
19.....	356			466	452	305	182	1
20.....	349			472	850	305	182	13
21.....	294			538	1,280	305	182	19
22.....	282			664	5,270	305	182	22
23.....	265			664	2,920	305	182	24
24.....	265			938	850	305		26
25.....	271			875	552	305		28
26.....	282			664	414	305		32
27.....	282			674	366	305		32
28.....	282			620	344	305		34
29.....	277			664	310	6,080		32
30.....	271			664	290	1,280		34
31.....	265			664		560		

NOTE.—Discharge, July 20-23, Aug. 21, and Sept. 15, estimated. No record Aug. 24 to Sept. 13, 1916, as gage was out of water.

Monthly discharge of Powder River near Arvada, Wyo., for the years ending Sept. 30, 1915, and 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
1915.				
September.....	5,520	255	1,330	79,100
1915-16.				
October.....	1,020	265	382	23,500
November 1-17.....	343	240	286	9,640
May 4-31.....	1,080	433	671	37,300
June.....	5,270	290	812	48,300
July.....	6,080	76	488	30,000
August 1-23.....	4,740	132	488	22,300
September 13-30.....	34	1	16.8	600

CLEAR CREEK NEAR ARVADA, WYO.

LOCATION.—In sec. 36, T. 57 N., R. 77 W., at Sorenson's ranch, $1\frac{1}{2}$ miles above mouth of creek and 16 miles north of Arvada, in Sheridan County. No tributary between station and mouth.

DRAINAGE AREA.—1,110 square miles (measured on base map of Wyoming; scale 1:500,000).

RECORDS AVAILABLE.—August 8, 1915, to September 30, 1916.

GAGE.—Chain gage on right bank one-fourth mile below diversion dam at Sorenson's ranch; read by Miss Carrie 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. Banks not subject to overflow. Stage of zero flow, 3.8 feet.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 7.14 feet at 10 a. m. June 20 (discharge, 1,410 second-feet); minimum discharge probably occurred during winter months.

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

DIVERSIONS.—Prior to December 31 1918, there were adjudicated diversions of 428 second-feet from Clear Creek.

REGULATION.—None.

ACCURACY.—Stage-discharge relation not permanent; control apparently shifts occasionally. Rating curve fairly well defined between 18 and 800 second-feet. Gage read to hundredths once daily. Daily discharge ascertained by applying gage height to rating table. Records good.

Discharge measurements of Clear Creek near Arvada, Wyo., during the year ending Sept. 30, 1916.

Date.	Made by—	Gage height.	Dis-charge.	Date.	Made by—	Gage height.	Dis-charge.
		<i>Feet.</i>	<i>Sec.-ft.</i>			<i>Feet.</i>	<i>Sec.-ft.</i>
Oct. 28	M. N. Grant, jr.	4.81	140	July 14	H. K. Smith.....	4.60	94
Apr. 14	R. H. Fletcher.....	5.04	199	Sept. 13	.....do.....	4.22	a 4
June 3	H. K. Smith.....	6.22	791				

^a Estimated.

Daily discharge, in second-feet, of Clear Creek near Arvada, Wyo., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Apr.	May.	June.	July.	Aug.	Sept.
1.....	212	139	.....	381	962	487	78	1
2.....	212	139	.....	336	882	295	56	3
3.....	212	129	.....	336	814	227	36	2
4.....	212	129	.....	336	848	242	22	1
5.....	212	139	.....	357	848	198	17	2
6.....	198	139	.....	548	962	129	20	1
7.....	242	150	.....	647	748	108	11	1
8.....	212	150	.....	882	647	50	24	1
9.....	198	150	.....	714	614	61	11	2
10.....	185	150	.....	781	714	64	9	1
11.....	173	139	.....	781	1,120	242	3	2
12.....	185	129	.....	781	1,050	161	2	4
13.....	185	119	.....	647	781	119	3	3
14.....	185	119	199	580	714	93	2	4
15.....	173	119	357	516	680	61	3	5
16.....	173	119	357	487	680	59	6	6
17.....	161	139	314	432	516	45	17	10
18.....	161	.....	314	432	647	38	12	13
19.....	173	.....	295	458	714	38	9	12
20.....	161	.....	295	458	1,380	41	3	10
21.....	150	.....	259	614	882	48	5	10
22.....	150	.....	242	848	1,180	40	6	10
23.....	150	.....	242	882	1,050	30	8	12
24.....	139	.....	259	848	580	28	4	10
25.....	139	.....	276	680	432	26	3	17
26.....	139	.....	314	781	381	20	3	16
27.....	139	.....	314	748	276	13	4	18
28.....	139	.....	336	614	487	15	3	28
29.....	139	.....	357	647	487	16	3	26
30.....	139	.....	405	680	548	100	2	28
31.....	139	.....	.....	882	.....	93	3	.....

Monthly discharge of Clear Creek near Arvada, Wyo., for the year ending Sept. 30, 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
October.....	242	139	174	10,700
November 1-17.....	150	119	135	4,560
April 14-30.....	405	199	302	10,200
May.....	882	336	617	37,900
June.....	1,380	276	755	44,900
July.....	487	13	103	6,330
August.....	78	2	12.5	769
September.....	28	1	8.6	512

PINEY CREEK AT KEARNEY, WYO.

LOCATION.—In sec. 26, T. 53 N., R. 83 W., at highway bridge 300 yards south of Kearney, in 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 September 30, 1916.

GAGES.—Chain gage on downstream side of bridge; read by Mrs. Lena Noyce. Gage used 1902-1906 was at same site but referred to different datum.

DISCHARGE MEASUREMENTS.—Made from single-span bridge or by wading.

CHANNEL AND CONTROL.—Channel composed of gravel and small boulders. Control 100 feet downstream at well defined rapids which were permanent during 1916. At stage of approximately 5 feet, water begins to flow through a small channel at the left bank which diverts water from Piney Creek some distance above the station.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 4.0 feet at 8 a. m. June 10 (discharge, 911 second-feet); minimum stage, 1.25 feet for several days in September (discharge, 12 second-feet).

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.

REGULATION.—None.

ACCURACY.—Stage-discharge relation practically permanent. Rating curve well defined between 13 and 900 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 Piney Creek at Kearney, Wyo., during the year ending Sept. 30, 1916.

Date.	Made by—	Gage height.	Dis- charge.	Date.	Made by—	Gage height.	Dis- charge.
		<i>Feet.</i>	<i>Sec.-ft.</i>			<i>Feet.</i>	<i>Sec.-ft.</i>
Oct. 26	M. N. Grant, jr.....	1.68	31.4	June 6	H. K. Smith.....	3.30	458
Apr. 18	R. H. Fletcher.....	2.34	141	July 15	.....do.....	1.78	42.1
Apr. 20	.....do.....	2.26	121				

Daily discharge, in second-feet, of Piney Creek at Kearney, Wyo., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1.....	48	25	.....	59	173	678	136	44	16
2.....	48	40	.....	46	173	678	160	34	14
3.....	48	54	.....	45	173	678	173	28	13
4.....	48	54	.....	46	200	678	121	23	12
5.....	48	54	.....	46	229	678	54	26	12
6.....	37	54	.....	46	313	471	54	30	12
7.....	32	54	.....	46	313	374	59	25	13
8.....	32	54	.....	46	374	527	90	25	13
9.....	42	54	.....	54	420	527	125	28	13
10.....	48	54	.....	72	420	775	143	26	13
11.....	48	54	.....	70	332	586	104	26	13
12.....	42	54	46	108	277	446	63	25	13
13.....	42	54	46	90	277	420	46	23	13
14.....	42	54	36	99	214	374	39	23	13
15.....	42	54	36	106	229	313	42	23	13
16.....	42	54	36	119	214	332	70	25	13
17.....	42	54	36	125	200	294	56	26	13
18.....	42	54	41	134	200	260	39	26	13
19.....	42	54	46	136	200	678	34	23	12
20.....	42	54	46	114	294	527	26	26	12
21.....	42	54	72	114	294	420	19	30	12
22.....	42	54	59	125	374	527	23	34	12
23.....	42	54	62	125	374	294	20	34	23
24.....	37	54	59	125	332	214	20	26	44
25.....	37	54	76	125	374	200	21	20	42
26.....	25	48	62	125	332	229	20	14	34
27.....	32	42	59	160	332	294	28	16	30
28.....	32	42	59	200	374	260	50	15	25
29.....	32	42	59	173	353	313	148	14	19
30.....	32	42	59	173	471	244	100	14	18
31.....	32	.....	81	.....	586	.....	56	15	.....

NOTE.—Discharge Nov. 28-30 estimated.

Monthly discharge of Piney Creek at Kearney, Wyo., for the year ending Sept. 30, 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
October.....	48	25	40.1	2.470
November.....	54	25	50.8	3.020
March 12-31.....	81	36	53.8	2.130
April.....	200	45	102	6.070
May.....	586	173	304	18.700
June.....	775	200	443	26.400
July.....	173	19	69.0	4.240
August.....	44	14	24.7	1.520
September.....	44	12	17.3	1.030

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, 4 miles below Alzada, in Fallon County.

DRAINAGE AREA.—About 780 square miles.

RECORDS AVAILABLE.—June 18, 1911, to September 30, 1916; April 3, 1904, to November 30, 1906, at Alzada above Thompson Creek.

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 feet lower than that of staff gage.

DISCHARGE MEASUREMENTS.—Made by wading or from cable.

CHANNEL AND CONTROL.—Bed of channel shifts during high water. Stream sluggish.

Banks cut 5 to 15 feet in sandy soil. Two channels at medium and one at high stage. Point of zero flow at gage height 1.8 feet; determined by levels, September 14, 1916.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 8.18 feet at 3.30 p. m. and 4.45 p. m. March 12 (discharge 1,490 second-feet); minimum stage 1.80 feet, or less, September 8-10 and 12-30 (discharge, 0).

1911-1916: Maximum stage recorded 15.3 feet April 6, 1912 (discharge, 4,550 second-feet); channel dry July 6 to August 7, and October 14-18, 1911; September 9-15, 1913; and September 8-10 and 12-30, 1916.

ICE.—Stage-discharge relation seriously affected by ice; winter flow estimated from observer's notes and weather records.

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 during year, except as affected by ice for short periods in January, February, and March. Rating curve well defined. Gage read to quarter tenths twice daily; during high water and changing stages, read more often. Discharge ascertained by applying mean daily gage height to rating table, except for periods during which stage-discharge relation is affected by ice. Record obtained by use of rating table, good; other records, fair.

Daily discharge, in second-feet, of Little Missouri River near Alzada, Mont., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1.....	39	14	16	16	.....	200	66	16	20	32	184	1.9
2.....	30	13	16	16	.....	140	228	16	20	23	151	1.0
3.....	30	14	16	16	.....	120	265	16	18	16	30	.9
4.....	26	17	16	16	.....	106	430	15	17	12	24	.4
5.....	24	18	16	15	.....	76	228	13	22	12	17	.3
6.....	49	16	16	14	.....	62	140	12	44	10	28	.3
7.....	32	16	16	14	.....	54	104	12	33	10	265	.1
8.....	28	16	16	14	.....	91	76	12	27	9.5	240	.0
9.....	23	15	16	13	.....	488	66	12	19	7.6	278	.0
10.....	19	14	16	14	.....	336	45	10	15	24	43	.0
11.....	19	20	14	14	.....	1,080	42	11	18	50	27	.1
12.....	19	19	14	14	.....	1,470	44	12	22	52	162	.0
13.....	18	16	14	13	.....	818	40	14	19	30	228	.0
14.....	16	14	13	12	.....	206	31	27	20	17	57	.0
15.....	14	12	13	10	.....	115	24	488	16	14	36	.0
16.....	16	14	13	10	30	83	31	368	15	12	20	.0
17.....	16	14	12	10	618	52	20	228	15	12	14	.0
18.....	16	18	12	10	880	40	22	195	12	45	12	.0
19.....	17	16	12	10	1,080	32	33	91	11	184	8.0	.0
20.....	16	16	12	.....	1,340	30	41	56	13	70	8.0	.0
21.....	16	15	12	.....	1,470	32	28	45	24	99	9.5	.0
22.....	15	15	14	.....	1,360	34	22	46	19	59	9.5	.0
23.....	14	16	14	.....	1,110	26	19	71	67	21	6.8	.0
24.....	15	16	14	.....	794	26	19	116	58	16	6.0	.0
25.....	14	15	14	.....	818	25	18	57	48	17	4.0	.0
26.....	14	15	14	.....	840	24	16	45	24	12	4.4	.0
27.....	13	15	14	.....	710	28	14	33	24	10	4.0	.0
28.....	14	15	13	.....	306	26	16	25	97	10	4.0	.0
29.....	14	15	12	.....	250	39	16	22	336	65	4.4	.0
30.....	14	15	12	.....	.....	50	16	24	99	50	3.4	.0
31.....	15	.....	12	.....	.....	44	.....	19	.....	140	2.2	.....

NOTE.—Discharge Jan. 20 to Feb. 15 estimated, because of ice, at 5 second-feet; Feb. 29 and Mar. 1, interpolated because of ice.

Monthly discharge of Little Missouri River near Alzada, Mont., for the year ending Sept. 30, 1916.

Month.	Discharge in second-feet.			Run off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
October.....	38	13	20.1	1,240
November.....	20	12	15.5	922
December.....	16	12	14.0	861
January.....	16		10.0	615
February.....	1,470		403	23,200
March.....	1,470	24	192	11,800
April.....	430	14	71.7	4,270
May.....	488	10	68.6	4,220
June.....	336	11	39.7	2,360
July.....	184	7.6	36.8	2,260
August.....	278	2.2	61.0	3,750
September.....	1.9	.0	.17	10
The year.....	1,470	.0	76.5	55,500

KNIFE RIVER BASIN.

KNIFE RIVER NEAR BRONCHO, N. DAK.

LOCATION.—In SE. $\frac{1}{4}$ sec. 4, T. 142 N., R. 90 W., at C. D. Smith's ranch, half 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 old station two miles below present site is probably about 5 square miles greater.

RECORDS AVAILABLE.—May 29, 1903, to September 30, 1916.

GAGE.—Chain gage on left bank just below observer's house; datum unchanged since March 23, 1905, when station was moved from original site. Gage read by C. D. Smith.

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

CHANNEL AND CONTROL.—Control shifts occasionally, causing slight changes in rating curve for low stages.

EXTREMES OF DISCHARGE.—Maximum stage during year, 21.1 feet March 28–29 (stage-discharge relation seriously affected by ice; discharge not computed); minimum stage recorded, 3.4 feet August 2–5, 19–31, September 1–8, 18–30 (discharge, 7 second-feet).

1903–1916: Maximum stage recorded, 24.0 feet June 26, 1914, determined by leveling from flood marks, (discharge computed from extension of rating curve, 7,700 second-feet); river reported dry September 6–8, 1905; September 18–19, 1908.

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

ACCURACY.—Stage-discharge relation not permanent owing to slight changes in control. Two rating curves fairly well defined below 2,000 second-feet used October 1 to June 24 and June 25 to September 30, 1916. Gage read once daily to tenths. Discharge ascertained by applying daily gage height to rating table. Records fair.

Discharge measurements of Knife River near Broncho, N. Dak., during the year ending Sept. 30, 1916.

Date.	Made by—	Gage height.	Discharge.
Apr. 26	W. B. Stevenson.....	<i>Feet.</i> 5.75	<i>Sec.-ft.</i> 248
Sept. 1	E. F. Chandler.....	3.44	8.8

Daily discharge, in second-feet, of Knife River near Broncho, N. Dak., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Apr.	May.	June.	July.	Aug.	Sept.
1.....	17	12	437	63	38	627	11	7
2.....	17	12	1,600	63	38	210	7	7
3.....	38	12	4,600	56	38	124	7	7
4.....	50	12	4,280	56	38	101	7	7
5.....	194	12	2,540	50	38	71	7	7
6.....	137	12	1,320	44	38	40	16	7
7.....	374	12	655	44	38	33	21	7
8.....	395	12	458	38	38	33	33	7
9.....	164	12	334	38	32	27	33	11
10.....	114	12	1,100	38	32	27	33	11
11.....	70	12	1,060	38	32	80	33	11
12.....	50	12	502	44	32	124	33	11
13.....	22	12	315	44	32	47	27	11
14.....	22	12	226	44	32	47	21	11
15.....	17	.....	137	44	27	40	21	11
16.....	17	.....	95	44	27	33	11	11
17.....	17	.....	63	38	27	33	11	11
18.....	17	.....	56	38	27	27	11	7
19.....	17	.....	56	38	27	11	7	7
20.....	17	.....	800	38	27	18	7	7
21.....	17	.....	3,420	38	27	16	7	7
22.....	17	.....	4,100	38	32	16	7	7
23.....	17	.....	958	38	480	16	7	7
24.....	17	.....	925	38	860	16	7	7
25.....	12	.....	712	86	800	16	7	7
26.....	12	.....	278	78	480	11	7	7
27.....	12	.....	194	63	334	11	7	7
28.....	12	.....	95	56	273	11	7	7
29.....	12	.....	86	50	296	11	7	7
30.....	12	.....	70	44	437	11	7	7
31.....	12	.....	.....	38	.....	11	7	.....

NOTE.—Flow Nov. 15-30 estimated at 12 second-feet.

Monthly discharge of Knife River near Broncho, N. Dak., for the year ending Sept. 30, 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
October.....	395	12	61.9	3,810
November.....	.....	.....	12.0	714
April.....	4,600	56	1,050	62,500
May.....	86	38	47.3	2,910
June.....	8.0	27	156	9,280
July.....	627	11	61.2	3,760
August.....	33	7	14.0	861
September.....	11	7	8.2	488

HEART RIVER BASIN.

HEART RIVER NEAR RICHARDTON, N. DAK.

LOCATION.—In sec. 21, T. 138 N., R. 92 W., opposite observer's house, 1 mile below highway bridge and about 11 miles south of Richardton, in Stark County.

DRAINAGE AREA.—1,250 square miles.

RECORDS AVAILABLE.—May 18, 1903, to September 30, 1916.

GAGE.—Overhanging chain gage installed May 31, 1913, opposite observer's house.

Gages previously used as follows: May 18, 1903, to November 26, 1910, chain gage at highway bridge 1 mile above, set so that readings from it are approximately 20 feet less than those from present gage; March 10, to September 3, 1911, a staff gage 30 rods upstream from observer's house, set to read same as gage at highway bridge; September 4, 1911, to March 31, 1913, chain gage (at present site), which was set to same datum as present gage, was washed out March 30-31, and replaced

May 31, 1913, by present gage, which has been used since that date except February 20 to May 16, 1916, when, owing to damage caused by ice, the chain gage at highway bridge was read. Gage read by W. F. Church.

DISCHARGE MEASUREMENTS.—At high stages made from highway bridge 1 mile above gage; at low stages by wading at different sections near gage.

CHANNEL AND CONTROL.—Bed composed of gravel and sand; shifting. During 1916 a dam built by beavers one-fourth mile below gage caused backwater at gage.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 34.7 feet April 4 (discharged 2,470 second-feet); minimum stage, 24.55 feet at 7.30 a. m. August 20 (discharge 0.6 second-foot).

1903-1916: Maximum stage, 25.9 feet (chain gage at highway bridge) June 10, 1906 (discharge, 8,020 second-feet); river reported dry July 26-August 11, August 20-23, 1903, September 1-19, 1905, July 22-27, 1914.

ICE.—Stage-discharge relation seriously affected by ice; flow not computed for winter months.

ACCURACY.—Stage-discharge relation seriously affected by dam built by beavers. Rating curve used April 1 to May 1 fairly well defined. Gage read once daily to half tenths. Discharge determined by shifting-control method except for period April 1 to May 1, for which it was ascertained by applying daily gage height to rating table. Records poor, owing to operations of beavers.

Discharge measurements of Heart River near Richardton, N. Dak., during the year ending Sept. 30, 1916.

Date.	Made by—	Gage height.	Dis-charge.
		<i>Feet.</i>	<i>Sec.-ft.</i>
Apr. 25	W. B. Stevenson.....	28.99	832
May 16	Harris Robinson.....	25.40	60
Sept 3	E. F. Chandler.....	24.97	4.6

Daily discharge, in second-feet, of Heart River near Richardton, N. Dak., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Apr.	May.	June.	July.	Aug.
1.....	15	24	585	256	45	102	3.0
2.....	10	24	966	226	41	113	3.0
3.....	8	24	1,070	196	41	138	3.0
4.....	60	24	2,470	181	36	102	3.0
5.....	70	17	1,760	152	41	80	4.0
6.....	70	24	1,070	152	41	65	8.0
7.....	70	20	862	125	50	60	8.0
8.....	91	24	629	113	41	50	6.0
9.....	91	24	565	102	41	65	55
10.....	70	17	1,500	91	36	65	55
11.....	55	11	1,100	80	32	75	17
12.....	41	11	629	80	32	80	14
13.....	41	17	428	80	32	96	8.0
14.....	32	20	337	91	28	80	6.0
15.....	28	20	304	102	20	65	3.0
16.....	24	20	288	80	20	50	2.5
17.....	24	24	256	60	20	41	2.0
18.....	20	24	241	60	17	36	1.6
19.....	24	17	673	55	17	28	1.3
20.....	14	17	1,670	55	24	24	.6
21.....	17	.....	1,580	60	24	17	.8
22.....	24	.....	2,280	60	20	14	1.3
23.....	28	.....	2,190	70	119	11	1.6
24.....	28	.....	2,030	60	211	36	2.0
25.....	24	.....	1,020	70	651	17	2.5
26.....	24	.....	585	70	1,070	14	2.0
27.....	24	.....	545	70	565	14	2.0
28.....	24	.....	354	60	226	11	2.0
29.....	28	.....	304	55	152	11	2.0
30.....	28	.....	256	50	125	11	2.5
31.....	24	.....	.....	45	.....	2	3.0

NOTE.—Data inadequate for determination of discharge Nov. 21 to Mar. 31 and Sept. 1-30.

Monthly discharge of Heart River near Richardton, N. Dak., for the year ending Sept. 30, 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
October.....	91	8	36.5	2,240
November 1-20.....	24	11	20.2	801
April.....	2,470	241	952	56,600
May.....	256	45	97.0	5,960
June.....	1,070	17	127	7,560
July.....	138	2	50.7	3,120
August.....	55	.6	7.28	448

CANNONBALL RIVER BASIN.

CANNONBALL RIVER AT STEVENSON, N. DAK.

LOCATION.—In sec. 20, T. 133 N., R. 82 W., on Standing Rock Indian Reservation, at F. H. Bingenheimer's house on old Stevenson ranch, 1 mile below M. H. Burdick's house, 5 miles east of present location of Stevenson post office¹, about 4 miles southeast of Timmer, and 4 miles above mouth of Dogtooth Creek.

DRAINAGE AREA.—3, 650 square miles.

RECORDS AVAILABLE.—June 10, 1903, to November 30, 1908; August 9, 1911, to September 30, 1916.

GAGE.—October 1, 1914, to September 1, 1915, chain on projecting cantilever timber on left bank at M. H. Burdick's house; read by Mrs. M. H. Burdick. Gage used from 1903 to 1908 was a chain on projecting timber of left bank 1 mile below Burdick's house; this gage was rebuilt September 1, 1915, and has been read daily since September 2 by Frank Bingenheimer. Datum of the two gages so related that readings on the gage at Burdick's are about 10.0 feet greater than on the gage at Bingenheimer's.

DISCHARGE MEASUREMENTS.—At low and medium stages made by wading at ford 15 rods below Burdick's or at the riffle 55 rods below; at medium and high stages from cable about 100 yards above the gage installed September 2, 1915, at Bingenheimer's ranch.

CHANNEL AND CONTROL.—Bed of stream composed of gravel and stones, in places covered with silt to depth of 1 foot; shifts slightly.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 11.2 feet (ice running) March 18, 1916; maximum stage recorded, open season, 8.9 feet April 13, 1916 (discharge, 3,900 second-feet); minimum stage recorded, 2.8 feet September 27, 1916 (discharge, 8 second-feet.)

1903-1908 and 1911-1916: Maximum stage recorded, 21.0 feet April 2, 1912 (discharge, 6,360 second-feet); channel reported dry August 12-15, September 10, 11, 1904, September 29 to October 15, 1905, October 22, 25, November 24, 1906, September 2-7, 10-18, 22-28, October 7, 23, 26, November 24, 1907, August 27, 28, September 13-16, 21-23, October 3-6, 11, 12, 31, November 3-7, 10-14, 1908, and September 2, 1913.

WINTER FLOW.—Stage-discharge relation affected by ice; data insufficient to warrant estimates of flow.

ACCURACY.—Stage-discharge relation practically permanent during year except as affected by ice. Rating curve well defined. Gage read twice daily to half tenths. Discharge ascertained by applying mean daily gage height to rating table, except November 11 to March 31 for which data are inadequate for determination of flow. Records good.

¹ Stevenson post office has been moved 5 miles west of former location.

Discharge measurements of Cannonball River at Stevenson, N. Dak., during the year ending Sept. 30, 1916.

Date.	Made by—	Gage height.	Dis-charge.	Date.	Made by—	Gage height.	Dis-charge.
		<i>Feet.</i>	<i>Sec.-ft.</i>			<i>Feet.</i>	<i>Sec.-ft.</i>
Apr. 20	V. H. Sprague.....	7.00	2,200	Aug. 30	E. F. Chandler.....	2.94	17.4
21	.....do.....	6.00	1,420	Sept. 21	.....do.....	2.88	13.4
June 8	.....do.....	8.52	101				

Daily discharge, in second-feet, of Cannonball River at Stevenson, N. Dak., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Apr.	May.	June.	July.	Aug.	Sept.
1.....	47	47	1,310	480	147	175	34	14
2.....	47	47	1,240	375	122	175	23	14
3.....	325	47	1,380	375	122	240	34	14
4.....	1,590	47	2,360	325	122	122	34	14
5.....	535	47	1,960	280	161	100	34	14
6.....	240	47	1,590	280	175	100	62	23
7.....	147	47	1,450	280	161	100	80	240
8.....	240	34	1,660	240	175	80	47	122
9.....	175	34	1,660	190	90	80	34	47
10.....	147	34	2,690	161	100	62	34	23
11.....	122		3,230	161	100	62	34	28
12.....	122		3,800	161	100	62	23	23
13.....	80		3,900	222	90	62	23	23
14.....	80		2,520	240	100	62	23	23
15.....	80		1,450	1,450	100	62	23	18
16.....	80		1,100	650	90	47	23	18
17.....	80		900	375	84	34	14	14
18.....	80		680	280	100	34	14	14
19.....	80		590	240	80	34	14	14
20.....	80		2,200	205	80	23	14	14
21.....	62		1,660	240	122	23	80	14
22.....	62		2,780	280	100	34	122	14
23.....	62		3,140	240	122	34	62	11
24.....	62		2,690	240	122	34	47	8
25.....	62		2,040	205	122	34	47	8
26.....	47		1,660	205	122	34	34	8
27.....	47		1,380	175	122	23	23	8
28.....	47		900	175	100	23	23	8
29.....	47		710	175	100	23	23	8
30.....	47		535	147	100	62	23	8
31.....	47			147		47	14	.....

Monthly discharge of Cannonball River at Stevenson, N. Dak., for the year ending Sept. 30, 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
October.....	1,590	47	160	9,840
November 1-10.....	47	34	43.1	855
April.....	3,900	535	1,840	109,000
May.....	1,450	147	297	18,300
June.....	175	80	114	6,780
July.....	240	23	67.3	4,140
August.....	122	14	36.1	2,220
September.....	240	8	27.0	1,610

'GRAND RIVER BASIN.

NORTH BRANCH OF GRAND RIVER AT HALEY, N. DAK.

LOCATION.—Near northeast corner 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, 1916.

GAGE.—Stage obtained by measuring distance from bench mark on highway bridge to water surface by means of metallic tape weighted at the end. From 1908 to 1911 a vertical staff gage 100 feet upstream from bridge was used. Observations made by H. N. Lungwitz.

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

CHANNEL AND CONTROL.—Bed of stream composed of gravel and silt. Control shifts occasionally.

EXTREMES OF DISCHARGE.—Maximum stage record during year, 8.6 feet February 21 (stage-discharge relation seriously affected by ice, discharge not computed); minimum stage recorded, 1.05 feet August 20 to September 30 (discharge 1.3 second-feet).

1908-1916: Maximum stage recorded 9.85 feet at 12 m. March 31, 1913 (discharge, from measurement, 5,810 second-feet); river reported dry August 9-15, 1908, October 1 to November 8, 1913, May 25 to June 13, 1914.

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

ACCURACY.—Stage-discharge relation not permanent; affected by shifting control. Stage read to half tenths twice daily. Daily discharge obtained by applying mean daily gage height to rating table for 1914. Records subject to error, as no discharge measurements were made during the year.

Daily discharge, in second-feet, of North Branch of Grand River at Haley, N. Dak., for the year ending Sept. 30, 1916.

Day.	Oct.	Apr.	May.	June.	July	Aug.	Sept.
1.....	3.4	3	22	30	108	11	1.3
2.....	3.4	78	16	19	120	9	1.3
3.....	3.4	86	8	13	84	6	1.3
4.....	3.4	108	7	11	72	5	1.3
5.....	3.4	114	9	9	39	5	1.3
6.....	3.4	132	16	7	16	5	1.3
7.....	3.4	84	7	5	11	5	1.3
8.....	3.4	62	5	5	11	5	1.3
9.....	3.4	39	3	3	11	5	1.3
10.....		22	2	4	16	4	1.3
11.....		22	2	5	13	3	1.3
12.....		16	1	6	13	3	1.3
13.....		22	1	7	16	3	1.3
14.....		21	1	7	22	3	1.3
15.....		20	3	8	22	3	1.3
16.....		22	13	9	22	3	1.3
17.....		22	13	10	16	3	1.3
18.....		22	39	11	39	3	1.3
19.....		84	13	11	49	3	1.3
20.....		240	16	16	30	1.3	1.3
21.....		213	16	11	30	1.3	1.3
22.....		126	11	7	39	1.3	1.3
23.....		49	11	7	39	1.3	1.3
24.....		44	16	11	39	1.3	1.3
25.....		30	22	16	34	1.3	1.3
26.....		28	16	30	30	1.3	1.3
27.....		22	22	30	22	1.3	1.3
28.....		26	30	49	22	1.3	1.3
29.....		22	30	84	22	1.3	1.3
30.....		22	30	96	19	1.3	1.3
31.....			32		13	1.3	.....

Monthly discharge of North Branch of Grand River at Haley, N. Dak., for the year ending Sept. 30, 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
October 1-9.....	3.4	3.4	3.40	60.7
April.....	240	3	60.0	3,570
May.....	39	1	14.0	861
June.....	96	3	17.9	1,070
July.....	120	11	33.5	2,060
August.....	11	1.3	3.31	204
September.....	1.3	1.3	1.30	77.4

GRAND RIVER NEAR WAKPALA, S. DAK.

LOCATION.—In or near sec. 8, T. 19 N., R. 29 E., on Standing Rock Indian Reservation at new steel highway bridge 4 miles south of Wakpala, Corson County, a station on Chicago, Milwaukee & St. Paul Railway.

DRAINAGE AREA.—5,300 square miles.

RECORDS AVAILABLE.—September 9, 1911, to September 30, 1916.

GAGE.—Chain gage on foot guardrail 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 or quicksand; shifting.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 10.6 feet at 5 p. m, April 20 (discharge, 3, 260 second-feet); minimum stage recorded, 4.3 feet September 23 (discharge, 15 second-feet).

1911-1915: Maximum stage recorded June 17 and 19, 1915 (discharge, 7,130 second-feet); minimum stage recorded, 1.8 to 2.2 feet September 13-15 and September 21 to October 1, 1913 (discharge, 0.1 second-foot).

ICE.—Stage-discharge relation seriously affected by ice; data insufficient to warrant estimates.

ACCURACY.—Stage-discharge relation not permanent. Three rating curves used, applicable as follows: October 1-12, 1915, fairly well defined; October 20 to November 28, poorly defined; April 1 to September 30, fairly well defined. Gage read once daily to tenths; readings believed to be fairly accurate and reliable, although occasionally they do not check with those made by engineers. Discharge ascertained by applying daily gage height to rating table; shifting-control method used October 13-19. Records fair.

Discharge measurements of Grand River near Wakpala, S. Dak., during the year ending Sept. 30, 1916.

Date.	Made by—	Gage height.	Dis-charge.	Date.	Made by—	Gage height.	Dis-charge.
		<i>Feet.</i>	<i>Sec.-ft.</i>			<i>Feet.</i>	<i>Sec.-ft.</i>
Oct. 30	V. H. Sprague.....	4.15	84	Aug. 29	E. F. Chandler.....	4.61	50
Apr. 22	.....do.....	9.74	3,040	Sept. 19	.....do.....	4.60	43
June 8	.....do.....	5.22	159				

Daily discharge, in second-feet, of Grand River near Wakpala, S. Dak., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Apr.	May.	June.	July.	Aug.	Sept.
1.....	214	72	1,220	685	960	215	.....	25
2.....	160	66	1,640	581	940	185	.....	25
3.....	160	61	2,060	478	920	185	.....	25
4.....	1,960	56	2,060	375	860	185	.....	25
5.....	1,740	56	2,060	332	800	166	.....	25
6.....	1,740	56	2,160	290	590	148	.....	25
7.....	1,580	56	2,260	250	380	130	.....	772
8.....	1,410	.....	2,360	238	170	130	.....	1,520
9.....	1,190	.....	2,480	226	170	65	.....	1,520
10.....	1,140	.....	2,300	215	170	50	.....	1,160
11.....	1,030	.....	2,120	215	178	42	.....	1,220
12.....	918	.....	1,940	200	185	35	.....	1,280
13.....	790	.....	1,760	200	258	50	.....	1,040
14.....	660	.....	1,730	200	330	35	.....	810
15.....	530	.....	1,700	2,600	291	35	.....	575
16.....	410	.....	1,100	2,540	253	.....	.....	520
17.....	278	.....	1,100	1,760	215	.....	.....	312
18.....	207	.....	1,880	1,520	185	.....	.....	105
19.....	136	.....	2,570	1,190	800	.....	.....	42
20.....	118	.....	3,260	860	890	.....	.....	34
21.....	100	.....	2,960	800	980	.....	.....	25
22.....	96	.....	2,780	800	832	.....	.....	20
23.....	92	.....	2,390	685	685	.....	.....	15
24.....	78	.....	2,000	920	330	.....	.....	50
25.....	78	.....	1,760	860	310	.....	.....	25
26.....	78	.....	1,600	800	290	.....	.....	25
27.....	78	.....	1,430	800	265	.....	.....	25
28.....	78	.....	1,270	860	240	.....	.....	25
29.....	66	.....	1,100	900	215	.....	50	25
30.....	85	.....	890	940	215	.....	35	25
31.....	72	.....	.....	980	.....	.....	35	.....

NOTE.—Discharge interpolated for lack of gage readings on following days: Oct. 1, 11, 13-15, 18, 20, 22, 26-27; Nov. 2, 3, and 5; Apr. 4, 6, 7, 10, 14, 19, 23, 26-28, and 30; May 2, 3, 5, 8, 9, 19, 29-30; June 1, 2, 4, 6, 7, 9, 11, 13, 15, 16, 20, 22, 25, 27, 28, and 30; July 5, 6, and 11; Sept. 7, 11, 13, 14, 17, 20, 22, and 27-29.

Monthly discharge of Grand River near Wakpala, S. Dak., for the year ending Sept. 30, 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
October.....	1,960	66	557	34,200
November 1-7.....	72	56	60.4	839
April.....	3,260	890	1,930	115,000
May.....	2,600	200	784	48,200
June.....	930	170	464	27,600
July 1-15.....	215	35	110	3,270
September.....	1,520	15	377	22,400

CHEYENNE RIVER BASIN.

CHEYENNE RIVER NEAR HOT SPRINGS,¹ S. DAK.

LOCATION.—In sec. 9, T. 9 S., R. 5 E., a mile above dam site of proposed Angostura irrigation project, 5 miles south of Cascade Springs, and 11 miles south of Hot Springs, in Fall River County. Nearest tributary, Cascade Creek, enters 2½ miles above.

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—September 11, 1914, to September 30, 1916. 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 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.

¹ Formerly Cheyenne River near Cascade Springs, S. Dak.

DISCHARGE MEASUREMENTS.—Made by wading or from cable 75 feet below gage.

CHANNEL AND CONTROL.—Bed composed of compacted gravel on which silt is deposited; shifts frequently. Principal control a short distance down stream; 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, 7.2 feet at 6 p. m., June 21 (discharge, 6,140 second-feet); minimum stage, 0.84 foot, September 12–14 (discharge, 24 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, and 43.4 second-feet from Cascade Creek.

REGULATION.—None.

ACCURACY.—Stage-discharge relation not permanent; shifts frequently; affected by ice for short periods. Rating curve used as standard fairly well defined between 24 second-feet and 24,000 second-feet. Frequent discharge measurements made to define shifts of control. Gage read to half tenths twice daily. Discharge ascertained by applying mean daily gage height to rating table; shifting-control method used April 1 to September 30. Records good.

Discharge measurements of Cheyenne River near Hot Springs, S. Dak., during the year ending Sept. 30, 1916.

Date.	Made by—	Gage height.	Dis-charge.	Date.	Made by—	Gage height.	Dis-charge.
		<i>Feet.</i>	<i>Sec.-ft.</i>			<i>Feet.</i>	<i>Sec.-ft.</i>
Jan. 25	Fred Noerenberg.....	1.25	52	July 10	Fred Noerenberg.....	0.87	24.5
May 22	.....do.....	3.01	1,140	12	Smith and Noerenberg.	4.06	1,840
June 6	.....do.....	1.60	235	Aug. 17	Fred Noerenberg.....	1.32	76
10	.....do.....	1.23	109	Sept. 15	.....do.....	.87	24.1
28	.....do.....	1.53	129				

Daily discharge, in second-feet, of Cheyenne River near Hot Springs, S. Dak., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1.....	1,110	230	118	80	39	188	230	220	286	258	604	160
2.....	895	230	105	80	44	105	212	202	382	192	337	122
3.....	762	212	105	80	52	112	130	184	670	105	373	74
4.....	670	230	105	80	52	118	160	151	700	68	298	37
5.....	599	212	105	70	52	355	130	145	450	52	122	32
6.....	555	212	118	70	52	355	160	130	250	37	85	30
7.....	500	212	118	70	52	860	178	125	181	33	57	30
8.....	460	212	105	70	52	400	178	125	151	30	1,490	30
9.....	450	195	130	160	52	290	242	125	118	28	622	30
10.....	410	195	130	195	44	525	223	125	1,230	26	415	28
11.....	355	195	130	130	44	400	246	103	610	178	435	25
12.....	346	160	105	28	44	525	246	125	622	2,000	294	24
13.....	364	160	105	52	1,580	610	238	167	1,350	540	274	24
14.....	332	130	105	44	2,000	355	220	154	1,780	360	223	24
15.....	332	130	92	60	3,770	212	195	139	990	282	98	25
16.....	355	130	92	44	4,700	212	181	238	373	420	74	26
17.....	355	195	92	52	2,460	160	181	294	209	3,220	90	26
18.....	555	178	80	60	1,890	118	181	220	110	2,110	64	26
19.....	450	160	80	70	1,580	136	282	184	178	1,160	49	28
20.....	378	130	80	80	1,310	136	302	167	142	540	110	28
21.....	310	130	80	80	1,190	145	284	2,340	4,020	223	110	26
22.....	332	130	92	80	795	145	450	1,430	2,730	122	85	23
23.....	290	130	105	60	599	130	364	795	1,440	105	80	30
24.....	250	160	118	60	640	130	302	455	884	85	74	28
25.....	270	212	105	52	582	105	250	368	535	74	85	26
26.....	250	160	80	44	525	105	216	455	396	57	64	26
27.....	250	130	80	39	475	136	250	455	278	40	98	26
28.....	250	130	80	31	370	130	230	368	160	43	223	26
29.....	230	130	80	28	270	160	216	254	535	49	258	25
30.....	230	130	80	39	.....	230	184	167	278	778	258	24
31.....	230	.....	80	34	.....	250	.....	125	.....	1,300	203	.....

NOTE.—Stage-discharge relation affected by ice Jan. 12–19, 26–31, Feb. 1–7, 28, and Mar. 1–3. Shifting control method used Apr. 1 to Sept. 30.

Monthly discharge of Cheyenne River near Hot Springs, S. Dak., for the year ending Sept. 30, 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
October.....	1,110	230	423	28,000
November.....	230	130	172	10,200
December.....	130	80	99.4	6,110
January.....	195	28	68.5	4,210
February.....	4,700	39	873	50,200
March.....	860	105	253	15,600
April.....	450	130	229	13,600
May.....	2,340	103	340	20,900
June.....	4,020	110	73.5	43,700
July.....	3,220	26	468	28,800
August.....	1,490	49	247	15,200
September.....	160	24	36.5	2,170
The year.....	4,700	24	326	237,000

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, $1\frac{1}{2}$ 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, 1916. May 26, 1903, to June 23, 1906, for station at the west outskirts of Belle Fourche. The records not directly comparable as Redwater River enters between the two stations and water is diverted from Belle Fourche River.

GAGES.—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 gates. 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 derived, 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.—Station maintained and record of daily discharge furnished by United States Reclamation Service.

WHITE RIVER BASIN.

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Daily discharge, in second-feet, of Belle Fourche River near Belle Fourche, S. Dak., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1.....	1,060	430	240	412	412	780	580	620	1,000	570	617	135
2.....	820	240	395	412	412	780	638	600	820	520	985	135
3.....	820	240	550	412	412	525	638	572	770	485	460	135
4.....	745	240	550	412	412	525	638	566	785	485	480	135
5.....	745	240	550	412	412	525	638	566	795	325	280	135
6.....	745	240	550	412	412	525	638	522	715	140	247	135
7.....	745	240	550	412	412	525	638	498	715	140	297	135
8.....	745	240	550	412	412	1,720	638	445	690	140	182	135
9.....	745	240	550	412	412	1,290	525	445	630	100	182	135
10.....	745	240	550	412	412	1,290	638	635	740	100	182	135
11.....	685	240	550	412	412	1,290	638	530	660	347	182	135
12.....	625	240	550	412	412	1,290	638	585	620	178	394	135
13.....	625	240	550	412	412	1,290	638	623	615	130	262	100
14.....	625	240	550	412	412	1,090	710	945	615	83	250	167
15.....	625	240	550	412	525	780	710	1,720	615	83	250	143
16.....	625	240	550	412	1,120	525	710	940	560	100	198	143
17.....	625	240	550	412	1,290	525	710	710	560	100	170	143
18.....	625	240	550	412	1,290	525	638	638	560	1,240	132	143
19.....	625	240	550	412	2,460	525	780	710	650	755	132	143
20.....	625	240	550	412	2,670	525	780	865	1,060	195	180	143
21.....	625	240	550	412	2,440	525	780	1,190	1,510	195	397	143
22.....	625	240	550	412	2,040	525	740	1,600	1,330	195	377	135
23.....	625	240	550	412	2,040	525	780	1,680	950	190	327	177
24.....	625	240	550	412	1,290	525	780	1,540	1,180	130	274	177
25.....	625	240	550	412	1,290	525	780	1,370	1,600	110	229	177
26.....	625	240	550	412	1,290	525	780	1,130	2,170	110	187	177
27.....	625	240	550	412	940	525	710	1,060	1,380	90	187	177
28.....	625	240	550	412	780	525	638	970	1,060	140	187	177
29.....	625	240	550	412	780	525	638	930	900	740	187	177
30.....	625	240	550	412	.....	580	638	780	675	330	187	177
31.....	625	.....	550	412	.....	580	.....	780	.....	195	199	.....

NOTE.—Records as furnished have been changed slightly to conform to computing rules of United States Geological Survey. Records show combined flow of river and canal at diversion dam.

Monthly discharge of Belle Fourche River near Belle Fourche, S. Dak., for the year ending Sept. 30, 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
October.....	1,060	625	681	41,900
November.....	430	240	246	14,600
December.....	550	240	535	32,900
January.....	412	412	412	25,300
February.....	2,670	412	966	55,600
March.....	1,720	525	733	45,100
April.....	1,780	525	681	40,500
May.....	1,720	445	863	53,100
June.....	2,170	560	898	53,400
July.....	1,240	83	279	17,200
August.....	985	132	284	17,500
September.....	177	100	148	8,810
The year.....	2,170	83	559	403,000

NOTE.—Monthly discharge computed by engineers of United States Geological Survey.

WHITE RIVER BASIN.

WHITE RIVER NEAR INTERIOR, S. DAK.

LOCATION.—Near southwest corner of sec. 7, T. 4 S., R. 18 E., at steel highway bridge on Pine Ridge Indian Reservation, 3 miles southwest of Interior, Stanley County.

DRAINAGE AREA.—4,090 square miles; area at old site 15 square miles less.

RECORDS AVAILABLE.—August 24, 1911, to September 30, 1916; June 24, 1904, to November 30, 1906 at station near southwest corner sec. 10, T. 4 S., R. 18 E.

GAGE.—Vertical staff, attached to downstream side of first pier at left end of bridge; read since August 31, 1911; temporary gage at same datum installed August 24 on a tree on left bank near southwest corner NW. $\frac{1}{4}$ sec. 17. Other gages used 1904–1906 are described in Water Supply Papers 130 (p. 181), 172 (p. 166) and 208 (p. 135). Gage read by George Carlhom.

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

CHANNEL AND CONTROL.—Control shifts occasionally. Bed composed of sand and some quicksand. Left bank steep and clean; right bank steeply sloping; clean.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 10.1 feet May 21, 1916 (discharge, 7,800 second-feet); minimum stage recorded, 3.42 feet September 13, 1916 (discharge, 24 second-feet).

1904–1906 and 1911–1916: Maximum stage recorded, 15.1 feet July 4, 1905 (discharge, 14,900 second-feet); river reported dry August 27–28, 1905 and July 13–15, 19–29, September 26–30, 1914.

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

ACCURACY.—Stage-discharge relation not permanent. Rating curve used October 1 to November 13, fairly well defined; curve used March 15 to September 30, well defined below 300 second-feet. Gage read twice daily to half-tenths. Discharge ascertained by applying mean daily gage height to rating table. Records good.

Discharge measurements of White River near Interior, S. Dak., during the year ending Sept. 30, 1916.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		<i>Feet.</i>	<i>Sec.-ft.</i>			<i>Feet.</i>	<i>Sec.-ft.</i>
Nov. 2	V. H. Sprague.....	3.99	89	Aug. 27	E. F. Chandler.....	3.58	46
Apr. 24	.....do.....	3.95	124	Sept. 17	.....do.....	3.44	23
June 6	.....do.....	4.18	202				

Daily discharge, in second-feet, of White River near Interior, S. Dak., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	1,020	90		137	108	210	229	174	30
2	828	81		147	167	210	174	157	42
3	462	78		309	203	248	157	615	30
4	225	75		394	167	330	108	210	30
5	170	75		229	137	288	137	147	30
6	129	75		181	108	188	174	114	30
7	117	105		154	124	288	510	108	30
8	111	111		256	81	225	309	86	30
9	111	99		256	81	188	124	134	30
10	111	90		233	77	174	103	228	24
11	108	81		214	81	560	114	157	24
12	105	78		188	81	860	309	103	24
13	105	75		167	86	925	229	59	24
14	105			124	192	762	114	77	24
15	102		206	114	2,120	795	86	70	24
16	640		196	108	958	642	439	50	24
17	1,100		192	121	394	439	1,820	50	30
18	435		192	108	210	288	700	42	30
19	265		170	134	147	210	210	63	30
20	188		196	178	140	203	157	330	30
21	152		210	127	5,320	462	94	762	30
22	138		233	124	4,750	462	94	288	30
23	135		268	108	2,240	486	167	167	30
24	105		214	108	2,920	958	192	108	30
25	135		181	108	1,880	1,100	124	59	30
26	132		160	108	1,360	1,200	94	42	30
27	120		147	108	990	860	81	40	30
28	108		137	108	560	330	35	59	30
29	99		114	94	486	248	30	59	30
30	90		111	137	330	462	860	59	30
31	90		81		268		372	36	

Monthly discharge of White River near Interior, S. Dak., for the year ending Sept. 30, 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
October.....	1,100	90	250	15,400
November 1-13.....	111	75	85.6	2,210
March 15-31.....	268	84	177	5,970
April.....	394	94	163	9,700
May.....	5,320	77	863	53,100
June.....	1,200	174	487	29,000
July.....	1,820	30	269	16,500
August.....	762	36	150	9,220
September.....	42	24	29.0	1,730

WHITE RIVER NEAR WESTOVER, S. DAK.

LOCATION.—In sec. 33, T. 3 S., R. 29 E., on Rosebud Indian Reservation, at steel highway bridge 2 miles below entrance of South Fork, 12 miles south of Murdo a station on Chicago, Milwaukee & St. Paul Railway about 2 miles from Westover in Lyman County.

RECORDS AVAILABLE.—August 25, 1911, to September 30, 1916.

DRAINAGE AREA.—7,850 square miles.

GAGE.—Chain gage on highway bridge read since April 8, 1912. Prior to that date a vertical staff in several sections, located about 40 rods downstream; datum 2.0 feet lower than that of present gage. An auxiliary staff gage fastened to downstream face of left abutment, at same datum as chain gage, has been read occasionally by observer since August 18, 1913. Gage read by J. E. Rawhauser to April 30, 1916, and by E. F. Sterner since that date.

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

CHANNEL AND CONTROL.—Bed composed of sand and firm gravel; shifts.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 10.6 feet May 26, 1916 (discharge, 7,700 second-feet); minimum stage recorded, 6.2 feet September 20 (discharge 80 second-feet).

1911-1916: Maximum stage recorded, 10.6 feet May 26, 1916 (discharge, 7,700 second-feet); minimum stage recorded, 5.3 feet November 11, 1912 (discharge, 4 second-feet).

ICE.—Stage-discharge relation seriously affected by ice; flow not computed.

ACCURACY.—Stage-discharge relation not permanent. Gage read once daily to half tenths. Discharge ascertained by shifting-control method except November 8 to December 15, for which it was determined from observer's notes and weather records. Records fair.

Discharge measurements of White River near Westover, S. Dak., during the year ending Sept. 30, 1916.

Date.	Made by—	Gage height.	Dis-charge.	Date.	Made by—	Gage height.	Dis-charge.
Nov. 1	V. H. Sprague.....	<i>Feet.</i> 6.93	<i>Sec.-ft.</i> 319	Aug. 26	E. F. Chandler.....	<i>Feet.</i> 7.04	<i>Sec.-ft.</i> 294
Apr. 24	.....do.....	6.93	433	Sept. 16	.....do.....	6.37	93
June 5	.....do.....	7.29	561				

Daily discharge, in second-feet, of White River near Westover, S. Dak., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Dec.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1.....	1,750	335	185	.....	1,070	335	335	1,010	570	335	140
2.....	1,610	335	185	.....	940	385	290	790	470	840	140
3.....	1,200	335	185	.....	810	385	290	535	385	610	132
4.....	1,200	335	185	.....	690	385	250	535	335	412	117
5.....	1,200	335	160	.....	570	440	290	535	270	335	100
6.....	740	335	160	.....	570	470	335	470	250	250	110
7.....	610	290	160	.....	650	535	290	470	250	335	105
8.....	412	290	160	.....	740	535	290	470	215	312	105
9.....	412	290	160	.....	740	535	250	412	270	250	95
10.....	360	290	140	.....	740	535	250	470	570	215	95
11.....	360	290	140	.....	790	535	250	570	360	172	100
12.....	312	290	140	.....	1,010	470	250	950	290	172	93
13.....	312	290	125	.....	895	470	250	2,650	290	172	90
14.....	312	215	110	.....	895	470	290	2,300	215	150	90
15.....	312	215	100	.....	790	412	385	1,680	200	140	90
16.....	312	215	.....	2,660	740	440	3,110	1,400	250	132	90
17.....	535	215	.....	3,110	740	385	2,140	950	2,560	172	90
18.....	2,740	215	.....	5,220	650	385	1,330	1,330	385	172	90
19.....	1,900	215	.....	3,530	570	335	650	1,900	2,060	172	90
20.....	1,900	215	.....	3,110	570	335	570	1,070	1,330	150	80
21.....	1,610	215	.....	5,220	500	335	570	950	695	150	82
22.....	1,200	215	.....	4,260	500	335	5,060	1,260	440	610	90
23.....	650	215	.....	3,310	500	385	3,650	950	335	950	0
24.....	440	215	.....	1,750	500	385	5,060	1,070	270	695	90
25.....	440	215	.....	1,470	385	385	7,030	1,260	232	385	85
26.....	440	185	.....	1,330	385	335	5,060	1,540	215	270	95
27.....	385	185	.....	1,070	385	335	3,210	1,680	360	232	95
28.....	385	185	.....	1,070	385	335	2,390	1,610	215	200	103
29.....	335	185	.....	1,070	385	335	1,610	1,610	232	172	103
30.....	335	185	.....	.....	335	335	1,260	1,200	232	160	103
31.....	335	.....	.....	.....	335	.....	1,180	.....	200	150	.....

Monthly discharge of White River near Westover, S. Dak., for the year ending Sept. 30, 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
October.....	2,740	312	808	49,700
November.....	335	185	252	15,000
December 1-15.....	185	100	153	4,550
February 16-29.....	5,220	1,070	2,730	75,800
March.....	1,070	335	638	39,200
April.....	535	335	409	24,300
May.....	7,030	250	1,550	95,300
June.....	2,650	412	1,120	66,600
July.....	2,560	200	482	29,600
August.....	950	132	306	18,800
September.....	140	80	99.3	5,910

SOUTH FORK OF WHITE RIVER¹ NEAR WESTOVER, S. DAK.

LOCATION.—At southwest corner of SE. $\frac{1}{4}$ sec. 10, T. 43 N., R. 28 W., at C. H. Kendall's ranch, on Rosebud Indian Reservation, 2 miles above mouth and about 4 miles south of Westover, in Mellette County.

DRAINAGE AREA.—1,590 square miles.

RECORDS AVAILABLE.—June 26, 1912, to September 30, 1916.

GAGE.—Overhanging chain gage on right bank, 6 rods below cable. Prior to September 18, 1913, a staff gage 10 rods below cable was read during the year. In 1912 a staff gage 30 rods below cable was read. All gages referred to same datum.

DISCHARGE MEASUREMENTS.—Made from cable or by wading.

CHANNEL AND CONTROL.—Bed composed of gravel and sand; shifts occasionally.

¹ Formerly called Little White River.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 7.3 feet, February 17, 1916 (stage discharge relation seriously affected by ice); minimum stage, 1.40 feet March 2 and 3.

1912-1916: Maximum stage recorded, 2.75 feet, April 7, 1915 (discharge, 2,780 second-feet); minimum stage recorded, 1.95 feet, October 21, 1914 (discharge, 20 second-feet). Records cover open-water season only.

ICE.—Stage-discharge relation seriously affected by ice; no readings December 16, 1915, to February 15, 1916.

Data insufficient to warrant publication of discharge records.

Discharge measurements of South Fork of White River near Westover, S. Dak., during the year ending Sept. 30, 1916.

Date.	Made by—	Gage height.	Dis-charge.	Date.	Made by—	Gage height.	Dis-charge.
Nov. 1	V. H. Sprague.....	<i>Feet.</i>	<i>Sec.-ft.</i>	Aug. 26	E. F. Chandler.....	<i>Feet.</i>	<i>Sec.-ft.</i>
Apr. 25	.....do.....	2.00	141	Sept. 16	.....do.....	2.01	70
June 5	.....do.....	2.02	225				65
			233				

Daily gage height, in feet, South Fork of White River near Westover, S. Dak., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Dec.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	2.03	2.29	2.1		1.45	1.8	2.0	2.6	2.2	2.0	2.0
2	2.03	2.29	2.1		1.4	1.8	2.0	2.5			2.05
3	2.3	2.25	2.1		1.4	1.9	2.0	2.2	2.05	2.0	
4	2.3	2.25	2.1		1.75	1.9	2.0	2.1	2.02	2.0	2.02
5	2.3	2.25			2.0	1.95	1.98	2.02	2.0	2.0	2.0
6	2.25	2.3	2.1		2.3		1.98	2.0	2.0		2.0
7	2.25	2.3	2.1		2.95	1.95		2.0	2.0	1.95	2.0
8		2.27	2.1			2.0	1.95	2.0	2.0	1.95	2.0
9	2.25	2.27	2.1		2.2		2.0	2.0	2.0		2.0
10	2.3	2.26	2.1		2.2	2.0	2.0	2.1	2.0	1.9	
11	2.31	2.25	2.1		1.65	2.0	2.0	2.3		1.9	1.9
12	2.3	2.2	2.2			2.0		2.1	1.95	1.9	1.9
13	2.3	2.2	2.3		1.65	2.0	2.0	2.0	1.95		
14	2.3		2.4		1.6	2.0	2.05	2.4	1.95	1.9	1.9
15	2.28	2.2	4.0		1.6	2.05	2.1		1.95	1.9	1.9
16	2.3	2.2		6.2	1.55		2.1	2.0	2.4	1.95	1.9
17		2.2		7.3	1.5	2.0	2.0	2.0	2.2	1.95	
18	2.3	2.5		5.5	1.5	2.0	2.0		2.1		1.95
19	2.3	2.5		4.6		2.05	2.6	2.0	2.1	1.9	2.0
20	2.3	2.5		4.0	1.6	2.0	2.2	2.05	2.0	2.9	2.0
21	2.3	2.4		4.0	1.55	2.0		2.1		2.5	2.0
22	2.3	2.4		4.0	1.55	1.95	2.1	2.2	1.95	2.3	2.0
23	2.3	2.3		3.4	1.6		2.1	2.1	1.9		2.0
24	2.3			3.0	1.6	2.0	3.0	2.0	1.95	2.0	2.0
25	2.3	2.2		2.8	1.55	2.0	2.2		1.95	2.0	2.0
26	2.3	2.2		2.65	1.55	2.0	2.2	2.5	1.9	2.0	2.0
27		2.2				2.0	2.4	2.3	1.9		2.0
28	2.3	2.1		2.4	1.65	2.0	2.2	2.25	1.95	2.0	
29	2.28	2.1		2.0	1.65	2.0	2.2	2.2	1.95	2.0	2.02
30	2.28	2.13			1.7			2.2	2.05	2.0	2.0
31					1.8		2.2		2.0	2.0	

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 streams have very little flow except spring run-off.

DRAINAGE AREA.—1,440 square miles (measured on base map of Wyoming; scale, 1:500,000).

RECORDS AVAILABLE.—May 23, 1915, to September 30, 1916.

GAGE.—Vertical staff at downstream side of center pier of bridge; read by Mrs. H. L. McCasland.

DISCHARGE MEASUREMENTS.—Made from two-span bridge or by wading.

CHANNEL AND CONTROL.—Bed composed of sand, gravel, and small boulders. Control 200 feet downstream at small rapids, which shift slightly. Banks not subject to overflow.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 3.7 feet, at 5 p. m.

June 19 (discharge, approximately 2,100 second-feet); minimum discharge occurs during winter months.

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

DIVERSIONS.—There are court decrees for diversion of 3,060 second-feet from the North Platte and tributaries in Colorado. During 1916 Michigan ditch diverted 6,500 acre-feet from a tributary of the North Platte to the Cache la Poudre drainage.

REGULATION.—None.

ACCURACY.—Stage-discharge relation not permanent but shifting between very narrow limits. Rating curve well defined between 200 and 1,600 second-feet. Gage read to quarter tenths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table. Records excellent.

Discharge measurements of North Platte River near Northgate, Colo., during the year ending Sept. 30, 1916.

Date.	Made by—	Gage height.	Discharge.
		<i>Feet.</i>	<i>Sec.-ft.</i>
May 13	H. K. Smith.....	3.23	1,520
June 10	R. H. Fletcher.....	3.09	1,380
Aug. 15	H. K. Smith.....	2.26	547

Daily discharge, in second-feet, of North Platte near Northgate, Colo., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Apr.	May.	June.	July.	Aug.	Sept.
1	179	160	.....	1,200	1,100	1,040	719	381
2	164	156	.....	995	1,150	995	670	324
3	164	152	.....	1,040	1,100	945	678	279
4	164	160	.....	850	1,100	898	678	260
5	206	160	.....	898	1,200	805	719	250
6	216	160	.....	1,040	1,260	719	760	246
7	206	152	.....	1,260	1,320	719	898	250
8	179	179	.....	1,380	1,200	678	898	241
9	175	197	.....	1,620	1,200	678	850	228
10	179	183	640	1,860	1,380	760	850	352
11	175	197	898	1,980	1,020	898	850	532
12	206	221	1,040	1,740	1,860	760	850	532
13	221	.....	995	1,440	1,740	640	898	468
14	206	.....	805	1,500	1,860	602	898	408
15	221	.....	760	1,500	1,860	602	532	324
16	257	.....	850	1,320	1,860	678	500	324
17	326	.....	898	1,200	1,860	602	500	298
18	320	.....	945	1,040	1,980	602	468	279
19	262	.....	1,040	898	1,980	602	408	260
20	246	.....	898	898	1,980	567	381	250
21	225	.....	678	1,200	1,860	532	352	246
22	211	.....	640	1,440	1,740	500	352	241
23	201	.....	760	1,500	1,380	468	324	246
24	197	.....	945	1,150	1,150	438	298	265
25	187	.....	1,150	805	1,150	381	288	280
26	179	.....	1,320	805	1,150	408	293	285
27	175	.....	1,500	898	1,150	468	293	288
28	179	.....	1,740	805	1,150	532	293	288
29	171	.....	1,740	898	1,150	602	293	288
30	175	.....	1,740	945	1,100	678	298	288
31	168	.....	.....	1,040	.....	719	352	.....

NOTE.—Shifting-control method used Oct. 1 to Nov. 12.

Monthly discharge of North Platte River near Northgate, Colo., for the year ending Sept. 30, 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
October.....	326	164	205	12,600
November 1-12.....	221	152	173	4,120
April 10-30.....	1,740	640	1,050	43,700
May.....	1,980	805	1,200	73,800
June.....	1,980	1,100	1,450	86,300
July.....	1,040	381	662	40,700
August.....	898	293	563	34,600
September.....	532	241	307	18,300

NORTH PLATTE RIVER AT SARATOGA, WYO.

LOCATION.—At highway bridge at Saratoga, in 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, 1916. State engineer maintained station at this point during 1913 and 1914.

GAGE.—Chain gage on upstream side of bridge; read by Miss Nora Doggett. Gage prior to 1911 was vertical staff 100 yards below bridge. Relation between datum of gages not determined.

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, 7.3 feet at 7:45 a. m. May 10 (discharge, 6,060 second-feet); minimum discharge during winter months estimated at 192 second-feet January 12 and 17.

ICE.—Stage discharge relation seriously affected by ice; flow estimated from discharge measurements, observer's notes, and weather records.

DIVERSIONS.—Prior to December 31, 1916, there were adjudicated diversions of 83 second-feet from the North Platte, between Saratoga and State line, and 934 second-feet from tributaries entering above.

REGULATION.—None.

ACCURACY.—Stage-discharge relation not permanent, but shifts between very narrow limits. Rating curve used before February 20 well defined; curve used after February 20 well defined between 160 and 6,600 second-feet. Gage read to hundredths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table. Records excellent, except those for winter period, which are fair.

Discharge measurements of North Platte River at Saratoga, Wyo., during the year ending Sept. 30, 1916.

Date.	Made by—	Gage height.	Dis-charge.	Date.	Made by—	Gage height.	Dis-charge.
		<i>Feet.</i>	<i>Sec.-ft.</i>			<i>Feet.</i>	<i>Sec.-ft.</i>
Oct. 6	R. H. Fletcher.....	4.08	438	May 11..	H. K. Smith.....	7.08	5,360
Jan. 6	R. I. Meeker.....	4.40	240	June 8..	R. H. Fletcher.....	6.61	4,350
26	.....do.....	4.12	259	Aug. 12..	H. K. Smith.....	4.72	886
Feb. 16	R. H. Fletcher.....	3.95	313				

^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, 1916.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1.....	455	365	407	238	310	300	870	2,690	4,490	2,500	870	650
2.....	425	365	371	238	310	345	920	2,500	4,240	2,310	870	610
3.....	395	335	371	238	310	300	920	2,220	3,990	2,130	920	540
4.....	395	265	395	238	310	315	870	2,220	4,490	1,950	920	505
5.....	455	335	413	238	310	310	920	2,500	4,740	1,780	920	540
6.....	455	335	401	238	310	540	690	3,300	4,740	1,620	1,080	440
7.....	455	335	419	238	310	470	650	3,990	4,240	1,470	1,080	440
8.....	443	413	407	238	310	470	575	4,490	4,240	1,330	1,080	440
9.....	419	407	379	210	310	398	470	5,260	4,490	1,260	970	440
10.....	413	455	413	210	310	505	610	5,790	5,000	1,330	970	540
11.....	431	437	347	210	310	575	970	5,260	5,790	1,470	920	575
12.....	455	359	335	192	310	575	1,330	5,000	5,790	1,540	825	690
13.....	455	305	347	210	310	690	1,470	4,740	5,790	1,260	825	690
14.....	488	285	353	245	310	650	1,400	4,240	5,260	1,140	870	610
15.....	455	242	365	245	310	610	1,400	3,750	5,520	1,140	825	540
16.....	520	371	335	228	310	610	1,470	3,300	5,000	1,080	780	505
17.....	520	353	245	192	310	650	1,330	2,890	5,260	970	780	470
18.....	555	419	238	210	310	870	1,470	2,690	5,260	970	735	440
19.....	555	431	245	228	310	970	1,620	2,500	5,520	970	650	410
20.....	520	431	310	245	310	1,700	1,700	2,890	5,790	1,020	610	410
21.....	520	425	365	245	320	2,890	1,400	3,750	4,740	870	540	410
22.....	520	455	365	245	340	2,500	1,200	3,750	4,490	735	540	410
23.....	520	449	320	265	345	2,500	1,400	3,520	3,750	690	470	410
24.....	520	488	285	265	345	2,310	1,700	3,300	3,300	650	380	410
25.....	488	395	245	265	330	1,540	2,040	3,300	2,890	650	356	650
26.....	431	455	245	265	315	1,330	2,500	3,090	2,890	650	380	610
27.....	413	455	285	265	350	1,330	2,890	2,890	2,890	575	410	575
28.....	425	413	245	265	300	1,200	3,300	3,300	2,690	690	380	540
29.....	407	347	238	285	340	1,400	3,750	3,520	2,690	735	440	470
30.....	407	379	238	285	.....	1,260	3,300	3,750	2,690	920	470	470
31.....	407	.....	238	285	.....	970	.....	4,240	.....	920	690	.....

NOTE.—Stage-discharge relation affected by ice Dec. 12, 13, 16-19, and Dec. 25 to Feb. 20; discharge record based on daily gage heights, discharge measurements, observer's notes, and weather records.

Monthly discharge of North Platte River at Saratoga, Wyo., for the year ending Sept. 30, 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
October.....	555	395	462	28,400
November.....	488	242	382	22,700
December.....	419	238	328	20,200
January.....	285	192	241	14,800
February.....	350	300	317	18,200
March.....	2,890	300	1,000	61,500
April.....	3,750	470	1,500	89,300
May.....	5,790	2,220	3,570	220,000
June.....	5,790	2,690	4,422	263,000
July.....	2,500	575	1,200	73,800
August.....	1,080	356	728	44,500
September.....	690	410	515	30,600
The year.....	5,790	192	1,220	887,000

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, in Carbon County.

Backwater from Pathfinder reservoir reaches within $2\frac{1}{4}$ 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, 1916.

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 at the rapids; practically permanent. Banks high and not subject to overflow.

EXTREMES OF DISCHARGE.—Maximum stage during year, from water-stage recorder, 3.97 feet from 6 to 9 a. m. June 14 (discharge, 6,360 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 84 second-feet from North Platte River between Saratoga and the station above Pathfinder and diversions of 1,270 second-feet from intervening tributaries.

REGULATION.—None.

ACCURACY.—Stage-discharge relation practically permanent. Rating curve well defined between 400 and 6,500 second-feet. Operation of water-stage recorder satisfactory except for short periods as shown by footnote to daily-discharge table. Daily discharge ascertained by applying to the rating table mean daily gage height determined by inspecting gage-height graph. Records excellent.

Discharge measurements of North Platte River above Pathfinder, Wyo., during the year ending Sept. 30, 1916.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		<i>Feet.</i>	<i>Sec.-ft.</i>			<i>Feet.</i>	<i>Sec.-ft.</i>
Oct. 15	R. H. Fletcher.....	1.18	541	June 20	H. K. Smith.....	3.80	5,960
May 12	.....do.....	3.80	5,880	Aug. 12	W. R. King.....	1.70	1,050
25	.....do.....	3.18	3,850				

Daily discharge, in second-feet, of North Platte River above Pathfinder, Wyo., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Dec.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1.....	820	487	566	-----	1,680	3,800	4,380	2,560	1,120	954
2.....	750	494	558	-----	1,600	3,180	4,770	2,440	1,200	942
3.....	702	487	582	-----	1,540	2,840	4,770	2,280	1,300	740
4.....	657	473	622	-----	1,470	2,620	4,800	2,190	1,400	639
5.....	606	466	590	-----	1,440	2,620	4,870	2,040	1,480	582
6.....	566	466	529	-----	1,440	2,950	5,200	1,880	1,550	590
7.....	543	466	536	-----	1,410	3,420	5,200	1,730	1,600	543
8.....	529	466	515	-----	1,310	4,320	5,040	1,650	1,500	508
9.....	522	480	501	-----	1,210	5,040	4,770	1,650	1,350	501
10.....	515	515	515	-----	1,080	5,710	4,740	1,580	1,200	648
11.....	515	480	501	1,210	1,180	6,060	5,370	1,620	1,100	614
12.....	515	487	508	1,350	1,470	5,880	5,880	1,580	1,050	740
13.....	515	265	424	1,490	1,730	5,710	6,060	1,600	1,030	884
14.....	522	350	445	1,630	2,060	5,370	6,230	1,520	920	740
15.....	550	392	466	1,780	2,110	5,040	5,880	1,360	860	720
16.....	598	338	473	1,930	1,990	4,540	5,880	1,260	910	648
17.....	614	386	431	1,540	1,950	4,170	5,710	1,210	910	590
18.....	648	522	-----	1,500	2,000	3,800	5,710	1,180	830	543
19.....	657	536	-----	1,700	2,080	3,470	5,710	1,130	770	508
20.....	684	636	-----	2,090	2,240	3,370	5,710	1,080	720	480
21.....	693	590	-----	3,020	2,320	3,400	5,540	1,050	1,080	466
22.....	675	657	-----	3,940	2,130	3,890	5,040	1,030	730	452
23.....	648	590	-----	3,860	1,880	4,060	4,770	970	630	431
24.....	630	675	-----	3,250	1,850	4,140	4,080	920	590	459
25.....	606	558	-----	3,230	2,130	3,890	3,620	875	536	473
26.....	598	494	-----	2,750	2,560	3,750	3,250	820	494	550
27.....	582	338	-----	2,170	2,950	3,600	2,970	800	466	693
28.....	536	344	-----	1,930	3,420	3,420	2,840	770	445	657
29.....	529	693	-----	1,900	3,860	3,500	2,730	770	438	598
30.....	515	529	-----	1,950	4,110	3,620	2,600	950	480	566
31.....	501	-----	-----	2,000	-----	3,860	-----	1,000	1,120	-----

NOTE.—Discharge Mar. 12-15, Apr. 11, 12, 27, 28, May 1-5, July 30 to Aug. 4, and Aug. 6-11 estimated by comparison with records of discharge at Saratoga.

Monthly discharge of North Platte River above Pathfinder, Wyo., for the year ending Sept. 30, 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
October.....	820	501	598	36,800
November.....	693	265	485	28,900
December 1-17.....	622	424	515	17,400
March 11-31.....	3,940	1,210	2,200	91,600
April.....	4,110	1,080	2,010	120,000
May.....	6,060	2,620	4,030	248,000
June.....	6,230	2,600	4,800	286,000
July.....	2,560	770	1,400	86,100
August.....	1,600	438	962	59,200
September.....	954	431	609	36,200

NORTH PLATTE RIVER AT PATHFINDER, WYO.

LOCATION.—In sec. 24, T. 29 N., R. 84 W., one-quarter mile below Pathfinder dam and one-third mile below old post office of Pathfinder, in 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, 1916.

GAGE.—Chain gage on left bank one-fourth mile below Pathfinder dam; read by J. C. Austin.

DISCHARGE MEASUREMENTS.—Made from cable 50 feet upstream from gage.

CHANNEL AND CONTROL.—No information.

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 the 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 and 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, 1916.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1.....	5	5	5	10	10	10	10	1,000	4,300	5,020	4,550	2,120
2.....	5	5	5	10	10	10	10	1,900	4,340	4,980	4,460	2,750
3.....	5	5	5	10	10	10	10	2,000	3,330	5,020	4,570	2,970
4.....	5	5	5	10	10	10	10	2,000	4,490	5,340	4,430	2,540
5.....	5	5	5	10	10	10	10	2,000	4,300	5,410	4,350	2,200
6.....	5	5	5	10	10	10	10	2,000	4,300	5,410	4,600	2,170
7.....	5	5	5	10	10	10	10	2,000	4,300	5,410	4,800	2,260
8.....	5	5	5	10	10	10	10	2,030	4,300	5,410	4,560	2,370
9.....	5	5	5	10	10	10	10	2,060	4,350	5,700	4,720	2,360
10.....	5	5	5	10	10	10	10	2,440	4,300	5,720	4,600	2,290
11.....	5	5	5	10	10	10	10	2,420	4,880	5,720	4,860	2,200
12.....	5	5	5	10	10	10	10	3,090	5,020	5,720	4,430	2,200
13.....	5	5	5	10	10	10	10	2,910	5,060	5,490	4,600	1,790
14.....	5	5	5	10	10	10	10	4,260	5,640	5,410	4,600	1,640
15.....	5	5	5	10	10	10	10	4,260	5,120	5,460	4,010	1,900
16.....	5	5	5	10	10	10	10	4,260	5,020	5,470	3,400	2,020
17.....	5	5	5	10	10	10	10	4,260	5,020	5,470	3,460	1,900
18.....	5	5	5	10	10	10	10	4,140	5,020	5,450	3,580	1,840
19.....	5	5	5	10	10	10	10	3,780	5,020	5,470	3,660	1,660
20.....	5	5	5	10	10	10	10	4,340	5,020	4,790	3,370	1,760
21.....	5	5	5	10	10	10	10	4,340	4,980	4,550	3,350	1,850
22.....	5	5	5	10	10	10	10	4,340	4,360	4,520	3,320	1,660
23.....	5	5	5	10	10	10	10	4,560	3,610	4,640	3,660	1,620
24.....	5	5	5	10	10	10	10	4,300	4,060	4,430	3,360	1,690
25.....	5	5	5	10	10	10	10	4,300	4,060	4,470	3,400	1,660
26.....	5	5	5	10	10	10	690	4,300	4,060	4,470	3,300	1,660
27.....	5	5	5	10	10	10	1,000	4,300	4,780	4,290	3,300	1,760
28.....	5	5	5	10	10	10	1,000	4,300	5,020	3,970	3,140	1,760
29.....	5	5	5	10	10	10	1,000	4,300	5,060	4,020	3,200	1,200
30.....	5	5	5	10	-----	10	1,000	4,300	5,060	3,950	2,140	750
31.....	90	-----	5	10	-----	150	-----	4,220	-----	3,910	2,060	-----

Monthly discharge of North Platte River at Pathfinder, Wyo., for the year ending Sept. 30, 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
October.....	90	5	7.7	474
November.....	5	5	5	298
December.....	5	5	5	307
January.....	10	10	10	615
February.....	10	10	10	575
March.....	150	10	14.5	892
April.....	1,000	10	165	9,820
May.....	4,560	1,000	3,380	208,000
June.....	5,640	3,330	4,610	274,000
July.....	5,720	3,910	5,000	307,000
August.....	4,860	2,060	3,870	238,000
September.....	2,970	750	1,950	116,000
The year.....	5,720	5	1,590	1,160,000

NOTE.—Figures changed slightly to conform to computation rules of United States Geological Survey.

NORTH PLATTE RIVER AND INTERSTATE CANAL AT WHALEN, WYO.

LOCATION.—In sec. 11, T. 26 N., R. 65 W., at head of Interstate canal at Whalen, in Goshen County. Nearest important tributary is Cottonwood Canyon Creek, an intermittent stream which enters $1\frac{1}{2}$ 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, 1916. Records represent the discharge passing the overall weir at Whalen and also that passing the head gates of canal, which are just above Whalen weir.

GAGE.—Vertical staff, zero at weir crest, is used to determine the flow over the weir, discharge being computed by a weir formula; flow through the four sluice gates in the dam, also computed. In the river, 75 feet downstream from the weir gage is a second gage, zero of which is 10 feet below that of the weir gage; second gage is used only in computing the discharge through the gates when the openings are submerged. Discharge through the head gates of the canal is computed from the nine gate openings. A vertical staff 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 88 second-feet between the Pathfinder reservoir and the gaging station at Whalen, exclusive of the diversion by United States Reclamation Service. Between Whalen and the State line there are adjudicated diversions of 240 second-feet.

REGULATION.—Records show chiefly the effect of the 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 and Interstate canal at Whalen, Wyo., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1....	2,560	475	357	151	101	169	822	1,990	4,470	4,410	4,030	2,840
2....	1,970	465	274	169	98	150	703	2,040	4,290	4,460	3,920	2,360
3....	1,360	448	280	187	100	167	725	1,920	4,370	4,460	4,290	2,260
4....	1,100	448	430	184	100	214	775	1,910	4,280	4,540	4,280	2,470
5....	957	440	442	209	103	349	972	2,620	3,690	4,520	4,440	2,800
6....	890	448	450	192	103	335	820	2,610	4,250	4,770	4,320	2,750
7....	835	455	495	187	104	488	804	2,570	4,150	4,770	4,530	2,480
8....	798	425	520	185	109	230	758	2,670	4,150	4,780	4,600	2,190
9....	683	418	416	191	109	229	673	2,700	4,050	4,900	4,720	2,090
10....	650	408	423	196	111	231	690	2,690	4,050	4,900	4,430	2,130
11....	640	430	565	204	124	390	658	2,720	4,060	5,160	4,600	2,120
12....	605	425	450	156	143	337	703	2,810	4,060	5,250	4,520	2,070
13....	585	385	390	126	162	288	959	3,040	4,600	5,580	4,680	2,060
14....	565	370	215	130	205	300	1,360	3,490	4,680	4,850	4,600	1,860
15....	560	385	215	131	271	378	1,410	3,520	4,630	5,080	4,640	2,240
16....	580	365	94	121	285	444	1,400	4,400	5,130	5,120	4,520	1,810
17....	600	350	138	104	325	490	1,380	4,440	4,640	5,150	3,960	1,670
18....	800	410	61	108	397	462	1,500	4,460	4,640	5,120	3,600	1,990
19....	755	530	158	108	493	460	1,570	4,530	4,680	4,990	3,490	2,120
20....	765	445	147	110	491	378	1,570	4,430	4,740	4,940	3,470	2,020
21....	690	545	157	112	551	325	1,550	4,150	4,690	5,030	3,540	1,970
22....	665	470	197	106	602	430	1,550	4,690	4,640	4,520	3,420	1,760
23....	610	446	225	112	597	620	1,510	5,140	4,070	4,340	3,420	1,820
24....	590	390	230	122	756	690	1,550	5,110	4,060	4,860	3,370	1,930
25....	600	365	228	123	734	870	1,580	5,110	3,700	4,610	3,500	1,780
26....	562	451	214	124	668	884	1,500	4,880	3,900	4,510	3,540	1,690
27....	567	373	147	118	493	814	1,480	4,770	3,840	4,630	4,130	1,730
28....	520	382	135	110	285	612	1,390	4,700	3,840	4,950	3,400	1,800
29....	505	150	76	106	208	721	1,340	4,610	4,220	4,710	3,340	1,870
30....	500	275	92	99	.....	744	1,780	4,600	4,410	4,580	3,240	1,730
31....	497	.....	80	100	.....	853	.....	4,500	.....	4,240	3,240	.....

Monthly discharge of North Platte River and Interstate canal at Whalen, Wyo., for the year ending Sept. 30, 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
October.....	2,560	497	792	48,700
November.....	545	150	412	24,500
December.....	565	61	268	16,500
January.....	209	99	141	8,670
February.....	756	98	304	17,500
March.....	884	150	453	27,900
April.....	1,780	658	1,180	70,200
May.....	5,140	1,910	3,670	226,000
June.....	5,130	3,690	4,320	257,000
July.....	5,580	4,240	4,800	295,000
August.....	4,720	3,240	3,990	245,000
September.....	2,840	1,670	2,080	124,000
The year.....	5,580	61	1,880	1,360,000

NOTE.—Quantities changed slightly to conform to computing rules of the United States Geological Survey.

Daily discharge, in second-feet, of Interstate canal, at Whalen, Wyo., for the year ending Sept. 30, 1916.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Day.	Apr.	May.	June.	July.	Aug.	Sept.
1.....		672	1,250	1,440	1,330	1,210	17.....		1,280	1,120	1,540	1,500	1,140
2.....		709	1,310	1,440	1,410	1,200	18.....		1,280	1,120	1,540	1,520	1,140
3.....		684	1,280	1,440	1,450	1,200	19.....		1,280	1,120	1,540	1,520	1,140
4.....		810	1,280	1,440	1,500	1,200	20.....		1,280	1,120	1,540	1,520	1,140
5.....		850	1,280	1,440	1,500	1,200	21.....		1,100	1,140	1,540	1,530	1,140
6.....		900	1,340	1,440	1,420	1,200	22.....		1,040	1,190	1,540	1,520	1,140
7.....		955	1,350	1,440	1,490	1,200	23.....		1,040	1,240	1,540	1,520	1,150
8.....	1,100	1,390	1,440	1,520	1,200	1,200	24.....		1,040	1,280	250	1,480	1,150
9.....	1,160	1,390	1,450	1,540	1,200	1,200	25.....		1,040	1,300	0	1,420	1,150
10.....	1,240	1,390	1,450	1,540	1,200	1,200	26.....	268	1,040	1,390	0	1,450	1,150
11.....	1,330	1,400	1,450	1,540	1,200	1,200	27.....	528	1,040	1,400	380	1,430	1,150
12.....	1,330	1,400	1,450	1,540	1,200	1,200	28.....	580	1,040	1,410	700	1,340	985
13.....	1,340	1,150	1,450	1,540	1,200	1,200	29.....	592	1,100	1,420	975	1,340	808
14.....	1,200	1,120	1,540	1,540	1,140	1,140	30.....	599	1,160	1,440	1,250	1,340	510
15.....	1,150	1,120	1,540	1,540	1,140	1,140	31.....		1,230		1,280	1,280	
16.....	1,280	1,120	1,540	1,540	1,140	1,140							

NOTE.—Head gates closed July 25, 25.

Monthly discharge of Interstate canal at Whalen, Wyo., for the year ending Sept. 30, 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
April.....	599	268	513	5,090
May.....	1,340	672	1,090	67,000
June.....	1,440	1,120	1,280	76,200
July.....	1,540	0	1,260	77,500
August.....	1,540	1,280	1,470	90,400
September.....	1,210	510	1,130	67,200
The period.....	1,540	0	1,220	393,000

NORTH PLATTE RIVER AT HENRY, NEBR.

LOCATION.—On west line of sec. 3, T. 23 N., R. 58 W., at highway bridge half a mile south of Henry post office, in Scotts Bluff County, within half a mile of Nebraska-Wyoming line. Nearest tributary, Spring Creek, enters just below.

DRAINAGE AREA.—22,100 square miles (measured on base map of Wyoming; scale, 1:500,000).

RECORDS AVAILABLE.—May 11, 1912, to August 31, 1916.

GAGE.—Three vertical staffs, one in each of the three channels. The datum of the first two gages is the same; that for the gage in third channel is 1 foot lower to avoid negative readings.

DISCHARGE MEASUREMENTS.—Made from pile-bent bridge.

CHANNEL AND CONTROL.—Bed composed of shifting sand.

EXTREMES OF DISCHARGE.—Maximum discharge recorded during the year, 4,600 second-feet on May 25; minimum discharge probably occurs during the winter months.

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

DIVERSIONS.—Prior to September 1, 1914, there was an approved diversion of 209 second-feet from the North Platte between the Wyoming-Nebraska State line and this station. The Mitchell canal diverts water just beyond the State line to serve approximately 16,000 acres but has no approved diversions.

REGULATION.—See North Platte at Pathfinder, Wyo.

ACCURACY.—Stage-discharge relation not permanent; control very shifting. Standard rating curve, which was used indirectly, fairly well defined. Records fair.

COOPERATION.—Daily discharge records furnished by State engineer of Nebraska.

Discharge measurements of North Platte River at Henry, Nebr., during the year ending Sept. 30, 1916.

Date.	Made by—	Dis-charge.	Date.	Made by—	Dis-charge.
		<i>Sec.-ft.</i>			<i>Sec.-ft.</i>
Apr. 22	D. P. Weeks, jr.	1,450	July 9	L. E. Timbers	3,200
May 6	.....do.....	1,520	15	D. P. Weeks, jr.	3,260
17	.....do.....	2,660	Aug. 1	.....do.....	2,860
28	.....do.....	4,050	10	L. E. Timbers	3,290
June 7	.....do.....	2,560	17	D. P. Weeks, jr.	2,810
11	L. E. Timbers	2,980	22	.....do.....	1,940
23	D. P. Weeks, jr.	3,380	30	L. E. Timbers	2,010
25	L. E. Timbers	2,890	Sept. 2	.....do.....	2,050

NOTE.—Discharge is the sum of discharge in three separate channels and Spring Creek; record shows total flow of river.

Daily discharge, in second-feet, of North Platte River at Henry, Nebr., for the year ending Sept. 30, 1916.

Day.	Apr.	May.	June.	July.	Aug.	Day.	Apr.	May.	June.	July.	Aug.
1.....	1,200	1,090	3,270	1,310	2,910	16.....	1,370	3,840	3,960	3,770	3,230
2.....	1,170	1,220	3,040	1,310	2,620	17.....	1,400	2,500	3,450	3,140	3,040
3.....	1,170	1,290	3,300	2,540	2,630	18.....	1,370	2,660	4,100	3,340	2,290
4.....	1,180	1,290	2,950	2,550	2,910	19.....	1,480	2,820	4,040	3,110	2,000
5.....	1,180	1,250	2,910	2,560	3,150	20.....	1,530	3,160	4,210	3,110	2,060
6.....	1,180	1,210	2,900	2,530	3,080	21.....	1,570	3,620	4,400	2,920	1,880
7.....	1,180	1,240	2,890	2,930	3,190	22.....	1,530	3,660	3,690	2,720	1,970
8.....	1,200	1,180	2,820	2,860	3,360	23.....	1,530	4,250	3,370	2,540	1,970
9.....	1,180	1,130	2,900	2,800	3,230	24.....	1,500	4,500	3,750	3,030	1,720
10.....	1,150	1,080	2,710	3,030	3,240	25.....	1,490	4,600	2,530	4,280	1,820
11.....	1,140	1,010	2,590	3,100	3,130	26.....	1,520	4,300	2,240	4,540	2,030
12.....	1,090	887	3,590	3,380	3,160	27.....	1,230	4,120	2,240	4,560	2,790
13.....	1,120	969	4,210	4,200	3,400	28.....	1,320	3,150	2,180	4,450	2,070
14.....	1,220	1,170	4,330	3,170	3,180	29.....	1,090	3,720	2,120	4,540	1,840
15.....	1,180	1,680	4,090	4,400	3,490	30.....	1,080	3,650	2,520	3,500	1,940
						31.....		3,450		2,880	1,860

NOTE.—Records reduced to three significant figures by United States Geological Survey.

Monthly discharge of North Platte River at Henry, Nebr., for the year ending Sept. 30, 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
April.....	1,570	1,080	1,280	76,200
May.....	4,600	887	2,440	150,000
June.....	4,400	2,120	3,240	193,000
July.....	4,560	1,310	3,200	197,000
August.....	3,490	1,720	2,620	161,000
The period.....				777,000

NOTE.—Monthly discharge computed by engineers of United States Geological Survey.

DOUGLAS CREEK NEAR KEYSTONE, WYO.

LOCATION.—In sec. 16, T. 14 N., R. 79 W., 900 feet above highway bridge and 1 mile above old mining camp at Keystone, in Albany County; 600 feet below site of proposed diversion dam of Bell supply canal No. 2. Nearest tributary, Keystone Creek, enters three-fourths mile below.

DRAINAGE AREA.—26 square miles (measured on topographic map).

RECORDS AVAILABLE.—July 25 to December 10, 1912; June 18, 1914, to November 12, 1916, when station was discontinued.

GAGE.—Bristol water-stage recorder on left bank 900 feet above highway bridge on road from Keystone to Holmes. Gage was originally 60 feet farther downstream, but a new gage was installed at present site May 23, 1915. Although referred to same datum, the gage readings are now higher, owing to the slope of water surface of creek.

DISCHARGE MEASUREMENTS.—Made from cable just above gage or by wading.

CHANNEL AND CONTROL.—Bed composed of cobble stones; permanent. No well defined control. Banks not subject to overflow.

EXTREMES OF DISCHARGE.—Maximum stage during year, from water-stage recorder, 3.5 feet from 7 to 9 p. m. June 4 (discharge, 281 second-feet); minimum discharge occurs during winter months.

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

DIVERSIONS.—No diversion above station.

REGULATION.—None.

ACCURACY.—Stage-discharge relation practically permanent. Rating curve fairly well defined below 200 second-feet. Operation of water-stage recorder satisfactory. Daily discharge ascertained by applying to rating table mean daily gage height obtained by inspection of gage-height graph. Records good.

COOPERATION.—Gage-height record furnished by Laramie Water Co. through C. C. Schrontz, general manager.

Discharge measurements of Douglas Creek near Keystone, Wyo., during the year ending Sept. 30, 1916.

Date.	Made by—	Gage height.	Dis- charge.
June 14	Robert Follansbee.....	<i>Feet.</i> 2.92	<i>Sec.-ft.</i> 161
Aug. 18	H. K. Smith.....	1.50	5.6

Daily discharge, in second-feet, of Douglas Creek near Keystone, Wyo., for the period Oct. 1, 1915, to Nov. 12, 1916.

Day.	Oct.	Nov.	Apr.	May.	June.	July.	Aug.	Sept.
1915-16.								
1.....	10.	3.8		22	231	31	17.	9.5
2.....	8.0	3.8		29	221	32	14.	7.5
3.....	7.0	3.8		35	231	28	14.	7.0
4.....	7.0	3.8		37	241	28	20.	8.4
5.....	7.0	4.6		59	241	25	19.	9.1
6.....	7.5	4.2		124	221	25	18.	9.8
7.....	5.4	4.2		152	201	25	16.	11.
8.....	5.0	2.7		152	201	22	12.	11.
9.....	5.4	4.6		191	221	20	14.	12.
10.....	5.0	3.0		181	241	20	12.	12.
11.....	6.2	9.0		152	221	22	8.5	9.0
12.....	6.6	11.		142	211	20	10.	7.0
13.....	6.6	7.0		133	211	17	14.	7.0
14.....	7.0			116	181	14	16.	6.6
15.....	9.0			93	161	14	12.	5.8
16.....	5.8			90	152	14	12.	5.0
17.....	10.			78	142	14	12.	4.2
18.....	9.5			72	133	12	8.5	3.8
19.....	9.0			79	124	12	7.5	4.6
20.....	9.0			99	107	12	8.5	5.0
21.....	11.			107	93	12	9.0	5.0
22.....	14.			104	84	12	8.0	6.2
23.....	13.		4.2	94	73	9.5	7.5	7.5
24.....	10.		14.	142	61	9.5	7.0	14.
25.....	5.8		7.5	171	52	12	8.0	4.6
26.....	5.0		8.5	152	45	9.5	9.0	5.4
27.....	5.0		14.	152	42	9.5	8.5	6.2
28.....	5.0		16.	171	37	12	8.0	5.8
29.....	4.6		18.	181	34	17	9.0	5.0
30.....	4.2		24.	221	33	17	12.	4.6
31.....	4.2			231		14	13.	

Day.	Oct.	Nov.	Day.	Oct.	Nov.	Day.	Oct.	Nov.
1916.			1916.			1916.		
1.....	5.4	5.8	11.....	7.0	4.2	21.....	7.5	
2.....	6.2	5.0	12.....	6.6	5.0	22.....	7.5	
3.....	7.0	5.0	13.....	6.6		23.....	6.2	
4.....	7.0	5.8	14.....	7.0		24.....	7.5	
5.....	7.0	6.2	15.....	7.0		25.....	6.6	
6.....	10	5.7	16.....	6.6		26.....	7.0	
7.....	14	5.2	17.....	7.0		27.....	6.6	
8.....	12	4.6	18.....	7.0		28.....	7.0	
9.....	8.5	4.2	19.....	8.0		29.....	5.8	
10.....	7.5	3.4	20.....	7.5		30.....	1.0	
						31.....	6.6	

NOTE.—Discharge Aug. 5, Sept. 4-9, 15 and 16 estimated, as gage heights were not available.

Monthly discharge of Douglas Creek near Keystone, Wyo., for the period Oct. 1, 1915, to Nov. 12, 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
1915.				
October.....	14	4.2	73.5	452
November 1-13.....	11	2.7	5.04	130
1916.				
April 23-30.....	24	4.2	13.3	211
May.....	231	22	121	7,440
June.....	241	33	148	8,810
July.....	32	9.5	17.5	1,080
August.....	20	7.0	11.7	719
September.....	14	3.8	7.32	436
October.....	14	1.0	7.23	445
November 1-12.....	6.2	3.4	5.0	119

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, in 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 30, 1916. State engineer maintained station at this point during 1913 and 1914.

GAGE.—Vertical staff on left bank 50 feet from ranger station; read by Mrs. Mark Edick. Prior to April 29, 1915, gage was 1 foot farther out in the stream and gave readings slightly different although referred to same datum.

DISCHARGE MEASUREMENTS.—Made from cable near gage or by wading at gage.

CHANNEL AND CONTROL.—Bed composed of coarse gravel and small boulders. Control at gage which is on riffle. 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, 3.35 feet at 7 p. m. June 19 (discharge, 641 second-feet); minimum discharge probably occurs during winter months.

WINTER FLOW.—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 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.

REGULATION.—None.

ACCURACY.—Stage-discharge relation practically permanent except for one change during high water in June. Rating curve used before change, well defined between 30 and 500 second-feet; curve used after the change based on two discharge measurements at stage of about 1.75 feet and the shape of the previous curve. Gage read to hundredths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table. Records good.

Discharge measurements of Big Creek near Big Creek, Wyo., during the year ending Sept. 30, 1916.

Date.	Made by—	Gage height.	Discharge.
		<i>Feet.</i>	<i>Sec.-ft.</i>
May 13	H. K. Smith.....	2.52	305
June 10	R. H. Fletcher.....	3.02	503
Aug. 15	H. K. Smith.....	1.78	65

Daily discharge, in second-feet, of Big Creek near Big Creek, Wyo., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Apr.	May.	June.	July.	Aug.	Sept.
1.....	44	24	76	180	411	332	74	44
2.....	45	29	41	150	411	296	84	35
3.....	45	21	42	161	411	260	106	38
4.....	45	19	50	170	452	244	94	39
5.....	41	19	50	201	452	227	94	39
6.....	38	18	49	195	432	227	111	39
7.....	38	32	44	245	391	211	82	39
8.....	38	23	49	295	452	227	78	39
9.....	38	29	47	352	473	227	76	39
10.....	38	23	67	332	494	244	67	39
11.....	39	.....	84	332	557	260	67	39
12.....	34	.....	94	314	557	211	72	34
13.....	37	.....	86	314	557	183	78	29
14.....	34	.....	78	295	557	180	67	26
15.....	39	.....	78	260	557	170	63	26
16.....	44	.....	84	278	557	155	58	26
17.....	38	.....	108	278	578	141	56	23.
18.....	38	.....	119	227	578	147	50	22
19.....	41	.....	103	227	578	138	47	23
20.....	38	.....	78	235	536	116	50	21
21.....	38	.....	74	243	473	108	52	21
22.....	38	.....	76	251	411	103	44	20
23.....	35	.....	124	260	391	98	44	32
24.....	34	.....	150	278	317	89	41	45
25.....	30	.....	173	295	242	86	44	30
26.....	26	.....	183	278	167	82	47	31
27.....	23	.....	192	295	295	82	45	32
28.....	29	.....	234	295	371	82	46	32
29.....	28	.....	208	332	352	82	48	30
30.....	26	.....	167	371	371	82	50	28
31.....	20	.....	.....	411	.....	78	52	.....

NOTE.—Shifting-control methods used June 11–Sept. 30. Discharge estimated Oct. 1, 2, and interpolated May 20–22, June 24, 25, July 2, 4, Aug. 12, 28–30, Sept. 5–10, 23, as gage was not read.

Monthly discharge of Big Creek near Big Creek, Wyo., for the year ending Sept. 30, 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
October.....	45	20	36.1	2,220
November 1–10.....	32	18	23.7	470
April.....	234	41	100	5,950
May.....	411	150	269	16,500
June.....	578	167	446	26,500
July.....	332	78	167	10,300
August.....	111	41	64.1	3,940
September.....	44	20	32.9	1,900

FRENCH CREEK NEAR FRENCH, WYO.

LOCATION.—In sec. 4, T. 14 N., R. 81 W., at Jenkins ranch, $3\frac{1}{2}$ miles southeast of French, in 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, 1916. State engineer maintained station at this point during 1913 and 1914.

GAGE.—Vertical staff on downstream end of heavy rock-filled crib on left bank one-fourth mile above headgate of French Creek Irrigation and Development Company's canal; read by Mrs. J. W. Jenkins.

DISCHARGE MEASUREMENTS.—Made from cable 75 feet upstream from gage or by wading.

CHANNEL AND CONTROL.—Bed composed of small boulders; control 30 feet downstream; shifts occasionally. Banks not subject to overflow.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 2.8 feet at 6 p. m. June 10 (discharge, 433 second-feet); minimum discharge occurs during winter months.

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 the station, but below the 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; shifts occasionally. Rating curve fairly well defined below 550 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 French Creek near French, Wyo., during the year ending Sept. 30, 1916.

Date.	Made by—	Gage height.	Discharge.
		Feet.	Sec.-ft.
May 12	H. K. Smith.....	2.27	203
June 11	R. H. Fletcher.....	2.75	420

Daily discharge, in second-feet, of French Creek near French, Wyo., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1.....	32	23	-----	20	101	338	175	41	27
2.....	32	24	-----	18	95	275	168	40	24
3.....	36	22	-----	17	83	295	162	39	23
4.....	32	21	-----	17	91	338	147	39	23
5.....	31	22	-----	14	142	361	128	45	21
6.....	30	22	-----	21	162	316	118	89	21
7.....	31	25	-----	20	208	275	111	48	21
8.....	31	26	-----	18	275	316	108	40	21
9.....	29	25	-----	21	275	361	103	48	28
10.....	26	24	-----	18	255	384	101	40	35
11.....	31	24	-----	33	215	384	97	35	25
12.....	30	25	18	31	222	384	95	34	23
13.....	31	25	17	30	215	384	85	41	21
14.....	29	23	19	32	187	361	78	40	20
15.....	29	21	18	26	156	361	74	34	20
16.....	26	20	18	30	136	361	69	34	20
17.....	29	21	18	32	133	338	66	33	18
18.....	26	20	18	34	125	361	64	29	18
19.....	26	21	20	31	128	361	60	29	17
20.....	26	21	23	30	156	316	56	28	17
21.....	26	23	23	31	178	295	54	30	17
22.....	25	20	24	33	168	275	49	28	17
23.....	26	21	23	45	162	233	46	26	17
24.....	25	23	20	55	184	225	48	24	20
25.....	25	21	19	76	215	218	50	24	18
26.....	24	22	20	81	187	208	46	24	19
27.....	20	21	20	97	178	204	46	25	18
28.....	24	20	21	111	211	201	46	24	18
29.....	25	20	19	145	233	191	48	24	18
30.....	26	20	18	103	316	181	50	33	17
31.....	26	-----	21	-----	338	-----	48	42	-----

NOTE.—Shifting-control method used Oct. 1 to Nov. 26. Discharge, Nov. 27-30, estimated because of ice.

Monthly discharge of French Creek near French, Wyo., for the year ending Sept. 30, 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
October.....	36	20	27.9	1,720
November.....	26	20	22.2	1,320
March 12-31.....	24	17	19.8	787
April.....	145	14	42.3	2,520
May.....	338	83	185	11,400
June.....	384	181	303	18,000
July.....	175	46	83.7	5,150
August.....	89	24	35.8	2,200
September.....	35	17	20.7	1,230

ENCAMPMENT RIVER AT ENCAMPMENT, WYO.

LOCATION.—In sec. 6, T. 14 N., R. 83 W., at lower end of smelter grounds at Encampment, in 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, 1916. 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 one foot lower, owing to the slope of water surface.

DISCHARGE MEASUREMENTS.—Made from cable 125 feet below gage, or by wading.

CHANNEL AND CONTROL.—Bed composed of gravel and small boulders. Control is not well defined, though there are small rapids 200 feet downstream.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 7.4 feet at 7 p. m. May 31, and 7 p. m. June 12 (discharge, 2,180 second-feet); minimum discharge occurs during winter months.

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 the 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 the station, the water diverted passes the gage. Water is also diverted below the station. Prior to December 31, 1916, there were adjudicated diversions from Encampment River amounting to 76 second-feet.

REGULATION.—None.

ACCURACY.—Stage-discharge relation practically permanent. Rating curve well defined below 3,000 second-feet. Gage read to half tenths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table. Records excellent.

Discharge measurements of Encampment River at Encampment, Wyo., during the year ending Sept. 30, 1916.

Date.	Made by—	Gage height.	Dis-charge.	Date.	Made by—	Gage height.	Dis-charge.
		<i>Feet.</i>	<i>Sec.-ft.</i>			<i>Feet.</i>	<i>Sec.-ft.</i>
Oct. 2	R. H. Fletcher.....	4.49	80	June 9	R. H. Fletcher.....	7.12	1,850
5	.....do.....	4.35	69	Aug. 14	H. K. Smith.....	4.79	134
May 11	H. K. Smith.....	6.96	1,580	Aug. 16	.....do.....	4.48	87

Daily discharge, in second-feet, of Encampment River at Encampment, Wyo., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Apr.	May.	June.	July.	Aug.	Sept.
1.....	70	48	-----	700	1,910	805	50	128
2.....	78	44	-----	610	1,910	470	58	81
3.....	70	45	89	770	1,910	445	155	58
4.....	73	44	81	1,010	1,910	420	149	48
5.....	68	50	81	1,420	1,910	352	111	52
6.....	70	44	89	1,660	1,660	352	109	70
7.....	52	41	89	1,660	1,780	330	93	101
8.....	58	41	99	1,660	1,780	330	91	109
9.....	52	48	81	1,660	1,910	330	99	70
10.....	50	52	89	1,660	1,910	290	105	58
11.....	52	50	121	1,660	1,910	290	93	55
12.....	55	47	146	1,480	2,040	290	163	50
13.....	59	42	146	1,480	1,910	272	220	42
14.....	57	45	160	1,660	1,910	255	149	43
15.....	65	45	190	1,420	1,910	255	111	44
16.....	70	45	190	1,260	1,910	220	105	45
17.....	68	45	190	1,100	1,910	205	128	42
18.....	59	45	238	1,010	1,910	160	75	40
19.....	87	45	255	1,010	1,780	99	50	43
20.....	83	45	255	840	1,660	89	58	42
21.....	73	44	220	1,010	1,540	81	55	43
22.....	70	44	238	920	1,420	73	51	44
23.....	68	44	255	1,100	1,260	73	55	40
24.....	64	44	375	1,200	1,100	60	63	63
25.....	48	44	552	1,310	1,060	60	75	99
26.....	48	44	670	1,200	1,100	60	60	133
27.....	44	42	735	1,360	1,060	60	52	105
28.....	41	44	1,010	1,420	1,010	60	48	114
29.....	44	44	965	1,540	1,010	60	89	138
30.....	52	44	700	1,660	920	60	146	128
31.....	52	-----	-----	1,910	-----	58	178	-----

NOTE.—Discharge, Nov. 15-25, 29, and 30, interpolated because of ice.

Monthly discharge of Encampment River at Encampment, Wyo., for the year ending Sept. 30, 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
October.....	87	41	61.3	3,770
November.....	52	41	45.0	2,680
April 3-30.....	1,010	81	297	16,500
May.....	1,910	610	1,300	79,900
June.....	2,040	920	1,630	97,000
July.....	805	58	225	13,800
August.....	220	48	98.2	6,040
September.....	138	40	70.9	4,220

JACK CREEK AT MATHESON'S RANCH, NEAR SARATOGA, WYO.

LOCATION.—About sec. 36, T. 17 N., R. 86 W., at Matheson's ranch, 14 miles south-west 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 30, 1916.

GAGE.—Vertical staff on left bank opposite ranch house; read by Miss Kathleen Montgomery. Prior to August 15, 1915, gage was 800 feet farther downstream and was referred to different datum.

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

CHANNEL AND CONTROL.—Bed composed of earth. Control 100 feet downstream at small rapids which shift during high water. Banks subject to overflow at stage of 4.0 feet.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 3.8 feet on May 21 (discharge, 181 second-feet); minimum stage, 1.4 feet on October 2 (discharge, about 3 second-foot).

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

DIVERSIONS.—Prior to December 31, 1916, there were adjudicated diversions of 9 second-feet from Jack Creek above the station and 93 second-feet below.

REGULATION.—None.

ACCURACY.—Stage-discharge relation not permanent. Two poorly defined rating curves were used, one applicable October 1 to November 12, the other March 26 to July 6. Gage read to quarter tenths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table or by shifting-control method. Records fair.

Discharge measurements of Jack Creek at Matheson's ranch, near Saratoga, Wyo., during the year ending Sept. 30, 1916.

Date.	Made by—	Gage height.	Dis-charge.	Date.	Made by—	Gage height.	Dis-charge.
		<i>Feet.</i>	<i>Sec.-ft.</i>			<i>Feet.</i>	<i>Sec.-ft.</i>
Oct. 6	R. H. Fletcher.....	1.49	5.3	June 8	R. H. Fletcher.....	2.88	73
May 10	H. K. Smith.....	3.18	92	Aug. 13	H. K. Smith.....	1.83	7.7

Daily discharge, in second-feet, of Jack Creek at Matheson's ranch, near Saratoga, Wyo., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	4	7		9	29	96	44	10	8
2	3	6		7	24	86	44	7	7
3	3	6		7	14	81	40	7	7
4	6	6		6	24	81	44	10	6
5	5	6		6	40	96	37	10	9
6									
7	5	6		6	58	102	37	8	9
8	6	9		10	86	96	28	12	7
9	5	8		9	81	76	27	9	6
10	5	8		6	96	76	28	9	7
11	5	8		8	102	96	26	22	7
12									
13	6	8		12	50	86	20	12	7
14	6	7		14	81	96	31	8	7
15				15	76	96	14	8	8
16				15	66	86	13	11	6
17	9			13	50	86	14	9	7
18									
19	10			15	37	81	15	8	6
20	10			13	40	86	12	8	6
21	10			19	34	76	11	7	7
22	11			19	44	96	10	10	7
23	11			11	62	81	10	7	6
24									
25	10			10	181	81	7	7	7
26	9			14	102	71	8	7	7
27	8			22	66	58	8	6	7
28	8			22	71	44	8	7	8
29	8			27	76	47	7	6	6
30									
31	8			34	81	44	7	7	8
	7		9	28	58	44	7	8	7
	7		9	37	58	47	7	6	7
	7		8	47	71	40	7	6	7
	7		12	29	71	44	9	7	7
	7		12		81		8	20	

NOTE.—Gage read Nov. 13 to Dec. 2, but data inadequate for determination of flow. Gage height observations discontinued Dec. 3 to Mar. 25.

Monthly discharge of Jack Creek at Matheson's ranch, near Saratoga, Wyo., for the year ending Sept. 30, 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
October.....	11	3	7.2	443
November 1-12.....	9	6	7.1	189
March 28-31.....	12	8	9.7	115
April.....	47	6	16.3	970
May.....	181	14	64.8	3,980
June.....	102	40	75.9	4,520
July.....	44	7	19.0	1,170
August.....	22	6	9.0	553
September.....	9	6	7.0	417

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, in Carbon County. Nearest tributary, Wagon-hound 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 September 30, 1916. 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 was referred to different datum.

DISCHARGE MEASUREMENTS.—Made from bridge or by wading.

CHANNEL AND CONTROL.—Bed composed of gravel. Control 75 feet downstream at bar of well compacted gravel and small boulders; permanent during 1916. Banks not subject to overflow. Stage of zero flow, 1.2 feet.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 3.1 feet at 9 a. m. June 11 (discharge, 688 second-feet); no flow for several days during July.

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 the station and 67 second-feet below.

REGULATION.—None.

ACCURACY.—Stage-discharge relation practically permanent. Rating curve well defined below 500 second-feet. Gage read to quarter tenths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table. Records excellent except those for low water, which are good.

Discharge measurements of Medicine Bow River near Medicine Bow, Wyo., during the year ending Sept. 30, 1916.

Date.	Made by—	Gage height.	Dis- charge.
		<i>Feet.</i>	<i>Sec.-ft.</i>
May 6	H. K. Smith.....	2.26	185
June 13	R. H. Fletcher.....	2.79	463
Aug. 5	Robert Follansbee.....	1.41	10.7

Daily discharge, in second-feet, of Medicine Bow River near Medicine Bow, Wyo., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Apr.	May.	June.	July.	Aug.	Sept.
1.....	28	28	.....	100	328	136	6	19
2.....	21	28	51	93	256	111	6	10
3.....	21	28	48	85	235	100	6	3
4.....	32	28	48	100	278	65	6	4
5.....	35	28	65	150	328	53	10	5
6.....	35	28	55	197	358	48	24	6
7.....	35	28	43	256	235	38	32	6
8.....	35	28	43	328	256	27	29	6
9.....	28	28	48	388	388	24	27	6
10.....	28	28	65	423	568	22	24	6
11.....	32	28	85	328	688	20	20	6
12.....	28	28	107	278	608	11	16	7
13.....	21	28	89	235	568	8	20	7
14.....	21	32	93	235	493	6	28	6
15.....	21	.....	93	197	493	6	24	6
16.....	21	.....	79	164	493	4	17	6
17.....	55	.....	79	150	493	3	11	5
18.....	48	.....	79	136	528	2	5	5
19.....	43	.....	79	136	493	2	3	4
20.....	43	.....	69	164	388	2	3	4
21.....	43	.....	60	235	358	1	6	3
22.....	43	.....	60	235	303	1	3	3
23.....	43	.....	73	164	197	1	3	3
24.....	35	.....	89	164	164	0	5	3
25.....	28	.....	89	180	164	0	2	3
26.....	28	.....	107	164	164	1	2	3
27.....	111	.....	136	164	164	0	2	3
28.....	28	.....	136	150	180	2	2	3
29.....	28	.....	111	164	164	4	2	3
30.....	28	.....	100	197	150	7	3	3
31.....	28	.....	.....	235	.....	8	14	.....

Monthly discharge of Medicine Bow River near Medicine Bow, Wyo., for the year ending Sept. 30, 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
October.....	55	21	32.0	1,970
November 1-14.....	32	28	28.3	786
April 2-30.....	136	43	77.7	4,470
May.....	423	85	199	12,200
June.....	688	150	349	20,800
July.....	136	0	23.0*	1,410
August.....	32	2	11.7	719
September.....	19	3	5.23	311

ROCK CREEK NEAR ARLINGTON, WYO.

LOCATION.—In sec. 25, T. 19 N., R. 79 W., at highway bridge $1\frac{1}{2}$ miles above Arlington, in Carbon County. Nearest tributary, Overland Creek enters half a mile above. Prior to January 12, 1916, station was at Arlington, $1\frac{1}{2}$ 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, 1916.

GAGE.—Bristol water-stage recorder on left bank just below bridge.

DISCHARGE MEASUREMENTS.—Made from bridge or by wading.

CHANNEL AND CONTROL.—Bed rough; composed of coarse gravel and small boulders.

No well-defined control. Banks high and not subject to overflow.

EXTREMES OF DISCHARGE.—Maximum stage during year, from water-stage recorder, 3.35 feet at 7 p. m. June 10 (discharge, 661 second-feet); minimum discharge occurred during winter months when discharge relation was affected by ice and was about 6 second-feet, January 19-21.

ICE.—Stage-discharge relation seriously affected by ice; flow estimated from discharge measurements, observer's notes, and weather 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 not permanent; numerous discharge measurements necessary to define shifts in control. Rating curve used October 1 to November 11 was referred to gage at original site and was well defined; curve used June 7 to September 30 fairly well defined. Operation of water-stage recorder fairly satisfactory. Daily discharge ascertained by applying to rating table mean daily gage height determined by inspecting gage-height graph or by shifting-control method. Records good after high water and fair previous to that time.

COOPERATION.—Base data furnished by Rock Creek Conservation Co. Some discharge measurements have been made by engineers of United States Geological Survey.

Discharge measurements of Rock Creek near Arlington, Wyo., during the year ending Sept. 30, 1916.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		<i>Feet.</i>	<i>Sec.-ft.</i>			<i>Feet.</i>	<i>Sec.-ft.</i>
Oct. 14	F. T. Cummings.....	^a 0.93	21.5	Mar. 28	M. W. Gordon.....	0.90	21.1
22	M. W. Gordon.....	^b .95	27.6	Apr. 10	F. T. Cummings.....	.90	16.4
29	.....do.....	^c .91	19.7	18	.....do.....	.98	30.1
Dec. 4	.....do.....	^d .98	18.2	May 2	.....do.....	1.35	71
Jan. 5	F. T. Cummings.....	^d 1.15	13.8	18	.....do.....	1.72	93
27	M. W. Gordon.....	^d 1.36	8.2	25	.....do.....	2.18	160
Feb. 19	.....do.....	^d .95	10.9	June 7	.....do.....	2.45	320
24	F. T. Cummings.....	^d .90	9.7	14	R. H. Fletcher.....	2.93	499
Mar. 1	M. W. Gordon.....	^d 1.06	8.6	July 1	F. T. Cummings.....	2.10	214
9	.....do.....	^d 1.02	14.5	23	.....do.....	1.20	41.9
19	.....do.....	.93	22.7	Aug. 4	M. W. Gordon.....	1.12	35.5

^a Old gage read 1.29.

^b Old gage read 1.43.

^c Old gage read 1.29.

^d Stage-discharge relation affected by ice.

Daily discharge, in second-feet, of Rock Creek near Arlington, Wyo., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1.....	26	16	27	16	8	9	20	67	337	244	38	21
2.....	28	17	24	18	8	9	18	71	326	250	37	21
3.....	25	16	23	20	8	10	17	74	410	222	40	19
4.....	25	14	21	17	8	11	19	85	422	203	37	19
5.....	21	16	20	14	8	11	18	124	452	190	34	19
6.....	22	18	18	13	9	11	18	195	406	178	40	19
7.....	20	19	16	12	10	12	16	236	358	163	32	19
8.....	21	18	15	12	12	12	18	253	395	149	29	19
9.....	26	16	18	10	13	14	12	293	471	131	31	18
10.....	27	16	20	10	14	16	16	306	566	129	31	18
11.....	25	19	20	9	14	19	18	274	547	118	31	16
12.....	22	20	24	8	13	23	21	238	528	100	32	14
13.....	20	18	27	8	13	29	21	219	528	93	33	12
14.....	18	22	21	8	12	41	24	178	509	83	33	10
15.....	20	35	18	8	12	41	26	144	547	72	33	10
16.....	18	33	18	7	12	31	26	127	566	71	33	10
17.....	30	27	18	7	11	29	27	108	566	70	25	10
18.....	29	27	18	7	11	26	29	98	547	64	25	10
19.....	31	22	17	6	11	23	27	100	528	56	23	10
20.....	29	20	17	6	11	24	26	97	471	53	24	20
21.....	26	19	19	6	11	26	27	110	414	51	24	20
22.....	29	20	25	7	11	33	29	118	358	49	23	21
23.....	29	20	22	10	11	26	29	106	274	43	21	21
24.....	31	20	19	8	10	24	32	129	306	43	21	20
25.....	25	19	18	8	10	30	37	160	323	41	21	21
26.....	18	20	17	8	11	29	43	151	358	38	21	21
27.....	16	20	16	8	12	24	51	151	340	38	21	20
28.....	15	22	16	8	12	21	55	193	306	36	20	20
29.....	17	24	16	8	12	24	59	224	306	37	19	20
30.....	18	27	16	8	.....	25	63	290	259	35	19	20
31.....	17	.....	16	8	.....	20	.....	347	.....	34	20	.....

NOTE.—Stage-discharge relation affected by ice Nov. 11 to Mar. 13; determinations of discharge based on frequent measurements, gage heights, and weather records. Discharge interpolated Mar. 17-18, Apr. 28 to May 1, Aug. 11-13, Sept. 11, 29, 30, as gage was out of order. Shifting-control method used Mar. 14 to June 6.

Monthly discharge of Rock Creek near Arlington, Wyo., for the year ending Sept. 30, 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
October.....	31	15	23.4	1,440
November.....	35	14	20.7	1,230
December.....	27	15	19.4	1,190
January.....	20	6	9.77	601
February.....	14	8	11.0	633
March.....	41	9	22.0	1,350
April.....	63	12	28.1	1,670
May.....	347	67	170	10,500
June.....	566	259	424	25,200
July.....	250	34	99.5	6,128
August.....	40	19	28.1	1,730
September.....	21	10	17.3	1,020
The year.....	566	6	72.5	52,700

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 maps).

RECORDS AVAILABLE.—July 30, 1914, to September 30, 1916.

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GAGE.—Bristol water-stage recorder on left bank just below lake outlet. Prior to

October 8, 1915, gage was 160 feet upstream, and was referred to different datum.

DISCHARGE MEASUREMENTS.—Made by wading.

ICE.—Stage-discharge relation not seriously affected by ice.

DIVERSIONS.—No diversions above.

REGULATION.—None.

ACCURACY.—Stage-discharge relation practically permanent. Rating curve fairly well defined below 40 second-feet. Water-stage recorder did not operate correctly during year, and only weekly staff gage readings are available. Discharge ascertained only for days on which staff gage was read.

COOPERATION.—Field data furnished by Rock Creek Conservation Co.

Discharge measurements of Deep Creek near Arlington, Wyo., during the year ending Sept. 30, 1916.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		<i>Feet.</i>	<i>Sec.-ft.</i>			<i>Feet.</i>	<i>Sec.-ft.</i>
Oct. 10	F. T. Cummings.....	^a 0.92	1.07	Mar. 30	M. W. Gordon.....	0.85	0.73
10	do.....	.92	1.18	May 6	F. T. Cummings.....	^b 3.05	3.98
30	M. W. Gordon.....	.92	1.42	June 4	do.....	2.20	31.6
Jan. 1	F. T. Cummings.....	.85	.92	July 12	do.....	1.60	12.4
Feb. 21	M. W. Gordon.....	.83	.58	Aug. 3	M. W. Gordon.....	1.20	3.42

^a Old gage read 0.63 feet.

^b Stage-discharge relation seriously affected by log jam.

Daily discharge, in second-feet, of Deep Creek near Arlington, Wyo., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1.....	1.6			0.8					30			
2.....												
3.....			1.0								3.0	
4.....									32			
5.....		1.3										
6.....							0.8	4.0				1.6
7.....				.8	1.0						3.0	
8.....									32	18		
9.....						1.0						
10.....	1.1								28			
11.....								5.0				
12.....		3.0								13		
13.....				.8	.8		1.0					
14.....						.5			43	10	2.6	1.3
15.....												
16.....												
17.....	1.6							5.8				
18.....		3.0										
19.....							.8					
20.....												
21.....				.8	.6	.5			41	3.8	1.6	1.3
22.....												
23.....	1.3											
24.....								9.4				
25.....												
26.....		1.3					1.3					
27.....					1.0							
28.....												
29.....	1.3											1.5
30.....	1.1			.9		.8			26	4.5	1.6	
31.....												

NOTE.—Operation of water-stage recorder unsatisfactory; and discharge given only for days on which staff gage was read. Data insufficient for determination of monthly discharge. Discharge estimated May 11.

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 September 30, 1916.

GAGE.—Vertical staff on downstream side of left abutment of bridge; read by Dave Wray.

DISCHARGE MEASUREMENTS.—Made from single-span bridge or by wading.

CHANNEL AND CONTROL.—Channel winding; bed composed of mud; sluggish current due to slight slope (0.0011 foot). Control practically at gage during low and medium stages, but during high water control is at first bend downstream. Left bank subject to overflow at stage 3.5 feet, right bank at stage 6.6 feet.

EXTREMES OF DISCHARGE.—Maximum stage during year, determined by levels from high-water mark, approximately 8.1 feet (discharge not determined); minimum stage, 0.50 foot for long periods during summer months (discharge 0.3 second-foot).

Maximum stage recorded during period 9.72 feet at 7 a. m. August 23, 1915, (discharge not determined); minimum discharge, creek dry for periods in summer.

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

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.—Stage-discharge relation practically permanent. Rating curve not well defined. Gage read to hundredths twice daily; during high water read more often. Daily discharge ascertained by applying mean daily gage height to rating table. Records good.

Discharge measurements of Muddy Creek near Shirley, Wyo., during the years ending Sept. 30, 1915 and 1916.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
1915.		<i>Feet.</i>	<i>Sec.-ft.</i>	1916.		<i>Feet.</i>	<i>Sec.-ft.</i>
May 6	R. H. Fletcher.....	0.95	3.4	May 7	H. K. Smith.....	1.93	29.7
June 17	.....do.....	.38	a. 2	June 13	R. H. Fletcher.....	.97	2.2
Sept. 25	.....do.....	2.24	53				

a Estimated.

Daily discharge, in second-feet, of Muddy Creek near Shirley, Wyo., for the years ending Sept. 30, 1915 and 1916.

Day.	May.	June.	July.	Aug.	Sept.	Day.	May.	June.	July.	Aug.	Sept.
1915.						1915.					
1.....		7.0	0	0	0.7	16.....	0	0.3	0	0.2	4.0
2.....		6.0	0	0	26	17.....	0	.2	0	0	3.0
3.....		5.0	0	0	122	18.....	0	.2	0	0	3.0
4.....		7.0	0	0	15	19.....	0	.1	0	0	3.0
5.....		4.0	0	0	15	20.....	.8	0	0	0	3.0
6.....	2.0	21	0	0	11	21.....	3.0	0	0	9.0	3.0
7.....	3.0	20	0	0	6.0	22.....	7.0	0	0	136	3.0
8.....	14	6.0	0	.5	2.0	23.....	7.0	0	0	330	3.0
9.....	7.0	5.0	0	49	2.0	24.....	3.0	0	0	102	3.0
10.....	1.0	5.0	0	.5	2.0	25.....	.9	.2	0	60.	3.0
11.....	.9	2.0	0	0	1.0	26.....	.7	0	0	22	54
12.....	.6	1.0	0	0	2.0	27.....	13	0	9.0	1.0	30
13.....	.3	.9	0	0	36	28.....	5.0	0	46	1.0	13
14.....	0	2.0	0	2.0	10	29.....	3.0	0	6.0	1.0	9.0
15.....	0	.6	0	3.0	6.0	30.....	55	0	.3	.8	6.0
						31.....	15		0	.7	

Day.	Oct.	Nov.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1915-16.									
1.....	5	4		9	11	14	0.3	0.3	15.3
2.....	4	4		8	11	22	.3	.3	10
3.....	3	4		7	10	13	.3	.3	.7
3.....	3	4		6	14	14	.3	.3	.5
5.....	3	4		8	14	13	.3	.3	.4
6.....	3	4		6	15	10	.3	.3	.3
7.....	3	4		6	22	11	.3	.3	.3
8.....	3	4		5	20	10	.3	.3	.3
9.....	3	4		9	17	9.0	.3	.3	.3
10.....	3	3		16	21	6.0	.3	.3	.3
11.....	3	3		24	21	6.0	.3	.3	.3
12.....	3	3		22	21	4.0	.3	.3	.3
13.....	4	2		18	21	3.0	.3	.3	.3
14.....	4	2		15	18	4.0	.3	.3	.3
15.....	5	2		15	17	2.0	.3	.3	.3
16.....	5	1		18	15	1.0	.3	.3	.3
17.....	4	1		12	13	1.0	.3	.3	.3
18.....	4	.9		16	16	1.0	.3	.3	.3
19.....	5	.9	103	16	14	.9	.3	.3	.3
20.....	5	1	99	9	15	1.0	.3	.3	.3
21.....	5		58	11	28	.9	.3	42	.3
22.....	4		35	20	22	.8	.3	.7	.3
23.....	4		34	20	16	.5	.3	.4	.3
24.....	4		24	17	18	.4	.3	.4	.3
25.....	4		24	16	17	.4	.3	.3	.3
26.....	4		15	16	14	.4	.3	.3	.3
27.....	4		13	13	17	.4	.3	.3	.3
28.....	4		16	15	13	.4	.3	.3	.3
29.....	4		16	18	13	.3	.3	.3	.4
30.....	4		8	13	13	.3	.3	.4	.4
31.....	4		9		13		.3	41	

NOTE.—Discharge Oct. 1-2, 1915, interpolated; Nov. 10-17 estimated because of ice. Run-off began Mar. 12, 1916, and reached a maximum stage of 8.1 feet before observer began readings.

Monthly discharge of Muddy Creek near Shirley, Wyo., for the years ending Sept. 30, 1915 and 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
1915.				
May 6-31.....	55	0	5.47	282
June.....	21	0	3.12	186
July.....	46	0	1.98	122
August.....	330	0	23.2	1,430
September.....	122	.7	13.3	791
The period.....				2,810
1915-16.				
October.....	5	3	3.87	238
November 1-20.....	4	.9	2.79	111
March 19-31.....	103	8	34.9	900
April.....	24	5	13.5	803
May.....	28	10	16.2	1,010
June.....	22	.3	5.02	299
July.....	.3	.3	.30	18
August.....	42	.3	2.98	183
September.....	15	.3	1.14	68

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, in 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.)

RECORDS AVAILABLE.—March 20, 1915, to September 30, 1916.

GAGE.—Vertical staff on left bank, 5 feet above footbridge; read by Mrs. Lewis Stillway.

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 subject to overflow at stage of 6.5 feet. Stage of zero flow, 0.9 foot.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 3.45 feet at 9 p. m. March 9 (discharge, 199 second-feet); practically dry for periods during the summer.

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. (Rating curve well defined between 2 and 100 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, 1916.

[Made by R. H. Fletcher.]

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	Feet.	Sec.-ft.		Feet.	Sec.-ft.
Oct. 14.....	1.68	8.7	May 24.....	2.18	36.3
May 12.....	2.47	64	May 25.....	2.16	32.9

Daily discharge, in second-feet, of Sage Creek above Pathfinder, Wyo., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1.....	9.8	7.5	-----	30	68	20	0.9	0.6	1.0
2.....	9.0	7.5	-----	33	65	21	1.0	.6	.9
3.....	8.7	7.5	-----	41	63	9.0	.8	.6	1.3
4.....	8.7	7.5	-----	39	58	8.4	.8	.6	1.5
5.....	8.7	7.2	26	28	53	10	.8	.6	1.6
6.....	8.4	7.2	26	22	54	10	.6	.8	2.1
7.....	8.4	7.2	17	19	74	8.7	.5	.8	2.2
8.....	8.1	6.9	21	16	72	7.2	.7	.7	2.2
9.....	8.1	7.8	94	25	74	7.8	.8	.8	2.3
10.....	8.4	9.0	98	25	78	6.3	.7	.8	2.0
11.....	8.7	11	51	39	69	3.5	.6	.8	1.9
12.....	9.0	12	94	50	63	1.8	.6	.8	1.9
13.....	9.0	11	96	45	57	2.0	.7	.8	1.7
14.....	7.8	10	58	36	54	1.8	.6	.8	1.5
15.....	6.6	8.4	42	41	46	1.7	.6	.8	1.3
16.....	8.4	7.8	33	43	45	1.6	.6	.8	1.2
17.....	9.8	8.1	35	35	41	1.6	.5	.8	1.2
18.....	9.8	8.1	46	44	31	1.7	.5	.9	1.2
19.....	9.8	8.4	48	46	28	1.4	.5	.9	1.2
20.....	9.0	8.4	86	45	32	1.6	.5	.9	1.1
21.....	9.0	8.4	27	42	56	1.7	.5	.9	1.1
22.....	8.7	7.8	95	48	52	1.6	.6	.9	1.2
23.....	8.7	7.8	81	50	37	1.7	.6	.8	1.2
24.....	8.4	7.8	54	51	35	1.6	.6	.8	1.2
25.....	8.4	7.8	44	57	34	1.1	.6	.8	1.2
26.....	8.4	7.2	40	63	32	1.0	.6	.8	1.1
27.....	8.4	7.2	39	63	28	.9	.5	.9	1.1
28.....	7.8	-----	39	67	24	1.0	.5	.9	1.1
29.....	7.8	-----	42	77	26	.9	.6	1.0	1.0
30.....	7.2	-----	26	69	23	.8	.6	1.0	1.0
31.....	7.8	-----	23	-----	22	-----	.6	1.0	-----

Monthly discharge of Sage Creek above Pathfinder, Wyo., for the year ending Sept. 30, 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
October.....	9.8	7.2	8.54	525
November 1-27.....	12	6.9	8.24	441
March 5-31.....	98	17	51.1	2,740
April.....	77	16	43.0	2,560
May.....	78	22	48.2	2,960
June.....	21	.8	4.65	277
July.....	1.0	.5	0.63	38.7
August.....	1.0	.6	0.81	49.8
September.....	2.3	.9	1.42	84.5

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, the flow line of which is one-half mile below gage.

DRAINAGE AREA.—70 square miles (measured on base map of Wyoming; scale, 1:500,000).

RECORDS AVAILABLE.—April 1 to September 30, 1915, and April 3 to September 9, 1916.

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.—Daily discharge records furnished by United States Reclamation Service.

Daily discharge, in second-feet, of Sand Creek near Alcova, Wyo., for the year ending Sept. 30, 1916.

Day.	Apr.	May.	June.	July.	Day.	Apr.	May.	June.	July.
1.		5.2	10		16.	10	5.2	2.6	
2.		5.2	5.2		17.	5.2	5.2	2.6	
3.	25	5.2	10		18.	10	5.2	2.6	
4.	25	5.2	5.2		19.	10	5.2	2.6	
5.	20	5.2	5.2		20.	25	5.2	2.6	
6.	20	5.2	2.6		21.	15	25	2.6	
7.	22	5.2	2.6		22.	5.2	15	2.6	0.1
8.	22	5.2	2.6		23.	10	10	2.6	
9.	22	5.2	2.6	0.5	24.	15	5.2	2.6	.1
10.	13	.7	5.2	.1	25.	5.2	5.2	2.6	
11.	15	5.2	5.2		26.	7.7	5.2	2.6	
12.	20	5.2	5.2		27.	10	10	2.6	
13.	13	5.2	10		28.	15	10	2.6	.1
14.	13	7.7	5.2		29.	15	10		
15.	5.2	7.7	5.2	.3	30.	5.2	5.2		
					31.		10		

NOTE.—Creek dry June 29 to Sept. 9, except on July 9, 10, 15, 22, 24, and 28.

Monthly discharge of Sand Creek near Alcova, Wyo., for the year ending Sept. 30, 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
April 3-30.	25	5.2	14.2	789
May.	25	.7	6.95	427
June.	10	.0	3.86	230
July.	.5	.0	.39	2.4
The period.				1,450

NOTE.—Monthly flow computed by engineers of the United States Geological Survey from record of daily discharge furnished by United States Reclamation Service.

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, 1916.

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. Stage of zero flow, 0.2 foot.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 3.46 feet at 5 p. m., May 2 (discharge, 964 second-feet); minimum discharge probably occurs during winter months.

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 the station. The original diversions below the station have been submerged by Pathfinder reservoir.

REGULATION.—None.

ACCURACY.—Stage-discharge relation not permanent, but shifts between fairly well defined limits. Fairly well defined standard rating curve used indirectly most of year. Gage read to quarter tenths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table, except March 12 to May 24 and July 1 to September 30, for which it was determined by shifting-control method. Records fair.

Discharge measurements of Sweetwater River near Alcova, Wyo., during the year ending Sept. 30, 1916.

Date.	Made by—	Gage height.	Dis-charge.	Date.	Made by—	Gage height.	Dis-charge.
		<i>Feet.</i>	<i>Sec.-ft.</i>			<i>Feet.</i>	<i>Sec.-ft.</i>
Oct. 17	R. H. Fletcher.....	0.77	90	Apr. 26	R. B. Diemer	2.26	455
18	do.....	.75	85	27	do.....	2.55	534
Apr. 3	R. B. Diemer.....	1.18	200	27	do.....	2.55	539
4	do.....	1.22	206	May 11	R. H. Fletcher.....	3.34	930

a Engineer for United States Reclamation Service.

Daily discharge, in second-feet, of Sweetwater River near Alcova, Wyo., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1.....	92	82	.....	219	938	347	160	59	51
2.....	95	80	.....	203	938	347	155	59	51
3.....	95	80	.....	199	798	379	146	59	51
4.....	92	80	.....	201	563	379	141	59	48
5.....	92	80	.....	208	543	379	128	59	49
6.....	92	80	.....	208	523	379	124	59	47
7.....	93	80	.....	208	584	379	116	58	46
8.....	93	78	.....	201	668	413	113	58	46
9.....	90	79	.....	190	775	448	109	59	44
10.....	90	80	.....	182	870	448	106	59	44
11.....	90	80	.....	172	960	413	102	59	44
12.....	87	80	105	176	915	448	101	59	44
13.....	87	80	190	262	915	485	95	59	44
14.....	87	80	262	466	870	485	92	59	46
15.....	87	80	219	604	775	485	90	59	44
16.....	87	80	180	625	668	466	88	58	42
17.....	85	80	190	710	563	430	85	57	41
18.....	86	80	236	775	504	413	80	56	39
19.....	85	80	249	775	448	413	80	55	39
20.....	85	.....	289	754	430	448	78	55	39
21.....	85	.....	485	668	413	448	76	55	39
22.....	82	.....	732	543	430	430	76	55	39
23.....	82	.....	625	430	448	430	76	55	39
24.....	81	.....	448	396	485	363	75	55	42
25.....	82	.....	289	430	485	317	74	55	38
26.....	81	.....	276	466	413	276	74	55	38
27.....	80	.....	212	543	379	224	74	55	38
28.....	80	.....	210	625	363	208	74	55	39
29.....	80	.....	203	732	347	184	72	55	46
30.....	80	.....	192	775	347	166	69	55	46
31.....	82	.....	203	.....	347	.....	65	55	.....

Monthly discharge of Sweetwater River near Alcova, Wyo., for the year ending Sept. 30, 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
October.....	95	80	86.6	5,320
November 1-19.....	82	78	79.9	3,010
March 12-31.....	732	105	290	11,500
April.....	775	172	432	25,700
May.....	960	347	603	37,100
June.....	485	166	381	22,700
July.....	166	65	96.6	5,940
August.....	59	55	57.1	3,510
September.....	51	38	43.4	2,580

HORSE CREEK NEAR ALCOVA, WYO.

LOCATION.—About 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, the 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, June 30, 1916.

GAGE.—Vertical staff on right bank at lower side of bridge; read by A. L. Johnson, and P. J. Wilder.

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 during winter.

DIVERSIONS.—Prior to July 1, 1914, there were adjudicated diversions of 11 second-feet from Horse Creek, and 2 second-feet from tributaries, all above the station.

REGULATION.—None.

COOPERATION.—Daily discharge records furnished by the United States Reclamation Service.

Daily discharge, in second-feet, of Horse Creek near Alcova, Wyo., for the year ending Sept. 30, 1916.

Day.	Mar.	Apr.	May.	June.	Day.	Mar.	Apr.	May.	June.
1.....		3.3	0.9	1.1	16.....		0.7	0.4	0.5
2.....		8.5	.9	1.7	17.....		.9	.7	.9
3.....		4.5	1.7	1.7	18.....	55	2.5	.9	1.1
4.....		7.0	.5	.7	19.....	61	2.5	.9	1.7
5.....		9.4	.5	.5	20.....	62	.5	.7	.7
6.....	100		.7	.7	21.....	64	.5	.7	.4
7.....	14		.5	.4	22.....	66	.4	.9	.5
8.....	11		.7	.5	23.....	34	1.7	.9	.5
9.....	12		.5	.5	24.....	29	1.7	1.1	.5
10.....	3.9		.5	.5	25.....	6.3	.5	1.1	.7
11.....		1.1	1.1	.5	26.....	8.5	.9	.7	.5
12.....		3.1	1.7	.7	27.....	3.9	.7	.7	.5
13.....		.9	.7	.5	28.....	11	.9	.7	.9
14.....		.4	.7	.4	29.....	6.3	1.7	.7	.9
15.....		.1	.5	.5	30.....	8.5	.9	1.1	.5
					31.....	7.0		1.7	

Monthly discharge of Horse Creek near Alcova, Wyo., for the year ending Sept. 30, 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
March 18-31.....	66	3.9	30.2	839
April.....	14	.4	3.53	211
May.....	1.7	.4	.84	51.6
June.....	1.7	.4	.72	42.8
The period.....	66	.4	5.49	1,140

NOTE.—Monthly discharge computed by engineers of the United States Geological Survey from records of daily flow furnished by the United States Reclamation Service.

CANYON CREEK NEAR ALCOVA, WYO.

LOCATION.—About sec. 2, T. 28 N., R. 84 W., at Irvine's ranch, 12 miles southwest of Alcova, in Carbon County. No tributary between station and Pathfinder reservoir, the flow line of which is a 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, 1916.

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.—Daily discharge records furnished by the United States Reclamation Service.

Daily discharge, in second-feet, of Canyon Creek near Alcova, Wyo., for the year ending Sept. 30, 1916.

Day.	Mar.	Apr.	May.	June.	Aug.	Sept.	Day.	Mar.	Apr.	May.	June.	Aug.	Sept.
1.....		8.0	9.8	0.5		0.5	16....	9.8	7.6	3.0			1.4
2.....		9.5	10			.9	17....	11	8.0	2.2	0.5		1.2
3.....		8.4	11			.6	18....	13	8.9	1.2	.6		1.4
4.....		8.0	9.8			.9	19....	12	10	1.4	.6		1.2
5.....	30	8.4	8.0			1.2	20....	17	12	2.0			1.4
6.....	32	8.0	7.0			1.1	21....	17	16	7.0			1.4
7.....	17	7.0	6.4			1.4	22....	14	12	3.9			.9
8.....	42	7.0	6.0			1.2	23....	17	12	2.7			.7
9.....	17	8.4	5.2			1.4	24....	7.0	12	2.2			1.2
10....	62	8.4	4.5			1.1	25....	8.0	11	2.2			1.7
11....	36	10	4.2			1.2	26....	8.3	12	2.1	.3	0.3	1.2
12....	42	10	3.9	.2		1.1	27....	8.9	11	1.8			2.0
13....	28	9.4	4.2	.5		.7	28....	9.4	12	1.8		.6	2.0
14....	13	8.0	4.8	.6		1.2	29....	8.0	12	1.2		.7	2.2
15....	8.9	7.0	4.5	.3		1.2	30....	5.7	10	1.2		1.1	2.2
							31....	7.6		1.4		.6	

NOTE.—Creek dry June 2-11, 16, 20-25, and June 27 to Aug. 25, 27.

Monthly discharge of Canyon Creek near Alcova, Wyo., for the year ending Sept. 30, 1916

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
March 5-31.....	62	5.7	18.6	996
April.....	16	7.0	9.73	579
May.....	11	1.2	4.41	271
June.....	.6	.0	0.14	8.3
July.....	.0	.0	.0	0
August.....	1.1	.0	.11	6.8
September.....	2.2	0.5	1.26	75.0
The period.....				1,940

NOTE.—Monthly discharge computed by engineers of the United States Geological Survey from records of daily flow furnished by the United States Reclamation Service.

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 to September 30, 1916.

DIVERSIONS.—Prior to December 31, 1916, there were adjudicated diversions of 72 second-feet from Bates Creek, all above the station.

COOPERATION.—Daily discharge records furnished by the United States Reclamation Service.

Daily discharge, in second-feet, of Bates Creek near Casper, Wyo., for the year ending Sept. 30, 1916.

Day.	Apr.	May.	July.	Aug.	Sept.	Day.	Apr.	May.	July.	Aug.	Sept.
1.....		42'		1.0	9.0	16.....	a 80		a 1.0	9.0	0.5
2.....		35		1.0	.5	17.....	71		1.0	1.0	a .5
3.....		35		1.0	a .5	18.....	71		1.0	1.0	.5
4.....		20		1.0	.5	19.....	77		1.0	.5	.5
5.....		20		.5	.5	20.....	84		1.0	a .5	.5
6.....		8.0		a .5	.5	21.....	71		1.0	.5	.5
7.....		a 1.5		.5	.5	22.....	77		1.0	.5	.5
8.....				.5	.5	23.....	a 71		a 1.0	.5	.5
9.....				38	.5	24.....	63		1.0	.5	a .5
10.....	63			38	a .5	25.....	56		1.0	.5	.5
11.....	97		300	9.0	.5	26.....	56		1.0	.5	.5
12.....	135		1.0	1.0	.5	27.....	49		1.0	a .5	.5
13.....	97		1.0	a 1.0	.5	28.....	71		1.0	.5	.5
.....	84		1.0	1.0	.5	29.....	71		1.0	.5	1.0
1.....	90		1.0	24	.5	30.....	a 56		a 1.0	.5	1.0
						31.....			1.0	24	.....

a Sunday; discharge interpolated as gage was not read.

NOTE.—Practically no flow May 8 to July 10.

Monthly discharge of Bates Creek near Casper, Wyo., for the year ending Sept. 30, 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
April 10-30.....	135	49	75.7	3,150
May.....	42	0	5.21	320
June.....	0	0	0	0
July.....	300	0	10.3	633
August.....	38	.5	5.13	315
September.....	9	.5	.82	48.8
The period.....				4,470

NOTE.—Monthly flow computed by engineers of the United States Geological Survey from records of daily discharge furnished by the United States Reclamation Service.

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 to September 30, 1916.

DIVERSIONS.—Prior to December 31, 1916, there were adjudicated diversions of 48 second-feet from Deer Creek, all above the station.

COOPERATION.—Daily discharge records furnished by United States Reclamation Service.

Daily discharge, in second-feet, of Deer Creek at Glenrock, Wyo., for the year ending Sept. 30, 1916.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Day.	Apr.	May.	June.	July.	Aug.	Sept.
1.....		338	140	0.5	0.2	0.2	16.....	338	186	9.0	132	0.2	0.2
2.....		304	104	.5	.2	.2	17.....	405	182	7.0	33	.2	.2
3.....		315	124	.5	.2	.2	18.....	439	168	6.8	.6	.2	.2
4.....		251	93	.5	.2	.2	19.....	392	147	5.6	.6	.2	.2
5.....		251	82	.3	.2	.2	20.....	283	147	5.2	.6	.2	.2
6.....		292	70	.3	.2	.2	21.....	392	350	5.2	.6	.2	.2
7.....		190	68	.3	.2	.2	22.....	403	432	5.0	.6	.2	.2
8.....		186	52	.3	.2	.2	23.....	403	436	4.8	.6	.2	.2
9.....		330	43	.3	.2	.2	24.....	389	360	5.4	.6	.2	.2
10.....		318	33	.5	.2	.2	25.....	421	304	3.0	.5	.2	.2
11.....	394	308	33	.3	.2	.2	26.....	425	236	2.5	.5	.2	.2
12.....	400	300	29	.3	.2	.2	27.....	382	220	1.4	.5	.2	.2
13.....	396	195	22	.3	.2	.2	28.....	338	215	.5	.5	.5	.2
14.....	280	190	21	.3	.2	.2	29.....	405	177	.5	.3	.2	.2
15.....	304	186	9.0	.5	.2	.2	30.....	385	164	.5	.3	.2	.3
							31.....		164		.3	.2	

NOTE.—Discharge estimated May 9-13, and records changed to conform to rules of United States Geological Survey.

Monthly discharge of Deer Creek at Glenrock, Wyo., for the year ending Sept. 30, 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
April 11-30.....	439	280	379	15,000
May.....	436	147	253	15,600
June.....	140	.5	32.8	1,950
July.....	132	.3	5.74	353
August.....	.2	.2	.20	12.3
September.....	.3	.2	.20	11.9
The period.....				32,900

NOTE.—Monthly discharge computed by engineers of United States Geological Survey from records of daily flow furnished by United States Reclamation Service.

BOXELDER CREEK NEAR CAREYHURST, WYO.

LOCATION.—Approximately in sec. 7, T. 33 N., R. 73 W., near mouth of creek $1\frac{1}{2}$ 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 to September 30, 1916.

DIVERSIONS.—Prior to December 31, 1916, there were adjudicated diversions of 80 second-feet from Boxelder Creek, all above the station.

COOPERATION.—Daily discharge records furnished by United States Reclamation Service.

Daily discharge, in second-feet, of Boxelder Creek near Careyhurst, Wyo., for the year ending Sept. 30, 1916.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Day.	Apr.	May.	June.	July.	Aug.	Sept.
1.....		203	70	4.5	4.5	4.5	16.....	194	124	6.0	4.5	4.5	4.5
2.....		168	70	4.5	4.5	4.5	17.....	203	115	5.0	4.5	4.5	4.5
3.....		160	35	4.5	4.5	4.5	18.....	177	124	5.0	4.5	4.5	4.5
4.....		160	24	4.5	4.5	4.5	19.....	177	106	5.0	4.5	4.5	4.5
5.....		168	24	4.5	4.5	4.5	20.....	186	106	5.0	4.5	4.5	4.5
6.....		168	35	4.5	4.5	4.5	21.....	186	194	5.0	4.5	4.5	4.5
7.....		168	42	4.5	4.5	4.5	22.....	203	222	5.0	4.5	4.5	4.5
8.....		142	42	4.5	4.5	4.5	23.....	237	212	5.0	4.5	4.5	4.5
9.....	124	194	19	4.5	4.5	4.5	24.....	203	203	5.0	4.5	4.5	4.5
10.....	150	186	9.0	4.5	4.5	4.5	25.....	222	212	5.0	4.5	4.5	4.5
11.....	186	186	9.0	4.5	4.5	4.5	26.....	222	160	5.0	4.5	4.5	4.5
12.....	212	168	9.0	4.5	4.5	4.5	27.....	177	142	5.0	4.5	4.5	4.5
13.....	203	142	9.0	4.5	4.5	4.5	28.....	186	124	4.5	4.5	4.5	4.5
14.....	186	142	6.0	4.5	4.5	4.5	29.....	230	106	4.5	4.5	4.5	4.5
15.....	168	132	6.0	4.5	4.5	4.5	30.....	168	88	4.5	4.5	4.5	4.5
							31.....		70		4.5	4.5	

Monthly discharge of Boxelder Creek near Careyhurst, Wyo., for the year ending Sept. 30, 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
April 9-30.....	237	124	191	8,330
May.....	222	70	155	9,530
June.....	70	4.5	16.1	958
July.....	4.5	4.5	4.5	277
August.....	4.5	4.5	4.5	277
September.....	4.5	4.5	4.5	268
The period.....				19,600

NOTE.—Monthly discharge computed by engineers of United States Geological Survey from records of daily discharge furnished by United States Reclamation Service.

LA PRELE CREEK NEAR FETTERMAN, WYO.

LOCATION.—Approximately in sec. 9, T. 33 N., R. 72 W. near mouth of creek, 4 miles east of Fetterman, in Converse County.

DRAINAGE AREA.—227 square miles (measured on base map of Wyoming; scale, 1:500,000).

RECORDS AVAILABLE.—April 23 to August 5, 1916.

DIVERSIONS.—Prior to December 31, 1916, there were adjudicated diversion of 73 second-feet from La Prele Creek, all above the station.

COOPERATION.—Daily discharge records furnished by United States Reclamation Service.

Daily discharge, in second-feet, of La Prele Creek near Fetterman, Wyo., for the year ending Sept. 30, 1916.

Day.	Apr.	May.	June.	July.	Aug.	Day.	Apr.	May.	June.	July.	Aug.
1.....		62	71	6.7	3.7	16.....		118	6.7	9.3	
2.....		62	62	6.7	3.2	17.....		98	6.7	5.0	
3.....		80	53	6.7	3.2	18.....		108	5.0	9.3	
4.....		89	35	6.7	3.2	19.....		108	5.0	6.7	
5.....		98	13	6.7	3.0	20.....		108	6.7	9.3	
6.....		98	13	6.7		21.....		108	5.0	9.3	
7.....		98	6.7	5.0		22.....		108	5.0	6.7	
8.....		98	5.0	5.0		23.....	25	108	5.0	5.0	
9.....		98	5.0	5.0		24.....	25	108	5.0	5.0	
10.....		98	6.7	6.7		25.....	35	108	6.7	3.7	
11.....		98	6.7	6.7		26.....	35	108	5.0	5.0	
12.....		108	6.7	5.0		27.....	35	108	5.0	6.7	
13.....		108	6.7	3.7		28.....	44	108	5.0	6.7	
14.....		108	6.7	3.7		29.....	44	108	6.7	5.0	
15.....		108	6.7	25		30.....	62	98	5.0	3.7	
						31.....		98		3.7	

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Monthly discharge of La Prele Creek near Fetterman, Wyo., for the year ending Sept. 30, 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
April 23-30.....	62	25	38.1	605
May.....	118	62	101	6,210
June.....	71	5.0	12.9	768
July.....	25	3.7	6.65	409
August 1-5.....	3.7	3.0	3.26	32.3
The period.....				8,020

NOTE.—Monthly discharge computed by engineers of United States Geological Survey from records of daily discharge furnished by United States Reclamation Service.

WAGON HOUND CREEK NEAR LABONTE, WYO.

LOCATION.—Approximately in sec. 16, T. 31 N., R. 71 W., at Eastman's ranch, near mouth of creek, 3 miles east of LaBonte, in Converse County.

DRAINAGE AREA.—145 square miles (measured on base map of Wyoming; scale, 1:500,000).

RECORDS AVAILABLE.—April 11 to September 30, 1916.

DIVERSIONS.—Prior to December 31, 1916, there were adjudicated diversions of 24 second-feet from Wagon Hound Creek, all above the station.

COOPERATION.—Daily discharge records furnished by United States Reclamation Service.

Daily discharge, in second-feet, of Wagon Hound Creek near LaBonte, Wyo., for the year ending Sept. 30, 1916.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Day.	Apr.	May.	June.	July.	Aug.	Sept.
1.....		12	1.0	1.0	1.0	1.0	16.....	69	1.0	1.0	1.0	1.0	0.2
2.....		8.5	1.0	1.0	1.0	.2	17.....	88	1.0	1.0	1.0	1.0	.2
3.....		5.5	1.0	1.0	1.0	.2	18.....	59	1.0	1.0	1.0	1.0	.2
4.....		3.0	1.0	3.0	1.0	.2	19.....	69	1.0	1.0	1.0	1.0	.2
5.....		1.0	1.0	3.0	1.0	.2	20.....	59	1.0	1.0	1.0	1.0	.2
6.....		.2	1.0	3.0	1.0	.2	21.....	69	1.0	1.0	1.0	1.0	.2
7.....		3.0	1.0	3.0	1.0	.2	22.....	100	40	1.0	1.0	1.0	.2
8.....		1.0	1.0	69	5.5	.2	23.....	100	24	1.0	1.0	1.0	.2
9.....		1.0	1.0	3.0	1.0	.2	24.....	69	18	1.0	1.0	1.0	.2
10.....		.2	1.0	3.0	1.0	.2	25.....	49	12	1.0	1.0	1.0	.2
11.....	59	.2	1.0	3.0	1.0	.2	26.....	49	12	1.0	1.0	1.0	.2
12.....	88	1.0	3.0	3.0	1.0	.2	27.....	40	8.5	1.0	1.0	1.0	.2
13.....	59	1.0	5.5	3.0	1.0	.2	28.....	8.5	8.5	1.0	1.0	1.0	.2
14.....	49	1.0	3.0	3.0	1.0	.2	29.....	8.5	5.5	1.0	1.0	1.0	.2
15.....	59	1.0	1.0	3.5	1.0	.2	30.....	24	3.0	1.0	1.0	1.0	.2
							31.....		1.0		1.0	1.0	

Monthly discharge of Wagon Hound Creek near LaBonte, Wyo., for the year ending Sept. 30, 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
April 11-30.....	100	8.5	58.7	2,330
May.....	40	.2	5.76	354
June.....	5.5	1.0	1.28	76.2
July.....	69	1.0	3.90	240
August.....	5.5	1.0	1.15	70.7
September.....	1.0	.2	.23	13.7
The period.....				3,080

NOTE.—Monthly discharge computed by engineers of United States Geological Survey from records of daily discharge furnished by United States Reclamation Service.

LABONTE CREEK NEAR LABONTE, WYO.

LOCATION.—Approximately in sec. 15, T. 31 N., R. 71 W., at Wiederander's ranch near mouth of creek, 2 miles east of LaBonte, in Converse County.

DRAINAGE AREA.—270 square miles (measured on base map of Wyoming; scale, 1:500,000).

RECORDS AVAILABLE.—April 12 to September 30, 1916.

DIVERSIONS.—Prior to December 31, 1916, there were adjudicated diversions of 34 second-feet from LaBonte Creek, all above the station.

COOPERATION.—Daily discharge records furnished by United States Reclamation Service.

Daily discharge, in second-feet, of LaBonte Creek near LaBonte, Wyo., for the year ending Sept. 30, 1916.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Day.	Apr.	May.	June.	July.	Aug.	Sept.
1.....		257	61	1.5	1.5	0.8	16....	326	122	24	1.5	1.5	0.6
2.....		252	60	1.5	1.5	.8	17....	343	127	15	1.5	1.5	.4
3.....		235	58	1.5	1.5	.8	18....	337	114	12	1.5	1.5	.4
4.....		218	55	1.8	1.5	.8	19....	331	98	12	1.5	1.5	.4
5.....		206	54	1.5	1.5	.8	20....	320	96	13	1.5	1.2	.4
6.....		203	32	1.5	1.5	.8	21....	308	116	16	1.5	1.2	.4
7.....		220	30	1.5	1.5	.8	21....	311	172	12	1.5	1.2	.4
8.....		203	26	1.5	1.5	.8	23....	308	141	8.4	1.5	1.2	.4
9.....		192	20	1.5	1.5	.8	24....	303	141	7.9	1.5	1.2	.3
10....		178	13	1.5	1.5	.6	25....	314	139	7.9	1.5	1.2	.3
11....		161	12	4.0	1.5	.6	26....	311	127	6.9	1.5	1.2	.3
12....	314	146	29	1.5	1.5	.6	27....	297	118	6.9	1.5	1.0	.3
13....	303	141	29	1.5	1.5	.6	28....	300	102	4.6	1.5	1.0	.3
14....	269	137	28	1.5	1.5	.6	29....	314	89	2.3	1.5	1.0	.3
15....	269	131	26	1.5	1.5	.6	30....	291	77	1.6	1.5	1.0	.3
							31....		68		1.5	1.0	

Monthly discharge of LaBonte Creek near LaBonte, Wyo., for the year ending Sept. 30, 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
April 12-30.....	343	269	309	11,600
May.....	257	68	152	9,350
June.....	61	1.6	22.8	1,360
July.....	4.0	1.5	1.59	97.8
August.....	1.5	1.0	1.35	83.0
September.....	.8	.3	.54	32.1
The period.....				22,500

NOTE.—Monthly discharge computed by engineers of United States Geological Survey from records of daily discharge furnished by the United States Reclamation Service.

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 to September 2, 1916.

DIVERSIONS.—Prior to December 31, 1916, there were adjudicated diversions of 81 second-feet from Horseshoe Creek, all above the station.

COOPERATION.—Daily discharge records furnished by United States Reclamation Service.

Daily discharge, in second-feet, of Horseshoe Creek near Glendo, Wyo., for the year ending Sept. 30, 1916.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Day.	Apr.	May.	June.	July.	Aug.	Sept.
1.....		102	19	3.0	2.5	2.5	16....	126	21	3.6	2.6	2.4	.....
2.....		60	19	2.9	2.5	2.5	17....	132	21	3.6	2.6	2.4	.....
3.....		50	18	2.9	2.5	.....	18....	134	21	3.6	2.6	2.4	.....
4.....		56	18	2.9	2.5	.....	19....	132	21	3.4	2.6	2.4	.....
5.....		39	12	2.9	2.5	.....	20....	130	21	3.4	2.6	2.4	.....
6.....		38	5.1	2.8	2.5	.....	21....	122	20	3.3	2.6	2.4	.....
7.....		31	4.2	2.7	2.5	.....	22....	122	20	3.3	2.5	2.4	.....
8.....		28	4.2	2.7	2.5	.....	23....	120	20	3.2	2.5	2.4	.....
9.....		27	4.2	2.7	2.4	.....	24....	120	20	3.2	2.5	2.4	.....
10.....		26	4.2	2.7	2.4	.....	25....	118	20	3.1	2.5	2.4	.....
11.....		25	3.9	2.7	2.4	.....	26....	118	20	3.1	2.5	2.4	.....
12.....		24	3.9	2.7	2.4	.....	27....	115	20	3.0	2.5	2.4	.....
13.....		24	3.7	2.7	2.4	.....	28....	115	19	3.0	2.5	2.4	.....
14.....		22	3.7	2.7	2.4	.....	29....	115	19	3.0	2.5	2.4	.....
15.....		22	3.7	2.7	2.4	.....	30....	113	19	3.0	2.5	2.4	.....
							31....	.....	19	.....	2.5	2.4	.....

Monthly discharge of Horseshoe Creek near Glendo, Wyo., for the year ending Sept. 30, 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
April 16-30.....	134	113	122	3,630
May.....	102	19	28.9	1,780
June.....	19	3.0	5.85	348
July.....	3.0	2.5	2.65	163
August.....	2.5	2.4	2.43	149
September 1-2.....	2.5	2.5	2.50	9.9
The period.....				6,080

NOTE.—Monthly discharge computed by engineers of United States Geological Survey from records of daily flow furnished by United States Reclamation Service.

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 to September 30, 1916.

DIVERSIONS.—Prior to December 31, 1916, there were adjudicated diversions of 92 second-feet from Cottonwood Creek, all above the station.

COOPERATION.—Daily discharge records furnished by United States Reclamation Service.

Daily discharge, in second-feet, of Cottonwood Creek near Wendover, Wyo., for the year ending Sept. 30, 1916.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Day.	Apr.	May.	June.	July.	Aug.	Sept.
1.....		4.3	9.6	5.0	4.3	1.3	16....		4.9	7.2	3.7	0.9	1.7
2.....		4.3	8.5	4.3	4.3	1.3	17....		4.9	7.2	3.7	.9	1.7
3.....		4.1	8.5	4.3	4.3	1.7	18....		5.3	7.2	3.7	.9	1.7
4.....		3.8	8.5	4.3	4.3	1.7	19....	24	5.3	7.2	3.7	1.3	1.7
5.....		3.5	7.6	3.7	63	1.7	20....	24	5.3	7.2	3.7	.9	1.7
6.....		3.5	7.6	3.7	1.7	1.7	21....	24	5.3	7.2	3.7	.9	1.7
7.....		3.5	7.6	3.7	1.3	1.7	22....	20	5.3	6.3	3.7	1.3	1.7
8.....		3.8	7.6	3.7	1.3	1.7	23....	20	6.0	5.6	3.7	1.3	1.7
9.....		4.1	6.8	3.7	1.3	1.7	24....	14	6.8	5.6	3.7	1.3	2.0
10.....		4.3	5.3	3.7	.9	1.7	25....	11	6.8	5.6	4.3	1.3	2.0
11.....		4.3	5.3	3.7	.9	1.7	26....	8.0	12	5.0	4.3	1.3	2.0
12.....		4.3	150	3.7	.9	1.5	27....	6.8	11	5.0	4.3	1.3	2.0
13.....		4.6	16	3.7	.9	1.5	28....	5.6	11	5.0	4.3	1.3	2.0
14.....		4.9	9.0	3.7	.9	1.7	29....	5.3	11	5.0	4.3	1.3	2.0
15.....		4.9	7.2	3.7	.9	1.7	30....	4.6	11	5.0	4.3	1.3	2.0
							31....	.....	11	.....	4.3	1.3	.....

Monthly discharge of Cottonwood Creek near Wendover, Wyo., for the year ending Sept. 30, 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
April 19-30.....	24	4.6	13.9	331
May.....	12	3.5	5.97	367
June.....	150	5.0	11.9	708
July.....	5.0	3.7	3.94	242
August.....	63	.9	3.55	218
September.....	2.0	1.3	1.73	103
The period.....				1,970

NOTE.—Monthly discharge computed by engineers of United States Geological Survey from records of daily flow furnished by United States Reclamation Service.

LARAMIE RIVER AT GLENDEVEY, COLO.

LOCATION.—In sec. 36, T. 10 N., R. 76 W., at highway bridge one-eighth mile west of Glendevy, in Larimer County. Stub Creek enters a short distance below gage, and Nunn Creek just above.

DRAINAGE AREA.—102 square miles (measured on Clason's sectional map of Colorado, edition of 1911).

RECORDS AVAILABLE.—June 24, 1904, to October 31, 1905; August 18, 1910, to September 30, 1916. 1914 and 1915 records published only by State engineer.

GAGE.—Bristol water-stage recorder on downstream side of right abutment.

DISCHARGE MEASUREMENTS.—Made from bridge or by wading.

CHANNEL AND CONTROL.—Bed composed of boulders and sand. Control is boulder riffle just below bridge.

EXTREMES OF DISCHARGE.—Maximum stage during year, from water-stage recorder, 3.55 feet at 6 p. m. May 31 (discharge, 475 second-feet); minimum discharge probably occurs during winter.

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

DIVERSIONS.—There are court decrees for diversions of 49 second-feet from Laramie River above station; total from the tributaries entering above not known, but of those decrees, 688 second-feet is for diversions into the Cache la Poudre basin. During 1916 a total of 27,470 acre-feet were diverted into the Cache la Poudre. In addition there is a conditional decree for diversion of not exceeding 1,235 second-feet through Laramie-Poudre tunnel. Diversion through tunnel in 1916 was 3,645 acre-feet.

REGULATION.—None.

COOPERATION.—Complete records furnished by State engineer.

Discharge measurements of Laramie River at Glendevy, Colo., during the year ending Sept. 30, 1916.

Date.	Made by—	Gage height.	Discharge.
June 16	Robert Follansbee.....	<i>Feet.</i> 3.08	<i>Sec.-ft.</i> 313
Aug. 16	Thomas Grieve, jr.....	2.20	57

Daily discharge, in second-feet, of Laramie River at Glendevy, Colo., for the year ending Sept. 30, 1916.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Day.	Apr.	May.	June.	July.	Aug.	Sept.
1.....		114	360	180	70	42	16....	42	180	272	80	51	36
2.....		102	324	166	70	36	17....	51	152	289	80	70	31
3.....		80	324	152	80	42	18....	60	139	289	80	70	31
4.....		80	360	126	80	42	19....	60	152	289	80	51	36
5.....		114	378	139	80	31	20....	42	194	255	80	42	31
6.....		166	342	114	80	36	21....	51	208	255	80	42	36
7.....		223	306	114	80	31	22....	60	194	208	80	36	42
8.....		238	324	114	80	31	23....	70	180	180	80	36	42
9.....		223	378	102	80	42	24....	80	238	180	80	36	51
10.....		208	397	102	80	102	25....	102	252	180	80	36	42
11....	60	208	378	91	80	60	26....	126	255	180	80	42	36
12....	51	208	378	91	60	70	27....	139	238	180	80	51	31
13....	51	194	378	80	42	60	28....	166	289	166	80	42	42
14....	42	194	342	80	42	51	29....	180	306	208	80	31	60
15....	51	194	289	80	42	42	30....	139	360	208	60	42	60
							31....		378		60	60	

Monthly discharge of Laramie River at Glendevy, Colo., for the year ending Sept. 30, 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
April 11-30.....	180	42	81.2	3,220
May.....	378	80	202	12,400
June.....	397	166	287	17,100
July.....	180	60	95.8	5,890
August.....	80	31	57.5	3,540
September.....	102	31	44.2	2,630
The period.....				44,800

LARAMIE RIVER NEAR JELM, WYO.

LOCATION.—In sec. 15, T. 12 N., R. 77 W., at highway bridge at Boswell's ranch, one-fourth mile below Colorado-Wyoming line, 4 miles south of Jelm, in Albany County. Stuck Creek enters 1 mile upstream.

DRAINAGE AREA.—293 square miles (measured on base map of Wyoming; scale, 1:500,000).

RECORDS AVAILABLE.—May 7, 1911, to September 30, 1916. From June 22, 1904, to October 31, 1905, a station was maintained at Decker's ranch, one-half mile south of the State line. The records at the two stations are comparable, as there are no tributaries or diversions of any account between them.

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.—Bed composed of gravel. Control a short distance downstream; practically permanent. 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, 3.3 feet May 10 (discharge, 1,500 second-feet); minimum discharge occurs during winter months.

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

DIVERSIONS.—Between this station and that at Glendevy, Colo., there are court decrees for diversions of 236 second-feet from Laramie River and 204 second-feet from intervening tributaries. These diversions are all in Colorado.

REGULATION.—None.

COOPERATION.—Station maintained in cooperation with State engineer of Colorado, and records published as furnished by that office. Some discharge measurements made by engineers of United States Geological Survey.

Discharge measurements of Laramie River near Jelm, Wyo., during the year ending Sept. 30, 1916.

Date.	Made by—	Gage height.	Dis-charge.
		<i>Feet.</i>	<i>Sec.-ft.</i>
Apr. 11	C. C. Hezmalhalch.....	1.30	103
June 16	Robert Follansbee.....	2.77	800
Aug. 17	Thos. Grieve, jr.....	1.45	129

Daily discharge, in second-feet, of Laramie River near Jelm, Wyo., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Apr.	May.	June.	July.	Aug.	Sept.
1.....	88	58	80	185	1,050	330	145	90
2.....	88	58	80	185	990	310	110	70
3.....	78	67	80	170	880	250	110	60
4.....	67	67	60	200	930	215	110	60
5.....	67	67	70	215	1,050	215	120	60
6.....	58	67	70	310	930	185	100	60
7.....	49	67	70	555	785	185	120	60
8.....	67	67	70	785	830	170	100	52
9.....	67	67	70	880	990	170	80	52
10.....	49	67	80	1,500	1,110	170	132	170
11.....	49	67	100	625	990	158	110	132
12.....	49	67	100	625	930	158	100	120
13.....	58	88	110	555	990	120	100	145
14.....	58	78	110	555	880	120	120	110
15.....	67	88	110	555	830	145	110	90
16.....	67	99	100	400	785	170	90	80
17.....	67	88	100	430	830	120	100	80
18.....	78	99	110	430	830	120	110	70
19.....	78	110	110	375	700	120	90	60
20.....	78	.....	100	460	660	100	80	60
21.....	88	.....	100	520	590	90	80	70
22.....	88	.....	110	460	555	90	80	70
23.....	99	.....	110	350	520	80	80	60
24.....	88	.....	132	375	555	90	70	110
25.....	67	.....	158	490	555	80	70	100
26.....	58	.....	170	555	490	80	80	80
27.....	58	.....	200	625	375	120	90	70
28.....	58	.....	230	625	430	132	80	60
29.....	67	.....	270	660	430	120	80	90
30.....	67	.....	215	785	375	145	80	80
31.....	67	.....	.....	930	.....	230	100	.....

Monthly discharge of Laramie River near Jelm, Wyo., for the year ending Sept. 30, 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
October.....	99	49	68.8	4,230.
November 1-19.....	110	58	75.6	2,850
April.....	270	60	116	6,900
May.....	1,500	170	528	32,500
June.....	1,110	375	762	45,300
July.....	330	80	154	9,470
August.....	145	70	97.6	6,000
September.....	170	52	82.4	4,900

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, in 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 30, 1916. The records for 1913 and 1914 were obtained by the Laramie Water Co. and published by the State engineer. From 1895 to 1900 and 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, whose datum is 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 in the pool formed by diversion dam. Gage originally at left end of dam just below Pioneer canal head gates. Chain gage on Pioneer canal is at the Johnson bridge $1\frac{1}{2}$ miles below intake. Gage is read by W. H. McCumber.

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 and is permanent. Banks are high and not subject to overflow. Stage of zero flow, zero on gage. Bed of canal is composed of shale which changes somewhat; control not well defined.

EXTREMES OF DISCHARGE.—Laramie River: Maximum stage during year, from water-stage recorder, 1.9 feet for several hours, May 10 and June 13 (discharge, 980 second-feet); minimum stage (mean for day) 0.08 foot November 11 (discharge, 12 second-feet).

Pioneer canal: Maximum stage recorded, 2.18 feet at 4.35 p. m. June 30 (discharge, 119 second-feet); minimum discharge of about 2 second-feet occurs during winter when gates are closed.

ICE.—Stage-discharge relation not 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 approximately 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 permanent. Rating curve well defined below 400 second-feet, but somewhat uncertain above. Operation of water-stage recorder satisfactory except for short periods, 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 those for high water, which are good.

Pioneer canal station: Stage-discharge relation apparently permanent. Rating curve fairly well defined. Gage read to hundredths twice daily May 21 to June 30; once daily for remainder of period. Daily discharge ascertained by applying mean daily gage height to rating table. Records good.

COOPERATION.—The Laramie Water Co., through C. C. Schrontz, general manager, furnished gage-height record.

Discharge measurements of Laramie River near Woods, Wyo., during the year ending Sept. 30, 1916.

Date.	Made by—	Gage height.	Discharge.
		<i>Feet.</i>	<i>Sec.-ft.</i>
Jan. 3	R. I. Meeker.....	0.28	44.4
May 19	H. K. Smith.....	1.11	440
June 17	Robert Follansbee.....	1.71	880

Daily discharge, in second-feet, of Laramie River near Woods, Wyo., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1.....	47	66	56	42	53	42	42	239	900	293	147	53
2.....	47	63	56	45	53	53	42	266	825	293	94	29
3.....	29	61	61	49	47	53	42	266	825	293	94	22
4.....	29	63	61	49	49	53	42	322	864	266	94	17
5.....	29	66	63	63	53	53	42	350	900	239	94	15
6.....	25	66	63	53	53	42	32	440	864	239	71	15
7.....	25	49	61	53	53	53	32	640	788	214	94	24
8.....	42	32	58	53	53	53	32	788	788	190	74	29
9.....	34	29	58	53	53	53	32	862	788	190	56	27
10.....	42	29	58	53	53	79	42	940	864	214	88	110
11.....	61	12	61	53	53	79	53	825	900	214	91	128
12.....	49	21	49	58	53	110	66	750	864	168	58	117
13.....	49	30	42	53	53	110	79	750	940	128	51	117
14.....	34	38	42	53	53	79	66	714	864	110	63	91
15.....	56	34	40	53	53	79	79	640	825	110	56	74
16.....	69	47	45	49	53	66	66	590	788	168	47	53
17.....	79	47	47	49	53	79	66	535	788	128	51	34
18.....	69	47	40	49	53	79	66	640	788	110	53	24
19.....	61	51	36	53	66	79	79	714	750	94	38	27
20.....	34	61	32	53	66	94	79	640	712	94	34	30
21.....	15	61	20	58	66	110	66	570	640	79	40	33
22.....	58	58	32	53	53	79	79	605	570	66	32	36
23.....	79	58	38	53	53	94	79	675	470	53	29	40
24.....	91	61	40	49	53	79	110	675	410	53	27	45
25.....	85	58	42	49	53	66	128	640	410	53	24	53
26.....	79	58	40	49	53	66	147	640	380	53	27	42
27.....	74	61	36	49	42	53	190	570	380	66	34	31
28.....	79	53	42	53	42	53	266	605	350	128	36	31
29.....	79	51	36	53	42	53	322	714	350	94	29	34
30.....	79	53	36	49	.....	53	266	750	322	110	27	34
31.....	71	.....	40	49	.....	53	.....	825	.....	128	53	.....

NOTE.—Discharge interpolated Nov. 12, May 16, 24, 25, July 31, Sept. 19-23, as gage was not read.

Monthly discharge of Laramie River near Woods, Wyo., for the year ending Sept. 30, 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
October.....	91	15	54.8	3,370
November.....	66	12	49.5	2,950
December.....	63	30	46.5	2,860
January.....	63	42	51.6	3,170
February.....	66	42	52.9	3,040
March.....	110	42	69.3	4,260
April.....	322	32	91.1	5,420
May.....	940	239	619	38,100
June.....	940	322	697	41,500
July.....	293	53	150	9,220
August.....	147	24	58.3	3,580
September.....	128	15	47.2	2,810
The year.....	940	12	166	120,000

Discharge measurements of Pioneer canal near Woods, Wyo., during the year ending Sept. 30, 1916.

Rate.	Made by—	Gage height.	Dis-charge.
		<i>Feet.</i>	<i>Sec.-ft.</i>
Jan. 3	R. I. Meeker.....	.....	2.2
May 19	H. K. Smith.....	1.63	68
June 17	Robert Follansbee.....	2.09	106

Daily discharge, in second-feet, of Pioneer canal near Woods, Wyo., for the year ending Sept. 30, 1916.

Day.	Oct.	Apr.	May.	June.	July.	Aug.	Sept.
1.....	28	44	66	106	99	72	61
2.....	35	52	66	99	74	72	59
3.....	35	52	66	106	74	72	56
4.....	35	52	66	106	74	72	54
5.....	35	52	66	101	74	72	52
6.....	35	52	66	92	74	72	50
7.....	35	52	66	98	74	72	48
8.....	35	52	66	109	74	72	46
9.....	2	52	66	108	75	71	44
10.....	2	52	66	92	76	71	42
11.....	2	52	66	92	78	70	43
12.....	2	52	66	91	79	70	44
13.....	2	52	66	93	78	70	44
14.....	2	54	66	93	77	69	45
15.....	2	56	66	92	76	68	46
16.....	2	57	66	104	75	67	47
17.....	2	58	66	106	74	67	47
18.....	2	59	66	106	74	66	47
19.....	2	60	67	107	74	66	47
20.....	2	61	69	108	74	65	47
21.....	2	62	71	109	72	64	47
22.....	2	63	88	106	72	64	47
23.....	2	64	78	106	72	63	47
24.....	2	65	78	108	72	62	47
25.....	2	67	81	112	72	62	47
26.....	2	67	81	114	72	61	47
27.....	2	67	81	114	72	61	47
28.....	2	67	83	112	72	61	47
29.....	2	67	83	117	72	61	47
30.....	2	67	83	118	72	61	47
31.....	2	-----	101	-----	72	61	-----

NOTE.—Discharge interpolated Apr. 7-9, 11, 12, 14, 16-24, 26 to May 17, 19, 20, July 3-7, 9-11, 13-17, 19-22, 24, 25, 27-31, Aug. 2-5, 7-12, 14-25, 28-31, Sept. 2-9, 11-16, 18-23, 25-29, as gage was not read. Leakage through head gates estimated at 2 second-feet Oct. 12, 1915, to Mar. 29, 1916. Discharge Mar. 30-31, 46 second-feet.

Monthly discharge of Pioneer canal near Woods, Wyo., for the year ending Sept. 30, 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
October.....	35	2	10.3	633
November.....			a 2.0	119
December.....			a 2.0	123
January.....			a 2.0	123
February.....			a 2.0	115
March.....			a 4.84	298
April.....	67	44	57.6	3,439
May.....	101	66	72.0	4,430
June.....	118	91	104	6,190
July.....	99	72	74.8	4,690
August.....	72	61	67.0	4,120
September.....	61	42	48.0	2,860
The year.....	118	2	37.2	27,000

a Estimated.

Combined monthly discharge of Laramie River and Pioneer canal near Woods, Wyo., for the year ending Sept. 30, 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
October.....	93	17	65.1	4,000
November.....	68	14	51.5	3,060
December.....	65	32	48.5	2,680
January.....	65	44	53.6	3,300
February.....	68	44	54.9	3,160
March.....	112	44	74.1	4,560
April.....	389	84	149	8,870
May.....	1,010	305	691	42,500
June.....	1,030	440	801	47,700
July.....	392	125	224	13,800
August.....	219	86	125	7,690
September.....	171	65	95.1	5,660
The year.....	1,030	14	203	147,000

LARAMIE RIVER AT TWO RIVERS, WYO.

LOCATION.—In sec. 5, T. 17 N., R. 74 W., at highway bridge at Two Rivers, in Albany County. Nearest tributary, Little Laramie River, enters one-fourth 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 September 30, 1916. 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; shifting. No well defined control. Banks high and not subject to overflow.

EXTREMES OF DISCHARGE.—Maximum stage, from water stage recorder, 3.45 feet at 1 p. m. June 9 (discharge, 566 second-feet); minimum discharge probably occurs during winter months.

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 not permanent; control shifting at high stages.

Rating curve used October 1 to November 11 fairly well defined; curve used after June 20 not well defined. Operation of water-stage recorder fairly satisfactory except for periods when clock ran down, as shown in footnote to daily-discharge table. Daily discharge ascertained by applying to rating table mean daily gage height determined by inspection of gage-height graph; shifting-control method used May 5 to June 12. Records good.

COOPERATION.—Gage-height record furnished by Laramie Water Co., through C. C. Schrontz, general manager.

Discharge measurements of Laramie River at Two Rivers, Wyo., during the year ending Sept. 30, 1916.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
Jan. 6	R. I. Meeker.....	<i>Feet.</i> a 1.98	<i>Sec.-ft.</i> 38.9	July 8	H. K. Smith.....	<i>Feet.</i> 1.61	<i>Sec.-ft.</i> 119
Feb. 15	R. H. Fletcher.....	a 2.60	70	Apr. 17	do.....	1.20	53
May 5	Follansbee and Smith..	1.41	106				

a Stage-discharge relation affected by ice.

Daily discharge, in second-feet, of Laramie River at Two Rivers, Wyo., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	May.	June.	July.	Aug.	Sept.
1.	88	113	-----	386	180	67	75
2.	54	107	-----	410	150	84	-----
3.	46	97	-----	446	120	75	-----
4.	44	80	-----	470	110	67	-----
5.	45	86	60	446	120	60	-----
6.	45	86	53	350	130	48	-----
7.	42	84	42	386	120	75	-----
8.	36	84	53	434	110	53	-----
9.	24	80	92	482	96	60	-----
10.	20	75	182	446	90	60	-----
11.	21	97	272	386	100	70	-----
12.	28	-----	362	434	112	83	-----
13.	42	-----	350	450	100	48	-----
14.	50	-----	266	465	90	42	-----
15.	54	-----	266	480	78	38	-----
16.	61	-----	314	492	75	30	-----
17.	77	-----	338	502	104	38	-----
18.	80	-----	362	450	98	42	-----
19.	89	-----	374	400	96	53	-----
20.	97	-----	326	338	92	12	-----
21.	97	-----	314	326	101	21	-----
22.	99	-----	310	183	101	56	-----
23.	107	-----	300	218	92	92	-----
24.	89	-----	350	266	83	60	-----
25.	93	-----	315	254	75	75	-----
26.	97	-----	278	242	75	48	-----
27.	99	-----	338	266	53	75	-----
28.	103	-----	362	278	48	83	-----
29.	103	-----	398	230	42	67	-----
30.	103	-----	434	205	48	48	-----
31.	99	-----	446	-----	55	75	-----

NOTE.—Discharge estimated by comparison with record of flow of Laramie River near Woods May 10, 11, 22-25, June 13-19, 30, July 1, 2, 9-19, 30, 31, Aug. 11, 22.

Monthly discharge of Laramie River at Two Rivers, Wyo., for the year ending Sept. 30, 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
October.....	107	20	68.8	4,230
November 1-11.....	113	75	89.9	1,960
May 5-31.....	446	42	280	15,000
June.....	502	183	371	22,100
July.....	180	42	95.0	5,840
August.....	92	12	57.5	3,540

LARAMIE RIVER NEAR LOOKOUT, WYO.

LOCATION.—About sec. 33, T. 21 N., R. 74 W., at steel highway bridge 9 miles north-east of Lookout, in Albany County. No tributary of importance between station and Wheatland reservoir No. 2, located 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 September 30, 1916, State engineer maintained station at this point during 1913 and 1914.

GAGE.—Bristol water-stage recorder on downstream 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 only at intervals, and practically permanent during 1916.

EXTREMES OF DISCHARGE.—Maximum stage during year, from water-stage recorder, 3.1 feet at 6 p. m. June 17 (discharge, 681 second-feet); minimum discharge probably occurs during winter months.

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 the Lookout station.

REGULATION.—None.

ACCURACY.—Stage-discharge relation practically permanent. Rating curve fairly well defined between 20 and 700 second feet. Operation of water-stage recorder fairly satisfactory except for short periods 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 good.

COOPERATION.—Gage-height record furnished by the Laramie Water Co. through C. C. Schrontz, general manager.

Discharge measurements of Laramie River near Lookout, Wyo., during the year ending Sept. 30, 1916.

Date.	Made by—	Gage height.	Discharge.
		<i>Feet.</i>	<i>Sec.-ft.</i>
May 4	Follansbee and Smith.....	1.72	100
June 15	Robert Follansbee.....	3.04	647
July 22	Follansbee and Hoyt.....	1.72	91

Daily discharge, in second-feet, of Laramie River near Lookout, Wyo., for the year ending Sept. 30, 1916.

Day.	Oct.	Apr.	May.	June.	July.	Aug.	Sept.
1.....	28		91	317	189	60	34
2.....	35		130	360	173	60	34
3.....	51		130	430	158	80	34
4.....	48		104	482	158	189	38
5.....	44		80	455	158	297	42
6.....	49		80	430	143	116	46
7.....	49		80	455	143	104	50
8.....	51		104	508	143	91	60
9.....	51		116	482	158	80	60
10.....	49		189	430	130	80	50
11.....	44		277	430	130	80	60
12.....	35		360	508	130	91	60
13.....	34		382	563	130	80	60
14.....	35		382	592	143	91	69
15.....	42		382	592	130	80	91
16.....	50		382	621	130	69	91
17.....	60		360	621	116	69	69
18.....	75		317	621	114	60	69
19.....	80		297	592	111	60	52
20.....	90		297	651	109	60	34
21.....	95		277	592	106	60	27
22.....	105		240	508	104	50	34
23.....	114		244	430	91	50	34
24.....	106		248	360	91	42	27
25.....	109		251	317	80	42	27
26.....	106		254	258	69	50	20
27.....	104	60	258	158	69	42	20
28.....	104	60	277	189	69	42	20
29.....	109	69	297	143	69	42	27
30.....	109	91	297	158	69	34	34
31.....	104		297		69	34	

NOTE.—Discharge estimated Oct. 16-22, May 23-26, July 18-21, Sept. 4-6, 19, by comparison with records of flow of Laramie River near Woods.

Monthly discharge of Laramie River near Lookout, Wyo., for the year ending Sept. 30, 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
October.....	114	28	69.8	4,290
April 27-30.....	91	60	70.0	555
May.....	382	80	241	14,800
June.....	651	143	442	26,300
July.....	189	69	119	7,320
August.....	297	34	76.9	4,730
September.....	91	20	45.8	2,730

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, in 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 to September 9, 1916.

GAGE.—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.—Bed composed of coarse gravel. Control at small rapids 100 feet downstream.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 2.55 feet, June 16-17 (discharge, 652 second-feet); minimum discharge probably occurs during winter months.

ICE.—No information.

DIVERSIONS.—One small diversion between this station and that at McGill.

REGULATION.—Flow at station shows effect of storage in Wheatland reservoir which has an adjudicated decree for 633 second-feet and a storage capacity of approximately 110,000 acre-feet. Entire flow of Laramie River below Lookout passes through Wheatland reservoir.

ACCURACY.—Stage-discharge relation apparently permanent. Rating curve not well defined, being based on only three measurements. Gage read to quarter tenths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table. Records fair.

COOPERATION.—Gage-height record furnished by Laramie Water Co. through C. C. Schrontz, general manager.

Discharge measurements of Laramie River below McGill, Wyo., during the year ending Sept. 30, 1916.

Date.	Made by—	Gage height.	Discharge.
		<i>Feet.</i>	<i>Sec.-ft.</i>
May 4	Follansbee and Smith.....	0.65	a8
June 15	Robert Follansbee.....	2.43	560
Aug. 17	H. K. Smith.....	1.24	96

a Estimated.

Daily discharge, in second-feet, of Laramie River below McGill, Wyo., for the year ending Sept. 30, 1916.

Day.	May.	June.	July.	Aug.	Sept.	Day.	May.	June.	July.	Aug.	Sept.
1.....		492	615	88	25	16.....	344	652	367	107	.....
2.....		479	580	128	14	17.....	467	652	300	107	.....
3.....		492	544	128	14	18.....	479	630	260	107	.....
4.....	10	531	544	70	10	19.....	479	615	209	38	.....
5.....	10	544	544	.....	5	20.....	358	615	209	25	.....
6.....	7	512	544	.....	2	21.....	344	622	179	14	.....
7.....	98	544	512	.....	2	22.....	450	615	166	5	.....
8.....	249	544	479	.....	1	23.....	479	615	147	25	.....
9.....	329	615	450	.....	1	24.....	479	615	138	25	.....
10.....	344	615	479	.....	.....	25.....	479	615	128	25	.....
11.....	367	645	479	.....	.....	26.....	580	615	124	25	.....
12.....	329	622	420	.....	.....	27.....	492	615	88	53	.....
13.....	320	372	420	128	.....	28.....	486	615	111	38	.....
14.....	320	378	394	107	.....	29.....	512	580	115	38	.....
15.....	320	580	394	103	.....	30.....	492	615	72	38	.....
						31.....	492	.....	98	38	.....

NOTE.—No record Aug. 5-12.

Monthly discharge of Laramie River below McGill, Wyo., for the year ending Sept. 30, 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
✓ May 4-31.....	580	7	361	20,000
June.....	652	372	575	34,200
July.....	615	72	326	20,000

LARAMIE RIVER NEAR WHEATLAND, WYO.

LOCATION.—In sec. 35, T. 25 N., R. 69 W., at highway bridge at Wheeler ranch, 10 miles northwest of Wheatland, in Platte County. Nearest tributary, Sibylee Creek, enters one-half mile below.

DRAINAGE AREA.—2,480 square miles (measured on base map of Wyoming; scale, 1:500,000).

RECORDS AVAILABLE.—April 13 to November 9, 1912; April 1, 1915, to November 10, 1916, when station was discontinued. State engineer maintained station at this point during 1913 and 1914.

GAGE.—Chain gage on upstream side of bridge; read by John Wilkinson. During 1912 a staff gage on right bank 300 feet above bridge; no determined relation between gages.

DISCHARGE MEASUREMENTS.—Made from single-span bridge or by wading.

CHANNEL AND CONTROL.—Bed composed of sand and gravel. Control 100 feet downstream at small rapids which form a pool at ordinary stages; permanent during 1916. Banks not subject to overflow. Stage of zero flow, about 0.2 foot.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 1.1 feet at 6 p. m. March 13 (discharge, 40 second-feet); minimum discharge practically zero during parts of August and September.

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 14 second-feet from Laramie River between the station at McGill and this station. In addition, there is an adjudicated decree of 633 second-feet for storage in Wheatland reservoir (capacity about 110,000 acre-feet) above McGill. Water from this reservoir passes McGill but is diverted above the Wheatland station.

REGULATION.—See diversions.

ACCURACY.—Stage-discharge relation practically permanent after winter of 1915-16.

Rating curve well defined below 40 second-feet. Gage read to quarter tenths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table. Records good.

COOPERATION.—Gage-height records furnished by Laramie Water Co. through C. C. Schrontz, general manager.

Discharge measurements of Laramie River near Wheatland, Wyo., during the year ending Sept. 30, 1916.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		<i>Feet.</i>	<i>Sec.-ft.</i>			<i>Feet.</i>	<i>Sec.-ft.</i>
Oct. 9	M. N. Grant, jr.	0.62	9.2	June 16	H. K. Smith.	0.41	1.7
Apr. 4	R. H. Fletcher. ....	.72	14.2	July 8	R. H. Fletcher. ....	.40	a 1.0

a Estimated.

Daily discharge, in second-feet, of Laramie River near Wheatland, Wyo., for the period Oct. 1, 1915, to Nov. 10, 1916.

Day.	Oct.	Nov.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1.....	13	10	.....	17	10	6	3	2	0	2.0	6.0
2.....	10	10	.....	18	9	6	2	2	0	2.2	6.0
3.....	10	10	.....	18	9	3	2	1	0	2.8	6.4
4.....	9	10	.....	12	10	5	1	1	0	3.8	6.0
5.....	10	10	.....	12	7	2	2	1	0	4.0	6.0
6.....	8	10	.....	12	4	2	2	1	0	4.0	6.0
7.....	9	10	.....	14	3	2	2	1	0	4.0	6.4
8.....	10	10	.....	12	3	1	2	0	0	4.0	6.4
9.....	10	10	.....	11	2	2	2	0	0	6.0	6.0
10.....	9	10	.....	11	2	2	2	0	0	6.0	6.4
11.....	8	10	.....	12	2	4	2	0	0	6.0	.....
12.....	9	6	31	12	4	9	3	1	1	6.0	.....
13.....	10	6	34	12	7	9	3	1	0	6.0	.....
14.....	10	6	34	12	14	7	2	1	0	4.0	.....
15.....	10	7	25	12	10	2	2	1	1	6.0	.....
16.....	16	7	20	14	8	2	2	1	1	6.0	.....
17.....	17	7	18	14	8	2	2	0	1	6.0	.....
18.....	16	7	18	13	8	7	2	0	1	7.2	.....
19.....	15	7	24	11	9	13	2	0	1	7.6	.....
20.....	12	7	25	11	18	14	2	0	1	7.6	.....
21.....	11	8	31	12	23	13	2	0	1	8.0	.....
22.....	11	9	31	11	18	8	1	0	1	8.0	.....
23.....	10	10	19	10	16	4	1	0	1	10	.....
24.....	10	9	24	10	16	3	1	0	1	10	.....
25.....	10	8	20	8	12	3	1	0	1	10	.....
26.....	10	7	14	9	10	3	1	0	1	9.0	.....
27.....	10	8	14	10	8	4	0	0	1	9.0	.....
28.....	10	7	16	10	8	3	1	0	2	7.6	.....
29.....	10	7	25	8	7	2	2	0	2	7.2	.....
30.....	10	7	25	10	6	3	2	0	2	7.2	.....
31.....	10	.....	20	.....	6	.....	2	0	.....	6.4	.....

NOTE.—Discharge estimated Nov. 13-22, 24, 25, 27-30, 1915, because of ice. Shifting-control methods used during open water, Oct. 1 to Nov. 30, 1915. Gage read, but data insufficient for estimates of flow, Nov. 11-18, 1916.

Monthly discharge of Laramie River near Wheatland, Wyo., for the period Oct. 1, 1915, to Nov. 10, 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
1915-16.				
October.....	17	8	10.7	658
November.....	10	6	8.33	496
March.....	34	14	23.4	928
April.....	18	8	11.9	708
May.....	23	2	8.94	550
June.....	14	1	4.93	293
July.....	3	0	1.81	111
August.....	2	0	.45	27.7
September.....	2	0	.67	39.9
1916.				
October.....	10	2	6.25	384
November 1-10.....	6.4	6	6.16	122

LARAMIE RIVER AT FORT LARAMIE, WYO.

LOCATION.—In sec. 28, T. 26 N., R. 64 W., at highway bridge at Fort Laramie, in Goshen County. No large tributary between station and mouth. $1\frac{1}{2}$ 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, 1916.

GAGE.—Vertical staff; read by Geo. Sandercock.

DISCHARGE MEASUREMENTS.—Made from highway bridge.

CHANNEL AND CONTROL.—No information.

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

DIVERSIONS.—By decree of district court dated December 27, 1912, there are adjudicated diversions of 47 second-feet between station near Laramie and Fort Laramie.

REGULATION.—See Laramie River below McGill, page 221.

COOPERATION.—Daily discharge 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, 1916.

Day.	Oct.	Nov.	May.	June.	July.	Aug.	Sept.
1.....	179	157	149	41	9.8	3.8	5.7
2.....	170	153	149	37	9.8	3.8	5.7
3.....	161	153	149	37	9.8	3.8	5.7
4.....	161	153	149	38	9.8	3.8	5.7
5.....	166	157	140	33	9.8	3.8	5.7
6.....	157	157	128	27	9.2	48.0	5.7
7.....	157	157	103	25	9.2	91.0	5.7
8.....	157	166	77	24	8.6	13.0	5.7
9.....	170	157	60	24	7.5	9.8	6.0
10.....	170	161	50	23	7.0	8.6	6.5
11.....	170	157	44	22	7.0	7.5	7.5
12.....	170	157	40	25	7.0	7.0	8.6
13.....	170	157	91	23	6.0	7.0	8.6
14.....	170	170	115	22	5.7	6.5	8.0
15.....	170	182	136	21	5.7	5.7	7.5
16.....	191	182	84	19	5.4	5.7	7.0
17.....	211	157	52	16	5.0	5.7	6.5
18.....	228	157	41	17	5.0	5.7	6.5
19.....	215	166	52	18	4.8	5.7	6.5
20.....	211	161	65	15	4.8	5.7	7.0
21.....	204	166	80	13	4.6	5.7	7.0
22.....	200	161	115	11	4.6	5.7	8.0
23.....	200	161	88	12	4.6	5.4	9.2
24.....	191	157	88	12	4.3	5.4	11.0
25.....	187	157	88	11	4.0	5.0	11.0
26.....	182	157	95	11	4.0	5.0	11.0
27.....	182	153	91	11	3.9	5.4	11.0
28.....	182	153	91	11	3.8	5.7	12.0
29.....	174	155	56	10	3.8	5.7	12.0
30.....	170	157	60	9.8	3.8	5.7	13.0
31.....	170	.....	48	.....	3.8	5.7	.....

NOTE.—Discharge estimated May 1 and Aug. 31.

Monthly discharge of Laramie River at Fort Laramie, Wyo., for the year ending Sept. 30, 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
October.....	228	157	181	11,100
November.....	182	153	160	9,520
May.....	149	40	86.5	5,500
June.....	41	9.8	20.6	1,230
July.....	9.8	3.8	6.20	381
August.....	91	3.8	10.1	621
September.....	13	5.7	7.90	470

NOTE.—Monthly discharge computed by engineers of United States Geological Survey from records of daily flow furnished by United States Reclamation Service.

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, in Albany County. No tributary of importance 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.—May 14, 1911, to October 31, 1912; April 1, 1915, to September 30, 1916. 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 site used during 1911 and 1912.

DISCHARGE MEASUREMENTS.—Made from single-span bridge or by wading.

CHANNEL AND CONTROL.—Bed composed of coarse gravel and small boulders, No well-defined control. At high stages water flows through channel around right end of bridge.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 3.3 feet at 7 a. m. June 10, 11, and 12 (discharge, 739 second-feet); minimum discharge, probably occurs during winter months.

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 changed during winter period. Rating curve used October 1 to November 16 well defined; curve used after March 26 fairly well defined above 100 second-feet, but poorly defined below. Gage read to hundredths twice daily. Discharge ascertained by applying mean daily gage height to rating table. Records good.

Discharge measurements of Little Laramie River near Filmore, Wyo., during the year ending Sept. 30, 1916.

Date.	Made by—	Gage height.	Discharge.
		<i>Feet.</i>	<i>Sec.-ft.</i>
May 20	H. K. Smith.....	1.91	170
June 13	Robert Follansbee.....	3.04	535
July 8	H. K. Smith.....	1.72	130

Daily discharge, in second-feet, of Little Laramie River near Filmore, Wyo., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	48	40		25	388	499	178	96	36
2	44	40		27	261	409	156	84	23
3	44	36		33	79	388	156	92	25
4	44	36		28	79	409	146	92	19
5	40	36		30	102	602	136	88	18
6	37	36		16	136	499	127	127	18
7	36	36		19	203	368	127	85	19
8	36	36		13	203	368	118	71	21
9	36	36		28	216	499	127	64	18
10	39	36		30	277	656	146	60	25
11	43	36		31	277	656	156	57	23
12	46	36		37	277	656	127	51	20
13	43	37		36	261	656	127	56	23
14	42	40		40	277	475	97	64	23
15	39	41		40	230	475	110	61	21
16	46	43		40	190	475	136	46	21
17	62			40	33	452	118	50	19
18	79			40	71	452	102	47	18
19	67			40	146	452	91	39	18
20	46			40	167	409	91	64	17
21	46			40	230	368	85	34	16
22	47			40	203	294	86	34	13
23	48			40	156	216	85	28	12
24	48			110	146	216	80	29	12
25	43			230	216	190	78	27	12
26	43		41	277	216	190	79	29	12
27	42		31	330	230	203	78	31	12
28	42		34	409	245	216	73	33	13
29	40		40	430	245	216	94	30	18
30	40		15	294	330	190	118	52	19
31	40		11		388		118	46	

Monthly discharge of Little Laramie River near Filmore, Wyo., for the year ending Sept. 30, 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
October	79	36	45.0	2,770
November 1-16	43	36	37.5	1,190
March 26-31	41	11	28.7	342
April	430	13	94.4	5,620
May	388	33	209	12,900
June	656	190	405	24,100
July	178	73	114	7,010
August	127	27	57.0	3,500
September	36	12	18.8	1,120

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, in 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 September 30, 1916. State engineer maintained station at this point during 1913 and 1914.

GAGE.—Bristol water-stage recorder located at bridge. Gage used during 1913 and 1914 was 400 feet downstream and was 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, 2.9 feet at 5 p. m. June 21 (discharge, 118 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 this station and the one near Filmore; none below station.

REGULATION.—None.

ACCURACY.—Stage-discharge relation practically permanent. Rating curve fairly well defined. Operation of water-stage recorder fairly satisfactory until last part of July after which gage heights were of little value. Daily discharge ascertained by applying to rating table, mean daily gage height determined by inspecting gage-height graph. Records fair.

COOPERATION.—Gage-height records furnished by Laramie Water Co., through C. C. Schrontz, general manager.

Discharge measurements of Little Laramie River at Two Rivers, Wyo., during the year ending Sept. 30, 1916.

Date.	Made by—	Gage height.	Dis-charge.	Date.	Made by—	Gage height.	Dis-charge.
		<i>Feet.</i>	<i>Sec.-ft.</i>			<i>Feet.</i>	<i>Sec.-ft.</i>
Jan. 6	R. I. Meeker		0.8	May 5	Follansbee and Smith	1.53	3.6
Feb. 15	R. H. Fletcher	a 3.70	3.8	July 8	H. K. Smith	1.30	b 1.0

a Stage-discharge relation affected by ice.

b Estimated.

Daily discharge, in second-feet, of Little Laramie River at Two Rivers, Wyo., for the year ending Sept. 30, 1916.

Day.	Oct.	Jan.	Feb.	May.	June.	July.	Aug.
1.....	7				22	3.0	
2.....	6				39	2.0	
3.....	4				43	2.0	
4.....	3			3	43	2.0	
5.....	3			2	39	2.0	
6.....	3	0.8		2	32	1.0	
7.....	3			2	35	1.0	
8.....	3			2	32	.8	
9.....	3			3	25	.8	
10.....	3			3	22	.8	
11.....	3			4	28	.8	
12.....	4			4	32	.8	
13.....	5			3	41	.8	5
14.....	10			5	49	.8	6
15.....	14		3.8	8	58	.8	5
16.....	23			6	67	.8	5
17.....	37			2	76	.8	4
18.....	38			2	84	.8	3
19.....	36			2	93	.8	3
20.....	32			1	102	.8	2
21.....	29			2	110	.8	2
22.....	26			2	74		2
23.....	22			2	52		3
24.....	16			2	39		2
25.....	7			3	28		2
26.....	4			3	22		2
27.....	3			3	17		2
28.....	2			5	10		2
29.....	1.3			5	8		2
30.....	1.0			8	5		2
31.....	.7			10			2

NOTE.—Discharge interpolated May 8-11, 23-25, June 13-20, and July 2, 14-19. Practically no flow July 21-31, and Sept. 9-19. No gage-height record Aug. 1-11, Sept. 1-8, and 20-30.

Monthly discharge of Little Laramie River at Two Rivers, Wyo., for the year ending Sept. 30, 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
October.....	38	0.7	11.4	701
May 4-31.....	10	1	3.54	197
June.....	110	5	44.2	2,630
July.....	3	0	.78	48
August 12-31.....	6	2	3.10	123

SIBYLEE CREEK NEAR WHEATLAND, WYO.

LOCATION.—In sec. 35, T. 25 N., R. 69 W., just above highway bridge half a mile above mouth and 10 miles northwest of Wheatland, in Platte County. No tributary between station and mouth.

DRAINAGE AREA.—568 square miles (measured on base map of Wyoming; scale, 1:500,000).

RECORDS AVAILABLE.—May 23, to November 4, 1912; April 1, 1915, to November 10, 1916, when station was discontinued. State engineer maintained station at this point during 1913 and 1914.

GAGE.—Vertical staff on left bank 150 feet above bridge; read by John Wilkinson. Gage used in 1912 was on opposite bank and was referred to datum 1.15 feet lower.

DISCHARGE MEASUREMENTS.—Made from single-span bridge, or by wading.

CHANNEL AND CONTROL.—Bed composed of sand and gravel. Control short distance downstream; slightly shifting. Banks not subject to overflow. Stage of zero flow, about 0.2 foot.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 1.55 feet at 7 a. m. May 12 (discharge, 148 second-feet); practically no flow during summer.

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 187 second-feet from Sibylee Creek, and 35 second-feet from tributaries, all above the station.

REGULATION.—None.

ACCURACY.—Stage-discharge relation not permanent; control shifting. Standard rating curve well defined; applied indirectly Mar. 12 to May 15. Gage read to hundredths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table. Records fair.

COOPERATION.—Gage-height record furnished by Laramie Water Co., through C. C. Schrontz, general manager.

Discharge measurements of Sibylee Creek near Wheatland, Wyo., during the year ending Sept. 30, 1916.

Date.	Made by—	Gage height.	Dis-charge.	Date.	Made by—	Gage height.	Dis-charge.
		<i>Feet.</i>	<i>Sec.-ft.</i>			<i>Feet.</i>	<i>Sec.-ft.</i>
Oct. 9	M. N. Grant, jr.....	0.60	11.3	June 16	H. K. Smith.....	0.40	2.8
Apr. 4	R. H. Fletcher.....	.88	49.1	July 8	R. H. Fletcher.....	.31	a.6

a Estimated.

Daily discharge, in second-feet, of Sibylee Creek near Wheatland, Wyo., for the period Oct. 1, 1915, to Nov. 10, 1916.

Day.	Oct.	Nov.	Mar.	Apr.	May.	June.	July.	Oct.	Nov.
1	7	10		53	17	2	0		2.0
2	6	22		45	15	3	0		2.0
3	6	17		55	11	2	0		1.8
4	7	18		55	8	2	1.2		1.8
5	7	18		46	5	14	.6		1.6
6	6	18		50	2	14	.8	0.1	2.0
7	7	17		52	2	8	1.0	.1	1.5
8	10	16		51	2	4	1.2	.2	1.6
9	10	18		50	5	4	.5	.2	1.5
10	10	18		45	33	2	.5	.2	2.0
11	10	18		47	27	2	.6	.2	
12	10	14	77	51	122	4	.8	.2	
13	10	18	77	51	70	5	.4	.2	
14	10	18	83	45	118	22	.4	.0	
15	10	18	68	46	53	8	.6	.2	
16	24	19	74	47	16	3	.6	.2	
17	28	20	65	42	11	1	.4	.1	
18	27	31	68	50	24	1	.4	.2	
19	25	20	68	46	18	5	.2	.2	
20	19	22	78	46	33	4	.2	.2	
21	19	27	94	47	64	2	.2	.2	
22	20	25	83	45	14	4	.2	.9	
23	20	25	68	40	13	2	.1	1.0	
24	20	27	72	46	29	2		1.1	
25	20	25	65	27	38	1		1.0	
26	20	25	52	24	27	2		1.2	
27	17	20	52	22	22	4		1.8	
28	17	24	52	22	27	2		1.6	
29	8	24	55	18	14	1		1.6	
30	6	24	58	17	8	1		1.8	
31	6		57		4			1.9	

NOTE.—Practically no-flow July 1-3, and July 24 to Oct. 5, 1916, gage read Nov. 11-18, 1916, but owing to ice, data inadequate for determination of flow.

Monthly discharge of Sibylee Creek near Wheatland, Wyo., for the period Oct. 1, 1915, to Nov. 10, 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
1915-16.				
October.....	28	6	13.6	836
November.....	31	10	20.5	1,220
March 12-31.....	94	52	68.3	2,710
April.....	55	17	42.7	2,540
May.....	122	2	27.5	1,690
June.....	22	1	4.27	254
July.....	1.2	0	0.35	21.5
August.....	.0	0	0.	0
September.....	.0	0	0.	0
1916.				
October.....	1.9	0	.54	33.2
November 1-10.....	2.0	1.5	1.78	35.3

NORTH LARAMIE RIVER NEAR WHEATLAND, WYO.

LOCATION.—In sec. 2, T. 25 N., R. 70 W., one-fourth mile above headgate of North Laramie Land Co.'s ditch and 13 miles northwest of Wheatland, in Platte County. No tributary of importance 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, 1916.

GAGE.—Bristol water-stage recorder on vertical cliff on left bank just below site of proposed dam.

DISCHARGE MEASUREMENTS.—Made from cable near gage or by wading.

CHANNEL AND CONTROL.—Bed composed of sand and gravel. Control 40 feet downstream at rapids; shifts somewhat.

EXTREMES OF DISCHARGE.—Maximum stage during year from water-stage recorder, 2.1 feet at 6 p. m., April 27 (discharge, 176 second-feet); stream practically dry after July 9.

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 the station and 27 second-feet below.

REGULATION.—None.

ACCURACY.—Stage-discharge relation shifts between narrow limits. Rating curve fairly well defined below 150 second-feet. Operation of water-stage recorder fairly satisfactory until June 5, after which it failed to record correctly; water below gage after July 15. Discharge ascertained by applying to rating table mean daily gage height determined by inspecting gage-height graph. Records fair.

COOPERATION.—Gage-height records furnished by North Laramie Land Co.

Discharge measurements of North Laramie River near Wheatland, Wyo., during the year ending Sept. 30, 1916.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
Oct. 9	M. N. Grant, jr.....	Feet. 1.35	Sec.-ft. 33.5	June 16	H. K. Smith.....	Feet. 1.10	15.7
Apr. 4	R. H. Fletcher.....	1.55	76	July 8	R. H. Fletcher.....	.70	a 1.5
5	do.....	1.60	84				

a Estimated.

Daily discharge, in second-feet, of North Laramie River near Wheatland, Wyo., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Dec.	Apr.	May.	June.	July.
1.....	45	8	2	85	145	88	6
2.....	45	8	2	80	135	106	5
3.....	40	8	4	79	125	96	5
4.....	40	8	6	71	115	88	4
5.....	40	11	4	63	115	79	3
6.....	35	8	1	79	106	71	3
7.....	30	6	2	71	115	66	2
8.....	35	4	.....	63	106	60	2
9.....	30	4	.....	71	106	55	.....
10.....	22	4	.....	88	96	49	.....
11.....	22	6	.....	125	88	44	.....
12.....	11	18	.....	145	79	38	.....
13.....	8	6	.....	135	79	32	.....
14.....	11	4	.....	135	79	27	.....
15.....	11	2	.....	135	71	22	.....
16.....	18	6	.....	155	79	16	.....
17.....	18	4	.....	155	96	15	.....
18.....	14	6	.....	155	135	14	.....
19.....	14	8	.....	155	106	14	.....
20.....	14	6	.....	155	88	13	.....
21.....	18	6	.....	155	96	12	.....
22.....	30	6	.....	155	79	12	.....
23.....	35	8	.....	145	79	11	.....
24.....	30	6	.....	145	79	10	.....
25.....	18	4	.....	155	79	10	.....
26.....	14	8	.....	155	79	9	.....
27.....	14	12	.....	166	79	9	.....
28.....	8	1	.....	155	71	8	.....
29.....	11	0	.....	155	71	7	.....
30.....	14	1	.....	155	71	7	.....
31.....	11	.....	.....	.....	79	.....	.....

NOTE.—Shifting-control method used Oct. 1 to Nov. 10. Discharge estimated Apr. 1, 2, June 7-15, 17-30, and July 1-7. Stream was almost dry for remainder of year. Observer reported considerable flow during March, but did not begin observations until Apr. 1.

Monthly discharge of North Laramie River near Wheatland, Wyo., for the year ending Sept. 30, 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
October.....	45	8	22.8	1,400
November.....	18	0	6.20	369
December 1-7.....	6	1	3.00	41.7
April.....	166	63	125	7,440
May.....	145	71	94.4	5,800
June.....	106	7	36.3	2,160
July 1-3.....	6	2	3.75	59.5

CHUGWATER CREEK AT CHUGWATER, WYO.

LOCATION.—In sec. 31, T. 21 N., R. 66 W., at highway bridge half a mile from railroad station at Chugwater, in 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, 1916. 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 site as vertical staff used previously; read by W. A. Taylor. 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; shifted slightly during 1916; control not well defined. Banks high and not subject to overflow.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 2.5 feet March 20, 21, and 24 (discharge, 90 second-feet); minimum stage, 1.02 feet on August 17 and 18 (discharge, 2.5 second-feet).

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

DIVERSIONS.—Prior to December 31, 1916, there were adjudicated diversions from Chugwater Creek of 73 second-feet above the station and 98 second-feet below.

REGULATION.—None.

ACCURACY.—Stage-discharge relation practically permanent except for one well-defined change March 20-24. Rating curve used before March 19 well defined, curve used after March 24 fairly well defined below 50 second-feet. Gage read to hundredths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table; shifting-control method used March 20-24. Records good.

Discharge measurements of Chugwater Creek at Chugwater, Wyo., during the year ending Sept. 30, 1916.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		<i>Feet.</i>	<i>Sec.-ft.</i>			<i>Feet.</i>	<i>Sec.-ft.</i>
Oct. 8	M. N. Grant, jr.....	1.67	33.4	June 17	H. K. Smith.....	1.18	4.8
Jan. 18	R. I. Meeker.....	1.34	12.3	July 7	R. H. Fletcher.....	1.12	3.8
Feb. 28	R. H. Fletcher.....	1.46	17.2	Sept. 3	P. V. Hodges.....	1.03	2.6
Apr. 6	do.....	1.80	29.8				

Daily discharge, in second-feet, of Chugwater Creek at Chugwater, Wyo., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1.....	27	30	21	14	13	16	31	13	4.9	3.1	2.8	2.6
2.....	26	30	20	15	13	14	31	12	4.9	3.1	2.7	2.6
3.....	26	30	23	14	13	21	31	13	4.9	3.1	2.7	2.7
4.....	26	30	25	14	14	25	30	10.4	4.9	3.1	2.7	2.7
5.....	26	30	27	14	14	39	30	11.0	4.9	3.1	2.7	2.6
6.....	26	30	26	13	13	21	31	7.8	4.9	3.0	2.7	2.6
7.....	26	30	22	13	14	20	31	7.8	5.3	3.0	2.6	2.6
8.....	26	30	21	13	14	30	31	6.6	4.9	2.8	2.6	2.6
9.....	26	30	21	15	16	36	31	5.3	4.9	3.0	2.6	2.6
10.....	26	30	22	16	21	36	29	5.3	4.9	3.0	2.6	2.6
11.....	26	26	21	13	19	36	29	5.3	5.1	3.0	3.0	2.6
12.....	26	20	21	12	19	36	31	5.3	5.1	3.0	2.8	2.7
13.....	26	20	17	13	19	44	48	5.3	5.3	3.0	2.6	2.6
14.....	26	19	20	13	20	44	40	5.3	5.1	3.0	2.6	2.6
15.....	32	10	20	14	21	52	41	5.3	4.9	2.8	2.6	2.6
16.....	42	25	17	14	21	52	38	5.3	4.9	2.8	2.6	2.6
17.....	40	20	14	13	29	50	33	5.3	4.9	2.8	2.5	2.6
18.....	40	20	13	13	25	54	32	5.3	4.9	2.8	2.5	2.6
19.....	40	23	13	13	27	52	29	5.3	4.9	3.1	2.6	2.6
20.....	40	34	14	13	27	76	29	9.4	5.1	3.1	2.6	2.6
21.....	36	23	16	13	30	78	23	12	4.9	3.0	2.6	2.6
22.....	36	27	23	13	25	66	19	9.4	4.9	2.8	2.6	2.6
23.....	33	26	25	13	27	63	15	7.3	4.9	2.7	2.6	2.6
24.....	33	26	23	13	27	90	17	6.6	4.9	2.8	2.6	2.6
25.....	33	26	12	13	26	38	19	5.8	4.8	2.7	2.6	2.7
26.....	33	19	14	14	22	40	24	5.6	4.8	2.7	2.6	3.0
27.....	33	20	14	13	21	30	26	5.3	4.6	2.8	2.6	3.0
28.....	33	15	14	13	20	30	18	5.3	4.2	2.8	2.6	3.0
29.....	33	15	14	13	18	31	14	5.3	3.9	2.8	2.6	3.0
30.....	33	25	14	13	.....	31	15	5.3	3.9	2.8	2.6	3.1
31.....	33	.....	15	13	.....	31	.....	4.9	.....	2.8	2.6	.....

NOTE.—Discharge estimated Dec. 16, May 14, July 28, 29, Aug. 12, Sept. 9, 10.

Monthly discharge of Chugwater Creek at Chugwater, Wyo., for the year ending Sept. 30, 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
October.....	42	26	31.2	1,920
November.....	34	10	24.6	1,460
December.....	27	12	18.8	1,160
January.....	16	12	13.4	824
February.....	30	13	20.3	1,170
March.....	90	14	41.4	2,550
April.....	48	14	28.2	1,680
May.....	13	4.9	7.16	440
June.....	5.3	3.9	4.85	289
July.....	3.1	2.7	2.92	180
August.....	3.0	2.5	2.64	162
September.....	3.1	2.6	2.68	159
The year.....	90	2.5	16.5	12,000

HORSE CREEK NEAR LA GRANGE, WYO.

LOCATION.—In SW. $\frac{1}{4}$ SW. $\frac{1}{4}$ sec. 34, T. 20 N., R. 61 W., 2 miles southeast of Wye-Cross ranch and $1\frac{1}{2}$ miles northwest of La Grange, in 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, 1916. From December 1, 1911, to December 31, 1912, fragmentary records are available for station at a point $1\frac{1}{4}$ 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; may shift. Control just below gage at small rapids; apparently permanent.

EXTREMES OF DISCHARGE.—Maximum stage affected by ice; maximum discharge, 104 second-feet, occurred at noon February 18; minimum stage, from water-stage recorder, 0.75 foot at 10.30 p. m. July 12 (discharge, 5.5 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 storage of 2,067 acre-feet above, and 5,202 acre-feet below station.

REGULATION.—None.

ACCURACY.—Stage-discharge relation practically permanent; affected by ice for short periods in January and February. Rating curve well defined below 80 second-feet. Operation of water-stage recorder satisfactory except for few days in winter when ice interfered. Records excellent.

Discharge measurements of Horse Creek near La Grange, Wyo., during the year ending Sept. 30, 1916.

Date.	Made by—	Gage height.	Dis-charge.	Date.	Made by—	Gage height.	Dis-charge.
		<i>Feet.</i>	<i>Sec.-ft.</i>			<i>Feet.</i>	<i>Sec.-ft.</i>
Oct. 26	Fletcher and Whiting..	1.50	50	Jan. 6	Fletcher and Whiting..	1.56	58
28	.....do.....	1.26	33.6	8	.....do.....	1.40	46.2
29	.....do.....	1.38	42.6	Apr. 6	R. H. Fletcher.....	1.18	27.8
29	.....do.....	1.14	22.7	July 6	.....do.....	.78	6.4
29	.....do.....	1.49	50				

Daily discharge, in second-feet, of Horse Creek near La Grange, Wyo., for the year ending Sept. 30, 1916.

Day.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1.....	52	46	45	32	66	48	9	9	9	9	15
2.....	52	47	45	32	43	38	10	8	9	9	14
3.....	53	49	53	34	45	34	10	9	8	9	14
4.....	53	56	59	32	65	32	10	9	8	8	14
5.....	54	60	56	35	70	31	10	9	7	9	14
6.....	54	58	57	41	64	27	10	8	7	10	14
7.....	54	55	48	37	54	27	10	7	6	11	14
8.....	51	54	48	41	59	31	10	7	7	12	14
9.....	51	54	54	45	61	33	10	7	7	12	14
10.....	52	54	44	50	60	35	10	8	8	11	14
11.....	53	45	45	65	61	32	10	7	8	10	14
12.....	50	45	37	68	60	31	11	7	6	11	15
13.....	51	49	37	59	60	30	12	8	6	11	15
14.....	40	51	36	68	60	29	12	9	6	11	14
15.....	50	57	35	69	59	31	12	9	6	11	14
16.....	53	38	34	83	59	30	11	9	7	11	14
17.....	64	27	33	85	56	27	11	9	7	10	14
18.....	50	41	32	84	55	24	11	9	7	10	14
19.....	51	47	34	79	55	23	11	9	6	10	14
20.....	53	47	41	82	54	22	11	10	6	11	14
21.....	50	50	48	78	55	21	12	9	6	10	14
22.....	51	64	41	76	54	20	12	10	6	9	14
23.....	50	64	48	74	54	20	12	9	6	10	14
24.....	52	58	46	63	59	20	13	9	6	11	14
25.....	52	46	48	69	63	18	12	9	6	9	14
26.....	49	53	45	61	62	16	11	9	6	16	12
27.....	49	55	41	60	59	14	10	9	7	14	12
28.....	40	52	39	56	55	14	10	9	8	12	12
29.....	39	42	37	53	54	9	10	9	8	14	12
30.....	54	34	36	.....	54	9	10	9	10	14	10
31.....	.....	49	32	.....	51	.....	10	.....	11	14	.....

NOTE.—Discharge estimated Jan. 10-13, 15-17, 26-28, and Jan. 31 to Feb. 6, when stage-discharge relation was affected by ice; also estimated Apr. 9, May 14-19, and Aug. 5-7.

Monthly discharge of Horse Creek near La Grange, Wyo., for the year ending Sept. 30, 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
November.....	64	39	51.2	3,050
December.....	64	27	49.9	3,070
January.....	59	32	43.0	2,640
February.....	85	32	59.3	3,410
March.....	70	51	57.6	3,540
April.....	48	9	25.9	1,540
May.....	13	9	10.7	658
June.....	10	7	8.60	512
July.....	11	6	7.13	438
August.....	16	8	10.9	670
September.....	15	10	13.7	816
The period.....				20,300

SOUTH PLATTE RIVER AT SOUTH PLATTE, COLO.

LOCATION.—In sec. 25, T. 7 S., R. 70 W., 300 feet below point where North Fork of South Platte enters at South Platte, in 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, 1916. 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 the records from 1895 to 1896 were taken under the direction of the Denver Power & Irrigation Co.

GAGE.—Bristol water-stage recorder on right bank 300 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 sand and fine gravel; shifts. Control 150 feet downstream at well-defined rapids; shifts considerably at times. Banks high and not subject to overflow.

ICE.—Stage-discharge relation seriously affected by ice; monthly mean discharge estimated from records obtained few miles below by Denver Union Water Co.

EXTREMES OF DISCHARGE.—Maximum stage during year, from water-stage recorder, 4.1 feet on June 15–16 (discharge, 1,130 second-feet); minimum discharge occurs during winter.

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 this water passes the gage before being diverted. There are also decrees for diversions of 1,075 second-feet from South Platte River, together with 3,326 second-feet and 46,000 acre-feet for a reservoir from tributaries above the station.

REGULATION.—Flow regulated to certain extent by Antero and Cheesman reservoirs on the South Platte, about 60 and 15 miles, respectively, above the forks.

ACCURACY.—Stage-discharge relation not permanent; shifts considerably at times; affected by ice during winter. Rating curves used as follows: October to December, well defined between 200 and 1,500 second-feet; March 7 to June 1, fairly well defined between 180 and 850 second-feet; June 3 to September 30, well defined between 75 and 400 second-feet, and fairly well defined to 1,000 second-feet. Operation of water-stage recorder continuous and fairly satisfactory. Daily discharge ascertained by applying to rating table mean daily gage height determined by inspecting gage-height graph. Records excellent for ordinary stages, good for high stages, and fair for extreme low water and for winter.

Discharge measurements of South Platte River at South Platte, Colo., during the year ending Sept. 30, 1916.

Date.	Made by—	Gage height.	Dis-charge.	Date.	Made by—	Gage height.	Dis-charge.
		<i>Feet.</i>	<i>Sec.-ft.</i>			<i>Feet.</i>	<i>Sec.-ft.</i>
Dec. 16	R. H. Fletcher.....	1.77	149	May 23	Follansbee and Smith..	3.75	740
Jan. 19	W. R. King.....	2.51	133	June 1	H. K. Smith.....	3.00	445
Feb. 10	do.....	2.62	136	July 8	W. R. King.....	3.38	800
Apr. 7	Thos. Grieve, Jr.....	2.05	196	Aug. 1	H. K. Smith.....	3.85	1,000

^a Stage-discharge relation affected by ice.

Daily discharge, in second-feet, of South Platte River at South Platte, Colo., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Dec.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1.....	432	252	174	74	182	252	438	408	980	347
2.....	515	252	150	32	182	278	530	471	1,000	347
3.....	452	235	139	53	182	265	645	714	1,080	327
4.....	432	235	162	80	171	332	834	691	1,030	288
5.....	432	235	174	108	182	525	906	622	956	252
6.....	452	252	150	108	193	620	882	668	810	252
7.....	310	270	150	38	193	581	786	714	762	234
8.....	235	270	139	55	182	562	810	738	738	218
9.....	310	290	150	55	216	562	882	762	691	218
10.....	432	270	150	76	216	581	1,000	762	691	218
11.....	452	252	150	76	216	562	956	810	668	269
12.....	452	162	128	69	228	544	931	786	645	269
13.....	452	118	128	76	240	525	1,000	645	645	269
14.....	473	96	150	76	252	507	1,030	762	600	327
15.....	515	365	150	62	240	472	1,080	762	556	347
16.....	515	212	128	69	228	454	1,080	622	622	327
17.....	494	217	145	69	216	472	980	600	668	269
18.....	473	161	162	76	228	438	906	556	668	252
19.....	473	185	139	62	228	421	714	578	691	234
20.....	412	203	139	304	216	472	691	556	645	218
21.....	370	188	188	360	216	562	668	492	645	234
22.....	412	188	188	375	216	640	600	460	600	202
23.....	412	174	162	332	216	740	556	429	578	202
24.....	310	174	174	291	216	700	534	408	534	160
25.....	270	162	139	252	228	640	513	408	556	110
26.....	290	150	174	240	240	600	471	556	534	110
27.....	310	188	150	228	252	544	408	534	513	98
28.....	310	118	150	228	278	489	388	534	429	98
29.....	290	162	174	216	278	454	408	612	388	110
30.....	290	162	203	216	278	438	408	691	408	134
31.....	270	.....	174	204	.....	438	.....	834	368	.....

NOTE.—Discharge estimated Nov. 14–19, Mar. 1–6, and June 2 from hydrograph comparison with records of Denver Union Water Co. at Platte Canyon. Discharge interpolated Dec. 17 and July 22, 29. Record discontinued Jan. 1 to Feb. 29. See footnote to table of monthly discharge.

Monthly discharge of South Platte River at South Platte, Colo., for the year ending Sept. 30, 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
October.....	515	235	395	24,300
November.....	365	96	207	12,300
December.....	203	128	156	9,590
January.....	.....	.....	118	7,260
February.....	.....	.....	124	7,130
March.....	375	32	147	9,040
April.....	278	171	220	13,100
May.....	740	252	505	31,100
June.....	1,080	388	734	43,700
July.....	834	408	619	38,100
August.....	1,080	368	668	41,100
September.....	347	98	231	13,700
The year.....	1,080	.....	345	250,000

NOTE.—Mean discharge for January and February computed from records obtained by Denver Union Water Co. at Platte Canyon by reducing them 1.4 per cent for difference in drainage area.

SOUTH PLATTE RIVER AT NORTH PLATTE, NEBR.

LOCATION.—In sec. 9, T. 13 N., R. 30 W., at pile-bent bridge half a mile south of North Platte, in Lincoln County. No tributary between station and mouth, 4 miles below.

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—June 1, 1914, to September 30, 1915.

GAGE.—Vertical staff fastened to pile bent of bridge; read once daily by Fred Spurrier.

DISCHARGE MEASUREMENTS.—Made from bridge.

CHANNEL AND CONTROL.—Shifting sand.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 5.5 feet at 8.45 a. m. April 1 (stage-discharge relation probably affected by ice); minimum stage recorded, 3.2 feet July 20, 21, 22, and 24 (discharge, 15 second-feet).

WINTER FLOW.—Stage-discharge relation seriously affected by ice, observations discontinued during winter.

DIVERSIONS.—Before September 1, 1914, there were approved diversions of 362 second-feet from South Platte River between Julesburg and North Platte.

REGULATION.—None.

ACCURACY.—Results fair; sufficient discharge measurements have been made to define fairly well the changes in stage-discharge relation. Daily discharge for April 1-13, as published in Water Supply Paper 406, page 253, is believed to be seriously in error due to effect of ice on stage-discharge relation.

COOPERATION.—Field data furnished by State engineer.

Discharge measurements of South Platte River at North Platte, Nebr., during the year ending Sept. 30, 1915.

Date.	Made by—	Gage height.	Dis-charge.	Date.	Made by—	Gage height.	Dis-charge.
		<i>Feet.</i>	<i>Sec.-ft.</i>			<i>Feet.</i>	<i>Sec.-ft.</i>
Apr. 19	C. J. McNamara.....	3.90	1,250	July 9	D. P. Weeks, jr.....	3.55	288
May 7	.....do.....	4.40	3,770	23	.....do.....	3.30	83
June 9	.....do.....	4.35	3,060	Aug. 9	.....do.....	3.70	388
26	D. P. Weeks, jr.....	3.98	1,200	Sept. 7	M. M. Garrett.....	3.40	211

Daily discharge, in second-feet, of South Platte River at North Platte, Nebr., for the year ending Sept. 30, 1915.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Day.	Apr.	May.	June.	July.	Aug.	Sept.
1.....		4,740	3,360	518	508	518	16.....	1,220	3,290	5,050	255	310	200
2.....		3,940	2,520	685	985	518	17.....	1,220	2,720	5,050	152	440	200
3.....		3,140	2,520	685	775	375	18.....	1,100	3,140	5,050	110	440	200
4.....		6,140	2,520	602	595	375	19.....	985	3,610	5,050	68	310	200
5.....		5,400	2,920	518	440	342	20.....	775	3,610	3,700	15	310	200
6.....		5,050	3,140	518	255	310	21.....	880	3,610	2,340	15	310	200
7.....		3,860	3,360	518	375	310	22.....	1,360	3,610	1,980	15	310	200
8.....		3,860	2,920	518	375	310	23.....	2,720	4,500	1,660	68	310	200
9.....		3,860	2,920	375	375	310	24.....	2,930	5,400	1,660	15	310	105
10.....		3,860	3,360	375	375	310	25.....	3,140	4,740	1,360	22	310	200
11.....		3,360	3,140	375	685	310	26.....	3,360	4,420	1,220	30	518	288
12.....		3,860	3,140	375	518	255	27.....	3,360	7,390	1,000	30	375	375
13.....		3,860	3,940	255	255	200	28.....	3,360	11,400	775	30	685	518
14.....	1,220	3,860	4,740	255	255	200	29.....	2,920	8,330	775	30	602	518
15.....	1,220	3,860	4,740	255	282	200	30.....	2,920	7,010	775	200	518	375
							31.....		5,750		30	518	.....

NOTE.—Discharge determined by indirect method for shifting control; discharge interpolated Apr. 18, 24, 25, May 2, 9, 16, 23, 30, June 6, 13, 20, 27, July 4, 11, 18, 25, Aug. 1, 8, 15, 22, 29, Sept. 5, 11, 19, 26; not determined Oct. 1 to Dec. 10. Gage height not recorded for days for which discharge was interpolated nor for Oct. 4, 11, 18, 25, Nov. 1, 8, 15, 22, 29, Dec. 6, and Dec. 11 to Mar. 31.

Monthly discharge of South Platte River at North Platte, Nebr., for the year ending Sept. 30, 1915.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
April 14-30.....	3,360	775	2,040	68,800
May.....	11,400	2,720	4,680	288,000
June.....	5,050	775	2,890	172,000
July.....	685	15	255	15,700
August.....	985	255	440	27,100
September.....	518	105	294	17,500
The period.....				589,000

LITTLE SOUTH PLATTE RIVER NEAR FAIRPLAY, COLO.

LOCATION.—In sec. 26, T. 11 S., R. 77 W., at Twin Bridges, about 5 miles northwest of Antero reservoir and 12 miles south of Fairplay, in Park County, on road to Buena Vista.

DRAINAGE AREA.—88 square miles.

RECORDS AVAILABLE.—May 9 to September 30, 1916.

GAGE.—Vertical staff and Bunker water-stage recorder on upstream side of old bridge.

DISCHARGE MEASUREMENTS.—Made from bridge or by wading.

COOPERATION.—Daily discharge records furnished by Van Sant-Houghton Co., engineers, of Denver.

Discharge measurements of Little South Platte River near Fairplay, Colo., during the year ending Sept. 30, 1916.

Date.	Made by—	Gage height.	Dis- charge.	Date.	Made by—	Gage height.	Dis- charge.
May 9	M. E. Bunker.....	<i>Feet.</i> 7.60	<i>Sec.-ft.</i> 69.1	June 15	M. E. Bunker.....	<i>Feet.</i> 7.93	<i>Sec.-ft.</i> 114
27	do.....	7.50	58.2	July 15	do.....	7.38	39.3
31	M. N. Grant, Jr.....	7.63	76.0				

Daily discharge, in second-feet, of Little South Platte River near Fairplay, Colo., for the year ending Sept. 30, 1916.

Day.	May.	June.	July.	Aug.	Sept.	Day.	May	June.	July.	Aug.	Sept.
1.....		92	85	98	30	16.....		109	44	50	30
2.....		89	98	50	28	17.....	57	106	39	44	29
3.....		98	98	32	26	18.....		112	50	44	28
4.....		105	92	26	26	19.....		112	39	45	27
5.....		122	86	26	26	20.....		106	34	39	26
6.....		126	64	27	28	21.....		109	34	39	26
7.....		122	64	30	27	22.....		98	34	34	26
8.....		123	71	29	26	23.....	78	90	26		24
9.....	71	129	85	26		24.....	92	81	27		22
10.....		143	78	25		25.....	85	82	34		21
11.....		126	82	26		26.....	92	82	44		20
12.....		133	92	44	40	27.....	98	77	57		20
13.....		154	79	44	37	28.....	98	86	57		20
14.....		126	64	44	34	29.....	85	64	57		23
15.....		109	44	44	32	30.....	78	71	71		24
						31.....	92		85		

This appears to be South fork of South Platte River on 1/50000 map for 1910.

Monthly discharge of Little South Platte River near Fairplay, Colo., for the year ending Sept. 30, 1916.

See one

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
June 23-30.....	154	64	106	6,310
July.....	98	26	61.7	3,790

NOTE.—Monthly discharge computed by engineers of United States Geological Survey from records of daily flow furnished by Van Sant-Houghton Co., Denver. Data insufficient for determination of monthly discharge in May, August, and September.

MIDDLE FORK OF SOUTH PLATTE RIVER AT ALMA, COLO.

LOCATION.—Approximately in sec. 13, T. 9 S., R. 78 W., at footbridge just east of Alma, in Park County.

DRAINAGE AREA.—23.7 square miles.

RECORDS AVAILABLE.—May 1 to August 15, 1916.

GAGE.—Vertical staff attached to upstream side of bridge near right bank; read to half tenths twice daily by W. H. Powless.

DISCHARGE MEASUREMENTS.—Made from bridge or by wading.

COOPERATION.—Daily discharge records furnished by Van Sant-Houghton Co., engineers, of Denver.

Discharge measurements of Middle Fork of South Platte River at Alma, Colo., during the year ending Sept. 30, 1916.

[Made by M. E. Bunger.]

Date.	Gage height.	Dis- charge.
	<i>Fect.</i>	<i>Sec.-ft.</i>
May 7.....	7.10	25.5
June 17.....	7.50	108
July 15.....	7.15	30.5

Daily discharge, in second-feet, of Middle Fork of South Platte River at Alma, Colo., for the year ending Sept. 30, 1916.

Day.	May.	June.	July.	Aug.	Day.	May.	June.	July.	Aug.
1.....	17.5	41.2	49.0	137	16.....	30.5	108	35.5	.....
2.....	17.5	49.0	35.5	58.8	17.....	17.5	108	42.2	.....
3.....	17.5	49.0	35.5	49.0	18.....	17.5	108	35.5	.....
4.....	17.5	49.0	30.5	58.8	19.....	15.2	108	35.5	.....
5.....	17.5	68.5	25.5	166	20.....	17.5	108	25.5	.....
6.....	17.5	49.0	25.5	68.5	21.....	17.5	68.5	17.5	.....
7.....	21.5	35.5	25.5	35.5	22.....	17.5	49.0	17.5	.....
8.....	17.5	35.5	25.5	30.5	23.....	7.2	49.0	17.5	.....
9.....	25.5	49.0	35.5	30.5	24.....	17.5	49.0	17.5	.....
10.....	30.5	108	30.5	30.5	25.....	21.5	49.0	17.5	.....
11.....	21.5	88.2	35.5	25.5	26.....	17.5	49.0	17.5	.....
12.....	21.5	108	49.0	25.5	27.....	17.5	49.0	25.5	.....
13.....	25.5	137	35.5	35.5	28.....	25.5	108	25.5	.....
14.....	30.5	108	30.5	108	29.....	25.5	58.8	25.5	.....
15.....	35.5	88.2	30.5	49.0	30.....	35.5	58.8	88.2	.....
					31.....	49.0	.....	108	.....

NOTE.—Discharge May 1-6 estimated.

Monthly discharge of Middle Fork of South Platte River at Alma, Colo., for they year ending Sept. 30, 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
May.....	49.6	7.2	22.1	1,360
June.....	137	35.5	73.0	4,340
July.....	108	17.5	33.9	2,080
August 1-15.....	166	25.5	60.6	1,800
The period.....				9,580

NOTE.—Monthly discharge computed by engineers of United States Geological Survey from records of daily flow furnished by Van Sant-Houghton Co., Denver.

MIDDLE FORK OF SOUTH PLATTE RIVER AT FAIRPLAY, COLO.

LOCATION.—Approximately in sec. 33, T. 9 S., R. 77 W., at bridge on road to the south of Fairplay, in Park County.

DRAINAGE AREA.—83 square miles.

RECORDS AVAILABLE.—October 17, 1910, to July 6, 1912; May 1 to October 31, 1916.

GAGE.—Vertical staff on upstream side of right abutment; read to hundredths twice daily by G. H. Eaton.

DISCHARGE MEASUREMENTS.—Made from bridge or by wading.

COOPERATION.—Daily discharge records furnished by Van Sant-Houghton Co., engineers, of Denver.

Discharge measurements of Middle Fork of South Platte River at Fairplay, Colo., during the year ending Sept. 30, 1916.

Date.	Made by—	Gage height.	Dis- charge.	Date.	Made by—	Gage height.	Dis- charge.
		<i>Feet.</i>	<i>Sec. ft.</i>			<i>Feet.</i>	<i>Sec. ft.</i>
May 6	M. E. Bunger.....	1.04	54.4	June 25	M. N. Grant, jr.....	1.76	193
June 6	.....do.....	1.95	315	July 15	M. E. Bunger.....	1.65	164

Daily discharge in second-feet of Middle Fork of South Platte River at Fairplay, Colo., for the year ending Sept. 30, 1916.

Day.	May.	June.	July.	Aug.	Sept.	Oct.	Day.	May.	June.	July.	Aug.	Sept.	Oct.
1.	51	182	254	386	85	53	16.	77	365	175	175	72	53
2.	51	182	224	254	77	53	17.	88	365	203	136	68	53
3.	51	190	224	203	77	51	18.	88	449	190	129	64	51
4.	51	285	224	216	74	51	19.	91	417	175	124	68	43
5.	51	236	190	417	72	51	20.	91	417	155	114	64	35
6.	55	165	182	216	72	51	21.	88	285	155	114	62	33
7.	108	136	182	190	64	51	22.	96	254	175	104	62	43
8.	120	165	216	190	64	51	23.	81	190	175	101	62	49
9.	124	203	224	175	64	51	24.	88	190	136	101	62	46
10.	148	254	216	148	72	51	25.	104	190	129	101	62	51
11.	148	301	182	129	88	51	26.	108	285	129	91	60	51
12.	136	417	254	148	91	51	27.	96	301	182	91	57	43
13.	136	495	190	190	88	51	28.	104	301	175	88	57	46
14.	124	417	190	254	81	51	29.	108	301	148	85	57	51
15.	104	301	175	190	72	31	30.	136	273	449	85	57	43
							31.	155	.....	386	85	.....	46

NOTE.—Discharge May 1-5 estimated.

Monthly discharge of Middle Fork of South Platte River at Fairplay Colo., for 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
May.....	155	51	98.6	6,060
June.....	495	136	284	16,900
July.....	449	129	202	12,400
August.....	386	85	162	9,960
September.....	91	57	69.2	4,120
October.....	53	33	48.6	2,990
The period.....				52,400

NOTE.—Monthly discharge computed by engineers of United States Geological Survey from records of daily flow furnished by Van Sant-Houghton Co., Denver.

TARRYALL CREEK NEAR JEFFERSON, COLO.

LOCATION.—In sec. 6, T. 9 S., R. 74 W., at Robbins ranch, 10 miles southeast of Jefferson, in Park County. Rock Creek enters half a mile below.

DRAINAGE AREA.—223 square miles (measured on map in Forest atlas).

RECORDS AVAILABLE.—June 27, 1912, to September 30, 1916. 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 staff 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. Gage read by Miss Esther 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 1916. 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, 2.4 feet at 6 p. m. July 31 (discharge, 425 second-feet); minimum stage, -0.25 foot, May 29 (discharge, 1 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 & 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 fairly permanent. Rating curve developed for gage used before April 22 fairly well defined between 25 and 370 second-feet; curve developed for new gage well defined between 20 and 65 second-feet and fairly well defined beyond these limits. Gage read to quarter tenths twice daily. Owing to high altitude of drainage basin (9,500 to 13,000 feet) considerable diurnal fluctuation is caused during spring by alternate melting and freezing, and mean daily gage height from morning and evening readings may be somewhat in error. Daily discharge ascertained by applying mean daily gage height to rating table. Records good for medium and fair for high and low stages.

Discharge measurements of Tarryall Creek near Jefferson, Colo., during the year ending Sept. 30, 1916.

Date.	Made by—	Gage height.	Dis-charge.	Date.	Made by—	Gage height.	Dis-charge.
Apr. 22	W. R. King.....	<i>Feet.</i> α 0.34	<i>Sec.-ft.</i> 21.2	July 14	Robert Follansbee.....	<i>Feet.</i> 0.48	<i>Sec.-ft.</i> 34.6
June 1	M. E. Bunger.....	.42	28.7	17	M. E. Bunger.....	.60	54
9	do.....	.60	54				

α New gage installed; old gage read —0.04 foot.

Daily discharge, in second-feet, of Tarryall Creek near Jefferson, Colo., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Dec.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1.....	49	23	20	.....	19	25	21	12	312	38
2.....	38	22	22	.....	23	24	39	44	110	39
3.....	42	23	22	.....	21	26	36	36	80	37
4.....	38	23	22	.....	23	64	32	51	190	29
5.....	32	23	23	.....	21	59	71	43	120	37
6.....	31	23	23	.....	21	37	83	44	120	36
7.....	27	29	26	.....	22	32	68	36	102	44
8.....	26.	28	28	.....	19	26	71	23	180	36
9.....	27	23	28	.....	21	28	68	12	88	38
10.....	27	29	28	.....	22	36	62	23	71	31
11.....	28	24	24	.....	22	25	54	39	62	44
12.....	30	22	.....	.....	24	26	68	170	51	34
13.....	30	16	.....	.....	25	24	48	110	94	32
14.....	35	14	.....	.....	24	13	62	54	94	36
15.....	33	11	.....	.....	23	9	68	44	80	29
16.....	37	18	.....	.....	21	24	25	50	62	32
17.....	29	18	.....	.....	24	11	36	62	71	28
18.....	28	23	.....	.....	21	6	48	41	72	34
19.....	26	23	.....	.....	21	5	58	65	64	37
20.....	27	23	.....	.....	19	6	44	41	68	29
21.....	27	24	.....	.....	19	50	51	41	58	26
22.....	26	23	.....	68	22	92	43	37	54	36
23.....	24	23	.....	56	27	58	37	41	58	37
24.....	24	23	.....	49	32	28	25	36	57	32
25.....	24	23	.....	37	28	11	26	26	59	18
26.....	24	23	.....	28	24	4	23	26	57	16
27.....	23	23	.....	34	25	2	24	52	52	26
28.....	23	23	.....	34	25	1	23	58	54	27
29.....	23	23	.....	29	31	1.	25	38	58	18
30.....	23	22	.....	28	29	2	22	170	54	18
31.....	23	.....	.....	25	.....	8	.....	375	59	.....

NOTE.—Stage-discharge relation affected by ice Nov. 22, and from Dec. 12 to Mar. 21.

Monthly discharge of Tarryall Creek near Jefferson, Colo., for the year ending Sept. 30, 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
October.....	49	23	29.2	1,800
November.....	29	11	22.3	1330
December 1-11.....	28	20	24.2	528
March 22-31.....	68	25	38.8	770
April.....	32	19	23.3	1,390
May.....	92	1	24.6	1,510
June.....	83	21	45.4	2,700
July.....	375	12	61.3	3,770
August.....	312	52	87.5	5,380
September.....	44	18	31.8	1,890

ROCK CREEK NEAR JEFFERSON, COLO.

LOCATION.—Approximately in sec. 5, T. 9 S., R. 74 W., at Robbins ranch, about 10 miles southeast of Jefferson.

DRAINAGE AREA.—44 square miles.

RECORDS AVAILABLE.—June 1 to August 19, 1916.

GAGE.—Staff on bridge; read once daily by Roy Wright.

DISCHARGE MEASUREMENTS.—Made by wading.

COOPERATION.—Daily discharge records furnished by Van Sant-Houghton Co., engineers, of Denver.

Discharge measurements of Rock Creek near Jefferson, Colo., during the year ending Sept. 30, 1916.

[Made by M. E. Bunger.]

Date.	Gage height.	Discharge.
	Feet.	Sec.-ft.
June 1.....	0.6	2.0
19.....	.55	1.4

Daily discharge, in second-feet, of Rock Creek near Jefferson, Colo., for the year ending Sept. 30, 1916:

Day.	June.	July.	Aug.	Day.	June.	July.	Aug.	Day.	June.	July.	Aug.
1.....	2.0	0.7	5.8	11.....	.....	2.75	4.65	21.....	1.0	1.0	.....
2.....	2.0	4.65	5.8	12.....	.....	3.5	4.65	22.....	.4	2.0	.....
3.....	.....	3.5	9.4	13.....	.....	2.0	5.8	23.....	.4	2.75	.....
4.....	.....	3.5	27.8	14.....	.....	2.0	5.8	24.....	.7	2.0	.....
5.....	.....	3.5	17.0	15.....	.....	3.5	5.8	25.....	1.0	2.75	.....
6.....	.....	3.5	5.8	16.....	.....	3.5	4.65	26.....	.7	3.5	.....
7.....	.....	3.5	5.8	17.....	.....	2.0	5.8	27.....	.7	3.5	.....
8.....	.....	2.0	17.0	18.....	.....	1.5	5.8	28.....	.4	5.8	.....
9.....	.....	2.75	5.8	19.....	1.5	1.0	4.65	29.....	.4	5.8	.....
10.....	.....	2.75	5.8	20.....	1.0	1.0	.....	30.....	.7	5.8	.....
								31.....	.....	17.0	.....

NOTE.—Discharge June 3-18 estimated at 2.0 second-feet.

Monthly discharge of Rock Creek near Jefferson, Colo., for the year ending Sept. 30, 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
June.....	2.0	0.4	1.50	89.3
July.....	17.0	.7	3.39	208
August 1-19.....	27.8	4.65	8.08	305
The period.....	.....	.....	.....	602

NOTE.—Monthly discharge computed by engineers of United States Geological Survey from records of daily flow furnished by Van Sant-Houghton Co., Denver.

NORTH FORK OF SOUTH PLATTE RIVER AT GRANT, COLO.

LOCATION.—In sec. 9, T. 7 S., R. 74 W., at Grant, in 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, 1916.

GAGE.—Vertical staff on left bank 250 feet above mouth of Geneva Creek; read by Mrs. M. McFarland, and Mrs. D. Eckhardt.

DISCHARGE MEASUREMENTS.—Made from foot log near gage or by wading.

CHANNEL AND CONTROL.—Bed composed of gravel. Principal control about 20 feet below gage at small rapids; shifts slightly during high water.

ICE.—Stage-discharge relation seriously affected by ice; observations of stage discontinued during winter; discharge measurements made monthly.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 2.4 feet at 6 p. m. June 12 (discharge, 85 second-feet); minimum discharge occurs during winter.

DIVERSIONS.—There are court decrees for diversion 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; shifted slightly during high water in June. Rating curve used before June 9, well defined between 7 and 275 second-feet; curve used after June 12 based on discharge measurement made June 28. Gage read to quarter tenths twice daily. Owing to high altitude of station (8,570 feet) considerable diurnal fluctuation is caused at certain seasons of year by alternate melting and freezing, and the mean daily gage height from morning and evening readings may be somewhat in error. Discharge ascertained by applying mean daily gage height to rating table; shifting control method used June 10 to September 30. Records good.

Discharge measurements of North Fork of South Platte River at Grant, Colo., during the year ending Sept. 30, 1916.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
Dec. 15	R. H. Fletcher.....	Feet. 2.20	Sec.-ft. 8.0	Apr. 21	W. R. King.....	Feet. 1.66	Sec.-ft. 17.5
Jan. 18	W. R. King.....	21.52	7.1	June 28	Robert Follansbee.....	2.07	47.7
Feb. 9	Do.....	21.45	6.3				

^a Stage-discharge relation affected by ice.

^b Complete ice cover but water flowing free as ice was arched over stream.

Daily discharge, in second-feet, of North Fork of South Platte River at Grant, Colo., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1.....	20	7					16	28	74	51	33	17
2.....	19	5					12	30	74	46	25	17
3.....	20	7					8	27	74	43	23	16
4.....	19	7					13	28	78	41	30	12
5.....	16	7					11	33	80	43	39	12
6.....	14	7					11	30	68	41	32	12
7.....	14	7					16	47	62	41	30	12
8.....	13	7					12	55	62	43	30	12
9.....	11	7			6.3		8	64	68	41	27	12
10.....	13	8					9	66	72	41	25	14
11.....	13						14	66	69	41	22	16
12.....	7						13	68	79	41	25	16
13.....	7						13	70	79	33	49	16
14.....	12						12	66	79	33	33	16
15.....	10		8			10	12	57	73	32	30	14
16.....	10					19	14	52	73	32	27	12
17.....	12					14	16	47	73	33	25	12
18.....	12			7.1		13	16	47	73	27	23	12
19.....	12					12	16	47	73	30	23	12
20.....	12					14	17	52	70	30	23	12
21.....	11					14	14	51	67	27	22	14
22.....	12					12	17	49	61	27	19	9
23.....	11					11	19	46	56	25	19	9
24.....	10					13	23	46	56	23	22	14
25.....	9					14	25	52	67	23	19	9
26.....	9					14	30	52	56	23	19	9
27.....	7					12	33	52	59	23	19	9
28.....	7					12	41	57	53	23	19	9
29.....	8					10	41	59	53	23	19	9
30.....	10					12	30	66	53	41	17	9
31.....	8					13		70		36	19	

NOTE.—Stage-discharge relation affected by ice Nov. 11 to Mar. 14; observations of stage discontinued Nov. 28 to Mar. 14, data insufficient to determine discharge.

Monthly discharge of North Fork of South Platte River at Grant, Colo., for the year ending Sept. 30, 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
October.....	20	7	11.9	732
November 1-10.....	8	5	6.90	137
March 15-31.....	19	10	12.9	434
April.....	41	8	17.7	1,050
May.....	70	27	51.0	3,140
June.....	80	53	67.8	4,030
July.....	51	23	34.1	2,100
August.....	49	17	25.4	1,560
September.....	17	9	12.5	744

NORTH FORK OF SOUTH PLATTE RIVER AT SOUTH PLATTE, COLO.

LOCATION.—In sec. 25, T. 3 S., R. 70 W., one-third mile above railroad station at South Platte, in 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, 1916.

GAGE.—Inclined staff on left bank one-third mile above railroad station; read by Miss A. Vermillion from October to June, and by Mrs. M. Wallbrecht, from June to September.

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.

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

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 3.07 feet at 10.30 a. m. May 11 (discharge, 448 second-feet); minimum discharge occurs during winter.

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 a number of small ice and fish ponds.

REGULATION.—None.

ACCURACY.—Stage-discharge relation not permanent; shifts occasionally during periods of high water and ice. Rating curve used October 1 to December 13 fairly well defined between 100 and 850 second-feet; curve used March 20 to September 30 well-defined between 35 and 425 second-feet. Gage read to half-tenths once daily to June 30, and twice daily after that date. Prior to June 30, one reading per day applied directly to rating table to ascertain discharge; thereafter, mean daily gage height was used. Records good except those for winter months which are only roughly approximate.

Discharge measurements of North Fork of South Platte River at South Platte, Colo., during the year ending Sept. 30, 1916.

Date.	Made by—	Gage height.	Dis-charge.	Date.	Made by—	Gage height.	Dis-charge.
		<i>Feet.</i>	<i>Sec.-ft.</i>			<i>Feet.</i>	<i>Sec.-ft.</i>
Dec. 16	R. H. Fletcher.....	a 2.13	46.1	May 23	Follansbee and Smith..	2.60	284
Jan. 19	W. R. King.....	a 2.67	46.4	June 1	H. K. Smith.....	2.92	356
Feb. 10	do.....	a 2.67	48.2	July 8	W. E. King.....	2.31	187
Apr. 7	Thos. Grieve, Jr.....	1.68	56	Aug. 1	H. K. Smith.....	2.79	334

^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, 1916.

Day.	Oct.	Nov.	Dec.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1.....	150	87	106	.....	83	134	403	231	312	145
2.....	150	87	70	.....	83	183	348	231	246	129
3.....	138	87	106	.....	92	157	312	202	202	123
4.....	138	87	70	.....	75	170	348	202	231	112
5.....	127	87	87	.....	112	183	348	202	312	112
6.....	127	87	127	.....	92	202	312	188	312	112
7.....	116	106	116	.....	67	246	278	196	278	112
8.....	116	106	106	.....	46	134	246	202	231	112
9.....	106	96	106	.....	67	330	278	216	231	112
10.....	106	70	116	.....	75	422	312	202	216	112
11.....	106	45	127	.....	75	442	366	216	202	134
12.....	106	45	106	.....	92	384	330	216	188	145
13.....	106	45	87	.....	112	312	403	216	246	162
14.....	116	70	.....	.....	112	348	392	183	330	145
15.....	127	106	.....	.....	102	246	362	178	246	138
16.....	138	127	.....	.....	112	246	370	178	216	123
17.....	138	127	.....	.....	112	246	377	188	188	112
18.....	138	127	.....	.....	123	231	366	188	175	112
19.....	127	127	.....	.....	123	216	366	178	162	112
20.....	127	127	.....	83	123	246	330	152	175	112
21.....	116	127	.....	102	112	278	312	157	175	112
22.....	116	106	.....	83	102	312	295	152	157	112
23.....	116	87	.....	83	112	312	312	152	145	112
24.....	116	87	.....	75	134	272	278	145	157	112
25.....	116	70	.....	46	145	298	278	134	162	102
26.....	106	70	.....	59	157	366	262	138	162	96
27.....	106	106	.....	92	170	326	262	138	157	92
28.....	96	45	.....	75	183	305	262	134	157	92
29.....	96	45	.....	75	157	319	262	134	145	92
30.....	96	70	.....	67	157	298	246	202	152	92
31.....	96	.....	.....	75	.....	384	.....	295	162	.....

NOTE.—Stage-discharge relation seriously affected by ice Dec. 14 to Mar. 19. Shifting-control method used May 24 to June 17. Discharge Dec. 14–31, estimated 56 second-feet, and March 1–19, as 35 second-feet because of ice.

Monthly discharge of North Fork of South Platte River at South Platte, Colo., for the year ending Sept. 30, 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
October.....	150	96	119	7,320
November.....	127	45	88.6	5,270
December.....	127	.....	75.2	4,620
January.....	.....	.....	a 49.6	3,050
February.....	.....	.....	a 50.2	2,890
March.....	.....	.....	50.8	3,120
April.....	183	46	110	6,550
May.....	442	134	276	17,000
June.....	403	246	321	19,100
July.....	295	134	185	11,400
August.....	330	145	207	12,700
September.....	162	92	116	6,900
The year.....	442	.....	138	99,900

a Estimated on account of ice, by a study of gage heights, weather records, observer's notes, and discharge measurements.

GENEVA CREEK AT GRANT, COLO.

LOCATION.—In sec. 9, T. 7 S., R. 74 W., at highway bridge at Grant, in 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, 1916. 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 December 15, 1915, to April 21, 1916; read by Mrs. M. McFarland and Mrs. D. Eckhardt.

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; shift in control during high water in June, 1915; practically permanent during 1916. Banks not subject to overflow.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 2.2 feet at 6 p. m. May 10 (discharge, 244 second-feet); minimum stage, 0.76 foot at 8 a. m. March 1 (discharge, 9 second-feet).

ICE.—Stage-discharge relation seriously affected by ice; flow estimated from discharge measurements, observer's notes, and weather records.

DIVERSION.—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 practically permanent; affected by ice from November to February. Rating curve well defined between 10 and 200 second-feet. Gage read to half tenths twice daily. Owing to high altitude of station (8,570 feet) considerable diurnal fluctuation is caused at certain seasons of year by alternate melting and freezing, and the mean daily gage height based on morning and evening readings may be somewhat in error. Discharge ascertained by applying mean daily gage height to rating table. Records good for spring months, and excellent for remainder of open-water season. A change in the stage-discharge relation for discharge below 70 second-feet was probably caused by the high water in June, 1915, as shown by discharge measurements made in 1916. Mean discharge for August, 1915, should be 10 per cent greater and that for September 25 per cent greater than figures published in Water-Supply Paper 406, page 260.

Discharge measurements of Geneva Creek at Grant, Colo., during the year ending Sept. 30, 1916.

Date.	Made by—	Gage height.	Dis-charge.	Date.	Made by—	Gage height.	Dis-charge.
		<i>Feet.</i>	<i>Sec.-ft.</i>			<i>Feet.</i>	<i>Sec.-ft.</i>
Dec. 15	R. H. Fletcher.....	a 1.15	12.8	Apr. 21	W. R. King.....	1.18	30.9
Jan. 17	W. R. King.....	a .98	12.4	June 28	Robert Follansbee.....	1.78	111
Feb. 9	.....do.....	.86	10.9				

a Stage-discharge relation affected by ice.

Daily discharge, in second-feet, of Geneva Creek at Grant, Colo., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	37	20	12	13	10	9	13	32	172	118	102	54
2	39	15	12	13	10	12	12	35	145	113	76	49
3	43	21	12	13	10	19	14	30	140	111	72	49
4	41	23	12	13	10	14	12	42	145	109	86	47
5	31	27	13	12	10	12	13	40	145	102	126	41
6	31	23	12	12	10	10	11	41	134	97	102	40
7	30	23	12	12	10	10	11	87	118	93	80	37
8	25	21	12	12	10	10	12	95	118	91	93	37
9	27	18	12	12	11	10	12	140	145	91	76	36
10	28	31	12	11	10	10	14	175	151	95	72	37
11	30	17	12	12	10	10	18	157	145	95	62	47
12	28	21	12	12	11	11	17	113	175	93	62	49
13	30	11	13	12	10	18	19	100	178	86	113	46
14	32	11	13	12	12	25	16	95	169	87	95	44
15	31	12	13	12	10	19	19	70	151	84	89	41
16	29	12	13	12	10	14	17	73	157	84	84	37
17	27	12	13	12	10	13	20	72	151	86	80	36
18	27	12	13	12	11	11	23	61	163	78	70	39
19	24	13	13	12	11	10	22	64	169	74	64	39
20	24	14	13	11	10	14	14	74	160	74	61	39
21	24	14	13	11	11	19	19	76	151	73	60	35
22	23	14	13	11	10	12	24	73	140	73	56	31
23	23	14	13	11	10	14	25	66	134	67	56	31
24	20	13	13	11	10	10	27	72	140	60	60	31
25	22	13	13	11	10	13	30	106	134	61	59	31
26	23	13	13	11	10	12	182	104	134	61	61	31
27	23	12	13	10	10	9	42	91	134	61	60	30
28	23	12	13	10	10	12	53	106	134	61	60	30
29	23	13	13	10	10	15	54	118	126	61	60	30
30	22	13	13	10	.....	12	38	121	121	91	61	30
31	25	.....	13	10	.....	14	.....	143	.....	93	59	.....

NOTE.—Stage-discharge relation affected by ice Nov. 14 to Feb. 8, and Apr. 7, 8; determination of discharge based on weather records, observer's notes, and discharge measurements.

Monthly discharge of Geneva Creek at Grant, Colo., for the year ending Sept. 30, 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
October	43	20	27.9	1,720
November	31	11	16.3	970
December	13	12	12.6	775
January	13	10	11.5	707
February	12	10	10.2	587
March	25	9	13.0	799
April	182	11	26.9	1,600
May	175	30	86.4	5,310
June	178	113	146	8,690
July	118	60	84.6	5,200
August	126	56	74.7	4,590
September	54	30	38.5	2,290
The year	186	9	45.8	33,200

CLEAR CREEK NEAR GOLDEN, COLO.

LOCATION.—In sec. 6, T. 4 S., R. 70 W., 1,000 feet below head gate 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.—About 380 square miles.

RECORDS AVAILABLE.—December 4, 1908, to December 31, 1909; June 8 to September 24, 1911; January 26, 1912, to September 30, 1916.

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 through narrow limits. Creek flows in canyon; banks not subject to overflow.

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

EXTREMES OF DISCHARGE.—Maximum stage during year from water-stage recorder, 3.30 feet at 3 a. m. June 18 (discharge, 872 second-feet); minimum discharge occurs during winter.

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 832 acre-feet were diverted. 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 at the head gate was about 7,110 acre-feet for 1916, as determined from estimates of flow by gate operator.

REGULATION.—None.

ACCURACY.—Stage-discharge relation not permanent but shifts through narrow limits. Mean rating curve well defined. Shifting-control method based on frequent discharge measurements used throughout entire year. Operation of water-stage recorder satisfactory except during winter period. Daily discharge ascertained by applying to rating table mean daily gage heights determined by inspecting gage-height graph. Records good.

COOPERATION.—Gage-height record furnished by Farmers Reservoir & Irrigation Co.

Discharge measurements of Clear Creek near Golden, Colo., during the year ending Sept. 30, 1916.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		<i>Feet.</i>	<i>Sec.-ft.</i>			<i>Feet.</i>	<i>Sec.-ft.</i>
Nov. 9	R. H. Fletcher.....	1.13	83	May 20	R. H. Fletcher.....	2.05	322
Jan. 14	Fletcher and King....	^a 1.91	42	June 21	H. K. Smith.....	3.08	746
Feb. 9	R. H. Fletcher.....	^a 1.38	54	Sept. 8	.....do.....	1.59	185
Mar. 14	W. R. King.....	.96	51				

^a Stage-discharge relation affected by ice.

NOTE.—The following measurements of the discharge of Golden ditch were made: Nov. 9, 13.1 second-feet; May 20, 25.2 second-feet; June 21, 30 second-feet; Sept. 8, 3.6 second-feet.

Daily discharge, in second-feet, of Clear Creek near Golden, Colo., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1.	146	99				66	158	517	615	426	244
2.	133	100				71	175	550	580	372	228
3.	121	99				72	144	536	605	352	222
4.	133	96				68	158	550	555	414	231
5.	127	94				71	168	595	526	453	218
6.	123	89			48	69	189	541	507	397	225
7.	119	85			46	70	298	475	498	376	203
8.	115	81			54	72	317	475	498	409	203
9.	111	86		54	58	66	340	526	517	418	197
10.	107	84			63	61	393	645	531	393	175
11.	114				63	76	414	665	507	344	228
12.	116				61	76	393	733	480	360	203
13.	112				63	86	393	764	440	393	228
14.	114		42		61	84	418	748	426	384	218
15.	127				60	82	356	717	393	384	209
16.	123				66	84	317	728	393	368	181
17.	120				66	81	295	759	440	356	170
18.	120				67	93	278	829	431	325	168
19.	125				61	97	270	818	414	306	160
20.	120				58	90	310	791	368	284	155
21.	116				71	85	295	738	356	295	146
22.	114				67	89	295	640	360	274	146
23.	108				68	90	237	640	321	254	148
24.	105				68	104	281	605	321	247	142
25.	108				58	118	317	610	302	254	142
26.	108				58	131	356	635	317	254	140
27.	110				64	148	360	640	321	234	135
28.	107				70	175	372	676	332	178	135
29.	104				74	206	418	702	340	212	125
30.	102				69	183	422	686	453	241	123
31.	100				70		494		466	260	

NOTE.—Stage-discharge relation seriously affected by ice Nov. 11 to Mar. 5; records discontinued except for occasional discharge measurements. Table shows entire flow of stream only when Golden ditch is not diverting water.

Monthly discharge of Clear Creek near Golden, Colo., for the year ending Sept. 30, 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
October.....	146	100	116	7,130
November 1-10.....	100	81	91.3	1,810
March 6-31.....	74	46	62.8	3,240
April.....	206	61	95.5	5,680
May.....	494	144	311	19,100
June.....	829	475	651	38,700
July.....	615	302	439	27,000
August.....	453	178	330	20,300
September.....	244	123	182	10,800

SOUTH BOULDER CREEK NEAR ROLLINSVILLE, COLO.

LOCATION.—In sec. 35, T. 1 S., R. 73 W., 1 mile west of Rollinsville, in Gilpin County.

Nearest important tributary, Jenny Creek, enters 4 miles above.

DRAINAGE AREA.—39 square miles (measured on topographic maps).

RECORDS AVAILABLE.—September 10, 1910, to September 30, 1916.

GAGE.—Vertical staff spiked to tree on left bank, 500 feet above bridge, used June 2 to September 30, 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, 2.08 feet at 5.30 p. m., June 17, and 5 p. m., June 19 (discharge, 300 second-feet); minimum discharge of 6 second-feet occurred for short periods during January and February, when stage-discharge relation was affected by ice.

ICE.—Stage-discharge relation affected by ice for short periods; discharge determined from gage heights, observer's notes, discharge measurements, and weather records.

DIVERSIONS.—No court decrees for diversion above station.

REGULATION.—None.

ACCURACY.—Stage-discharge relation fairly permanent; shifts occasionally through narrow limits. Rating curve used October 1 to May 7 fairly well defined between 5 and 240 second-feet; curve used May 8 to morning of June 1, fairly well defined, between 5 and 240 second-feet; curve used afternoon of June 1 to September 30 fairly well defined between 20 and 300 second-feet. Gage read to quarter tenths twice 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, 1916.

Date.	Made by—	Gage height.	Dis-charge.	Date.	Made by—	Gage height.	Dis-charge.
		<i>Feet.</i>	<i>Sec.-ft.</i>			<i>Feet.</i>	<i>Sec.-ft.</i>
Oct. 19	W. R. King.....	1.01	18.3	June 23	H. K. Smith.....	1.81	209
Jan. 27	T. J. Watkins.....	.75	8.6	Aug. 16	P. V. Hodges.....	1.28	44.2
May 8	W. R. King.....	1.81	119	Sept. 28	.....do.....	1.00	19.0
June 2	.....do.....	b 1.90	238				

a New gage installed on downstream side of abutment; old gage read 1.90 feet.

b Gage installed 500 feet above the bridge; gage installed May 8 read 2.10 feet.

Daily discharge, in second-feet, of South Boulder Creek near Rollinsville, Colo., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1.....	27	15	9	8	6	9	19	45	198	205	106	26
2.....	26	14	7	8	6	9	21	43	239	188	91	29
3.....	25	15	7	9	6	10	19	47	239	188	100	26
4.....	24	15	8	10	7	10	19	47	239	188	106	25
5.....	23	13	8	10	8	10	19	48	239	168	103	23
6.....	22	13	9	9	9	9	19	55	239	151	100	23
7.....	21	14	10	9	10	10	19	67	239	151	85	21
8.....	20	13	10	9	10	10	19	96	239	168	76	21
9.....	22	12	11	10	9	10	20	119	239	140	63	21
10.....	22	13	11	9	9	12	19	132	239	123	58	21
11.....	18	18	10	8	9	12	23	146	273	117	42	23
12.....	16	23	9	7	9	14	23	146	273	106	50	23
13.....	22	16	9	7	8	18	23	132	273	103	48	20
14.....	19	21	10	7	9	14	25	132	273	91	58	19
15.....	21	14	9	8	9	26	25	132	273	100	53	17
16.....	24	18	9	7	9	19	25	119	273	94	48	17
17.....	22	18	8	6	9	19	25	108	273	106	42	20
18.....	19	16	8	6	9	21	30	98	273	100	40	19
19.....	20	15	7	7	9	22	30	91	273	79	33	17
20.....	20	12	9	8	9	21	29	98	273	58	42	17
21.....	22	16	10	8	9	24	30	98	273	58	30	17
22.....	16	19	11	10	9	24	31	98	256	60	29	17
23.....	18	13	12	10	8	23	31	96	239	48	30	17
24.....	18	16	10	9	8	18	37	98	222	48	29	19
25.....	16	13	10	10	10	19	40	119	222	50	27	17
26.....	16	13	7	9	9	19	42	132	239	53	32	17
27.....	15	12	7	8	9	19	47	132	205	58	29	21
28.....	12	11	8	7	9	23	47	132	222	58	29	19
29.....	13	10	7	7	9	19	39	146	222	63	27	19
30.....	15	10	7	7	-----	18	39	146	222	110	29	17
31.....	15	-----	7	7	-----	19	-----	165	-----	120	26	-----

NOTE.—Stage-discharge relation affected by ice Nov. 28-29, Dec. 4-6, 12-22, 27-31, Jan. 1, 7, 12-19, 28-31, and Feb. 1-4, 27-28; discharge determined by study of gage-height record, weather records, observer's notes, and discharge measurements. Discharge estimated Oct. 1, 2.

Monthly discharge of South Boulder Creek near Rollinsville, Colo., for the year ending Sept. 30, 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
October.....	27	12	19.6	1,210
November.....	23	10	14.7	875
December.....	11	7	8.84	544
January.....	10	6	8.19	504
February.....	10	6	8.59	494
March.....	26	9	16.5	1,010
April.....	47	19	27.8	1,650
May.....	165	43	105	6,460
June.....	273	198	247	14,700
July.....	205	48	108	6,640
August.....	106	26	53.6	3,300
September.....	29	17	20.3	1,210
The year.....	273	6	53.2	38,600

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, 1916.

Date.	Stream.	Tributary to—	Locality.	Gage height.	Dis-charge.
				<i>Feet.</i>	<i>Sec.-ft.</i>
✓ Sept. 2	Heart River.....	Missouri River....	Mandan, N. Dak.....		47
✓ Aug. 30	Dogtooth Creek.....	Cannonball River....	Near Timmer, N. Dak.....		2.2
Sept. 21	do.....	do.....	do.....		2.4
✓ Oct. 30	Oak Creek.....	Grand River.....	Wakpala, S. Dak.....		4.0
Apr. 22	do.....	do.....	do.....		177
Aug. 29	do.....	do.....	do.....		1.6
Sept. 1	do.....	do.....	do.....		2.3
✓ May 26	North Platte.....	Platte River.....	Pathfinder, Wyo.....	5.53	4,320
✓ May 26	Canyon Creek.....	North Platte River....	Irvine's ranch, near Alcova, Wyo.....	.68	1.7
✓ May 4	Laramie River.....	do.....	Sec. 24, T. 22 N., R. 74 W., at McGill, Wyo.....	1.08	α 8.0
June 15	do.....	do.....	do.....	2.98	553
✓ June 17	do.....	do.....	do.....	1.86	86
✓ May 26	Bear Creek.....	South Platte River....	Morrison, Colo.....		80
✓ July 20	Fall River.....	Big Thompson Creek....	Sec. 13, T. 5 N., R. 74 W., about 300 feet above Roaring River.		30.2
✓ 20	Roaring River.....	Fall River.....	Sec. 13, T. 5 N., R. 74 W., at mouth.		32.1

α Estimated.



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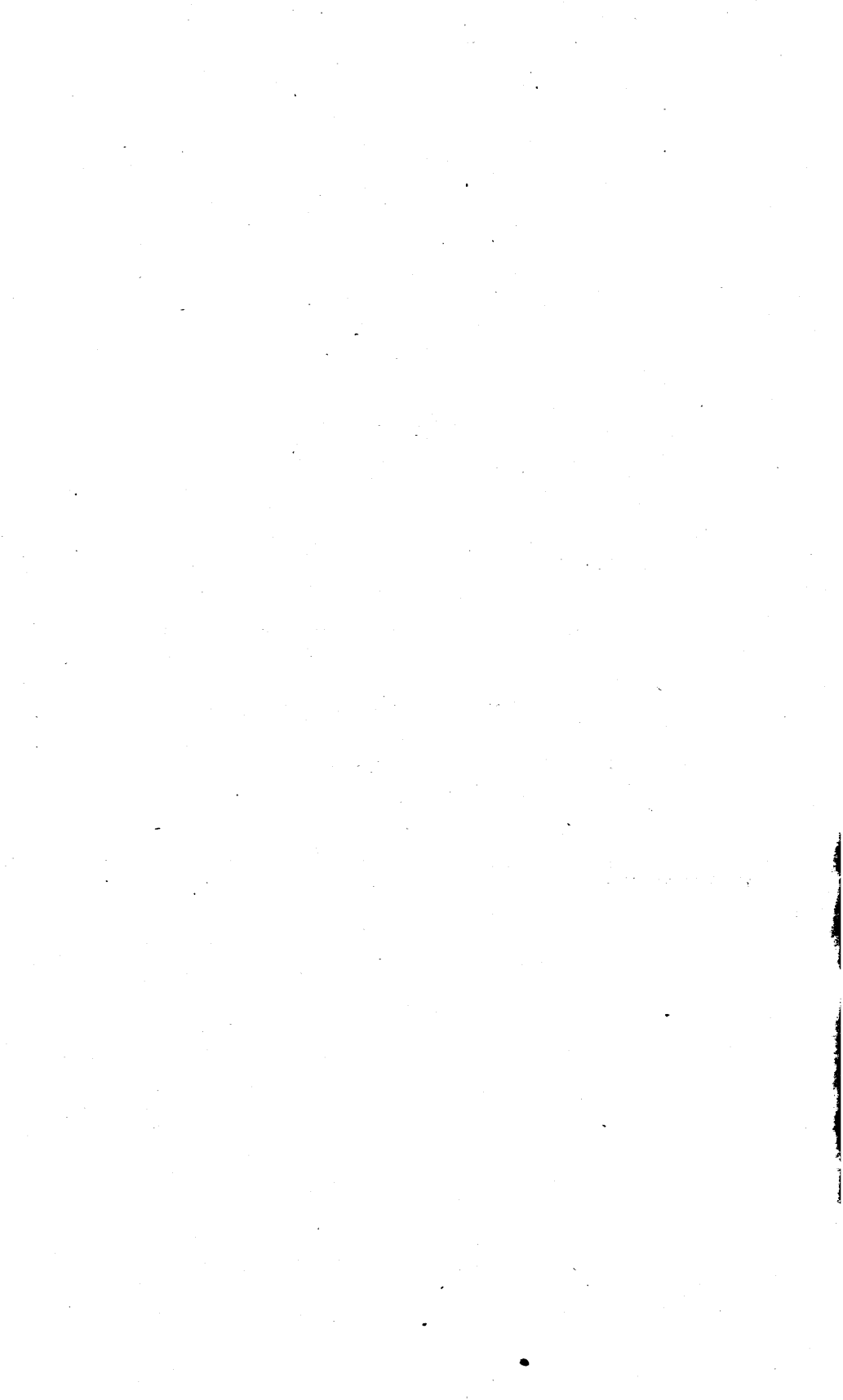
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STREAM-GAGING STATIONS
AND
PUBLICATIONS RELATING TO WATER RESOURCES

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 in 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.
 Atlanta, Ga., Post Office Building.
 Madison, Wis., care of Railroad Commission of Wisconsin.
 Chicago, Ill., 1404 Kimball Building.
 Topeka, Kans., 25 Federal Building.
 Helena, Mont., Montana National Bank Building.
 Denver, Colo., 403 New Post Office Building.
 Tucson, Ariz., University of Arizona.
 Salt Lake City, Utah, 421 Federal Building.
 Boise, Idaho, 615 Idaho Building.
 Tacoma, Wash., 406 Federal Building.
 Portland, Oreg., 606 Post Office Building.
 San Francisco, Cal., 328 Customhouse.
 Los Angeles, Cal., 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 4,100 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 similar 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.
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.
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.

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

Report.	Character of data.	Year.
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.

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 1916. 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 1916, 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, and 433, which contain records for the Ohio River basin for those years.

Numbers of water-supply papers containing results of stream measurements, 1899-1916.

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, 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	ⁱ 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	^t 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

^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 3, 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 (Marais 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. xxix.)

GAGING STATIONS.

NOTE.—Dash after a date indicates that station was being maintained September 30, 1916; period after a date indicates discontinuance. Tributaries are shown by indentation.

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 Canyon 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.

Belt Creek near Belt, Mont., 1905-6.

Highwood Creek near Highwood, Mont., 1905-6.

¹ Records for 1889-90 published at Sun River above Augusta, Mont.

Missouri River tributaries—Continued.

Two Medicine River (head of Marias River) near Midvale, Mont., 1902-3.

Two Medicine River at Family, Mont., 1907-

Marias River near Shelby, Mont., 1902-1908; 1911-

Badger Creek near Family, Mont., 1907-

Birch Creek at Swift dam, near Dupuyer, Mont., 1913-

Birch Creek near Dupuyer, Mont., 1907-

Birch Creek at Nelson's ranch, near Dupuyer, Mont., 1914-

Birch Creek at Hall's ranch, near Dupuyer, Mont., 1913-1916.

Birch Creek at Robare, Mont., 1914-

Dupuyer Creek at Dupuyer, Mont., 1908-1912.

Dupuyer Creek near Valier, Mont., 1912-

Cut Bank Creek at Cut Bank, Mont., 1905-

Dry Fork of Marias River near Valier, Mont., 1911-1915.

Teton River at Strabane, near Belleview, Mont., 1904-1906; 1908-

Teton River near Chouteau, Mont., 1904-1906; 1913; 1915-

Spring Creek near Strabane, Mont., 1913.

Deep Creek at Frazier's ranch, near Chouteau, Mont., 1912.

Deep Creek near Chouteau, Mont., 1911-

Willow Creek near Chouteau, Mont., 1912-

Muddy Creek near Bynum, Mont., 1912-

Blackleaf Creek near Bynum, Mont., 1912-

Judith River near Lewistown, Mont., 1910.

Musselshell River, North Fork (head of Musselshell River), near Delpine, Mont., 1909-1911.

Musselshell River, North Fork, near Martinsdale, Mont., 1907-1914.

Musselshell River at Harlowton, Mont., 1907-

Musselshell River at Shawmut, Mont., 1902-1907.

Musselshell River at Lavina, Mont., 1906.

Checkerboard Creek near Delpine, Mont., 1909-1911; 1913-14.

South Fork of Musselshell River near Martinsdale, Mont., 1907-1914.

American Fork near Harlowton, Mont., 1907-1911; 1913.

Lebo Creek near Harlowton, Mont., 1907-1911; 1913.

Boxelder Creek:

Flatwillow Creek near Flatwillow, Mont., 1911-

Milk River, South Fork (head of Milk River), near Browning, Mont., 1905-

Milk River at international boundary, 1913-

Milk River at Havre, Mont., 1898-

Milk River at Chinook, Mont., 1897.

Milk River at Malta, Mont., 1902-

Milk River at Hinsdale, Mont., 1908-1914.

Milk River near Vandalia, Mont., 1915-

North Fork of Milk River near Browning, Mont., 1911-12.

North Fork of Milk River near Kimball, Alberta, 1913-

Fort Belknap canal near Chinook, Mont., 1903-

Winter-Anderson canal near Chinook, Mont., 1906; 1908.

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 ² near Chinook, Mont., 1905-

Cook canal near Chinook, Mont., 1905-

Matheson canal near Chinook, Mont., 1905-

¹ Formerly called West Fork of Milk River.

² Formerly called North Fork of Milk River.

Missouri River tributaries—Continued.

Milk River tributaries—Continued.

- Paradise Valley canal near Chinook, Mont., 1903—
- Harlem canal near Zurich, Mont., 1903—
- Agency ditch near Harlem, Mont., 1905—
- 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—
- 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.
- Wind River at Riverton, Wyo., 1906-1908; 1911-12; 1915—
- Big Horn River at Thermopolis, Wyo., 1900-1905; 1910-1912; 1915—
- Big Horn River near Hardin, Mont., 1904—
- Warm Spring Creek near Dubois, Wyo., 1911-12.
- Horse Creek at Dubois, Wyo., 1910-1912.
- Red Creek near Dubois, Wyo., 1909.
- Dinwoody Creek near Crowheart, Wyo., 1909.
- Meadow Creek near J. K. ranch, Wyo., 1909.
- Willow Creek at J. K. ranch, Wyo., 1909.

Missouri River tributaries—Continued.

Yellowstone River tributaries—Continued.

Big Horn River tributaries—Continued.

- Bull Lake Creek near J. K. ranch, Wyo., 1909.
- Dry Creek at Crowheart, Wyo., 1909.
- Popo Agie River near Lander, Wyo., 1911-12.
- Popo Agie River below Arapahoe, Wyo., 1906-1909; 1911-12; 1915-
Little Popo Agie River at Hudson, Wyo., 1907-1909; 1911-12; 1915-
Little Wind River at Fort Washakie, Wyo., 1908-9.
- Little Wind River above Arapahoe, Wyo., 1906-1909; 1911-12; 1915-
North Fork of Little Wind River:
St. Lawrence Creek near Wind River, Wyo., 1909.
- Trout Creek at Wind River, Wyo., 1909.
- Owl Creek near Thermopolis, Wyo., 1910-1912; 1915-
- No Wood Creek at Bonanza, Wyo., 1910-1912; 1915-
Tensleep Creek near Tensleep, Wyo., 1910-1912; 1915-
Paintrock Creek near Hyattsville, Wyo., 1912.
- Paintrock Creek near Bonanza, Wyo., 1910-1912; 1915-
Greybull River near Meeteetse, Wyo., 1910-1912; 1915-
Greybull River at Meeteetse, Wyo., 1897-1903.
- Wood River near Meeteetse, Wyo., 1910-1912; 1915-
Shell Creek at Shell, Wyo., 1915-
Shoshone River near Ishawooa, Wyo., 1915-
Shoshone River at Marquette, Wyo., 1896; 1903; 1905-1908.
- Shoshone River at Cody, Wyo., 1902-1909.
- Shoshone River at Corbett dam, Wyo., 1908-
Shoshone River at Lovell, Wyo., 1897-1899.
- Soap Creek near St. Xavier, Mont., 1911-
Rottengrass Creek near St. Xavier, Mont., 1911-
Little Horn River near Wyola, Mont., 1911-
Little Horn River near Crow Agency, Mont., 1905-6; 1911-
Prairie Dog ditch near Story, Wyo., 1903.
- Lodgegrass Creek near Lodgegrass, Mont., 1911-
Tongue River near Dayton, Wyo., 1903; 1911-12.
- Tongue River at Carneyville, Wyo., 1911-12; 1915-
Goose Creek at Sheridan, Wyo., 1895-1897; 1911-12; 1915-
Little Goose Creek at Sheridan, Wyo., 1896-7; 1911-12.
- Powder River, South Fork (head of Powder River), near Kaycee, Wyo., 1911.
- Powder River near Arvada, Wyo., 1915-
Middle Fork of Powder River near Kaycee, Wyo., 1911-12.
- North Fork of Powder River near Kaycee, Wyo., 1911.
- Clear Creek at Buffalo, Wyo., 1896-1900; 1902-1904; 1911-12.
- Clear Creek near Buffalo, Wyo., 1911-12.
- Clear Creek near Arvada, Wyo., 1915-
Piney Creek at Kearney, Wyo., 1902-1906; 1911-12; 1915-
Cruetz 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.

Missouri River tributaries—Continued.

- Heart River near Richardton, N. Dak., 1903–
- Apple Creek near Bismark, 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–
- 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 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., 1904–05.
- James River near Lamoure, N. Dak., 1903.
- Big Sioux River near Watertown, S. Dak., 1900–1903.
- Big Sioux River near Sioux Falls, S. Dak., 1900–1901.
- Rock River at Luverne, Minn., 1911–1914.
- Grizzly Creek, continuation of Colorado Creek (head of North Platte River) near Hebron, Colo., 1904–05.
- North Platte River near North Gate, Colo., 1915–
- North Platte River near Hebron, Colo., 1904–5.
- North Platte River near Cowdrey, Colo., 1904–5.
- North Platte River near Pinkhampton, Colo., 1904.
- North Platte River at Saratoga, Wyo., 1903–1906; 1909; 1911–12; 1915–
- North Platte River above Pathfinder, Wyo., 1913–
- North Platte River at Pathfinder, Wyo., 1905–
- North Platte River at Alcova, Wyo., 1904–5.
- North Platte River near Douglas, Wyo., 1894.
- North Platte River near Orin Junction, Wyo., 1894–1900.
- North Platte River at Guernsey, Wyo., 1900–1908; 1912.

Missouri River tributaries—Continued.

North Platte River and Interstate canal at Whalen, Wyo., 1909—

North Platte River near Fort Laramie, Wyo., 1887—1890.

North Platte River at Henry, Nebr., 1912—1916.

North Platte River near Mitchell, Nebr., 1901—1913.

North Platte River at Scottsbluff, Nebr., 1912.

North Platte River near Gering, Nebr., 1897—1900.

North Platte River near Camp Clark, Nebr., 1896—1900.

North Platte River at Bridgeport, Nebr., 1902—1906; 1915.

North Platte River at North Platte, Nebr., 1895—1915.

Platte River near Lexington, Nebr., 1902—1906.

Platte River near Elm Creek, Nebr., 1914—15.

Platte River near Columbus, Nebr., 1895—1915.

Platte River near Freemont, Nebr., 1913—1915.

Platte River near Leshara, Nebr., 1911—1913.

Platte River near South Bend Nebr., 1903.

Little Grizzly Creek at Hebron, Colo., 1904—5.

Roaring Fork of North Platte River near Hebron, Colo., 1904—5.

North Fork of North Platte River at Higo, Colo., 1904—5.

Middle Fork of North Platte River:

Michigan Creek near Walden, Colo., 1904—5.

Michigan Creek near Cowdrey, Colo., 1904—5.

Canadian River at Cowdrey, Colo., 1904—5.

Douglas Creek near Keystone, Wyo., 1912; 1914—1916.

Mullen Creek near French, Wyo., 1911.

Big Creek near Big Creek (Downington), Wyo., 1911—12; 1915—

French Creek near French, Wyo., 1911—12; 1915—

Brush Creek near Saratoga, Wyo., 1911—12; 1915.

Encampment River near Peryam's ranch, Wyo., 1900.

Encampment River at Encampment, Wyo., 1911—12; 1915—

Cow Creek near Saratoga, Wyo., 1911—12.

Spring Creek near Saratoga, Wyo., 1911—12.

North Spring Creek near Saratoga, Wyo., 1913—1915.

Jack Creek at Matheson's ranch, near Saratoga, Wyo., 1913—

Jack Creek at Blydenburg's ranch, near Saratoga, Wyo., 1912.

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—

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—

Sage Creek above Pathfinder reservoir, Wyo., 1915—

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—

Missouri River tributaries—Continued.

Platte River tributaries—Continued.

- La Bonte Creek near La Bonte, Wyo., 1916—
- Horseshoe Creek near Glendo, Wyo., 1916—
- Cottonwood Creek near Wendover, Wyo., 1916—
- Laramie River at Glendevy, 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—
- Laramie River at McGill, Wyo., 1915.
- Laramie River below McGill, Wyo., 1916—
- 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.
- South Platte River at Denver, Colo., 1895-1906; 1909-1913.
- South Platte River near Kersey, Colo., 1901-1903; 1905-1913.
- South Platte River near Orchard, Colo., 1895-1900.
- South Platte River at Julesburg, Colo., 1902-1906; 1908-1914.
- South Platte River near Big Spring, Nebr., 1902-3.
- South Platte River at North Platte, Nebr., 1914-1915.
- Little South Platte River near Fairplay, Colo., 1916—
- Middle Fork of South Platte River at Alma, Colo., 1916.
- Middle Fork of South Platte River at Fairplay, Colo., 1910-1912; 1916—
- Tarryall Creek near Como, Colo., 1911-12.
- Tarryall Creek near Jefferson, Colo., 1910—
- Tarryall Creek near Hayman, Colo., 1910-1912.
- Jefferson Creek at Jefferson, Colo., 1910-1912.
- Michigan Creek near Jefferson, Colo., 1910-1912.
- Rock Creek near Jefferson, Colo., 1916—
- Goose Creek near Cheeseman Lake, Colo., 1899.
- North Fork of South Platte River at Grant, Colo., 1910—
- North Fork of South Platte River at Cassells, Colo., 1908-1913.
- North Fork of South Platte River at South Platte, Colo., 1909-10; 1913—
- Geneva Creek above Jackwhacker Creek, near Grant, Colo., 1909-1911.

Missouri River tributaries—Continued.

Platte River tributaries—Continued.

South Platte River tributaries—Continued.

North Fork of South Platte River at South Platte, Colo.—Continued.

Geneva Creek at Old Geneva smelter, near Grant, Colo., 1909-1911.

Geneva Creek at Sullivan's ranch, near Grant, Colo., 1908-1911.

Geneva Creek at Grant, Colo., 1911-

Smelter Creek at Old Geneva smelter, near Grant, Colo., 1909-1911.

Duck Lake Creek near Grant, Colo., 1909-1911.

Scott Gomer Creek at Sullivan's ranch, near Grant, Colo., 1909-1913.

Bear Creek near Morrison, Colo.,¹ 1888-1891; 1895-1902.

Clear Creek at Idaho Springs, Colo., 1910-1912.

Clear Creek at Forkscreek, Colo., 1899-1912.

Clear Creek near Golden, Colo., 1887-88; 1908-9; 1911-

St. Vrain Creek at Lyons, Colo.,¹ 1888-1892; 1895-1903; 1909-1913.

Boulder Creek at Orodell, Colo.,² 1887-1890; 1907-1913.

Boulder Creek near Boulder, Colo.,¹ 1888-1892; 1895-1901; 1907-1909.

South Boulder Creek near Rollinsville, Colo., 1910-

South Boulder Creek at Eldorado Springs (near Marshall), Colo., 1888-1892; 1895-1901; 1909-1913.

Community canal near Marshall, Colo., 1909.

Big Thompson Creek near Arkins, Colo.,¹ 1888-1892; 1895-1911.

Handy ditch near Arkins, Colo., 1899-1900; 1903.

Cache la Poudre River near Elkhorn, Colo., 1909-1911.

Cache la Poudre River near Fort Collins, Colo., 1909-1911.

Cache la Poudre River at mouth of canyon near Fort Collins, Colo., 1884-1901; 1910-1913.

Cache la Poudre River near Greeley, Colo., 1903.

Crow Creek:

Middle Fork of Crow Creek near Hecla, Wyo., 1902.

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 Junction, Kans., 1895-1905.

Kansas River near St. George, Kans., 1904.

Kansas River near Topeka, Kans., 1904.

Kansas River at Lecompton, Kans., 1899-1906.

Kansas River near Lawrence, Kans., 1895-1899.

South Fork of Republican River at Benkelman, Nebr., 1894-95; 1903-1906.

Frenchman Creek near Wauneta, Nebr., 1895-96.

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.

Kansas River near Lawrence, Kans.—Continued.

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 (Marais des Cygnes) River at Ottawa, Kans., 1902-1905.

Gasconade River at Arlington, Mo., 1903-1906.

Piney Fork of Gasconade River near Houston, Mo., 1908-1909.

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.
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 Bighorn 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. 15c.
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. 25c. [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 flood 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 Ogallala, Nebr., gives chemical analyses of the water, and discusses disadvantages of under flow 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 formations, 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 topography, 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 the 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 well 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 waters, 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 developments 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. Schnyder, 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. \$2.35. 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 comprising 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, Montana, 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 thermal 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. 58, 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:

*(1) Oil and 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. 184-186). 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:

(f) Anticlines in central Wyoming, by C. J. Hares (pp. 233-280, Pl. XXIII). 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.

Covers a large region in northwestern Wyoming, west of the Big Horn Mountains. Give 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 Bighorn 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 together 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 topographic 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-Redfield¹ (Northville, Aberdeen, Redfield, and Byron quadrangles), South Dakota. 5c.
- 168. Jamestown-Tower¹ (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.
Discusses efficiency of pumps and water lifts 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. 5c.
- *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 measurement. 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 soils; 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, Cal., 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. 5c.
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.
Siltng 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.

151. Field assay of water, by M. O. Leighton. 1905. 77 pp., 4 pls.
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.
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.
Scope indicated by amplification of title.
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- *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 well 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 well-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. C. 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 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:
*(e) 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. C. 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 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 Juan 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; discusses 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, Cal., 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.

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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.

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