

DEPARTMENT OF THE INTERIOR

ALBERT B. FALL, Secretary

UNITED STATES GEOLOGICAL SURVEY

GEORGE OTIS SMITH, Director

WATER-SUPPLY PAPER 476

FACE WATER SUPPLY OF THE
UNITED STATES

1918

PART VI. MISSOURI RIVER BASIN

NATHAN C. GROVER, Chief Hydraulic Engineer

W. A. LAMB and ROBERT FOLLANSBEE, District Engineers

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



WASHINGTON

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Water Resources Branch,
Geological Survey,
Box 3106, Capitol Station
Oklahoma City, Okla.

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SURFACE WATER SUPPLY OF MISSOURI RIVER BASIN, 1918.

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, 1918.

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, 1895-1919.

1895.....	\$12,500.00
1896.....	20,000.00
1897 to 1900, inclusive.....	50,000.00
1901 to 1902, inclusive.....	100,000.00
1903 to 1906, inclusive.....	200,000.00
1907.....	150,000.00
1908 to 1910, inclusive.....	100,000.00
1911 to 1917, inclusive.....	150,000.00
1918.....	175,000.00
1919.....	148,244.10

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

Measurements of stream flow have been made at about 4,500 points in the United States and also at many points in Alaska and the Hawaiian Islands. In July, 1916, 1,180 gaging stations were being maintained by the Survey and the cooperating organizations. Many

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

DEFINITION OF TERMS.

The volume of water flowing in a stream—the “run-off” or “discharge”—is expressed in various terms, each of which has become associated with a certain class of work. These terms may be divided into two groups—(1) those that represent a rate of flow, as second-feet, gallons per minute, miner’s inches, and discharge in second-feet per square mile, and (2) those that represent the actual quantity of water, as run-off in depth 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-foot” is an abbreviation for “cubic feet per second.” A second-foot is the rate of discharge of water flowing in a channel of rectangular cross section 1 foot wide and 1 foot deep at an average velocity of 1 foot per second. It is generally used as a fundamental unit from which others are computed.

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

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

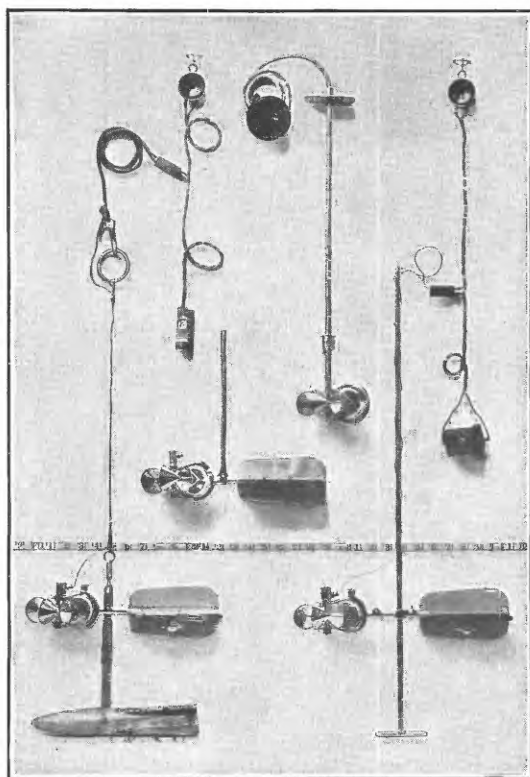
An “acre-foot,” equivalent to 43,560 cubic feet, is the quantity required to cover an acre to the depth of 1 foot. The term is commonly used in connection with storage for irrigation.

The following terms not in common use are here defined:

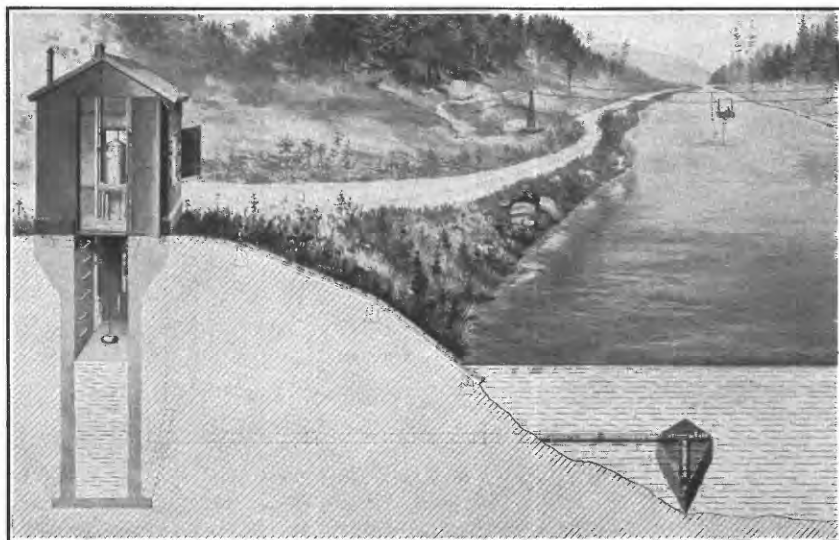
“Stage-discharge relation,” an abbreviation for the term “relation of gage height to discharge.”

“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.

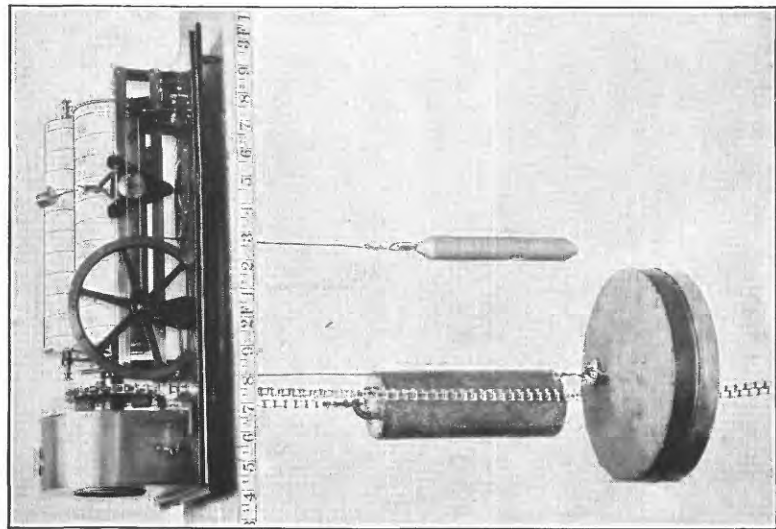
The “point of zero flow” for a given gaging station is that point on the gage—the gage height—to which the surface of the river would fall if there were no flow.



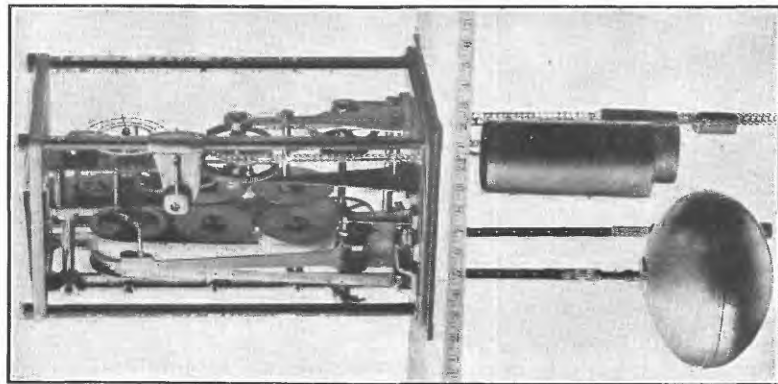
A. PRICE CURRENT METERS.



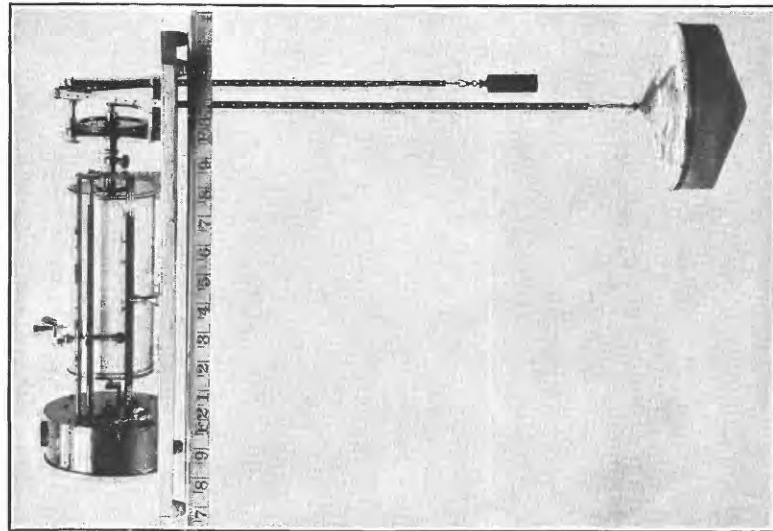
B. TYPICAL GAGING STATION.



4. STEVENS CONTINUOUS.



B. GURLEY PRINTING.
WATER-STAGE RECORDERS.



C. FRIEZ.

EXPLANATION OF DATA.

The data presented in this report cover the year beginning October 1, 1917, and ending September 30, 1918. At the beginning of January in most parts of the United States much of the precipitation in the preceding three months is stored as ground water in the form of snow or ice, or in ponds, lakes, and swamps, and this stored water passes off in the streams during the spring break-up. At the end of September, on the other hand, the only stored water available for run-off is possibly a small quantity in the ground; therefore the run-off for the year beginning October 1 is practically all derived from precipitation within that year.

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

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

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

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

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

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

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

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

ACCURACY OF FIELD DATA AND COMPUTED RESULTS.

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

A paragraph in the description of the station 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

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

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

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

COOPERATION.

Much of the work in Montana has been carried on under cooperative agreement with the United States Reclamation Service, the work being done by the Geological Survey and the expense borne by the Reclamation Service. The legislature of the State of Montana made an appropriation for stream-gaging work, which was expended by the State engineer, as provided in the act, in accordance with paragraph 3, section 2244, of the Revised Codes of 1907 of the State of Montana, which reads as follows:

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

This fund was expended largely on work in connection with the several Carey projects in Montana and in computing data on water-right filings and adjudications. A State hydrographer was employed who worked directly with the Geological Survey.

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

Officials of the Yellowstone National Park have furnished gage readings and paid for a 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 maintenance of stations on North Platte River above Pathfinder, Sage Creek above Pathfinder, Dinwoody Creek near Lenore, and on Bull Lake Creek near Lenore, Wyo., and also furnished records for certain stations as acknowledged in connection with descriptions of those stations.

The United States Forest Service furnished gage-height records for Big Creek near Big Creek and Middle Fork of Popo Agie River near Lander.

Gage-height records and transportation necessary to obtain data were furnished by Laramie Water Co. for Laramie River and Pioneer Canal near Woods and by Hawk Springs Development Co. for Horse Creek near La Grange.

The L. Z. Leiter estate, through J. C. Beebe, manager, furnished records of gage height for Piney Creek at Ucross, and transportation to a number of stations in the vicinity. The Buffalo Manufacturing Co. furnished daily gage-height records for Clear Creek near Buffalo. The State engineer of Colorado furnished records for Laramie River near Jelm, Wyo. Gage-height records were furnished by the Wyoming Irrigation Co. for Shell Creek at Shell and by the North Laramie Land Co. for North Laramie River near Wheatland. The Farmers Reservoir & Irrigation Co. furnished records of gage height and paid for maintenance of station on Clear Creek near Golden.

In Colorado the State engineer paid the gage observers at the stations on South Platte River at South Platte, North Fork of South Platte River at Grant, North Fork of South Platte River at South Platte, and Geneva Creek at Grant.

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

The work in Iowa has been carried on under cooperative agreement with the State Highway Commission, with Mr. R. W. Clyde, drainage engineer, of the commission, in charge. His part-time salary and expense and the observers' salaries were paid by the highway commission.

In Kansas the work was done in cooperation with the Kansas Water Commission, H. A. Rice, secretary, under terms of the water commission act of the legislature of 1917 (chap. 172, Session Laws of Kansas, 1917, p. 218). The cooperative agreement with the Kansas Water Commission was entered into May 11, 1917, for an investigation of the water resources of Kansas. District headquarters were established June 1, 1917, in Federal Building, Topeka, Kans.

The North Topeka Drainage District, V. R. Parkhurst, engineer, and the South Side Levee District No. 6, at Topeka, cooperated in the investigations in Kansas by constructing a reinforced-concrete well and shelter for the water-stage recorder at the gaging station on Kansas River at Topeka. This work was completed in the spring of 1918.

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

A. H. Tuttle, E. F. Chandler, R. F. Edwards, and L. H. Hershner, and by C. S. Heidel, State hydrographer of 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 P. V. Hodges, S. B. Soulé, and J. B. Spiegel.

Data for two stations in Yellowstone National Park were collected under the direction of G. C. Baldwin, district engineer, and prepared for publication under the direction of C. G. Paulsen, district engineer, assisted by A. G. Fielder, B. A. Howell, and Miss E. H. Haugse.

Data for stations in the Missouri River basin in Iowa were collected and prepared for publication under the direction of W. G. Hoyt, district engineer, assisted by R. W. Clyde and H. C. Beckman.

Data for stations in the Kansas River basin were collected and prepared for publication by R. C. Rice, district engineer, who was assisted by E. L. Grant, A. K. Gowans, and Mrs. R. C. Rice.

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, 1918; also miscellaneous measurements made in summer of 1910.

GAGE.—Stage determined by measuring with graduated rod, the depth on a peg in concrete well set with its top at elevation of crest of weir. Observations made by P. V. Maxwell. Float gage in concrete well used in 1912 and 1913. During 1911 a temporary vertical staff on 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 the weir or by wading.

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

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 1.90 feet, July 8–10, 14–16 (discharge, 450 second-feet); minimum stage recorded, 0.30 foot at 6 p. m. August 1, 7 a. m. and 6 p. m. August 2, and 7 a. m. August 3 (discharge, 24 second-feet).

1911–1918: 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 practically permanent. Rating curve well defined. Gage read to hundredths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table. Records good.

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

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

May 18, 1918; gage height, 1.74 feet; discharge, 388 second-feet.

Daily discharge, in second-feet, of Red Rock Creek below Red Rock Reservoir, near Monida, Mont., for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1.....	78	124	124	51	51	48	48	328	266	244	34	138
2.....	78	124	124	51	51	48	48	328	259	237	24	138
3.....	78	124	120	51	51	48	48	336	247	234	47	136
4.....	78	124	113	51	51	48	48	347	237	228	78	133
5.....	78	124	102	51	51	48	56	358	237	228	78	133
6.....	78	124	90	51	51	48	56	362	237	225	78	133
7.....	78	124	78	51	51	48	56	370	237	228	78	133
8.....	78	124	69	51	51	48	56	374	237	450	78	133
9.....	78	124	69	51	51	48	56	374	228	450	78	133
10.....	80	124	64	51	51	48	56	382	228	450	78	133
11.....	82	124	64	51	51	48	56	382	228	446	78	133
12.....	82	124	61	51	51	48	56	382	228	437	78	133
13.....	82	124	59	51	51	48	98	386	222	424	106	133
14.....	82	124	59	51	51	48	147	391	222	424	138	129
15.....	86	124	59	51	51	48	172	391	222	407	138	129
16.....	86	124	59	51	51	48	214	391	234	208	138	129
17.....	88	124	59	61	51	48	228	382	250	131	138	129
18.....	90	124	59	51	51	48	234	382	250	69	138	129
19.....	90	124	54	51	51	48	237	382	250	69	138	129
20.....	90	124	51	51	51	48	240	370	250	69	138	129
21.....	124	124	51	51	51	48	240	358	250	58	138	129
22.....	124	124	51	51	51	48	266	339	250	45	138	129
23.....	124	124	51	51	51	48	306	328	250	45	138	145
24.....	124	124	51	51	51	48	321	328	250	45	138	162
25.....	124	124	51	51	51	48	321	328	247	45	138	167
26.....	124	124	51	51	51	48	321	328	244	45	138	167
27.....	124	124	51	51	51	48	321	306	244	45	138	167
28.....	124	124	51	51	51	48	321	285	244	45	138	167
29.....	124	124	51	51	.....	48	328	279	244	45	138	167
30.....	124	124	51	51	.....	48	328	272	244	45	138	167
31.....	124	.....	51	51	.....	48	.....	272	.....	45	138	.....

Monthly discharge of Red Rock Creek below Red Rock Reservoir, near Monida, Mont., for the year ending Sept. 30, 1918.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October.....	124	78	96.9	5,960
November.....	124	124	124	7,380
December.....	124	51	67.7	4,160
January.....	51	51	51.0	3,140
February.....	51	51	51.0	2,830
March.....	48	48	48.0	2,950
April.....	328	48	176	10,500
May.....	391	272	349	21,500
June.....	266	222	241	14,300
July.....	450	45	202	12,400
August.....	138	24	110	6,760
September.....	167	129	140	8,330
The year.....	450	24	138	100,000

BEAVERHEAD RIVER AT BARRATTS, MONT.

LOCATION.—In SW. $\frac{1}{4}$ SW. $\frac{1}{4}$ sec. 20, T. 8 S., R. 9 W., on highway bridge at point where highway crosses railroad and where both highway and railroad bridges cross river, 1 mile above Barratts, in Beaverhead County, 2 miles below mouth of Grasshopper Creek, and 10 miles southwest of Dillon.

DRAINAGE.—Not measured.

RECORDS AVAILABLE.—August 12, 1907, to September 30, 1918.

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, 2.20 feet at 7.50 a. m. July 12 (discharge, 878 second-feet); minimum stage, 0.80 foot June 7, 8, and July 4 (discharge, 202 second-feet).

1907-1918: Maximum stage recorded, 6.0 feet June 19 and 20, 1908 (discharge, 3,640 second-feet); minimum stage recorded, 0.42 foot June 23, 1910 (discharge, 114 second-feet).

ICE.—Observer did not report ice during year, and the records for January and February have been computed using open-channel rating. These records should be used with caution as temperature records indicate possible ice effect.

DIVERSIONS.—Numerous diversions are made above station. Water rights aggregating 85,866 inches of water are decreased 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.—Operation of the dam used to store flood waters of Red Rock Creek near Monida has some effect on flow at this station.

ACCURACY.—Stage-discharge relation practically permanent during year, except for possible slight ice effect in January and February. Rating curve is well defined between 170 and 820 second-feet. Gage read to tenths twice daily. Daily discharge ascertained by applying gage height to rating table. Records good except possibly for January and February when the stage-discharge relation may have been affected by ice.

Beaverhead River is called Red Rock Creek from its source in Red Rock lakes to the post office of Red Rock, below which it is called Beaverhead River. Principal tributaries of this river above station are Grasshopper Creek, 12 miles south of Dillon; Horse Prairie Creek, 20 miles south; and Rattlesnake and Blacktail Deer creeks. Irrigation has probably been practiced in Beaverhead Valley longer than in any other valley in Montana, ditches constructed in the early seventies being still in operation.

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

May 17, 1918: Gage height, 1.80 feet; discharge, 648 second-feet.

Daily discharge, in second-feet, of Beaverhead River at Barratts, Mont., for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1.....	294	642	509	553	368	363	494	702	359	239	359	278
2.....	294	669	509	553	368	363	494	702	338	239	359	258
3.....	314	669	509	553	368	363	494	702	298	220	318	239
4.....	334	669	509	553	368	363	447	702	278	202	318	239
5.....	334	669	509	553	368	363	402	759	258	220	318	239
6.....	334	642	485	504	368	363	402	788	220	278	318	239
7.....	334	615	461	456	368	363	402	818	202	278	318	239
8.....	334	615	461	456	368	363	402	818	202	239	318	239
9.....	334	642	461	456	368	363	402	818	239	239	318	278
10.....	334	669	461	411	368	363	447	818	278	239	318	278
11.....	334	669	461	411	368	363	447	818	359	239	318	239
12.....	376	669	461	411	368	363	494	759	402	702	318	239
13.....	376	615	461	411	368	363	494	759	494	380	318	239
14.....	376	615	461	411	368	363	494	702	568	518	298	278
15.....	376	615	461	411	368	363	494	702	594	788	298	318
16.....	376	615	461	411	368	363	494	702	543	674	318	318
17.....	398	615	461	411	368	385	494	647	543	788	318	318
18.....	420	615	461	411	368	406	494	620	594	620	318	318
19.....	466	615	461	411	368	429	494	594	568	494	298	318
20.....	466	615	461	411	368	475	518	568	494	447	278	298
21.....	466	615	461	411	368	452	543	543	447	402	278	278
22.....	466	615	461	411	368	475	543	494	494	380	298	278
23.....	514	615	461	411	368	523	568	447	494	359	318	318
24.....	514	615	485	368	368	548	594	424	470	359	318	318
25.....	514	615	509	368	367	548	594	402	424	359	298	318
26.....	514	669	509	368	368	574	594	402	402	380	278	338
27.....	514	669	558	368	368	599	594	402	298	402	278	359
28.....	514	615	558	368	368	548	620	402	258	402	278	359
29.....	538	563	558	368	.....	548	647	402	239	359	278	359
30.....	563	563	558	368	.....	548	702	380	239	359	278	359
31.....	615	.....	558	368	.....	548	.....	359	.....	359	278	.....

Monthly discharge of Beaverhead River at Barratts, Mont., for the year ending Sept. 30, 1918.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October.....	615	294	417	25,600
November.....	669	563	630	37,500
December.....	558	461	489	30,100
January.....	553	368	430	26,400
February.....	368	368	368	20,400
March.....	599	363	433	26,600
April.....	702	402	510	30,300
May.....	818	359	618	38,000
June.....	594	202	387	23,000
July.....	788	202	392	24,100
August.....	359	278	307	18,900
September.....	359	239	290	17,300
The year.....	818	202	440	318,000

MISSOURI RIVER AT FORT BENTON, MONT.

LOCATION.—In NE. $\frac{1}{4}$ sec. 26, T. 24 N., R. 8 E., on 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, 1918, United States Geological Survey records.

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

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

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 6.30 feet at 10 a. m. June 20 (discharge, 31,200 second-feet); minimum stage recorded, January 11 (discharge, 3,270 second-feet).

1881–1918: Maximum stage recorded, 9.90 feet May 27, 1917 (discharge 55,200 second-feet); maximum stage recorded by United States Weather Bureau, 15.3 feet June 7, 1908 (discharge not computed); minimum stage recorded, –0.2 foot September 10, 1914 (discharge, 2,250 second-feet); minimum stage recorded by United States Weather Bureau, –0.5 foot August 7–10, 17 and 18, 1910 (discharge not computed).

Open season records only; flow may have been lower during winter months.

ICE.—Stage-discharge relation seriously affected by ice; December 17 to 31 flow not computed.

DIVERSIONS.—Numerous diversions from tributaries.

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

ACCURACY.—Stage-discharge relation permanent except during the winter. Rating curve well defined above 2,050 second-feet. Daily gage heights October 1 to December 16 are mean of two readings daily to hundredths. Daily discharge October 7 to December 16 ascertained by applying gage heights to rating table; January 1 to September 30 determined by Great Falls Company. Records fair.

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

June 20, 1918: Gage height, 6.30 feet; discharge, 31,200 second-feet.

Daily discharge, in second-feet, of Missouri River at Fort Benton, Mont., for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1.....	6,840	6,240	7,540	7,490	5,330	4,770	9,220	10,000	12,000	9,670	6,250	4,390
2.....	6,700	6,420	7,540	6,690	5,230	5,070	8,450	11,200	12,300	8,370	5,730	4,120
3.....	6,560	6,490	7,580	6,860	5,980	5,390	7,570	11,200	11,500	6,450	5,630	4,950
4.....	6,490	6,600	7,580	6,780	6,550	5,420	7,960	13,500	11,400	6,040	5,590	4,890
5.....	6,420	6,940	7,540	6,350	6,980	5,640	7,840	13,800	11,600	5,530	5,730	5,150
6.....	6,350	7,780	7,750	5,680	7,060	5,420	7,560	14,800	11,900	5,100	5,390	4,680
7.....	6,350	7,920	7,580	6,540	6,580	6,070	7,800	14,600	12,800	4,730	5,560	4,620
8.....	6,350	6,980	7,610	5,250	6,250	6,570	8,220	15,200	14,300	4,510	5,660	4,190
9.....	6,140	6,350	7,360	3,510	5,940	6,520	8,060	16,300	16,700	4,460	5,490	4,550
10.....	5,900	6,070	7,300	3,330	6,160	6,880	8,240	16,100	19,000	4,650	5,500	4,430
11.....	5,900	6,000	7,220	3,270	5,900	7,140	9,040	15,400	22,000	4,950	5,520	4,130
12.....	5,860	6,720	6,880	4,260	5,480	7,050	8,860	15,200	23,700	5,090	5,580	4,790
13.....	6,000	5,580	6,700	5,220	5,650	7,010	8,740	15,000	25,100	4,690	5,690	4,250
14.....	6,000	5,510	6,770	5,440	5,330	7,290	8,990	15,000	26,800	4,580	6,060	4,250
15.....	6,070	5,440	6,770	5,470	4,740	6,970	9,370	15,700	27,200	4,530	5,190	4,790
16.....	6,100	5,440	6,700	5,210	4,990	8,010	9,990	15,100	27,900	5,000	4,980	4,460
17.....	6,140	5,440	.....	5,980	4,840	7,920	9,680	15,700	27,200	5,520	4,970	4,250
18.....	6,140	5,580	.....	5,950	5,400	7,830	11,000	15,600	27,200	5,440	4,960	4,190
19.....	6,140	5,900	.....	6,240	5,330	7,750	10,700	14,400	28,000	4,980	4,140	4,460
20.....	6,210	6,140	.....	6,300	5,150	8,400	9,940	14,600	27,200	5,160	4,800	4,330
21.....	6,210	6,700	.....	5,630	5,480	8,660	8,620	13,800	26,200	5,340	5,060	4,070
22.....	6,140	6,560	.....	6,270	5,080	8,600	8,010	13,500	26,200	6,100	4,940	4,030
23.....	6,100	6,840	.....	6,960	5,550	8,220	9,210	13,300	24,600	6,950	4,900	4,240
24.....	6,070	6,810	.....	6,740	6,140	8,680	9,180	13,300	22,300	6,370	4,720	4,310
25.....	6,070	7,050	.....	7,380	5,700	9,120	8,900	13,300	19,200	6,400	4,640	4,520
26.....	6,100	7,190	.....	6,900	5,280	8,830	9,490	12,800	15,600	6,260	4,360	4,730
27.....	6,140	7,330	.....	6,530	5,110	9,340	9,440	12,800	13,600	6,120	4,460	5,060
28.....	6,140	7,500	.....	6,040	5,500	9,460	9,550	12,400	13,100	6,030	4,760	4,700
29.....	6,140	7,540	.....	6,260	.....	9,900	9,480	11,600	12,900	6,430	4,320	4,560
30.....	6,140	7,500	.....	5,620	.....	9,900	9,380	11,300	10,500	6,240	4,720	4,990
31.....	6,140	.....	.....	5,520	.....	9,320	.....	11,800	.....	5,890	4,520	.....

NOTE.—Dec. 17–31, affected by ice, discharge not computed.

*Monthly discharge of Missouri River at Fort Benton, Mont., for the year ending
Sept. 30, 1918.*

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October.....	6,849	5,860	6,200	331,000
November.....	7,920	5,440	6,560	390,000
December 1-16.....	7,750	6,700	7,280	231,000
January.....	7,490	3,270	5,840	359,000
February.....	7,060	4,740	5,670	315,000
March.....	9,900	4,770	7,390	454,000
April.....	11,000	7,560	8,950	533,000
May.....	16,300	10,000	13,800	848,000
June.....	28,000	10,500	19,300	1,150,000
July.....	9,670	4,460	5,730	352,000
August.....	6,250	4,140	5,170	318,000
September.....	5,150	4,030	4,500	268,000

MADISON RIVER BASIN.

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, 1918.

GAGE.—Vertical staff on left bank; read by park rangers and soldiers attached to Riverside soldier station.

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

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

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 1.62 feet July 1, 6, and September 9 (discharge, 682 second-feet); minimum stage, 1.32 feet November 17-24 (discharge, 440 second-feet).

1913-1918: Maximum stage recorded, 2.64 feet at 6 p. m. June 10, 1917 (discharge, 1,950 second-feet); minimum stage, 1.25 feet July 21-25, 1915 (discharge, 370 second-feet).

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

DIVERSIONS.—None above station.

REGULATION.—None.

ACCURACY.—Stage-discharge relation affected by aquatic growth. Two fairly well-defined rating curves used, one applicable October 1-6 and July 1 to September 30, the other October 7 to December 8. Gage read to half-tenths once daily. Daily discharge ascertained by applying daily gage height to rating table. Records fair.

MADISON RIVER BASIN.

19

Discharge measurements of Madison River near Yellowstone, Mont., during the year ending Sept. 30, 1918.

[Made by G. C. Baldwin.]

Date.	Gage height.	Discharge.
June 29.....	<i>Fect.</i> 1.64	<i>Sec.-ft.</i> 712
Sept. 6.....	1.37	459

Daily discharge, in second-feet, of Madison River near Yellowstone, Mont., for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Dec.	July.	Aug.	Sept.	Day.	Oct.	Nov.	Dec.	July.	Aug.	Sept.
1.....	497	491	491	682	497	482	16.....	491	491	.....	579	497	462
2.....	497	491	491	682	497	478	17.....	491	440	.....	535	497	462
3.....	497	491	491	682	497	474	18.....	491	440	.....	535	497	462
4.....	462	491	491	682	497	470	19.....	491	440	.....	535	497	462
5.....	497	491	491	682	497	466	20.....	491	440	.....	535	497	462
6.....	497	491	491	682	497	462	21.....	491	440	.....	497	497	462
7.....	491	491	491	630	497	462	22.....	491	440	.....	497	497	462
8.....	491	491	491	630	497	462	23.....	491	440	.....	497	497	469
9.....	491	491	.....	630	497	682	24.....	491	440	.....	497	497	535
10.....	491	491	.....	630	497	579	25.....	491	491	.....	497	497	497
11.....	491	491	.....	630	497	497	26.....	543	491	.....	497	497	469
12.....	491	491	.....	579	497	497	27.....	543	491	.....	497	497	462
13.....	491	491	.....	579	497	462	28.....	543	491	.....	497	497	462
14.....	491	491	.....	579	497	497	29.....	491	491	.....	497	494	462
15.....	491	491	.....	579	497	535	30.....	491	491	.....	497	490	535
							31.....	491	.....	.....	497	486	.....

NOTE.—Discharge interpolated, for lack of gage readings, Aug. 29 to Sept. 5.

Monthly discharge of Madison River near Yellowstone, Mont., for the year ending Sept. 30, 1918.

[Drainage area, 410 square miles.]

Month.	Discharge in second-feet.				Run-off.	
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches.	Acre-feet.
October.....	543	462	496	1.21	1.40	30,500
November.....	491	440	477	1.16	1.29	28,400
December 1-8.....	491	491	491	1.20	.36	7,790
July.....	682	497	572	1.40	1.61	35,200
August.....	497	486	496	1.21	1.40	30,500
September.....	682	462	488	1.19	1.33	29,000

PRICKLY PEAR CREEK BASIN.**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 mouth of Moose Creek, and 3 miles north of Rimini, in Lewis and Clark County.

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—March 13, 1915, to September 30, 1918.

GAGE.—Friez water-stage recorder on left bank opposite ranger station; observer, D. H. Lewis a forest ranger. On March 4, 1918, the gage was moved to a new concrete control about 75 feet downstream and set at a different datum.

DISCHARGE MEASUREMENTS.—Made from footbridge at the location of the original gage.

CHANNEL AND CONTROL.—Gravel and boulders; slightly shifting. On March 4, 1918, a concrete control was constructed about 75 feet below the gage. 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 reported during year, 1.84 feet at 9 p. m. June 7, (discharge, 172 second-feet); minimum stage reported, 0.04 foot November 9–11, (discharge, 2.8 second-feet).

1915–1918: Maximum stage recorded, 4.87 feet at 2 p. m. May 15, 1917 (discharge, 948 second-feet); minimum stage, 1.28 feet at 6 p. m. October 10, 1916 (discharge, 1.4 second-feet).

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

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

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

ACCURACY.—Stage-discharge relation not permanent; changed during October and November; concrete control constructed the last week in February, but a change in the rating occurred during the high water in May when a channel was formed outside the control. Rating curves used as follows: November 19 to February 23, well defined between 3 and 15 second-feet; March 4 to May 15, and September 28–30, well defined between 4 and 35 second-feet; May 16 to September 13, well defined between 5 and 100 second-feet; shifting-control method used October 1 to November 20, and September 14–27. Gage read to hundredths once daily October 1 to February 2; operation of water-stage recorder satisfactory March 4 to September 30, except for periods indicated in footnote to daily-discharge table. Daily discharge, November 21 to February 2, ascertained by applying daily gage height to rating table; March 4 to September 30, except September 13–27 and periods indicated in footnote to daily-discharge table, by applying to rating table mean daily gage height obtained from recorder graph. Records good, except for periods for which gage heights were not obtained.

Discharge measurements of Tenmile Creek near Rimini, Mont., during the year ending Sept. 30, 1918.

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. 7	A. H. Tuttle.....	0.09	3.7	Apr. 23	Lamb and Edwards....	0.86	22.2
20	W. A. Lamb.....	.14	6.3	30	W. A. Lamb.....	.97	33
Jan. 3	do.....	.31	11.2	June 3	do.....	1.41	96
Feb. 2	do.....	.10	5.4	July 2	do.....	.75	6.6
23	do.....	.01	3.4	Sept. 11	do.....	.44	6.3
Mar. 4	do.....	.43	4.5	28	do.....	.53	6.6
24	do.....	.60	10.0				

Daily discharge, in second-feet, of Tenmile Creek near Rimini, Mont., for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June.	July.	Aug.	Sept.
1.....	6.2	8.6	11.8	15.0	4.5	.....	15.9	53	99	18.2	7.5	6.9
2.....	6.2	8.6	6.4	15.0	4.5	.....	15.8	73	94	17.0	7.8	6.9
3.....	5.4	7.5	6.4	11.0	.....	.....	15.6	104	99	15.5	8.1	6.9
4.....	5.4	4.5	6.4	9.8	.....	4.7	15.3	138	113	14.0	8.9	6.9
5.....	5.4	4.3	6.4	9.8	.....	4.7	15.3	146	131	13.0	9.3	6.9
6.....	5.4	4.3	6.4	9.8	.....	4.7	15.2	122	138	13.0	8.7	6.9
7.....	8.6	3.9	6.4	8.0	.....	4.6	15.0	111	158	10.0	8.1	6.9
8.....	8.6	3.4	6.4	7.0	.....	4.6	14.8	101	154	8.9	7.5	6.9
9.....	8.6	2.8	6.4	5.9	.....	4.5	22	88	145	8.5	6.9	6.9
10.....	8.6	2.8	6.4	5.9	.....	4.5	22	73	134	8.1	6.6	6.9
11.....	8.6	2.8	6.4	5.9	.....	4.5	28	75	120	9.7	6.9	6.9
12.....	7.7	3.6	6.4	5.9	.....	4.5	29	96	105	8.5	6.6	6.9
13.....	7.7	5.0	8.0	5.9	.....	4.5	31	118	100	7.5	6.6	6.6
14.....	7.2	5.2	10.4	5.9	.....	4.5	32	130	91	17.6	7.2	15.9
15.....	6.7	5.4	12.6	5.9	.....	4.5	29	152	76	40	6.9	14.8
16.....	6.7	5.7	12.6	5.9	.....	5.2	26	149	71	26	6.9	8.3
17.....	6.4	5.9	11.0	5.9	.....	5.9	25	138	68	19.4	7.2	7.6
18.....	6.4	6.2	15.0	5.9	.....	6.4	22	136	58	16.0	7.2	6.4
19.....	5.4	6.7	15.0	5.9	.....	6.7	22	120	52	14.5	6.9	5.9
20.....	5.4	6.7	15.0	5.9	.....	6.7	20	110	45	13	7.2	6.2
21.....	5.4	6.4	14.2	5.9	.....	6.7	22	97	38	13	7.5	6.7
22.....	5.4	6.4	13.4	5.9	.....	7.3	23	94	37	11.2	7.5	6.7
23.....	5.4	6.4	11.0	5.9	3.4	8.3	23	105	34	10.9	7.2	7.0
24.....	5.4	6.4	9.8	5.9	.....	11.6	27	107	32	10.7	6.9	7.1
25.....	5.4	6.4	9.8	5.9	.....	13.4	30	94	32	10.4	6.4	7.1
26.....	10.1	6.4	9.2	5.9	.....	15.4	27	90	27	10.1	6.0	7.2
27.....	10.1	6.4	9.5	5.4	.....	15.9	27	84	25	9.9	6.6	7.3
28.....	10.1	6.4	10.4	5.2	.....	14.8	26	73	24	9.6	6.9	7.3
29.....	10.1	6.4	10.4	5.0	.....	15.1	26	79	22	9.3	6.9	7.0
30.....	10.1	6.4	10.4	4.5	.....	15.3	41	97	21	8.5	6.9	7.3
31.....	9.8	.....	10.4	4.5	.....	15.6	.....	102	.....	7.8	6.9	.....

NOTE.—Gage not read Feb. 3-22, 24-28, and Mar. 1-3. Water stage recorder did not operate satisfactorily Mar. 5-10, 16, 29-31, Apr. 2-7, 21, July 23-28, Aug. 6-8, 25, Sept. 3-7 and 24-27; discharge interpolated.

Monthly discharge of Tenmile Creek near Rimini, Mont., for the year ending Sept. 30, 1918.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October.....	10.1	5.4	7.22	444
November.....	8.6	2.8	5.60	330
December.....	15	6.4	9.69	596
January.....	15	4.5	6.97	429
February.....			3.78	210
March.....	15.9		7.55	464
April.....	41	14.8	23.2	1,380
May.....	152	53	105	6,460
June.....	158	21	78.1	4,660
July.....	40	7.5	13.2	812
August.....	9.3	6.0	7.25	446
September.....	15.9	5.9	7.51	447
The year.....	158	2.8	23.0	16,700

NOTE.—Discharge for February and Mar. 1-4, estimated by comparison with records for station on Tenmile Creek near Helena.

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, 1918.

GAGE.—Staff on right bank; read by David B. Crane.

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

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

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 3.60 feet May 5, 14, 15, 16 (discharge, 186 second-feet); minimum stage recorded, 1.80 feet at 7.45 p. m. July 10 (practically no flow).

1908-1918: Maximum stage recorded, 5.60 feet at 6.30 p. m. May 28, 1917 (discharge, 865 second-feet); practically no flow in afternoon of July 10, 1918.

ICE.—Stage-discharge relation slightly 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 not permanent. Rating curve used February 4 to September 30 well defined below 85 second-feet. Gage read to half-tenths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table; shifting-control method used October 1 to February 3. Records fair October to February; good for other months.

Discharge measurements of Tenmile Creek near Helena, Mont., during the year ending Sept. 30, 1918.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
Feb. 3	W. A. Lamb.....	Feet.	Sec.-ft.	Apr. 30	W. A. Lamb.....	Feet.	Sec.-ft.
21	A. H. Tuttle.....	2.30	10.2	Sept. 30	do.....	2.75	51
24	W. A. Lamb.....	2.40	6.0			2.20	5.5
		2.26	7.3				

^a Stage-discharge relation affected by ice.

Daily discharge, in second-feet, of Tenmile Creek near Helena, Mont., for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1.....	10	20	25	28	10	5.2	44	69	124	8.7	0.8	0.2
2.....	10	18	20	28	10	16	52	76	124	6.3	.5	.6
3.....	11	17	17	23	10	16	52	80	118	5.5	.2	1.1
4.....	12	20	17	22	10	13	41	115	132	5.5	.4	.8
5.....	12	19	17	21	13	13	34	177	146	4.0	.6	.8
6.....	12	17	17	17	9.5	15	34	168	154	4.0	.5	.5
7.....	12	17	16	17	8.7	7.5	31	141	164	2.5	.5	.5
8.....	12	17	15	16	7.5	6.3	41	132	159	.5	.2	.8
9.....	12	15	15	18	7.5	21	46	132	146	.8	.2	1.2
10.....	14	12	16	16	7.5	5.5	57	124	141	.1	.2	1.1
11.....	15	12	17	16	7.5	13	57	132	115	1.2	.2	.8
12.....	15	12	22	16	7.5	16	63	129	101	.8	.5	.8
13.....	15	12	22	16	7.5	16	59	159	90	1.1	.5	.8
14.....	15	12	17	16	7.5	8.7	69	177	76	2.2	.5	11
15.....	15	12	16	16	7.5	9.5	63	186	59	.5	.5	11
16.....	16	15	21	15	7.5	7.5	55	186	52	41	.5	4.9
17.....	17	17	22	15	7.5	16	57	168	55	24	.5	3.1
18.....	17	17	32	15	7.0	26	48	168	44	11	.2	2.2
19.....	17	17	36	11	6.5	24	46	150	38	9.5	.2	1.8
20.....	18	17	32	10	6.0	24	44	136	34	8.7	.6	1.5
21.....	18	18	22	10	6.0	24	48	118	31	7.5	.6	1.2
22.....	18	19	24	10	6.0	24	46	112	34	5.5	.5	2.5
23.....	20	20	28	10	9.0	24	46	118	31	6.3	.5	4.9
24.....	20	20	36	10	9.5	34	46	132	26	13	.5	7.5
25.....	21	20	22	11	8.7	31	57	118	21	8.7	.5	7.5
26.....	21	18	45	10	6.3	41	46	115	16	11	.4	5.5
27.....	20	17	45	10	5.5	46	44	101	11	16	.2	5.5
28.....	18	17	45	10	5.2	55	48	98	11	11	.5	5.5
29.....	18	17	49	10	.....	36	46	95	11	7.5	.2	7.5
30.....	22	18	49	10	.....	46	48	118	11	4.0	.2	7.5
31.....	21	.....	32	10	.....	46	.....	129	.....	1.8	.2	.....

NOTE.—Stage-discharge relation slightly affected by ice Feb. 4, 15, and 18-23; discharge interpolated.

Monthly discharge of Tenmile Creek near Helena, Mont., for the year ending Sept. 30, 1918.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October.....	22	10	15.9	978
November.....	20	12	16.6	988
December.....	49	15	26.1	1,600
January.....	28	10	14.9	916
February.....	13	5.2	7.92	440
March.....	55	5.2	22.1	1,360
April.....	69	31	48.9	2,910
May.....	186	69	131	8,060
June.....	164	11	75.8	4,510
July.....	69	.1	9.64	593
August.....	.8	.2	.41	25
September.....	11	.2	3.35	199
The year.....	186	.1	31.2	22,600

LITTLE PRICKLY PEAR CREEK BASIN.

LITTLE PRICKLY PEAR CREEK NEAR MARYSVILLE, MONT.

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

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

RECORDS AVAILABLE.—May 24, 1913, to September 30, 1918, at present site; April 12 to May 23, 1913, about a quarter of a mile above present site; May 18, 1909, to December 31, 1911, at station formerly maintained above mouth of Deadman Creek.

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

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

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

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 2.10 feet May 5 (discharge, 124 feet); minimum stage, 1.05 feet February 19-24 (discharge, 2.5 second-feet).

1909-1911 and 1913-1918: Maximum stage recorded, 3.8 feet May 25 and 26, 1917 (discharge, 454 second-feet); minimum stage, 2.28 feet (old gage) March 7-13, 1911 (discharge, 1.2 second-feet).

ICE.—Stage-discharge relation affected very little, if any, by ice. Open-channel rating assumed applicable throughout the winter.

DIVERSIONS.—Several small ditches take water from the stream above the station.

REGULATION.—None.

ACCURACY.—Stage-discharge relation not permanent. Rating curve used October 1 to January 9, fairly well defined between 5 and 150 second-feet. Gage read to hundredths once daily; during May and June twice daily. Daily discharge ascertained by applying daily gage height to rating table; shifting-control method used January 10 to September 30. Records fair.

Discharge measurements of Little Prickly Pear Creek near Marysville, Mont., during the year ending Sept. 30, 1918.

[Made by W. A. Lamb.]

Date.	Gage height.	Discharge.
	<i>Feet.</i>	<i>Sec.-ft.</i>
Mar. 26.....	1.39	26.8
Aug.....	1.13	25.5

Daily discharge, in second-feet, of Little Prickly Pear Creek near Marysville, Mont., for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June	July.	Aug.	Sept.
1.....	10	5.0	7.5	13	5	3.5	41	61	56	35	30	20
2.....	10	5	7.5	13	5.5	3.5	41	74	56	35	30	20
3.....	7.5	5	7.5	16	5.5	3.5	36	90	56	35	28	18
4.....	7.5	5	5.0	16	5.5	3.5	34	110	58	31	28	18
5.....	7.5	5	5.0	16	5.5	3.5	32	124	60	31	28	18
6.....	7.5	5	2.5	16	6	4.0	33	114	70	32	28	18
7.....	7.5	5	2.5	16	6	4	30	98	70	32	28	18
8.....	7.5	5	2.5	16	6	4	30	94	72	32	28	18
9.....	7.5	5	2.5	13	3.5	4	30	78	75	30	25	16
10.....	7.5	5	2.5	13	3.5	4	35	75	75	30	25	16
11.....	7.5	5	2.5	11	4	4.5	41	69	79	30	25	16
12.....	7.5	5	2.5	11	4	4.5	49	65	80	30	25	16
13.....	7.5	5	2.5	11	4	4.5	53	64	78	30	25	16
14.....	7.5	5	2.5	11	4	4.5	55	75	75	30	25	18
15.....	7.5	5	2.5	11	4.5	4.5	55	82	74	42	25	18
16.....	7.5	5	2.5	8.5	4.5	5	54	83	70	43	25	17
17.....	7.5	5	2.5	8.5	4.5	5	52	83	62	40	23	15
18.....	7.5	5	5.0	8.5	4.5	7.5	50	78	60	36	23	15
19.....	7.5	5	10	8.5	2.5	7.5	46	70	58	36	23	15
20.....	7.5	5	10	6.5	2.5	13	46	66	53	34	23	15
21.....	7.5	5	7.5	6.5	2.5	14	47	64	51	31	22	15
22.....	7.5	5	7.5	6.5	2.5	14	45	60	49	31	22	15
23.....	7.5	5	7.5	6.5	2.5	17	45	56	48	31	22	15
24.....	7.5	5	5.0	6.5	2.5	20	45	59	49	31	22	15
25.....	7.5	5	5	7	3.0	20	45	61	47	31	20	15
26.....	7.5	2.5	5	7	3	24	46	62	45	31	20	15
27.....	7.5	2.5	5	7	3	30	46	62	43	31	20	15
28.....	7.5	2.5	5	7	3	33	46	54	40	31	20	15
29.....	7.5	2.5	5	5	-----	33	46	53	40	31	20	15
30.....	7.5	2.5	13	5	-----	35	46	53	40	31	20	15
31.....	5.0	-----	13	5	-----	37	-----	53	-----	31	20	-----

Monthly discharge of Little Prickly Pear Creek near Marysville, Mont., for the year ending Sept. 30, 1918.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October.....	10	5	7.58	466
November.....	5	2.5	4.58	273
December.....	13	2.5	5.35	329
January.....	16	5.0	10.1	621
February.....	6	2.5	4.04	224
March.....	37	3.5	12.1	744
April.....	55	30	43.3	2,580
May.....	124	53	73.9	4,540
June.....	80	40	59.6	3,550
July.....	43	30	32.7	2,010
August.....	30	20	24.1	1,480
September.....	20	15	16.4	976
The year.....	124	2.5	24.6	17,800

LITTLE PRICKLY PEAR CREEK 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, 1918.

GAGE.—Vertical staff attached to tree on right bank about 40 feet above ford; read by Melville 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, 3.10 feet May 7 (discharge, 372 second-feet); minimum stage, 0.50 foot August 8–15 (discharge, 6.5 second-feet).

1909–1911 and 1913–1918: 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 low-water flow appropriated.

REGULATION.—None.

ACCURACY.—Stage-discharge relation permanent. Rating curve well defined between 10 and 500 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 Little Prickly Pear Creek near Canyon Creek, Mont., during the year ending Sept. 30, 1918.

[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>
November 25	0.93	32.3	June 4	1.61	105
March 26	1.74	114	August 2	.63	11.3
May 11	2.34	213			

Daily discharge, in second-feet, of Little Prickly Pear Creek near Canyon Creek, Mont., for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Dec.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	30	38	38	.....	127	285	113	16	23	16
2	30	38	38	.....	127	285	113	16	16	16
3	30	38	38	.....	127	306	113	16	10.5	16
4	30	38	38	.....	142	306	106	16	10.5	16
5	30	38	38	.....	142	328	106	16	10.5	16
6	30	38	38	.....	142	350	100	16	10.5	16
7	30	38	38	.....	142	372	100	16	10.5	16
8	30	38	38	.....	142	350	100	16	6.5	16
9	30	38	38	.....	150	306	100	23	6.5	16
10	30	38	38	.....	150	285	100	23	6.5	16
11	30	38	38	.....	158	285	88	23	6.5	16
12	30	38	38	.....	158	265	76	23	6.5	23
13	30	38	38	.....	158	265	65	23	6.5	23
14	30	38	38	.....	158	246	55	23	6.5	30
15	30	38	38	.....	158	227	46	30	6.5	30
16	30	38	46	.....	158	227	38	30	10.5	30
17	30	38	46	76	174	209	38	38	10.5	30
18	30	38	46	76	174	209	30	38	10.5	23
19	30	38	46	76	191	209	30	46	10.5	23
20	30	38	46	76	191	209	23	46	10.5	23
21	30	38	55	76	209	191	23	46	10.5	23
22	30	38	55	76	209	191	23	55	10.5	23
23	30	38	55	76	227	174	23	55	10.5	23
24	30	38	55	76	227	158	23	55	10.5	23
25	30	30	65	82	227	142	23	55	10.5	23
26	30	30	65	88	237	142	23	55	10.5	16
27	30	30	65	100	246	127	23	46	16	16
28	30	30	70	113	246	127	23	46	16	16
29	30	30	70	127	265	127	16	38	16	16
30	34	38	76	127	265	113	16	38	16	16
31	34	.....	76	127	.....	113	.....	30	16	.....

Monthly discharge of Little Prickly Pear Creek near Canyon Creek, Mont., for the year ending Sept. 30, 1918.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October.....	34	30	30.3	1,860
November.....	38	30	36.7	2,180
December.....	76	38	48.6	2,990
March 17-31.....	127	76	91.5	2,720
April.....	265	127	181	10,800
May.....	372	113	230	14,100
June.....	113	16	58.5	3,480
July.....	55	16	32.7	2,010
August.....	23	6.5	8.61	529
September.....	30	16	20.2	1,200

SUN RIVER BASIN.

NORTH FORK OF SUN RIVER NEAR AUGUSTA, MONT.

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

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—January 1, 1916, to September 30, 1918, at the present site. From August 5, 1889, to December 31, 1890; and October 31, 1903, to December 31, 1915, a station was located in sec. 33, T. 22 N., R. 7 W., at the Henningson ranch, 8 miles downstream from the present site. Flow of stream is 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 during a part of 1916 but was discontinued in 1917. From October 31, 1903, to December 31, 1915, an overhanging chain gage was located on the left bank below the ranch buildings of the Henningson Co. From August 5, 1889, to December 31, 1890, the gage was near this point.

DISCHARGE MEASUREMENTS.—Made from highway bridge about half a mile below gage.

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

EXTREMES OF DISCHARGE.—Maximum stage recorded during the year, 6.02 feet on June 10-11 (discharge, 11,600 second-feet); minimum stage recorded, 0.0 from October 11 to November 1, and February 28 to March 2.

1889-1918: Maximum stage recorded, 11.4 feet at 2 a. m. June 21, 1916 (discharge, 32,300 second-feet); minimum stage recorded, 0.0 April 7 and 8, 1915 (discharge, 15 second-feet).

ICE.—Discharge relation not seriously affected by ice.

DIVERSIONS.—October 11 to November 1, 1917, water was diverted through head gates for the purpose of testing the canal. September 16-22, 1918, water was diverted through the sluicing tunnel.

REGULATION.—None.

ACCURACY.—Stage-discharge relation permanent and was not affected by ice during year. Rating curve well defined. Gage read to hundredths once daily, except during June, when readings were made twice daily. Daily discharge ascertained by applying daily gage height to rating table. Records good.

COOPERATION.—Complete records furnished by United States Reclamation Service, but data have been slightly revised to conform to the Survey methods of computations.

Daily discharge, in second-feet, of North Fork of Sun River near Augusta, Mont., for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1.....	96	-----	198	767	315	210	408	2,330	3,420	1,390	332	87
2.....	96	184	184	907	307	210	399	3,040	2,820	1,390	332	87
3.....	96	184	178	1,070	291	217	372	3,860	2,460	1,320	332	87
4.....	96	184	178	1,180	291	224	372	5,580	2,640	1,260	291	87
5.....	96	184	178	907	291	224	364	6,110	3,420	1,130	291	73
6.....	96	210	178	713	307	217	364	4,670	5,350	1,130	291	68
7.....	96	210	178	649	291	217	372	3,860	6,020	1,130	276	50
8.....	291	210	178	608	276	217	416	3,320	7,680	1,070	276	50
9.....	124	210	178	588	261	224	480	2,330	9,250	1,070	276	43
10.....	17	210	178	557	254	217	608	2,160	11,000	1,000	261	43
11.....	-----	210	178	557	254	217	713	2,030	10,400	1,000	261	37
12.....	-----	184	178	538	239	217	883	1,920	9,520	883	224	37
13.....	-----	184	178	509	232	217	1,260	2,770	8,810	883	461	34
14.....	-----	184	178	461	224	217	1,260	3,720	8,880	1,260	461	34
15.....	-----	184	184	434	217	217	1,260	3,860	7,660	1,000	291	34
16.....	-----	184	198	425	217	210	1,230	3,880	5,760	1,000	291	-----
17.....	-----	184	217	416	217	210	1,230	3,420	5,120	883	291	-----
18.....	-----	184	332	390	217	210	1,100	3,230	5,240	713	291	-----
19.....	-----	204	461	372	217	210	1,120	2,590	5,120	659	276	-----
20.....	-----	204	399	372	210	204	1,160	2,080	4,850	639	254	-----
21.....	-----	204	332	372	210	217	1,310	1,920	4,040	639	232	-----
22.....	-----	217	332	364	210	224	1,390	2,060	4,020	639	204	-----
23.....	-----	217	291	356	210	224	1,320	2,110	3,720	639	178	124
24.....	-----	217	276	340	204	269	1,320	2,330	3,820	639	152	152
25.....	-----	217	269	332	204	284	1,600	2,240	3,230	639	152	184
26.....	-----	217	254	332	204	323	1,390	1,680	2,820	598	124	217
27.....	-----	217	217	332	210	356	1,460	1,680	2,330	557	124	254
28.....	-----	217	204	332	210	390	1,500	1,600	2,080	509	107	291
29.....	-----	217	443	332	-----	416	1,530	1,600	1,800	461	96	291
30.....	-----	210	509	323	-----	443	1,600	2,330	1,720	443	96	291
31.....	-----	-----	681	323	-----	461	-----	2,330	-----	416	87	-----

NOTE.—All water turned into canal Oct. 11 to Nov. 1, and through sluicing tunnel Sept. 16-22. Discharge measurement of canal Oct. 31 showed discharge 257 second-feet.

Monthly discharge of North Fork of Sun River near Augusta, Mont., for the year ending Sept. 30, 1918.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October 1-10.....	291	17	110	2,180
November 2-30.....	217	184	201	11,600
December.....	681	178	262	16,100
January.....	1,180	323	521	32,000
February.....	315	204	242	13,400
March.....	461	204	255	15,700
April.....	1,600	364	993	59,100
May.....	6,110	1,600	2,860	176,000
June.....	11,000	1,720	5,170	308,000
July.....	1,390	416	871	53,600
August.....	461	87	246	15,100

SUN RIVER AT FORT SHAW, MONT.

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

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—May 16, 1912, to September 30, 1918. A station on Sun River at Sun River, maintained July 31, 1905, to December 31, 1912, gave records for practically the same drainage area.

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

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

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

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 9.91 feet at 5.15 a. m. June 11 (discharge, 9,660 second-feet; minimum flow estimated 200 second-feet December 12 and 13; lower flow probably occurred during frozen season when gage was not read.

1905-1918: Maximum stage recorded, 13.4 feet June 7, 1908 (discharge 18,400 second-feet); minimum stage recorded at Sun River, 1.3 feet September 14, 1906 (discharge, 47 second-feet); at Fort Shaw, 1.65 feet August 5, 6, and 8, 1914 (discharge, 95 second-feet). The high-stage discharge at Fort Shaw and Sun River is practically the same but at low stages the operation of Sun River canal (capacity about 50 second-feet), which takes out between the stations, may cause a material difference.

ICE.—Stage-discharge relation slightly affected by ice December 4, 5, 8; discharge, interpolated. Seriously affected by ice December 11-15, 25-31, January 6-10, February 17-28; flow computed from hydrograph, using temperature records and observer's notes. Flow not computed January 11 to February 5.

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

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

ACCURACY.—Stage-discharge relation not permanent; slightly affected by ice December 4, 5, 8, 11-15, 25-31; January 6-10; February 17-28; seriously by ice January 11-31, February 1-5; slight change in control probably occurred during high water of February 5 and 6. Rating curve used October 1 to February 5, well defined between 400 and 9,000 second-feet; curve used February 6 to September 30, well defined between 350 and 9,000 second-feet. Gage read to hundredths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table, except for periods of ice effect, for which it was determined from observer's notes and weather records. Records good for open-water periods; fair for periods of ice effect.

Discharge measurements of Sun River at Fort Shaw, Mont., during the year ending Sept. 30, 1918.

[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>
May 28.....	5.97	1,700	July 17.....	5.65	1,230
June 21.....	7.31	4,210	Sept. 9.....	4.35	388

Daily discharge, in second-feet, of Sun River at Fort Shaw, Mont., for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1.....	479	462	418	1,280	.....	553	584	2,390	3,220	1,270	382	400
2.....	446	434	390	1,190	.....	635	548	2,950	2,740	1,180	420	420
3.....	446	402	362	1,260	.....	635	498	3,370	2,150	1,100	420	420
4.....	446	434	356	1,070	.....	527	475	4,880	2,150	1,060	462	420
5.....	446	442	350	898	.....	396	475	5,920	2,460	1,010	462	420
6.....	446	442	344	800	3,980	354	548	5,430	3,800	968	548	400
7.....	446	442	327	700	4,180	404	522	4,320	4,900	885	518	400
8.....	438	442	294	550	4,380	436	498	4,020	6,100	845	508	400
9.....	454	434	361	450	3,010	378	522	2,990	7,030	808	484	400
10.....	454	422	246	350	2,060	436	950	2,570	7,870	808	484	400
11.....	446	410	220	.....	1,100	378	1,070	2,240	9,070	703	471	400
12.....	448	410	200	.....	993	378	1,240	2,210	8,350	641	462	389
13.....	426	402	200	.....	845	428	1,140	2,480	8,140	612	453	364
14.....	426	410	250	.....	612	444	1,090	3,430	7,830	641	440	364
15.....	426	410	300	.....	508	436	1,190	3,920	7,510	808	532	354
16.....	426	394	438	.....	462	404	1,090	4,020	5,830	1,320	498	348
17.....	446	383	488	.....	400	444	1,140	3,720	5,100	1,100	382	331
18.....	446	383	525	.....	330	527	1,090	3,050	5,100	968	382	440
19.....	454	394	773	.....	300	527	1,100	2,670	5,000	925	382	420
20.....	446	383	773	.....	270	444	1,140	2,350	4,800	885	508	382
21.....	446	394	622	.....	300	404	1,320	2,300	4,100	737	462	382
22.....	446	402	576	.....	400	396	1,490	2,030	3,700	641	462	382
23.....	446	410	525	.....	440	404	1,420	2,030	3,700	612	462	273
24.....	446	410	438	.....	400	428	1,360	2,170	3,600	641	462	382
25.....	446	402	370	.....	380	416	1,560	2,210	3,120	641	440	420
26.....	446	410	320	.....	380	471	1,690	2,030	2,650	612	420	428
27.....	454	402	260	.....	400	503	1,490	1,830	2,190	584	420	420
28.....	426	383	240	.....	480	503	1,420	1,700	1,850	558	400	400
29.....	438	402	360	.....	.....	480	1,490	1,550	1,850	558	400	400
30.....	497	402	680	.....	.....	480	1,750	1,730	1,400	462	400	382
31.....	454	.....	1,100	.....	.....	553	.....	2,720	.....	400	400	.....

NOTE.—Discharge Feb. 7 and 10 interpolated. Gage not read Jan. 11 to Feb. 5.

Monthly discharge of Sun River at Fort Shaw, Mont., for the year ending Sept. 30, 1918.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October.....	497	426	446	27,400
November.....	462	383	412	24,500
December.....	1,100	200	420	25,800
January 1-10.....	1,280	350	855	17,000
February 6-28.....	4,380	270	1,160	52,900
March.....	635	354	458	28,200
April.....	1,750	475	1,060	63,100
May.....	5,920	1,550	2,940	181,000
June.....	9,070	1,400	4,580	273,000
July.....	1,320	400	805	49,500
August.....	548	382	449	27,600
September.....	440	273	391	23,300

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, 1918.

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, 3.20 feet December 29, 1917 (discharge, 127 second-feet); minimum stage recorded, 0.35 foot July 10-13 (discharge, 6 second-feet).

1905-1918: 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.

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 changed probably during the high water in December and again during June. Rating curves fairly well defined. Gage read to half-tenths once daily. Daily discharge ascertained by applying daily gage height to rating table. Records fair.

Discharge measurements of Willow Creek near Augusta, Mont., during the year ending Sept. 30, 1918.

[Made by W. A. Lamb.]

Date.	Gage height.	Discharge.
	<i>Fet.</i>	<i>Sec.-ft.</i>
May 28.....	1.52	50
June 22.....	1.00	22.4
Sept. 4.....	.83	16.2

Daily discharge, in second-feet, of Willow Creek near Augusta, Mont., for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1.....	18	16	16	79	30	28	34	48	46	18	25	16
2.....	18	16	16	74	30	28	34	48	46	16	24	19
3.....	18	16	16	64	31	30	34	54	46	16	24	18
4.....	18	16	15	54	31	30	34	59	46	14	22	18
5.....	18	16	15	48	34	30	34	64	48	14	24	16
6.....	18	16	14	40	34	30	36	64	48	13	25	16
7.....	18	16	14	38	34	30	36	64	50	12	25	16
8.....	18	16	14	31	34	30	38	54	54	9	24	16
9.....	18	16	12	26	34	30	42	54	52	7	24	16
10.....	18	16	12	30	32	30	44	59	50	6	22	16
11.....	18	18	12	31	32	31	44	62	48	6	22	16
12.....	18	18	14	31	31	31	44	64	45	6	22	16
13.....	18	18	14	31	30	31	46	62	44	6	22	16
14.....	18	18	15	32	30	32	46	62	40	11	22	16
15.....	18	18	15	32	30	31	48	62	37	86	22	16
16.....	18	18	15	34	30	32	46	64	36	68	22	16
17.....	18	18	18	34	30	34	40	64	35	50	22	16
18.....	18	18	22	34	28	40	40	64	32	42	22	14
19.....	18	18	32	34	28	36	40	62	30	36	22	14
20.....	18	16	30	34	26	32	40	62	27	31	20	14
21.....	18	16	18	34	26	34	44	59	25	30	20	14
22.....	18	16	30	34	26	36	44	56	24	30	20	14
23.....	18	16	30	32	26	36	42	56	24	30	19	16
24.....	18	16	22	32	28	38	42	54	22	30	19	16
25.....	18	16	18	31	28	38	42	54	22	30	18	18
26.....	18	16	18	31	28	38	44	54	20	28	18	18
27.....	18	16	15	31	28	36	44	54	20	28	18	16
28.....	16	16	15	31	28	36	46	52	19	28	18	16
29.....	16	16	127	31	.....	36	46	50	19	26	16	16
30.....	16	16	103	31	.....	36	48	52	19	26	16	16
31.....	16	.....	79	30	.....	36	.....	46	.....	25	16	.....

Monthly discharge of Willow Creek near Augusta, Mont., for the year ending Sept. 30, 1918.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October.....	18	16	17.7	1,090
November.....	18	16	16.6	988
December.....	127	12	26.0	1,600
January.....	79	26	37.4	2,300
February.....	34	26	29.9	1,660
March.....	40	30	33.1	2,040
April.....	48	34	41.4	2,460
May.....	64	46	57.5	3,540
June.....	54	19	35.8	2,130
July.....	86	6	25.1	1,540
August.....	25	16	21.1	1,300
September.....	19	14	16.0	952
The year.....	127	6	29.8	21,600

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, half a mile from Augusta, in Lewis and Clark County.

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—December 2, 1904, to September 30, 1918.

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 1918 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 of a mile above gage and there are two to four channels. Control subject to change at high stages.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 3.60 feet December 30 (stage-discharge relation affected by ice; flow not computed); maximum open-water stage recorded, 3.1 feet July 15 (discharge, 421 second-feet); minimum open-water stage recorded, 1.8 feet October 3-9, 14-18, November 19-30, December 1-12 (discharge, 29 second-feet).

1905-1918: 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 ice; gage readings discontinued during winter.

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

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

ACCURACY.—Stage-discharge relation changed during winter. Rating curve used October 1 to December 12 poorly defined; curve used March 19 to September 30 well defined between 40 and 200 second-feet. Gage read to half-tenths once daily. Daily discharge ascertained by applying daily gage heights to rating table. Records fair.

Discharge measurements of South Fork of Sun River at Augusta, Mont., during the year ending Sept. 30, 1918.

[Made by W. A. Lamb.]

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
1911.	<i>Feet.</i>	<i>Sec.-ft.</i>	1912.	<i>Feet.</i>	<i>Sec.-ft.</i>
Apr. 9.....	2.05	70	July 17.....	2.50	170
May 28.....	2.57	183	Sept. 4.....	1.76	41.7
June 22.....	2.08	78			

Daily discharge, in second-feet, of South Fork of Sun River at Augusta, Mont., for the year ending Sept. 30, 1918.

Day.	Oct.	Nov	Dec.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1.....	40	40	29	.....	60	90	214	60	60	36
2.....	40	40	29	.....	44	97	181	54	54	44
3.....	29	40	29	.....	60	107	181	54	49	44
4.....	29	40	29	.....	60	140	166	54	49	40
5.....	29	40	29	.....	54	214	166	54	54	36
6.....	29	40	29	.....	66	214	181	54	60	36
7.....	29	40	29	.....	66	214	181	49	54	36
8.....	29	40	29	.....	66	214	196	49	49	36
9.....	29	40	29	.....	80	214	214	44	49	44
10.....	34	40	29	.....	80	196	214	44	49	44
11.....	34	40	29	.....	80	196	214	44	49	40
12.....	34	40	29	.....	80	231	196	40	49	40
13.....	34	40	.....	.....	80	271	181	33	49	36
14.....	29	40	.....	.....	80	316	166	33	49	36
15.....	29	40	.....	.....	73	341	166	421	49	36
16.....	29	40	.....	.....	73	366	153	271	49	36
17.....	29	40	.....	.....	73	394	153	181	49	36
18.....	29	40	.....	.....	73	341	140	140	49	36
19.....	40	29	.....	66	73	271	128	128	49	36
20.....	40	29	.....	66	73	251	88	107	49	36
21.....	40	29	.....	54	80	231	80	97	49	36
22.....	40	29	.....	54	90	231	80	97	44	36
23.....	40	29	.....	54	90	214	80	88	44	44
24.....	40	29	.....	60	90	214	80	97	44	49
25.....	40	29	.....	60	90	214	73	73	44	44
26.....	40	29	.....	60	90	214	66	73	40	44
27.....	40	29	.....	60	97	196	66	73	40	44
28.....	55	29	.....	60	96	196	60	73	36	40
29.....	94	29	.....	60	96	181	66	73	36	40
30.....	40	29	.....	60	90	181	60	60	36	40
31.....	40	.....	.....	60	.....	181	.....	60	36	.....

NOTE.—Gage read Dec. 13-31; discharge not determined owing to ice effect. Gage not read Jan. 1 to Mar. 18.

Monthly discharge of South Fork of Sun River at Augusta, Mont., for the year ending Sept. 30, 1918.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October.....	94	29	37.2	2,290
November.....	40	29	35.6	2,120
December 1-12.....	29	29	29.0	690
March 19-31.....	66	54	59.5	1,530
April.....	97	44	76.4	4,550
May.....	394	90	224	13,800
June.....	214	60	140	8,330
July.....	421	33	89.6	5,510
August.....	60	36	47.3	2,910
September.....	49	36	39.4	2,340

MARIAS RIVER BASIN.

TWO MEDICINE RIVER NEAR GLACIER PARK, MONT.

LOCATION.—At highway bridge over Two Medicine River half a mile below lower Two Medicine dam, on road to Two Medicine Chalets, 4 miles northwest of Glacier Park railway station, in Teton County.

DRAINAGE AREA.—56.2 square miles (measured from topographic map).

RECORDS AVAILABLE.—May 26 to September 30, 1918.

GAGE.—Stevens continuous water-stage recorder on downstream side of left abutment of highway bridge; referred to vertical enamel staff gage, on outside of well.

DISCHARGE MEASUREMENTS.—Made by wading or from downstream side of single span highway bridge.

CHANNEL AND CONTROL.—Bed of stream is smooth and current regular. A gravel and cobblestone riffle 75 feet below the gage forms the control. Channel is free from vegetable matter and fairly permanent.

EXTREMES OF DISCHARGE.—Maximum stage recorded 7.85 feet at 6 a. m. June 11, 1918 (discharge, 1,390 second-feet); minimum stage 4.26 feet at 11 p. m. September 30 (discharge, 34 second-feet).

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

REGULATION.—Flow subject to regulation by lower Two Medicine reservoir half a mile above station.

DIVERSIONS.—None.

ACCURACY.—Stage-discharge relation permanent. Rating curve fairly well defined between 50 and 1,200 second-feet. Operation of water-stage recorder satisfactory. Records good.

Discharge measurements of Two Medicine River near Glacier Park, Mont., during the year ending Sept. 30, 1918.

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 26	R. F. Edwards.....	5.37	189	July 7	W. A. Lamb.....	5.30	194
June 14	W. A. Lamb.....	7.55	1,180	Aug. 8	do.....	4.75	83
18	do.....	6.75	675	Sept. 8	do.....	4.51	58

Daily discharge, in second-feet, of Two Medicine River near Glacier Park, Mont., for the year ending Sept. 30, 1918.

Day.	May.	June.	July.	Aug.	Sept.	Day.	May.	June.	July.	Aug.	Sept.
1.....		507	274	90	62	17.....	.....	779	192	80	50
2.....		519	263	91	62	18.....	.....	702	185	78	47
3.....		460	263	93	57	19.....	.....	688	176	74	45
4.....		403	255	91	57	20.....	.....	678	167	69	44
5.....		418	244	91	55	21.....	.....	636	152	71	42
6.....		523	247	90	55	22.....	.....	585	143	67	42
7.....		664	185	91	55	23.....	.....	552	131	65	42
8.....		842	183	85	56	24.....	.....	531	125	62	43
9.....		1,060	181	82	57	25.....	.....	511	119	60	42
10.....		1,280	185	78	59	26.....	.....	204	479	116	61
11.....		1,370	190	78	60	27.....	.....	199	452	107	59
12.....		1,320	190	78	58	28.....	.....	187	433	100	58
13.....		1,220	181	78	57	29.....	.....	190	433	96	57
14.....		1,170	174	79	55	30.....	.....	234	348	93	57
15.....		1,080	170	82	52	31.....	.....	355	.....	91	55
16.....		937	183	80	51						

Monthly discharge of Two Medicine River near Glacier Park, Mont., for the year ending Sept. 30, 1918.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
May 26-31.....	355	187	228	2,710
June.....	1,370	348	719	42,800
July.....	274	91	173	10,600
August.....	93	55	75.2	4,620
September.....	62	40	50.0	2,990
The period.....				63,700

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, nearest tributary.

DRAINAGE AREA.—368 square miles.

RECORDS AVAILABLE.—April, 1907, to September 30, 1918.

GAGE.—Overhanging chain gage installed May 27, 1918, on left bank about 30 feet below old gage which was washed away during night of May 3. Gage heights for May 4–27 obtained by measuring depth at old gage; read by W. Wansen and J. M. O'Hara. Temporary staff gage used May 4, to July 7, 1917, on account of high water. Datum of original gage, which was at same site as present gage, was lowered 0.95 foot July 21, 1908. Original chain gage and bench marks were destroyed by flood of June 2, 1913, and on June 10 a staff gage was installed at a different datum on left bank about 125 feet above site of chain gage. On July 23, 1913, this staff gage was removed to site of chain gage and was set to read 1.85 feet higher than staff gage installed June 10. Overhanging chain gage, installed September 18, 1913, was set to read 1 foot higher than staff gage installed July 23, 1913, and read to May 7, 1916, when destroyed by flood. Temporary gages at independent datum read May 16 to July 15, 1916. Overhanging chain gage installed July 15, 1916, on left bank about 150 feet below barn belonging to Holy Family Mission; washed out night of May 3, 1918.

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

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

EXTREMES OF DISCHARGE.—Maximum stage reported during year, 7.60 feet, 7 a. m. May 4 (discharge, 4,950 second-feet); minimum stage recorded, 2.61 feet October 6, December 7, 12, and 13 (discharge, 36 second-feet).

1907–1918: Maximum stage recorded, 8.15 feet June 9, 1909 (discharge, 7,600, second-feet); undoubtedly higher in June, 1908, but gage washed out and no estimate on record; minimum stage recorded, 1.3 feet January 12 to March 8, 1908 (discharge, 17 second-feet).

ICE.—Stage-discharge relation very little affected, if any, by ice.

DIVERSIONS.—Water diverted about 2 miles above gage by ditch which supplies about 100 acres on farm at the Holy Family Mission. From April 18 to September 25, 1918, a total diversion of 13,108 acre-feet was made by the United States Reclamation Service above the station to irrigate lands in the vicinity of Seville on Blackfeet Indian Reservation.

REGULATION.—None.

ACCURACY.—Stage-discharge relation changed by high water occurring January 1 and 2. A rating curve used October 1 to January 1, well defined between 20 and 3,200 second-feet; curve used January 2 to September 30 well defined between 40 and 5,000 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 Two Medicine River at Family, Mont., during the year ending Sept. 30, 1918.

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>
Apr. 14 ^a	W. A. Lamb.....	4. 51	1,090	July 16	W. A. Lamb.....	3. 29	245
May 27	Lamb and Edwards....	3. 92	540	Aug. 8	do.....	2. 78	91
June 13 ^a	W. A. Lamb.....	5. 52	2,220	Sept. 5	do.....	2. 73	84

^a Measurement made from highway bridge, 3 miles upstream from gage.

Daily discharge, in second-feet, of Two Medicine River at Family, Mont., for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1.....	50	77	54	2,530	131	84	331	1,760	1,140	552	95	67
2.....	43	82	43	1,990	147	84	331	1,910	1,010	500	95	106
3.....	43	73	45	1,320	159	92	250	2,450	906	422	92	90
4.....	40	66	43	1,060	159	84	264	4,530	917	344	88	86
5.....	39	77	45	746	159	84	264	4,110	978	303	81	81
6.....	36	70	43	518	174	73	311	3,380	1,040	267	121	77
7.....	45	73	36	487	183	84	300	2,920	1,270	239	111	101
8.....	45	77	38	428	165	79	331	1,930	1,540	222	90	95
9.....	50	65	43	401	136	84	587	1,700	1,800	212	84	111
10.....	48	65	43	562	131	84	837	1,590	2,150	199	84	113
11.....	43	70	40	663	131	88	937	1,590	2,470	215	84	113
12.....	50	66	36	886	106	84	1,010	1,700	2,360	196	88	109
13.....	43	70	36	704	131	84	1,070	1,810	2,190	190	86	104
14.....	44	65	50	457	118	73	1,130	2,530	2,100	190	81	99
15.....	43	63	73	401	111	79	837	2,350	1,890	202	79	95
16.....	43	54	82	376	97	88	720	1,990	1,570	246	90	101
17.....	57	45	77	292	84	111	640	1,590	1,260	196	88	97
18.....	50	50	91	292	84	183	609	1,320	1,060	190	92	88
19.....	54	73	186	292	73	183	624	1,380	1,120	180	84	81
20.....	54	65	276	222	73	190	791	1,160	1,040	168	84	77
21.....	57	66	266	222	79	215	1,300	1,010	957	150	79	73
22.....	54	70	301	256	95	229	988	906	876	139	75	75
23.....	54	57	161	331	106	264	791	810	754	128	75	95
24.....	51	58	134	300	101	331	837	810	720	134	71	104
25.....	57	58	116	340	95	487	988	720	616	150	71	104
26.....	65	57	112	206	84	493	866	601	587	134	67	104
27.....	65	56	112	239	79	500	791	559	545	134	61	99
28.....	63	57	91	206	79	457	810	545	481	128	55	95
29.....	45	45	134	159	-----	457	967	616	457	116	55	90
30.....	40	54	576	145	-----	457	1,460	896	624	111	52	86
31.....	54	-----	1,120	131	-----	386	-----	1,080	-----	104	50	-----

Monthly discharge of Two Medicine River at Family, Mont., for the year ending Sept. 30, 1918.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October.....	65	36	49.2	3,020
November.....	82	45	64.1	3,810
December.....	1,120	36	145	8,920
January.....	2,530	131	553	34,000
February.....	183	73	117	6,500
March.....	500	73	202	12,400
April.....	1,460	250	732	43,600
May.....	4,530	545	1,680	104,000
June.....	2,470	457	1,210	72,000
July.....	552	104	215	13,200
August.....	121	50	80.9	4,970
September.....	113	67	93.9	5,590
The year.....	4,530	36	431	312,000

NOTE.—Two Medicine canal was operated Apr. 18 to Sept. 25, except July 3-5. A total of 13,108 acre-feet was diverted to the canal as follows: April, 664 acre-feet; May, 1,542 acre-feet; June, 4,302 acre-feet; July, 3,437 acre-feet; August, 2,195 acre-feet; and September, 968 acre-feet.

MARIAS RIVER NEAR SHELBY, MONT.

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

DRAINAGE AREA.—2,610 square miles.

RECORDS AVAILABLE.—April 4, 1902, to January 12, 1908; April 23, 1911, to September 30, 1918.

GAGES.—Chain gage on downstream side of bridge. April 4, 1902, to January 12, 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 Emma Moser.

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

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

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 6.3 feet June 10 (discharge, 5,020 second-feet); minimum open-water stage recorded, 2.2 feet September 8–12, 14–17, 21, December 5 (discharge, 198 second-feet).

1902–1907 and 1911–1918: 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 December 9 to February 28.

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

REGULATION.—None.

ACCURACY.—Stage-discharge relation permanent during the year, except for the period affected by ice, December 9 to February 28. Rating curve well defined between 350 and 10,000 second-feet. Gage read to tenths once daily; occasional readings to half-tenths. Daily discharge ascertained by applying daily gage height to rating table. Discharge interpolated for following days: March 6, 9, 12, 18; April 4, 30; May 2, 13, 20, 24, 26, 30; June 4, 7, 9, 11, 14–17, 22; July 30; August 1, 3, 9, 13, 25, 29; September 22, 27, 28. Open-water records good.

Discharge measurements of Marias River near Shelby, Mont., during the year ending Sept. 30, 1918.

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. 12	Jones and Lamb.....	2.65	384	June 18	W. A. Lamb.....	5.00	2,670
May 7	W. A. Lamb.....	6.20	4,940	Aug. 14	do.....	2.79	466

Daily discharge, in second-feet, of Marias River near Shelby, Mont., for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Dec.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1.....	320	368	368	1,340	668	2,020	2,420	1,240	368	368
2.....	274	368	230	1,660	668	2,510	2,560	1,240	368	536
3.....	274	320	230	1,660	668	3,000	2,560	896	904	420
4.....	274	320	230	1,440	668	3,500	2,290	896	1,440	536
5.....	320	368	198	1,340	668	4,410	2,020	896	600	368
6.....	320	420	230	1,340	600	4,810	2,020	816	600	420
7.....	320	476	230	1,250	668	3,500	2,590	816	600	420
8.....	320	420	230	1,160	668	4,410	3,160	816	1,440	198
9.....	320	394		1,410	600	3,500	4,090	816	1,440	198
10.....	368	368		1,660	896	3,850	5,020	816	1,440	198
11.....	368	394		1,340	1,240	2,280	4,720	816	420	198
12.....	320	394		1,340	1,440	2,020	4,410	816	420	198
13.....	320	420		1,340	1,660	2,510	4,610	816	448	230
14.....	274	394		1,240	1,440	3,000	4,610	816	476	198
15.....	274	368		1,240	1,660	3,160	4,610	816	420	198
16.....	320	368		1,340	1,440	3,160	4,610	816	476	198
17.....	320	394		1,900	1,240	3,160	4,610	816	476	198
18.....	320	420		1,960	1,340	2,700	4,610	816	536	230
19.....	320	368		2,020	1,240	2,420	4,220	740	420	230
20.....	320	368		2,020	1,060	2,220	2,280	740	420	230
21.....	320	368		2,420	1,550	2,020	2,150	816	420	198
22.....	320	420		2,420	1,660	1,780	2,580	816	420	719
23.....	320	368		2,560	1,660	2,020	3,000	816	420	1,240
24.....	274	368		1,440	1,900	1,960	3,160	816	420	1,340
25.....	320	368		1,440	1,780	1,900	2,850	668	420	1,340
26.....	320	320		816	1,780	1,780	2,850	668	420	1,240
27.....	320	320		816	1,440	1,660	2,850	420	536	1,120
28.....	320	368		980	1,440	1,440	2,850	420	536	1,010
29.....	368	368		896	1,550	1,440	2,560	420	428	896
30.....	368	320		896	1,780	1,440	2,020	394	320	320
31.....	368			668		1,440		368	320	

NOTE.—Discharge, Dec. 9 to Feb. 28, not determined owing to insufficient data for determining effect of ice.

Monthly discharge of Marias River near Shelby, Mont., for the year ending Sept. 30, 1918.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October.....	368	274	319	19,600
November.....	476	320	377	22,400
December 1-8.....	368	198	243	3,860
March.....	2,560	668	1,460	89,800
April.....	1,900	600	1,240	73,800
May.....	4,810	1,440	2,610	160,000
June.....	5,020	2,020	3,300	196,000
July.....	1,240	368	770	47,300
August.....	1,440	320	593	36,500
September.....	1,340	198	506	30,100

BADGER CREEK NEAR FAMILY, MONT.

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

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

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

GAGE.—Chain gage read by Joe Trombley. The original staff gage established April 20, 1907, and bench marks, were washed out in the flood of June, 1908. The new chain gage was established July 22, 1908, about 400 feet farther upstream at a different datum. This gage was washed out May 25, 1909, and a new gage reset at different datum on right bank 400 feet below old Piegan Mission crossing.

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

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

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 6.35 feet May 5 at 8 a. m. (discharge, 1,460 second-feet); minimum stage recorded, 3.90 feet September 21 (discharge 40 second-feet).

1907–1918: Maximum stage recorded, 6.30 feet June 12, 1917 (discharge, 1,910 second-feet); minimum stage recorded, 3.90 feet September 21, 1918 (discharge, 40 second-feet).

ICE.—Observations discontinued during ice period.

DIVERSIONS.—United States Reclamation Service diverts water from Badger Creek to irrigate land in the eastern part of Blackfeet Indian Reservation north of Birch Creek. A total of 11,654 acre-feet were diverted between May 20 and September 30, as follows: in May, 1,350 acre-feet; June, 2,254; July, 3,684; August, 1,514, and in September, 2,852.

REGULATION.—None.

ACCURACY.—Stage-discharge relation not permanent. Rating curve used October 1 to January 26, well defined between 140 and 800 second-feet; curve used March 24 to September 30, except April 1–23, July 13–22, and August 1–19, well defined between 60 and 1,000 second-feet. Gage read to half-tenths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table. Shifting-control method used April 1–23, July 13–22, and August 1–19. Records fair, October to April; good, May to September.

Discharge measurements of Badger Creek near Family, Mont., during the year ending Sept. 30, 1918.

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. 14	W. A. Lamb.....	5.10	361	July 16	W. A. Lamb.....	4.53	204
May 27	R. F. Edwards.....	5.03	389	Aug. 8	do.....	4.42	141
June 13	W. A. Lamb.....	5.85	981	Sept. 5	do.....	4.07	67

Daily discharge, in second-feet, of Badger Creek near Family, Mont., for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Dec.	Jan.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1.	148	141	125	.....	.....	122	763	648	242	77	93
2.	141	141	141	.....	.....	120	888	531	213	71	86
3.	156	141	125	431	.....	120	930	470	213	69	75
4.	156	141	127	376	.....	110	1,260	512	206	67	75
5.	156	148	148	312	.....	112	1,100	597	196	82	66
6.	156	141	148	286	.....	104	930	701	196	86	66
7.	161	141	161	269	.....	114	888	747	196	102	66
8.	156	136	161	253	.....	114	829	888	196	133	93
9.	148	136	.....	240	.....	128	597	948	137	120	75
10.	148	136	.....	184	.....	156	481	1,120	174	136	75
11.	148	136	.....	148	.....	242	493	1,130	150	136	56
12.	148	136	.....	148	.....	265	512	1,040	117	153	56
13.	148	132	.....	176	.....	309	648	1,000	120	144	53
14.	141	132	.....	176	.....	370	913	913	142	142	48
15.	136	132	.....	231	.....	344	804	804	196	142	53
16.	141	132	.....	206	.....	317	804	611	168	142	56
17.	156	132	.....	210	.....	235	685	557	162	159	53
18.	156	125	.....	100	.....	231	648	543	177	150	53
19.	161	125	.....	125	.....	253	584	531	136	150	48
20.	158	118	.....	216	.....	280	493	493	133	150	48
21.	146	118	.....	184	.....	425	481	425	133	150	40
22.	141	125	.....	156	.....	410	436	385	112	136	117
23.	141	134	.....	206	.....	362	493	385	122	136	122
24.	141	136	.....	206	110	385	512	352	128	136	136
25.	141	132	.....	197	122	493	447	352	117	136	122
26.	141	125	.....	206	133	425	405	296	110	136	122
27.	141	125	.....	.....	133	385	385	296	122	102	122
28.	141	125	.....	.....	128	385	395	288	110	86	122
29.	141	127	.....	.....	122	380	470	288	97	66	122
30.	184	125	.....	.....	133	577	512	257	97	66	110
31.	136	.....	.....	.....	128	.....	701	.....	86	66	.....

NOTE.—Gage not read Dec. 9 to Jan. 2, and Jan. 27 to Mar. 23.

Monthly discharge of Badger Creek near Family, Mont., for the year ending Sept. 30, 1918.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October.....	184	136	149	9,160
November.....	148	118	132	7,860
December 1-8.....	161	125	142	2,250
January 3-26.....	431	100	219	10,400
March 24-31.....	133	110	126	2,000
April.....	577	104	276	16,400
May.....	1,260	385	661	40,600
June.....	1,130	257	604	35,900
July.....	242	86	153	9,410
August.....	159	66	117	7,190
September.....	136	40	80.8	4,810

NOTE.—See "Diversions" for amount of water diverted from Badger Creek.

BIRCH CREEK AT SWIFT DAM, NEAR DUPUYER, MONT.

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

DRAINAGE AREA.—About 120 square miles.

RECORDS AVAILABLE.—March 26, 1913, to September 30, 1918.

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

DISCHARGE MEASUREMENTS.—Made from footbridge 300 feet above gage or by wading near gage. Spillway overflow is measured from footbridge or by wading on crest of spillway.

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

EXTREMES OF DISCHARGE.—Maximum stage recorded during the year 3.54 feet June 16-17 (discharge, 608 second-feet); minimum flow estimated at 2 second-feet February 12-19, March 5-24, and April 1-20.

1913-1918: Maximum discharge, 5,275 second-feet at 5 a. m. June 21, 1916; minimum discharge, 0.9 second-foot March 6, 1915. Minimum flow is controlled and maximum partly regulated by valves at dam.

ICE.—Stage-discharge relation seriously affected by ice December 28-29. Flow estimated by engineers of Valier-Montana Land & Water Co.

DIVERSIONS.—Two small ditches divert water just below dam and above gage; known locally as Cote ditch and Jones ditch.

REGULATION.—Dam is used to store flood and winter flow, and during dry periods will release no more water than can be handled by the canal system of the Valier Carey project in addition to amount required by prior rights. Acre-feet in storage at end of each month was as follows: October, 0; November, 0; December, 0; January, 0; February, 2,560; March, 5,820; April, 13,200; May, 26,400; June, 21,100; July, 6,140; August, 3,550; September, 0. Spillway did not overflow in 1918.

ACCURACY.—Stage-discharge relation changed slightly in November and during high water December 27 to January 6. Rating curve used October 1 to December 31 well defined below 600 second-feet; curve used January 1 to September 30 well defined between 100 and 600 second-feet and fairly well defined below 100 second-feet. Gage read to hundredths once daily. Daily discharge ascertained by applying daily gage height to rating table, except November 15 to December 6, for which shifting-control method was used, and February 3 to April 20, for which leakage through valves was estimated on basis of discharge measurements. Records fair October to December; good for rest of year.

COOPERATION.—All field data except two discharge measurements furnished by the engineering department of the Valier-Montana Land & Water Co. Computations made by United States Geological Survey.

Discharge measurements of Birch Creek at Swift dam near, Dupuyer, Mont., during the year ending Sept. 30, 1918.

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. 19	Ebner and Stalzer.....	2.14	57	July 14	Noble and Eichhof.....	3.28	456
Jan. 4	Wardwell and Stalzer..	3.02	329	26	Heidel and Ebner.....	2.89	276
Mar. 17	Wardwell and Thomas..		a 1.5	26	do.....	2.69	196
Apr. 9	T. M. Wardwell.....		a 1.6	Aug. 24	Noble and Chin.....	2.36	95
May 4	G. M. Monley.....	1.85	24.8	Sept. 6	Monley and Noble.....	2.84	253
23	Monley and Shaddock..	2.79	220	27	Ebner and Starleigh...	2.20	74
June 30	Monley and Noble.....	3.44	548				

a Gates closed; discharge represents leakage through valves.

Daily discharge, in second-feet, of Birch Creek at Swift dam, near Dupuyer, Mont., for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1.....	57	74	40	385	57	3	2	26	228	555	153	236
2.....	56	74	40	359	57	3	2	26	228	498	148	236
3.....	52	73	40	385	55	3	2	26	228	481	148	236
4.....	54	73	50	335	55	3	2	26	228	459	148	228
5.....	56	73	60	265	55	2	2	46	416	385	148	232
6.....	56	71	60	228	30	2	2	46	416	459	148	244
7.....	56	68	60	111	3	2	2	46	416	481	148	257
8.....	60	67	63	82	3	2	2	46	427	538	145	269
9.....	60	68	60	101	3	2	2	46	427	538	122	269
10.....	60	67	61	91	3	2	2	46	427	538	116	269
11.....	57	68	63	91	3	2	2	46	481	538	99	269
12.....	56	70	63	101	2	2	2	46	526	492	99	120
13.....	56	95	64	111	2	2	2	46	555	492	103	84
14.....	54	77	63	99	2	2	2	46	555	492	103	84
15.....	52	57	63	89	2	2	2	228	584	470	103	84
16.....	52	57	61	84	2	2	2	228	596	395	103	78
17.....	52	57	61	77	2	2	2	228	596	364	103	78
18.....	53	57	74	68	2	2	2	228	596	364	103	73
19.....	60	57	256	65	2	2	2	228	596	349	103	73
20.....	65	57	85	80	2	2	2	228	596	340	103	73
21.....	70	57	81	67	3	2	3	228	596	340	103	73
22.....	73	57	98	77	3	2	3	228	596	340	103	73
23.....	71	56	81	84	3	2	3	228	596	335	103	80
24.....	70	56	77	84	3	2	3	228	567	340	145	80
25.....	77	56	64	84	3	3	3	228	596	340	199	80
26.....	81	56	70	73	3	3	3	228	572	269	206	77
27.....	77	56	300	73	3	3	3	228	596	192	206	73
28.....	81	56	320	65	3	3	26	228	572	192	206	71
29.....	81	56	320	65	-----	3	26	228	584	186	206	49
30.....	77	57	354	65	-----	3	26	228	584	173	206	5
31.....	77	-----	320	65	-----	3	-----	228	-----	161	206	-----

Monthly discharge of Birch Creek at Swift dam, near Dupuyer, Mont., for the year ending Sept. 30, 1918.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October.....	81	52	63.2	3,890
November.....	95	56	64.1	3,810
December.....	354	40	112	6,890
January.....	385	65	129	7,930
February.....	57	2	13.1	728
March.....	3	2	2.4	148
April.....	26	2	4.6	274
May.....	228	26	143	8,790
June.....	596	228	499	29,700
July.....	555	161	390	24,000
August.....	206	99	140	8,610
September.....	269	5	138	8,210
The year.....	596	2	142	103,000

BIRCH CREEK NEAR DUPUYER, MONT.

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

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

RECORDS AVAILABLE.—July 25, 1907, to September 30, 1918.

GAGE.—One-inch square steel bar graduated to tenths and driven securely into bed of stream; read by Wade Starleigh. Considerable trouble has been experienced in maintaining gages on this stream. Numerous types have been tried and all have been broken by ice or torn down by floods. For full report see Water-Supply Paper 456.

DISCHARGE MEASUREMENTS.—Made by wading or from cable.

CHANNEL AND CONTROL.—Principal control is riffle about 100 feet below. Channel composed of clean gravel; control is gravel bar about 250 feet below gage. Banks are of medium height covered with brush and subject to overflow.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 5.90 feet June 17-18 (discharge, 651 second-feet); minimum open-water stage, 3.22 feet April 5, 16-20 (discharge, 14 second-feet).

1907-1918: Maximum stage recorded, 10.0 feet June 21, 1916 (discharge estimated, 5,000 second-feet); minimum stage recorded April 21-30, 1915 (discharge, 7 second-feet).

ICE.—Stage-discharge relation seriously affected by ice; data insufficient to warrant estimates of flow December 4 to April 2.

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.

ACCURACY.—Stage-discharge relation not permanent; affected by shifting control and by ice. Rating curve used October 1 to December 3, well defined between 80 and 750 second-feet; curve used April 3 to June 29, fairly well defined between 13 and 660 second-feet; July 12 to September 30, well defined between 54 and 300 second-feet. Gage read to hundredths once daily. Daily discharge ascertained by applying the daily gage height to rating table. Shifting-control method used June 30 to July 11. Records are good except those for period of shifting control which are fair.

COOPERATION.—Gage heights and most of the discharge measurements furnished by engineering department of Valier-Montana Land & Water Co. Computations made by United States Geological Survey.

Discharge measurements of Birch Creek near Dupuyer, Mont., during the year ending Sept. 30, 1918.

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. 11	Wardwell and Chin....	3.84	84	June 20	Monley and Noble.....	5.80	619
Dec. 14	do.....	5.90	19.9	July 27	Heidel and Ebner.....	4.64	214
Jan. 3	Wardwell and Mahoney.....		394	Aug. 3	Ebner and Starleigh....	4.40	164
Feb. 21	Wardwell and Wilson.....		16.2	8	Noble and Starleigh....	4.35	149
Mar. 4	Wardwell and Tawney.....		17.7	24	Monley and Starleigh....	4.12	111
17	Wardwell and Thomas.....		20.1	31	Noble and Starleigh....	4.62	202
Apr. 26	Monley and Starleigh....	3.27	18.2	Sept. 20	Ebner and Starleigh....	4.04	99
May 23	do.....	4.70	246				

Daily discharge, in second-feet, of Birch Creek near Dupuyer, Mont., for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Dec.	Apr.	May.	June.	July.	Aug.	Sept.
1.....	106	82	60	-----	20	246	574	159	251
2.....	96	82	57	-----	19	246	550	159	251
3.....	95	82	34	28	19	246	530	159	251
4.....	90	82	-----	20	19	246	489	159	251
5.....	90	82	-----	14	20	246	489	159	251
6.....	90	79	-----	16	20	272	414	159	265
7.....	90	79	-----	16	20	330	450	150	265
8.....	83	77	-----	16	28	428	482	150	279
9.....	83	72	-----	18	33	464	515	132	265
10.....	83	72	-----	17	38	428	515	132	303
11.....	80	72	-----	17	40	428	515	116	279
12.....	79	72	-----	17	55	538	494	116	225
13.....	79	72	-----	16	61	578	457	116	121
14.....	79	73	-----	16	71	578	475	116	111
15.....	79	71	-----	16	74	619	457	116	108
16.....	79	69	-----	14	246	619	405	116	104
17.....	79	68	-----	14	246	661	371	108	98
18.....	79	67	-----	14	246	661	355	116	104
19.....	79	67	-----	14	259	640	355	116	100
20.....	79	67	-----	14	259	619	339	116	96
21.....	77	69	-----	16	259	619	339	116	94
22.....	74	73	-----	16	246	640	339	111	100
23.....	73	74	-----	16	246	640	349	111	105
24.....	73	73	-----	16	246	661	339	111	100
25.....	74	69	-----	19	246	619	333	190	98
26.....	77	68	-----	16	259	661	294	206	99
27.....	78	65	-----	19	259	619	218	206	96
28.....	79	68	-----	20	259	619	213	206	94
29.....	48	67	-----	20	246	640	206	206	89
30.....	38	67	-----	18	246	594	179	206	36
31.....	42	-----	-----	-----	246	-----	169	206	-----

Monthly discharge of Birch Creek near Dupuyer, Mont., for the year ending Sept. 30, 1918.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October.....	106	38	78.4	4,820
November.....	82	65	72.7	4,330
April 3-30.....	28	14	16.9	939
May.....	259	19	147	9,040
June.....	661	246	514	30,600
July.....	574	169	394	24,200
August.....	206	111	147	9,040
September.....	303	36	163	9,700

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, nearest railway point.

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

RECORDS AVAILABLE.—July 17, 1912, to September 30, 1918.

GAGE.—Vertical steel staff on right bank, 1,000 feet above diversion dam, since June 23, 1916; read by Cecil Carey and others. 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, 1917, 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 from cable 30 feet below gage or from bridge 5 miles below gage.

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 gage forms the control at certain stages.

EXTREMES OF DISCHARGE.—Maximum discharge, about 300 second-feet December 31; minimum stage, 2.44 feet July 13 and 14 (discharge, 7.8 second-feet).

1912-1918: Maximum stage recorded, 6.5 feet on June 21, 1916, determined by level from flood marks (discharge, 2,180 second-feet); minimum stage, 2.22 feet August 9, 1914 (discharge, 4.4 second-feet).

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

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

REGULATION.—None.

ACCURACY.—Stage-discharge relation changed during high water December 28 to January 4; affected by ice October 22, 28-31, November 30 to March 24, and April 2-4. Rating curve used October 1 to November 29, well defined between 20 and 2,000 second-feet; curve used April 5 to September 30 well defined between 15 and 8 second-feet. Daily discharge ascertained by applying gage height to rating table. Records during open-channel flow are good; for other periods, fair.

COOPERATION.—Base data furnished by the Valier-Montana Land & Water Co.

Discharge measurements of Dupuyer Creek near Valier, Mont., during the year ending Sept. 30, 1918.

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. 5	Wardwell and Carmody	2.74	23	Mar. 19	T. M. Wardwell.....	a 4.00	90
31	Ebner and Wardwell...	3.00	37.9	23	Wardwell and Carey...	a 3.59	87
Dec. 7	T. M. Wardwell.....	a 3.00	21.0	26	T. M. Wardwell.....	3.14	67
19	Wardwell and Ebner...	a 4.08	104	28	Wardwell and Carey...	3.10	57
Jan. 1	Ebner and Thomas.....	(b)	252	Apr. 6	Wardwell and Monley...	3.11	61
12	T. M. Wardwell.....	(b)	54	26	Monley and Carey.....	3.12	63
23	Wardwell and Sage.....	a 3.79	40.2	June 1	do.....	3.19	73
Feb. 7	Wardwell and Wilson...	.....	44.3	July 23	Heideland and Noble....	2.72	17.0
22	Wardwell and Thomas...	.....	16.0	Aug. 10	H. A. Noble.....	2.86	25.5
Mar. 2	Wardwell and Tawney...	.....	53	Sept. 16	do.....	2.78	18.9
5	T. M. Wardwell.....	.....	40.8				

a Stage-discharge relation affected by ice.

b Gage bent over by ice during high water Dec. 29-31; gage height not determined.

Daily discharge, in second-feet, of Dupuyer Creek near Valier, Mont., for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Dec.	Apr.	May.	June.	July.	Aug.	Sept.
1.....	28	45	30	54	66	74	10	23	29
2.....	28	50	28	53	72	72	10	29	36
3.....	26	49	26	52	82	72	9	25	29
4.....	24	39	24	51	84	65	10	23	26
5.....	24	39	22	49	102	63	9	23	23
6.....	24	38	21	65	108	63	9	44	21
7.....	26	37	21	61	104	59	8.8	35	20
8.....	26	35	20	65	113	57	8.6	29	23
9.....	24	34		66	113	57	8.4	25	24
10.....	22	32		66	108	57	8.4	25	25
11.....	23	32		65	118	57	8.0	24	23
12.....	24	32		63	113	54	8.0	27	19
13.....	26	31		63	118	55	7.8	29	20
14.....	23	30		61	118	59	7.8	25	20
15.....	22	30		59	128	49	8.6	25	20
16.....	24	30		54	118	44	29	25	21
17.....	24	30		51	120	41	24	27	20
18.....	34	28		52	113	37	20	26	18
19.....	30	28		52	108	29	18	26	18
20.....	34	27		51	102	27	16	26	18
21.....	39	27		49	97	25	16	26	18
22.....	39	27		57	97	24	15	25	23
23.....	39	27		57	89	21	15	23	28
24.....	39	27		49	84	21	35	20	28
25.....	35	27		55	91	18	33	17	28
26.....	37	27		65	84	16	28	18	28
27.....	38	27		72	84	16	30	18	28
28.....	38	27		57	82	10	28	19	28
29.....	38	30		76	76	10	26	18	28
30.....	38	30		68	72	12	24	18	28
31.....	38				68		24	18	

NOTE.—Discharge, Oct. 22, 28-31, Nov. 30 to Dec. 8, and Apr. 2-4 estimated because office. Gage not read, discharge interpolated Oct. 27, Nov. 16, 24, Sept. 19, 20, 22, 24, 26, 27, 29, and 30.

Monthly discharge of Dupuyer Creek near Valier, Mont., for the year ending Sept. 30, 1918.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October.....	39	22	30.1	1,850
November.....	50	27	32.4	1,930
December.....			52	3,200
January.....			62	3,810
February.....			30	1,670
March.....			55	3,380
April.....	76	49	58.6	3,490
May.....	128	66	97.8	6,010
June.....	74	10	42.1	2,510
July.....	35	7.8	16.5	1,010
August.....	44	17	24.5	1,510
September.....	36	18	23.9	1,420
The year.....			43.9	31,800

NOTE.—Discharge for December, January, February, and March, estimated by engineers of the Valier-Montana Land & Water Co., because of ice, from discharge measurements, weather records, and comparison with records of flow for Birch Creek.

CUT BANK CREEK NEAR BROWNING, MONT.

LOCATION.—In NW. $\frac{1}{4}$ sec. 15, T. 33 N., R. 11 W., on Blackfeet Reservation on left bank, 100 feet above highway bridge on Browning-Babb trail, 6 miles north of Browning, in Teton County.

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—April 17 to September 30, 1918.

GAGE.—Stevens continuous water-stage recorder, in wooden shelter on left bank 100 feet above highway bridge.

DISCHARGE MEASUREMENTS.—Made from lower side of highway bridge or by wading.

CHANNEL AND CONTROL.—Control is a sandstone ledge and boulders 40 feet below gage; fairly permanent. Banks high and not subject to overflow except at extreme stages when two small channels on right bank carry water.

EXTREMES OF DISCHARGE.—Maximum stage during period from water-stage recorder, 3.93 feet at 11 a. m. June 11 (discharge, 1,020 second-feet); minimum stage, from water-stage recorder, 0.63 foot at 2 p. m. September 30 (discharge, 48 second-feet).

DIVERSIONS.—None.

REGULATION.—None.

ACCURACY.—Stage-discharge relation permanent during year. Rating curve well defined between 50 and 1,000 second-feet. Operation of water-stage recorder satisfactory except for periods indicated in footnote to daily-discharge table. Daily discharge ascertained by applying to rating table the mean daily-gage heights obtained by inspecting gage-height graph. Records good.

Discharge measurements of Cut Bank Creek near Browning, Mont., during the year ending Sept. 30, 1918.

[Made by W. A. Lamb.]

Date.	Gage height.	Dis-charge.	Date.	Gage height.	Dis-charge.
	<i>Feet.</i>	<i>Sec.-ft.</i>		<i>Feet.</i>	<i>Sec.-ft.</i>
Apr. 17.....	1.62	154	July 15.....	1.61	155
May 22.....	2.05	221	Aug. 13.....	.96	74
June 14.....	3.57	812			

Daily discharge, in second-feet, of Cut Bank Creek near Browning, Mont., for the year ending Sept. 30, 1918.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Day.	Apr.	May.	June.	July.	Aug.	Sept.
1.....		382	382	173	93	53	16.....		399	584	159	86	64
2.....		439	357	175	88	52	17.....		152	368	487	144	79
3.....		495	303	178	92	50	18.....		143	337	482	139	78
4.....		738	277	167	92	60	19.....		154	308	491	133	77
5.....		922	303	158	92	60	20.....		176	287	474	131	75
6.....		721	366	154	90	59	21.....		234	258	424	130	69
7.....		556	382	150	88	59	22.....		245	236	389	122	68
8.....		458	382	146	86	69	23.....		218	226	386	118	65
9.....		376	389	142	84	75	24.....		222	222	354	126	62
10.....		330	389	139	82	78	25.....		245	211	333	118	64
11.....		322	732	136	80	76	26.....		222	196	300	109	61
12.....		314	910	133	78	73	27.....		226	188	277	104	63
13.....		345	814	130	76	72	28.....		220	176	254	99	64
14.....		466	776	141	78	69	29.....		222	184	245	96	58
15.....		436	743	152	83	66	30.....		282	236	196	94	56
							31.....		366		94	52	

NOTE.—Water-stage recorder stopped May 15-18, July 6-14, and Aug. 6-12. Discharge, May 15-18 and Aug. 6-12, interpolated; July 6-14 by comparison with Cut Bank Creek at Cut Bank.

*Monthly discharge of Cut Bank Creek near Browning, Mont., for the year ending Sept. 30, 1918.**

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
April 17-30.....	282	143	212	5,890
May.....	922	176	371	22,800
June.....	910	196	439	26,100
July.....	178	94	135	8,300
August.....	93	52	76.1	4,680
September.....	78	51	59.7	3,550
The period.....				71,300

CUT BANK CREEK AT CUT BANK, MONT.

LOCATION.—In 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, 1918.

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

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

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

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 5.57 feet at 8 a. m. June 12 (discharge, 905 second-feet); minimum stage recorded, 3.80 feet November 19 (discharge, 38 second-feet).

1905-1918: Maximum stage recorded, 10.0 feet June 5, 1908 (approximate discharge computed from extension of rating curve, 8,810 second-feet); minimum, 2.5 feet November 29, 30, 1905 (discharge, 5 second-feet).

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

DIVERSIONS.—Intake of Great Northern Railway's pumping station is 100 feet below gage; average quantity pumped is about 14,000 gallons an hour for 18 hours a day, equivalent to a continuous flow of 0.4 second-foot. There are also some small diversions for irrigation on Blackfeet Indian Reservation above gage.

REGULATION.—None.

ACCURACY.—Stage-discharge relation practically permanent throughout year except as affected by ice during winter. Rating curve well defined between 44 and 900 second-feet. Gage read to quarter-tenths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table. Records fair.

Discharge measurements of Cut Bank Creek at Cut Bank, Mont., during the year ending Sept. 30, 1918.

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. 10	W. A. Lamb.....	4.06	51	June 13	B. E. Jones.....	5.55	893
Apr. 11	do.....	4.62	228	Aug. 14	W. A. Lamb.....	4.24	80
May 22	do.....	4.78	291				

Daily discharge, in second feet, of Cut Bank Creek at Cut Bank, Mont., for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Apr.	May.	June.	July.	Aug.	Sept.
1.....	42	112	137	314	468	196	77	86
2.....	42	93	157	422	485	149	75	88
3.....	42	88	103	461	422	170	75	93
4.....	42	70	103	523	355	174	79	86
5.....	42	64	88	680	409	174	86	86
6.....	42	55	103	779	349	174	75	79
7.....	47	53	119	769	409	174	75	77
8.....	44	60	103	654	552	174	75	77
9.....	47	64	119	508	654	174	75	75
10.....	47	51	157	415	741	165	75	75
11.....	51	42	201	384	855	153	75	75
12.....	53	44	245	397	905	153	75	75
13.....	55	53	260	384	875	137	86	75
14.....	60	64	271	447	769	145	77	66
15.....	60	84	260	508	715	170	75	75
16.....	60	88	220	516	689	174	79	75
17.....	64	70	201	501	663	165	77	75
18.....	88	55	178	441	606	165	75	72
19.....	84	38	178	384	552	174	75	72
20.....	70		192	372	477	174	77	70
21.....	67		230	337	384	174	84	67
22.....	70		271	326	397	174	70	61
23.....	88		276	292	384	165	66	67
24.....	88		260	265	397	133	66	75
25.....	77		271	260	372	125	60	75
26.....	70		282	260	326	99	61	70
27.....	64		292	230	298	99	60	67
28.....	53		276	220	265	96	64	67
29.....	103		282	210	250	93	64	58
30.....	157		292	220	220	88	67	58
31.....	157			220		86	77	

NOTE.—Discharge Nov. 20-30 estimated, because of ice, as 30 second-feet. Gage not read Dec. 1 to Mar. 31.

Monthly discharge of Cut Bank Creek near Cut Bank, Mont., for the year ending Sept. 30, 1918.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October.....	157	42	67.0	4,120
November.....	112	30	52.6	3,130
April.....	292	88	204	12,100
May.....	779	210	410	25,200
June.....	905	220	507	30,200
July.....	196	86	151	9,280
August.....	86	60	73.5	4,520
September.....	93	58	73.9	4,400

TETON RIVER AT STRABANE, MONT.

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

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—November 26, 1904, to December 31, 1906; June 1, 1908, to September 30, 1918.

GAGE.—Chain gage on upstream side of highway bridge installed March 23, 1911, read by Jas. Peebles, jr. November 26, 1904, to March 8, 1905, a staff gage 40 feet above head of Kroff's irrigation ditch was used; March 9, 1905, to May 7, 1906, a staff gage was 250 feet upstream; May 8, 1906, to December 31, 1906, a staff gage at Bjornstad's ranch, $1\frac{1}{2}$ miles above gage, used until May 7, 1906. All gages at different datums.

DISCHARGE MEASUREMENTS.—Made by wading or from bridge.

CHANNEL AND CONTROL.—Bed composed of coarse gravel; likely to shift. Several channels at all stages.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 4.25 feet at 4 p. m. June 10 (discharge, 636 second-feet); minimum open-water stage, 1.88 feet April 5 and 6 (discharge, 25 second-feet).

1908–1918: 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.—Stage-discharge relation probably affected by ice February 1 to March 31. Daily gage readings were made during the period, but flow not computed because no discharge measurements were made.

DIVERSIONS.—Several canals divert water above station, the largest being Teton Cooperative Co.'s canal, which diverts flood water 1 mile above gage.

REGULATION.—The operation of canal head gates cause some fluctuations at gage.

ACCURACY.—Stage-discharge relation not permanent; probably affected by ice during February and March. Rating curve used October 1 to January 31, and May 5 to July 15 well defined between 70 and 1,000 second-feet; curve used July 15 to September 30 well defined between 40 and 500 second-feet. Gage read to hundredths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table except April 1 to May 4, for which shifting-control method was used. Records good.

Discharge measurements of Teton River at Strabane, Mont., during the year ending Sept. 30, 1918.

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. 10	W. A. Lamb.....	1.90	28.6	July 16	W. A. Lamb.....	2.69	169
May 21	do.....	2.28	122	30	C. S. Heidel.....	2.45	123
June 12	do.....	3.70	463	Sept. 5	W. A. Lamb.....	2.18	76
22	do.....	3.08	306				

Daily discharge, in second-feet, of Teton River at Strabane, Mont., for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Dec.	Jan.	Apr.	May.	June.	July.	Aug.	Sept.
1.....	88	74	64	152	29	113	166	214	117	96
2.....	88	74	64	168	32	146	159	203	117	96
3.....	84	72	68	166	32	170	152	181	122	96
4.....	84	72	68	150	29	334	159	170	122	88
5.....	84	72	68	137	25	516	166	170	122	82
6.....	88	68	70	130	25	443	236	170	122	86
7.....	80	68	70	126	29	354	311	159	117	83
8.....	74	68	68	116	29	344	471	148	113	83
9.....	72	72	64	105	47	294	578	148	110	80
10.....	72	72	64	101	29	196	625	148	104	77
11.....	76	72	68	101	68	168	611	137	104	73
12.....	76	68	68	94	68	159	516	126	104	73
13.....	80	68	68	94	74	166	493	126	104	69
14.....	84	68	74	94	74	216	487	126	99	69
15.....	84	72	76	99	74	282	451	217	99	66
16.....	88	72	84	99	72	236	362	164	104	48
17.....	88	74	88	94	72	214	294	193	104	38
18.....	92	72	92	94	72	212	270	175	104	38
19.....	92	72	94	92	72	174	259	153	99	38
20.....	94	74	88	88	72	144	357	122	99	38
21.....	94	74	84	80	72	130	306	113	99	41
22.....	94	74	84	80	64	126	282	122	99	41
23.....	94	70	80	74	64	126	282	122	99	43
24.....	90	70	76	74	64	148	282	113	96	48
25.....	88	70	74	80	64	126	282	113	96	48
26.....	84	70	74	74	76	126	277	117	96	48
27.....	84	68	68	74	76	122	277	113	93	43
28.....	80	68	62	72	76	116	275	117	93	43
29.....	80	66	54	68	88	116	264	122	88	43
30.....	76	66	47	68	103	126	259	122	88	43
31.....	74	-----	128	64	-----	159	-----	117	85	-----

NOTE.—Ice effect Feb. 1 to Mar. 31; discharge not determined because of lack of discharge measurements.

Monthly discharge of Teton River at Strabane, Mont., for the year ending Sept. 30, 1918.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October.....	94	72	84.1	5,170
November.....	74	66	70.7	4,210
December.....	128	47	74.2	4,560
January.....	166	64	100	6,150
April.....	103	25	59.0	3,510
May.....	516	113	202	12,400
June.....	625	152	330	19,600
July.....	217	113	146	8,980
August.....	122	85	104	6,400
September.....	96	38	61.9	3,680

TETON RIVER NEAR CHOUTEAU, MONT.

LOCATION.—In SW. $\frac{1}{4}$ NE. $\frac{1}{4}$ sec. 36, T. 24 N., R. 5 W., at highway bridge $1\frac{1}{4}$ miles south of Chouteau, in Teton County.

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—May 7 to September 30, 1918, at present location; November 30, 1904, to July 31, 1906; May 27 to December 6, 1913; and April 14, 1915, to September 30, 1917, at former location. See "Gage."

GAGE.—Wire gage on lower side of highway bridge installed April 19, 1918; read since May 7, 1918, by Wm. Upman. At former location in SW. $\frac{1}{4}$ sec. 25, T. 24 N., R. 5 W., vertical staff fastened to pile on downstream side of bridge near left bank was read after May 7, 1913. Prior to that date a chain gage at same datum fastened to floor of bridge was read. Flow at two locations is practically the same, but gages set at different datum.

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

CHANNEL AND CONTROL.—Bed of stream composed of heavy gravel and sand; control gravel riffle 150 feet below gage and has remained fairly permanent.

EXTREMES OF DISCHARGE.—Maximum stage recorded during the year, 3.17 feet at 9 a. m., June 11 (discharge, 272 second-feet); minimum stage, 1.53 feet, August 13-14, 16-19, 22-25, 27-30, and September 1-5 (discharge, 3.6 second-feet).

ICE.—Records discontinued during winter.

DIVERSIONS.—Numerous canals divert water for irrigation above station.

REGULATION.—Operation of canals above, practically controls the low-water flow.

ACCURACY.—Stage-discharge relation at new location permanent during the year.

Rating curve is fairly well defined between 4 and 275 second-feet. Gage read to hundredths once daily. Daily discharge ascertained by applying daily gage height to rating table. Records good.

Discharge measurements of Teton River near Chouteau, Mont., during the year ending Sept. 30, 1918.

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. 8	B. E. Jones.....	4.06	27.0	June 21	W. A. Lamb.....	2.16	31.4
Apr. 9	W. A. Lamb.....	3.95	28.3	July 17	do.....	1.81	9.7
19	do.....	2.08	26.5	30	C. S. Heidel.....	1.68	6.8
May 7	do.....	2.91	210	Sept. 5	W. A. Lamb.....	1.63	5.4
June 12	do.....	3.15	257				

Daily discharge, in second-feet, of Teton River near Chouteau, Mont., for the year ending Sept. 30, 1918.

Day.	May.	June.	July.	Aug.	Sept.	Day.	May.	June.	July.	Aug.	Sept.
1.....		28	15.6	7.0	3.6	16.....	124	142	12.8	3.6	4.6
2.....		28	14.6	6.5	3.6	17.....	134	91	11.0	3.6	4.6
3.....		25	14.6	6.5	3.6	18.....	126	66	10.2	3.6	4.6
4.....		23	9.6	6.0	3.6	19.....	111	49	9.6	3.6	4.6
5.....		23	9.6	6.0	3.6	20.....	104	37	9.3	4.0	4.6
6.....		23	9.6	5.5	4.6	21.....	76	32	9.3	4.0	4.6
7.....	202	27	9.6	5.0	4.6	22.....	67	27	9.3	3.6	4.6
8.....	202	42	9.6	4.6	4.6	23.....	47	26	9.3	3.6	4.6
9.....	172	142	9.6	4.6	4.6	24.....	38	23	8.7	3.6	4.6
10.....	147	241	9.6	4.2	4.6	25.....	38	23	8.1	3.6	4.6
11.....	139	272	9.6	4.2	4.6	26.....	38	21	8.1	4.0	4.6
12.....	121	258	9.6	4.2	4.6	27.....	38	20	8.1	3.6	4.6
13.....	98	241	9.6	3.6	4.6	28.....	38	18	8.1	3.6	4.6
14.....	98	224	10.2	3.6	4.6	29.....	38	14.1	7.5	3.6	4.6
15.....	132	207	11.8	4.0	4.6	30.....	32	15.6	7.5	3.6	4.6
						31.....	28	.....	7.0	4.0	.....

Monthly discharge of Teton River near Chouteau, Mont., for the year ending Sept. 30, 1918.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
May.....	202	28	95.5	4,740
June.....	272	14.1	80.3	4,780
July.....	15.6	7.0	9.89	608
August.....	7.0	3.6	4.35	267
September.....	4.6	3.6	4.43	264

SPRING CREEK NEAR STRABANE, MONT.

LOCATION.—In NE. $\frac{1}{4}$ SE. $\frac{1}{4}$ sec. 2, T. 24 N., R. 7 W., at highway bridge half a mile southeast of buildings on Peeble's ranch, $1\frac{1}{4}$ miles south of Strabane and 16 miles west of Chouteau, Teton County.

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—May 30 to December 31, 1913; April 14, 1917, to September 30, 1918.

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

DISCHARGE MEASUREMENTS.—Made from bridge or by wading.

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

EXTREMES OF DISCHARGE.—Maximum stage reported during year, 1.50 feet at 4 p. m. March 31 (discharge, 26 second-feet); minimum stage, 0.10 foot July 11-13 (discharge, 1.1 second-feet).

1913 and 1917-1918: Maximum stage reported, 2.44 feet at 4 p. m. May 31, 1917 (discharge, 66 second-feet); minimum discharge, 0.5 second-foot on August 26, 1913 (obtained at old gage location).

ICE.—Discharge relation not seriously affected by ice; open channel rating applicable.

DIVERSIONS.—None.

REGULATION.—None.

ACCURACY.—Stage-discharge relation permanent during year. Rating curve well defined below 22 second-feet. Gage read to hundredths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table. Records good for open-channel flow and fair for winter.

Discharge measurements of Spring Creek near Strabane, Mont., during the year ending Sept. 30, 1918.

Date.	Made by—	Gage height.	Discharge.
May 21	W. A. Lamb.....	Feet.	Sec.-ft.
July 30	C. S. Heidel.....	0.55	5.8
		.17	1.5

Daily discharge, in second-feet, of Spring Creek near Strabane, Mont., for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1.....	2.7	5.6	6.1	13.1	3.8	2.7	10.8	6.4	4.3	1.5	1.5	2.0
2.....	2.7	5.8	6.1	16.0	4.0	2.6	10.2	6.1	4.3	1.5	1.5	1.8
3.....	2.9	6.1	6.1	18.7	3.8	4.3	9.4	6.1	4.3	1.5	1.5	1.7
4.....	3.1	5.8	5.8	16.7	3.8	4.9	8.2	6.1	4.3	1.4	1.7	1.6
5.....	3.1	5.8	5.8	13.3	4.4	2.5	8.0	5.6	3.8	1.4	1.8	1.6
6.....	3.6	5.6	5.7	12.5	4.3	2.7	9.4	5.3	3.8	1.4	1.7	1.6
7.....	3.6	5.6	5.6	11.7	4.3	3.1	20.7	5.3	3.8	1.2	1.7	1.6
8.....	3.8	5.6	5.6	10.6	4.5	3.8	17.1	6.1	3.6	1.2	1.6	1.6
9.....	3.8	5.6	5.3	7.5	5.1	4.4	15.6	6.7	3.6	1.2	1.6	1.6
10.....	3.8	5.6	5.0	5.8	6.0	4.8	13.7	9.1	3.6	1.2	1.6	1.6
11.....	3.8	5.6	5.0	5.3	5.0	4.0	11.9	8.5	3.4	1.1	1.6	1.6
12.....	4.0	5.8	5.0	4.8	6.6	3.5	10.8	7.4	3.1	1.1	1.6	1.5
13.....	4.0	5.8	5.3	4.8	5.8	3.7	9.8	6.4	2.8	1.1	1.5	1.5
14.....	4.0	5.8	5.6	4.4	4.0	4.6	8.5	6.7	2.2	1.4	1.5	1.4
15.....	4.0	5.8	6.3	4.0	3.8	5.1	6.7	7.0	1.9	2.6	1.5	1.4
16.....	4.0	6.1	6.4	3.8	4.9	6.7	6.4	7.0	1.7	2.0	1.6	1.4
17.....	4.3	6.1	11.5	3.8	6.0	7.5	5.1	7.8	1.7	1.7	1.5	1.2
18.....	4.3	6.1	16.0	3.6	5.0	9.6	4.4	7.4	1.5	1.5	1.5	1.2
19.....	4.5	6.1	16.7	3.6	4.4	16.2	3.8	6.3	1.5	1.5	1.5	1.2
20.....	4.5	6.1	14.3	3.4	3.7	14.5	3.8	5.8	1.4	1.5	1.5	1.2
21.....	4.5	5.8	13.1	3.4	3.4	16.7	3.8	5.8	1.2	1.4	1.4	1.2
22.....	4.8	5.8	12.9	3.6	2.8	18.2	7.7	5.6	1.2	1.5	1.4	1.2
23.....	4.8	5.8	8.4	3.6	2.5	18.0	6.7	5.3	1.2	1.7	1.4	1.6
24.....	4.8	5.8	8.0	3.6	2.5	15.2	6.1	5.3	1.5	1.8	1.4	1.7
25.....	5.0	5.8	8.0	3.9	2.2	12.5	8.2	5.3	1.5	1.8	1.2	1.8
26.....	5.0	5.8	8.0	4.0	2.2	12.7	8.4	5.6	1.5	1.7	1.2	1.7
27.....	5.0	5.8	7.7	3.8	2.0	12.5	7.0	5.6	1.5	1.7	1.2	1.4
28.....	5.0	5.8	7.7	3.8	2.0	12.5	6.7	5.3	1.7	1.5	1.2	1.4
29.....	5.0	6.1	11.7	3.6	-----	12.9	6.4	5.0	1.7	1.5	1.2	1.4
30.....	5.3	6.1	12.9	3.6	-----	12.9	6.4	4.8	1.5	1.6	1.2	1.4
31.....	5.3	-----	13.9	3.7	-----	21.7	-----	4.5	-----	1.6	1.2	-----

Monthly discharge of Spring Creek near Strabane, Mont., for the year ending Sept. 30, 1918.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October.....	5.3	2.7	4.16	256.
November.....	6.1	5.6	5.83	347
December.....	16.7	5.0	8.44	519
January.....	18.7	3.4	6.71	413
February.....	6.6	2.0	4.03	224
March.....	21.7	2.5	8.94	550
April.....	20.7	3.8	8.72	519
May.....	9.1	4.5	6.17	379
June.....	4.3	1.2	2.50	149
July.....	2.6	1.1	1.51	92.8
August.....	1.8	1.2	1.47	90.4
September.....	2.0	1.2	1.50	89.3
The year.....	20.7	1.1	5.01	3,630

♣
SPRING CREEK NEAR CHOUTEAU, MONT.

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

RECORDS AVAILABLE.—April 13, 1917, to September 30, 1918.

DRAINAGE AREA.—Not measured.

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

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

CHANNEL AND CONTROL.—Bed composed of gravel and small stones at gage. Banks fairly high; may be overflowed. Control is rock ledge extending diagonally across stream, being 20 feet below gage on right and 40 feet on left bank; may shift slightly.

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

1917-1918: Maximum stage reported during year, 2.40 feet January 1 and 2 (discharge, 37 second-feet); minimum stage 2.05 feet September 22 (discharge, 12 second-feet).

ICE.—Probably no ice effect on stage-discharge relation.

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

REGULATION.—None.

ACCURACY.—Stage-discharge relation permanent during year; not affected by ice.

Rating curve well defined between 10 and 40 second-feet. Gage read to hundredths once daily. Daily discharge obtained by applying daily gage heights to rating table. Records good.

Discharge measurements of Spring Creek near Chouteau, Mont., during the year ending Sept. 30, 1918.

Date.	Made by—	Gage height.	Discharge.
Apr. 19	W. A. Lamb.....	<i>Feet.</i> 2.17	<i>Sec.-ft.</i> 19.7
May 21	do.....	2.19	19.9
July 30	C. S. Heidel.....	2.12	16.4

Daily discharge, in second-feet, of Spring Creek near Chouteau, Mont., for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1.....	15	18	18	37	22	15	22	20	14	19	15	14
2.....	15	18	18	37	22	15	22	20	15	15	15	14
3.....	15	18	18	29	21	21	15	19	15	15	15	14
4.....	15	18	18	29	21	19	22	19	14	15	15	14
5.....	15	18	18	29	21	21	21	20	14	15	15	14
6.....	15	18	18	29	21	21	21	19	14	15	15	14
7.....	15	18	18	29	21	21	22	21	14	15	15	14
8.....	15	18	18	29	18	21	22	22	15	15	15	14
9.....	15	18	18	29	16	22	22	22	21	15	15	14
10.....	15	18	18	29	18	19	22	23	21	14	15	14
11.....	15	18	18	22	18	16	22	23	22	14	15	14
12.....	15	18	18	22	19	16	21	23	22	14	15	14
13.....	15	18	18	22	19	16	21	23	23	15	15	14
14.....	15	18	22	22	18	16	21	23	23	16	15	14
15.....	15	18	22	22	18	16	21	23	23	22	15	14
16.....	15	18	22	22	18	18	20	23	22	18	15	14
17.....	15	18	22	22	18	18	20	23	21	18	15	13
18.....	15	18	22	22	18	18	20	23	21	18	15	13
19.....	15	18	22	22	17	21	20	22	21	18	15	13
20.....	15	18	22	21	17	22	19	22	21	15	15	13
21.....	15	18	22	21	16	22	19	21	21	15	15	13
22.....	15	18	22	20	17	22	20	21	21	15	15	12
23.....	15	18	22	20	18	22	20	21	21	22	15	13
24.....	15	18	22	20	18	22	20	18	21	22	15	14
25.....	18	18	22	18	18	22	20	18	21	21	14	14
26.....	18	18	22	19	18	22	20	15	21	21	14	14
27.....	18	18	22	21	17	22	20	15	21	20	14	14
28.....	18	18	22	21	15	22	20	15	21	18	14	14
29.....	18	18	29	21	.....	22	20	15	21	18	14	14
30.....	18	18	29	21	.....	22	20	15	21	16	14	14
31.....	18	.....	29	21	.....	22	.....	14	.....	16	14	.....

Monthly discharge of Spring Creek near Chouteau, Mont., for the year ending Sept. 30, 1918.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October.....	18	15	15.7	965
November.....	18	18	18.0	1,070
December.....	29	18	21.0	1,290
January.....	37	18	24.1	1,480
February.....	22	15	18.5	1,030
March.....	22	15	19.8	1,220
April.....	22	15	20.5	1,220
May.....	23	14	20.0	1,230
June.....	23	14	19.5	1,160
July.....	22	14	16.9	1,040
August.....	15	14	14.8	910
September.....	14	12	13.7	815
The period.....	37	12	18.6	13,400

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, 1918.

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

DISCHARGE MEASUREMENTS.—Made by wading.

CHANNEL AND CONTROL.—Bar of gravel 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, 7.1 feet January 1 (discharge, 477 second-feet); minimum stage recorded, 5.36 feet September 20–23 (discharge, 28 second-feet).

1911–1918: Maximum stage recorded, 10.5 feet 7 a. m. June 21, 1912 (discharge, from extension of rating curve, 3,050 second-feet); minimum stage recorded, 5.28 feet September 25, 1915, and 5.27 feet September 6, 1914 (discharge, 11 second-feet).

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

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

REGULATION.—None.

ACCURACY.—Stage-discharge relation not permanent. Affected by ice. Rating curve used fairly well defined below 700 second-feet. Gage read to hundredths once daily. Daily discharge ascertained by applying gage height to rating table October 1 to December 1, December 19–23, and December 30 to January 9. Discharge estimated December 2–18 and 24–29. Shifting-control method used March 21 to September 30. Records fair.

Discharge measurements of Deep Creek near Chouteau, Mont., during the year ending Sept. 30, 1918.

[Made by W. A. Lamb.]

Date.	Gage height.	Discharge.
	<i>Fect.</i>	<i>Sec.-ft.</i>
Apr. 9.....	5.68	76
June 22.....	5.95	85
Sept. 9.....	5.44	32.7

Daily discharge, in second-feet, of Deep Creek near Chouteau, Mont., for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Dec.	Jan.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1.....	36	80	44	477	-----	80	86	143	53	40	31
2.....	40	73	40	324	-----	73	101	132	48	40	41
3.....	40	60	40	207	-----	49	120	120	48	36	34
4.....	40	54	40	156	-----	60	188	110	43	36	34
5.....	40	54	35	96	-----	73	228	118	43	36	31
6.....	40	54	35	96	-----	80	228	128	43	44	31
7.....	44	54	35	105	-----	80	199	158	39	44	31
8.....	44	49	35	96	-----	88	196	163	35	44	31
9.....	40	49	35	66	-----	80	170	222	35	40	34
10.....	40	49	35	-----	-----	80	196	222	35	36	34
11.....	40	49	35	-----	-----	79	196	250	32	36	34
12.....	40	49	30	-----	-----	79	196	234	30	36	31
13.....	40	49	30	-----	-----	86	170	231	32	40	31
14.....	40	49	30	-----	-----	86	170	231	32	36	31
15.....	40	44	30	-----	-----	86	170	213	53	36	31
16.....	40	44	150	-----	-----	85	170	161	143	36	31
17.....	44	44	50	-----	-----	77	183	136	122	36	31
18.....	54	44	40	-----	-----	77	170	126	103	36	29
19.....	54	44	270	-----	-----	77	158	114	86	36	29
20.....	54	44	207	-----	-----	69	147	105	72	44	28
21.....	60	44	96	-----	80	69	126	94	59	36	28
22.....	60	44	80	-----	73	83	126	86	53	33	28
23.....	60	44	80	-----	96	90	107	79	53	33	28
24.....	54	44	75	-----	80	82	126	79	53	33	34
25.....	54	44	70	-----	88	82	126	72	53	33	41
26.....	54	44	60	-----	88	88	116	65	53	30	41
27.....	54	44	50	-----	88	96	116	65	53	30	41
28.....	54	36	50	-----	80	96	107	59	53	30	37
29.....	54	36	150	-----	73	86	107	65	48	30	34
30.....	60	40	383	-----	73	86	105	59	43	30	34
31.....	66	-----	363	-----	80	-----	124	-----	43	30	-----

Monthly discharge of Deep Creek near Chouteau, Mont., for the year ending Sept. 30, 1918.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October.....	66	36	47.7	2,930
November.....	80	36	48.5	2,890
December.....	383	30	87.2	5,360
January 1-9.....	477	66	180	3,210
March 21-31.....	96	73	81.7	1,780
April.....	96	49	80.1	4,770
May.....	228	86	152	9,350
June.....	250	59	135	8,030
July.....	143	30	54.5	3,350
August.....	44	30	36.0	2,210
September.....	41	28	32.8	1,950

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 2 miles above Bynum, in Teton County.

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—May 24, 1912, to September 30, 1918.

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

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

EXTREMES OF DISCHARGE.—Maximum gage height, 3.95 feet at 1.15 p. m. December 31 (discharge, 152 second-feet); minimum gage height, 2.31 feet August 31 (discharge, 0.0 second-feet).

1912-1918: Maximum stage recorded, 6.9 feet June 21, 1916, determined by leveling from flood marks (discharge, determined from extension of rating curve, 976 second-feet); channel dry August 18, 23, 24, 31; September 1-3, 10, 29; October 7, 1912; and August 31, 1918.

ICE.—Stage-discharge relation not affected by ice; gage observations discontinued during winter.

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

REGULATION.—None.

ACCURACY.—Stage-discharge relation changed during high water the last of December; affected by ice January 15 to March 23, and by ice jam April 6. Rating curve used October 1 to December 29 fairly well defined between 2 and 150 second feet; curve used January 3 to September 30 (except for ice period) well defined between 0.3 and 40 second-feet. Gage read to hundredths once daily; (two readings daily during rapid fluctuation of stage). Daily discharge ascertained by applying gage height to rating table; shifting-control method used December 30 to January 2. Records fair October to January 2, and good March 24 to September 30.

Discharge measurements of Muddy Creek near Bynum, Mont., during the year ending Sept. 30, 1918.

Date.	Made by—	Gage height.	Discharge.
		<i>Feet.</i>	<i>Sec.-ft.</i>
Apr. 10	W. A. Lamb.....	2.95	25.5
May 27	Lamb and Edwards.....	2.51	2.5
July 30	C. S. Heidel.....	2.36	0.3

Daily discharge, in second-feet, of Muddy Creek near Bynum, Mont., for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Dec.	Jan.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1.	1.0	1.0	1.0	100		7.7	7.7	2.3	0.5	0.2	0.2
2.	1.0	1.0	1.0	57		10.0	5.4	2.3	.5	.2	.4
3.	1.0	1.0	1.0	37		5.4	5.4	2.3	.5	.2	.2
4.	1.0	1.0	1.0	26		5.4	3.8	2.3	.9	.2	.2
5.	1.0	1.0	1.0	16		5.4	3.8	2.3	.5	.4	.2
6.		1.0	1.0	1.0	16	14	3.8	2.3	.4	.5	.2
7.	1.0	1.0	1.0	13		22	3.8	2.3	.4	.3	.2
8.	1.0	1.0	1.0	8.1		42	3.8	2.3	.4	.3	.1
9.	1.0	1.0	.5	5.4		33	3.8	2.3	.4	.2	.2
10.	1.0	1.0	.5	3.8		26	5.4	2.3	.4	.2	.2
11.	1.0	1.0	.5	3.8		19	7.7	1.4	.4	.2	.2
12.	1.0	1.0	.5	2.3		19	16.0	1.4	.3	.3	.2
13.	1.0	1.0	.5	1.4		16	10.0	1.4	.2	.3	.2
14.	1.0	1.0	1.0	1.4		16	7.7	1.4	.2	.2	.2
15.	1.0	1.0	1.0			13	5.4	1.4	2.3	.2	.2
16.	1.0	1.0	1.0			7.7	5.4	1.4	2.3	.3	.2
17.	1.0	1.0	1.9			7.7	5.4	1.4	1.4	.2	.2
18.	1.0	1.0	1.9			7.7	3.8	1.4	.5	.2	.2
19.	1.0	1.0	5.8			7.7	3.8	1.4	.5	.2	.2
20.	1.0	1.0	4.3			10.0	3.8	1.4	.5	.3	.2
21.	1.0	1.0	1.9			7.7	3.8	.5	.2	.3	.2
22.	1.0	1.0	1.9			7.7	3.8	.5	.2	.2	.2
23.	1.0	1.0	1.9			7.7	3.8	1.4	.2	.2	.4
24.	1.0	1.0	1.9		13	7.7	3.8	1.4	.2	.2	.2
25.	1.0	1.0	1.0		16	7.7	3.8	1.4	.5	.2	.2
26.	1.0	1.0	1.0		13	5.4	3.8	.5	.2	.2	.2
27.	1.0	1.0	1.0		10.	10.0	3.8	.5	.5	.2	.2
28.	1.0	1.0	1.0		7.7	10.0	3.8	.9	.5	.2	.2
29.	1.0	1.0	50		7.7	10.0	3.8	1.4	.5	.1	.2
30.	1.0	1.0	105		7.7	7.7	2.3	1.4	.3	.1	.2
31.	1.0		152		7.7		2.3		.2	.0	

Monthly discharge of Muddy Creek near Bynum, Mont., for the year ending Sept. 30, 1918.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October.....	1.0	1.0	1.00	61.5
November.....	1.0	1.0	1.00	59.5
December.....	152	.5	12.9	689
January 1-14.....	100	1.4	20.6	572
March 24-31.....	16	7.7	10.4	165
April.....	42	5.4	12.5	744
May.....	16	2.3	4.98	306
June.....	2.3	.5	1.56	92.8
July.....	2.3	.2	0.55	33.8
August.....	.5	.0	0.23	14.1
September.....	.4	.1	0.21	12.5

BLACKLEAF CREEK NEAR BYNUM, MONT.

LOCATION.—In NW. $\frac{1}{4}$ SE. $\frac{1}{4}$ sec. 22, T. 26 N., R. 6 W., 200 feet above mouth of creek and 2 miles above Bynum, in Teton County.

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—May 24, 1912, to September 30, 1918.

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

DISCHARGE MEASUREMENTS.—Made by wading near gage.

CHANNEL AND CONTROL.—Banks fairly high; not likely to overflow. Stream bed fine sand and gravel. Control, a gravel riffle, shifting.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year occurred December 31, estimated at 180 second-feet by comparison with Muddy Creek. No gage height as stage-discharge relation was affected by ice. Minimum stage, no flow; water standing in pools June 8 to September 30.

1912-1918: Maximum stage recorded, 5.85 feet June 21, 1916, determined by leveling from flood marks (discharge determined from extension of rating curve 600 second-feet); channel dry July 21 to October 3, 1914.

ICE.—There is considerable difficulty in estimating flow during ice period on account of the sudden changes in temperature, due principally to chinook winds. There was ice on creek October 29-31, but none on riffle, the data for this period being computed as open channel. A little ice formed during November but did not materially affect stage-discharge relation so that open-channel rating table was applied throughout the month. The December records show two ice periods of considerable extent, December 9-14 and December 26 to January 1. The former was severe and was broken by the chinook winds on the 14th, the 15th being open. From December 15-25, the riffle was practically free from ice, although ice formed on creek above. The sudden rise of the 19th and 20th, due to chinook winds, caused water to flow over ice, but as riffle was not obstructed open-channel rating assumed applicable. During the period December 26-31 no gage readings were made. The observer reported snow melting fast on 29th and flooded on 30th and 31st. The flow has been estimated on basis of comparison with Muddy Creek near Bynum for same period. January 2-7, open; January 8-14, estimated from observer's notes, temperature record, and comparison with Muddy Creek.

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

REGULATION.—None.

ACCURACY.—Stage-discharge relation not permanent; also affected by ice. Rating curve used October 1 to January 14 for open channel; well defined below 100 second-feet; curve used March 24 to June 7 well defined below 60 second-feet. Gage read to hundredths once daily. Daily discharge ascertained by applying gage height to rating table; December 9-14, 26-31, January 1 and 6-14, estimated because of ice. Records for open channel, good.

Discharge measurements of Blackleaf Creek near Bynum, Mont., during the year ending Sept. 30, 1918.

Date.	Made by—	Gage height.	Dis-charge.
		<i>Feet.</i>	<i>Sec.-ft.</i>
Apr. 10	W. A. Lamb	3.34	33.5
May 27	Lamb and Edwards	3.14	9.4
July 30	C. S. Heidel	2.78	.0

Daily discharge, in second-feet, of Blackleaf Creek near Bynum, Mont., for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Dec.	Jan.	Mar.	Apr.	May.	June.
1.....	1.3	14	2.3	150	.....	6.0	12	3.0
2.....	1.0	6.6	2.3	49	.....	10	10	3.0
3.....	1.0	4.7	2.3	30	.....	0	10	3.0
4.....	1.0	2.3	2.3	23	.....	8.7	8.7	3.0
5.....	1.0	2.3	1.5	28	.....	10	6.0	3.0
6.....	1.0	2.3	1.5	24	.....	4.2	4.2	1.8
7.....	1.5	2.3	1.5	23	.....	1.8	4.2	1.8
8.....	1.5	2.3	1.5	20	.....	32	4.2	.....
9.....	1.3	2.3	1.5	20	.....	49	6.0	.....
10.....	.8	1.5	1.5	17	.....	32	21	.....
11.....	.8	1.5	1.5	13	.....	23	23	.....
12.....	1.3	1.5	1.5	11	.....	21	69	.....
13.....	1.3	1.5	1.5	9	.....	19	32	.....
14.....	1.3	1.5	11	7	.....	19	15	.....
15.....	1.3	1.3	20	.....	.....	15	15	.....
16.....	1.5	1.5	20	.....	.....	12	15	.....
17.....	2.3	1.5	23	.....	.....	12	12	.....
18.....	1.5	1.5	17	.....	.....	10	12	.....
19.....	1.3	2.3	31	.....	.....	10	10	.....
20.....	1.3	1.5	78	.....	.....	10	10	.....
21.....	4.7	1.5	20	.....	.....	10	6.0	.....
22.....	4.7	1.5	12	.....	.....	12	6.0	.....
23.....	3.5	2.3	11	.....	.....	12	6.0	.....
24.....	3.5	2.3	6.6	.....	27	12	6.0	.....
25.....	3.5	2.3	5.5	.....	10	12	8.7	.....
26.....	3.5	2.3	4.7	.....	19	12	10	.....
27.....	2.3	2.3	4.7	.....	8.7	23	8.7	.....
28.....	3.5	2.3	4.7	.....	4.2	23	6.0	.....
29.....	2.3	2.3	50	.....	3.0	23	6.0	.....
30.....	4.7	2.3	100	.....	4.2	19	4.2	.....
31.....	4.7	.....	180	.....	4.2	.....	3.0	.....

Monthly discharge of Blackleaf Creek near Bynum, Mont., for the year ending Sept. 30, 1918.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October.....	4.7	0.8	2.14	132
November.....	14	1.3	2.59	154
December.....	180	1.5	20.1	1,240
January 1-14.....	150	7.	30.3	841
March 24-31.....	27	3.0	10.0	159
April.....	49	.0	15.4	916
May.....	69	3.0	11.9	732
June.....	3.0	.0	.62	36.9

NOTE.—No flow during July, August, and September.

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, 1918.

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

DISCHARGE MEASUREMENTS.—Made from bridge or by wading.

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

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 2.62 feet at 8 p. m. June 11 (discharge, 1,340 second-feet); minimum stage 0.0 foot at 8.30 a. m. July 14 (discharge, 62 second-feet).

1907-1918: Maximum stage recorded, 5.3 feet at 8 a. m. May 27, 1917 (discharge, 4,020 second-feet); minimum stage recorded dry August 4-11, 1910.

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

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

REGULATION.—None.

ACCURACY.—Stage-discharge relation not permanent. Rating curve used October 1-11 well defined above 40 second-feet; curve used November 21 to May 6 fairly well defined between 75 and 530 second-feet; curve used May 7 to September 30 well defined between 50 and 1,000 second-feet. Gage read to quarter-tenths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table; shifting-control method used October 12 to November 20. Records fair.

Discharge measurements of Musselshell River at Harlowton, Mont., during the year ending Sept. 30, 1918.

[Made by C. S. Heidel.]

Date.	Gage height.	Discharge.
	<i>Feet.</i>	<i>Sec.-ft.</i>
Nov. 21.....	0.70	137
Apr. 16.....	1.38	451
May 25.....	1.93	842

Daily discharge, in second-feet, of Musselshell River at Harlowton, Mont., for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Dec.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1.....	112	217	148	.....	627	353	785	176	193	123
2.....	110	243	127	.....	479	374	817	154	184	148
3.....	107	257	117	.....	294	439	804	130	221	148
4.....	100	188	127	.....	266	563	785	118	291	145
5.....	100	188	152	.....	270	843	842	108	268	140
6.....	93	156	175	.....	275	902	969	99	247	138
7.....	93	137	213	.....	248	817	1,090	93	215	133
8.....	90	137	239	.....	226	754	1,130	82	184	128
9.....	88	130	.....	.....	270	723	1,190	77	167	130
10.....	93	120	.....	.....	395	675	1,240	74	156	173
11.....	93	120	.....	.....	520	670	1,320	70	162	167
12.....	101	124	.....	.....	532	658	1,310	68	156	156
13.....	101	127	.....	.....	538	606	1,290	65	159	218
14.....	101	134	.....	.....	634	612	1,270	64	162	261
15.....	101	141	.....	.....	687	664	1,210	830	156	283
16.....	101	137	.....	.....	456	717	1,120	693	156	310
17.....	101	145	.....	.....	479	792	1,020	1,290	159	268
18.....	101	145	.....	.....	411	817	935	823	156	234
19.....	101	148	.....	749	338	817	830	512	148	208
20.....	104	145	.....	895	303	810	736	432	138	196
21.....	104	141	.....	764	280	736	652	395	159	187
22.....	104	137	.....	634	303	699	578	381	215	182
23.....	104	137	.....	821	303	664	544	355	176	179
24.....	98	137	.....	895	289	634	497	334	159	234
25.....	101	148	.....	807	328	836	452	334	159	372
26.....	98	148	.....	940	338	856	360	381	162	377
27.....	98	148	.....	895	308	817	298	368	159	330
28.....	98	152	.....	756	318	785	265	326	148	283
29.....	145	156	.....	694	338	754	244	276	138	272
30.....	148	164	.....	667	348	766	199	241	128	276
31.....	179	.....	.....	707	.....	754	.....	208	123	.....

NOTE.—Gage not read Dec. 7 to Mar. 18.

Monthly discharge of Musselshell River at Harlowton, Mont., for the year ending Sept. 30, 1918.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean:	
October.....	179	88	105	6,460
November.....	257	120	154	9,160
December 1-8.....	239	117	162	2,570
March 19-31.....	940	634	786	20,300
April.....	687	226	380	22,600
May.....	902	353	707	43,500
June.....	1,320	199	826	49,200
July.....	1,290	64	308	18,900
August.....	291	123	174	10,700
September.....	377	123	213	12,700

FLATWILLOW CREEK NEAR FLATWILLOW, MONT.

LOCATION.—In NE. $\frac{1}{4}$ sec. 19, T. 12 N., R. 25 E., at Henkel's ranch, 12 miles above Flatwillow, Fergus County, and 30 miles north of Roundup. All records prior to 1918 were obtained at old station in sec. 23, T. 12 N., R. 25 E., at Flatwillow Ranch Co.'s ranch, about 4 miles downstream.

DRAINAGE AREA.—About 195 square miles (measured on 1916 map of Fergus County).
RECORDS AVAILABLE.—April 17 to September 30, 1918, at present site; May 1, 1911, to December 2, 1918, at old site, 4 miles downstream.

GAGE.—Vertical staff near right bank, 4 feet above private wagon bridge, 200 feet west of barn, on Henkel's ranch. Gage read by F. W. Henkel.

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

CHANNEL AND CONTROL.—Banks fairly high and overgrown with willows. Stream bed earth and gravel. Current sluggish. Control composed of gravel; may shift.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year 4.0 feet 5 p. m. July 17 (discharge, 224 second-feet); minimum stage recorded 1.20 feet at 5 p. m. July 13 (discharge, 25 second-feet).

1911–1918: Maximum stage recorded 9.0 feet, estimated by observer at old location June 4–11, 1917 (discharge, 454 second-feet in creek and 500 second-feet additional in canal); minimum stage 2.1 feet at old location September 3 and 4, 1912 (discharge, 1.0 second-foot).

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

DIVERSIONS.—Numerous small ones above gage.

REGULATION.—None.

ACCURACY.—Stage-discharge relation affected by ice October 26–30 and after December 2, 1917, until spring of 1918. Rating curve used October 1 to December 2 well defined for range of stage during period; curve used April 17 to September 30 well defined below 150 second-feet. Gage read to half-tenths daily in 1917 and to hundredths in 1918. Daily discharge ascertained by applying daily gage height to rating table. Discharge October 1 to December 2 includes flow in canal (3 second-feet). Gage used after April 12, 1918, is above the point of diversion to the canal. Records good.

Discharge measurements of Flatwillow Creek near Flatwillow, Mont., during the year ending Sept. 30, 1918.

[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>
Nov. 22.....	<i>a</i> 2.66	42.6	May 27.....	2.15	83
Apr. 17.....	<i>b</i> 2.54	110	Sept. 16.....	1.50	42.2

a Gage height refers to old gage below canal diversion; canal carried 3 second-feet on this date.

b New gage located at Henkel's ranch above canal diversion.

Daily discharge, in second-feet, of Flatwillow Creek near Flatwillow, Mont., for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Dec.	Apr.	May.	June.	July.	Aug.	Sept.
1.....	47	60	47	.....	86	90	35	56	48
2.....	47	55	51	.....	86	99	36	58	52
3.....	47	55	.....	.....	86	97	35	58	52
4.....	47	51	.....	.....	87	100	34	58	52
5.....	47	51	.....	.....	89	100	33	59	52
6.....	47	51	.....	.....	90	90	33	58	41
7.....	47	53	.....	.....	93	82	32	58	41
8.....	47	53	.....	.....	94	80	32	53	41
9.....	45	51	.....	.....	111	76	32	52	41
10.....	45	51	.....	.....	108	73	27	52	41
11.....	47	53	.....	.....	97	72	27	52	40
12.....	47	51	.....	.....	90	66	27	50	40
13.....	47	51	.....	.....	86	59	25	50	40
14.....	47	53	.....	.....	85	56	35	46	42
15.....	47	53	.....	.....	83	50	66	46	42
16.....	47	53	.....	.....	85	46	146	49	42
17.....	47	51	.....	110	85	46	224	48	40
18.....	47	51	.....	107	85	48	125	44	37
19.....	47	51	.....	106	80	54	100	60	37
20.....	47	49	.....	107	79	53	79	53	37
21.....	49	47	.....	106	83	53	83	93	36
22.....	49	45	.....	101	82	52	72	143	35
23.....	51	45	.....	99	83	48	64	79	36
24.....	55	45	.....	97	71	46	66	66	38
25.....	60	47	.....	96	73	40	70	60	41
26.....	60	47	.....	96	78	35	71	58	49
27.....	60	45	.....	93	82	53	83	58	44
28.....	60	45	.....	92	94	36	53	58	41
29.....	60	47	.....	89	93	35	56	58	47
30.....	60	47	.....	86	93	35	58	48	47
31.....	60	.....	.....	.....	90	.....	59	42	.....

Monthly discharge of Flatwillow Creek near Flatwillow, Mont., for the year ending Sept. 30, 1918.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October.....	60	45	50.3	3,090
November.....	60	45	50.2	2,990
April 17-30.....	110	86	98.9	2,750
May.....	111	71	87.2	5,360
June.....	100	35	62.3	3,710
July.....	224	25	61.9	3,810
August.....	143	42	58.8	3,620
September.....	52	35	42.4	2,520

NOTE.—Records, October and November, at old site include flow in canal (3 second-feet); records Apr. 17 to Sept. 30 at new site above diversion to canal.

MILK RIVER BASIN.

SOUTH FORK OF MILK RIVER NEAR INTERNATIONAL BOUNDARY.

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, 5 miles south of international boundary and about 30 miles northeast of Browning.

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

RECORDS AVAILABLE.—April 28, 1905, to September 30, 1918.

GAGE.—Stevens continuous water-stage recorder reinstalled October 13, 1917, on left bank 400 feet below site of water-stage recorder used April 13, 1913, to October 12, 1917; April 28 to May 8, 1905, a staff gage; May 8, 1905, to April 13, 1913, overhanging chain gage. All gages at same datum. Read by Mrs. Viola Saffell to May 24; no observer thereafter.

DISCHARGE MEASUREMENTS.—Made from cable 300 feet above gage or by wading.

CHANNEL AND CONTROL.—Bed 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 during extreme floods.

EXTREMES OF DISCHARGE.—Maximum stage recorded 3.40 feet at 9 a. m. January 2 (stage-discharge relation affected by ice; flow computed at 370 second-feet); minimum stage 1.42 feet August 29 (discharge, 5.1 second-feet).

1905–1918: 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.—Ice period extends from November 30 to April 3. Flow computed from hydrograph based upon discharge measurements, temperature records, observer's notes, and comparison with North Fork of Milk River and Milk River at Milk River, Alberta.

DIVERSIONS.—None.

REGULATION.—None.

ACCURACY.—Stage-discharge relation not permanent; affected by ice November 30 to April 3. Standard rating curve well defined between 12 and 300 second-feet. Operation of water-stage recorder satisfactory May 24 to September 30; unsatisfactory October 1 to May 23, and gage heights obtained by the observer once daily to hundredths. Daily discharge ascertained by applying daily gage height to rating table except for period of ice effect for which it was determined from discharge measurements, temperature records, observer's notes, and by comparisons with North Fork of Milk River near international boundary and Milk River at Milk River, Alberta. Shifting-control method used for greater part of year. Records fair.

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

Discharge measurements of South Fork of Milk River near international boundary during the year ending Sept. 30, 1918.

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. 13	A. W. P. Lowrie ^a	1.68	30	May 12	B. Russell ^a	2.73	207
Nov. 8	do.....	1.80	42	30	C. H. Ellacott ^a	2.10	77
11	B. E. Jones.....	1.80	44	June 15	B. E. Jones.....	2.01	72
21	S. H. Frame ^a	1.79	35	17	V. A. Newhall ^a	1.98	62
Dec. 6	D. G. Chadsey ^a	^b 1.68	^b 20	July 6	C. H. Ellacott.....	1.70	32
Jan. 3	S. H. Frame.....	^b 2.88	^b 217	15	W. A. Lamb.....	1.60	22
30	do.....	^b 1.80	^b 17.8	25	C. H. Ellacott.....	1.73	31
Feb. 22	A. W. P. Lowrie.....	^b 1.64	^b 12.6	Aug. 13	W. A. Lamb.....	1.64	22
Mar. 14	W. A. Lamb.....	^b 1.75	^b 31	14	C. H. Ellacott.....	1.66	25
31	C. M. O'Neil ^a	^b 2.36	^b 110	Sept. 5	do.....	1.65	22
Apr. 12	W. A. Lamb.....	2.85	258	8	W. A. Lamb.....	1.54	15
24	C. M. O'Neil ^a	2.33	124	27	C. H. Ellacott.....	1.58	19.7

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

^b Stage-discharge relation affected by ice.

Daily discharge, in second-feet, of South Fork of Milk River near international boundary for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1.....	30	96	32	280	15	21	110	205	101	50	21.0	21.0
2.....	28	94	25	370	16	22	130	204	97	41	20.0	30.0
3.....	27	92	19	220	17	22	150	208	89	33	18.0	24.0
4.....	26	79	19	160	17	20	126	193	82	34	18.0	23.0
5.....	25	59	20	100	17	19	138	183	82	34	19.0	22.0
6.....	28	56	20	78	18	18	196	173	82	33	26.0	22.0
7.....	32	44	18	66	19	18	191	169	82	32	26.0	19.0
8.....	37	43	18	52	20	20	215	164	82	30	24.0	15.0
9.....	32	48	17	44	22	22	347	160	87	28	18.0	17.0
10.....	30	45	16	40	24	22	279	156	87	24	13.0	19.0
11.....	28	43	16	36	22	23	257	171	85	24	12.0	20.0
12.....	30	41	14	34	19	24	257	207	89	22	16.0	14.0
13.....	32	39	12	33	15	27	235	171	85	22	25.0	11.4
14.....	34	39	11	32	14	31	222	161	78	22	29.0	10.2
15.....	31	40	10	32	13	33	209	150	73	22	21.0	9.6
16.....	49	41	12	31	13	35	196	140	68	26	18.0	9.6
17.....	44	39	11	30	13	42	147	135	62	27	23.0	10.2
18.....	38	37	11	30	13	54	144	131	61	21	24.0	9.6
19.....	49	36	12	29	13	78	140	126	59	23	20.0	9.0
20.....	49	35	18	28	12	90	137	124	55	18	18.0	9.0
21.....	54	35	18	28	12	100	134	121	53	16	15.0	9.0
22.....	59	34	19	27	13	120	130	118	51	17	11.4	9.0
23.....	49	34	18	27	13	140	127	106	50	24	10.8	9.0
24.....	59	36	20	27	15	160	124	94	49	31	11.4	10.2
25.....	56	32	22	26	16	180	158	94	49	33	6.0	11.4
26.....	54	33	21	26	18	160	174	87	43	39	5.7	17.0
27.....	52	33	22	24	19	150	191	85	43	36	6.6	20.0
28.....	49	34	24	22	20	140	208	80	42	30	5.7	19.0
29.....	47	34	30	20	.....	160	208	76	47	28	5.1	18.0
30.....	36	33	40	18	.....	130	207	74	49	26	6.0	18.0
31.....	34	.....	120	14	.....	110	.....	82	.....	24	11.4	.....

NOTE.—Gage not read Oct. 3, 4, 26-28; Nov. 10, 14, 15, 17-19, 26, 27, 29; Dec. 2, 27; Jan. 4; Feb. 5, 17, 25; Mar. 17-19, 21-23, 25-27, 29-30; Apr. 14, 15, 18-23, 26, 27, 30; May. 1, 2, 4, 6, 7, 8, 14, 15, 17, 18, 20, 21, and 23; discharge interpolated except for days of ice effect.

Monthly discharge of South Fork of Milk River near international boundary for the year ending Sept. 30, 1918.

[Drainage area, 288 square miles.]

Month.	Discharge in second-feet.				Run-off.	
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches.	Acre-feet.
October.....	59	25	39.6	0.138	0.16	2,430
November.....	96	32	43.1	.160	.18	2,740
December.....	120	10	22.1	.077	.09	1,330
January.....	370	14	64.0	.222	.26	3,940
February.....	24	12	16.4	.057	.06	911
March.....	180	18	70.7	.245	.28	4,350
April.....	347	110	183	.635	.71	10,900
May.....	207	74	140	.486	.56	8,610
June.....	101	42	68.7	.239	.27	4,090
July.....	50	16	28.1	.098	.11	1,730
August.....	29	5.1	16.3	.057	.07	1,090
September.....	30	9.0	15.5	.054	.06	922
The year.....	370	5.1	59.3	.206	2.81	43,000

MILK RIVER AT EASTERN CROSSING OF INTERNATIONAL BOUNDARY.

LOCATION.—In NE. $\frac{1}{4}$ sec. 6, T. 37 N., R. 9 E., at international boundary line 30 miles north of Rudyard, Hill County, Mont., and 37 miles south of Many Berries, Alberta, the nearest railway stations.

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

GAGE.—Stevens continuous water-stage recorder on right (south) bank. Installed September 14, 1918, and referred to two staff gages, one inside of well and one in trench outside. April 1, 1913, to August 13, 1913, staff gage on left (north) bank, 200 feet below present gage. August 13, 1913, to March 22, 1917, Gurley printing gage referred to staff gage in river 10 feet below gage house. April 9 to June 13, 1917, several temporary gages were used, but all readings have been referred to the staff gage at the site of the one used August 13, 1913, to March 22, 1917. June 14 to September 18 readings on a staff gage at present location. September 18, 1917, Gurley printing gage installed on right (south) bank and referred to two staff gages, one inside in well and one outside in trench. Gage gave trouble continuously but attempts at using it were made until the escapement on the clock was broken August 14, 1918. August 16 to September 14 a Stevens 8-day water-stage recorder was temporarily used, but records were not accurate on account of 0.05 foot lag in the instrument. The zero of the north bank gage was at elevation 2,696.58 feet sea level, and the present south bank gage at elevation 2,698.92 feet sea level. Staff gages read and automatic gages attended to by Frank Galloway.

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

EXTREMES OF DISCHARGE.—Maximum stage recorded during year is 5.72 feet March 2, 1918 (discharge affected by ice); maximum discharge recorded is 1,250 second-feet (gage height 3.02 feet); minimum stage recorded, 0.73 feet September 28–30 (discharge, 44 second-feet).

1909–1918: Maximum stage recorded, 9.60 feet April 9, 1917 (discharge, 4,860 second-feet); minimum stage, channel reported dry August 3–17, 22, 23, 1914.

ICE.—Stage-discharge relation seriously affected by ice December 1 to March 31. No flow computed.

DIVERSIONS.—None.

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

ACCURACY.—Stage-discharge relation not permanent. Daily gage height records obtained as follows: April 20 to May 13, 1918, May 28 to June 19, and June 24–30 from Gurley printing gage; October 12 to December 21, 1918, February 12 to April 19, May 14 to 27, June 20–23, July 1 to August 15, 1918, from observer's readings, usually once daily during open-channel flow, and twice a week at other times to hundredths. August 16 to September 14 records from Stevens 8-day recorder, by straight-line method or by average hourly discharge. September 15–30 records from Stevens continuous water-stage recorder. All gage heights referred to inside gage datum. Daily discharge ascertained by shifting-control method. Records fair.

Discharge measurements of Milk River at eastern crossing of international boundary during the year ending Sept. 30, 1918.

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. 6	P. A. Fetterley ^a	1.50	189	July 31	Jones and Burley ^a	2.19	406
15	Jones and Lamb.....	1.19	114	Aug. 9	B. E. Jones.....	1.68	248
Dec. 20	W. A. Lamb.....	b 1.59	57	15	W. A. Lamb.....	1.71	250
Feb. 12	do.....	b 2.92	302	16	R. F. Edwards.....	1.77	274
Mar. 27	A. H. Tuttle.....	b 2.86	1,030	19	A. W. P. Lowrie.....	1.84	305
Apr. 20	G. S. Wenden ^a	1.68	291	20	do.....	1.84	306
May 5	Lamb and Tuttle.....	1.69	286	21	do.....	2.74	980
9	A. W. P. Lowrie ^a	1.64	274	23	R. F. Edwards.....	1.87	349
June 3	Edwards and Tuttle.....	1.19	149	26	Edwards and Burley...	1.78	289
13	R. F. Edwards.....	1.70	242	29	B. E. Jones.....	1.57	212
18	A. W. P. Lowrie ^a	1.96	330	31	R. F. Edwards.....	1.46	194
19	W. A. Lamb.....	1.98	331	Sept. 3	do.....	1.31	154
24	R. F. Edwards.....	2.02	365	10	do.....	1.31	146
July 20	W. A. Lamb.....	2.03	362	14	do.....	1.14	116

^a Engineer, Irrigation Branch, Department of the Interior, Calgary, Alberta.

^b Stage-discharge relation affected by ice.

Daily discharge, in second-feet, of Milk River at eastern crossing of international boundary for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Apr.	May.	June.	July.	Aug.	Sept.
1.....	77	141	601	350	158	347	375	187
2.....	77	96	299	363	154	363	363	171
3.....	74	198	272	335	156	390	335	156
4.....	70	171	244	310	147	355	283	165
5.....	63	145	281	296	143	380	267	165
6.....	56	187	318	289	160	371	277	154
7.....	53	171	355	280	158	371	273	149
8.....	61	169	335	264	178	380	270	147
9.....	63	165	431	286	228	363	252	147
10.....	64	145	461	293	241	363	233	147
11.....	63	132	499	289	252	363	233	143
12.....	63	122	520	280	247	367	241	139
13.....	64	118	541	264	250	363	267	134
14.....	68	116	479	283	264	359	264	116
15.....	70	114	455	303	283	367	250	91
16.....	70	105	423	281	299	375	267	74
17.....	70	96	391	259	324	375	270	60
18.....	70	96	359	238	347	375	306	52
19.....	61	96	328	233	328	385	306	49
20.....	89	96	261	224	335	375	310	47
21.....	77	96	250	215	347	367	765	47
22.....	85	96	247	233	359	363	461	47
23.....	56	96	264	228	371	375	367	47
24.....	50	95	306	224	351	371	335	47
25.....	132	95	331	219	347	371	324	47
26.....	91	94	310	215	359	375	296	46
27.....	87	82	296	210	359	380	277	46
28.....	76	70	293	182	367	395	247	44
29.....	94	57	286	178	367	405	215	44
30.....	132	44	306	176	367	405	196	44
31.....	152	.....	.....	165	.....	405	189	.....

NOTE.—Discharge interpolated; Nov. 14, 16, 19–22, 24, 25, 27–29, Apr. 3, 5, 6, 12, 16, 17, May 16, 17, 20, 24–26.

Monthly discharge of Milk River at eastern crossing of international boundary for the year ending Sept. 30, 1918.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October.....	152	50	76.7	4,720
November.....	198	44	117	6,960
December ^a			^a 53.0	3,260
April.....	601	244	358	21,300
May.....	363	165	257	15,800
June.....	371	143	275	16,400
July.....	405	347	374	23,000
August.....	765	189	300	18,400
September.....	187	44	98.4	5,860

^a Estimated from comparisons of records for Milk River at Milk River, Alta. and at Havre, Mont.

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, 1918.

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

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

CHANNEL AND CONTROL.—Bed of stream composed of fine gravel and sand; shifts frequently. Banks are overflowed at high stages.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 16.42 feet March 20 (discharge, 9,150 second-feet); minimum stage recorded 5.50 feet September 30 (discharge, 22 second-feet).

1898–1918: Maximum stage recorded, 17.2 feet March 12, 1916 (discharge not determined); minimum stage recorded, 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.—Stage-discharge relation seriously affected by ice.

DIVERSIONS.—None.

REGULATION.—During 1918 the St. Mary canal was in operation and a total of 56,380 acre-feet was added to Milk River flow.

ACCURACY.—Stage-discharge relation not permanent; also affected by ice December 14 to March 16 except January 2–8. Gage read to hundredths twice daily during open-water season and three times a week during winter; winter record poor. Daily discharge October 1 to December 10 determined by applying mean daily gage height to rating table; December 14 to March 16 determined from gage heights corrected for ice effect by means of discharge measurements, observer's notes, weather records, and study of records of flow of Milk River at Milk River; shifting-control method used March 17 to September 30. Records poor for winter; fair for remainder of year.

Discharge measurements of Milk River at Havre, Mont., during the year ending Sept. 30, 1918.

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. 13	Lamb and Jones	6.60	151	May 27	A. H. Tuttle	6.09	230
Dec. 19	W. A. Lamb	6.41	56	June 4	Tuttle and Edwards	5.83	135
Jan. 5	A. H. Tuttle	^a 10.07	2,350	12	R. F. Edwards	6.10	195
6	do	^a 9.67	2,260	14	do	6.28	223
23	W. A. Lamb	^b 6.16	78	19	W. A. Lamb	6.50	296
26	do	^b 6.24	69	23	R. F. Edwards	6.63	309
Feb. 12	do	^b 7.78	320	25	do	6.70	332
Mar. 9	A. H. Tuttle	^b 8.18	328	July 10	do	6.75	326
21	W. A. Lamb	15.22	7,790	20	W. A. Lamb	6.70	280
31	do	8.37	1,290	30	A. H. Tuttle	6.95	370
Apr. 6	A. H. Tuttle	6.81	473	Aug. 9	do	6.46	196
May 3	Edwards and Tuttle	6.16	253	15	W. A. Lamb	6.30	221
12	R. F. Edwards	6.37	266	Sept. 17	R. F. Edwards	6.05	106
19	do	6.23	252				

^a Ice running but practically no effect on stage-discharge relation.

^b Stage-discharge relation affected by ice.

Daily discharge, in second-feet, of Milk River at Havre, Mont., for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1.	80		96	1,120	61	100	1,150	306	138	344	344	195
2.	78		34	2,200	57	101	1,030	306	138	325	288	181
3.	74		34	5,150	60	140	742	288	133	325	325	181
4.	86		34	4,010	60	180	714	325	138	335	306	138
5.	67		35	2,360	940	220	686	364	133	344	288	136
6.	66		36	2,200	1,820	260	526	306	133	325	271	136
7.	58		36	1,970	1,150	300	578	306	124	344	239	129
8.	54		37	1,410	1,470	340	686	344	124	325	224	129
9.	54		38	501	740	385	742	255	122	325	209	129
10.	54		39	500	580	340	742	306	122	325	224	160
11.	52		42	430	550	295	856	271	143	325	224	143
12.	52		44	360	320	250	856	255	195	325	255	153
13.	50	156	46	290	220	205	856	271	195	325	255	165
14.	48	142	48	220	120	165	786	255	224	325	224	122
15.	47	144	50	165	100	122	714	239	209	306	224	117
16.	48	138	51	140	90	455	632	224	209	344	224	112
17.		133	53	115	80	4,320	632	224	239	325	239	107
18.		144	55	90	70	4,940	526	255	271	325	239	67
19.		154	56	71	60	8,070	526	255	288	306	239	59
20.		140	186	73	50	9,150	476	271	306	288	239	51
21.		127	142	75	50	7,720	476	239	325	288	239	44
22.		117	99	77	56	5,460	452	239	325	306	407	37
23.		107	86	79	62	4,210	344	239	325	288	407	35
24.		97	74	79	68	3,310	344	271	344	239	325	35
25.		88	62	80	74	2,940	306	239	344	325	239	32
26.		88	50	80	80	2,680	306	224	344	325	233	31
27.		96	40	77	87	2,360	306	239	344	306	226	31
28.		104	40	72	93	1,920	385	224	344	364	220	31
29.		98	40	68		1,470	288	209	364	364	214	31
30.		93	40	65		1,610	325	188	344	364	208	22
31.			40	63		1,280		165		364	201	

NOTE.—Gage not read, discharge estimated from records of flow of Milk River at Milk River as 87 second feet, Oct. 17-31, and 190 second-feet Nov. 1-12. Discharge interpolated or estimated (gage not read) Oct. 13, Nov. 16, 18, 20, 22-24, 29, Dec. 4-9, 11-14, 16-18, 21, 23-26, 28-31; Jan. 11-14, 16-18, 20-22, 24, 25, 27-29, 31; Feb. 1, 2-5, 13-20, 22-28; Mar. 1, 3-8, 10-14, 28; Apr. 14; July 4, 9, 11, 12; Aug. 8, 26-31; Sept. 15, 16, 21.

Monthly discharge of Milk River at Havre, Mont., for the year ending Sept. 30, 1918.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October.....	87	47	73.3	4,510
November.....	190	88	148	8,810
December.....	186	34	56.9	3,500
January.....	5,150	63	780	48,000
February.....	1,820	50	327	18,200
March.....	9,150	100	2,110	130,000
April.....	1,150	288	600	35,700
May.....	364	165	261	16,000
June.....	364	122	233	13,900
July.....	364	239	324	19,900
August.....	407	201	258	15,900
September.....	195	22	98.0	5,830
The year.....	9,150	22	442	320,000

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, 1918.

GAGE.—Chain fastened to guard rail on downstream side of bridge; read by employees of United States Reclamation Service. The gage has been moved several times to different points on bridge, but datum was not changed.

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 half a mile below the gage.

EXTREMES OF DISCHARGE.—Maximum stage reported 20.17 feet at 8 a. m. March 27 (discharge, 11,500 second-feet); minimum stage 1.04 feet at 4 p. m., July 4 (discharge, 4 second-feet).

1902-1918: Maximum stage recorded, 20.17 feet March 27, 1918 (discharge 11,500 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.—Ice present December 1 to March 25.

DIVERSIONS.—Entire run-off from drainage basin above does not pass the station for seven irrigation canals, 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.

REGULATION.—None.

ACCURACY.—Stage-discharge relation for low stages changed during winter; affected by ice. Rating curves well defined. Gage read to hundredths once daily October 1 to March 31, and twice daily for remainder of year. Daily discharge ascertained by applying gage height to rating table except January 1 to March 25, for which it was determined from discharge measurements, temperature records, observer's notes relative to ice, and by comparison with records of flow for Milk River at Havre and near Vandalia. Records excellent, except those for winter, which are fair.

Discharge measurements of Milk River at Malta, Mont., during the year ending Sept. 30, 1918.

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. 5	A. H. Tuttle.....	213.60	3,940	May 9	Edwards and Tuttle...	2.66	453
6	do.....	214.10	4,310	17	R. F. Edwards.....	1.82	120
Feb. 14	W. A. Lamb.....	211.80	2,600	20	do.....	1.20	19.2
Mar. 22	A. H. Tuttle.....	217.91	5,530				

a Stage-discharge relation affected by ice.

Daily discharge, in second-feet, of Milk River at Malta, Mont., for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1.....	164	152	300	50	200	9,020	1,480	83	33	49	43
2.....	131	141	300	50	500	8,980	1,510	83	28	49	38
3.....	112	141	850	50	800	9,070	1,240	43	17	46	33
4.....	164	141	1,400	50	1,100	9,280	1,000	98	4	43	30
5.....	237	164	3,900	50	1,500	9,690	673	79	7	43	28
6.....	237	177	4,350	50	1,800	9,720	199	94	9	43	28
7.....	237	205	4,500	100	1,700	4,900	103	94	21	43	28
8.....	254	205	4,000	200	1,400	4,720	304	90	17	43	28
9.....	220	205	3,500	800	1,100	4,330	448	103	23	46	28
10.....	205	220	2,200	1,800	1,000	4,110	589	90	26	43	15
11.....	190	237	1,600	2,900	1,000	3,570	535	83	23	46	13
12.....	177	237	1,000	3,800	1,000	4,110	495	98	23	46	26
13.....	177	237	800	3,700	1,000	4,240	505	98	30	46	30
14.....	177	254	600	2,400	1,000	3,930	525	83	26	46	30
15.....	164	254	400	2,000	900	3,870	457	65	30	79	23
16.....	152	254	350	1,400	900	3,990	264	49	35	332	19
17.....	141	254	300	800	1,300	3,900	116	46	23	107	19
18.....	141	205	350	500	2,000	3,660	154	35	19	79	21
19.....	152	205	300	400	3,700	3,510	467	46	13	72	19
20.....	141	205	250	300	4,500	2,970	414	35	30	79	19
21.....	152	220	200	200	5,100	2,500	179	33	36	72	19
22.....	190	237	150	100	5,500	1,770	132	33	43	68	19
23.....	725	272	150	100	6,000	1,520	316	33	43	68	19
24.....	545	254	120	100	6,300	1,360	292	35	33	65	19
25.....	237	237	110	100	10,300	1,260	154	33	33	58	19
26.....	177	205	100	150	11,400	1,150	137	33	35	43	19
27.....	177	190	100	150	11,500	1,100	132	28	35	30	43
28.....	152	177	100	150	11,200	692	132	19	40	35	38
29.....	152	177	80	.....	10,700	225	126	23	49	43	30
30.....	152	190	70	.....	9,840	129	126	26	55	46	30
31.....	141	.....	60	.....	9,220	.....	98	.....	49	46	.....

NOTE.—Data inadequate for determination of discharge for January.

Monthly discharge of Milk River at Malta, Mont., for the year ending Sept. 30, 1918.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October.....	725	112	206	12,700
November.....	272	141	208	12,400
January.....	4,500	60	1,630	63,300
February.....	3,800	50	802	44,500
March.....	11,500	200	4,050	249,000
April.....	9,720	129	4,110	245,000
May.....	1,510	98	429	26,400
June.....	103	19	59.7	3,550
July.....	55	4	28.6	1,760
August.....	332	30	63.0	3,870
September.....	43	13	25.8	1,540

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, 1918. Station maintained at Hinsdale, 8 miles upstream from May 13, 1908, to September 30, 1914. Discharge nearly same at both points.

GAGE.—Sloping gage painted on concrete of right abutment downstream side of dam. A temporary gage 50 feet downstream and at same datum as regular gage was read November 15, 1917, to January 5, 1918, because of ice. February 15 to March 19, 1918, the gage above the dam was read. Gages read by employees of United States Reclamation Service.

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

CHANNEL AND CONTROL.—Water surface in large pool below dam is controlled by gravel bar at medium and low stages. Banks high; left is overflowed at high stages.

EXTREMES OF DISCHARGE.—Maximum stage reported during year, 34.3 feet March 28 (discharge, 24,900 second-feet); minimum stage, 3.3 feet July 30; gates closed, movable crest down; no flow.

1908-1918: Maximum stage 34.5 feet April 11, 1917 (discharge, 25,200 second-feet); channel reported dry August 9-13, 1910.

ICE.—Ice on control November 20-30 may have had some effect on stage-discharge relation, but data as computed are consistent with Malta station and are applied to open channel rating table. During December the ice effect was apparently serious and as no discharge measurements were made, no attempt has been made to compute flow for month. Flow for January and February is based upon hydrographic comparison with Milk River at Malta, where three measurements were made to determine flow. Curve of relation between gages above and below dam used for high-water portion. Temperature records at Malta and observer's notes used as part of the study. March 1-27 computed as indicated above. March 28, open channel.

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

REGULATION.—Flow partly regulated by the diversion dam at station and by storage in Nelson reservoir.

ACCURACY.—Stage-discharge relation not permanent during year; seriously affected by ice. Four rating curves used, applicable as follows: October 1-3, poorly defined; October 4 to November 30, poorly defined; March 28 to May 6, fairly well defined between 800 and 2,000 second-feet; May 15 to September 10, fairly well defined between 50 and 800 second-feet. Gage read to hundredths once daily. Accurate readings are difficult to obtain when gates are open and when flow over dam is large. Daily discharge ascertained by applying daily gage height rating table. Discharge January 1 to March 27 obtained from comparison with records of flow for Milk River at Malta, study of weather records, and observer's notes; high-water discharge determined from relation between readings of gages above and below dam. Shifting-control method used May 7-14 and September 11-30. Open-channel records fair; others poor.

Discharge measurements of Milk River near Vandalia, Mont., during the year ending Sept. 30, 1918.

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. 15	Jones and Lamb.....	4.50	196	June 7	R. F. Edwards.....	4.45	106
Apr. 27	Edwards and Tuttle...	11.85	1,690	July 2	do.....	4.10	62
May 6	do.....	10.10	906	Sept. 20	do.....	4.20	58
15	R. F. Edwards.....	8.10	740				

NOTE.—Measurements Apr. 27 and May 6 were made from bridge over crest of dam; May 15, from highway bridge 4 miles by river below gage; other measurements by wading near the gage.

Daily discharge, in second-feet, of Milk River near Vandalia, Mont., for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1.....	108	196	50	100	550	19,500	723	178	62	5	164
2.....	108	196	50	80	550	16,000	510	178	62	10	74
3.....	70	196	60	70	550	14,900	778	178	62	15	74
4.....	496	196	80	60	550	14,600	1,310	151	62	22	125
5.....	287	196	90	20	550	14,000	1,310	118	46	22	118
6.....	75	196	90	10	635	14,600	1,040	99	30	22	112
7.....	30	196	2,000	10	1,330	15,100	980	99	15	22	74
8.....	30	196	5,600	10	1,770	13,100	900	99	15	30	99
9.....	30	216	6,400	10	1,770	7,920	820	99	15	68	74
10.....	30	216	6,000	10	1,770	6,300	740	86	10	51	106
11.....	30	216	5,500	10	1,770	6,480	670	86	10	51	112
12.....	300	262	4,300	20	1,770	5,590	600	86	10	30	99
13.....	339	274	4,000	1,200	1,330	5,000	660	86	10	30	99
14.....	59	262	2,200	5,000	1,120	5,590	660	86	10	22	96
15.....	75	216	1,900	4,270	1,220	5,850	770	74	10	22	94
16.....	75	196	1,300	4,270	1,660	6,300	678	74	10	30	91
17.....	75	196	900	1,660	1,890	7,020	678	74	10	30	70
18.....	91	196	750	1,020	2,130	7,200	326	74	10	1,360	62
19.....	100	216	600	820	2,640	7,020	30	74	10	926	60
20.....	108	250	600	635	4,720	6,480	30	74	10	237	58
21.....	125	287	550	465	7,730	6,120	56	74	10	515	58
22.....	142	238	400	325	9,700	4,740	470	74	10	1,180	58
23.....	160	196	350	270	11,800	3,400	497	74	10	7,920	58
24.....	216	196	300	270	13,000	2,490	344	74	15	7,200	58
25.....	378	196	250	380	13,200	2,050	252	74	15	2,230	58
26.....	391	196	250	550	14,400	1,780	284	74	15	575	58
27.....	365	187	250	550	19,700	1,690	318	74	178	1,010	58
28.....	352	196	200	550	24,900	1,540	301	74	151	1,010	58
29.....	250	238	200	.....	24,100	1,360	214	62	22	1,360	58
30.....	178	206	160	.....	23,100	797	178	62	10	425	58
31.....	178	.....	150	.....	22,000	.....	178	.....	0	416	.....

NOTE.—Data inadequate for determination of discharge for December.

Monthly discharge of Milk River near Vandalia, Mont., for the year ending Sept. 30, 1918.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October.....	496	30	170	10,500
November.....	287	187	214	12,700
January.....	6,400	50	1,470	90,400
February.....	5,000	10	809	44,900
March.....	24,900	550	6,900	424,000
April.....	19,500	797	7,480	445,000
May.....	1,310	30	558	34,300
June.....	178	62	93.0	5,530
July.....	178	0	29.5	1,810
August.....	7,920	5	866	53,200
September.....	164	58	81.4	4,840

NORTH FORK OF MILK RIVER NEAR BROWNING, MONT.

LOCATION.—In sec. 20, T. 37 N., R. 11 W., at Martin's ranch, 2 miles above outlet of St. Mary canal and 28 miles north of Browning, on Blackfeet Indian Reservation.

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—Fragmentary records during summer of 1918.

GAGE.—Wooden staff on right bank opposite Martin's house, and 500 feet above road crossing.

DISCHARGE MEASUREMENTS.—Made by wading near the gage.

CHANNEL AND CONTROL.—Bed of stream composed of small gravel; fairly permanent.

REGULATION.—None.

ACCURACY.—Stage-discharge relation permanent during 1918. Gage read to nearest tenth. Record of discharge good.

COOPERATION.—Station maintained in cooperation with United States Reclamation Service.

Discharge measurements of North Fork of Milk River near Browning, Mont., during the year ending Sept. 30, 1918.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
June 18	B. E. Jones.....	<i>Feet.</i>	<i>Sec. ft.</i>	July 9	W. A. Lamb.....	<i>Feet.</i>	<i>Sec. ft.</i>
26	do.....	1.51	16.5 16.3	Sept. 7	do.....	1.50 1.48	15.6 15.6

Daily discharge, in second-feet, of North Fork of Milk River near Browning, Mont., for the year ending Sept. 30, 1918.

Day.	June.	July.	Day.	June.	July.	Day.	June.	July.
1.....		16	11.....		16	21.....		
2.....		16	12.....		16	22.....		
3.....		16	13.....		16	23.....		
4.....		16	14.....		16	24.....		
5.....		16	15.....		16	25.....		
6.....		16	16.....		16	26.....	16	
7.....		16	17.....		16	27.....	16	
8.....		16	18.....	16.5	16	28.....	16.5	
9.....		16	19.....		16	29.....	16.5	
10.....		16	20.....			30.....	16	
						31.....		

NORTH FORK OF MILK RIVER NEAR INTERNATIONAL BOUNDARY.²

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

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

RECORDS AVAILABLE.—January 1, 1913, to September 30, 1918. July 21, 1909, to December 31, 1912, station was maintained by Irrigation Office of Department of Interior, of Canada, in NE. $\frac{1}{4}$ sec. 13, T. 1, R. 23 W. fourth meridian, about 2 miles downstream; May 6, 1911 to December 31, 1912, station was maintained at Alexander Dubray's ranch, 2 miles south of international boundary.

² Formerly called "North Fork of Milk River near Kimball, Alberta."

GAGE.—A Stevens water-stage recorder on left bank; Chas. Barnett, observer.

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

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

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 3.55 feet July 16–18 (discharge, 427 second-feet); minimum stage, 1.36 feet September 18–22 (discharge, 18 second-feet).

1909–1918: Maximum stage recorded, 3.9 feet (referred to station maintained by Canada; see paragraph on "Records available") July 27, 28, 1909 (discharge, 591 second-feet); minimum discharge, 5.5 second-feet February 11, 1916.

ICE.—Stage-discharge relation seriously affected by ice December 2 to April 2.

DIVERSIONS.—None.

REGULATION.—Amount of water turned into river by St. Mary canal: June, 15,400 acre-feet; July, 24,000 acre-feet; August, 14,800 acre-feet; September, 2,180 acre-feet; making an approximate total of 56,400 acre-feet.

ACCURACY.—Stage-discharge relation seriously affected by ice December 2 to April 2, and by shifting control October 1 to November 1, April 3–10, May 1 to June 5, June 21 to August 10, August 25 to September 10. Daily gage heights ascertained by straight-line method from Stevens water-stage recorder records October 1 to December 1, and after April 2; observer's readings on chain gage December 2 to April 2. Daily discharge obtained by applying mean gage heights to rating table November 11 to December 1, April 11–30, June 6–20, August 11–24, and September 11–30. Indirect method used for periods affected by shifting control noted above. December 2 to April 2 obtained from discharge measurements, temperature records, observer's notes, and comparisons with South Fork of Milk River at boundary, and Milk River at Milk River, Alberta. Records are good for open channel and fair for other periods.

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

Discharge measurements of North Fork of Milk River near international boundary, during the year ending Sept. 30, 1918.

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	A. W. P. Lowrie ^a	1.66	34	May 13	B. Russell ^a	1.85	41
Nov. 7	do.....	1.71	38	24	R. F. Edwards.....	1.66	31
10	B. E. Jones.....	1.70	36	29	C. H. Ellacott ^a	1.63	25
20	S. H. Frame.....	1.71	37	June 16	V. A. Newhall ^a	3.36	322
Dec. 5	D. G. Chadsey ^a	b1.97	35	17	B. E. Jones and W. A. Lamb.....	3.40	341
Jan. 2	S. H. Frame.....	b3.41	87	July 5	C. H. Ellacott.....	3.50	398
Feb. 1	do.....	b3.09	22	11	W. A. Lamb.....	3.52	419
21	A. W. P. Lowrie.....	b3.25	19.4	24	C. H. Ellacott.....	3.51	413
Mar. 13	do.....	b2.58	24	Aug. 13	do.....	3.09	259
31	C. M. O'Neil ^a	b2.07	55	Sept. 5	do.....	2.41	142
Apr. 2	do.....	1.69	31	26	W. A. Lamb.....	2.38	130
23	do.....	1.70	35		C. H. Ellacott.....	1.42	19.3
24	do.....	1.72	38				

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

^b Stage-discharge relation affected by ice.

Daily discharge, in second-feet, of North Fork of Milk River near international boundary for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1.....	46	58	33	110	22	23	36	54	30	389	273	162
2.....	45	53	34	90	22	23	31	48	29	389	254	164
3.....	43	47	34	84	21	23	34	44	81	386	244	157
4.....	40	44	35	76	22	23	45	46	145	400	247	150
5.....	39	42	35	66	22	23	55	44	164	405	239	148
6.....	38	40	35	60	22	22	54	40	197	400	237	138
7.....	36	40	34	60	22	21	52	40	214	408	242	130
8.....	35	39	32	54	23	22	69	45	216	416	237	116
9.....	36	39	30	50	23	23	107	46	219	416	242	98
10.....	38	37	28	45	25	23	78	46	237	416	242	46
11.....	38	37	25	41	25	23	71	47	247	419	244	26
12.....	37	36	20	40	24	24	66	45	273	416	261	24
13.....	36	35	18	39	22	24	61	41	295	422	261	23
14.....	35	34	19	39	20	24	60	40	310	424	263	21.7
15.....	34	34	19	38	20	25	48	39	318	424	275	2..0
16.....	34	33	18	38	20	27	46	41	328	427	283	21.0
17.....	40	34	19	38	20	30	44	46	336	427	295	20.0
18.....	42	37	20	38	20	39	44	42	336	422	323	18.0
19.....	42	34	22	38	20	48	45	39	336	419	331	18.0
20.....	44	34	25	38	20	56	46	36	333	419	333	18.0
21.....	44	34	27	38	19	65	52	36	328	413	333	18.0
22.....	41	37	29	37	19	68	50	41	336	411	305	18.0
23.....	41	37	29	36	19	74	42	33	336	408	278	18.1
24.....	45	35	30	35	20	80	37	32	339	413	249	19.6
25.....	42	34	32	34	20	90	53	29	346	413	214	20.6
26.....	42	34	33	32	21	80	46	28	359	411	199	20.3
27.....	36	33	32	29	22	65	54	27	357	411	185	19.3
28.....	42	33	35	27	23	72	61	26	367	389	175	19.3
29.....	50	34	40	25	.....	75	65	25	376	381	146	18.6
30.....	41	34	80	23	.....	62	57	25	384	359	140	18.9
31.....	45	.....	100	22	.....	55	.....	27	.....	315	146	.....

Monthly discharge of North Fork of Milk River near international boundary, for the year ending Sept. 30, 1918.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October.....	50	34	40.2	2,470
November.....	58	33	37.7	2,240
December.....	100	18	32	1,970
January.....	110	22	45.8	2,820
February.....	25	19	21.4	1,190
March.....	90	21	43.0	2,640
April.....	107	31	53.6	3,190
May.....	54	25	38.6	2,370
June.....	384	29	272	16,200
July.....	427	315	405	24,900
August.....	333	140	248	15,200
September.....	164	18	57.0	3,390
The year.....	427	18	109	678,600

NOTE.—St. Mary canal contributed 15,400 acre-feet during June; 24,000 acre-feet during July; 14,800 acre-feet in August; and 2,180 acre-feet in September.

BIG SANDY CREEK NEAR LAREDO, MONT.

LOCATION.—At Frank Goldchesky's ranch, 3 miles northwest of Laredo, in Hill County.

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—March 18 to September 30, 1918.

GAGE.—Overhanging wire gage on right bank, northwest of ranch buildings; read by Frank Goldchesky.

DISCHARGE MEASUREMENTS.—Made from highway bridge 1 mile above gage or by wading near control.

CHANNEL AND CONTROL.—Control is 300 feet below gage and is formed by sandstone ledge and boulders. Same for both high and low stages. Stage-discharge relation may be affected by vegetable growth in channel at low-water stages; otherwise control is permanent.

EXTREMES OF DISCHARGE.—Maximum stage recorded for the year is 13.8 feet at 5 p. m. March 20 (discharge, 4,550 second-feet); stream in pool stage after June 21, except August 28–31.

ICE.—No records obtained.

DIVERSIONS.—None.

REGULATION.—None.

ACCURACY.—Stage-discharge relation affected by vegetable growth in channel during June. Rating curve used March 18 to June 10 well defined. Gage read to tenths twice daily. Daily discharge obtained by applying mean daily gage height to rating table; shifting-control method used June 11–21. Pool stage, June 21 to September 30, except August 28–31. Records good.

Discharge measurements of Big Sandy Creek near Laredo, Mont., during the year ending Sept. 30, 1918.

[Made by W. A. Lamb.]

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
Mar. 18.....	<i>Feet.</i> a11.3	<i>Sec.-ft.</i> 3,050	May 4.....	<i>Feet.</i> 2.93	<i>Sec.-ft.</i> 9.6
31.....	4.28	176	June 20.....	b2.98	2.1

a Velocity determined by use of floats, applying a coefficient of 0.85 to obtain mean velocity.

b Stage-discharge relation affected by growth of weeds in channel.

Daily discharge, in second-feet, of Big Sandy Creek near Laredo, Mont., for the year ending Sept. 30, 1918.

Day.	Mar.	Apr.	May.	June.	Aug.	Day.	Mar.	Apr.	May.	June.	Aug.
1.....		167	13	14		16.....		54	8	7	
2.....		133	10	14		17.....		49	8	6	
3.....		107	4	14		18.....	3,290	49	8	4	
4.....		85	12	14		19.....	3,950	40	8	3	
5.....		85	14	14		20.....	4,430	40	8	3	
6.....		72	14	14		21.....	3,590	40	8	2	
7.....		72	11	14		22.....	2,340	31	8		
8.....		72	8	14		23.....	1,490	27	8		
9.....		72	8	14		24.....	1,320	23	11		
10.....		72	8	14		25.....	1,160	23	21		
11.....		72	8	13		26.....	1,000	23	14		
12.....		72	8	12		27.....	840	23	14		
13.....		72	8	10		28.....	680	27	14		2
14.....		72	8	9		29.....	520	31	14		2
15.....		60	8	8		30.....	360	16	14		2
						31.....	196		14		2

NOTE.—Stream in pool stage June 22 to Aug. 27 and Sept. 1–30.

Monthly discharge of Big Sandy Creek near Laredo, Mont., for the year ending Sept. 30, 1918.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
March 18-31.....	4,430	196	1,800	50,000
April.....	167	16	59.4	3,530
May.....	21	4	10.4	640
June.....	14	2	7.23	430
July.....	0	0	0	0
August.....	2	2	.26	15.5
September.....	0	0	0	0
The period.....				54,000

BEAVER CREEK NEAR HAVRE, MONT.

LOCATION.—About 5 miles southwest of Havre and 2 miles south of old buildings at Fort Assiniboine in military reservation.

DRAINAGE AREA.—Not computed.

RECORDS AVAILABLE.—May 4 to September 30, 1918.

GAGE.—Vertical staff with enameled face braced to cottonwood tree on left bank about 100 feet upstream from the broken-down footbridge; read by W. E. Wiltner.

DISCHARGE MEASUREMENTS.—Made by wading at gage.

CHANNEL AND CONTROL.—Creek has a good gravel bottom and for low water the control is a cattle ford 50 feet downstream from gage. High-water control probably same as that for low water.

EXTREMES OF DISCHARGE.—Maximum stage recorded 0.94 foot May 9 (discharge, 25 second-feet); minimum stage recorded 0.39 foot September 23 and 24 (discharge, 0.8 second-foot).

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

DIVERSIONS.—Some small diversions above station.

REGULATION.—None.

ACCURACY.—Stage-discharge relation permanent during open-channel period. Rating curve based on three discharge measurements made during 1918 and one measurement made during 1919 is used throughout year. Gage read to hundredths twice daily. Daily discharge obtained by applying mean daily gage height to rating table. Records good.

Discharge measurements of Beaver Creek near Havre, Mont., during the year ending Sept. 30, 1918.

Date.	Made by—	Gage height.	Discharge.
		<i>Feet.</i>	<i>Sec.-ft.</i>
May 4	W. A. Lamb.....	0.91	22.3
June 20	do.....	.58	5.9
Sept. 17	R. F. Edwards.....	.41	1.0

Daily discharge, in second-feet, of Beaver Creek near Havre, Mont., for the year ending Sept. 30, 1918.

Day.	May.	June.	Sept.	Day.	May.	June.	Sept.	Day.	May.	June.	Sept.
1.....		18		11.....	22	8.2		21.....	18		
2.....		16		12.....	22	7.0		22.....	18		0.8
3.....		16		13.....	20	6.2		23.....	17		.8
4.....	22	15		14.....	20	5.8		24.....	16		.8
5.....	22	14		15.....	20	4.9		25.....	22		2.9
6.....	22	13		16.....	19	5.2		26.....	22		3.2
7.....	23	12		17.....	19	5.8		27.....	22		2.5
8.....	23	10		18.....	19	7.0		28.....	18		2.5
9.....	25	9.4		19.....	19	14.0		29.....	18		1.4
10.....	22	8.6		20.....	19	9.8		30.....	17		1.6
								31.....	20		

Monthly discharge of Beaver Creek near Havre, Mont., for the year ending Sept. 30, 1918.

Month.	Discharge in second-feet.			Run-off in acre- feet.
	Maximum.	Minimum.	Mean.	
May 4-31.....	25	16	20.2	1,120
June 1-20.....	18	4.9	10.3	409
September 22-30.....	3.2	0.8	1.83	32.7

LITTLE BOXELDER CREEK NEAR HAVRE, MONT.

LOCATION.—In sec. 20, T. 30 N., R. 17 E., at ranch buildings on PX ranch, 22 miles southeast of Havre, in Hill County.

RECORDS AVAILABLE.—May 4 to September 30, 1918.

DRAINAGE AREA.—Not measured.

GAGE.—Vertical staff with enamel face on right bank; read by E. A. Kinsella.

CHANNEL AND CONTROL.—Bed of stream composed of cobblestones, gravel, and sand.

Control is bar of same material about 20 feet below gage; fairly permanent. Banks fairly high. Left bank covered with bushes; may cause backwater at high stages.

DISCHARGE MEASUREMENTS.—Made by wading near gage. High water may be measured from highway bridge a quarter of a mile below gage.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 1.34 feet May 9 at 8 a. m. (discharge, 8.5 second-feet); minimum stage, 0.80 foot September 19-30 (discharge, 0.1 second-foot).

ICE.—Station not operated during frozen season in 1918.

DIVERSIONS.—Small ditch diverts water for irrigation of hay meadows about half a mile above gage; capacity of ditch between 3 and 4 second-feet.

REGULATION.—None.

ACCURACY.—Stage-discharge relation permanent during 1918. Rating curve well defined between 0 and 10 second-feet. Gage read to hundredths twice daily.

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

Discharge measurements of Little Boxelder Creek near Havre, Mont., during the year ending Sept. 30, 1918.

Date.	Made by—	Gage height.	Dis- charge.
		<i>Feet.</i>	<i>Sec.-ft.</i>
May 4	A. H. Tuttle.....	1.29	6.7
June 20	W. A. Lamb.....	1.11	3.8
Sept. 18	R. F. Edwards.....	.89	.53

Daily discharge, in second-feet, of Little Boxelder Creek near Havre, Mont., for the year ending Sept. 30, 1918.

Day.	May.	June.	July.	Aug.	Sept.	Day.	May.	June.	July.	Aug.	Sept.
1.....		6.2	2.1	0.4	0.4	16.....	6.2	2.0	0.4	0.8	0.4
2.....		6.8	2.1	.4	.4	17.....	6.2	1.7	.4	.8	.2
3.....		6.8	.8	.4	.4	18.....	6.2	1.8	.4	.8	.4
4.....		6.8	.8	.4	.4	19.....	6.0	1.8	.4	.4	.1
5.....	6.5	6.0	.4	.4	.4	20.....	6.2	3.6	.4	.4	.1
6.....	6.6	6.5	.4	.8	.4	21.....	6.0	3.3	.4	1.1	.1
7.....	6.8	5.2	.4	.4	.4	22.....	5.8	3.3	.4	.8	.1
8.....	7.0	4.4	.4	.4	.4	23.....	5.8	2.8	.4	.4	.1
9.....	7.5	4.4	.4	.4	.4	24.....	5.8	2.8	1.8	.4	.1
10.....	7.1	3.6	.4	.4	.4	25.....	5.8	2.8	1.8	.4	.1
11.....	7.1	3.2	.4	.4	.4	26.....	5.8	2.1	.8	.4	.1
12.....	6.8	3.0	.4	.8	.4	27.....	5.8	2.1	.4	.4	.1
13.....	6.0	2.7	.4	.4	.4	28.....	5.8	3.3	.4	.4	.1
14.....	6.2	2.4	3.6	.8	.4	29.....	5.8	3.6	.4	.4	.1
15.....	6.2	2.1	.8	.4	.4	30.....	5.8	3.3	.4	.4	.1
						31.....	6.2		.4	.4	

Monthly discharge of Little Boxelder Creek near Havre, Mont., for the year ending Sept. 30, 1918.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
May 5-31.....	7.5	5.8	6.26	335
June.....	6.8	1.7	3.68	219
July.....	3.6	.4	.76	46.7
August.....	1.1	.4	.51	31.4
September.....	.4	.1	.28	16.7
The period.....				559

CLEAR CREEK NEAR BEARPAW, MONT.

LOCATION.—In sec. 35, T. 30 N., R. 17 E., 200 feet below mouth of Wind Creek, 25 miles southeast of Havre, and 8 miles north of Bearpaw, in Blaine County.

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—May 4 to September 30, 1918.

GAGE.—Overhanging chain gage on right bank opposite observer's house; read by Mrs. H. H. White.

DISCHARGE MEASUREMENTS.—Made by wading, or from highway bridge 400 feet above.

CHANNEL AND CONTROL.—Control composed of cobblestones firmly embedded in gravel, and about 30 feet below gage. Channel free from vegetation. Banks low; subject to overflow at stage of 2.5 feet, gage datum.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 1.46 feet May 9 (discharge, 21 second-feet); minimum stage recorded, 0.63 foot on June 23 (discharge, 0.3 second-foot).

ICE.—None during season of 1918.

DIVERSIONS.—No data.

REGULATION.—None.

ACCURACY.—Stage-discharge relation permanent during year. Rating curve well defined below 25 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 Clear Creek near Bearpaw, Mont., during the year ending Sept. 30, 1918.

Date.	Made by—	Gage height.	Dis-charge.
May 4	A. H. Tuttle.....	<i>Feet.</i> 1.43	<i>Sec.-ft.</i> 19.8
June 20	W. A. Lamb.....	.81	2.6
Sept. 18	R. F. Edwards.....	.74	1.4

Daily discharge, in second-feet, of Clear Creek near Bearpaw, Mont., for the year ending Sept. 30, 1918.

Day.	May.	June.	July.	Aug.	Sept.	Day.	May.	June.	July.	Aug.	Sept.
1.....		12	3.0	1.5	1.8	16.....	16	3.9	1.8	6.4	0.9
2.....		12	2.3	1.2	2.0	17.....	16	4.5	2.4	8.5	.4
3.....		5.0	2.4	1.5	2.1	18.....	16	10.0	2.1	8.0	1.5
4.....	20	5.0	.9	1.2	2.0	19.....	15	4.5	3.0	3.7	1.5
5.....	19	5.0	1.4	1.5	1.8	20.....	15	2.8	1.6	13	1.2
6.....	19	5.0	2.1	1.5	1.6	21.....	14	3.9	1.8	13	1.5
7.....	19	4.5	3.2	2.1	1.4	22.....	16	1.6	1.2	5.5	1.5
8.....	20	4.5	2.2	2.0	1.8	23.....	16	.3	1.5	3.2	1.5
9.....	21	4.1	2.1	2.4	1.8	24.....	16	1.0	3.2	2.1	1.8
10.....	19	3.7	2.0	2.4	2.1	25.....	16	1.2	5.0	1.8	2.8
11.....	18	3.7	1.2	2.4	2.1	26.....	16	1.2	3.2	1.5	2.8
12.....	17	3.2	1.8	5.5	2.1	27.....	15	1.5	3.2	.9	2.8
13.....	17	3.7	2.1	5.0	2.0	28.....	14	2.2	3.2	.9	2.8
14.....	16	2.8	1.8	6.7	1.8	29.....	13	2.4	3.2	1.0	2.8
15.....	15	2.8	2.0	4.1	.9	30.....	13	2.6	2.1	1.0	2.8
						31.....	13		2.1	.9	.....

Monthly discharge of Clear Creek near Bearpaw, Mont., for the year ending September 30, 1918.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
May 4-31.....	21	13	16.4	911
June.....	12	.3	4.02	239
July.....	5.0	.9	2.28	140
August.....	13	.9	3.63	223
September.....	2.8	.4	1.86	111
The period.....				1,620

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 head gates of canal on Milk River, 8 miles west of Chinook, in Blaine County.

RECORDS AVAILABLE.—June 21, 1903, to September 30, 1918.

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

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

ACCURACY.—Stage-discharge relation not permanent. Several rating curves used throughout the year, applicable for short periods. Gage read to hundredths once daily. Daily discharge ascertained by applying daily gage height to rating table or by shifting-control method. Records fair.

The water in the Fort Belknap canal is diverted from the north bank of Milk River in SE. $\frac{1}{4}$ sec. 20, T. 33 N., R. 18 E., to irrigate lands on 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, 1918.

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 2	Tuttle and Edwards.....	0.30	9.6	June 12	R. F. Edwards.....	1.51	46
11	R. F. Edwards.....	.38	10.3	14	do.....	1.68	52
13	do.....	.38	10.8	22	do.....	1.82	58
19	do.....	.34	9.2	25	do.....	1.82	56
24	Tuttle and Parker.....	.54	16.1	July 9	do.....	2.03	75
June 1	Edwards and Tuttle.....	1.44	42	30	A. H. Tuttle.....	1.49	59
4	do.....	1.40	40	Aug. 7	do.....	1.26	52
8	B. E. Jones.....	1.56	46				

Daily discharge, in second-feet, of Fort Belknap canal near Chinook, Mont., for the year ending Sept. 30, 1918.

Day.	Oct.	Apr.	May.	June.	July.	Aug.	Sept.
1.....	0.4	.....	9.6	42	58	49	13.5
2.....	.4	.....	9.6	41	65	51	13.5
3.....	.4	.....	9.6	41	45	51	13.5
4.....	1.0	.....	9.6	40	73	52	13.5
5.....	1.7	.....	8.1	41	74	52	13.5
6.....	2.3	.....	8.1	40	71	53	13.0
7.....	2.3	.....	8.1	44	74	53	13.0
8.....	2.3	.....	8.1	47	76	49	13.0
9.....	1.9	.....	13.0	49	73	54	13.0
10.....	1.5	.....	11.4	52	76	49	13.0
11.....	1.5	.....	11.4	51	77	48	13.0
12.....	1.5	.....	11.4	47	78	45	13.0
13.....	1.5	.....	11.4	55	79	48	11.4
14.....	1.5	.....	10.0	32	80	46	11.4
15.....	1.5	.....	10.0	50	80	41	9.1
16.....	1.9	.....	10.5	54	81	43	9.1
17.....	1.9	.....	10.5	54	83	44	9.1
18.....	1.5	.....	10.5	56	83	40	9.1
19.....	1.5	.....	10.0	61	81	23	9.1
20.....	1.5	.....	10.0	57	57	17	.....
21.....	.....	.....	9.6	59	79	13.5	.....
22.....	.....	.....	9.6	60	80	14.6	.....
23.....	.....	.....	14	59	81	13.0	.....
24.....	.....	.....	16	61	82	14.0	.....
25.....	.....	.....	17	56	82	14.6	.....
26.....	.....	.....	27	56	83	14.6	.....
27.....	.....	.....	24	56	77	14.0	.....
28.....	.....	20	30	58	69	14.0	.....
29.....	.....	17	38	58	65	14.0	.....
30.....	.....	13.5	45	57	59	14.0	.....
31.....	.....	.....	40	.....	56	13.5	.....

Monthly discharge of Fort Belknap canal near Chinook, Mont., for the year ending Sept. 30, 1918.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October 1-20.....	2.3	0.4	1.50	59.5
May.....	45	8.1	15.2	935
June.....	61	32	51.1	3,040
July.....	83	45	73.4	4,510
August.....	54	13.0	34.8	2,110
September 1-19.....	13.5	9.1	11.9	448

LODGE CREEK AT INTERNATIONAL BOUNDARY.

LOCATION.—In SE. $\frac{1}{4}$ sec. 12, T. 1, R. 29 W. third meridian, at Willow Creek barracks of the Royal Northwest Mounted Police, 1 mile north of international boundary, in Saskatchewan, Canada, 36 miles north of Havre, Mont.

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

RECORDS AVAILABLE.—April 1, 1917, to September 30, 1918. April 25, 1910, to October 31, 1916, maintained by Irrigation Branch (now Reclamation Service), Department of Interior, Canada.

GAGE.—Inclined staff on right bank at Willow Creek post. Read by Wm. Tudgay and Hugh L. Dixon.

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

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

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 12.90 feet March 31 (discharge, 2,700 second-feet; stage-discharge relation affected by ice); creek dry October 1 to March 22 and July 1 to September 30.

1917-1918: Maximum stage recorded that of March 31, 1918; creek dry July 16, 1917, to March 22, 1918, and July 1 to September 30, 1918.

ICE.—Stage-discharge relation affected by ice and snow March 23 to April 1.

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

REGULATION.—None.

ACCURACY.—Stage-discharge relation changed April 2-17 and May 1-11; affected by ice March 23 to April 1. Rating curve well defined below 100 second-feet and fairly well above 100 second-feet. Gage read to hundredths twice daily. Daily discharge obtained by applying mean daily gage height to rating table April 18-30 and May 12 to June 30; March 23 to April 1 estimated because of ice; April 2-17 and May 1-11 by shifting-control method. Stream dry after June 30 and prior to March 23. Records good.

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

Discharge measurements of Lodge Creek at international boundary during the year ending Sept. 30, 1918.

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. 14	P. A. Fetterly ^a	5.87	0	May 7	A. W. P. Lowrie ^a	2.25	67
Apr. 6	G. S. Wenden ^a	7.88	815	12	R. F. Edwards.....	1.93	30
12	do.....	7.80	1,756	20	do.....	1.69	14.30
15	do.....	3.12	1,555	June 4	Tuttle and Edwards.....	1.50	6.20
21	A. H. Tuttle.....	2.98	158	11	A. W. P. Lowrie.....	1.32	1.87
21	G. S. Wenden.....	2.58	114	21	do.....	1.12	b.08
26	do.....	2.28	86	July 18	do.....	.92	0
May 1	do.....	2.30	53	Aug. 17	do.....	.96	0
2	Tuttle and Edwards.....		74				

^a Engineer, Reclamation Service, Department of Interior, Canada.

^b Discharge determined by using a 15-inch weir.

Daily discharge, in second-feet, of Lodge Creek at international boundary for the year ending Sept. 30, 1918.

Day.	Mar.	Apr.	May.	June.	Day.	Mar.	Apr.	May.	June.
1.....		2,000	580	730	16.....		888	200	83
2.....		898	610	660	17.....		457	162	61
3.....		810	640	620	18.....		284	150	61
4.....		512	650	590	19.....		185	140	46
5.....		678	680	590	20.....		155	145	23
6.....		891	720	520	21.....		136	140	18
7.....		643	710	460	22.....		126	145	700
8.....		800	690	400	23.....	3	148	130	2,600
9.....	1,260	540	360	24.....	10	140	120	1,400	
10.....	1,140	460	360	25.....	30	100	110	920	
11.....	1,560	370	188	26.....	100	92	110	83	
12.....	1,810	300	160	27.....	500	92	120	3	
13.....	1,470	280	160	28.....	800	80	105	3	
14.....	1,380	260	127	29.....	1,200	70	96	3	
15.....	1,470	210	105	30.....	2,000	63	92	3	
				31.....	2,700		85		

Monthly discharge of Lodge Creek at international boundary for the year ending Sept. 30, 1918.

Month.	Discharge in second-feet.				Run-off.	
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches.	Acre-feet.
March 23-31.....	2,700	3.	816	1.01	0.338	14,600
April.....	2,000	63	678	.841	.938	40,300
May.....	72	8.5	31.5	.391	.451	1,940
June.....	26	.03	4.01	.0050	.006	239
The year.....						57,100

NOTE.—Creek dry, Oct. 1 to Mar. 22 and July 1 to Sept. 30.

BATTLE CREEK AT INTERNATIONAL BOUNDARY.

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

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—April 1, 1917, to September 30, 1918.

GAGE.—Stevens continuous water-stage recorder referred to two vertical staff gages, one in gage well and one outside. Readings from outside staff gage used during the year owing to silting of intake pipe of recorder. Gage read by John Buckley.

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

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

EXTREME OF DISCHARGE.—Maximum mean daily discharge during year, 2,500 second-feet March 31; pool stage July 13 to August 17, practically no flow.

1917 and 1918: Maximum stage recorded, 8.50 feet at 9.40 a. m. April 13, 1917 (discharge, 3,200 second-feet); no flow July 13 to August 17, 1918.

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

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

REGULATION.—None.

ACCURACY.—Stage-discharge relation not permanent; affected by ice. Standard rating curve well defined below 3,000 second-feet. Operation of water-stage recorder not satisfactory owing to silt in intake pipe. Outside staff gage read to hundredths once daily. Daily discharge ascertained by applying daily gage heights to rating table; shifting-control method used October 1-7, November 8-20, and April 9-17; November 21-30 and March 25-31 estimated because of ice. Records fair.

Discharge measurements of Battle Creek at international boundary during the year ending Sept. 30, 1918.

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. 2	P. A. Fetterly <i>a</i>	2.59	25	May 17	A. W. P. Lowrie.....	2.93	72
Nov. 16	do.....	2.76	34	June 5	Edwards and Tuttle...	2.64	37
19	Jones and Lamb.....	2.62	25	12	A. W. P. Lowrie.....	2.44	15.6
Apr. 3	G. S. Wenden <i>a</i>	4.88	737	July 7	R. F. Edwards.....	2.05	<i>b</i> 2
9	do.....	6.05	1,450	17	A. W. P. Lowrie.....	1.78	(<i>c</i>)
10	do.....	5.69	1,113	Aug. 15	do.....	1.08	(<i>c</i>)
14	do.....	5.01	721	26	do.....	2.15	<i>d</i> 1.85
24	do.....	3.40	170	Sept. 25	do.....	1.93	<i>d</i> 0.16
30	do.....	3.10	109				

a Engineer, Reclamation Service, Department of Interior, Canada.

b Estimated.

c Water standing in pools; no flow.

d Discharge measured with 48-inch weir.

Daily discharge, in second-feet, of Battle Creek at international boundary for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1.....	28	35	.....	1,880	107	47	1.20	.....	1.85
2.....	27	35	.....	1,180	105	46	1.11	.....	1.85
3.....	23	33	.....	746	105	39	.84	.....	1.98
4.....	21	36	.....	674	105	39	.84	.....	1.85
5.....	20	37	.....	679	109	36	1.11	.....	1.85
6.....	18	41	.....	810	107	33	.84	.....	1.46
7.....	18	42	.....	725	113	32	.66	.....	1.20
8.....	21	43	.....	805	106	30	.48	.....	.93
9.....	21	33	.....	1,310	100	26	.28	.....	.93
10.....	21	39	.....	1,080	94	22	.16	.....	.84
11.....	22	20	.....	805	88	17.4	.12	.....	.84
12.....	21	24	.....	714	81	15.6	.08	.....	.66
13.....	22	23	.....	838	81	12.9	.....	.....	.48
14.....	21	15.6	.....	821	76	11.0	.....	.....	.39
15.....	23	17.4	.....	735	75	7.5	.....	.....	.57
16.....	24	33	.....	816	72	6.6	.....	.....	.48
17.....	24	31	.....	620	72	4.8	.....	.....	.39
18.....	25	30	.....	363	70	4.8	.....	0.40	.30
19.....	25	28	.....	318	70	8.5	.....	.60	.30
20.....	26	22	.....	234	67	5.2	.....	1.00	.26
21.....	26	18	.....	195	60	4.3	.....	1.20	.24
22.....	31	18	.....	171	60	3.0	.....	1.11	.20
23.....	16.5	17	.....	176	60	2.5	.....	.93	.14
24.....	22	17	.....	171	63	2.4	.....	1.98	.14
25.....	24	10	25	155	63	1.85	.....	2.4	.18
26.....	9.5	12	60	137	59	1.72	.....	1.72	.18
27.....	18.3	14	100	133	56	1.72	.....	3.8	.18
28.....	18.3	14	500	137	51	1.59	.....	2.4	.14
29.....	21	10	1,000	124	52	1.33	.....	1.98	.10
30.....	23	12	2,200	116	48	1.46	.....	1.98	.84
31.....	25	.....	2,500	.....	48	.....	.....	1.72	.....

NOTE.—Data inadequate for determination of discharge Dec. 1 to Mar. 24, owing to effect of ice on stage-discharge relation. No flow July 13 to Aug. 17.

Monthly discharge, of Battle Creek at international boundary for the year ending Sept. 30, 1918.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October.....	31	9.5	22.1	1,360
November.....	43	10	25.3	1,510
March 25-31.....	2,500	25	912	12,700
April.....	1,880	116	589	35,000
May.....	113	48	78.2	4,810
June.....	47	1.33	15.5	922
July.....	1.20	0	.25	15.4
August.....	3.8	0	.75	46.1
September.....	1.98	.10	.72	42.8

BATTLE CREEK NEAR CHINOOK, MONT.

LOCATION.—In sec. 3, T. 33 N., R. 19 E., on downstream side of highway bridge $4\frac{1}{2}$ miles north of Chinook, in Blaine County.

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—April 22, 1905, to September 30, 1918.

GAGE.—Chain gage on downstream handrail of highway bridge read since April 9, 1918; prior to that date an overhanging chain gage on left bank 500 feet above highway bridge. Both gages at same datum.

CHANNEL AND CONTROL.—Bed of stream sandy and shifting. Banks high, not subject to overflow. Low-water control is sand bar below gage; no well-defined control at high stages.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year 16.50 feet, March 31 (stage-discharge relation affected by backwater from Milk River; discharge, estimated, 12,000 second-feet); minimum stage, 0.22 feet, August 7, 9, and 10 (discharge, 0.4 second-foot).

1905-1918: Maximum stage, 16.50 feet, March 31, 1918 (flow, estimated, 12,000 second-feet on account of backwater from Milk River); channel reported dry, September 3 to October 22, 1905; July 8 to November 20, 1908; June 21 to end of year 1910; July 22 to 30, 1911; September 7-23, 1913; July 14 to October 4, 1914; and August 10 to September 9, 1917.

ICE.—Stage-discharge relation seriously affected by ice November 16 to March 28, 1918.

DIVERSIONS.—About 15 ditches divert water from Battle Creek in Canada; three ditches divert about 20 second-feet in United States and several small pumping plants supply water for irrigation of bottom lands along creek above station. Below station Cook and Matheson canals divert.

REGULATION.—None.

ACCURACY.—Large change in stage-discharge relation occurred during winter; slight changes in April, May, and June; affected by ice. Rating curve used October 1 to November 15 well defined between 4 and 50 second-feet; curve used April 1 to September 30, except for periods of shifting control, well defined. Gage read to quarter-tenths or hundredths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table; March 21-28 estimated, using measurement of March 21; March 29-31 estimated because of backwater from Milk River; shifting-control method used April 26 to May 6, May 12-14, and June 11-13. Open-channel records good; other records fair.

Discharge measurements of Battle Creek near Chinook, Mont., during the year ending Sept. 30, 1918.

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>
Nov. 19	Jones and Lamb.....	0.27	37.9	June 5	Edwards and Tuttle...	0.94	44
Mar. 21	W. A. Lamb.....	3.80	260	12	R. F. Edwards.....	.78	24.9
Apr. 8	A. H. Tuttle.....	5.47	1,150	15	do.....	.69	19.2
May 2	Tuttle and Edwards....	1.49	149	21	do.....	1.04	54
11	R. F. Edwards.....	1.42	111	26	do.....	.58	10.5
13	do.....	1.34	111	July 8	do.....	.39	3.4
19	do.....	1.22	81				

^a Stage-discharge relation seriously affected by ice.

Daily discharge, in second-feet, of Battle Creek near Chinook, Mont., for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	28	24		2,640	169	56	7.0	1.2	0.8
2	27	24		1,610	149	53	6.2	1.2	.8
3	26	23		794	134	53	5.5	1.2	.8
4	23	23		794	129	50	5.0	1.2	.8
5	21	23		550	124	48	4.0	.8	.8
6	21	24		1,440	122	43	4.0	.8	.8
7	21	25		1,400	118	39	4.0	.4	.8
8	20	27		1,170	110	37	4.0	.6	.8
9	20	34		1,050	110	35	4.0	.4	.8
10	20	34		1,860	110	33	3.6	.4	.8
11	19	34		794	110	28	3.6	.8	.8
12	19	35		766	112	24	3.4	1.6	.8
13	18	35		916	110	18	3.8	1.2	.8
14	18	35		1,050	103	18	4.0	1.2	.8
15	18	35		980	95	17	4.0	1.2	.8
16	18			884	91	12	3.8	1.2	.8
17	18			854	88	9.8	3.6	1.2	.8
18	18			626	85	8.7	3.6	.48	.8
19	17			454	80	8.7	3.6	53	.8
20	16			386	73	15	3.6	31	.8
21	20		200	342	70	45	3.6	8.7	.8
22	22		210	260	67	38	3.6	6.2	.8
23	23		210	250	66	19	3.6	5.5	.8
24	25		180	240	66	11	3.6	5.0	.8
25	25		700	220	66	9.2	3.6	3.2	.8
26	25		150	201	66	9.8	3.6	2.2	.8
27	25		600	186	64	8.7	3.6	1.8	.8
28	25		1,200	178	63	8.2	3.0	1.4	.8
29	25		7,000	178	63	8.7	1.2	1.2	.8
30	25		10,000	171	60	8.2	1.0	.8	.8
31	24		12,000		60		1.2	.8	

NOTE.—Discharge Nov. 16-30 estimated because of ice at second-feet. Gage read Dec. 1 to Jan. 12, but data is inadequate for determination of discharge. No gage records Jan. 13 to Mar. 20.

Monthly discharge of Battle Creek near Chinook, Mont., for the year ending Sept. 30, 1918.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	28	16	21.6	1,330
November	35	20	25.2	1,500
March	12,000	150	2,950	64,400
April	2,640	171	771	45,900
May	169	60	94.6	5,820
June	56	8.2	25.7	1,530
July	7.0	1.0	3.74	230
August	53	.4	5.98	368
September	.8	.8	.8	47.6

COOK CANAL NEAR CHINOOK, MONT.

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

RECORDS AVAILABLE.—April 10, 1905, to September 30, 1918.

GAGE.—Vertical staff on left bank about 1,000 feet above point at which canal turns west and runs parallel with road; read by Adam Jamison. New vertical staff gage installed 300 feet below old gage May 18, 1918, but was not read by observer.

DISCHARGE MEASUREMENTS.—Made by wading where canal passes 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 likely to cause backwater.

ACCURACY.—Rating curve well defined between 3 and 24 second-feet. Gage read to half-tenths daily, but records are not reliable. Daily discharge ascertained by applying daily gage height to rating table. Records poor.

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 head gage.

Discharge measurements of Cook canal near Chinook, Mont., during the year ending Sept. 30, 1918.

[Made by R. F. Edwards.]

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	<i>Feet.</i>	<i>Sec.-ft.</i>		<i>Feet.</i>	<i>Sec.-ft.</i>
June 12.....	2.06	4.8	June 21.....	3.27	19.7
15.....	2.59	9.5	26.....	2.49	8.9

Daily discharge, in second-feet, of Cook canal near Chinook, Mont., for the year ending Sept. 30, 1918.

Day.	June.	July.	Aug.	Day.	June.	July.	Aug.	Day.	June.	July.	Aug.
1.....		9.2		11.....	6.2	3.6		21.....	16.5	0.8	2.7
2.....		9.1		12.....	7.0	3.2		22.....	16.8	.8	1.0
3.....		8.7		13.....	9.8	2.0		23.....	23.2	.8	.6
4.....		9.1		14.....	11.4	1.7		24.....	22.2	.7	.1
5.....		9.4		15.....	10.8	1.6		25.....	18.5	.6	
6.....		6.6		16.....	11.8	1.4		26.....	11.0	.6	
7.....		9.7		17.....	11.6	.8		27.....	15.2	.7	
8.....		9.6		18.....	11.8	.9	7.7	28.....	13.0	1.7	
9.....		9.4		19.....	12.3	.8	6.0	29.....	11.8	1.6	
10.....	4.3	9.5		20.....	11.8	.8	4.8	30.....	8.7		
								31.....			

Monthly discharge of Cook canal near Chinook, Mont., for the year ending Sept. 30, 1918.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
June.....	23.2	4.3	12.6	523
July.....	9.7	0.6	3.72	229
August.....	7.7	0	0.74	46

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, a quarter of a 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, 1918 (irrigation seasons only).

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

DISCHARGE MEASUREMENTS.—Made by wading below gage.

CHANNEL AND CONTROL.—The bed of the canal is mud, with no definite point of control. Weeds grow in bottom of canal during summer.

ACCURACY.—Stage-discharge relation permanent during season. Rating curve well defined between 1 and 11 second-feet. Gage read to hundredths once daily; records are doubtful as shown by readings of engineer and observer for some dates. Daily discharge ascertained by applying gage height to rating table. Canal dry August 9–17. The flow August 18–31 was due to heavy rain water running through canal and not used for irrigation but was washed into the small tributary of Milk River. Records fair.

Canal diverts water from Battle Creek for irrigation of lands on the north side of Milk River valley. Water can be wasted into a small tributary of Milk River.

Discharge measurements of Matheson canal near Chinook, Mont., during the year ending Sept. 30, 1918.

[Made by R. F. Edwards.]

Date.	Gage height.	Discharge.
	<i>Feet.</i>	<i>Sec.-ft.</i>
June 15.....	3.80	2.2
21.....	4.50	6.6
26.....	3.98	3.1

Daily discharge, in second-feet, of Matheson canal near Chinook, Mont., for the year ending Sept. 30, 1918.

Day.	June.	July.	Aug.	Day.	June.	July.	Aug.	Day.	June.	July.	Aug.
1.....		1.7	0.7	11.....	6.6	0.9	0	21.....	6.9	0.9	5.4
2.....		.9	.9	12.....	3.3	.8	0	22.....	3.2	.8	5.1
3.....		1.7	.9	13.....	3.2	.9	0	23.....	.9	.9	4.2
4.....		1.5	.9	14.....	3.3	.8	0	24.....	2.7	.8	3.2
5.....		1.6	.9	15.....	2.8	.8	0	25.....	4.0	.7	3.2
6.....		1.6	.8	16.....	2.6	.9	0	26.....	3.3	.7	2.8
7.....		1.7	.3	17.....	2.7	.8	0	27.....	3.8	.6	2.2
8.....		1.3	.3	18.....	2.4	.8	10.6	28.....	2.7	.3	1.7
9.....	6.0	1.1	0	19.....	2.7	.6	8.5	29.....	2.4	1.1	1.6
10.....	5.9	1.1	0	20.....	2.6	.6	7.2	30.....	2.2	1.2	1.5
								31.....	.....	.6	1.3

Monthly discharge of Matheson canal near Chinook, Mont., for the year ending Sept. 30, 1918.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
June 9-30.....	6.9	0.9	3.46	151
July.....	1.7	.3	0.99	61
August.....	10.6	0	2.07	127

PARADISE CANAL NEAR CHINOOK, MONT.

LOCATION.—In SW. $\frac{1}{4}$ sec. 35, T. 33 N., R. 20 E., 300 feet below head gates, 30 feet below flume of Cook canal, on ranch of Rudolph Friede, 6 miles southeast of Chinook, in Blaine County.

RECORDS AVAILABLE.—June, 1903, to August, 1909; January 1, 1911, to September 30, 1918.

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

DISCHARGE MEASUREMENTS.—Made by wading.

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

ACCURACY.—Stage-discharge relation not permanent. Rating curve used June 1–18, well defined below 20 second-feet; curve used June 19 to July 21, well defined below 20 second-feet; curve used July 31 to August 9, well defined below 9 second-feet. Gage read to hundredths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table. Records good.

Paradise Valley canal diverts water from south bank of Milk River in 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 canal near Chinook, Mont., during the year ending Sept. 30, 1918.

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 11	R. F. Edwards.....	1.24	3.2	July 6	R. F. Edwards.....	2.18	17.3
16	do.....	2.10	18.8	11	do.....	2.20	17.1
20	do.....	1.78	10.3	31	A. H. Tuttle.....	1.84	8.3
27	do.....	1.95	13.1				

Daily discharge, in second-feet, of Paradise canal near Chinook, Mont., for the year ending Sept. 30, 1918.

Day.	June.	July.	Aug.	Day.	June.	July.	Aug.	Day.	June.	July.	Aug.
1.....	0	14.9	6.5	11.....	3.0	15.3	0.0	21.....	2.9	12.9	0.0
2.....	0	14.9	4.2	12.....	5.8	17.4	.0	22.....	4.0	2.1	.0
3.....	0	17.4	4.2	13.....	14.0	18.1	.0	23.....	6.7	1.5	4.7
4.....	0	16.7	2.8	14.....	18.9	18.3	.0	24.....	13.4	1.2	.5
5.....	0	16.3	2.6	15.....	20.4	14.8	.0	25.....	15.6	1.0	.2
6.....	0	16.7	1.9	16.....	19.2	14.8	.0	26.....	14.8	3.4	.0
7.....	0	16.5	1.4	17.....	12.8	14.6	.0	27.....	13.0	9.3	.0
8.....	0	15.8	1.4	18.....	2.5	14.6	.0	28.....	14.6	9.5	.0
9.....	1.0	16.0	.5	19.....	8.0	13.2	.0	29.....	16.3	10.3	.0
10.....	2.1	14.6	.0	20.....	11.9	14.4	.0	30.....	16.7	9.0	.0
								31.....	.....	8.4	.0

Monthly discharge of Paradise canal near Chinook, Mont., for the year ending Sept. 30, 1918

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
June.....	20.4	0.0	7.92	471
July.....	18.3	1.0	12.4	762
August.....	6.5	.0	1.00	61.5

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 and $1\frac{1}{2}$ miles southeast of Great Northern Railway section house at Zurich, in Blaine County.

RECORDS AVAILABLE.—June, 1903, to September 30, 1918.

GAGE.—Vertical staff on right bank about 500 feet below head gates of canal. Read by Zenas Philips June 16 to July 7, and by John Palm July 8 to August 23.

DISCHARGE MEASUREMENTS.—Made by wading or from bridge over head gates.

CHANNEL AND CONTROL.—Bed of canal is earth with no definite control. Check weirs several miles below gage may cause some backwater at high stages. Aquatic plants growing in canal during irrigation season also cause backwater and much silt is deposited.

ACCURACY.—No gage heights recorded June 23–29, July 6, 7, August 18; discharge interpolated. Irrigation season closed August 23. Stage-discharge relation not permanent. Rating curve used June 20 to July 20 and August 10–23, fairly well defined between 4 and 45 second-feet. Gage read to half-tenths once daily. Daily discharge ascertained by applying daily gage height to rating table; shifting-control method used June 16–20 and July 21 to August 9. Records good.

Harlem canal diverts water from north bank of Milk River in 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, 1918.

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>
June 11	R. F. Edwards.....	2.00	4.9	July 12	R. F. Edwards.....	3.74	31.1
16	do.....	2.31	9.2	Aug. 3	Edwards and Tuttle....	4.70	41.9
20	do.....	2.32	7.6	Aug. 7	A. H. Tuttle.....	4.55	37.3

Daily discharge, in second-feet, of Harlem canal near Zurich, Mont., for the year ending Sept. 30, 1918.

Day.	June.	July.	Aug.	Day.	June.	July.	Aug.	Day.	June.	July.	Aug.
1.....		14.3	43.9	11.....	4.9	29.2	41.0	21.....	13.6	35.0	17.9
2.....		15.5	42.6	12.....	4.9	29.7	39.8	22.....	14.6	41.8	14.9
3.....		15.8	42.6	13.....	4.9	32.6	36.1	23.....	14.4	42.8	12.8
4.....		14.6	41.0	14.....	4.9	41.0	31.5	24.....	14.3	43.6	
5.....		13.9	41.5	15.....	4.9	45.7	24.8	25.....	14.1	43.6	
6.....		14.0	41.3	16.....	15.2	29.2	22.8	26.....	14.0	43.1	
7.....		14.1	37.8	17.....	15.8	5.0	17.9	27.....	13.8	45.2	
8.....		14.2	38.5	18.....	16.4	5.4	27.0	28.....	13.6	44.6	
9.....		18.6	44.1	19.....	16.1	7.4	36.1	29.....	13.4	44.6	
10.....		21.9	42.3	20.....	14.6	20.2	31.5	30.....	13.2	46.5	
								31.....		44.6	

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

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
June 11–30.....	16.4	4.9	12.1	480
July.....	46.5	5.0	28.3	1,740
August 1–23.....	44.1	12.8	33.5	1,580

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 1,000 feet below highway bridge, half a mile below head gate, and 4 miles south of Harlem, in Blaine County.

RECORDS AVAILABLE.—July 14, 1905, to September 30, 1918.

GAGE.—Vertical staff on right hand downstream post of check weir at spillway. Gage read by Gretchen Coates.

DISCHARGE MEASUREMENTS.—Made from bridge.

CHANNEL AND CONTROL.—Bed of canal is earth; backwater is caused by aquatic plants growing in canal during operating season and also by a check gate 1 mile below station; the amount of which varies with the quantity of water diverted.

ACCURACY.—Stage-discharge relation affected by changes in channel and operation of check 1 mile below gage. Four rating curves used during year, applicable for short periods. Gage read to hundredths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table; shifting-control method used May 17–27 and June 8–14. Records good.

Agency ditch takes water from south bank of Milk River in sec. 32, T. 32 N., R. 23 E., for irrigation of lands on Fort Belknap Indian Reservation. Water not required for irrigation can be wasted into White Bear Creek, about 12 miles below head gate. This canal has been given a prior right by court decree to 125 second-feet of the water of Milk River and tributaries above the point of diversion.

Discharge measurements of Agency ditch near Harlem, Mont., during the year ending Sept. 30, 1918.

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 10	R. F. Edwards.....	4.06	85	June 10	R. F. Edwards.....	a 4.13	39
14	do.....	3.99	86	17	do.....	a 3.93	36.6
17	do.....	a 4.47	22.3	19	do.....	3.38	54
23	Parker and Tuttle.....	a 4.50	17.3	28	do.....	3.02	39.4
31	Edwards and Tuttle...	a 4.57	22.7	July 5	do.....	a 3.58	22.5
June 6	A. H. Tuttle.....	3.81	72	12	do.....	2.85	18.5
7	B. E. Jones.....	a 4.18	37				

^a Checks in canal 1 mile below gage.

Daily discharge, in second-feet, of Agency ditch near Harlem, Mont., for the year ending Sept. 30, 1918.

Day.	May.	June.	July.	Aug.	Day.	May.	June.	July.	Aug.
1.....		23	51	3.4	16.....	80	38	23	.....
2.....		21	42	4.6	17.....	24	37	33	.....
3.....		15	38	5.5	18.....	24	42	27	.....
4.....		15	48	.....	19.....	22	56	26	.....
5.....		87	23	.....	20.....	23	52	19	.....
6.....		74	23	.....	21.....	21	60	19	.....
7.....		56	20	.....	22.....	19	61	20	.....
8.....		37	18	.....	23.....	17	61	20	.....
9.....		40	17	.....	24.....	17	52	17	.....
10.....	87	40	18	.....	25.....	16	47	18	.....
11.....	86	40	18	.....	26.....	17	42	20	.....
12.....	84	39	18	.....	27.....	19	45	0	.....
13.....	84	35	19	.....	28.....	27	36	0	.....
14.....	82	34	19	.....	29.....	26	35	0	.....
15.....	82	36	20	.....	30.....	23	41	1.6	.....
					31.....	23	.....	3.4	.....

NOTE.—Date of opening of canal not known; gage readings commenced May 10. Checks placed May 17, removed May 18; placed again June 7, removed June 18; placed July 4 and removed July 10. Canal closed July 27–29.

Monthly discharge of Agency ditch near Harlem, Mont., for the year ending Sept. 30, 1918.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
May 10-31.....	87	16	41.0	1,790
June.....	87	15	43.2	2,570
July.....	51	0	20.6	1,270
August 1-3.....	5.5	3.4	4.5	26.8
The period.....				5,660

PEOPLES CREEK NEAR DODSON, MONT.

LOCATION.—On Fort Belknap Indian Reservation, 800 feet above United States Reclamation Service diversion dam and 7 miles southeast of Dodson, in Phillips County.

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—April 30 to September 30, 1918.

GAGE.—Overhanging chain gage on right bank, 800 feet above dam; read by Lazure Eraux.

DISCHARGE MEASUREMENTS.—Made by wading.

CHANNEL AND CONTROL.—Bed of stream at gage composed of sand. Control is sand bar 100 feet downstream from gage; probably shifts, at high stages control is drowned out. Banks fairly high, but are overflowed at extreme stages.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year 1.16 feet April 30 (discharge, 19.3 second-feet); no flow after June 10.

ICE.—Station not maintained during winter; but very little flow.

DIVERSIONS.—No data.

REGULATION.—None.

ACCURACY.—Stage-discharge relation not permanent. Rating curve used May 4-16, fairly well defined between 3 and 15 second-feet; curves used May 21 to June 10, well defined below 15 second-feet. Gage read to even hundredths once daily; records are only fair. Daily discharge ascertained by applying gage height to rating table; shifting-control method used May 1-3 and 16-20. Records fair.

Discharge measurements of Peoples Creek near Dodson, Mont., during the year ending Sept. 30, 1918.

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. 30	Edwards and Tuttle...	1.15	18.8	May 21	R. F. Edwards.....	0.98	6.8
May 4	R. F. Edwards.....	1.13	13.5	May 23	Tuttle and Parker.....	.95	6.0
May 10	do.....	1.11	12.5	June 10	R. F. Edwards.....	.69	a .4

^a Estimated.

Daily discharge, in second-feet, of Peoples Creek near Dodson, Mont., for the year ending Sept. 30, 1918.

Day.	Apr.	May.	June.	Day.	Apr.	May.	June.	Day.	Apr.	May.	June.
1.....		18.0	4.3	11.....		8.8		21.....		6.8	
2.....		16.7	6.8	12.....		10.9		22.....		5.8	
3.....		12.4	6.3	13.....		10.2		23.....		4.7	
4.....		12.3	5.2	14.....		11.6		24.....		2.9	
5.....		10.9	3.8	15.....		4.8		25.....		6.3	
6.....		10.2	4.3	16.....		4.4		26.....		5.7	
7.....		10.2	1.7	17.....		3.6		27.....		3.8	
8.....		10.2	2.9	18.....		7.0		28.....		2.1	
9.....		9.5	1.6	19.....		6.9		29.....		2.9	
10.....		11.6	.4	20.....		6.9		30.....	19.3	3.4	
								31.....		2.1	

NOTE.—No flow after June 10.

Monthly discharge of Peoples Creek near Dodson, Mont., for the year ending Sept. 30, 1918.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
May.....	18.0	2.1	7.86	483
June.....	6.8	.0	1.24	73.8

FRENCHMAN RIVER AT INTERNATIONAL BOUNDARY.

LOCATION.—In SW. $\frac{1}{4}$ sec. 4, T. 1, R. 10 W. third meridian, at Ball's ranch, in Saskatchewan, just across the international boundary from eastern side of lot 3, sec. 6, T. 37 N., R. 34 E., in United States.

DRAINAGE AREA.—1,875 square miles. (Measured by Reclamation Service, Department of the Interior, Canada.)

RECORDS AVAILABLE.—April 1, 1917, to September 30, 1918.

GAGE.—Stevens continuous water-stage recorder referred to staff gage in well; read by Mrs. W. B. Chamberlain.

DISCHARGE MEASUREMENTS.—Made from cable 20 feet above gage or by wading.

CHANNEL AND CONTROL.—A bar composed of boulders and gravel forms the principal control at low and medium stages. At high stages this bar is drowned out and control is below, causing a slight reversal in form of rating curve.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year 8.65 feet at 1 p. m. April 6 (discharge, 2,240 second-feet); minimum stage recorded 1.95 feet September 21-23 (discharge, 8.5 second-feet).

1917-1918: Maximum stage reported 9.99 feet at 11.30 a. m. April 30, 1917 (discharge, 2,780 second-feet); minimum discharge, 5.2 second-feet March 27, 1917; a lower flow probably occurred during winter of 1917-18, but no flow was computed.

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

DIVERSIONS.—Several ditches divert water for irrigation about 60 miles above station at Saskatchewan.

REGULATION.—None.

ACCURACY.—Stage-discharge relation not permanent. Daily discharge obtained by applying gage heights to rating tables as follows: Rating curve used October 1, well defined between 20 and 2,820 second-feet; curve used October 8 to November 23, well defined between 20 and 2,820 second-feet; April 2 to September 30, well defined between 20 and 2,820 second-feet. Operation of water-stage recorder satisfactory except for periods indicated in footnote to daily-discharge table.

Daily discharge ascertained by applying mean daily gage heights to rating table or for days of considerable fluctuation by averaging the hourly discharge. Records good.

COOPERATION.—Station maintained in cooperation with reclamation service, department of interior, Canada.

Discharge measurements of Frenchman River at international boundary during the year ending Sept. 30, 1918.

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	P. A. Fetterley ^a	2.53	19.2	May 22	Edwards and Tuttle.....	3.05	122
22	do.....	2.51	18.7	27	A. W. P. Lowrie.....	2.96	108
Nov. 17	B. E. Jones.....	2.66	40	28	do.....	2.94	98
28	P. A. Fetterley.....	2.66	41	June 1	do.....	2.86	89
Apr. 3	A. W. P. Lowrie ^a	6.80	1,570	9	Edwards and Tuttle.....	2.75	80
4	do.....	6.56	1,500	July 2	A. W. P. Lowrie.....	2.54	48
5	do.....	7.40	1,750	3	R. F. Edwards.....	2.52	45
6	do.....	8.62	2,280	6	A. W. P. Lowrie.....	2.44	42
7	do.....	5.60	1,110	Aug. 2	do.....	2.22	20
8	do.....	4.10	470	6	do.....	2.33	30
15	do.....	5.70	1,190	Sept. 3	do.....	2.14	15.3
18	do.....	5.40	1,040	18	do.....	1.98	9.2
May 8	Edwards and Tuttle.....	3.36	206				

^a Engineer, Reclamation Service, Department of the Interior, Canada.

NOTE.—Velocities for measurements made during April, were determined by means of floats. Mean velocity in vertical obtained by applying a coefficient of 0.90 to observed velocity.

Daily discharge, in second-feet, of Frenchman River at international boundary, for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Apr.	May.	June.	July.	Aug.	Sept.
1.....	48	15	1,540	277	90	55	23	190
2.....	46	20	1,530	251	86	51	21	185
3.....	44	20	1,530	240	80	48	18	175
4.....	44	20	1,480	229	77	46	16	160
5.....	43	20	1,670	222	79	42	15	145
6.....	41	35	2,140	219	79	42	22	132
7.....	39	35	1,100	216	76	41	32	120
8.....	37	35	504	212	77	41	24	132
9.....	30	35	472	212	76	42	20	128
10.....	27	35	459	209	73	41	19	120
11.....	24	40	459	203	70	41	20	112
12.....	23	40	467	184	67	39	22	104
13.....	24	40	594	176	73	35	31	100
14.....	22	40	800	165	74	33	27	100
15.....	24	40	1,030	157	63	30	32	97
16.....	20	43	1,190	150	54	30	29	94
17.....	20	43	1,180	144	59	28	40	97
18.....	20	44	1,040	142	54	28	25	94
19.....	24	27	1,040	137	54	27	22	94
20.....	24	35	954	133	52	26	20	91
21.....	22	30	705	133	69	25	19	85
22.....	20	35	570	128	62	24	31	85
23.....	20	35	463	124	55	24	29	85
24.....	15	35	418	122	60	24	21	91
25.....	27	35	399	117	62	24	20	100
26.....	24	40	387	111	88	24	21	116
27.....	16	42	380	109	80	27	28	120
28.....	22	35	349	106	66	27	28	116
29.....	29	35	326	102	60	26	26	104
30.....	22	30	307	96	57	25	24	108
31.....	17	-----	-----	86	-----	25	21	-----

NOTE.—Discharge, Oct. 2-7 and Nov. 3-16, estimated, because gage did not operate, from records of flow for Frenchman River at 76 ranch. Discharge, Nov. 23-30, estimated because of ice. Mean discharge, Apr. 5-7, Aug. 6 and 7 determined from hourly discharge. No records Dec. 1 to Mar. 31. Discharge, Apr. 1, estimated.

Monthly discharge of Frenchman River at international boundary for the year ending Sept. 30, 1918.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October.....	48	15	27.7	1,700
November.....	44	15	33.8	2,010
April.....	2,140	307	849	50,500
May.....	277	86	165	10,100
June.....	90	52	69.1	4,110
July.....	55	24	33.6	2,070
August.....	40	15	24.5	1,510
September.....	23	8.5	11.6	690

BEAVER CREEK NEAR MALTA, MONT.

LOCATION.—In NW. $\frac{1}{4}$ sec. 30, T. 28 N., R. 33 E., at highway bridge at Hales crossing, at site of proposed reservoir of United States Reclamation Service, 28 miles southeast of Malta, in Phillips County.

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—March 31, 1917, to September 30, 1918.

GAGE.—Chain gage on downstream handrail of highway bridge; Gage read by Chas. Hales.

DISCHARGE MEASUREMENTS.—Made from highway bridge or by wading at old ford crossing, 500 feet above bridge.

CHANNEL AND CONTROL.—Channel is straight for 150 feet above and 200 feet below gage. Banks are high and practically without vegetation. Left bank is overflowed at gage height 18.5 feet. The low-water control is gravel and cobblestone bar 400 feet below gage; probably shifting. At stages above the gage height 12.5 the river cuts across the first oxbow loop below and has a decided increase of slope, materially increasing the discharge. Point of zero flow found to be about 0.10 foot.

EXTREMES OF DISCHARGE.—Maximum discharge, estimated, 4,850 second-feet March 20 (stage-discharge relation affected by ice); no flow May 7 to September 30.

1917-1918: Maximum stage recorded, 19.5 feet, April 6, 1917 (discharge, 4,990 second-feet); no flow during periods in each year.

ICE.—Creek practically freezes solid during winter, and ice jams are frequent during spring break-up. No records obtained for this period.

DIVERSIONS.—No diversions from main stream; several on small tributaries above.

REGULATION.—None.

ACCURACY.—Stage discharge relation permanent during year. Rating curve well defined between 10 and 3,000 second-feet. Gage read to hundredths daily. Daily discharge ascertained by applying gage height to rating table.

Discharge measurements of Beaver Creek near Malta, Mont., during the year ending Sept. 30, 1918.

[Made by A. H. Tuttle.]

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
Mar. 24.....	<i>Feet.</i> 16.18	<i>Sec.-ft.</i> a 2,730	Mar. 25.....	<i>Feet.</i> 12.02	<i>Sec.-ft.</i> 1,300
24.....	15.14	2,140	Apr. 10.....	.93	25.9

a Velocity determined by surface method.

Daily discharge, in second-feet, of Beaver Creek near Malta, Mont., for the year ending Sept. 30, 1918.

Day.	Mar.	Apr.	May.	Day.	Mar.	Apr.	May.	Day.	Mar.	Apr.	May.
1.....		92	0.0	11.....		22.....		21.....	4,850	4.0	.....
2.....		57	1.5	12.....		22.....		22.....	4,290	6.5	.....
3.....		51	12.5	13.....		22.....		23.....	4,360	1.5	.....
4.....		46	4.0	14.....		16.....		24.....	2,380	.0	.....
5.....		41	1.5	15.....		16.....		25.....	1,350	.0	.....
6.....		32	1.5	16.....		12.5		26.....	870	1.5	.....
7.....		28	4.0	17.....		12.5		27.....	528	4.0	.....
8.....		25		18.....		1.5		28.....	363	1.5	.....
9.....		24		19.....	1,520	1.5		29.....	253	1.5	.....
10.....		25		20.....	4,850	4.0		30.....	176	1.5	.....
								31.....	145		.....

NOTE.—Gage read Mar. 1-18; data inadequate for determination of discharge. No flow May 7 to Sept. 30.

Monthly discharge of Beaver Creek near Malta, Mont., for the year ending Sept. 30, 1918.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
March 19-31.....	4,850	145	2,000	51,600
April.....	92.0	0	19.1	1,140
May 1-8.....	12.5	0	3.13	49.7
The period.....				52,800

BEAVER CREEK NEAR BOWDOIN, MONT.

LOCATION.—In sec. 23, T. 31 N., R. 32 E., at highway bridge on Glacier Park trail 4 miles NE. of Bowdoin and 3 miles west of Saco, in Phillips County.

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—April 1 to September 30, 1918.

GAGE.—Chain gage on downstream handrail of highway bridge, read by Eugene and Blanche Terry.

CHANNEL AND CONTROL.—Bed of stream is soft clay (gumbo) and banks continually slip into creek during high water. Control is a gravel riffle about 300 feet below gage; will probably shift. Considerable backwater may be caused by heavy growth of brush along banks. Banks are high but will be overflowed at extreme stages when whole valley is covered with water above gage height of about 19 feet.

EXTREMES OF DISCHARGE.—Maximum stage recorded, 18.5 feet at 5 p. m., August 25 (discharge from extension of rating table, 2,000 second-feet); no flow June 5 to July 29 and September 15-29.

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

DIVERSIONS.—Numerous diversions from creek for irrigation of hay meadows above station.

REGULATION.—Low-water flow partly regulated by diversion dams above.

ACCURACY.—Stage-discharge relation permanent during year. Rating curve well defined between 8 and 300 second-feet and poorly defined above 300 second-feet. Gage read to tenths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table. Records good except for high water of August, which is based upon logarithmic extension of rating curve.

Discharge measurements of Beaver Creek near Bowdoin, Mont., during the year ending Sept. 30, 1918.

Date.	Made by—	Gage height.	Dis-charge.	Date.	Made by—	Gage height.	Dis-charge.
Mar. 21	A. H. Tuttle.....	<i>Feet.</i> 10.70	<i>Sec.-ft.</i> 559	Apr. 10	A. H. Tuttle.....	<i>Feet.</i> 4.84	<i>Sec.-ft.</i> 71
Apr. 1	W. A. Lamb.....	7.45	291	29	Tuttle and Edwards...	3.60	8.2

a Stage-discharge relation affected by ice.

Daily discharge, in second-feet, of Beaver Creek near Bowdoin, Mont., for the year ending Sept. 30, 1918.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Day.	Apr.	May.	June.	July.	Aug.	Sept.
1.....	290	11.5	1.0	.....	3.0	28	16.....	58	1.0	.....	.....	11.5	.....
2.....	203	11.5	.0	.....	3.0	28	17.....	64	3.0	.....	.....	21.0	.....
3.....	116	11.5	.5	.....	3.0	28	18.....	67	3.0	.....	.....	5.5	.....
4.....	109	17	1.0	.....	3.0	28	19.....	43	2.0	.....	.....	5.5	.....
5.....	109	11.5	.....	.....	3.0	28	20.....	43	3.0	.....	.....	11.5	.....
6.....	95	11.5	.....	.....	3.0	28	21.....	33	3.0	.....	.....	88	.....
7.....	81	11.5	.....	.....	4.2	28	22.....	33	2.0	.....	.....	95	.....
8.....	67	10.0	.....	.....	6.1	1.0	23.....	30	3.5	.....	.....	682	.....
9.....	67	11.5	.....	.....	3.0	1.0	24.....	19	7.0	.....	.....	1,330	.....
10.....	67	11.5	.....	.....	3.0	1.0	25.....	19	1.0	.....	.....	1,920	.....
11.....	55	7.0	.....	.....	3.0	1.0	26.....	15	5.5	.....	.....	1,400	.....
12.....	55	5.5	.....	.....	4.2	1.0	27.....	15	3.0	.....	.....	519	.....
13.....	49	4.2	.....	.....	10.0	1.0	28.....	11.5	1.0	.....	.....	275	.....
14.....	49	0.0	.....	.....	7.0	1.0	29.....	7.0	1.0	.....	.....	285	.....
15.....	58	0.0	.....	.....	11.5	.....	30.....	8.5	1.0	.....	5.5	88	67
							31.....	.....	1.0	.....	3.0	46	.....

NOTE.—Discharge, Apr. 2, interpolated. No flow June 5 to July 29 and Sept. 15-29.

Monthly discharge of Beaver Creek near Bowdoin, Mont., for the year ending Sept. 30, 1918.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
April.....	290	7.0	64.5	3,840
May.....	17	.0	5.70	350
June.....	1.0	0	.08	4.8
July.....	5.5	.0	.28	17.2
August.....	1,920	3.0	22	13,600
September.....	67	.0	9.00	536
The period.....				18,300

BEAVER CREEK NEAR HINSDALE, MONT.

LOCATION.—One-quarter of a mile south of northeast corner of sec. 28, T. 31 N., R. 35 E., at highway bridge on main road to Saco, half a mile north of railroad, 5 miles west of Hinsdale, in Valley County, and about 6 miles above mouth.

DRAINAGE AREA.—Not computed.

RECORDS AVAILABLE.—April 1 to September 30, 1918.

GAGE.—Wire on downstream side of bridge; read by A. S. Garcia.

DISCHARGE MEASUREMENTS.—Made from downstream side of bridge or by wading.

CHANNEL AND CONTROL.—Bottom of stream consists of gravel and boulders; not likely to shift. At high water brush and vegetation growing on banks may cause back-water.

EXTREMES OF DISCHARGE.—Maximum stage recorded 16.55 feet August 23 (discharge, 2,580 second-feet); minimum stage 0.58 feet September 25 and 26 (discharge, 0.3 second-feet).

ICE.—Stage-discharge relation seriously affected by ice. Station not operated during winter:

REGULATION.—None.

ACCURACY.—Gage read to half-tenths twice daily. Stage-discharge relation permanent during year. Rating curve well defined between 15 and 700 second-feet and fairly well defined below 15 second-feet. Daily discharge obtained by applying mean daily gage height to rating table. Records good, except those for stages above 700 second-feet, which are roughly approximate.

Discharge measurements of Beaver Creek near Hinsdale, Mont., during the year ending Sept. 30, 1918.

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. 1	W. A. Lamb.....	5.02	673	May 7	Tuttle and Edwards...	0.93	10.8
5	A. H. Tuttle.....	2.27	216	16	R. F. Edwards.....	.80	2.9
May 7	Tuttle and Edwards...	.93	12.5	June 8	Tuttle and Edwards...	.60	a, 4

a Discharge determined by use of floats.

Daily discharge, in second-feet, of Beaver Creek near Hinsdale, Mont., for the year ending Sept. 30, 1918.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Day.	Apr.	May.	June.	July.	Aug.	Sept.
1.....	638	18	3.0	1.0	8.0	98	17.....	106	6.2	0.5	0.5	3.0	6.2
2.....	468	18	2.0	2.6	2.6	53	18.....	106	6.2	.9	1.4	210	2.6
3.....	332	18	1.4	2.6	1.4	68	19.....	122	4.3	1.4	11	215	2.0
4.....	266	18	1.0	2.6	4.3	98	20.....	114	4.3	2.0	16	75	1.4
5.....	202	18	1.0	2.6	39	39	21.....	98	4.3	2.0	16	98	.9
6.....	170	18	1.0	3.0	21	39	22.....	90	4.3	2.0	8.0	1,580	.5
7.....	154	18	1.0	2.6	2.6	39	23.....	75	4.3	2.0	2.6	2,580	.5
8.....	122	18	1.0	.9	.9	39	24.....	75	4.3	1.4	1.4	2,130	.4
9.....	122	18	1.0	.4	.7	39	25.....	75	4.3	9.3	1.4	960	.3
10.....	122	14	.9	.5	.9	39	26.....	46	4.3	32	4.3	777	.3
11.....	122	9.3	.7	.5	1.0	43	27.....	46	4.3	18	4.3	1,286	.7
12.....	130	9.3	.7	.4	2.0	35	28.....	39	4.3	8.0	4.3	1,160	.7
13.....	114	9.3	.7	.4	3.0	32	29.....	18	4.3	2.6	14	986	.7
14.....	106	9.3	.5	.4	2.0	53	30.....	18	3.0	.4	49	434	.9
15.....	106	9.3	.5	.4	1.0	11	31.....	.....	3.0	.....	25	226	.....
16.....	106	9.3	.5	.7	1.4	11							

Monthly discharge of Beaver Creek near Hinsdale, Mont., for the year ending Sept. 30, 1918.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
April.....	638	18	144	8,570
May.....	18	3.0	9.60	590
June.....	32	0.4	3.31	197
July.....	49	0.4	5.83	358
August.....	2,580	0.7	412	25,300
September.....	98	0.3	25.1	1,490
The period.....	.....	.....	.....	36,500

ROCK CREEK NEAR HINSDALE, MONT.

LOCATION.—In sec. 10, T. 31 N., R. 36 E., at Ottenstror's ranch, 2 miles below head gates of Rock Creek canal and 6 miles northeast of Hinsdale, in Valley County.

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—April 19, 1912, to September 30, 1918. From July 5, 1905, to December 31, 1907, data were obtained at a station 2 miles upstream, just below diversion dam of Rock Creek canal. Flow at these two points is practically the same.

GAGE.—Combined overhanging chain and staff gage on the left bank back of John Ottenstror's house. Chain gage reads to 16 feet and staff 16 to 24 feet. Original chain gage washed out during spring flood of 1917 and new one installed 30 feet above old site is now in use. Gage read by John Hoerster.

DISCHARGE MEASUREMENTS.—Made by wading a quarter of a mile below gage at low and medium stages, and from a bridge 2 miles below at high stages.

CHANNEL AND CONTROL.—The water at gage is deep and sluggish at low water. Control is a gravel bar a quarter of a mile below; shifts slightly at high water. Left bank high and not subject to overflow at the gage; right bank fairly high but is over-flowed at flood stages.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year 18.3 feet at 7 p. m. March 25 (discharge, 3,460 second-feet); no flow October 1-27, 1917, and for short periods April, May, June, July, and August, due in most instances to placing of flashboards on diversion dam.

1906-7 and 1912-1918: Maximum stage recorded 18.40 feet June 9, 1906, determined by leveling from flood marks (discharge, from extension of rating curve, 6,220 second-feet); no flow April 14 to May 2, May 9-24, and after July 62, 1906; after September 28, 1907; April 23-25, 27, 28, 30, May 1, 2, 4, 1913; May 3, 5, 8, 10, 13, 1915; after September 13, 1917; April 11-14, May 17-20, 23-26, June 14, 16-18, 20, 23, 26-30, July 7, and August 6-17, 1918.

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

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

REGULATION.—None.

ACCURACY.—Stage-discharge relation for low water changed by the spring flood. Rating curve well defined below 150 second-feet. Gage read to nearest tenths daily. Daily discharge ascertained by applying daily gage height to rating table. Records good.

Discharge measurements of Rock Creek near Hinsdale, Mont., during the year ending Sept. 30, 1918.

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. 16	Lamb and Jones.....	5.30	a 2.0	June 8	A. H. Tuttle.....	5.41	a 0.2
Apr. 27	Tuttle and Edwards.....	5.97	46	July 2	R. F. Edwards.....	5.40	a. 1
May 7	do.....	5.68	9.6				

a Estimated.

Daily discharge, in second-feet, of Rock Creek near Hinsdale, Mont., for the year ending Sept. 30, 1918.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1		357	20	0.1	0.1	0.1	0.1
2		271	20	.1	.1	.1	.1
3		179	20	.1	.1	.1	.1
4		91	20	.1	.1	.1	.1
5		51	34	.1	.1	.1	.1
6		20	20	.1	.1		.1
7		4.4	4.4	.1			.1
8		4.4	4.4	.1	.1		.1
9		.1	4.4	.1	.1		.1
10		.1	4.4	.1	.1		.1
11			1.3	.1	.1		.1
12			1.3	.1	.1		.1
13			1.3	.1	.1		.1
14			1.3		.1		.1
15		.1	.1	.1	.1		.1
16		4.4	.1		.1		.1
17		225			.1		.1
18		91			.1	51	.1
19		91		.8	.1	51	.1
20		51			.1	51	.1
21		51	.1	.1	.1	20	.1
22	1,180	51	.1	.1	.1	271	.1
23	2,110	51			.1	1,240	.1
24	2,230	20		.1	.1	271	.1
25	3,260	4.4		.1	.1	179	.1
26	3,200	20			.1	51	.1
27	2,820	51	.1		.1	34	.1
28	1,960	51	.1		.1	4.4	.1
29	1,240	34	.1		.1	1.3	.1
30	863	34	.1		.1	.1	.1
31	486		.1		.1	.1	

Combined daily discharge, in second-feet, of Rock Creek and Rock Creek canal near Hinsdale, Mont., for the year ending Sept. 30, 1918.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1		357	20	13.1	2.1	0.1	6.5
2		271	20	13.1	1.9	.1	6.5
3		179	20	11.3	1.3	.1	6.5
4		91	20	11.3	1.3	.1	6.5
5		51	34	12.2	1.0	.1	6.5
6		20	20	9.6	1.0	0	6.5
7		4.4	19.1	9.6	.6	0	6.5
8		4.4	19.3	7.7	.4	0	.1
9		.1	19.3	5.9	.4	0	.1
10		.1	19.3	5.2	.4	0	.1
11		0	16.2	4.7	.4	0	.1
12		0	16.2	4.7	.4	0	.1
13		0	16.2	5.9	.4	0	.1
14		0	16.2	5.8	.4	0	.1
15		.1	21.1	5.9	.1	0	.1
16		4.4	19.1	5.1	.1	0	.1
17		225	17	5.1	.1	0	.1
18		91	16	5.1	.1	83	.1
19		91	14.9	8.7	.1	85	.1
20		51	14.9	8.7	.1	85	.1
21		51	15.0	8.8	.1	52	.1
22	1,180	51	17.1	6.5	.1	305	.1
23	2,110	51	17.0	5.8	.1	1,274	.1
24	2,230	20	17.0	4.7	.1	290	.1
25	3,260	4.4	16.0	4.1	.1	198	.1
26	3,200	20	14.9	3.4	.1	70	.1
27	2,820	51	15.0	3.4	.1	53	.1
28	1,960	51	15.0	2.0	.1	23.4	.1
29	1,240	34	17.1	2.0	.1	20.3	.1
30	863	34	17.1	2.0	.1	17.1	.1
31	486		15.0		.1	17.1	

Monthly discharge of Rock Creek near Hinsdale, Mont., for the year ending Sept. 30, 1918.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
March 22-31.....	3,260	486	1,930	38,300
April.....	357	0	60.3	3,590
May.....	34	0	5.87	361
June.....	0.8	0	.09	5.4
July.....	0.1	0	.10	6.2
August.....	1,240	0	71.8	4,410
September.....	0.1	0.1	0.1	6.0

NOTE.—No flow Oct. 1-27.

Combined monthly discharge of Rock Creek and Rock Creek canal near Hinsdale, Mont., for the year ending Sept. 30, 1918.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
March 22-31.....	3,260	486	1,930	38,300
April.....	357	0	60.3	3,590
May.....	34	14.9	17.9	1,100
June.....	13.1	2.0	6.71	399
July.....	2.1	.1	.44	27.1
August.....	1,274	0	83.0	5,100
September.....	6.5	.1	1.59	94.6

NOTE.—No flow Oct. 1-27.

ROCK CREEK CANAL NEAR HINSDALE, MONT.

LOCATION.—In SW. $\frac{1}{4}$ sec. 10, T. 31 N., R. 36 E., 150 feet below first check weir and bridge, 1 mile below intake from Rock Creek, and about 6 miles northeast of Hinsdale.

RECORDS AVAILABLE.—May 7 to September 30, 1918.

GAGE.—Vertical staff gage on left bank, 150 feet below first check weir and bridge over canal; read by John Hoerster.

DISCHARGE MEASUREMENTS.—Made by wading or from highway bridge 1 mile downstream.

CHANNEL AND CONTROL.—Bed solid with sand and fine gravel and heavy clay underneath. Weeds grow in bottom during summer. Flow probably affected by check 1 mile downstream.

ACCURACY.—Stage-discharge relation permanent. Rating curve well defined below 42 second-feet. Gage read to half-tenths daily, May 7 to September 7. Records good.

Water is diverted from Rock Creek to irrigate land on west side of creek. No water returned to creek.

Discharge measurements of Rock Creek canal near Hinsdale, Mont., during the year ending Sept. 30, 1918.

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 7	Edwards and Tuttle...	4.29	16	June 8	Edwards and Tuttle...	3.85	7.1
16	R. F. Edwards.....	4.52	18.1	July 2	R. F. Edwards.....	3.34	41.5

a Estimated.

Daily discharge, in second-feet, of Rock Creek canal, near Hinsdale, Mont., for the year ending Sept. 30, 1918.

Day.	May.	June.	July.	Aug.	Sept.	Day.	May.	June.	July.	Aug.	Sept.
1.....		13.0	2.0	.....	6.4	16.....	19.0	5.1	.....	.....	.....
2.....		13.0	1.8	.....	6.4	17.....	17.0	5.1	.....	.....	.....
3.....		11.2	1.2	.....	6.4	18.....	16.0	5.1	.....	32	.....
4.....		11.2	1.2	.....	6.4	19.....	14.9	7.9	.....	34	.....
5.....		12.1	.9	.....	6.4	20.....	14.9	8.7	.....	34	.....
6.....		9.5	.9	.....	6.4	21.....	14.9	8.7	.....	32	.....
7.....	14.7	9.5	.6	.....	6.4	22.....	17.0	6.4	.....	34	.....
8.....	14.9	7.6	.3	.....	.....	23.....	17.0	5.8	.....	34	.....
9.....	14.9	5.8	.3	.....	.....	24.....	17.0	4.6	.....	19	.....
10.....	14.9	5.1	.3	.....	.....	25.....	16.0	4.0	.....	19	.....
11.....	14.9	4.6	.3	.....	.....	26.....	14.9	3.4	.....	19	.....
12.....	14.9	4.6	.3	.....	.....	27.....	14.9	3.4	.....	19	.....
13.....	14.9	5.8	.3	.....	.....	28.....	14.9	2.0	.....	19	.....
14.....	14.9	5.8	.3	.....	.....	29.....	17.0	2.0	.....	19	.....
15.....	21.0	5.8	.....	.....	.....	30.....	17.0	2.0	.....	17	.....
						31.....	14.9	.....	.....	17	.....

Monthly discharge of Rock Creek canal near Hinsdale, Mont., for the year ending Sept. 30, 1918.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
May 7-31.....	21	14.7	15.9	788
June.....	13	2	6.66	396
July 1-14.....	2	.3	.76	21.0
August 18-31.....	34	17	24.8	670
September 1-7.....	6.4	6.4	6.4	88.9

NOTE.—No flow July 15 to Aug. 17.

PORCUPINE CREEK AT NASHUA, MONT.

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

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—July 11, 1908, to September 30, 1918.

GAGE.—Vertical staff in three sections nailed to trees on left bank; read by Rosie Brocksmith.

DISCHARGE MEASUREMENTS.—Made by wading near gage, or at high stages from a bridge a quarter of a mile below.

CHANNEL AND CONTROL.—Bed of stream is of mud with a slight gravel bar forming control at low stages. This is soon drowned out, as creek rises and the control is the whole channel below gage.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 13.2 feet at 6 p. m. August 22 (discharge, 718 second-feet); no flow July 3 to August 21.

1909-1918: Maximum stage recorded, 18.0 feet April 11, 1916, determined by leveling from flood marks (discharge from extension of rating curve, 2,700 second-feet); no flow for periods during several years.

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

DIVERSIONS.—A United States Reclamation Service canal is practically completed which will divert the entire flow during irrigation season; approximately 200 acre-feet were diverted in 1918.

REGULATION.—A United States Reclamation Service reservoir on the middle fork of stream partially regulates flood flow.

ACCURACY.—Stage-discharge relation permanent during year. Rating curve well defined below 30 second-feet and poorly defined above. Gage read to hundredth twice daily; record fair. Daily discharge ascertained by applying rating table to daily gage height. Records fair.

Discharge measurements of Porcupine Creek at Nashua, Mont., during the year ending Sept. 30, 1918.

Date.	Made by—	Gage height.	Discharge.
Apr. 28	Edwards and Tuttle.....	<i>Feet.</i> 4.00	<i>Sec.-ft.</i> 23.5
May 26	A. H. Tuttle.....	3.10	a, 8

a Float measurement.

Daily discharge, in second-feet, of Porcupine Creek, at Nashua, Mont., for the year ending Sept. 30, 1918.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1.....		190	10	0.8	0.3	.....	0.8
2.....		221	12	.8	.3	.....	.8
3.....		190	10	.8	.....	.....	.8
4.....		89	7.5	.8	.....	.....	.8
5.....		48	14	.8	.....	.....	1.5
6.....		36	12	.8	.....	.....	1.5
7.....		32	12	.8	.....	.....	.8
8.....		17	10	.8	.....	.....	.6
9.....		24	10	.8	.....	.....	.6
10.....		24	7.5	.8	.....	.....	.3
11.....		24	7.5	.8	.....	.....	.3
12.....		28	7.5	.8	.....	.....	.3
13.....		28	7.5	.8	.....	.....	.3
14.....		20	7.5	.8	.....	.....	.3
15.....		20	6.2	.8	.....	.....	.3
16.....		334	6.2	.7	.....	.....	.3
17.....		207	4.8	.6	.....	.....	.3
18.....		116	4.8	.5	.....	.....	.3
19.....		83	4.8	.4	.....	.....	.3
20.....		73	3.8	.8	.....	.....	.3
21.....		58	2.8	.8	.....	.....	.2
22.....		48	2.8	.8	.....	454	.3
23.....		42	2.8	.0	.....	123	.3
24.....		36	2.8	.0	.....	32	.3
25.....		32	2.8	.3	.....	20	.3
26.....		32	.8	.3	.....	7.5	.4
27.....	338	26	.8	.3	.....	4.8	.5
28.....	438	22	.8	.3	.....	2.8	.5
29.....	232	20	.8	.3	.....	1.5	.5
30.....	207	17	.8	.3	.....	.8	.5
31.....	200	.....	.8	.....	.....	.8	.....

NOTE.—No flow Oct. 1 to Nov. 30 and July 3 to Aug. 21.

Monthly discharge of Porcupine Creek at Nashua, Mont., for the year ending Sept. 30, 1918.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October.....	0	0	0	0
November.....	0	0	0	0
March 27-31.....	438	200	283	2,810
April.....	334	17	71.2	4,240
May.....	14	.8	5.95	368
June.....	.8	.0	.61	36.2
July.....	.3	.0	.02	1.2
August.....	454	.0	20.9	1,290
September.....	1.5	.2	.51	30.3

LITTLE PORCUPINE CREEK BASIN.

LITTLE PORCUPINE CREEK AT FRAZER, MONT.

LOCATION.—In NE. $\frac{1}{4}$ sec. 28, T. 27 N., R. 44 E., half a mile above diversion dam at intake to reservoir of United States Reclamation Service on Fort Peck Indian Reservation, half a mile north of Frazer, in Valley County.

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—July 13, 1908, to September 30, 1916; April 3 to September 30, 1918. (See under "Gage.")

GAGE.—Vertical staff on left bank directly north of buildings on William Ivey's ranch; read by Daniel Martin. July 13, 1908, to September 30, 1910, staff gage $1\frac{1}{2}$ miles downstream; April 14, 1911, to May 10, 1913, staff gage a quarter of a mile below present site. Flow at three points is practically the same.

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

CHANNEL AND CONTROL.—Principal control bar of small rocks and gravel. At high stages willows growing on banks of stream may cause small changes in stage-discharge relation.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 1.02 feet April 3 at 4 p. m. (discharge, 20 second-feet); no flow May 28 to September 30.

1908-1918: Maximum discharge recorded, about 500 second-feet April 5, 1912; no flow during periods for each year.

ICE.—Channel is usually dry during winter.

DIVERSIONS.—None above station; entire flow except extreme floods diverted into reservoir half a mile below. Amount of water diverted during 1918, as reported by United States Reclamation Service, was 2,650 acre-feet.

REGULATION.—None.

ACCURACY.—Stage-discharge relation permanent during year. Rating curve well defined below and fairly well defined above 20 second-feet. Gage read to even hundredths once daily. Daily discharge obtained by applying rating table to daily gage heights. Records good.

Discharge measurements of Little Porcupine Creek at Frazer, Mont., during 1917 and 1918.

Date.	Made by—	Gage height.	Dis-charge.	Date.	Made by—	Gage height.	Dis-charge.
1917.		<i>Feet.</i>	<i>Sec.-ft.</i>	1918.		<i>Feet.</i>	<i>Sec.-ft.</i>
May 14	A. H. Tuttle.....	0.68	7.9	Apr. 4	Tuttle and Conner.....	0.83	10.5
June 12	do.....	.65	4.1	26	A. H. Tuttle.....	.73	6.7

Daily discharge, in second-feet, of Little Porcupine Creek at Frazer, Mont., for the year ending Sept. 30, 1918.

Day.	Apr.	May.	Day.	Apr.	May.	Day.	Apr.	May.
1.....		4.1	11.....	4.1	2.1	21.....	20	1.1
2.....		3.6	12.....	4.7	1.7	22.....	16	.8
3.....	20	3.1	13.....	4.7	1.7	23.....	13	.8
4.....	10	3.1	14.....	4.7	1.7	24.....	9.1	.6
5.....	8.8	2.8	15.....	8.4	1.4	25.....	10	.6
6.....	7.1	2.8	16.....	15	1.4	26.....	7.7	.3
7.....	5.2	2.4	17.....	46	1.4	27.....	7.1	.3
8.....	4.1	2.4	18.....	79	1.1	28.....	6.4	.0
9.....	4.1	2.4	19.....	47	1.1	29.....	5.2	.0
10.....	4.7	2.1	20.....	29	1.1	30.....	4.7	.0
						31.....		.0

* *Monthly discharge of Little Porcupine Creek at Frazer, Mont., for the year ending Sept. 30, 1918.*

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
April 3-30.....	79	4.1	14.5	805
May.....	4.1	.0	1.55	95.3

NOTE.—No flow May 28 to September 30.

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, 1918, at present site; August 15, 1908, to May 1, 1911, in 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 United States Reclamation Service camp in NE. $\frac{1}{4}$ sec. 4, T. 29 N., R. 51 E., 18 miles north of Poplar.

GAGE.—Chain gage on left bank at United States Reclamation Service camp; read by F. W. Cothren, an employee of the Reclamation Service. Gage moved 300 feet upstream September 15, 1918.

DISCHARGE MEASUREMENTS.—Made by wading near the gage or from the highway bridge at Poplar, 8 miles below.

CHANNEL AND CONTROL.—Composed of gravel, clay, and boulders; shifts slightly, usually at extreme stages.

EXTREMES OF DISCHARGE.—Maximum stage recorded during the year, 9.15 feet at 5 p. m. March 23 (discharge, 3,140 second-feet); no flow December 16 and 17, when river was frozen practically solid.

1908-1918: Maximum stage resorded, 12.0 feet April 10, 1912; determined by leveling from flood marks (discharge determined from extension rating curve 10,000 second-feet); no flow December 16 and 17, 1918.

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

DIVERSIONS.—Poplar River canals, "East and West," diverted water above gage for irrigation of about 2,000 acre-feet. When the system of reservoirs is completed, about 28,000 acres may be irrigated. Low flow during July and August owing to the fact that all water was diverted above station.

REGULATION.—None.

ACCURACY.—Stage-discharge relation permanent except as affected by ice. Rating curve well defined between 10 and 500 second-feet and fairly well defined above 500 second-feet. Gage read to half-tenths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table. Records good, except those for periods of ice effect, which are fair.

Discharge measurements of Poplar River near Poplar, Mont., during the year ending Sept. 30, 1918.

[Made by A. H. Tuttle.]

Date.	Gage height.	Discharge.
	<i>Feet.</i>	<i>Sec.-ft.</i>
Apr. 1 ^a	6.00	473
24 ^a	5.23	213
Sept. 15.....	4.48	53

^a Measurement made from highway bridge at Poplar, 8 miles below gage.

Daily discharge, in second-feet, of Poplar River near Poplar, Mont., for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Dec.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1.....	11	21	21	.....	476	131	46	8	14	74
2.....	11	21	26	.....	398	131	40	8	14	74
3.....	14	21	20	.....	325	120	40	8	8	66
4.....	14	26	16	.....	272	120	40	8	8	66
5.....	14	30	12	.....	255	120	40	8	8	59
6.....	14	30	8	.....	208	120	35	8	8	59
7.....	14	30	5	.....	193	110	35	8	8	52
8.....	14	30	2	.....	180	110	35	8	8	52
9.....	14	30	.5	.....	154	91	30	8	8	52
10.....	14	30	1.5	.....	120	82	26	8	8	46
11.....	14	35	.5	.....	110	82	21	8	8	42
12.....	14	35	.5	.....	110	74	21	8	8	38
13.....	14	35	.5	.....	100	74	18	8	8	32
14.....	14	35	.5	.....	100	66	18	8	8	52
15.....	14	35	.5	.....	100	66	18	8	8	52
16.....	14	35	.0	.....	239	59	14	8	8	50
17.....	18	35	.0	.....	398	55	14	8	20	42
18.....	18	35	.8	.....	456	52	14	8	23	40
19.....	18	35	9	26	361	50	14	8	20	46
20.....	18	35	26	35	290	46	14	8	18	43
21.....	18	35	30	642	272	55	14	8	14	46
22.....	3.6	35	30	1,280	255	66	14	8	180	40
23.....	4.8	35	30	2,760	255	63	11	8	154	49
24.....	20	35	26	1,620	223	59	11	13	100	40
25.....	18	32	20	1,790	223	52	11	23	86	40
26.....	18	30	18	1,700	193	46	8	18	82	40
27.....	20	30	16	1,620	193	46	8	30	79	40
28.....	21	30	14	1,280	180	46	8	21	74	40
29.....	21	30	12	1,190	166	46	8	18	74	40
30.....	21	21	10	902	166	46	8	18	74	40
31.....	21	.....	10	615	.....	46	.....	18	74	.....

NOTE.—Decrease in flow Oct. 22 and 23 caused by a heavy freeze. Discharge, Dec. 4-18 and 24-31, estimated because of ice from temperature records and observer's notes. Increase in flow, Dec. 19-23, caused by a chinook wind. Gage not read Jan. 1 to Mar. 18. Water from ditch turned into river Sept. 14.

Monthly discharge of Poplar River near Poplar, Mont., for the year ending Sept. 30, 1918.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October.....	21	3.6	15.4	947
November.....	35	21	31.1	1,850
December.....	30	0	11.8	728
March 19-31.....	2,760	26	1,190	30,700
April.....	476	100	232	13,800
May.....	131	46	75.2	4,620
June.....	46	8	21.1	1,260
July.....	30	8	11.1	682
August.....	180	8	39.1	2,400
September.....	74	32	48.2	2,870

BIG MUDDY CREEK BASIN.

BIG MUDDY CREEK NEAR CULBERTSON, MONT.

LOCATION.—In NE. $\frac{1}{4}$ sec. 20, T. 29 N., R. 54 E., 300 feet above ford at Kraft's ranch, 11 miles above mouth, 16 miles northwest of Culbertson, in Sheridan County, and 8 miles above site of original station at Boyd's ranch.

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—July 19, 1909, to September 30, 1918, at present station; July 14, 1908, to July 19, 1909, at Boyd's ranch.

GAGE.—Overhanging wire gage on left bank installed September 17, 1918; read by Jacob Kraft. July 19, 1909, to September 16, 1918, an inclined staff at same location and datum; July 14, 1908, to July 19, 1909, staff gage at Boyd's ranch.

DISCHARGE MEASUREMENTS.—Made by wading at ford or from the highway bridge 9 miles below gage or from highway bridge at Homestead 20 miles above.

CHANNEL AND CONTROL.—A bar of gravel with few small boulders forms principal low-water control; as creek rises this control is drowned out and control becomes indefinite. Creek has low gradient, crooked channel, and mud banks which are subject to overflow only at extreme stages. Aquatic plants grow in channel and sometimes affect stage-discharge relation.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 9.50 feet at 3 p. m. March 30 (discharge, 1,070 second-feet); minimum stage, 1.75 feet July 17-21 and August 11-14 (discharge, 0.8 second-foot).

ACCURACY.—Gage-height records reliable, readings taken to nearest half-tenth once daily. Stage-discharge relation permanent during the year. Rating curve well defined between 10 and 1,500 second-feet and fairly well defined below 10 second-feet. Gage read to half-tenths once daily. Daily discharge obtained by applying daily gage height to rating table. Records good.

Discharge measurements of Big Muddy Creek near Culbertson, Mont., during the year ending Sept. 30, 1918.

Date.	Made by—	Gage height.	Discharge.
Apr. 2 ^a	Tuttle & Conner.....	Feet. 4.81	Sec.-ft. 190
23 ^b	do.....	4.75	186
Sept. 17 ^c	A. H. Tuttle.....	1.98	3.5

^a Measurement made at highway bridge at Homestead, 20 miles above gage. Flow of Smoke Creek (26 second-feet) added.

^b Measured at highway bridge at Homestead. Flow of Smoke Creek (12 second-feet) added.

^c Measurement made with floats.

Daily discharge, in second-feet, of Big Muddy Creek at Culbertson, Mont., for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Dec.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	5.5	14	7.0		458	82	28	4.0	2.0	8.5
2	4.0	14			212	82	22	4.0	1.5	8.5
3	4.0	12			147	82	20	4.0	1.5	8.5
4	4.0	12			124	72	20	4.0	1.5	10.0
5	3.0	12			110	65	18	4.0	1.5	10.0
6	3.0	10			90	62	18	4.0	1.5	8.5
7	4.0	10			68	62	14	4.0	1.0	8.5
8	4.0	8.5			68	56	14	3.0	1.0	7.0
9	3.0	8.5			65	50	16	3.0	1.0	4.0
10	3.0	7.0			62	44	16	2.0	1.0	4.0
11	2.0	7.0			59	44	16	1.0	.8	4.0
12	2.0	7.0			56	44	14	1.0	.8	4.0
13	2.0	7.0			56	39	12	1.0	.8	4.0
14	2.0	8.5			56	36	7.0	1.0	.8	4.0
15	2.0	8.5			59	30	7.0	1.0	1.5	4.0
16	3.0	8.5			62	32	7.0	1.0	5.5	4.0
17	3.0	8.5			62	26	7.0	.8	4.0	4.0
18	5.5	7.0			162	26	7.0	.8	4.0	4.0
19	10	7.0			212	28	7.0	.8	4.0	4.0
20	10	8.5			212	28	7.0	.8	4.0	2.0
21	8.5	8.5			212	26	7.0	.8	3.0	2.6
22	10	8.5			212	26	7.0	1.0	3.0	2.8
23	10	10			188	28	7.0	1.0	3.0	2.8
24	12	10		740	188	30	7.0	1.0	3.0	2.8
25	12	10		894	133	32	7.0	.8	4.0	2.8
26	14	10		806	115	30	7.0	1.0	4.0	3.2
27	16	10		806	106	30	7.0	2.0	5.5	3.2
28	18	10		784	98	30	7.0	2.0	5.5	3.6
29	18	8.5		960	94	30	7.0	2.0	7.0	3.6
30	17	8.5		1,070	90	30	7.0	2.0	7.0	3.4
31	16			612		28		2.0	4.0	

NOTE.—Gage not read Dec. 2 to Mar. 23.

Monthly discharge of Big Muddy Creek near Culbertson, Mont., for the year ending Sept. 30, 1918.

Month	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	18	2.0	7.44	457
November	14	7.0	9.32	555
March 24-31	1,070	612	834	13,200
April	458	56	128	7,620
May	82	26	42.3	2,600
June	28	7.0	11.6	690
July	4.0	.8	1.96	121
August	7.0	.8	2.86	176
September	10.0	2.0	4.88	290

WOLF CREEK NEAR MEDICINE LAKE, MONT.

LOCATION.—In SE. $\frac{1}{4}$ NW. $\frac{1}{4}$ sec. 31, T. 33 N., R. 54 E., 100 feet below proposed dam site of United States Reclamation Service, 50 miles northeast of Poplar on Poplar Plentywood trail, and 12 miles northwest of Medicine Lake, in Sheridan County.

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—April 1 to September 16, 1918.

GAGE.—Overhanging wire gage installed September 16, 1918. Prior to that date a vertical staff 20 feet downstream was read; both gages in same pool above control; read by David Summers.

DISCHARGE MEASUREMENTS.—Made by wading.

CHANNEL AND CONTROL.—A bar composed of heavy cobblestones, gravel, and clay forms low-water control. At high water stream overflows right bank and control is probably drowned. Left bank is high and will not be overflowed.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year 2.40 feet April 17 (discharge, 28 second-feet); no flow June 28 to July 9 and August 9-18.

ICE.—Stream probably dry during winter.

DIVERSIONS.—None.

REGULATION.—None.

ACCURACY.—Stage-discharge relation permanent during year. Rating curve well defined between 2 and 10 second-feet. Gage read to tenths three times weekly. Daily discharge obtained by applying gage heights to rating table for days on which the gage was read, and interpolating discharge for intervening days. Records fair.

Discharge measurements of Wolf Creek near Medicine Lake, Mont., 1916-1918.

[Made by Tuttle and Conner.]

Date.	Gage height.	Dis-charge.	Date.	Gage height.	Dis-charge.
1916.	Feet.	Sec.-ft.	1918.	Feet.	Sec.-ft.
July 22.....	1.11	3.3	Apr. 2	1.21	4.8
			May 29.....	1.01	2.2

Daily discharge, in second-feet, of Wolf Creek near Medicine Lake, Mont., for the year ending Sept. 30, 1918.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Day.	Apr.	May.	June.	July.	Aug.	Sept.
1.....	4.0	6.0	1.6	0.0	0.2	0.5	16.....	22	2.1	0.5	0.1	0.0	0.2
2.....	4.6	4.5	1.2	.0	.1	.3	17.....	28	2.1	.3	.1	.0	.....
3.....	5.2	3.8	1.2	.0	.1	.1	18.....	17	2.1	.1	.1	.0	.....
4.....	4.2	3.2	1.2	.0	.1	.1	19.....	6.0	2.1	.1	.1	.7	.....
5.....	3.2	3.8	1.2	.0	.1	.1	20.....	7.1	3.3	.1	.1	1.4	.....
6.....	3.2	4.5	1.2	.0	.1	.1	21.....	8.2	4.5	.1	.1	2.1	.....
7.....	3.2	3.8	1.2	.0	.1	.1	22.....	9.3	4.5	.1	.1	3.2	.....
8.....	3.0	3.2	1.2	.0	.1	.1	23.....	7.6	4.5	.1	.1	3.2	.....
9.....	2.7	2.8	1.2	.0	.0	.1	24.....	6.0	3.8	.1	.1	3.2	.....
10.....	2.7	2.4	1.2	.1	.0	.1	25.....	5.2	3.2	.1	.5	2.6	.....
11.....	2.7	2.1	1.2	.1	.0	.1	26.....	4.5	3.2	.1	.5	2.1	.....
12.....	2.7	2.1	1.2	.1	.0	.1	27.....	6.0	3.2	.1	.5	2.1	.....
13.....	2.7	2.1	1.2	.1	.0	.1	28.....	7.6	2.6	.1	.5	2.1	.....
14.....	9.1	2.1	1.2	.1	.0	.1	29.....	7.6	2.1	.0	.5	1.6	.....
15.....	16	2.1	.8	.1	.0	.1	30.....	7.6	2.1	.0	.4	1.2	.....
							31.....	2.1	.....	.....	.3	.8	.....

Monthly discharge of Wolf Creek near Medicine Lake, Mont., for the year ending Sept. 30, 1918:

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
April.....	28	2.7	7.30	434
May.....	6.0	2.1	3.10	191
June.....	1.6	.0	.66	39.3
July.....	.5	.0	.15	9.2
August.....	3.2	.0	.88	54.1
September.....	.5	.1	.14	4.1
The period.....				552

SMOKE CREEK NEAR POPLAR, MONT.

LOCATION.—In SE. $\frac{1}{4}$ SW. $\frac{1}{4}$ sec. 7, T. 30 N., R. 54 E., just above ford on Poplar-Homestead trail, 30 miles northeast of Poplar, in Sheridan County.

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—April 21 to July 6, 1918.

GAGE.—Vertical staff on left bank graduated in feet and tenths; read by Leon Fough.

DISCHARGE MEASUREMENTS.—Made by wading a ford 200 feet below gage.

CHANNEL AND CONTROL.—Control is gravel bar with a few heavy boulders; may change during high stages. Banks low, covered with grass, and are overflowed at high stages.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 1.69 feet, April 2 (discharge, 25 second-feet); minimum stage recorded, 0.60 foot, May 31 to June 14, June 16-22 and 24-29, July 1-6 (discharge, 4.6 second-feet).

DIVERSIONS.—None. Site of proposed United States Reclamation Service dam is about half a mile upstream.

ACCURACY.—Stage-discharge relation permanent during period of record. Rating curve well defined between 3 and 40 second-feet. Gage read to tenths once daily; record subject to slight error after June 22. Daily discharge obtained by applying rating table to daily gage height for days when gage was read. Records fair.

Discharge measurements of Smoke Creek near Poplar, Mont., 1916-1918, during the year ending Sept. 30, 1918.

[Made by Tuttle and Conner.]

Date.	Gage height.	Dis-charge.	Date.	Gage height.	Dis-charge.
1916.	<i>Feet.</i>	<i>Sec.-ft.</i>	1918.	<i>Feet.</i>	<i>Sec.-ft.</i>
July 22.....	0.53	3.8	Apr. 23.....	1.40	16.6
1918.			May 29.....	.71	5.7
Apr. 2.....	1.69	25.5			

Daily discharge, in second-feet, of Smoke Creek near Poplar Mont., for the year ending Sept. 30, 1918.

Day.	Apr.	May.	June.	July.	Day.	Apr.	May.	June.	July.
1.....		10.0	4.6	4.6	16.....		5.8	4.6	
2.....		9.8	4.6	4.6	17.....		5.8	4.6	
3.....		9.8	4.6	4.6	18.....		5.8	4.6	
4.....		9.8	4.6	4.6	19.....		5.8	4.6	
5.....		8.4	4.6	4.6	20.....		5.8	4.6	
6.....		8.4	4.6	4.6	21.....	22	5.8	4.6	
7.....		8.1	4.6		22.....	18	5.8	4.6	
8.....		7.8	4.6		23.....	17	5.8	5.8	
9.....		7.4	4.6		24.....	15	5.8	4.6	
10.....		7.1	4.6		25.....	14	5.8	4.6	
11.....		6.4	4.6		26.....	13	5.8	4.6	
12.....		6.8	4.6		27.....	16	5.8	4.6	
13.....		7.1	4.6		28.....	14	5.8	4.6	
14.....		6.8	4.6		29.....	12	5.8	4.6	
15.....		6.4	5.8		30.....	11	5.8	5.8	
					31.....		4.6		

NOTE.—Discharge interpolated for following days when gage was not read: Apr. 25, 29, May 1, 7, 9, 24, 28, June 6, 12, 19, 29, and July 4.

Monthly discharge of Smoke Creek near Poplar, Mont., for the year ending Sept. 30, 1918.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
April 21-30.....	22	11	15.2	302
May.....	10	4.6	6.83	420
June.....	5.8	4.6	4.72	281
July 1-6.....	4.6	4.6	4.60	54.7
The period.....				1,080

YELLOWSTONE RIVER BASIN.

YELLOWSTONE RIVER NEAR CANYON HOTEL, YELLOWSTONE NATIONAL PARK.

LOCATION.—In approximately sec. 16, T. 13 S., R. 10 E. Montana meridian, half a mile upstream from Upper Falls and Canyon soldier station, $1\frac{1}{4}$ miles south of Canyon Hotel, and 13 miles below outlet of Lake Yellowstone.

DRAINAGE AREA.—1,280 square miles (measured on topographic maps).

RECORDS AVAILABLE.—June 23, 1913, to September 30, 1918.

GAGE.—Friez water-stage recorder on left bank, about 450 feet above Chittenden Bridge, and about 900 feet below former vertical staff installed October 11, 1916, at about same datum. Vertical staff used September 13, 1913, to October 11, 1916. Original gage used June 22 to September 12, 1913, was of same type and at same site, but set to datum 1.03 feet higher than later staff. Readings on original gage reduced to datum of later staff. Gage read by privates and noncommissioned officers attached to Canyon soldier station.

DISCHARGE MEASUREMENTS.—Made by wading at low stages at a gravel and boulder section 100 feet below former staff gage. High-stage measurements made from cable about one-fifth of a mile above new gage.

CHANNEL AND CONTROL.—One channel at all stages. Bed of stream composed of gravel and boulders; control formed by upper portion of the Upper Yellowstone Falls and is practically permanent.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 4.50 feet at 3 p. m., June 27 (discharge, 8,550 second-feet); minimum stage, 1.17 feet October 21-27 (discharge, 1,030 second-feet). A lower gage height and smaller discharge probably occurred during period of no record.

1913-1918: Maximum stage recorded June 27, 1918; minimum stage, 0.75 foot October 16, 1915 (discharge, 675 second-feet). A less gage height and discharge occurred during periods of no records.

ICE.—Stage-discharge relation affected by ice; gage reading discontinued during winter.

DIVERSIONS.—None above station.

REGULATION.—None.

ACCURACY.—Stage-discharge relation permanent. Rating curve is well defined.

Discharge ascertained by applying mean daily gage height to rating table, obtained by inspecting recorder graph. Records good.

Discharge measurements of Yellowstone River near Canyon Hotel, Yellowstone National Park, during the year ending Sept. 30, 1918.

[Made by G. C. Baldwin.]

Date.	Gage height.	Discharge.
June 27.....	Feet. 4.50	Sec.-ft. 8,550
Sept. 5.....	1.69	1,560

Daily discharge, in second-feet, of Yellowstone River near Canyon Hotel, Yellowstone National Park, for the year ending Sept. 30, 1918.

Day.	Oct.	June.	July.	Aug.	Sept.	Day.	Oct.	June.	July.	Aug.	Sept.
1.....	1,420	.....	7,900	3,830	1,820	16.....	1,140	.....	6,090	2,540	.....
2.....	1,390	.....	7,750	3,830	1,750	17.....	1,090	.....	5,800	2,540	.....
3.....	1,380	.....	7,590	3,700	1,710	18.....	1,060	.....	5,660	2,440	.....
4.....	1,350	.....	7,590	3,700	1,670	19.....	1,060	.....	5,520	2,360	.....
5.....	1,330	.....	7,440	3,590	1,640	20.....	1,040	.....	5,390	2,360	.....
6.....	1,310	.....	7,280	3,360	1,630	21.....	1,030	.....	5,250	2,270	.....
7.....	1,290	.....	7,130	3,240	.....	22.....	1,030	.....	5,120	2,190	.....
8.....	1,270	.....	6,980	3,240	.....	23.....	1,030	.....	4,980	2,190	.....
9.....	1,260	.....	6,820	3,240	.....	24.....	1,030	.....	4,850	2,100	.....
10.....	1,240	.....	6,680	3,030	.....	25.....	1,030	.....	4,720	2,040	.....
11.....	1,220	.....	6,530	2,930	.....	26.....	1,030	.....	4,580	2,010	.....
12.....	1,180	.....	6,380	2,820	.....	27.....	1,030	8,550	4,460	1,980	.....
13.....	1,170	.....	6,240	2,730	.....	28.....	.....	8,390	4,330	1,940	.....
14.....	1,160	.....	6,240	2,630	.....	29.....	.....	8,220	4,200	1,920	.....
15.....	1,150	.....	6,090	2,630	.....	30.....	.....	8,220	4,080	1,900	.....
						31.....	.....	.....	3,950	1,870	.....

Monthly discharge of Yellowstone River near Canyon Hotel, Yellowstone National Park, for the year ending Sept. 30, 1918.

[Drainage area, 1,280 square miles.]

Month.	Discharge in second-feet.				Run-off.	
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches.	Acre-feet.
October 1-27.....	1,420	1,030	1,170	0.914	0.92	62,700
June 27-30.....	8,550	8,220	8,340	6.52	.97	66,200
July.....	7,900	3,950	5,920	4.62	5.33	364,000
August.....	3,830	1,870	2,680	2.09	2.41	165,000
September 1-6.....	1,820	1,630	1,700	1.33	.30	20,200

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, 1918.

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; read by Mrs. Lena Bassett.

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

CHANNEL AND CONTROL.—Bed of stream composed of small rocks. Current swift at all stages; no definite control visible but has not shifted since station was established. Banks high and not subject to overflow.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 11.5 feet on June 14 and 15 (discharged from extended rating curve, 26,500 second-feet); minimum stage, 0.85 feet February 15-23 (discharge, 935 second-feet).

1910-1918: Maximum stage recorded, 11.5 feet on June 14 and 15 (discharge from extended rating curve, 26,500 second-feet); minimum stage, 0.6 foot January 1, 1916 (discharge, 830 second-feet).

ICE.—Practically open channel throughout winter.

DIVERIONS.—No water diverted from Yellowstone River above station.

REGULATION.—Yellowstone Lake furnishes a natural but uncontrolled regulation.

ACCURACY.—Stage-discharge relation permanent; no ice effect during the year. Rating curve well defined between 1,000 and 18,300 second-feet. Gage read once daily to the half-tenths. Daily discharge ascertained by applying gage heights to rating table throughout the year, except January 31 to February 4, when the discharge was interpolated. Records good.

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

August 29, 1918: Gage height, 2.80 feet; discharge, 2,730 second-feet.

Daily discharge, in second-feet, of Yellowstone River at Corwin Springs, Mont., for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1.....	2,500	1,700	1,400	1,310	1,090	1,010	1,700	2,120	7,970	12,200	4,980	2,560
2.....	2,500	1,700	1,310	1,310	1,090	1,010	1,700	2,500	7,220	11,900	4,980	2,560
3.....	2,450	1,700	1,220	1,310	1,080	1,070	1,700	2,930	6,610	12,200	4,700	2,560
4.....	2,340	1,600	1,220	1,310	1,088	1,070	1,600	4,070	9,590	11,300	4,700	2,450
5.....	2,340	1,600	1,310	1,260	1,070	1,040	1,550	4,420	11,800	10,900	4,600	2,450
6.....	2,280	1,600	1,360	1,310	1,070	1,010	1,550	4,980	13,700	11,000	4,420	2,450
7.....	2,230	1,600	1,310	1,310	1,070	1,010	1,400	4,240	15,200	11,000	4,240	2,340
8.....	2,230	1,600	1,310	1,310	1,070	1,010	1,400	4,790	17,500	10,700	4,070	2,340
9.....	2,180	1,600	1,310	1,310	1,070	1,010	1,450	4,420	18,500	10,400	3,900	2,560
10.....	2,180	1,600	1,310	1,310	1,070	1,010	1,450	3,900	21,900	9,870	3,750	2,620
11.....	2,120	1,500	1,220	960	1,070	1,010	1,600	3,400	25,800	9,590	3,750	2,340
12.....	2,120	1,450	1,220	1,400	1,070	1,010	1,650	3,470	25,800	9,310	3,610	2,230
13.....	2,120	1,400	1,140	1,140	1,070	1,010	1,700	3,610	25,200	9,310	3,610	2,120
14.....	2,010	1,400	1,310	1,100	1,010	1,140	1,800	5,380	26,500	9,030	3,540	2,230
15.....	2,010	1,400	1,400	1,100	935	1,140	1,900	6,020	26,500	8,760	3,540	2,230
16.....	2,010	1,400	1,310	1,070	935	1,070	1,750	5,590	24,800	8,490	3,500	2,230
17.....	1,900	1,400	1,310	1,070	935	1,070	1,650	5,590	23,500	8,230	3,470	3,120
18.....	1,800	1,400	1,400	1,070	935	1,100	1,600	5,180	21,500	7,970	3,330	2,120
19.....	1,800	1,400	1,400	1,070	935	1,140	1,580	4,240	24,500	7,720	3,190	2,120
20.....	1,700	1,400	1,310	1,070	935	1,220	1,500	3,900	23,500	7,220	3,190	2,010
21.....	1,800	1,310	1,310	1,070	935	1,310	1,550	3,980	21,200	7,220	3,120	1,960
22.....	1,800	1,380	1,310	1,070	935	1,310	1,600	4,600	21,500	6,970	3,120	1,960
23.....	1,800	1,310	1,310	1,070	935	1,360	1,600	4,980	21,500	6,730	3,060	2,010
24.....	1,800	1,310	1,310	1,070	1,010	1,400	1,600	6,250	21,200	6,730	2,930	1,960
25.....	1,800	1,310	1,310	1,070	1,010	1,450	1,600	6,490	20,100	6,490	2,930	1,960
26.....	1,800	1,310	1,400	1,070	1,010	1,500	1,650	5,800	17,700	6,250	2,800	1,960
27.....	1,700	1,360	1,360	1,070	1,010	1,500	1,700	5,280	16,400	6,020	2,800	1,960
28.....	1,700	1,360	1,360	1,070	1,010	1,500	1,650	4,980	14,900	5,380	2,800	1,900
29.....	1,400	1,400	1,360	1,100	.....	1,500	1,620	6,730	13,100	5,380	2,800	2,560
30.....	1,600	1,400	1,360	1,100	.....	1,550	1,800	6,730	12,200	5,180	2,680	2,230
31.....	1,700	.....	1,360	1,100	.....	1,550	.....	7,840	.....	5,180	2,560	.....

Monthly discharge of Yellowstone River at Corwin Springs, Mont., for the year ending Sept. 30, 1918.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October.....	2,500	1,400	1,990	122,000
November.....	1,700	1,310	1,460	86,900
December.....	1,400	1,140	1,320	81,200
January.....	1,400	960	1,160	71,300
February.....	1,090	935	1,020	56,600
March.....	1,550	1,010	1,200	73,800
April.....	1,900	1,400	1,620	96,400
May.....	7,840	2,120	4,790	295,000
June.....	26,500	6,610	18,600	1,110,000
July.....	12,200	5,180	8,540	525,000
August.....	4,980	2,560	3,580	220,000
September.....	2,620	1,900	2,240	133,000
The year.....	26,500	935	3,960	2,870,000

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, 1918. 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 Matt Griebler, employee of United States Reclamation Service.

DISCHARGE MEASUREMENTS.—Made from bridge at Glendive or from ferryboat 100 feet below dam.

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 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, 10.8 feet June 20 (discharge, 126,000 second-feet); minimum stage recorded, 1.7 feet November 20 to December 13 (discharge, 6,240 second-feet).

1903-1918: Maximum open-channel stage recorded, 10.8 feet June 20, 1918 (discharge, 126,000 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 19; flow not computed. Slight ice effect may have occurred during December, but open-channel rating used.

DIVERSIONS.—The Lower Yellowstone canal, which diverts water to irrigate 66,000 acres of land, heads at the north abutment of dam. Of the several diversions from the main stream above station, the United States Reclamation Service Huntley project and the Billings Carey Act project are the largest. There are numerous diversions on the tributaries.

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 for the periods affected by ice. Rating curve fairly well defined by measurements made at Glendive Bridge and referred to the gage at Intake through a curve of relation between gage heights at the two stations. Gage read to nearest tenth twice daily. Daily discharge ascertained by applying mean daily gage heights to rating table throughout the open season. Flow not computed January 1 to March 19 on account of ice on control. Records fair.

No discharge measurements were made during year.

Daily discharge, in second-feet, of Yellowstone River at Intake, Mont., for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Dec.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1.....	8,940	7,800	6,240	-----	14,800	11,500	21,900	61,400	19,000	7,800
2.....	8,940	7,530	6,240	-----	14,000	12,900	21,400	51,500	16,800	7,800
3.....	8,940	7,260	6,240	-----	12,900	11,800	24,400	44,300	14,000	8,360
4.....	8,490	7,260	6,240	-----	12,200	10,200	24,900	39,400	14,000	7,800
5.....	8,650	6,740	6,240	-----	10,800	11,100	23,400	36,800	13,200	7,800
6.....	8,360	6,740	6,240	-----	10,200	12,200	23,900	36,200	12,900	7,800
7.....	8,360	6,740	6,240	-----	9,540	14,400	25,400	34,900	13,600	7,800
8.....	8,360	6,740	6,240	-----	9,540	17,300	30,800	34,300	13,600	7,800
9.....	8,360	6,740	6,240	-----	9,540	20,000	42,200	33,100	16,000	7,800
10.....	8,360	6,740	6,240	-----	10,200	21,900	50,800	32,000	18,200	7,800
11.....	7,800	6,740	6,240	-----	10,200	24,400	65,200	30,800	17,700	8,360
12.....	7,800	6,740	6,240	-----	10,200	25,400	74,500	29,600	14,800	8,940
13.....	7,800	6,740	6,240	-----	10,200	23,400	81,600	31,400	12,900	8,360
14.....	7,800	6,740	7,000	-----	11,500	20,900	90,500	32,500	12,200	8,360
15.....	7,800	6,740	7,260	-----	12,900	19,500	98,000	33,100	11,800	8,360
16.....	7,530	6,740	7,260	-----	15,200	18,200	106,000	34,900	11,100	8,360
17.....	7,260	6,740	7,000	-----	16,000	18,600	113,000	40,100	10,800	8,360
18.....	7,000	6,740	6,740	-----	14,800	19,500	118,000	46,400	10,800	8,360
19.....	6,740	6,740	6,740	-----	12,900	20,400	124,000	45,000	10,800	10,200
20.....	6,740	6,240	6,740	75,300	11,800	21,400	126,000	36,800	10,800	9,540
21.....	6,740	6,240	6,740	46,400	11,500	21,400	123,000	32,000	14,800	8,940
22.....	6,740	6,240	6,740	44,300	11,100	21,400	121,000	30,200	13,200	8,360
23.....	6,740	6,240	6,740	39,400	10,800	19,000	116,000	28,600	13,600	8,360
24.....	6,740	6,240	6,740	34,900	10,800	19,000	112,000	27,000	12,500	8,360
25.....	6,740	6,240	6,740	33,100	10,800	21,900	101,000	25,400	11,500	8,360
26.....	6,740	6,240	6,740	28,000	11,500	22,400	99,800	24,900	10,500	8,650
27.....	6,740	6,240	6,740	24,900	10,800	23,400	99,800	23,900	9,540	12,900
28.....	6,740	6,240	6,740	20,000	10,200	24,400	99,800	22,900	8,940	12,900
29.....	6,740	6,240	6,740	17,300	10,200	25,400	88,000	21,900	8,650	11,500
30.....	7,260	6,240	6,740	16,800	10,800	23,900	72,200	21,900	8,360	9,540
31.....	7,260	-----	6,740	16,000	-----	22,900	-----	20,400	7,800	-----

Monthly discharge of Yellowstone River at Intake, Mont., for the year ending Sept. 30, 1918.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October.....	8,940	6,740	7,600	467,000
November.....	7,800	6,240	6,650	396,000
December.....	7,260	6,240	6,580	405,000
March 20-31.....	75,300	16,000	33,000	785,000
April.....	16,000	9,540	11,600	690,000
May.....	25,400	10,200	19,400	1,190,000
June.....	126,000	21,400	77,300	4,600,000
July.....	61,400	20,400	33,700	2,070,000
August.....	19,000	7,800	12,700	781,000
September.....	12,900	7,800	8,790	523,000

BIG TIMBER CREEK NEAR BIG TIMBER, MONT.

LOCATION.—Near center of SW. $\frac{1}{4}$ NE. $\frac{1}{4}$ sec. 6, T. 2 N., R. 14 E., at Iverson's ranch, $2\frac{1}{2}$ miles below junction of forks of Big Timber Creek and 10 miles northwest of Big Timber, in Sweet Grass County. Prior to April 5, 1918, station was in SE. $\frac{1}{4}$ sec. 5, T. 2 N., R. 14 E.

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—April 13, 1912, to September 30, 1918.

GAGE.—A temporary chain gage on left bank opposite sheep sheds on Webb's ranch; read by John Kremper until March 31, 1918. Beginning April 5, 1918, an overhanging wire gage on left bank about 500 feet below Iverson's wagon bridge and $1\frac{1}{2}$ miles upstream from site of previous gage; moved 75 feet downstream August 30, 1918; read by Iver Iverson.

DISCHARGE MEASUREMENTS.—Made from bridge or by wading. After bridge was destroyed one flood measurement was made by floats.

CHANNEL AND CONTROL.—Bed is of sand and gravel. Left bank very high and clean; right bank low and wooded. The current is swift.

EXTREMES OF DISCHARGE.—Maximum stage during year, 6.9 feet early on the morning of July 15, as determined the same day from high-water marks at gage (discharge, 1,960 second-feet); minimum stage, 1.90 feet October 17, 20, January 30, February 25-27, and March 20 (discharge, 20 second-feet).

1912-1918: Maximum stage recorded, 6.9 feet early on the morning of July 15, 1918, as determined the same day from high-water marks at gage (discharge, 1,960 second-feet); minimum discharge, 7 second-feet, March 20, 1915.

ICE.—Stage-discharge relation seriously affected by ice for a few short periods only; discharges interpolated for those periods.

DIVERSIONS.—Numerous irrigating ditches divert water both above and below the gage.

REGULATION.—None.

ACCURACY.—Stage-discharge relation permanent at old site, used until April. Low-water rating at new site slightly changed by high water. Rating curves well defined. Gage read to half-tenths twice daily before April 1 and to hundredths after April 1. Daily discharge ascertained by applying mean daily gage height to rating tables except for periods indicated in footnote to daily-discharge table. Records fair.

Discharge measurements of Big Timber Creek near Big Timber, Mont., during the year ending Sept. 30, 1918.

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. 1	W. A. Lamb.....	2.20	41.3	June 7	C. S. Heidel.....	4.45	433
Apr. 5	C. S. Heidel.....	^a 2.44	42.1	July 15	do.....	5.86	1,210
May 18	W. A. Lamb.....	3.25	128	Aug. 30	W. A. Lamb.....	^b 2.63	54

^a Gage at Iverson's ranch.

^b Gage moved 75 feet downstream; gage height at old site, 2.69 feet.

Daily discharge, in second-feet, of Big Timber Creek near Big Timber, Mont., for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1.....	34	31	44	42	26	25	42	72	146	212	130	49'
2.....	40	34	34	34	27	25	42	78	130	231	154	60
3.....	40	32	62	42	28	25	42	93	136	231	154	55
4.....	34	32	48	42	28	25	42	133	166	194	172	49
5.....	34	28	25	62	25	25	42	146	261	180	161	48
6.....	32	31	28	55	25	25	42	126	341	170	136	46
7.....	28	28	28	48	22	25	39	122	415	201	114	43
8.....	34	28	28	40	25	25	44	122	461	186	97	50
9.....	34	31	28	32	25	25	53	106	578	190	88	66
10.....	32	26	34	32	25	25	55	100	789	166	73	65
11.....	34	28	40	32	25	25	53	103	814	161	89	67
12.....	28	26	25	32	25	25	56	100	926	161	95	58
13.....	28	31	31	32	25	25	61	98	960	161	84	57
14.....	28	32	25	32	25	25	67	113	1,030	423	74	354
15.....	22	26	44	32	25	28	64	124	860	1,210	69	122
16.....	24	25	42	34	25	25	61	127	848	338	68	115
17.....	20	24	44	32	25	20	59	124	800	357	68	88
18.....	24	28	54	32	25	25	58	127	772	316	65	86
19.....	22	26	57	32	25	28	57	117	812	274	63	70
20.....	20	28	70	34	25	28	55	115	716	246	63	66
21.....	21	31	57	37	25	28	53	107	518	210	67	65
22.....	21	25	62	25	25	32	51	100	487	199	69	65
23.....	22	32	54	28	25	32	53	113	518	194	61	114
24.....	24	31	52	25	22	42	54	122	564	219	68	117
25.....	24	28	51	25	20	42	56	113	549	186	59	95
26.....	25	26	50	24	20	48	56	113	373	144	62	90
27.....	25	25	48	31	20	54	47	107	274	244	64	84
28.....	31	26	47	26	25	54	55	103	236	174	61	82
29.....	37	25	46	25	.....	48	57	111	212	159	56	79
30.....	44	28	44	20	.....	48	63	118	180	147	51	80
31.....	40	.....	43	26	.....	42	.....	138	.....	147	49	.....

NOTE.—Stage-discharge relation affected by ice Oct. 28, 29, Dec. 7, 8, 25-31, Feb. 1-3, 14-21, and Mar. 6-9, discharge interpolated. Gage not read Jan. 6-14 (discharge based on observer's notes), Apr. 1-4 and Aug. 13 (discharge interpolated). Temporary overflow through a secondary channel, June 11-13; daily discharge obtained by adding 20 per cent to the flow in main channel (percentage of flow carried by overflow channel based on observer's notes). Discharge July 16 to Aug. 29 determined by shifting-control method.

Monthly discharge of Big Timber Creek near Big Timber, Mont., for the year ending Sept. 30, 1918.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October.....	44	20	29.2	1,800
November.....	34	24	28.4	1,690
December.....	70	25	43.4	2,670
January.....	62	20	33.7	2,070
February.....	28	20	24.6	1,370
March.....	54	20	31.4	1,930
April.....	67	39	52.6	3,130
May.....	146	72	113	6,950
June.....	1,030	130	529	31,500
July.....	1,210	147	246	15,100
August.....	172	49	86.6	5,320
September.....	354	43	82.8	4,930
The year.....	1,210	20	184	78,500

SWEETGRASS CREEK ABOVE MELVILLE, MONT.

LOCATION.—Near center of sec. 27, T. 5 N., R. 13 E., on T. S. Lavold's ranch, 9 miles northwest of Melville, in Sweet Grass County.

DRAINAGE AREA.—About 63 square miles (measured on topographic map).

RECORDS AVAILABLE.—August 21, 1913, to September 30, 1918; 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 the two stations.

GAGE.—Vertical staff on left bank three-fourths of a mile above T. S. Lavold's house; read by T. S. Lavold.

DISCHARGE MEASUREMENTS.—Made by wading 100 feet above gage or from bridge near observer's house.

CHANNEL AND CONTROL.—Stream bed of gravel and boulders; shifting. Banks high; not subject to overflow.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 2.85 feet at 3 p. m. June 11 (discharge, 1,510 second-feet); minimum stage, 0.5 foot December 12–15 and January 11–19 (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).

1913–1918: Maximum stage recorded at present site, 2.85 feet at 3 p. m. June 11, 1918 (discharge, 1,510 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 changed by high water after June 7. Rating curve used October 1 to June 12 fairly well defined below 1,000 second-feet. Gage read to half-tenths once daily. Daily discharge ascertained by applying daily gage height to rating table to October 1 to June 12; shifting-control method used June 13 to September 30. Records fair.

Discharge measurements of Sweetgrass Creek above Melville, Mont., during the year ending Sept. 30, 1918,

Date.	Made by—	Gage height.	Discharge.
		<i>Feet.</i>	<i>Sec.-ft.</i>
Apr. 5	C. S. Heidel	0.63	19.0
June 7	do	2.20	630
Aug. 29	W. A. Lamb	.93	74

Daily discharge, in second-feet, of Sweetgrass Creek above Melville, Mont., for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Dec.	Jan.	Apr.	May.	June.	July.	Aug.	Sept.
1.....	80	63	27	32	19	37	123	161	146	70
2.....	63	63	27	32	19	37	123	161	164	78
3.....	49	63	27	32	19	37	149	161	136	70
4.....	49	63	27	27	23	37	210	175	149	70
5.....	49	63	27	27	23	37	269	149	136	62
6.....	49	63	27	23	23	37	418	149	164	70
7.....	49	63	27	23	23	43	615	178	152	62
8.....	49	63	27	23	19	49	730	164	152	70
9.....	49	63	19	19	19	136	860	164	139	62
10.....	49	63	19	19	19	136	1,140	194	152	70
11.....	49	37	19	13	19	136	1,510	197	126	68
12.....	49	37	13	13	19	136	1,060	166	126	68
13.....	49	37	13	13	19	136	1,080	152	105	60
14.....	49	37	13	13	23	136	941	325	105	158
15.....	49	37	13	13	23	123	1,220	1,010	94	144
16.....	63	37	37	13	23	123	874	331	105	158
17.....	49	37	49	13	23	123	743	302	94	144
18.....	49	37	37	13	23	123	684	278	107	144
19.....	49	37	37	13	23	136	584	217	96	131
20.....	49	37	27	19	23	136	436	200	107	131
21.....	49	27	27	19	23	136	397	184	107	131
22.....	49	27	27	19	23	136	531	172	107	131
23.....	49	27	27	19	23	136	362	144	96	144
24.....	49	27	27	19	23	136	337	172	88	184
25.....	49	27	27	19	23	123	308	158	78	169
26.....	49	27	27	19	23	123	282	144	88	141
27.....	63	27	27	.....	23	123	221	133	78	128
28.....	63	27	27	.....	23	123	221	146	88	141
29.....	63	27	23	.....	27	123	172	146	70	94
30.....	63	27	23	.....	37	123	161	146	78	141
31.....	63	.....	23	.....	.....	123	.....	146	78	.....

Monthly discharge of Sweetgrass Creek above Melville, Mont., for the year ending Sept. 30, 1918.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October.....	80	49	53.2	3,270
November.....	63	27	42.3	2,520
December.....	49	13	25.7	1,580
January 1-26.....	32	13	19.5	1,010
April.....	37	19	22.4	1,330
May.....	136	37	106	6,520
June.....	1,220	123	559	33,300
July.....	1,010	133	210	12,900
August.....	164	70	113	6,950
September.....	184	62	110	6,540

SWEETGRASS CREEK BELOW MELVILLE, MONT.

LOCATION.—Near middle of south line of sec. 27, T. 4 N., R. 15 E., at Crum's ranch a quarter of a mile above head of intake canal of Big Timber Carey project and 6 miles southeast of Melville, Sweet Grass County.

DRAINAGE AREA.—137 square miles (measured on topographic maps).

RECORDS AVAILABLE.—April 1, 1909, to November 10, 1916, and August 8, 1917, to September 30, 1918; May 4, 1907, to April 1, 1909, at Adam's ranch $2\frac{1}{2}$ miles downstream.

GAGE.—Overhanging chain gage on left bank about 100 feet west of Crum's house; read by Chas. E. Crum.

DISCHARGE MEASUREMENTS.—Made by wading or from highway bridge half a mile above gage.

CHANNEL AND CONTROL.—Stream bed of clean gravel; bar producing riffle about 300 feet around a bend below gage likely to shift. Right bank low; subject to overflow during high stages; left bank is a cut bank at the gage and not overflowed at that point but is lower and may be subject to overflow about 200 feet below gage.

EXTREMES OF DISCHARGE.—Maximum stage for open-channel period during year 4.06 feet at 8 a. m. on June 11 and 14 (discharge, 1,300 second-feet); minimum stage, 1.52 feet at 5 p. m. April 3 (discharge, 40 second-feet).

1909-1918: Maximum stage recorded, 4.2 feet during June high water, as estimated on June 27, 1916, from high-water marks (discharge determined from extension of rating table, 1,700 second-feet); 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; data insufficient to warrant estimate of flow.

DIVERSIONS.—There are adjudicated rights from Sweetgrass Creek amounting to over 500 second-feet, and numerous ditches divert water both above and below the station.

REGULATION.—None.

ACCURACY.—Stage-discharge relation fairly permanent during year, except for period of ice effect, December 6 to March 19. Rating curve fairly well defined. Gage read to hundredths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table. Records fair.

Discharge measurements of Sweetgrass Creek below Melville, Mont., during the year ending Sept. 30, 1918.

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. 1	W. A. Lamb.....	1.79	68	June 7	C. S. Heidel.....	3.31	684
Apr. 5	C. S. Heidel.....	1.58	43.1	July 15	do.....	3.78	1,060
May 18	W. A. Lamb.....	2.15	122	Aug. 29	W. A. Lamb.....	1.74	61

Daily discharge, in second-feet, of Sweetgrass Creek below Melville, Mont., for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Dec.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1.....	67	80	61	-----	46	50	137	97	102	64
2.....	67	80	61	-----	41	43	150	100	104	83
3.....	62	75	63	-----	40	46	147	100	110	75
4.....	62	75	57	-----	46	44	161	90	130	69
5.....	62	69	55	-----	45	49	167	83	161	64
6.....	75	67	-----	-----	50	49	512	75	164	64
7.....	70	64	-----	-----	44	46	666	72	150	63
8.....	73	63	-----	-----	44	58	776	72	144	70
9.....	75	64	-----	-----	49	93	846	76	106	106
10.....	75	64	-----	-----	52	142	1,030	77	98	75
11.....	72	58	-----	-----	52	152	1,170	69	104	64
12.....	73	62	-----	-----	48	155	1,090	69	102	62
13.....	70	50	-----	-----	55	122	1,090	67	93	59
14.....	70	50	-----	-----	55	114	1,120	158	90	150
15.....	73	58	-----	-----	55	118	962	846	80	161
16.....	75	62	-----	-----	48	116	987	460	77	134
17.....	69	62	-----	-----	48	125	904	340	75	122
18.....	63	56	-----	-----	46	132	715	330	76	98
19.....	72	61	-----	-----	47	144	761	255	69	93
20.....	72	56	-----	108	53	152	518	250	69	88
21.....	72	55	-----	57	48	158	561	198	77	75
22.....	72	55	-----	55	48	144	417	164	73	80
23.....	72	55	-----	63	46	130	444	158	67	96
24.....	69	55	-----	53	46	152	450	175	67	284
25.....	70	57	-----	53	46	155	433	161	64	188
26.....	67	56	-----	53	44	155	298	132	64	150
27.....	75	55	-----	53	45	169	224	139	63	161
28.....	67	55	-----	50	56	172	179	144	64	155
29.....	75	53	-----	48	49	161	142	120	62	127
30.....	72	59	-----	48	49	150	108	110	64	144
31.....	77	-----	-----	47	-----	139	-----	110	53	-----

NOTE.—Gage read Dec. 6 to Mar. 19, but data inadequate for determination of discharge owing to ice effect.

Monthly discharge of Sweetgrass Creek below Melville, Mont., for the year ending Sept. 30, 1918.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October.....	80	62	70.5	4,330
November.....	68	53	61.6	3,670
December 1-5.....	68	55	60.4	599
March 20-31.....	108	47	57.5	1,370
April.....	56	40	48	2,860
May.....	172	44	117	7,190
June.....	1,170	108	576	34,300
July.....	846	67	171	10,500
August.....	164	62	91.4	5,620
September.....	284	59	107	6,370

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, 1918.

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 sub-

ject to overflow except at extreme stages. Current at gage is sluggish at low stages, but of medium velocity at high stages.

EXTREMES OF DISCHARGE.—Maximum stage recorded, 8.35 feet at 5.30 p. m. March 27 (discharge, 480 second-feet); minimum stage, 4.07 feet August 19 (discharge, 36 second-feet).

1911-1918: 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 about 1,000 acres near Pryor is diverted about 30 miles above Coburn.

REGULATION.—None.

ACCURACY.—Stage discharge relation permanent during the year. Rating curve well defined between 20 and 200 second-feet and fairly well above 200 second-feet. Gage read to tenths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table. Records good.

Discharge measurements of Pryor Creek at Coburn, Mont., during the year ending Sept. 30, 1918.

[Made by W. A. Lamb.]

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. 5.....	4.35	57	May 14.....	5.39	161
Apr. 27.....	5.04	122	Aug. 19.....	4.08	37

Daily discharge, in second-feet, of Pryor Creek at Coburn, Mont., for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Dec.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1.....	56	121	65	.....	246	152	141	44	43	38
2.....	56	106	65	.....	207	152	136	44	43	38
3.....	56	87	65	.....	162	152	126	44	43	38
4.....	56	83	65	.....	212	157	124	44	43	38
5.....	56	83	65	.....	172	157	126	44	43	38
6.....	56	78	65	.....	162	157	121	44	49	38
7.....	56	74	.....	.....	152	167	121	50	81	38
8.....	56	74	.....	.....	162	172	118	47	51	45
9.....	56	74	.....	.....	152	290	106	44	51	45
10.....	56	74	.....	.....	152	306	106	44	49	79
11.....	56	74	.....	.....	177	268	101	59	43	53
12.....	56	74	.....	.....	152	256	96	115	43	45
13.....	56	65	.....	.....	147	207	78	55	43	42
14.....	56	65	.....	.....	197	152	78	51	43	38
15.....	56	65	.....	.....	290	147	69	51	43	45
16.....	56	65	.....	.....	284	147	60	51	43	61
17.....	60	65	.....	.....	172	172	60	44	43	79
18.....	65	65	.....	.....	152	147	60	44	42	53
19.....	65	65	.....	.....	147	147	60	50	36	49
20.....	65	65	.....	.....	142	127	60	44	38	45
21.....	65	65	.....	.....	132	147	60	44	38	45
22.....	74	65	.....	.....	132	145	60	44	38	45
23.....	74	65	.....	.....	136	137	60	44	38	70
24.....	74	65	.....	.....	122	142	60	45	38	122
25.....	78	65	.....	.....	112	192	56	44	38	66
26.....	83	65	.....	.....	112	187	52	44	38	53
27.....	78	65	.....	480	127	234	87	44	38	53
28.....	74	65	.....	422	240	256	78	44	38	53
29.....	74	65	.....	300	300	182	60	44	42	53
30.....	92	65	.....	256	177	155	44	44	42	55
31.....	96	.....	.....	256	.....	147	.....	44	38	.....

Monthly discharge of Pryor Creek, at Coburn, Mont., for the year ending Sept. 30, 1918.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October.....	96	56	64.9	3,990
November.....	121	65	72.4	4,310
December 1-6.....	65	65	65.0	774
March 27-31.....	480	256	343	3,400
April.....	300	112	174	10,400
May.....	306	137	180	11,100
June.....	141	44	85.5	5,090
July.....	115	44	48.3	2,970
August.....	81	36	43.2	2,660
September.....	122	38	52.0	3,090

WIND RIVER AT RIVERTON, WYO.

LOCATION.—In sec. 2, T. 1 S., R. 4 E., at highway bridge three-fourths of a mile east of Riverton, in Fremont County. Popo Agie River joins Wind River to form the Big Horn three-fourths of a mile below.

DRAINAGE AREA.—2,320 square miles (measured on base map of Wyoming; scale, 1:500,000).

RECORDS AVAILABLE.—May 15, 1911, to October 31, 1912; April 1, 1915, to September 30, 1918. From May 14, 1906, to November 1, 1908, a station was maintained at Walker's ferry about 1 mile above the present station. No streams enter between the two sites; records directly comparable.

GAGE.—Friez water-stage recorder installed April 4, 1917, referred to chain gage on downstream side of first pier bent from left bank used previously.

DISCHARGE MEASUREMENTS.—Made from bridge.

CHANNEL AND CONTROL.—Channel composed of sand and gravel; high water during 1917 formed large sand bar just below gage, completely changing the control. This filled in slightly during 1918. Right bank subject to overflow at extremely high water.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year 12.8 feet at 11 a. m. June 16 (discharge, 9,300 second-feet); minimum discharge occurs during winter.

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

DIVERSIONS.—Water is diverted from Wind River and its tributaries for the irrigation of about 27,000 acres. Under the Wyoming law of 1 second-foot for 70 acres this would require 386 second-feet.

REGULATION.—None.

ACCURACY.—Stage-discharge relation practically permanent except for one shift during high water in June; affected by ice during winter. Rating curves used before and after change in control fairly well defined. Operation of water-stage recorder satisfactory, except that observer did not set it closer than to nearest tenth. Daily discharge ascertained by applying mean daily gage height, determined by inspection of gage-height graph, to rating table. Records good.

Discharge measurements of Wind River at Riverton, Wyo., during the year ending Sept. 30, 1918.

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>
Apr. 10	Robert Follansbee.....	6.29	403	June 27	P. V. Hodges.....	10.62	4,620
May 20	P. V. Hodges.....	7.42	1,190	Sept. 14	J. B. Spiegel.....	7.39	848

Daily discharge, in second-feet, of Wind River at Riverton, Wyo., for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Apr.	May.	June.	July.	Aug.	Sept.
1.....	736	352	-----	465	1,690	2,790	1,800	930
2.....	710	370	-----	582	1,640	2,660	1,800	930
3.....	684	370	-----	660	1,690	2,540	1,900	930
4.....	658	-----	-----	895	2,200	2,540	1,880	965
5.....	632	-----	-----	1,330	3,060	2,420	1,880	930
6.....	605	-----	-----	1,420	4,050	2,300	1,880	895
7.....	578	-----	-----	1,420	4,870	2,540	1,780	830
8.....	578	-----	-----	1,560	5,800	2,420	1,580	830
9.....	578	-----	-----	1,460	6,200	2,540	1,490	895
10.....	550	-----	405	1,280	7,440	3,070	1,360	1,110
11.....	525	-----	562	1,160	8,800	2,790	1,310	1,000
12.....	525	-----	562	1,080	9,300	2,660	1,270	895
13.....	525	-----	562	1,040	8,800	2,720	1,230	860
14.....	500	-----	595	1,040	8,800	2,790	1,230	860
15.....	500	-----	628	1,380	8,560	2,660	1,190	930
16.....	500	-----	498	1,420	8,800	2,660	1,150	930
17.....	500	-----	435	1,510	7,660	2,420	1,150	930
18.....	478	-----	405	1,420	7,600	2,300	1,070	860
19.....	432	-----	405	1,330	7,200	2,300	1,040	830
20.....	455	-----	355	1,200	7,500	2,360	1,000	860
21.....	478	-----	332	1,200	8,000	2,420	965	830
22.....	478	-----	355	1,280	7,000	2,300	930	800
23.....	478	-----	405	1,380	6,580	2,300	895	800
24.....	455	-----	498	1,560	6,580	2,200	860	800
25.....	478	-----	435	1,600	5,920	2,080	860	830
26.....	478	-----	465	1,690	5,320	2,080	860	860
27.....	410	-----	562	1,640	4,600	1,780	495	830
28.....	352	-----	465	1,600	4,270	1,700	930	830
29.....	335	-----	465	1,460	3,650	1,700	930	800
30.....	335	-----	435	1,460	3,070	1,750	930	800
31.....	352	-----	-----	1,640	-----	1,750	930	-----

NOTE.—Gage did not operate Oct. 1-5, June 18-22, July 13, 20, 28-31, and Aug. 1-3; discharge based on comparative hydrograph of Big Horn River at Thermopolis. Shifting-control method used, June 11-17.

Monthly discharge of Wind River at Riverton, Wyo., for the year ending Sept. 30, 1918.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October.....	736	335	512	31,500
April 10-30.....	628	332	468	19,500
May.....	1,690	465	1,290	79,300
June.....	9,300	1,640	5,890	350,000
July.....	3,070	1,700	2,370	146,000
August.....	1,900	860	1,260	77,500
September.....	1,110	800	879	52,300

BIG HORN RIVER AT THERMOPOLIS, WYO.

LOCATION.—In sec. 36, 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, 1918. State engineer maintained station at this point during 1913 and 1914.

GAGE.—Chain gage on downstream handrail on bridge, installed May 4, 1916, at datum 1 foot lower than staff gage used previously; read by Mrs. Thos. Roe and Miss Florence Erlos.

DISCHARGE MEASUREMENTS.—Made from two-span bridge.

CHANNEL AND CONTROL.—Channel composed of coarse gravel and small boulders; control a short distance below gage; practically permanent. High-water control is vertical walls of canyon entrance half a mile downstream. Banks high and not subject to overflow.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 13.3 feet at 7 p. m.

June 17 (discharge, 19,200 second-feet); minimum stage, 0.80 foot at 5 p. m.

January 14 (discharge, 325 second-feet).

ICE.—Stage-discharge relation not affected by ice during 1918.

DIVERSIONS.—Prior to December 31, 1916, adjudicated diversions of 4 second-feet from Big Horn River above the station and 202 second-feet below. In addition, an adjudicated diversion of 366 second-feet for power above the station.

REGULATION.—None.

ACCURACY.—Stage-discharge relation permanent; not affected by ice. Rating curve well-defined above 800 second-feet. Gage read to hundredths twice daily. Daily discharge-ascertained by applying mean daily gage height to rating table. Records excellent except those for extremely low stages, which are fair.

Discharge measurements of Big Horn River at Thermopolis, Wyo., during the year ending Sept. 30, 1918.

Date.	Made by—	Gage height.	Dis-charge.	Date.	Made by—	Gage height.	Dis-charge.
May 21	P. V. Hodges.....	<i>Fect.</i> 3.04	<i>Sec.-ft.</i> 2,250	Aug. 17	P. V. Hodges.....	<i>Fect.</i> 2.42	<i>Sec.-ft.</i> 1,460
Aug. 17	do.....	2.48	1,550	Sept. 7	J. B. Spiegel.....	2.10	1,080

Daily discharge, in second-feet, of Big Horn River at Thermopolis, Wyo., for the year ending Sept. 30, 1918.

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1.....	1,180	800	760	720	510	563	800	935	3,020	6,000	2,040	1,130
2.....	1,080	1,030	800	720	563	563	815	850	3,190	4,680	1,880	1,130
3.....	1,080	980	800	800	484	590	890	1,030	3,020	4,840	2,040	1,130
4.....	1,080	935	720	760	441	650	890	1,236	3,020	4,510	2,040	1,130
5.....	1,030	935	650	760	463	620	845	1,500	3,680	4,510	2,530	1,130
6.....	935	935	563	720	484	760	760	2,200	4,840	4,340	2,530	1,130
7.....	980	800	405	685	510	845	760	2,530	6,166	4,180	2,700	1,080
8.....	980	935	441	650	535	800	760	2,860	7,810	4,340	2,200	1,030
9.....	980	935	375	563	563	720	800	2,860	9,460	5,000	2,200	1,030
10.....	1,030	890	375	563	590	800	845	3,020	11,100	5,170	2,040	1,030
11.....	980	800	423	563	590	890	980	2,860	12,400	5,830	1,740	1,390
12.....	935	760	484	405	563	890	1,130	2,530	14,100	5,830	1,620	1,280
13.....	935	760	590	423	620	1,080	1,130	2,200	15,800	5,660	1,620	1,180
14.....	935	800	503	350	620	1,080	1,130	1,880	16,900	5,170	1,500	1,130
15.....	935	845	720	405	620	980	1,280	1,880	17,500	5,500	1,500	1,080
16.....	890	935	590	390	590	890	1,440	2,360	18,400	5,340	1,390	1,130
17.....	935	890	720	535	590	935	1,280	2,700	19,000	5,170	1,390	1,280
18.....	935	845	720	590	535	890	1130	2,700	18,700	5,500	1,390	1,280
19.....	890	845	760	535	535	935	980	2,530	17,400	4,680	1,280	1,280
20.....	890	800	760	535	535	845	935	2,360	17,000	4,180	1,280	1,130
21.....	890	800	760	535	484	890	845	2,200	16,200	4,180	1,180	1,130
22.....	845	845	800	510	463	800	845	2,200	16,100	4,020	1,180	1,080
23.....	845	845	760	510	484	800	800	2,360	18,400	3,850	1,180	1,080
24.....	890	845	760	510	535	800	845	2,360	18,500	3,520	1,080	1,130
25.....	845	845	845	535	563	800	935	2,530	17,700	3,520	1,080	1,130
26.....	845	890	760	535	620	800	935	2,860	15,600	3,190	1,030	1,230
27.....	890	890	685	510	590	800	935	3,020	14,600	3,190	1,030	1,230
28.....	890	890	845	590	590	890	1,030	3,190	11,400	2,860	1,030	1,180
29.....	845	845	760	620	.....	980	1,080	3,020	8,640	2,360	1,130	1,180
30.....	685	760	760	563	.....	980	980	2,700	7,150	2,200	1,130	1,130
31.....	720	.....	720	510	.....	935	.....	2,700	.....	2,040	1,130	.....

Monthly discharge of Big Horn River at Thermopolis, Wyo., for the year ending Sept. 30, 1918.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October.....	1,180	685	929	57,100
November.....	1,030	760	864	51,400
December.....	845	375	667	41,000
January.....	800	350	568	34,900
February.....	620	441	545	30,300
March.....	1,080	563	832	51,200
April.....	1,440	760	961	57,200
May.....	3,190	890	2,330	143,000
June.....	19,000	3,020	12,200	726,000
July.....	6,000	2,040	4,370	268,000
August.....	2,700	1,030	1,580	97,200
September.....	1,390	1,030	1,160	69,000
The year.....	19,000	350	2,250	1,630,000

BIG HORN RIVER NEAR HARDIN, MONT.

LOCATION.—In SW. $\frac{1}{4}$ sec. 13, T. 1 S., R. 33 E., at highway bridge on Crow Indian Reservation half a mile above junction of Big Horn and Little Horn rivers, 2 miles from Hardin, in Big Horn County.

DRAINAGE AREA.—20,700 square miles.

RECORDS AVAILABLE.—June 16, 1904, to September 30, 1918.

GAGE.—Chain gage attached to west span, downstream side of highway bridge; read since November 30, 1917, by H. R. Kean. A temporary staff gage 20 feet farther downstream was used October 11 to November 22, 1913, and the readings reduced to datum of chain gage; November 23, 1913, to November 30, 1917, chain gage on upstream side of Chicago, Burlington & Quincy Railroad bridge at same datum.

DISCHARGE MEASUREMENTS.—Made from highway bridge.

CHANNEL AND CONTROL.—Stream bed gravel; free from vegetation; slightly shifting. Banks high and not subject to overflow except at extreme stages.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 10.1 feet June 17, 18 (discharge, 33,200 second-feet); minimum stage recorded December 12; flow computed at 1,200 second-feet.

1904-1918: Maximum stage recorded, 9.8 feet June 17, 1908 (discharge, 40,800 second-feet); minimum discharge recorded 625 second-feet by current-meter measurement January 15, 1917.

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

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 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 affected by ice and shifting control. Rating curve used October 1 to March 15, well defined between 1,600 and 8,000 second-feet; curve used March 16 to September 30, well defined between 2,500 and 30,000 second-feet. Gage read to half-tenths once daily, occasionally twice daily. Daily discharge for open channel ascertained by applying mean daily gage heights to rating tables for period of ice effect by applying to rating table mean daily gage height corrected for ice effect by means of discharge measurements, observer's notes and weather records. Records during open channel good; for period of ice effect fair.

Discharge measurements of Big Horn River near Hardin, Mont., during the year ending Sept. 30, 1918.

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. 4	W. A. Lamb.....	4.27	2,220	Mar. 7	W. A. Lamb.....	a 6.20	3,400
Nov. 29	do.....	4.24	2,290	27	do.....	4.33	2,830
Jan. 6	do.....	a 5.10	2,380	June 7	do.....	6.36	10,400
30	A. H. Tuttle.....	a 4.72	1,950	25	A. H. Tuttle.....	b 9.48	28,800
Feb. 8	W. A. Lamb.....	a 5.30	1,990	Aug. 23	W. A. Lamb.....	4.38	2,910
20	do.....	a 4.90	1,230				

a Stage-discharge relation affected by ice.

b On account of drift in stream, surface velocities were obtained at several points and a coefficient of 0.90 used so obtain mean in vertical.

Daily discharge, in second-feet, of Big Horn River near Hardin, Mont., for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1.....	2,550	2,140	2,040	5,480	1,560	2,140	3,020	3,600	7,090	17,400	4,900	2,240
2.....	2,550	2,040	2,040	6,060	1,560	3,260	3,020	2,750	7,090	15,100	4,900	2,240
3.....	2,240	2,340	2,040	5,480	1,750	4,100	2,490	3,020	7,090	13,500	4,230	2,490
4.....	2,440	2,340	2,100	4,760	2,040	4,420	2,490	3,020	7,090	13,000	4,230	2,490
5.....	2,340	2,340	1,940	3,520	2,550	4,270	2,240	3,300	7,490	12,000	3,910	2,490
6.....	2,140	2,140	1,750	2,440	2,440	3,520	2,490	3,600	7,900	11,500	3,600	2,490
7.....	2,340	2,240	1,560	2,340	2,550	3,390	2,750	4,230	10,100	11,000	5,240	2,490
8.....	2,340	2,140	1,490	2,770	1,990	3,390	3,020	5,240	11,500	10,600	5,240	2,490
9.....	2,040	1,940	1,420	1,940	1,940	3,280	3,600	6,700	13,500	10,600	4,900	2,490
10.....	2,240	2,140	1,350	1,750	2,140	4,420	3,600	7,090	17,900	10,600	4,900	2,750
11.....	2,140	2,140	1,280	1,560	3,000	4,760	3,600	7,090	23,000	11,000	4,560	2,750
12.....	2,140	2,140	1,200	1,560	2,770	6,850	3,300	7,490	28,400	11,500	4,230	3,020
13.....	1,940	1,940	1,320	1,940	2,550	8,770	3,020	6,700	29,100	12,000	4,230	3,020
14.....	2,140	2,140	1,470	2,140	2,340	9,680	2,750	6,320	29,800	12,500	3,600	3,020
15.....	2,140	2,140	1,470	2,340	1,940	10,400	3,600	5,590	31,800	13,000	3,600	3,020
16.....	1,940	1,940	1,750	2,340	1,750	13,800	4,230	5,590	26,400	12,500	3,300	3,020
17.....	2,140	2,140	1,940	2,340	1,750	14,100	2,750	5,590	23,200	12,500	3,020	2,490
18.....	2,140	2,140	4,100	2,550	1,560	14,600	3,020	5,590	33,200	13,000	3,020	2,490
19.....	1,940	1,940	4,100	2,550	1,380	13,500	3,020	5,590	32,500	9,190	3,020	2,490
20.....	2,140	2,140	4,590	2,550	1,230	5,590	3,020	5,950	31,800	11,500	3,300	2,490
21.....	2,140	2,140	4,420	2,550	1,230	4,900	3,080	5,590	31,100	10,100	3,300	2,490
22.....	2,140	2,140	4,420	2,770	1,380	4,560	3,140	5,590	30,400	9,190	3,020	2,490
23.....	1,940	1,940	3,520	2,770	1,940	3,910	3,200	5,590	28,400	8,750	3,020	2,750
24.....	2,140	2,140	3,260	3,000	1,940	3,600	3,260	5,590	27,700	7,090	3,020	6,320
25.....	2,140	2,140	3,000	2,550	1,750	3,300	3,320	5,240	28,400	7,090	2,750	4,900
26.....	1,940	1,940	2,770	2,340	1,940	3,020	3,380	5,950	29,800	9,190	2,490	3,600
27.....	2,140	2,140	2,770	2,140	1,940	2,880	3,440	6,700	28,400	8,750	2,490	2,490
28.....	2,140	2,240	2,660	2,140	1,940	2,750	3,600	6,700	26,400	7,490	2,490	2,490
29.....	1,940	2,040	2,440	2,140	.....	2,750	3,600	6,700	19,800	7,090	2,490	2,490
30.....	2,040	2,100	3,520	1,940	.....	3,600	3,600	6,700	19,100	6,320	2,240	2,490
31.....	2,140	.....	5,480	1,560	.....	2,750	.....	7,090	.....	5,590	2,240	.....

NOTE.—Stage-discharge relation affected by ice Dec. 5 to Mar. 15. Gage not read Dec. 8-13; discharge determined by comparison with records of flow for Shoshone River at Corbett dam, Wyo., and Big Horn River at Thermopolis, Wyo.

Monthly discharge of Big Horn River near Hardin, Mont., for the year ending Sept. 30, 1918.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October.....	2,550	1,940	2,160	133,000
November.....	2,340	1,940	2,120	126,000
December.....	5,480	1,200	2,560	157,000
January.....	6,060	1,560	2,720	167,000
February.....	3,000	1,230	1,960	109,000
March.....	14,600	2,140	5,690	350,000
April.....	4,230	2,240	3,160	188,000
May.....	7,490	2,750	5,530	340,000
June.....	33,200	7,090	22,200	1,320,000
July.....	17,400	5,590	10,700	658,000
August.....	5,240	2,240	3,600	221,000
September.....	6,320	2,240	2,830	168,000
The year.....	33,200	1,200	5,440	3,940,000

DINWOODY CREEK NEAR LENORE, WYO.

LOCATION.—In sec. 10, T. 5 N., R. 5 W., at highway bridge on road from Riverton to Dubois, 14 miles northwest of Lenore, on Shoshone Indian Reservation. No tributary between station and mouth, a quarter of a mile below.

DRAINAGE AREA.—114 square miles (measured on base map of Wyoming; scale, 1:500,000).

RECORDS AVAILABLE.—May 15 to September 30, 1918. Station maintained at same site from January 16 to October 31, 1909.

GAGE.—Stevens water-stage recorder at left bridge abutment; referred to datum of gage used during 1909.

DISCHARGE MEASUREMENTS.—Made from single-span bridge and by wading 500 feet downstream.

CHANNEL AND CONTROL.—Bed of stream composed of boulders, probably permanent. Control at large boulders 25 feet downstream, apparently permanent. Banks not subject to overflow.

EXTREMES OF DISCHARGE.—Maximum stage during period from water-stage recorder, 3.73 feet from 4 a. m. to 2 p. m. June 18 (discharge, 1,360 second-feet); minimum stage, 1.35 feet at 7 p. m. September 30 (discharge, 80 second-feet).

ICE.—No data.

DIVERSIONS.—One small ditch diverts water from Dinwoody Creek above station.

REGULATION.—Natural regulation to limited extent by Dinwoody Lake and numerous other small lakes on headwaters.

ACCURACY.—Stage-discharge relation apparently permanent. Rating curve well defined between 30 and 800 second-feet. Operation of water-stage recorder satisfactory. Daily discharge ascertained by applying mean daily gage height to rating table. Records good.

Discharge measurements of Dinwoody Creek near Lenore, Wyo., during the year ending Sept. 30, 1918.

Date.	Made by—	Gage height.	Dis-charge.
		<i>Feet.</i>	<i>Sec.-ft.</i>
May 16	P. V. Hodges.....	1.32	75
June 29	do.....	2.62	605
Sept. 16	J. B. Spiegel.....	1.70	174

Daily discharge, in second-feet, of Dinwoody Creek near Lenore, Wyo., for the year ending Sept. 30, 1918.

Day.	May.	June.	July.	Aug.	Sept.	Day.	May.	June.	July.	Aug.	Sept.
1.....		137	426	482	296	16.....	82	1,280	668	334	172
2.....		142	405	560	296	17.....	88	1,250	620	324	169
3.....		137	426	710	288	18.....	98	1,320	590	284	154
4.....		137	488	768	256	19.....	100	1,250	602	268	134
5.....		169	482	742	219	20.....	95	1,180	626	264	126
6.....		324	454	662	179	21.....	86	1,110	680	252	134
7.....		530	518	548	154	22.....	88	1,080	756	240	151
8.....		626	578	459	160	23.....	84	1,080	782	219	172
9.....		710	596	415	179	24.....	86	1,140	620	205	185
10.....		872	716	375	172	25.....	108	1,140	542	222	179
11.....		970	749	375	151	26.....	134	1,040	442	272	142
12.....	1,000		710	400	126	27.....	151		872	356	320
13.....	1,080		626	390	120	28.....	151		710	347	338
14.....	1,180		632	352	123	29.....	137		590	380	334
15.....	1,180		704	342	142	30.....	123		500	426	312
						31.....	123			448	300

Monthly discharge of Dinwoody Creek near Lenore, Wyo., for the year ending Sept. 30, 1918.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
May 16-31.....	151	82	108	3,430
June.....	1,320	137	825	49,100
July.....	782	347	561	34,500
August.....	768	205	389	23,900
September.....	296	88	166	9,880
The period.....				121,000

BULL LAKE CREEK NEAR LENORE, WYO.

LOCATION.—Near north line of sec. 17, T. 3 N., R. 2 W., at highway bridge, 14 miles southeast of Lenore, in the Shoshone Indian Reservation. No tributary between station and mouth, a quarter of a mile below.

DRAINAGE AREA.—132 square miles (measured on base map of Wyoming; scale, 1 : 500,000).

RECORDS AVAILABLE.—May 18 to September 30, 1918. During 1909, eight discharge measurements made at same site.

GAGE.—Stevens water-stage recorder attached to downstream end of center bridge pier.

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

CHANNEL AND CONTROL.—Channel composed of large boulders, probably permanent; control at small rapids just below gage, apparently permanent. Banks not subject to overflow.

EXTREMES OF DISCHARGE.—Maximum stage during period from water-stage recorder, 4.2 feet at 2 p. m. June 16 (discharge, 3,990 second-feet); minimum stage, 1.07 feet at 8 p. m. September 23 (discharge, 146 second-feet).

ICE.—No data.

DIVERSIONS.—One small ditch diverts water from Bull Lake Creek above station.

REGULATION.—Flow naturally regulated by Bull Lake, which has an area of 4 square miles.

ACCURACY.—Stage-discharge relation apparently permanent. Rating curve well defined below 1,400 second-feet; extended above 1,400 second-feet. Operation of water-stage recorder satisfactory. Daily discharge ascertained by applying mean daily gage height to rating table. Records good.

Discharge measurements of Bull Lake Creek near Lenore, Wyo., during the year ending Sept. 30, 1918.

Date.	Made by—	Gage height.	Dis-charge.
		<i>Feet.</i>	<i>Sec.-ft.</i>
May 18	P. V. Hodges.....	1.36	257
June 29	do.....	2.50	1,190
Sept. 17	J. B. Spiegel.....	1.23	204

Daily discharge, in second-feet, of Bull Lake Creek near Lenore, Wyo., for the year ending Sept. 30, 1918.

Day.	May.	June.	July.	Aug.	Sept.	Day.	May.	June.	July.	Aug.	Sept.
1.....		345	855	575	310	16.....		3,900	972	366	172
2.....		366	772	620	296	17.....		3,620	822	345	200
3.....		415	705	688	296	18.....	233	3,410	772	320	200
4.....		560	762	790	283	19.....	229	3,190	743	301	190
5.....		790	790	866	257	20.....	214	3,040	714	283	183
6.....	1,180	790	855	237	21.....	204	2,900	733	292	169	
7.....	1,140	781	800	214	22.....	204	2,880	733	249	162	
8.....	1,690	844	671	200	23.....	218	2,820	688	237	149	
9.....	2,090	922	560	190	24.....	233	3,020	696	229	158	
10.....	2,600	1,020	496	194	25.....	265	2,750	628	229	172	
11.....	3,060	998	445	190	26.....	296	2,340	552	245	186	
12.....	3,260	935	415	183	27.....	306	1,950	469	278	190	
13.....	3,340	960	410	166	28.....	306	1,510	463	278	186	
14.....	3,560	1,090	398	155	29.....	288	1,200	469	296	172	
15.....	3,720	1,090	388	169	30.....	301	1,010	496	296	162	
					31.....	320		531	296		

Monthly discharge of Bull Lake Creek near Lenore, Wyo., for the year ending Sept. 30, 1918.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
May 18-31.....	320	204	258	7,160
June.....	3,900	345	2,270	135,000
July.....	1,090	463	768	47,200
August.....	866	229	436	26,800
September.....	310	149	200	11,900
The year.....				228,000

POPO AGIE RIVER BELOW ARAPAHOE, WYO.

LOCATION.—In sec. 23. T. 1 S., R. 3 E., at highway bridge 200 yards below Little Wind River, 6 miles above junction of Popo Agie and Wind rivers to form the Big Horn, and half a mile from Arapahoe, in Fremont County.

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 November 26, 1918, when station was discontinued.

GAGE.—Inclined staff at left bank just below bridge, installed October 7, 1916; referred to same datum as vertical staff located on downstream side of first pier from left bank, which was read previously. 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.—Channel composed of sand and gravel. Control slightly shifting; during latter part of 1918 temporary diversion dam changed control. Right bank subject to overflow at high water.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 6.7 feet at 6 a. m. June 22 (discharge, 5,340 second-feet); minimum stage probably occurs during winter.

DIVERSIONS.—Between this station and that on Little Wind River above Arapahoe, there were adjudicated diversions of 583 second-feet from Popo Agie River and its tributaries, prior to December 31, 1916.

REGULATION.—None.

ACCURACY.—Stage-discharge relation permanent, except period August 4 to September 30, when erection of temporary dam below station changed the control. Rating curve well defined between 100 and 6,000 second-feet. Gage read to hundredths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table. Records excellent except for stages above 6,000 second-feet and for August and September when dam was in place, for which they are fair.

Discharge measurements of Popo Agie River below Arapahoe, Wyo., during the year ending Sept. 30, 1918.

Date.	Made by—	Gage height.	Discharge.
July 1	P. V. Hodges.....	Feet.	Sec.-ft.
Sept. 19	J. B. Spiegel.....	2.84	929
		1.84	242

Daily discharge, in second-feet, of Popo Agie River below Arapahoe, Wyo., for the period Apr. 11 to Nov. 26, 1918.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1.....		265	1,180	900	93	41	304	282
2.....		318	1,110	770	80	42	314	275
3.....		418	1,330	710	89	54	304	262
4.....		514	1,830	680	125	74	296	255
5.....		710	2,210	650	136	93	318	255
6.....		900	2,810	680	149	94	296	232
7.....		970	3,270	680	158	106	392	245
8.....		1,110	3,530	622	140	116	431	236
9.....		1,040	3,980	680	116	127	384	232
10.....		900	4,490	868	98	161	368	242
11.....	396	740	4,830	970	87	161	356	223
12.....	337	680	4,490	900	75	149	333	223
13.....	318	622	4,150	835	64	138	311	217
14.....	337	680	4,320	970	62	138	311	200
15.....	356	835	3,980	900	61	186	296	211
16.....	300	900	3,820	770	74	229	282	211
17.....	265	900	3,150	680	64	245	272	209
18.....	203	900	2,920	680	58	245	348	166
19.....	189	802	2,710	622	61	245	376	195
20.....	217	740	2,410	567	61	245	345	211
21.....	217	770	3,530	514	50	245	326	200
22.....	217	802	5,340	464	60	229	318	217
23.....	232	835	4,150	376	62	229	304	229
24.....	265	970	3,530	318	56	333	304	226
25.....	248	1,040	2,920	300	49	372	300	223
26.....	300	1,040	2,410	248	46	372	296	223
27.....	337	1,110	1,920	203	49	352	296	.....
28.....	300	1,040	1,650	156	42	333	286	.....
29.....	265	900	1,330	133	41	314	289	.....
30.....	248	970	1,110	125	38	296	275	.....
31.....		1,040	.....	100	38	.....	275	.....

NOTE.—Discharge Aug. 4 to Sept. 30 determined by indirect method.

Monthly discharge of Popo Agie River below Arapahoe, Wyo., for the period Apr. 11 to Nov. 26, 1918.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
April 11-30.....	396	189	277	11,000
May.....	1,110	265	821	50,500
June.....	5,340	1,110	3,010	179,000
July.....	970	100	583	35,800
August.....	158	38	76.8	4,720
September.....	372	41	199	11,800
October.....	431	272	320	19,700
November 1-26.....	282	166	227	11,700
The period.....				324,000

MIDDLE FORK OF POPO AGIE RIVER NEAR LANDER, WYO.

LOCATION.—In center of sec. 24, T. 32 N., R. 101 W., at Middle Fork ranger station, 11 miles southwest of Lander, in Fremont County. Nearest tributary enters from south 3 miles below.

DRAINAGE AREA.—84 square miles (measured on Forest atlas).

RECORDS AVAILABLE.—April 1, 1911, to June 30, 1912; April 9 to September 30, 1918.

GAGE.—Vertical staff fastened to downstream side of Forest Service bridge; read by forest ranger. Gage used in 1911 and 1912 vertical staff a short distance downstream and referred to different datum.

DISCHARGE MEASUREMENTS.—Made from two-span bridge or by wading.

CHANNEL AND CONTROL.—Channel composed of boulders, which may shift during high stages; control not well defined. Banks not subject to overflow except during extremely high stages.

EXTREMES OF STAGE.—Maximum stage recorded during year, 2.8 feet at 8 a. m. June 11; minimum stage occurs during winter.

ICE.—Stage-discharge relation affected by ice.

DIVERSION.—None above station. Prior to December 31, 1916, there were adjudicated diversions of 179 second-feet from Middle Fork, above station.

REGULATION.—Alternate melting and freezing of mountain snow causes diurnal fluctuation during spring; no artificial regulation.

ACCURACY.—Stage-discharge relation practically permanent. Gage read to half-tenths twice daily. Daily discharge not determined owing to lack of discharge measurements for defining rating curve at high stages.

Discharge measurements of Middle Fork of Popo Agie River near Lander, Wyo., during the year ending Sept. 30, 1918.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
Apr. 9	Robert Follansbee.....	<i>Feet.</i> 0.60	<i>Sec.-ft.</i> 25.0	June 30	P. V. Hodges.....	<i>Feet.</i> 1.50	<i>Sec.-ft.</i> 225
May 19	P. V. Hodges.....	1.27	169	Sept. 18	J. B. Spiegel.....	.69	54

Daily discharge, in second feet, of Middle Fork of Popo Agie River near Lander, Wyo., for the year ending Sept. 30, 1918.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Day.	Apr.	May.	June.	July.	Aug.	Sept.
1.....		129	255	204	81	23	16.....	55	204	555	215	43	81
2.....		140	240	215	100	30	17.....	60	193	555	215	37	72
3.....		182	270	204	119	55	18.....	54	182	525	204	43	55
4.....		204	445	215	113	40	19.....	36	171	525	215	43	43
5.....		240	470	182	109	43	20.....	65	150	498	193	30	40
6.....		240	525	193	109	43	21.....	58	193	1,240	193	27	37
7.....		240	525	193	81	37	22.....	72	193	650	171	25	37
8.....		255	650	193	72	37	23.....	90	228	525	150	21	129
9.....	25	182	720	228	72	90	24.....	135	240	470	150	19	129
10.....	37	160	650	215	69	72	25.....	125	193	335	129	19	119
11.....	46	129	720	255	64	55	26.....	117	215	300	119	19	90
12.....	46	103	650	228	55	43	27.....	94	193	335	109	19	81
13.....	86	129	650	240	52	40	28.....	81	171	270	109	25	72
14.....	72	171	685	255	52	43	29.....	81	182	255	81	23	72
15.....	57	204	618	228	55	81	30.....	109	228	228	90	23	94
							31.....		255		76	21	

NOTE.—Rating table applied indirectly Apr. 9 to 25.

Monthly discharge of Middle Fork of Popo Agie River near Lander, Wyo., for the year ending Sept. 30, 1918.

[Drainage area, 84 square miles.]

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
April 9-30.....	135	25	72.8	3,180
May.....	255	103	190	11,700
June.....	1,240	228	511	30,400
July.....	255	76	183	11,300
August.....	119	19	52.9	3,250
September.....	129	23	62.8	3,740
The period.....				63,600

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, and a quarter of a mile above confluence with Popo Agie River.

DRAINAGE AREA.—716 square miles (measured on base map of Wyoming; scale, 1:500,000 map).

RECORDS AVAILABLE.—May 14, 1911, to October 31, 1912; April 1, 1915, to November 27, 1918, when station was discontinued. From May 11, 1906, to December 17, 1909, a station was maintained a short distance above the present one. The flow at the two points is comparable.

GAGE.—Chain gage on upstream side of railroad bridge; read by R. H. Knox.

DISCHARGE MEASUREMENTS.—Made from single-span bridge.

CHANNEL AND CONTROL.—Channel composed of sand and gravel. Control a short distance downstream; practically permanent during 1918. Banks high and not subject to overflow.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 5.75 feet at 6 p. m., June 23 (discharge, 2,480 second-feet); minimum discharge probably occurs during winter.

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

DIVERSIONS.—Water is diverted from Little Wind River and tributaries for the irrigation of about 52,000 acres. Under the Wyoming law of 1 second-foot for 70 acres this would require 742 second-feet.

REGULATION.—None.

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

Discharge measurements of Little Wind River above Arapahoe, Wyo., during the year ending Sept. 30, 1918.

Date.	Made by—	Gage height.	Discharge.
July 1	P. V. Hodges	<i>Feet.</i> 3.67	<i>Sec.-ft.</i> 484
Sept. 19	J. B. Spiegel	2.45	70

Daily discharge, in second-feet, of Little Wind River above Arapahoe, Wyo., for the period Apr. 11 to Nov. 27, 1918.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1.....		76	334	499	29	22	101	115
2.....		91	359	384	25	23	100	112
3.....		130	384	334	22	24	105	106
4.....		154	529	334	21	28	100	105
5.....		195	725	288	24	26	126	105
6.....		311	1,000	311	25	24	144	100
7.....		311	1,380	311	37	23	154	101
8.....		288	1,600	246	37	24	186	93
9.....		288	1,700	267	29	28	162	103
10.....		267	1,700	412	26	28	154	82
11.....	130	228	1,940	469	28	28	154	88
12.....	130	195	1,940	359	30	28	149	91
13.....	119	180	1,820	359	28	28	140	85
14.....	119	154	2,050	439	29	28	142	82
15.....	130	195	1,940	412	29	32	135	89
16.....	108	210	1,820	359	30	42	128	88
17.....	88	228	1,600	311	26	51	119	66
18.....	54	210	1,380	311	25	70	135	56
19.....	52	210	1,280	267	28	70	149	76
20.....	72	180	1,180	228	26	79	140	88
21.....	72	180	1,380	210	24	91	130	85
22.....	78	180	2,290	195	28	86	130	75
23.....	70	180	2,290	167	28	88	140	52
24.....	80	210	1,820	130	25	85	135	63
25.....	73	246	1,600	119	26	100	130	68
26.....	85	288	1,180	100	27	100	130	47
27.....	119	288	1,000	79	26	100	128	73
28.....	100	311	835	61	24	100	121	-----
29.....	85	267	690	48	23	100	121	-----
30.....	76	267	592	40	22	100	112	-----
31.....		288	-----	33	22	-----	115	-----

Monthly discharge of Little Wind River above Arapahoe, Wyo., for the period Apr. 11 to Nov. 27, 1918.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
April 11-30.....	130	52	92.0	3,650
May.....	311	76	220	13,500
June.....	2,290	334	1,340	79,700
July.....	499	33	261	16,000
August.....	37	21	26.7	1,640
September.....	100	22	55.2	3,280
October.....	186	100	133	8,180
November 1-27.....	115	47	85.0	4,550
The period.....	-----	-----	-----	130,000

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, 1918.

GAGE.—Chain gage on left bank, 1,000 feet below the store at Bonanza; read by Mrs. W. E. Taylor. Datum may differ slightly from that used from 1910 to 1912, as bench mark had been destroyed and there was no means of checking the old gage.

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

CHANNEL AND CONTROL.—Bed of channel composed of gravel. Control 100 feet downstream at small rapids which are shifting between narrow limits.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 7.8 feet at 5 p. m., June 12 and 13 (discharge, 4,080 second-feet); minimum discharge probably occurs during winter.

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

DIVERSIONS.—Prior to December 31, 1916, adjudicated diversions of 80 second-feet from No Wood River above the station and 42 second-feet below, all for irrigation.

In addition, there is a decree for a power diversion of 115 second-feet below.

ACCURACY.—Stage-discharge relation practically permanent except for slight shift in August and September. Rating curve well defined. Gage read to half-tenths once daily. Daily discharge ascertained by applying gage height to rating table; shifting-control method used August 25 to September 30. Records fair.

Discharge measurements of No Wood Creek at Bonanza, Wyo., for the year ending Sept. 30, 1918.

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>
May 12	P. V. Hodges.....	4.51	1,180	Sept. 11	J. B. Spiegel.....	2.62	147
June 25	do.....	5.34	1,820				

Daily discharge, in second-feet, of No Wood Creek at Bonanza, Wyo., for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1.....	201	290	.....	705	331	1,660	735	185	133
2.....	201	290	.....	705	331	1,520	645	185	130
3.....	185	252	.....	645	423	1,240	645	170	143
4.....	185	234	.....	765	375	1,820	705	156	143
5.....	185	234	.....	830	895	2,680	615	156	130
6.....	185	217	.....	765	1,240	3,080	475	105	143
7.....	185	217	.....	705	1,740	3,380	645	130	130
8.....	185	217	.....	705	1,660	3,180	585	92	130
9.....	185	217	.....	765	1,660	3,680	645	80	143
10.....	185	217	.....	765	1,820	3,880	645	60	130
11.....	170	201	.....	705	1,740	3,980	1,240	165	148
12.....	170	234	.....	705	1,310	4,080	895	165	162
13.....	156	217	.....	705	1,100	4,080	830	151	162
14.....	170	234	.....	290	1,170	3,780	960	151	162
15.....	170	217	.....	375	1,240	3,880	895	151	375
16.....	156	217	.....	1,310	1,240	3,080	705	138	353
17.....	156	217	.....	765	1,380	2,880	765	138	271
18.....	170	217	.....	449	1,380	2,590	585	133	271
19.....	156	217	.....	353	1,380	2,140	331	146	271
20.....	156	217	.....	290	1,240	2,060	290	146	234
21.....	201	185	.....	290	1,380	1,660	475	146	201
22.....	217	234	.....	331	1,310	1,590	423	133	217
23.....	217	234	.....	331	1,380	2,680	423	120	130
24.....	201	217	290	353	1,660	2,140	375	108	170
25.....	185	217	290	331	1,820	1,660	375	153	185
26.....	185	217	475	375	1,660	1,380	375	140	70
27.....	185	234	475	290	1,590	1,240	375	138	80
28.....	201	234	530	475	1,380	1,100	375	138	70
29.....	201	217	530	399	1,240	830	353	135	271
30.....	252	217	585	331	1,240	960	290	135	271
31.....	271	.....	705	.....	1,740	.....	234	133	.....

NOTE.—Gage not read Dec. 1 to Mar. 23.

Monthly discharge of No Wood Creek at Bonanza, Wyo., for the year ending Sept. 30, 1918.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October.....	271	156	188	11,600
November.....	290	185	226	13,400
March 24-31.....	705	290	485	7,700
April.....	1,310	290	560	33,300
May.....	1,320	331	1,290	79,300
June.....	4,080	830	2,460	146,000
July.....	1,240	234	578	35,500
August.....	185	60	138	8,480
September.....	375	70	181	10,800

TENSLEEP CREEK NEAR TENSLEEP, WYO.

LOCATION.—In sec. 12, T. 47 N., R. 88 W., 800 feet east of county bridge at Burke's ranch, 5 miles above Tensleep, Washakie County. Nearest tributary, Canyon Creek, enters a quarter of a mile upstream.

DRAINAGE AREA.—228 square miles (measured on base map of Wyoming; scale 1 : 500,000).

RECORDS AVAILABLE.—September 21, 1910, to December 31, 1912; April 19, 1915, to September 30, 1918.

GAGE.—Stevens water-stage recorder installed May 11, 1918, referred to inclined gage used previously; at left bank 800 feet upstream from county bridge, opposite vertical rock cliff. Datum lowered 1 foot, September 26, 1916.

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

CHANNEL AND CONTROL.—Bed composed of coarse gravel and small boulders. Control just below gage at rapids, which were fairly permanent in 1918. Right bank vertical rock cliff; left bank subject to overflow at extremely high water.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 6.7 feet at 4 a. m. June 11 (discharge, 2,300 second-feet); minimum stage occurs during winter.

ICE.—Stage-discharge relation not seriously affected by ice. Open-channel rating curve assumed applicable.

DIVERSIONS.—There is a diversion of about 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.—Diurnal fluctuation during spring, caused by alternate melting and freezing of mountain snow.

ACCURACY.—Stage-discharge relation practically permanent. Rating curve well-defined between 40 and 1,000 second-feet. Prior to May 11, gage read to hundredths once daily, after that date water-stage recorder operated satisfactorily until the middle of June, and after that time operation very unsatisfactory, as shown by footnote to table of daily discharge. Records for October, March, April, and May good, for remainder of year fair. No records November 1 to February 28.

Discharge measurements of Tensleep Creek near Tensleep, Wyo., during the year ending Sept. 30, 1918.

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 8	P. V. Hodges.....	2.18	230	Aug. 13	P. V. Hodges.....	1.48	98
May 11	do.....	2.12	220	Sept. 10	J. B. Spiegel.....	1.31	72
June 25	do.....	3.04	518				

Daily discharge, in second-feet, of Tensleep Creek near Tensleep, Wyo., for the year ending Sept. 30, 1918.

Day.	Oct.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1.....	80	45	190	52	710	212	125	58
2.....	76	48	73	55	500	212	116	65
3.....	77	49	45	60	530	212	108	70
4.....	82	48	47	84	750	224	100	75
5.....	76	47	48	152	850	212	110	70
6.....	74	55	49	236	1,000	212	120	70
7.....	75	54	47	224	1,000	212	125	70
8.....	76	50	47	224	1,200	201	125	70
9.....	72	57	48	290	1,450	224	120	70
10.....	71	48	48	236	1,750	230	110	71
11.....	74	47	58	212	1,850	215	108	70
12.....	72	48	52	212	1,600	200	115	70
13.....	71	46	54	190	1,600	180	100	75
14.....	68	52	59	236	1,550	260	98	80
15.....	69	51	66	320	1,450	360	96	85
16.....	71	48	55	422	1,450	352	94	82
17.....	71	46	54	369	1,300	300	92	80
18.....	54	48	52	352	1,200	300	90	84
19.....	72	50	49	352	1,100	200	88	84
20.....	71	49	48	320	800	170	85	84
21.....	71	48	53	369	600	160	82	83
22.....	70	52	55	369	600	160	79	83
23.....	56	54	58	460	540	160	76	83
24.....	64	54	54	582	756	160	73	83
25.....	69	66	51	624	540	150	70	82
26.....	71	100	48	500	422	150	67	82
27.....	69	110	46	422	336	150	64	82
28.....	69	116	49	369	276	143	63	82
29.....	68	152	49	422	262	134	63	80
30.....	68	186	50	666	236	134	63	123
31.....	68	212	-----	802	-----	130	62	-----

NOTE.—No gage readings Oct. 28–31, Mar. 1, 2, June 3–8, 17–22, July 10–15, 17–27, Aug. 1–3, 5–10, 12, 14–17, 19–26, 28–31, Sept. 1–9, 11–16, 25–28; discharge estimated from comparative hydrograph of Shell Creek near Shell.

Monthly discharge of Tensleep Creek near Tensleep, Wyo., for the year ending Sept. 30, 1918.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October.....	82	54	70.8	4,350
March.....	212	45	68.9	4,240
April.....	190	45	56.7	3,370
May.....	802	52	328	20,200
June.....	1,850	236	940	55,900
July.....	360	130	204	12,500
August.....	125	62	93.1	5,720
September.....	123	58	78.2	4,650

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, half a mile below.

DRAINAGE AREA.—398 square miles (measured on base map of Wyoming; scale, 1: (500,000).

RECORDS AVAILABLE.—July 28, 1910, to October 31, 1912; April 19, 1915, to September 30, 1918.

GAGE.—Chain on right bank 300 feet below ranch; read by Mrs. Wm. Paumer; used since April 11, 1917. From April 19, 1915, to November 18, 1916, staff gage at same location and datum. From July 28, 1910, to October 31, 1912, a chain gage was located near house. No definite relation between gages at two locations, as high water changed channel between.

DISCHARGE MEASUREMENTS.—Made from cable 65 feet below gage or by wading nearby.

CHANNEL AND CONTROL.—Bed composed of gravel. Control at rapids composed of small boulders 150 feet below gage; shifted during 1918. Right bank low and will be overflowed at stage of 2 feet.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 5.3 feet at 8 a. m. June 12 (discharge, 3,390 second-feet); minimum discharge probably occurs during winter.

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

DIVERSIONS.—Prior to December 31, 1916, there were adjudicated diversions of 66 second-feet from Paintrock Creek, practically all being above the station.

REGULATIONS.—Diurnal fluctuation during spring, caused by alternate melting and freezing of mountain snow.

ACCURACY.—Stage-discharge relation not permanent. Standard rating-curve well defined, but sufficient measurements were not obtained to define closely the shifts in control. Gage read to hundredths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table; shifting-control method used May 1 to September 30. Records fair.

Discharge measurements of Paintrock Creek near Bonanza, Wyo., during the year ending Sept. 30, 1918.

Date.	Made by—	Gage height.	Dis-charge.
		<i>Feet.</i>	<i>Sec.-ft.</i>
May 12	P. V. Hodges.....	1.91	187
June 25	do.....	3.26	931
Sept. 11	J. B. Spiegel.....	1.30	33.6

Daily discharge, in second-feet, of Paintrock Creek near Bonanza, Wyo., for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Dec.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	51	91	71		30	68	775	216	43	35
2	45	85			31	73	560	252	35	33
3	43	80			36	88	560	275	30	43
4	41	85			39	96	895	326	28	39
5	41	80			33	142	1,520	242	47	36
6	35	80			49	247	1,520	256	180	35
7	30	80			41	220	1,740	256	188	31
8	31	80			41	234	1,850	224	152	33
9	38	80			47	300	2,070	224	107	33
10	41	80			43	242	2,180	234	96	33
11	38	80			53	200	2,620	456	66	35
12	33	80			53	188	2,400	337	51	31
13	31	80			55	176	2,290	260	41	28
14	35	80			75	200	2,180	456	39	30
15	36	80			184	295	2,180	370	38	71
16	36	80			85	370	1,630	270	36	102
17	51	78			75	348	1,740	220	35	96
18	68	80			75	290	1,200	229	33	96
19	78	80			68	234	1,200	173	35	91
20	78	78			68	290	1,110	159	35	88
21	80	73			71	359	895	145	35	93
22	80	73			71	364	855	135	36	102
23	80	66			73	462	815	126	35	110
24	80	66		25	68	554	1,360	93	36	123
25	85	71		27	68	554	855	102	38	116
26	85	73		28	80	430	700	159	43	123
27	83	73		28	73	342	462	129	43	116
28	99	73		35	78	305	430	99	43	123
29	108	75		30	66	332	342	96	43	126
30	99	75		28	66	672	430	75	43	159
31	102			30		895		55	43	

Monthly discharge of Paintrock Creek near Bonanza, Wyo., for the year ending Sept. 30, 1918.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October.....	108	30	60.0	3,690
November.....	91	66	77.8	4,630
March 24-31.....	35	25	28.9	459
April.....	184	30	63.2	3,760
May.....	895	68	309	19,000
June.....	2,620	342	1,310	78,000
July.....	456	55	214	13,200
August.....	188	28	56.5	3,470
September.....	159	28	73.7	4,390

SHELL CREEK AT SHELL, WYO.

LOCATION.—Near west edge of sec. 26, T. 53 N., R. 91 W., 450 feet above head gate of Shell canal, three-fourths of a mile northeast of Shell, Big Horn County. Nearest tributary, Trap per Creek, enters a short distance above.

DRAINAGE AREA.—256 square miles (measured on base map of Wyoming; scale, 1:500,000).

RECORDS AVAILABLE.—April 1, 1915, to September 30, 1918. From July 1, 1911, to October 31, 1914, station maintained by Wyoming Irrigation Co. and published in reports of State engineer.

GAGE.—Vertical staff on right bank 450 feet above canal head gate; read by J. G. Tatlock. Beginning June 18, 1918, gage heights refer to gage on opposite side of creek set 2.80 feet higher than original gage. All readings referred to original datum.

DISCHARGE MEASUREMENTS.—Made from suspension footbridge at gage or by wading at same section.

CHANNEL AND CONTROL.—Bed composed of gravel. Control just below gage at gravel bar, which shifts during high water. Banks subject to overflow during extremely high water.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year from high-water mark, 8.35 feet on June 11 (discharge, 1,910 second-feet); minimum discharge probably occurs during winter.

ICE.—No information, as records are discontinued during winter.

DIVERSIONS.—Prior to December 31, 1916, there were adjudicated diversions of 8 second-feet from Shell Creek above the station, and 104 second-feet below.

REGULATION.—Flow controlled to a certain extent by storage of water in Adelaide reservoir located on Shell Creek, 25 miles above Shell; capacity of reservoir 1,410 acre-feet. Water stored in reservoir beginning of high-water period and released in latter part of summer.

ACCURACY.—Stage-discharge relation not permanent; high water of 1918 cut new overflow channel around gage. Rating curves used as follows: October 1 to June 10, fairly well defined; after high water, not well defined; above discharge of 600 second-feet, only roughly approximated. Gage read to hundredths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table. Records fair.

Discharge measurements of Shell Creek at Shell, Wyo., during the year ending Sept. 30, 1918.

[Made by P. V. Hodges.]

Date.	Gage height.	Dis-charge.
	<i>Feet.</i>	<i>Sec.-ft.</i>
May 23.....	4.98	272
June 26.....	5.49	508
Aug. 15.....	4.18	111

Daily discharge, in second-feet, of Shell Creek at Shell, Wyo., for the year ending Sept. 30, 1918.

Day.	Oct.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1.....	84	-----	67	68	512	292	129	99
2.....	74	-----	65	68	392	260	129	112
3.....	74	-----	65	68	410	245	134	120
4.....	84	-----	65	90	670	230	139	112
5.....	84	-----	65	126	1,060	230	129	115
6.....	84	-----	66	117	1,440	245	134	112
7.....	84	-----	67	145	1,440	230	150	112
8.....	84	67	68	145	1,560	202	150	112
9.....	84	68	67	175	1,610	202	139	110
10.....	84	68	68	145	1,720	215	139	112
11.....	82	69	71	135	1,910	275	129	109
12.....	81	70	71	128	1,700	215	134	107
13.....	81	70	73	124	1,650	190	120	109
14.....	81	68	73	141	1,600	215	115	112
15.....	81	68	78	188	1,550	310	112	120
16.....	81	68	75	188	1,500	215	125	120
17.....	81	68	69	175	1,450	215	112	117
18.....	72	68	67	188	1,400	215	112	118
19.....	76	69	65	200	1,330	190	112	115
20.....	80	69	65	200	1,050	180	110	112
21.....	80	71	65	225	855	170	112	104
22.....	80	69	65	225	855	170	113	102
23.....	80	69	67	280	790	160	113	112
24.....	80	69	67	340	665	150	113	120
25.....	80	67	69	375	610	170	113	118
26.....	81	67	67	310	488	170	112	115
27.....	84	68	67	280	405	160	112	112
28.....	81	67	68	265	335	148	112	112
29.....	81	67	65	265	345	150	112	120
30.....	80	68	64	155	365	134	112	112
31.....	80	69	-----	212	-----	139	109	-----

NOTE.—Gage washed out June 11-17; discharge determined from high-water mark and comparative hydrograph of Tensleep Creek near Tensleep. No gage readings Nov. 1 to Mar. 8.

Monthly discharge of Shell Creek at Shell, Wyo., for the year ending Sept. 30, 1918.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October.....	84	72	80.7	4,960
March 8-31.....	71	67	68.4	3,260
April.....	78	64	67.8	4,030
May.....	375	68	185	11,400
June.....	1,910	345	1,060	63,100
July.....	310	134	203	12,500
August.....	150	109	122	7,500
September.....	120	99	113	6,720

SHOSHONE RIVER NEAR ISHAWOOA, WYO.

LOCATION.—In SW. $\frac{1}{4}$ sec. 23, T. 51 N., R. 104 W., at Hartung's private bridge, $1\frac{1}{2}$ miles north of Ishawooa, in Park County. Nearest tributary, Bull Creek, enters $1\frac{1}{2}$ miles downstream.

DRAINAGE AREA.—532 square miles (measured on base map of Wyoming; scale, 1:500,000).

RECORDS AVAILABLE.—May 7, 1915, to September 30, 1918.

GAGE.—Vertical staff fastened to bridge piling; read by Albert Hartung. Prior to May 24, 1918, gage half a mile upstream at Spaulding's ranch. Flow at two points comparable.

DISCHARGE MEASUREMENTS.—Made from pile bent bridge.

CHANNEL AND CONTROL.—Bed of stream composed of coarse gravel which may shift; control not well defined. Banks not subject to overflow.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 7.0 feet at 6.45 a. m. June 14 (discharge, 7,740 second-feet); minimum discharge probably occurs during winter.

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

DIVERSIONS.—Prior to December 31, 1916, there were adjudicated diversions of 26 second-feet from South Fork above station and 40 second-feet below.

REGULATION.—Diurnal fluctuation during spring, caused by alternate melting and freezing of mountain snow.

ACCURACY.—Stage-discharge relation apparently permanent. Rating curve used October 1 to May 22 well defined; curve used May 24 to September 30 not well defined. Gage read to hundredths once daily prior to May 22 and twice daily for remainder of year. Daily discharge ascertained by applying mean daily gage height to rating table. Records only fair prior to May 22, owing to uncertainty in gage heights; good after that date.

Discharge measurements of Shoshone River near Ishawooa, Wyo., during the year ending Sept. 30, 1918.

Date.	Made by—	Gage height.	Discharge.
		<i>Feet.</i>	<i>Sec.-ft.</i>
May 24	P. V. Hodges.....	^a 2.18	969
June 22	do.....	4.95	4,470
Sept. 12	J. B. Spiegel.....	1.02	247

^a Original gage at Spaulding's ranch read 3.22 feet.

Daily discharge, in second-feet, of Shoshone River near Ishawooda, Wyo., for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Dec.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1.....	256	142	115	-----	197	410	945	2,280	860	232
2.....	236	142	-----	-----	197	434	780	2,400	990	244
3.....	216	197	-----	-----	160	630	1,040	2,400	990	260
4.....	236	197	-----	-----	142	965	1,920	2,160	900	244
5.....	216	178	-----	-----	142	1,030	2,530	2,040	820	224
6.....	178	178	-----	-----	135	840	3,050	3,050	740	224
7.....	178	178	-----	-----	125	900	3,470	2,400	600	224
8.....	197	160	-----	-----	160	580	3,920	2,280	570	224
9.....	178	160	-----	-----	178	730	4,540	2,530	540	340
10.....	197	160	-----	-----	178	580	5,460	2,280	480	280
11.....	178	160	-----	-----	197	530	6,620	2,280	480	256
12.....	197	160	-----	-----	216	482	5,820	2,280	458	244
13.....	178	142	-----	-----	296	458	6,620	2,160	425	240
14.....	197	197	-----	-----	340	580	6,780	2,400	408	240
15.....	142	178	-----	-----	276	458	6,620	2,040	398	510
16.....	142	178	-----	-----	256	216	5,980	2,040	392	381
17.....	142	178	-----	-----	216	318	6,460	1,800	408	304
18.....	160	160	-----	-----	216	160	5,980	1,920	381	272
19.....	142	142	-----	-----	216	160	5,980	1,680	350	256
20.....	135	108	-----	-----	178	580	5,500	1,680	345	240
21.....	128	115	-----	-----	178	630	5,500	1,570	320	240
22.....	197	115	-----	-----	178	680	4,860	1,360	312	232
23.....	178	122	-----	-----	216	790	5,180	1,360	292	236
24.....	135	197	-----	108	216	900	5,020	1,360	276	248
25.....	128	108	-----	122	256	900	5,180	1,360	292	228
26.....	142	142	-----	128	340	705	3,920	1,040	284	216
27.....	142	135	-----	128	296	635	3,470	990	276	232
28.....	142	115	-----	160	256	510	2,920	945	264	208
29.....	142	135	-----	142	256	480	2,530	900	264	208
30.....	142	115	-----	160	296	780	2,160	900	252	360
31.....	142	-----	-----	197	-----	1,120	-----	860	244	-----

NOTE.—Gage not read Dec. 2 to Mar. 23.

Monthly discharge of Shoshone River near Ishawooda, Wyo., for the year ending Sept. 30, 1918.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October.....	256	128	172	10,600
November.....	197	108	153	9,100
March 24-31.....	197	108	143	2,270
April.....	340	125	217	12,900
May.....	1,120	160	618	38,000
June.....	6,780	780	4,370	260,000
July.....	3,050	860	1,830	113,000
August.....	990	244	471	29,000
September.....	510	208	262	15,600

SOAP CREEK NEAR ST. XAVIER, MONT.

LOCATION.—In sec. 20, T. 5 S., R. 32 E., at Henry Reed's ranch, 9 miles south of St. Xavier and 1 mile above mouth of stream, in Big Horn County.

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—September 11, 1911, to September 30, 1918. April 25, 1914, to June 12, 1915, at Frank Annerer's ranch about a quarter of a mile above present site; September 11, 1911, to November 30, 1913, in W. $\frac{1}{4}$ NW. $\frac{1}{4}$ sec. 2, T. 6 S., R. 32 E., about a quarter of a mile above headworks of Soap Creek ditch.

GAGE.—Overhanging chain gage on right bank opposite Henry Reed's house; read by Henry Reed. Original gage, in use September 11, 1911, to November 30, 1913, was overhanging chain gage about a quarter of a mile above headworks of Soap Creek ditch; gage used April 25, 1914, to June 12, 1915, a chain gage on foot-bridge near Frank Annerer's house, about a quarter of a mile above present site.

DISCHARGE MEASUREMENTS.—Made by wading or from highway bridge about 1 mile upstream from gage.

CHANNEL AND CONTROL.—Bed of stream at principal control is composed of gravel and silt, shifts slightly. Stage-discharge relation affected at times by growth of aquatic plants in channel.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 7.97 feet at 8.05 a. m. March 17 (discharge, 341 second-feet); minimum stage recorded, 2.76 feet July 6 at 6 p. m. (discharge, 13.5 second-feet).

1911-1918: Maximum stage recorded, 12.8 feet May 11, 1914, determined by leveling from flood marks (discharge determined from extension of rating curves 438 second-feet); minimum stage recorded, 2.1 feet September 10, 1914 (discharge 1 second-foot).

ICE.—Stage-discharge relation seriously affected by ice December 3 to March 16. Flow not computed.

DIVERSIONS.—Soap Creek ditch diverts above station during summer for irrigation.

REGULATION.—None.

ACCURACY.—Stage-discharge relation practically permanent during the year except for ice effect. Rating curve well defined between 12 and 82 second-feet. Gage read to hundredths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table. Records good below 82 second-feet and only fair above.

Discharge measurements of Soap Creek near St. Xavier, Mont., during the year ending Sept. 30, 1918.

[Made by W. A. Lamb.]

Date.	Gage height.	Dis-charge.	Date.	Gage height.	Dis-charge.
	<i>Fect.</i>	<i>Sec.-ft.</i>		<i>Fect.</i>	<i>Sec.-ft.</i>
Oct. 2.....	3.15	25	June 7.....	3.43	44
May 15.....	4.23	69	Aug. 21.....	2.90	16.2

Daily discharge, in second-feet, of Soap Creek near St. Xavier, Mont., for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Dec.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1.....	22	29	24	-----	50	65	82	14	16	31
2.....	22	26	23	-----	54	64	49	14	16	25
3.....	23	25	23	-----	76	78	46	14	15	25
4.....	23	25	-----	-----	81	81	43	16	16	23
5.....	23	25	-----	-----	92	76	36	15	16	22
6.....	23	25	-----	-----	98	75	35	14	153	48
7.....	23	25	-----	-----	74	68	33	15	36	50
8.....	23	25	-----	-----	97	85	32	15	15	24
9.....	23	25	-----	-----	100	246	31	15	16	26
10.....	23	24	-----	-----	125	239	28	16	16	24
11.....	23	25	-----	-----	131	192	18	18	15	23
12.....	23	24	-----	-----	58	88	16	23	16	34
13.....	23	24	-----	-----	49	86	14	19	15	36
14.....	23	24	-----	-----	65	76	19	17	15	27
15.....	23	25	-----	-----	245	69	17	65	15	29
16.....	22	24	-----	-----	98	67	15	26	15	26
17.....	23	23	-----	321	72	65	15	18	15	23
18.....	24	24	-----	301	50	78	16	18	16	32
19.....	24	24	-----	296	56	80	15	15	16	50
20.....	24	24	-----	173	83	68	15	15	16	36
21.....	24	23	-----	122	46	54	14	15	16	32
22.....	26	23	-----	74	52	47	14	15	17	34
23.....	24	23	-----	54	44	44	14	17	16	32
24.....	24	23	-----	64	40	37	15	18	16	25
25.....	24	23	-----	54	40	40	15	42	16	27
26.....	24	25	-----	44	47	129	15	24	16	25
27.....	24	24	-----	44	80	68	14	16	15	25
28.....	24	24	-----	56	260	161	15	17	16	25
29.....	29	24	-----	52	119	87	15	17	16	25
30.....	36	24	-----	45	76	69	15	17	16	28
31.....	30	-----	-----	50	-----	80	-----	16	15	-----

NOTE.—Data inadequate for determination of discharge Dec. 4 to Jan. 5. Gage not read Jan. 6 to Mar. 16.

Monthly discharge of Soap Creek, near St. Xavier, Mont., for the year ending Sept. 30, 1918.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October.....	36	22	24.2	1,490
November.....	29	23	24.4	1,450
March 17-31.....	321	44	117	3,480
April.....	260	40	85.3	5,080
May.....	246	37	89.1	5,480
June.....	82	14	24.0	1,430
July.....	65	14	19.2	1,180
August.....	153	15	20.8	1,280
September.....	50	22	29.7	1,770

ROTTENGRASS CREEK NEAR ST. XAVIER, MONT.

LOCATION.—In NW. $\frac{1}{4}$ sec. 6, T. 5 S., R. 23 E., a quarter of a mile above crossing of Big Horn canal, in 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, 1918.

GAGE.—Overhanging chain on left bank about a quarter of a mile above crossing of Big Horn canal; read by Loren S. Stanley October 1 to November 24, 1917, and by W. H. Ferguson June 7 to August 17, 1918.

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, 6.4 feet at 8 a. m. July 14 (discharge, 104 second-feet); minimum discharge, 4 second-feet November 13, 14, and 22.

1911-1918: Maximum stage recorded, 11.3 feet March 30, 1917 (approximate discharge, 500 second-feet); minimum stage recorded, 2.3 feet September 27, 1911 (discharge, 0.3 second-foot).

ICE.—Stage-discharge relation seriously affected by ice; observations discontinued November 24 for winter.

DIVERSIONS.—None.

REGULATION.—None.

ACCURACY.—Stage-discharge relation changed during the period for which no records are available. Rating curve used October 1 to November 24, well defined between 4 and 60 second-feet; curve used June 7 to August 21, well defined between 5 and 80 second-feet. Gage read to half-tenths once daily. Daily discharge ascertained by applying daily gage height to rating table, except for periods shown in footnote to daily-discharge table. Records good for October and November; June 7 to August, poor.

Discharge measurements of Rottengrass Creek near St. Xavier, Mont., during the year ending Sept. 30, 1918.

[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>
Oct. 2.....	3.20	7.8	June 7.....	4.99	51
May 15.....	5.56	70	Aug. 21.....	3.20	7.1

Daily discharge, in second-feet, of Rottengrass Creek near St. Xavier, Mont., for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	June.	July.	Aug.	Day.	Oct.	Nov.	June.	July.	Aug.
1.....	6	8.4	.....	7.0	72	16.....	8	7	15	88	4.5
2.....	5.2	8	.....	7	80	17.....	10	6	9.2	55	5
3.....	7	7	.....	7	88	18.....	9	10	10	22	5.5
4.....	10	6	.....	8.5	88	19.....	8	10	13	4.5	6
5.....	9	6	.....	7	88	20.....	6	9	14	4.5	6.5
6.....	10	8	.....	7	94	21.....	6	7	9.2	9.2	7
7.....	8	8	51	8	100	22.....	9	4	10	14	.....
8.....	8	8	45	10	70	23.....	11	5	9.9	18	.....
9.....	6	9	45	12	39	24.....	9	6	9.7	22	.....
10.....	6	8	51	16	33	25.....	8	.....	9.5	18	.....
11.....	6	6	51	7	27	26.....	10	.....	9.3	14	.....
12.....	6	5	42	7	21	27.....	10	.....	9.1	4.5	.....
13.....	6	4	32	7	15	28.....	10	.....	8.9	22	.....
14.....	6	4	32	104	9	29.....	8	.....	8.7	39	.....
15.....	6	8	25	28	4.5	30.....	6	.....	8.5	50	.....
						31.....	7	.....	.....	61	.....

NOTE.—Gage not read June 23-29, July 7, 8, 12, 17, 21, 23, 25, 28, 30, 31, Aug. 2, 4, 6, 8, 10-14, and 17-20; discharge interpolated. No records Nov. 25 to June 6 and Aug. 22 to Sept. 30.

Monthly discharge of Rottengrass Creek near St. Xavier, Mont., for the year ending Sept. 30, 1918.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October.....	11	5.2	7.75	477
November 1-24.....	10	4.0	6.98	332
June 7-30.....	51	8.5	22	1,050
July.....	104	4.5	22.2	1,360
August 1-21.....	100	4.5	41.1	1,710

LITTLE HORN RIVER NEAR WYOLA, MONT.

LOCATION.—In W. $\frac{1}{2}$ SW. $\frac{1}{4}$ sec. 28, T. 2 S., R. 35 E., a quarter of a mile below proposed headworks of Little Horn canal No. 3, 16 miles above Lodgegrass Creek, and 4 miles southwest of Wyola, in Big Horn County.

DRAINAGE AREA.—260 square miles.

RECORDS AVAILABLE.—September 7, 1911, to September 30, 1918.

GAGE.—Overhanging chain gage on right bank; read by Granville Collins.

DISCHARGE MEASUREMENTS.—Made from cable 75 feet below gage or by wading near cable.

CHANNEL AND CONTROL.—Bed composed of boulders and gravel; shifts occasionally at high stage. Left bank high and not subject to overflow; right bank high but subject to overflow about 100 feet below gage.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 7.0 feet at 8 a. m. June 12 (discharge, 1,480 second-feet); minimum open channel (discharge, 100 second-feet during several periods in the year; a lesser discharge probably occurred in the winter.

1912-1918: Maximum stage recorded, 7.1 feet June 22, 1917 (discharge, 1,580 second-feet); minimum stage, 4.2 feet April 10 and 12, 1915 (discharge, 32 second-feet).

ICE.—Stage-discharge relation seriously affected by ice December 6 to March 16; flow not computed.

DIVERSIONS.—Small amount diverted for irrigation.

REGULATION.—None.

ACCURACY.—Stage-discharge relation not permanent; affected by shifting control and by ice. Rating curves used as follows: October 1 to May 31, fairly well defined below 500 second-feet; June 7-30, well defined between 500 and 1,100 second-feet; July 11 to September 30, well defined between 80 and 200 second-feet. Gage read to tenths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table; shifting-control method used June 1-6 and July 1-10. Records good.

Discharge measurements of Little Horn River near Wyola, Mont., during the year ending Sept. 30, 1918.

Date.	Made by—	Gage height.	Dis-charge.	Date.	Made by—	Gage height.	Dis-charge.
Oct. 3	W. A. Lamb.....	<i>Feet.</i> 4.35	<i>Sec.-ft.</i> 98	June 26	A. H. Tuttle.....	<i>Feet.</i> 5.50	<i>Sec.-ft.</i> 558
June 6	do.....	6.30	1,010	Aug. 22	W. A. Lamb.....	4.58	146

Daily discharge, in second-feet, of Little Horn River near Wyola, Mont., for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1.....	100	131	.....	100	142	452	410	172	120
2.....	100	131	.....	100	142	428	370	158	120
3.....	100	131	.....	100	208	486	352	186	120
4.....	100	120	.....	120	331	680	366	172	120
5.....	100	120	.....	134	418	829	361	172	120
6.....	100	120	.....	120	418	980	357	172	120
7.....	100	120	.....	100	331	1,040	309	172	120
8.....	100	120	.....	110	373	1,140	284	145	120
9.....	100	120	.....	120	491	1,140	240	145	120
10.....	100	120	.....	142	418	1,240	236	145	120
11.....	100	120	.....	131	292	1,340	266	145	120
12.....	100	120	.....	120	274	1,380	266	145	120
13.....	100	120	.....	120	274	1,380	232	120	120
14.....	100	120	.....	188	240	1,410	266	120	132
15.....	100	120	.....	240	331	1,380	232	120	145
16.....	100	120	.....	131	396	1,140	216	132	145
17.....	100	120	166	120	396	1,170	201	132	125
18.....	100	100	240	124	352	1,100	186	120	120
19.....	110	100	131	142	352	859	172	120	120
20.....	131	100	154	154	312	662	172	120	120
21.....	142	100	131	154	373	533	216	120	120
22.....	142	100	131	166	352	484	201	120	120
23.....	131	100	120	154	365	533	201	120	120
24.....	120	100	131	142	442	533	172	120	145
25.....	120	100	131	120	542	558	232	120	145
26.....	131	116	131	120	516	533	232	120	145
27.....	142	100	131	193	491	533	201	120	125
28.....	142	100	166	208	373	484	201	120	120
29.....	166	100	120	154	312	508	172	120	120
30.....	166	100	120	154	331	414	172	120	145
31.....	166	.....	100	.....	501	.....	172	120	.....

NOTE.—Discharge, Dec. 6 to Jan. 25, not determined, owing to lack of data for determining ice effect. Gage not read Jan. 26 to Mar. 16.

Monthly discharge of Little Horn River near Wyola, Mont., for the year ending Sept. 30, 1918.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October.....	166	100	116	7,130
November.....	131	100	113	6,720
March 17-31.....	240	100	140	4,160
April.....	240	100	139	8,270
May.....	542	142	358	22,000
June.....	1,410	414	845	50,300
July.....	410	172	247	15,200
August.....	186	120	137	8,420
September.....	145	120	126	7,500

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, 1918; 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.—Sloping staff gage used since August 10, 1917. Prior to that date the following gages were used: September 7, 1911, to April 1, 1912, staff on downstream end of bridge pier near left bank; April 6, 1912, to August 9, 1917, chain gage on downstream side of railway bridge; gages at same datum. Records 1905, 1906, obtained from chain gage on upstream side of railroad bridge at Crow Agency. Stevens water-stage recorder in wooden shelter on right bank, installed December 4, 1916; destroyed by dynamite May 5, 1917; new Stevens recorder installed May 27, 1917, at same location and datum. Records from water-stage recorder not used owing to continual silting of intake pipe. Chain gage read by Lawrence Robison and Roswell Shriver.

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; shifting. Banks high; not subject to overflow below gage height about 14 feet.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 8.6 feet at 8 a. m. June 19 (discharge, 2,500 second-feet); minimum stage, 4.05 feet at 6.30 p. m. July 17 (discharge, 56 second-feet).

1905-1906 and 1912-1918: Maximum stage recorded, 10.8 feet April 6, 1917 (discharge, 3,930 second-feet); minimum stage, 4.05 feet July 17, 1918 (discharge, 56 second-feet).

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

DIVERSIONS.—Several diversions for irrigation from main stream and tributaries above station. Low flow of July 17-20 due to diversion above.

REGULATION.—None.

ACCURACY.—Stage-discharge relation changed during March, April, and May. Rating curve used October 1 to December 7, well defined between 150 and 4,000 second-feet; curve used May 12 to September 30 well defined between 150 and 4,000 second-feet. Gage read to nearest half-tenth once daily. Daily discharge October 1 to December 7 and May 12 to September 30, except December 3-6, ascertained by applying daily gage height to rating table; shifting-control method used March 21 to May 11. Records good except those which were determined by shifting-control method which are fair.

Discharge measurements of Little Horn River near Crow Agency, Mont., during the year ending Sept. 30, 1918.

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. 3	W. A. Lamb.....	4.40	136	May 15	W. A. Lamb.....	5.65	599
Nov. 29	do.....	4.49	157	June 7	do.....	6.86	1,380
Mar. 27	do.....	6.00	937	June 27	A. H. Tuttle.....	5.80	689
Apr. 26	do.....	5.25	463	Aug. 23	W. A. Lamb.....	4.51	171

Daily discharge, in second-feet, of Little Horn River near Crow Agency, Mont., for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Dec.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1.....	129	202	156	-----	488	416	817	453	197	141
2.....	129	219	156	-----	488	358	757	411	197	141
3.....	129	219	145	-----	436	381	699	411	197	168
4.....	129	219	134	-----	386	401	757	411	228	168
5.....	129	219	124	-----	386	452	757	411	228	168
6.....	129	171	114	-----	381	551	879	411	228	168
7.....	129	171	104	-----	381	659	1,330	371	1,520	168
8.....	129	171	-----	-----	381	599	1,720	371	411	182
9.....	129	171	-----	-----	426	654	1,070	333	228	197
10.....	129	156	-----	-----	530	1,120	1,520	296	197	197
11.....	129	156	-----	-----	530	880	1,590	296	197	168
12.....	129	156	-----	-----	524	592	2,040	411	197	168
13.....	129	156	-----	-----	524	543	1,720	411	197	168
14.....	129	156	-----	-----	572	592	2,240	296	197	197
15.....	129	156	-----	-----	626	644	1,980	296	212	228
16.....	129	156	-----	-----	910	592	1,860	296	228	212
17.....	129	156	-----	-----	621	644	1,780	56	228	228
18.....	156	156	-----	-----	457	644	1,780	67	197	228
19.....	156	142	-----	-----	406	644	2,500	90	182	228
20.....	156	142	-----	-----	401	618	1,590	141	168	228
21.....	156	142	-----	1,980	401	644	1,520	296	168	228
22.....	156	142	-----	2,010	498	644	1,200	296	168	197
23.....	156	156	-----	2,040	551	644	1,330	261	168	228
24.....	156	156	-----	2,080	545	592	942	261	168	212
25.....	156	156	-----	2,110	391	757	787	261	168	228
26.....	186	156	-----	1,180	436	817	699	261	168	228
27.....	186	156	-----	910	483	817	644	261	154	228
28.....	186	156	-----	820	530	757	644	261	141	228
29.....	186	156	-----	820	632	1,070	543	278	141	228
30.....	186	156	-----	820	572	1,260	543	228	141	228
31.....	202	-----	-----	488	-----	1,330	-----	197	141	-----

NOTE.—Discharge December 3-6 estimated because of ice. Gage read December 9-15, 22, and January 2 (discharge not determined because of ice); no gage readings for other periods, December 8 to March 20. Decrease in flow July 17-19 due to diversions above gage.

Monthly discharge of Little Horn River near Crow Agency, Mont., for the year ending Sept. 30, 1918.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October.....	202	129	148	9,100
November.....	219	142	166	9,880
December 1-7.....	156	104	133	1,850
March 21-31.....	2,110	488	1,390	30,300
April.....	910	381	496	29,500
May.....	1,330	358	688	42,300
June.....	2,500	543	1,270	75,600
July.....	453	56	294	18,100
August.....	1,520	141	237	14,600
September.....	228	141	199	11,800

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 a quarter of a mile south of Lodgegrass, in Crow Indian Reservation, in Big Horn County.

DRAINAGE AREA.—Not measured (142 square miles at old site 6 miles upstream).

RECORDS AVAILABLE.—March 24, 1916, to September 30, 1918, at present site; September 9, 1911, to December 28, 1915, at old site 6 miles above in SW. $\frac{1}{4}$ sec. 29, T. 6 S., R. 35 E., a quarter of a mile above Lodgegrass ditch.

GAGE.—Overhanging wire gage on left bank. At old site an overhanging chain gage at different datum.

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

CHANNEL AND CONTROL.—An outcrop of sandstone overlain with boulders and gravel forms control; may shift, owing to movement of the boulders and gravel.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 4.10 feet at 2 p. m. June 15 (discharge, 624 second-feet); minimum stage, 1.68 feet August 31 to September 2 (discharge, 16 second-feet).

1911–1918: 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 a quarter of a mile above headworks of this ditch; hence flow during irrigation season is not comparable to that at present site.

REGULATION.—None.

ACCURACY.—Stage-discharge relation not permanent; affected by ice and by shifting control. Rating curve used October 1 to November 30 is well defined between 10 and 50 second-feet. Gage read to nearest quarter-tenth once daily. Daily discharge October 1 to November 30 ascertained by applying daily gage height to rating table. Shifting-control method used March 23 to September 30. Records fair.

Discharge measurements of Lodgegrass Creek at Lodgegrass, Mont., during the year ending Sept. 30, 1918.

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. 3	W. A. Lamb.....	2.07	19.4	June 6	W. A. Lamb.....	3.34	272
Apr. 26	do.....	2.23	72	Aug. 26	A. H. Tuttle.....	2.76	167
May 15	do.....	2.55	142	Aug. 23	W. A. Lamb.....	1.74	19.3

Daily discharge, in second-feet, of Lodgegrass Creek at Lodgegrass, Mont., for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1.....	22	27	-----	78	95	176	88	24	16
2.....	21	30	-----	61	86	159	82	26	16
3.....	21	30	-----	59	90	148	78	25	18
4.....	21	27	-----	61	102	210	75	28	18
5.....	21	27	-----	63	120	187	73	29	18
6.....	21	24	-----	62	170	245	71	82	18
7.....	21	24	-----	64	153	329	61	106	23
8.....	22	22	-----	96	138	391	54	141	29
9.....	22	22	-----	182	315	416	51	100	32
10.....	22	22	-----	113	395	463	53	22	32
11.....	22	22	-----	100	304	490	46	22	32
12.....	22	22	-----	81	182	516	42	22	32
13.....	21	22	-----	69	165	543	40	22	32
14.....	18	22	-----	75	156	571	40	22	32
15.....	18	22	-----	81	151	624	128	22	32
16.....	21	22	-----	88	146	605	86	21	35
17.....	22	22	-----	95	156	516	49	20	36
18.....	18	22	-----	88	143	499	40	18	36
19.....	27	22	-----	88	148	459	40	18	33
20.....	27	22	-----	87	143	379	40	17	33
21.....	27	22	-----	90	133	315	38	17	30
22.....	27	21	-----	90	131	275	37	20	30
23.....	30	21	199	77	130	239	37	18	31
24.....	30	21	176	72	139	208	38	18	34
25.....	30	21	167	78	135	191	42	18	34
26.....	30	22	128	78	150	165	37	18	37
27.....	27	22	110	77	182	159	35	18	34
28.....	27	22	144	247	168	124	31	18	34
29.....	27	22	107	281	144	104	20	17	34
30.....	24	22	81	125	146	329	26	18	34
31.....	24	-----	71	-----	133	-----	26	16	-----

NOTE.—Gage read Dec. 1 to Jan. 9 and Mar. 17–22; discharge not determined owing to ice effect. Gage not read Jan. 10 to Mar. 16.

Monthly discharge of Lodgegrass Creek at Lodgegrass, Mont., for the year ending Sept. 30, 1918.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October.....	30	18	23.8	1,460
November.....	30	21	23.0	1,370
March 23-31.....	199	71	131	2,340
April.....	281	59	96.9	5,770
May.....	395	86	160	9,840
June.....	624	104	334	19,900
July.....	128	20	51.7	3,180
August.....	141	16	31.7	1,950
September.....	37	16	29.5	1,760

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.—September 1, 1915, to September 30, 1918.

GAGE.—Chain gage on upstream guardrail of bridge, since May 4, 1916; read by John Watt. Prior to that date gage was inclined staff, 1 mile upstream at K ranch.

DISCHARGE MEASUREMENTS.—Made from two-span highway bridge or by wading.

CHANNEL AND CONTROL.—Bed composed of silt and gravel. Control just above mouth of Clear Creek. During extremely high water there is backwater from Clear Creek.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year 8.75 feet July 14 (discharge, 10,800 second-feet); minimum discharge, 48 second-feet). October 1. No records for winter.

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

DIVERSIONS.—Prior to December 31, 1916, there were adjudicated diversions of 9 second-feet from Powder River, above the station, and none between it and State line.

REGULATION.—None.

ACCURACY.—Stage-discharge relation not permanent but shifts between narrow limits. Rating curve well defined below 3,000 second-feet but uncertain above. Gage read to hundredths once daily. Daily discharge ascertained by applying gage height to rating table; shifting-control method used August 1 to September 30. Stage-discharge relation affected by backwater from Clear Creek May 27 to June 17; amount of backwater effect estimated from current-meter measurement and comparison with records for other streams. Records fair.

Discharge measurements of Powder River near Arvada, Wyo., during the year ending Sept. 30, 1918.

Date.	Made by—	Gage height.	Dis-charge.
		<i>Feet.</i>	<i>Sec.-ft.</i>
Oct. 1	P. V. Hodges.....	3.40	51
June 16	do.....	5.15	511
Sept. 1	Robert Follansbee.....	3.04	57

Daily discharge, in second-feet, of Powder River near Arvada, Wyo., for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1.....	48	104	-----	300	210	485	414	102	57
2.....	52	148	-----	285	192	612	140	124	58
3.....	55	192	-----	290	175	740	127	146	58
4.....	55	159	-----	242	255	740	114	78	51
5.....	58	182	-----	224	322	740	93	100	58
6.....	58	159	-----	192	390	740	72	166	58
7.....	66	149	-----	201	645	740	517	232	61
8.....	66	143	-----	210	850	740	962	76	69
9.....	66	130	-----	200	1,680	975	140	1,240	59
10.....	66	130	-----	210	1,470	6,080	172	349	58
11.....	66	143	-----	255	1,380	740	4,610	295	57
12.....	66	149	-----	433	2,150	692	5,000	172	66
13.....	74	143	-----	440	2,920	645	7,900	116	75
14.....	74	143	-----	566	850	602	10,800	85	84
15.....	84	148	-----	692	740	560	3,700	69	94
16.....	89	153	-----	745	912	522	1,840	63	104
17.....	74	153	-----	798	795	522	2,640	1,030	104
18.....	74	143	-----	850	1,120	975	3,440	332	104
19.....	80	143	-----	651	1,120	7,160	2,640	196	135
20.....	91	130	-----	452	1,120	6,620	1,590	414	130
21.....	104	130	-----	378	1,120	1,470	545	138	130
22.....	116	130	-----	305	1,120	1,120	586	114	143
23.....	116	130	-----	270	538	740	378	104	104
24.....	130	130	-----	270	647	3,440	324	96	143
25.....	143	130	305	270	756	1,680	270	87	143
26.....	143	130	255	275	865	2,160	950	78	143
27.....	143	130	305	280	975	360	545	74	130
28.....	159	130	485	270	975	308	295	69	124
29.....	122	130	305	260	912	255	950	64	114
30.....	84	130	270	260	1,020	1,110	530	62	104
31.....	130	-----	305	-----	1,120	-----	111	60	-----

NOTE.—Discharge interpolated for following days when gage was not read: Oct. 21, 29; Nov. 2, 15, 25, 29; Apr. 1, 2, 7, 14, 16, 17, 19, 21, 26, 28; May 2, 5, 12, 24–26, 30; June 2, 4, 28; July 5, 7, 13, 17, 20, 24, 30; Aug. 2, 6, 24, 25, 27, 28, 30, 31; Sept. 8–10, 12–15, 29.

Monthly discharge of Powder River near Arvada, Wyo., for the year ending Sept. 30, 1918.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October.....	159	48	88.8	5,460
November.....	192	104	141	8,390
March 25–31.....	485	255	319	4,430
April.....	850	192	369	22,000
May.....	2,920	175	947	58,200
June.....	7,160	255	1,480	88,100
July.....	10,800	72	1,690	104,000
August.....	1,240	60	204	12,500
September.....	143	51	93.6	5,370

CLEAR CREEK NEAR BUFFALO, WYO.

LOCATION.—In sec. 6, T. 50 N., R. 82 W., just above power house of Buffalo Manufacturing Co., 4 miles west of Buffalo, in Johnson County.

DRAINAGE AREA.—120 square miles (measured on topographic map).

RECORDS AVAILABLE.—June 16, 1917, to September 30, 1918. From May 2, 1896, to February 28, 1900, station maintained at measuring flume 1 mile upstream. Flow at two points comparable. From October 24, 1902, to December 31, 1904, and May 8, 1911, to June 11, 1912, a station was maintained at highway bridge in Buffalo. Flow not comparable, as several ditches divert water between.

GAGE.—Chain gage at left bank 300 feet above power house; read by W. M. Black and H. L. Jones.

DISCHARGE MEASUREMENTS.—Made from car and cable 50 feet upstream from gage. Low-water measurements made by wading opposite power house.

CHANNEL AND CONTROL.—Bed composed of large boulders. Control is at large boulders 10 feet downstream, which are permanent. Banks low, but not subject to overflow, as range of stage is small.

ICE.—Stage-discharge relation seriously affected by ice; records discontinued.

EXTREMES OF DISCHARGE.—Maximum stage recorded, 3.7 feet at 7.30 a. m. June 10 (discharge, 850 second-feet); minimum discharge occurs during winter.

DIVERSIONS.—Pipe line of Buffalo Manufacturing Co. diverts water from Clear Creek $1\frac{1}{2}$ miles upstream. A separate record of flow through pipe line is kept and flow added to that at gaging station to give total flow of creek. Four lakes and French Creek canal, and North Fork and French Creek canal divert water from Clear Creek above the station. During 1918 about 11,800 acre-feet were diverted between June 1 and September 30. There were adjudicated decrees for diversions of 428 second-feet below the station prior to December 1, 1916.

REGULATION.—Alternate melting and freezing of mountain snow during spring of year causes diurnal fluctuation in flow. No artificial regulation.

ACCURACY.—Stage-discharge relation permanent; affected by ice during winter. Rating curve well defined. Gage read to hundredths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table. Records excellent, except those for high water, which are good.

Discharge measurements of Clear Creek near Buffalo, Wyo., during the year ending Sept. 30, 1918.

Date.	Made by—	Gage height.	Discharge.
		<i>Feet.</i>	<i>Sec.-ft.</i>
June 18	P. V. Hodges.....	2.98	506
July 6	E. B. Dearden.....	1.88	112
Aug. 31	Robert Follansbee.....	1.32	30.0

Daily discharge, in second-feet, of Clear Creek near Buffalo, Wyo., for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Dec.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	22	18	11	.....	5.2	13	37	262	109	61	28
2	22	21	10	.....	5.6	13	50	199	94	58	31
3	20	19	8.0	.....	5.8	17	123	171	93	54	37
4	16	19	6.0	.....	6.0	14	111	249	100	54	38
5	17	19	5.0	.....	5.6	10	118	476	105	80	35
6	16	18	5.0	.....	5.2	9.2	211	542	113	111	33
7	19	18	5.0	.....	5.2	8.4	98	610	111	111	29
8	18	18	4.6	.....	4.8	16	66	565	102	94	29
9	18	18	5.0	.....	5.6	15	136	655	113	80	32
10	16	13	6.0	.....	5.2	22	116	700	174	74	31
11	19	8.4	6.0	.....	5.8	21	82	655	262	66	27
12	16	5.6	.....	.....	6.0	35	85	565	199	61	26
13	15	8.8	.....	.....	5.4	37	98	610	168	57	24
14	16	8.4	.....	.....	4.8	45	116	565	208	56	28
15	15	12	.....	.....	5.4	28	150	565	159	58	53
16	17	8.8	.....	.....	5.2	20	165	498	150	53	44
17	17	4.6	.....	.....	5.4	16	168	498	153	46	42
18	17	4.6	.....	.....	5.8	15	174	498	171	44	39
19	19	8.4	.....	.....	6.0	11	171	412	168	43	36
20	13	10	.....	.....	7.6	14	147	348	134	42	35
21	18	19	.....	.....	9.6	15	174	310	109	38	32
22	16	12	.....	.....	11	14	153	390	109	36	30
23	19	10	.....	.....	12	13	168	310	94	35	28
24	18	10	.....	.....	5.2	16	186	433	93	35	34
25	15	10	.....	.....	5.0	12	19	273	293	96	38
26	12	10	.....	4.8	17	18	202	239	93	32	37
27	10	5.6	.....	5.2	19	20	153	196	87	32	38
28	11	10	.....	5.0	16	17	128	162	77	32	36
29	33	10	.....	.....	17	18	120	156	75	30	34
30	33	12	.....	.....	13	21	165	134	69	30	51
31	18	.....	.....	.....	17	.....	242	.....	66	.....	.....

NOTE.—Discharge Dec. 3–11 estimated because of ice. Gage not read Dec. 12 to Feb. 23. The above table does not include water diverted by the pipe line of Buffalo Manufacturing Co.

Monthly discharge of Clear Creek near Buffalo, Wyo., for the year ending Sept. 30, 1918.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	33	10	17.8	1,090
November	21	4.6	12.3	732
December 1–11	11	4.6	6.51	142
February 24–28	5.2	4.8	5.04	50
March	19	4.8	8.62	530
April	45	8.4	18.4	1,090
May	273	37	141	8,670
June	700	134	409	24,300
July	262	66	124	7,620
August	111	29	53.7	3,300
September	53	24	34.5	2,050

Combined monthly discharge of Clear Creek and Tailrace near Buffalo, Wyo., for the year ending Sept. 30, 1918.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October.....	46	22	30.1	1,850
November.....	34	17	25.1	1,490
December 1-11.....	24	18	19.4	423
February 24-28.....	18	18	18.0	173
March.....	30	13	21.5	1,320
April.....	58	21	31.0	1,840
May.....	286	50	154	9,470
June.....	713	147	422	25,100
July.....	274	78	137	8,420
August.....	123	41	65.7	4,040
September.....	65	36	46.5	2,770

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, Sheridan County. No tributary between station and mouth of creek.

DRAINAGE AREA.—1,110 square miles (measured on base map of Wyoming; scale, 1:500,000).

RECORDS AVAILABLE.—August 8, 1915, to September 30, 1918.

GAGE.—Chain gage on right bank, a quarter of a mile below diversion dam at Sorenson's ranch; read by John Watt.

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 river 150 feet apart; upper dike 100 feet below gage acts as low-water control. At high water, lower dike is control. At low-water stages silt collects in the crevices of the rock dike causing slight backwater. Banks not subject to overflow. Stage of zero flow, 3.8 ft.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 8.4 feet at 5 p. m. June 10 (discharge, 2,840 second-feet); minimum discharge probably occurs during winter.

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

DIVERSIONS.—Prior to December 31, 1916, there were adjudicated diversions of 428 second-feet from Clear Creek.

REGULATION.—None.

ACCURACY.—Stage-discharge relation practically permanent. Rating curve well defined. Gage read to hundredths once daily. Daily discharge ascertained by applying daily reading to rating table. Records good except those for low stages which are fair.

Discharge measurements of Clear Creek near Arvada, Wyo., during the year ending Sept. 30, 1918.

[Made by P. V. Hodges.]

Date.	Gage height.	Dis-charge.
	<i>Feet.</i>	<i>Sec.-ft.</i>
Oct. 1.....	4.54	62
June 16.....	7.22	1,650

Daily discharge, in second-feet, of Clear Creek near Arvada, Wyo., for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	60	136		262	360	1,580	174	55	63
2	56	112		244	420	1,540	112	268	61
3	60	124		225	480	1,490	75	480	65
4	63	112		155	590	1,580	55	340	88
5	63	112		172	955	1,680	55	55	100
6	71	112		190	1,320	2,180	28	218	92
7	71	136		190	1,400	2,620	22	380	92
8	71	124		190	1,240	2,840	17	320	96
9	71	112		190	1,580	2,730	16	255	100
10	71	112		280	1,580	2,620	17	190	92
11	71	112		405	1,320	2,620	17	155	88
12	71	112		380	1,160	2,620	40	95	92
13	71	101		360	1,000	2,400	115	125	98
14	71	101		408	1,000	1,980	190	125	112
15	77	112		455	1,080	1,980	300	112	92
16	77	112		410	1,400	1,580	340	75	92
17	71	112		365	1,580	1,780	260	100	125
18	71	101		320	1,320	1,490	190	88	125
19	71	90		340	1,320	1,490	190	369	140
20	112	90		360	1,240	1,160	172	650	125
21	92	90		360	1,240	1,000	155	208	125
22	71	101		360	1,240	860	155	125	125
23	77	101		360	1,240	930	140	100	125
24	77	101		340	1,240	1,080	140	92	125
25	77	101	430	380	1,350	895	140	84	140
26	77	101	455	392	1,490	685	55	75	140
27	77	90	430	405	1,680	505	100	72	140
28	101	90	1,080	392	1,320	402	125	69	140
29	71	90	590	380	1,320	300	80	67	140
30	71	90	340	380	1,320	237	78	66	172
31	136		280		1,320		75	64	

NOTE.—Discharge interpolated for following days when gage was not read: Oct. 21, Nov. 25, 29, Apr. 1, 2, 7, 14, 16, 17, 19, 21, 26, 28, May 2, 5, 12, 25, 26, 30, June 2, 11, 28, 30, July 1, 7, 15, 20, 24, 30, Aug. 2, 6, 9, 24, 25, 27, 28, 30, 31, Sept. 8, 23, 28. No records Dec. 1 to Mar. 24.

Monthly discharge of Clear Creek near Arvada, Wyo., for the year ending Sept. 30, 1918.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	136	56	75.7	4,650
November	136	90	106	6,310
March 25-31	1,080	280	515	7,150
April	455	155	322	19,200
May	1,680	360	1,200	73,800
June	2,840	237	1,560	92,800
July	340	16	117	7,190
August	650	55	177	10,900
September	172	61	110	6,550

PINEY CREEK AT UCROSS, WYO.

LOCATION.—In NW. $\frac{1}{4}$ sec. 18, T. 53 N., R. 80 W., at highway bridge a quarter of a mile from Ucross, in Sheridan County. No tributary between station and mouth half a mile below.

DRAINAGE AREA.—253 square miles (measured on base map of Wyoming, scale 1:500,000).

RECORDS AVAILABLE.—May 12, 1917, to September 30, 1918.

GAGE.—Chain gage attached to highway bridge; read by Miss Alma Larsen.

DISCHARGE MEASUREMENTS.—Made from highway bridge. Low-water measurements by wading 200 feet downstream.

CHANNEL AND CONTROL.—Bed composed of silt and gravel which will shift. Control 50 feet downstream at riffle composed of compact gravel; shifted during 1918. Banks not subject to overflow.

ICE.—Stage-discharge relation affected by ice.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 5 feet on morning of June 11 from high water mark (discharge, 1,900 second-feet); minimum stage recorded, 1.32 feet on August 28 and 29 (discharge, 6 second-feet).

DIVERSIONS.—Prior to December 31, 1916, there were adjudicated diversions of 351 second-feet from Piney Creek, all above station.

REGULATION.—Headwaters are chain of small mountain lakes, the largest of which, Cloud Peak, is used as reservoir for irrigation. Alternate melting and freezing of mountain snow in spring of year causes some diurnal fluctuation.

ACCURACY.—Stage-discharge relation not permanent; sufficient discharge measurements obtained to determine limits of shift. Standard rating curve well defined. Gage read to half-tenths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table; shifting-control method used June 6 to September 30. Records fair.

Discharge measurements of Piney Creek at Ucross, Wyo., during the year ending Sept. 30, 1918.

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 19	P. V. Hodges.....	3.50	708	Aug. 4	E. B. Dearden.....	1.67	31.6
July 12	E. B. Dearden.....	2.00	92	31	Robert Follansbee.....	1.34	7.3
31	do.....	1.40	25.6				

Daily discharge, in second-feet, of Piney Creek at Ucross, Wyo., for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Dec.	Apr.	May.	June.	July.	Aug.	Sept.
1.		50	44		160	535	66	30	10
2.		53			184	460	40	34	11
3.					220	485	19	50	15
4.					272	638	17	30	11
5.					290	845	22	36	15
6.					535	1,300	22	40	29
7.					510	1,380	22	85	29
8.				83	485	1,560	24	102	25
9.				105	450	1,560	26	76	25
10.				169	415	1,640	70	49	27
11.				169	370	1,720	114	40	29
12.				178	370	1,220	102	46	25
13.				220	350	1,220	102	53	29
14.				220	290	1,220	114	46	33
15.				238	438	1,140	126	46	38
16.				178	456	980	112	35	33
17.				142	474	910	85	32	38
18.				105	492	845	76	25	33
19.				116	510	692	60	22	38
20.				129	438	665	49	96	33
21.				134	510	535	63	32	33
22.		58		142	510	485	49	27	33
23.		44		142	485	535	47	27	33
24.		53		124	535	415	45	22	42
25.		58		169	665	350	56	22	51
26.		58		137	535	272	94	22	60
27.		58		105	438	238	79	10	60
28.		58		155	415	175	72	6	33
29.		58		150	370	122	60	6	52
30.		58		142	460	87	53	11	52
31.		47			510		46	8	

NOTE.—Discharge interpolated for following days because gage was not read: Oct. 26, 27, Apr. 26, May 9, 16-18, Sept. 1, 10, 13, 14, 21, 24, 25, 30. No record Oct. 1 to Apr. 7 except as shown in table.

Monthly discharge of Piney Creek at Ucross, Wyo., for the year ending Sept. 30, 1918.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October 22-31.....	58	44	55.0	1,090
April 8-30.....	238	83	150	6,840
May.....	665	160	424	26,100
June.....	1,720	87	808	48,100
July.....	126	17	62.3	3,830
August.....	102	6	37.6	2,310
September.....	60	10	32.5	1,930

LITTLE MISSOURI RIVER BASIN.

LITTLE MISSOURI RIVER NEAR ALZADA, MONT.

LOCATION.—Near southwest corner of T. 8 S., R. 60 E., at Walker's ranch, 300 yards below site of proposed dam, 2 miles below mouth of Thompson Creek, and 4 miles below Alzada, in Fallon County.

DRAINAGE AREA.—About 780 square miles.

RECORDS AVAILABLE.—June 18, 1911, to September 30, 1918.

GAGE.—Overhanging chain gage on right bank, read by John Walker; gage used during 1911 was vertical staff on left bank, 150 feet downstream. Datum of chain gage 0.08 foot lower than that of staff gage.

DISCHARGE MEASUREMENTS.—Made by wading or from cable.

CHANNEL AND CONTROL.—Bed shifts during high water. Stream sluggish. Banks cut 5 to 15 feet in sandy soil. Two channels at medium and one at high stage.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 11.97 feet at 6.10 p. m. March 15 (discharge, 2,770 second-feet); no flow October 1-26.

1911-1918: Maximum stage recorded, 15.3 feet April 6, 1912 (discharge, 4,550 second-feet); minimum stage, channel dry July 6 to August 7, and October 14-18, 1911; September 9-15, 1913; September 8-10, 12-30, and October 1-7, 1916; January 4-6, September 19-30, and October 1-26, 1917.

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

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 except as affected by ice. Rating curve well defined. Gage read to quarter-tenths twice daily. Daily discharge determined by applying mean daily gage height to rating table. Records good.

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

May 2, 1918: Gage height, 2.67 feet; discharge, 52 second-feet.

Daily discharge, in second-feet, of Little Missouri River, near Alzada, Mont., for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1.....		6.0	4.0	50	6.8	512	44	79	113	24	10	9.0
2.....		6.0	4.0	80	6.0	740	34	60	66	16	9.0	9.0
3.....		6.0	4.0	67	5.2	707	27	38	48	25	9.0	8.0
4.....		6.0	4.0	67	4.8	868	21	29	40	16	7.2	24
5.....		6.0	4.0	83	4.0		21	25	31	14	66	79
6.....		5.6	4.0	65	4.4		18	17	96	12	371	86
7.....		4.8	4.8	72	4.8		26	16	415	12	936	47
8.....		4.8	4.8	45	4.8		24	14	128	6.4	898	24
9.....		4.8	4.0	43	62		25	29	47	51	894	17
10.....		4.8	4.0	41	188		24	371	33	35	96	13
11.....		4.8	4.0	43	482		19	737	24	22	53	12
12.....		4.8	4.0	34	746		14	381	20	136	41	7.6
13.....		4.8	4.0	21	537		14	164	16	72	29	6.4
14.....		4.8	4.0	15	240		16	78	14	120	20	9.0
15.....		4.8	6.0	14	96	2,320	16	51	12	406	14	158
16.....		4.0	6.0	12	72	1,370	601	39	11	860	12	226
17.....		4.0	5.6	12	147	890	450	43	8.4	1,250	37	118
18.....		4.0	4.8	12	107	975	245	37	8.4	1,020	25	54
19.....		4.0	4.8	12	62	1,110	155	33	5.6	547	13	34
20.....		4.0	4.8	12	70	624	104	35	50	113	7.2	23
21.....		4.0	4.4	12	116	315	273	31	128	65	5.6	16
22.....		4.0	4.8	10	67	186	257	22	54	49	4.4	11
23.....		4.0	4.8	9.0	53	134	213	20	47	35	4.0	11
24.....		4.0	4.8	9.0	54	85	240	17	30	25	3.7	21
25.....		4.0	4.0	9.0	518	76	221	24	29	22	2.8	939
26.....		4.0	4.0	9.0	719	50	85	160	21	37	2.5	757
27.....	4.8	4.0	4.0	9.0	624	28	97	611	20	30	1.0	436
28.....	6.0	4.0	4.0	8.0	500	40	160	521	16	41	3.7	78
29.....	6.0	4.0	4.0	8.0		38	193	560	14	31	2.2	49
30.....	6.0	4.0	4.8	7.2		54	160	390	12	17	8.5	41
31.....	6.0		6.0	6.8		62		394		12	11	

NOTE.—No flow, Oct. 1-26. Stage-discharge relation seriously affected by ice Mar. 5-14; discharge not determined.

Monthly discharge of Little Missouri River near Alzada, Mont., for the year ending Sept. 30, 1918.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October.....	6.0	0	0.93	57
November.....	6.0	4.0	4.63	276
December.....	6.0	4.0	4.49	276
January.....	83	6.8	28.9	1,780
February.....	746	4.0	196	10,900
April.....	601	14	134	7,970
May.....	737	14	162	9,960
June.....	415	5.6	52.2	3,110
July.....	1,250	6.4	165	10,100
August.....	936	1.0	116	7,130
September.....	939	6.4	111	6,600

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, at former site of post office of Broncho, Mercer County. Present location of post office is about 6 miles from this station. Spring Creek enters 15 miles below station and Elm Creek half a mile above.

DRAINAGE AREA.—1,260 square miles; drainage area at original location 2 miles downstream was nearly the same, perhaps 5 square miles greater.

RECORDS AVAILABLE.—May 29, 1903, to September 30, 1918.

GAGE.—Chain on cantilever timber on left bank near observer's house; datum unchanged since March 23, 1905, when station was moved to present location.

DISCHARGE MEASUREMENTS.—Made from cable about 500 feet above gage or by wading.

CHANNEL AND CONTROL.—Stream bed below gage composed of large stones and gravel; nearly permanent. Channel narrow with steep banks, which are not overflowed at gage heights less than 20 feet.

EXTREMES OF DISCHARGE.—Maximum stage during year, 17.9 feet August 22 (discharge, 4,950 second-feet); minimum open-water stage, 3.3 feet October 5 (discharge, 4 second-feet).

1903-1918: Maximum stage recorded, 24.0 feet June 26, 1914 (discharge, 7,700 second-feet); river reported dry September 6-8, 1905, and September 18-19, 1908.

ICE.—Stage-discharge relation seriously affected by ice; records discontinued through part of the winter.

ACCURACY.—Stage-discharge relation changed during winter. Two poorly defined rating curves used during year applicable October 1 to November 24 and March 25 to September 30. Gage read once daily to nearest tenth, with occasional readings to half-tenths. Daily discharge ascertained by applying daily gage height to rating table. Records poor.

Discharge measurements of Knife River near Broncho, N. Dak., during the year ending Sept. 30, 1918.

Date.	Made by—	Gage height.	Discharge.
Apr. 12	L. B. Dale.....	<i>Feet.</i> 4.12	<i>Sec.-ft.</i> 26
Aug. 28	E. F. Chandler.....	5.01	123

Daily discharge, in second-feet, of Knife River near Broncho, N. Dak., for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1.....	4	11	.....	67	57	19	7	32	67
2.....	4	11	.....	57	40	19	7	25	67
3.....	4	11	.....	48	32	19	7	25	48
4.....	4	11	.....	48	25	19	5	14	48
5.....	4	11	.....	40	25	19	5	14	48
6.....	4	11	.....	40	19	19	5	10	40
7.....	4	11	.....	40	19	19	5	10	40
8.....	4	11	.....	32	19	19	5	10	40
9.....	7	11	.....	32	19	19	5	10	40
10.....	11	11	.....	25	19	19	5	10	40
11.....	11	11	.....	25	14	19	5	10	40
12.....	11	11	.....	32	14	19	5	10	40
13.....	11	11	.....	32	14	14	7	7	40
14.....	11	11	.....	32	14	14	7	7	32
15.....	11	11	.....	32	14	14	7	7	32
16.....	11	11	.....	40	14	14	7	7	25
17.....	11	11	1,420	154	14	14	7	7	25
18.....	11	11	2,800	290	14	25	7	7	25
19.....	11	11	1,900	409	14	25	5	764	19
20.....	11	11	2,360	368	14	25	5	1,500	19
21.....	11	11	2,530	348	14	14	5	3,650	19
22.....	11	11	2,360	271	14	10	5	4,680	19
23.....	11	11	1,940	100	14	10	5	3,830	19
24.....	11	11	674	100	14	10	5	3,560	19
25.....	11	.....	474	88	19	10	7	2,450	19
26.....	11	.....	409	77	19	10	10	1,340	19
27.....	11	.....	235	77	19	10	10	235	19
28.....	11	.....	139	67	19	7	154	133	19
29.....	11	.....	112	67	19	7	218	105	19
30.....	11	.....	88	57	19	7	290	77	19
31.....	11	.....	88	.....	19	.....	57	77	.....

NOTE.—Gage not read Nov. 25 to Mar. 16. Discharge Mar. 17-24 estimated because of ice; Aug. 25, 26, and 29 interpolated.

Monthly discharge of Knife River near Broncho, N. Dak., for the year ending Sept. 30, 1918.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October.....	11	4	9.1	560
November 1-24.....	11	11	11.0	524
March 17-31.....	2,800	88	1,170	34,800
April.....	409	25	103	6,130
May.....	57	14	19.5	1,200
June.....	25	7	15.6	928
July.....	290	5	28.5	1,750
August.....	4,680	7	730	44,900
September.....	67	19	32.2	1,920

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 11 miles south of Richardton, in Stark County.

DRAINAGE AREA.—1,250 square miles.

RECORDS AVAILABLE.—May 18, 1903, to September 30, 1918.

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 about 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, March 20 to April 10, and August 23 to September 11, 1918, when, owing to damage caused by ice and by flood, 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. From 1916 to March 20, 1918, a dam built by beavers a quarter of a mile below gage caused backwater at gage.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 34.1 feet August 23 (discharge, 1,730 second-feet); minimum stage, 25.4 feet October 16 (stage-discharge relation affected by backwater from beaver dam; flow estimated at 0.8 second-foot).

1903-1918: Maximum stage, 25.9 feet from chain gage at highway bridge June 10, 1906 (discharge, 8,020 second-feet); river reported dry July 26 to August 11, August 20-23, 1903, September 1-19, 1905, July 22-27, 1914.

ICE.—Stage-discharge relation seriously affected by ice; flow not determined for winter.

ACCURACY.—Stage-discharge relation affected by backwater from beaver dam October 1 to March 19; by ice December 2 to March 18; fairly permanent during remainder of the year. Rating curve used March 20 to September 11, fairly well defined between 38 and 1,700 second-feet. Gage read to half-tenths once daily during open channel flow (see footnote to daily discharge table). Daily discharge October 1 to December 2 ascertained by applying gage-height rating table after applying a correction of -0.90 foot for backwater from beaver dam a quarter of a mile below gage; March 20 to September 11, gage heights applied to rating table. October 1 to December 2, records are poor; March 20 to September 11, fair.

Discharge measurements of Heart River near Richardton, N. Dak., during the year ending Sept. 30, 1918.

Date.	Made by—	Gage height.	Dis-charge.
Apr. 11	L. B. Dale.....	<i>Feet.</i> 25.39	<i>Sec.-ft.</i> 37.2
Aug. 28	E. F. Chandler.....	25.87	88

Daily discharge, in second-feet, of Heart River near Richardton, N. Dak., for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Dec.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1.....	2	3	4	-----	58	34	21	2	9	9
2.....	2	2.5	7	-----	38	29	18	2	21	7
3.....	2	4	-----	-----	38	29	43	2	21	7
4.....	2	4	-----	-----	21	25	18	2	18	4
5.....	2.5	3	-----	-----	21	21	21	2	14	4
6.....	3	5	-----	-----	21	21	43	2	12	2
7.....	2.5	5	-----	-----	21	21	21	2	12	2
8.....	2	4	-----	-----	21	18	18	2.5	9	2
9.....	2.5	4	-----	-----	21	18	25	2	7	1.5
10.....	2.5	4	-----	-----	21	18	25	2	5	1.5
11.....	3	4	-----	-----	38	18	25	2	5	1.2
12.....	3	4	-----	-----	34	18	21	3	4	-----
13.....	2.5	4	-----	-----	34	14	18	3	3	-----
14.....	3	5	-----	-----	34	12	12	5	5	-----
15.....	1	7	-----	-----	29	12	12	5	5	-----
16.....	1	5	-----	-----	38	12	12	9	5	-----
17.....	1	5	-----	-----	58	12	12	9	4	-----
18.....	2.5	5	-----	-----	69	12	12	9	5	-----
19.....	2.5	5	-----	1,040	80	12	12	5	38	-----
20.....	3	5	-----	1,490	128	12	12	5	38	-----
21.....	4	5	-----	1,180	351	9	12	5	21	-----
22.....	2	5	-----	972	323	9	9.0	4	1,410	-----
23.....	3	5	-----	887	165	9	7.0	4	1,620	-----
24.....	3	5	-----	535	104	9	7.0	5	1,130	-----
25.....	4	4	-----	429	80	9	7.0	7	413	-----
26.....	3	4	-----	295	64	12	3.0	9	204	-----
27.....	2	4	-----	191	53	18	3.0	9	116	-----
28.....	4	4	-----	128	48	18	2.5	12	86	-----
29.....	4	4	-----	140	43	18	2.0	12	48	-----
30.....	4	7	-----	116	38	18	2.0	12	21	-----
31.....	3	-----	-----	80	-----	29	-----	9	21	-----

NOTE.—Gage washed out by high water Mar. 19 and Aug. 23. Gage readings made at highway bridge 1 mile upstream Mar. 20 to Apr. 10 and Aug. 23 to Sept. 30. Gage read occasionally Dec. 3 to Feb. 23 and daily Feb. 24 to Mar. 18; discharge not determined because of ice. Discharge, Sept. 12-30, not determined until the new gage placed by observer Sept. 12 can be checked with level.

Monthly discharge of Heart River near Richardton, N. Dak., for the year ending Sept. 30, 1918.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October.....	4.0	1.0	2.63	162
November.....	7.0	2.5	4.48	297
March 19-31.....	1,490	80	576	14,900
April.....	351	21	69.7	4,150
May.....	34	9	17.0	1,060
June.....	43	2.0	15.2	904
July.....	12	2.0	5.27	324
August.....	1,620	3.0	172	10,600
September 1-11.....	9	1.2	3.75	82

CANNONBALL RIVER BASIN.

CANNONBALL RIVER AT STEVENSON,² N. DAK.

LOCATION.—In NW. $\frac{1}{4}$ sec. 21, T. 133 N., R. 82 W., at boundary of Standing Rock Indian Reservation, 5 miles east of present location of Stevenson post office, 4 miles above mouth of Dogtooth Creek, and 4 miles southeast of Timmer, in Morton County.

DRAINAGE AREA.—3,650 square miles.

RECORDS AVAILABLE.—June 10, 1903, to November 30, 1908; August 9, 1911, to September 30, 1918.

GAGE.—Cantilever chain gage on left bank reinstalled September 1, 1915, at same location and datum as gage read 1903 to 1908. From October 1, 1911, to September 1, 1915, a cantilever chain gage on left bank at Burdick's ranch, 1 mile above. Gage read daily by Frank H. Bingenheimer. Datum of two gages is such that readings on the gage at Burdick's ranch are 10.0 feet greater than on the present gage.

DISCHARGE MEASUREMENTS.—At low and medium stages made by wading at ford 100 yards below gage; at high stages made from cable 20 rods above gage.

CHANNEL AND CONTROL.—Bed of stream composed of sand, gravel, and stones, covered in places by silt to a depth of a foot. Control composed of stones and small boulders, located at riffle about 20 rods below gage; shifts slightly.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 10.5 feet March 18, when stage-discharge relation affected by ice jam (discharge estimated 3,500 second-feet); minimum stage, 2.5 feet September 4–23 (discharge 1.1 second-feet).

1903–1908 and 1911–1918: Maximum stage 21.0 feet April 2, 1912 (discharge, 6,360 second-feet); no flow during periods each year 1904–1908 and 1913.

REGULATION.—None.

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

ACCURACY.—Stage-discharge relation affected by ice and by shifting control. Rating curve used October 1 to December 1 fairly well defined below 4,000 second-feet. Gage read to nearest tenth once daily; occasionally to half-tenths. Daily discharge ascertained by applying gage height to rating table for period October 1 to December 1; shifting-control method used March 13 to September 30, except period April 7–20, June 16–25 and 27–29, when discharge was obtained by interpolation. Records for open channel are fair; those for period of ice effect, March 13–20, are poor.

Discharge measurements of Cannonball River near Stevenson, N. Dak., during the year ending Sept. 30, 1918.

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. 31	H. A. Noble.....	2.71	4.5	June 26	A. Hulteng.....	3.01	43.7
Apr. 2	A. Hulteng.....	4.40	331	Aug. 30	E. F. Chandler.....	2.58	1.5
May 31	do.....	3.49	121				

² Stevenson post office has been moved 5 miles west of former location.

Daily discharge, in second-feet, of Cannonball River at Stevenson, N. Dak., for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1.....	2.0	5.0	-----	452	142	153	24	4.4	1.6
2.....	2.0	5.0	-----	400	120	127	24	4.2	1.6
3.....	2.0	5.0	-----	302	98	127	23	4.2	1.6
4.....	1.8	5.0	-----	264	100	84	23	4.0	1.1
5.....	1.8	5.0	-----	193	100	67	22	6.5	1.1
6.....	1.8	5.0	-----	193	100	67	22	6.2	1.1
7.....	1.5	5.0	-----	190	102	67	21	6.2	1.1
8.....	1.5	5.0	-----	187	64	67	21	5.9	1.1
9.....	1.5	5.0	-----	184	64	53	12	5.9	1.1
10.....	1.5	5.0	-----	181	66	53	12	5.6	1.1
11.....	1.5	5.0	-----	178	50	53	12	5.6	1.1
12.....	1.8	5.0	-----	175	52	39	12	5.3	1.1
13.....	2.0	6.5	122	172	52	40	11	5.3	1.1
14.....	2.0	6.5	280	169	69	54	11	3.0	1.1
15.....	2.0	6.5	325	167	69	54	10.4	2.0	1.1
16.....	2.0	8.0	1,170	165	54	54	6.2	2.0	1.1
17.....	2.0	14	1,660	163	40	53	5.9	316	1.1
18.....	2.0	14	3,500	161	54	52	5.9	7.4	1.1
19.....	2.5	14	965	159	56	51	5.6	4.6	1.1
20.....	3.0	14	1,800	157	56	50	5.6	2.7	1.1
21.....	3.0	14	1,920	155	75	49	5.3	2.7	1.1
22.....	3.0	11	1,560	187	75	48	5.3	2.6	1.1
23.....	2.5	11	2,640	187	76	47	5.0	2.6	1.1
24.....	2.5	11	2,560	134	59	46	8.0	2.5	1.6
25.....	2.0	11	2,160	111	60	45	14	2.5	1.6
26.....	2.5	11	1,840	226	60	44	13	2.4	1.6
27.....	3.0	11	1,480	164	80	42	22	2.4	1.6
28.....	5.0	11	1,280	140	80	40	21	2.3	1.6
29.....	5.0	11	998	140	102	38	21	2.3	1.6
30.....	5.0	8.0	620	142	102	37	12	1.6	1.6
31.....	5.0	-----	508	-----	124	-----	7.1	1.6	-----

NOTE.—No records Dec. 1 to Mar. 12 except occasional gage readings; discharge not determined because of ice.

Monthly discharge of Cannonball River at Stevenson, N. Dak., for the year ending Sept. 30, 1918.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October.....	5.0	1.5	2.47	152
November.....	14	5.0	8.45	503
March 13-31.....	3,500	122	1,440	54,300
April.....	452	111	193	11,500
May.....	142	40	77.5	4,770
June.....	153	37	60.0	3,570
July.....	24	5.0	13.6	836
August.....	316	1.6	14.0	861
September.....	1.6	1.1	1.27	76

GRAND RIVER BASIN.

GRAND RIVER NEAR WAKPALA, S. DAK.

LOCATION.—In SW. $\frac{1}{4}$ sec. 9, T. 19 N., R. 29 E., on Standing Rock Indian Reservation, at steel highway bridge 4 miles south of Wakpala, Corson County, a station on Chicago, Milwaukee & St. Paul Railway.

DRAINAGE AREA.—5,410 square miles.

RECORDS AVAILABLE.—September 9, 1911, to March 18, 1918, when the bridge and gage were destroyed by flood and the station was discontinued.

GAGE.—Chain gage on foot guardrail on downstream side of highway bridge. Read by James Soft.

DISCHARGE MEASUREMENTS.—Made from highway bridge; at very low stages sometimes by wading at the ford 40 rods below the bridge.

CHANNEL AND CONTROL.—Bed composed of soft silt and quicksand; shifting.

EXTREME OF DISCHARGE.—Maximum stage recorded during year 18.0 feet March 18 (discharge not computed on account of ice); minimum stage recorded 3.9 feet October 13.

1911-1918: Maximum stage recorded, 18.0 feet June 17, 1915 (discharge 7,130 second-feet); minimum stage, 1.8 feet September 24, 1913 (discharge, 0.1 second-foot).

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

DIVERSIONS.—No data.

REGULATION.—No diversions or storage above that, so far as known, are great enough to noticeably affect the flow.

Data insufficient to warrant publication of discharge.

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

October 30, 1917: Gage height, 4.14 feet; discharge, 4.7 second-feet.

Daily gage height, in feet, of Grand River near Wakpala, S. Dak., for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Dec.	Feb.	Mar.	Day.	Oct.	Nov.	Dec.	Feb.	Mar.
1.....		4.0	4.45		12.0	16.....				9.0	10.0
2.....	4.0				14.0	17.....	3.9	4.2			
3.....		4.0	4.3			18.....				9.0	18.0
4.....					17.0	19.....		4.4			
5.....		4.2	4.2			20.....	3.9				
6.....	4.0					21.....		4.4		8.0	
7.....					10.0	22.....					
8.....	4.0	4.2	4.2			23.....	3.9			6.0	
9.....					7.0	24.....		4.45			
10.....	3.9	4.2				25.....					
11.....				7.5	8.0	26.....		4.45		9.0	
12.....				10.5		27.....	3.9				
13.....	3.9	4.2				28.....		4.45			
14.....				9.0	9.0	29.....					
15.....						30.....	4.0				
						31.....					

GRAND RIVER AT DAVIS CITY, IOWA.

LOCATION.—In sec. 35, T. 68 N., R. 26 W., at highway bridge in Davis City, Decatur County, 22 miles below mouth of Long Creek.

DRAINAGE AREA.—660 square miles (measured by engineers of the Iowa Highway Commission on U. S. Post Route map; scale, 1 inch=1 mile.)

RECORDS AVAILABLE.—May 14 to Sept. 30, 1918.

GAGE.—Chain gage attached to downstream side of bridge; read by W. L. Severe.

DISCHARGE MEASUREMENTS.—Made by wading below dam during low stages, from downstream side of highway bridge during medium stages, and from railroad bridge about 500 feet below gage during extremely high stages.

CHANNEL AND CONTROL.—Control is a rock-fill dam about 300 feet below gage; not permanent.

EXTREMES OF STAGE.—Maximum stage recorded during period of records, 14.7 feet at 6 a. m. June 6; minimum stage, 1.57 feet at 7 p. m. September 19. A stage of 22.8 feet on the present gage was reached in 1885, according to a distinct high-water mark.

Data inadequate for determination of daily discharge.

Discharge measurements of Grand River at Davis City, Iowa, during the period Sept. 27, 1917, to Sept. 30, 1918.

[Made by W. G. Hoyt.]

Date.	Gage height.	Dis-charge.	Date.	Gage height.	Dis-charge.
1917.	<i>Feet.</i>	<i>Sec.-ft.</i>	1918.	<i>Feet.</i>	<i>Sec.-ft.</i>
Sept. 27.....	1.76	12.2	May 15.....	1.86	5.2

Daily gage height, in feet, of Grand River at Davis City, Iowa, for the year ending Sept. 30, 1918.

Day.	May.	June.	July.	Aug.	Sept.	Day.	May.	June.	July.	Aug.	Sept.
1.....		3.75	2.38	1.82	1.96	16.....	1.80	2.43	1.98	1.72	1.65
2.....		4.0	2.33	1.82	2.16	17.....	1.78	2.35	1.98	1.76	1.65
3.....		5.55	2.26	1.87	2.26	18.....	1.90	2.31	2.06	1.86	1.60
4.....		5.5	2.28	1.87	2.16	19.....	1.95	2.29	1.92	2.26	1.57
5.....		8.7	2.28	1.82	2.06	20.....	1.82	2.29	1.98	3.75	1.60
6.....		12.95	4.1	1.77	1.96	21.....	6.1	2.25	1.87	2.76	1.60
7.....		5.75	4.0	1.77	1.91	22.....	6.4	2.23	1.97	2.28	1.59
8.....		4.5	2.88	1.67	2.36	23.....	5.4	2.29	1.87	2.56	1.63
9.....		3.75	2.48	1.77	2.26	24.....	4.4	5.0	1.89	3.35	1.60
10.....		3.4	2.42	1.82	2.21	25.....	3.25	5.6	1.97	3.35	1.65
11.....		3.3	2.20	1.82	1.96	26.....	2.62	4.8	1.87	2.76	1.65
12.....		2.79	2.18	1.81	1.91	27.....	4.0	3.2	1.87	2.16	1.60
13.....		2.69	1.98	1.77	1.85	28.....	6.25	3.1	1.77	2.16	1.60
14.....	2.00	2.67	2.08	1.82	1.75	29.....	8.1	2.98	1.82	2.36	1.59
15.....	1.83	2.49	2.18	1.77	1.70	30.....	5.9	2.88	1.77	2.26	1.65
						31.....	3.9		1.77	1.86	

CHEYENNE RIVER BASIN.

CHEYENNE RIVER NEAR HOT SPRINGS, S. DAK.

LOCATION.—In sec. 9, T. 9 S., R. 5 E., 1 mile above dam site of proposed Angostura irrigation project, 5 miles south of Cascade Springs, and 11 miles south of Hot Springs, in Fall River County. Nearest tributary, Cascade Creek, enters 2½ miles above.

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—September 11, 1914, to September 30, 1918. Station maintained at Edgemont June 19, 1903, to November 30, 1906, but flow is not directly comparable as a number of small tributaries intervene.

GAGE.—Inclined slope gage on right bank one-third of a mile below Noerenberg's fruit farm; read by Fred Noerenberg. Friez water-stage recorder used prior to April 2, 1915, but abandoned as stream carried too much silt during flood.

DISCHARGE MEASUREMENTS.—Made from cable 75 feet below gage or by wading.

CHANNEL AND CONTROL.—Bed composed of compacted gravel on which silt is deposited; shifts frequently. Principal control a short distance downstream and will shift 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, 12.0 feet at 7 p. m. July 14 (discharge, 19,000 second-feet); minimum discharge, 20 second-feet October 1–6, July 7, and September 1.

ICE.—Spring water from Cascade Creek prevents formation of ice except for brief periods.

DIVERSIONS.—Permits granted for diversions amounting to 93.4 second-feet from Cheyenne River above station, and 43.4 second-feet from Cascade Creek.

REGULATION.—None.

ACCURACY.—Stage-discharge relation not permanent; sufficient measurements obtained to define limits of shift. Standard rating curve well-defined. Gage read to hundredths twice daily except during periods of low water when it is read once daily; during floods, gage read several times daily. Records good.

Discharge measurements of Cheyenne River near Hot Springs, S. Dak., during the year ending Sept. 30, 1918.

[Made by Fred Noerenberg.]

Date.	Gage height.	Dis-charge.	Date.	Gage height.	Dis-charge.
1911.	<i>Feet.</i>	<i>Sec.-ft.</i>	1912.	<i>Feet.</i>	<i>Sec.-ft.</i>
Feb. 11.....	1.10	81	June 16.....	0.98	43.9
Mar. 1.....	1.86	319	28.....	2.08	278
June 1.....	5.22	3,700	Sept. 24.....	1.20	39.5
2.....	3.64	1,340			

Daily discharge, in second-feet, of Cheyenne River near Hot Springs, S. Dak., for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1.....	20	34	34	35	26	371	52	136	4,880	102	162	20
2.....	20	29	34	52	30	380	66	144	1,130	86	130	24
3.....	20	29	34	52	37	357	66	104	375	56	130	53
4.....	20	29	34	66	40	292	90	74	330	43	152	80
5.....	20	34	29	66	46	505	117	66	225	29	115	69
6.....	20	34	29	52	40	334	149	55	180	24	1,710	56
7.....	22	34	29	40	30	305	149	45	152	20	4,280	53
8.....	25	34	29	40	30	280	174	40	46	1,130	8,940	40
9.....	29	29	29	30	30	244	233	38	29	1,300	5,680	43
10.....	26	29	29	30	40	164	650	197	24	665	2,190	50
11.....	26	29	27	26	81	207	742	620	40	250	1,130	40
12.....	29	29	26	26	149	478	620	453	44	632	735	46
13.....	34	34	23	26	214	292	428	260	34	970	510	43
14.....	34	34	22	24	99	505	197	174	22	13,500	330	43
15.....	34	34	22	24	99	428	187	149	29	7,980	250	43
16.....	38	29	26	26	90	334	149	222	46	2,740	243	34
17.....	38	26	34	30	74	214	110	136	40	7,980	600	40
18.....	34	26	34	30	60	149	149	74	34	7,080	570	40
19.....	26	26	29	30	52	197	136	63	3,260	3,640	970	46
20.....	26	26	29	30	46	180	99	52	3,420	1,500	3,640	44
21.....	26	26	26	30	47	122	74	81	2,460	970	1,300	40
22.....	26	26	26	30	50	104	66	74	1,050	970	570	40
23.....	26	29	26	30	52	99	55	42	600	1,600	375	40
24.....	26	29	26	30	252	90	164	52	540	1,300	290	53
25.....	22	29	26	30	252	74	95	66	2,600	540	215	80
26.....	22	29	26	40	214	66	85	561	970	290	152	130
27.....	22	29	26	52	478	81	74	244	330	250	115	310
28.....	22	29	26	40	428	90	207	313	250	330	90	250
29.....	22	34	26	30	.....	99	149	952	322	198	69	145
30.....	34	34	26	30	.....	74	127	3,350	208	232	61	198
31.....	34	.....	26	28	.....	59	.....	8,010	.....	232	46	.....

NOTE.—Stage-discharge relation affected by ice Dec. 7-16, 28, 29, Jan. 11-16, Jan. 25 to Feb. 3, Feb. 16-28, Mar. 7-9, 15; discharge estimated from observer's notes and temperature records. Shifting-control method used Oct. 1 to Dec. 31, June 4-26.

Monthly discharge of Cheyenne River near Hot Springs, S. Dak., for the year ending Sept. 30, 1918.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October.....	38	20	26.6	1,640
November.....	34	26	30.1	1,790
December.....	34	22	28.0	1,720
January.....	66	24	35.6	2,190
February.....	478	26	110	6,110
March.....	505	59	231	14,200
April.....	742	52	189	11,200
May.....	8,010	38	543	33,400
June.....	4,880	22	789	46,900
July.....	13,500	20	1,830	113,000
August.....	8,940	46	1,150	70,700
September.....	310	20	73.1	4,350
The year.....	13,500	20	424	307,000

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, 1918. May 26, 1903, to June 23, 1906, for station at the west outskirts of Belle Fourche; the records at these points are not directly comparable, as Redwater River enters between the two stations and water is diverted from Belle Fourche River.

GAGE.—Inclined staff 100 feet from crest of diversion dam, and a gage in canal. See "Computation of discharge."

COMPUTATION OF DISCHARGE.—The following information was supplied by United States Reclamation Service: The records of daily discharge represent the entire flow of the river at the diversion dam and have been corrected for water diverted through Inlet canal and passed through the sluice gages. The diversion dam acts as a weir; the crest is 400 feet long; the gage is about 100 feet from the crest and is read twice daily. Careful discharge measurements were made in the river above and below the dam before the coefficient was established, and the discharge rating table as originally computed has not been changed. The quantity diverted is determined at a gaging station maintained on Inlet canal, and the rating curve is checked by frequent discharge measurements. The sluice gates are seldom used and the flow through them is estimated.

DIVERSIONS.—In that part of the drainage area in Wyoming there were prior to July 1, 1914, adjudicated diversions of 25 second-feet from Belle Fourche River and 237 second-feet from tributaries. In South Dakota, authorized diversions of 102 second-feet from Belle Fourche River above the gaging station and about 2,500 second-feet from tributaries. Below the station, authorized diversions of 3,103 second-feet from Belle Fourche River.

ACCURACY.—United States Reclamation Service considers the records fair.

COOPERATION.—Complete records furnished and station maintained by United States Reclamation Service.

Daily discharge, in second-feet, of Belle Fourche River near Belle Fourche, S. Dak., for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1.....	153	220	174	443	214	1,280	328	516	234	144	192	64
2.....	161	198	174	274	270	916	346	516	219	115	108	66
3.....	153	198	173	295	274	588	346	516	216	102	96	75
4.....	143	185	178	244	287	569	333	600	219	96	98	72
5.....	148	195	182	159	310	1,520	317	611	198	100	116	78
6.....	130	190	185	144	468	1,880	302	636	182	100	460	475
7.....	148	184	168	130	489	976	292	677	227	96	558	530
8.....	158	185	204	159	494	676	274	481	214	94	140	483
9.....	161	165	178	144	451	1,060	265	934	813	139	62	300
10.....	161	166	146	166	507	776	247	1,110	382	292	128	295
11.....	148	194	145	129	784	382	258	1,020	239	274	508	1,240
12.....	161	194	184	159	570	616	256	578	177	256	436	668
13.....	174	187	182	174	401	856	256	783	144	206	342	109
14.....	174	187	196	144	420	1,790	281	965	174	301	448	122
15.....	174	187	220	159	439	1,080	292	910	102	310	222	174
16.....	185	187	228	159	382	676	489	755	90	490	159	167
17.....	185	183	248	129	239	666	420	845	84	2,340	129	152
18.....	185	183	352	159	310	646	413	265	60	1,340	144	152
19.....	185	185	240	159	256	596	516	338	36	1,770	90	157
20.....	185	185	242	174	144	616	486	55	30	1,750	63	153
21.....	185	188	232	182	144	292	458	292	50	892	50	144
22.....	185	171	212	196	369	546	458	373	1,080	580	34	147
23.....	185	178	138	200	920	536	407	346	808	480	55	137
24.....	190	170	196	214	1,120	516	496	314	456	384	51	215
25.....	199	170	100	239	748	477	540	310	346	310	57	586
26.....	192	173	148	144	485	448	540	364	255	269	64	496
27.....	192	170	71	180	2,040	429	596	507	202	283	64	313
28.....	192	170	48	222	2,240	426	646	420	401	239	60	224
29.....	192	173	40	222		420	536	330	274	206	60	162
30.....	195	178	164	206		373	401	399	184	174	64	144
31.....	208		238	206		340		256		144	62	

NOTE.—Records as furnished have been changed slightly to conform to computation rules of United States Geological Survey.

Monthly discharge of Belle Fourche River near Belle Fourche, S. Dak., for the year ending Sept. 30, 1918.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October.....	208	130	173	10,600
November.....	220	165	183	10,900
December.....	352	40	180	11,100
January.....	443	129	191	11,700
February.....	2,240	144	563	31,300
March.....	1,880	292	741	45,600
April.....	646	247	393	23,400
May.....	1,110	55	549	33,800
June.....	1,080	30	270	16,100
July.....	2,340	94	461	28,300
August.....	558	34	163	10,000
September.....	1,240	64	270	16,100
The year.....	2,340	30	344	245,000

WHITE RIVER BASIN.

WHITE RIVER NEAR INTERIOR, S. DAK.

LOCATION.—Near southwest corner of sec. 7, T. 4 S., R. 18 E., on Pine Ridge Indian Reservation, at steel highway bridge 3 miles southwest of Interior, where county line between Jackson and Pennington counties intersects White River.

DRAINAGE AREA.—9,090 square miles. The station maintained during 1904–1906, 4 miles below, had a drainage area about 15 square miles greater.

RECORDS AVAILABLE.—June 24, 1904, to November 30, 1906 at original station in section 10, T. 4 S., R. 18 E.; August 24, 1911 to September 30, 1918, at present location.

GAGE.—A vertical staff attached to downstream side of first pier or abutment at left end of highway bridge; read by Geo. Carlhom.

DISCHARGE MEASUREMENTS.—Made from highway bridge; at extremely low stages, sometimes by wading.

CHANNEL AND CONTROL.—Silt and sand, changing gradually.

EXTREMES OF DISCHARGE.—Maximum stage during year, 8.4 feet February 24, caused by ice jams; maximum discharge July 17, 3,260 second-feet; minimum stage 3.3 feet October 13 (discharge 8 second-feet).

1911-1918: Maximum stage recorded, 13.0 feet June 12, 1915 (discharge, 13,300 second-feet); channel reported dry July 13-15, 19-29, September 26 to October 4, 1914.

ICE.—Stage-discharge relation seriously affected by ice December 2 to March 17.

DIVERSIONS.—No data.

REGULATION.—No known storage above sufficiently great to noticeably affect the flow.

ACCURACY.—Stage-discharge relation affected by ice December 3 to March 17, and by shifting control throughout the year. Standard rating curve fairly well defined. Gage read to half-tenths twice daily. Daily discharge ascertained by shifting-control method. Records for open channel, fair; for winter period, poor.

Discharge measurements of White River near Interior, S. Dak., during the year ending Sept. 30, 1918.

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. 27	H. A. Noble.....	3.77	45	May 29	Alf. Hulteng.....	4.18	172
Mar. 31	Alf. Hulteng.....	4.37	121	June 30	do.....	4.72	351

Daily discharge, in second-feet, of White River near Interior, S. Dak., for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Dec.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1.....	22	79	54	505	75	218	640	258	68	18
2.....	20	50	59	580	103	146	760	103	64	18
3.....	18	50	59	555	140	131	580	79	54	18
4.....	18	50	.....	412	390	90	300	54	50	20
5.....	15	50	.....	218	580	79	555	43	199	31
6.....	15	50	.....	59	530	59	300	43	59	43
7.....	15	50	.....	50	1,400	59	180	43	226	36
8.....	18	50	.....	146	700	59	238	43	458	28
9.....	18	54	.....	90	580	530	530	70	300	24
10.....	16	47	.....	31	458	855	730	279	199	22
11.....	12	43	.....	480	322	322	1,140	199	116	22
12.....	8	43	.....	555	279	131	960	122	332	26
13.....	8	43	.....	367	238	131	435	106	163	26
14.....	12	43	.....	238	191	90	258	1,180	103	26
15.....	18	43	.....	367	156	116	180	1,400	68	24
16.....	18	47	.....	610	890	103	163	458	54	22
17.....	22	47	.....	457	322	83	116	2,500	68	22
18.....	31	43	.....	367	238	79	103	995	1,700	26
19.....	26	47	.....	300	2,160	75	368	700	700	26
20.....	22	50	.....	238	760	68	435	458	995	26
21.....	22	43	.....	199	345	63	279	368	530	26
22.....	18	43	.....	199	218	59	131	580	140	22
23.....	26	47	.....	163	146	63	90	258	68	22
24.....	31	50	.....	131	116	59	86	180	50	26
25.....	36	50	.....	131	116	68	153	163	36	43
26.....	36	50	.....	108	116	730	116	279	24	36
27.....	46	50	.....	103	218	258	131	238	22	33
28.....	36	50	.....	103	505	163	218	199	18	36
29.....	36	54	.....	90	555	180	238	116	18	47
30.....	36	59	.....	131	345	670	390	79	18	435
31.....	36	.....	.....	119	.....	890	.....	68	18	.....

NOTE.—Gage read on following days during ice period, but data insufficient for determining daily discharge: December 4-7, 19-22; February 6-14, 24-28.

Monthly discharge of White River near Interior, S. Dak., for the year ending Sept. 30, 1918.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October.....	46	8	22.9 ^a	1,410
November.....	79	43	49.2	2,930
December.....			437	2,280
January.....			417	1,050
February.....			4175	9,720
March.....	610	31	261	16,000
April.....	2,160	75	440	26,200
May.....	890	59	214	13,200
June.....	1,140	86	360	21,400
July.....	2,500	43	376	23,100
August.....	1,700	18	223	13,700
September.....	435	18	41.0	2,440
The year.....	2,500		184	133,000

^a Estimated from observer's notes, temperature and precipitation records.

WHITE RIVER AT WESTOVER, S. DAK.

LOCATION.—In sec. 32, T. 3 S., R. 29 E., on boundary of Rosebud Indian Reservation, at steel highway bridge at Westover, in Lyman County, 12 miles south and slightly east from Murdo, on Chicago, Milwaukee & St. Paul Railway, and 2 miles below mouth of South Fork of White River.

DRAINAGE AREA.—7,850 square miles.

RECORDS AVAILABLE.—August 25, 1911, to September 30, 1918.

GAGE.—Chain gage attached to steel highway bridge. Vertical staff gage with same datum as chain gage is bolted to concrete abutment of bridge, left bank. During 1911 the gage was a vertical staff, left bank about 40 rods downstream from the present location, and its datum was such as to make readings about 2.0 feet greater than from the present gage; read by E. F. Sterner.

DISCHARGE MEASUREMENTS.—Made from the highway bridge.

CHANNEL AND CONTROL.—Sand, silt, and quicksand; scours and shifts suddenly.

EXTREMES OF DISCHARGE.—Maximum discharge, 7,550 second-feet June 1; minimum stage, 6.10 feet September 19 (discharge, 70 second-feet).

1911-1918: Maximum stage recorded, 13.0 feet April 4, 1915 (discharge, 15,200 second-feet); minimum stage, 5.3 feet November 11, 1912 (discharge, 4 second-feet).

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

DIVERSIONS.—No data.

REGULATION.—No storage above great enough, so far as known to noticeably affect flow.

ACCURACY.—Stage-discharge relation not permanent; seriously affected by ice and by shifting control. Gage read to half-tenths twice daily during open channel flow and three times weekly during January. Daily discharge during open channel periods ascertained by shifting-control method. Discharge December 4 to March 20 estimated from observer's notes relative to ice, weather records and comparisons, with records for adjacent streams. Records poor.

Discharge measurements of White River at Westover, S. Dak., during the year ending Sept. 30, 1918.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
Oct. 26	H. A. Noble.....	<i>Feet.</i> 6.60	<i>Sec.-ft.</i> 113	May 28	Alf. Hulteng.....	<i>Feet.</i> 7.82	<i>Sec.-ft.</i> 893
Mar. 30	Alf. Hulteng.....	7.42	515	June 28	do.....	7.09	243

Daily discharge, in second-feet, of White River at Westover, S. Dak., for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Dec.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1.....	130	150	156	105	1,470	678	1,260	5,540	250	335	110
2.....	130	140	156	105	1,070	570	950	2,920	634	312	135
3.....	122	130	160	105	740	535	695	2,470	535	270	125
4.....	117	130	156	105	650	610	535	1,680	385	250	125
5.....	110	130	146	105	740	760	440	1,070	290	200	125
6.....	110	132	137	105	500	895	412	1,610	258	840	113
7.....	110	137	137	117	385	1,680	360	950	250	1,200	110
8.....	110	137	137	150	570	2,060	335	650	243	900	110
9.....	105	137	122	200	650	2,390	335	335	215	744	105
10.....	105	137	137	840	290	1,400	470	250	215	610	105
11.....	105	137	137	1,200	200	1,400	1,470	215	215	470	100
12.....	105	137	137	1,330	172	1,140	1,820	312	200	412	100
13.....	105	137	122	1,070	290	895	1,140	335	185	360	100
14.....	105	140	130	500	385	722	740	1,610	185	335	100
15.....	105	146	137	500	440	650	535	1,470	160	290	100
16.....	107	146	122	250	385	535	360	895	2,140	270	100
17.....	110	146	115	215	385	3,110	335	695	1,540	270	90
18.....	107	146	115	185	500	2,060	312	535	2,740	1,160	85
19.....	105	146	115	185	840	1,470	326	470	2,560	3,310	75
20.....	105	146	108	500	1,400	1,820	335	412	1,470	3,310	85
21.....	105	146	122	500	1,610	2,920	270	360	1,140	2,560	105
22.....	114	146	122	570	1,260	1,820	412	290	1,140	1,820	100
23.....	114	146	122	500	1,140	1,610	290	412	950	1,680	132
24.....	105	146	122	740	1,070	790	250	500	695	900	440
25.....	105	146	122	2,740	1,010	695	258	335	650	440	290
26.....	105	146	108	2,560	895	610	895	335	740	270	215
27.....	109	156	108	2,220	820	535	1,260	335	535	232	185
28.....	117	156	108	1,900	740	500	840	270	412	185	160
29.....	125	160	108	.....	740	1,140	1,010	290	385	150	172
30.....	130	167	108	.....	610	2,060	1,820	290	412	140	200
31.....	140	.....	108	.....	740	.....	2,920	.....	360	125	.....

Monthly discharge of White River at Westover, S. Dak., for the year ending Sept. 30, 1918.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October.....	140	105	112	6,890
November.....	167	130	143	8,510
December.....	.....	.....	127	7,810
January.....	.....	.....	105	6,460
February.....	2,740	.....	700	38,900
March.....	1,610	172	1,050	64,600
April.....	3,110	500	1,270	75,600
May.....	2,920	250	755	46,400
June.....	5,540	215	928	55,200
July.....	2,740	160	713	43,800
August.....	3,310	125	785	48,300
September.....	440	75	137	8,150
The year.....	5,540	75	567	411,000

SOUTH FORK OF WHITE RIVER NEAR WESTOVER, S. DAK.

LOCATION.—In NE. $\frac{1}{4}$ sec. 15, T. 43 N., R. 28 W., on Rosebud Indian Reservation, 2 miles above mouth of stream, 4 miles south of Westover, in Lyman County, and 16 miles south of Murdo.

DRAINAGE AREA.—1,590 square miles.

RECORDS AVAILABLE.—June 26, 1912, to September 30, 1918, when station was discontinued.

GAGE.—Chain gage on projecting timber, on right bank about 5 rods below cable. In 1912 and 1913 vertical staff gages at or near the same point were used, with precisely the same datum. Read by Mrs. C. H. Kendall.

DISCHARGE MEASUREMENTS.—Made by wading near the gage; at high stages made from the cable.

CHANNEL AND CONTROL.—Sandy and shifting.

EXTREMES OF DISCHARGE.—Maximum discharge recorded during year, 2,800 second-feet, May 30; minimum stage 1.9 feet October 10 (discharge, 24 second-feet).

1912-1918: Maximum discharge recorded, 3,800 second-feet, May 30, 1918; minimum stage 1.95 feet October 21, 1914 (discharge, 30 second-feet).

ICE.—Stage-discharge relation seriously affected by ice December 3 to March 15. Data insufficient for computation of discharge.

ACCURACY.—Stage-discharge relation changed frequently; seriously affected by ice. Standard rating curve poorly defined. Gage read to quarter-tenths once daily except Sunday during open-channel season. Daily discharge obtained by shifting-control method. Records poor.

Discharge measurements of South Fork of White River near Westover, S. Dak., during the year ending Sept. 30, 1918.

Date.	Made by—	Gage height.	Dis-charge.	Date.	Made by—	Gage height.	Dis-charge.
Oct. 26	H. A. Noble.....	<i>Feet.</i> 2.17	<i>Sec.-ft.</i> 92	May 28	Alf Hulteng.....	<i>Feet.</i> 2.39	<i>Sec.-ft.</i> 150
Mar. 29	Alf Hulteng.....	2.04	263	June 28	do.....	2.19	83

Daily discharge, in second-feet, of South Fork of White River near Westover, S. Dak., for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Dec.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1.....	34	62	148	.....	236	81	620	81	81	62
2.....	34	62	100	.....	203	124	341	81	81	62
3.....	34	62	.....	.....	203	176	62	100	81	62
4.....	34	62	.....	.....	203	269	34	90	81	62
5.....	34	62	.....	.....	216	236	81	81	81	62
6.....	34	62	.....	.....	236	203	34	124	81	62
7.....	31	62	.....	.....	192	203	15	236	124	62
8.....	28	62	.....	.....	148	203	15	124	1,180	62
9.....	24	62	.....	.....	148	176	19	102	690	62
10.....	24	62	.....	.....	148	236	24	81	203	81
11.....	24	71	.....	.....	176	306	24	81	152	62
12.....	28	81	.....	.....	176	271	24	81	100	62
13.....	24	81	.....	.....	148	236	24	81	100	62
14.....	36	81	.....	.....	148	176	24	81	100	62
15.....	48	100	.....	.....	148	148	24	81	100	62
16.....	48	100	.....	730	269	148	24	81	100	62
17.....	48	100	.....	620	269	148	24	81	100	62
18.....	48	124	.....	474	306	148	24	100	100	62
19.....	48	148	.....	474	236	136	24	90	100	62
20.....	48	148	.....	386	176	124	81	81	100	62
21.....	81	124	.....	306	176	89	81	81	105	62
22.....	62	100	.....	269	176	81	81	81	100	62
23.....	100	100	.....	236	124	81	81	81	100	100
24.....	100	100	.....	236	124	81	81	81	100	100
25.....	96	124	.....	236	124	81	81	100	90	100
26.....	92	148	.....	236	203	100	81	81	81	100
27.....	148	148	.....	236	203	100	81	81	81	100
28.....	105	148	.....	236	216	148	81	81	62	100
29.....	62	148	.....	262	143	148	81	81	62	100
30.....	62	148	.....	236	81	2,800	81	81	62	100
31.....	62	.....	.....	236	.....	850	.....	81	62	.....

NOTE.—Discharge interpolated for the following days when gage was not read: Oct. 7, 14, 25, 28, 31; Nov. 4, 8, 11, 18, 23, 25; Mar. 24, 31; Apr. 7, 14, 21; May 5, 12, 19; June 2, 9, 16, 22, 23, 27, 30; July 4, 9, 14, 19, 21, 28, 31; Aug. 4, 9, 16, 18, 23, 25; Sept. 1, 8, 12, 15, 19, 22, 29. Data inadequate for determination of discharge Dec. 3 to Mar. 10.

Monthly discharge of South Fork of White River near Westover, S. Dak., for the year ending Sept. 30, 1918.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October.....	148	24	54.2	3,330
November.....	148	63	98.1	5,840
March 16-31.....	730	236	338	10,700
April.....	306	81	185	11,000
May.....	2,800	81	268	16,500
June.....	620	15	78.4	4,670
July.....	236	81	91.9	5,650
August.....	1,180	62	150	9,220
September.....	100	62	72.8	4,330

LITTLE SIOUX RIVER BASIN.

LITTLE SIOUX RIVER AT CORRECTIONVILLE, IOWA.

LOCATION.—In sec. 1, T. 88 N., R. 43 W., at Illinois Central Railroad bridge half a mile southwest of Correctionville, Woodbury County.

DRAINAGE AREA.—2,190 square miles (measured by Iowa Highway Commission engineers from United States Post Route map; scale, 1 inch=1 mile).

RECORDS AVAILABLE.—May 28 to September 30, 1918.

GAGE.—Chain gage attached to upstream side of bridge; read by E. H. Worrell.

DISCHARGE MEASUREMENTS.—Made from downstream side of highway bridge about 1,000 feet above gage during medium and low stages, and from downstream side of railroad bridge during high stages.

CHANNEL AND CONTROL.—Bed of river composed of sand and clay; likely to shift.

EXTREMES OF STAGE.—Maximum stage recorded during period of records 13.8 feet at 5 p. m. June 3; minimum stage, 2.56 feet September 29.

REGULATION.—No appreciable fluctuation at gage is noticeable from operation of power plant in Correctionville.

Data inadequate for determination of daily discharge.

The following discharge measurements were made by W. G. Hoyt:

September 22, 1917: Gage height, 2.98 feet; discharge, 167 second-feet.

May 28, 1918: Gage height, 5.22 feet; discharge, 898 second-feet.

Daily gage height, in feet, of Little Sioux River at Correctionville, Iowa, for the year ending Sept. 30, 1918.

Day.	May.	June.	July.	Aug.	Sept.	Day.	May.	June.	July.	Aug.	Sept.
1.....		6.7	3.85	3.85	4.75	16.....		6.15	3.75	3.2	3.35
2.....		6.5	3.77	3.75	4.7	17.....		5.7	3.5	3.35	3.2
3.....		11.2	3.7	3.65	4.2	18.....		5.4	3.5	4.0	3.2
4.....		11.4	3.7	3.5	4.0	19.....		5.2	3.35	3.65	3.2
5.....		9.35	3.8	3.4	3.9	20.....		4.9	3.55	3.75	3.2
6.....		9.25	3.65	3.2	3.8	21.....		4.8	3.55	4.35	3.2
7.....		9.5	4.35	3.5	3.9	22.....		4.6	3.35	4.45	2.72
8.....		10.2	4.05	3.45	3.7	23.....		4.5	3.35	4.25	2.72
9.....		9.3	4.55	3.35	3.65	24.....		4.25	3.25	4.2	2.70
10.....		9.0	4.4	3.15	3.8	25.....		4.15	3.15	4.55	2.86
11.....		8.8	4.35	3.15	3.5	26.....		4.1	3.8	5.0	2.86
12.....		8.65	4.25	3.25	3.4	27.....		3.9	3.6	5.5	2.78
13.....		9.2	4.05	3.35	3.45	28.....	5.25	4.25	3.55	5.3	2.90
14.....		8.55	3.85	3.5	3.45	29.....	6.45	3.9	3.55	4.9	3.56
15.....		6.7	3.75	3.35	3.35	30.....	5.70	3.35	4.1	4.85	2.66
						31.....	6.70		4.1	4.8	

BOYER RIVER BASIN.**BOYER RIVER AT LOGAN, IOWA.**

LOCATION.—In sec. 24, T. 79 N., R. 43 W., at highway bridge at south edge of Logan, Boyer County, 30 miles above mouth of river.

DRAINAGE AREA.—845 square miles (measured by engineers of Iowa Highway Commission from United States Post Route map; scale, 1 inch=1 mile).

RECORDS AVAILABLE.—May 24 to September 30, 1918.

GAGE.—Chain gage attached to upstream side of bridge; read by C. F. Peckenpough.

DISCHARGE MEASUREMENTS.—Made from downstream side of bridge.

CHANNEL AND CONTROL.—Channel is dredged ditch with clay bottom; may shift.

Control for low stages is limestone ledge about 500 feet below gage; probably permanent.

EXTREMES OF STAGE.—Maximum stage recorded during period of records, 17.9 feet at 10 a. m. June 5; minimum stage, 1.58 feet September 29.

Data inadequate for determination of daily discharge.

The following discharge measurement was made by W. G. Hoyt:

May 25, 1918: Gage height, 4.20 feet; discharge, 220 second-feet.

Daily gage height, in feet, of Boyer River at Logan, Iowa, for the year ending Sept. 30, 1918.

Day.	May.	June.	July.	Aug.	Sept.	Day.	May.	June.	July.	Aug.	Sept.
1.....		6.4	3.0	2.39	1.87	16.....		3.85	2.75	2.29	2.00
2.....		6.0	2.95	2.19	2.03	17.....		3.8	2.59	2.31	1.98
3.....		3.1	2.79	2.33	1.99	18.....		3.3	2.54	2.27	1.98
4.....		14.8	2.73	2.29	2.05	19.....		3.25	2.57	2.33	1.94
5.....		17.2	4.1	2.13	1.99	20.....		3.2	2.55	2.39	1.88
6.....		14.3	4.1	1.99	2.01	21.....		3.15	2.49	2.47	1.88
7.....		9.35	3.25	2.23	2.05	22.....		3.05	2.41	2.75	1.88
8.....		6.4	2.89	2.07	2.01	23.....		3.0	2.29	2.35	1.90
9.....		5.5	2.69	2.15	1.99	24.....	13.7	3.0	2.35	2.61	1.94
10.....		4.45	2.87	2.23	1.87	25.....	6.8	3.5	3.29	2.23	1.96
11.....		4.0	2.75	2.09	2.05	26.....	4.6	3.15	2.79	2.39	1.98
12.....		3.85	2.69	2.23	2.07	27.....	12.4	3.1	2.69	2.13	1.66
13.....		3.85	2.55	2.29	2.09	28.....	7.8	3.65	3.4	2.11	1.66
14.....		4.6	2.49	2.13	2.09	29.....	7.4	3.4	2.41	2.11	1.58
15.....		3.85	2.65	2.13	2.08	30.....	8.2	3.15	2.51	2.03	1.88
						31.....	6.6		2.49	2.09	

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 Colorado topographic map; scale, 1:500,000).

RECORDS AVAILABLE.—May 23, 1915, to September 30, 1918.

GAGE.—Gurley water-stage recorder installed April 8, 1918, referred to chain gage on downstream side of bridge and used since May 13, 1916. Original gage was a staff gage on middle pier of bridge referred to same datum.

DISCHARGE MEASUREMENTS.—Made from two-span bridge or by wading.

CHANNEL AND CONTROL.—Bed composed of sand, gravel, and small boulders. Principal control 200 feet downstream at small rapids; shifts between narrow limits. Banks not subject to overflow.

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

EXTREMES OF DISCHARGE.—Data too few.

DIVERSIONS.—There are court decrees for diversions of 3,060 second-feet from North Platte River and tributaries in Colorado. During 1918 Michigan ditch diverted 2,660 acre-feet from a tributary of the North Platte to the Cache la Poudre Basin between May 24 and August 11.

REGULATION.—None.

ACCURACY.—Stage-discharge relation fairly permanent. Rating curve well defined. Operation of water-stage recorder satisfactory during the infrequent intervals the observer could attend to it. Daily discharge ascertained by applying to rating table mean daily gage height determined by inspecting gage-height graph. Record too fragmentary to determine monthly discharge.

Discharge measurements of North Platte River near Northgate, Colo., during the year ending Sept. 30, 1918.

Date.	Made by—	Gage height.	Dis-charge.
		<i>Feet.</i>	<i>Sec.-ft.</i>
Apr. 8	P. V. Hodges.....	2.25	544
June 20	J. H. Bailey.....	4.80	3,400
Sept. 18	P. V. Hodges.....	1.48	165

Daily discharge, in second-feet, of North Platte River near Northgate, Colo., for the year ending Sept. 30, 1918.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Day.	Apr.	May.	June.	July.	Aug.	Sept.
1.....					312		16.....	1,090					
2.....				690	203		17.....	900					
3.....				650			18.....	900			900		164
4.....				690			19.....	900	1,520	3,530	900		157
5.....				690			20.....	770	1,410	3,530	810		148
6.....	535			610			21.....	650	1,410	3,810	690		141
7.....	570			570			22.....	730	1,360	3,810	650		133
8.....	535		2,480	570			23.....		1,300		650		130
9.....	570		2,610	570			24.....		1,360		610	160	151
10.....	690		2,610	570			25.....		1,410		535	154	177
11.....	810		2,350	730			26.....				380	148	200
12.....	900			770			27.....				370	144	205
13.....	1,090			810			28.....				350	138	205
14.....	1,240						29.....				321	133	200
15.....	1,240						30.....				312	130	191
							31.....				312	144	.....

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, 1918. State engineer maintained station at this point during 1913 and 1914.

GAGE.—Chain gage on upstream side of bridge; read by Miss Nora Doggett and Miss Carrie Priquet. Original gage read prior to 1911 was vertical staff, 100 yards below bridge. No determined relation between gages.

DISCHARGE MEASUREMENTS.—Made from two-span highway bridge or by wading.

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, 9.5 feet at 8 a. m. June 14 and 16 (discharge, 11,400 second-feet); minimum discharge occurs during winter.

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

DIVERSIONS.—Prior to December 31, 1916, there were adjudicated diversions of 83 second-feet from the North Platte between Saratoga and State line.

REGULATION.—None.

ACCURACY.—Stage-discharge relation not permanent, but shifts between narrow limits at low stages. Rating curve well defined. Gage read to hundredths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table. Records excellent, except for ice period, for which they are fair.

Discharge measurements of North Platte River at Saratoga, Wyo., during the year ending Sept. 30, 1918.

Date.	Made by—	Gage height.	Discharge.
Feb. 6	S. B. Soule.....	<i>Feet.</i> a 4.10	<i>Sec.-ft.</i> 308
Apr. 12	P. V. Hodges.....	5.12	1,390
Sept. 16	do.....	4.04	353

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, 1918.

Day.	Oct.	Nov.	Dec.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1.....	442	471	504	317	1,620	1,180	4,220	5,160	609	262
2.....	471	471	471	340	1,540	1,390	4,920	3,340	609	262
3.....	471	504	471	340	1,540	1,620	4,680	2,380	609	298
4.....	471	609	362	362	1,390	2,560	4,930	1,940	609	298
5.....	471	572	362	362	1,390	2,940	5,650	1,860	609	298
6.....	471	536	298	388	1,250	3,550	6,150	1,700	609	317
7.....	442	536	362	413	691	4,450	6,900	1,390	536	340
8.....	413	536	362	471	887	4,450	7,900	1,320	536	388
9.....	413	504	317	650	943	4,920	8,650	1,390	471	362
10.....	413	471	317	442	1,060	4,680	9,150	1,390	471	362
11.....	413	471	317	471	1,120	4,220	10,200	1,540	471	442
12.....	413	442	317	536	1,390	3,550	10,400	1,700	471	13
13.....	413	413	317	738	1,700	3,140	10,900	1,540	413	388
14.....	388	442	317	572	1,390	2,940	11,200	1,700	413	340
15.....	388	504	317	572	2,120	3,340	10,700	1,700	413	340
16.....	388	471	340	1,120	1,860	4,220	-10,900	1,700	388	362
17.....	388	442	362	650	1,320	4,220	10,700	1,700	388	340
18.....	388	362	388	691	1,320	4,680	10,200	1,700	388	340
19.....	388	317	362	572	1,250	4,450	9,400	1,540	388	317
20.....	362	317	388	609	1,460	4,450	9,750	1,390	340	317
21.....	413	413	413	650	999	4,680	9,150	1,250	340	298
22.....	442	442	388	691	1,060	4,450	9,150	1,250	340	298
23.....	413	442	388	784	1,060	4,680	8,150	1,120	340	298
24.....	413	471	388	887	1,120	4,920	7,650	1,120	298	340
25.....	442	471	388	1,120	1,120	5,650	6,650	1,120	298	504
26.....	471	504	388	1,250	1,250	5,650	6,150	999	298	504
27.....	471	471	413	1,460	1,250	5,550	5,160	887	298	471
28.....	471	362	413	1,620	1,320	5,650	3,770	691	298	471
29.....	362	362	413	1,620	1,180	5,650	3,340	691	298	452
30.....	317	413	413	1,700	1,180	5,900	3,550	691	298	452
31.....	413	.....	413	1,540	.....	5,650	.....	609	262	.....

NOTE.—Discharge Dec. 10-16 and Mar. 1-4 estimated because of ice. Shifting-control method used Aug. 15 to Sept. 30.

Monthly discharge of North Platte River at Saratoga, Wyo., for the year ending Sept. 30, 1918.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October.....	471	317	420	25,800
November.....	609	317	458	27,300
December.....	504	298	376	23,100
January.....			323	19,900
February.....			311	17,300
March.....	1,700	317	772	47,500
April.....	2,120	609	1,290	76,800
May.....	5,900	1,180	4,180	257,000
June.....	11,200	3,340	7,650	455,000
July.....	5,160	609	1,560	95,900
August.....	609	262	423	26,000
September.....	504	262	362	21,500
The year.....	11,200	262	1,510	1,090,000

NOTE.—Discharge for January and February estimated because of ice from gage heights and temperature records, 1 discharge measurement, and observer's notes.

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. Back-water from Pathfinder reservoir reaches within $2\frac{1}{2}$ 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, 1918.

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 and is practically permanent. Banks high and not subject to overflow.

EXTREMES OF DISCHARGE.—Maximum stage during year from water-stage recorder, 5.6 feet June 15, 16, 17, and 19 (discharge, 15,300 second-feet); minimum discharge occurs during winter, when observations are discontinued.

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

DIVERSIONS.—Prior to December 31, 1916, there were adjudicated diversions of 84 second-feet from North Platte River between Saratoga and the station above Pathfinder.

REGULATION.—Diurnal fluctuation during spring, caused by alternate melting and freezing of mountain snow.

ACCURACY.—Stage-discharge relation permanent. Rating curve well-defined. 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 excellent.

Discharge measurements of North Platte River above Pathfinder, Wyo., during the year ending Sept. 30, 1918.

Date.	Made by—	Gage height.	Discharge.
		<i>Feet.</i>	<i>Sec.-ft.</i>
Oct. 3	S. B. Soulé.....	1.05	477
June 10	P. V. Hodges.....	4.72	10,100
Sept. 20	do.....	1.06	446

Daily discharge, in second-feet, of North Platte River above Pathfinder, Wyo., for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1.....	574	438	.....	2,060	1,590	6,730	3,420	831	275
2.....	606	494	.....	2,130	1,560	6,310	2,950	780	275
3.....	522	550	.....	2,130	1,700	5,720	2,560	730	275
4.....	522	566	.....	1,880	2,090	5,530	2,380	693	282
5.....	536	582	.....	1,680	2,730	5,530	2,260	666	282
6.....	550	606	.....	1,650	3,420	5,910	2,170	639	337
7.....	543	614	.....	1,560	4,210	6,950	1,990	630	346
8.....	529	614	.....	1,460	5,170	8,110	1,830	630	350
9.....	508	590	.....	1,400	5,530	9,380	1,810	614	388
10.....	480	574	.....	1,290	6,110	10,400	1,810	598	515
11.....	459	550	780	1,410	5,720	11,500	1,750	566	424
12.....	445	522	800	1,720	5,170	12,700	1,990	522	417
13.....	431	480	853	1,930	4,360	13,600	2,130	487	410
14.....	424	473	897	2,220	3,800	14,100	2,210	466	438
15.....	424	494	978	2,690	3,540	14,700	2,220	452	639
16.....	424	508	1,010	2,840	3,890	15,000	2,130	424	598
17.....	424	550	1,030	2,620	4,510	15,000	2,090	399	558
18.....	417	566	1,050	2,190	5,000	14,400	1,950	388	529
19.....	424	522	1,170	1,810	5,350	14,100	1,950	377	515
20.....	445	424	1,320	1,540	5,170	13,600	1,850	366	452
21.....	417	388	1,350	1,400	5,170	12,700	1,680	360	424
22.....	424	388	1,340	1,340	5,000	12,400	1,540	342	404
23.....	431	452	1,180	1,400	5,000	12,400	1,410	328	377
24.....	466	543	1,320	1,480	5,170	11,500	1,350	319	372
25.....	487	566	1,500	1,580	5,720	10,400	1,360	314	372
26.....	487	558	1,750	1,620	6,310	9,120	1,290	310	399
27.....	494	574	2,130	1,720	6,730	7,400	1,240	303	558
28.....	452	566	2,480	1,970	6,520	5,910	1,190	296	614
29.....	342	466	2,580	1,950	6,520	4,830	1,090	289	614
30.....	382	459	2,360	1,760	6,520	4,070	990	282	606
31.....	404	.....	2,420	.....	6,730	.....	908	275	.....

Monthly discharge of North Platte River above Pathfinder, Wyo., for the year ending Sept. 30, 1918.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October.....	606	342	467	28,700
November.....	614	388	523	31,100
March 11-31.....	2,580	780	1,440	60,000
April.....	2,840	1,290	1,810	108,000
May.....	6,730	1,560	4,710	290,000
June.....	15,000	4,070	10,000	595,000
July.....	3,420	908	1,850	114,000
August.....	831	275	473	29,100
September.....	639	275	435	25,900

NORTH PLATTE RIVER AT PATHFINDER, WYO.

LOCATION.—In sec. 24, T. 29 N., R. 84 W., a quarter of a mile below Pathfinder dam and one-third of a mile below old post office of Pathfinder, 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, 1918.

GAGE.—Chain gage on left bank a quarter of a mile below Pathfinder dam; read by J. C. Austin.

DISCHARGE MEASUREMENTS.—Made from cable, 50 feet above gage.

EXTREMES OF DISCHARGE.—No data.

ICE.—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, which materially changes the natural run-off of the river.

COOPERATION.—Records furnished by United States Reclamation Service.

Daily discharge, in second-feet, of North Platte River at Pathfinder, Wyo., for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1.....	2,140	5	5	5	5	5	525	3,620	4,970	5,900	4,640	3,330
2.....	1,260	5	5	5	5	5	525	4,420	4,990	6,050	4,640	3,330
3.....	1,100	5	5	5	5	5	525	4,600	5,060	5,190	4,100	3,330
4.....	1,100	5	5	5	5	5	525	4,600	5,060	6,110	4,000	3,330
5.....	1,100	5	5	5	5	5	225	4,600	5,060	5,620	4,100	3,330
6.....	1,100	5	5	5	5	5	90	4,600	4,880	5,510	4,100	3,330
7.....	1,100	5	5	5	5	5	10	4,600	5,020	4,930	4,100	3,300
8.....	1,100	5	5	5	5	5	10	4,600	5,020	4,870	4,100	3,300
9.....	1,100	5	5	5	5	5	10	4,600	5,020	4,900	4,100	3,300
10.....	1,100	5	5	5	5	5	10	4,760	5,040	4,920	4,100	3,260
11.....	1,100	5	5	5	5	5	10	4,920	5,060	4,970	4,140	3,260
12.....	1,100	5	5	5	5	5	10	4,920	5,060	5,020	3,880	3,260
13.....	1,100	5	5	5	5	5	850	4,920	5,060	5,020	3,700	3,260
14.....	1,100	5	5	5	5	5	1,090	4,920	4,910	5,020	3,750	3,200
15.....	1,100	5	5	5	5	5	1,100	4,920	4,900	5,020	3,750	2,300
16.....	1,100	5	5	5	5	5	1,100	4,130	4,990	5,020	3,750	2,300
17.....	1,100	5	5	5	5	5	1,100	4,600	5,060	4,990	3,750	2,300
18.....	1,100	5	5	5	5	5	1,100	4,710	5,630	4,970	3,790	2,300
19.....	1,100	5	5	5	5	5	1,100	4,820	7,150	4,990	3,790	2,300
20.....	1,100	5	5	5	5	5	1,100	800	8,820	5,060	3,790	2,300
21.....	255	5	5	5	5	5	1,870	2,700	9,860	5,040	4,070	2,300
22.....	5	5	5	5	5	5	2,000	4,600	10,600	4,970	3,720	2,300
23.....	5	5	5	5	5	5	2,200	4,710	11,200	4,970	3,720	2,300
24.....	5	5	5	5	5	5	2,200	4,870	11,500	4,940	3,720	2,300
25.....	5	5	5	5	5	5	2,200	4,900	11,500	4,970	3,720	1,810
26.....	5	5	5	5	5	5	2,200	4,920	9,690	4,970	3,790	1,500
27.....	5	5	5	5	5	5	2,200	4,920	8,940	4,970	3,750	1,500
28.....	5	5	5	5	5	10	2,200	4,920	9,520	4,970	2,820	1,500
19.....	5	5	5	5	5	5	2,200	4,920	6,630	4,970	2,820	1,500
30.....	5	5	5	5	5	330	2,470	4,920	6,240	4,920	3,330	1,500
31.....	5	5	5	5	5	510	4,710	4,710	4,160	3,330	3,330	.....

NOTE.—Quantities changed slightly to conform to computation rules used by United States Geological Survey.

Monthly discharge of North Platte River at Pathfinder, Wyo., for the year ending Sept. 30, 1918.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October.....	2,140	5	758	46,600
November.....	5	5	5	298
December.....	5	5	5	307
January.....	5	5	5	307
February.....	5	5	5	278
March.....	510	5	32	1,970
April.....	2,470	10	1,100	65,500
May.....	4,920	800	4,510	277,000
June.....	11,500	4,880	6,750	402,000
July.....	6,110	4,160	5,090	313,000
August.....	4,640	2,820	3,840	236,000
September.....	3,330	1,500	2,610	155,000
The year.....	11,500	5	2,070	1,500,000

NOTE.—Monthly means computed by engineers of the United States Geological Survey.

NORTH PLATTE RIVER NEAR CASPER, WYO.

LOCATION.—In sec. 31, T. 32 N., R. 81 W., at highway bridge at Speas ranch, half a mile below Bessemer Canyon, in Natrona County. Nearest tributary, Bates Creek, enters about 3 miles upstream.

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—April 9, 1917, to September 30, 1918.

GAGE.—Vertical staff.

DISCHARGE MEASUREMENTS.—Made from bridge.

CHANNEL AND CONTROL.—Channel apparently permanent. Control located below bridge.

DIVERSIONS.—Prior to December 31, 1916, there were no adjudicated diversions from North Platte River between this station and Pathfinder reservoir.

REGULATION.—(See North Platte at Pathfinder.)

COOPERATION.—Complete records furnished by United States Reclamation Service.

Daily discharge, in second-feet, of North Platte River near Casper, Wyo., for the year ending Sept. 30, 1918.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Day.	Apr.	May.	June.	July.	Aug.	Sept.
1.....	350	3,610	4,840	6,760	4,710	3,430	16....	1,000	3,920	5,250	5,260	3,850	2,530
2.....	330	4,550	5,050	6,700	4,840	3,330	17....	960	4,780	6,930	5,310	3,840	2,240
3.....	310	4,600	5,020	6,480	6,330	3,330	18....	950	4,820	7,500	5,280	3,920	2,220
4.....	560	4,750	5,000	6,560	4,450	3,380	19....	910	4,600	8,300	5,260	3,900	2,220
5.....	510	4,780	4,840	6,090	4,310	3,330	20....	860	620	9,210	5,330	3,680	2,220
6.....	590	4,840	4,980	6,450	4,330	3,330	21....	1,850	2,500	10,000	5,670	4,170	2,220
7.....	350	4,840	5,000	5,400	4,310	3,360	22....	1,870	4,610	10,700	5,400	3,870	2,220
8.....	450	4,780	4,890	5,500	4,260	3,300	23....	2,010	4,820	10,800	5,260	3,870	2,240
9.....	560	5,190	5,000	5,500	4,220	3,300	24....	2,010	4,840	10,800	5,370	2,250	2,250
10.....	650	5,190	5,020	5,440	4,260	3,300	25....	2,020	4,860	9,090	5,260	3,850	1,300
11.....	760	5,090	5,020	5,910	4,630	3,300	26....	2,020	4,860	9,250	5,210	3,870	1,300
12.....	870	5,110	4,340	5,330	3,920	3,280	27....	2,040	4,860	9,710	5,190	3,610	1,310
13.....	1,000	5,110	4,890	5,330	3,900	2,960	28....	2,040	4,860	6,890	5,280	2,860	1,340
14.....	1,130	5,090	4,820	5,310	3,870	2,340	29....	2,040	4,860	6,910	5,370	2,860	1,350
15.....	1,080	5,030	4,970	5,260	3,870	3,110	30....	2,670	4,760	6,760	5,150	3,280	1,320
							31....	.....	4,890	.....	4,960	3,430	.....

NOTE.—Quantities changed slightly to conform to computation rules used by United States Geological Survey.

Monthly discharge of North Platte River near Casper, Wyo., for the year ending Sept. 30, 1918.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
April.....	2,670	310	1,160	69,000
May.....	5,190	620	4,580	282,000
June.....	10,800	4,340	6,730	400,000
July.....	6,760	4,960	5,560	342,000
August.....	6,330	2,800	4,030	248,000
September.....	3,430	1,300	2,560	152,000
The period.....	.....	.....	.....	1,490,000

NOTE.—Monthly means computed by engineers of the United States Geological Survey.

NORTH PLATTE RIVER AT MCKINLEY, WYO.

LOCATION.—About in sec. 21, T. 31 N., R. 69 W., at highway bridge at McKinley, in Converse County. Nearest tributary, Elkhorn Creek, enters several miles below.

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—April 1, 1917, to September 30, 1918.

GAGE.—Vertical staff.

DISCHARGE MEASUREMENTS.—Made from bridge.

DIVERSIONS.—Prior to December 31, 1916, there were adjudicated diversions of 53 second-feet from North Platte River between Casper station and McKinley.

REGULATION.—(See North Platte at Pathfinder.)

COOPERATION.—Complete records furnished by United States Reclamation Service.

Daily discharge, in second-feet, of North Platte River at McKinley, Wyo., for the year ending Sept. 30, 1918.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Day.	Apr.	May.	June.	July.	Aug.	Sept.
1.....	800	6,060	5,890	6,610	5,010	3,230	16.....	1,700	6,780	5,720	5,720	3,950	2,540
2.....	800	6,240	5,890	6,420	5,010	3,230	17.....	2,060	6,780	5,890	5,720	3,700	2,540
3.....	800	6,240	6,060	6,420	5,010	3,230	18.....	2,060	6,780	8,420	5,720	3,700	2,540
4.....	970	6,420	5,890	6,240	4,470	3,230	19.....	2,060	6,780	5,890	5,550	3,700	2,540
5.....	1,340	6,780	6,060	6,060	6,240	3,230	20.....	2,430	6,780	7,140	5,550	3,700	2,370
6.....	1,700	6,960	6,780	6,240	5,300	2,990	21.....	2,610	6,610	7,680	6,610	3,700	2,370
7.....	1,700	7,320	5,550	6,060	5,300	2,990	22.....	2,610	5,370	8,860	5,550	3,700	2,370
8.....	1,520	7,320	6,060	6,060	4,750	2,990	23.....	2,970	6,060	9,820	5,550	3,700	2,370
9.....	1,520	7,320	5,890	6,240	3,950	2,990	24.....	2,970	6,060	10,600	5,550	3,460	2,370
10.....	970	7,320	5,720	6,240	3,950	3,460	25.....	3,700	6,060	9,330	5,550	3,460	2,370
11.....	970	6,960	5,720	6,060	3,950	2,760	26.....	3,870	6,240	9,330	5,550	3,460	2,370
12.....	1,160	6,960	5,720	6,780	3,700	2,540	27.....	4,240	6,060	9,330	5,550	3,460	2,370
13.....	1,160	6,780	5,720	6,060	3,700	2,540	28.....	4,600	6,060	9,330	5,300	3,230	1,570
14.....	1,520	6,780	5,720	6,060	3,460	2,540	29.....	5,550	6,060	7,860	5,300	3,230	1,400
15.....	1,520	6,780	5,720	5,890	3,700	2,540	30.....	5,720	6,240	6,780	5,300	3,230	1,400
							31.....	.....	6,240	.....	5,300	3,230	.....

NOTE.—Quantities changed slightly to conform to computation rules used by United States Geological Survey.

Monthly discharge of North Platte River at McKinley, Wyo., for the year ending Sept. 30, 1918.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
April.....	5,720	800	2,250	134,000
May.....	7,320	5,370	6,550	403,000
June.....	10,600	5,550	7,010	417,000
July.....	6,780	5,300	5,900	363,000
August.....	6,240	3,230	4,000	246,000
September.....	3,460	1,400	2,600	155,000
The period.....				1,720,000

NOTE.—Monthly means computed by engineers of the United States Geological Survey.

NORTH PLATTE RIVER ABOVE AND BELOW WHALEN, WYO.

LOCATION.—In sec. 11, T. 26 N., R. 65 W., at diversion dam at Whalen, Goshen County. Nearest important tributary is Cottonwood Canyon Creek, an intermittent stream that 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, 1918. Prior to October 1, 1916, the combined flow of the river and Interstate canal was given, and in addition, the flow through the Interstate canal. Beginning October 1, 1916, the flow above Whalen is given, which represents the flow of river and Interstate canal combined. The flow below Whalen represents the flow in the river passing the dam (overfall weir) below Interstate canal diversion. Difference between the two records represents the amount diverted.

GAGE.—To determine the flow over the weir a vertical staff is used, its zero being at the weir crest. The discharge is then computed by a weir formula. There are also four sluice gates in the dam, through which the discharge is computed. In the river, 75 feet downstream from the weir gage, is another, with zero 10 feet lower. The second gage is only used in computing the discharge through the gates when the openings are submerged. The discharge through the headgates of Interstate and Fort Laramie canals is computed from the gate openings. Vertical staffs located in the canals below the headgates are used in computing the discharge when the head-gate openings are submerged.

DISCHARGE MEASUREMENTS.—Made from cable 1 mile below weir, in order to check the coefficients used in the discharge computations.

DIVERSIONS.—Prior to December 31, 1916, there were adjudicated diversions from North Platte River of 32 second-feet between McKinley and Whalen gaging station exclusive of the diversion by United States Reclamation Service. Between Whalen and the State line there are adjudicated diversions of 240 second-feet.

REGULATION.—The discharge represents chiefly the effect of the Pathfinder reservoir which stores water for use in the Interstate and Fort Laramie canals.

COOPERATION.—Records furnished by United States Reclamation Service.

Daily discharge, in second-feet, of North Platte River above Whalen, Wyo., for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1.....	3,460	661	402	218	100	125	508	3,230	6,350	6,800	5,640	4,130
2.....	3,020	661	402	277	100	120	493	3,280	6,440	6,790	5,150	4,120
3.....	3,130	593	402	348	100	160	550	4,930	6,420	6,570	5,430	4,120
4.....	3,080	548	402	317	110	200	900	6,020	6,280	6,490	5,370	4,100
5.....	2,450	510	178	289	125	200	990	6,670	6,670	5,980	4,820	4,070
6.....	2,200	456	180	290	125	200	903	7,190	6,780	7,000	5,520	4,060
7.....	2,230	415	187	262	135	200	1,010	7,360	6,620	6,360	5,410	4,070
8.....	2,050	340	160	200	140	225	1,360	7,780	5,940	6,280	5,080	4,100
9.....	2,050	389	127	190	150	225	1,210	7,760	6,290	5,880	5,430	4,100
10.....	1,980	456	122	150	160	225	1,090	7,860	6,290	5,830	4,870	4,110
11.....	1,980	456	148	150	160	320	866	8,120	6,050	6,560	4,870	4,200
12.....	1,930	456	187	140	160	400	905	7,680	6,050	6,980	4,890	4,200
13.....	2,080	442	177	130	170	400	975	7,560	5,980	6,760	4,980	4,180
14.....	1,960	442	179	125	170	340	1,050	7,380	5,910	5,590	4,730	4,220
15.....	1,940	442	172	125	170	350	1,280	7,300	5,650	5,960	4,590	4,370
16.....	1,480	442	186	125	170	330	1,960	7,240	5,740	6,600	4,660	4,160
17.....	1,480	442	196	125	170	340	2,630	7,080	5,540	6,310	4,570	3,620
18.....	1,480	442	207	125	150	340	2,380	6,420	7,010	6,670	4,600	3,580
19.....	1,480	442	262	125	110	320	2,240	6,740	6,860	6,190	4,560	3,200
20.....	1,480	428	277	125	100	340	2,040	6,740	6,690	6,280	4,470	3,040
21.....	1,480	428	293	120	100	350	1,810	6,780	8,670	6,100	4,760	3,080
22.....	1,400	428	342	120	110	325	1,840	4,290	9,160	6,370	4,510	3,190
23.....	1,460	428	420	130	140	325	1,880	4,520	10,700	6,190	4,760	2,810
24.....	1,370	428	262	135	170	325	2,720	6,220	11,800	6,110	4,570	2,900
25.....	1,994	428	231	115	170	340	2,860	6,160	10,800	5,730	4,570	2,960
26.....	828	414	316	115	170	340	3,080	6,390	10,800	6,010	4,610	3,070
27.....	753	402	278	115	150	370	3,370	6,360	10,500	5,950	4,590	2,990
28.....	661	402	194	115	140	380	3,620	6,340	8,810	5,840	4,570	2,310
29.....	593	402	143	115	.....	370	3,480	6,450	8,970	5,720	4,660	2,130
30.....	593	402	185	115	.....	400	3,400	6,490	8,740	5,810	3,920	2,040
31.....	571	.....	218	100	.....	480	.....	6,590	.....	5,890	3,760	.....

NOTE.—Quantities changed slightly to conform to computation rules used by United States Geological Survey.

PLATTE RIVER BASIN.

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Monthly discharge of North Platte River above Whalen, Wyo., for the year ending Sept. 30, 1918.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October.....	3,460	571	1,730	106,000
November.....	661	340	454	27,000
December.....	402	122	240	14,800
January.....	348	100	166	10,200
February.....	170	100	140	7,780
March.....	480	120	302	18,600
April.....	3,620	493	1,780	106,000
May.....	8,120	3,230	6,490	398,000
June.....	11,800	5,540	7,480	445,000
July.....	7,000	5,590	6,250	384,000
August.....	5,640	3,760	4,800	295,000
September.....	4,370	2,040	3,570	212,000
The year.....	11,800	100	2,800	2,020,000

NOTE.—Monthly means computed by engineers of the United States Geological Survey.

Daily discharge, in second-feet, of North Platte River below Whalen, Wyo., for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1.....	2,510	661	402	218	100	125	508	2,410	4,940	4,930	3,720	2,310
2.....	2,720	661	402	277	100	120	493	2,430	5,020	4,870	3,240	2,290
3.....	2,500	593	402	348	100	160	550	4,060	5,000	4,640	3,520	2,290
4.....	2,310	548	402	317	110	200	900	5,160	4,860	4,590	3,450	2,320
5.....	1,630	510	178	289	125	200	990	5,800	5,240	4,030	2,900	2,420
6.....	1,400	456	180	290	125	200	903	6,300	5,360	5,000	3,750	2,400
7.....	1,380	415	187	262	135	200	1,010	6,470	5,190	4,350	3,490	2,420
8.....	1,370	340	160	200	140	225	1,360	6,870	4,510	4,260	3,170	2,440
9.....	1,390	389	127	190	150	225	1,210	6,870	4,820	3,840	3,480	2,490
10.....	1,320	456	122	150	160	225	806	7,020	4,800	3,800	3,130	2,490
11.....	1,320	456	148	150	160	320	406	7,230	4,570	4,530	3,150	2,780
12.....	1,260	456	187	140	160	400	175	6,800	4,560	4,920	3,170	2,780
13.....	1,360	442	177	130	170	400	255	6,680	4,480	4,700	3,240	2,760
14.....	1,230	442	179	125	170	340	403	6,480	4,380	4,500	3,000	2,800
15.....	1,210	442	172	125	170	350	630	6,400	4,110	4,000	2,860	3,030
16.....	1,480	442	186	125	170	330	1,320	6,310	4,020	4,550	2,890	3,000
17.....	1,480	442	196	125	170	340	1,900	6,120	3,890	4,270	2,850	2,460
18.....	1,480	442	207	125	150	340	1,640	5,400	5,240	4,630	2,820	2,420
19.....	1,480	442	262	125	110	320	1,500	5,640	5,060	4,150	2,800	2,040
20.....	1,480	428	277	125	100	340	1,300	5,400	4,880	4,240	2,700	1,880
21.....	1,480	428	293	120	100	350	1,030	5,600	6,860	4,060	2,970	2,000
22.....	1,460	428	342	120	110	325	1,050	3,040	7,410	4,330	2,730	2,330
23.....	1,460	428	420	130	140	325	1,080	2,220	8,860	4,150	2,970	1,950
24.....	1,370	428	262	135	170	325	1,960	4,880	10,000	4,190	2,760	2,070
25.....	994	428	231	115	170	340	2,090	4,820	9,000	3,810	2,750	2,210
26.....	828	414	316	115	170	340	2,280	5,060	9,000	4,080	2,780	2,320
27.....	753	402	278	115	150	370	2,540	5,030	8,670	4,030	2,760	2,240
28.....	661	402	194	115	140	380	2,810	5,000	6,980	3,920	2,720	1,860
29.....	593	402	143	115	.....	370	2,660	5,090	7,140	3,800	2,840	1,380
30.....	593	402	185	115	.....	400	2,570	5,120	6,910	3,890	2,090	1,340
31.....	571	.....	218	100	.....	480	.....	5,210	.....	3,970	1,930	.....

Monthly discharge of North Platte River below Whalen, Wyo., for the year ending Sept. 30, 1918.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October.....	2,720	571	1,390	85,500
November.....	661	340	454	27,000
December.....	420	122	240	14,800
January.....	348	100	166	10,200
February.....	170	100	140	7,780
March.....	480	120	302	18,600
April.....	2,810	175	1,280	76,200
May.....	7,230	2,220	5,380	331,000
June.....	10,000	3,890	5,860	349,000
July.....	5,000	3,800	4,200	264,000
August.....	3,750	1,930	2,990	184,000
September.....	3,030	1,340	2,310	137,000
The year.....	10,000	100	2,080	1,510,000

BIG CREEK NEAR BIG CREEK, WYO.

LOCATION.—In sec. 32, T. 13 N., R. 81 W., at Big Creek ranger station, 2 miles west of Big Creek post office, 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, 1918. State engineer maintained station at this point during 1913 and 1914.

GAGE.—Stevens water-stage recorder installed May 13, 1918, and referred to vertical staff on left bank 50 feet from ranger station. Prior to April 29, 1915, gage was placed 1 foot farther out in the stream and gave readings slightly different although referred to same datum.

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

CHANNEL AND CONTROL.—Bed composed of coarse gravel and small boulders. Control at gage which is on riffle; slightly shifting. Right bank subject to overflow at stage of 4.2 feet; left bank high. Stage of zero flow, 0.6 foot.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 4.4 feet at 11 p. m. June 13 (discharge, 1,160 second-feet); minimum discharge probably occurs during winter.

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

DIVERSIONS.—Prior to December 31, 1916, there were no adjudicated diversions from Big Creek above the station in Wyoming, but below the diversions amount to 100 second-feet. In Colorado Independence ditch diverts from Big Lake to the North Platte drainage basin about 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.—Diurnal fluctuation during spring, caused by alternating melting and freezing of mountain snow.

ACCURACY.—Stage-discharge relation practically permanent. Rating curve well defined. Operation of water-stage recorder satisfactory when observer could attend to it. Daily discharge ascertained by applying to rating table mean daily gage height obtained by inspecting gage-height graph. Records good.

Discharge measurements of Big Creek at Big Creek, Wyo., during the year ending Sept. 30, 1918.

Date.	Made by—	Gage height.	Discharge.
		<i>Feet.</i>	<i>Sec.-ft.</i>
Apr. 9	P. V. Hodges.....	1.56	38.4
May 13	S. B. Soule.....	2.08	147
Sept. 18	P. V. Hodges.....	1.50	29.9

Daily discharge, in second-feet, of Big Creek near Big Creek, Wyo., for the year ending Sept. 30, 1918.

Day.	May.	June.	July.	Aug.	Sept.	Day.	May.	June.	July.	Aug.	Sept.
1.....		346	226	60	34	16.....	274	955	107	38	30
2.....		346	202	57	34	17.....	274	905	105	36	31
3.....		386	190	56	34	18.....	292	855	123	34	30
4.....		427	180	54	35	19.....	292	755	113	32	30
5.....		470	170	54	35	20.....	309	755	102	30	30
6.....		560	150	54	35	21.....	328	705	100	31	30
7.....		655	140	52	35	22.....	309	655	97	31	29
8.....		705	130	48	32	23.....	346	655	90	31	31
9.....		705	120	46	34	24.....	386	605	86	31	44
10.....		805	129	45	32	25.....	406	515	102	30	50
11.....		905	160	44	28	26.....	427	427	95	31	42
12.....		955	120	43	27	27.....	427	366	90	31	44
13.....		1,000	151	42	25	28.....	427	309	83	32	40
14.....	226	1,060	118	41	24	29.....	406	274	76	32	36
15.....	242	1,000	102	40	23	30.....	406	242	70	33	36
						31.....	386		63	33	

NOTE.—No gage heights July 4-9, 26-31, Aug. 1, 11-14, 23-31. Sept. 1-6; discharge determined from hydrograph for Encampment River at Encampment.

Monthly discharge of Big Creek near Big Creek, Wyo., for the year ending Sept. 30, 1918.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
May 14-31.....	427	226	342	12,200
June.....	1,060	242	643	38,300
July.....	226	63	122	7,500
August.....	60	30	40.4	2,480
September.....	50	23	33.3	1,980

FRENCH CREEK NEAR FRENCH, WYO.

LOCATION.—In sec. 5, T. 14 N., R. 81 W., at Jenkins's ranch, 2½ miles southeast of French, in Carbon County. No tributary between station and mouth, 2 miles below.

DRAINAGE AREA.—60 square miles (measured on topographic map).

RECORDS AVAILABLE.—April 30, 1911, to October 31, 1912; April 1, 1915, to July 13, 1918. State engineer maintained station at this point 1913 and 1914.

GAGE.—Vertical staff at right bank, 400 feet upstream from highway bridge; read by Miss Pearl Jenkins. Prior to April 10, 1918, gage was 1 mile downstream. Flow at two points practically comparable.

DISCHARGE MEASUREMENTS.—Made from two-span bridge or by wading.

CHANNEL AND CONTROL.—Channel composed of large boulders; control 25 feet downstream; apparently permanent. Left bank subject to overflow at stage of 3.5 feet.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 5 feet at 7 p. m. June 13 (discharge, 1,350 second-feet); minimum stage occurs during winter.

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

DIVERSIONS.—Prior to December 31, 1916, adjudicated diversions of 4.3 second-feet from French Creek; part above station not known.

REGULATION.—Alternate melting and freezing of mountain snow causes diurnal fluctuation during spring of year; no artificial regulation.

ACCURACY.—Stage-discharge relation apparently permanent. Rating curve fairly well defined below 600 second-feet, but uncertain above. Gage read to hundredths twice daily. Daily discharge ascertained by applying mean daily gage heights to rating table. Records good.

Discharge measurements of French Creek near French, Wyo., during the year ending Sept. 30, 1918.

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>
Apr. 10	P. V. Hodges.....	1.48	24.2	June 26	S. B. Soule.....	3.45	483
May 15	S. B. Soule.....	2.29	105	Sept. 17	P. V. Hodges.....	1.48	27.2

Daily discharge, in second-feet, of French Creek near French, Wyo., for the year ending Sept. 30, 1918.

Day.	Apr.	May.	June.	July.	Sept.	Day.	Apr.	May.	June.	July.	Sept.
1.....		33	246	262		16.....	26	141	1,050		
2.....		49	246	262		17.....	26	151	935		25
3.....		60	262	262		18.....	25	151	880		25
4.....		73	312	230		19.....	24	136	825		25
5.....		80	370	230		20.....	21	129	880		26
6.....		94	438	246		21.....	18	64	770		26
7.....		102	560	262		22.....	22	167	715		26
8.....		99	665	262		23.....	24	200	610		26
9.....		99	770	230		24.....	25	215	535		32
10.....	25	85	990	230		25.....	28	230	510		30
11.....	28	74	1,050	215		26.....	28	262	438		28
12.....	32	70	1,170	200		27.....	27	262	392		26
13.....	34	68	1,230	186		28.....	22	278	392		26
14.....	33	78	1,170			29.....	22	295	312		26
15.....	31	120	1,050			30.....	26	295	295		26
						31.....		312			

NOTE.—No gage heights Apr. 11, June 8, Sept. 18-21, 29-30; discharge interpolated.

Monthly discharge of French Creek near French, Wyo., for the year ending Sept. 30, 1918.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
April 10-30.....	34	18	26.0	1,080
May.....	312	33	144	8,850
June.....	1,230	246	669	39,800
July 1-13.....	262	186	237	6,110
September 17-30.....	32	25	26.6	739

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, 1918. State engineer maintained station at this point during 1913 and 1914.

GAGE.—Chain gage on left bank at tailing flume which crosses river; read by Earl Waite and L. A. Cunningham. Prior to June 6, 1912, gage was 175 feet farther downstream, and although referred to same datum, read about 1 foot lower, owing to slope of river.

DISCHARGE MEASUREMENTS.—Made from cable, 125 feet below gage, or by wading.

CHANNEL AND CONTROL.—Channel composed of gravel and small boulders; practically permanent during 1918. Control is not well defined, though there are small rapids 200 feet downstream.

EXTREMES OF DISCHARGE.—Maximum discharge during year estimated at 2,600 second-foot June 14; minimum discharge occurs during winter.

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

DIVERSIONS.—Three large irrigation ditches divert water at a point 1 mile above 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 amount 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.—Diurnal fluctuation during spring from alternate melting and freezing of mountain snow.

ACCURACY.—Stage-discharge relation permanent during the year. Rating curve well defined. 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, 1918.

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>
Feb. 7	S. B. Soulé.....	4.48	43.0	June 25	S. B. Soulé.....	6.05	891
Apr. 11	P. V. Hodges.....	4.30	111	Sept. 19	P. V. Hodges.....	3.82	33.7
May 11	S. B. Soulé.....	5.58	590				

a Stage-discharge relation affected by ice.

Daily discharge, in second-feet, of Encampment River at Encampment, Wyo., for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Dec.	Feb.	Apr.	May.	June.	July.	Aug.	Sept.
1	49	75	104					428	53	25
2	47	89						405	50	25
3	57	93				1,730		382	47	30
4	53	89				860		360	44	30
5	57	84						320	41	33
6										
7	59	89						320	38	36
8	53	93		43				282	35	36
9	45	93						275	32	36
10	47	104					2,210	255	29	36
11	49	97			96		2,330	360	26	36
12										
13	59	89			112	605	2,450	360	23	33
14	59	93					2,500	275	20	30
15	75	84					2,550	255	23	30
16	72	84					2,600	216	20	36
17	59	75					2,400	181	18	36
18										
19	72	79					2,200	192	16	36
20	75	97					1,970	201	16	33
21	84	97					1,850	173	16	36
22	75	104					1,850	148	16	33
23	75	84					1,680	140	16	31
24										
25	84	79					1,620	130	16	40
26	89	84					1,510	108	16	50
27	93	89					1,400	96	16	74
28	89	84					1,200	102	16	135
29	84	93					1,020	140	16	135
30										
31	87	104					860	92	18	96
	90	93					685	78	20	78
	93	89				1,730	605	70	20	61
	93	89					550	65	22	50
	84	104				1,620	525	60	25	46
	75							56	25	

NOTE.—No gage heights Oct. 26, 27, June 12-16, July 28 to Aug. 11; discharge determined from hydrograph of Big Creek near Big Creek.

Monthly discharge of Encampment River at Encampment, Wyo., for the year ending Sept. 30, 1918.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	93	45	70.4	4,330
November	104	75	90	5,360
June 9-30	2,600	525	1,660	72,400
July	428	56	210	12,900
August	53	16	25.6	1,570
September	135	25	47.4	2,820

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, 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, 1918.

GAGE.—Bristol water-stage recorder on left bank just below bridge.

DISCHARGE MEASUREMENTS.—Made from bridge or by wading.

CHANNEL AND CONTROL.—Bed rough and composed of coarse gravel and small boulders; control not well defined. Banks high and not subject to overflow.

EXTREMES OF DISCHARGE.—Maximum daily stage during year from water-stage recorder, 3.4 feet on June 18 and 19 (discharge, 1,240 second-feet); minimum discharge, 16 second-feet, August 26, 29-31, September 1, 2, 8, and 9.

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

DIVERSIONS.—Prior to December 31, 1916, there were adjudicated permits for diversion of about 4 second-feet from Rock Creek above, and 209 second-feet below the station.

REGULATION.—None.

ACCURACY.—Stage-discharge relation not permanent; frequent discharge measurements believed to define limits of shift. Standard rating curve well defined below 500 second-feet but uncertain above. Operation of water-stage recorder fairly satisfactory. Daily discharge ascertained by applying to rating table mean daily gage height determined by inspection of gage-height graph. Shifting-control method used for greater part of the year. Records fair.

COOPERATION.—Field data furnished by Rock Creek Conservation Co. through F. C. Bosler.

Discharge measurements of Rock Creek near Arlington, Wyo., during the year ending Sept. 30, 1918.

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. 7	M. W. Gordon a.....	0.60	28.3	June 28	M. W. Gordon a.....	1.58	315
Dec. 17	do.....	.70	34.3	July 6	H. Luck a.....	1.10	148
Feb. 8	do.....	.35	24.2	Sept. 18	do.....	1.00	102
Mar. 16	do.....	.37	28.5		P. V. Hodges.....	.22	16.7
May 2	do.....	.75	43.8				

a Employee of Rock Creek Conservation Co.

Daily discharge, in second-feet, of Rock Creek near Arlington, Wyo., for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1.....	28	24	33	32	20	27	30	44	510	188	46	16
2.....	28	27	33	32	20	26	33	44	485	192	39	16
3.....	28	28	33	32	22	26	34	52	535	196	40	17
4.....	28	28	33	32	22	27	34	87	535	222	40	18
5.....	28	29	32	31	22	28	35	138	535	183	39	17
6.....	28	29	31	31	23	30	30	122	510	167	37	17
7.....	28	29	30	30	23	31	37	142	535	167	37	17
8.....	33	29	28	29	24	31	34	183	535	146	38	16
9.....	34	29	27	28	23	36	42	142	585	146	33	16
10.....	34	28	25	25	24	35	44	122	685	188	31	18
11.....	34	28	26	24	24	35	45	126	710	122	30	23
12.....	34	28	27	24	25	37	47	146	785	162	28	19
13.....	34	27	28	24	25	35	46	146	810	122	28	17
14.....	27	26	30	24	25	35	40	146	935	122	26	17
15.....	25	25	31	24	27	32	44	209	985	142	24	18
16.....	25	25	32	24	28	31	42	192	1,060	118	22	20
17.....	24	25	34	24	28	38	39	192	1,160	118	22	20
18.....	19	26	35	24	26	37	41	214	1,240	102	20	18
19.....	26	28	35	24	25	37	48	192	1,240	179	20	18
20.....	24	30	35	24	25	37	42	236	1,110	58	20	18
21.....	25	30	34	23	25	34	47	318	1,080	48	18	18
22.....	22	31	34	22	25	35	49	318	1,080	48	18	18
23.....	27	31	33	22	26	31	44	285	985	48	18	19
24.....	35	30	32	23	26	37	46	360	860	48	18	20
25.....	34	30	31	24	28	35	43	410	635	49	17	20
26.....	33	30	31	24	29	35	40	435	585	47	16	24
27.....	34	30	32	23	30	34	47	460	460	45	18	34
28.....	32	30	32	22	29	34	45	460	360	40	18	43
29.....	30	32	33	22	.....	34	46	435	267	38	16	43
30.....	28	33	33	22	.....	34	42	460	183	38	16	41
31.....	26	.....	33	20	.....	34	.....	485	.....	36	16	.....

NOTE.—Stage-discharge relation affected by ice Oct. 28 to Mar. 5; discharge based on gage heights, discharge measurements, and temperature records.

Monthly discharge of Rock Creek near Arlington, Wyo., for the year ending Sept. 30, 1918.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October.....	35	19	28.9	1,780
November.....	33	24	28.5	1,700
December.....	35	25	31.5	1,940
January.....	32	20	25.5	1,570
February.....	30	20	25.0	1,390
March.....	38	26	33.2	2,040
April.....	49	30	41.2	2,450
May.....	485	44	236	14,500
June.....	1,240	183	733	43,600
July.....	222	36	114	7,010
August.....	46	16	26.1	1,600
September.....	43	16	21.2	1,260
The year.....	1,240	16	112	80,800

DEEP CREEK NEAR ARLINGTON, WYO.

LOCATION.—In sec. 16, T. 17 N., R. 79 W., at outlet of Sand Lake, 12 miles southwest of Arlington, in Carbon County, at an elevation of 10,100 feet. No tributary within several miles.

DRAINAGE AREA.—3.7 square miles (measured on topographic map).

RECORDS AVAILABLE.—July 30, 1914, to September 2, 1918.

GAGE.—Bristol water-stage recorder on left bank just below lake outlet. Prior to October 8, 1915, gage was 160 feet upstream, and referred to different datum.

DISCHARGE MEASUREMENTS.—Made by wading.

CHANNEL AND CONTROL.—Bed composed of coarse, well compacted gravel which shifts at intervals. Control not well defined.

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

EXTREMES OF DISCHARGE.—Data too few.

DIVERSIONS.—No diversions above.

REGULATION.—Flow regulated naturally by Sand Lake, which has an area of about 95 acres.

ACCURACY.—Stage-discharge relation not permanent. Standard rating curve well defined below 40 second-feet. Operation of water-stage recorder fairly satisfactory. Daily discharge ascertained by applying to rating table mean daily gage height obtained by inspecting gage-height graph; shifting-control method used June 5 to August 9. Records fair.

COOPERATION.—Field data furnished by Rock Creek Conservation Co., through F. C. Bosler.

Discharge measurements of Deep Creek near Arlington, Wyo., during the year ending Sept. 30, 1918.

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. 5	M. W. Gordon a.....	1.04	0.94	Apr. —	M. W. Gordon a.....	0.80	0.28
Dec. 12	do.....	.80	.38	June 5	do.....	1.10	2.3
Jan. 15	do.....	.82	.32	July 19	H. Luck a.....	.65	1.4
Feb. 28	do.....	.80	.27	Sept. 14	P. V. Hodges.....	.99	.49

a Employee of Rock Creek Conservation Co.

Daily discharge, in second-feet, of Deep Creek near Arlington, Wyo., for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1.....		0.2	0.3	0.3	0.2	0.3	0.3			29	0.9	0.7
2.....		.2	.3	.3	.4	.3	.3			24	.8	.7
3.....		.3	.3	.3	.6	.3	.3			27	.8	
4.....		.2	.3	.3	.3	.5	.3			29	.7	
5.....	0.9	.4	.3	.3	.3	.3	.3		2.3	32	.6	
6.....		.2	.3	.4	.3	.3	.3		3.0	28	.5	
7.....		.2	.3	.3	.3	.4	.3		3.0	21	.4	
8.....		.2	.3	.3	.3	.4	.3		4.6	26	.3	
9.....		.2	.3	.3	.3	.3	.3		5.6	23	.3	
10.....		.2	.3	.3	.3	.4	.3		10	18	.2	
11.....		.2	.3	.3	.3	.4	.3		12	13	.2	
12.....		.2	.3	.3	.3	.4	.3		15	10	.3	
13.....		.2	.3	.4	.3	.4	.3		14	12	.2	
14.....		.3	.3	.4	.3	.4	.3		14	9.2	.3	.5
15.....		.3	.3	.3	.3	.4			20	6.8	.4	
16.....		.2	.3	.3	.3	.3			20	5.6	.6	
17.....		.2	.3	.3	.3	.3			24	4.6	.8	
18.....		.3	.3	.3	.2	.4			24	3.2	.8	
19.....		.2	.3	.3	.3	.3			20	1.8	1.2	
20.....		.2	.3	.3	.6	.3			24	2.3	1.2	
21.....		.2	.3	.3	.8	.3			20	3.2	1.2	
22.....		.2	.3	.3	1.0	.3				4.6	.8	
23.....		.2	.3	.3	.8	.3				6.2	.8	
24.....		.2	.4	.3	.4	.5				3.1	.8	
25.....		.2	.4	.3	.3	.6				1.7	.8	
26.....		.2	.3	.3	.4	.4				1.5	.8	
27.....		.2	.3	.3	.3	.4				1.4	1.0	
28.....	.3	.2	.3	.2	.3	.4				1.3	1.0	
29.....	.2	.3	.3	.3		.4			68	1.2	1.0	
30.....	.2	.3	.3	.3		.3			60	1.1	1.0	
31.....	.3		.3	.2		.3				1.0	1.0	

Monthly discharge of Deep Creek near Arlington, Wyo., for the year ending Sept. 30, 1918.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
November.....	0.4	0.2	0.23	13.7
December.....	.4	.3	.31	19.1
January.....	.4	.2	.30	18.4
February.....	1.0	.2	.39	21.7
March.....	.6	.3	.36	22.1
April-14.....	.2	.3	.29	8.1
July.....	32	1.0	11.3	695
August.....	1.2	.2	.70	43

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, 1918.

GAGE.—Vertical staff 5 feet above footbridge at left bank; read by J. S. Wolf.

DISCHARGE MEASUREMENTS.—Made from footbridge or by wading.

CHANNEL AND CONTROL.—Bed composed of boulders embedded in sand. Control a short distance below bridge at riffle which is permanent. Banks subject to overflow at stage of 6.5 feet. Stage of zero flow, 0.9 foot.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 2.8 feet at 6 p. m. March 23, and 6 a. m. May 26 (discharge, 118 second-feet); minimum stage, 1.14 feet July 9–13, 14–16, 22–24 (discharge, 0.7 second-foot).

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

DIVERSIONS.—Prior to December 31, 1916, there were adjudicated diversions of 16 second-feet from Sage Creek, all above the station.

REGULATION.—None.

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

Discharge measurements of Sage Creek above Pathfinder, Wyo., during the year ending Sept. 30, 1918.

Date.	Made by—	Gage height.	Discharge.
June 10	P. V. Hodges.	<i>Fect.</i> 1.74	<i>Sec.-ft.</i> 10.1
Sept. 20	do.....	1.40	3.3

Daily discharge, in second-feet, of Sage Creek above Pathfinder, Wyo., for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1.	1.8	12	.....	57	40	42	1.0	0.8	1.0
2.	1.8	12	.....	50	56	33	.8	.8	1.0
3.	1.8	13	.....	25	61	26	.8	.9	1.0
4.	1.8	14	.....	21	69	22	.8	.9	1.0
5.	1.8	14	.....	21	80	17	1.6	1.0	1.0
6.	1.8	14	.....	23	84	14	.8	1.9	1.0
7.	4.0	14	.....	31	92	23	.8	1.0	1.0
8.	4.0	14	.....	31	92	17	.8	1.0	1.0
9.	4.0	13	17	42	92	13	.8	.9	1.0
10.	4.0	13	17	57	80	10	.8	.9	1.0
11.	4.8	12	17	47	58	6.9	.7	.9	1.0
12.	4.8	12	29	63	61	5.0	.7	.9	1.0
13.	4.8	13	29	84	63	3.2	1.0	.9	1.0
14.	4.8	13	17	100	92	2.1	.8	.9	1.0
15.	4.8	13	19	100	76	1.9	.7	1.2	3.0
16.	4.8	12	12	78	78	1.2	.7	1.4	2.8
17.	4.8	10	13	48	75	.8	1.8	1.5	2.8
18.	4.8	10	16	38	78	2.4	1.1	1.3	2.8
19.	4.8	12	15	25	68	7.5	.8	.9	2.8
20.	4.8	13	17	35	65	5.8	.8	1.0	2.9
21.	6	12	11	32	63	15	.8	1.0	3.0
22.	6	12	19	40	65	42	.8	1.8	3.0
23.	6	11	55	26	56	32	.7	.9	3.0
24.	9	12	31	38	55	23	.7	.9	3.0
25.	9	10	40	36	49	17	.8	1.8	3.0
26.	12	11	59	44	76	8.7	.8	1.4	3.0
27.	12	13	76	44	52	3.7	.8	1.0	3.6
28.	12	12	62	36	44	2.6	.8	1.0	2.8
29.	12	12	55	32	44	1.4	.8	1.0	3.8
30.	12	12	44	35	44	1.3	.8	1.0	3.8
31.	12	.....	55	.....	43	.....	.8	1.0	.....

Monthly discharge of Sage Creek above Pathfinder, Wyo., for the year ending Sept. 30, 1918.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October.....	12	1.8	5.9	363
November.....	14	10	12.3	732
March 9-31.....	76	11	31.5	1,440
April.....	100	21	44.6	2,650
May.....	92	40	66.2	4,070
June.....	42	.8	13.4	797
July.....	1.8	.7	.86	53
August.....	1.9	.8	1.09	67
September.....	3.8	1.0	2.14	127

DEWEESE CREEK NEAR ALCOVA, WYO.

LOCATION.—In sec. 18, T. 27 N., R. 84 W., at Weaver's ranch, near entrance of creek into Pathfinder reservoir, in Carbon County.

DRAINAGE AREA.—41 square miles (measured on base map of Wyoming; scale, 1:500,000.)

RECORDS AVAILABLE.—March 4, 1917, to September 30, 1918.

DIVERSIONS.—Prior to December 31, 1916, there were adjudicated diversions of 4.4 second-feet from Deweese Creek above station.

COOPERATION.—Complete records furnished by United States Reclamation Service.

Daily discharge, in second-feet, of Deweese Creek, near Alcova, Wyo., for the year ending Sept. 30, 1918.

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

Monthly discharge of Deweese Creek near Alcova, Wyo., for the year ending Sept. 30, 1918.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
April.....	14	1	7.8	464
May.....	14	1	3.3	203
June.....	14	1	3.8	226
July.....	26	1	5.2	320
August.....	14	1	4.5	277
September.....	1	1	1.0	60
The period.....				1,550

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 half a mile below.

DRAINAGE AREA.—70 square miles (measured on base map of Wyoming; scale, 1:500,000).

RECORDS AVAILABLE.—April 1, 1915, to September 30, 1918.

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.—Records of daily discharge furnished by United States Reclamation Service.

Daily discharge, in second-feet, of Sand Creek near Alcova, Wyo., for the year ending Sept. 30, 1918.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Day.	Apr.	May.	June.	July.	Aug.	Sept.
1.....	11	5	0	2	2	2	16.....	2	6	0	4	2	2
2.....	3	5	0	2	2	2	17.....	2	6	0	3	2	2
3.....	3	5	0	2	2	2	18.....	6	4	0	3	2	2
4.....	3	5	0	2	2	2	19.....	2	4	0	2	2	2
5.....	3	5	0	2	5	2	20.....	2	4	6	2	2	2
6.....	3	5	0	2	6	2	21.....	2	4	21	2	2	2
7.....	2	5	0	2	11	2	22.....	2	4	21	2	2	2
8.....	2	5	0	2	16	2	23.....	2	4	21	2	2	2
9.....	2	5	0	2	16	2	24.....	4	4	21	2	2	2
10.....	2	5	0	3	2	2	25.....	4	4	21	2	2	2
11.....	2	5	0	4	2	2	26.....	5	4	6	2	2	2
12.....	4	6	0	4	2	2	27.....	5	4	6	2	2	2
13.....	4	6	0	4	2	2	28.....	5	4	2	2	2	2
14.....	5	6	0	4	2	2	29.....	5	4	2	2	2	2
15.....	5	6	0	4	2	2	30.....	5	2	2	2	2	2
							31.....		0		2	2	

Monthly discharge of Sand Creek near Alcova, Wyo., for the year ending Sept. 30, 1918.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
April.....	11	2	3.6	214
May.....	6	0	4.5	277
June.....	21	0	4.3	256
July.....	4	2	2.5	154
August.....	16	2	3.4	200
September.....	2	2	2.0	119
The period.....				1,230

NOTE.—Monthly means computed by engineers of the United States Geological Survey.

SWEETWATER RIVER NEAR ALCOVA, WYO.

LOCATION.—In sec. 17, T. 29 N., R. 86 W., at Schoonmaker's ranch, 27 miles west of Alcova, in Natrona County. Backwater from Pathfinder reservoir comes to a point 5 miles below. Nearest tributary, Dry Creek, enters 6 miles below.

DRAINAGE AREA.—2,270 square miles (measured on base map of Wyoming; scale 1:500,000).

RECORDS AVAILABLE.—August 28, 1913, to September 30, 1918.

GAGE.—Vertical staff on left bank at old bridge abutment 200 feet above footbridge; read by H. D. Schoonmaker

DISCHARGE MEASUREMENTS.—Made from footbridge or by wading.

CHANNEL AND CONTROL.—Bed composed of gravel. Control 25 feet downstream at small rapids which change during high water. Banks high and not subject to overflow.

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

DIVERSIONS.—Prior to December 31, 1916, there were adjudicated diversions of 102 second-feet from Sweetwater River, above the station. The original diversions below the station have been submerged by Pathfinder reservoir.

REGULATION.—None.

COOPERATION.—Records of daily discharge furnished by United States Reclamation Service.

Daily discharge, in second-feet, of Sweetwater River near Alcova, Wyo., for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Dec.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1.....	53	79	57	-----	95	220	375	130	43	22
2.....	53	60	60	-----	88	216	353	117	36	20
3.....	55	59	57	-----	88	222	324	107	36	22
4.....	55	60	47	-----	88	277	321	103	39	26
5.....	55	60	42	-----	97	310	302	93	39	24
6.....	55	62	54	-----	108	370	289	82	33	24
7.....	53	64	57	-----	182	410	342	78	32	24
8.....	53	60	57	-----	245	452	397	77	33	24
9.....	53	60	-----	-----	280	488	408	58	35	27
10.....	53	60	-----	143	165	518	440	46	35	28
11.....	53	64	-----	148	170	522	440	45	32	28
12.....	53	65	-----	97	197	485	445	45	29	29
13.....	53	66	-----	93	225	410	450	57	28	29
14.....	53	60	-----	90	318	357	465	72	29	30
15.....	53	57	-----	95	415	324	445	72	30	38
16.....	53	60	-----	106	564	317	408	72	26	37
17.....	53	63	-----	132	564	321	373	72	26	45
18.....	53	63	-----	95	448	345	343	69	27	43
19.....	55	66	-----	85	346	347	325	69	25	43
20.....	55	63	-----	83	304	346	310	69	24	43
21.....	57	54	-----	83	263	336	282	69	24	43
22.....	55	55	-----	87	218	315	255	61	24	43
23.....	57	60	-----	85	197	302	261	63	24	43
24.....	56	60	-----	83	178	299	299	61	23	45
25.....	54	60	-----	88	212	289	263	61	22	43
26.....	59	60	-----	93	267	277	362	55	20	43
27.....	66	60	-----	93	232	314	299	53	20	43
28.....	57	68	-----	90	280	346	218	51	22	43
29.....	60	75	-----	90	310	378	178	48	20	43
30.....	92	54	-----	90	250	418	152	45	22	43
31.....	91	-----	-----	95	-----	425	-----	45	23	-----

Monthly discharge of Sweetwater River near Alcova, Wyo., for the year ending Sept. 30, 1918.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October.....	92	53	57.3	3,520
November.....	79	54	61.9	3,680
December 1-8.....	60	42	53.9	855
March 10-31.....	148	83	97.5	4,250
April.....	564	88	246	14,600
May.....	522	216	353	21,700
June.....	465	152	337	20,100
July.....	130	45	69.2	4,250
August.....	43	20	28.4	1,750
September.....	45	20	34.6	2,060

NOTE.—Monthly means computed by engineers of the United States Geological Survey.

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, flow line of which is half a mile below gage.

DRAINAGE AREA.—119 square miles (measured on base map of Wyoming; scale, 1 : 500,000).

RECORDS AVAILABLE.—March 23, 1915, to September 30, 1918.

GAGE.—Vertical staff on right bank at lower side of bridge; read by Thomas Igoe.

DISCHARGE MEASUREMENTS.—Made from single-span bridge or by wading.

CHANNEL AND CONTROL.—Bed composed of coarse gravel. Control a short distance below gage.

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

DIVERSIONS.—Prior to December 31, 1916, there were adjudicated diversions of 11 second-feet from Horse Creek.

REGULATION.—None.

COOPERATION.—Records of daily discharge furnished by United States Reclamation Service.

Daily discharge, in second-feet, of Horse Creek near Alcova, Wyo., for the year ending Sept. 30, 1918.

Day.	Oct.	Apr.	May.	June.	July.	Aug.	Sept.
1.....	0.7	1	1	1	1	1	1
2.....	.7	1	1	1	1	1	1
3.....	.7	1	1	1	1	1	1
4.....	.7	26	1	1	1	1	1
5.....	.7	36	1	1	1	1	1
6.....	.7	39	1	1	1	1	1
7.....	.7	62	1	1	1	1	1
8.....	.7	59	1	1	1	1	1
9.....	.8	49	1	1	1	1	1
10.....	.8	23	1	1	1	1	1
11.....	.8	17	1	1	1	1	1
12.....	.8	17	1	1	1	1	1
13.....	.8	19	2	1	1	1	1
14.....	.8	19	1	1	1	1	1
15.....	.8	26	1	1	1	1	1
16.....	.8	17	1	1	1	1	1
17.....	.8	13	1	1	1	1	2
18.....	.8	3	1	1	1	1	2
19.....	.8	3	1	32	1	1	2
20.....	.8	6	1	9	1	1	2
21.....	.8	6	1	19	1	1	2
22.....	.8	6	1	3	1	1	2
23.....	.8	3	1	1	1	1	2
24.....	.8	2	1	1	1	1	2
25.....	.8	1	1	2	1	1	2
26.....	.8	1	1	1	1	1	2
27.....	.8	1	1	1	1	1	2
28.....	.....	1	1	1	1	1	2
29.....	.....	1	1	1	1	1	2
30.....	.....	1	1	1	1	1	2
31.....	.....	.....	1	.....	1	1	.....

Monthly discharge of Horse Creek near Alcova, Wyo., for the year ending Sept. 30, 1918.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October 1-27.....	0.8	0.7	0.8	43
April.....	62	1	15.3	910
May.....	2	1	1.0	61
June.....	32	1	3.0	179
July.....	1	1	1.0	61
August.....	1	1	1.0	61
September.....	2	1	1.5	89

NOTE.—Monthly means computed by engineers of the United States Geological Survey.

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, flow line of which is 1 mile below gage.

DRAINAGE AREA.—54 square miles (measured on base map of Wyoming; scale, 1:500,000).

RECORDS AVAILABLE.—April 1, 1915, to September 30, 1918.

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.—Records of daily discharge furnished by United States Reclamation Service.

Daily discharge, in second-feet, of Canyon Creek near Alcova, Wyo., for the year ending Sept. 30, 1918.

Day.	Oct.	Apr.	May.	June.	July.	Aug.	Sept.
1.....	0.4	14	11	2	4	1	0
2.....	.4	16	12	1	3	1	0
3.....	.4	12	13	1	4	1	0
4.....	.4	6	12	1	11	1	1
5.....	.4	5	16	1	3	1	1
6.....	.4	6	18	1	4	1	1
7.....	.5	13	14	1	2	1	1
8.....	.5	12	14	1	2	1	1
9.....	.6	17	16	1	4	1	1
10.....	.6	16	20	1	5	1	1
11.....	.6	12	20	1	7	1	1
12.....	.6	16	20	1	3	1	1
13.....	.6	18	20	1	3	1	1
14.....	.6	26	17	1	3	1	1
15.....	.6	26	16	1	4	1	3
16.....	.6	17	13	1	4	1	1
17.....	.6	11	11	62	4	0	1
18.....	1.2	9	10	5	28	0	1
19.....	1.2	8	10	3	3	0	1
20.....	1.2	14	7	3	3	0	1
21.....	2.0	12	6	130	2	0	1
22.....		16	6	23	2	0	1
23.....		13	5	13	2	0	1
24.....		10	4	6	2	0	1
25.....		12	3	5	2	0	1
26.....		7	4	5	2	0	1
27.....		10	4	3	2	0	1
28.....		7	3	3	2	0	1
29.....		9	3	2	2	0	1
30.....		12	3	3	1	0	1
31.....			1		1	0	

Monthly discharge of Canyon Creek near Alcova, Wyo., for the year ending Sept. 30, 1918.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October 1-21.....	2.0	0.4	0.69	28.7
March.....	26	5	12.7	756
April.....	20	1	10.7	658
May.....	130	1	9.4	559
June.....	28	1	4.0	246
July.....	1	0	.5	30.7
August.....	3	0	1.0	59.5
September.....				

NOTE.—Monthly means computed by engineers of the United States Geological Survey.

BATES CREEK NEAR CASPER, WYO.

LOCATION.—Approximately in sec. 12, T. 31 N., R. 82 W., near mouth of creek, 21 miles southwest of Casper, in Natrona County.

DRAINAGE AREA.—383 square miles (measured on base map of Wyoming; scale, 1:500,000).

RECORDS AVAILABLE.—April 10, 1916, to 1918.

DIVERSIONS.—Prior to December 31, 1916, there were adjudicated diversions of 72 second-feet from Bates Creek, all above the station.

COOPERATION.—Records of daily discharge furnished by United States Reclamation Service.

Daily discharge, in second-feet, of Bates Creek near Casper, Wyo., for the year ending Sept. 30, 1918.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Day.	Apr.	May	June.	July.	Aug.	Sept.
1.....		57	0	1	1	1	16.....	76	113	0	16	1	1
2.....		57	0	1	1	1	17.....	69	125	0	16	1	1
3.....		33	0	1	1	1	18.....	76	113	0	40	1	1
4.....		142	0	1	1	1	19.....	40	91	0	10	1	1
5.....		280	0	1	1	1	20.....	40	76	0	1	1	1
6.....		295	0	1	1	1	21.....	51	69	0	1	1	1
7.....		340	0	1	1	1	22.....	113	51	0	1	1	1
8.....		295	0	1	1	1	23.....	101	31	0	1	1	1
9.....		248	0	113	1	1	24.....	51	31	0	1	1	1
10.....		204	0	23	1	1	25.....	76	31	0	1	1	1
11.....		189	0	16	1	1	26.....	83	31	4	1	1	1
12.....		173	0	16	1	1	27.....	76	10	4	1	1	1
13.....		125	0	10	1	1	28.....	45	1	4	1	1	1
14.....		125	0	23	1	1	29.....	57	1	4	1	1	1
15.....		57	0	23	1	1	30.....	57	0	1	1	1	1
							31.....		0		1	1	

Monthly discharge of Bates Creek near Casper, Wyo., for the year ending Sept. 30, 1918.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
April 16-30.....	113	40	67.4	2,010
May.....	340	0	111	6,820
June.....	4	0	0.6	36
July.....	113	1	10.5	646
August.....	1	1	1.0	61
September.....	1	1	1.0	60

NOTE.—Monthly means computed by engineers of the United States Geological Survey.

DEER CREEK AT GLENROCK, WYO.

LOCATION.—In sec. 4, T. 33 N., R. 75 W., near mouth of creek, at Glenrock, in Converse County.

DRAINAGE AREA.—63 square miles (measured on base map of Wyoming; scale, 1:500,000).

RECORDS AVAILABLE.—April 11, 1916, to May 11, 1918.

DIVERSIONS.—Prior to December 31, 1916, there were adjudicated diversions of 48 second-feet from Deer Creek, all above the station.

COOPERATION.—Records of daily discharge furnished by United States Reclamation Service.

Daily discharge, in second-feet, of Deer Creek at Glenrock, Wyo., for the year ending Sept. 30, 1918.

Day.	Apr.	May.	Day.	Apr.	May.	Day.	Apr.	May.
1.....		350	11.....		480	21.....	191	.....
2.....		550	12.....			22.....	194	.....
3.....		796	13.....			23.....	210	.....
4.....		890	14.....	1,050		24.....	224	.....
5.....		1,080	15.....	738		25.....	233	.....
6.....		1,270	16.....	413		26.....	278	.....
7.....		1,110	17.....	438		27.....	303	.....
8.....		1,150	18.....	405		28.....	281	.....
9.....		1,080	19.....	163		29.....	258	.....
10.....		638	20.....	67		30.....	265	.....
						31.....		.....

Monthly discharge of Deer Creek at Glenrock, Wyo., for the year ending Sept. 30, 1918.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
April 14-30.....	1,050	67	336	11,300
May 1-11.....	1,270	350	854	18,600

NOTE.—Monthly means computed by engineers of the United States Geological Survey.

BOXELDER CREEK NEAR CAREYHURST, WYO.

LOCATION.—Approximately in sec. 7, T. 33 N., R. 73 W., near mouth of creek, 1½ miles east of Careyhurst, in Converse County.

DRAINAGE AREA.—193 square miles (measured on base map of Wyoming; scale, 1:500,000).

RECORDS AVAILABLE.—May 17 to October 31, 1911; April 9, 1916, to September 30, 1918.

DIVERSIONS.—Prior to December 31, 1916, there were adjudicated diversions of 80 second-feet from Boxelder Creek, all above station.

COOPERATION.—Records of daily discharge furnished by United States Reclamation Service.

Daily discharge, in second-feet, of Boxelder Creek near Careyhurst, for the year ending Sept. 30, 1918.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Day.	Apr.	May.	June.	July.	Aug.	Sept.
1.....	96	161	258	4	4	4	16.....	271	430	30	4	4	4
2.....	102	210	233	4	4	4	17.....	233	430	26	4	4	4
3.....	102	271	200	4	4	4	18.....	143	447	22	4	4	4
4.....	102	430	180	4	4	4	19.....	88	430	18	4	4	4
5.....	88	475	171	4	4	4	20.....	88	447	15	4	4	4
6.....	88	657	167	4	4	4	21.....	88	475	12	4	4	4
7.....	88	807	152	4	4	4	22.....	110	462	8	4	4	4
8.....	64	717	152	4	4	4	23.....	110	462	6	4	4	4
9.....	68	566	135	4	4	4	24.....	96	417	6	4	4	4
10.....	72	505	110	4	4	4	25.....	118	417	4	4	4	4
11.....	72	475	96	4	4	4	26.....	190	312	8	4	4	4
12.....	88	298	68	4	4	4	27.....	135	271	6	4	4	4
13.....	135	417	64	4	4	4	28.....	135	285	6	4	4	4
14.....	190	417	38	4	4	4	29.....	135	258	6	4	4	4
15.....	285	430	33	4	4	4	30.....	118	258	4	4	4	4
							31.....		210		4	4	4

Monthly discharge of Boxelder Creek near Careyhurst, Wyo., for the year ending Sept. 30, 1918.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
April.....	285	64	123	7,320
May.....	807	161	414	25,500
June.....	258	4	74.5	4,430
July.....	4	4	4.0	246
August.....	4	4	4.0	246
September.....	4	4	4.0	238
The period.....				38,000

NOTE.—Monthly means computed by engineers of the United States Geological Survey.

LA PRELE CREEK NEAR FETTERMAN, WYO.

LOCATION.—About in sec. 9, T. 33 N., R. 72 W., near mouth of creek, 4 miles from Fetterman, in Converse County.

DRAINAGE AREA.—227 square miles.

RECORDS AVAILABLE.—April 23 to August 5, 1916; April 1 to September 30, 1918.

DIVERSIONS.—Prior to December 31, 1916, there were adjudicated diversions of 73 second-feet from La Prele Creek, all above station.

COOPERATION.—Records of daily discharge furnished by United States Reclamation Service.

Daily discharge, in second-feet, of La Prele Creek near Fetterman, Wyo., for the year ending Sept. 30, 1918.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Day.	Apr.	May.	June.	July.	Aug.	Sept.
1.....	8	70	70	6	4	2	16.....	14	251	8	8	4	4
2.....	8	88	61	6	4	2	17.....	16	165	8	6	2	4
3.....	8	110	61	8	4	2	18.....	18	150	6	6	2	4
4.....	8	135	54	8	6	4	19.....	20	150	6	6	2	4
5.....	8	165	46	6	4	4	20.....	22	150	54	8	4	2
6.....	8	226	122	8	4	4	21.....	24	150	11	11	4	2
7.....	8	282	46	8	4	2	22.....	26	135	6	8	2	2
8.....	8	316	42	6	4	2	23.....	28	122	6	8	2	2
9.....	8	379	36	11	4	2	24.....	30	122	4	6	4	4
10.....	8	437	36	11	4	4	25.....	33	99	4	11	4	4
11.....	9	408	36	11	4	4	26.....	36	88	4	8	2	4
12.....	9	408	30	6	4	4	27.....	39	79	4	8	2	6
13.....	9	408	30	18	2	2	28.....	42	79	6	11	2	6
14.....	11	408	11	18	2	2	29.....	46	79	8	8	4	6
15.....	13	316	8	14	4	4	30.....	54	70	4	6	4	6
							31.....		70		6	2	4

Monthly discharge of La Prele Creek near Fetterman, Wyo., for the year ending Sept. 30, 1918.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
April.....	54	8	19.3	1,150
May.....	437	70	197	12,100
June.....	122	4	27.6	1,640
July.....	18	6	8.7	535
August.....	6	2	3.4	209
September.....	6	2	3.5	208
The period.....				15,800

NOTE.—Monthly means computed by engineers of the United States Geological Survey.

WAGON HOUND CREEK NEAR LABONTE, WYO.

LOCATION.—Approximately in sec. 16, T. 31 N., R. 71 W., near mouth of creek, at Eastman's ranch, 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, 1916, to September 30, 1918.

DIVERSIONS.—Prior to December 31, 1916, there were adjudicated diversions of 24 second-feet from Wagon Hound Creek, all above the station.

COOPERATION.—Records of daily discharge furnished by United States Reclamation Service.

Daily discharge, in second-feet, of Wagon Hound Creek near LaBonte, Wyo., for the year ending Sept. 30, 1918.

Day.	Apr.	May.	June.	July.	Aug.	Day.	Apr.	May.	June.	July.	Aug.
1.....	50	58	0	0	0	16.....	75	28	0	0	0
2.....	53	78	0	0	0	17.....	55	22	0	0	0
3.....	54	84	0	0	0	18.....	38	16	0	0	0
4.....	57	87	0	0	0	19.....	28	7	32	0	0
5.....	55	85	0	0	141	20.....	40	5	96	0	0
6.....	59	84	0	0	32	21.....	41	2	4	96	0
7.....	63	85	0	0	0	22.....	45	1	0	0	0
8.....	66	67	0	0	0	23.....	51	1	0	0	0
9.....	71	57	0	0	0	24.....	50	1	0	0	0
10.....	72	61	0	0	0	25.....	52	1	0	0	0
11.....	74	66	0	36	0	26.....	90	0	0	0	0
12.....	76	78	0	6	0	27.....	141	0	0	0	0
13.....	78	67	0	0	0	28.....	95	0	0	0	0
14.....	75	52	0	0	0	29.....	66	0	0	0	0
15.....	93	42	0	0	0	30.....	59	0	0	0	0
						31.....		0		0	0

Monthly discharge of Wagon Hound Creek near LaBonte, Wyo., for the year ending Sept. 30, 1918.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
April.....	141		64.1	3,810
May.....	87	0	36.6	2,250
June.....	96	0	4.4	262
July.....	96	0	4.5	277
August.....	141	0	5.6	344
The period.....				6,940

NOTE.—Monthly means computed by engineers of the United States Geological Survey.

LABONTE CREEK NEAR LABONTE, WYO.

LOCATION.—Approximately in sec. 15, T. 31 N., R. 71 W., at Soden'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 map).

RECORDS AVAILABLE.—April 12, 1916, to September 30, 1918.

DIVERSIONS.—Prior to December 31, 1916, there were adjudicated diversions of 34 second-feet from LaBonte Creek, all above the station.

COOPERATION.—Records of daily discharge furnished by United States Reclamation Service.

Daily discharge, in second-feet, of LaBonte Creek near LaBonte, Wyo., for the year ending Sept. 30, 1918.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Day.	Apr.	May.	June.	July.	Aug.	Sept.
1.....	195	616	122	15	4	0	16.....	325	407	20	15	0	2
2.....	210	590	122	14	4	0	17.....	325	380	12	14	0	2
3.....	223	596	87	13	3	0	18.....	315	407	10	19	0	2
4.....	235	620	77	13	3	0	19.....	345	315	22	17	0	2
5.....	252	630	112	13	3	0	20.....	323	295	14	14	0	2
6.....	258	637	83	13	3	0	21.....	367	258	13	130	0	2
7.....	275	677	67	5	75	0	22.....	387	223	12	18	0	2
8.....	295	645	77	6	3	0	23.....	395	223	40	15	0	2
9.....	302	697	62	5	3	0	24.....	404	208	26	14	0	2
10.....	258	533	62	26	2	0	25.....	425	194	19	56	0	2
11.....	295	533	53	86	2	0	26.....	472	180	17	52	0	2
12.....	323	450	38	20	2	0	27.....	493	157	14	15	0	2
13.....	335	387	32	21	0	0	28.....	507	150	13	14	0	2
14.....	302	387	35	15	0	0	29.....	520	138	13	13	0	2
15.....	302	345	22	17	0	0	30.....	595	127	13	9	0	2
							31.....	.....	113	.....	5	0	.....

Monthly discharge of LaBonte Creek near LaBonte, Wyo., for the year ending Sept. 30, 1918.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
April.....	595	195	342	29,400
May.....	697	113	391	24,000
June.....	122	10	43.6	2,590
July.....	130	5	22.6	1,390
August.....	75	0	3.4	209
September.....	2	0	1.0	60
The period.....				48,700

NOTE.—Monthly means computed by engineers of the United States Geological Survey.

HORSESHOE CREEK NEAR GLENDO, WYO.

LOCATION.—Approximately in sec. 26, T. 29 N., R. 68 W., at Hauf's ranch, near mouth of creek, 4 miles southeast of Glendo, in Platte County.

DRAINAGE AREA.—203 square miles (measured on base map of Wyoming; scale, 1:500,000).

RECORDS AVAILABLE.—April 16, 1916, to September 2, 1918.

DIVERSIONS.—Prior to December 31, 1916, there were adjudicated diversions of 81 second-feet from Horseshoe Creek, all above the station.

COOPERATION.—Records of daily discharge furnished by United States Reclamation Service.

Daily discharge, in second-feet, of Horseshoe Creek near Glendo, Wyo., for the year ending Sept. 30, 1918.

Day.	Apr.	May.	June.	July.	Day.	Apr.	May.	June.	July.
1.....	27	217	93	2	16.....	148	217	127	.....
2.....	35	217	82	2	17.....	165	200	93	.....
3.....	35	237	72	2	18.....	165	165	82	.....
4.....	43	237	290	2	19.....	182	148	72	.....
5.....	52	237	165	2	20.....	182	133	62	.....
6.....	62	200	148	2	21.....	148	120	52	.....
7.....	82	217	148	2	22.....	148	107	43	.....
8.....	72	217	148	2	23.....	148	107	2	.....
9.....	82	257	133	.....	24.....	148	93	2	.....
10.....	82	257	133	.....	25.....	165	93	2	.....
11.....	133	237	133	.....	26.....	165	82	2	.....
12.....	133	237	133	.....	27.....	182	82	2	.....
13.....	142	237	127	.....	28.....	182	82	2	.....
14.....	142	217	127	.....	29.....	200	93	2	.....
15.....	148	217	127	.....	30.....	200	120	2	.....
					31.....		120		.....

NOTE.—No flow July 9 to Sept. 30.

Monthly discharge of Horseshoe Creek near Glendo, Wyo., for the year ending Sept. 30, 1918.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
April.....	200	27	127	7,560
May.....	257	82	174	10,700
June.....	290	2	86.9	5,170
July.....	2	0	0.5	31
August.....	0	0	0	0
September.....	0	0	0	0
The period.....				23,500

NOTE.—Monthly means computed by engineers of the United States Geological Survey.

COTTONWOOD CREEK NEAR WENDOVER, WYO.

LOCATION.—Approximately in sec. 16, T. 27 N., R. 67 W., near mouth of creek, 1½ miles south of Wendover, in Platte County.

DRAINAGE AREA.—150 miles (measured on base map of Wyoming; scale, 1:500,000).

RECORDS AVAILABLE.—April 19, 1916, to September 30, 1918.

DIVERSIONS.—Prior to December 31, 1916, there were adjudicated diversions of 31 second-feet from Cottonwood Creek, all above the station.

COOPERATION.—Records of daily discharge furnished by United States Reclamation Service.

Daily discharge, in second-feet, of Cottonwood Creek near Wendover, Wyo., for the year ending Sept. 30, 1918.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Day.	Apr.	May.	June.	July.	Aug.	Sept.
1.....	3	22	26	7	2	2	16.....	3	36	7	4	2	2
2.....	3	21	25	7	2	2	17.....	3	34	7	3	2	2
3.....	3	22	24	7	2	2	18.....	4	26	7	3	2	2
4.....	4	21	21	7	2	2	19.....	4	22	4	2	2	2
5.....	4	19	24	7	2	2	20.....	4	23	4	2	2	2
6.....	4	17	106	7	7	2	21.....	3	14	6	2	2	2
7.....	3	17	84	7	2	2	22.....	4	12	7	2	2	2
8.....	3	11	58	7	2	2	23.....	10	7	6	2	2	2
9.....	4	14	52	7	2	2	24.....	15	7	7	2	2	2
10.....	4	36	38	6	2	2	25.....	16	6	7	2	2	2
11.....	4	38	36	6	2	2	26.....	23	7	6	2	2	2
12.....	4	38	10	6	2	2	27.....	21	7	6	2	2	2
13.....	4	117	10	6	2	2	28.....	32	11	7	2	2	2
14.....	4	38	8	5	2	2	29.....	36	7	7	2	2	2
15.....	3	38	8	4	2	2	30.....	22	52	7	2	2	2
							31.....		38		2	2	.....

Monthly discharge of Cottonwood Creek near Wendover, Wyo., for the year ending Sept. 30, 1918.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
April.....	36	3	8.5	506
May.....	117	6	25.1	1,540
June.....	106	4	20.8	1,240
July.....	7	2	4.3	264
August.....	7	2	2.2	135
September.....	2	2	2.0	119
The period.....				3,800

NOTE.—Monthly means computed by engineers of the United States Geological Survey.

LARAMIE RIVER NEAR JELM, WYO.

LOCATION.—In sec. 15, T. 12 N., R. 77 W., at highway bridge at Boswell's ranch, a quarter of a mile below Colorado-Wyoming boundary line, 4 miles south of Jelm, in Albany County. Stuck Creek enters 1 mile above.

DRAINAGE AREA.—293 square miles (measured on base map of Wyoming; scale, 1: 500,000 map).

RECORDS AVAILABLE.—May 7, 1911, to September 30, 1918. From June 22, 1904, to October 31, 1905, a station was maintained at Decker's ranch, half a mile south of the State line. The records at the two stations are comparable, as 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; slightly shifting. Left bank is overflowed at gage height 3.0 feet. Flow passes through three well defined high-water channels.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 3.4 feet from June 11 to 14 (discharge, 1,790 second-feet); minimum discharge occurs during winter.

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

DIVERSIONS.—There are court decrees for diversions of 349 second-feet from Laramie River above station, and about 800 from tributaries. Of this amount 688 second-feet are for diversion into the Cache La Poudre drainage basin. During 1918 a total of 18,986 acre-feet were diverted into the Cache La Poudre between May 19 and November 9. Also a conditional decree for a diversion not exceeding 1,235 second-feet into the Cache La Poudre drainage basin through the Laramie-Poudre tunnel. During 1918 the tunnel diverted a total of 10,722 acre-feet.

REGULATION.—Diurnal fluctuation during spring, caused by alternate melting and freezing of mountain snow.

ACCURACY.—Stage-discharge relation practically permanent. Rating curve well-defined. Operation of water-stage recorder fairly satisfactory. Daily discharge ascertained by applying to rating table mean daily gage heights obtained by inspection of gage-height graph; shifting-control method used October 1 to November 19. Records good.

Discharge measurements of Laramie River near Jelm, Wyo., during the year ending Sept. 30, 1918.

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. 17	J. H. Baily.....	0.90	46.3	June 21	J. H. Baily.....	3.09	1,220
June 13	P. V. Hodges.....	3.42	1,830	July 25	R. G. Hosea.....	1.50	178

Daily discharge, in second-feet, of Laramie River near Jelm, Wyo., for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Apr.	May.	June.	July.	Aug.	Sept.
1.....	62	52	-----	95	1,000	315	112	46
2.....	62	62	-----	112	940	277	124	46
3.....	52	62	-----	137	1,120	259	124	67
4.....	52	62	-----	184	1,080	259	125	62
5.....	52	62	-----	245	1,060	241	127	62
6.....	52	52	-----	281	1,180	234	130	62
7.....	52	52	-----	319	1,390	259	134	46
8.....	52	52	-----	307	1,320	224	140	46
9.....	52	42	-----	355	1,480	241	130	80
10.....	52	52	-----	355	1,580	296	124	101
11.....	42	62	80	335	1,680	315	115	71
12.....	42	72	90	315	1,790	241	106	54
13.....	42	82	119	296	1,790	400	107	46
14.....	42	62	129	285	1,790	510	108	46
15.....	42	62	137	315	1,680	347	108	54
16.....	42	62	137	410	1,480	296	108	62
17.....	42	62	112	510	1,320	315	75	74
18.....	42	62	90	605	1,240	259	70	66
19.....	42	62	90	570	1,180	224	71	62
20.....	42	-----	90	656	1,390	208	71	60
21.....	42	-----	90	626	1,480	241	54	60
22.....	42	-----	90	648	1,320	234	54	62
23.....	33	-----	90	774	960	202	54	62
24.....	24	-----	90	1,010	910	178	62	62
25.....	24	-----	90	1,110	765	178	62	62
26.....	33	-----	90	1,170	570	150	62	62
27.....	33	-----	101	1,120	510	132	62	62
28.....	42	-----	90	1,190	400	132	54	62
29.....	42	-----	88	1,220	364	124	46	62
30.....	52	-----	86	1,280	335	112	46	62
31.....	52	-----	-----	1,180	-----	112	46	-----

NOTE.—No gage heights Apr. 19, 20, Aug. 4-18, Sept. 24-30; discharge determined from hydrograph for Laramie River near Woods.

Monthly discharge of Laramie River near Jelm, Wyo., for the year ending Sept. 30, 1918.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October.....	62	24	44.5	2,740
November 1-19.....	82	42	59.9	2,260
April 11-30.....	137	80	99.0	3,930
May.....	1,280	95	581	35,700
June.....	1,790	335	1,170	69,600
July.....	510	112	242	14,900
August.....	140	46	90.7	5,580
September.....	101	46	61.0	3,630

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, 1918. From 1895 to 1900 and from May 7 to November 11, 1911, a station was maintained at Woods Landing in sec. 11, T. 13 N., R. 77 W. The records are not directly comparable, as Fox Creek enters between and a few small ditches divert water.

GAGE.—Bristol water-stage recorder 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 in Pioneer canal is at Johnson bridge, $1\frac{1}{2}$ miles below intake; read by employee of Laramie Water Co.

DISCHARGE MEASUREMENTS.—Made from cable 2,000 feet above dam. Measurements of Pioneer canal made at Johnson Bridge and this quantity is subtracted from flow at cable to determine flow at diversion dam.

CHANNEL AND CONTROL.—Channel at gage is pool formed by concrete diversion dam about 2 feet high. Control is dam itself and is permanent. Banks high and not subject to overflow. Stage of zero flow is 0.0 foot. Channel in canal is composed of shale which changes somewhat; control at concrete drop, 1 mile downstream.

EXTREMES OF DISCHARGE.—(Laramie River). Maximum stage during year from water-stage recorder, 3.1 feet from 8 a. m. to 2 p. m. June 14 (discharge, 2,100 second-feet); minimum stage probably occurs during winter.

ICE.—Stage-discharge relation affected by ice when crest of dam is not kept free from ice; records discontinued during winter.

DIVERSIONS.—By decree of district court dated December 27, 1912, there were adjudicated diversions of about 10 second-feet from Laramie River between the State line and Pioneer dam, exclusive of 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. Operation of water-stage recorder satisfactory except for periods given in footnote to table of daily discharge. Daily discharge ascertained by applying to rating table mean daily gage height obtained by inspection of gage-height graph. Records good except for periods of missing gage heights, for which they are fair.

Canal station: Gage-height record so fragmentary that, although rating curve is well-defined, the discharge record can only be considered roughly approximate.

Discharge measurements of Laramie River near Woods, Wyo., during the year ending Sept. 30, 1918.

[Made by P. V. Hodges.]

Date.	Gage height.	Discharge.
	<i>Feet.</i>	<i>Sec.-ft.</i>
June 13.....	3.00	1,980
Sept. 12.....	.33	65

Daily discharge, in second-feet, of Laramie River near Woods, Wyo., for the year ending Sept. 30, 1918.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1		99	118	1,290	279	68	60
2		87	138	1,080	217	81	60
3		78	185	1,120	213	68	58
4		76	263	1,120	213	73	58
5		76	352	1,200	203	81	60
6		68	441	1,290	185	85	62
7		63	560	1,470	194	89	64
8		63	560	1,560	185	93	66
9		68	640	1,650	169	84	68
10		96	600	1,650	213	76	70
11		96	537	1,830	279	67	66
12		118	477	1,920	217	58	63
13		138	441	1,920	333	58	65
14		153	492	1,920	530	59	70
15		145	600	1,830	284	60	72
16		118	800	1,650	231	60	75
17		118	880	1,470	308	33	75
18		105	960	1,470	302	42	75
19		96	920	1,290	247	28	75
20		96	1,000	1,380	213	28	78
21		93	1,040	1,470	181	28	78
22		90	1,080	1,560	173	25	78
23		105	1,200	1,160	165	22	80
24		111	1,380	1,120	135	18	80
25	108	118	1,470	920	135	15	80
26	111	120	1,470	720	169	15	80
27	118	125	1,380	560	102	18	80
28	90	120	1,380	499	145	22	81
29	90	111	1,470	392	81	24	76
30	99	105	1,470	333	73	26	68
31	105		1,380		76	28	

NOTE.—No gage heights Apr. 21, Aug. 6, 7, 9, 11, 13-15, 20, 22-24, 27, 29, 30, Sept. 1-11, 13-27; discharge determined from hydrograph for Laramie River near Jeim.

Monthly discharge of Laramie River near Woods, Wyo., for the year ending Sept. 30, 1918.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
March 25-31	118	90	103	1,430
April	153	63	102	6,070
May	1,470	118	829	51,000
June	1,920	333	1,290	76,800
July	530	73	208	12,800
August	93	15	49.4	3,040
September	81	58	70.7	4,210
The period				155,000

Discharge measurements of Pioneer canal near Woods, Wyo., during the year ending Sept. 30, 1918.

Date.	Made by—	Gage height.	Dis-charge.	Date.	Made by—	Gage height.	Dis-charge.
June 13	P. V. Hodges	<i>Feet.</i>	<i>Sec.-ft.</i>	Aug. 21	Robert Follansbee	<i>Feet.</i>	<i>Sec.-ft.</i>
July 17	do.	0.76	11.4	Sept. 12	P. V. Hodges	.47	33.7
	do.	2.55	190				21.9

^a Leakage through gates.

Daily discharge, in second-feet, of Pioneer canal near Woods, Wyo., for the year ending Sept. 30, 1918.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1		4	5	60	80	29	2
2		4	5	60	64	29	2
3		4	5	80	64	29	2
4		4	5	95	64	29	2
5		4	5	95	56	23	2
6		4	5	95	54	16	2
7		4	5	95	54	16	2
8		4	5	95	52	16	2
9		4	5	95	48	16	2
10		4	5	95	48	21	2
11		4	5	95	48	28	2
12		4	5	95	44	28	2
13		4	5	95	37	27	2
14		4	5	95	37	27	2
15		4	5	95	37	27	2
16		4	5	95	27	26	2
17		4	5	95	12	26	2
18		4	5	95	13	27	2
19		4	5	95	13	28	2
20		4	5	95	13	31	2
21		4	48	95	13	34	2
22		4	48	95	29	35	2
23		4	48	95	29	35	2
24		4	48	95	29	35	2
25	4	4	48	95	29	35	2
26	4	4	60	95	29	36	2
27	4	4	60	95	29	36	2
28	4	4	60	95	29	35	2
29	4	4	60	95	29	35	2
30	4	4	60	95	29	35	2
31	4		60		29	36	

NOTE.—Gage read July 4-8, 12, 16, 17, 20; Aug. 4, 5, 8, 10, 12, 16, 17, 21, 26, 28, 31. Discharge Mar. 25 to May 20, Sept. 1-30 represents leakage, as gates were closed. Discharge for the other periods when gage was not read based on information relative to change of head gates, as supplied by Laramie Water Co.

Monthly discharge of Pioneer canal near Woods, Wyo., for the year ending Sept. 30, 1918.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
March 25-31	4	4	4.5	56
April	4	4	4.0	238
May	60	5	22.6	1,390
June	95	60	92.2	5,490
July	80	12	37.7	2,320
August	36	16	28.6	1,760
September	2	2	2.0	119
The period				11,400

Combined monthly discharge of Laramie River and Pioneer canal near Woods, Wyo., for the year ending Sept. 30, 1918.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
March 25-31.....	122	94	107	1,490
April.....	157	67	106	6,310
May.....	1,530	123	851	52,300
June.....	2,020	428	1,390	82,700
July.....	567	102	246	15,100
August.....	110	50	78.0	4,800
September.....	83	60	72.7	4,330
The period.....				167,000

LARAMIE RIVER AT TWO RIVERS, WYO.

LOCATION.—In sec. 5, T. 17 N., R. 74 W., at highway bridge at Two Rivers, Albany County. Nearest tributary, Little Laramie River, enters a quarter of a mile below.

DRAINAGE AREA.—1,290 square miles (measured on base map of Wyoming; scale, 1: 500,000).

RECORDS AVAILABLE.—May 6, 1911, to October 31, 1912; October 1, 1913, to September 30, 1918. Station maintained by State engineer during 1913 and 1914.

GAGE.—Bristol water-stage recorder on left bank just above bridge. Gage used since 1915 was referred to datum 0.74 foot higher than that of 1912. Gage on left bank 400 feet above bridge used during 1913 and 1914.

DISCHARGE MEASUREMENTS.—Made from bridge or by wading.

CHANNEL AND CONTROL.—Bed composed of sand and gravel, and is shifting. Control not well defined. Banks high and not subject to overflow.

EXTREMES OF DISCHARGE.—Maximum stage from water-stage recorder, 5.4 feet from 5 to 7 p. m. June 16 (discharge, 1,850 second-feet); minimum probably occurs during winter.

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

DIVERSIONS.—By decree of district court dated December 27, 1912, there were adjudicated diversions of 414 second-feet from Laramie River between this and the station near Woods.

REGULATION.—None.

ACCURACY.—Stage-discharge relation not permanent. Standard rating curve used October 1 to June 17 fairly well defined; rating curve used June 18 to September 30 well defined below 1,000 second-feet but somewhat uncertain above. Operation of water-stage recorder fairly satisfactory until July 31; gage read to hundredths occasionally after that date. Daily discharge obtained by applying to rating table mean daily gage height determined by inspection of gage-height graph; shifting-control method used April 13 to May 31. Records fair.

Discharge measurements of Laramie River at Two Rivers, Wyo., during the year ending Sept. 30, 1918.

[Made by P. V. Hodges.]

Date.	Gage height.	Dis-charge.	Date.	Gage height.	Dis-charge.
	<i>Feet.</i>	<i>Sec.-ft.</i>		<i>Feet.</i>	<i>Sec.-ft.</i>
Apr. 13.....	1.65	164	July 18.....	2.47	320
June 12.....	4.95	1 250	Sept. 11.....	.96	25.6
July 18.....	2.50	314			

Daily discharge, in second-feet, of Laramie River, at Two Rivers, Wyo., for the year ending Sept. 30, 1918.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Day.	Apr.	May.	June.	July.	Aug.	Sept.
1.....		178	1,180	320	90	29	16.....	217	414	1,850	356	48	27
2.....		173	1,180	282	89	29	17.....	206	414	1,740	338	46	27
3.....		168	1,060	246	88	29	18.....	174	479	1,650	320	45	27
4.....		178	899	238	86	29	19.....	145	512	1,510	346	44	25
5.....		199	899	232	85	29	20.....	217	548	1,310	307	42	23
6.....		244	899	225	84	29	21.....	210	530	1,250	258	40	22
7.....		294	950	218	82	29	22.....	188	566	1,310	234	39	21
8.....		367	1,000	212	81	29	23.....	178	604	1,310	234	38	22
9.....		414	1,060	206	75	29	24.....	178	644	1,370	211	36	23
10.....		446	1,120	200	70	28	25.....	178	686	1,250	190	34	24
11.....		512	1,180	211	65	26	26.....	188	776	900	179	33	25
12.....		512	1,240	246	60	25	27.....	188	874	750	169	32	26
13.....	164	479	1,570	270	57	26	28.....	199	924	618	139	30	26
14.....	174	446	1,710	307	54	26	29.....	199	978	436	119	29	26
15.....	195	414	1,780	374	51	26	30.....	188	1,090	346	119	29	27
							31.....		1,150		100	29	.....

NOTE.—No gage heights July 4-9, 16, 17, Aug. 2-7, 9-14, 16-21, 23-28, 30, Sept. 1, 3-8, 10, 13-15, 17, 19-21, 23-25, 27-29; discharge interpolated. Stage-discharge relation affected by backwater from Little Laramie River June 9-12, 22, 23; maximum effect estimated at 0.4 foot.

Monthly discharge of Laramie River at Two Rivers, Wyo., for the year ending Sept. 30, 1918.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
April 13-30.....	217	145	188	6,710
May.....	1,150	168	523	32,200
June.....	1,850	346	1,180	70,200
July.....	374	100	239	14,700
August.....	90	29	55.2	3,390
September.....	29	21	26.3	1,560
The period.....				129,000

LARAMIE RIVER AT FORT LARAMIE, WYO.

LOCATION.—At highway bridge in sec. 28, T. 26 N., R. 64 W., at Fort Laramie, in Goshen County. No 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 map).

RECORDS AVAILABLE.—April 4, 1915, to September 30, 1918.

GAGE.—Vertical staff.

DISCHARGE MEASUREMENTS.—Made from highway bridge.

CHANNEL AND CONTROL.—No data.

EXTREMES OF DISCHARGE.—Data not available.

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

DIVERSIONS.—By decree of district court dated December 27, 1912, there were adjudicated diversions of 61 second-feet between station below McGill and Fort Laramie.

REGULATION.—See Laramie River below McGill (U. S. Geol. Survey Water-Supply Paper 456).

COOPERATION.—Records of daily discharge furnished by United States Reclamation Service.

Daily discharge, in second-feet, of Laramie River at Fort Laramie, Wyo., for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Dec.	Apr.	May.	June.	July.	Aug.	Sept.
1.....	96	118	155	245	310	360	420	155	99
2.....	69	130	155	270	310	555	375	145	96
3.....	56	130	150	300	320	825	280	135	99
4.....	53	130	150	360	338	800	220	155	96
5.....	53	148	150	360	360	280	190	159	106
6.....	50	148	148	350	395	295	185	155	105
7.....	50	148	148	310	400	310	180	165	105
8.....	50	140	148	280	425	555	165	175	105
9.....	50	140	155	280	448	650	225	157	100
10.....	47	140	155	275	470	760	275	165	98
11.....	50	148	165	270	465	648	265	161	111
12.....	43	148	165	285	395	685	230	163	111
13.....	64	140	196	295	395	685	235	165	111
14.....	64	148	220	350	500	835	525	155	90
15.....	75	148	220	340	710	1,050	215	161	90
16.....	53	148	200	345	685	1,210	285	215	105
17.....	43	148	165	340	650	1,450	350	195	105
18.....	53	140	150	295	645	1,390	310	185	105
19.....	69	140	150	275	615	1,450	290	180	105
20.....	78	140	175	260	555	1,570	280	155	105
21.....	72	148	208	260	525	1,640	255	145	105
22.....	75	148	175	265	400	1,500	245	145	105
23.....	75	148	150	270	375	1,390	230	143	105
24.....	92	140	150	310	335	1,450	205	155	105
25.....	96	155	155	320	335	1,640	175	135	105
26.....	96	160	100	330	295	1,500	165	125	100
27.....	108	200	200	335	280	1,430	165	145	100
28.....	108	216	216	338	280	1,260	155	145	98
29.....	118	216	216	340	310	800	161	125	99
30.....	114	180	175	330	335	585	165	105	100
31.....	114	.....	150	.....	375	.....	155	125	.....

Monthly discharge of Laramie River at Fort Laramie, Wyo., for the year ending Sept. 30, 1918.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October.....	118	43	72.1	4,430
November.....	216	118	151	8,980
December.....	220	148	168	10,300
April.....	360	245	306	18,200
May.....	710	280	427	26,300
June.....	1,640	280	986	58,700
July.....	525	155	244	15,000
August.....	215	105	155	9,530
September.....	111	90	102	6,070

NOTE.—Monthly means computed by engineers of the United States Geological Survey.

LITTLE LARAMIE RIVER NEAR FILMORE, WYO.

LOCATION.—In sec. 9, T. 15 N., R. 77 W., at private bridge at May's ranch, $1\frac{1}{2}$ miles south of Filmore, in Albany County. No large tributary between station and junction of North, Middle, and South forks, 4 miles above.

DRAINAGE AREA.—155 square miles (measured on base map of Wyoming; scale, 1: 500,000).

RECORDS AVAILABLE.—July 5, 1902, to August 15, 1903; May 14, 1911, to October 31, 1912; April 1, 1915, to September 30, 1918. State engineer maintained station at this point during 1913 and 1914.

GAZE.—Vertical staff on downstream side of left bridge abutment; read by Claude May. Gage used since April 1, 1915, was referred to datum 0.21 foot lower than gage at same location used during 1911 and 1912.

DISCHARGE MEASUREMENTS.—Made from single-span bridge or by wading.

CHANNEL AND CONTROL.—Bed composed of coarse gravel and small boulders, which shifted during 1918. Control not well defined. During high water there is flow through channel around right end of bridge.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 4.85 feet at 7 a. m. June 14 (discharge, 1,920 second-feet); minimum stage probably occurs during winter.

ICE.—State-discharge relation seriously affected by ice; observation discontinued during winter.

DIVERSIONS.—Prior to December 31, 1916, there were adjudicated diversions of 43 second feet from the Little Laramie above station, and 255 second-feet from tributaries entering above.

REGULATION.—None.

ACCURACY.—Stage-discharge relation not permanent. Standard rating curve well-defined. Gage read to hundredths twice daily. Daily discharge obtained by applying mean daily gage height to rating table; shifting-control method used. Records fair.

Discharge measurements of Little Laramie River near Filmore, Wyo., during the year ending Sept. 30, 1918.

[Made by P. V. Hodges.]

Date.	Gage height.	Discharge.
	Feet.	Sec.-ft.
June 12.....	4.32	1,480
Sept. 12.....	.88	37.8

Daily discharge, in second-feet, of Little Laramie River near Filmore, Wyo., for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Dec.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1.....	28	45	31		55	56	496	285	87	29
2.....	28	45			46	66	445	268	94	53
3.....	28	45			32	77	470	268	102	62
4.....	28	45			31	97	517	268	86	54
5.....	28	45			29	114	686	268	87	62
6.....	28	42			28	123	746	268	87	51
7.....	28	40			42	150	930	436	86	48
8.....	28	39			45	140	1,140	236	77	53
9.....	28	38			62	159	1,300	236	72	50
10.....	28	39			66	148	1,370	236	72	48
11.....	28	36			53	148	1,480	285	71	45
12.....	28	33			63	126	1,480	268	72	39
13.....	28	39			63	117	1,560	285	75	38
14.....	28	35			93	117	1,560	323	71	38
15.....	28	38			60	134	1,480	221	68	48
16.....	28	41			38	177	1,600	221	68	52
17.....	28	46			44	177	1,440	221	48	44
18.....	33	37			34	187	1,370	208	45	39
19.....	35	38			40	163	1,220	194	43	36
20.....	36	39			38	199	1,300	194	46	37
21.....	36	35			56	210	1,330	170	41	32
22.....	36	36			57	210	1,410	159	40	33
23.....	36	36			56	239	1,410	148	37	35
24.....	35	33		70	62	268	1,040	138	38	31
25.....	32	32		79	63	304	898	128	31	48
26.....	32	31		79	63	323	594	119	31	48
27.....	32	29		72	68	353	460	110	33	48
28.....	32	29		66	60	481	411	110	31	48
29.....	34	30		70	53	561	358	94	29	48
30.....	40	34		67	53	611	285	87	29	38
31.....	45			55		611		87	29	

Monthly discharge of Little Laramie River near Filmore, Wyo., for the year ending Sept. 30, 1918.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October.....	45	28	31.3	1,920
November.....	46	29	37.7	2,240
March 24-31.....	79	55	69.8	1,110
April.....	93	28	51.8	3,080
May.....	611	56	222	13,600
June.....	1,600	285	1,030	61,300
July.....	436	87	211	13,000
August.....	102	29	58.9	3,620
September.....	62	29	44.5	2,650

LITTLE LARAMIE RIVER AT TWO RIVERS, WYO.

LOCATION.—On line between secs. 5 and 6, T. 17 N., R. 74 W., at highway bridge half a mile south of Two Rivers, Albany County. No tributary between station and mouth, half a mile below.

DRAINAGE AREA.—310 square miles (measured on base map of Wyoming; scale, 1:500,000).

RECORDS AVAILABLE.—May 6, 1911, to October 31, 1912; October 1, 1913, to September 30, 1918. State engineer maintained station at this point during 1913 and 1914.

GAGE.—Bristol water-stage recorder at bridge. Gage used during 1913 and 1914 was 400 feet downstream and referred to different datum.

DISCHARGE MEASUREMENTS.—Made from bridge or by wading.

CHANNEL AND CONTROL.—Bed composed of sand and gravel which is fairly permanent. Control not well-defined. Banks not subject to overflow, except during extremely high water.

EXTREMES OF DISCHARGE.—Maximum stage during year from water-stage recorder, 5.7 feet during afternoon of June 16 (discharge 1,240 second-feet); minimum stage, 1.88 feet on August 30 and 31 (discharge, 0.6 second-feet).

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

DIVERSIONS.—Prior to December 31, 1916, there were adjudicated diversions from Little Laramie River of 422 second-feet between station near Filmore and this station; none below station.

REGULATION.—None.

ACCURACY.—Stage-discharge relation not permanent. Standard rating curve well-defined. Operation of water-stage recorder satisfactory. Daily discharge ascertained by applying to rating table mean daily gage height obtained from inspection of gage-height graph; shifting-control method used for entire period. Records fair.

Discharge measurements of Little Laramie River at Two Rivers, Wyo., during the year ending Sept. 30, 1918.

[Made by P. V. Hodges.]

Date.	Gage height.	Dis-charge.	Date.	Gage height.	Dis-charge.
	<i>Feet.</i>	<i>Sec.-ft.</i>		<i>Feet.</i>	<i>Sec.-ft.</i>
Apr. 13.....	2.48	70	July 18.....	2.88	79
June 12.....	5.50	1,160	Sept. 11.....	2.20	4.5

Daily discharge, in second-feet, of Little Laramie River at Two Rivers, Wyo., for the year ending Sept. 30, 1918.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Day.	Apr.	May.	June.	July.	Aug.	Sept.
1.....		47	302	138	25	0.8	16.....	91	37	1,240	84	15	3.6
2.....		45	251	112	23	.8	17.....	55	34	1,240	84	16	4.6
3.....		41	150	98	22	3.6	18.....	37	31	1,220	84	12	4.6
4.....		40	148	105	22	4.2	19.....	45	33	1,220	84	10	4.2
5.....		41	204	105	21	3.6	20.....	78	34	1,140	72	7.3	3.6
6.....		45	268	91	20	3.8	21.....	91	34	1,090	66	6.0	3.4
7.....		44	380	84	20	4.0	22.....	78	33	1,190	66	5.0	3.4
8.....		50	638	66	20	4.2	23.....	68	33	1,160	66	3.8	3.4
9.....		54	813	60	19	4.4	24.....	60	39	1,120	66	3.2	3.2
10.....		56	925	78	17	4.6	25.....	60	39	915	60	2.6	3.6
11.....		70	1,030	120	16	4.6	26.....	60	34	660	55	1.9	4.6
12.....		84	1,140	105	16	4.6	27.....	65	39	548	45	1.4	5.2
13.....		72	66	1,140	98	16	28.....	72	48	420	36	1.1	5.6
14.....		84	52	1,160	120	15	29.....	63	78	268	33	1.0	5.6
15.....	120	42	1,220	105	14	3.2	30.....	53	138	204	31	.6	5.2
							31.....		219		28	.6	.....

NOTE.—No gage heights June 10, 11, Sept. 6-10; discharge interpolated.

Monthly discharge of Little Laramie River at Two Rivers, Wyo., for the year ending Sept. 30, 1918.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
April 13-30.....	120	37	69.6	2,480
May.....	219	31	54.2	3,330
June.....	1,240	148	780.	46,400
July.....	138	28	78.9	4,850
August.....	25	.6	12.0	738
September.....	5.6	.8	3.93	234
The period.....				58,000

NORTH LARAMIE RIVER NEAR WHEATLAND, WYO.

LOCATION.—In sec. 2, T. 25 N., R. 70 W., a quarter of a mile above head gate of North Laramie Land Co.'s ditch and 18 miles northwest of Wheatland, Platte County. No important tributary within 10 miles of station.

DRAINAGE AREA.—366 square miles (measured on base map of Wyoming; scale, 1:500,000).

RECORDS AVAILABLE.—November 6, 1914, to September 30, 1918.

GAGE.—Stevens water-stage recorder installed March 7, 1918, and referred to original staff gage; located at left bank on vertical cliff just below proposed dam site.

DISCHARGE MEASUREMENTS.—Made from cable near gage or by wading.

CHANNEL AND CONTROL.—Bed composed of sand and gravel. Control located 40 feet downstream at rapids, which were permanent during 1918.

EXTREMES OF DISCHARGE.—Maximum stage during year from water-stage recorder, 3.05 feet at noon May 9 (discharge, 592 second-feet); minimum stage, 0.38 foot at 10 a. m. August 22 (discharge, 0.4 second-foot).

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

DIVERSIONS.—Prior to December 31, 1916, there were adjudicated diversions of 37 second-feet from North Laramie River, above the station, and 27 second-feet below.

REGULATION.—None.

ACCURACY.—Stage-discharge relation practically permanent during the year. Rating curve well defined. 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 excellent.

Discharge measurements of North Laramie River near Wheatland, Wyo., during the year ending Sept. 30, 1918.

Date.	Made by—	Gage height.	Dis-charge.	Date.	Made by—	Gage height.	Dis-charge.
Mar. 8	P. V. Hodges.....	<i>Feet.</i> 1.04	<i>Sec.-ft.</i> 28.2	July 3	P. V. Hodges.....	<i>Feet.</i> 0.90	<i>Sec.-ft.</i> 13.4
24	"do.....	1.82	142	Sept. 22	J. B. Spiegel.....	.80	6.8

Daily discharge, in second-feet, of North Laramie River near Wheatland, Wyo., for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Dec.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1.....	17	20	20	-----	100	190	153	18	10	2.4
2.....	17	23	23	-----	103	215	141	16	10	2.5
3.....	16	23	23	-----	87	260	115	14	8.4	3.8
4.....	16	23	20	-----	82	322	103	13	7.0	7.0
5.....	20	23	20	-----	62	400	103	12	6.6	6.2
6.....	20	23	20	-----	60	465	95	11	7.0	6.2
7.....	20	23	20	-----	60	488	92	11	8.4	5.8
8.....	20	23	-----	26	57	465	90	11	25.0	5.8
9.....	20	23	-----	-----	68	488	87	15	20.0	6.2
10.....	20	23	-----	-----	82	400	78	17	13.0	7.0
11.....	16	23	-----	-----	108	360	68	18	9.1	6.6
12.....	16	22	-----	-----	141	340	62	22	8.4	5.8
13.....	16	22	-----	-----	202	290	56	16	5.4	5.0
14.....	16	22	-----	-----	190	260	54	14	5.0	9.8
15.....	16	23	-----	-----	202	260	50	13	6.5	13
16.....	16	23	-----	-----	141	245	43	14	8.0	10
17.....	16	23	-----	-----	118	215	43	17	9.5	9.8
18.....	20	22	-----	-----	113	230	39	19	11	8.4
19.....	23	20	-----	-----	93	215	41	22	12	7.7
20.....	23	20	-----	-----	98	190	42	24	14	7.7
21.....	23	20	-----	-----	130	178	51	27	3.8	7.0
22.....	20	20	-----	-----	178	178	53	29	.6	7.0
23.....	20	20	-----	-----	190	165	46	31	1.5	7.0
24.....	23	20	-----	126	165	153	43	26	2.5	7.0
25.....	23	23	-----	112	178	153	37	19	3.4	7.0
26.....	23	23	-----	115	245	153	33	28	2.1	7.0
27.....	23	23	-----	115	275	163	28	22	2.3	7.0
28.....	20	22	-----	90	215	176	23	30	2.6	7.0
29.....	20	23	-----	81	190	190	20	22	2.7	7.0
30.....	20	20	-----	78	190	165	19	15	2.5	7.0
31.....	20	-----	-----	89	-----	141	-----	13	2.6	-----

NOTE.—Gage not read Oct. 18, Nov. 3-8, May 28, July 17-22, Aug. 15-19, Sept. 26-30; discharge interpolated.

Monthly discharge of North Laramie River near Wheatland, Wyo., for the year ending Sept. 30, 1918.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October.....	23	16	19.3	1,190
November.....	23	20	22.0	1,310
December 1-7.....	23	20	20.9	290
March 24-31.....	126	78	101	1,600
April.....	275	57	137	8,150
May.....	488	141	162	16,100
June.....	153	19	63.6	3,780
July.....	31	11	18.7	1,150
August.....	25	.6	7.45	458
September.....	13	2.4	6.89	410

CHUGWATER CREEK AT CHUGWATER, WYO.

LOCATION.—In sec. 31, T. 21 N., R. 66 W., 300 feet above highway bridge half a mile from railroad station at Chugwater, 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, 1918. State engineer maintained station at this point during 1913 and 1914.

GAGE.—Chain gage on left bank 300 feet above bridge, installed April 6, 1916, at same datum and location as vertical staff used previously; read by Artie Allen and Carl Nulle. Prior to February 6, 1912, gage was on bridge and referred to different datum.

DISCHARGE MEASUREMENTS.—Made from single-span bridge or by wading.

CHANNEL AND CONTROL.—Channel composed of sand which shifted considerably during 1918; no well-defined control. Banks high and not subject to overflow.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 3.6 feet at 12:30 p. m. July 23 (discharge, 240 second-feet); minimum discharge, 10 second-feet on September 1.

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

DIVERSIONS.—Prior to December 31, 1916, there were adjudicated diversions from Chugwater Creek of 73 second-feet above station, and 98 second-feet below.

REGULATION.—None.

ACCURACY.—Stage-discharge relation not permanent. Rating curve used October 1 to June 7 not well defined; curve used June 25 to September 30 well defined. Gage read to hundredths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table. Records good except for periods of shifting control and ice, for which they are fair.

Discharge measurements of Chugwater Creek at Chugwater, Wyo., during the year ending Sept. 30, 1918.

Date.	Made by—	Gage height.	Dis-charge.	Date.	Made by—	Gage height.	Dis-charge.
Mar. 9	P. V. Hodges.....	<i>Feet.</i> 1.38	<i>Sec.-ft.</i> 30.7	Sept. 6	J. B. Spiegel.....	<i>Feet.</i> 1.19	<i>Sec.-ft.</i> 12.1
July 3	do.....	1.49	22.3	6	do.....	1.19	12.5

Daily discharge, in second-feet, of Chugwater Creek at Chugwater, Wyo., for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1.....	16	26	29	23	15	15	74	74	33	28	10	10
2.....	17	25	30	30	20	18	70	70	31	26	10	10
3.....	20	27	24	23	25	26	70	65	30	22	10	12
4.....	15	23	23	24	22	32	74	65	31	21	10	13
5.....	16	27	25	24	21	32	74	65	30	19	30	14
6.....	16	33	25	26	25	26	74	70	27	18	15	12
7.....	16	21	18	30	20	29	70	65	33	16	15	12
8.....	17	21	15	28	19	31	70	56	176	13	15	12
9.....	16	22	15	23	20	31	70	47	86	11	14	12
10.....	16	25	14	20	25	30	70	47	63	20	13	13
11.....	16	25	14	15	27	30	70	56	45	39	13	13
12.....	15	24	14	14	26	31	78	65	42	15	13	12
13.....	16	20	14	14	21	30	93	65	36	13	13	11
14.....	16	27	14	14	20	30	93	60	31	12	14	11
15.....	16	26	14	14	17	34	108	60	28	12	83	12
16.....	15	24	29	14	21	33	103	56	135	14	28	13
17.....	16	26	23	14	18	32.	93	43	70	10	23	12
18.....	16	23	24	16	16	33	88	30	47	12	19	12
19.....	17	28	36	16	16	32	88	25	35	12	16	12
20.....	18	27	23	16	14	33	78	24	208	13	16	12
21.....	21	31	18	18	18	33	78	22	165	13	16	12
22.....	21	28	30	18	22	33	74	24	60	13	16	11
23.....	21	23	23	18	28	36	74	27	108	45	15	11
24.....	23	30	27	18	26	38	74	27	130	104	15	13
25.....	18	23	24	18	18	46	70	25	60	45	14	14
26.....	16	30	18	20	14	56	70	26	46	16	14	14
27.....	16	23	29	18	20	60	74	28	42	15	13	13
28.....	16	29	25	18	18	65	83	28	36	14	13	12
29.....	15	23	23	16	.....	70	83	30	33	13	12	12
30.....	21	30	24	16	.....	74	78	30	30	12	11	13
31.....	23	.....	24	14	.....	74	.....	37	.....	11	10	.....

NOTE.—Stage-discharge relation affected by ice Dec. 8-14, Jan. 10-31, Feb. 1, 2, 17-23; discharge determined from temperature records and observer's notes. Shifting-control method used June 8-25.

Monthly discharge of Chugwater Creek at Chugwater, Wyo., for the year ending Sept. 30, 1918.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October.....	23	15	17.3	1,060
November.....	33	20	25.7	1,530
December.....	36	14	22.2	1,360
January.....	30	14	19.0	1,170
February.....	28	14	20.4	1,130
March.....	74	15	37.8	2,320
April.....	108	70	78.9	4,690
May.....	74	22	45.5	2,800
June.....	208	27	64.2	3,820
July.....	104	10	20.9	1,290
August.....	83	10	17.1	1,050
September.....	14	10	12.2	726
The year.....	208	10	31.7	22,900

HORSE CREEK NEAR LAGRANGE, 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 Laramie, 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, 1918. From December 1, 1911, to December 31, 1912, fragmentary records are available 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 which may shift. Control is just below station at small rapids which shifts between narrow limits.

EXTREMES OF DISCHARGE.—Maximum stage during year from water-stage recorder, 3.3 feet at 9 p. m. June 22 (discharge, 366 second-feet); minimum discharge, 9 second-feet December 9-12.

ICE.—Stage-discharge relation not seriously affected by ice except during short periods snow blowing in creek frequently blocks it temporarily.

DIVERSIONS.—Prior to December 31, 1916, there were adjudicated permits for diversions of 1,163 second-feet from Horse Creek above station, and 71 second-feet below. In addition, there were permits for 2,067 acre-feet storage above and 5,202 acre-feet below station.

REGULATION.—None.

ACCURACY.—Stage-discharge relation not permanent but shifted slightly during year; affected by ice December 9 to February 3. Rating curves well defined; one used October 1 to February 17 and the other March 1 to September 30. 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 excellent except for periods of shifting control and ice, for which they are fair.

The following discharge measurement was made by P. V. Hodges.
March 9, 1918: Gage height, 1.59 feet; discharge, 69 second-feet.

Daily discharge, in second-feet, of Horse Creek near Lagrange, Wyo., for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1.....	38	41	12	25	25	71	48	35	24	15	20	38
2.....	38	43	11	25	37	74	50	33	22	14	23	39
3.....	37	43	11	25	39	81	50	28	20	14	36	42
4.....	37	43	11	25	41	80	48	27	19	15	41	43
5.....	37	41	11	22	48	77	54	27	18	14	35	43
6.....	38	38	11	22	54	71	54	26	18	14	28	46
7.....	38	22	11	22	60	74	58	26	15	15	30	50
8.....	39	21	12	22	61	71	57	24	35	14	31	49
9.....	40	21	9	19	50	68	54	25	33	14	32	48
10.....	41	18	9	11	57	63	49	23	111	15	32	47
11.....	41	17	9	14	60	63	45	23	75	15	32	46
12.....	42	17	9	16	66	62	42	23	57	15	32	45
13.....	42	16	11	16	70	62	40	18	42	15	32	42
14.....	41	15	16	16	70	66	42	18	28	14	32	41
15.....	41	16	19	19	48	71	46	17	14	19	32	41
16.....	41	16	19	22	43	73	42	16	12	21	40	46
17.....	41	17	19	22	43	71	42	16	11	29	60	46
18.....	43	15	19	22	52	69	42	16	11	40	58	44
19.....	42	14	19	16	62	67	47	15	12	43	54	42
20.....	42	14	19	19	57	66	46	12	27	50	58	42
21.....	42	14	19	16	38	63	50	11	27	73	49	42
22.....	42	14	19	16	37	58	55	12	114	51	47	43
23.....	41	13	19	19	69	50	56	14	42	43	47	42
24.....	43	14	14	22	92	52	56	16	27	58	46	42
25.....	46	12	14	22	89	54	50	20	17	60	46	49
26.....	45	12	16	22	73	54	40	20	16	54	46	58
27.....	45	11	19	19	71	54	43	20	18	50	43	55
28.....	44	12	22	16	63	52	44	21	17	46	42	50
29.....	39	12	22	16	.....	54	42	22	16	45	39	48
30.....	42	12	22	16	.....	50	38	22	15	33	38	47
31.....	46	.....	25	19	.....	47	.....	26	.....	21	38	.....

NOTE.—Stage-discharge relation affected by ice Dec. 9 to Feb. 3; discharge determined from gage height and temperature records and observer's notes. No gage heights Aug. 11-18; discharge determined from hydrograph for Chugwater Creek at Chugwater. Shifting control method used Feb. 18-28.

Monthly discharge of Horse Creek near Lagrange, Wyo., for the year ending Sept. 30, 1918.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October.....	46	37	41.1	2,530
November.....	44	11	20.6	1,230
December.....	25	9	15.4	947
January.....	25	11	19.5	1,200
February.....	92	25	56.2	3,120
March.....	81	47	64.1	3,940
April.....	58	38	47.7	2,840
May.....	35	11	21.0	1,290
June.....	114	11	30.4	1,810
July.....	73	14	30.3	1,860
August.....	60	20	39.3	2,420
September.....	58	38	45.2	2,690
The year.....	114	9	35.7	25,900

SOUTH PLATTE RIVER AT SOUTH PLATTE, COLO.

LOCATION.—In sec. 25, T. 7 S., R. 70 W., 375 feet below North Fork of South Platte, 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, 1918. 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 375 feet below forks; in use since March 14, 1910. From March 28, 1902, to May 7, 1905, the gage was at the highway bridge. On May 7, 1905, gage was moved to its present site, 150 feet below bridge. Datum of new gage probably somewhat different. Recording gage is referred to datum of gage established in 1905.

DISCHARGE MEASUREMENTS.—Made from cable near gage or by wading.

CHANNEL AND CONTROL.—Bed composed of coarse sand and fine gravel; shifts. Control 35 feet downstream at well-defined rapids; shifts considerably at times. Banks high and not subject to overflow.

ICE.—Stage-discharge relation seriously affected by ice; monthly mean discharge estimated from records obtained a few miles below by Denver Union Water Co.

EXTREMES OF DISCHARGE.—Maximum stage during year from water-stage recorder, 6.9 feet from 4 to 6 a. m. June 24 (discharge, 3,000 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 which passes the gage before being diverted. 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 20 miles above the forks, respectively.

ACCURACY.—Stage-discharge relation not permanent but shifted during winter; affected by ice December 1 to March 4. Rating curve used October 1 to May 23 well defined; rating curve used May 24 to September 30 well defined. Operation of water-stage recorder fairly satisfactory except during latter part of September. Daily discharge ascertained by applying mean daily gage height obtained from inspection of gage-height graph to rating table. Records good except during winter, for which they are fair.

Discharge measurements of South Platte River at South Platte, Colo., during the year ending Sept. 30, 1918.

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. 7	Robert Follansbee.....	1.38	96	May 27	S. B. Soule.....	3.28	715
7	do.....	1.42	95	June 7	P. V. Hodges.....	3.97	1,110
Jan. 7	S. B. Soule.....	1.23	65	17	Robert Follansbee.....	4.65	1,530
Feb. 15	do.....	^a 2.12	106	July 24	Spiegel and Hodges.....	3.60	951
Apr. 10	do.....	1.78	184	24	J. B. Spiegel.....	3.59	892

^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, 1918.

Day.	Oct.	Nov.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1.....	180	66	75	156	675	705	840	464	342
2.....	164	68	100	177	700	705	758	464	353
3.....	151	66	112	109	700	785	680	486	950
4.....	151	56	114	144	750	758	655	486	922
5.....	151	60	132	151	775	1,040	868	556	812
6.....	117	66	121	132	800	1,070	895	580	486
7.....	106	90	117	137	800	1,100	868	705	442
8.....	102	74	132	130	800	1,190	868	655	383
9.....	114	74	121	137	800	1,220	895	630	407
10.....	134	77	100	169	775	1,250	1,190	630	421
11.....	335	87	110	169	775	1,310	1,680	605	307
12.....	983	90	100	196	750	895	1,460	580	260
13.....	357	90	94	225	725	1,010	1,370	532	243
14.....	117	84	74	258	775	1,550	1,160	504	187
15.....	96	90	67	310	850	1,610	1,190	468	150
16.....	92	82	63	532	875	1,610	1,130	455	237
17.....	87	82	67	578	982	1,490	1,130	404	324
18.....	87	64	82	532	1,010	1,370	1,100	368	310
19.....	87	55	90	510	955	1,310	922	328	296
20.....	92	132	87	510	900	1,490	840	290	282
21.....	87	132	88	488	850	1,550	812	268	268
22.....	87	108	82	555	800	1,870	812	249	255
23.....	79	106	71	578	800	2,260	1,010	258	242
24.....	79	106	74	600	840	2,650	868	258	228
25.....	84	96	82	625	812	2,000	812	307	238
26.....	87	85	84	675	785	1,740	705	342	248
27.....	84	114	90	725	705	1,490	680	346	258
28.....	87	90	132	725	705	1,250	605	342	208
29.....	71	110	121	675	680	1,100	580	368	279
30.....	71	128	114	675	680	950	556	392	250
31.....	64	.....	151	.....	730	.....	486	380	.....

NOTE.—Gage not read Mar. 1-4, Sept. 16, 18-23, 25-30; discharge interpolated. Shifting-control method used May 20-23.

Monthly discharge of South Platte River at South Platte, Colo., for the year ending Sept. 30, 1918.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October.....	983	64	148	9,100
November.....	132	55	87.6	5,210
December.....	.....	.....	118	7,260
January.....	.....	.....	116	7,130
February.....	.....	.....	123	6,830
March.....	151	63	98.3	6,040
April.....	725	130	388	23,100
May.....	1,010	675	792	48,700
June.....	2,650	705	1,340	79,707
July.....	1,680	486	917	56,407
August.....	705	249	442	27,200
September.....	950	150	357	21,200
The year.....	2,650	.....	412	298,000

NOTE.—Monthly discharge for December, January, and March computed from records obtained by Denver Union Water Co. at Platte Canyon, by reducing them 1.4 per cent for difference in drainage area.

NORTH FORK OF SOUTH PLATTE RIVER AT GRANT, COLO.

LOCATION.—In sec. 9, T. 7 S., R. 74 W., at Grant, Park County, 250 feet above mouth of Geneva Creek.

DRAINAGE AREA.—51 square miles (measured on Forest atlas).

RECORDS AVAILABLE.—July 18, 1910, to March 31, 1918.

GAGE.—Vertical staff on left bank 250 feet above mouth of Geneva Creek; read by Mrs. M. McFarland.

DISCHARGE MEASUREMENTS.—Made by wading.

CHANNEL AND CONTROL.—Bed composed of gravel. Principal control about 20 feet below gage at small rapids; not permanent.

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

DIVERSIONS.—There are court decrees for diversions of 5.5 second-feet from North Fork above station and 24 second-feet from tributaries entering above.

REGULATION.—None.

Discharge measurements of North Fork of South Platte River at Grant, Colo., during the year ending Sept. 30, 1918.

Date.	Made by—	Gage height.	Dis-charge.
Nov. 9	Robert Follansbee.....	<i>Feet.</i> 1.51	<i>Sec.-ft.</i> 8.9
Jan. 8	S. B. Soulé.....	<i>a</i> 1.74	7.8

a Stage-discharge relation affected by ice.

Daily discharge, in second-feet, of North Fork of South Platte River at Grant, Colo., for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Dec.	Jan.	Mar.	Day.	Oct.	Nov.	Dec.	Jan.	Mar.
1.....	8	10	10	.....	.....	16.....	8	12	.....	.....	.....
2.....	8	10	10	.....	.....	17.....	9	12	.....	.....	.....
3.....	8	13	10	.....	.....	18.....	7	10	.....	.....	.....
4.....	7	15	9	.....	.....	19.....	9	9	.....	.....	.....
5.....	7	14	9	.....	.....	20.....	8	8	.....	.....	.....
6.....	7	14	8	.....	.....	21.....	11	10	.....	.....	.....
7.....	8	12	8	.....	.....	22.....	9	11	.....	.....	.....
8.....	9	12	8	7.8	.....	23.....	8	8	.....	.....	.....
9.....	9	11	.....	.....	.....	24.....	8	8	.....	.....	11
10.....	9	9	.....	.....	.....	25.....	6	8	.....	.....	7
11.....	9	11	.....	.....	.....	26.....	7	8	.....	.....	10
12.....	9	8	.....	.....	.....	27.....	8	8	.....	.....	9
13.....	9	4	.....	.....	.....	28.....	11	8	.....	.....	8
14.....	9	10	.....	.....	.....	29.....	14	9	.....	.....	6
15.....	9	12	.....	.....	.....	30.....	11	10	9	.....	9
						31.....	10	.....	.....	.....	6

NOTE.—Stage-discharge relation affected by ice Oct. 30 to Nov. 1, Nov. 18-21, 24-30, Dec. 1-8; discharge determined from daily gage height and temperature records and observer's notes.

Monthly discharge of North Fork of South Platte River at Grant, Colo., for the year ending Sept. 30, 1918.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October.....	14	6	8.7	535
November.....	15	4	10.1	601
December 1-8.....	10	8	9.0	143
March 24-31.....	11	10	8.2	130

NORTH FORK OF SOUTH PLATTE RIVER AT SOUTH PLATTE, COLO.

LOCATION.—In sec. 25, T. 3 S., R. 70 W., one-third of a mile above railroad station at South Platte, 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, 1918.

GAGE.—Inclined staff on left bank one-third of a mile above railroad station; read by Mrs. Mata Wallbrecht.

DISCHARGE MEASUREMENTS.—Made from cable 300 feet above gage or by wading.

CHANNEL AND CONTROL.—Bed composed of gravel and sand. Principal control a short distance below gage; shifting between narrow limits. Banks not subject to much overflow.

ICE.—Stage-discharge relation seriously affected by ice; discharge not determined because of insufficient data.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 4.4 feet at 9 a. m. June 22 (discharge, 1,080 second-feet); minimum discharge occurs during winter.

DIVERSIONS.—Court decrees for diversions 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.—Diurnal fluctuation during spring, caused by alternate melting and freezing of mountain snow.

ACCURACY.—Stage-discharge relation shifted between narrow limits. Standard rating curve well defined. Gage read to half-tenths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table; shifting-control method used May 16 to June 10 and August 1 to September 30. Records good.

Discharge measurements of North Fork of South Platte River at South Platte, Colo., during the year ending Sept. 30, 1918.

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. 7	Robert Follansbee.....	1.83	71	May 27	S. B. Soulé.....	3.11	460
Jan. 7	S. B. Soulé.....	a 1.95	23.5	June 7	P. V. Hodges.....	3.25	475
Feb. 15	do.....	a 2.25	39.6	July 24	Spiegel and Hodges....	3.12	456
Apr. 10	do.....	2.05	116				

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, 1918.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1.....	69	69	23	.....	.....	.....	90	202	462	508	257	113
2.....	69	65	18	.....	.....	.....	100	202	440	485	257	124
3.....	69	65	22	.....	.....	.....	84	202	485	462	272	196
4.....	69	65	24	.....	.....	.....	80	230	508	440	242	182
5.....	69	65	24	.....	.....	.....	76	260	485	440	227	156
6.....	69	65	22	.....	.....	.....	61	275	462	440	224	182
7.....	69	59	22	24	.....	.....	90	325	508	440	284	169
8.....	65	54	20	.....	.....	.....	71	325	552	440	254	156
9.....	36	54	20	.....	.....	.....	96	308	645	485	224	156
10.....	47	47	20	.....	.....	.....	122	325	670	462	224	156
11.....	54	42	22	.....	.....	.....	102	290	745	620	222	141
12.....	65	47	.....	.....	.....	58	113	2 0	770	620	222	131
13.....	69	50	.....	.....	.....	61	124	260	820	598	236	117
14.....	69	47	.....	.....	.....	24	148	275	920	575	236	109
15.....	69	45	.....	.....	40	28	161	290	795	620	208	113
16.....	65	45	.....	.....	.....	24	161	380	720	670	191	148
17.....	69	42	.....	.....	.....	26	148	380	720	530	177	156
18.....	65	36	.....	.....	.....	40	136	420	670	440	164	136
19.....	59	42	.....	.....	.....	43	148	420	670	440	151	124
20.....	63	45	.....	.....	.....	43	124	462	820	440	158	117
21.....	69	45	.....	.....	.....	47	113	420	895	440	148	113
22.....	59	49	.....	.....	.....	35	148	462	1,030	400	148	109
23.....	65	49	.....	.....	.....	35	174	508	975	575	148	96
24.....	72	49	.....	.....	.....	43	174	575	975	440	141	102
25.....	69	36	.....	.....	.....	47	188	575	820	420	141	113
26.....	72	26	.....	.....	.....	52	202	552	770	380	129	113
27.....	69	18	.....	.....	.....	65	230	485	670	360	122	117
28.....	69	22	.....	.....	.....	90	230	508	598	360	129	113
29.....	69	23	.....	.....	.....	61	202	462	575	325	129	113
30.....	69	24	.....	.....	.....	65	188	508	530	308	129	113
31.....	69	.....	.....	.....	.....	84	.....	552	.....	290	115	.....

NOTE.—Stage-discharge relation affected by ice Oct. 29, 31, Nov. 15, 16, 18-26, 28-30, Dec. 1, 3-5, 7-11; discharge determined from daily gage-height and temperature records and observer's notes.

Monthly discharge of North Fork of South Platte River at South Platte, Colo., for the year ending Sept. 30, 1918.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October.....	72	36	65.5	4,030
November.....	69	18	46.3	2,760
December 1-11.....	24	18	21.5	469
March 12-31.....	90	24	48.6	1,930
April.....	230	61	136	8,060
May.....	575	202	377	23,200
June.....	1,030	440	690	41,100
July.....	670	230	466	28,700
August.....	284	115	191	11,700
September.....	196	96	133	7,910

GENEVA CREEK AT GRANT, COLO.

LOCATION.—In sec. 9, T. 7 S., R. 74 W., just below highway bridge at Grant, Park County, 300 feet above mouth of creek.

DRAINAGE AREA.—74 square miles (measured on map in Forest atlas).

RECORDS AVAILABLE.—November 3, 1911, to March 31, 1918. From July 5, 1908, to November 3, 1911, a station was maintained at Sullivan's ranch, 3 miles above Grant. Except during the spring run-off, the flow at the two points is practically the same.

GAGE.—Vertical staff on right bank just below bridge; temporary vertical staff on downstream side of left abutment used November 8, 1916, to May 5, 1917, and November 9, 1917, to March 31, 1918; read by Mrs. M. McFarland.

DISCHARGE MEASUREMENTS.—Made from single-span bridge or by wading.

CHANNEL AND CONTROL.—Bed composed of coarse gravel. Principal control 50 feet downstream at gravel bar, which shifts at intervals. Banks not subject to overflow.

EXTREMES OF DISCHARGE.—Data too few.

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

DIVERSIONS.—Court decree for diversion 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; rating curve well defined. Gage read to hundredths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table. Records good except during winter period, for which they are fair.

Discharge measurements of Geneva Creek at Grant, Colo., during the year ending Sept. 30, 1918.

Date.	Made by—	Gage height.	Discharge.
Nov. 9	Robert Follansbee.....	<i>Feet.</i> 0.85	<i>Sec.-ft.</i> 11.5
Jan. 8	S. B. Soulé.....	.78	13.6

Daily discharge, in second-feet, of Geneva Creek at Grant, Colo., for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.
1.....	24	22	12	12	10	12	16.....	19	21	13	12	10	13
2.....	24	19	13	12	10	12	17.....	20	22	13	12	10	12
3.....	23	13	13	12	10	12	18.....	14	21	13	12	10	12
4.....	23	12	12	12	12	11	19.....	15	21	13	12	10	11
5.....	23	12	12	12	12	12	20.....	18	18	13	12	10	11
6.....	23	13	12	13	11	10	21.....	20	17	13	12	10	11
7.....	23	12	9	13	12	11	22.....	21	17	13	12	10	12
8.....	22	20	10	13	13	12	23.....	16	15	13	12	10	11
9.....	22	18	12	13	13	12	24.....	19	13	13	12	11	12
10.....	22	18	13	10	12	12	25.....	18	13	13	12	12	12
11.....	22	22	13	8	11	11	26.....	18	13	12	12	12	16
12.....	22	22	13	10	10	11	27.....	14	13	12	11	13	14
13.....	22	13	13	12	11	11	28.....	18	12	15	11	13	13
14.....	21	21	13	12	10	12	29.....	32	12	12	11	.....	13
15.....	20	18	13	12	10	12	30.....	42	10	13	11	.....	16
							31.....	26	.....	12	11	.....	13

NOTE.—Stage-discharge relation affected by ice Nov. 24 to Dec. 27, Jan. 6-31, Feb. 17-23; discharge determined from gage height and temperature records and 1 discharge measurement.

Monthly discharge of Geneva Creek at Grant, Colo., for the year ending Sept. 30 1918.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October.....	42	14	21.5	1,320
November.....	22	10	16.4	976
December.....	15	9	12.5	769
January.....	13	8	11.7	719
February.....	13	10	11.0	611
March.....	16	10	12.1	744
The period.....				5,140

CLEAR CREEK NEAR GOLDEN, COLO.

LOCATION.—In sec. 6, T. 4 S., R. 70 W., 1,000 feet below head gates of Golden ditch and 2 miles above Golden, in Jefferson County. Only important tributary between station and mouth, Ralston Creek, enters 12 miles below.

DRAINAGE AREA.—Approximately 380 square miles.

RECORDS AVAILABLE.—December 4, 1908, to December 31, 1909; June 8 to September 24, 1911; January 29, 1912, to September 30, 1918.

GAGE.—Water-stage recorder on left bank 1,000 feet below head of Golden ditch. Staff gage near water-stage recorder used chiefly during year.

DISCHARGE MEASUREMENTS.—Made from cable near gage or by wading.

CHANNEL AND CONTROL.—Bed composed of coarse gravel and small boulders. Principal control 25 feet downstream at rapids; shifts occasionally. Creek flows in canyon; banks not subject to overflow.

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

EXTREMES OF DISCHARGE.—Maximum stage recorded, 5.4 feet at 4 p. m. June 14 (discharge, 2,090 second-feet); minimum discharge occurs during winter.

DIVERSIONS.—Court decree for a diversion of 53 second-feet from the headwaters of Fraser River to the West Fork of Clear Creek, and approximately 950 acre-feet were diverted in 1918 between June 1 and August 22. Above the Golden station there is a court decree for a diversion of 26 second-feet by the Golden ditch. The diversion by this ditch past the Clear Creek gaging station was about 6,000 acre-feet for 1918.

REGULATION.—None.

ACCURACY.—Stage-discharge relation fairly permanent; affected by ice during winter. Rating curve well-defined. Daily discharge for greater part of time ascertained by applying daily reading of staff gage to rating table; shifting-control method used May 11 to June 7. Records fair.

Discharge measurements of Clear Creek near Golden, Colo., during the year ending Sept. 30, 1918.

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	Soulé and Follansbee..	1.22	78	Apr. 23	P. V. Hodges.....	1.40	101
2	do.....	1.23	73	May 21	S. B. Soulé.....	2.72	564
Jan. 11	Soulé and Hodges.....	.77	18.0	June 19	Robert Follansbee....	4.61	1,490
Feb. 4	do.....	a 2.38	44.4	July 26	Spiegel and Hodges....	2.61	477

a Stage-discharge relation affected by ice.

NOTE.—The following measurements of the discharge of Golden ditch were made: Nov. 2, 13.8 second feet; Jan. 4, no flow; Apr. 23, 4.6 second-feet; May 21, 17.8 second-feet; July 26, 18.4 second-feet.

Daily discharge, in second-feet, of Clear Creek near Golden, Colo., for the year ending Sept. 30, 1918.

Day.	Oct.	Apr.	May.	June.	July.	Aug.	Sept.
1	82		104	638	1,100	341	
2	86		132	610	1,040	341	
3	83		160	605	980	306	
4	80		188	708	862	341	
5	79		216	703	758	341	
6	76		244	758	758	324	
7	73		271	862	764	341	
8	72		259	1,040	770	306	
9	72		247	1,160	776	271	
10	73		236	1,340	782	236	
11	75		274	1,610	788	236	
12	78		274	1,730	794	236	
13	72		278	1,790	801	236	
14	71		278	2,090	808	236	
15	72		316	1,790	808	236	
16	75		430	1,730	808	203	
17	75		480	1,670	808	203	
18	75		530	1,670	758		
19	76		535	1,550	645		
20	75		535	1,670	595		
21	74	113	550	1,610	550		120
22	72	110	585	1,670	550		118
23	72	102	630	1,730	550		118
24	72	102	736	1,670	550		118
25	75	104	736	1,550	502		124
26	75	107	730	1,460	466		132
27	75	110	730	1,340	414		140
28	75	113	780	1,220	414		140
29	75	110	670	1,160	376		128
30	75	107	665	1,100	376		120
31	75		665		341		

NOTE.—Water-stage recorder not operating satisfactorily Apr. 21 to Aug. 17: discharge based on one reading of staff gage daily. No gage heights Oct. 21, 23-31, Apr. 22, 26, 27, 29-30, May 2-6, 8, 9, July 7-14: discharge interpolated.

Monthly discharge of Clear Creek near Golden, Colo., for the year ending Sept. 30, 1918.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	86	71	75.3	4,630
April 21-30	113	102	108	2,140
May	780	104	434	26,700
June	2,090	605	1,340	79,700
July	1,100	341	687	42,200
August 1-17	341	203	278	9,370
September 21-30	140	118	126	2,500

NORTH BOULDER CREEK AT SILVER LAKE, COLO.

LOCATION.—In NW. $\frac{1}{4}$ sec. 28, T. 1 N., R. 73 W., at outlet of Silver Lake in Colorado National Forest.

DRAINAGE AREA.—8.7 square miles (measured by special survey).

RECORDS AVAILABLE.—August 20, 1913, to September 30, 1918.

GAGE.—Friez water-stage recorder which indicates head on the weir.

DISCHARGE MEASUREMENTS.—Made by means of standard sharp-crested weir 10 feet long having a low-water section 5 feet long.

EXTREMES OF DISCHARGE.—No data.

ICE.—Weir kept open during winter.

DIVERSIONS.—None above station.

REGULATION.—Winter flow increased by storage in Silver Lake (capacity, 2,080 acre-feet).

COOPERATION.—Complete records furnished by city engineer of Boulder.

Daily discharge, in second-feet, of North Boulder Creek at Silver Lake, Colo., for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1.....	120	108	64	42	54	47	46	52	474	746	487	254
2.....	130	116	64	43	51	47	47	55	474	706	483	254
3.....	130	116	64	42	51	47	47	56	474	706	484	254
4.....	130	113	62	42	48	47	48	56	482	725	480	260
5.....	130	113	62	40	47	47	48	50	486	760	520	260
6.....	130	110	60	38	46	47	48	50	494	830	580	168
7.....	130	88	60	38	46	47	48	50	542	774	596	160
8.....	135	88	60	38	46	48	48	50	838	760	550	164
9.....	135	88	60	38	46	48	50	50	879	804	676	164
10.....	135	84	47	38	46	47	50	50	1,330	816	510	98
11.....	135	84	43	38	46	47	50	50	1,140	843	484	112
12.....	135	85	43	38	47	47	48	50	1,140	856	452	114
13.....	135	85	43	38	45	47	48	50	1,140	960	520	163
14.....	135	82	43	38	44	47	48	50	1,220	952	526	191
15.....	135	80	42	42	45	47	50	52	1,330	946	534	192
16.....	120	77	42	40	46	47	50	96	1,330	932	540	194
17.....	120	73	42	40	46	54	50	128	1,330	932	546	195
18.....	100	72	43	40	46	54	50	156	1,330	906	546	198
19.....	104	72	42	40	47	54	50	195	1,250	830	500	192
20.....	167	72	42	38	45	54	50	219	1,220	746	436	193
21.....	156	70	42	38	47	54	46	228	1,510	794	402	192
22.....	134	70	42	40	47	54	46	241	1,580	806	400	184
23.....	134	69	42	44	47	54	47	254	1,640	760	334	178
24.....	133	67	40	54	47	54	48	307	1,630	706	308	171
25.....	134	64	40	58	47	54	48	335	1,510	672	284	164
26.....	138	65	40	58	47	54	48	370	1,270	647	280	158
27.....	144	66	40	58	47	52	48	377	1,120	615	274	155
28.....	147	67	42	58	47	52	50	394	946	587	264	150
29.....	148	65	42	54	.....	52	52	416	844	580	263	150
30.....	146	64	40	53	.....	52	53	416	788	550	254	152
31.....	152	.....	40	53	.....	47	.....	406	.....	520	253	.....

Monthly discharge of North Boulder Creek at Silver Lake, Colo., for the year ending Sept. 30, 1918.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October.....	16.7	10.0	13.4	824
November.....	11.6	6.4	8.23	490
December.....	6.4	4.0	4.77	293
January.....	5.8	3.8	4.41	271
February.....	5.4	4.4	4.68	260
March.....	5.4	4.7	5.00	307
April.....	5.3	4.6	4.87	290
May.....	41.6	5.0	17.1	1,050
June.....	164	47.4	105	6,250
July.....	96.0	52.0	76.7	4,720
August.....	67.6	25.3	44.5	2,740
September.....	26.0	9.8	18.1	1,080
The year.....	164	3.8	25.6	18,600

SOUTH BOULDER CREEK NEAR ROLLINSVILLE, COLO.

LOCATION.—In sec. 35, T. 1 S., R. 73 W., 1 mile west of Rollinsville, Gilpin County

Nearest large tributary, Jenny Creek, enters 3 miles above.

DRAINAGE AREA.—39 square miles (measured on topographic maps).

RECORDS AVAILABLE.—September 10, 1910, to May 1, 1918.

GAGE.—Vertical staff spiked to tree on left bank, 500 feet above bridge, used since June 2, 1916; vertical staff on downstream side of right abutment, used May 8 to June 1, 1916; vertical staff on upstream side of right abutment used prior to May 8, 1916; read by Miss Grace Grant.

DISCHARGE MEASUREMENTS.—Made from two-span bridge or by wading.

CHANNEL AND CONTROL.—Bed composed of coarse gravel and small boulders. Control not well-defined; shifts occasionally. Banks not subject to overflow.

EXTREMES OF DISCHARGE.—Data too few.

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

DIVERSIONS.—No court decrees for diversion above station.

REGULATION.—None.

ACCURACY.—Stage-discharge relation permanent; affected by ice, as shown in footnote to table of daily discharge. Rating curve well-defined. Gage read to hundredths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table. Records good.

Discharge measurements of South Boulder Creek near Rollinsville, Colo., during the year ending Sept. 30, 1918.

[Made by S. B. Soulé.]

Date.	Gage height.	Discharge.
	<i>Feet.</i>	<i>Sec.-ft.</i>
Oct. 12.....	0.88	8.2
Dec. 14.....	a. 99	11.0
Feb. 26.....	a. 84	7.5

^aStage-discharge relation affected by ice.

Daily discharge, in second-feet, of South Boulder Creek near Rollinsville, Colo., for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Dec.	Feb.	Mar.	Apr.	Day.	Oct.	Nov.	Dec.	Feb.	Mar.	Apr.
1.....	6.2	16	15	.....	.....	22	16.....	5.5	13	.....	.....	9	32
2.....	6.2	15	.....	.....	.....	23	17.....	5.5	9	.....	.....	9	33
3.....	6.2	15	.....	.....	.....	22	18.....	6.2	8	.....	.....	13	33
4.....	6.2	15	.....	.....	.....	26	19.....	6.9	6	.....	.....	14	32
5.....	6.2	14	.....	.....	.....	23	20.....	7.6	9	.....	.....	11	24
6.....	6.2	14	.....	.....	.....	24	21.....	8.3	14	.....	.....	8	23
7.....	6.2	14	.....	.....	.....	24	22.....	8.3	8	.....	.....	16	24
8.....	6.2	14	.....	.....	.....	23	23.....	8.3	9	.....	.....	16	29
9.....	6.2	14	.....	.....	9	24	24.....	8.3	12	.....	.....	16	31
10.....	4.8	17	.....	.....	9	26	25.....	9.3	9	.....	.....	16	33
11.....	4.8	19	.....	.....	10	30	26.....	10	8	.....	7.5	28	36
12.....	6.2	14	.....	.....	13	35	27.....	11	13	.....	.....	27	41
13.....	6.9	14	.....	.....	12	41	28.....	12	9	.....	.....	32	32
14.....	6.9	14	11	.....	11	39	29.....	13	9	.....	.....	21	36
15.....	5.5	14	.....	.....	11	33	30.....	14	15	.....	.....	23	37
							31.....	15	.....	.....	.....	21	.....

NOTE.—Stage-discharge relation affected by ice Oct. 25 to Nov. 1, Nov. 16-20, 28, 29, Mar. 9, 10, 14-18, 22-25; discharge determined from daily gage heights, discharge measurements, and temperature records.

Monthly discharge of South Boulder Creek near Rollinsville, Colo., for the year ending Sept. 30, 1918.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October.....	15	4.8	7.75	477
November.....	19	6	12.5	744
March 9-31.....	32	8	15.4	702
April.....	41	22	29.7	1,770

BIG THOMPSON CREEK NEAR DRAKE, COLO.

LOCATION.—In sec. 2, T. 5 N., R. 71 W., at highway bridge No. 7 in Big Thompson Canyon, 200 yards below Loveland dam and $1\frac{1}{2}$ miles east of Drake, in Larimer County. Nearest tributary, North Fork, enters at Drake.

DRAINAGE AREA.—274 square miles (measured on topographic maps).

RECORDS AVAILABLE.—September 18, 1917, to September 30, 1918.

GAGE.—Bristol pressure gage attached to left bridge abutment.

DISCHARGE MEASUREMENTS.—Made from single span bridge.

CHANNEL AND CONTROL.—Channel is pool in which several feet of silt are deposited and scoured out. Control 50 feet downstream at rapids of compact gravel; practically permanent. Banks not subject to overflow.

ICE.—Stage-discharge relation seriously affected by ice. Winter measurements made at section half a mile upstream.

EXTREMES OF DISCHARGE.—Data too few.

DIVERSIONS.—Court decrees for diversions of 23 second-feet from river above station and 2,277 second-feet below; also decrees for storage of 81,000 acre-feet below station.

REGULATION.—Alternate melting and freezing of mountain snow during spring causes diurnal fluctuation of discharge. No artificial regulation.

ACCURACY.—Stage-discharge relation permanent; affected by ice during December. Rating curve well-defined. Operation of recording gage fairly satisfactory until June 5, after which date chain gage readings only available. Daily discharge ascertained by applying to rating table mean daily gage height obtained by inspection of gage-height graph. Records good.

COOPERATION.—Field data furnished by city of Loveland. Check measurements made by United States Geological Survey.

Discharge measurements of Big Thompson Creek near Drake, Colo., during the year ending Sept. 30, 1918.

Date.	Made by—	Gage height.	Dis-charge.	Date.	Made by—	Gage height.	Dis-charge.
		<i>Inches.</i>	<i>Sec.-ft.</i>			<i>Inches.</i>	<i>Sec.-ft.</i>
Oct. 17	E. S. Bice.....	13	36.1	Feb. 19	E. S. Bice.....	.....	20.2
Nov. 14	do.....	11	29.8	Mar. 1	do.....	.....	36.4
27	Robert Follansbee.	12	33.3	20	do.....	10.5	29.9
Dec. 18	E. S. Bice.....	a 13	33.4	Apr. 19	do.....	13.9	54
28	do.....	11.2	29.0	May 19	do.....	27.8	308
Jan. 8	do.....	a 13	16.4	June 19	do.....	42	1,310
22	do.....	.....	17.6	Sept. 17	do.....	21.5	140
Feb. 5	do.....	.....	19.2				

a Stage-discharge relation affected by ice.

Daily discharge, in second-feet, of Big Thompson Creek near Drake, Colo., for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.
1.	61	44	34	28		36	27	102	460		
2.	61	42	30	27			27	109	432	392	
3.	57	42	31	26			27	131	470		
4.	54	40	23				26	167	543		
5.	52	38	24		19		26	179	630		
6.	52	38	24				26	194			201
7.	46	40	23				25	230	870		
8.	52	40	24	16			26	242	1,190		
9.	49	36	24				26	225		279	
10.	46	34	25				30	232			
11.	44	30	26				34	201			
12.	46	31	27				42	183	1,310		
13.	44	30	28				51	171			
14.	42	32	29				66	179			96
15.	42	36	30				73	194		291	
16.	38	35	31				59	252			
17.	38	30	32				51	282			
18.	35	24	33				42	306			
19.	30	29	33		20		48	291	1,310		
20.	29	34	33			25	57	312	1,310		
21.	28	38	33			23	64	402			54
22.	27	34	33	18		22	66	470		309	
23.	26	32	32			23	66	480			
24.	25	31	30			26	73	480	870		
25.	24	30	30			31	77	485			
26.	24	31	30			30	84	495	485		
27.	30	31	29			37	96	506			
28.	35	24	28			28	97	516			
29.	40	30	32			28	98	527			
30.	49	34	30			27	99	537		322	
31.	49		26			27		548			

NOTE.—No gage heights Oct. 20-29; discharge determined from temperature records. Stage-discharge relation affected by ice Dec. 6-26; discharge determined from temperature records and observer's notes. Bristol gage did not operate correctly subsequent to June 28; only weekly chain gage readings available.

Monthly discharge of Big Thompson Creek near Drake, Colo., for the year ending Sept. 30, 1918.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October.....	61	24	41.1	2,530
November.....	44	24	34.0	2,020
December.....	34	23	28.9	1,780
January.....			18.0	1,110
February.....			19.0	1,060
March.....			28.0	1,720
April.....	99	25	53.6	3,190
May.....	548	102	311	19,100

NOTE.—Monthly mean for January, February, and March based on discharge measurements and temperature records.

NISHNABOTNA RIVER BASIN.

WEST NISHNABOTNA RIVER AT WHITE CLOUD, IOWA.

LOCATION.—In sec. 2, T. 71 N., R. 41 W., at highway bridge in White Cloud, Mills County, and 3 miles above mouth of Silver Creek.

DRAINAGE AREA.—950 square miles. (Measured by engineers of the Iowa Highway Commission on United States Post Route Map; scale, 1 inch=1 mile.)

RECORDS AVAILABLE.—May 23 to September 30, 1918.

GAGE.—Chain gage attached to downstream side of bridge; read by Chas. N. Ham-mack.

DISCHARGE MEASUREMENTS.—Made from downstream side of bridge.

CHANNEL AND CONTROL.—Sand and silt; likely to shift.

EXTREMES OF DISCHARGE.—Maximum stage recorded during period of records, 14.2 feet at 7 a. m., June 7; minimum stage, 0.96 foot, September 10 and 14–18.

REGULATION.—Flow is regulated somewhat by dam and mill 200 feet above gage.

Data inadequate for determination of daily discharge.

Discharge measurements of West Nishnabotna River at White Cloud, Iowa, during the period Sept. 27, 1917, to Sept. 30, 1918.

[Made by W. G. Hoyt.]

Date.	Gage height.	Dis-charge.	Date.	Gage height.	Dis-charge.
1917.	<i>Feet.</i>	<i>Sec.-ft.</i>	1918.	<i>Feet.</i>	<i>Sec.-ft.</i>
Sept. 27.....	2.14	70.6	May 23.....	3.94	259
			24.....	7.62	933

Daily gage height, in feet, of West Nishnabotna River at White Cloud, Iowa, for the year ending Sept. 30, 1918.

Day.	May.	June.	July.	Aug.	Sept.	Day.	May.	June.	July.	Aug.	Sept.
1.....		8.35	2.55	1.87	1.04	16.....		5.55	2.51	1.33	0.96
2.....		11.4	2.42	1.67	1.32	17.....		4.75	2.43	1.22	.96
3.....		7.55	2.32	1.66	1.35	18.....		4.15	2.23	1.78	.96
4.....		7.1	2.29	1.61	1.07	19.....		3.7	2.13	1.87	1.38
5.....		12.2	2.40	1.56	1.09	20.....		3.25	2.17	1.66	1.14
6.....		13.6	2.34	1.47	1.21	21.....		3.3	2.01	1.78	1.06
7.....		14.0	2.42	1.37	1.19	22.....		3.1	1.90	1.40	.97
8.....		12.2	2.45	1.29	1.08	23.....	3.95	3.85	1.83	1.63	.98
9.....		7.75	2.20	1.25	1.44	24.....	6.0	3.8	1.99	1.40	1.16
10.....		7.1	2.29	1.22	.96	25.....	11.7	3.8	2.15	1.31	3.14
11.....		5.2	2.12	1.24	1.18	26.....	7.9	3.45	2.09	1.31	3.64
12.....		4.5	2.02	1.80	2.22	27.....	9.3	3.0	1.98	1.34	4.28
13.....		4.45	1.95	1.88	1.01	28.....	12.2	2.77	2.07	1.15	5.24
14.....		4.65	2.04	2.25	.96	29.....	8.1	2.69	1.65	1.52	4.66
15.....		5.95	2.29	1.55	.96	30.....	10.5	2.69	1.49	1.22	2.86
						31.....	8.65	.....	1.78	1.13	.....

EAST NISHNABOTNA RIVER AT RED OAK, IOWA.

LOCATION.—In sec. 20, T. 72 N., R. 38 W., at highway bridge on Coolbaugh Street in Red Oak, Montgomery County, 35 miles above junction with West Nishnabotna River.

DRAINAGE AREA.—940 square miles (measured by engineers of the Iowa Highway Commission on United States Post Route Map; scale, 1 inch=1 mile.)

RECORDS AVAILABLE.—May 22 to September 30, 1918.

GAGE.—Chain gage attached to upstream side of bridge; read by Leonard England.

DISCHARGE MEASUREMENTS.—Made from downstream side of bridge during medium and high stages, and by wading during low stages.

CHANNEL AND CONTROL.—Bed composed of sand and mud; likely to shift.

EXTREMES OF DISCHARGE.—Maximum stage recorded during period of records, 13.6 feet at 6 p. m., May 29; minimum stage, 1.53 feet at 6 a. m., September 28. River reached a stage of about 21.7 feet on the present gage during 1916.

Data inadequate for determination of daily discharge.

Discharge measurements of East Nishnabotna River at Red Oak, Iowa, for the period Sept. 27, 1917, to Sept. 30, 1918.

[Made by W. G. Hoyt.]

Date.	Gage height.	Dis-charge.	Date.	Gage height.	Dis-charge.
1917.	<i>Feet.</i>	<i>Sec.-ft.</i>	1918.	<i>Feet.</i>	<i>Sec.-ft.</i>
Sept. 25.....	2.25	78.4	May 22.....	2.14	30.6

Daily gage height, in feet, of East Nishnabotna River at Red Oak, Iowa, for the year ending Sept. 30, 1918.

Day.	May.	June.	July.	Aug.	Sept.	Day.	May.	June.	July.	Aug.	Sept.
1.....		8.3	2.40	2.10	2.01	16.....		4.9	2.26	2.09	1.76
2.....		7.8	2.48	2.08	1.95	17.....		3.5	3.45	2.09	1.81
3.....		6.2	2.42	1.96	1.85	18.....		3.2	4.55	2.07	1.82
4.....		5.35	2.34	1.94	1.91	19.....		3.0	2.77	2.97	1.82
5.....		5.3	2.34	2.04	2.05	20.....		2.88	2.45	2.85	1.74
6.....		11.7	2.32	1.88	1.94	21.....		2.68	2.35	4.6	1.92
7.....		10.4	2.30	1.88	1.94	22.....	2.12	2.58	2.25	2.77	1.78
8.....		8.75	2.28	1.88	1.88	23.....	4.55	2.76	2.43	2.49	1.74
9.....		6.2	2.29	1.84	1.88	24.....	3.5	2.66	2.27	2.37	1.78
10.....		5.6	2.25	1.82	1.86	25.....	9.3	2.66	3.55	2.45	1.77
11.....		4.3	2.27	1.82	1.86	26.....	9.7	3.7	2.59	2.53	1.73
12.....		3.85	2.27	1.86	1.86	27.....	11.5	3.1	2.54	1.99	1.71
13.....		3.65	2.13	1.88	1.86	28.....	12.4	3.05	2.32	2.05	1.53
14.....		3.5	2.07	2.60	1.79	29.....	13.4	2.72	2.12	2.13	1.63
15.....		4.15	2.33	2.22	1.78	30.....	12.2	2.56	2.16	1.99	1.73
						31.....	9.0		2.10	1.99	.....

NODAWAY RIVER BASIN.

NODAWAY RIVER AT CLARINDA, IOWA.

LOCATION.—In sec. 32, T. 69 N., R. 36 W., at highway bridge known as "Fred. C. Brummett Bridge," half a mile east of Clarinda, Page County, and 7 miles above mouth of East Nodaway River.

DRAINAGE AREA.—770 square miles (measured by engineers of the Iowa Highway Commission on United States Post Route Map; scale, 1 inch=1 mile).

RECORDS AVAILABLE.—May 17 to September 30, 1918.

GAGE.—Chain gage attached to upstream side of bridge; read by Floyd Kelley.

DISCHARGE MEASUREMENTS.—Made from downstream side of bridge during medium and high stages, and by wading during low stages.

CHANNEL AND CONTROL.—Dredged channel with clay bottom; may shift.

EXTREMES OF DISCHARGE.—Maximum stage recorded during period of records, 8.0 feet at 6 p. m. May 28; minimum stage, 1.24 feet September 5.

Data inadequate for determination of daily discharge.

The following discharge measurement was made by W. G. Hoyt:
Sept. 26, 1917, Gage height unknown; discharge, 13 second-feet.
May 16, 1918: Gage height, 1.86 feet; discharge, 11 second-feet.

Daily gage height, in feet, of Nodaway River at Clarinda, Iowa, for the year ending Sept. 30, 1918.

Day.	May.	June.	July.	Aug.	Sept.	Day.	May.	June.	July.	Aug.	Sept.
1.....		4.8	2.06	2.10		16.....			2.06		1.53
2.....		4.3	2.08	2.10	1.36	17.....	1.86	2.22	2.06		1.99
3.....		4.5	2.06	2.10	1.35	18.....	1.76	2.16	2.06		
4.....		6.85	2.08	2.09	1.49	19.....		2.06	2.06		
5.....		3.65	2.06	2.09	1.24	20.....	1.92	2.03	2.06		
6.....		6.3	2.06	2.09	1.41	21.....	2.04	2.10			
7.....		5.9		2.09	1.47	22.....	2.22	2.06	2.35		
8.....		4.1	2.06	3.0		23.....		2.08	2.35		
9.....			2.06	3.1	1.29	24.....	2.32	1.98	2.35		
10.....		2.64	2.06	3.0	1.71	25.....		2.26	2.35	1.59	
11.....		2.22	2.06		1.61	26.....	2.46		2.35	1.59	
12.....		2.34	2.06		1.29	27.....	3.75	2.50	2.35	1.59	
13.....		2.26	2.06		1.49	28.....	8.0	2.14		1.49	
14.....		2.21			1.29	29.....	7.8	2.16	2.10	1.49	
15.....		2.18	2.24			30.....	5.55		2.10	1.59	
						31.....	4.2		2.10	1.59	

WEST NODAWAY RIVER AT VILLISCA, IOWA.

LOCATION.—In sec. 28, T. 71 N., R. 36 W., at Chicago, Burlington & Quincy Railroad bridge half a mile west of Villisca, Montgomery County, and 1 mile above junction with Middle Nodaway River.

DRAINAGE AREA.—350 square miles (measured by engineers of the Iowa Highway Commission on United States post-route map; scale, 1 inch=1 mile).

RECORDS AVAILABLE.—May 20 to September 30, 1918.

GAGE.—Chain gage attached to upstream side of bridge; read by G. S. Dunn.

DISCHARGE MEASUREMENTS.—Made from downstream side of bridge during medium and high stages, and by wading during low stages.

CHANNEL AND CONTROL.—Bed composed of sand and mud; shifting.

EXTREMES OF DISCHARGE.—Maximum stage recorded during period of records, 12.2 feet at 6 p. m. May 28; minimum stage, 1.47 feet August 28.

Data inadequate for determination of discharge.

Discharge measurements of West Nodaway River at Villisca, Iowa, for the period Sept. 26 to Sept. 30, 1918.

[Made by W. G. Hoyt.]

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
1917.	Feet.	Sec.-ft.	1918.	Feet.	Sec.-ft.
Sept. 26.....	2.13	6.2	May 5.....	1.97	8.2

Daily gage height, in feet, of West Nodaway River at Villisca, Iowa, for the year ending Sept. 30, 1918.

Day.	May.	June.	July.	Aug.	Sept.	Day.	May.	June.	July.	Aug.	Sept.
1.....		7.15	2.18	2.21	1.65	16.....		2.41	1.79	2.66	1.55
2.....		8.4	2.04	1.83	1.59	17.....		2.45	2.01	2.24	1.74
3.....		8.7	2.08	1.81	1.55	18.....		2.23	1.97	4.35	1.68
4.....		5.85	2.18	1.82	1.55	19.....		1.95	1.91	7.15	1.60
5.....		6.5	2.42	1.76	1.81	20.....	1.92	1.97	1.67	3.25	1.74
6.....		8.05	1.94	1.76	1.65	21.....	2.35	1.78	1.75	2.72	1.56
7.....		6.6	1.92	1.76	1.77	22.....	2.70	2.32	1.73	2.28	1.54
8.....		4.75	1.88	1.66	1.65	23.....	2.23	1.93	1.77	1.74	1.50
9.....		4.4	2.04	1.66	1.63	24.....	2.27	3.2	1.79	1.56	1.60
10.....		3.1	1.98	1.66	1.93	25.....	2.93	3.2	1.77	1.56	2.14
11.....		2.37	1.88	1.66	1.65	26.....	1.80	3.5	1.93	1.53	1.86
12.....		2.75	1.82	1.66	1.53	27.....	5.0	3.3	1.91	1.51	1.80
13.....		2.43	1.67	1.66	1.51	28.....	11.5	2.18	1.75	1.47	1.68
14.....		2.21	2.35	6.0	1.63	29.....	10.8	2.52	1.73	1.71	1.72
15.....		2.55	3.0	3.75	1.63	30.....	7.2	2.38	1.75	1.85	1.70
						31.....	7.1		1.75	1.65	

NOTE.—Rise Aug. 1 caused by construction of a temporary dam below gage.

KANSAS RIVER BASIN.

REPUBLICAN RIVER AT WAKEFIELD, KANS.

LOCATION.—In NE. $\frac{1}{4}$ sec. 5, T. 10 S., R. 4 E., at highway bridge 1,000 feet north of Union Pacific Railroad station at Wakefield, Clay County. No large tributaries enter between this point and confluence with Smoky Hill River to form Kansas River near Junction City, 16 miles (air line) downstream.

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—June 21, 1917, to September 30, 1918.

GAGE.—Chain gage bolted to upstream guard timber of highway bridge in center of middle span; read by S. R. Winsor. On June 13, 1918, a vertical staff, reading from 13.55 to 20.3 feet was spiked to a large cottonwood tree, 25 feet downstream from south end of bridge on right bank for use during extremely high stages; set at same datum as chain gage.

DISCHARGE MEASUREMENTS.—Made from downstream side of highway bridge or by wading.

CHANNEL AND CONTROL.—Bed is sandy, shifting, and clear of vegetation; stage-discharge relation, however, has not been affected. River is confined within fairly high banks; bank full stage is about 11 feet. Left bank is overflowed at high stages and river spreads out over valley floor to a width of 2 to 3 miles. Right bank at gage is high and not subject to overflow. Channel bends slightly about a quarter of a mile upstream, and is straight for a long distance downstream from the gage.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 6.55 at 7:50 a. m. May 24, 1918 (discharge, 4,830 second-feet); minimum stage recorded during year, 2.1 feet at 8:20 a. m. July 20, 1918 (discharge, 98 second-feet).

1917-18: Maximum stage recorded, same as given above; minimum stage recorded, 1.6 feet at 7 p. m. September 12, 1917 (discharge, 40 second-feet). During the flood of June, 1915, the river rose to within a few feet of the bridge floor, which is approximately at gage height 22 $\frac{1}{2}$ feet, and the entire valley was flooded.

ICE.—Stage-discharge relation affected by ice.

REGULATION.—Flow is affected by regulation of a dam at Clay Center.

ACCURACY.—Stage-discharge relation practically permanent. Rating curve well defined. Gage read to quarter-tenths twice daily during open-water periods, and once daily to open-water surface, except as noted, during ice periods. Daily discharge ascertained by applying mean daily gage height to rating table, except for period of ice effect December 8, 1917, to February 24, 1918, for which it was determined from observer's notes, weather records and comparison with other records in Kansas River basin. Records for open water excellent; winter records subject to error.

Discharge measurements of Republican River at Wakefield, Kans., during period June 21, 1917, to Sept. 30, 1918.

[Made by R. C. Rice.]

Date.	Gage height.	Dis-charge.	Date.	Gage height.	Dis-charge.	Date.	Gage height.	Dis-charge.
1917.	<i>Feet.</i>	<i>Sec.-ft.</i>	1918.	<i>Feet.</i>	<i>Sec.-ft.</i>	1918.	<i>Feet.</i>	<i>Sec.-ft.</i>
June 21.....	3.38	750	Mar. 22.....	3.36	686	June 14.....	3.68	914
July 26.....	2.04	84	May 25.....	5.38	2,600	July 18.....	2.52	241
Sept. 5.....	1.78	55	May 25.....	5.26	2,380			

Daily gage height, in feet, of Republican River at Wakefield, Kans., for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1.....	4.6	2.55	2.8	3.05	3.2	3.55	3.25	3.35	3.5	2.65	3.25	2.7
2.....	4.25	2.55	2.8	3.05	3.3	3.5	3.25	3.3	5.05	2.65	3.2	3.15
3.....	4.0	2.55	2.85	3.0	3.25	3.35	3.25	3.25	5.95	2.6	3.1	2.95
4.....	3.7	2.5	2.85	3.05	3.4	3.6	3.2	3.2	5.65	2.6	3.0	3.15
5.....	3.45	2.65	2.8	3.05	3.4	3.95	3.2	3.15	6.2	2.45	3.0	3.6
6.....	3.3	2.6	2.65	3.05	3.3	4.05	3.2	3.2	5.4	2.4	2.9	3.25
7.....	3.15	2.55	2.2	3.1	3.4	3.9	3.2	3.2	5.05	2.6	2.8	3.0
8.....	3.05	2.6	2.65	3.2	3.5	4.05	3.2	3.2	4.7	2.3	2.8	3.0
9.....	2.95	2.55	2.75	3.2	3.45	4.05	3.2	3.15	5.4	2.4	2.8	2.85
10.....	2.9	2.6	2.65	3.15	3.55	3.75	3.15	3.1	4.8	2.4	2.75	2.7
11.....	2.85	2.6	2.8	3.0	3.5	3.85	3.15	3.1	4.3	2.35	2.7	2.7
12.....	2.7	2.7	2.9	3.0	3.5	3.75	3.15	3.05	4.0	2.35	3.35	2.65
13.....	2.7	2.65	2.9	3.05	3.5	3.7	3.1	3.05	3.8	2.35	4.2	2.6
14.....	2.65	2.65	2.75	3.3	3.5	3.65	3.15	3.05	3.65	2.3	3.8	2.5
15.....	2.7	2.7	2.7	3.25	3.2	3.55	3.25	3.0	3.5	2.4	3.4	2.5
16.....	2.6	2.65	2.7	3.1	3.65	3.5	3.2	2.95	3.35	2.4	3.35	2.55
17.....	2.6	2.7	2.75	3.3	4.0	3.45	3.25	2.95	3.3	2.4	3.45	2.55
18.....	2.6	2.65	2.95	3.4	3.9	3.45	3.2	2.9	3.2	2.55	3.35	2.5
19.....	2.55	2.75	2.9	3.35	2.9	3.4	3.3	2.85	3.15	2.45	3.6	2.55
20.....	2.55	2.7	2.9	3.2	3.95	3.35	3.35	2.85	3.1	2.15	3.6	2.45
21.....	2.5	2.8	2.9	3.5	4.1	3.4	3.25	2.8	3.0	5.15	3.55	2.45
22.....	2.55	2.8	3.0	3.2	3.8	3.35	3.25	2.95	2.9	5.25	3.45	2.5
23.....	2.5	2.8	2.9	3.2	3.7	3.35	3.25	6.0	2.9	4.9	3.6	2.5
24.....	2.55	2.8	2.85	3.3	4.1	3.3	3.3	6.45	2.85	4.5	3.5	2.5
25.....	2.6	2.75	2.8	3.3	3.35	3.3	3.4	5.35	2.8	4.25	3.45	2.5
26.....	2.5	2.8	2.9	3.2	4.0	3.3	3.35	4.8	2.7	3.9	3.5	3.1
27.....	2.5	2.8	3.05	3.25	3.7	3.25	3.4	4.2	2.75	3.75	3.3	3.05
28.....	2.5	2.85	2.8	3.3	3.6	3.25	3.35	3.6	2.65	3.6	3.1	2.85
29.....	2.65	2.8	3.05	3.25	.....	3.3	3.4	4.1	2.65	3.4	2.95	2.8
30.....	2.55	2.8	2.85	3.25	.....	3.25	3.4	4.4	2.8	3.3	2.9	2.9
31.....	2.55	.....	2.9	3.2	.....	3.2	.....	3.85	.....	3.35	2.8	.....

NOTE.—Gage read to top of ice Dec. 8-12, 20-22, 24, Feb. 21-22, 24; Feb. 26, slush ice; Feb. 27; no ice.

Daily discharge, in second-feet, of Republican River at Wakefield, Kans., for the period June 21, 1917, to Sept. 30, 1918.

Day.	June.	July.	Aug.	Sept.	Day.	June.	July.	Aug.	Sept.
1917.					1917.				
1.....		482	80	98	16.....		216	196	52
2.....		428	74	113	17.....		236	128	44
3.....		428	68	62	18.....		216	98	62
4.....		402	57	74	19.....		196	89	52
5.....		402	178	68	20.....		196	178	74
6.....		351	113	74	21.....	730	178	128	303
7.....		376	402	74	22.....	664	160	144	236
8.....		326	511	74	23.....	664	160	160	196
9.....		326	376	80	24.....	632	144	160	280
10.....		303	511	48	25.....	600	160	113	303
11.....		280	798	62	26.....	540	160	128	303
12.....		236	326	44	27.....	540	128	128	326
13.....		258	258	57	28.....	511	160	113	351
14.....		236	196	62	29.....	511	178	113	1,200
15.....		196	216	57	30.....	540	68	89	870
					31.....		89	80	-----

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1917-18.												
1.....	1,860	258	376 ^a			834	632	697	798	303	632	326
2.....	1,450	258	376			798	632	664	2,470	303	600	570
3.....	1,200	258	402			697	632	632	3,810	280	540	455
4.....	944	236	402			870	600	600	3,340	280	482	570
5.....	764	303	376			1,160	600	570	4,220	216	482	870
6.....	664	280	303			1,250	600	600	2,970	196	428	632
7.....	570	258	128			1,110	600	600	2,470	280	376	482
8.....	511	280			300	1,250	600	600	1,990	160	376	482
9.....	455	258				1,250	600	570	2,970	196	376	402
10.....	428	280				984	570	540	2,120	196	351	326
11.....	402	280				1,070	570	540	1,510	178	326	326
12.....	326	326				984	570	511	1,200	178	697	303
13.....	326	303				944	540	511	1,020	178	1,400	280
14.....	303	303				907	570	511	907	160	1,020	236
15.....	326	326				834	632	482	798	196	730	236
16.....	280	303		250		798	600	455	697	196	697	258
17.....	280	326				764	632	455	664	196	764	258
18.....	280	303			400	764	600	428	600	258	697	236
19.....	258	351	200			730	664	402	570	216	870	258
20.....	258	326				697	697	402	540	113	870	216
21.....	236	376				730	632	376	482	2,610	834	216
22.....	258	376			350	697	632	455	428	2,750	764	236
23.....	236	376				697	632	3,890	428	2,260	870	236
24.....	258	376			a 540	664	664	4,650	402	1,740	798	236
25.....	280	351			697	664	730	2,900	376	1,456	764	236
26.....	236	376			1,200	664	697	2,120	326	1,110	798	540
27.....	236	376			944	632	730	1,400	351	984	664	511
28.....	236	402			870	632	697	870	303	870	540	402
29.....	303	376				664	730	1,300	303	730	455	376
30.....	258	376				632	730	1,620	376	664	428	428
31.....	258					600	-----	1,070	-----	697	376	-----

^a Estimated.

NOTE.—Stage-discharge relation affected by ice, Dec. 8 to Feb. 27. Braced figures show mean discharge for period included.

Monthly discharge of Republican River at Wakefield, Kans., for the period June 21, 1917, to Sept. 30, 1918.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
1917.				
June 21-30.....	730	511	593	11,800
July.....	482	68	248	15,200
August.....	798	57	200	12,300
September.....	1,200	44	190	11,300
The period.....				50,600
1917-18.				
October.....	1,860	236	474	29,100
November.....	402	236	319	19,000
December.....			231	14,200
January.....			250	15,400
February.....			421	23,400
March.....	1,250	600	838	51,500
April.....	730	540	634	37,700
May.....	4,650	376	1,010	62,100
June.....	4,220	303	1,310	78,000
July.....	2,750	113	650	40,000
August.....	1,400	326	645	39,700
September.....	870	216	371	22,100
The year.....	4,650	113	598	432,000

KANSAS RIVER AT OGDEN, KANS.

LOCATION.—In SE. $\frac{1}{4}$ sec. 12, T. 11 S., R. 6 E., at highway bridge three-fourths of a mile southeast of Ogden, Riley County. Sevenmile Creek enters from north one-fourth of a mile upstream; Clark Creek enters from south 2 miles upstream. Smoky Hill and Republican rivers unite near Junction City, 6 miles by direct line (10 miles by river) upstream, to form Kansas River. Camp Funston is at Ogden Flats along Kansas River, $1\frac{1}{2}$ miles upstream.

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—June 19, 1917, to September 30, 1918.

GAGE.—Chain gage bolted to upstream handrail of highway bridge in center of first span from right bank (south span); read by Arthur Estes.

DISCHARGE MEASUREMENTS.—Made from downstream side of highway bridge or by wading.

CHANNEL AND CONTROL.—Bed composed of sand; a stone jetty on right bank about 50 feet downstream from bridge partially controls the flow at low stage. There are old bridge members in the channel below the bridge, the remains of an old bridge that was washed out. Bank full stage occurs at about stage of 18 feet, and both banks are overflowed considerably at flood stage.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 11.4 feet at 6 p. m. June 8, 1918 (discharge, 11,400 second-feet); minimum stage recorded during open-water period, 4.4 feet at 5.30 p. m. October 23, 1917, also 4.4 feet at 6.25 p. m. September 22, 1918 (discharge, 417 second-feet). A lower stage of 4.15 feet, at 12.40 p. m. December 26, 1917, occurred when stage-discharge relation was affected by ice.

1917-18: Maximum stage recorded, same as given above; minimum stage recorded, 3.8 feet, at 7.15 p. m. August 2, 1917 (discharge, 230 second-feet).

ICE.—Stage-discharge relation affected by ice. Maximum ice thickness recorded for winter 1917-18, 17 inches, January 22, 1918.

REGULATION.—Flow affected somewhat by mill and power regulation on the tributaries of Kansas River.

ACCURACY.—Stage-discharge relation fairly permanent. Rating curves used as follows: June 19, 1917, to June 8, 1918, and July 1 to September 30, 1918, well defined below 2,400 second-feet; fairly well defined above 2,400 second-feet. Shifting-control method used June 9–30, 1918, on account of temporary change in stage-discharge relation. Gage read to quarter-tenths twice daily during open-water periods, and once daily to open-water surface, except as noted, during ice periods. Daily discharge ascertained by applying mean daily gage height to rating table, except for period of ice effect, December 8, 1917, to February 23, 1918, for which it was determined from observer's notes, weather records, and comparison with records for Republican River at Wakefield. Records for open water good; winter records subject to error.

Discharge measurements of Kansas River at Ogden, Kans., for the period June 19, 1917, to Sept. 30, 1918.

[Made by R. C. Rice.]

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
1917.	Feet.	Sec.-ft.	1918.	Feet.	Sec.-ft.	1918.	Feet.	Sec.-ft.
June 19.....	6.34	1,660	Mar. 21.....	5.58	1,090	May 27.....	8.65	4,690
July 25.....	4.23	354	May 24.....	8.72	4,970	June 12.....	8.06	3,400
Sept. 3.....	5.13	769	May 24.....	8.90	5,100	July 17.....	5.04	692

Daily gage height, in feet, of Kansas River at Ogden, Kans., for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1.....	5.9	4.7	4.9	4.95	5.1	5.7	5.35	7.15	8.65	5.45	5.85	5.0
2.....	6.9	4.65	4.9	5.05	5.2	5.8	5.25	6.85	8.1	5.45	6.0	5.75
3.....	6.7	4.7	4.75	5.25	5.1	5.75	5.4	6.7	8.75	5.4	6.15	5.45
4.....	6.4	4.7	4.95	5.05	5.05	5.8	5.4	6.35	8.5	5.0	5.85	5.5
5.....	6.1	4.55	4.9	5.0	5.2	6.0	5.35	6.0	9.1	5.5	5.7	5.65
6.....	5.9	4.7	4.85	5.1	5.1	6.3	5.35	5.9	10.45	5.2	5.5	6.7
7.....	5.55	4.7	4.6	5.05	5.2	6.35	5.3	5.8	11.0	5.05	5.45	7.8
8.....	5.5	4.7	5.5	5.1	5.2	6.25	5.25	5.65	11.4	5.1	5.2	7.0
9.....	5.4	4.75	5.2	5.1	5.15	6.4	5.2	5.4	10.8	5.0	5.15	6.1
10.....	5.15	4.75	5.2	5.9	4.95	6.25	5.2	5.4	9.65	4.8	5.0	5.7
11.....	5.1	4.75	5.3	5.9	4.6	6.25	5.2	5.4	8.6	4.65	4.95	5.4
12.....	5.0	4.55	5.15	5.55	4.8	6.35	5.2	5.3	8.0	4.7	4.95	5.05
13.....	5.05	4.8	5.1	5.55	4.6	6.15	5.15	5.25	7.65	4.8	5.65	4.95
14.....	4.85	4.75	5.05	5.15	5.05	6.1	5.05	5.15	7.3	4.65	6.3	4.85
15.....	4.9	4.75	4.95	4.45	5.0	6.0	5.2	5.15	7.1	4.8	6.0	4.6
16.....	4.85	4.8	4.65	5.4	4.3	5.9	5.25	5.05	6.85	4.8	5.65	4.8
17.....	4.8	4.75	4.7	4.95	4.3	5.8	5.25	5.05	6.7	5.15	5.5	4.7
18.....	4.9	4.8	5.05	5.25	5.2	5.8	5.3	5.05	6.5	5.25	5.65	4.55
19.....	4.8	4.65	5.15	5.25	5.15	5.5	5.9	5.15	6.4	5.45	5.9	4.6
20.....	4.7	4.85	5.0	5.2	4.6	5.65	6.55	4.95	6.25	5.15	6.2	4.55
21.....	4.75	4.8	4.6	5.1	4.6	5.6	6.3	4.8	6.15	5.0	6.05	4.6
22.....	4.65	4.9	4.5	5.2	5.25	5.5	6.2	5.95	6.0	7.65	6.25	4.5
23.....	4.5	4.95	4.6	5.15	5.05	5.35	6.1	5.65	6.0	8.65	5.95	4.55
24.....	4.7	4.95	4.45	5.2	5.35	5.4	6.1	5.8	5.95	7.95	6.0	4.75
25.....	4.7	5.1	4.5	5.3	6.15	5.5	6.0	8.65	5.85	7.2	5.75	4.55
26.....	4.75	4.55	4.15	5.2	6.1	5.3	6.05	8.15	5.7	6.8	5.75	4.55
27.....	4.7	4.9	4.5	5.2	6.15	5.4	5.95	8.65	5.6	6.5	5.85	4.9
28.....	4.7	4.9	5.5	5.1	6.0	5.45	5.9	7.5	5.6	6.3	5.6	5.55
29.....	4.55	4.9	5.55	5.2	.....	5.4	5.95	7.15	5.45	6.2	5.45	5.9
30.....	4.75	4.7	5.2	5.05	.....	5.3	6.35	7.55	5.8	6.05	5.3	6.6
31.....	4.7	.....	5.1	5.2	.....	5.25	.....	7.7	.....	6.0	5.15	.....

NOTE.—Gage read to top of ice Dec. 8–11, Dec. 23–25 and 27, Jan. 4–8, Feb. 16–23. Slush ice Mar. 1.

Daily discharge, in second-feet, of Kansas River at Ogden, Kans., for the period June 19, 1917, to Sept. 30, 1918.

Day.	June.	July.	Aug.	Sept.	Day.	June.	July.	Aug.	Sept.
1917.					1917.				
1.....		956	285	956	16.....		538	5,720	417
2.....		923	230	859	17.....		455	6,930	455
3.....		923	285	798	18.....		455	5,830	436
4.....		685	315	769	19.....	1,680	561	5,140	475
5.....		769	300	798	20.....	1,630	495	5,420	436
6.....		769	315	769	21.....	1,500	436	4,680	381
7.....		685	740	538	22.....	1,930	417	3,250	538
8.....		740	859	475	23.....	1,330	417	2,350	561
9.....		659	1,410	584	24.....	1,290	399	2,410	659
10.....		740	1,290	633	25.....	1,130	436	1,830	608
11.....		633	1,410	475	26.....	1,100	417	1,450	1,130
12.....		633	2,530	561	27.....	1,060	399	1,830	891
13.....		584	1,930	516	28.....	1,060	399	1,830	769
14.....		495	1,330	475	29.....	1,020	347	1,450	740
15.....		516	2,240	455	30.....	891	257	1,210	1,330
					31.....		300	1,100	

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1917-18.												
1.....	1,290	538	633			1,130	891	2,530	4,770	956	1,250	685
2.....	2,240	516	633			1,210	828	2,180	3,840	956	1,370	1,170
3.....	2,030	538	561			1,170	923	2,030	4,950	923	1,500	956
4.....	1,730	538	659			1,210	923	1,680	4,500	685	1,250	990
5.....	1,450	475	633			1,370	891	1,370	5,620	990	1,130	1,100
6.....	1,290	538	608			1,630	891	1,290	8,778	798	990	2,030
7.....	1,020	538	495			1,680	859	1,210	10,300	712	956	3,390
8.....	990	538				1,580	828	1,100	11,400	740	798	2,350
9.....	923	561				1,730	798	923	9,600	685	769	1,450
10.....	769	561				1,580	798	923	6,600	584	685	1,130
11.....	740	561				1,580	798	923	4,300	516	659	923
12.....	685	475			500	1,680	798	859	3,300	538	659	712
13.....	712	584				1,500	769	828	2,900	584	1,100	659
14.....	608	561				1,450	712	769	2,500	516	1,630	608
15.....	633	561				1,370	798	769	2,250	584	1,370	495
16.....	608	584			500	1,290	828	712	2,000	584	1,100	584
17.....	584	561				1,210	828	712	1,850	769	990	538
18.....	633	584				1,210	859	712	1,700	828	1,100	475
19.....	584	516				990	1,290	769	1,600	956	1,290	495
20.....	538	608				1,100	1,880	659	1,450	769	1,540	475
21.....	561	584				1,060	1,630	584	1,350	685	1,410	495
22.....	516	633				990	1,540	1,330	1,250	3,180	1,580	455
23.....	455	659				891	1,450	1,100	1,300	4,770	1,330	475
24.....	538	659				923	1,450	5,040	1,250	3,620	1,370	561
25.....	538	740				990	1,370	4,770	1,150	2,590	1,170	475
26.....	561	475				1,450	859	1,410	3,920	1,050	2,130	475
27.....	538	633				1,500	923	1,330	4,770	1,000	1,830	633
28.....	538	633				1,370	956	1,290	2,970	1,020	1,630	1,020
29.....	475	633					923	1,330	2,530	920	1,540	956
30.....	561	538					859	1,680	3,040	1,170	1,410	859
31.....	538						828		3,250		1,370	769

NOTE.—Stage-discharge relation affected by ice Dec. 8 to Feb. 23. Braced figures show mean discharge for period included.

Monthly discharge of Kansas River at Ogden, Kans., for the period June 19, 1917, to Sept. 30, 1918.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
1917.				
June 19-30.....	1, 930	891	1, 300	30, 900
July.....	956	257	563	34, 600
August.....	6, 930	230	2, 190	135, 000
September.....	1, 320	381	650	38, 700
The period.....				239, 000
1917-18.				
October.....	2, 240	455	835	51, 300
November.....	740	475	571	34, 000
December.....			485	29, 800
January.....			500	30, 700
February.....			650	36, 100
March.....	1, 730	828	1, 220	75, 000
April.....	1, 880	712	1, 090	64, 900
May.....	5, 040	584	1, 810	111, 000
June.....	11, 400	920	3, 520	209, 000
July.....	4, 770	516	1, 270	78, 100
August.....	1, 630	659	1, 130	69, 500
September.....	3, 390	455	967	57, 500
The year.....	11, 400		1, 170	847, 000

KANSAS RIVER AT TOPEKA, KANS.

LOCATION.—Midway between Topeka Sand Co.'s sand dip and Fowler's sand dip, between foot of Topeka Avenue and Harrison Street, 300 feet downstream from Chicago, Rock Island & Pacific Railroad Co.'s bridge and 1,900 feet upstream from Melan arch highway bridge on Kansas Avenue, Topeka, Shawnee County. Reinforced-concrete well and shelter for water-stage recorder is in high-water portion of channel on right bank, 50 feet north of concrete levee. Soldier Creek enters about $1\frac{1}{2}$ miles downstream.

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—April 24 to August 31, 1904; June 12, 1917, to September 30, 1918.

GAGE.—Water-stage recorder location: Stevens water-stage recorder used April 4 to May 30, 1918. Beginning May 31, 1918, outside staff gage read by E. F. Charlton. Gage datum same as for United States Geological Survey chain gage.

Chain gage location: Chain gage bolted to downstream end of floor beam of second span of Chicago, Rock Island & Pacific Railroad bridge, 235 feet out from right abutment; read by T. H. Beeson. Gage set to read same as United States Weather Bureau chain gage on Melan arch bridge on June 12, 1917, when the stage there read 9.1 feet at 1.40 p. m. Chain gage removed during 1919.

1904: Vertical staff, painted on south face of first pier from left end of bridge; set at an arbitrary datum. Gage used for flood observations.

DISCHARGE MEASUREMENTS.—Made from downstream side of Chicago, Rock Island & Pacific Railroad bridge or from downstream side of Sardou Avenue highway bridge, about 1 mile downstream from water-stage recorder location.

CHANNEL AND CONTROL.—Bed composed of sand and silt. Melan bridge and old piles and riprapping under and upstream from Melan bridge act as a partial control for the stage-discharge relation. Sand bars in the channel on the left bank between Chicago, Rock Island & Pacific Railroad bridge and Melan bridge influenced the stage-discharge relation of Geological Survey chain gage at medium and low stages, but do not appear to affect the stage-discharge relation of the

water-stage recorder, which is more directly within the main channel at all stages. Both banks have levees protecting Topeka, and the stream is confined within these at all stages.

During January and February, 1918, considerable piling was removed from under Melan bridge by North Topeka drainage district and South Side levee district No. 6, for the purpose of increasing the scouring effect and carrying capacity of the river channel during high-water periods.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, water-stage recorder location, 12.4 feet at 4 p. m. May 29, 1918 (discharge, 24,400 second-feet); minimum stage recorded, 3.15 feet at 7.30 a. m. September 28, 1918 (discharge, 705 second-feet). These are also the extremes recorded since station was established in 1917.

ICE.—Stage-discharge relation seriously affected by ice; data not sufficient to warrant estimates of flow. The activities of Topeka Sand Co. kept the channel past the Survey chain gage open part of the time during the frozen period December 5, 1917, to February 11, 1918, although the stage-discharge relation was undoubtedly affected. Maximum ice thickness recorded during year, 15 to 17 inches, February 3, 1918.

REGULATION.—None, except slight effect from power regulation on tributaries upstream noticeable at low stages.

ACCURACY.—Stage-discharge relation fairly permanent. Rating curves used as follows: October 1 to December 4, 1917, and February 12 to April 3, 1918, fairly well defined between 1,010 and 3,500 second-feet; April 4 to September 30, 1918, fairly well defined. Chain and staff gages read to quarter-tenths twice daily during open-water period, and daily to open-water surface, except as noted, during ice period. During period April 4 to May 30, 1918, intake pipe became partially clogged and water-stage recorder did not always check with outside staff gage. Graph record corrected to outside gage datum. Daily discharge ascertained by applying mean daily gage height to rating table, except for winter period December 5, 1917, to February 11, 1918, when stage-discharge relation was affected by ice. No discharge measurements made during this period and no estimate of flow has been made. Records good.

Discharge measurements of Kansas River at Topeka, Kans., during the year ending Sept. 30, 1918.

[Made by R. C. Rice.]

Date.	Gage height.			Dis-charge.	Date.	Gage height.			Dis-charge.
	U. S. Weather Bureau gage at Melan bridge.	U. S. Geological Survey gages.				U. S. Weather Bureau gage at Melan bridge.	U. S. Geological Survey gages.		
		Chain gage at railroad bridge.	Water-stage recorder.				Chain gage at railroad bridge.	Water-stage recorder.	
	<i>Feet.</i>	<i>Feet.</i>	<i>Feet.</i>	<i>Sec.-ft.</i>		<i>Feet.</i>	<i>Feet.</i>	<i>Feet.</i>	<i>Sec.-ft.</i>
Nov. 8.....		4.13	-----	1,200	June 10.....	9.27	9.25	9.11	11,900
Mar. 5.....		5.08	-----	2,080	June 17.....	5.68	6.10	5.59	3,260
May 3.....		5.55	5.30	2,930	July 11.....	3.90	4.45	3.88	1,120
May 31.....	8.62	8.54	8.45	9,640	Aug. 26.....	4.50	4.15	4.61	1,890

^a Computed from gage relation.

Daily gage-height, in feet, of Kansas River at Topeka, Kans., for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1.....	4.85	4.05	4.1	4.65	4.7	5.2	4.45	4.6	7.7	4.5	4.9	3.95
2.....	5.0	4.05	4.05	4.6	4.6	5.1	4.35	4.9	7.6	4.65	4.9	4.3
3.....	5.25	4.1	4.15	4.55	4.5	4.95	4.5	5.35	7.55	4.35	4.75	4.1
4.....	5.6	4.15	4.1	4.6	4.6	5.05	3.9	5.2	6.9	4.25	4.7	7.05
5.....	5.45	4.1	4.05	4.7	4.65	5.1	4.0	5.05	8.2	4.4	4.65	6.7
6.....	5.35	4.05	4.05	4.7	4.6	5.1	4.1	4.85	8.7	4.2	4.5	5.6
7.....	5.15	4.0	4.65	4.7	4.6	5.25	4.15	4.6	9.0	4.3	4.35	6.7
8.....	5.0	4.1	4.95	4.55	-----	5.45	4.0	4.4	8.95	4.15	4.2	6.3
9.....	4.75	4.05	5.05	4.5	4.7	-----	3.9	4.35	9.3	4.1	4.3	6.1
10.....	4.7	4.05	5.2	-----	4.85	5.35	3.95	4.25	9.05	4.0	4.2	5.4
11.....	4.65	4.1	5.3	-----	4.85	5.4	3.9	4.15	8.25	3.9	4.0	4.9
12.....	4.5	4.05	5.5	4.7	4.5	5.4	3.85	4.1	7.45	3.9	4.0	4.6
13.....	4.45	3.95	5.5	4.7	4.45	5.35	3.85	4.05	6.85	3.75	3.8	4.4
14.....	4.4	4.05	-----	4.7	-----	-----	3.85	4.0	6.4	3.7	3.8	4.2
15.....	4.3	4.1	-----	4.8	4.2	5.2	3.95	3.9	6.1	3.8	4.3	4.1
16.....	4.35	4.0	-----	4.8	4.25	5.0	3.85	3.85	5.8	3.75	4.9	4.0
17.....	4.25	4.1	-----	4.8	5.3	5.0	3.85	3.8	5.6	3.8	5.2	3.85
18.....	4.35	4.1	4.8	-----	4.3	5.0	3.85	3.8	5.4	3.8	4.9	3.75
19.....	4.3	4.05	4.75	5.85	-----	4.85	3.9	3.75	5.3	3.95	4.6	3.7
20.....	4.35	4.05	4.7	4.9	5.25	-----	4.2	3.75	5.15	3.95	4.6	3.6
21.....	4.35	4.0	4.8	4.9	5.1	4.8	4.55	3.7	5.0	4.05	4.7	3.45
22.....	4.4	4.0	4.75	4.9	5.4	4.8	4.9	3.9	4.95	3.8	4.9	3.4
23.....	4.25	3.9	4.7	4.75	6.95	4.7	4.75	5.15	4.75	4.05	4.95	3.3
24.....	4.2	4.1	4.8	4.75	5.45	4.6	4.75	8.45	4.8	5.95	4.9	3.35
25.....	4.25	4.1	-----	4.8	-----	4.6	4.7	10.0	4.7	6.45	4.7	3.2
26.....	4.2	4.1	4.05	4.8	4.85	4.5	4.65	8.95	4.65	6.8	4.6	3.6
27.....	4.15	4.15	4.2	4.7	5.15	4.55	4.7	7.7	4.55	6.9	4.5	3.4
28.....	4.1	4.0	3.7	4.85	5.25	4.4	4.75	7.75	4.5	5.7	4.4	3.2
29.....	4.1	4.1	4.25	4.65	-----	4.45	4.65	10.6	4.5	5.45	4.4	3.3
30.....	4.1	4.05	4.4	-----	-----	4.45	4.6	11.5	4.6	5.2	4.25	3.8
31.....	4.0	-----	4.6	-----	-----	4.5	-----	8.6	-----	4.95	4.05	-----

NOTE.—Gage record from chain gage at Chicago, Rock Island & Pacific Railroad bridge, Oct. 1, 1917, to Apr. 3, 1918. Beginning Apr. 4, 1918, gage heights were measured at water-stage recorder location (see station description). Readings to top of ice Dec. 7 to 13 and 18 to 22, 1917; and Jan. 12 to 26 and Feb. 21 and 22, 1918. Omitted gage heights indicate no readings.

Daily discharge, in second-feet, of Kansas River at Topeka, Kans., for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Dec.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1.....	1,920	1,130	1,170	-----	2,350	1,490	1,880	7,620	1,760	2,280	1,180
2.....	2,100	1,130	1,130	-----	2,220	1,400	2,280	7,360	1,940	2,280	1,540
3.....	2,420	1,170	1,220	-----	2,040	1,540	2,940	7,280	1,600	2,080	1,330
4.....	2,900	1,220	1,170	-----	2,160	1,140	2,700	5,740	1,480	2,010	6,070
5.....	2,690	1,170	-----	-----	2,220	1,230	2,490	9,000	1,650	1,940	5,340
6.....	2,550	1,130	-----	-----	2,220	1,330	2,210	10,500	1,430	1,760	4,940
7.....	2,280	1,090	-----	-----	2,420	1,380	1,880	11,400	1,540	1,600	5,340
8.....	2,100	1,170	-----	-----	2,690	1,230	1,650	11,300	1,380	1,430	4,540
9.....	1,800	1,130	-----	-----	2,620	1,140	1,600	12,400	1,330	1,540	4,180
10.....	1,750	1,130	-----	-----	2,550	1,180	1,480	11,600	1,230	1,430	3,020
11.....	1,700	1,170	-----	-----	2,620	1,140	1,380	9,150	1,140	1,230	2,280
12.....	1,540	1,130	-----	1,540	2,620	1,100	1,330	6,980	1,140	1,230	1,880
13.....	1,490	1,050	-----	1,490	2,550	1,100	1,280	5,640	1,020	1,060	1,650
14.....	1,440	1,130	-----	1,380	2,450	1,100	1,230	4,740	980	1,060	1,430
15.....	1,350	1,170	-----	1,260	2,350	1,180	1,140	4,180	1,060	1,540	1,330
16.....	1,400	1,090	-----	1,300	2,100	1,100	1,100	3,660	1,020	2,280	1,220
17.....	1,300	1,170	-----	2,480	2,100	1,100	1,060	3,340	1,060	2,700	1,100
18.....	1,400	1,170	-----	1,350	2,100	1,100	1,060	3,020	1,060	2,280	1,020
19.....	1,350	1,130	-----	1,880	1,920	1,140	1,020	2,860	1,180	1,880	980
20.....	1,400	1,130	-----	2,420	1,890	1,430	1,020	2,630	1,180	1,880	910
21.....	1,400	1,090	-----	2,220	1,860	1,820	980	2,420	1,280	2,010	825
22.....	1,440	1,090	-----	2,220	1,860	2,280	1,140	2,350	1,060	2,280	800
23.....	1,300	1,010	-----	2,400	1,750	2,080	2,630	2,080	1,280	2,350	760
24.....	1,260	1,170	-----	2,690	1,640	2,080	9,750	2,140	3,910	2,280	780
25.....	1,300	1,170	-----	2,300	1,640	2,010	14,900	2,010	4,840	2,010	720
26.....	1,260	1,170	-----	1,920	1,540	1,940	11,300	1,940	5,540	1,880	910
27.....	1,220	1,220	-----	2,280	1,590	2,010	7,620	1,820	5,740	1,760	800
28.....	1,170	1,090	-----	2,420	1,440	2,080	7,750	1,760	3,500	1,650	720
29.....	1,170	1,170	-----	-----	1,490	1,940	17,200	1,760	3,100	1,650	760
30.....	1,170	1,130	-----	-----	1,490	1,880	20,600	1,880	2,700	1,480	1,060
31.....	1,090	-----	-----	-----	1,540	-----	10,200	-----	2,350	1,280	-----

NOTE.—Discharge Feb. 22 and 23 estimated, on account of ice.

Monthly discharge of Kansas River at Topeka, Kans., for the year ending Sept. 30, 1918.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October.....	2,900	1,090	1,630	100,000
November.....	1,220	1,010	1,140	67,800
February 12-28.....	2,690	1,260	1,970	66,400
March.....	2,690	1,440	2,070	127,000
April.....	2,280	1,100	1,490	88,700
May.....	20,600	980	4,410	271,000
June.....	12,400	1,760	5,350	318,000
July.....	5,740	980	1,980	122,000
August.....	2,700	1,060	1,810	111,000
September.....	6,070	720	1,980	118,000

KANSAS RIVER AT BONNER SPRINGS, KANS.

LOCATION.—In NW. $\frac{1}{4}$ sec. 32, T. 11 S. R. 23 E., at highway bridge at Bonner Springs, Wyandotte County. Wolf Creek enters from north just above Atchison, Topeka & Santa Fe Railway bridge half a mile upstream. Kansas River joins Missouri River at Kansas City, 18 miles downstream by river. Station is above backwater influence of Missouri River.

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—July 8, 1917, to September 30, 1918.

GAGE.—Chain gage on upstream handrail of highway bridge in center of second span from left bank; read by M. E. Kenton till June 8, 1918; since then by B. L. Rehm.

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

CHANNEL AND CONTROL.—Bed composed of sand, somewhat shifting. Left bank high and fairly steep; right bank subject to overflow at stage of about 18 feet. An earth levee protects the right bank from excessive overflow. The river passes under the Atchison, Topeka & Santa Fe Railway bridge and pile trestle on right bank at a slight angle but straightens out halfway between this bridge and the highway bridge and is normal to the highway bridge and for some distance downstream.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 15.35 feet at 7.50 a. m. May 30, 1918 (discharge, 48,600 second-feet); minimum stage recorded, 3.15 feet at 6 p. m. September 30, 1918 (discharge, 805 second-feet).

ICE.—Stage-discharge relation seriously affected by ice. Maximum ice thickness recorded during winter 1917-18, 12 inches, January 20-22 and February 2-5, 1918.

REGULATION.—Flow is affected by regulation of Bowersock mills at Lawrence.

ACCURACY.—Stage-discharge relation changed considerably after the rise in August, 1917, after which it was fairly permanent. Rating curves used as follows: July 8 to August 15, 1917, based on measurement made July 8, 1917, and shape of 1918 curve; August 16, 1917, to September 30, 1918, fairly well defined above 1,000 second-feet. Gage read to quarter-tenths twice daily during open-water periods, and once daily to open-water surface, except as noted, during ice periods.

Daily discharge ascertained by applying mean daily gage height to rating table, except for winter periods, December 8-22, December 27, 1917, to February 13, 1918, February 21 and 22, 1918, when stage-discharge relation was affected by ice. Discharge estimated February 21 and 22, 1918, and interpolated June 8-10, 1918. Open-water records for 1917 fair; for 1918 good.

Discharge measurements of Kansas River at Bonner Springs, Kans., during the year ending Sept. 30, 1918.

Made by R. C. Rice.]

Date.	Gage height.	Dis-charge.	Date.	Gage height.	Dis-charge.
	<i>Feet.</i>	<i>Sec.-ft.</i>		<i>Feet.</i>	<i>Sec.-ft.</i>
Mar. 19.....	4.27	2,340	June 21.....	4.72	3,080
May 10.....	4.06	2,040	July 12.....	3.69	1,430
June 1.....	8.18	12,300			

Daily gage height, in feet, of Kansas River at Bonner Springs, Kans., for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1.....	4.35	3.7	3.7	3.7	4.2	4.55	3.85	4.35	7.35	4.35	4.5	3.6
2.....	4.25	3.7	3.7	3.9	4.25	4.5	3.85	4.35	6.95	4.25	4.3	5.3
3.....	4.2	3.7	3.7	3.95	4.25	4.45	3.85	4.35	6.7	4.15	4.25	5.55
4.....	4.3	3.65	3.65	4.0	4.2	4.35	3.8	4.5	6.2	4.0	4.1	5.35
5.....	4.5	3.7	3.65	4.0	4.2	4.3	3.85	4.6	7.0	3.95	3.95	6.3
6.....	4.7	3.75	3.65	4.0	4.2	4.3	3.85	4.55	7.55	4.0	3.95	6.05
7.....	4.6	3.7	3.6	4.0	4.25	4.3	3.85	4.4	7.75	3.95	3.95	5.65
8.....	4.4	3.7		4.0	4.2	4.4	3.85	4.3		3.9	3.9	5.6
9.....	4.3	3.7		4.05	4.15	4.5	3.8	4.2		3.9	3.75	5.35
10.....	4.3	3.7		4.05	4.2	4.55	3.8	4.05		3.85	3.7	5.25
11.....	4.1	3.7		4.05	4.15	4.6	3.8	4.0	7.6	3.65	3.75	4.8
12.....	4.0	3.7		4.1	4.15	4.55	3.8	4.0	7.15	3.6	3.65	4.4
13.....	4.05	3.75		4.1	4.15	4.55	3.8	3.85	6.5	3.65	3.5	4.1
14.....	4.0	3.7		4.1	4.1	4.5	3.8	3.9	6.1	3.6	3.5	3.95
15.....	4.0	3.7		4.1	4.1	4.45	3.8	3.85	6.2	3.55	3.45	3.85
16.....	3.9	3.7		4.05	4.1	4.4	3.8	3.75	5.45	3.45	3.45	3.7
17.....	3.9	3.75		4.05	4.0	4.3	3.8	3.7	5.3	3.5	3.85	3.7
18.....	3.9	3.75		4.1	3.95	4.25	3.75	3.7	5.1	3.55	4.2	3.5
19.....	3.95	3.7		4.05	3.9	4.25	3.8	3.65	4.95	3.5	4.3	3.6
20.....	3.8	3.75		4.05	3.8	4.2	3.85	3.6	4.8	3.6	4.0	3.65
21.....	3.8	3.75		4.05		4.2	3.9	3.6	4.7	3.7	3.9	3.45
22.....	3.8	3.75		4.1		4.15	4.0	3.6	4.6	3.7	3.9	3.4
23.....	3.9	3.7	3.75	4.1	3.6	4.1	4.2	3.85	4.55	3.7	4.05	3.3
24.....	3.85	3.7	3.8	4.15	3.6	4.1	4.3	5.45	4.45	3.65	5.0	3.3
25.....	3.9	3.7	3.8	4.2	3.8	4.05	4.3	7.25	4.4	4.35	4.55	3.3
26.....	3.8	3.7	3.9	4.2	4.2	4.0	4.35	8.5	4.3	5.5	4.35	3.2
27.....	3.8	3.75		4.2	4.4	4.0	4.35	7.3	4.3	5.5	4.1	3.2
28.....	3.8	3.7		4.2	4.45	3.95	4.35	6.4	4.2	6.15	3.95	3.25
29.....	3.8	3.7		4.2		3.95	4.4	12.6	4.0	5.25	3.85	3.25
30.....	3.7	3.7	3.65	4.2		3.9	4.4	14.9	4.3	5.45	3.85	3.15
31.....	3.7		3.65	4.2				11.7		5.2	3.8	

a 15.35 feet at 7.50 a. m.

NOTE.—River frozen, Dec. 8–22, Dec. 27–Feb. 13, Feb. 21–22. No observed gage heights for days on which no record is given. Gage read to top of ice Feb. 10–12. No gage observer June 8–10.

Daily discharge, in second-feet, of Kansas River at Bonner Springs, Kans., for the period July 8, 1917, to Sept. 30, 1918.

Day.	July.	Aug.	Sept.	Day.	July.	Aug.	Sept.	Day.	July.	Aug.	Sept.
1917.				1917.				1917.			
1.....		1,360	3,150	11.....	2,230	3,620	5,200	21.....	1,630	7,040	2,060
2.....		1,220	2,890	12.....	2,070	3,350	4,990	22.....	1,560	6,800	1,900
3.....		1,160	2,720	13.....	2,070	3,530	3,980	23.....	1,560	6,920	1,820
4.....		1,160	2,640	14.....	1,990	5,220	3,600	24.....	1,560	5,870	1,820
5.....		1,220	2,380	15.....	1,990	6,020	3,060	25.....	1,560	4,780	2,140
6.....		1,160	2,220	16.....	1,840	8,080	2,720	26.....	1,560	4,470	4,080
7.....		1,220	2,140	17.....	1,840	5,760	2,460	27.....	1,700	4,470	4,670
8.....	2,480	1,290	2,140	18.....	1,770	6,100	2,380	28.....	1,700	3,790	3,600
9.....	2,480	2,650	3,060	19.....	1,560	7,940	2,140	29.....	1,560	3,420	3,060
10.....	2,400	4,000	3,600	20.....	1,630	7,040	2,060	30.....	1,420	3,420	2,720
								31.....	1,420	3,420	.....

Daily discharge, in second-feet, of Kansas River at Bonner Springs, Kans., for the period July 8, 1917, to Sept. 30, 1918—Continued.

Day.	Oct.	Nov.	Dec.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1917-18.											
1.....	2,460	1,450	1,450	.....	2,800	1,660	2,460	9,040	2,460	2,720	1,320
2.....	2,300	1,450	1,450	.....	2,720	1,660	2,460	7,940	2,300	2,380	4,170
3.....	2,220	1,450	1,450	.....	2,640	1,660	2,460	7,290	2,140	2,300	4,680
4.....	2,380	1,380	1,380	.....	2,460	1,590	2,720	6,100	1,900	2,060	4,270
5.....	2,720	1,450	1,380	.....	2,380	1,660	2,890	8,080	1,820	1,820	6,330
6.....	3,060	1,520	1,380	.....	2,380	1,660	2,800	9,630	1,900	1,820	5,760
7.....	2,890	1,450	1,320	.....	2,380	1,660	2,550	10,200	1,820	1,820	4,880
8.....	2,550	1,450	.....	.....	2,550	1,660	2,380	10,100	1,740	1,740	4,780
9.....	2,380	1,450	.....	.....	2,720	1,590	2,220	9,990	1,740	1,520	4,270
10.....	2,380	1,450	.....	.....	2,800	1,590	1,980	9,880	1,660	1,450	4,080
11.....	2,060	1,450	.....	.....	2,890	1,590	1,900	9,780	1,380	1,520	3,240
12.....	1,900	1,450	.....	.....	2,800	1,590	1,900	8,480	1,320	1,380	2,550
13.....	1,980	1,520	.....	.....	2,800	1,590	1,660	6,800	1,380	1,200	2,060
14.....	1,900	1,450	.....	2,060	2,720	1,590	1,740	5,870	1,320	1,200	1,820
15.....	1,900	1,450	.....	2,060	2,640	1,590	1,660	6,100	1,260	1,140	1,660
16.....	1,740	1,450	.....	2,060	2,550	1,590	1,520	4,470	1,140	1,140	1,450
17.....	1,740	1,520	.....	1,900	2,380	1,590	1,450	4,170	1,200	1,660	1,450
18.....	1,740	1,520	.....	1,820	2,300	1,520	1,450	3,790	1,260	2,220	1,200
19.....	1,820	1,450	.....	1,740	2,300	1,590	1,380	3,510	1,200	2,380	1,320
20.....	1,590	1,520	.....	1,590	2,220	1,660	1,320	3,240	1,320	1,900	1,380
21.....	1,590	1,520	.....	1,500	2,220	1,740	1,320	3,060	1,450	1,740	1,140
22.....	1,590	1,520	.....	1,410	2,140	1,900	1,320	2,890	1,450	1,740	1,080
23.....	1,740	1,450	1,520	.....	1,320	2,060	2,220	2,800	1,450	1,980	970
24.....	1,660	1,450	1,590	1,320	2,060	2,380	4,470	2,640	1,380	3,600	970
25.....	1,740	1,450	1,590	1,590	1,980	2,380	8,760	2,550	2,460	2,800	970
26.....	1,590	1,450	1,740	2,220	1,900	2,460	12,600	2,380	4,570	2,460	860
27.....	1,590	1,520	.....	2,550	1,900	2,460	8,900	2,380	4,570	2,060	860
28.....	1,590	1,450	.....	2,640	1,820	2,460	6,560	2,220	5,980	1,820	915
29.....	1,590	1,450	.....	.....	1,820	2,550	31,700	1,900	4,080	1,660	915
30.....	1,450	1,450	.....	.....	1,740	2,550	45,700	2,380	4,470	1,660	805
31.....	1,450	.....	.....	.....	1,700	.....	26,700	.....	3,980	1,590	.....

Monthly discharge of Kansas River at Bonner Springs, Kans., for the period July 8, 1917, to Sept. 30, 1918.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
1917.				
July 8-31.....	2, 480	1, 420	1, 820	86, 500
August.....	8, 080	1, 160	4, 110	253, 000
September.....	5, 200	1, 820	2, 910	173, 000
1917-18.				
October.....	3, 060	1, 450	1, 980	122, 000
November.....	1, 520	1, 380	1, 470	87, 500
February 14-28.....			1, 850	55, 000
March.....	2, 890	1, 700	2, 350	144, 000
April.....	2, 550	1, 590	1, 850	110, 000
May.....	45, 700	1, 320	6, 150	378, 000
June.....	10, 200	1, 900	5, 660	337, 000
July.....	5, 980	1, 140	2, 200	135, 000
August.....	3, 600	1, 140	1, 890	116, 000
September.....	6, 330	805	2, 410	143, 000

SMOKY HILL RIVER AT ELLSWORTH, KANS.

LOCATION.—In SE. $\frac{1}{4}$ sec. 20, T. 15 S., R. 8 W., at Pioneer Memorial highway bridge at Ellsworth, Ellsworth County. Turkey Creek enters from south 2 miles upstream; Oxide Creek enters from south 2 miles downstream.

DRAINAGE AREA.—7,980 square miles.

RECORDS AVAILABLE.—April 17, 1895, to October 31, 1905, and July 23 to September 30, 1918. Station discontinued October 31, 1905; reestablished July 23, 1918.

GAGE.—Chain gage fastened to upstream concrete handrail in center span of reinforced concrete arch bridge, read by E. A. Forkner.

1895-1905: Staff gage used, in two sections, fastened to pier of old highway bridge on south bank at different datum.

DISCHARGE MEASUREMENTS.—Made from downstream side of highway bridge or by wading.

CHANNEL AND CONTROL.—Bed composed of sand, shifting. Channel is straight in vicinity of gage, left bank high. Right bank low and is overflowed at high stage. Bank-full stage about 20 feet.

EXTREMES OF DISCHARGE.—Maximum stage recorded during period, 2.8 feet, July 23 and 24 (discharge, 150 second-feet); minimum stage recorded during period, 2.05 feet September 23-25 (discharge, 29 second-feet).

1895-1905: Maximum stage recorded, 16.55 feet July 5, 1895 (discharge, 21,000 second-feet); minimum stage recorded, 0.5 foot August 4-7, 1901 (discharge, 5 second-feet). Gage used during this period at different datum than present gage.

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

REGULATION.—None.

ACCURACY.—Stage-discharge relation fairly permanent. Rating curve well defined above 100 second-feet, based on discharge measurements made during 1918 and 1919, poorly defined below 100 second-feet. Gage read to quarter-tenths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table. Records fair.

The following discharge measurement was made by R. C. Rice:

July 23, 1918: Gage height, 2.80 feet; discharge, 149 second-feet.

Daily gage height, in feet, of Smoky Hill River at Ellsworth, Kans., for the year ending Sept. 30, 1918.

Day.	July.	Aug.	Sept.	Day.	July.	Aug.	Sept.	Day.	July.	Aug.	Sept.
1.....		2.45	2.1	11.....		2.2	2.15	21.....		2.35	2.1
2.....		2.4	2.15	12.....		2.2	2.1	22.....		2.3	2.05
3.....		2.35	2.15	13.....		2.35	2.1	23.....	2.8	2.3	2.05
4.....		2.3	2.2	14.....		2.4	2.1	24.....	2.8	2.3	2.05
5.....		2.25	2.2	15.....		2.55	2.1	25.....	2.75	2.3	2.05
6.....		2.2	2.2	16.....		2.7	2.1	26.....	2.65	2.25	2.2
7.....		2.25	2.15	17.....		2.6	2.1	27.....	2.7	2.2	2.15
8.....		2.25	2.15	18.....		2.5	2.1	28.....	2.6	2.2	2.1
9.....		2.25	2.1	19.....		2.45	2.1	29.....	2.5	2.15	2.1
10.....		2.25	2.1	20.....		2.4	2.1	30.....	2.5	2.15	2.1
								31.....	2.45	2.2	-----

Daily discharge, in second-feet, of Smoky Hill River at Ellsworth, Kans., for the year ending Sept. 30, 1918.

Day.	July.	Aug.	Sept.	Day.	July.	Aug.	Sept.	Day.	July.	Aug.	Sept.
1.....		32	34	11.....		46	40	21.....		67	34
2.....		74	40	12.....		46	34	22.....		60	29
3.....		67	40	13.....		67	34	23.....	150	60	29
4.....		60	46	14.....		74	34	24.....	150	60	29
5.....		53	46	15.....		99	34	25.....	139	60	29
6.....		46	46	16.....		128	34	26.....	118	53	46
7.....		53	40	17.....		108	34	27.....	128	46	40
8.....		53	40	18.....		90	34	28.....	108	46	34
9.....		53	34	19.....		82	34	29.....	90	40	34
10.....		53	34	20.....		74	34	30.....	90	40	34
								31.....	82	46	-----

Monthly discharge of Smoky Hill River at Ellsworth, Kans., for the year ending Sept. 30, 1918.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
July 23-31.....	150	82	117	2,090
August.....	128	40	64.1	3,940
September.....	46	29	36.1	2,150

SMOKY HILL RIVER NEAR ABILENE, KANS.

LOCATION.—In SE. $\frac{1}{4}$ sec. 23, T. 13 S., R. 1 E., at highway bridge at Sand Springs, 4 miles west of Abilene, Dickinson County. Holland Creek enters from south, 3 miles downstream. Station is 5 miles in a direct line (9 miles by river) below mouth of Solomon River.

DRAINAGE AREA.—18,700 square miles (authority, United States Weather Bureau).

RECORDS AVAILABLE.—United States Geological Survey: June 19 to September 30, 1918. United States Weather Bureau: November 22, 1904, to June 18, 1918.

GAGE.—Chain gage of United States Weather Bureau fastened to downstream handrail of highway bridge, 56 feet from left abutment, read by T. W. Sherman. Gage installed July 6, 1917, by Montrose W. Hayes, meteorologist, United States Weather Bureau, by levels from bench marks; replaced gages previously used at this station.

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

CHANNEL AND CONTROL.—Sand and silt. Control fairly permanent. Channel is straight, with well distributed velocity for a long distance up and down stream from the gage, curving gently some distance downstream. Bank-full stage about 22 feet. Both banks are overflowed at extremely high stages, the right bank for a considerable distance. Overflow on the left bank is controlled largely by railroad embankments that parallel the river for some distance.

EXTREMES OF DISCHARGE.—Maximum stage recorded during period, February 3 to September 30, 1918, 17.6 feet June 7 (discharge, 9,250 second-feet); minimum stage recorded during same period, 0.1 foot, August 12-14, September 19-20, also days in February (discharge, 84 second-feet).

1904-1918: United States Weather Bureau record—Maximum stage recorded, 24.0 feet June 11, 1908 (discharge, not determined); minimum stage recorded, —0.5 foot July 12, 1911, and other dates (discharge, not determined). High-water mark, 28.4 feet, May 29, 1903, notch cut in root on south side of cottonwood tree by observer, on north side of Golden Belt highway directly across from pump house; determined by levels from bench marks by M. W. Hayes, meteorologist, United States Weather Bureau, in 1917. (A high-water mark of 27.3 feet for this date has been given by United States Weather Bureau in various issues of "Daily River Stages.")

ICE.—Stage-discharge relation affected by ice. Sand Springs, which furnish the water supply for Abilene, flow into the river a short distance upstream from gage and tend to keep river open at gage, except during severe weather.

REGULATION.—Flow is affected by regulation of mill dams on Smoky Hill River and its principal tributaries upstream. The Riverside Light, Power & Gas Co.'s dam, south of Abilene, about 10 miles downstream from gage, backs water within a mile of Sand Springs. It is stated by officials of the company that in the history of the dam the backwater has never reached as far as Sand Springs.

ACCURACY.—Stage-discharge relation permanent. Rating curve used February 3 to September 30, 1918, well defined between 200 and 1,500 second-feet and between 2,500 and 8,000 second-feet; poorly defined below 200 second-feet. Above 8,000 second-feet curve has been developed from study of high-water measurement made June 13, 1919, and of area and velocity curves. Gage read to quarter-tenths twice daily beginning June 19, 1918; prior to that it was read to tenths by United States Weather Bureau. Daily discharge ascertained by applying mean daily gage height to rating table for period February 3 to September 30, 1918. No estimate of flow made for ice period December 3, 1917, to February 2, 1918. Records for February to May, fair; June to September, good.

COOPERATION.—Gage height record October 1, 1917, to June 18, 1918, furnished by United States Weather Bureau.

The following discharge measurement was made by R. C. Rice:

July 19, 1918: Gage height, 1.38 feet; discharge, 400 second-feet.

Daily gage height, in feet, of Smoky Hill River near Abilene, Kans., for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1.....	2.3	0.8	0.9	0.9	0.4	1.0	1.4	4.5	7.8	1.1	2.75	0.25
2.....	1.7	.8	.9	.9	.3	1.0	1.4	3.8	3.7	1.1	1.9	.2
3.....	1.3	.8	.7	.5	.2	1.0	1.4	2.7	3.4	1.1	1.25	.2
4.....	1.3	.7	.8	.5	.2	1.4	1.1	2.1	9.1	1.0	.85	1.5
5.....	1.0	.6	.8	.4	.2	2.0	1.0	1.5	10.6	1.0	.65	7.15
6.....	1.0	.7	.9	.3	.1	2.4	.9	1.2	14.7	1.0	.5	7.35
7.....	.9	.8	.9	.4	.1	2.4	.9	1.0	17.0	.95	.45	2.9
8.....	.8	.8	.9	.5	.2	2.2	.8	.9	15.7	.8	.4	2.2
9.....	.4	.8	.9	.3	.2	2.0	.8	.8	8.2	.7	.25	1.4
10.....	1.0	.7	1.0	.4	.1	2.0	.7	.8	7.0	.8	.2	.35
11.....	1.2	.6	1.0	.5	.1	1.8	.7	.7	6.1	.95	.15	.35
12.....	.9	.6	1.0	.5	.2	1.4	.9	.7	5.3	.7	.1	.35
13.....	.6	.6	.9	.3	.4	1.4	.7	.7	4.8	.6	.1	.3
14.....	.4	.8	.9	.3	.8	1.0	.7	.6	4.3	.5	.1	.3
15.....	.3	.8	.9	.4	1.2	1.0	.8	.6	3.8	.6	.9	.4
16.....	.7	.8	.9	.4	1.3	1.0	.8	.6	3.4	.6	2.1	.4
17.....	.5	.8	.9	.5	1.3	1.0	1.1	.7	3.1	1.9	1.7	.3
18.....	.6	.9	.9	.5	1.1	.9	3.7	.6	2.9	1.55	1.4	.2
19.....	.6	.8	.9	.5	1.1	.9	3.2	.5	2.7	1.25	1.05	.1
20.....	1.2	.6	.9	.3	1.1	.9	2.7	.5	2.5	2.25	.95	.1
21.....	.9	.7	.9	.3	1.2	.8	2.3	.5	2.2	4.9	.8	.15
22.....	.6	.8	.9	.4	1.3	.7	2.1	.5	2.0	6.3	.6	.15
23.....	.6	.8	.9	.4	1.2	.7	1.8	3.1	1.95	3.2	.55	.15
24.....	.8	.9	.9	.4	1.2	.7	2.0	1.8	1.85	1.8	.6	.3
25.....	.8	.9	.9	.5	1.2	.6	1.5	6.2	1.8	1.55	.7	.5
26.....	.8	.7	.9	.4	1.1	.6	1.6	8.1	1.8	1.4	.7	1.2
27.....	.9	.7	.9	.4	1.0	.7	1.4	4.5	1.6	1.3	.65	2.5
28.....	.9	.8	.9	.4	1.0	.7	1.5	3.2	1.4	1.65	.55	3.0
29.....	.8	.9	.9	.4	-----	.7	4.0	1.9	1.3	1.35	.4	6.5
30.....	.8	.9	.9	.4	-----	1.0	5.4	4.6	1.3	1.1	.3	4.05
31.....	.8	-----	.9	.4	-----	1.0	-----	10.2	-----	1.6	.25	-----

NOTE.—Gage read to top of ice Dec. 8-Jan. 2, Jan. 26-Feb. 2.

Daily discharge, in second-feet, of Smoky Hill River near Abilene, Kans., for the year ending Sept. 30, 1918.

Day.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1.....		278	408	1,480	2,800	308	870	108
2.....		278	408	1,240	1,200	308	578	100
3.....	100	278	408	852	1,100	308	357	100
4.....	100	408	308	646	3,510	278	237	442
5.....	100	612	278	442	4,500	278	188	2,490
6.....	84	748	250	340	7,460	278	154	2,580
7.....	84	748	250	278	9,250	264	144	922
8.....	100	680	224	250	8,230	224	134	680
9.....	100	612	224	224	3,000	200	108	408
10.....	84	612	200	224	2,420	224	100	125
11.....	84	544	200	200	2,070	264	92	125
12.....	100	408	250	200	1,770	200	84	125
13.....	134	408	200	200	1,590	176	84	116
14.....	224	278	200	176	1,410	154	84	116
15.....	340	278	224	176	1,240	176	250	134
16.....	374	278	224	176	1,100	176	646	134
17.....	374	278	308	200	992	578	510	116
18.....	308	250	1,200	176	922	459	408	100
19.....	308	250	1,030	154	852	357	293	84
20.....	308	250	852	154	782	697	264	84
21.....	340	224	714	154	680	1,630	224	92
22.....	374	200	646	154	612	2,150	176	92
23.....	340	200	544	992	595	1,030	165	92
24.....	340	200	612	544	561	544	176	116
25.....	340	176	442	2,110	544	459	200	154
26.....	308	176	476	2,950	544	408	200	340
27.....	278	200	408	1,480	476	374	188	782
28.....	278	200	442	1,030	408	493	165	957
29.....		200	1,310	578	374	391	134	2,220
30.....		278	1,810	1,520	374	308	116	1,320
31.....		278		4,230		476	108	

Monthly discharge of Smoky Hill River near Abilene, Kans., for the year ending Sept. 30, 1918.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
February 3-28.....	374		227	11,700
March.....	748	176	349	21,500
April.....	1,810	200	502	29,900
May.....	4,230	154	759	46,700
June.....	9,250	374	2,050	122,000
July.....	2,150	154	457	28,100
August.....	870	84	240	14,800
September.....	2,580	84	508	30,200
The period.....				305,000

SOLOMON RIVER NEAR BENNINGTON, KANS.

LOCATION.—In SW. $\frac{1}{4}$ sec. 28, T. 11 S., R. 3 W., at "Darling Point" highway bridge, 2 miles north and $3\frac{1}{2}$ miles west from Bennington, Ottawa County, and 5 miles southeast of Minneapolis. Salt Creek enters from west about $1\frac{1}{2}$ miles upstream.

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—October 1, 1917, to September 30, 1918.

GAGE.—Vertical staff painted on downstream cylinder pier of highway bridge on right bank, with vertical staff, fastened to same pier, for low stages; read by Eugene Gray.

DISCHARGE MEASUREMENTS.—Made from downstream side of highway bridge or by wading.

CHANNEL AND CONTROL.—Sand and silt, somewhat shifting. Channel is narrow and winding, with steep banks heavily wooded. One channel except at extremely high stage, when overflow occurs through a draw 500 feet west of the bridge. Stream is at a slight angle to bridge. Bank-full stage about gage height 25 feet.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 21.0 feet at noon, June 6, 1918 (discharge, about 8,130 second-feet, determined from extension of rating curve); minimum stage recorded during year, 1.35 feet November 22, 1917 (discharge, 14 second-feet).

ICE.—Stage-discharge relation seriously affected by ice. Maximum ice thickness recorded, winter 1917-18, 16 inches, February 5, 1918.

REGULATION.—Flow noticeably affected by regulation of mill dams upstream on Solomon River and the North and South forks; the nearest milldam is at Minneapolis.

ACCURACY.—Stage-discharge relation fairly permanent for low and medium stages. Rating curves used, fairly well defined below 2,100 second-feet, but not defined by discharge measurements for the high stages that occurred during May, June, and September. Staff gage read to quarter-tenths twice daily during open-water season, oftener during extremely high-water periods, and daily to open-water surface, except as noted, during ice periods. Daily discharge ascertained by applying mean daily gage height to rating table except for period of ice effect, December 8, 1917, to February 23, 1918, for which it was determined from observer's notes, weather records, and comparison with records for other stations in the upper Kansas River basin. Records for open-water periods good, except for May, June, and September, which are fair; winter records subject to error.

Discharge measurements of Solomon River near Bennington, Kans., during the year ending Sept. 30, 1918.

[Made by R. C. Rice.]

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	<i>Feet.</i>	<i>Sec.-ft.</i>		<i>Feet.</i>	<i>Sec.-ft.</i>
Mar. 23.....	2.06	69	June 14.....	4.53	481
May 26.....	7.54	1,140	July 19.....	3.87	385
27.....	5.49	652			

Daily gage height, in feet, of Solomon River near Bennington, Kans., for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1.....	3.0	2.0	1.8	1.8	1.9	2.3	1.95	2.5	4.05	2.8	5.2	2.25
2.....	2.4	1.7	1.75	1.6	2.0	1.85	1.95	2.45	10.9	2.65	4.5	2.6
3.....	2.25	1.55	3.0	1.6	2.05	1.8	2.15	2.45	15.6	2.6	3.85	6.0
4.....	2.45	1.65	1.85	1.6	2.1	2.3	2.05	2.5	17.3	2.6	3.3	14.6
5.....	1.9	1.55	2.3	2.4	2.2	2.3	1.75	2.0	19.4	2.65	2.6	12.25
6.....	2.2	1.7	1.5	2.2	2.2	2.35	1.85	2.3	19.9	2.75	2.45	5.4
7.....	1.95	1.7	1.5	1.9	2.15	2.9	1.9	2.1	9.05	2.4	2.25	3.5
8.....	2.35	1.75	1.6	1.65	2.2	4.65	1.85	2.1	6.9	2.4	2.35	2.9
9.....	1.8	1.55	1.6	1.6	2.2	3.7	2.15	2.1	6.75	2.45	2.25	.....
10.....	1.8	1.4	1.65	1.7	2.4	3.05	2.1	2.15	5.95	2.5	2.2	.....
11.....	1.6	1.55	2.45	1.95	3.0	3.3	1.95	1.8	5.65	2.4	2.25	.....
12.....	1.45	1.4	1.5	2.0	2.7	2.75	1.85	1.75	5.1	2.5	2.2	.....
13.....	1.55	1.55	2.3	2.0	2.7	2.35	2.1	1.85	4.7	2.4	2.3	2.6
14.....	1.65	1.8	2.05	2.05	2.7	2.6	1.95	1.9	4.55	2.3	2.3	2.15
15.....	1.6	2.05	1.95	2.4	2.8	2.35	2.2	1.75	4.4	2.35	3.9	2.05
16.....	1.6	2.2	2.0	2.35	2.7	2.25	2.2	1.8	4.15	3.0	4.85	1.95
17.....	1.85	2.0	2.2	2.3	2.3	2.05	2.45	1.7	4.0	2.9	3.8	2.3
18.....	1.65	1.8	2.0	2.35	2.25	2.05	2.3	1.7	3.75	3.95	3.1	2.15
19.....	1.45	1.75	2.15	2.0	2.5	2.15	3.25	1.4	3.65	4.15	3.1	2.05
20.....	1.4	1.65	2.65	1.9	3.0	2.2	3.05	1.3	3.55	4.75	2.7	2.0
21.....	1.75	1.35	2.5	3.1	3.0	2.1	2.4	2.5	3.45	8.95	2.6	2.1
22.....	1.8	1.35	1.95	2.5	2.8	1.9	2.3	2.15	3.05	6.4	2.75	1.95
23.....	1.65	1.6	2.0	2.2	2.7	2.15	2.35	5.8	3.2	4.1	2.95	1.9
24.....	1.5	3.0	2.4	2.35	2.65	2.15	2.3	14.1	3.05	3.5	3.0	1.95
25.....	1.65	1.85	1.3	2.25	2.7	1.95	2.45	10.6	3.05	2.9	2.95	1.9
26.....	1.65	2.95	1.6	2.45	2.6	2.15	2.35	7.1	3.05	2.8	2.8	3.3
27.....	1.65	2.0	2.0	2.1	2.2	2.0	2.4	4.95	3.0	2.95	2.4	4.85
28.....	1.75	1.6	2.15	2.6	2.3	1.65	2.5	3.85	3.1	2.8	2.45	10.4
29.....	2.0	2.0	2.0	2.3	.....	2.05	2.65	3.45	3.05	2.55	2.3	5.45
30.....	1.5	1.65	2.1	2.05	.....	2.25	2.5	4.7	2.65	5.05	2.25	3.55
31.....	1.65	.....	2.55	2.0	.....	2.25	.....	5.4	.....	6.2	2.25	.....

a 21.0 feet at noon.

NOTE.—Gage read to top of ice Dec. 8-12. No record Sept. 9-12, observer away.

Daily discharge, in second-feet, of Solomon River near Bennington, Kans., for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1.....	208	62	40			102	56	130	391	176	616	95
2.....	116	32	36			45	56	123	2,490	152	476	144
3.....	95	23	208			40	81	123	4,900	144	355	780
4.....	123	29	45			102	68	130	5,880	144	256	4,340
5.....	50	23	102			102	36	62	7,140	152	144	3,120
6.....	88	32	20		50	109	45	102	7,450	168	123	656
7.....	56	32	20			192	50	74	1,730	116	95	292
8.....	109	36				506	45	74	1,020	116	109	192
9.....	40	23				328	81	74	980	123	95	182
10.....	40	16				216	74	81	769	130	88	173
11.....	26	23				256	56	40	706	116	95	163
12.....	18	16				168	45	36	596	130	88	154
13.....	23	23				109	74	45	516	116	102	144
14.....	29	40				144	56	50	486	102	102	81
15.....	26	68				109	88	36	456	109	364	68
16.....	26	88		50	100	95	88	40	409	208	546	56
17.....	45	62				68	123	32	382	192	346	102
18.....	29	40				68	102	32	337	373	224	81
19.....	18	36				81	248	16	319	409	224	68
20.....	16	29				88	216	13	301	526	160	62
21.....	36	14			150	74	116	130	283	1,690	144	74
22.....	40	14				50	102	81	216	882	168	56
23.....	29	26				81	109	736	240	400	200	50
24.....	20	208	60		152	81	102	4,070	216	292	208	56
25.....	29	45			160	56	123	2,350	216	192	200	50
26.....	29	200			144	81	109	1,080	216	176	176	256
27.....	29	62			88	62	116	566	208	200	116	546
28.....	36	26			102	29	130	355	224	176	123	2,270
29.....	62	62			.....	68	152	283	216	137	102	666
30.....	20	29			.....	95	130	516	152	586	95	301
31.....	29	.....			.....	95	.....	656	.....	828	95	.....

NOTE.—Stage-discharge relation affected by ice Dec. 8-Feb. 23. Braced figures show mean discharge for period included.

Monthly discharge of Solomon River near Bennington, Kans., for the year ending Sept. 30, 1918.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October.....	208	16	49.7	3,060
November.....	208	14	47.3	2,810
December.....	208	.....	59.1	3,630
January.....	.....	.....	50	3,070
February.....	.....	.....	92.7	5,150
March.....	506	40	119	7,320
April.....	248	36	95.9	5,710
May.....	4,070	13	391	24,000
June.....	7,450	152	1,310	78,000
July.....	1,690	102	299	18,400
August.....	1,616	88	201	12,400
September.....	4,340	50	509	30,300
The year.....	7,450	.....	268	194,000

BIG BLUE RIVER AT RANDOLPH, KANS.¹

LOCATION.—In SW. $\frac{1}{4}$ sec. 12, T. 7 S., R. 6 E., at new highway bridge three-fourths of a mile east of Randolph, Riley County. Fancy Creek enters from west half a mile downstream. Black Vermilion River enters from east 15 miles by river upstream. Station is 21 miles in a direct line (about 32 miles by river) upstream from mouth of river, which joins Kansas River near Manhattan.

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—April 17 to September 30, 1918.

GAGE.—Chain gage bolted to upstream handrail of highway bridge 64 feet east from concrete pier on right bank; read by Giles S. Webb. A staff gage, reading from 6.0 to 30.9 feet, is bolted to this pier near downstream end for use during extremely high stages; set by levels from bench mark.

DISCHARGE MEASUREMENTS.—Made from downstream side of highway bridge or by wading.

CHANNEL AND CONTROL.—Sand and gravel, control fairly permanent between high-water periods. Banks are fairly high but are overflowed at extreme stages. Bank-full stage about 20 feet.

EXTREMES OF DISCHARGE.—Maximum stage recorded during period, 16.7 feet at 7.55 p. m. June 1 (discharge, 17,400 second-feet); minimum stage recorded during period, 2.5 feet at 6.50 a. m. August 29 (discharge, 300 second-feet).

ICE.—Stage-discharge relation affected by ice.

REGULATION.—Flow is affected by regulation of power plant at Blue Rapids.

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

Discharge measurements of Big Blue River at Randolph, Kans., during the year ending Sept. 30, 1918.

[Made by R. C. Rice.]

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	<i>Feet.</i>	<i>Sec.-ft.</i>		<i>Feet.</i>	<i>Sec.-ft.</i>
Apr. 17.....	3.15	416	May 29.....	15.28	15,100
May 22.....	10.51	8,340	June 13.....	4.00	853
May 23.....	12.72	11,400	July 16.....	2.77	329
May 28.....	14.94	14,800			

¹ Known locally as "Blue River."

Daily gage height, in feet, of Big Blue River at Randolph, Kans., for the year ending Sept. 30, 1918.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Day.	Apr.	May.	June.	July.	Aug.	Sept.
1.....		3.45	6.65	3.1	3.3	4.3	16.....	.....	3.1	3.7	2.75	4.2	2.65
2.....		3.45	5.6	3.25	3.4	8.5	17.....	3.25	3.1	3.8	2.8	3.8	2.75
3.....		3.3	6.0	3.1	3.2	7.8	18.....	3.35	3.1	3.7	2.8	3.6	2.7
4.....		3.35	8.75	3.05	2.95	7.55	19.....	3.3	3.05	3.55	2.85	3.75	2.75
5.....		3.25	7.3	2.95	2.75	8.3	20.....	3.5	3.0	3.4	3.0	3.8	2.75
6.....		3.25	6.0	3.15	2.75	6.25	21.....	3.5	2.95	3.3	3.05	3.2	2.7
7.....		3.3	5.4	2.95	2.75	4.4	22.....	3.45	9.3	3.3	2.95	3.0	2.7
8.....		3.3	5.0	2.7	2.7	3.75	23.....	3.45	13.15	3.2	2.85	2.95	2.65
9.....		3.25	4.8	3.0	2.7	3.55	24.....	3.6	11.85	3.25	3.55	3.35	2.8
10.....		3.3	4.85	2.85	2.65	3.3	25.....	3.6	7.3	3.15	8.65	3.15	2.75
11.....		3.05	4.6	2.7	2.7	3.2	26.....	3.6	5.5	3.2	5.25	2.9	2.75
12.....		3.05	4.25	2.75	2.9	3.15	27.....	3.55	4.9	3.2	4.65	2.9	2.9
13.....		3.1	4.1	2.75	3.55	2.95	28.....	3.5	15.3	3.1	4.0	2.65	2.95
14.....		3.05	3.9	2.75	4.05	3.1	29.....	3.6	13.6	3.2	3.7	2.55	2.8
15.....		2.6	3.5	2.75	5.2	2.95	30.....	3.5	8.45	3.05	4.15	2.75	2.65
							31.....	.....	7.45	.....	3.6	2.85	.....

Daily discharge, in second-feet, of Big Blue River at Randolph, Kans., for the year ending Sept. 30, 1918.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Day	Apr.	May.	June.	July.	Aug.	Sept.
1.....		535	3,420	400	470	1,060	16.....	.....	400	660	325	995	313
2.....		535	2,260	450	510	5,720	17.....	450	400	720	332	720	325
3.....		470	2,700	400	430	4,850	18.....	490	400	660	332	610	318
4.....		490	6,040	386	362	4,540	19.....	470	386	585	341	690	325
5.....		450	4,220	362	325	5,480	20.....	560	373	510	373	720	325
6.....		450	2,700	415	325	2,980	21.....	560	362	470	386	430	318
7.....		470	2,050	362	325	1,140	22.....	535	6,760	470	362	373	318
8.....		470	1,650	518	318	690	23.....	535	12,100	430	341	362	313
9.....		450	1,470	373	318	585	24.....	610	10,200	450	585	490	332
10.....		470	1,520	341	313	470	25.....	610	4,220	415	5,920	415	325
11.....		386	1,300	318	318	430	26.....	610	2,150	430	1,900	350	325
12.....		386	1,030	325	350	415	27.....	585	1,560	430	1,340	350	350
13.....		400	925	325	585	362	28.....	560	15,200	400	855	313	362
14.....		386	785	325	890	400	29.....	610	12,700	430	660	304	332
15.....		308	560	325	1,850	362	30.....	560	5,660	386	960	325	313
							31.....	.....	4,410	.....	610	341	.....

Monthly discharge of Big Blue River at Randolph, Kans., for the year ending Sept. 30, 1918.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
April 17-30.....	610	450	553	15,400
May.....	15,200	308	2,710	167,000
June.....	6,040	386	1,340	79,700
July.....	5,920	318	679	41,800
August.....	1,850	304	499	30,700
September.....	5,720	313	1,150	68,400
The period.....				403,000

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, 1918.

Date.	Stream.	Tributary to—	Locality.	Discharge
July 30	Clear Creek.....	Powder River.....	Sec. 18, T. 53 N., R. 80 W., just above mouth of Piney Creek, Wyo.	<i>Sec. ft.</i> 56
Aug. 4	do.....	do.....	do.....	20.2
4	Piney Creek.....	Clear Creek.....	Kearney, Wyo.....	40.3

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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 of the United States.

4. Complete sets are available for consultation in the local office of the water-resources branch of the Geological Survey, as follows:

Boston, Mass., 2500 Customhouse.
 Albany, N. Y., Room 704 Journal Building.
 Harrisburg, Pa., Care of Water Supply Commission.
 Asheville, N. C., 32-35 Broadway.
 Chattanooga, Tenn., Temple Court Building.
 Madison, Wis., care of Railroad Commission of Wisconsin.
 Chicago, Ill., 1404 Kimball Building.
 Ames, Iowa, care of State Highway Commission.
 Topeka, Kans., 23 Federal Building.
 Helena, Mont., Montana National Bank Building.
 Denver, Colo., 403 New Post Office Building.
 Salt Lake City, Utah, 421 Federal Building.
 Boise, Idaho, 615 Idaho Building.
 Idaho Falls, Idaho, 228 Federal Building.
 Tacoma, Wash., 406 Federal Building.
 Portland, Oreg., 606 Post Office Building.
 San Francisco, Calif., 328 Customhouse.
 Los Angeles, Calif., 619 Federal Building.
 Austin, Tex., Capitol Building.
 Honolulu, Hawaii, 14 Capitol Building.

A list of the Geological Survey's publications may be obtained by applying to the Director, United States Geological Survey, Washington, D. C.

STREAM-FLOW REPORTS.

Stream-flow records have been obtained at about 4,510 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.

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

Report.	Character of data.	Year.
W 16.....	Descriptions, measurements, and gage heights, western Mississippi River below junction of Missouri and Platte, and western United States.	1897.
19th A, pt. 4.....	Descriptions, measurements, ratings, and monthly discharge (also some long-time records).	1897.
W 27.....	Measurements, ratings, and gage heights, eastern United States, eastern Mississippi River, and Missouri River.	1898.
W 28.....	Measurements, ratings, and gage heights, Arkansas River, and western United States.	1898.
20th A, pt. 4.....	Monthly discharge (also for many earlier years).....	1898.
W 35 to 39.....	Descriptions, measurements, gage heights, and ratings.....	1899.
21st A, pt. 4.....	Monthly discharge.....	1899.
W 47 to 52.....	Descriptions, measurements, gage heights, and ratings.....	1900.
22d A, pt. 4.....	Monthly discharge.....	1900.
W 65, 66.....	Descriptions, measurements, gage heights, and ratings.....	1901.
W 75.....	Monthly discharge.....	1901.
W 82 to 85.....	Complete data.....	1902.
W 97 to 100.....	do.....	1903.
W 124 to 135.....	do.....	1904.
W 165 to 178.....	do.....	1905.
W 201 to 214.....	do.....	1906.
W 241 to 252.....	do.....	1907-8.
W 261 to 272.....	do.....	1909.
W 281 to 292.....	do.....	1910.
W 301 to 312.....	do.....	1911.
W 321 to 332.....	do.....	1912.
W 351 to 362.....	do.....	1913.
W 381 to 394.....	do.....	1914.
W 401 to 414.....	do.....	1915.
W 431 to 444.....	do.....	1916.
W 451 to 464.....	do.....	1917.
W 471 to 484.....	do.....	1918.

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 1918. 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 1918, for any station in the area covered by Part III are published in Water-Supply Papers 83, 98, 128, 169, 205, 243, 263, 283, 303, 323, 353, 383, 403, 433, 453, and 473, which contain records for the Ohio River basin for those years.

Numbers of water-supply papers containing results of stream measurements, 1899-1918.

Year.	I North Atlantic slope basins (St. John River to York River).	II South Atlantic and eastern Gulf of Mexico River to the Missis- sippi).	III Ohio River basin.	IV St. Lawrence River and Great Lakes basins.	V Hudson Bay and upper Missis- sippi River basins.	VI Missouri River basin.	VII Lower Missis- sippi River basin.	VIII Western Gulf of Mexico basins.	IX Colorado River basin.	X Great Basin.	XI Pacific slope basins in Cali- fornia.	XII North Pacific slope basins.		
1899 ^a	35	b 35, 36	36	36	c 36, 37	37	37	37	d 37, 38	38, e 39	38, f 39	Pacific slope basins in Washing- ton and Columbia River.	Snake River basin.	Lower Columbia River and Pacific slope basins in Oregon.
1900 ^g	47, h 48	48, i 49	48, i 49	48, i 49	48, i 50	50	50	50	50	51	51	38	38	38
1901.....	65, 75	65, 75	65, 75	65, 75	65, 75	k 65, 66, 75	66, 75	66, 75	66, 75	66, 75	66, 75	51	51	51
1902.....	65, 82	b 82, 83	65, 75	65, 75	66, 75	k 65, 66, 75	66, 75	66, 75	66, 75	66, 75	66, 75	66, 75	66, 75	66, 75
1903.....	97	b 87, 98	98	98	98	k 83, 84	84	84	84	85	85	85	85	85
1904.....	n 124, o 125	p 126, 127	128	128	k 98, 99, 100	99	k 98, 99	100	100	100	100	100	100	100
1905.....	n 163, o 164	p 167, 168	169	170	k 128, 130	130, q 131	k 128, 131	132	133	133, r 134	134	135	135	135
1906.....	n 201, o 202	p 203, 204	205	206	k 171	172	k 169, 173	174	175, s 177	176, t 177	177	178	178	177, 178
1907-s.....	241	242	243	244	245	246	247	248	249	250, r 251	251	252	252	252
1909.....	281	282	283	284	285	286	287	288	289	290, s 291	291	292	292	292
1910.....	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	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	386	387	387	388	389	390	391	392	393	394
1915.....	401	402	403	404	405	406	407	408	409	410	411	412	413	414
1916.....	431	432	433	434	435	436	437	438	439	440	441	442	443	444
1917.....	451	452	453	454	455	456	457	458	459	460	461	462	463	464
1918.....	471	472	473	474	475	476	477	478	479	480	481	482	483	484

^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 Kings and Kern 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 Snake 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 Yackin 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, 1918; period after a date indicates discontinuance. Tributaries are shown by indention.

Red Rock Creek (head of Missouri River) above Red Rock reservoir, near Monida, Mont., 1911; 1914–15.

Red Rock Creek below Red Rock reservoir, near Monida, Mont., 1911–

Red Rock Creek at Lima, Mont., 1907–1911.

Red Rock Creek at Red Rock, Mont., 1890.

Beaverhead River (continuation of Red Rock Creek) at Barratts, Mont., 1907–

Beaverhead River at Dillon, Mont., 1907.

Jefferson River (continuation of Red Rock-Beaverhead River) near Silverstar, Mont., 1910–1916.

Jefferson River at Sappington, Mont., 1894–1905.

Missouri River at Toston, Mont., 1890; 1910–1916.

Missouri River near Townsend, Mont., 1891–1901; 1903–4.

Missouri River at Canyon Ferry, Mont., 1889.

Missouri River near Craig, Mont., 1890–1892.

Missouri River at Cascade, Mont., 1902–1915.

Missouri River at Great Falls, Mont., 1897–1905.

Missouri River at Fort Benton, Mont., 1910–

Missouri River near Williston, N. Dak., 1905–1907.

Missouri River at Mannhaven, N. Dak., 1904.

Missouri River at Washburn, N. Dak., 1905.

Missouri River at Bismarck, N. Dak., 1904–5.

Missouri River at Kansas City, Mo., 1905–6.

Missouri River tributaries:

Passamari River [Ruby Creek] near Alder, Mont., 1911-1914.

Bighole River near Dewey, Mont., 1910-1913.

Big Pipestone Creek near Whitehall, Mont., 1910-11.

Whitetail Creek near Whitehall, Mont., 1911.

Little Whitetail Creek near Whitehall, Mont., 1911.

Boulder River:

Muskrat Creek near Boulder, Mont., 1912-1914.

Gibbon River (head of Madison River) near Yellowstone, Mont., 1913-1916.

Madison River near Yellowstone, Mont., 1913-

Madison River near Norris, Mont., 1897-1905; 1910.

Madison River near Red Bluff, Mont., 1890-1894; 1897-1902.

Madison River near Three Forks, Mont., 1893-1897.

Gallatin River near Salesville, Mont., 1895-1905; 1910-1913.

Gallatin River near Bozeman, Mont., 1889-1891.

Gallatin River at Logan, Mont., 1893-1905.

Middle Creek near Bozeman, Mont., 1895-96; 1898-1900; 1902-3.

Crow Creek near Townsend, Mont., 1912-13.

Crow Creek near Radersburg, Mont., 1901.

Deep Creek near Townsend, Mont., 1910-1915.

Prickly Pear Creek near Clancy, Mont., 1908-1916.

Prickly Pear Creek at East Helena, Mont., 1908-1913.

Lump Gulch Creek near Clancy, Mont., 1908-1913.

Tenmile Creek near Rimini, Mont., 1915-

Tenmile Creek near Helena, Mont., 1908-

Sevenmile Creek at Birdseye, Mont., 1908-1913.

Little Prickly Pear Creek near Marysville, Mont., 1909-1911; 1913-

Little Prickly Pear Creek near 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.

¹Records for 1889-90 published at Sun River above Augusta, Mont.

Missouri River tributaries—Continued.

- Belt Creek near Belt, Mont., 1905-6.
- Highwood Creek near Highwood, Mont., 1905-6.
- Two Medicine River (head of Marias River) near Glacier Park, Mont., 1918-
- Two Medicine 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-
 - Cutbank Creek near Browning, Mont., 1918-
 - 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; 1917-
 - Spring Creek near Chouteau, Mont., 1917-
 - 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-
 - Muddy Creek near Agawam, Mont., 1917.
 - 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 Harlowtown, 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 international boundary, 1905-
- Milk River at eastern crossing [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 international boundary [Kimball, Alberta], 1913-
 - Big Sandy Creek near Laredo, Mont., 1918-
 - Beaver Creek near Havre, Mont., 1918-
 - Boxelder Creek near Havre, Mont., 1918-
 - Fort Belknap canal near Chinook, Mont., 1903-

Missouri River tributaries—Continued.

Milk River tributaries—Continued.

- Clear Creek near Bearpaw, Mont., 1918–
- Winter-Anderson canal near Chinook, Mont., 1906; 1908.
- Lodge Creek¹ at international boundary, 1917–
- Lodge Creek at Chinook, Mont., 1906–1908.
- Reser ditch near Chinook, Mont., 1905–6.
- West Fork ditch near Chinook, Mont., 1905–6.
- Battle Creek² at international boundary, 1917–
- Battle Creek near Chinook, Mont., 1905–
- Cook canal near Chinook, Mont., 1905–
- Matheson canal near Chinook, Mont., 1905–
- Paradise Valley canal near Chinook, Mont., 1903–
- Harlem canal near Zurich, Mont., 1903–
- Agency ditch near Harlem, Mont., 1905–
- Peoples Creek near Dodson, Mont., 1918–
- Frenchman Creek near international boundary, 1917–
- Beaver Creek near Malta, Mont., 1916–
- Beaver Creek overflow near Bowdoin, Mont., 1903–1906; 1908–1912.
- Beaver Creek near Saco (Ashfield), Mont., 1903–1906; 1908–1912.
- Beaver Creek near Bowdoin, Mont., 1918–
- Beaver Creek near Hinsdale, Mont., 1918–
- Rock Creek near Hinsdale, Mont., 1905–1907; 1912–
- Rock Creek canal near Hinsdale, Mont., 1905–1907; 1918–
- Porcupine Creek at Nashua, Mont., 1908–
- Little Porcupine Creek near Frazer, Mont., 1908–1916.
- Wolf Creek near Wolf Point, Mont., 1908–1914.
- Wolf Point ditch at Wolf Point, Mont., 1909.
- Poplar River near Poplar, Mont., 1908–
- Big Muddy Creek near Culbertson, Mont., 1908–
- Wolf Creek near Medicine Lake, Mont., 1918–
- Smoke Creek near Poplar, Mont., 1918–
- 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–

¹ Formerly called West Fork of Milk River.² Formerly called North Fork of Milk River.

Missouri River tributaries—Continued.

Yellowstone River tributaries—Continued.

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 Lenore,¹ Wyo., 1909; 1918–

Meadow Creek near J. K. ranch, Wyo., 1909.

Willow Creek at J. K. ranch, Wyo., 1909.

Bull Lake Creek near Lenore, Wyo., 1909; 1918–

Dry Creek at Crowheart, Wyo., 1909.

Popo Agie River below Arapahoe, Wyo., 1906–1909; 1911–12; 1915–1918.

Middle Fork of Popo Agie River² near Lander, Wyo., 1911–12; 1918–

Little Popo Agie River at Hudson, Wyo., 1907–1909; 1911–12; 1915–1917.

Little Wind River at Fort Washakie, Wyo., 1908–9.

Little Wind River above Arapahoe, Wyo., 1906–1909; 1911–12; 1915–1918.

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; 1915–1917.

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; 1915–16.

Greybull River at Meeteetse, Wyo., 1897–1903.

Wood River near Meeteetse, Wyo., 1910–1912; 1915–1917.

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., 1908–1916.

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., 1911–1915.

Lodgegrass Creek at Lodgegrass, Mont., 1916–

¹ Records for 1909 published under "Dinwoody Creek near Crowheart, Wyo."² Records for 1911 and 1912 published under "Popo Agie River near Lander, Wyo."

Missouri River tributaries—Continued.

Yellowstone River tributaries—Continued.

Tongue River near Dayton, Wyo., 1903; 1911-12.

Tongue River at Carneyville, Wyo., 1911-12; 1915-1917.

Goose Creek at Sheridan, Wyo., 1895-1897; 1911-12; 1915-16.

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 near Buffalo, Wyo., 1911-12; 1917-

Clear Creek at Buffalo, Wyo., 1896-1900; 1902-1904; 1911-12.

Clear Creek near Arvada, Wyo., 1915-

Piney Creek at Kearney, Wyo., 1902-1906; 1911-12; 1915-1917.

Piney Creek at Ucross, Wyo., 1917-

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.

Heart River near Richardton, N. Dak., 1903-

Apple Creek near Bismarck, N. Dak., 1905.

Cannonball River at Stevenson, N. Dak., 1903-1908; 1911-

Grand River, North Branch (head of Grand River), at Haley, N. Dak., 1908-1917.

Grand River near Seim, S. Dak., 1904-1906.

Grand River near Wakpala, S. Dak., 1911-

Moreau [Owl] River near Bixby, S. Dak., 1904-1906.

Cheyenne River at Edgemont, S. Dak., 1903-1906.

Cheyenne River near Hot Springs [Cascade Springs], S. Dak., 1914-

Cheyenne River near Wasta, S. Dak., 1914-15.

Beaver Creek near Edgemont, S. Dak., 1905-6.

Hat Creek near Edgemont, S. Dak., 1905-6.

Battle Creek near Hermosa, S. Dak., 1903.

Spring Creek near Rapid, S. Dak., 1903-1905.

Rapid Creek at Big Bend, S. Dak., 1915-1917.

Rapid Creek at Rapid, S. Dak., 1903-1906.

Boxelder Creek at Blackhawk, S. Dak., 1903-1905.

Corbin-Morse ditch at Rapid, S. Dak., 1906.

Elk Creek near Piedmont, S. Dak., 1903.

Belle Fourche River at Belle Fourche, S. Dak., 1903-1906.

Belle Fourche River near Belle Fourche, S. Dak., 1906; 1912-

Redwater River near Minnesela, S. Dak., 1903.

Redwater River at Belle Fourche, S. Dak., 1903-1906.

Spearfish Creek near Spearfish, S. Dak., 1903-1906.

Redwater ditch at Minnesela, S. Dak., 1904-1906.

Crow Creek near Belle Fourche, S. Dak., 1904.

Owl Creek near Belle Fourche, S. Dak., 1904.

Indian Creek near Belle Fourche, S. Dak., 1904.

White River at Crawford, Nebr., 1897.

White River near Interior, S. Dak., 1904-1906; 1911-1918.

Missouri River tributaries—Continued.

White River near Westover, S. Dak., 1911-1918.

South Fork of White River near Westover, S. Dak., 1912-1918.

Niobrara River near Valentine (Fort Niobrara), Nebr., 1897; 1899; 1901-1906.

Niobrara River near Spencer, Nebr., 1908.

Niobrara River near Lynch, Nebr., 1913-1915.

Niobrara River at Niobrara, Nebr., 1902; 1910-1913.

Red Deer Lake (on Plum Creek) near Woodlake, Nebr., 1904-5.

James River near Lamoure, N. Dak., 1903.

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.

Big Sioux River at Correctionville, Iowa, 1918-

Boyer River at Logan, Iowa, 1918-

Grizzly Creek, continuation of Colorado Creek (head of North Platte River) near Hebron, Colo., 1904-5.

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 near Northgate, Colo., 1915-

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 Casper, Wyo., 1917-

North Platte River near Douglas, Wyo., 1894.

North Platte River near Orin Junction, Wyo., 1894-1900.

North Platte River at McKinley, Wyo., 1917-

North Platte River at Guernsey, Wyo., 1900-1908; 1912.

North Platte River above and below 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 Fremont, 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 Higho, 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-

Missouri River tributaries—Continued.

Platte River tributaries—Continued.

- 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., 1913-1917.
- 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; 1915-1917.
- Rock Creek near Arlington, Wyo., 1911-
- Rock Creek near Rock River, Wyo., 1911-12.
- Deep Creek near Arlington, Wyo., 1914-
- Little Medicine Bow River:
 - Muddy Creek near Shirley, Wyo., 1915-1917.
- Sage Creek above Pathfinder reservoir, Wyo., 1915-
- Deweese Creek near Alcova, Wyo., 1917-
- Sand Creek above Alcova, Wyo., 1915-
- Sweetwater River near Splitrock, Wyo., 1902-3.
- Sweetwater River near Alcova, Wyo., 1913-
- Horse Creek near Alcova, Wyo., 1915-
- Canyon Creek near Alcova, Wyo., 1915-
- Bates Creek near Casper, Wyo., 1916-
- Deer Creek at Glenrock, Wyo., 1916-
- Boxelder Creek near Careyhurst, Wyo., 1911; 1916-
- La Prele Creek near Fetterman, Wyo., 1916; 1918-
- Wagon Hound Creek near La Bonte, Wyo., 1916-
- La Bonte Creek near La Bonte, Wyo., 1916-
- Horseshoe Creek near Glendo, Wyo., 1916-
- Cottonwood Creek near Wendover, Wyo., 1916-
- Laramie River at 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., 1915-1917.
- Laramie River at McGill, Wyo., 1915.
- Laramie River below McGill, Wyo., 1916-1917.
- Laramie River near Wheatland, Wyo., 1912; 1915-16.
- Laramie River near Uva, Wyo., 1895-1900; 1903.
- Laramie River at Fort Laramie, Wyo., 1915-
 - McIntyre Creek near Gleneyre, Colo., 1904-5.
 - Little Laramie River near Hatton, Wyo., 1902-3.
 - Little Laramie River near Filmore, Wyo., 1911-12; 1915-
 - Little Laramie River near Laramie, Wyo., 1903.
 - Little Laramie River at Two Rivers, Wyo., 1911-
 - Sibylee Creek near Wheatland, Wyo., 1912; 1915-16.
 - North Laramie River near Wheatland, Wyo., 1912; 1914-
 - North Laramie River at Uva, Wyo., 1911-12.
 - Chugwater Creek at Chugwater, Wyo., 1911-12; 1915-

Missouri River tributaries—Continued.

Platte River tributaries—Continued.

- 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., 1914-15.
- 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., 1910-1917.
- 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.
- 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
- North Boulder Creek at Silver Lake, Colo., 1913-
- 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.

¹ Published only in Water-Supply Paper 74.² Published as "North Boulder Creek above Boulder" in Thirteenth Ann. Rept., pt. 3.

Missouri River tributaries—Continued.

Platte River tributaries—Continued.

South Platte River tributaries—Continued.

Big Thompson Creek near Drake, Colo., 1917—

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 Loup 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.

West Nishnabotna River at White Cloud, Iowa, 1918—

East Nishnabotna River at Red Oak, Iowa, 1918—

Nodaway River at Clarinda, Iowa, 1918—

West Nodaway River at Villisca, Iowa, 1918—

Republican River, North Fork (head of Kansas River), near Haigler, Nebr., 1896.

Republican River, North Fork, near Benkelman, Nebr., 1894–95; 1903–1906.

Republican River at Culbertson, Nebr., 1913–1915.

Republican River at Bostwick, Nebr., 1904–1915.

Republican River near Superior, Nebr., 1896–1903.

Republican River at Wakefield, Kans., 1917—

Republican River at Junction, Kans., 1895–1905.

Kansas River at Ogden, Kans., 1917—

Kansas River near St. George, Kans., 1904.

Kansas River near Topeka, Kans., 1904; 1917—

Kansas River at LeCompton, Kans., 1896; 1899–1906.

Kansas River near Lawrence, Kans., 1881–1899.

Kansas River at Bonner Springs, Kans., 1917—

South Fork of Republican River at Benkelman, Nebr., 1894–95; 1903–1906.

Frenchman Creek near Wauneta, Nebr., 1895–96.

Frenchman Creek near Palisade, Nebr., 1894–1896.

Frenchman Creek at Culbertson, Nebr., 1913–1915.

Smoky Hill River at Ellsworth, Kans., 1895–1905; 1918—

Smoky Hill River at Solomon, Kans., 1904.

Smoky Hill River near Abilene, Kans., 1918—

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 Bennington, Kans., 1917—

Solomon River near Niles, Kans., 1897–1903.

Big Blue River at Beatrice, Nebr., 1910–1915.

Big Blue River at Randolph, Kans., 1918—

¹ Published only in Water-Supply Paper 74.

Missouri River tributaries—Continued.

Kansas River tributaries—Continued.

Big 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., 1908-9.

Piney Fork of Gasconade River near Hooker, Mo., 1903. (Also called Big Piney Creek.)

Little Piney Creek near Arlington, Mo., 1903.

Grand River basin.

Grand River at Davis City, Iowa, 1918-

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 Big Horn Mountains, by Elwood Mead. 1899. 62 pp., 7 pls. 10c.

Discusses water divisions, districts, appropriations, reservoirs, and administrative questions.

- *29. Wells and windmills in Nebraska, by E. H. Barbour. 1899. 85 pp., 27 pls. 15c.

Describes home-made windmills; discusses briefly action of water underground, transmission and storage of windmill power, precipitation, surface waters for irrigation, supply for cities and towns, salt water, and blowing wells.

- *34. Geology and water resources of a portion of southeastern South Dakota, by J. E. Todd. 1900. 34 pp., 10 pls. 10c.

Describes areas in Turner, Hutchinson, Bonhomme, Yankton, and Clay counties, including typical sections of the valleys of James and Vermilion rivers.

- *44. Profiles of rivers in the United States, by Henry Gannett. 1901. 100 pp., 11 pls. 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 floods discharge and frequency on Kansas, Loup, and Platte rivers; contains also index to literature on floods in American streams.
- *184. The underflow of the South Platte Valley, by C. S. Slichter and H. C. Wolff. 1906. 42 pp. 5c.
Describes investigations of velocity, direction, quantity of underflow, and the underflow ditch at Ogallala, Nebr., gives chemical analyses of the water, and discusses disadvantages of underflow canals; describes also the investigation at North Platte, Nebr., and gives suggestions for construction of small pumping plants.
- *195. Underground waters of Missouri, their geology and utilization, by E. M. Shepard. 1907. 224 pp., 6 pls. 30c.
Describes the topography and geology of the State, the waters of the various formations, and discusses the water supplies by districts and counties; gives statistics of city water supplies, analyses of waters, and many well records.
- *215. Geology and water resources of a portion of the Missouri River valley in north-eastern 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. Schuyler, pp. 617-740, pls. 48-102. Describes reservoir sites on Goose Creek, Tarryall Creek, and South Fork of South Platte River in Colorado; gives tables of reservoir capacity and areas.

Nineteenth Annual Report of the United States Geological Survey, 1897-98; Charles D. Walcott, Director. 1898. (Pts. II, III, IV, and V, 1899.) 6 parts in 7 vols. and separate case for maps with Pt. V. *Pt. IV, Hydrography, viii, 814 pp., 118 pls. \$1.85. Contains:

*Preliminary report on the geology and water resources of Nebraska west of the one hundred and third meridian, by N. H. Darton, pp. 719-785, pls. 74-118. Describes topography and drainage of the area, the general geology of Nebraska, and the geology of the area covered by the report; the water horizons, and deep-seated waters; discusses springs, streams, irrigation, climate, and timber, and gives list of elevations.

——— *Pt. V, Forest reserves, pp. xvii-400, 110 pls. (16 maps in separate case, paper, 75c.; cloth, \$1.00.) \$1.25. Contains:

*Black Hills Forest Reserve, by H. S. Graves, pp. 67-164, pls. 14-36.

*Big Horn Forest Reserve, by F. E. Town, pp. 165-190, pls. 37-42.

Yellowstone Park Forest Reserve, southern part, from notes by T. S. Brandegee, pp. 213-216. These reports contain many descriptions of the streams of the forest reserves.

Twentieth Annual Report of the United States Geological Survey, 1898-99; Charles D. Walcott, Director. 1899. (Pts. II, III, IV, V, and VII, 1900.) 7 parts in 8 vols. and separate case for maps with Pt. V. *Pt. V, Forest reserves, xix, 498 pp., 159 pl., 8 maps in separate case. \$2.80. Contains:

*Pikes Peak, Plum Creek, and South Platte reserves, by J. G. Jack, pp. 39-115, pls. 8-47. Describes briefly the drainage of the forest reserves.

Twenty-first Annual Report of the United States Geological Survey, 1899-1900; Charles D. Walcott, Director. 1900. (Pts. III, IV, VI, VI continued, and VII, 1901.) 7 parts in 8 vols., and separate case for maps with Pt. V. *Pt. IV, Hydrography, 768 pp., 156 pls. \$2.35. 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, Lama Johnny, French, Battle Spring, Hat, Cascade, Stockade Beaver, and Beaver Creeks), and irrigation, the soils, mineral resources, climate, temperature, and timber.

*The High Plains and their utilization, by W. D. Johnson, pp. 601-741, pls. 113-146. Describes the area lying in an irregular belt about midway across the long eastward slope of the Great Plains and including parts of Wyoming, Colorado, Nebraska, Kansas, New Mexico, Oklahoma, and Texas; discusses the origin and structure of the High Plains, the precipitation, temperature, and other factors of climate, experiments with irrigation, and the use of mountain streams, local storm-water storage, and artesian waters. Concluded in the Twenty-second Annual Report, Pt. IV, pp. 631-669, pls. 51-65.

— *Pt. V, Forest reserves, 711 pp., 143 pls., 39 maps in separate case. \$3.85. Contains:

*Lewis and Clarke Forest Reserve, Mont., by H. B. Ayres, pp. 27-80, pls. 2-32. Briefly describes the valleys of the streams.

BULLETINS.

An asterisk (*) indicates that the Geological Survey's stock of the paper is exhausted. Many of the papers so marked may be purchased from the SUPERINTENDENT OF DOCUMENTS, WASHINGTON, D. C.

- *47. Analyses of waters of the Yellowstone National Park, with an account of the methods of analysis employed, by F. A. Gooch and J. E. Whitfield. 1888. 84 pp.

Describes methods used in analyzing natural waters and contains analyses of 43 geyser, spring, and surface waters in Yellowstone National Park.

- *264. Record of deep-well drilling for 1904, by M. L. Fuller, E. F. Lines, and A. C. Veatch. 1905. 106 pp. 10c.

Discusses the importance of accurate well records to the driller, to owners of oil, gas, and water wells, and to the geologist; describes the general methods of work; gives tabulated records of wells in Kansas and Missouri, and detailed records of wells in Greeley County, Kansas, and Randolph County, Missouri. These wells were selected because they give definite stratigraphic information.

265. Geology of the Boulder district, Colo., by N. M. Fenneman. 1905. 101 pp., 5 pls. 15c.

Describes the geology of a rectangular area 16 miles north and south by 9 miles east and west, in the southwestern part of which is situated the city of Boulder. Discusses briefly (pp. 67-69) the flowing wells and water-bearing formations, including the Dakota sandstone. Contains a geologic map of the area.

- *298. Record of deep-well drilling for 1905, by M. L. Fuller and Samuel Sanford. 1906. 299 pp. 25c.

Gives an account of progress in the collection of well records and samples; contains tabulated records of wells in Colorado, Iowa, Kansas, Minnesota, Missouri, Montana, Nebraska, North Dakota, South Dakota, and Wyoming, and detailed records of wells in Geary and Wyandotte counties, Kansas; Jackson County, Missouri; Teton County, Montana; and Beadle and Miner counties, South Dakota. The wells of which detailed sections are given were selected because they afford valuable stratigraphic information.

- *364. Geology and mineral resources of the Laramie basin, Wyo. (a preliminary report), by N. H. Darton and C. E. Siebenthal. 1909. 81 pp., 8 pls. 20c.
Describes the geology and contains a geologic map. Includes a section on ground water (pp. 67-78), in which are given well data and 6 water analyses. A part of the area is covered by Geologic Folio 173, which also contains information on ground water.
- *395. Radioactivity of the 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:
*(i) 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. 164-166). It also includes well records that contain some data in regard to water (pp. 186-189).
627. The lignite field of northwestern South Dakota, by D. E. Winchester, C. J. Hares, E. R. Lloyd, and E. M. Parks. 1916. 169 pp., 11 pls. 25c.
Describes the geology and contains geologic maps of Harding and Perkins counties. Describes the drainage and water supply and contains a small amount of data on deep wells not given in Water-Supply Paper 227.
- *641. Contributions to economic geology, 1916, Part II, Mineral fuels; David White, G. H. Ashley, and M. R. Campbell, geologists in charge.
Issued also in separate chapters. The following chapter contains information on ground water:
*(i) Anticlines in central Wyoming, by C. J. Hares (pp. 233-280, Pl. 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. Gives detailed data regarding surface waters, springs, wells, and ground-water prospects in the numerous anticlinal areas described in the report. See pages 15, 16, 56-188. Includes a geologic map and section.

PROFESSIONAL PAPERS.

Professional papers are distributed free by the Geological Survey as long as its stock lasts. An asterisk (*) indicates that this stock has been exhausted. Many of the papers marked with an asterisk may, however, be purchased from the SUPERINTENDENT OF DOCUMENTS, WASHINGTON, D. C. Professional papers are of quarto size.

- *17. Preliminary report on the geology and water resources of Nebraska west of the one hundred and third meridian, by N. H. Darton. 1903. 69 pp., 43 pls. 50c.

Describes topography and general geology of Nebraska, the streams, springs, and deep-seated waters, and irrigation; gives list of elevations.

- *32. Preliminary report on the geology and underground water resources of the central Great Plains, by N. H. Darton. 1905. 433 pp., 72 pls. \$1.80.

Describes topography, drainage, stratigraphy, historical geology, and the water horizons; discusses deep wells and prospects (by counties and towns) in South Dakota (see Water-Supply Paper 227), Nebraska, central and western Kansas, eastern Colorado, and eastern Wyoming; discusses also the occurrence of coal, petroleum, and natural gas, salt, gypsum, gold, iron ore, and other minerals.

- *53. Geology and water resources of the Big Horn basin, Wyoming, by C. A. Fisher. 1906. 72 pp., 16 pls.

Describes the topography of the region, the stratigraphic, structural, and historical geology and the underground waters, coal, oil, and gas, building stone, and other mineral resources; discusses briefly irrigation and mineral waters.

- *65. Geology and water resources of the northern portion of the Black Hills and adjoining regions in South Dakota and Wyoming, by N. H. Darton. 1909. 105 pp., 24 pls. 40c.

Describes the topography of the region and the stratigraphic, structural, and historical geology of the sedimentary rocks; discusses their mineral resources, including underground water, coal, gypsum, etc.; contains also information concerning the surface waters.

MONOGRAPHS.

Monographs are of quarto size. They are not distributed free, but may be obtained from the Geological Survey or from the SUPERINTENDENT OF DOCUMENTS, WASHINGTON, D. C., at the prices indicated. An asterisk (*) indicates that the Survey's stock of the paper is exhausted.

25. The glacial Lake Agassiz, by Warren Upham. 1896. 658 pp., 38 pls. \$1.70.

Contains a chapter (pp. 523-582) on "Artesian and common wells of the Red River Valley," which discusses the sources of artesian water, the fresh waters in the drift sheets, the saline and alkaline waters in the Dakota sandstone, and the use of artesian water for irrigation; contains analyses of waters from wells, streams, and lakes in Red River Valley and the adjoining region; and gives notes on wells in Clay, Kittson, Marshall, Norman, Polk, Traverse, and Wilkin counties, in Minnesota; in Cass, Grand Forks, Pembina, Richland, Traill, and Walsh counties, in North Dakota; and in a part of the area covered by Lake Agassiz, in Manitoba. The monograph includes numerous maps relating to the Pleistocene geology of the region and a map (Pl. XXXVII) showing the distribution and depths of artesian wells in glacial drift and bedrock.

- *27. Geology of the Denver Basin in Colorado, by S. F. Emmons, Whitman Cross, and G. H. Eldridge. 1896. 556 pp., 31 pls. \$1.50.

Contains a discussion of the water in the Pleistocene deposits (pp. 272, 273) and a section on artesian wells (pp. 401-465). Discusses the history of artesian-water developments in Colorado, the water-bearing horizons, the artesian structure, the quantity of artesian water, and the yield and decrease in yield of flowing wells. Includes three analyses of well waters and maps showing the geology of the region and the original area of artesian flow.

GEOLOGIC FOLIOS.

Under the plan adopted for the preparation of a geologic map of the United States the entire area is divided into small quadrangles, bounded by certain meridians and parallels, and these quadrangles, which number several thousand, are separately surveyed and mapped.¹ The unit of survey is also the unit of publication, and the maps and description of each quadrangle are issued in the form of a folio. When all the folios are completed they will constitute the Geologic Atlas of the United States.

A folio is designated by the name of the principal town or of a prominent natural feature within the quadrangle. Each folio includes maps showing the topography, geology, underground structure, and mineral deposits of the area mapped and several pages of descriptive text. The text explains the maps and describes the topographic and geologic features of the country and its mineral products. The topographic map shows roads, railroads, waterways, and, by contour lines, the shapes of the hills and valleys and the height above sea level of all points in the quadrangle. The areal-geology map shows the distribution of the various rocks at the surface. The structural-geology map shows the relations of the rocks to one another underground. The economic-geology map indicates the location of mineral deposits that are commercially valuable. The artesian-water map shows the depth to underground-water horizons. Economic-geology and artesian-water maps are included in folios if the conditions in the areas mapped warrant their publication. The folios are of special interest to students of geography and geology and are valuable as guides in the development and utilization of mineral resources.

The folios numbered from 1 to 163, inclusive, are published in only one form (18 by 22 inches), called the library edition. Some of the folios that bear numbers higher than 163 are published also in an octavo edition (6 by 9 inches). Owing to a fire in the Geological Survey building May 18, 1913, the stock of geologic folios was more or less damaged by fire and water, but 80 or 90 per cent of the folios are usable. They will be sold at the uniform price of 5 cents each, with no reduction for wholesale orders. This rate applies to folios in stock from 1 to 184, inclusive (except reprints), also to the library edition of folio 186. The library edition of folios 185, 187, and higher numbers sells for 25 cents a copy, except that some folios which contain an unusually large amount of matter sell at higher prices. The octavo edition of folio 185 and higher numbers sells for 50 cents a copy, except folio 193, which sells for 75 cents a copy. A discount of 40 per cent is allowed on an order for folios or for folios 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.

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.

- *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.
- *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 measurements. 1901. 51 pp., 12 pls. 15c.
Describes the methods used by the Survey in 1901-2. (See also Nos. 64, 94, and 95.)
- *64. Accuracy of stream measurements, by E. C. Murphy. 1902. 99 pp., 4 pls. (See No. 95.) 10c.
Describes methods of measuring velocity of water and of measuring and computing stream flow, and compares results obtained with the different instruments and methods; describes also experiments and results at the Cornell University hydraulic laboratory. A second, enlarged, edition published as Water-Supply Paper 95.
- *67. The motions of underground waters, by C. S. Slichter. 1902. 106 pp., 8 pls. 15c.
Discusses origin, depth, and amount of underground waters; permeability of rocks and porosity of 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 formulae for rainfall, run-off, and evaporation; discusses effect of forests on rainfall and run-off.
87. Irrigation in India (second edition), by H. M. Wilson. 1903. 238 pp., 27 pls. 25c.
First edition was published in Part II of the Twelfth Annual Report.
93. Proceedings of first conference of engineers of the Reclamation Service, with accompanying papers, compiled by F. H. Newell, chief engineer. 1904. 361 pp. 25c.
Contains, in addition to an account of the organization of the hydrographic [water-resources] branch of the United States Geological Survey, and the report of the conference, the following papers of more or less general interest:
Limits of an irrigation project, by D. W. Ross.
Relation of Federal and State laws to irrigation, by Morris Bien.
Electrical transmission of power for pumping, by H. A. Storrs.
Correct design and stability of high masonry dams, by Geo. Y. Wisner.
Irrigation surveys and the use of the plane table, by J. B. Lippincott.
The use of alkaline waters for irrigation, by Thomas H. Means.
- *94. Hydrographic manual of the United States Geological Survey, prepared by E. C. Murphy, J. C. Hoyt, and G. B. Hollister. 1904. 76 pp., 3 pls. 10c.
Gives instruction for field and office work relating to measurements of stream flow by current meters. (See also No. 95.)
- *95. Accuracy of stream measurements (second, enlarged, edition), by E. C. Murphy. 1904. 169 pp., 6 pls.
Describes methods of measuring and computing stream flow and compares results derived from different instruments and methods. (See also No. 94.)
- *103. A review of the laws forbidding pollution of inland waters in the United States, by E. B. Goodell. 1904. 120 pp. (See No. 152.)
Explains the legal principles under which antipollution statutes become operative, quotes court decisions to show authority for various deductions, and classifies according to scope the statutes enacted in the different States.
- *110. Contributions to the hydrology of eastern United States, 1904; M. L. Fuller, geologist in charge. 1905. 211 pp., 5 pls. 10c.
Contains the following reports of general interest. The scope of each paper is indicated by its title.
Description of underflow meter used in measuring the velocity and direction of underground water, by Charles S. Slichter.
The California or "stovepipe" method of well construction, by Charles S. Slichter.
Approximate methods of measuring the yield of flowing wells, by Charles S. Slichter.
Corrections necessary in accurate determinations of flow from vertical well casings, from notes furnished by A. N. Talbot.
Experiment relating to problems of well contamination at Quitman, Ga., by S. W. McCallie.
113. The disposal of strawboard and oil-well wastes, by R. L. Sackett and Isaiah Bowman. 1905. 52 pp., 4 pls. 5c.
The first paper discusses the pollution of streams by sewage and by trade wastes, describes the manufacture of strawboard, and gives results of various experiments in disposing of the waste. The second paper describes briefly the topography, drainage, and geology of the region about Marion, Ind., and the contamination of rock wells and of streams by waste oil and brine.
- *114. Underground waters of eastern United States; M. L. Fuller, geologist in charge. 1905. 285 pp., 18 pls. 25c.
Contains report on "Occurrence of underground waters," by M. L. Fuller, discussing sources, amount, and temperature of waters, permeability and storage capacity of rocks, water-bearing formations, recovery of water by springs, wells, and pumps, essential condition of artesian flows, and general conditions affecting underground waters in eastern United States.

119. Index to the hydrographic progress reports of the United States Geological Survey, 1888 to 1903, by J. C. Hoyt and B. D. Wood. 1905. 253 pp. 15c.
Scope indicated by title.
120. Bibliographic review and index of papers relating to underground waters published by the United States Geological Survey, 1879-1904, by M. L. Fuller. 1905. 128 pp. 10c.
Scope indicated by title.
- *122. Relation of the law to underground waters, by D. W. Johnson. 1905. 55 pp. 5c.
Defines and classifies underground waters, gives common-law rules relating to their use, and cites State legislative acts affecting them.
140. Field measurements of the rate of movement of underground waters, by C. S. Slichter. 1905. 122 pp., 15 pls. 15c.
Discusses the capacity of sand to transmit water, describes measurements of underflow in Rio Hondo, San Gabriel, and Mohave River valleys, Calif., and on Long Island, N. Y., gives results of tests of wells and pumping plants, and describes stovepipe method of well construction.
143. Experiments on steel-concrete pipes on a working scale, by J. H. Quinton. 1905. 61 pp., 4 pls. 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. Dele.

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. A. 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.

- *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:
*(c) Relation of stream gaging to the science of hydraulics, by C. H. Pierce and R. W. Davenport, pp. 77-84.
(e) A method of correcting river discharge for a changing stage, by B. E. Jones, pp. 117-130.
(f) Conditions requiring the use of automatic gages in obtaining records of stream flow, by C. H. Pierce, pp. 131-139.
- *400. Contributions to the hydrology of the United States, 1916. N. 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, Calif., and was undertaken for the purpose of learning "the laws which control the movement of bed load, and specially to determine how the quantity of load is related to the stream's slope and discharge and to the degree of comminution of the *débris*."

A highly technical report.

105. Hydraulic mining *débris* in the Sierra Nevada, by G. K. Gilbert. 154 pp., 34 pls. 1917.

Presents the results of an investigation undertaken by the United States Geological Survey in response to a memorial from the California Miners' Association asking that a particular study be made of portions of the Sacramento and San Joaquin valleys affected by detritus from torrential streams. The report deals largely with geologic and physiographic aspects of the subject, traces the physical effects, past and future, of the hydraulic mining of earlier decades, the similar effects which certain other industries induce through stimulation of the erosion of the soil, and the influence of the restriction of the area of inundation by the construction of levees. Suggests cooperation by several interests for the control of the streams now carrying heavy loads of *débris*.

BULLETINS.

- *32. Lists and analyses of the mineral springs of the United States (a preliminary study), by A. C. Peale. 1886. 235 pp.

Defines mineral waters, lists the springs by States, and gives tables of analyses so far as available.

- *319. Summary of the controlling factors of artesian flows, by Myron L. Fuller. 1908. 44 pp., 7 pls. 10c.

Describes underground reservoirs, the sources of underground waters, the confining agents, the primary and modifying factors of artesian circulation, the essential and modifying factors of artesian flow, and typical artesian systems.

479. The geochemical interpretation of water analyses, by Chase Palmer. 1911. 31 pp. 5c.

Discusses the expression of chemical analyses, the chemical character of water and the properties of natural water; gives a classification of water based on property values and reacting values, and discusses the character of the waters of certain rivers as interpreted directly from the results of analyses; discusses also the relation of water properties to geologic formations, silica in river water, and the character of the water of the Mississippi and the Great Lakes and St. Lawrence River as indicated by chemical analyses.

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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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