FOURTEENTH BIENNIAL REPORT

of the

STATE ENGINEER

to the

GOVERNOR OF NORTH DAKOTA

1929-1930

ROBT. E. KENNEDY
State Engineer

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LETTER OF TRANSMITTAL

The Honorable

GEORGE F. SHAFER,
Governor of North Dakota.

Sir:

This report, due September 30, 1930, was delayed to include the stream gaging records prepared by the U. S. Geological Survey and a study on Evaporation from North Dakota Lakes.

This was all destroyed in the Capitol fire of December 28, 1930. The evaporation report is being published separately.

Respectfully submitted,

ROBT. E. KENNEDY,
State Engineer.

Bismarck, North Dakota.
May 1, 1931.

PART I

PERSPECTUS OF DEPARTMENTAL ACTIVITIES

Fourteenth Biennial
Report of
State Engineer of
North Dakota

CONTENTS

DEPARTMENTAL ACTIVITIES AND OPPORTUNITIES

For purposes of cost keeping the activities of this department have been grouped under seven principal features which will serve as an outline for this discussion. They are:

(1) Miscellaneous Examinations and Surveys
(2) Irrigation
(3) Hydrometry
(4) Flood Control
(5) River and Lake Improvement
(6) Topographic Surveys
(7) Meteorology.

(1) MISCELLANEOUS EXAMINATIONS AND SURVEYS

This is the waste basket for the numerous small surveys and reconnaissances which this department is called upon to make. Some of these develop later into worth while projects.

There is one class of work coming under this feature which deserves larger consideration. That is the surveying and mapping the grounds of our various state institutions.

Landscape Maps of State Institutions: Several of our institutions now have such maps but they are all very much out of date. Such a map should show not only the buildings and roads and shrubbery but also be a record of the engineering features that might otherwise be lost, such as the location of the underground conduits, water pipes and valves, sewer lines, steam and power lines. In several of our institutions much of this information now exists only in the mind of the chief engineer.

The land lines of the institution property should be marked with concrete monuments and a map prepared placing these various distances on record and available to any interested party.

Such maps were prepared for the Institution for Feeble Minded at Grafton. Part of them were destroyed by the Capitol fire but will be replaced.

(2) IRRIGATION

This Department was founded in 1905 and patterned after the Wyoming laws to take care of the extensive irrigation development which seemed so promising at that time. This has been consistently and persistently encouraged and propagandized since that time until the advent of the present incumbent. Yet up to June 1, 1929 there were only 113 irrigation and 34 industrial water rights recorded. A questionnaire of that date was sent out to the 113 assumed irrigators. Fifty cards were returned. Twenty-three reported a completed project but only eight permit holders irrigated in 1928. The total area was 634 acres. Excuses offered were failure of dams and too much rain. A similar inventory of the 1929 and 1930 irrigated acreage was lost in the fire.

Proposed federal projects within the state such as the Bowman Project in the southwest corner and the Mouse River Loop Project in

McHenry County in the north central part of the state have received only scant and fainthearted approval by the Bureau of Reclamation.

Difficulties in the path of irrigation are numerous and intricate, altho not insurmountable. The more obvious are (1) the twilight zone between aridity and humidity. If the western section of the state had just a little more rain or a litte less the most suitable type of agriculture could be more easily determined. As it is now the dry farmers have taken up all the land. There is no open range. They cultivated about one half of it in 1929. (2) Dry farmers do not make good irrigationists because the methods are radically different and involve much more labor. Immigration would have to be induced from other irrigated sections to the west or southwest which is against the normal direction of such movement. (3) Our choice of crop is somewhat restricted by our latitude. We cannot take advantage of the early produce market. This is not so serious as (4) the fact that we have only one stream in the state that does not go dry when the weather does. That is the Missouri River. It has such a flat slope, however, nine inches to the mile, that no gravity diversion is possible. Pumping out of the Missouri River while a failure at Williston may yet succeed under different conditions. Elsewhere irrigation development is dependent upon reservoirs.

In general, reservoir sites are not within feasible proximity of the lands susceptible of irrigation. River bottoms are almost always cut into numerous small tracts by a meandering stream. Pumping to each individual tract is the more feasible method and that has not been extensively adopted due, probably, to the above difficulties.

Lower Yellowstone Irrigation Project

The Lower Yellowstone Federal Reclamation project comprises an irrigable area of about 59,000 acres. Approximately two-thirds of this area is in Montana and one-third in North Dakota. The project is served by a main canal approximately 71 miles in length, having its intake from the Yellowstone River about 17 miles below Glendive. Other irrigation works comprise approximately 250 miles of laterals and about 90 miles of drainage ditches. Over three thousand structures are required to properly control the water. These consist of siphons, flumes, checks, drops, turnouts, bridges, etc.

The irrigable area in North Dakota is classified as follows:

15,058	acres of productive land
5,261	" " temporarily unproductive land
20,319	Acres total

The temporarily unproductive land is so classified by reason of damage from seepage or from brush and timber covering. This land will pass into the productive list whenever changed conditions make it productive.

The project is being operated by the Federal Government and will be until the end of 1931, when the management of the system will be turned over to the water users. Since 1926 no appropriations have been

made by Congress for operation and maintenance, the entire amount required being advanced by the water users.

A large program of drainage construction was begun in 1927 and completed early in 1930. Drains have been built to practically every area showing damage by seepage, and the results have been very gratifying. A particular example is a case where a piece of land having water from one to two feet deep on it in 1928 produced 75 bushels of oats per acre in 1930 after being drained.

The area irrigated and the per acre cost of water is as follows:

	Area Irrigated	Construction Repayment	O. & M.	Total
1928	(Not Segregated)	$1.05	$1.10	$2.15
1929	6089	1.50	1.10	2.60
1930	9214	1.45	1.15	2.60

Following is a comparison of the per acre returns from irrigated crops and dry-farmed crops within the project:

	Irrigated Crop	Dry-farmed Crop
1928	$25.27	$12.37
1929	32.58	9.18
1930	33.39	4.48

Alfalfa, sugar beets and Great Northern beans are the principal crops. Some barley is raised to provide grain for feeding operations during the winter months. A sugar factory at Sidney handles all of the beets raised on the project. The average production of beets during 1930 was 12.6 tons per acre, which is higher than ever before produced on the project and compares favorably with the older beet growing sections of the country.

Some settlement work has been carried on and several new families placed on project farms.

That Twelve Million Dollars!

A word might here be said about the twelve million dollar balance between what the state contributed to the Federal Reclamation fund from the sale of public lands within the state and the amount reinvested in the Williston and Lower Yellowstone Projects in the state.

A claim to this money is revived whenever we have a large undertaking for which we need federal assistance. We tend to overlook the fact that the money was raised for irrigation, and claims thereto would be much more valid if restricted to irrigation projects which have a reasonable possibility of success.

But the fallacy lies deeper. No federal revenue can have a geographical label. Else eastern money would not be spent on North Dakota roads. The idea of financing federal irrigation within each state by the proceeds from the sale of its own public lands was an excellent

sales talk but it is pernicious in principle if carried to its logical conclusion. It has occasioned much confusion of thought.

(3) HYDROMETRY

The following gaging stations are now being maintained in this state. Discharge records available for the years 1927-1930 are published in the rear of this volume.

Stream or Lake	Location	Primary Purposes
Missouri River	Williston	Navigation and local development
" "	Sanish	" " " "
" "	Bismarck	" " " "
Little Missouri R.	Medora	Contribution to Missouri R. and local development
Knife River	Hazen	" " " " "
Heart River	Sunny	" " " " "
Cannonball River	Timmer	" " " " "
James River	Jamestown	" " " " "
Mouse River	Sherwood	Flood control
Mouse River	Minot	" "
Mouse River	Westhope	" "
Devils Lake	Lakewood	Study of evaporation and inflow
Red River	Fargo	Flood control and local development
Red River	Grand Forks	" " " " "
Bois des Sioux R.	Fairmont	Flood control
Sheyenne River	Sheyenne	Contribution to Red River and local development
Sheyenne River	West Fargo	" " " " " "
Goose River	Hillsboro	" " " " " "
Park River	Grafton	" " " " " "
Pembina River	Neche	" " " " " "

(4) FLOOD CONTROL

This is a "stand by" duty. The hydrometric and meteorological data gathered thru the years becomes very much in demand when a disastrous flood occurs and much public ado is aroused. Thus far only two flood problems have been reviewed by this Department. One was at Marmarth and one at Minot.

The Mouse River Flood Control Project at Minot, because it is on an international stream, is now being investigated by the Corp of Engineers, U. S. Army at St. Paul, Minnesota.

(5) RIVER AND LAKE IMPROVEMENT

The **Missouri River Diversion Project** whereby a portion of the waters of the Missouri River would be diverted to Devils Lake and the Sheyenne and James Rivers thereby supplementing the water supply and solving the sewage disposal problem for all the principal cities on these streams in the two Dakotas has been under investigation by the Corps of

Engineers, U. S. Army at Kansas City, Missouri. The conclusions are not yet available for publication.

A number of **recreational ponds** have been created by small dams installed in streams in various parts of the state and supervised by this Department. The dams are usually of a cheap type of construction suitable to the use of donated labor and community effort. The opportunity for such installations is extensive and the demand seems to be growing, for which the State Game and Fish Commissioner Mr. Burnie Maurek is largely responsible. Most of the requests come thru his Department.

(6) TOPOGRAPHIC SURVEYS

Topographic surveys have been extended to include and complete the Mouse River valley in this state. Fig. 1 shows the areas now covered by topographic sheets.

(7) METEOROLOGY

This feature has been developed from studies begun for the Mouse River Flood Control Project. One phase involved is an effort to find the general factors which govern the co-ordination between the rain that falls on the ground and the water that runs off in the stream. This is a very moot question among engineers. The relationship apparently discovered from those studies is rough and its application needs much verification to overcome the conviction of many engineers that such a relationship cannot be isolated. If it can be verified it will greatly enhance the value of the weather bureau data in the many areas where no stream flow records are available.

Another study is published separately entitled "Evaporation from North Dakota Lakes." Here a formula is developed from the evaporation data obtained not only in this state but in several Great Plains states from the Gulf to the Canadian Line.

Mention is also made of the possibility of cycles in rainfall which may bring back our lakes to their pristine beauty.

STATE ENGINEER DEPARTMENT REPORTS NOT PUBLISHED IN THE BIENNIAL REPORTS

(1) Mouse River Flood Control Project, 1927
Part I. Location of chain of Lakes Route thru City of Minot, North Dakota. Cost Estimate.
Part II. Meteorological and Hydraulic Studies (published in Thirteenth Biennial Report).

(2) Missouri River Diversion, 1927
Hydraulic studies and preliminary cost estimate of project proposed to divert water from the Missouri River to Devils Lake and the James and Sheyenne Rivers.

(3) Missouri River Dam, 1927
Hydraulic studies and preliminary cost estimate of project to construct large dam in the Missouri River at the Big Bend in North Dakota.

(4) Marmarth Flood Control Project, 1929
Hydraulic studies and preliminary cost estimate of project to protect city of Marmarth, North Dakota, from floods from the Little Missouri River.

(5) Evaporation from North Dakota Lakes, 1931
Monthly and annual evaporation for several points thruout the state is computed by a new formula derived from data obtained in this and other states thruout the Great Plains.

N. B. Numerous other reports have been issued by previous incumbents of the office but record of them was destroyed by the Capitol fire.

LOSSES INCURRED IN CAPITOL FIRE OF DECEMBER 28, 1930

UNCOMPLETED PROJECTS ON HAND

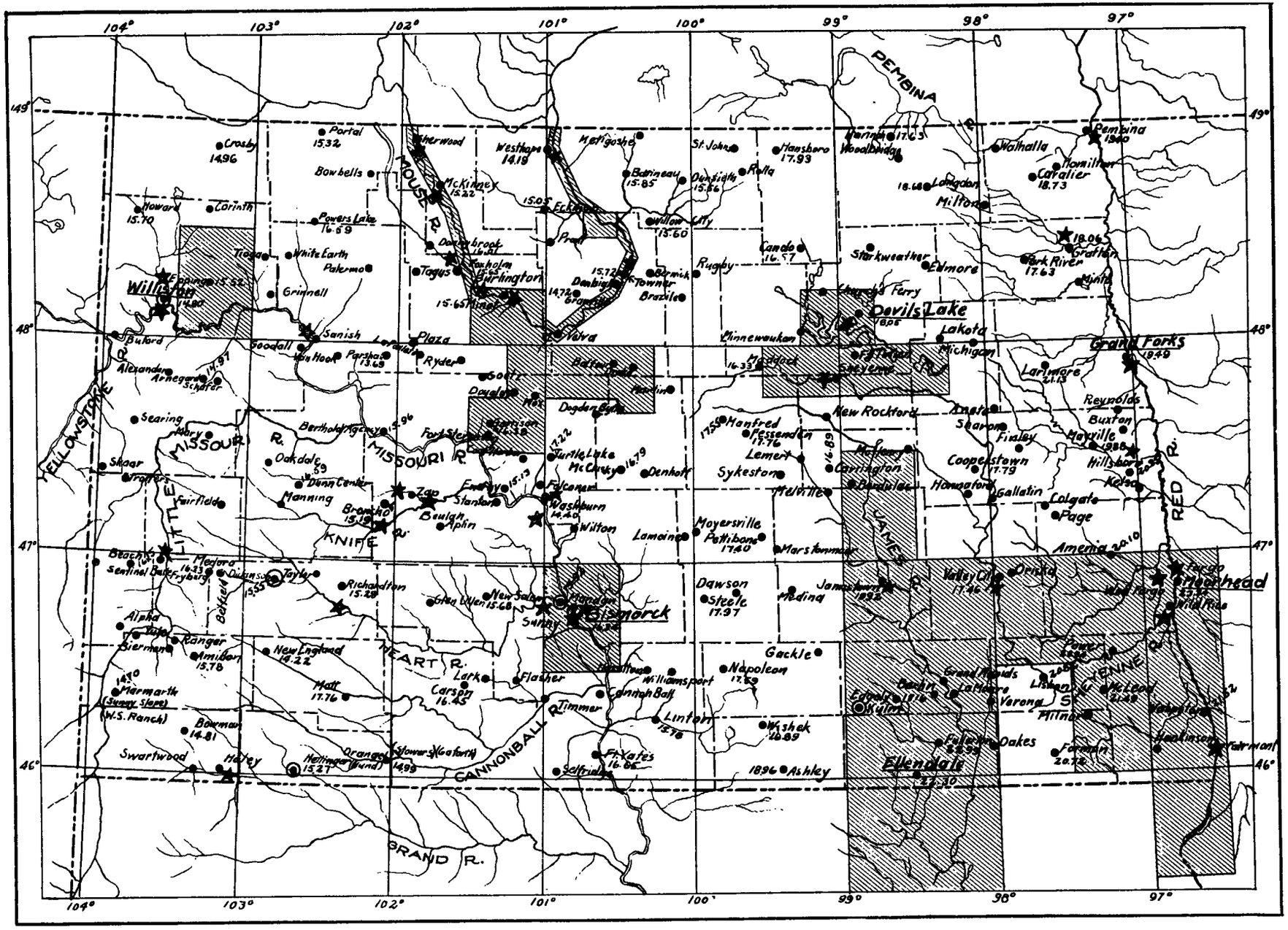
All uncompleted projects were destroyed in the Capitol fire of December 28, 1930. All can be worked up again. The principal projects are here described from memory and from data that has been recovered from other sources.

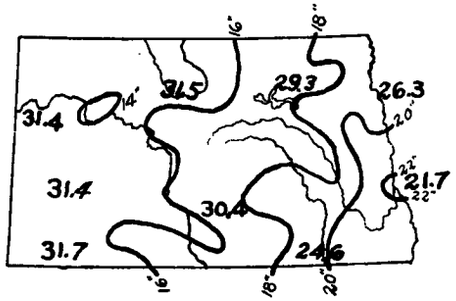
(1) MOUSE RIVER FLOOD DAM ABOVE TOWNER, NORTH DAKOTA

This project mentioned in the previous Biennial Report is located on the J. B. Eaton ranch on the Mouse River south of Towner. It was proposed in order to insure a crop of wild hay in the years when the river did not overflow.

If we may assume that a 3000 second-foot flood at Minot, such as occurred in 1928, is the smallest flow that will cause floods in this section then ten such floods have occurred since 1894. In addition to this there have been in the same period and for years without flood seven May or June rainfalls that were twice the normal or more. This makes 17 of the 36 years during which the dam would not be very useful or about every other year.

FIG. 1





LEGEND

WEATHER BUREAU STATIONS
FIRST CLASS
BISMARCK - SECTION CENTER
WILLISTON
DEVILS LAKE
ELLENDALE
MOORHEAD, MINN.
SECOND CLASS
GRAND FORKS
•=COOPERATIVE OBSERVER, PAST OR PRESENT
◉=U.S. DEPT. OF AGRI. BUR. OF PLANT INDUSTRY FIELD STATIONS.

★=GAGING STATIONS PAST OR PRESENT.
▨=AREAS TOPOGRAPHICALLY MAPPED.
102=LINES OF EQUAL PRECIPITATION.
16.34=AVERAGE PER ANNUM PRECIPITATION, 10 YEARS OR MORE.
30.1=AVERAGE EVAPORATION.

STATE OF NORTH DAKOTA
DEPARTMENT OF STATE ENGINEER

HYDROLOGICAL MAP OF NORTH DAKOTA

DRAWN: B.P.J. SUBMITTED: B.P.J.
CHECKED: REK. APPROVED R. H. Ens

BISMARCK, N.D. 3-23-31 | I-B-2

Borings and topography of the dam site were lost in the fire but the cost of the dam was around $18,000.

(2) KENMARE DAM IN DES LACS

If the two Des Lacs lakes could be separated by a dam and a difference of two or three feet maintained between them, both lakes would be greatly improved. The upper lake would be deepened sufficiently to make it suitable for fish, and the lower lake could be flushed out with no appreciable loss in the upper lake. The upper lake contains about 20 square miles in area. The lower lake now on the same level and connected by a narrow channel is about 1½ square miles in area. It receives the sewage from the city of Kenmare and is at times a nauseating nuisance. With a two foot difference in elevation at the dam opening the gates would raise the lower lake twelve inches in 24 hours and lower the upper lake theoretically one inch, actually an unappreciable amount.

The difficulty encountered is a highway fill across the upper lake. This was a very expensive job, due to settlement of the fill in the lake bottom ooze. Until no further settlement is assured it will be impossible to ascertain what free board can be safely established.

Here again it is desirable to compute the stages of the lake as it would have been had such a dam been in place since the gaging record began at Minot on the Mouse River of which the Des Lacs River is a large and nearby tributary. A brief gaging record is also available for the Des Lacs River.

In this study evaporation is an important factor. No outflow or inflow occurs during some years. The only factors affecting the water surface elevation at these times are rainfall, evaporation and sub-seepage inflow.

(3) DAM IN BEAVER LAKE NEAR BURNSTAD

This lake, sometimes called Red Lake, needs to be deepened a few feet to make it suitable and safe for fish. The dam would be an inexpensive structure but the contributing river is really an arm of the lake for a long distance upstream and any rise in the lake level inundates large areas of hay meadow.

Natural flooding is, of course, an Act of God, but any artificial flooding makes the responsible parties liable for damages. No funds are in sight at present to meet these expenses.

(4) ARROWWOOD DAM

The Arrowwood Lake in the James River about 23 miles north of Jamestown is an unusually attractice body of water with several miles of sandy beach and wooded banks. Its normal stage is about four feet. A four foot dam across its outlet would make it suitable for fish. Money is available for this as soon as the necessary flowage rights have been obtained.

(5) INVESTIGATION OF WEATHER CYCLES

The rainfall records for all the stations of ten years or more in the two Dakotas, Montana, Wyoming and Minnesota had been worked up into graphs which tended to reveal the presence of similar cycles.

It remained for Mr. J. W. Shuman of Power Engineering Company, Minneapolis, Minnesota, to bring out the frequent coincidence between these cycles and those of the sunspot and other stellar phenomena. This study will be continued with the assistance of Mr. Shuman.

(6) EVAPORATION FROM NORTH DAKOTA LAKES

Comment has been made upon this previously. It is now completed and ready for publication.

RECORDS DESTROYED IN CAPITOL FIRE

(1) All irrigation permits and maps.

(2) Library of numerous reports from other states since 1905.

(3) Maps and plans of numerous proposed projects not included in (1) above.

(4) Correspondence Files.

(5) Four volumes of Missouri River Commission Maps.

(6) Field notes and township plats of the General Land Office Survey, approximately 2100 townships and 300 volumes of field notes. These were lost in the vault.

Personal property consisted of engineering library and numerous notes taken from innumerable sources not replaceable.

Total loss estimated at $29,500 fully covered by insurance where replacement is possible. Much is being replaced from Federal Bureaus.

FINANCIAL STATEMENT

Budget available July 1, 1929

Salary, State Engineer	$ 6,000.00
Clerkhire, stenographic	2,700.00
Postage	100.00
Office Supplies	100.00
Furniture & Fixtures	100.00
Printing	300.00
Miscellaneous	300.00
Travel Expense	3,000.00
Field Assistants	3,000.00
Hydrographic Survey	2,000.00
Missouri River Commission	3,600.00
Flood Irrigation (prior)	2,954.41
General prior	1,462.10
Total	$25,616.51

COST DISTRIBUTION

The cost accounting system was destroyed in the fire but a copy of the first sheet of each quarter's report had been sent to the governor and was preserved in his vault which did not burn.

The expenditures for the quarter ending June 30, 1930 were distributed as follows:

Principal Feature	This quarter	To date
Miscellaneous Examinations and Surveys	311.67	1,696.01
Irrigation	71.08	71.08
Hydrometry	789.39	2,300.11
Flood Control	72.00	226.56
River and Lake Improvement	1,131.48	4,858.21
Topographic Surveys		2,179.24
Meteorology	340.16	1,895.48
Total	2,715.78	13,226.69
Total appropriation	$25,616.51	
Balance to date	$12,389.82	

PART II

DAILY DISCHARGE
OF
NORTH DAKOTA RIVERS

Fourteenth Biennial Report
of
State Engineer of
North Dakota

DAILY DISCHARGE OF NORTH DAKOTA RIVERS

1928-1929-1930

The following tabulation is furnished by the U. S. Geological Survey of which Nathan C. Grover is Chief Hydraulic Engineer. The Missouri River drainage stations are under the supervision of Mr. W. A. Lamb, District Engineer, Helena, Montana. The Hudson Bay drainage stations are under the supervision of Mr. Chas L. Batchelder, 202 Old Capitol Bldg., St. Paul, Minnesota.

CONTENTS

MISSOURI RIVER DRAINAGE

HUDSON BAY DRAINAGE

MISSOURI RIVER DRAINAGE

Missouri River at Williston, N. Dak.

LOCATION.—In sec. 31, T. 154 N., R. 101 W., 7 miles west of Williston, N. Dak., 50 feet downstream from Lewis & Clark Highway Bridge on U. S. Highway No. 85. Painted Woods Creek enters from left 1 mile upstream. Yellowstone River enters from right about 25 miles upstream. Little Muddy enters from left 6 miles downstream. Reached by highway from Williston over U. S. Highway No. 85.

DRAINAGE AREA.—167,530 square miles.

RECORDS AVAILABLE.—March 1905-May 1907. October 1928-September 1930.

GAGE.—Au gage installed October 22, 1928 in wooden shelter over well connected with river by 3" pipe. Located on left bank 50 feet below bridge. Inside staff gage with enameled gage faces 0-13.4 ft. and outside wire gage on downstream side of bridge. Inspected by Mr. Andrew Bjorlo, Williston, N. Dak.

DISCHARGE MEASUREMENTS.—Open water section. Downstream side of highway bridge, 20 feet intervals. Stations are marked in red paint on concrete guard rail. Special reel is stored in gage house.

CHANNEL AND CONTROL.—Control is entire river channel below gage. Bed of sand and silt. Shifting. Ice gorging frequent.

EXTREMES OF DISCHARGE.—1928-1930; Maximum stage 10.8 ft. June 8, 1929, discharge 109,000 second-feet; minimum stage, ice conditions, January 30-31, discharge 5,650 second-feet.

ICE.—Severe ice conditions during winter. Occasional gorges during period when ice breaks up.

DIVERSIONS.—Flow is affected somewhat by numerous irrigation diversions and power developments in Montana.

REGULATION.—None.

ACCURACY.—Records fair. Weakness is in shifting control, frequent measurements necessary.

MONTHLY DISCHARGE OF MISSOURI RIVER AT WILLISTON, N. DAK.

Month	Discharge in second-feet Maximum	Minimum	Mean	Run-off in acre-feet
1928				
September, 17 days	16,100	13,400	14,800	499,000
1928-1929				
October	17,800	13,400	14,700	904,000
November	15,400	12,300	13,600	809,000
December	.....	.....	11,600	713,000
January	13,400	5,650	9,020	555,000
February	9,660	5,910	8,170	454,000
March, 17 days	97,300	8,380	30,500	1,030,000
April	52,400	17,800	26,800	1,590,000
May	92,400	19,800	38,800	2,390,000
June	105,000	52,400	69,800	4,150,000
July	60,200	12,900	36,800	2,260,000
August	12,300	8,060	9,820	604,000
September	14,700	8,380	11,700	696,000
The period	105,000	5,650	23,442	16,155,000
1929-1930				
October	15,000	12,600	13,900	855,000
November	13,800	.....	11,400	678,000
December	.....	.....	8,870	545,000
January	.....	.....	10,900	670,000
February	.....	.....	22,300	1,240,000
March	.....	.....	16,900	1,040,000
April	77,800	25,700	33,400	1,990,000
May	37,600	24,500	29,400	1,810,000
June	49,200	26,400	36,800	2,190,000
July	30,400	13,000	21,100	1,300,000
August	33,300	10,000	17,400	1,070,000
September	15,800	10,700	12,800	762,000
The period	77,800		19,597	7,131,850

DAILY DISCHARGE IN SECOND-FEET OF MISSOURI RIVER AT WILLISTON, N. DAK., FOR YEAR ENDING SEPTEMBER 30, 1928

Day	September
1	-------
2	-------
3	-------
4	-------
5	-------
6	-------
7	-------
8	-------
9	-------
10	-------
11	-------
12	-------
13	-------
14	15,400
15	15,400
16	15,800
17	16,100
18	15,400
19	15,400
20	15,400
21	15,400
22	15,400
23	14,700
24	14,700
25	14,000
26	14,000
27	14,000
28	14,000
29	13,400
30	13,700

DAILY DISCHARGE IN SECOND-FEET OF MISSOURI RIVER AT WILLISTON, N. DAK., FOR YEAR ENDING SEPTEMBER 30, 1929

Day	Oct.:	Nov.:	Dec.:	Jan.:	Feb.:	Mar.:	Apr.:	May:	June:	July:	Aug.:	Sept.:
1	14,000	15,400	12,300	13,100	5,910	8,380	45,000	27,200	76,100	55,500	12,300	8,380
2	14,000	14,700	12,300	13,400	6,100	8,720	52,400	28,700	58,300	56,300	11,800	8,380
3	13,400	14,700	12,300	13,400	6,100	9,080	52,400	30,200	54,400	57,300	11,800	8,720
4	13,400	14,700	12,300	13,100	6,400	9,080	38,000	28,700	54,400	58,300	11,300	9,080
5	13,400	14,000	11,800	12,000	6,510	9,080	30,200	30,200	56,400	59,300	10,800	9,080
6	13,400	14,700	11,800	11,300	6,730	9,080	30,200	31,700	66,500	60,200	10,300	9,080
7	13,400	14,700	11,800	10,400	6,830	9,080	33,200	31,700	84,200	57,100	10,800	9,080
8	13,400	14,000	11,800	9,660	6,730	9,460	34,800	27,200	105,000	54,000	10,800	9,460
9	13,400	13,400	11,300	9,080	7,100	10,800	38,000	27,200	72,100	50,900	10,800	10,300
10	13,400	14,000	10,800	8,380	7,480	.....	31,700	30,200	60,200	47,800	10,800	10,800
11	13,400	14,000	9,460	7,910	8.060	.....	24,500	33,200	64,200	44,700	10,800	11,300
12	13,400	13,400	9,080	8,220	8,550	.....	23,200	31,700	84,200	41,500	10,800	12,900
13	13,400	13,400	9,080	8,380	9,080	.....	20,800	31,700	86,300	39,700	10,300	13,400
14	13,700	13,400	10,300	8,380	9,270	.....	19,800	25,800	84,200	38,000	9,870	13,400
15	14,000	13,400	11,300	8,220	8,900	.....	17,800	23,200	84,200	37,000	10,800	13,400
16	14,700	13,400	11,800	8,720	8,720	.....	18,700	19,800	82,200	35,200	10,800	13,400
17	14,700	13,400	12,000	9,080	8,720	.....	18,700	19,800	80,200	33,400	9,870	13,400
18	14,700	13,400	12,000	9,080	8,900	.....	18,700	19,800	78,100	31,500	9,460	12,900
19	14,700	13,400	12,000	9,460	9,270	.....	17,800	22,000	80,200	28,700	9,080	12,300
20	15,400	12,900	12,000	9,660	9,270	.....	17,800	27,200	80,200	28,000	9,080	12,300
21	16,100	13,400	12,000	9,270	9,460	.....	17,800	31,700	82,200	27,200	8,720	12,300
22	16,100	13,400	12,000	8,900	9,460	.....	18,700	38,000	76,100	26,500	8,380	12,300
23	16,100	13,400	12,000	8,380	9,660	.....	18,700	38,000	62,200	25,800	8,380	12,300
24	16,900	13,400	12,000	7,910	9,460	97,300	19,800	39,800	58,300	25,800	8,380	12,300
25	17,800	12,900	12,000	7,350	9,460	62,200	20,800	43,200	56,400	23,200	8,380	12,900

26	16,900	12,900	12,000	6,850	9,080	48,600	23,200	54,400	54,400	20,800	8,380	13,400
27	16,100	12,900	12,000	6,510	8,900	39,800	24,500	68,100	52,400	17,800	8,380	13,400
28	16,100	12,900	12,000	6,300	8,720	36,400	24,500	76,100	52,400	15,400	8,380	13,400
29	16,100	12,300	12,000	5,820	.....	56,600	24,500	86,300	53,400	15,400	8,060	14,000
30	15,400	12,300	12,000	5,650	.....	55,700	27,200	88,300	54,400	13,400	8,380	14,700
31	15,400	.....	12,000	5,650	.....	39,800	.....	92,400	.....	12,900	8,380	.....

Wire gage on bridge prior to Oct. 21. Recorder installed Oct. 22. Discharge Oct. 7 and Oct. 14, interpolated because of missing gage heights. Ice Nov. 30-March 23—Ice Gorge Mar. 10-23, discharge not computed. Intake plugged 6/29 to 7/22. Discharge computed from Bismarck and Sanish.

DAILY DISCHARGE IN SECOND-FEET OF MISSOURI RIVER AT WILLISTON, N. DAK., FOR THE YEAR ENDING SEPTEMBER 30, 1930

Day	Oct.:	Nov.:	Dec.:	Jan.:	Feb.:	Mar.:	Apr.:	May:	June:	July:	Aug.:	Sept.:
1	14,600	13,000	9,260	12,200	10,800	18,900	40,300	33,300	26,400	26,400	12,200	15,400
2	14,600	13,000	9,260	12,200	10,800	18,900	40,300	43,300	38,800	25,100	11,500	15,000
3	15,000	13,000	9,260	12,200	10,800	18,900	40,300	34,300	49,200	25,100	11,500	15,000
4	15,000	13,400	9,260	12,200	10,800	18,900	40,300	34,300	47,800	23,300	11,100	14,200
5	15,000	13,400	9,260	12,200	10,800	18,900	77,800	34,300	43,800	22,200	10,700	13,400
6	15,000	13,400	9,260	12,200	10,800	8,110	31,300	33,300	41,200	21,700	10,000	13,000
7	15,000	13,400	9,260	12,200	10,800	8,110	25,700	30,400	36,500	21,200	10,000	13,000
8	14,600	13,400	9,260	12,200	10,800	8,110	25,700	31,300	33,300	21,700	11,100	13,000
9	14,200	13,400	9,260	12,200	10,800	8,110	25,700	32,300	29,500	21,700	11,900	12,600
10	14,600	13,800	9,260	12,200	10,800	8,110	26,400	36,500	27,900	21,700	11,900	11,900
11	14,600	13,800	8,450	11,600	25,200	7,270	27,100	37,600	28,700	21,200	12,200	12,200
12	14,200	13,800	8,450	11,600	25,200	7,270	28,700	36,500	35,400	20,700	12,200	12,600
13	14,200	13,400	8,450	11,600	25,200	7,270	27,100	33,300	41,200	19,700	12,200	12,600
14	14,200	12,600	8,450	11,600	25,200	7,270	27,100	31,300	41,200	20,700	12,200	14,200
15	14,200	13,000	8,450	11,600	25,200	7,270	29,500	29,500	42,500	23,300	12,600	15,800
16	14,200	13,000	8,450	11,600	25,200	15,300	32,300	27,100	45,100	25,100	16,600	15,800
17	14,200	12,600	8,450	11,600	25,200	15,300	34,300	27,100	45,100	27,900	21,700	14,600
18	13,800	12,200	8,450	11,600	25,200	15,300	34,300	26,400	38,800	30,400	28,700	13,000
19	13,800	11,900	8,450	11,600	25,200	15,300	35,400	25,100	34,300	26,400	33,300	12,200
20	13,400	11,900	8,450	11,600	25,200	15,300	37,600	24,500	32,300	23,300	31,300	12,600
21	13,400	9,280	8,900	9,150	32,900	20,400	36,500	25,100	33,300	21,700	30,400	12,200
22	13,800	8,200	8,900	9,150	32,900	20,400	35,400	25,100	38,800	20,700	26,400	11,900
23	13,400	7,840	8,900	9,150	32,900	20,400	33,300	25,100	37,600	19,700	24,500	11,500
24	13,000	7,840	8,900	9,150	32,900	20,400	31,300	25,100	36,500	18,300	22,700	11,100
25	13,000	7,840	8,900	9,150	32,900	20,400	30,400	25,700	35,400	17,500	22,200	11,100

26	12,600	8,060	8,900	9,150	32,900	29,100	29,500	25,700	35,400	16,200	20,700	11,500
27	12,600	8,060	8,900	9,150	32,900	29,100	28,700	26,400	35,400	15,400	19,700	11,100
28	12,600	8,060	8,900	9,150	32,900	29,100	28,700	26,400	34,300	14,600	18,800	11,100
29	12,600	8,060	8,900	9,150	.....	29,100	30,400	25,100	31,300	13,800	17,000	11,100
30	12,600	8,060	8,900	9,150	.....	29,100	31,300	24,500	27,900	13,400	16,200	10,700
31	13,000	.....	8,900	9,150	.....	29,100	.....	24,500	.....	13,000	15,800	.....

MISSOURI RIVER DRAINAGE

Missouri River at Sanish, N. Dak.

LOCATION.—In W. ½ Sec. 14, T. 152 N., R. 93 W., one-half mile west of Sanish, N. Dak. At highway bridge between Sanish and Watford City, state highway No. 23 on M. St. P. & St. M. Ry. one mile below mouth of Little Knife River. Reached by highway from Williston or Stanley over state highways Nos. 8 and 23 or from Bismarck by highways Nos. 6 and 23 or by railway.

RECORDS AVAILABLE.—October, 1928—September, 1930.

GAGE.—Stevens wire gage on left span highway bridge. Read to hundredths once daily by H. J. Houser, Sanish, N. Dak.

DISCHARGE MEASUREMENTS.—Open water section. Downstream side of highway bridge. Use special reel which is stored in observer's garage. Ice section is 200 feet below bridge section.

CHANNEL AND CONTROL—Channel control has no fixed section. Shifting. Liable to ice gorging at bridge.

EXTREMES OF DISCHARGE.—1928-1930; maximum stage, 9.7 ft., June 9, 1929, discharge, 90,000 second-feet; minimum stage, ice conditions, February 3, discharge, 5,180 second-feet.

DIVERSIONS.—Numerous large and small diversions for irrigation in Montana.

REGULATION.—None below Great Falls dam.

ACCURACY.—Good records may be obtained if sufficient discharge measurements are made to determine effects of shifting control.

MONTHLY DISCHARGE OF MISSOURI RIVER AT SANISH, N. DAK.

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1928				
September, 8 days	15,400	13,500	14,000	222,000
1928-1929				
October	18,300	12,900	14,800	910,000
November	15,400	12,900	14,300	851,000
December	.....	.....	10,600	652,000
January	.....	.....	9,190	565,000
February	9,700	5,180	7,560	420,000
March, 16 days	85,800	8,820	28,200	895,000
April	50,900	19,900	29,600	1,760,000
May	84,400	28,700	42,200	2,590,000
June	90,000	52,200	69,500	4,140,000
July	58,700	16,800	36,200	2,230,000
August	15,400	7,620	10,100	621,000
September	14,100	8,000	11,600	690,000
The period	90,000	5,180	23,654	16,324,000
1929-1930				
October	14,900	12,500	13,600	836,000
November	14,100	.....	11,700	696,000
December	.....	.....	8,800	546,000
January	.....	.....	9,610	591,000
February	.....	.....	16,500	916,000
March	.....	.....	18,000	1,110,000
April	81,000	24,000	32,700	1,950,000
May	40,100	24,700	30,700	1,890,000
June	50,700	26,200	39,000	2,320,000
July	34,000	13,700	23,600	1,450,000
August	32,200	10,200	17,400	1,070,000
September	17,900	11,800	13,900	827,000
The period	81,000	10,200	19,600	14,202,000

DAILY DISCHARGE IN SECOND-FEET OF MISSOURI RIVER AT SANISH, N. DAK., FOR YEAR ENDING SEPTEMBER 30, 1928

Day	September
1	.....
2	.....
3	.....
4	.....
5	.....
6	.....
7	.....
8	.....
9	.....
10	.....
11	.....
12	.....
13	.....
14	.....
15	.....
16	.....
17	.....
18	.....
19	.....
20	.....
21	.....
22	.....
23	15,400
24	14,700
25	14,100
26	13,500
27	13,500
28	13,500
29	13,500
30	13,500

DAILY DISCHARGE IN SECOND-FEET OF MISSOURI RIVER AT SANISH, N. DAK., FOR YEAR ENDING SEPTEMBER 30, 1929

Day	Oct.:	Nov.:	Dec.:	Jan.:	Feb.:	Mar.:	Apr.:	May:	June:	July:	Aug.:	Sept.:
1	13,500	15,400	12,300	11,000	5,720	9,260	38,800	32,000	74,600	57,400	15,400	8,000
2	13,500	15,400	12,300	11,000	5,440	8,820	50,900	33,100	65,200	58,700	14,100	8,400
3	13,500	15,400	12,300	11,000	5,180	8,820	48,400	34,200	61,300	58,700	13,500	8,820
4	13,500	15,400	11,700	11,000	5,440	8,820	41,200	34,200	61,300	58,700	12,300	8,820
5	14,100	14,700	11,200	11,000	5,720	10,200	36,400	35,300	65,200	53,500	11,700	8,820
6	14,100	14,700	12,300	10,200	6,600	10,200	33,100	36,400	70,400	52,200	11,200	8,400
7	13,500	14,100	12,300	10,200	6,600	9,700	29,800	36,400	74,600	49,600	11,200	9,260
8	13,500	14,700	12,300	9,700	6,300	8,820	35,300	37,600	83,000	49,600	10,700	8,820
9	13,500	14,700	12,300	9,700	6,300	8,820	34,200	38,800	90,000	47,200	10,700	9,260
10	13,500	14,700	11,200	9,700	6,300	9,260	33,100	34,200	67,800	44,800	9,700	9,260
11	13,500	14,700	10,700	8,820	6,300	.....	35,300	36,400	63,900	42,400	11,200	11,200
12	13,500	14,700	10,200	8,400	6,600	.....	28,700	37,600	77,400	41,200	10,700	11,200
13	13,500	14,700	10,200	9,260	6,920	.....	27,600	37,600	84,400	37,600	10,200	12,900
14	13,500	14,100	10,200	8,820	7,260	.....	25,500	34,200	78,800	36,400	10,200	12,900
15	12,900	14,100	9,700	8,820	8,400	.....	23,500	30,900	77,400	32,000	10,200	14,100
16	12,900	14,100	9,260	8,820	8,400	.....	23,500	30,900	73,200	29,800	10,200	13,500
17	14,100	14,100	9,260	8,820	8,400	.....	22,500	29,800	71,800	26,600	10,200	13,500
18	14,700	14,100	9,700	8,820	8,820	.....	20,700	28,700	76,000	26,600	9,700	12,900
19	14,700	14,100	9,700	8,400	8,820	.....	20,700	28,700	76.000	28,700	9,700	12,900
20	15,400	14,100	10,000	8,400	8,820	.....	20,700	29,800	77,400	27,600	9,260	12,900
21	15,400	13,500	10,000	8,820	8,820	.....	19,900	37,600	78,800	26,600	9,260	12,300
22	16,100	14,100	10,000	9,700	8,400	.....	20,700	42,400	73,200	29,800	8,820	12,900
23	16,100	14,100	10,000	9,700	8,000	.....	21,600	46,000	66,500	29,800	8,400	14,100
24	16,800	13,500	10,000	9,260	9,700	.....	22,500	47,200	61,300	26,600	8,000	14,100
25	16,800	13,500	10,000	8,820	9,700	.....	23,500	47,200	58,700	25,500	8,400	13,500

26	17,600	13,500	10,000	8,400	9,700	85,800	26,600	50,900	57,400	23,500	8,400	12,900
27	18,300	13,500	10,000	8,400	9,700	63,900	28,700	62,600	58,700	23,500	8,400	12,300
28	17,600	13,500	10,000	8,400	9,260	50,900	29,800	67,800	54,800	21,600	8,000	12,900
29	16,800	13,500	10,000	7,260	.....	41,200	32,000	71,800	53,500	21,600	8,000	13,500
30	16,100	12,900	10,000	7,260	.....	63,900	33,100	74,600	52,200	16,800	7,620	14,100
31	16,100	.....	10,000	6,920	.....	52,200	.....	84,400	.....	16,800	8,000	.....

Ice conditions Nov. 19-Mar. 25. Ice Jams Mar. 11-25 (not computed) Shifting control method May 1 to Sept. 22.

DAILY DISCHARGE IN SECOND-FEET OF MISSOURI RIVER AT SANISH, N. DAK., FOR YEAR ENDING SEPTEMBER 30, 1930

Day	Oct.:	Nov.:	Dec.:	Jan.:	Feb.:	Mar.:	Apr.:	May:	June:	July:	Aug.:	Sept.:
1	13,300	12,500	9,500	13,500	8,790	25,500	40,200	35,000	26,200	32,200	13,300	17,900
2	13,300	12,500	9,500	13,500	8,790	25,500	40,200	37,000	30,400	28,600	12,500	16,400
3	14,100	12,900	9,500	13,500	8,790	25,500	40,200	40,100	47,000	28,600	12,100	16,400
4	13,700	12,900	9,500	13,500	8,790	25,500	40,200	38,000	45,800	27,000	11,500	15,400
5	14,500	13,300	9,500	13,500	8,790	25,500	81,000	36,000	43,400	27,000	11,200	15,400
6	14,100	13,300	8,730	12,800	9,660	13,900	27,800	34,000	42,300	23,300	10,500	14,100
7	14,900	14,100	8,730	12,800	9,660	13,900	26,200	34,000	39,000	24,700	10,500	14,100
8	14,500	13,700	8,730	12,800	9,660	13,900	24,700	33,100	35,000	24,000	10,200	13,700
9	14,500	13,700	8,730	12,800	9,660	13,900	25,400	35,000	33,100	24,700	10,200	13,700
10	14,100	13,300	8,730	12,800	9,660	13,900	24,000	36,000	31,300	23,300	10,500	13,300
11	14,100	13,300	8,100	9,740	9,500	10,000	26,200	35,000	31,300	24,000	11,200	12,500
12	13,300	12,900	8,100	9,740	9,500	10,000	28,600	32,200	32,200	22,600	11,800	12,900
13	13,300	12,900	8,100	9,740	9,500	10,000	29,500	30,400	44,600	22,600	12,500	12,900
14	14,100	12,500	8,100	9,740	9,500	10,000	27,800	27,800	50,700	21,400	12,100	13,300
15	14,500	12,900	8,100	9,740	9,500	10,000	27,800	27,000	45,800	21,400	12,900	13,700
16	13,700	12,500	6,890	6,850	17,400	15,900	27,800	27,000	45,800	24,000	12,500	15,900
17	14,100	13,300	6,890	6,850	17,400	15,900	30,400	27,000	48,200	27,800	14,100	17,400
18	14,100	13,300	6,890	6,850	17,400	15,900	30,400	26,200	42,300	32,200	22,000	16,400
19	14,100	9,610	6,890	6,850	17,400	15,900	33,100	24,700	39,000	31,000	32,200	14,500
20	13,700	9,610	6,890	6,850	17,400	15,900	34,000	24,700	29,500	29,500	31,300	13,700
21	13,700	9,610	8,370	6,880	30,100	22,300	37,000	27,000	30,400	27,000	32,200	13,300
23	13,300	9,610	8,370	6,880	30,100	22,300	35,000	27,800	40,100	24,000	27,800	13,300
23	13,700	9,610	8,370	6,880	30,100	22,300	34,000	27,800	43,400	23,300	24,000	13,300
24	12,900	9,610	8,370	6,880	30,100	22,300	30,400	27,000	41,200	20,800	23,300	12,500
25	12,900	9,610	8,370	6,880	30,100	22,300	31,300	27,800	40,100	20,200	23,300	12,100

26	12,500	9,430	11,200	8,190	28,300	20,200	27,800	27,800	38,000	17,900	23,300	12,100
27	12,900	9,430	11,200	8,190	28,300	20,200	27,800	30,400	40,100	16,900	22,600	12,100
28	12,500	9,430	11,200	8,190	28,300	20,200	27,800	31,300	39,000	15,900	21,400	11,800
29	13,300	9,430	11,200	8,190	.....	20,200	30,400	28,600	42,300	15,900	21,400	11,800
30	12,500	9,430	11,200	8,190	.....	20,200	33,100	27,800	34,000	14,500	18,400	11,800
31	12,500	.....	11,200	8,190	.....	20,200	.....	27,000	.....	13,700	17,900	.....

Minimum discharge determined by indirect method 4700 second-feet, Feb. 4. Ice present Nov. 19 to April 4. Discharges determined by study of observer's readings, discharge measurements and weather bureau records.

MISSOURI RIVER DRAINAGE

Missouri River at Bismarck, N. Dak.

LOCATION.—At city water plant in Sec. 31, T. 139 N., R. 80 W., one mile west of Bismarck, Burleigh County.

DRAINAGE AREA.—190,650 square miles.

RECORDS AVAILABLE.—October, 1904—April, 1906. October, 1927—September, 1930.

GAGE.—An Au recorder installed in shelter over old well at city water works on left bank half way between N. P. Railway bridge and Memorial Highway bridge in operation since October 17, 1928. Inspected daily by W. B. Hartley, engineer at the water plant. A chain gage on the Northern Pacific Railway bridge has been the only gage in use prior to October 17, 1928. A wire-tape gage is located on the highway bridge.

DISCHARGE MEASUREMENTS.—Made with reel and frame on highway bridge one-half mile below gage. Measurements under ice cover usually made near gage. Initial point for soundings at left pier. Bed clean, sandy, shifting. Shifting sand bars may divide channel at low stages. Channel straight for one-half mile above and one mile below gage. Water swift at high stages. Left bank looking downstream high, right bank gradually sloping and is overflowed only during extreme high water.

CHANNEL AND CONTROL.—No well defined control. Bed composed of rapidly shifting sands. Extreme ice conditions during cold weather.

EXTREMES OF DISCHARGE.—1927-1930; maximum stage 13.2 ft., March 24, 1928, discharge 201,600 second-feet; minimum stage 1.08 ft., February 5, 1929, discharge 5,800 second-feet.

DIVERSIONS.—None from main stream in North Dakota.

REGULATION.—None on main stream in North Dakota.

ACCURACY.—Because of shifting control and severe winter conditions, frequent discharge measurements are necessary in order to obtain good results.

MONTHLY DISCHARGE OF MISSOURI RIVER AT BISMARCK, N. DAK.

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1927-1928				
October	25,000	19,600	21,700	1,330,000
November 14 days	22,200	17,300	20,400	566,000
March 15-31	201,000	68,600	121,000	4,080,000
April	101,000	25,900	37,800	2,250,000
May	107,000	26,800	63,000	3,870,000
June	125,000	54,400	77,600	4,620,000
July	122,000	41,800	79,700	4,900,000
August	45,400	14,600	28,100	1,730,000
September	15,900	12,800	14,000	833,000
The period	201,000	12,800	51,477	24,179,000
1928-1929				
October	18,000	12,800	14,700	904,000
November	17,600	13,000	15,100	898,000
December	.....	.....	9,600	590,000
January	.....	.....	10,400	640,000
February	10,800	5,800	8,180	454,000
March	77,300	9,040	17,500	1,080,000
April	60,900	22,300	34,300	2,040,000
May	93,900	29,500	40,100	2,470,000
June	105,000	51,700	73,100	4,350,000
July	58,100	23,200	37,700	2,320,000
August	21,900	10,200	14,100	867,000
September	13,100	9,850	11,100	660,000
The period	105,000	5,800	23,900	17,273,000
1929-1930				
October	14,900	12,200	13,800	848,000
November	13,500	7,540	12,600	750,000
December	14,900	5,950	8,230	506,000
January	.....	.....	8,470	521,000
February	.....	.....	18,200	1,010,000
March	.....	.....	28,600	1,760,000
April	72,400	24,600	35,700	2,120,000
May	41,600	25,400	32,100	1,970,000
June	59,800	28,600	38,800	2,310,000
July	36,600	15,400	23,100	1,420,000
August	39,000	10,600	17,600	1,080,000
September	20,600	11,400	15,100	898,000
The period	72,400	.....	21,000	15,193,000

DAILY DISCHARGE IN SECOND-FEET OF MISSOURI RIVER AT BISMARCK, N. DAK., FOR YEAR ENDING SEPTEMBER 30, 1928

Day	Oct.:	Nov.:	Jan.:	Mar.:	Apr.:	May:	June:	July:	Aug.:	Sept.:
1	23,100	18,800	.....	.....	101,000	26,800	116,000	68,600	40,600	14,600
2	23,100	18,800	.....	.....	92,200	26,800	120,000	73,100	40,600	14,600
3	23,100	17,300	.....	.....	61,400	26,800	124,000	87,300	45,400	14,000
4	24,000	19,600	.....	.....	57,100	26,800	125,000	97,200	44,200	14,600
5	24,000	20,400	.....	.....	53,600	30,900	125,000	98,900	45,400	15,200
6	25,000	20,400	.....	.....	44,200	30,900	113,000	101,000	41,800	15,200
7	25,000	21,300	.....	.....	41,800	44,200	97,200	98,900	37,300	15,900
8	25,000	22,100	.....	.....	37,300	44,200	90,600	101,000	37,300	15,900
9	24,000	22,200	.....	.....	34,100	43,000	84,100	106,000	35,100	15,200
10	24,000	22,200	.....	.....	35,100	40,600	79,300	106,000	34,100	15,200
11	24,000	21,300	.....	.....	34,100	41,800	77,700	122,000	30,900	14,600
12	23,100	21,300	.....	.....	33,000	41,800	73,100	111,000	34,100	15,200
13	22,200	19,600	.....	.....	33,000	41,800	67,200	98,900	35,100	14,600
14	22,200	19,600	.....	.....	31,900	47,900	59,900	85,700	35,100	14,000
15	21,300	.....	.....	68,600	31,900	54,400	59,900	79,300	29,800	13,400
16	20,400	.....	.....	68,600	30,900	59,900	59,900	76,200	27,800	13,400
17	20,400	.....	.....	74,600	29,800	80,900	59,900	73,100	25,900	12,800
18	19,600	.....	17,600	102,000	29,800	88,900	62,800	71,600	24,000	12,800
19	19,600	.....	.....	127,000	27,800	88,900	65,700	73,100	23,100	13,400
20	20,400	.....	.....	146,000	25,900	87,300	65,700	77,700	21,300	13,400
21	20,400	.....	.....	166,000	25,900	82,500	58,500	74,600	20,400	13,400
22	20,400	.....	.....	168,000	26,800	79,300	58,500	71,600	18,000	13,400
23	20,400	.....	.....	144,000	26,800	77,700	57,100	73,100	17,300	12,800
24	20,400	.....	.....	201,000	26,800	79,300	59,900	73,100	17,300	12,800
25	20,400	.....	.....	118,000	26,800	82,500	64,300	70,100	16,600	12,800

26	20,400	.....	.....	151,000	26,800	85,700	61,400	64,300	15,900	12,800
27	19,600	.....	.....	144,000	26,800	88,900	61,400	54,400	15,900	14,000
28	19,600	.....	.....	113,000	27,800	92,200	65,700	50,400	15,900	13,400
29	19,600	.....	.....	98,900	27,800	98,900	61,400	46,000	15,200	13,400
30	19,600	.....	.....	92,200	27,800	104,000	54,400	41,800	14,600	13,400
31	19,600	.....	.....	79,300	.....	107,000	.....	41,800	14,600	.....

Shifting control method Oct. 1 to Nov. 14; and June 1 to Sept. 30. Ice Nov. 15. River frozen Nov. 16 to March 14. Records discontinued during winter. Discharge measurement Jan. 18, 1928.

DAILY DISCHARGE IN SECOND-FEET OF MISSOURI RIVER AT BISMARCK, N. DAK., FOR YEAR ENDING SEPTEMBER 30, 1929

Day	Oct.:	Nov.:	Dec.:	Jan.:	Feb.:	Mar.:	Apr.:	May:	June:	July:	Aug.:	Sept.:
1	13,400	17,600	12,400	12,000	7,120	10,200	59,500	31,700	97,400	50,200	21,900	10,200
2	13,400	17,200	12,000	12,000	6,740	10,200	52,600	33,900	97,400	53,300	20,700	9,850
3	13,400	16,800	11,400	12,000	6,080	9,600	56,700	33,900	87,600	58,100	19,500	9,850
4	14,000	16,400	11,400	12,000	6,080	9,040	60,900	33,900	72,400	58,100	18,400	9,850
5	14,000	16,400	11,400	12,000	5,800	9,040	54,000	32,800	63,300	56,500	17,900	9,850
6	14,000	15,600	10,800	12,000	5,800	9,040	46,100	33,900	63,300	58,100	16,900	9,850
7	14,000	15,600	12,000	12,000	5,800	9,600	38,600	33,900	68,700	54,900	16,400	9,850
8	14,000	15,600	11,400	12,000	6,080	9,600	33,900	33,900	76,100	50,200	15,400	9,850
9	14,000	15,600	11,400	12,000	6,080	9,600	36,200	35,100	95,400	48,700	15,400	9,850
10	14,000	16,000	11,400	12,000	6,400	10,200	43,600	35,100	105,000	47,200	14,900	9,850
11	13,400	16,000	10,200	11,300	6,400	10,200	42,300	31,700	83,700	44,300	14,400	9,850
12	13,400	15,600	9,040	10,800	6,740	10,800	38,600	32,800	63,300	40,300	14,400	9,850
13	12,800	15,600	9,040	10,200	6,740	11,400	32,800	36,200	66,800	36,600	14,400	10,200
14	12,800	15,600	9,040	9,600	7,120	12,000	30,600	38,600	79,900	35,500	14,000	10,600
15	12,800	15,600	9,600	9,040	7,540	13,400	27,300	37,400	78,000	33,300	14,000	11,000
16	12,800	16,000	9,600	8,500	8,500	15,200	25,300	33,900	72,400	31,300	14,000	11,400
17	12,800	15,600	10,200	8,500	10,200	15,200	24,300	32,800	70,500	29,500	13,500	12,200
18	13,700	14,800	10,200	8,500	10,500	15,200	23,800	31,700	70,500	27,700	13,100	12,600
19	14,100	14,800	9,040	8,500	10,800	15,200	23,300	30,600	68,700	26,900	13,100	13,100
20	14,800	14,400	8,000	8,500	10,800	15,200	23,800	30,600	72,400	26,100	13,500	12,600
21	15,200	14,800	8,000	9,040	10,800	15,200	22,400	29,500	78,000	26,900	13,100	12,600
22	15,200	13,700	8,000	9,600	9,600	15,200	22,800	31,700	81,800	27,700	12,200	12,600
23	15,600	13,700	8,000	9,600	10,200	15,200	22,300	33,900	79,900	27,700	11,800	12,200
24	16,000	13,400	8,000	10,200	9,600	15,200	23,800	38,600	68,700	28,600	11,400	12,200
25	16,400	13,400	8,000	10,800	10,200	15,200	24,300	41,100	61,500	30,400	11,000	12,200

26	16,800	14,400	8,000	11,400	10,200	15,200	25,300	41,100	58,100	29,500	10,600	12,200
27	17,200	14,400	8,000	11,400	10,200	15,200	26,300	38,600	56,500	27,700	10,200	12,200
28	17,600	13,700	8,000	10,200	10,800	15,200	27,300	62,300	53,300	27,700	10,200	12,200
29	18,000	13,000	8,000	9,600	.....	77,300	28,400	74,200	51,700	26,900	10,200	11,800
30	18,000	13,000	8,000	9,040	.....	52,600	31,700	83,800	51,700	25,400	10,200	11,800
31	18,000	.....	8,000	8,000	.....	62,300	.....	93,900	.....	23,200	10,200	.....

Gage heights Oct. 1-17 read by U. S. Weather Bureau at N. P. Ry. bridge. Shifting control April 11 to June 2, and Oct. 18 to Dec. 1. Ice Dec. 2 to Mar. 28.

DAILY DISCHARGE IN SECOND-FEET OF MISSOURI RIVER AT BISMARCK, N. DAK., FOR YEAR ENDING SEPTEMBER 30, 1930

Day	Oct.:	Nov.:	Dec.:	Jan.:	Feb.:	Mar.:	Apr.:	May:	June:	July:	Aug.:	Sept.:
1	12,200	13,500	6,970	6,710	6,450	30,600	48,700	26,900	30,400	36,600	14,900	20,600
2	12,200	13,500	7,250	6,710	6,450	30,600	58,100	29,500	29,500	34,400	14,400	19,500
3	12,600	13,100	7,840	6,710	6,450	30,600	59,800	32,300	28,600	31,300	13,500	18,400
4	12,600	13,100	8,800	6,710	6,450	30,600	68,700	37,800	43,700	29,500	13,500	17,400
5	13,100	13,500	9,490	6,710	6,450	30,600	72,400	39,000	59,800	28,600	12,600	17,400
6	13,500	13,100	11,400	9,150	8,830	21,800	59,800	35,500	59,800	26,900	12,200	16,900
7	14,000	13,100	14,900	9,150	8,830	21,800	47,200	33,300	50,200	25,400	12,200	16,400
8	14,000	13,100	14,400	9,150	8,830	21,800	27,700	33,300	42,900	23,200	11,800	15,900
9	14,400	13,500	11,800	9,150	8,830	21,800	24,600	33,300	37,800	21,900	11,000	15,400
10	14,900	13,500	9,140	9,150	8,830	21,800	24,600	35,500	35,500	21,300	11,000	14,900
11	14,900	13,500	7,840	13,500	10,700	19,900	24,600	36,600	33,300	20,700	10,600	14,400
12	14,400	13,500	7,540	13,500	10,700	19,900	24,600	37,800	34,400	20,700	10,600	14,400
13	14,400	13,500	7,840	13,500	10,700	19,900	25,400	40,300	35,500	20,700	11,800	14,400
14	14,400	13,500	7,840	13,500	10,700	19,900	26,100	40,300	39,800	20,700	12,200	14,000
15	14,400	13,500	7,540	13,500	10,700	19,900	27,700	41,600	48,700	20,700	12,200	13,500
16	14,000	13,500	7,540	10,100	19,100	28,100	28,600	37,800	44,300	19,500	12,600	13,500
17	14,000	13,500	7,250	10,100	19,100	28,100	30,400	35,500	42,900	19,000	12,600	14,000
18	14,000	13,100	7,250	10,100	19,100	28,100	30,400	27,700	44,300	19,000	12,600	15,900
19	14,000	13,100	7,540	10,100	19,100	28,100	33,300	27,700	42,900	20,700	13,100	16,900
20	14,000	12,600	7,540	10,100	19,100	28,100	34,400	27,700	36,600	23,900	17,200	16,900
21	14,000	12,600	6,970	6,260	36,200	33,800	34,400	27,700	32,300	27,700	32,800	16,400
22	14,400	13,500	6,440	6,260	36,200	33,800	35,500	26,900	31,300	28,600	39,000	14,900
23	14,400	12,600	5,950	6,260	36,200	33,800	33,300	25,400	30,300	26,100	33,300	14,000
24	14,000	12,200	5,950	6,260	36,200	33,800	31,300	25,400	33,300	23,200	26,100	13,100
25	14,000	11,800	6,190	6,260	36,200	33,800	28,600	26,100	35,500	21,300	23,900	13,100

26	14,000	11,400	6,440	5,670	34,400	35,700	26,900	26,100	36,600	20,100	23,200	12,600
27	13,500	11,000	6,970	5,670	34,400	35,700	26,900	27,700	36,600	19,000	23,200	12,200
28	13,500	9,850	7,840	5,670	34,400	35,700	26,100	28,500	36,600	17,900	22,500	11,800
29	13,500	8,150	8,470	5,670	.....	35,700	26,100	29,500	35,500	16,900	23,200	11,800
30	13,500	7,540	8,310	5,670	.....	35,700	26,100	31,300	36,600	16,400	22,500	11,400
31	13,500	.....	7,840	5,670	.....	35,700	.....	31,300	.....	15,400	21,900	.....

Stage-discharge relation affected by ice Nov. 21 to Apr. 2. Discharge determined by study of gage heights, observer's notes, discharge measurements and temperature records.

MISSOURI RIVER DRAINAGE

Little Missouri River at Medora, N. Dak.

LOCATION.—In NE¼ sec. 27, T. 140 N., R. 102 W., at bridge on U. S. Highway No. 10 about 150 feet downstream from railway bridge one-third mile west of Northern Pacific Railway depot at Medora in Billings county.

DRAINAGE AREA.—6,190 square miles.

RECORDS AVAILABLE.—May 1903—October 1908, October 1921—April 1926, September 1928—September 1930.

GAGE.—Wire gage on upstream side of bridge. Read daily to even hundredths by Richard Hellickson, Medora, N. Dak.

DISCHARGE MEASUREMENTS.—Measured from highway bridge or by wading about 500 feet above bridge. Bed of stream largely of gravel and quicksand; clean, shifting. One channel at all stages except when an occasional shifting sand bar may temporarily divide channel. Water swift at ordinary stages. Channel straight for 150 feet above and 300 feet below gage.

CHANNEL AND CONTROL.—Shifting bars of clay, sand and gravel across a width of about 500 feet cause lack of any stable control.

EXTREMES OF DISCHARGE.—1903-1908; 1921-1926; 1928-1930; Maximum stage 17.2 ft. June 7, 1929, discharge 33,700 second-feet; minimum discharge 2 second-feet, September 28, 1905.

DIVERSION.—Irrigation diversions from Wyoming and Montana tributaries probably do not have a great effect on the discharge at the station.

REGULATION.—None.

ACCURACY.—Because of shifting control frequent discharge measurements are necessary to insure accurate results.

MONTHLY DISCHARGE OF LITTLE MISSOURI RIVER AT MEDORA, N. DAK.

Month	Maximum	Minimum	Mean	acre-feet Run-off in
	Discharge in second-feet			
1928				
September	480	13	140	8,330
1928-1929				
October	174	20	63.7	3,920
November, 26 days	109	16	45.5	2,350
March, 21 days	13,500	1130	6470	269,000
April	13,100	1050	3210	191,000
May	28,800	416	3120	192,000
June	33,700	251	4690	279,000
July	368	115	212	13,000
August	188	29	82.6	5,080
September	234	24	55.5	3,300
The period	33,700	16	.....	958,650

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1929-1930				
October	580	60	185	11,400
November, 19 days	73	36	538	2,030
March, 23 days	2,040	305	1080	49,300
April	493	90	176	10,500
May	346	51	147	9,040
June	3,320	286	1310	78,000
July	674	25	148	9,100
August	416	10	93	5,720
September	3,560	32	300	17,900
The period	3,560	10	.....	192,990

DAILY DISCHARGE IN SECOND-FEET OF LITTLE MISSOURI RIVER AT MEDORA, N. DAK., FOR YEAR ENDING SEPT. 30, 1928

Day	August	September
1	.....	71
2	.....	76
3	.....	55
4	.....	34
5	.....	28
6	.....	23
7	.....	13
8	.....	94
9	.....	76
10	.....	59
11	.....	130
12	.....	76
13	.....	65
14	.....	55
15	.....	51
16	.....	41
17	.....	31
18	.....	28
19	.....	114
20	.....	480
21	.....	456
22	.....	456
23	.....	366
24	.....	288
25	.....	236
26	.....	204
27	.....	168
28	.....	146
29	.....	135
30	.....	130
31	67	.....

DAILY DISCHARGE IN SECOND-FEET OF LITTLE MISSOURI RIVER AT MEDORA, N. DAK., FOR YEAR ENDING SEPTEMBER 30, 1929

Day	Oct.:	Nov.:	Jan.:	March.	Apr.:	May:	June:	July:	Aug.:	Sept.:
1	89	69	.....	.....	13,100	1,050	19,000	251	111	29
2	67	69	.....	.....	8,530	1,300	11,900	218	111	28
3	55	69	.....	.....	6,750	1,130	9,700	218	115	111
4	51	65	.....	.....	5,720	1,130	9,400	218	130	234
5	48	57	.....	.....	4,700	929	6,070	218	144	102
6	44	44	.....	.....	5,050	852	4,540	188	159	86
7	31	48	.....	.....	4,540	778	33,700	203	174	82
8	20	37	2.2	.....	4,380	778	14,100	286	188	62
9	20	31	.....	.....	4,090	674	5,050	286	134	52
10	20	28	.....	.....	3,690	674	3,690	251	134	50
11	20	30	.....	1,130	4,090	642	3,690	188	90	39
12	20	36	.....	3,200	3,320	610	4,870	174	94	31
13	34	36	.....	3,690	2,760	550	2,550	158	72	29
14	20	30	.....	2,550	2,140	552	2,240	163	56	29
15	20	24	.....	3,090	1,950	550	1,390	174	52	24
16	21	19	.....	3,090	1,760	550	1,300	368	56	33
17	31	17	.....	2,550	1,760	550	1,130	286	72	34
18	35	16	.....	3,320	1,660	778	968	251	78	31
19	39	16	.....	4,380	1,660	852	742	188	72	28
20	43	67	.....	4,700	1,570	778	674	234	62	24
21	47	109	.....	5,440	1,570	610	550	346	56	29
22	59	109	.....	6,990	1,570	550	522	218	56	24
23	71	34	.....	6,520	1,480	522	493	155	47	36
24	94	61	.....	11,900	1,390	466	440	174	47	34
25	160	34	.....	12,200	1,390	416	416	188	50	47

26	174	27	.....	9,700	1,220	929	391	251	44	36
27	174	.....	.....	6,520	1,220	5,650	326	188	33	78
28	146	.....	.....	7,480	1,130	6,520	305	144	31	111
29	119	.....	.....	12,200	1,050	9,400	368	124	33	56
30	109	.....	.....	13,500	1,050	27,300	251	160	31	75
31	89	.....	.....	11,900	.....	28,800	.....	115	29	.....

River frozen from Nov. 27 to Dec. 15. No records from Dec. 15 to March 10. Observer's record Oct. 17-22 disregarded. Discharge Oct. 17-20 and 22 interpolated from measurement Oct. 21, 1928.

DAILY DISCHARGE IN SECOND-FEET OF LITTLE MISSOURI RIVER AT MEDORA, N. DAK., FOR YEAR ENDING SEPTEMBER 30, 1930

Day	Oct.:	Nov.:	Feb.:	March:	Apr.:	May:	June:	July:	Aug.:	Sept.:
1	82	60	.....	.....	305	166	346	674	25	90
2	72	68	.....	.....	288	160	391	610	22	68
3	218	58	.....	.....	251	98	1,950	466	18	62
4	234	73	.....	.....	203	98	2,760	416	18	58
5	188	54	.....	.....	234	98	3,320	368	16	52
6	166	42	.....	.....	218	111	2,440	305	56	44
7	140	56	.....	.....	188	124	2,040	234	39	44
8	113	56	.....	.....	174	124	1,760	174	16	82
9	104	68	.....	1,660	174	115	1,300	147	14	115
10	466	56	.....	2,040	158	111	1,570	122	12	174
11	580	47	.....	1,660	147	104	1,390	109	10	391
12	100	36	.....	1,660	142	234	1,480	100	10	708
13	466	42	.....	1,760	137	268	1,570	88	10	3,560
14	326	50	.....	1,570	152	346	1,950	84	10	2,040
15	251	62	.....	1,660	147	326	1,570	73	10	326
16	218	72	148	1,660	493	346	550	60	13	218
17	234	42	.....	1,300	268	326	466	57	16	166
18	188	39	.....	1,220	203	188	346	66	368	134
19	218	42	.....	1,050	188	166	305	57	416	115
20	218	.....	.....	1,050	163	158	286	48	305	98
21	174	.....	.....	814	150	137	368	44	286	72
22	158	.....	.....	890	134	122	346	38	218	62
23	134	.....	.....	852	134	109	1,390	32	188	56
24	120	.....	.....	890	98	88	610	29	188	50
25	109	.....	.....	778	90	92	1,660	28	171	46

26	113	.....	.....	493	90	75	1,860	28	150	42
27	82	.....	.....	368	90	63	1,390	28	73	39
28	56	.....	.....	391	90	60	1,480	25	58	36
29	78	.....	.....	440	90	51	1,300	25	39	33
30	73	.....	.....	391	90	51	1,130	25	33	32
31	60	.....	.....	305	.....	51	.....	25	75	.....

Stage-discharge relation seriously affected by ice Nov. 20 to Mar. 8; data insufficient to warrant estimates of flow.

MISSOURI RIVER DRAINAGE

Knife River at Hazen, N. Dak.

LOCATION.—On the east section line near the northeast corner of Sec. 19, T. 144 N., R. 86 W., on state highway No. 25, 0.7 mile south of railway depot at Hazen, Mercer County, a station on the Killdeer branch of the Northern Pacific Railway.

RECORDS AVAILABLE.—October, 1928—September, 1930.

GAGE.—Wire gage on downstream handrail of highway bridge. Read daily to even hundredths by Mrs. Fred Haas, Box 117, Hazen.

DISCHARGE MEASUREMENTS.—Made from bridge or by wading near control. Water sluggish at gage, but swift at control. Both banks wooded. Channel straight for 800 feet above and 500 feet below gage. Good measurements should be obtained.

CHANNEL AND CONTROL.—The low water control is a riffle about 500 feet downstream from gage, composed of sand and gravel, probably shifting at high stages.

EXTREME OF DISCHARGE.—1928-1930; maximum stage 23.2 ft., February 21, 1930, discharge, 3,070 second-feet; minimum stage 1.66 ft., August 27, 1929, discharge, 1.2 second-feet.

DIVERSIONS.—None.

REGULATIONS.—Small dam at Beulah 10 miles upstream regulated for park purposes may cause some fluctuations.

ACCURACY.—Good.

MONTHLY DISCHARGE OF KNIFE RIVER AT HAZEN, N. DAK.

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1928-1929				
October 13 days	27	24	26.1	673
November 23 days	47	24	30.6	1,400
March	548	315	436	5,190
April	680	35	127	7,380
May 4 days	41	34	38	301
June	845	26	192	11,401
July	245	9	25.9	1,590
August	15	1.2	8.42	518
September	17	1.4	6.47	385
The period	845	1.2	.....	28,838
1929-1930				
October	20	5.6	10.0	615
November 9 days	13	8.0	10.9	195
February 8 days	3,070	635	1,860	29,500
March	2,740	305	1,010	62,100
April	335	78	203	12,100
May	165	29	79.0	4,860
June	1,870	25	249	14,800
July	56	6.2	18.4	1,130
August	33	8.4	20.9	1,290
September	87	34	59.3	3,530
The period	3,070	5.6	.....	130,120

DAILY DISCHARGE IN SECOND-FEET OF KNIFE RIVER AT HAZEN, N. DAK., FOR YEAR ENDING SEPTEMBER 30, 1929

Day	Oct.:	Nov.:	March:	April:	May:	June:	July:	Aug.:	Sept.:
1	....	26	....	680	34	755	28	12	7.4
2	....	44	....	486	39	800	26	11	8.0
3	....	44	....	305	39	845	21	12	7.4
4	....	39	....	215	41	305	19	12	5.0
5	....	29	....	165	....	215	18	12	5.0
6	....	28	....	165	....	155	16	11	5.6
7	....	38	....	155	....	110	24	12	5.9
8	....	47	....	205	....	100	22	13	3.5
9	....	31	....	185	....	100	21	12	2.6
10	....	30	....	135	....	100	20	11	3.8
11	....	30	....	110	....	175	18	11	5.3
12	....	29	....	92	....	345	21	10	4.7
13	....	29	....	78	....	215	13	15	5.3
14	....	28	....	69	....	285	9	15	5.9
15	....	28	....	47	....	215	14	12	12
16	....	27	....	47	....	165	16	6.5	2.3
17	....	27	....	49	....	135	17	6.5	1.4
18	....	26	....	51	....	195	15	5.9	7.7
19	25	26	....	56	....	165	17	5.9	6.5
20	26	25	....	51	....	51	14	5.3	6.5
21	27	25	....	51	....	45	245	2.6	5.9
22	27	24	....	49	....	38	42	3.8	16
23	26	24	....	47	....	37	25	5.6	3.5
24	27	....	....	46	....	31	20	5.0	3.5
25	26	....	....	44	....	28	19	5.0	5.9
26	26	....	474	42	....	28	17	2.0	8.4
27	27	....	429	41	....	31	15	1.2	8.4
28	24	....	315	36	....	28	13	6.8	17
29	26	....	429	39	....	28	13	8.0	6.5
30	26	....	418	35	....	26	12	5.0	7.1
31	27	....	548	....	....	....	12	5.0	....

Ice present Nov. 24 to Mar. 25. Discharge interpolated Nov. 11-22 and June 2. Shifting control method used August 15 to September 30.

DAILY DISCHARGE IN SECOND-FEET OF KNIFE RIVER AT HAZEN, N. DAK., FOR YEAR ENDING SEPTEMBER 30, 1930

Day	Oct.:	Nov.:	Feb.:	March:	Apr.:	May:	June:	July:	Aug.:	Sept.:
1	5.6	13	.....	620	255	78	29	56	8.4	34
2	5.9	13	.....	620	255	69	26	51	13	35
3	5.9	13	.....	535	285	69	26	36	14	36
4	6.2	12	.....	440	275	69	25	35	15	39
5	7.7	11	.....	385	295	87	87	33	15	42
6	11	10	.....	375	285	165	105	25	15	39
7	12	9.6	.....	345	285	105	165	24	17	36
8	12	8.8	.....	305	265	78	185	24	17	42
9	11	8.0	.....	305	255	78	165	23	17	47
10	15	.....	.....	315	195	69	165	21	18	47
11	12	.....	.....	325	185	69	265	20	19	51
12	11	.....	.....	785	165	92	145	18	19	69
13	11	.....	.....	1,120	165	96	1,870	18	20	74
14	12	.....	.....	1,200	175	120	1,020	16	21	69
15	12	.....	.....	1,440	185	125	462	12	21	64
16	11	.....	.....	2,740	205	135	305	16	23	64
17	8.4	.....	.....	2,690	205	145	275	13	21	64
18	8.4	.....	.....	2,350	255	135	125	9.6	20	60
19	9.2	.....	.....	1,460	335	105	105	7.4	21	56
20	10	.....	.....	1,420	305	78	82	9.6	21	56
21	7.7	.....	3,070	1,460	265	74	78	8.0	23	48
22	7.7	.....	2,700	1,330	205	60	135	7.4	24	56
23	8.4	.....	2,350	1,510	135	56	396	6.2	26	64
24	9.2	.....	2,000	1,960	115	44	215	13	26	74
25	11	.....	1,670	1,590	105	43	315	12	26	87

26	9.2	.....	1,840	1,170	92	41	265	8	26	87
27	10	.....	653	815	87	36	155	12	27	87
28	9.2	.....	635	548	87	35	110	10	27	87
29	9.2	.....	.....	429	87	33	87	8.8	28	87
30	12	.....	.....	345	78	30	82	8.8	28	87
31	20	.....	.....	355	.....	29	.....	7.4	33	.....

Daily discharge Feb. 22 to 24 interpolated because of missing gage heights.

MISSOURI RIVER DRAINAGE

Heart River at Sunny, N. Dak.

LOCATION.—NE¼ Sec. 25, T. 139 N., R. 82 W., at highway bridge about 300 feet below Northern Pacific Railway bridge, nine-tenths mile west of Sunny, Morton County, five miles west of Mandan and about 10 miles above the mouth of the river.

DRAINAGE AREA.—3,320 square miles.

RECORDS AVAILABLE.—April, 1924—September, 1930.

GAGE.—Chain gage on downstream side of bridge. Read once or twice daily to even hundredths by Roy Morrell, Mandan.

DISCHARGE MEASUREMENTS.—Made from bridge or by wading.

CHANNEL AND CONTROL.—The sandy stream bed is liable to shift. Ice gorging causes changing stage-discharge relation when ice goes out. Ice jams in Missouri at mouth of Heart River may have some backwater effect.

EXTREMES OF DISCHARGE.—1924-1930; maximum stage 17.54 ft., March 24, 1930, discharge, 3,240 second-feet; minimum stage, 3.88 ft., August 20, 1929, discharge, 0.00 second-feet.

ICE.—Stage-discharge affected by ice.

DIVERSIONS.—None.

ACCURACY.—Good. Backwater from ice jams in Missouri River may affect it for short period at extremely rare intervals.

MONTHLY DISCHARGE OF THE HEART RIVER AT SUNNY, N. DAK.

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1928				
March 6 days	1,380	368	732	8,710
April	318	77	176	10,500
May	168	24	58.2	3,580
June	368	8	86.8	5,160
July	1,610	158	644	39,600
August	1,550	54	264	16,200
September	137	8	49.5	2,950
The period	1,610	8	.....	86,700
1928-1929				
October	32	4	13.9	855
November	58	16	34.7	2,060
December	.....	.....	25	1,540
January	.....	.....	10	615
February	.....	.....	12.1	672
March	2,510	25	743	45,700
April	2,330	103	425	25,300
May	1,180	56	119	7,320
June	2,690	96	738	43,900
July	88	10	41.2	2,530
August	27	0	10.0	615
September	16	2.1	6.91	411
The period	2,690	0	182	131,518

Month	Discharge in second-feet Maximum	Minimum	Mean	Run-off in acre-feet
1929-1930				
October	14	3	7.61	468
November 20 days	18	12	15.0	595
March 11 days	3,240	662	1,740	38,000
April	990	13.	453	27,000
May	198	62	126	7,750
June	2,540	52	434	25,800
July	209	17	620	3,810
August	17	2	9.87	607
September	19	7	11.3	672
The period	3,240	2	.....	104,702

DAILY DISCHARGE IN SECOND-FEET OF HEART RIVER AT SUNNY, N. DAK., FOR YEAR ENDING SEPTEMBER 30, 1928

Day	March:	April:	May:	June:	July:	August:	Sept.:
1	.....	318	77	24	394	148	137
2	.....	306	77	24	343	158	97
3	.....	294	77	24	282	158	87
4	.....	282	77	16	224	148	77
5	.....	258	73	16	224	137	68
6	.....	247	73	16	356	127	58
7	.....	224	73	16	282	201	58
8	.....	212	68	8	1,310	1,550	58
9	.....	201	58	8	1,040	1,010	58
10	.....	190	54	8	892	668	58
11	.....	179	44	8	1,250	528	58
12	.....	179	49	58	1,610	501	54
13	.....	168	49	49	1,280	612	49
14	.....	168	49	40	1,340	247	58
15	.....	168	40	44	668	224	58
16	.....	168	37	49	501	179	68
17	.....	158	37	49	447	168	49
18	.....	158	32	49	394	158	32
19	.....	158	27	87	394	117	32
20	.....	148	27	127	528	107	24
21	.....	148	97	148	1,250	97	24
22	.....	137	168	158	1,490	97	24
23	.....	132	107	168	950	87	49
24	.....	127	77	179	724	68	40
25	.....	117	49	190	501	77	32
26	1,380	107	44	168	294	97	24
27	1,050	97	40	148	247	68	21
28	724	87	40	168	212	58	16
29	474	77	32	190	201	54	8
30	394	77	27	368	168	148	8
31	368	.....	24	.....	156	179	.....

Note—Daily discharges March 27, April 9 and 23 interpolated.

DAILY DISCHARGE IN SECOND-FEET OF HEART RIVER AT SUNNY, N. DAK., FOR THE YEAR ENDING SEPTEMBER 30, 1929

Day	Oct.:	Nov.:	Dec.:	Jan.:	Feb.:	Mar.:	Apr.:	May:	June:	July:	Aug.:	Sept.:
1.	8	16	25	10	8	30	2,330	103	1,930	88	27	2.1
2.	8	24	25	10	8	30	1,380	103	2,690	76	24	2.1
3.	6	32	25	10	8	30	1,080	96	2,690	70	19	2.1
4.	6	32	25	10	8	30	870	96	2,000	67	19	7.0
5.	6	40	25	10	8	30	615	88	1,310	65	18	7.0
6.	8	58	25	10	8	25	615	82	615	63	18	6.1
7.	8	58	25	10	8	25	570	82	438	61	16	6.1
8.	4	49	25	10	8	25	661	76	358	58	21	6.1
9.	4	24	25	10	8	25	570	76	253	65	18	5.2
10.	6	24	25	10	8	25	481	88	253	63	15	5.2
11.	8	24	25	10	10	200	397	82	253	56	12	5.2
12.	16	24	25	10	10	200	304	76	753	48	10	5.2
13.	8	24	25	10	10	200	222	70	800	46	10	8.0
14.	8	24	25	10	10	200	238	70	847	41	10	8.0
15.	8	24	25	10	10	200	222	70	988	41	10	8.0
16.	8	32	25	10	10	500	222	65	1,080	39	10	7.0
17.	8	32	25	10	10	500	208	61	1,490	37	10	6.1
18.	8	32	25	10	10	500	193	63	800	33	9.0	5.2
19.	16	32	25	10	10	1,710	166	63	548	32	1.6	5.2
20.	16	32	25	10	10	2,510	166	61	397	30	0.0	4.4
21.	16	32	25	10	20	1,990	142	61	286	30	4.4	4.4
22.	16	32	25	10	20	2,100	142	58	253	29	4.4	4.4
23.	16	40	25	10	20	1,280	142	56	222	33	3.5	6.1
24.	24	58	25	10	20	1,080	142	56	180	24	3.5	8.0
25.	24	58	25	10	20	894	132	56	142	18	2.6	10

26.	16	49	25	10	20	894	121	58	121	12	2.6	13
27.	32	40	25	10	20	847	112	76	96	11	2.6	16
28.	32	32	25	10	20	1,040	103	63	142	11	2.6	13
29.	32	32	25	10	.....	1,180	103	70	103	11	2.6	11
30.	32	32	25	10	.....	2,330	103	397	96	10	2.1	10
31.	24	.....	25	10	.....	2,390	.....	1,180	.....	10	2.1	.....

Ice Oct. 20-21, Nov. 30 to March 18. Shifting control Mar. 19-26—Discharge interpolated Oct. 10, April 17, June 4, 5 and 13.

DAILY DISCHARGE IN SECOND-FEET OF HEART RIVER AT SUNNY, N. DAK., FOR THE YEAR ENDING SEPTEMBER 30, 1930

Day	Oct.:	Nov.:	March:	April:	May:	June:	July:	Aug.:	Sept.:
1	4	16	....	578	133	55	209	17	7
2	4	14	....	578	129	55	198	17	7
3	5	16	....	578	129	55	177	17	7
4	7	16	....	662	137	54	157	16	8
5	7	14	....	750	133	52	126	16	7
6	5	14	....	890	137	52	111	15	8
7	4	14	....	750	147	52	98	15	10
8	3	12	....	662	147	55	94	14	11
9	5	14	....	578	147	81	81	13	12
10	9	18	....	458	147	84	78	12	12
11	12	18	....	384	147	94	52	10	15
12	9	16	....	351	177	2,540	45	9	16
13	8	16	....	321	177	1,200	41	7	17
14	7	14	....	293	188	2,600	37	7	18
15	7	14	....	293	198	1,250	33	4	19
16	6	14	....	336	177	478	31	3	19
17	6	16	....	662	147	336	30	2	16
18	6	16	....	742	137	243	26	2	19
19	5	14	....	990	129	209	26	6	12
20	5	14	....	402	118	177	35	7	11
21	8	....	2,480	351	111	157	31	14	10
22	8	....	2,410	321	100	137	28	13	10
23	9	....	2,290	293	90	122	25	13	10
24	10	....	3,240	267	90	578	22	10	10
25	10	....	1,990	198	90	458	20	8	9
26	10	....	1,690	209	84	420	19	7	9
27	10	....	1,360	209	81	402	19	6	8
28	9	....	1,200	188	78	368	19	5	8
29	10	....	1,090	167	76	351	18	7	7
30	14	....	750	137	67	293	18	7	7
31	14	....	662	....	62	....	17	7	....

Notes—June 4 discharge interpolated on account of missing gage height. Ice Nov. 1 to Mar. 20; data insufficient for computation of discharge.

MISSOURI RIVER DRAINAGE

Cannonball River at Timmer, N. Dak.

LOCATION.—In NW¼ Sec. 21, T. 133 N., R. 82 W., on the F. S. Bingenheimer ranch 3½ miles south of Timmer, N. Dak.

DRAINAGE AREA.—3,650 square miles.

RECORDS AVAILABLE.—June, 1903—November, 1908, August, 1911—September, 1918, October, 1921—September, 1930.

GAGE.—Cantilever gage on left bank with regulation weight and wire chain ¼ mile upstream from observer's house. Read once a day by F. S. Bingenheimer, Timmer, N. Dak.

DISCHARGE MEASUREMENTS.—Made at high stage from cable car about 150 feet upstream from gage. Low stage measurements made by wading ¼ mile downstream from gage at riffle.

CHANNEL AND CONTROL.—One channel at all stages. High left bank and medium high right bank looking downstream. Right bank covered with brush.

EXTREMES OF DISCHARGE.—1903-1908; 1911-1918; 1921-1930; maximum stage, 11.1 ft., March 18, 1929, discharge, 6,520 second-feet; minimum stage, 2.10 ft., August 17, 1930, discharge, 0.00 second-feet.

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

REGULATIONS.—No dams or diversions.

ACCURACY.—Fairly accurate records obtainable.

MONTHLY DISCHARGE OF CANNONBALL RIVER NEAR TIMMER, N. DAK.

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1928				
March 5 days	359	202	280	2,780
April	178	31	72.3	4,300
May	31	4	18.1	1,110
June	960	2	127	7,500
July	2,420	101	433	26,600
August	2,500	43	203	12,500
September	2,180	21	165	9,820
The period	2,500	2	.....	64,610
1928-1929				
October	21	42	9.79	602
November 23 days	21	42	12.7	579
March	6,390	1,140	2,980	118,000
April	1,340	73	353	21,000
May	573	32	70.3	4,320
June	1,410	59	467	27,800
July	53	2.7	19.3	1,200
August	163	0.1	16.2	996
September	30	0	4.46	265
The period	6,390	0	.....	174,762

MONTHLY DISCHARGE OF CANNONBALL RIVER NEAR TIMMER, N. DAK. (Continued)

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1929-1930				
October	256	1.3	18.8	1,160
November 16 days	28	6.5	11.5	365
February 5 days	1,560	136	927	9,190
March 16 days	3,220	328	1,250	39,700
April	949	67	218	18,000
May	530	25	114	7,010
June	572	10	71.7	4,270
July	169	0.9	25.9	1,590
August	0.8	0	0.32	20
September	29	0.2	3.84	228
The period	3,220	0	.....	81,533

DAILY DISCHARGE IN SECOND-FEET OF CANNONBALL RIVER NEAR TIMMER, N. DAK., FOR YEAR ENDING SEPTEMBER 30, 1928

Day	March:	April:	May:	June:	July:	August:	Sept.:
1	.....	178	31	4	1,020	101	43
2	.....	136	31	4	2,420	101	43
3	.....	136	31	4	1,220	85	43
4	.....	118	31	4	960	85	43
5	.....	118	31	4	790	2,500	43
6	.....	101	21	4	680	845	43
7	.....	101	21	4	527	228	43
8	.....	85	21	4	323	156	31
9	.....	85	21	2	289	118	31
10	.....	101	31	4	527	306	31
11	.....	70	21	2	397	156	31
12	.....	70	21	12	359	136	31
13	.....	70	12	78	359	156	31
14	.....	56	12	56	323	136	2,180
15	.....	56	12	56	397	118	1,280
16	.....	56	12	31	323	101	289
17	.....	56	12	31	257	85	156
18	.....	56	12	21	202	70	101
19	.....	56	21	12	359	70	70
20	.....	70	31	12	273	68	56
21	.....	43	12	12	178	66	56
22	.....	43	12	93	136	64	43
23	.....	43	12	70	156	62	43
24	.....	43	12	70	136	60	43
25	.....	43	12	118	118	58	43
26	.....	43	12	85	136	56	31
27	359	31	12	418	118	85	21
28	323	31	12	960	118	70	21
29	257	31	12	680	118	56	21
30	257	43	12	960	118	43	21
31	202	.....	4	.....	101	43	.....

Note.—Stage-discharge relation affected by ice until March 27. Gage heights read on staff one-fourth mile downstream from chain gage, June 20-27, July 15 to Aug. 4, Aug. 7-18, Aug. 25-Sept. 13, and Sept. 17-30. Discharge Aug. 19-25 interpolated.

DAILY DISCHARGE IN SECOND-FEET OF CANNONBALL RIVER NEAR TIMMER, N. DAK., FOR THE YEAR ENDING SEPTEMBER 30, 1929

Day	Oct.:	Nov.:	Mar.:	April:	May:	June	July	Aug.:	Sept.:
1.	21	4.2	.....	950	108	303	53	2.3	0.1
2.	21	4.2	.....	1,340	86	620	48	163	0.0
3.	21	4.2	.....	1,140	83	1,270	43	32	0.0
4.	21	4.2	.....	832	73	1,410	39	100	0.1
5.	21	4.2	.....	620	67	1,140	34	51	0.1
6.	21	4.2	.....	1,010	61	722	32	30	0.1
7.	21	12	.....	620	59	573	39	19	0.1
8.	12	12	.....	573	53	373	34	23	0.1
9.	4.2	12	.....	409	51	271	30	18	0.1
10.	4.2	12	.....	337	59	227	28	11	0.1
11.	4.2	21	.....	271	83	618	26	8.8	0.0
12.	4.2	21	2,400	241	59	1,010	23	8.8	0.0
13.	4.2	21	1,480	213	51	1,270	21	6.2	0.1
14.	4.2	21	1,620	187	46	670	19	5.3	0.1
15.	4.2	21	1,270	175	51	428	18	6.5	0.0
16.	4.2	12	2,590	163	59	670	16	4.7	0.0
17.	4.2	12	5,380	163	46	573	14	3.1	0.1
18.	4.2	12	6,390	152	43	373	12	2.7	0.1
19.	4.2	12	5,120	140	39	271	11	1.9	0.0
20.	4.2	21	4,880	130	41	213	10	1.3	0.1
21.	4.2	21	5,620	119	39	175	8.8	1.0	0.1
22.	21	12	4,750	108	39	140	7.7	0.8	0.1
23.	12	12	3,460	100	37	119	6.5	0.5	6.5
24.	12	....	2,030	93	34	104	5.9	0.3	11
25.	12	....	1,700	90	32	97	5.3	0.3	19
26.	12	....	1,480	83	34	93	4.7	0.2	28
27.	4.2	....	1,550	80	48	73	4.1	0.2	30
28.	4.2	....	3,010	77	46	67	3.5	0.1	19
29.	4.2	....	2,030	73	41	64	3.1	0.1	10
30.	4.2	....	1,700	93	37	59	3.1	0.1	8.8
31.	4.2	....	1,140	.....	573	.....	2.7	0.1	.....

No records from Nov. 25 to Mar. 4. Ice Nov. 24, and March 5-11.

DAILY DISCHARGE IN SECOND-FEET OF CANNONBALL RIVER NEAR TIMMER, N. DAK., FOR YEAR ENDING SEPTEMBER 30, 1930

Day	Oct.:	Nov.:	Feb.:	Mar.:	Apr.:	May:	June:	July:	Aug.:	Sept.:
1.	4.7	10.0	.....	.....	262	62	23	121	0.8	0.2
2.	3.5	11.1	.....	.....	247	70	21	102	0.7	0.3
3.	2.7	12.3	.....	.....	262	65	20	169	0.4	0.3
4.	1.9	28	.....	.....	247	59	18	82	0.3	0.4
5.	1.5	17.5	.....	.....	219	56	17	56	0.2	0.5
6.	1.3	17.5	.....	.....	219	146	15	45	0.4	0.6
7.	1.3	12.3	.....	.....	219	193	14	35	0.3	0.5
8.	6.5	10.0	.....	.....	193	219	13	27	0.2	0.7
9.	3.5	8.8	.....	.....	193	233	12	23	0.1	0.6
10.	53	7.7	.....	.....	169	125	11	20	0.1	0.5
11.	256	7.7	.....	.....	169	91	10	15	0	25
12.	108	7.7	.....	.....	181	398	21	13	0	27
13.	30	7.7	.....	.....	146	530	14	10	0	29
14.	21	8.8	.....	.....	181	247	12	6.8	0	9.2
15.	12	11.1	.....	.....	219	169	13	14	0	6.0
16.	6.5	6.5	.....	2,060	310	125	12	12	0	2.5
17.	5.9	.....	.....	2,620	949	105	219	10	0	2.3
18.	4.7	.....	.....	3,220	453	91	121	8.4	0	1.8
19.	3.5	.....	.....	2,330	310	73	105	6.8	0	1.1
20.	3.5	.....	.....	1,490	277	62	98	6.0	0.2	0.9
21.	3.5		1,560	1,350	247	56	219	4.6	0.7	0.8
22.	3.1	.....	1,280	1,350	169	45	572	3.2	0.7	0.6
23.	3.1	.....	770	1,220	125	45	105	2.5	0.6	0.5
24.	3.5	.....	887	949	109	40	88	2.0	0.6	0.6
25.	3.1	.....	136	716	95	38	73	1.5	0.6	0.6

26.	3.5	.....	.....	617	88	35	59	1.5	0.7	0.5
27.	4.1	.....	.....	491	82	33	48	1.2	0.8	0.5
28.	5.3	.....	.....	434	76	31	40	1.1	0.6	0.5
29.	5.9	.....	.....	398	70	29	33	1.1	05	0.5
30.	6.5	.....	.....	328	67	27	125	0.9	0.3	0.7
31.	8.8	.....	.....	434	.....	25	.....	0.9	0.2	.....

No flow Aug. 11 to 19. Discharge interpolated Oct. 29. Stage-discharge relation affected by ice Nov. 17 to Mar. 20. Data insufficient to warrant estimates of flow except Feb. 21 to 25 and Mar. 12-15.

MISSOURI RIVER DRAINAGE

James River at Jamestown, N. Dak.

LOCATION.—At about the middle of the east boundary of SE¼ Sec. 36, T. 140 N., R. 64 W., at the asylum bridge, at Jamestown, Stutsman County, and about 1½ miles downstream from mouth of Pipestem Creek.

RECORDS AVAILABLE.—June, 1928—September, 1930.

GAGE.—High water gage is vertical staff reading from 10.0 feet to 19.5 feet bolted to steel channel piling on downstream side near right bank. Low water vertical staff with a third section enamel face is set in stream bed near right bank. Read to hundredths daily by S. C. Calvelage, who is Chief Engineer for the State Insane Hospital which is about 1 mile southeast of gage. His residence is about one-half mile southwest of gage.

DISCHARGE MEASUREMENTS.—Measured from bridge at high stages. A good wading section at ordinary stages is about 150 feet below gage. The stream bed is gravel, and silt, with some vegetation and is possibly shifting. One channel at all stages, water sluggish at gage with varying angle of current. Channel curved above and below gage. Both banks high, having brush and occasional small trees, and not subject to overflow. Rubbish dumped from bridge may affect low water control.

CHANNEL AND CONTROL.—Gravel and silt bed of stream with no well defined riffle, but an island about 75 feet below gage is drowned out at a stage of about 10 feet. Below this island the channel narrows to a section about 40 feet wide with fairly steep banks.

EXTREMES OF DISCHARGE.—1928-1930; maximum stage, 14.2 ft., March 14, 1929, discharge, 1,100 second-feet; minimum stage, 6.12 ft., September 15-18, 1929, discharge, 0.2 second-feet.

DIVERSIONS.—None.

REGULATIONS.—A small dam a quarter of a mile upstream is occasionally regulated for park purposes.

ACCURACY.—Records at this station should be fair or good depending on frequency and range of discharge measurements.

MONTHLY DISCHARGE OF JAMES RIVER AT JAMESTOWN, N. DAK.

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1928				
June 11 days	80	15	40.1	875
July	714	60	210	12,900
August	70	34	46.1	2,830
September	34	20	25.8	1,540
The period	714	15	.....	18,100
1928-1929				
October	15.0	2.0	10.6	652
November	10.2	2.0	5.56	331
December	4.0	2.0	2.52	155
January	2.0	2.0	2.0	123
February	2.0	2.0	2.0	111
March	989	2.0	182	11,200
April	53	28	41.6	2,480
May	43	19	27.4	1,680
June	19.0	8.7	12.0	714
July	8.4	0.8	4.18	257
August	2.8	0.6	.76	46.7
September	2.2	0.2	1.00	59.5
The period	989	0.2	24.6	17,809.2
1929-1930				
October	28	1.2	1.99	122
November	20	1.0	1.63	97
December	1.6	0.4	0.85	52
January	1.0	0.8	0.85	52
February	550	0.8	111	6,160
March	565	31	264	16,200
April	416	56	153	9,100
May	118	30	71.4	4,390
June	28	15	17.7	1,050
July	14	1.0	5.82	358
August	1.2	0.4	0.70	43
September	1.0	0.8	0.95	57
The period	565	0.4	52.2	37,700

DAILY DISCHARGE IN SECOND-FEET OF JAMES RIVER AT JAMESTOWN, N. DAK., FOR YEAR ENDING SEPTEMBER 30, 1928

Day	June:	July:	August:	September:
1	....	80	70	34
2	....	148	60	34
3	....	332	60	34
4	....	505	60	34
5	....	714	51	34
6	....	714	51	27
7	....	482	51	27
8	....	409	51	27
9	....	423	51	27
10	....	353	51	27
11	....	248	42	27
12	....	196	42	27
13	....	160	42	27
14	....	136	42	34
15	....	124	42	27
16	....	113	42	27
17	....	113	42	27
18	....	102	42	27
19	....	102	42	27
20	15	113	42	20
21	15	113	42	20
22	15	113	42	20
23	20	113	42	20
24	20	102	42	20
25	24	91	42	20
26	42	80	42	20
27	70	70	42	20
28	70	70	42	20
29	80	70	42	20
30	70	60	42	20
31	....	60	34	....

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DAILY DISCHARGE IN SECOND-FEET OF JAMES RIVER AT JAMESTOWN, N. DAK., FOR YEAR ENDING SEPTEMBER 30, 1929

Day	Oct.:	Nov.:	Dec.:	Jan.:	Feb.:	Mar.:	April:	May:	June:	July:	Aug.:	Sept.:
1	15.0	2.0	4.0	2.0	2.0	2.0	43	43	19	8.4	0.6	1.0
2	15.0	2.0	4.0	2.0	2.0	2.0	52	43	19	8.4	0.6	0.6
3	15.0	2.0	4.0	2.0	2.0	2.0	43	43	14	8.4	0.6	0.6
4	15.0	2.0	4.0	2.0	2.0	2.0	43	35	14	8.4	0.6	0.6
5	15.0	4.0	2.0	2.0	2.0	2.0	43	34	14	8.4	0.6	0.8
6	15.0	4.0	2.0	2.0	2.0	2.0	43	34	14	8.4	0.6	0.2
7	15.0	4.0	2.0	2.0	2.0	2.0	53	34	14	5.2	0.6	0.2
8	15.0	4.0	2.0	2.0	2.0	2.0	43	33	14	5.2	0.6	0.4
9	15.0	4.0	2.0	2.0	2.0	2.0	43	26	14	5.2	0.6	0.4
10	15.0	4.0	2.0	2.0	2.0	10.2	43	33	14	5.2	0.6	0.4
11	15.0	4.0	2.0	2.0	2.0	102.	44	33	14	5.2	0.6	0.4
12	10.2	4.0	2.0	2.0	2.0	276.	44	33	14	5.2	0.6	0.6
13	10.2	4.0	2.0	2.0	2.0	626.	44	33	14	5.2	0.6	0.6
14	10.2	6.5	4.0	2.0	2.0	989.	44	33	14	3.0	0.6	0.6
15	10.2	6.5	4.0	2.0	2.0	887.	44	26	14	3.0	0.6	0.6
16	10.2	10.2	4.0	2.0	2.0	535.	44	26	13	2.8	0.6	0.2
17	10.2	10.2	4.0	2.0	2.0	430.	44	26	13	2.8	0.6	0.2
18	10.2	10.2	2.0	2.0	2.0	416.	44	26	8.7	2.8	0.6	0.2
19	10.2	10.2	2.0	2.0	2.0	276.	44	26	8.7	2.8	0.6	0.4
20	10.2	6.5	2.0	2.0	2.0	184.	44	20	8.7	2.8	0.6	0.4
21	10.2	6.5	2.0	2.0	2.0	172.	44	19	8.7	2.8	0.8	2.0
22	10.2	6.5	2.0	2.0	2.0	124.	36	19	8.7	2.8	2.8	2.0
23	6.5	6.5	2.0	2.0	2.0	102.	28	19	8.7	2.8	0.8	2.0
24	6.5	6.5	2.0	2.0	2.0	102.	28	19	8.7	2.8	0.8	2.0
25	6.5	6.5	2.0	2.0	2.0	70.	36	19	8.7	2.8	0.8	2.0

26	6.5	6.5	2.0	2.0	2.0	70.	36	19	8.7	2.8	0.8	2.2
27	6.5	6.5	2.0	2.0	2.0	80.	38	19	8.7	2.8	0.8	2.2
28	6.5	6.5	2.0	2.0	2.0	60.	35	19	8.7	0.8	1.0	2.2
29	6.5	6.5	2.0	2.0	....	51.	35	19	8.7	0.8	1.0	2.2
30	4.0	4.0	2.0	2.0	....	42.	....	19	8.7	0.8	1.0	2.2
31	2.0	....	2.0	2.0	....	27.	43	19	.....	0.8	1.0	.....

Shifting control April 1 to September 30.

DAILY DISCHARGE IN SECOND-FEET OF JAMES RIVER AT JAMESTOWN, N. DAK., FOR YEAR ENDING SEPTEMBER 30, 1930

Day	Oct.:	Nov.:	Dec.:	Jan.:	Feb.:	Mar.:	April:	May:	June:	July:	Aug.:	Sept.:
1	2.2	1.2	1.6	0.8	0.8	96	416	86	28	14	1.0	1.0
2	2.0	1.0	1.6	0.8	0.8	37	304	86	27	13	1.0	1.0
3	2.0	1.0	1.4	0.8	1.0	42	304	86	26	13	1.0	1.0
4	1.8	1.0	1.4	0.8	1.0	40	262	86	25	13	1.0	1.0
5	1.8	1.2	1.4	0.8	1.0	44	262	75	24	12	1.0	1.0
6	2.0	1.2	1.2	1.0	1.0	36	248	75	22	10	1.0	1.0
7	2.0	1.4	1.2	1.0	1.2	31	234	70	20	9.2	1.0	1.0
8	2.0	1.4	1.2	1.0	1.2	80	208	75	18	9.1	1.0	1.0
9	2.0	1.4	1.2	1.0	1.2	130	184	80	17	8.4	1.2	1.0
10	2.0	1.4	1.2	1.0	1.4	290	172	86	16	7.6	0.8	1.0
11	2.4	1.6	1.0	0.8	1.2	565	172	86	16	7.2	0.8	1.0
12	2.6	1.6	0.8	0.8	1.2	535	172	91	16	6.9	0.8	1.0
13	2.6	1.8	0.8	0.8	1.2	430	130	118	15	6.2	0.6	1.0
14	2.6	2.0	0.8	0.8	1.4	346	86	113	15	5.5	0.4	1.0
15	2.4	2.0	0.8	0.8	1.2	374	56	108	15	5.0	0.6	1.0
16	2.6	2.0	0.6	0.8	1.6	430	56	102	15	4.5	0.4	1.0
17	2.4	2.0	0.6	0.8	2.0	416	60	80	15	4.2	0.4	1.0
18	2.2	2.0	0.6	0.8	4.5	388	75	80	15	4.0	0.4	1.0
19	2.2	1.8	0.6	0.8	24.	276	91	75	15	3.8	0.4	1.0
20	2.2	1.8	0.6	1.0	402.	267	118	68	15	3.6	0.4	1.0
21	2.2	1.8	0.4	0.8	490.	221	124	58	15	3.4	0.4	1.0
22	2.0	1.8	0.4	0.8	490.	196	113	58	15	3.4	0.4	1.0
23	2.0	1.8	0.4	0.8	460.	208	108	52	16	2.8	0.4	1.0
24	2.0	1.8	0.4	0.8	550.	221	108	50	16	2.2	0.4	0.8
25	2.0	1.8	0.4	0.8	304.	304	102	48	16	1.8	0.6	0.8

26	.....	1.6	1.8	0.4	0.8	136.	290	102	46	16	1.4	0.6	0.8
27	.....	1.2	1.8	0.4	0.8	118.	208	91	40	16	1.2	0.6	0.8
28	.....	1.2	1.8	0.6	0.8	118.	346	86	38	16	1.0	0.6	0.8
29	.....	1.2	1.8	0.6	0.8	.....	445	80	36	15	1.0	0.8	0.8
30	.....	1.2	1.8	0.8	1.0	.....	445	80	32	15	1.0	0.8	0.8
31	.....	1.2	.....	0.8	1.0	.....	445	.....	30	.....	1.0	0.8	.....

HUDSON BAY DRAINAGE

Red River of the North at Fargo, N. Dak.

LOCATION.—Above dam half mile above highway bridge connecting Front Street, Fargo, Cass County, N. Dak., with Moorhead, Minn., 10 miles above mouth of Sheyenne River.

DRAINAGE AREA.—6,420 square miles.

RECORDS AVAILABLE.—June, 1901—September, 1930.

GAGE.—Vertical staff attached to tree on left bank 6 rods above dam looking downstream; vertical staff for convenient comparison attached to upper end of fishway, left end of dam. Gage read by City Engineer.

DISCHARGE MEASUREMENTS.—Made from footbridge a few feet upstream from gage.

CHANNEL AND CONTROL.—Bed composed of clay and silt; nearly permanent. Control is timber and steel crib dam, rock filled, below gage; has settled a few inches since construction. At extreme low stage the fall over the dam is about 5 feet.

EXTREMES OF DISCHARGE.—1901-1930; maximum open-water stage recorded, 17.34 ft., July 11, 1916, discharge, 7,740 second-feet; minimum stage, 0.50 ft., September 3, 1924, discharge, 8 second-feet.

ICE.—Stage-discharge relation affected by ice.

DIVERSION.—None.

REGULATION.—No power plants or storage above the station nearer than 60 miles, and storage not great enough ordinarily to affect discharge at station.

ACCURACY.—Stage-discharge relation changed slightly due to settling of dam; slightly affected by ice during year. Rating curve fairly well defined between 80 and 4,400 second-feet. Gage read by City Engineer to hundredths once daily except during winter, when it was read once or twice a week. Daily discharge obtained by applying daily gage height to rating table. Open-water records fair, winter records poor.

MONTHLY DISCHARGE OF THE RED RIVER OF THE NORTH AT FARGO, N. DAK.

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1927-1928				
October	.....	.....	208	12,800
November	.....	.....	174	10,400
December	.....	.....	92	5,660
January	.....	.....	97	5,960
February	.....	.....	86	4,950
March	.....	.....	951	58,500
April	.....	.....	499	29,700
May	.....	.....	371	22,800
June	.....	.....	295	17,600
July	.....	.....	294	18,100
August	.....	.....	78.2	4,810
September	.....	.....	113	6,720
The period	.....	.....	273	198,000
1828-1929				
October	.....	.....	136	8,360
November	.....	.....	153	9,100
December	.....	.....	123	7,560
January	.....	.....	75.6	4,650
February	.....	.....	70.3	3,900
March	.....	.....	1420	87,300
April	.....	.....	513	30,500
May	.....	.....	357	22,000
June	.....	.....	174	10,400
July	.....	.....	75.2	4,620
August	.....	.....	23.3	1,430
September	.....	.....	24.6	1,460
The period	.....	.....	264	191,000
1929-1930				
October	74	38	53.7	3,300
November	108	30	62.2	3,700
December	38	30	33.7	2,070
January	38	30	36.5	2,240
February	620	38	149	8,280
March	1340	265	711	43,700
April	780	265	398	23,700
May	1120	310	590	36,300
June	410	225	290	17,300
July	265	60	145	8,920
August	90	20	57.9	3,560
September	22	11	16.2	964
The period	1340	11	213	154,034

DAILY DISCHARGE IN SECOND-FEET OF RED RIVER OF THE NORTH AT FARGO, N. DAK., FOR THE YEAR ENDING SEPTEMBER 30, 1928

Day	Oct.:	Nov.:	Dec.:	Jan.:	Feb.:	Mar.:	Apr.:	May:	June:	July:	Aug.:	Sept.:
1	194	194	.....	.....	.....	.....	1,520	488	254	a208	90	212
2	a194	194	.....	.....	102	.....	1,040	488	223	223	90	a177
3	194	223	102	.....	.....	122	852	488	a223	223	90	a143
4	194	223	.....	.....	102	.....	738	444	223	223	90	108
5	223	223	.....	83	.....	102	684	444	223	223	a99	108
6	288	a209	.....	.....	.....	.....	582	a466	223	288	108	108
7	254	194	102	.....	51	.....	488	488	223	444	128	108
8	254	194	.....	.....	.....	122	a425	534	194	a444	90	108
9	238	223	.....	102	.....	.....	362	488	168	444	74	a99
10	223	194	102	.....	102	.....	288	a466	a168	402	74	90
11	223	223	.....	83	.....	.....	362	444	168	324	90	74
12	223	223	102	.....	.....	.....	362	362	168	288	a82	90
13	254	a184	.....	.....	.....	168	324	a325	168	288	74	90
14	223	144	.....	.....	.....	.....	362	288	168	324	74	128
15	194	144	.....	.....	83	.....	a362	288	168	a324	74	152
16	a194	144	.....	.....	.....	.....	362	324	168	324	60	a121
17	194	144	102	.....	.....	144	324	324	a168	288	60	90
18	168	144	.....	102	.....	a169	288	324	168	254	74	90
19	168	144	.....	.....	.....	194	324	362	168	254	a74	90
20	223	a169	83	.....	83	194	402	a343	488	254	74	108
21	223	194	.....	102	.....	288	444	324	974	254	60	90
22	223	168	.....	.....	.....	444	a444	324	823	a328	60	108
23	a196	168	66	122	.....	794	444	324	632	402	48	a118
24	168	a145	.....	.....	.....	1,600	402	324	a517	402	48	128
25	168	122	.....	.....	83	2,900	402	362	402	324	60	108

26	194	a129	.....	.....	.....	3,480	444	288	362	288	a75	128
27	194	a136	83	.....	.....	3,760	488	288	324	254	90	152
28	194	144	.....	102	83	3,840	488	288	288	223	90	108
29	194	144	.....	.....	.....	3,760	a488	288	223	a223	60	74
30	a194	144	.....	102	.....	3,300	488	254	194	223	74	a91
31	194	.....	.....	.....	.....	2,470	.....	254	.....	144	90	.....

a—Interpolated.

DAILY DISCHARGE IN SECOND-FEET OF RED RIVER OF THE NORTH AT FARGO, N. DAK., FOR THE YEAR ENDING SEPTEMBER 30, 1929

Day	Oct.:	Nov.:	Dec.:	Jan.:	Feb.:	Mar.:	Apr.:	May:	June:	July:	Aug.:	Sept.:
1	108	180	152	a108	60	a74	670	420	248	108	24	a24
2	108	a173	a140	a108	a60	a74	620	420	a248	90	24	24
3	90	a166	128	108	a60	a74	520	420	248	74	30	24
4	108	a159	128	a104	a60	a74	570	374	248	a74	a27	24
5	90	152	a121	a99	60	74	570	a397	248	74	24	24
6	74	108	a115	a94	a64	a74	570	420	212	60	20	24
7	a91	108	108	90	a67	a74	a520	a397	180	a67	20	16
8	108	152	a108	86	a70	a82	470	374	212	74	20	a18
9	90	212	a108	a83	74	a91	420	374	a196	74	20	20
10	90	180	108	81	62	a100	420	330	180	60	20	24
11	128	a180	a108	a78	a50	108	420	330	180	48	a20	24
12	108	180	108	74	38	152	374	352	152	74	20	24
13	90	152	a115	a74	a50	248	420	374	152	108	20	24
14	a99	180	a121	a74	a62	720	a445	374	152	a99	24	24
15	108	180	128	a74	74	1,690	470	374	152	90	24	a24
16	128	212	a140	74	a74	2,740	470	374	a166	74	20	24
17	152	212	152	a72	a74	3,480	520	374	180	90	20	24
18	180	a182	a152	a70	74	3,880	470	374	180	108	a22	a24
19	152	152	152	a67	a77	4,280	570	a352	180	90	24	a24
20	152	152	a146	a64	a80	4,440	570	330	180	74	24	a24
21	a166	152	a139	a62	a84	4,440	a570	374	128	a74	24	a24
22	180	152	a133	60	87	4,120	570	374	108	74	24	a24
23	180	128	a127	a60	90	3,480	570	330	a118	74	24	a24
24	212	108	a120	a60	a90	2,170	570	330	128	74	24	24
25	212	a108	a114	a60	90	1,440	570	330	128	74	a24	24

26	180	108	108	a60	a85	1,100	520	a330	152	74	24	24
27	180	108	a108	a60	a79	1,040	470	330	152	38	24	30
28	a180	108	108	60	74	980	a495	330	152	a56	30	30
29	180	a118	a108	a60	.....	1,100	520	288	128	74	30	a34
30	152	128	a108	a60	.....	870	470	a268	a118	60	24	38
31	152	.....	108	a60	.....	770	.....	248	.....	48	24	.....

a—Interpolated

DAILY DISCHARGE IN SECOND-FEET OF RED RIVER OF THE NORTH AT FARGO, N. DAK., FOR THE YEAR ENDING SEPTEMBER 30, 1930

Day	Oct.:	Nov.:	Dec.:	Jan.:	Feb.:	Mar.:	Apr.:	May:	June:	July:	Aug.:	Sept.:
1	48	60	38	35	38	570	560	360	410	265	60	19
2	48	60	38	38	38	330	560	360	410	265	60	11
3	48	60	38	38	38	330	670	310	360	265	75	11
4	48	60	38	38	41	288	725	310	360	245	90	11
5	48	74	38	38	43	288	780	310	265	225	60	22
6	43	90	36	38	45	330	615	310	310	225	35	22
7	38	90	34	38	48	310	560	360	310	225	35	22
8	38	74	32	38	48	310	460	410	288	150	60	22
9	38	60	30	38	48	265	460	410	265	120	60	22
10	48	70	33	38	48	265	360	510	265	150	60	22
11	54	80	35	30	48	360	360	645	225	185	60	11
12	60	90	38	34	48	560	360	780	225	185	60	11
13	67	90	38	38	48	780	310	835	225	185	60	22
14	74	108	38	38	48	947	310	947	310	185	60	22
15	74	108	38	38	48	1,120	360	1,000	310	185	60	22
16	60	90	38	38	48	1,280	360	1,120	310	120	90	22
17	60	75	36	36	48	1,340	310	1,060	310	90	90	22
18	74	60	34	34	52	1,340	310	1,000	310	90	90	11
19	74	60	32	32	56	1,280	310	947	265	60	90	11
20	56	48	30	30	60	1,230	310	780	225	75	90	11
21	38	38	30	32	74	1,120	310	725	225	90	90	16
22	38	30	30	34	152	1,060	310	615	245	90	60	22
23	48	30	30	36	241	891	265	560	265	90	60	22
24	60	34	30	38	330	835	265	510	265	120	48	11
25	60	38	30	38	570	780	265	485	265	120	35	11

26	.....	48	38	30	38	620	725	265	460	310	90	35	11
27	.....	48	38	30	38	620	670	288	460	310	75	20	11
28	.....	48	38	30	38	620	670	310	410	310	60	20	11
29	.....	60	38	30	38	.....	615	310	460	288	90	20	11
30	.....	60	38	30	38	.....	588	310	435	265	90	35	11
31	.....	60	.....	33	38	.....	560	.....	410	.....	90	27	.....

Discharge interpolated for days when gage was not read. Stout corrections applied during construction of dam Feb. 20 to Mar. 6 and of fishway Mar. 13 to April 5; Fishway open Apr. 6-Aug. 30; Fishway opened deeper Aug. 7-14.

HUDSON BAY DRAINAGE

Red River of the North at Grand Forks, N. Dak.

LOCATION.—At Northern Pacific Railway bridge between Grand Forks, Grand Forks County, N. Dak., and East Grand Forks, Minnesota, half a mile below mouth of Red Lake River.

DRAINAGE AREA.—25,500 square miles.

RECORDS AVAILABLE.—June 1901,-September 1930. Gage-height records at same point kept by United States Engineer Corps from 1882 to 1901 and a few discharge measurements made by them in early years.

GAGE.—Vertical staff attached to ice-breaker below center pier of bridge. Gages maintained by the United States Engineer Corps and the United States Weather Bureau at the same bridge have a datum 5.00 feet higher than the gage datum of the Geological Survey and are more convenient for use. The Weather Bureau gage is used with correction applied. Observers were Alex Slattery, Harold Bowes, A. S. Gray, Eddie Roning, Marloe Axtell.

DISCHARGE MEASUREMENTS.—Made from Great Northern Railway bridge a quarter of a mile above gage.

CHANNEL AND CONTROL.—Clay and silt; changes very slowly.

EXTREMES OF DISCHARGE.—1882-1930; Maximum stage recorded 50.2 ft. April 10, 1897, discharge 43,000 second-feet; minimum discharge 11.9 second-feet, February 16, 1930. (Stage-discharge relation affected by ice.)

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

DIVERSIONS.—None.

REGULATION.—No power plants above with sufficient storage to cause noticeable variations in flow.

ACCURACY.—Stage-discharge relation permanent except as affected by ice. Rating curve well defined between 400 and 15,000 second-feet and fairly well defined to 30,000 second-feet. Gage read to quarter-tenths twice daily except during winter period when it was read twice a week. Daily discharge ascertained by applying mean daily gage height to rating table except for periods indicated in foot note to table of daily discharge. Open-water records good, winter records fair.

MONTHLY DISCHARGE OF RED RIVER OF THE NORTH AT GRAND FORKS, N. DAK.

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1927-1928				
October	.....	.....	1,110	68,200
November	1,010	853	960	57,100
December	.....	.....	730	44,900
January	.....	.....	580	35,700
February	.....	.....	600	33,300
March	11,300	615	2,490	153,000
April	12,200	2,420	4,870	290,000
May	2,980	1,400	2,230	137,000
June	4,140	1,400	2,330	139,000
July	2,980	1,440	2,130	131,000
August	2,250	1,010	1,310	80,600
September	3,440	1,400	2,230	133,000
The period	12,200	.....	1,800	1,302,800
1928-1929				
October	1,780	1,310	1,430	87,900
November	1,880	845	1,260	75,000
December	966	845	943	58,000
January	966	707	869	53,400
February	695	561	637	35,400
March	17,100	695	6,870	422,000
April	6,700	2,420	3,730	222,000
May	2,420	1,830	2,090	129,000
June	1,880	925	1,320	78,600
July	1,220	549	783	48,100
August	497	313	390	24,000
September	320	268	293	17,400
The period	17,100	268	1,730	1,250,800
1929-1930				
October	593	185	349	21,500
November	416	365	406	24,200
December	411	255	318	19,600
January	255	143	194	11,900
February	695	11.9	297	16,500
March	8,250	76.8	4,450	274,000
April	9,600	1,400	3,940	234,000
May	6,430	1,580	3,110	191,000
June	2,090	845	1,150	68,400
July	806	296	591	36,300
August	296	143	202	12,400
September	170	131	151	9,000
The period	9,600	11.9	1,270	918,800

DAILY DISCHARGE IN SECOND-FEET OF RED RIVER OF THE NORTH AT GRAND FORKS, N. DAK., FOR YEAR ENDING SEPTEMBER 30, 1928

Day	Oct.:	Nov.:	Dec.:	Jan.:	Feb.:	Mar.:	Apr.:	May:	June:	July:	Aug.:	Sept.:
1	1,050	1,010	730	580	600	615	11,600	2,980	1,490	2,980	1,440	2,580
2	1,050	1,010	730	580	600	615	12,200	2,980	1,490	2,700	1,440	3,440
3	1,050	1,010	730	580	600	615	11,700	2,700	1,490	2,700	1,010	2,980
4	1,050	1,010	730	580	600	615	10,100	2,870	1,490	2,420	1,130	2,530
5	1,050	1,010	730	580	600	615	8,870	2,870	1,490	2,420	1,180	2,300
6	1,060	1,010	730	580	600	615	6,980	2,870	1,400	2,140	1,220	2,140
7	1,060	1,010	730	580	600	615	6,290	2,640	1,400	2,420	1,260	2,040
8	1,060	1,010	730	580	600	615	5,640	2,420	1,400	2,420	1,260	1,880
9	1,060	1,010	730	580	600	615	5,330	2,420	1,400	2,420	1,260	1,880
10	1,060	1,010	730	580	600	615	5,030	2,420	1,630	2,420	1,260	1,880
11	1,200	1,010	730	580	600	648	4,440	2,420	1,630	2,420	1,260	2,250
12	1,200	970	730	580	600	681	4,490	2,420	1,630	2,420	1,260	2,040
13	1,200	970	730	580	600	714	4,020	2,420	1,630	2,420	1,260	1,400
14	1,200	970	730	580	600	747	3,560	2,420	1,630	2,420	1,260	1,630
15	1,200	970	730	580	600	780	3,560	2,140	1,630	2,300	1,260	1,830
16	1,150	970	730	580	600	780	3,330	2,140	1,630	2,140	1,310	2,090
17	1,150	970	730	580	600	780	2,980	2,140	1,630	2,040	1,310	2,200
18	1,150	930	730	580	600	816	2,980	2,140	1,880	2,040	1,350	2,750
19	1,150	930	730	580	600	853	2,980	2,140	2,420	2,040	1,350	2,750
20	1,150	930	730	580	600	853	2,980	2,140	3,100	2,040	1,350	2,750
21	1,100	930	730	580	600	1,050	2,980	2,140	3,560	2,040	1,400	2,580
22	1,100	930	730	580	600	1,090	2,700	1,880	4,140	2,040	1,350	2,420
23	1,100	930	730	580	600	1,260	2,420	1,880	4,140	1,930	1,310	2,420
24	1,100	930	730	580	600	1,780	2,420	1,880	3,910	1,830	1,260	2,420
25	1,100	930	730	580	600	4,020	2,420	1,880	3,910	1,680	1,180	2,140

26	1,080	930	730	580	600	5,770	2,420	1,880	3,560	1,630	1,130	2,140
27	1,080	891	730	580	600	7,420	2,700	1,880	3,560	1,630	1,130	1,880
28	1,080	878	730	580	600	8,870	2,980	1,880	3,330	1,580	1,050	1,880
29	1,080	866	730	580	.....	10,000	2,980	1,400	3,330	1,490	1,400	1,880
30	1,080	853	730	580	.....	10,800	2,980	1,400	2,980	1,440	1,630	1,880
31	1,080	.....	730	580	.....	11,300	.....	1,400	.....	1,440	2,250	.....

Ice effect on discharge Nov. 12 to March 29. Discharge estimated Oct. 1-31 and Dec. 1 to Feb. 28.

DAILY DISCHARGE IN SECOND-FEET OF RED RIVER OF THE NORTH AT GRAND FORKS, N. DAK., FOR YEAR ENDING SEPTEMBER 30, 1929

Day	Oct.:	Nov.:	Dec.:	Jan.:	Feb.:	Mar.:	Apr.:	May:	June:	July:	Aug.:	Sept.:
1	1,640	1,880	845	966	695	695	6,700	2,420	1,830	1,220	497	313
2	1,400	1,780	845	966	695	695	5,960	2,420	1,830	1,130	473	308
3	1,400	1,580	845	966	695	695	5,900	2,420	1,880	1,050	452	304
4	1,400	1,400	845	946	695	750	5,150	2,420	1,780	966	443	298
5	1,400	1,400	845	925	684	806	4,610	2,420	1,730	885	443	298
6	1,400	1,400	885	925	672	781	4,140	2,250	1,730	845	452	298
7	1,400	1,310	925	925	660	756	4,020	2,250	1,730	768	452	298
8	1,400	1,400	966	925	660	731	4,440	2,250	1,730	806	443	292
9	1,400	1,490	966	925	660	768	4,730	2,250	1,400	806	437	288
10	1,400	1,400	966	925	643	806	4,610	2,250	1,400	806	432	288
11	1,400	1,400	966	925	626	806	4,140	2,250	1,400	768	438	288
12	1,400	1,400	966	925	626	806	3,850	2,250	1,400	806	447	288
13	1,400	1,350	966	925	626	806	3,270	2,140	1,260	845	432	288
14	1,400	1,350	966	912	626	1,400	3,440	2,140	1,130	806	423	288
15	1,400	1,350	966	898	626	2,420	3,270	2,140	1,050	806	402	284
16	1,400	1,310	966	885	626	3,910	2,980	2,140	966	768	387	278
17	1,400	1,310	966	885	626	6,840	2,980	1,980	1,050	768	358	268
18	1,400	1,260	966	885	609	9,690	2,980	1,980	1,130	806	363	268
19	1,400	1,260	966	865	593	11,400	2,980	1,980	1,130	806	372	268
20	1,400	1,220	966	845	585	14,000	2,980	1,980	1,090	768	372	278
21	1,400	1,180	966	845	577	15,600	2,980	1,980	1,090	731	358	288
22	1,400	1,130	966	845	569	16,100	2,980	1,830	1,050	695	333	282
23	1,400	1,050	966	832	561	16,900	2,870	1,830	1,010	695	328	278
24	1,400	1,010	966	819	561	17,100	2,980	1,830	966	660	320	288
25	1,400	966	966	806	606	16,700	2,870	1,830	925	654	313	298

26	1,400	885	966	787	650	16,600	2,870	1,830	1,090	638	313	308
27	1,310	845	966	768	695	14,000	2,980	1,880	1,140	676	320	313
28	1,400	845	966	750	695	13,700	2,980	1,930	1,180	606	320	320
29	1,540	845	966	731	.....	10,700	2,700	1,830	1,260	586	333	320
30	1,630	885	966	719	.....	8,710	2,420	1,830	1,260	549	333	310
31	1,780	.....	966	707	.....	7,200	.....	1,830	.....	549	320	.....

Ice effect Dec. 1, to Mar. 25; gage height record unreliable July 25 to Sept. 30, discharge estimated from Emerson record, by substracting from Emerson 40 sec. ft. July 25 to Aug. 9; 30 sec. ft. Aug. 10 to Sept. 30.

DAILY DISCHARGE IN SECOND-FEET OF RED RIVER OF THE NORTH AT GRAND FORKS, N. DAK., FOR THE YEAR ENDING SEPTEMBER 30, 1930

Day	Oct.:	Nov.:	Dec.:	Jan.:	Feb.:	Mar.:	Apr.:	May:	June:	July:	Aug.:	Sept.:
1	201	365	411	255	143	768	5,580	1,580	2,090	806	296	143
2	218	365	406	255	143	768	5,580	1,580	1,880	806	296	143
3	201	371	401	255	143	768	5,570	1,580	1,730	806	296	143
4	218	377	396	248	143	787	6,090	1,630	1,630	768	275	156
5	218	383	390	240	143	806	7,790	1,630	1,540	768	255	156
6	201	390	385	233	143	885	8,380	1,880	1,440	768	255	156
7	201	396	380	225	143	925	9,600	2,040	1,400	768	255	143
8	185	402	375	218	143	966	8,400	2,140	1,310	731	236	143
9	185	407	370	218	143	966	7,340	2,140	1,260	695	236	143
10	185	412	365	218	143	1,200	6,410	2,140	1,220	695	218	131
11	265	416	355	218	143	1,440	5,700	2,140	1,220	695	218	143
12	345	416	346	218	143	2,300	5,090	2,640	1,180	660	218	143
13	593	416	336	218	143	3,370	4,310	3,100	1,090	660	201	143
14	593	416	327	212	135	4,440	3,500	3,730	1,050	660	201	156
15	500	416	318	206	127	5,450	2,980	4,260	966	626	201	156
16	471	416	309	200	119	6,060	2,640	4,730	925	626	185	156
17	471	416	300	193	156	6,660	2,420	5,090	925	626	185	170
18	443	416	291	185	170	7,270	2,040	6,430	925	626	185	170
19	443	416	283	180	390	7,760	2,040	5,330	925	626	185	170
20	443	416	275	174	417	8,250	1,580	5,030	925	593	170	170
21	443	416	271	168	444	8,010	1,830	4,730	925	561	170	170
22	471	416	267	162	471	7,720	1,400	4,400	925	500	170	170
23	416	416	263	156	593	7,560	1,400	4,140	925	471	170	143
24	365	416	259	153	695	7,420	1,440	3,560	925	443	156	143
25	365	416	255	150	660	7,190	1,440	3,270	925	390	156	143

26	365	416	255	148	695	6,980	1,490	3,100	885	341	156	143
27	365	416	255	145	695	6,700	1,490	2,870	885	341	156	143
28	365	416	255	143	695	6,770	1,540	2,640	845	341	143	143
29	365	416	255	143	.....	6,160	1,540	2,420	845	318	143	143
30	365	416	255	143	.....	5,830	1,540	2,250	845	318	143	143
31	365	.....	255	143	.....	5,640	.....	2,200	.....	296	143	.....

Gage heights Nov. 1 to Feb. 24 based upon occasional observations. Max. discharge 9600 sec. ft, April 7, (gage ht. 18.9 ft.) Minimum discharge 119 sec ft. Feb. 16 (gage height 3.9 ft. ice effect.) Discharge est. Oct. 11 and 12.

HUDSON BAY DRAINAGE

Bois Des Sioux River near Tenney, Minn., and Fairmont, N. Dak.

LOCATION.—Near center of Sec. 22, T. 130 N., R. 47 W. at Soo Railway bridge 5 miles west of Tenney, Wilkin County, Minn., and 2 miles east of Fairmont, Richland County, N. Dak., on the boundary between the two states.

DRAINAGE AREA.—1,460 square miles.

RECORDS AVAILABLE.—April 1919-September 1930.

GAGE.—Vertical staff attached to the piling pier of the Soo Railway bridge; read by Math Schmit and Harry Voss.

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

CHANNEL AND CONTROL.—Bed composed of silt and fine clay, overgrown with weeds, which clog the channel by an amount varying with the season. No considerable shifts in channel likely because normal velocities insufficient to erode.

EXTREMES OF DISCHARGE.—1919-1930; Maximum discharge 390 second-feet April 22, 1922; no flow during several long periods.

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

DIVERSIONS.—None.

REGULATION.—There are no reservoirs or power plants which affect the flow. The station is 15 miles below the outlet of Lake Traverse with no considerable tributaries entering between, so that abrupt changes in discharge are unlikely. Very extensive ditching and drainage work in the tributary area during the past 15 years may affect the distribution of flow.

ACCURACY.—Stage-discharge relation not permanent; affected by ice and by heavy aquatic growth. Rating curve fairly well defined below 400 second-feet. Gage read to half-tenths two or three times a week. Daily discharge ascertained by applying gage height to rating table by direct or indirect method and by interpolating for days when gage was not read. Records poor.

MONTHLY DISCHARGE OF BOIS DES SIOUX RIVER NEAR TENNEY, MINN.

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1927-1928				
October	4	2	2.4	148
November	2	0	0.4	23.8
March	40	0	14.9	916
April	40	22	27.8	165
May	22	5	14.6	898
June	5	2	4.2	250
July	4	3	3.2	197
August	3	2	2.2	135
September	2	0	0.6	35.7
The period	40	0	5.9	2,768.5
1928-1929				
October	2	1	1.5	92
November	....	....	0.8	48
December	0	0	0	0
January	0	0	0	0
February	0	0	0	0
March	48	0	24.2	1,490
April	53	11	37.1	2,210
May	53	25	36.3	2,230
June	25	11	18.7	1,110
July	11	5	8.2	504
August	4	1	2.3	141
September	1	0	0.5	30
The period	53	0	10.8	7,855
1929-1930				
October	....	....	2.0	123
November	....	....	1.0	60
December	0	0	0	0
January	0	0	0	0
February	38	0	8.6	478
March	64	31	56.4	3,470
April	20	7	9.5	565
May	28	9	19.4	1,190
June	15	7	9.4	559
July	7	0	3.2	197
August	0	0	0	0
September	0	0	0	0
The period	64	0	9.2	6,642

DAILY DISCHARGE IN SECOND-FEET OF BOIS DES SIOUX RIVER NEAR TENNEY, MINN., FOR YEAR ENDING SEPTEMBER 30, 1928

Day	Oct.:	Nov.:	Dec.:	Jan.:	Feb.:	Mar.:	Apr.:	May:	June:	July:	Aug.:	Sept.:
1	3	2	0	0	0	0	40	22	5	4	3	2
2	3	2	0	0	0	0	40	22	5	4	3	1
3	3	2	0	0	0	0	40	22	5	4	3	0
4	3	1	0	0	0	0	40	22	4	4	3	0
5	3	1	0	0	0	0	40	22	3	4	3	0
6	4	1	0	0	0	0	35	19	3	3	2	0
7	4	1	0	0	0	0	35	16	3	3	2	0
8	4	1	0	0	0	0	35	16	2	3	2	0
9	3	1	0	0	0	0	35	16	2	3	2	0
10	2	1	0	0	0	0	35	16	2	3	2	0
11	2	0	0	0	0	0	32	16	2	3	2	0
12	2	0	0	0	0	0	29	16	2	3	2	0
13	2	0	0	0	0	0	25	16	3	3	2	0
14	2	0	0	0	0	0	22	16	4	3	2	0
15	2	0	0	0	0	0	22	16	5	3	2	0
16	2	0	0	0	0	0	22	15	5	3	2	0
17	2	0	0	0	0	2	22	14	5	3	2	1
18	2	0	0	0	0	5	22	14	5	3	2	1
19	2	0	0	0	0	10	22	13	5	3	2	1
20	2	0	0	0	0	25	22	13	5	3	2	1
21	2	0	0	0	0	30	22	13	5	3	2	1
22	2	0	0	0	0	35	22	13	5	3	2	1
23	2	0	0	0	0	35	22	13	5	3	2	1
24	2	0	0	0	0	40	22	13	5	3	2	1
25	2	0	0	0	0	40	22	13	5	3	2	1

26	2	0	0	0	0	40	22	13	5	3	2	1
27	2	0	0	0	0	40	22	10	5	3	2	1
28	2	0	0	0	0	40	22	8	5	3	2	1
29	2	0	0	0	0	40	22	5	5	3	2	1
30	2	0	0	0	....	40	22	5	5	3	2	1
31	2	....	0	0	....	40	....	5	....	3	2	....

DAILY DISCHARGE IN SECOND-FEET OF BOIS DES SIOUX RIVER NEAR TENNEY, MINN., FOR YEAR ENDING SEPTEMBER 30, 1929

Day	Oct.:	Nov.:	Dec.:	Jan.:	Feb.:	Mar.:	Apr.:	May:	June:	July:	Aug.:	Sept.:
1	1	2	0	0	0	0	11	53	25	11	4	1
2	1	2	0	0	0	0	12	51	25	11	4	1
3	1	1	0	0	0	1	12	49	25	10	4	1
4	1	1	0	0	0	4	12	48	25	9	4	1
5	1	1	0	0	0	7	13	46	25	8	3	1
6	1	1	0	0	0	10	13	44	24	7	3	1
7	1	1	0	0	0	13	13	45	23	7	3	1
8	1	1	0	0	0	16	19	46	22	7	3	1
9	1	1	0	0	0	19	25	46	21	7	3	1
10	1	1	0	0	0	22	27	49	20	7	3	1
11	1	1	0	0	0	25	28	48	20	7	3	1
12	1	1	0	0	0	27	30	40	19	7	2	1
13	1	1	0	0	0	30	32	32	19	7	2	1
14	1	1	0	0	0	32	37	32	19	8	2	1
15	2	1	0	0	0	34	43	32	19	8	2	1
16	2	1	0	0	0	37	48	32	19	9	2	0
17	2	1	0	0	0	39	50	32	19	9	2	0
18	2	1	0	0	0	42	51	32	19	9	2	0
19	2	1	0	0	0	44	53	32	19	9	2	0
20	2	1	0	0	0	45	53	31	19	9	2	0
21	2	1	0	0	0	46	53	30	19	9	2	0
22	2	1	0	0	0	47	53	30	19	9	2	0
23	2	0	0	0	0	48	53	29	16	9	2	0
24	2	0	0	0	0	40	53	28	14	9	2	0
25	2	0	0	0	0	32	53	28	11	9	2	0

26	2	0	0	0	0	24	53	28	11	9	2	0	
27	2	0	0	0	0	16	53	28	11	9	1	0	
28	2	0	0	0	0	14	53	28	11	8	1	0	
29	2	0	0	0	---	13	53	27	11	7	1	0	
30	2	0	0	0	---	11	53	26	11	6	1	0	
31	2	---	0	0	---	11	---	25	---	5	1	---	

DAILY DISCHARGE IN SECOND-FEET OF BOIS DE3 SIOUX RIVER NEAR TENNEY, MINN., FOR YEAR ENDING SEPTEMBER 30, 1930

Day	Oct.:	Nov.:	Dec.:	Jan.:	Feb.:	Mar.:	Apr.:	May:	June:	July:	Aug.:	Sept.:
1	2	2	0	0	0	40	20	9	15	7	0	0
2	2	2	0	0	0	46	9	9	14	7	0	0
3	2	2	0	0	0	52	9	9	13	7	0	0
4	2	2	0	0	0	58	9	10	13	7	0	0
5	2	2	0	0	0	64	9	11	13	7	0	0
6	2	2	0	0	0	64	9	12	13	7	0	0
7	2	2	0	0	0	64	9	13	13	7	0	0
8	2	2	0	0	0	64	10	18	12	6	0	0
9	2	2	0	0	0	64	10	23	10	6	0	0
10	2	2	0	0	0	64	11	28	9	5	0	0
11	2	1	0	0	0	64	11	28	9	5	0	0
12	2	1	0	0	0	64	11	27	9	4	0	0
13	2	1	0	0	0	64	10	27	9	4	0	0
14	2	1	0	0	0	64	9	26	9	4	0	0
15	2	1	0	0	0	64	8	25	9	3	0	0
16	2	1	0	0	0	63	7	25	8	3	0	0
17	2	1	0	0	0	61	8	24	8	2	0	0
18	2	1	0	0	0	60	8	24	9	2	0	0
19	2	1	0	0	0	58	9	23	8	2	0	0
20	2	1	0	0	0	56	9	22	8	1	0	0
21	2	0	0	0	14	54	9	22	7	1	0	0
22	2	0	0	0	28	53	9	21	7	1	0	0
23	2	0	0	0	29	53	9	20	7	1	0	0
24	2	0	0	0	31	53	9	20	7	0	0	0
25	2	0	0	0	32	53	9	19	7	0	0	0

26	2	0	0	0	34	53	9	19	7	0	0	0	0
27	2	0	0	0	36	53	9	19	7	0	0	0	0
28	2	0	0	0	38	53	9	18	7	0	0	0	0
29	2	0	0	0	---	53	9	17	7	0	0	0	0
30	2	0	0	0	---	42	9	16	7	0	0	0	0
31	2	---	0	---	---	31	---	16	---	0	0	0	---

HUDSON BAY DRAINAGE

Sheyenne River at Sheyenne, N. Dak.

LOCATION.—About one mile north of Sheyenne on highway No. 4. It is located on the steel truss bridge with wooden floor. The city of Sheyenne is located on the Leeds branch of the Northern Pacific Railway from Carrington, N. Dak. Railroad connections are inconvenient.

RECORDS AVAILABLE.—April 1929-September 1930.

GAGE.—Ten-foot horizontal enameled face staff fastened to upper guard on the edge of the wooden floor of the bridge. Wire cable with 5 lb. window weight runs over pulley fastened at the foot of the staff and has one marker wired in place. Observer is Edwin F. Hallsten, Sheyenne, N. Dak. Observer is mail carrier who passes over the bridge and takes a reading at 8 o'clock in the morning.

DISCHARGE MEASUREMENTS.—Measurements taken from bridge. Two foot permanent station markers painted on hand rail.

CHANNEL AND CONTROL.—Banks composed of alluvial loam heavily sodded with marsh and aquatic grasses.
Both banks low and subject to overflow.
Channel straight above and below station. Velocity slow.
One channel at all stages.

EXTREMES OF DISCHARGE.—1929-1930; Maximum stage 8.79 feet, February 24, 1930, discharge 990 second-feet; minimum, zero flow during summer months.

DIVERSIONS.—None.

REGULATIONS.—None.

ACCURACY.—Accuracy should be good. Difficulty is experience in obtaining discharge measurements at the proper stages to provide data for rating curve.

MONTHLY DISCHARGE OF SHEYENNE RIVER AT SHEYENNE, N. DAK.

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1929				
April, 5 days	.....	.....	7.84	77.8
May	41.0	5.5	11.0	676
June	37	1.0	10.1	601
July	.....	.....	0.26	15.9
August	.....	.....	0.05	3.2
September	.....	.....	0	0
The period	41	0	4.39	1,370

Month	Discharge in second-feet Maximum	Minimum	Mean	Run-off in acre-feet
1929-1930				
October	.....	.....	0.11	6.9
November	5.5	.....	3.29	196
December	.....	.....	0.50	30.7
February	990	0	217	12,100
March	425	114	247	15,200
April	114	13	47.7	2,840
May	56	9	25.5	1,570
June	7	.....	1.60	95.2
July	.....	.....	0.20	12.3
August	.....	.....	0.05	3.1
September	0	0	0	0
The period	990	0	44.2	32,054.22

DAILY DISCHARGE IN SECOND-FEET OF SHEYENNE RIVER AT SHEYENNE, N. DAK., FOR THE YEAR ENDING SEPTEMBER 30, 1929

Day	April:	May:	June:	July:	August:	September:
1	.....	14	37	0.3	0.1	0
2	.....	14	33	0.3	0.1	0
3	.....	13	17	0.3	0.1	0
4	.....	12	13	0.3	0.1	0
5	.....	11	12	0.3	0.1	0
6	.....	10	11	0.3	0.1	0
7	.....	8.9	10	0.3	0.1	0
8	.....	7.7	10	0.3	0.1	0
9	.....	6.6	10	0.3	0.1	0
10	.....	12	11	0.3	0.1	0
11	.....	12	11	0.3	0.1	0
12	.....	11	10	0.3	0.1	0
13	.....	10	11	0.3	0.1	0
14	.....	10	11	0.3	0.1	0
15	.....	8.9	11	0.3	0.1	0
16	.....	8.3	8.9	0.3	0.1	0
17	.....	6.6	9.2	0.3	0	0
18	.....	5.5	9.4	0.3	0	0
19	.....	6.1	9.7	0.2	0	0
20	.....	6.1	10	0.2	0	0
21	.....	5.5	7.4	0.2	0	0
22	.....	7.7	6.1	0.2	0	0
23	.....	6.6	5.0	0.2	0	0
24	.....	5.0	4.6	0.2	0	0
25	.....	5.5	3.8	0.2	0	0
26	8.9	5.5	3.4	0.2	0	0
27	8.3	11	3.0	0.2	0	0
28	5.0	9.4	2.3	0.2	0	0
29	5.0	9.4	1.6	0.2	0	0
30	12	41	1.0	0.2	0	0
31	.....	41	.....	0.2	0	----

DAILY DISCHARGE IN SECOND-FEET OF SHEYENNE RIVER AT SHEYENNE, N. DAK., FOR YEAR ENDING SEPTEMBER 30, 1930

Day	Oct.:	Nov.:	Dec.:	Jan.:	Feb.:	Mar.:	Apr.:	May:	June:	July:	Aug.:	Sept.:
1	0	1.6	0.5	0	0	331	114	17	7	0.2	0.1	0
2	0	3.8	0.5	0	0	272	114	13	6	0.2	0.1	0
3	0	5.0	0.5	0	0	238	108	13	4.4	0.2	0.1	0
4	0	5.5	0.5	0	0	190	102	11	4.3	0.2	0.1	0
5	0	5.5	0.5	0	0	168	102	10	4.1	0.2	0.1	0
6	0	5.0	0.5	0	0	154	96	11	4.0	0.2	0.1	0
7	0	5.0	0.5	0	0	140	80	13	3.6	0.2	0.1	0
8	0	4.6	0.5	0	0	126	70	15	2.6	0.2	0.1	0
9	0	4.6	0.5	0	0	147	65	16	1.4	0.2	0.1	0
10	0.5	4.6	0.5	0	0	238	55	17	0.5	0.2	0.1	0
11	0.5	4.2	0.5	0	0	331	46	19	0.5	0.2	0.1	0
12	0.5	4.2	0.5	0	0	405	43	25	0.5	0.2	0.1	0
13	0.5	3.8	0.5	0	0	425	40	36	0.5	0.2	0.1	0
14	0.5	3.8	0.5	0	0	425	36	36	0.5	0.2	0.1	0
15	0.5	3.8	0.5	0	0	425	33	30	0.5	0.2	0.1	0
16	0.5	3.8	0.5	0	0	425	30	38	0.5	0.2	0	0
17	0	3.8	0.5	0	0	405	27	46	0.5	0.2	0	0
18	0	2.0	0.5	0	2	425	26	46	0.5	0.2	0	0
19	0	2.0	0.5	0	45	385	23	56	0.5	0.2	0	0
20	0	2.0	0.5	0	140	331	30	46	0.5	0.2	0	0
21	0	2.0	0.5	0	405	272	28	53	0.5	0.2	0	0
22	0	2.0	0.5	0	780	218	26	46	0.5	0.2	0	0
23	0	2.0	0.5	0	955	190	22	38	0.5	0.2	0	0
24	0	2.0	0.5	0	990	154	20	30	0.5	0.2	0	0
25	0	2.0	0.5	0	955	126	20	24	0.5	0.2	0	0

26	.....	0	2.0	0.5	0	780	120	20	20	0.5	0.2	0	0
27	.....	0	2.0	0.5	0	630	120	15	18	0.5	0.2	0	0
28	.....	0	2.0	0.5	0	405	120	13	15	0.5	0.2	0	0
29	.....	0	2.0	0.5	0	.....	114	13	14	0.5	0.2	0	0
30	.....	0	.....	0.5	0	.....	114	13	11	0.5	0.2	0	0
								---	9	.....	0.2	0	--

HUDSON BAY DRAINAGE

Sheyenne River at West Fargo, N. Dak.

LOCATION.—At West Fargo, N. Dak., formerly called Haggart in Sec. 6, T. 139 N., R 40 W., at the steel truss bridge with concrete floor on U. S. Highway No. 10 north of the Northern Pacific Railway station about one-half mile. Station is about one-fourth mile downstream from the original station, maintained for the years 1902-1907 and 1919. No tributaries enter the river between the two sites.

RECORDS AVAILABLE.—1902-1907, 1919, 1929-1930.

GAGE.—Ten foot horizontal enameled face staff is placed in the truss even with the edge of the floor. Wire cable holding 5 lb. window weight runs over pulley in end of staff and has two markers soldered to cable ten feet apart. Observer is R. E. Alford, West Fargo.

DISCHARGE MEASUREMENTS.—Measurements are taken from the bridge; two foot permanent station marks for sounding are painted on the hand rail.

CHANNEL AND CONTROL.—Banks composed of alluvial loam apparently quite stable. Left bank looking upstream is low bench while right bank is steep and rises directly up to the bridge abutment. One channel at all stages. Channel straight for about 100 feet above station but curved above that point. Velocity slow. Formation of ice impeded by discharge of warm sewage from Armour Packing Plant about ⅝-mile above the station.

EXTREMES OF DISCHARGE.—1902-1907, 1919, 1929-1930; Maximum discharge April 28, 1919, 2,220 second-feet; minimum 2.08 ft. September 21, 1929, discharge 7 second-feet.

DIVERSIONS.—None.

REGULATION.—The Northern Pacific dam is located about a quarter of a mile upstream.

ACCURACY.—Accuracy should be good.

MONTHLY DISCHARGE OF SHEYENNE RIVER AT WEST FARGO, N. DAK.

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1929-1930				
October	46	24	32.8	2,020
November	46	15	33.3	1,980
December	30	15	20.0	1,230
January	27	14	17.4	1,070
February	438	11	61.8	3,430
March	1,470	330	838	51,500
April	1,780	224	676	40,200
May	320	197	269	16,500
June	251	64	124	7,380
July	60	36	47.8	2,940
August	34	22	26.9	1,650
September	28	18	23.7	1,410
The period	1,780	11	181	131,000

DAILY DISCHARGE IN SECOND-FEET OF SHEYENNE RIVER AT WEST FARGO, N. DAK., FOR YEAR ENDING SEPTEMBER 30, 1930

Day	Oct.:	Nov.:	Dec.:	Jan.:	Feb.:	Mar.:	Apr.:	May:	June:	July:	Aug.:	Sept.:
1	26	32	15	27	14	540	1,000	222	251	60	32	24
2	26	32	16	26	14	510	1,020	220	242	60	32	26
3	26	34	16	25	14	480	1,400	217	233	56	34	26
4	26	34	17	24	14	480	1,550	215	224	56	32	24
5	26	36	17	23	14	412	1,780	215	197	56	28	24
6	26	38	18	22	14	400	1,400	197	170	56	28	24
7	26	40	18	22	14	340	1,320	206	153	56	30	24
8	24	44	18	21	14	352	1,190	224	145	56	28	26
9	26	44	18	20	14	330	960	233	137	52	28	26
10	28	44	18	19	14	364	840	242	116	48	26	28
11	30	44	18	18	13	412	734	270	116	48	24	26
12	34	44	18	17	13	510	632	300	109	48	22	28
13	38	44	18	17	12	510	600	310	109	48	24	28
14	44	46	18	16	12	649	510	320	109	48	24	26
15	46	46	18	16	11	821	510	310	109	48	24	26
16	44	46	18	15	17	900	480	290	109	46	22	26
17	44	44	18	15	23	1,170	451	300	102	46	24	24
18	44	40	17	14	29	1,040	437	310	96	46	23	23
19	40	36	17	14	35	1,080	437	300	96	48	26	23
20	38	34	17	14	40	1,350	400	300	96	48	24	24
21	36	30	17	14	46	1,440	340	300	90	48	24	22
22	34	28	19	14	52	1,470	310	300	90	48	26	21
23	32	20	21	14	60	1,440	280	290	84	46	28	21
24	32	17	23	14	69	1,440	270	290	84	44	28	22
25	32	19	24	14	151	1,420	260	290	84	44	30	21

26	.....	30	19	26	14	233	1,280	242	290	79	40	30	20
27	.....	30	18	28	14	335	1,190	233	290	79	38	29	20
28	.....	32	16	30	14	438	980	233	280	74	36	28	20
29	.....	32	16	29	14	.....	940	224	270	69	36	26	19
30	.....	32	15	28	14	.....	860	224	270	64	36	24	18
31	.....	32	.....	28	14	.....	880	.....	270	.....	36	26	....

Ice effect Nov. 17 to Apr. 5. Shifting control Sept. 14-30.

HUDSON BAY DRAINAGE

Pembina River at Neche, N. Dak.

LOCATION.—At Great Northern Railway bridge two-thirds mile north of Neche, Pembina County, N. Dak.

DRAINAGE AREA.—2,960 square miles (revised).

RECORDS AVAILABLE.—May 1903-September 1915, and April 1919-September 1930.

GAGE.—Vertical staff bolted to concrete abutment at north end of railway bridge; read to tenths once daily by P. J. Horgan.

DISCHARGE MEASUREMENTS.—Made from highway bridge 20 rods below railway bridge or by wading below Great Northern dam.

CHANNEL AND CONTROL.—Bed composed of clay and silt. Control is loose-rock dam about 3 feet high, a third of a mile below gage, constructed to give sufficient depth of water for the intake of Great Northern Railway water tank; shifts slightly.

EXTREMES OF DISCHARGE.—1903-1915; 1919-1930; Maximum open water stage recorded, 20.9 feet May 2, 1904, discharge 3,870 second-feet; minimum stage recorded, 1.3 feet September 15, 16, 18, 19, and 21-24, 1911, discharge 1.0 second-feet.

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

REGULATION.—None.

ACCURACY.—Stage-discharge relation not permanent; affected by ice and by shift of control. Both rating curves fairly well defined. Records fair.

MONTHLY DISCHARGE OF PEMBINA RIVER AT NECHE, N. DAK.

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1927-1928				
October	292	156	230	14,100
November	172	.....	123	7,320
December	.....	.....	50	3,070
January	.....	.....	40	2,460
February	.....	.....	25	1,440
March	1,270	.....	323	19,900
April	674	222	357	21,200
May	328	95	209	12,900
June	292	109	181	10,800
July	328	95	152	9,350
August	95	40	59.4	3,650
September	109	40	71.6	4,260
The period	2,940	.....	297	216,000
1928-1929				
October	132	114	122	7,500
November	97	.....	44.8	2,670
December	.....	.....	22.4	1,380
January	.....	.....	12.0	738
February	.....	.....	8.0	444
March	750	.....	183	11,300
April	350	132	220	13,100
May	132	97	110	6,760
June	114	30	79.4	4,720
July	25	1.0	6.21	382
August	5.5	2.5	3.86	237
September	12	1.5	4.77	284
The period	750	1.0	68.3	49,515
1929-1930				
October	47	2.5	19.0	1,170
November	63	.....	45.8	2,730
April	2,900	1	928	55,200
May	530	294	458	28,200
June	294	168	216	12,900
July	330	5.5	83.7	5,270
August	.....	2.5	15.9	978
September	63	2.5	10.1	601
The period	2,900	1	.....	107,049

DAILY DISCHARGE IN SECOND-FEET OF PEMBINA RIVER AT NECHE, N. DAK., FOR YEAR ENDING SEPTEMBER 30, 1928

Day	Oct.:	Nov.:	Dec.:	Jan.:	Feb.:	Mar.:	Apr.:	May:	June:	July:	Aug.:	Sept.:
1	292	172	50	40	25	25	674	239	124	140	95	40
2	292	156	50	40	25	25	674	222	140	140	95	40
3	292	156	50	40	25	25	652	205	140	140	95	40
4	292	156	50	40	25	25	652	188	140	140	82	40
5	274	156	50	40	25	25	630	172	124	140	82	49
6	274	156	50	40	25	25	525	156	109	140	82	49
7	274	156	50	40	25	25	484	156	109	328	82	49
8	274	156	50	40	25	25	444	156	109	292	82	49
9	274	156	50	40	25	25	424	172	124	274	70	49
10	274	156	50	40	25	25	366	172	140	256	59	49
11	256	140	50	40	25	25	366	188	156	222	59	59
12	256	140	50	40	25	25	328	188	188	205	59	59
13	256	140	50	40	25	25	328	188	188	188	59	59
14	256	100	50	40	25	25	292	188	222	140	59	70
15	256	100	50	40	25	25	292	205	239	140	59	70
16	256	100	50	40	25	25	274	256	239	140	59	70
17	239	100	50	40	25	25	256	292	239	140	49	70
18	239	100	50	40	25	32	256	310	256	140	49	82
19	222	100	50	40	25	40	239	328	274	124	49	82
20	205	100	50	40	25	49	239	328	292	124	49	82
21	188	100	50	40	25	70	239	310	256	124	49	95
22	188	100	50	40	25	95	239	292	222	124	49	95
23	156	100	50	40	25	784	222	274	156	124	49	95
24	156	100	50	40	25	1,250	222	256	205	109	40	95
25	156	100	50	40	25	1,270	222	239	205	109	40	35

26	.....	172	100	50	40	25	1,180	222	205	188	95	40	95
27	.....	172	100	50	40	25	1,070	239	172	188	95	40	95
28	.....	172	100	50	40	25	1,079	239	124	156	95	40	109
29	.....	172	100	50	40	25	1,030	239	95	156	95	40	109
30	.....	172	100	50	40	.....	894	239	95	140	95	40	109
31	.....	172	.....	50	40	.....	740	.....	95	.....	95	40	.....

DAILY DISCHARGE IN SECOND-FEET OF PEMBINA RIVER AT NECHE, N. DAK., FOR YEAR ENDING SEPTEMBER 30, 1929

Day	Oct.:	Nov.:	Dec.:	Jan.:	Feb.:	Mar.:	Apr.:	May:	June:	July:	Aug.:	Sept.:
1	114	97	25	12	8	6	240	132	97	25	5.5	2.5
2	114	63	25	12	8	6	350	132	97	16	5.5	2.5
3	114	63	25	12	8	6	350	132	114	8.5	5.5	2.5
4	114	63	25	12	8	6	312	132	114	2.5	5.5	2.5
5	114	63	25	12	8	6	240	132	114	1.0	5.5	5.5
6	114	63	25	12	8	6	240	132	114	1.0	5.5	5.5
7	114	63	25	12	8	6	240	132	114	1.0	5.5	5.5
8	114	63	25	12	8	6	258	132	114	1.5	5.5	2.5
9	114	63	25	12	8	6	276	114	114	1.5	5.5	1.5
10	114	63	25	12	8	8	312	114	114	2.5	5.5	1.5
11	132	47	25	12	8	8	330	114	114	2.5	5.5	1.5
12	132	47	25	12	8	8	294	114	97	2.5	5.5	1.5
13	132	47	25	12	8	8	204	114	97	2.5	5.5	1.5
14	132	36	25	12	8	12	240	114	97	2.5	5.5	1.5
15	132	36	25	12	8	12	240	114	97	2.5	2.5	1.5
16	132	36	20	12	8	16	186	97	80	2.5	2.5	1.5
17	132	36	20	12	8	16	168	97	80	2.5	2.5	1.5
18	132	36	20	12	8	25	168	97	63	2.5	2.5	2.5
19	132	30	20	12	8	163	168	97	63	8.5	2.5	2.5
20	132	30	20	12	8	350	168	97	63	8.5	2.5	5.5
21	132	30	20	12	8	750	168	97	63	5.5	2.5	5.5
22	132	30	20	12	8	670	168	97	63	8.5	2.5	5.5
23	132	30	20	12	8	550	168	97	47	8.5	2.5	5.5
24	114	30	20	12	8	539	168	97	47	12	2.5	8.5
25	114	30	20	12	8	510	168	97	36	12	2.5	8.5

26	114	30	20	12	8	430	168	97	36	12	2.5	8.5
27	114	30	20	12	8	350	168	97	36	8.5	2.5	12
28	114	30	20	12	8	312	168	97	36	8.5	2.5	12
29	114	30	20	12	8	312	132	97	30	8.5	2.5	12
30	114	30	20	12	8	312	132	97	30	5.5	2.5	12
31	114	30	20	12	8	275	.....	97	.....	5.5	2.5	.....

DAILY DISCHARGE IN SECOND-FEET OF PEMBINA RIVER AT NECHE, N. DAK., FOR YEAR ENDING SEPTEMBER 30, 1930

Day	Oct.:	Nov.:	April:	May:	June:	July:	Aug.:	Sept.:
1	8.5	47	1	510	294	294	30	2.5
2	8.5	47	36	490	276	330	30	2.5
3	5.5	47	30	490	276	294	30	2.5
4	5.5	47	312	470	258	240	30	2.5
5	2.5	47	918	470	258	168	30	2.5
6	2.5	63	1,950	470	258	168	36	8.5
7	2.5	63	2,740	490	258	168	30	2.5
8	5.5	63	2,960	490	258	132	30	2.5
9	5.5	63	2,370	510	258	132	30	2.5
10	8.5	63	1,930	510	240	150	30	2.5
11	8.5	63	1,750	530	240	114	20	2.5
12	8.5	63	1,490	530	240	97	20	5.5
13	8.5	63	1,090	530	222	63	20	8.5
14	12	63	710	510	222	36	20	8.5
15	16	63	730	510	222	25	20	12
16	16	63	710	490	204	16	10	12
17	16	63	690	490	204	12	10	16
18	20	63	644	470	204	8.5	10	16
19	20	47	630	470	186	5.5	10	16
20	25	36	610	470	186	5.5	5.5	20
21	36	36	590	470	168	8.5	5.5	20
22	36	30	590	450	168	12	5.5	25
23	30	30	590	407	168	12	5.5	30
24	30	20	590	450	180	16	5.5	30
25	30	20	570	450	168	20	5.5	30
26	30	20	550	430	168	20	2.5	36
27	36	20	550	390	168	25	2.5	47
28	36	20	530	350	168	25	2.5	47
29	36	20	530	312	168	20	2.5	63
30	36	20	510	294	186	20	2.5	63
31	47	.....	.....	294	.....	20	2.5	....

HUDSON BAY DRAINAGE

Mouse (Souris) River at Minot, North Dakota

LOCATION.—In Minot, N. Dak. at the foot-bridge across the Mouse River 100 feet from the Great Northern Railway roundhouse until the construction of a dam in 1923 in the river 4 2/3 miles downstream from the gage. The crest of this dam was in an elevation of 9.07 feet on the gage and introduced considerable disturbance of the stage-discharge relation because of the operation of the gate. A staff was installed on the Valker bridge just above the dam in 1924. The record from this point included the operation of the gate but it was not entirely satisfactory.

In 1927 a staff was placed on the Saugstad bridge five miles below Minot. Parallel records and partial records were kept at the three stations at various intervals.

GAGE.—Vertical staff gage attached to piling of the bridges in Minot; wire gage used at the Saugstad bridge. Records are now taken at Minot by F. H. Peters.

DISCHARGE MEASUREMENTS.—Made from the Main Street foot-bridge and other bridges and by wading.

CHANNEL AND CONTROL.—Channel in clay and silt, nearly permanent, but changed somewhat in recent years by encroachment of the channel through the city.

EXTREMES OF DISCHARGE.—1903-1930; Maximum stage 21.9 feet, April 20, 1904, discharge 12,000 second-feet; minimum stage, zero during February 1930 and at various places during the summer of 1930.

ICE.—Stage-discharge relation only slightly affected by ice.

DIVERSIONS.—None.

REGULATIONS.—None.

ACCURACY.—Stage-discharge relation fairly permanent during year, except for slight ice effect and for backwater from City Park dam. It was built to raise the low water stage. Its operation disturbs the gage rating, especially when gate is only partly open. Otherwise rating curve fairly well defined between 3 and 3,500 second-feet. Gage read to tenths once daily. Daily discharge ascertained by applying daily gage height to rating table. Records fair.

MONTHLY DISCHARGE OF MOUSE (SOURIS) RIVER AT MINOT, NORTH DAKOTA

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1927-1928				
October	108	86	99.4	6,110
November	92	.....	62.7	3,730
December	.....	.....	21.5	1,320
January	.....	.....	12.0	738
February	.....	.....	10.0	575
March	.....	.....	169	10,400
April	2,940	694	1,740	104,000
May	730	184	460	28,300
June	500	135	221	13,200
July	840	276	486	29,900
August	820	57	268	16,500
September	50	13	21.9	1,300
The period	2,940	.....	297	216,000
1928-1929				
October	29	20	24.0	1,480
April, 17 days	.....	.....	136	4,600
May	117	31	61	3,750
June	397	54	178	10,600
July	50	3	19.6	1,200
August	.....	.....	3.0	184
September	.....	.....	5.3	315
The period	.....	.....	.....	22,129
1929-1930				
October	6	3	4.4	271
November	12	1	5.0	298
December	.....	.....	1.0	61.5
January	.....	.....	0.5	30.7
February	295	0	53.3	2,960
March	382	21	185	11,400
April	920	202	573	34,100
May	202	57	116	7,130
June	57	36	43.8	2,610
July	.....	.....	18.0	1,110
August	.....	.....	0.5	30.7
September	.....	.1	0.2	8.9
The period	920	0	82.8	60,010.8

DAILY DISCHARGE IN SECOND-FEET OF MOUSE (SOURIS) RIVER AT MINOT, N. DAK., FOR YEAR ENDING SEPTEMBER 30, 1928

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	April.	May	June	July	Aug.	Sept.
1	100	92	30	12	10	10	1,320	730	184	276	820	50
2	100	92	30	12	10	10	1,710	682	184	419	780	43
3	92	86	30	12	10	10	1,760	706	170	386	700	37
4	100	80	30	12	10	10	1,840	694	157	342	620	31
5	100	75	30	12	10	10	2,000	706	157	309	544	24
6	100	75	30	12	10	10	2,170	706	145	287	490	19
7	92	75	30	12	10	10	2,380	706	145	276	436	19
8	100	80	30	12	10	10	2,590	706	157	840	400	17
9	100	80	30	12	10	10	2,680	682	157	329	364	16
10	100	86	30	12	10.5	10	2,740	644	145	295	346	14
11	100	80	20	12	10	10	2,860	596	157	382	329	13
12	108	80	20	12	10	10	2,940	540	145	454	295	13
13	108	50	20	12	10	10	2,860	460	135	400	261	13
14	100	50	20	12	10	10	2,710	420	135	278	261	13
15	100	50	20	12	10	10	2,530	440	135	364	220	13
16	108	50	20	12	10	10	2,330	440	135	312	204	13
17	100	50	20	12	10	10	2,110	440	135	346	164	13
18	100	50	20	12	10	10	1,890	420	135	382	134	13
19	100	50	20	12	10	10	1,580	380	135	640	120	14
20	108	50	20	12	10	10	1,280	360	145	580	107	16
21	100	50	15	12	10	150	1,080	340	157	580	95	17
22	108	50	15	12	10	150	935	340	170	562	84	21
23	108	50	15	12	10	150	830	320	284	562	74	26
24	100	50	15	12	10	150	744	320	320	544	70	28
25	100	50	15	12	10	150	706	266	400	544	61	31
26	100	50	15	12	10	150	694	248	480	580	57	28
27	92	50	15	12	10	150	706	214	480	640	54	26
28	92	50	15	12	10	1,000	730	198	500	720	57	24
29	86	50	15	12	10	1,000	744	198	440	780	57	26
30	92	50	15	12	....	1,000	744	184	420	820	57	26
31	86	....	15	12	....	1,000	.....	184	.....	840	57	....

Foot-bridge record used Apr. 1-21 and July 9-Sept. 30. Valker Bridge record used Oct. 1 to Mar. 31 and April 22 to June 30. Saugstad Bridge record used July 1-8.

DAILY DISCHARGE IN SECOND-FEET OF MOUSE (SOURIS) RIVER AT SAUGSTAD BRIDGE, MINOT, N. DAK., FOR YEAR ENDING SEPTEMBER 30, 1929

Day	Oct.	Nov.	April	May	June	July	Aug.	Sept.
1	29	20	.....	87	132	50	3	4
2	29	20	.....	82	162	43	3	4
3	29	20	.....	72	152	41	3	4
4	29	.....	.....	67	142	39	3	4
5	26	.....	.....	62	182	39	3	4
6	24	.....	.....	67	232	43	3	4
7	24	.....	.....	60	397	38	3	4
8	24	.....	.....	52	287	32	3	4
9	24	.....	.....	49	298	30	3	4
10	24	.....	.....	47	309	28	3	4
11	24	.....	.....	44	309	27	3	4
12	24	.....	.....	41	309	22	3	4
13	22	.....	.....	38	320	19	3	4
14	20	.....	112	37	298	19	3	4
15	20	.....	117	36	232	17	3	4
16	20	.....	122	31	192	16	3	4
17	22	.....	132	39	172	14	3	4
18	24	.....	142	43	127	14	3	7
19	26	.....	152	43	112	8	3	7
20	26	.....	152	51	97	9	3	7
21	29	.....	152	39	72	9	3	7
22	26	.....	152	36	222	8	3	7
23	26	.....	152	34	112	7	3	7
24	24	.....	152	39	82	7	3	7
25	24	.....	142	43	77	6	3	7
26	24	.....	122	82	62	6	3	7
27	22	.....	122	117	67	5	3	7
28	20	.....	132	112	60	3	3	7
29	20	.....	122	107	58	3	3	7
30	20	.....	142	117	54	3	3	7
31	20	.....	.....	117	.....	3	3	....

DAILY DISCHARGE IN SECOND-FEET OF MOUSE (SOURIS) RIVER AT MINOT, N. DAK., FOR YEAR ENDING SEPTEMBER 30, 1930

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.
1	4	8	1	0.5	0	21	400	202	57	18	0.5	0.2
2	4	8	1	0.5	0	21	436	202	57	18	0.5	0.2
3	4	9	1	0.5	0	21	472	187	52	18	0.5	0.2
4	4	10	1	0.5	0	26	620	172	52	18	0.5	0.2
5	4	12	1	0.5	0	26	760	157	48	18	0.5	0.2
6	4	12	1	0.5	0	37	760	150	48	18	0.5	0.2
7	4	12	1	0.5	0	50	720	143	48	18	0.5	0.2
8	3	12	1	0.5	0	134	700	129	48	18	0.5	0.2
9	3	9	1	0.5	0	188	680	115	48	18	0.5	0.2
10	4	9	1	0.5	0	261	720	108	48	18	0.5	0.2
11	4	6	1	0.5	0	295	760	115	44	18	0.5	0.2
12	4	6	1	0.5	0	329	800	129	44	18	0.5	0.2
13	4	4	1	0.5	0	329	860	143	44	18	0.5	0.2
14	4	4	1	0.5	0	278	920	143	40	18	0.5	0.2
15	4	4	1	0.5	0	295	920	129	40	18	0.5	0.2
16	4	4	1	0.5	0	295	920	122	40	18	0.5	0.1
17	4	4	1	0.5	0	220	880	115	40	18	0.5	0.1
18	4	3	1	0.5	0	172	800	115	44	18	0.5	0.1
19	4	2	1	0.5	180	127	640	115	44	18	0.5	0.1
20	4	2	1	0.5	188	107	520	105	44	18	0.5	0.1
21	4	1	1	0.5	228	107	412	96	44	18	0.5	0.1
22	4	1	1	0.5	295	142	376	87	40	18	0.5	0.1
23	5	1	1	0.5	196	164	340	77	40	18	0.5	0.1
24	5	1	1	0.5	228	164	304	77	40	18	0.5	0.1
25	5	1	1	0.5	84	172	286	67	40	18	0.5	0.1
26	5	1	1	0.5	37	212	268	67	36	18	0.5	0.1
27	5	1	1	0.5	31	261	250	67	36	18	0.5	0.1
28	6	1	1	0.5	26	164	234	67	36	18	0.5	0.1
29	6	1	1	0.5	....	364	218	62	36	18	0.5	0.1
30	6	1	1	0.5	....	364	202	62	36	18	0.5	0.1
31	6	....	1	0.5	....	382	.....	57	....	18	0.5	....

Discharge estimated zero during Feb. 1 to 18. Discharge estimated on account of ive Nov. 6 to Apr. 4; while pond behind dam was filling May 20-22; and for period when gage was not read July 1 to Sept. 19.

HUDSON BAY DRAINAGE

Mouse (Souris) River near Westhope, N. Dak.

LOCATION.—In T. 163 N., R. 79 W., on county highway bridge about two and one-half miles east of Westhope on the road to Landa. Six miles south of international boundary.

RECORDS AVAILABLE.—July 1929-September 1930.

GAGE.—Chain gage located on upstream side of highway bridge. Read to hundredths once a day by A. C. Anderson, Landa, N. Dak.

DISCHARGE MEASUREMENTS.—Measurements made from a highway bridge at the gage or by wading a short distance below the bridge. Bed of stream is black mud. Banks are low and subject to overflow. A few willows grow along the edge of the dredged channel but except for them the banks are covered with wild hay.

CHANNEL AND CONTROL.—Control is indefinite. The channel of the stream has been dredged for many miles above and below the station. The dredged banks are subject to overflow at a stage of about five feet.

EXTREMES OF DISCHARGE.—1929-1930; Maximum stage 6.98 feet, March 31 and April 1-2, 1930, discharge 1,130 second-feet; minimum stage .34 ft. August 29-30 and September 1-2, 1930, discharge 2 second-feet.

DIVERSIONS.—None.

REGULATIONS.—None.

ACCURACY.—Good records should be obtained at this station.

MONTHLY DISCHARGE OF MOUSE (SOURIS) RIVER NEAR WESTHOPE, NORTH DAKOTA.

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1929				
July, 6 days	.....	.....	38.5	458
August	.....	.....	13.4	824
September	.....	.....	6.5	387
The period	.....	.....	.....	1669
1929-1930				
October	19	3	8.3	510
November, 17 days	33	16	20.5	691
March, 9 days	1,130	992	1,040	18,600
April	1,130	753	922	54,900
May	726	138	388	23,700
June	138	66	101	6,010
July	84	11	41.0	2,520
August	14	2	5.4	332
September	14	2	8.7	518
The period	1,130	2	.....	107,781

DAILY DISCHARGE IN SECOND-FEET OF MOUSE (SOURIS) RIVER NEAR WESTHOPE, N. DAK., FOR YEAR ENDING SEPTEMBER 30, 1929

Day	July:	Aug.:	Sept.:
1	.....	37	3
2	.....	17	a 3
3	.....	22	a 3
4	.....	22	3
5	.....	22	a 3
6	.....	22	3
7	.....	21	a 7
8	.....	21	11
9	.....	19	a 10
10	.....	19	10
11	.....	21	5
12	.....	21	a 5
13	.....	14	5
14	.....	21	3
15	.....	13	3
16	.....	9	a 4
17	.....	13	5
18	.....	a 11	6
19	.....	a 8	a 5
20	.....	6	a 4
21	.....	a 6	3
22	.....	7	6
23	.....	a 7	a 8
24	.....	a 6	a 9
25	.....	6	11
26	44	a 6	10
27	a 38	6	a 10
28	33	a 4	11
29	44	3	a 12
30	35	a 3	a 15
31	37	3	....

a—Interpolated.

DAILY DISCHARGE IN SECOND-FEET OF MOUSE (SOURIS) RIVER NEAR WESTHOPE, N. DAK., FOR YEAR ENDING SEPTEMBER 30, 1930

Day	Oct.:	Nov.:	Mar.:	Apr.:	May:	June:	July:	Aug.:	Sept.:
1	13	16	.....	1,130	726	138	84	14	2
2	14	20	.....	1,130	700	138	79	14	2
3	14	20	.....	1,090	651	138	70	12	3
4	14	20	.....	1,060	604	128	66	11	3
5	4	20	.....	1,030	560	128	70	12	10
6	3	20	.....	1,030	540	123	70	12	14
7	4	20	.....	1,030	520	113	61	7	12
8	4	20	.....	1,060	482	103	52	5	10
9	5	20	.....	1,030	446	98	52	5	11
10	6	20	.....	992	412	98	52	5	10
11	6	20	.....	992	412	98	49	5	10
12	5	20	.....	960	412	79	44	4	11
13	5	20	.....	960	412	93	42	3	8
14	5	20	.....	960	396	103	39	3	5
15	5	20	.....	960	396	108	33	5	6
16	5	20	.....	930	380	108	38	5	10
17	4	33	.....	900	365	108	35	4	11
18	4	....	.....	870	350	108	35	3	10
19	4	....	.....	870	335	108	35	3	5
20	3	....	.....	840	335	108	28	3	5
21	5	....	.....	810	305	98	29	3	8
22	7	....	.....	810	277	98	26	3	14
23	8	....	992	810	291	88	21	3	14
24	8	....	992	810	305	84	28	4	14
25	10	....	992	781	252	74	22	4	11
26	12	....	1,030	781	228	76	26	3	10
27	14	....	1,030	781	228	79	11	3	10
28	17	....	1,030	753	216	74	22	3	9
29	19	....	1,060	753	192	66	15	2	7
30	14	....	1,090	753	148	79	18	2	5
31	15	....	1,130	.....	138	....	18	3	....