Floods of 1950

GEOLOGICAL SURVEY WATER-SUPPLY PAPER 1137

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Douglas McKay, *Secretary*

GEOLOGICAL SURVEY

W. E. Wrather, *Director*

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[The letters in parentheses preceding the titles are those used to designate the papers for separate publication]

Missouri River Basin Floods of April-May 1950 in North and South Dakota

By R. E. OLTMAN *and others*

FLOODS OF 1950

GEOLOGICAL SURVEY WATER-SUPPLY PAPER 1137-A

Prepared in cooperation with the North Dakota State Water Conservation Commission, the South Dakota State Engineer, the Corps of Engineers, United States Army, and the United States Bureau of Reclamation

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MISSOURI RIVER BASIN FLOODS OF APRIL-MAY 1950 IN NORTH AND SOUTH DAKOTA

By R. E. Oltman and others

ABSTRACT

In areal coverage and magnitude of peak discharge the floods of April-May 1950 in the Missouri River Basin in North and South Dakota were unprecedented in the area. These floods were characterized by an extremely late spring breakup of ice, by great flood peaks resulting from snow melt, and by two separate floods in the James River Valley in less than a month.

The primary cause of the floods was the rapid melting of the season's great accumulation of snow, one of the deepest on record. In the period between the normal spring breakup time and the actual breakup of river ice, considerably more snow accumulated. Some of this was melted by a few warm days and the melt was stored as water behind snow barriers in upland watercourses. A sudden increase in temperature beginning April 13 and lasting until most of the snow had been converted into runoff resulted in rapid rise of flood waters.

Tributary flood waters made the Missouri River from Mobridge to Yankton, S. Dak., rise to near the maximum recorded discharge. At Sioux City, Iowa, the 1950 flood peak-discharge exceeded any previously recorded by the Geological Survey.

The center of the flooded area west of the Missouri River lay in the Cannonball River Basin which had the greatest water content of snow on the ground just before the ice broke up. Floods north and south of this area were relatively less intense. Scattered records of the Cannonball River and a study of newspaper accounts and other information show that the flood of 1950 was greatest since the area was settled. Flooding of the James River at Jamestown was the greatest since 1897, and the floods of April and May 1950 were of nearly the same stage.

Itemized flood damages were made by Federal and State agencies, and relief was sent to the area by the Department of the Army and the American National Red Cross.

Data include records of stage and discharge at 54 gaging stations for the period of flood, a summary of peak discharges and comparative data for past and present maxima, a table of crest stages, and weather associated with the 1950 flood.

INTRODUCTION

The floods of April and May 1950 on tributaries of the Missouri River between Bismarck, N. Dak., and Pierre, S. Dak., exceeded in size on many of these streams any previously known. Floodwater damage throughout the area was estimated at $10,000,000. Damage to bridges was particularly costly. West of the Missouri River the floods were notable for their rapid rise and magnitude of peak discharge; east of the Missouri they were notable for their long duration.

This report is the first chapter of a volume which the Geological Survey proposes to publish annually to describe the major floods of each year. It presents hydrologic information about the floods at an earlier date and in considerably more detail than it is possible to do in the annual Surface Water-Supply reports of the Geological Survey. Consequently, its data are intended to be of special value to the planning engineer concerned with the design and construction of bridges, water works, flood protection works, irrigation structures, and other building where floods must be considered. Included are brief discussions of the causal factors, extent of damages, descriptions of separate floods, and essential basic hydrological data. Information is arranged in this order: description of floods, damage, meteorology, measuring flood discharge, records of stage and discharge at gaging stations, summary of past maximum and present floods, flood profiles, and related changes in ground water levels.

The flood area is shown in figure 1, and the places where flood measurements were made are shown in figure 2.

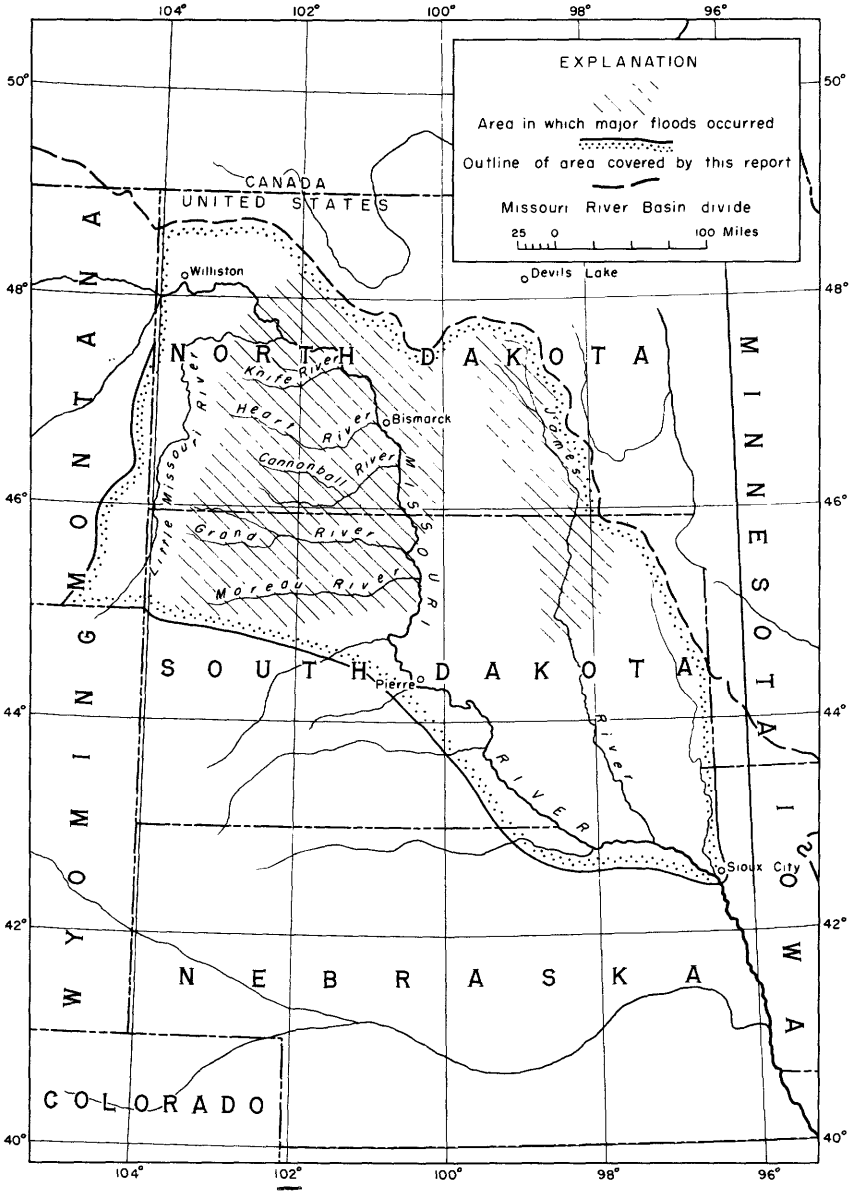


Figure 1.—Map showing area of 1950 floods in North and South Dakota

ADMINISTRATION AND PERSONNEL

This report was prepared in the Surface Water Branch of the U. S. Geological Survey, under the general administration of J. V. B. Wells, chief. The field and office work in connection with the collection, computation, and presentation of data was done by the staff of the Bismarck district office under the supervision of H. M. Erskine, district engineer. Several engineers of the Geological Survey detailed from other parts of the United States assisted the local personnel in office and field. Coordination of the field work was done by Hollister Johnson, hydraulic engineer. This report was assembled and the text was prepared by the staff of the special reports office in Lincoln, Nebr., R. E. Oltman, engineer in charge.

ACKNOWLEDGMENTS

The collection of field data and compilation of records in this report was done as a part of the Interior Department Program for development of the Missouri River Basin.

The general investigation of surface-water resources in the area covered by this report is performed by the Geological Survey in cooperation with the North Dakota State Water Conservation Commission, the South Dakota State Engineer, the Corps of Engineers, and the Bureau of Reclamation. The Corps of Engineers, Bureau of Reclamation, Bureau of Public Roads, and Weather Bureau also furnished data or services in connection with this report. The North Dakota State Water Conservation Commission, J. J. Walsh, Chief Engineer, furnished the services of three surveymen and equipment to assist in the collection of field information with regard to computation of peak discharges.

Acknowledgment of material furnished by individuals or corporations is made in the text at the place where the material appears.

GENERAL DESCRIPTION OF FLOODS

The floods of April and May 1950 in the Missouri River Basin in North and South Dakota resulted from the rapid melting of the winter's abnormal accumulation of snow. The fall of 1949-50 was mild and dry to mid-December; then it merged into one of the most extreme winters in the climatic records of North Dakota. Snowfall was excessive throughout January, and especially so east of the Missouri River. Near the end of the month an area 50 miles wide, extending from Devils Lake to the South Dakota line, was classified as a disaster area and the army assisted in moving food and fuel to snowbound farms within it.

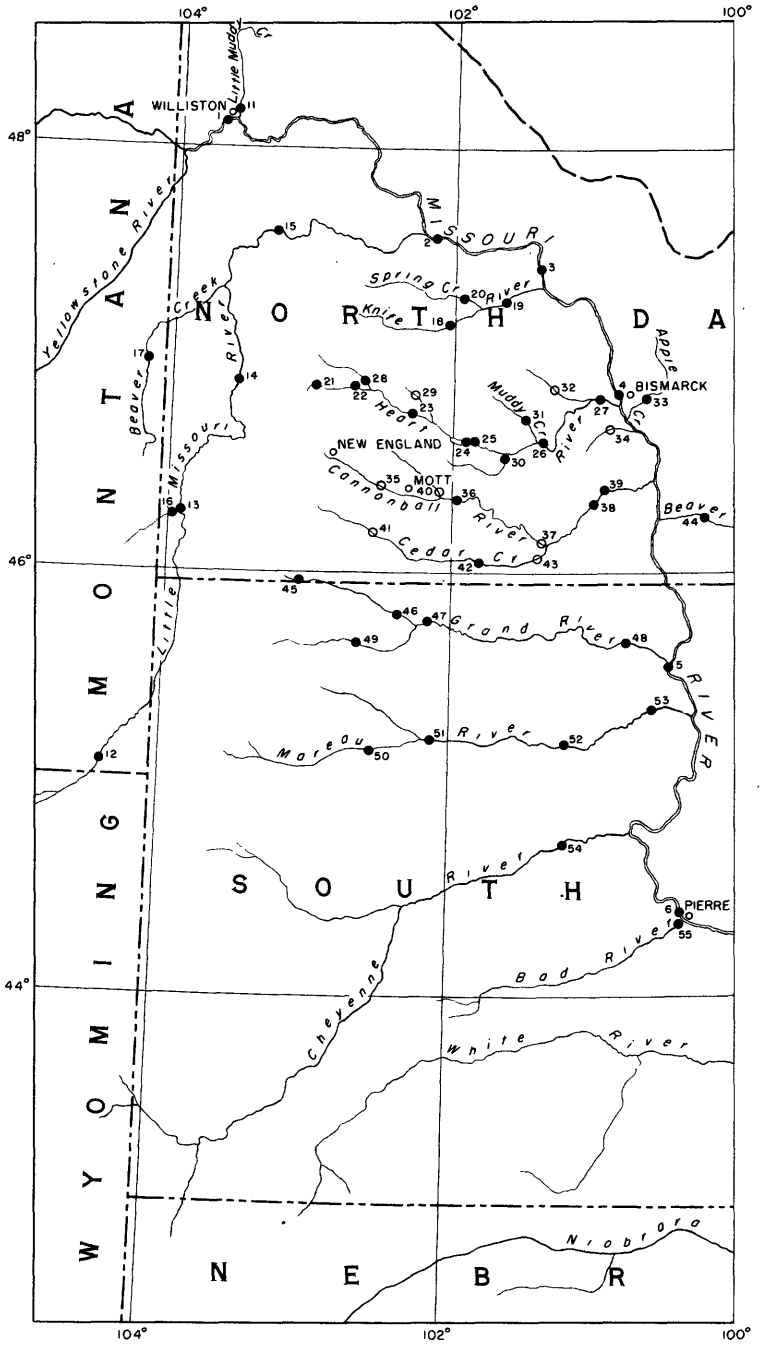
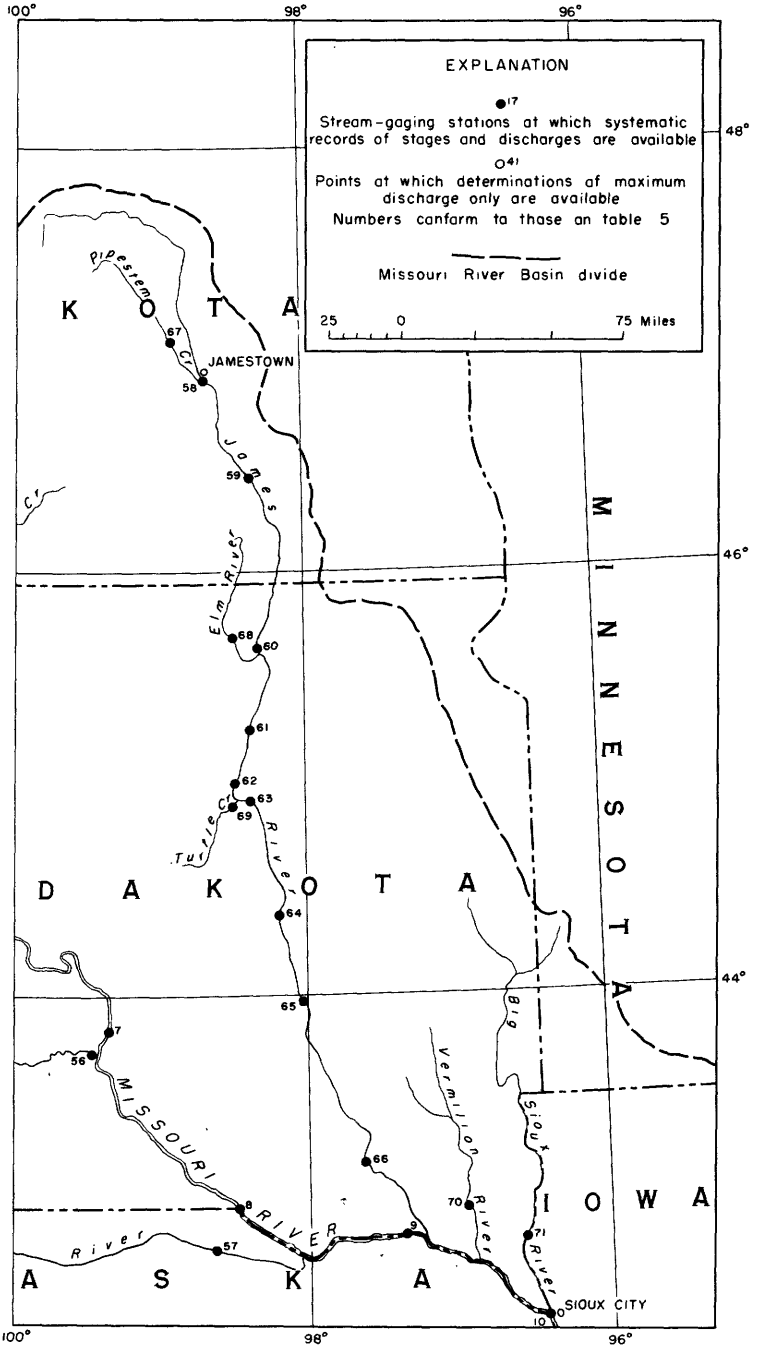


Figure 2.—Map of Missouri River Basin in North and South



Dakota showing location of flood-determination points

February moderated somewhat, but March was unusually cold and wet, and there was little runoff. April continued unusually cold until the second week. The breakup of ice on the Missouri River at Bismarck, N. Dak., is the latest known, except that of 1846. Weather Bureau records date from 1881.

The following excerpts taken from the United States Weather Bureau monthly publication, Climatological Data for North Dakota, give a brief but emphatic account of the antecedent weather conditions:

December 1949.--"The first 10 days of December were a continuation of the above-normal temperatures and light precipitation that prevailed during November. After the 10th, temperatures averaged considerably below normal and precipitation averaged above normal ***. Precipitation for the State averaged 0.65 inches or 0.17 inch above normal***.

January 1950.--"Cold weather began on the first of January and there were no periods warm enough to melt any snow during the entire month. It was the coldest January of record in North Dakota***. The maximum temperature did not go above zero on more than half of the days. Precipitation averaged more than twice the normal amount. Many stations reported more snow fall than in any previous January, and with wind velocities above average, blizzard conditions prevailed on many days***. The mean temperature for the State was -10.5° or 17.2° below the average***. Precipitation for the State averaged 1.04 inches or 0.55 inch above the January normal. The mean for the eastern division was 1.32 inches, for the middle division 1.03 inches, and for the western division 0.75 inch***. Average snow fall for the eastern division was 18.7 inches, for the middle division 14.7 inches, and for the western division 10.0 inches***.

February 1950.--"Following the coldest January of record, February averaged only slightly below normal for temperature and the precipitation was light. Very little melting occurred during the month and much of the heavy snow cover at the end of January remained on the ground throughout February***. The mean temperature for the State was 8.8° or 0.9° below the average***. Precipitation for the State averaged 0.32 inches or 0.15 inch below the February normal***. This is the first February since 1944 that more precipitation occurred in the western division than in the eastern division. The greatest amount for any station was 1.15 inches at New England***.

March 1950.--"March 1950 is the fourth consecutive month with the temperature below normal***. The precipitation was above normal for the winter with unusually heavy amounts in January and March. Several blizzards occurred during the month***. A storm began on the 25th with light snow and moderate easterly winds***. By the 26th normal to heavy snow was falling over the south half of the State except for rain in the southeast portion. Accumulations up to 20 inches of snow fell in south central and southwest portions of the State and this was one of the worst blizzards to hit these areas. Transportation was entirely tied up and numerous cars were stalled along the highway***. Precipitation for the State averaged 1.38 inches or 0.59 inch above the March normal. Most of the precipitation occurred

between the 20th and 27th. The average precipitation for the eastern division was 1.46 inches, for the middle division 1.33 inches, and for the western division 1.35 inches. The greatest amount for any station was 3.64 inches at New England. The greatest amount in 24 hours was 1.68 inches at New England on the 23rd***.

April 1950.--"The month opened with extremely heavy snow cover in the southwest and south central sections and lesser snow cover in nearly all other portions of the state. The heaviest snow cover was reported in New Salem with 27 inches on the ground and Carson with 23 inches on the ground on the first***. The weather continued unseasonably cold for the first two weeks and the snow cover was very slow in disappearing. River ice was solid in most sections except for flooding on the Red River. After the 14th it became much warmer and most of the snow melted. Runoff was very rapid and flooding occurred on nearly all streams of the State***."

Wind action formed extraordinarily deep snowdrifts during the course of the long winter. Many of the smaller ditches and drainage ways were so choked with hard-packed snow that any water from melting snow could not run off but was absorbed by the drifts as stored water or as ice. Bulldozer operators sent out to open county highways after the storm that occurred near the end of March reported that these snow dams contained much water. One operator told of being nearly inundated by a rush of water released from a snow dam by the passage of the bulldozer. With much of the seasonal precipitation stored in snow dams, rapid release of floodwater took place when temperatures suddenly rose sufficiently to melt the snow. The ponding of water by snowdrifts across valleys and small depressions was particularly frequent in the country west of the Missouri River. In the region east of the Missouri River where the land is generally flat and dotted with saucerlike depressions, the snow was more evenly distributed.

Just before the spring breakup the greatest amount of water stored as snow, as found by the Corps of Engineers surveys made March 28-30, was in the Cannonball River drainage area. Figure 3, a map of the flooded area prepared by the Corps of Engineers, shows the lines of equal water content of snow on the ground on March 30. Slightly more than 50 percent of the Missouri River Basin area of North Dakota was covered by snow with water content of two or more inches, an unusually large areal coverage in the Great Plains for snow of water content so high as that.

Observations on the absence or presence of ice on top of the ground and the degree of saturation of the ground were also made at the time of the snow surveys. A study of these observations indicates that the opportunity for infiltration was probably small during the breakup. A field moisture survey reportedly made about May 1 in the headwaters of the Cannonball River Basin near New England verified the fact that infiltration was small, at least in that area.

Near the close of March ice on the lower reaches of some of the tributaries west of the Missouri River began to break up. The Heart

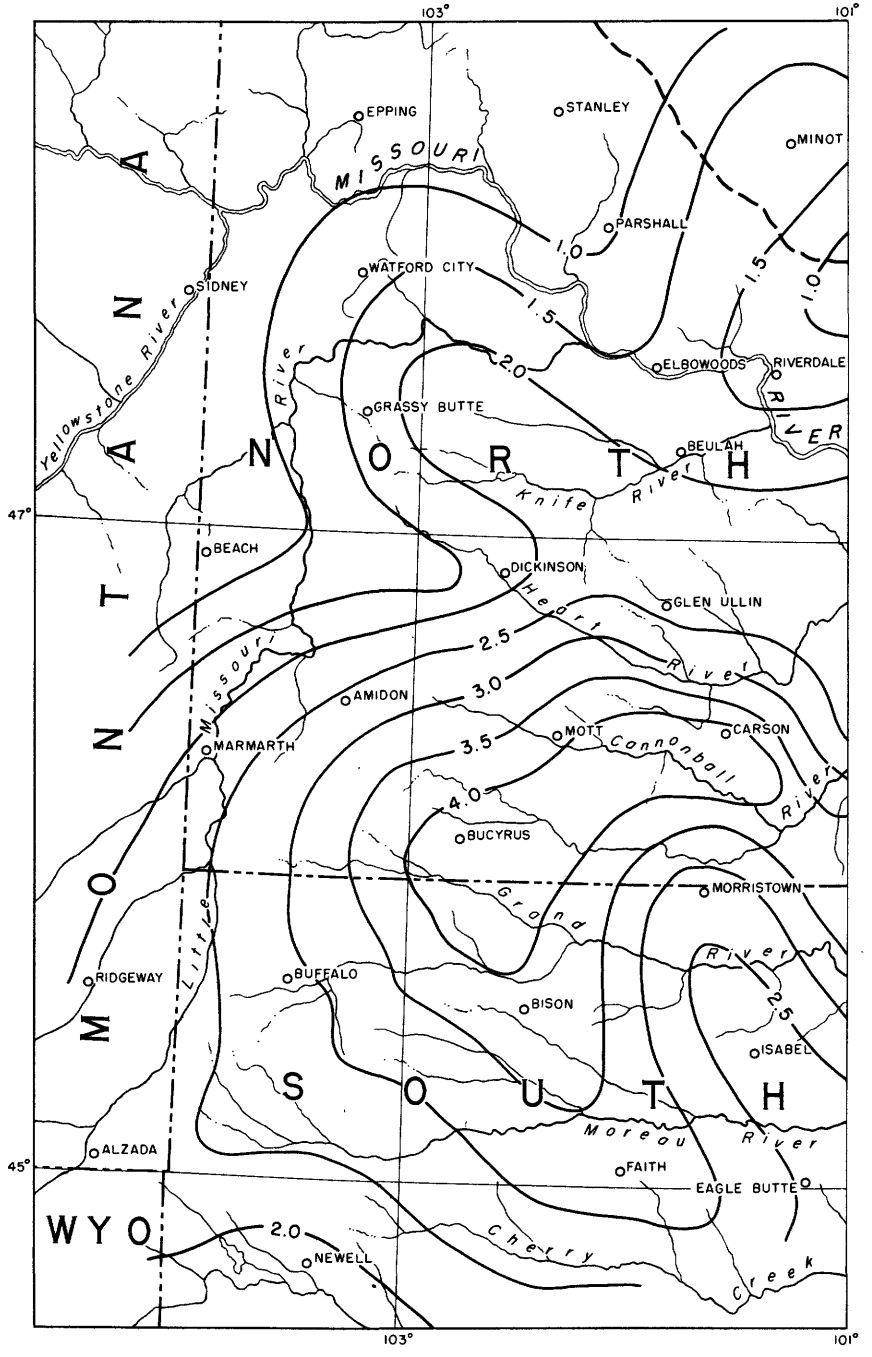
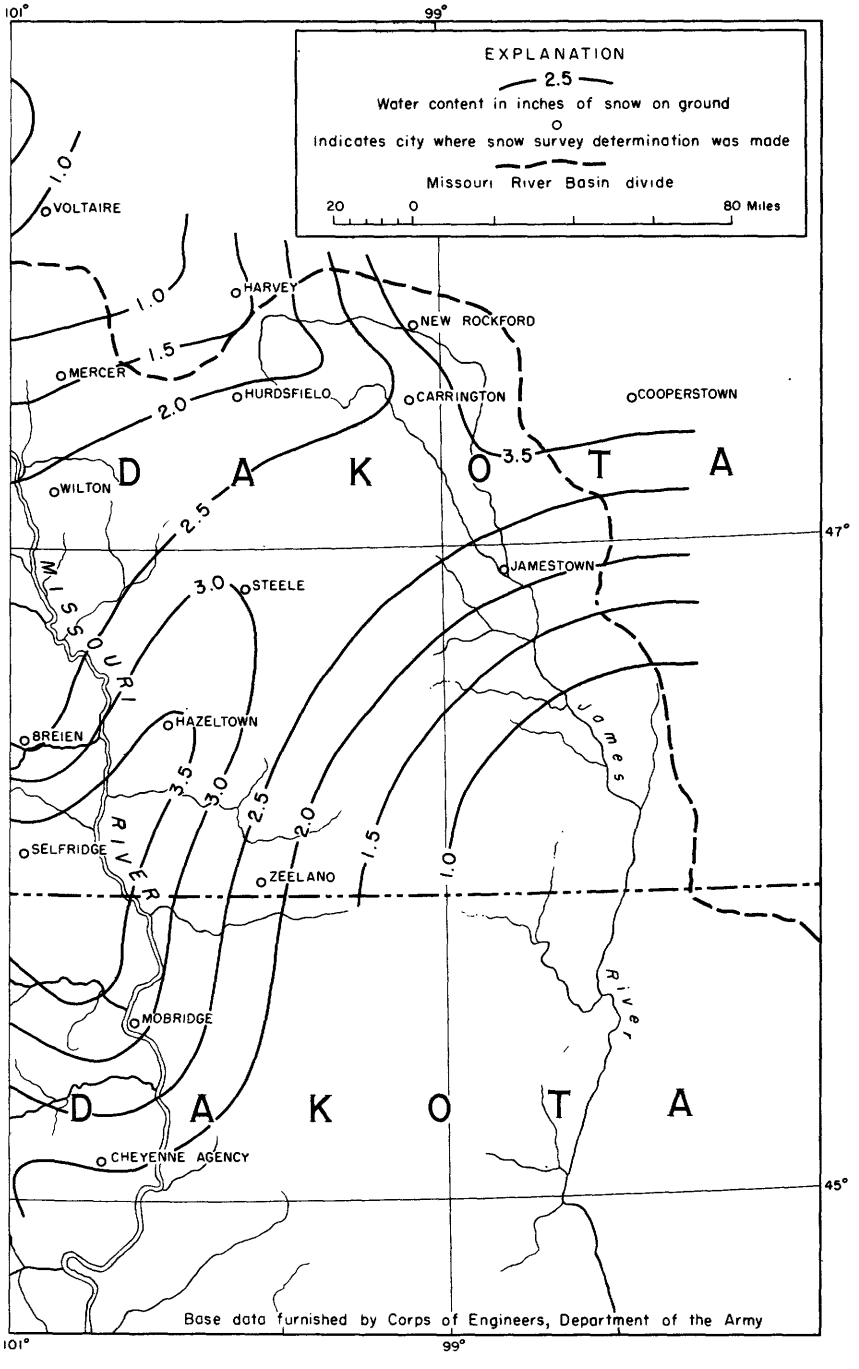


Figure 3.—Map showing water content of snow on



ground in flooded area on Mar. 30, 1950

River on March 30 began a fairly rapid rise and ice on its lower reaches began breaking up. The Knife and other rivers west of the Missouri were similarly affected in their lower reaches but no really significant melting of the heavy snow cover took place.

On April 6 a moderate increase in temperature was recorded at all stations throughout North Dakota. This warm period was of short duration and caused but little runoff, although ice went out on the lower reaches of some tributaries west of the Missouri, and the smaller tributaries east of the Missouri near the North Dakota-South Dakota State line reached peak stage and discharge. The major consequence of this brief warm period over most of the area was that much snow was converted into water which was stored in snowdrifts and held ready for immediate release on the first day of significant melting. The next warm period began on April 13, continued until April 22, and caused flooding throughout the area. When temperatures again dropped the only snow left on the ground was in remnants of huge drifts. Figure 4 shows the daily maximum and minimum temperatures at selected weather stations in or adjacent to the flooded area.

After April 22 the weather turned cold again. More snow or rain fell intermittently until May 9. Temperatures were below normal during this period and snow cover accumulated rapidly. By the end of the first week in May serious floods were again feared. However, west of the Missouri River the flood threat did not materialize; moisture resulting from snow melt either evaporated or was absorbed by the ground, and streams rose but little. In the James River drainage area melting of the snow that had fallen between April 23 and May 9, together with water that had not yet run off from the first spring breakup, caused flood peaks slightly greater than those of April at the Jamestown, N. Dak., gage.

The Little Missouri River, which formed the western and northern boundary of the area subjected to severe flooding, went overbank onto the flats between the mouth of Cherry Creek and the Missouri River near the end of March. No reports of flood damage in this area were found in the local newspapers, but the figures compiled by the Corps of Engineers show a minor amount resulted.

The flood threat of the Knife River to Hazen, N. Dak., was recognized as early in the season as March 10 by the Hazen Star. Snow cover was much heavier than normal by mid-March and much of it was whipped into huge drifts that formed in highway cuts and on the south slopes of hills. The Army established headquarters at Beulah, N. Dak., in March for directing the relief work of "operation snowbound," the use of a few track-laying motor vehicles to carry fuel and food to snowbound farms. Near the end of March, daily temperatures were warm enough to cause increased flow in the Knife River even though there was no sign of runoff in the gullies and dry runs. The increased flow caused the ice on the lower Knife River to break up or rise, but not much of it moved out. Ice jams held firm until the warm weather of April 6-7, when the increased flow broke the jams loose and the local residents thought the spring flood danger past. Colder

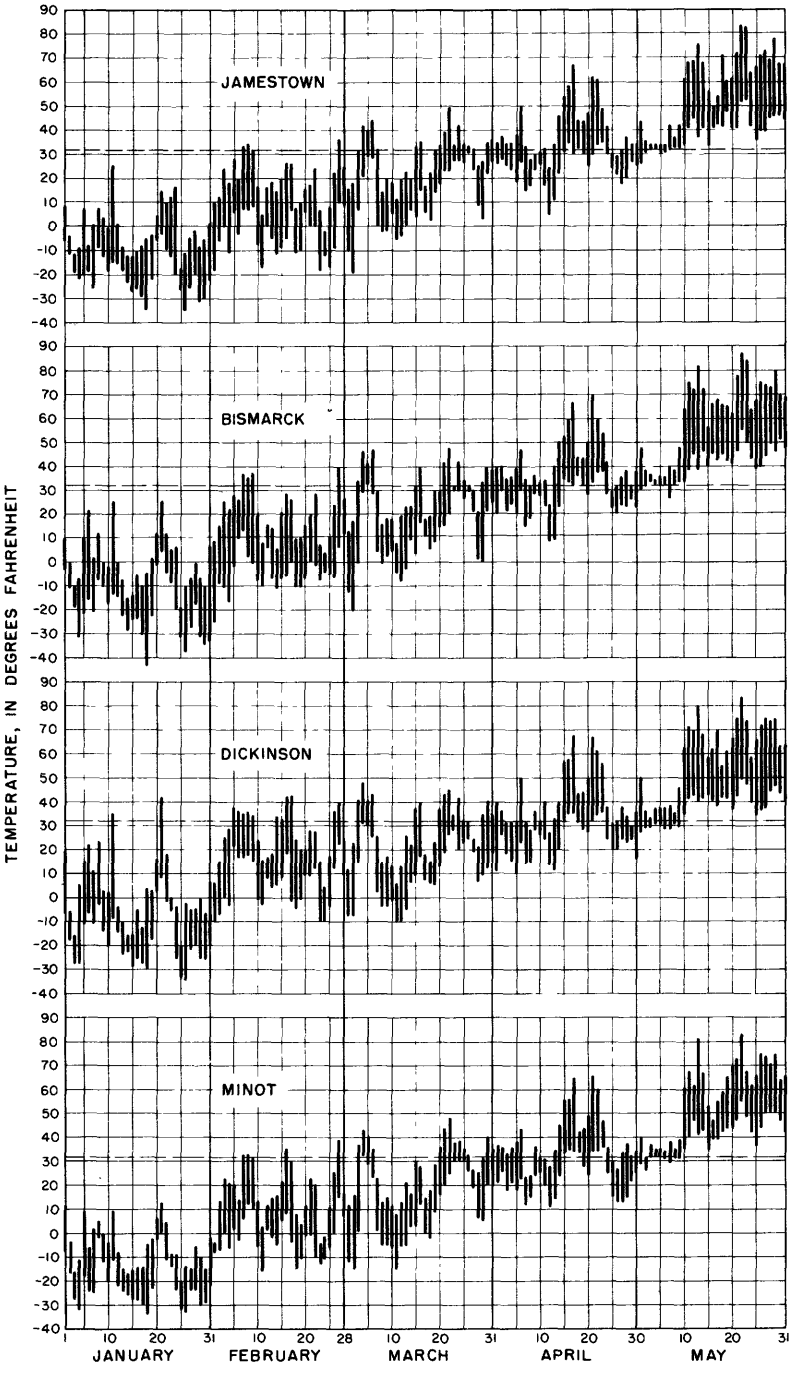


Figure 4.—Daily range of temperatures at four weather stations in North Dakota for Jan. 1 to May 31, 1950

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weather delayed the melt of the remaining snow until the warm period beginning April 13 when melting and runoff were very rapid and the Knife River soon was out of banks in its entire length. On April 17 Beulah was isolated and flood water forced fifty families to leave their homes. The towns of Center, Stanton, and Hazen, N. Dak., were also seriously flooded.

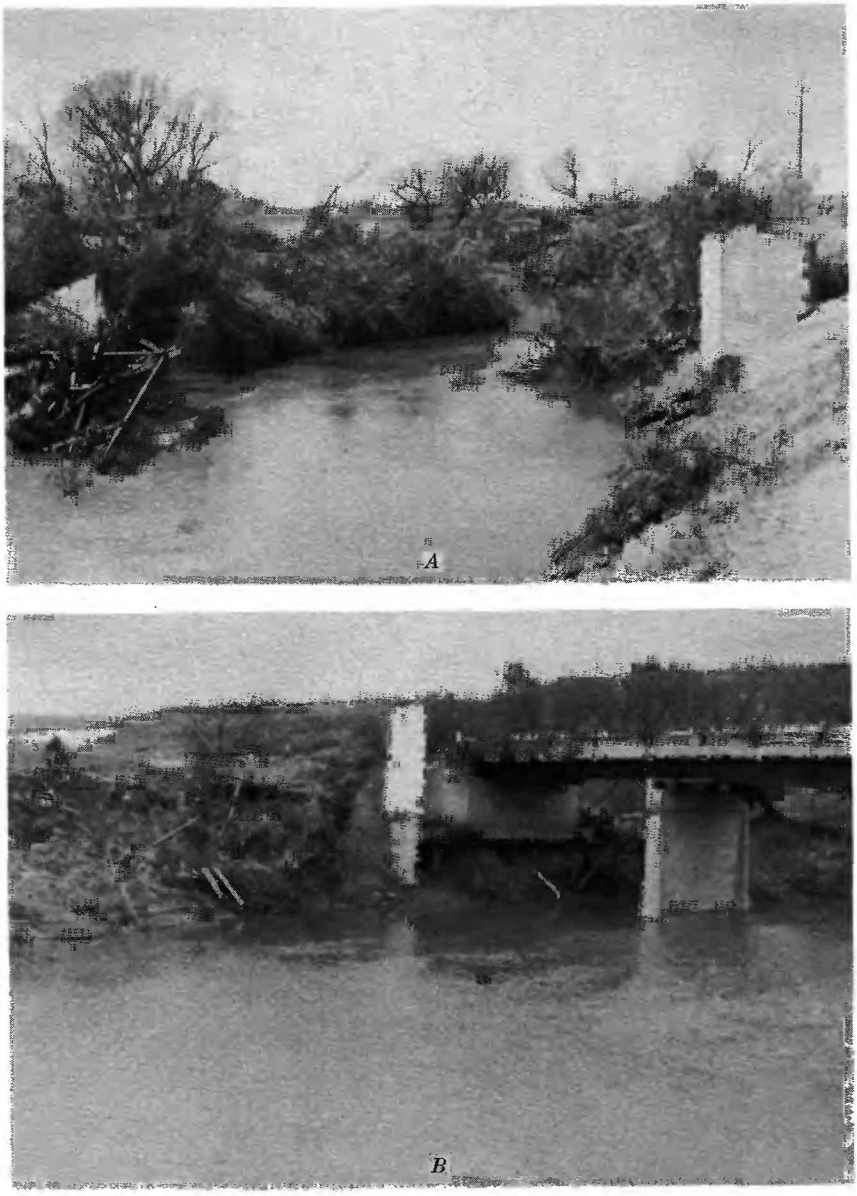
Soon after the flood, inquiries were made of long-time residents of the flooded area in the Knife Valley to determine the relative magnitude of the 1950 and earlier floods. According to the information gathered the 1943 flood was about one-half foot higher than the 1950 flood at both Beulah and Hazen. No one questioned--and some have lived in the area since 1884--could remember any flood that approached the size of the 1943 and 1950 floods.

The breakup on the Heart River resembled that on the Knife River; downstream ice broke up and jammed long before any appreciable snow-melt runoff occurred. On March 31, the Heart River formed an ice jam below Mandan, N. Dak., that caused water to back over the southeast part of the town, which is unprotected by dikes. Breaching of a dike downstream from Mandan allowed the floodwaters to close U. S. Highway 10 between Bismarck and Mandan from April 17 to 21.

Heart Butte Reservoir, situated on the Heart River about 60 miles upstream from Mandan, was completed in December 1949 by the U.S. Bureau of Reclamation. The operation of this reservoir and the dikes built by the Corps of Engineers to protect the city, saved Mandan from severe damage by flood during the big thaw of April 16-19. Even with most of the water from the drainage area above the dam stored in Heart Butte Reservoir, the flow reaching Mandan from Antelope, Muddy and Sweetbriar Creeks, and from numerous small streams that enter the Heart River below the reservoir, was near record-breaking and thoroughly tested the dikes.

Throughout their length the Heart River and tributaries seriously damaged or totally destroyed many bridges. The damage resulted from severe pounding by ice floes and the erosive action of the water upon the submerged parts of bridge structures and overtopped approach fills. As elsewhere, it was not unusual to see ice cakes weighing about 20 tons mingled among smaller cakes and left stranded after recession of the flood. The Heart River destroyed the 52-year-old span at Gladstone, N. Dak., on April 16, isolating the city and disrupting the natural gas supply. The Lehigh bridge was seriously twisted by ice floes as were many others downstream. The span across Muddy Creek, on which the Geological Survey gage near Almont, N. Dak., was located, was completely demolished. (See pl. 1.)

In addition to costly damage to bridges, the Heart River and tributaries stopped through-traffic on the Northern Pacific Railway's main line for nearly a week because of washouts west of Mandan caused by Sweetbriar Creek and the main river. (See pl. 2, A.) All of the town of Almont was at one time inundated except for the school



FLOODS MAKE GAGE MAINTENANCE DIFFICULT.

A. Both gage and bridge destroyed on Muddy Creek near Almont.
B. Gage structure on Cannonball River near New Leipzig damaged and exposed by bank erosion.

SWOLLEN RIVER AND FLOATING ICE CAUSE WIDESPREAD DAMAGE.

A. Northern Pacific main line washed out by Heart River. B. Cannonball River damage to Mott estimated at $1,000,000.

house. Traffic between Bismarck and Mandan on U. S. Highway 10 was stopped for several days during mid-April because of flood water from the Heart River.

The Apple Creek drainage area is normally insignificant in producing serious floods, but during April the water from this area slowed both rail and highway travel for many days where U. S. Highway 10 and the Northern Pacific cross McKenzie Slough, a large depression that drains into Apple Creek about 15 miles east of Bismarck. Flooding of Apple Creek put water 2 feet deep over the floor of the transmitter house of radio station KFYR, a few miles east of Bismarck, and marooned the operators.

Destruction in the Cannonball River Basin was greater than any other in the flooded area. The story of the breakup is again the same; ice in the vicinity of Breien, N. Dak., broke up and jammed, causing minor flooding on April 3, but the main snow melt began about April 14 or 15.

Hardest hit of any town in the flooded area was Mott, N. Dak., which took a severe battering from ice jams and flood water. An appraisal of damages made by Corps of Engineers personnel soon after the flood placed the loss at Mott at $1,000,000. The concrete arch bridge across the Cannonball River at the Milwaukee Road depot remained relatively undamaged despite the severe battering it was subjected to. Most of the damage in that part of town on the left bank resulted from immersion, that on the right bank was caused by ice-battering and erosion. (See pls. 2, B, and 3.) Flood waters cut off the city's power supply and put part of the city water system out of operation.

Both the Northern Pacific and Chicago, Milwaukee, St. Paul and Pacific branch lines in the Cannonball Valley were put out of operation for weeks by washouts and destroyed bridges, the Northern Pacific suffering the more severe damage to right of way. (See pl. 4.) The abutments of many relatively new county highway bridges across the Cannonball were severely damaged by bank scour. (See pl. 5.) Some flood damage was done to the towns of Breien and Solen, N. Dak.

The powerful erosive action of the floodwaters along Cedar Creek and the Cannonball River wrought many destructive changes in channel and damaged farm lands along both streams by depositing sand and silt on them. (See pl. 6.) The Cannonball destroyed a recently completed bridge when it erupted from an artificial channel that had been made to straighten a bend in its natural channel. (See pl. 6; the bridge is also shown on pl. 5, A.) Damage to highway shoulders caused by the local drainage is illustrated on plate 7, A and is described in detail on page 20.

The spillway at Cedar Creek dam north of Reeder, N. Dak., failed during the breakup. The failure was gradual so no significant amount of flow was added to the flood crest on Cedar Creek.

The floods of 1950 on the Cannonball River and Cedar Creek, according to old inhabitants and available newspaper accounts, were the greatest experienced since the area was first settled. The Geological Survey has maintained a gage more or less regularly in the vicinity of Breien since 1903. Figure 5 shows the plot of observed annual maximum instantaneous peak discharge at this gage for the periods of available record from 1903 to June 1950. It shows that the size of the 1950 flood is outstanding. There is some evidence that the headwater areas of the Cannonball River may have experienced greater floods than that of 1950; the Hettinger County Herald for April 20, 1950 contains this statement, "*** not since 1912 has New England witnessed such high water." The 1950 flood reached above the 18-foot mark on the Cannonball bridge at New England.

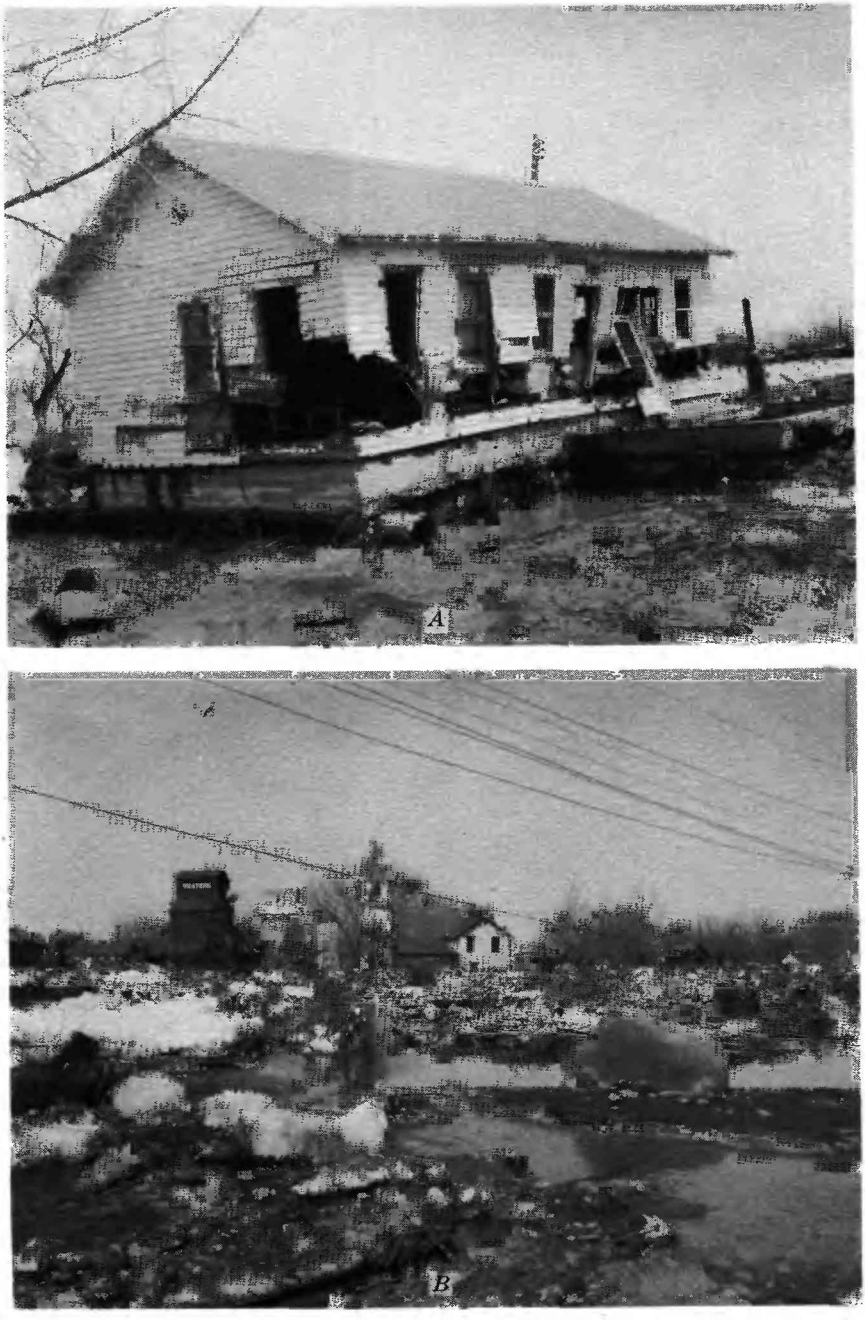
The floods in the Grand River Basin were similar to those in the Cannonball Basin, but damage to bridges did not reach the same proportions. Plate 7, B, shows damage to a bridge approach near Shadehill, S. Dak. Floods in the Moreau River Basin south of the Grand River were proportionately less severe.

Jamestown, N. Dak., located at the junction of Pipestem Creek and James River, has been damaged frequently by floods because the streams often peak simultaneously. The 1950 floods were unusual because the combined flow of the two streams resulted in two separate peaks of nearly the same magnitude, coming on April 17 (see pl. 8) and May 13. Both floods were from snow melt; the latter flood was caused by remnants of the winter snow plus that which fell during the cold weather of late April and early May.

Damage from ice and standing water was heavy in the low-lying regions of Jamestown. The Crippled Children's Home had to be closed and the pupils temporarily quartered elsewhere, and many persons were forced from their homes. The long duration of the flood, both in the city of Jamestown and in the rural areas, made it particularly costly. Much farm land along the James River downstream could not be seeded until near the end of June because of the floods. Total damages to Jamestown and areas south along the James River were estimated to be $2,435,000 in both floods.

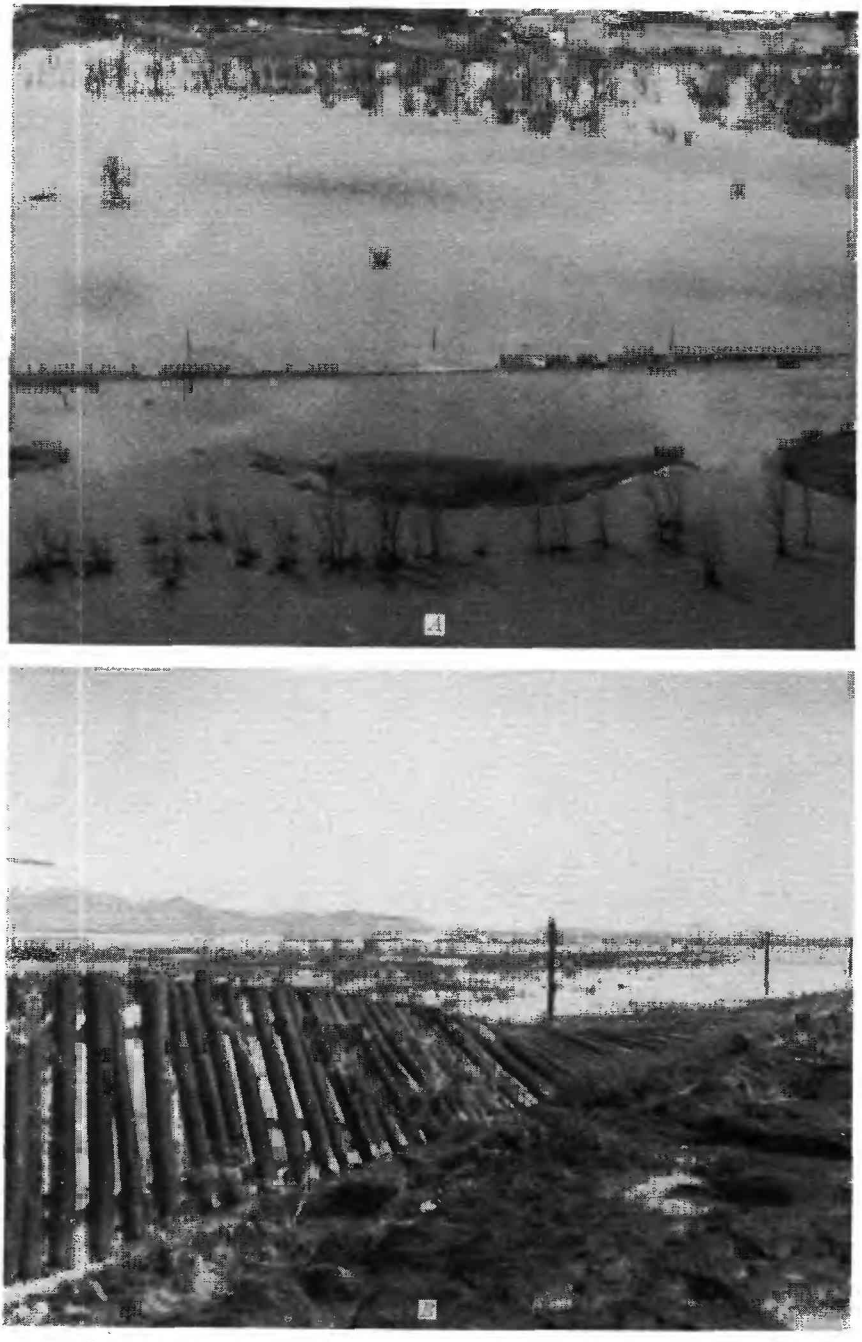
The White River of South Dakota flooded in late March and caused severe ice jams. Part of the bridge carrying U. S. Highway 183 across the river was destroyed.

Flooding along the Missouri River was confined to overflow, which is not considered particularly damaging to the lands along the river. Although the flood along the main river was the greatest since 1943, it did not draw much attention throughout the flooded area because of the greater floods in the tributaries. At Fort Pierre, S. Dak., about 80 percent of the town was flooded. Damage consisted largely of flooded basements and disrupted business operations. Severe damage to a recently completed highway fill was wrought at Sioux City, Iowa, about April 20.



BATTERING ICE INCREASES DAMAGE AT MOTT.

A. Ice damages grain elevator office. B. Ice jam above concrete arch bridge. Photo by Diedes Studio, Mott, N. Dak.



DAMAGE TO NORTHERN PACIFIC RAILWAY BRANCH LINE NEAR BREIEN.

A. Northern Pacific tracks washed out. Photo by Don Vogtman, U. S. Fish and Wildlife Service. B. Weeks were required to rebuild twisted and destroyed tracks.

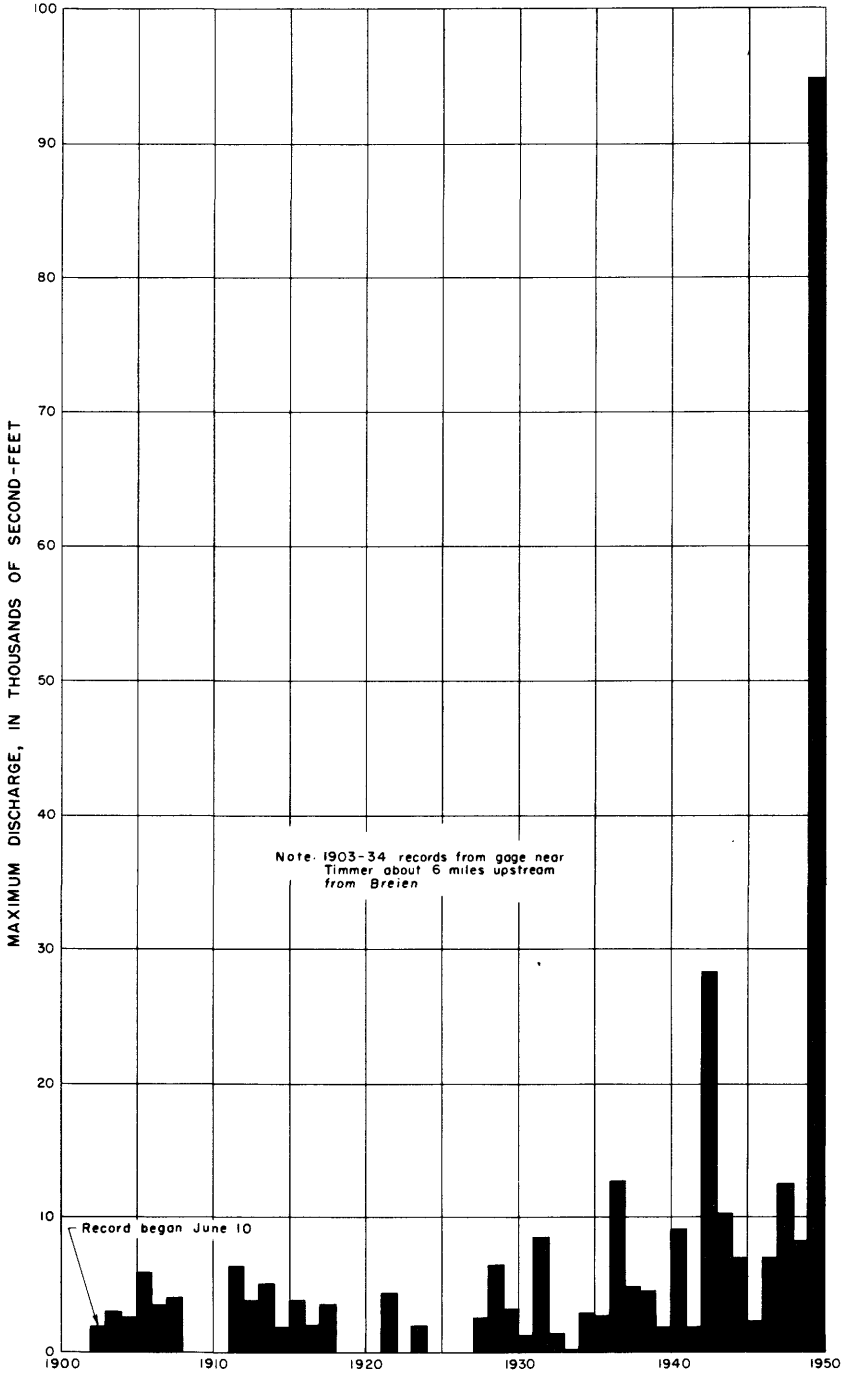


Figure 5. — Maximum annual floods of Cannonball River at Breien, N. Dak.

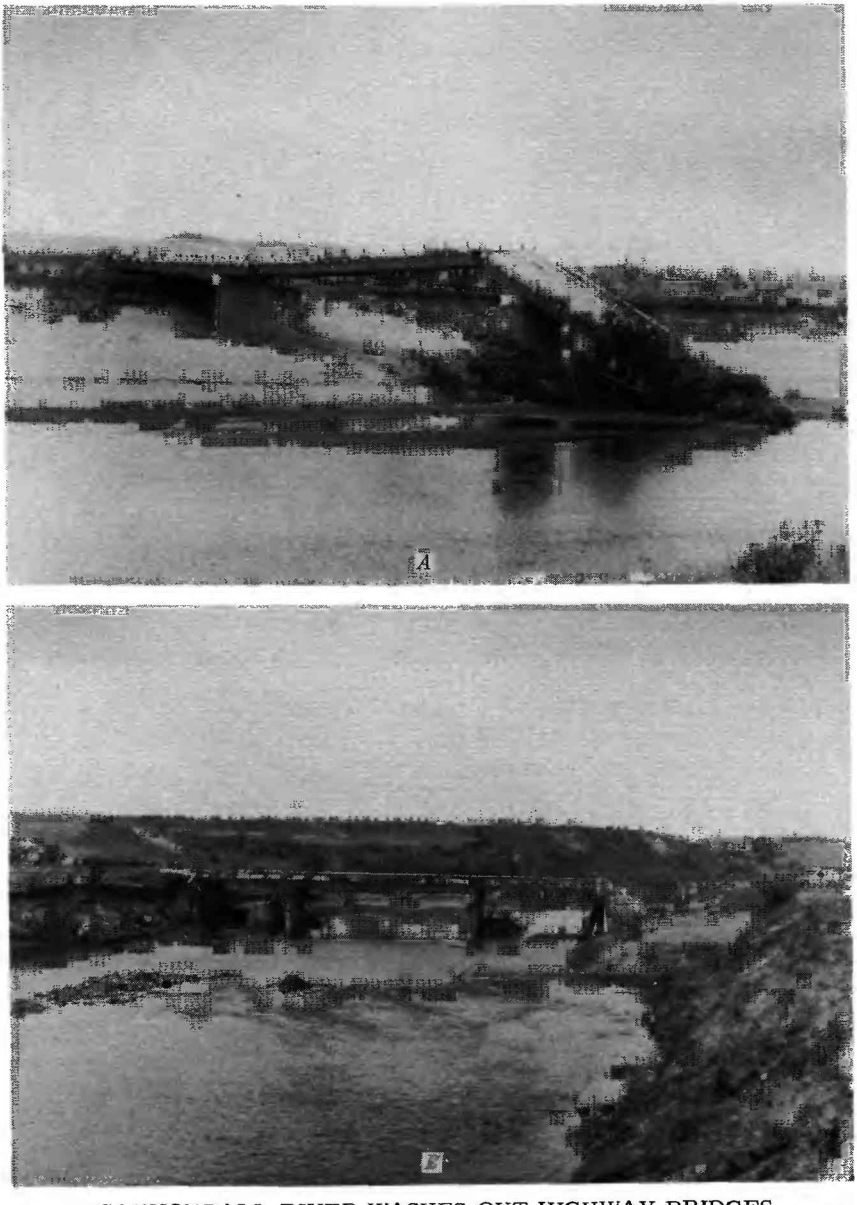
Flooding from small tributaries and from sloughs or lakes caused damages at many communities throughout the area. The towns of Napoleon and Strasburg in North Dakota were flooded by waters from sloughs that could not drain away fast enough through natural outlets. Many small lakes and sloughs that had been dry or nearly dry for several years were filled by the snow-melt water to the highest levels known. This was especially true in the area of poorly developed drainage between the Missouri River and the James River. Many of the sloughs, after filling, could empty only by evaporation or by seepage to the water table because natural surface drainage is poor. Highways of all classes, from unimproved country roads to major Federal routes, were subjected to closure or delays in traffic and to varying degrees of damage by the ponded water. Some major routes and many secondary routes suffered damage to the extent of requiring complete rebuilding.

FLOOD DAMAGES

That the flood had caused considerable damage and human privation was recognized at an early date. On April 17 the American National Red Cross classified the flood disaster in North Dakota as Type A and hastened to assist local people to repair and rebuild damaged farms and homes.

Although no lives were lost by drowning, one man in Hettinger County, N. Dak., died of a heart attack induced by exertions resulting from the flood. Data on the total number of houses destroyed or damaged by the floods in the Missouri River Basin in North Dakota are not available, although two houses were reported carried away at Solen. The sparsely settled country west of the Missouri River reduced the opportunity for flood damage. Mott suffered most heavily west of the Missouri, and Jamestown suffered most heavily east of the Missouri; 500 homes were evacuated at Jamestown.

The Red Cross set up local headquarters at Mott to handle the heavy relief work there. The National Guard assigned troops and equipment to Mott and to other flood communities in southwestern North Dakota to do guard duty and to work in conjunction with the Red Cross in relief activities. The Red Cross assisted 56 families in Grant County and 72 in Hettinger County; 40 Indian families driven into Shields by high water along the Cannonball received temporary tent shelters and food. The number of families given assistance and the expenditures for relief in each county by the Red Cross are listed in table 1. Data in this table are indicative of the number of people suffering damage from the flood. A total expenditure for all flood relief in the state of North Dakota of $151,733.63 was made by the Red Cross; this was divided as follows:



CANNONBALL RIVER WASHES OUT HIGHWAY BRIDGES.

A. This was new County Bridge near town of Cannonball. B. Bank scour causes bridge failure south of Heil.

CANNONBALL RIVER DAMAGES BRIDGES AND FARM LANDS.

A. River erupts from artificial channel to destroy bridge. Photo by Don Vogtman, U. S. Fish and Wildlife Service. B. Sand and silt deposited on farm land near Breien.

Rescue, transportation, and shelter	$35,112.14
Food and clothing	14,261.84
Rebuilding and repair	70,229.27
Medical, nursing, and sanitation	2,337.78
Household furnishings	24,466.89
Farm supplies, livestock, and equipment	4,649.23
Occupational training, equipment, and supplies	676.48

Table 1.—American Red Cross relief by counties in the flooded area in Missouri River Basin in North Dakota[1/]

County	Number of families suffering loss	Number of families assisted	Expenditures for relief
Adams	62	12	$ 417.62
Bowman	30	15	441.42
Burleigh	50	46	5,622.04
Emmons	1	1	148.20
Grant	70	56	11,554.28
Hettinger	120	72	13,260.81
LaMoure	30	4	1,402.73
Logan	1	0	0
Mercer	60	35	1,932.75
Morton	120	57	10,040.05
Oliver	11	7	330.05
Stark	24	1	66.33
Stutsman	650	534	18,766.04
*Standing Rock Indian Reservation	110	101	18,420.19

*All of Sioux County and Part of Carson County, S. Dak.

The Corps of Engineers, Department of the Army, began surveying all damages immediately after the flood. The data listed in table 2 were furnished by the Corps of Engineers from their compilation.

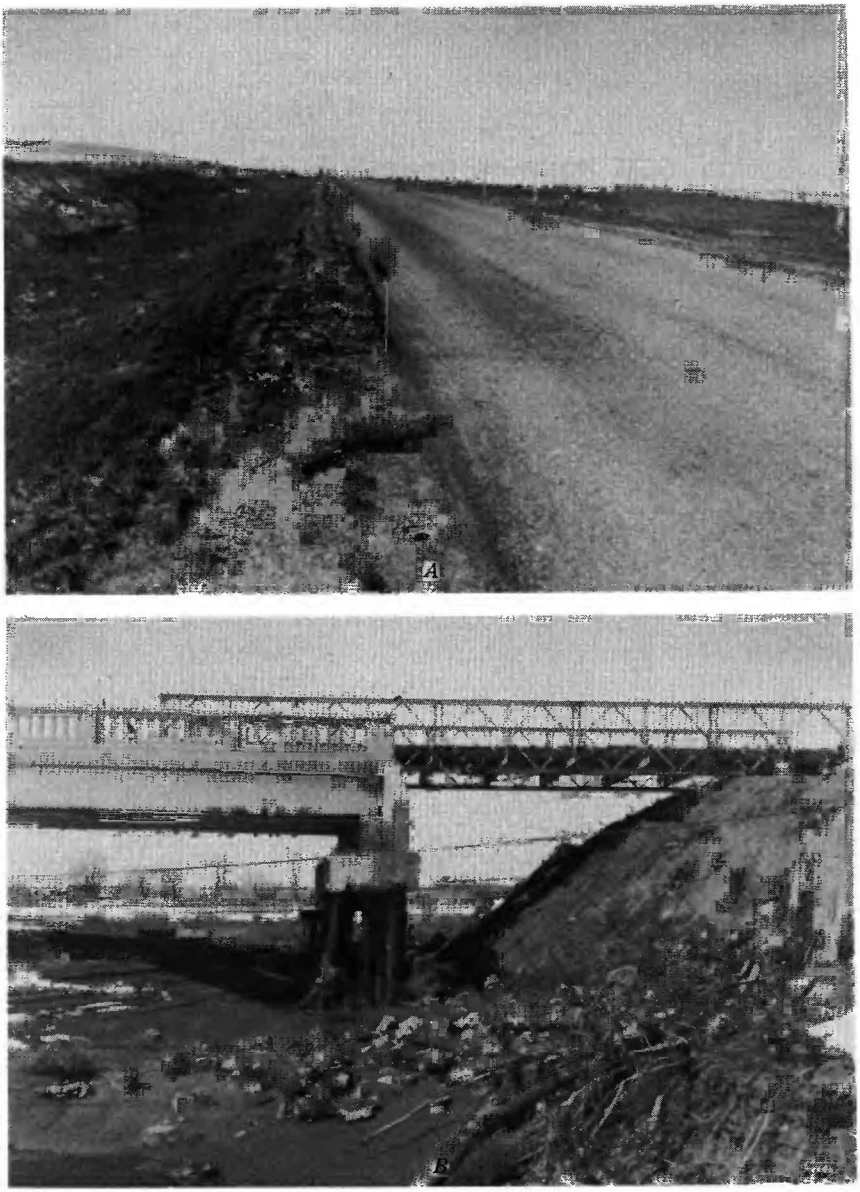
The Bureau of Public Roads has compiled estimates by counties for the flooded area showing the total damages suffered by both Federal-aid and other highway systems in each State. These estimates are listed in table 3.

1/ Data furnished by Robert Brumett, State Relations Officer, American Red Cross.

Table 2.—Total damages caused by the 1950 floods in the Missouri River drainage of North and South Dakota

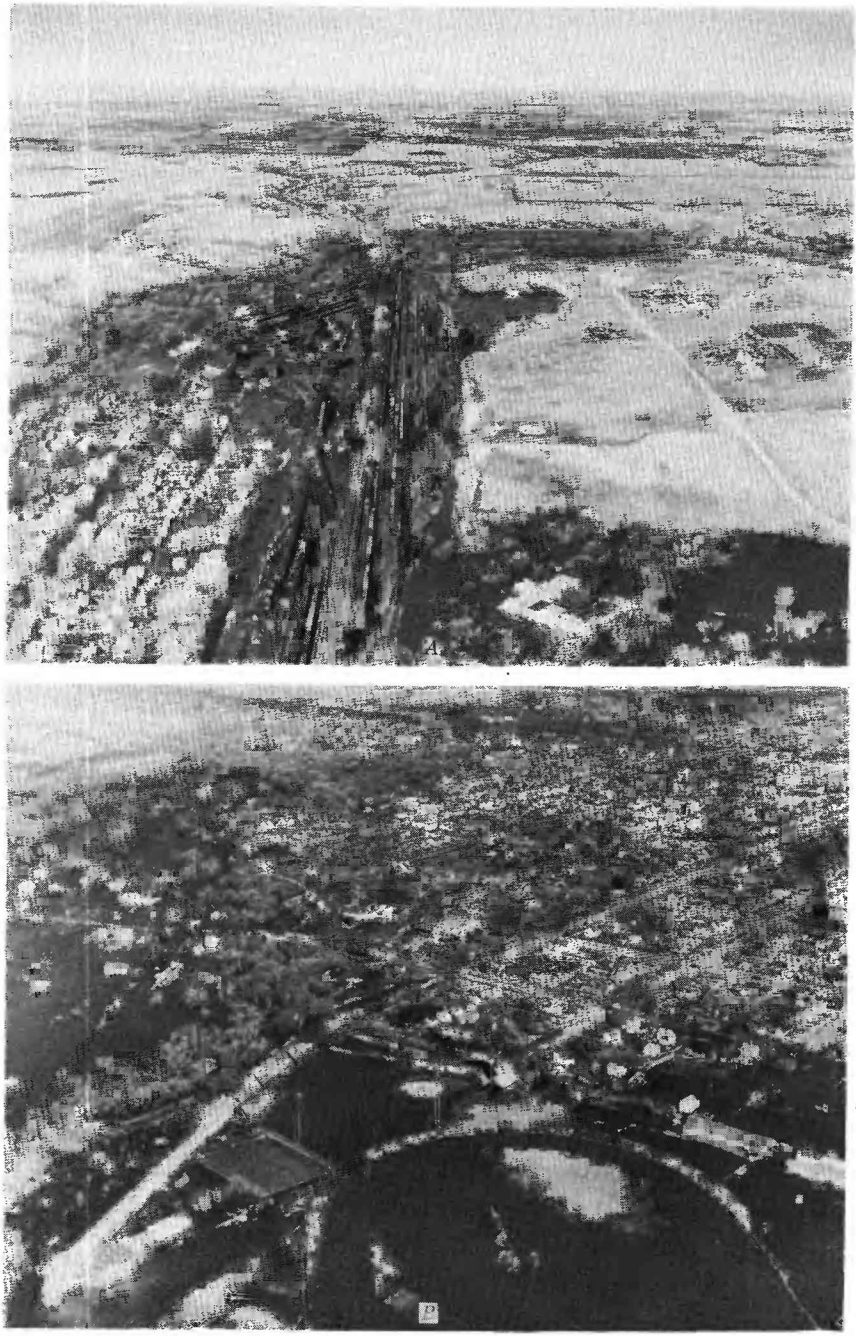
Basin	Damage				Total
	Individual and corporate		County and state		
	Direct	Indirect	Direct	Indirect	
Missouri River and small tributaries in N. Dak.	$ 129,000	$ 29,000	$ --	$ --	$ 158,000
Little Missouri River	6,000	--	--	--	6,000
Knife River	106,000	72,000	29,000	--	207,000
Heart River	345,000	65,000	621,000	12,000	1,043,000
Cannonball River	1,098,000	226,000	486,000	--	1,810,000
Grand River	*	*	*	*	1,239,000
Moreau River	*	*	*	*	137,000
James River, N. Dak.	866,000	889,000	100,000	--	1,855,000
Missouri River and small tributaries in S. Dak.	*	*	*	*	1,091,000
James River, S. Dak.	*	*	*	*	2,167,000
GRAND TOTAL					$ 9,713,000

*Total not broken down according to classification used.



HIGHWAY SYSTEM DAMAGED BY LOCAL DRAINAGE AND STREAMS.

A. Local drainage erodes shoulder of U. S. Highway 10. B. Shadehill bridge approach washed out by Grand River.



PIPESTEM CREEK AND JAMES RIVER FLOOD JAMESTOWN IN APRIL.

A. Northern Pacific Railway along Pipestem Creek in West Jamestown. B. South Jamestown and Fairgrounds flooded again like this in May. Photo by J. J. Walsh, Chief Engineer and Secretary, North Dakota Water Conservation Commission.

Table 3.—Damages to highways and bridges by the 1950 floods in the Missouri River Basin in North and South Dakota

County	Federal aid	Non-Federal aid	Total
Adams, N. Dak.	$ 74,500	$ 175,000	$ 249,500
Billings, N. Dak.	None	4,400	4,400
Bowman, N. Dak.	18,000	87,000	105,000
Burleigh, N. Dak.	63,000	75,000	138,000
Dickey, N. Dak.	33,000	7,500	40,500
Dunn, N. Dak.	60,000	12,500	72,500
Emmons, N. Dak.	42,000	32,720	74,720
Foster, N. Dak.	None	102,500	102,500
Grant, N. Dak.	63,300	405,700	469,000
Hettinger, N. Dak.	133,800	284,200	418,000
Kidder, N. Dak.	60,000	92,090	152,090
LaMoure, N. Dak.	61,850	55,200	117,050
Logan, N. Dak.	398,000	43,125	441,125
McIntosh, N. Dak.	None	30,200	30,200
McLean, N. Dak.	25,000	85,435	110,435
Mercer, N. Dak.	47,000	20,500	67,500
Morton, N. Dak.	164,000	435,850	599,850
Oliver, N. Dak.	500	76,700	77,200
*Sheridan, N. Dak.	283,000	69,735	352,735
Sioux, N. Dak.	None	24,650	24,650
Slope, N. Dak.	31,000	58,500	89,500
Stark, N. Dak.	210,000	158,000	368,000
Stutsman, N. Dak.	167,290	628,000	795,290
*Wells, N. Dak.	242,000	84,680	326,680
Total - N. Dak.	2,177,240	3,049,185	5,226,425
Corson, S. Dak.	--	--	T 132,500
Harding, S. Dak.	--	--	T 27,450
Perkins, S. Dak.	--	--	T 361,600
Total - S. Dak.	--	--	T 521,550
TOTAL MISSOURI RIVER BASIN			$5,747,975

*Parts of county are outside Missouri River Basin.
TNo separation made between Federal aid and non-Federal aid losses.

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The damages to the Federal-aid highways in table 3 are computed on the basis of the cost of replacing damaged structures or pavements with ones meeting adequate standards. Damages to highways not receiving Federal aid are computed on the basis of cost of repairs.

Damage to highway pavements from flood waters was severe where highways crossing flood plains were submerged for several hours or days. Rapidly flowing water had little direct effect on paved road surfaces but brought about damage by eroding the subgrade and fill material. An unusual occurrence found most often in the counties east of the Missouri River in North Dakota was the erosion by wave action on the highway fills that were built across formerly dry lake beds. West of the Missouri River, because of the heavy 1950 snowfall and drifting action, the highway maintenance forces necessarily had to be satisfied with plowing open the traveled road only; the berms were covered several feet deep with hard-packed snow. During the breakup, melt water naturally followed the channel of least resistance and ran down the shallow trough formed by the edge of the paving and the snow bank, the velocities of such flow being high on the steeper grades. Typical erosion of pavement and shoulder caused by this action is pictured in plate 7, A.

Detailed investigations of damages at and around Jamestown were made under the direction of the North Dakota State Engineer working in cooperation with the City Engineer of Jamestown for both the April and May floods. These estimates of damage are shown in table 4. Although the May flood reached a slightly higher stage than the April flood, it caused less damage because the first flood had ruined so many things beyond further spoiling. Then, too, the first flood gave people valuable experience in preventing future flood damage.

Table 4.-Flood damages to Jamestown and vicinity

Item	April	May	Total
Streets, parks, sewers	$ 410,000	$ 58,000	$ 468,000
Dwellings	927,000	185,000	1,112,000
Stores, apartment and tourist houses	35,000	7,000	42,000
Flooded basements	100,000	20,000	120,000
Lawns and gardens	10,000	2,000	12,000
Crippled Children's Home	35,000	-	35,000
Fairgrounds	50,000	3,000	53,000
Churches, schools, hospitals	50,000	2,000	52,000
Railroads	5,000	1,000	6,000
Industrial plants	10,000	2,000	12,000
Miscellaneous	98,000	15,000	113,000
Total - Jamestown	$1,730,000	$295,000	$2,025,000
Total - Below Jamestown	235,000	175,000	410,000
Total - Jamestown and below	$1,965,000	$470,000	$2,435,000

METEOROLOGY

(Prepared by staff of United States Weather Bureau)

The average annual amount of precipitation in North and South Dakota ranges from near 24 inches in the easternmost part to about 10 inches in the west. Precipitation in the entire area is most frequently caused by a wedge of polar air lifting warm air from the Gulf of Mexico. About half of the year's rain falls in May, June, and July; peak rainfall is in June.

The floods which came in April and May 1950 were due to the combined effects of an unusually late spring, abnormal amounts of snow (especially in North Dakota where three times the normal snowfall was recorded), and extreme variations in temperature from week to week, and even day to day. March had been a cold, wet month, marked at either end by an intense storm -- in the first week, a blizzard, one of the most severe in the history of eastern South Dakota; in the last week, a snowstorm, with stations in the Black Hills reporting up to 60 inches of snow. The higher temperatures which followed the storm melted most of the snow in the southern half of South Dakota and caused light flooding. However, all of North Dakota was snow-covered at the month's end. An extremely heavy cover lay in some sections.

April 1950 was one of the coldest Aprils on record in South Dakota, and the coldest since 1920 in North Dakota. Mean temperatures for the month, like those for March, were below normal. A deep trough over the eastern part of the United States on the mean 700-millibar chart, (showing heights at 700 millibars, roughly 10,000 feet) for April, concurrent with a strong mean ridge in the west, resulted in repeated polar outbreaks over the Dakotas. The abnormal snowfall during April was caused by overrunning of Pacific maritime air rather than air from the Gulf of Mexico.

In the first two weeks of April there were three successive polar outbreaks, each bringing snow and plunging temperatures. From the 7th to the 10th the air was so cold that maximum temperatures hovered near the point of normal minimum temperatures. The third surge of polar air, which invaded the Dakotas on April 10, even brought some maximum temperatures down below the normal minimum, as can be seen in figure 6. This last outbreak was the result of almost straight flow from the northernmost part of the Continent to the Mexican border (fig. 7). Temperatures rose steeply during the latter part of the period; still, mid-April found a snow cover which was increasingly heavy from north-central South Dakota into southern North Dakota.

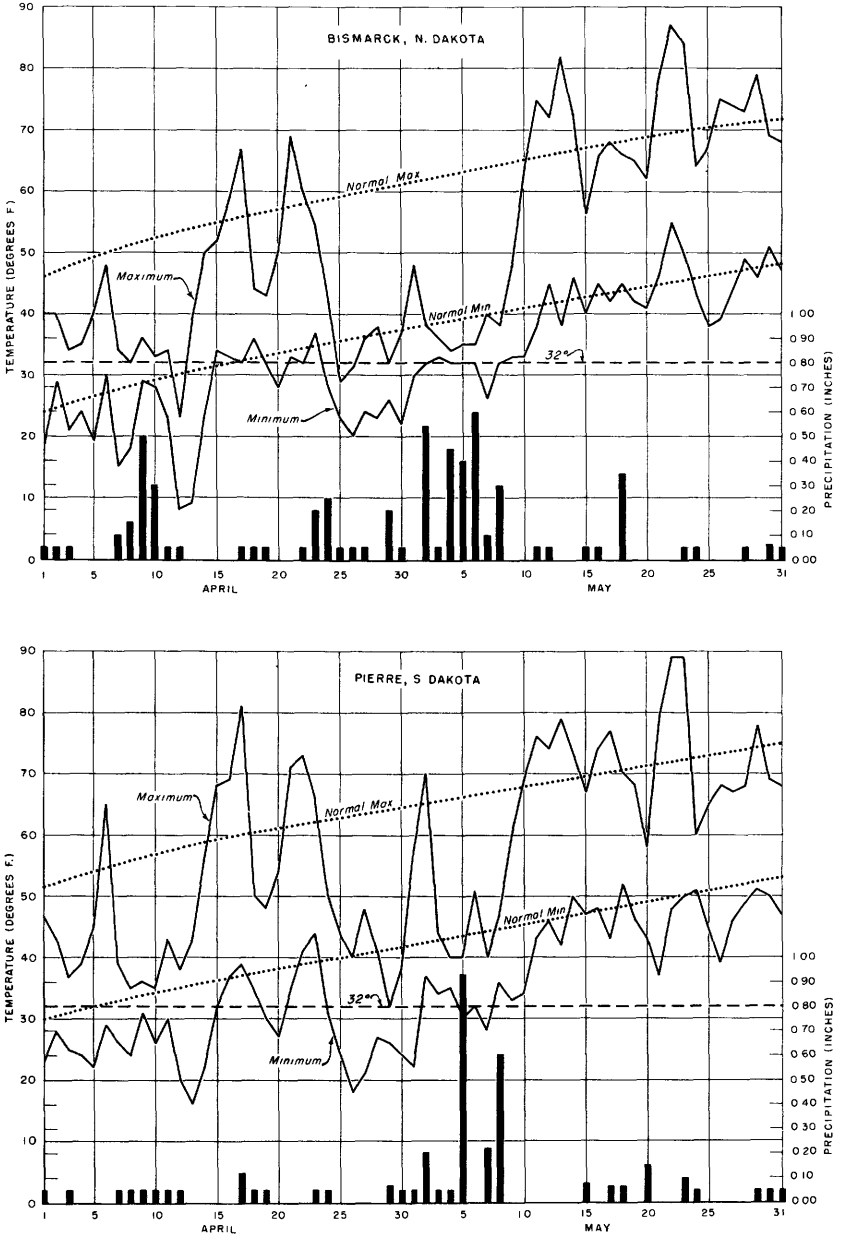

Figure 6.—Temperature and precipitation in April and May 1950 at Bismarck, N. Dak., and Pierre, S. Dak.

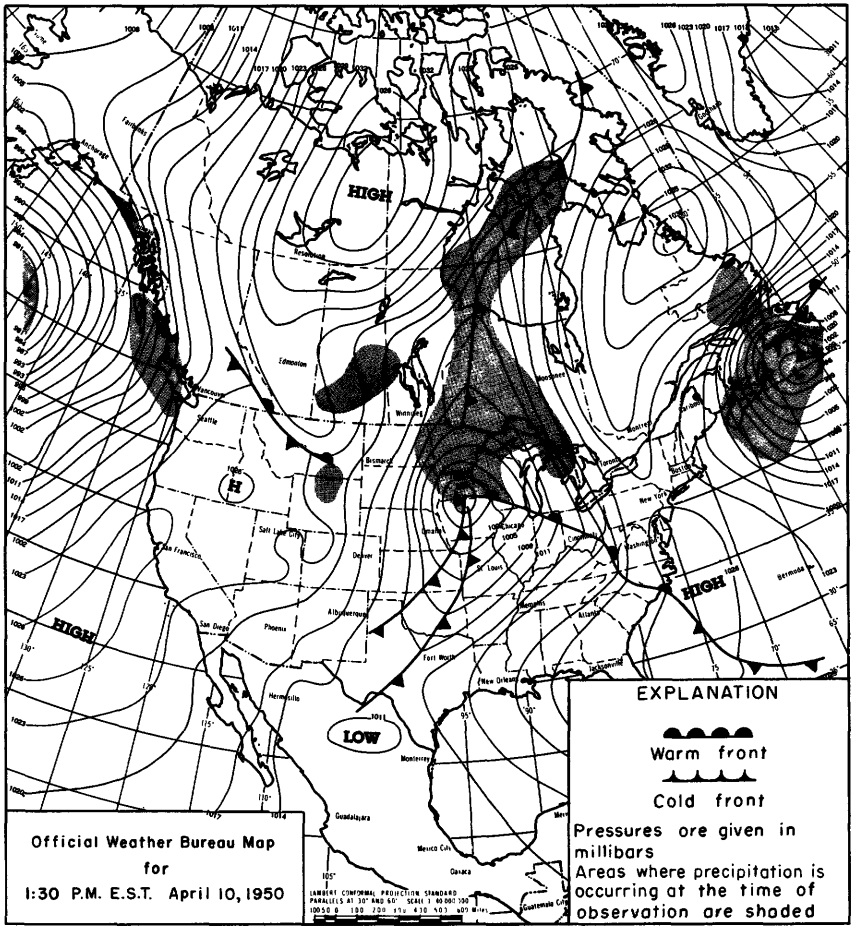

Figure 7.—Surface weather chart for Apr. 10, 1950

In South Dakota the breakup of ice on the Missouri River on April 2 prevented major gorges, although the threat of flood was ever-present throughout April. Rivers, creeks, and smaller streams were flooding fields and highways in the south-central area of North Dakota in the middle of April, but the western rivers were still frozen.

During the third week in April, only minor cold fronts crossed the Dakotas, and the upward trend in temperature continued. Ice started breaking on the Missouri River in North Dakota near Bismarck on the 15th. The major part of the snow cover melted, and runoff was so rapid that there was flooding everywhere except on the Missouri and Souris Rivers in North Dakota.

On the 18th polar air again moved down into the Dakotas bringing snow and low temperatures but temperatures rose rapidly and by the 21st most minimum temperatures were above freezing. In the course of the next two days, a complex low-pressure system developed in the central part of the country and resulted in one of the worst storms in the region during the spring season. The deep low-pressure area which moved slowly eastward from its position in South Dakota, and an overlying moist warm tongue of air gave North Dakota the greatest snowfall recorded for April since 1892. Some of the lowest temperatures for so late in the season were recorded during this last week in April, and by the end of the month the thaw in South Dakota was two weeks late.

Mean temperatures were again below normal in the Dakotas in May. The mean trough at 700 millibars lay directly over the two states, and the heavy precipitation in North Dakota during the month resulted in part from this. An unusually strong flow of air from the Gulf of Mexico carried most of the moisture that fell during the month.

Low temperatures and abundant precipitation characterized the first week of May. On May 1 a low pressure area formed in Nevada and Utah and was stimulated by a system of fronts which had moved inland from the Pacific. During the next two days the system moved eastward, and one center of the complex low appeared in South Dakota. Precipitation, mostly rain in South Dakota and snow in North Dakota, accompanied the low as it moved into southeastern North Dakota. It was soon damped out by a ridge which pushed down from the Canadian high.

On the morning of the 4th the polar front which had come down from Canada during the last week in April had an east-west orientation across the middle of the country. The winds on either side of the front blew in strong opposition; the dewpoints in the south were high. The 700-millibar chart confirmed the surface indication of overrunning Gulf air. Snow and rain fell in both Dakotas.

The precipitation continued into the morning of the 5th, while in central Kansas a low was deepening rapidly. By afternoon the low, with a central pressure of less than 975 millibars, was centered in eastern South Dakota. The winds were strong, and heavy precipitation fell over both Dakotas, primarily in the form of snow. In South Dakota as much as 17 inches of snow were reported. The low moved to northern Minnesota and filled slightly, but snow and rain continued to fall in both Dakotas. Once again minimum temperatures fell below freezing. The season in North Dakota was later than in any previous year.

A new ridge of the Canadian high pushed down over the Dakotas on the 7th, and a low which had developed in Arizona moved into Utah. The great area of precipitation associated with the low reached into western South Dakota, producing more rain and snow. On the morning of the 8th the pressure areas were much the same as in the first week of May: a low in southeastern Colorado, the polar front oriented east-west across the middle of the country, a sharp wind contrast across the front, overrunning indicated over the Dakotas on the 700-millibar chart. The results were also the same. On the morning of the 9th rain and snow continued to fall in North Dakota, although precipitation had ended in most of South Dakota. Temperatures rose sharply from the 9th through the 13th, until they considerably exceeded the normal. Comparison of maximum temperatures for this period with the average maxima in figure 6 shows how marked were the departures.

As the system moved eastward, the Pacific high nosed into the Continent. The Dakotas were dominated by Pacific air until the 12th. During this period minimum temperatures had finally risen above freezing. For the following five days minor polar fronts passed the Dakotas causing but little rain and a slight lowering of temperatures. On the 16th, however, North Dakota received heavy rain when a polar front which passed on the 15th began retreating as a warm front. The James and Pipestem Rivers reached new crests in the Jamestown area about May 15. The flooding was not so severe as it had been in April, however. It rained heavily in North Dakota again on May 19 with the passage of a Pacific front. Although the temperatures in the Dakotas were above normal during the third week of May, the precipitation, too, was above normal.

Pacific air dominated the Dakotas until a new Pacific front approached on May 22. A ridge of the Pacific high extended up into the Gulf of Alaska at this time, and by the 23d a separate center of high pressure had formed off the Canadian west coast. The high, combined with the deepening of the frontal trough which moved east of the Dakotas, produced a flow from the north into those States. As a result, it was polar air from central Canada and the Hudson's Bay region, rather than maritime air from the Pacific, that flowed into the Dakotas. This circulation continued through the 25th, while the high moved southeastward across Canada and into the United States. For the next two days winds were from the south over the Dakotas as

the high moved east of those States. There was no appreciable rain, and maximum temperatures reached as high as the 80's. During the remaining days in May, temperatures averaged near normal and precipitation was scanty.

When the records of the month were compiled, it was found that South Dakota had received its greatest average snowfall for May in 60 years of record--more than 5-1/2 inches. The melted snow and ice in the James River drainage area in North Dakota above Jamestown moved slowly across South Dakota during the month. By the month's end the crest, the highest recorded for May, was still not out of the state. Flood came at seeding time, and high water remained until the end of the month.

MEASUREMENT OF FLOOD DISCHARGES

It was generally impossible to make current-meter measurements of flood discharges by the Geological Survey's standard techniques at many regular gaging stations in the flooded area west of the Missouri River because roads were impassable and bridges from which measurements are usually made were washed out, submerged, or isolated by flooding at approaches. (The techniques of making current-meter measurements and plotting rating curves have been described in many Water-Supply Papers and are fully explained in Water-Supply Paper 888.) At several locations the flood either destroyed or submerged the gage and no record of the peak was obtained. Measurements of maximum flow at these unusable gaging stations and at places where there had been no gaging stations were made by calculating the flow from slope-area observations and the flow through contracted openings. Fairly detailed information about these methods as they have been used by the Geological Survey for severe floods is given in Water-Supply Papers 773-E, 796-G, 798, 799, 800, 816, 843, and 888.

Marks left by melting snowdrifts interfered considerably with attempts to determine peak discharge. In some places the presence of snowdrifts prevented the flood water at the peak of its rise from coming in contact with the ground and, consequently, no flood marks were left there. High-water marks left on snowdrifts had been lowered by the melting of the snow before Geological Survey engineers were able to make a survey and were unreliable indicators of the flood crest.

STAGES AND DISCHARGES AT STREAM-GAGING STATIONS

Explanation of Data

The following paragraph taken from Geological Survey Water-Supply Paper 1080, p. 39, is offered here in definition of the term "base data."

"The basic data systematically collected at stream-gaging stations consist of records of stage, measurements of discharge, and general information useful in determining the daily flow from the records of gage heights and discharge measurements. The records of stage are obtained either by periodic direct readings on a nonrecording gage or by a water-stage recorder which provides a continuous graph of stage. Measurements of discharge are generally made by a current meter, the methods of use of which are outlined in standard textbooks. Occasionally, determination of extraordinary peak flows must be made by auxiliary methods referred to in the preceding section of this report. A typical stream-gaging station is usually equipped with a water-stage recorder and cableway and a suspended car from which discharge measurements are made. Rating tables showing the discharges for indicated stages are prepared from the results of discharge measurements. At some river stations, other or auxiliary devices are used in the determination of discharge, such as artificial controls, turbines, venturi meters, and gates, so calibrated as to indicate rates of discharge."

The data tabulated on the following pages for each stream gaging station show: a station description, a table showing the daily discharge throughout the 3-month period April to June 1950, and a table showing the stage and discharge at selected intervals during each day of the period of major flood flow, generally April 14 to May 13, in sufficient detail to permit reliable definition of the flood hydrograph. It is intended to sacrifice no completeness of detail just to arrive at a concise tabulation.

The station description gives information on the type, location, and datum of the gage, the drainage area above the gage, and information about stages and discharges during the flood. Information about stages and discharges includes the following: the method used in determining the stage, the method used to define the rating curve applicable during the flood period, the maximum stage and discharge during the period April-June 1950 and for the indicated period of station records, plus historical stages when available, and remarks on miscellaneous items.

Mean daily discharges for the months April to June 1950 (March to June in a few cases) are tabulated below the station description. This period covers the floods throughout the area and gives adequate definition of antecedent conditions and of the recession. Runoff volumes are expressed in depth in inches over the drainage area and in acre-feet. Figure 8 shows hydrographs of mean daily discharge at nine

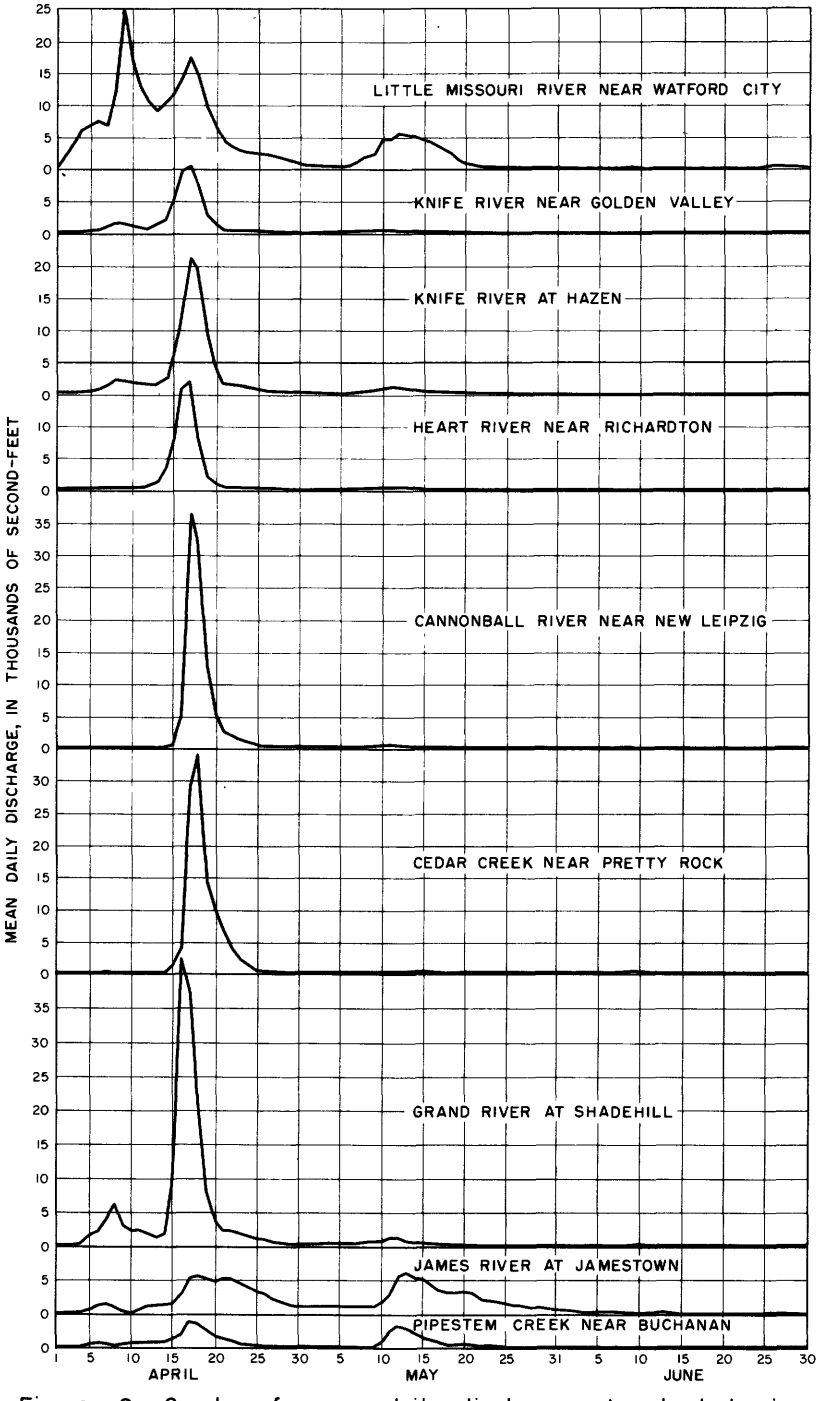

Figure 8.—Graphs of mean daily discharge at selected river measurement stations in Missouri River Basin, Apr. 1–June 30, 1950

selected stream-gaging stations for the period April-June. Hydrographs of mean daily discharge for Missouri River gaging stations situated from Williston, N. Dak., to Sioux City, Iowa, are shown on figure 9. The fast flow of streams draining the western slope compared to the relatively slow rate of runoff typical of streams draining the flat areas east of the Missouri River is illustrated by figure 10 which shows several representative instantaneous discharge hydrographs made at the period of flood crest.

A table following the tabulation of mean daily discharge gives the stages and discharges at selected times of day for each station. The interval for presentation of momentary stage and discharge information was selected so as to offer exact hydrograph definition without the inclusion of unnecessary data. Standard time is the basis throughout. Data for each station are listed from April 14 until the recession has proceeded to the point where sufficient definition is furnished by the table of mean daily discharges.

Automatic gage recordings are given if available. When they are not, graphs were constructed on the basis of manual gage readings, high-water marks, and other pertinent evidence, and the indicated stages were scaled from the graph. Departures from this general procedure are noted in the description under gage-height record.

Records are presented in downstream order. The first record is that for the most upstream Missouri River station reported on, followed by the remaining main-stream stations. Then the tributary stations follow in similar order. Only records for streams on which floods occurred and for those streams on the fringe of the flooded area are included.

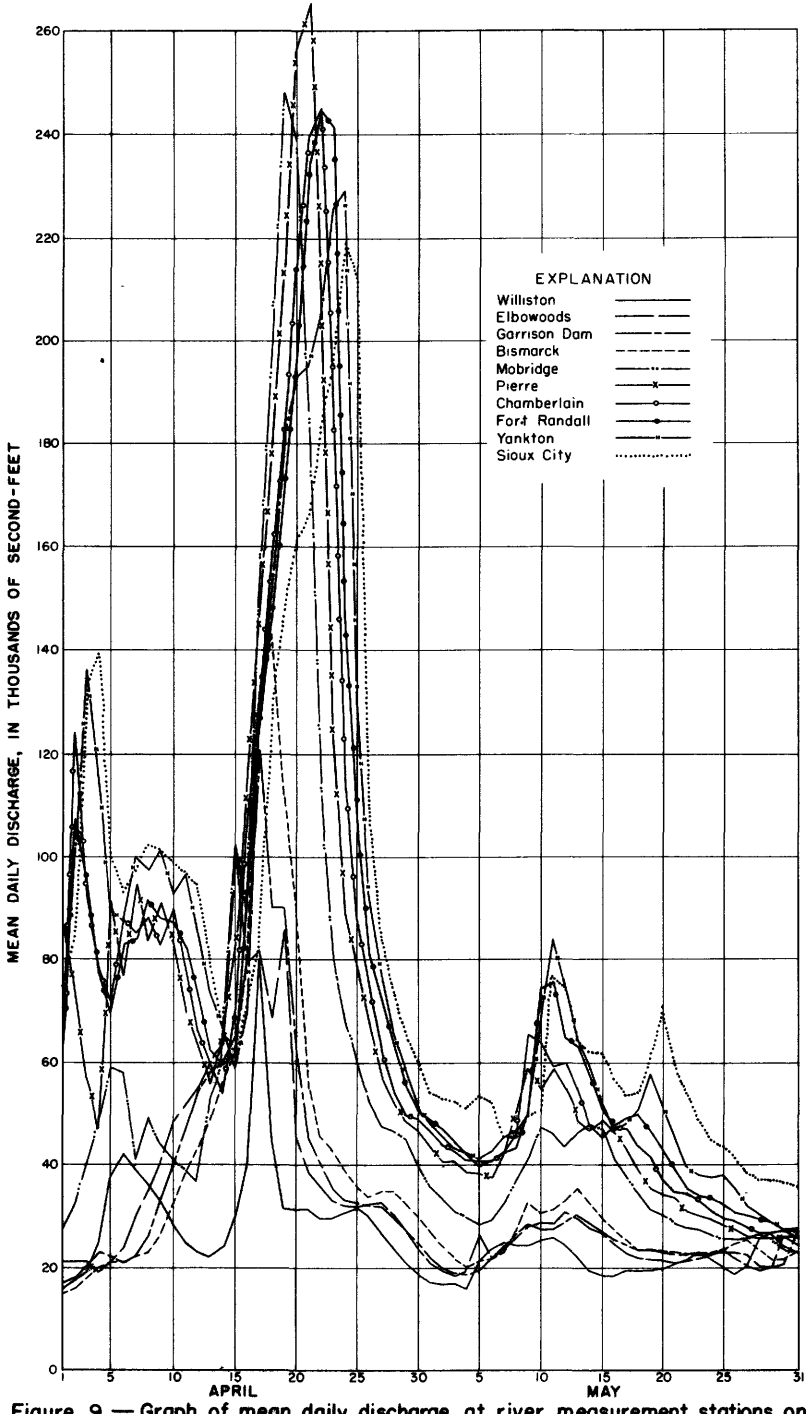

Figure 9.—Graph of mean daily discharge at river measurement stations on Missouri River from Williston, N. Dak., to Sioux City, Iowa, Apr. 1 to June 1, 1950

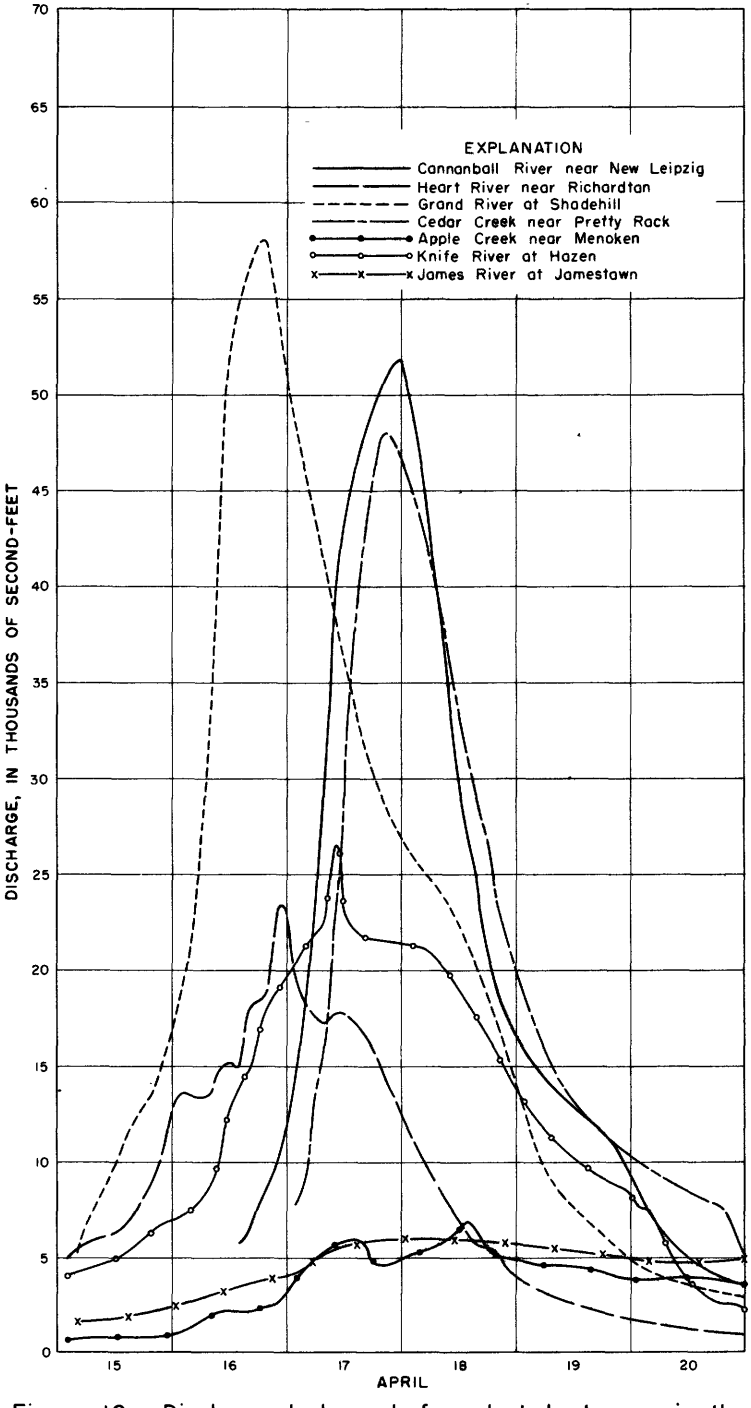

Figure 10.—Discharge hydrograph for selected streams in the Missouri River Basin, April 1950

Missouri River Main Stem

Missouri River near Williston, N. Dak.

Location.—Lat. 48°07', long. 103°44', in sec. 31, T. 154 N., R. 101 W., at Lewis and Clark Highway bridge, 7 miles west of Williston, and 25 miles downstream from Yellowstone River. Datum of gage is 1,830.20 feet above mean sea level, datum of 1929.
Drainage area.—164,500 square miles.
Gage-height record.—Water-stage recorder graph except for period 1 p.m. Apr. 26 to 9 a.m. Apr. 28, when there was no gage-height record.
Discharge record.—Stage-discharge relation defined by current-meter measurements. Stage-discharge relation affected by ice, Apr. 1-16. Discharge for period of no gage-height record interpolated. Shifting-control method used Apr. 17 to June 30.
Maxima.—April-May 1950: Discharge, 110,000 second-feet 10 a.m. Apr. 17; gage height, 11.97 feet 11:30 a.m. Apr. 6 (affected by ice).
1928 to March 1950: Discharge, 231,000 second-feet Apr. 4, 1930, from rating curve extended above 80,000 second-feet; gage height, 19.78 feet Mar. 28, 1943 (ice jam).
Remarks.—Many diversions above station for irrigation. Flow partly regulated by Fort Peck Reservoir.

Mean discharge, in second-feet, 1950

Day	April	May	June	Day	April	May	June	Day	April	May	June
1	16,000	17,000	25,200	11	25,000	25,500	49,000	21	31,300	20,800	59,300
2	16,000	16,700	27,800	12	23,000	24,300	46,800	22	29,700	21,500	58,100
3	19,000	16,800	26,200	13	22,000	22,000	41,100	23	28,900	23,100	54,400
4	25,000	17,900	24,400	14	24,000	19,300	37,700	24	30,900	21,900	53,100
5	38,000	21,100	24,500	15	30,000	18,800	36,000	25	31,900	20,100	56,100
6	42,000	23,700	25,700	16	40,000	18,400	39,900	26	30,000	18,800	62,000
7	39,000	24,900	25,800	17	80,000	19,400	48,300	27	26,700	20,000	57,400
8	36,000	24,200	26,100	18	44,600	19,200	50,200	28	23,800	25,600	51,600
9	33,000	24,200	32,600	19	31,200	19,300	50,100	29	21,000	26,700	48,900
10	28,000	25,100	45,200	20	31,200	19,900	55,100	30	18,600	24,200	44,800
								31	-	22,900	-
Mean monthly discharge, in second-feet									30,530	21,400	42,780
Runoff, in thousand acre-feet									1,816	1,316	2,546
Runoff, in inches									0.21	0.15	0.29

Missouri River near Elbowoods, N. Dak.

Location.—Lat. 47°34', long. 102°12', in NE¼NE¼ sec. 12, T. 147 N., R. 91 W., at bridge on State Highway 8, 2 miles downstream from Little Missouri River, and 2½ miles west of Elbowoods. Datum of gage is 1,720.55 feet above mean sea level, datum of 1929.
Drainage area.—179,800 square miles.
Gage-height record.—Graph drawn on basis of once-daily wire-weight gage readings and records for stations near Williston and below Garrison Dam.
Discharge record.—Stage-discharge relation defined by current-meter measurements below 110,000 second-feet and extended by logarithmic plotting. Stage-discharge relation affected by ice Apr. 1 to 9 a.m. Apr. 15. Shifting-control method used 9 a.m. Apr. 15 to June 30.
Maxima.—April-May 1950: Discharge, 161,000 second-feet 8:45 a.m. Apr. 15; gage height, 17.30 feet 8 p.m. Apr. 10 (affected by ice).
1939 to March 1950: Discharge, about 260,000 second-feet Mar. 26, 1947, from rating curve extended above 110,000 second-feet by logarithmic plotting (gage height, 23.2 feet).
Remarks.—Flow partly regulated by Fort Peck Reservoir.

Mean discharge, in second-feet, 1950

Day	April	May	June	Day	April	May	June	Day	April	May	June
1	21,000	21,000	22,800	11	52,000	28,500	42,000	21	38,100	20,900	57,400
2	21,000	19,400	23,100	12	55,000	30,900	49,200	22	35,600	21,300	61,700
3	21,000	18,400	24,600	13	60,000	29,700	45,400	23	32,800	21,800	57,600
4	19,000	19,100	25,100	14	63,500	27,600	39,800	24	31,900	22,400	52,400
5	21,000	26,000	25,400	15	100,000	26,500	39,000	25	31,900	23,400	51,900
6	24,000	21,900	24,300	16	79,000	24,400	38,600	26	32,200	21,800	56,200
7	30,000	23,700	25,300	17	81,500	22,600	41,600	27	32,600	20,200	63,600
8	35,000	25,800	25,700	18	68,200	21,900	52,200	28	30,200	19,400	58,200
9	40,000	27,800	26,800	19	85,200	21,700	52,600	29	27,400	19,900	51,700
10	48,000	28,800	29,500	20	45,200	21,300	52,900	30	23,400	26,000	48,800
								31	-	24,600	-
Mean monthly discharge, in second-feet									42,860	23,310	42,180
Runoff, in thousand acre-feet									2,550	1,433	2,510
Runoff, in inches									0.27	0.15	0.26

Missouri River near Elbowoods, N. Dak. (Cont'd.)

Gage height, in feet, and discharge, in second-feet, at indicated time, 1950

Hour	Gage height	Discharge	Gage height	Discharge	Gage height	Discharge	Gage height	Discharge	Gage height	Discharge	Gage height	Discharge
	April 14		April 15		April 16		April 17		April 18		April 19	
2												
4	14.56	61,600	14.52	68,000	10.02	79,900	10.21	83,100	8.84	60,500	11.03	96,700
6												
8	14.48	62,600	14.90	71,000	9.93	78,400	10.25	83,700	8.73	58,800	11.18	99,200
10												
N	14.43	63,400	13.60	140,000	9.88	77,600	10.23	83,400	8.84	60,600	10.88	94,200
2												
4	14.38	64,300	11.50	104,600	9.85	77,100	10.15	82,100	9.27	67,600	10.10	81,300
6												
8	14.36	65,700	10.70	91,200	9.94	78,600	9.98	79,300	10.01	79,800	9.20	66,400
10												
12	14.36	65,700	10.30	84,600	10.07	80,800	9.63	73,500	10.63	90,000	8.60	56,800
	April 20		April 21		April 22		April 23		April 24		April 25	
4	8.10	49,400										
8	7.88	46,300	7.27	38,400	7.06	35,900	6.80	33,100				
N	7.70	43,900							6.68	31,900	6.69	31,900
4	7.57	42,200	7.20	37,500	7.00	35,300	6.71	32,200				
8	7.49	41,100										
12	7.42	40,200	7.12	36,600	6.92	34,400	6.68	31,900	6.68	31,900	6.70	32,000
	April 26		April 27		April 28		April 29		April 30		May 1	
4												
8			6.81	33,000			6.37	28,200	5.91	23,800	5.70	21,200
N	6.72	32,200			6.53	30,000						
4			6.78	32,700			6.26	27,000	5.80	22,800	5.67	20,500
8												
12	6.75	32,400	6.71	31,900	6.41	28,700	6.07	25,200	5.73	21,900	5.65	20,200
	May 2		May 3		May 4		May 5		May 6		May 7	
4												
8	5.62	19,800	5.40	18,300	5.55	19,000						
N							5.73	19,800	6.10	21,900	6.39	23,700
4	5.53	19,200	5.40	18,300	5.61	19,300						
8												
12	5.43	18,600	5.48	18,700	5.65	19,400	5.93	21,000	6.25	22,800	6.53	24,600
	May 8		May 9		May 10		May 11		May 12		May 13	
4	6.57	24,900										
8	6.63	25,400					6.91	28,400	7.13	30,900	7.17	30,200
N	6.73	26,200	6.89	27,800	7.00	29,000						
4	6.72	26,100					6.88	28,300	7.20	31,500	7.09	29,100
8	6.74	26,300										
12	6.78	26,700	6.96	28,600	6.98	28,900	6.95	29,000	7.24	31,400	7.04	28,300

Supplemental record.—Apr. 15, 8:45 a.m., 14.93 ft., 161,000 sec.-ft.

Missouri River below Garrison Dam, N. Dak.

Location.—Lat. 47°23'35", long. 101°23'48", in E½ sec. 8, T. 145 N., R. 84 W., 5 miles northwest of Stanton, N. Dak., 6 miles upstream from Knife River, and 8 miles downstream from site of Garrison Dam. Datum of gage is 1600 feet above mean sea level, datum of 1929, from Corps of Engineers bench mark.

Drainage area.—181,400 square miles.

Gage-height record.—Water-stage recorder graph except for periods Apr. 1-3, 5, 6, 17-19, 24-26, June 14-18, 23-28, during which only intermittent record and the ranges in stage were available.

Discharge record.—Stage-discharge relation defined by current-meter measurements below 66,000 second-feet and extended to peak stage on basis of rating characteristics at other Missouri River stations. Stage-discharge relation affected by ice Apr. 1-16. Discharge for periods of intermittent record computed on basis of known ranges in stage, 2 discharge measurements, and records for stations near Elbowoods and at Bismarck. Shifting-control method used Apr. 17 to June 30.

Maxima.—April-May 1950: Discharge, 220,000 second-feet 8:30 p.m. Apr. 16 (gage height, 87.64 feet).

1948 to March 1950: Discharge, 210,000 second-feet Apr. 3, 1948 (gage height, 94.55 feet, site and datum then in use).

Remarks.—Flow partly regulated by Fort Peck Reservoir.

Mean discharge, in second-feet, 1950

Day	April	May	June	Day	April	May	June	Day	April	May	June
1	17,000	21,900	26,100	11	47,000	27,200	40,500	21	45,600	22,600	54,700
2	18,000	19,800	23,700	12	54,000	28,900	45,900	22	40,500	22,400	59,900
3	20,000	18,900	24,100	13	58,000	30,200	45,100	23	35,700	22,400	61,000
4	23,000	18,700	25,800	14	60,000	28,800	43,000	24	33,000	22,400	56,000
5	22,000	19,300	27,200	15	65,000	27,100	39,000	25	32,500	23,100	52,000
6	21,000	21,300	25,300	16	80,000	25,500	36,000	26	32,000	22,900	53,000
7	22,000	24,000	24,300	17	120,000	24,300	38,000	27	32,000	22,400	58,000
8	26,000	26,400	25,500	18	90,000	23,500	45,000	28	30,000	20,200	64,000
9	33,000	28,600	26,700	19	90,000	23,300	51,400	29	27,400	19,600	52,800
10	40,000	27,200	31,500	20	82,100	23,200	52,800	30	25,000	20,900	49,700
								31	-	27,200	-
Mean monthly discharge, in second-feet									43,390	23,680	41,930
Runoff, in thousand acre-feet									2,582	1,456	2,495
Runoff, in inches									0.27	0.15	0.26

Missouri River at Bismarck, N. Dak.

Location.—Lat. 46°48'50", long. 100°49'10", in sec. 31, T. 139 N., R. 80 W., at Bismarck city water plant, 2,100 feet downstream from Northern Pacific Railway bridge, 1 mile west of Bismarck, and about 4 miles upstream from Heart River. Datum of gage is 1,618.38 feet above mean sea level, datum of 1929.

Drainage area.—186,400 square miles.

Gage-height record.—Water-stage recorder graph except for period June 12, 13 when no record was available. Doubtful gage-height record May 7-14 due to partially plugged intake, graph based on engineers' readings and shape of recorder graph.

Discharge record.—Stage-discharge relation defined by current-meter measurements. Stage-discharge relation affected by ice Apr. 1 to 3 p.m. Apr. 18. Discharge for period of no gage-height record computed on basis of one discharge measurement and records for station below Garrison Dam. Shifting-control method used 3 p.m. Apr. 18 to June 30.

Maxima.—April-May 1950: Discharge, 192,000 second-feet 11 p.m. Apr. 17 (gage height, 18.72 feet, from floodmark).

1904-05, 1927 to March 1950: Discharge, 282,000 second-feet Apr. 3, 1943; gage height, 22.2 feet Apr. 1, 1943, from floodmarks.

Maximum stage known, 31.6 feet, present site and datum, Mar. 31, 1881 (ice jam).

Remarks.—Flow partly regulated by Fort Peck Reservoir.

Mean discharge, in second-feet, 1950

Day	April	May	June	Day	April	May	June	Day	April	May	June
1	15,000	27,000	27,900	11	38,000	31,200	32,100	21	54,900	23,000	54,000
2	16,000	23,600	26,800	12	43,000	33,000	40,000	22	45,500	22,700	59,000
3	18,000	21,500	24,300	13	49,000	35,300	50,000	23	42,600	22,500	63,600
4	20,000	20,200	24,400	14	56,600	32,900	45,700	24	38,800	22,900	61,500
5	21,000	21,100	26,500	15	62,300	29,300	38,000	25	35,800	23,500	54,200
6	21,000	21,300	28,100	16	83,700	27,200	34,700	26	33,800	24,800	54,000
7	22,000	23,000	26,800	17	130,000	25,300	33,700	27	34,900	25,200	57,800
8	23,000	27,000	26,700	18	143,000	23,200	35,700	28	34,900	23,600	63,800
9	26,000	32,600	29,100	19	112,000	23,400	47,800	29	32,500	21,800	58,500
10	32,000	30,900	29,100	20	93,800	23,000	52,900	30	29,800	21,500	52,000
								31	-	23,100	-
Mean monthly discharge, in second-feet									46,960	25,370	41,960
Runoff, in thousand acre-feet									2,794	1,560	2,497
Runoff, in inches									0.28	0.16	0.25

Gage height, in feet, and discharge, in second-feet, at indicated time, 1950

Hour	Gage height	Discharge	Gage height	Discharge	Gage height	Discharge	Gage height	Discharge	Gage height	Discharge	Gage height	Discharge
	April 14		April 15		April 16		April 17		April 18		April 19	
2			16.03	59,700					18.18	177,000		
4	15.81	54,000	16.04	59,700	15.98	62,100	15.14	123,000	18.04	171,000	14.52	113,000
6			16.05	61,100					17.80	163,000		
8	15.91	56,000	16.10	61,500	15.88	61,200	14.80	117,000	17.63	156,000	14.51	113,000
10			16.60	65,500					17.37	146,000		
N	15.98	57,000	16.15	63,400	15.55	58,500	14.55	113,000	17.12	138,000	14.48	112,000
2			16.03	62,500					16.88	130,000		
4	16.00	58,000	16.08	63,000	14.10	92,300	14.97	120,000	16.00	124,000	14.45	112,000
6			16.20	63,900					15.56	121,000		
8	16.01	59,000	16.15	63,400	15.57	123,000	16.50	147,000	15.17	119,000	14.42	111,000
10			16.10	63,000					14.84	117,000		
12	16.02	59,700	16.05	62,600	15.38	124,000	18.60	190,000	14.67	115,000	14.34	110,000
	April 20		April 21		April 22		April 23		April 24		April 25	
4	14.24	108,000										
8	14.04	105,000	10.37	56,100	9.36	45,500	9.14	43,500	8.64	38,900	8.35	36,300
N	13.50	97,000										
4	12.82	87,200	9.87	50,700	9.30	45,100	8.95	41,800	8.58	38,400	8.24	35,300
8	12.05	76,600										
12	11.36	68,000	9.57	47,600	9.23	44,400	8.80	40,400	8.48	37,500	8.10	34,100
	April 26		April 27		April 28		April 29		April 30		May 1	
4			8.14	34,700	8.18	35,200	7.95	33,300				
8	8.03	33,500	8.17	35,000	8.19	35,400	7.90	33,000	7.57	30,100		
N			8.13	34,700	8.20	35,500	7.88	32,800			7.18	27,000
4	8.05	33,800	8.16	35,000	8.13	34,800	7.81	32,100	7.48	29,400		
8			8.18	35,200	8.04	34,100	7.73	31,500				
12	8.08	34,100	8.18	35,200	7.99	33,700	7.68	31,100	7.38	28,500	7.02	25,700
	May 2		May 3		May 4		May 5		May 6		May 7	
4	6.84	24,300	6.59	22,500	6.33	20,800	6.20	19,900	6.38	21,200		
8	6.75	23,600	6.45	21,600	6.28	20,500	6.24	20,200	6.30	20,600		
N	6.70	23,200	6.40	21,300	6.26	20,400	6.33	20,800	6.30	20,600		
4	6.67	23,000	6.36	21,000	6.18	19,800	6.44	21,600	6.39	21,300		
8	6.65	23,000	6.34	20,800	6.17	19,700	6.59	22,700	6.44	21,600		
12	6.64	22,900	6.34	20,800	6.18	19,800	6.68	23,300	6.48	21,900		

Supplemental record.—Apr. 15, 4:30 p.m., 15.90 ft., 61,200 sec.-ft.; 5 p.m., 16.23 ft., 63,900 sec.-ft.; Apr. 16, 1 p.m., 13.70 ft., 80,000 sec.-ft., 1:30 p.m., 13.35 ft., 78,600 sec.-ft.; 2:30 p.m., 14.46 ft., 95,200 sec.-ft.; 3:30 p.m., 14.00 ft., 90,500 sec.-ft.; 7 p.m., 15.62 ft., 122,000 sec.-ft.; Apr. 17, 2 p.m., 14.53 ft., 113,000 sec.-ft.; 11 p.m., 18.72 ft., 192,000 sec.-ft.

Missouri River near Mobridge, S. Dak.

Location.—Lat. 45°32', long. 100°29', in sec. 7, T. 18 N., R. 30 E., at bridge on U. S. Highway 12, 3 miles west of Mobridge, and 3½ miles downstream from Grand River. Datum of gage is 1,527.19 feet above mean sea level, datum of 1929.
Drainage area.—208,700 square miles.
Gage-height record.—Water-stage recorder graph except Apr. 1-6 when gage heights are from graph based on once-daily wire-weight gage readings.
Discharge record.—Stage-discharge relation defined by current-meter measurements. Stage-discharge relation affected by ice Apr. 1-13; discharge computed on basis of two discharge measurements, gage heights, and records for stations nearby. Shifting-control method used Apr. 14 to June 30. Gage heights used to hundredths.
Maxima.—April-May 1950: Discharge, 251,000 second-feet Apr. 19 (gage height, 17.14 feet).
1928 to March 1950: Discharge, 282,000 second-feet Apr. 5, 1943; gage height, 19.55 feet Mar. 28, 1943 (ice jam).
Remarks.—Flow partly regulated by Fort Peck Reservoir.

Mean discharge, in second-feet, 1950

Day	April	May	June	Day	April	May	June	Day	April	May	June
1	28,000	36,000	23,600	11	39,000	46,000	28,200	21	186,000	28,800	53,900
2	32,000	33,400	27,000	12	37,000	43,200	34,900	22	111,000	28,000	52,700
3	40,000	31,000	28,800	13	53,000	46,000	47,300	23	80,400	27,200	60,800
4	49,000	29,700	27,000	14	59,700	47,300	54,600	24	67,600	26,200	68,900
5	59,000	28,500	25,300	15	104,000	46,600	49,600	25	59,600	25,700	64,700
6	58,000	29,100	25,000	16	88,800	41,000	41,300	26	52,300	25,600	57,400
7	41,000	32,800	26,100	17	151,000	37,400	36,400	27	47,200	25,800	55,700
8	49,000	37,200	25,100	18	197,000	34,300	33,500	28	46,700	26,100	59,800
9	44,000	40,700	24,300	19	248,000	31,300	32,200	29	44,600	25,300	68,000
10	41,000	47,200	27,200	20	239,000	30,100	47,300	30	39,800	23,800	59,300
								31	-	22,900	-
Mean monthly discharge, in second-feet									79,760	33,360	42,200
Runoff, in thousand acre-feet									4,746	2,051	2,511
Runoff, in inches									0.43	0.18	0.23

Gage height, in feet, and discharge, in second-feet, at indicated time, 1950

Hour	Gage height	Dis-charge	Gage height	Dis-charge	Gage height	Dis-charge	Gage height	Dis-charge	Gage height	Dis-charge	Gage height	Dis-charge
	April 14		April 15		April 16		April 17		April 18		April 19	
2	9.84	56,900	12.00	117,000	10.81	82,400	12.63	135,000	14.08	179,000	16.76	243,000
4	9.66	53,000	12.12	120,000	10.71	79,400	12.83	141,000	14.12	181,000	16.92	246,000
6	9.56	50,500	12.03	118,000	10.57	75,600	12.95	145,000	14.19	183,000	16.97	248,000
8	9.54	49,400	11.87	113,000	10.46	73,100	12.98	146,000	14.21	184,000	17.01	248,000
10	9.57	50,100	11.78	110,000	10.43	71,800	13.03	148,000	14.38	188,000	17.06	250,000
N	9.66	53,000	11.67	107,000	10.48	73,500	13.02	147,000	14.52	193,000	17.06	250,000
2	9.68	53,400	11.51	102,000	10.72	80,200	13.15	151,000	14.64	195,000	17.12	251,000
4	9.61	51,300	11.37	98,000	11.19	93,000	13.23	153,000	14.76	199,000	17.12	251,000
6	9.69	52,700	11.18	92,600	11.55	103,000	13.36	157,000	14.95	203,000	17.12	251,000
8	10.51	74,200	11.08	89,800	11.73	109,000	13.46	160,000	15.57	217,000	17.10	250,000
10	11.24	94,200	11.06	89,400	11.98	116,000	13.85	172,000	16.13	229,000	17.04	249,000
12	11.58	104,000	10.97	86,600	12.36	127,000	14.06	179,000	16.54	238,000	16.99	248,000
	April 20		April 21		April 22		April 23		April 24		April 25	
4	16.92	246,000	15.49	215,000	11.73	129,000	9.64	84,200	8.95	71,600	8.36	62,400
8	16.77	243,000	14.97	204,000	11.14	116,000	9.50	81,200	8.77	68,500	8.22	60,300
N	16.67	241,000	14.44	191,000	10.75	107,000	9.42	79,400	8.60	65,600	8.14	59,100
4	16.45	236,000	13.80	175,000	10.40	100,000	9.42	79,800	8.49	64,000	8.08	58,500
8	16.19	230,000	13.10	159,000	10.12	94,200	9.26	76,800	8.59	66,200	8.00	57,400
12	15.88	224,000	12.36	142,000	9.98	91,200	9.16	75,200	8.47	64,200	7.90	55,900
	April 26		April 27		April 28		April 29		April 30		May 1	
4	7.80	54,600	7.27	47,200	7.14	46,600	7.04	45,500	6.76	41,400	6.43	36,900
8	7.72	53,500	7.24	46,800	7.15	46,800	7.00	45,000	6.70	40,600	6.39	36,400
N	7.64	52,300	7.23	47,000	7.15	47,200	6.98	44,800	6.64	39,600	6.33	35,700
4	7.56	51,200	7.22	47,000	7.12	46,700	6.94	44,200	6.58	38,900	6.30	35,400
8	7.46	49,800	7.22	47,300	7.09	46,200	6.88	43,200	6.53	38,200	6.30	35,400
12	7.38	48,800	7.17	46,800	7.05	45,600	6.81	42,200	6.50	37,800	6.23	34,500
	May 2		May 3		May 4		May 5		May 6		May 7	
4	6.27	35,100	5.90	31,500	5.69	30,100	5.56	29,300	5.39	28,400	5.75	31,900
8	6.21	34,400	5.88	31,400	5.67	29,900	5.54	29,200	5.36	28,200	5.80	32,500
N	6.19	34,200	5.85	31,100	5.63	29,600	5.46	28,700	5.34	28,100	5.88	33,300
4	6.09	33,100	5.82	30,900	5.60	29,500	5.23	27,000	5.51	29,500	5.86	33,200
8	5.83	30,800	5.79	30,800	5.59	29,500	5.44	28,600	5.69	31,100	5.86	33,300
12	5.90	31,500	5.72	30,200	5.55	29,200	5.45	28,800	5.75	31,800	5.88	33,600
	May 8		May 9		May 10		May 11		May 12		May 13	
4	5.94	34,400	6.25	38,500	6.85	46,600	6.98	47,600	6.79	43,700	6.85	44,200
8	6.08	36,200	6.21	37,800	6.89	47,000	6.96	47,000	6.79	43,600	6.92	45,200
N	6.22	38,000	6.28	38,700	6.89	46,800	6.85	45,200	6.77	43,100	6.98	46,000
4	6.31	39,400	6.35	39,500	6.90	46,800	6.85	45,000	6.77	43,100	7.03	46,700
8	6.31	39,400	6.66	44,000	6.99	48,100	6.84	44,800	6.79	43,200	7.08	47,500
12	6.27	38,900	6.78	45,600	6.98	47,800	6.80	44,000	6.81	43,600	7.12	48,100

Missouri River at Pierre, S. Dak.

Location.—Lat. 44°22'25", long. 100°22'05", in SW¼ sec. 32, T. 111 N., R. 79 W., at Chicago and North Western Railway bridge at Pierre, 1½ miles upstream from Bad River. Datum of gage is 1,414.41 feet above mean sea level, datum of 1929.
Drainage area.—243,500 square miles.
Gage-height record.—Water-stage recorder graph.
Discharge record.—Stage-discharge relation defined by current-meter measurements. Stage-discharge relation affected by ice Apr. 1-4; discharge computed on basis of one discharge measurement and gage heights. Shifting control method used Apr. 5 to June 30. Gage heights used to hundredths.
Maxima.—April-May 1950: Discharge, 269,000 second-feet Apr. 21 (gage height, 18.44 feet).
1929 to March 1950: Discharge, 281,000 second-feet Apr. 6, 1943 (gage height, 19.65 feet).
Remarks.—Flow partly regulated by Fort Peck Reservoir.

Mean discharge, in second-feet, 1950

Day	April	May	June	Day	April	May	June	Day	April	May	June
1	85,100	43,200	25,400	11	69,800	58,300	26,900	21	265,000	33,500	38,400
2	73,000	40,800	24,400	12	62,400	54,400	27,700	22	205,000	31,000	51,800
3	57,100	40,600	24,400	13	55,600	48,400	28,800	23	122,000	30,000	53,300
4	47,800	38,400	26,300	14	65,000	46,700	39,100	24	88,700	29,400	57,900
5	90,400	38,200	27,700	15	83,700	48,200	50,200	25	78,400	28,400	65,200
6	76,700	37,600	26,900	16	118,000	46,700	48,800	26	67,200	27,100	63,100
7	94,200	41,700	26,100	17	146,000	43,500	44,000	27	57,800	26,100	56,500
8	83,700	50,200	26,600	18	179,000	38,800	38,700	28	51,300	25,700	53,900
9	90,600	58,300	26,700	19	214,000	35,300	36,500	29	48,800	25,600	56,100
10	82,400	54,900	27,000	20	255,000	34,200	35,000	30	46,800	26,100	64,900
								31	-	26,100	-
Mean monthly discharge, in second-feet									102,000	38,950	39,940
Runoff, in thousand acre-feet									6,070	2,395	2,377
Runoff, in inches									0.47	0.18	0.18

Gage height, in feet, and discharge, in second-feet, at indicated time, 1950

Hour	Gage height	Discharge	Gage height	Discharge	Gage height	Discharge	Gage height	Discharge	Gage height	Discharge	Gage height	Discharge
	April 14		April 15		April 16		April 17		April 18		April 19	
2	8.10	53,500	9.27	71,000	11.60	113,000	12.00	122,000	14.17	169,000	15.30	194,000
4	8.18	54,600	9.26	70,900	11.68	115,000	12.17	126,000	14.31	172,000	15.42	197,000
6	8.34	56,900	9.26	70,900	11.75	116,000	12.39	131,000	14.39	174,000	15.58	200,000
8	8.59	60,500	9.30	71,500	11.79	117,000	12.65	136,000	14.45	176,000	15.73	204,000
10	8.90	65,200	9.38	72,900	11.85	119,000	12.96	143,000	14.49	176,000	15.92	208,000
N	9.21	70,100	9.65	77,300	11.87	119,000	13.19	148,000	14.60	179,000	16.14	213,000
2	9.34	72,100	10.05	84,000	11.90	120,000	13.39	153,000	14.70	181,000	16.36	219,000
4	9.40	73,200	10.52	92,300	11.92	120,000	13.56	156,000	14.77	182,000	16.56	223,000
6	9.37	72,600	10.87	98,700	11.94	121,000	13.65	158,000	14.85	184,000	16.75	228,000
8	9.31	71,700	11.16	104,000	11.95	121,000	13.87	163,000	14.91	186,000	16.98	233,000
10	9.27	71,000	11.35	108,000	11.95	121,000	13.97	165,000	15.02	188,000	17.17	238,000
12	9.26	70,900	11.50	111,000	11.96	121,000	14.07	167,000	15.14	191,000	17.31	241,000
	April 20		April 21		April 22		April 23		April 24		April 25	
4	17.56	248,000	18.27	265,000	17.70	246,000	13.43	143,000	10.85	96,400	9.83	80,100
8	17.76	252,000	18.33	266,000	17.35	233,000	12.72	129,000	10.57	92,100	9.86	80,600
N	17.93	256,000	18.44	269,000	16.74	211,000	12.20	120,000	10.25	87,000	9.82	79,900
4	18.02	259,000	18.32	266,000	16.08	195,000	11.75	111,000	10.10	84,500	9.71	78,100
8	18.11	261,000	18.17	262,000	15.27	179,000	11.38	105,000	9.97	82,400	9.57	75,900
12	18.17	262,000	17.96	256,000	14.36	161,000	11.09	100,000	9.87	80,700	9.41	73,400
	April 26		April 27		April 28		April 29		April 30		May 1	
4	9.27	71,200	8.55	60,500	8.00	52,700	7.74	49,000	7.68	47,900	7.40	44,400
8	9.16	69,500	8.49	59,600	7.95	52,000	7.74	49,000	7.66	47,700	7.35	43,800
N	8.98	66,800	8.37	57,900	7.91	51,400	7.73	48,800	7.60	47,000	7.30	43,200
4	8.83	64,500	8.26	56,300	7.84	50,500	7.72	48,600	7.54	46,100	7.25	42,600
8	8.73	63,000	8.16	54,900	7.79	49,700	7.71	48,400	7.48	45,400	7.21	42,100
12	8.64	61,700	8.10	54,100	7.77	49,500	7.69	48,100	7.42	44,700	7.19	41,900
	May 2		May 3		May 4		May 5		May 6		May 7	
4	7.10	40,900	7.08	40,600	6.94	39,100	6.86	38,200	6.84	37,700	7.22	41,000
8	7.11	41,000	7.11	40,900	6.88	38,500	6.89	38,400	6.85	37,800	7.35	42,300
N	7.08	40,700	7.11	40,900	6.81	37,800	6.93	38,700	6.83	37,500	7.38	42,600
4	7.07	40,600	7.08	40,500	6.80	37,700	6.91	38,500	6.80	37,300	7.31	41,800
8	7.04	40,300	7.06	40,300	6.80	37,600	6.85	37,900	6.81	37,300	7.28	41,500
12	7.07	40,500	7.01	39,700	6.84	38,000	6.82	37,600	6.98	38,800	7.25	41,100
	May 8		May 9		May 10		May 11		May 12		May 13	
4	7.35	42,100	8.75	59,900	8.45	55,200	8.68	58,000	8.62	56,900	8.17	49,500
8	7.62	45,000	8.69	58,900	8.42	54,800	8.71	58,500	8.52	55,500	8.12	48,700
N	7.86	47,800	8.65	58,300	8.39	54,200	8.73	58,800	8.45	54,500	8.11	48,300
4	8.52	56,700	8.63	57,900	8.36	53,800	8.71	58,300	8.34	53,000	8.10	48,000
8	9.02	63,900	8.59	57,300	8.42	54,500	8.70	58,200	8.30	52,400	8.08	47,500
12	8.93	62,600	8.53	56,300	8.60	57,000	8.68	57,800	8.22	51,300	8.06	47,000

Missouri River at Chamberlain, S. Dak.

Location.—Lat. 43°29', long. 99°20', in NE¼ sec. 16, T. 104 N., R. 71 W., at bridge on U. S. Highway 16 at Chamberlain, 1,200 feet downstream from Chicago, Milwaukee, St. Paul and Pacific Railroad bridge. Datum of gage is 1,320.22 feet above mean sea level, datum of 1929.
Drainage area.—250,800 square miles.
Gage-height record.—Water-stage recorder graph except Apr. 25 to June 6, when gage heights are from graph based on once or twice-daily wire-weight gage readings.
Discharge record.—Stage-discharge relation defined by current-meter measurements. Stage-discharge relation affected by ice Apr. 1. Shifting-control method used Apr. 2-16, Apr. 22 to June 30. Gage heights used to hundredths.
Maxima.—April-May 1950: Discharge, 250,000 second-feet Apr. 22 (gage height, 18.80 feet).
1928-29, 1945 to March 1950: Discharge, 213,000 second-feet Apr. 2, 1947 (gage height, 16.22 feet).
Maximum stage known, 19.3 feet Apr. 7, 1943.
Remarks.—Flow partly regulated by Fort Peck Reservoir.

Mean discharge, in second-feet, 1950

Day	April	May	June	Day	April	May	June	Day	April	May	June
1	65,400	46,700	27,000	11	78,100	59,100	27,300	21	239,000	34,800	33,900
2	124,000	43,900	26,600	12	65,800	59,900	27,200	22	245,000	34,500	35,500
3	92,500	42,400	25,100	13	59,700	54,300	27,200	23	190,000	33,000	52,500
4	78,200	41,100	24,200	14	53,700	47,800	28,000	24	115,000	30,800	59,100
5	71,800	40,500	25,100	15	68,800	45,200	35,700	25	87,800	29,900	63,200
6	88,000	40,600	27,500	16	107,000	47,200	51,700	26	74,100	29,100	67,300
7	85,000	41,400	28,200	17	126,000	47,000	51,700	27	62,100	27,600	64,100
8	88,200	46,000	27,600	18	158,000	43,500	45,900	28	54,100	26,600	56,900
9	82,500	65,200	27,300	19	181,000	41,500	39,800	29	49,600	26,600	54,000
10	89,600	63,400	27,300	20	212,000	36,600	36,000	30	48,900	27,000	59,400
								31	-	27,100	-
Mean monthly discharge, in second-feet									104,700	41,300	39,410
Runoff, in thousand acre-feet									6,230	2,539	2,345
Runoff, in inches									0.47	0.19	0.18

Gage height, in feet, and discharge, in second-feet, at indicated time, 1950

Hour	Gage height	Dis-charge	Gage height	Dis-charge	Gage height	Dis-charge	Gage height	Dis-charge	Gage height	Dis-charge	Gage height	Dis-charge
	April 14		April 15		April 16		April 17		April 18		April 19	
2	8.80	54,300	9.13	58,700	10.40	79,800	12.55	122,000	13.61	144,000	14.90	170,000
4	8.80	54,300	9.32	61,400	10.73	85,600	12.53	122,000	13.82	148,000	15.00	172,000
6	8.79	54,200	9.55	64,800	11.22	94,500	12.53	122,000	14.03	153,000	15.10	175,000
8	8.78	54,100	9.70	67,200	11.62	102,000	12.52	122,000	14.18	156,000	15.19	176,000
10	8.75	53,700	9.83	69,400	11.94	109,000	12.51	121,000	14.38	160,000	15.35	180,000
N	8.74	53,600	9.95	71,500	12.22	114,000	12.52	122,000	14.47	162,000	15.45	182,000
2	8.71	53,200	10.02	72,800	12.31	117,000	12.58	123,000	14.57	164,000	15.51	183,000
4	8.69	53,000	10.03	73,100	12.41	119,000	12.70	125,000	14.62	165,000	15.56	184,000
6	8.69	53,000	10.04	73,400	12.47	120,000	12.83	128,000	14.64	165,000	15.65	186,000
8	8.71	53,200	10.11	74,700	12.51	121,000	13.13	134,000	14.68	166,000	15.74	188,000
10	8.79	54,200	10.13	75,000	12.51	121,000	13.28	137,000	14.72	167,000	15.90	191,000
12	8.90	55,500	10.21	76,500	12.54	122,000	13.41	140,000	14.77	168,000	16.07	194,000
	April 20		April 21		April 22		April 23		April 24		April 25	
4	16.40	201,000	17.93	233,000	18.80	250,000	17.92	220,000	13.37	126,000	11.52	95,400
8	16.73	208,000	18.09	236,000	18.80	250,000	17.44	208,000	12.87	117,000	11.25	91,300
N	17.01	214,000	18.26	239,000	18.75	248,000	16.73	192,000	12.58	112,000	10.82	84,700
4	17.23	218,000	18.47	244,000	18.65	244,000	15.92	176,000	12.35	109,000	10.69	82,700
8	17.45	223,000	18.61	247,000	18.47	237,000	14.99	158,000	12.12	105,000	10.57	80,800
12	17.72	228,000	18.68	248,000	18.26	230,000	14.05	139,000	11.86	101,000	10.46	79,100
	April 26		April 27		April 28		April 29		April 30		May 1	
4	10.40	78,400	9.55	66,100	8.71	55,900	8.18	50,300	8.00	49,100	7.84	47,800
8	10.28	76,600	9.39	64,000	8.60	54,700	8.10	49,600	8.00	49,100	7.82	47,700
N	10.09	73,700	9.23	62,000	8.51	53,700	8.07	49,400	7.97	48,900	7.77	47,200
4	10.00	72,500	9.09	60,300	8.44	53,000	8.05	49,300	7.95	48,800	7.68	46,400
8	9.83	69,900	8.95	58,600	8.36	52,300	8.03	49,200	7.91	48,300	7.60	45,600
12	9.70	68,100	8.83	57,300	8.26	51,100	8.01	49,000	7.89	48,200	7.55	45,100
	May 2		May 3		May 4		May 5		May 6		May 7	
4	7.50	44,600	7.28	42,900	7.07	41,400	6.99	40,600	7.01	40,500	7.10	40,900
8	7.44	44,100	7.25	42,700	7.03	41,100	6.98	40,400	7.02	40,500	7.12	41,000
N	7.40	43,800	7.22	42,500	7.02	41,100	6.98	40,400	7.04	40,600	7.16	41,100
4	7.38	43,700	7.18	42,200	7.02	41,100	6.98	40,300	7.05	40,600	7.18	41,400
8	7.34	43,300	7.14	41,900	7.01	40,900	6.99	40,400	7.08	40,900	7.22	41,700
12	7.31	43,100	7.10	41,600	7.00	40,800	7.00	40,400	7.09	40,800	7.28	42,300
	May 8		May 9		May 10		May 11		May 12		May 13	
4	7.33	42,700	8.68	57,500	9.37	66,300	8.80	58,000	9.09	61,300	8.83	57,400
8	7.42	43,500	9.00	61,600	9.30	65,200	8.79	57,800	9.10	61,300	8.78	56,600
N	7.53	44,500	9.50	68,700	9.21	64,000	8.85	58,400	9.01	60,000	8.60	54,400
4	7.75	46,800	9.80	73,300	9.10	62,300	8.95	59,700	8.98	59,500	8.45	52,600
8	8.07	50,300	9.60	69,900	8.99	60,600	9.00	60,300	8.93	58,800	8.34	51,200
12	8.35	53,500	9.43	67,400	8.87	59,000	9.05	60,900	8.88	58,200	8.25	50,200

Missouri River below Fort Randall Dam, S. Dak.

Location.—Lat. 42°58'55", long. 98°29'35", in SW¼NE¼ sec. 28, T. 35 N., R. 10 W. (Nebraska land lines), 6 miles downstream from Randall Creek, 7 miles downstream from Fort Randall Dam, and 12 miles south of Lake Andes. Datum of gage is 1,230.00 feet above mean sea level, datum of 1929. (Corps of Engineers bench mark.)
Drainage area.—263,530 square miles.
Gage-height record.—Water-stage recorder graph. Once-daily wire-weight gage readings by Weather Bureau, for gage at U. S. Highway 18, about 21 miles upstream, were used Apr. 1-25 to supplement record at recorder site.
Discharge record.—Stage-discharge relation defined by current-meter measurements. Discharge for Apr. 1-25, when no discharge measurements were made at recorder site, was computed on basis of six discharge measurements, and gage heights at U. S. Highway 18 bridge, 21 miles upstream from gage. Shifting-control method used Apr. 26 to June 30. Gage heights used to half tenths.
Maxima.—April-May 1950: Discharge, 249,000 second-feet Apr. 23 (gage height, 15.83 feet), computed on basis of gage heights and discharge measurements at site 21 miles upstream.
1947 to March 1950: Discharge, 182,000 second-feet Apr. 6, 1949 (gage height, 12.36 feet).
Flood of April 1943 reached a stage of about 16.5 feet. Maximum stage known, April 1881, was about 5 feet higher than that of April 1943.
Remarks.—Flow partly regulated by Fort Peck Reservoir.

Mean discharge, in second-feet, 1950

Day	April	May	June	Day	April	May	June	Day	April	May	June
1	63,000	48,900	27,900	11	81,900	75,200	27,000	21	223,000	39,000	34,900
2	107,000	47,100	27,900	12	72,300	64,900	27,900	22	244,000	35,300	33,700
3	96,300	44,200	27,600	13	62,300	63,000	28,200	23	241,000	34,100	33,300
4	77,000	42,000	27,000	14	59,700	57,600	28,800	24	145,000	33,300	45,300
5	69,300	39,500	25,800	15	61,600	50,800	29,400	25	105,000	32,200	52,200
6	82,800	40,500	25,200	16	90,700	47,700	33,300	26	81,000	30,800	56,800
7	83,600	42,000	26,400	17	127,000	48,900	48,300	27	72,600	30,100	63,000
8	91,600	43,100	27,300	18	145,000	49,600	48,300	28	63,000	29,400	61,100
9	88,000	49,600	27,300	19	171,000	46,500	41,500	29	55,200	28,800	56,000
10	87,100	73,800	27,000	20	194,000	43,100	37,100	30	50,200	27,900	52,900
								31	-	27,600	-
Mean monthly discharge, in second-feet									106,400	44,080	36,950
Runoff, in thousand acre-feet									6,330	2,710	2,198
Runoff, in inches									0.45	0.19	0.16

Missouri River at Yankton, S. Dak.

Location.—Lat. 42°52', long. 97°24', between sec. 18, T. 93 N., R. 55 W., and sec. 13, T. 93 N., R. 56 W., at Meridian Highway Bridge in Yankton, 7 miles upstream from James River. Datum of gage is 1,159.68 feet above mean sea level, datum of 1929.
Drainage area.—279,500 square miles.
Gage-height record.—Water-stage recorder graph except Apr. 30 to June 9, when daily gage heights are from graph based on once-daily wire-weight gage readings.
Discharge record.—Stage-discharge relation defined by current-meter measurements. Shifting-control method used throughout period. Gage heights used to half tenths.
Maxima.—April-May 1950: Discharge, 237,000 second-feet Apr. 24 (gage height, 11.60 feet).
1930 to March 1950: Discharge, 282,000 second-feet Apr. 8, 1943; gage height, 14.80 feet Mar. 22, 1932 (ice jam).
Maximum stage known, 30.5 feet, present datum, Apr. 5, 1881 (ice jam).
Remarks.—Flow partly regulated by Fort Peck Reservoir.

Mean discharge, in second-feet, 1950

Day	April	May	June	Day	April	May	June	Day	April	May	June
1	69,400	48,000	25,200	11	96,200	83,800	26,600	21	195,000	45,100	39,800
2	100,000	45,800	25,900	12	85,000	74,700	26,600	22	204,000	39,800	36,800
3	136,000	43,000	27,000	13	73,600	64,400	27,000	23	225,000	38,000	35,200
4	113,000	42,400	27,400	14	66,400	59,700	27,800	24	229,000	37,400	34,600
5	89,900	41,100	26,300	15	58,800	52,700	28,200	25	129,000	38,000	48,800
6	87,400	42,400	26,300	16	69,400	46,500	29,900	26	92,400	35,200	59,700
7	100,000	45,100	25,500	17	129,000	47,200	36,200	27	76,900	32,100	65,400
8	97,500	46,500	25,900	18	152,000	50,300	59,700	28	65,400	30,300	69,400
9	101,000	49,500	26,300	19	182,000	57,900	54,400	29	58,800	29,000	66,400
10	92,400	70,400	27,000	20	193,000	51,100	45,800	30	50,300	27,400	63,500
								31	-	25,900	-
Mean monthly discharge, in second-feet									113,900	46,470	38,150
Runoff, in thousand acre-feet									6,779	2,858	2,270
Runoff, in inches									0.45	0.19	0.15

Missouri River at Sioux City, Iowa

Location.—Lat. 42°29', long. 96°25', in sec. 17, T. 29 N., R. 9 E., sixth principal meridian (Nebraska land lines), at bridge on U. S. Highway 77 at Sioux City, 2.5 miles downstream from Big Sioux River. Datum of gage is 1,076.96 feet above mean sea level, datum of 1929.
Drainage area.—314,600 square miles.
Gage-height record.—Water-stage recorder graph except for April 10, 16, 18, May 9, 10, and June 18 when gage heights were obtained from a graph based on once-daily wire-weight gage readings and the reliable portion of the recorder record.
Discharge record.—Stage-discharge relation defined by current-meter measurements. Shifting-control method used throughout period. Gage heights used to half tenths.
Maxima.—April-May 1950: Discharge, 252,000 second-feet Apr. 25 (gage height, 18.44 feet).
1928-31, 1938 to March 1950: Discharge, 212,000 second-feet Apr. 10, 1943 (gage height, 18.72 feet).
Maximum stage known, 22.5 feet Apr. 23, 1881.
Remarks.—Flow partly regulated by Fort Peck Reservoir.

Mean discharge, in second-feet, 1950

Day	April	May	June	Day	April	May	June	Day	April	May	June
1	74,600	53,900	34,900	11	96,800	76,500	33,400	21	166,000	59,500	49,100
2	84,100	52,700	34,900	12	94,200	74,000	32,700	22	182,000	53,900	45,700
3	133,000	52,100	34,600	13	79,100	63,900	33,000	23	195,000	48,500	43,500
4	139,000	50,900	35,300	14	67,100	62,000	34,900	24	219,000	44,600	39,100
5	109,000	53,300	34,200	15	61,400	61,400	36,500	25	212,000	43,500	39,600
6	92,900	52,100	32,000	16	57,000	56,400	34,600	26	110,000	41,500	60,200
7	97,400	45,100	30,600	17	82,200	53,300	35,300	27	83,500	38,200	68,400
8	102,000	45,100	30,300	18	128,000	53,900	69,600	28	73,400	37,000	75,900
9	101,000	49,100	32,000	19	145,000	60,800	85,400	29	65,800	37,000	73,400
10	98,700	50,300	34,200	20	161,000	70,900	62,700	30	60,200	36,500	65,200
								31	-	35,700	-
Mean monthly discharge, in second-feet									112,400	52,050	45,040
Runoff, in thousand acre-feet									6,687	3,201	2,680
Runoff, in inches									0.40	0.19	0.16

Little Missouri River Basin

Little Missouri River near Watford City, N. Dak.

Location.—Lat. 47°36', long. 103°16', in NW¼ sec. 35, T. 148 N., R. 99 W., at bridge on U. S. Highway 85, 17⅞ miles south of Watford City, and 18 miles upstream from Cherry Creek. Datum of gage is 1929.03 feet above mean sea level, datum of 1929.
Drainage area.—8,490 square miles.
Gage-height record.—Water-stage recorder graph except Mar. 1-5, 8-22, Apr. 21 to May 7, May 20-23 when graph was drawn based on once or twice-daily gage readings.
Discharge record.—Stage-discharge relation defined by current-meter measurements below 67,000 second-feet and extended to peak stage. Shifting-control method used Apr. 22 to June 30. Affected by ice Mar. 1 to Apr. 16.
Maxima.—April-May 1950: Discharge, about 60,000 second-feet 9 a.m. Apr. 9 (gage height, 21.42 feet, backwater from ice).
1934 to March 1950: Discharge, 110,000 second-feet Mar. 25, 1947 (gage height, 24.0 feet, from floodmark).
Remarks.—Some diversions above station for irrigation.

Mean discharge, in second-feet, 1950

Day	March	April	May	June	Day	March	April	May	June
1	0	600	842	334	16	46	14,000	4,560	401
2	0	2,000	798	309	17	112	17,400	4,200	355
3	23	4,000	738	283	18	147	14,800	3,360	488
4	56	6,000	682	265	19	130	10,100	2,270	351
5	114	7,000	682	245	20	114	6,620	1,610	283
6	5,670	7,500	807	233	21	109	4,440	1,110	230
7	8,510	7,000	1,300	221	22	200	3,460	842	202
8	6,340	12,000	2,010	378	23	1,000	2,910	764	183
9	2,190	25,000	2,440	432	24	3,500	2,460	674	169
10	551	17,500	4,800	397	25	2,500	2,310	621	624
11	350	13,000	4,800	346	26	2,000	2,170	558	772
12	200	10,500	5,820	276	27	1,500	2,130	512	666
13	150	9,000	5,520	359	28	1,200	1,880	454	531
14	112	10,000	5,550	309	29	1,000	1,300	417	606
15	74	11,500	5,160	422	30	800	1,040	387	494
					31	700	-	355	-
Mean monthly discharge, in second-feet						1,271	7,654	2,085	372
Runoff, in acre-feet						78,140	455,400	128,200	22,140
Runoff, in inches						0.17	1.01	0.28	0.05

Knife River Basin

Knife River near Golden Valley, N. Dak.

Location.—Lat. 47°09', long. 102°05', in SW¼ sec. 3, T. 142 N., R. 90 W., at county highway bridge, 2½ miles downstream from Elm Creek and 10 miles south of Golden Valley.

Drainage area.—1,230 square miles.

Gage-height record.—Water-stage recorder graph, except for periods Apr. 8, 12-14 (2 p.m.) and June 21 for which there was no record, Apr. 15 (11 p.m.) to Apr. 18 (2 p.m.) when graph was drawn based on floodmark in gage house and outside gage readings on Apr. 17, 18, and Apr. 21 to May 1, May 4-17 when a graph was drawn based on occasional outside gage readings.

Discharge record.—Stage-discharge relation defined by current-meter measurements below 7,750 second-feet and extended to peak stage on basis of normal extension of rating for main channel and estimated flow through overflow section. Gage heights used to hundredths Apr. 15 (12 m.) to May 13; half tenths between 3.8 and 6.9 feet, hundredths below and tenths above these limits May 14 to June 30. Stage-discharge relation affected by ice Apr. 1-15 (12 m.).

Maxima.—April-May 1950: Discharge, 10,900 second-feet 12 p.m. Apr. 16 (gage height, 26.37 feet, from floodmark in well).

1903-19, 1921-24, 1943 to March 1950: Discharge, 7,700 second-feet June 26, 1914 (gage height, 24.0 feet, from floodmark, site and datum then in use).

Maximum stage since 1903, 26.7 feet, from floodmark, Mar. 26, 27, 1943 (discharge, 11,500 second-feet, from rating curve extended above 7,750 second-feet).

Remarks.—Small diversions above station.

Mean discharge, in second-feet, 1950

Day	April	May	June	Day	April	May	June	Day	April	May	June
1	120	138	38	11	1,000	500	33	21	676	75	29
2	100	138	36	12	800	442	32	22	625	69	27
3	100	148	35	13	1,200	472	32	23	504	64	25
4	150	168	34	14	2,000	260	31	24	488	60	27
5	300	188	33	15	4,900	193	31	25	418	56	37
6	500	228	32	16	9,510	154	30	26	310	52	36
7	1,000	324	31	17	10,300	126	30	27	234	50	32
8	1,700	372	35	18	7,550	105	32	28	204	47	32
9	1,500	396	35	19	2,800	93	32	29	184	45	35
10	1,300	527	34	20	1,060	84	30	30	158	42	33
								31	-	39	-
Mean monthly discharge, in second-feet									1,723	182	32.3
Runoff, in acre-feet									102,500	11,220	1,920
Runoff, in inches									1.56	0.17	0.03

Gage height, in feet, and discharge, in second-feet, at indicated time, 1950

Hour	Gage height	Discharge	Gage height	Discharge	Gage height	Discharge	Gage height	Discharge	Gage height	Discharge	Gage height	Discharge
	April 14		April 15		April 16		April 17		April 18		April 19	
2			16.38		23.75	7,680	26.35	10,900	25.21	9,130	18.20	4,140
4			17.24		24.20	8,020	26.32	10,800	25.05	8,920	17.45	3,730
6			17.25		24.62	8,420	26.27	10,800	25.83	8,660	16.80	3,400
8			17.45		25.00	8,860	26.21	10,700	24.54	8,340	16.30	3,150
10			18.18		25.38	9,370	26.14	10,500	24.30	8,110	15.85	2,930
N			19.44	4,870	25.65	9,760	26.07	10,400	24.00	7,860	15.40	2,730
2	15.00	2,100	20.85	5,720	25.87	10,100	25.97	10,300	23.55	7,540	14.93	2,520
4	15.34		21.75	6,300	26.10	10,500	25.86	10,100	22.95	7,120	14.38	2,290
6	15.60		21.97	6,450	26.19	10,600	25.75	9,920	22.15	6,570	13.80	2,060
8	15.66		22.28	6,660	26.28	10,800	25.63	9,740	21.28	6,000	13.18	1,840
10	15.88		22.73	6,970	26.34	10,900	25.50	9,540	20.20	5,330	12.65	1,660
12	16.11		23.25	7,340	26.37	10,900	25.36	9,340	19.10	4,670	12.25	1,520
	April 20		April 21		April 22		April 23		April 24		April 25	
4	11.53	1,310			8.55	606	8.15	533	7.72	459		
8	11.00	1,150	9.07	706	8.70	634	8.03	512	7.73	461	7.62	443
N	10.43	1,000			8.85	662	7.87	485	7.87	485		
4	10.03	910	8.68	630	8.90	672	7.75	464	8.02	510	7.27	388
8	9.73	844			8.57	609	8.05	515	8.08	521		
12	9.48	790	8.48	592	8.20	542	7.85	482	7.94	497	7.00	350
	April 26		April 27		April 28		April 29		April 30		May 1	
4					5.46	190						
8	6.75	318			5.55	197						
N			5.94	231	5.80	218	5.38	183	5.06	158	4.73	135
4	6.60	299			5.75	214						
8					5.66	206						
12	6.40	276	5.56	198	5.59	200	5.21	170	4.91	148	4.74	136
	May 2		May 3		May 4		May 5		May 6		May 7	
4												
8	4.72	134			5.08	160	5.33	179	5.70	209	6.64	304
N			4.91	148								
4	4.78	139			5.25	173	5.46	190	6.02	238	6.95	344
8												
12	4.86	144	4.98	153	5.42	187	5.66	206	6.34	269	7.20	378
	May 8		May 9		May 10		May 11		May 12		May 13	
4	7.18	375	7.13	368			8.07	519			7.94	497
8	7.00	350	7.05	357	8.07	519	7.98	504	7.54	430	8.07	519
N	7.00	350	7.20	378			7.92	493			8.10	524
4	7.18	375	7.39	406	8.30	560	7.85	482	7.48	421	7.83	478
8	7.32	396	7.58	437			7.90	490			7.40	408
12	7.31	394	7.75	464	8.18	538	7.84	480	7.78	470	6.96	345

Knife River at Hazen, N. Dak.

Location.—Lat. 47°17', long. 101°37', in NE¼ sec. 19, T. 144 N., R. 86 W., at county highway bridge, 0.5 mile south of Hazen, and 2 miles upstream from Antelope Creek.
Drainage area.—2,352 square miles.
Gage-height record.—Water-stage recorder graph.
Discharge record.—Stage-discharge relation defined by current-meter measurements below 15,900 second-feet and extended to peak stage on basis of contracted-opening measurement and computed flow over the road at the gage and logarithmic plotting of curve for main channel. Gage heights used to hundredths Apr. 14 to May 13, half tenths between 4.5 feet and 6.5 feet, hundredths below and tenths above these limits, May 14 to June 30. Stage-discharge relation affected by ice Apr. 1-14.
Maxima.—April-May 1950: Discharge, 22,700 second-feet 10-11 a.m. Apr. 17 (gage height, 25.93 feet).
1928-33, 1937 to March 1950: Discharge, 26,500 second-feet (revised) Mar. 26, 27, 1943 (gage height, 26.3 feet).
Remarks.—Some diversions above station. Flow regulated by Ilo Lake (capacity 7,130 acre-feet).

Mean discharge, in second-feet, 1950

Day	April	May	June	Day	April	May	June	Day	April	May	June
1	300	419	140	11	1,900	1,220	120	21	1,820	252	103
2	250	400	135	12	1,600	1,120	120	22	1,670	234	98
3	250	404	130	13	1,700	998	120	23	1,290	222	93
4	350	417	135	14	2,500	892	118	24	1,140	204	95
5	450	430	130	15	5,150	660	114	25	993	193	104
6	800	464	125	16	12,500	504	106	26	787	182	111
7	1,500	537	119	17	21,800	415	106	27	656	176	114
8	2,200	665	130	18	18,600	352	109	28	570	171	105
9	2,100	742	125	19	10,400	310	110	29	499	166	102
10	2,000	958	120	20	4,460	278	106	30	455	155	101
								31	-	150	-
Mean monthly discharge, in second-feet									3,356	461	115
Runoff, in acre-feet									199,700	28,340	6,820
Runoff, in inches									1.59	0.23	0.05

Gage height, in feet, and discharge, in second-feet, at indicated time, 1950

Hour	Gage height	Dis-charge	Gage height	Dis-charge	Gage height	Dis-charge	Gage height	Dis-charge	Gage height	Dis-charge	Gage height	Dis-charge
	April 14		April 15		April 16		April 17		April 18		April 19	
2	13.15	2,000	18.48	4,020	22.93	7,170						
4	13.25	2,050	18.86	4,210	23.18	7,540	25.85	21,900	25.78	21,200	24.68	12,300
6	13.34	2,100	19.18	4,370	23.41	7,920						
8	13.50	2,150	19.48	4,520	23.77	8,590	25.90	22,400	25.69	20,400	24.46	11,000
10	13.73	2,200	19.78	4,690	24.32	10,300						
N	14.03	2,300	20.08	4,860	24.75	12,700	25.92	22,600	25.56	19,100	24.29	10,100
2	14.32	2,400	20.48	5,100	24.92	13,900						
4	14.71	2,550	21.08	5,480	25.05	14,800	25.83	21,700	25.37	17,400	24.10	9,420
6	15.43	2,800	21.78	5,990	25.26	16,500						
8	16.13	3,100	22.21	6,350	25.45	18,100	25.82	21,600	25.16	15,700	23.87	8,810
10	17.08	3,450	22.52	6,660	25.53	18,800						
12	17.81	3,800	22.70	6,870	25.62	19,700	25.79	21,300	24.92	13,900	23.60	8,250
	April 20		April 21		April 22		April 23		April 24		April 25	
4	23.08	7,390	13.68	1,990	12.68	1,670	11.74	1,400	10.69	1,130		
8	20.98	5,410	13.41	1,900	12.73	1,690	11.51	1,330	10.69	1,130	10.25	1,020
N	17.78	3,670	13.11	1,810	13.00	1,770	11.34	1,290	10.70	1,130		
4	15.78	2,770	12.80	1,710	12.84	1,720	11.13	1,230	10.77	1,140	9.89	943
8	14.81	2,390	12.53	1,630	12.43	1,600	10.93	1,180	10.85	1,160		
12	14.10	2,130	12.47	1,610	12.04	1,480	10.76	1,140	10.80	1,150	9.62	884
	April 26		April 27		April 28		April 29		April 30		May 1	
4												
8	9.29	816	8.49	665								
N					7.90	567	7.44	495	7.16	453	6.92	418
4	8.96	751	8.35	642								
8												
12	8.70	703	8.23	621	7.66	529	7.33	478	7.04	435	6.83	405
	May 2		May 3		May 4		May 5		May 6		May 7	
4												
8											7.55	512
N	6.77	397	6.81	402	6.93	419	6.97	425	7.18	456		
4											7.86	561
8												
12	6.81	402	6.86	409	6.95	422	7.11	446	7.48	501	7.97	578
	May 8		May 9		May 10		May 11		May 12		May 13	
4	7.98	580			8.99	757	10.57	1,100				
8	8.12	602	8.80	721	9.31	820	10.71	1,130	10.74	1,140		
N	8.51	670			10.07	982	11.35	1,290			10.06	980
4	8.87	734	9.01	761	10.63	1,110	11.55	1,340	10.50	1,080		
8	8.94	748			10.75	1,140	11.39	1,300				
12	8.87	734	8.98	755	10.67	1,120	11.15	1,240	10.47	1,070	9.99	965

Supplemental record.—Apr. 17, 10-11 a.m., 25.93 ft., 22,700 sec.-ft.; Apr. 20, 2 a.m., 23.42 ft., 7,930 sec.-ft.; 6 a.m., 22.33 ft., 6,460 sec.-ft.; 10 a.m., 19.23 ft., 4,400 sec.-ft.; 2 p.m., 16.61 ft., 3,120 sec.-ft.; 6 p.m., 15.23 ft., 2,550 sec.-ft.; 10 p.m., 14.45 ft., 2,250 sec.-ft.

Spring Creek at Zap, N. Dak.

Location.—Lat. 47°16'50", long. 101°55'10", in SW¼ sec. 14, T. 144 N., R. 89 W., 250 feet downstream from Northern Pacific Railway trestle in Zap and 9 miles upstream from Knife River.
Drainage area.—545 square miles.
Gage-height record.—Water-stage recorder graph, except for periods Apr. 1-15, Apr. 19 to June 23, for which a graph was drawn based on one or more wire-weight gage readings daily.
Discharge record.—Stage-discharge relation defined by current-meter measurements. Gage heights used to hundredths Apr. 14 to May 13, half tenths 3.3 to 5.7 feet, hundredths below and tenths above these limits Apr. 13, May 14 to June 30. Stage-discharge relation affected by ice Apr. 1-12.
Maxima.—April-May 1950: Discharge, 4,580 second-feet 9:30 a.m. Apr. 17 (gage height, 18.80 feet).
1924, 1945 to March 1950: Discharge, 2,890 second-feet Apr. 7, 1949 (gage height, 16.0 feet).
Remarks.—Flow regulated by Ilo Lake (capacity 7,130 acre-feet).

Mean discharge, in second-feet, 1950

Day	April	May	June	Day	April	May	June	Day	April	May	June
1	50	84	26	11	400	167	22	21	272	44	20
2	60	75	25	12	500	230	26	22	211	44	18
3	80	82	27	13	587	238	26	23	171	38	17
4	100	84	28	14	848	182	22	24	165	36	18
5	150	83	26	15	2,470	166	18	25	150	34	22
6	200	95	24	16	4,310	182	19	26	129	32	24
7	400	112	23	17	4,400	150	20	27	117	32	22
8	250	130	20	18	2,290	72	20	28	106	30	23
9	150	153	19	19	745	62	20	29	95	29	22
10	280	166	21	20	391	52	21	30	96	27	21
								31	-	25	-
Mean monthly discharge, in second-feet									672	89.2	22.0
Runoff, in acre-feet									40,010	5,490	1,310
Runoff, in inches									1.38	0.19	0.05

Gage height, in feet, and discharge, in second-feet, at indicated time, 1950

Hour	Gage height	Discharge	Gage height	Discharge	Gage height	Discharge	Gage height	Discharge	Gage height	Discharge	Gage height	Discharge
	April 14		April 15		April 16		April 17		April 18		April 19	
2	8.07	635	12.15	1,540					17.43	3,690		
4	8.07	635	12.62	1,670	17.90	3,980	18.71	4,520	16.95	3,400	10.40	963
6	8.09	638	13.10	1,800					16.30	3,050		
8	8.13	645	13.60	1,960	18.30	4,240	18.79	4,570	15.55	2,680	9.60	795
10	8.21	660	14.15	2,140					14.82	2,350		
N	8.38	692	14.73	2,350	18.63	4,470	18.74	4,540	14.15	2,070	9.08	699
2	8.70	755	15.30	2,580					13.50	1,820		
4	9.40	899	16.00	2,890	18.67	4,500	18.48	4,360	13.00	1,650	8.60	621
6	10.20	1,080	16.58	3,200					12.52	1,510		
8	10.70	1,190	16.92	3,390	18.71	4,520	18.20	4,170	12.11	1,390	8.12	547
10	11.20	1,310	17.22	3,560					11.73	1,290		
12	11.70	1,430	17.50	3,740	18.72	4,530	17.80	3,910	11.37	1,200	7.73	490
	April 20		April 21		April 22		April 23		April 24		April 25	
4												
8	7.12	411					4.71	171				
N			5.79	268	5.19	211			4.68	168	4.45	150
4	6.65	358					4.61	163				
8												
12	6.27	316	5.44	234	4.92	188	4.64	165	4.58	160	4.30	140
	April 26		April 27		April 28		April 29		April 30		May 1	
4												
8												
N	4.13	128	3.98	118	3.81	106	3.61	94	3.70	99	3.41	82
4												
8												
12	4.03	121	3.88	111	3.72	100	3.59	92	3.65	96	3.28	74
	May 2		May 3		May 4		May 5		May 6		May 7	
4												
8									3.54	89		
N	3.27	73	3.40	81	3.45	84	3.42	82			3.87	110
4									3.73	101		
8												
12	3.39	80	3.45	84	3.44	83	3.47	85	3.81	106	4.00	119
	May 8		May 9		May 10		May 11		May 12		May 13	
4									4.85	182		
8									5.11	204	5.73	262
N	4.16	130	4.49	153	4.66	167	4.64	165	5.54	243		
4									5.72	261	5.36	226
8									5.86	275		
12	4.33	142	4.63	164	4.65	166	4.73	172	5.92	281	5.10	203

Supplemental record.—Apr. 17, 9:30 a.m., 18.80 ft., 4,580 sec.-ft.

Heart River Basin

Heart River near South Heart, N. Dak.

Location.—Lat. 46°51'40", long. 102°56'50", in SW¼ sec. 8, T. 139 N., R. 97 W., half a mile downstream from North Creek and 2 miles east of South Heart.
Drainage area.—315 square miles.
Gage-height record.—Water-stage recorder graph, except 12 p.m. Apr. 15 to 6:30 a.m. Apr. 16, and 2:30 p.m. Apr. 16 to 1:30 a.m. Apr. 17, for which record is based on graph drawn through partial record and high-water marks; and 4 a.m. June 28 to June 30, for which record is based on graph drawn through partial record and observer's readings.
Discharge record.—Stage-discharge relation defined by current-meter measurements. Affected by ice Apr. 1-15. Shifting control method used May 7-8, 10-14, 22-25.
Maxima.—April-May 1950: Discharge, 4,080 second-feet 6:30 p.m. Apr. 16 (gage height, 21.67 ft. from floodmark in gage well).
1947 to March 1950: 2,400 second-feet Mar. 31, 1949 (gage height, 17.75 feet).

Mean discharge, in second-feet, 1950

Day	April	May	June	Day	April	May	June	Day	April	May	June
1	15	21	3.5	11	71	251	3.4	21	75	8.1	2.2
2	16	24	3.5	12	482	120	2.9	22	72	7.1	1.9
3	12	22	3.2	13	770	70	2.8	23	61	6.7	1.7
4	11	24	3.0	14	994	44	2.8	24	79	6.2	2.0
5	10	25	2.9	15	2,120	30	3.6	25	73	5.8	2.8
6	12	45	2.9	16	3,740	21	3.0	26	56	5.6	7.1
7	41	69	2.9	17	2,470	18	3.0	27	46	5.0	6.7
8	104	71	3.0	18	1,200	13	3.0	28	33	4.7	4.1
9	143	59	3.2	19	357	11	2.6	29	26	4.2	3.0
10	69	158	4.6	20	115	9.5	2.4	30	22	3.9	2.4
								31	-	3.6	-
Mean monthly discharge, in second-feet									443	37.6	3.20
Runoff, in acre-feet									26,370	2,310	191
Runoff, in inches									1.57	0.14	0.01

Gage height, in feet, and discharge, in second-feet, at indicated time, 1950

Hour	Gage height	Dis-charge	Gage height	Dis-charge	Gage height	Dis-charge	Gage height	Dis-charge	Gage height	Dis-charge	Gage height	Dis-charge
	April 14		April 15		April 16		April 17		April 18		April 19	
2	11.73	874	15.32	1,580	21.15	3,820	20.65	3,570	15.18	1,690	8.91	552
4	11.57	847	15.47	1,630	21.46	3,970	20.14	3,340	14.86	1,620	8.58	509
6	11.36	814	15.58	1,670	20.98	3,730	19.42	3,030	14.50	1,540	8.28	470
8	11.18	786	15.76	1,720	20.62	3,550	18.66	2,720	14.06	1,440	8.01	435
10	11.14	780	16.05	1,810	20.30	3,410	17.89	2,440	13.52	1,320	7.70	398
N	11.53	841	16.38	1,900	20.02	3,280	17.21	2,220	12.92	1,200	7.37	358
2	11.95	911	16.68	1,990	20.65	3,570	16.66	2,060	12.31	1,090	6.98	312
4	12.48	1,000	17.20	2,150	21.23	3,860	16.27	1,960	11.68	976	6.54	265
6	13.35	1,160	17.92	2,380	21.65	4,060	16.00	1,890	11.02	863	6.14	228
8	14.00	1,290	19.06	2,820	21.60	4,040	15.76	1,830	10.40	766	5.81	199
10	14.63	1,420	19.97	3,220	21.36	3,920	15.58	1,790	9.79	675	5.54	177
12	15.10	1,520	20.63	3,540	21.05	3,760	15.40	1,750	9.32	609	5.32	160
	April 20		April 21		April 22		April 23		April 24		April 25	
4	4.96	132	4.16	80	3.84	62	3.73	56	3.86	63	4.23	84
8	4.79	120	4.08	75	3.98	69	3.76	58	3.97	68	4.00	70
N	4.72	115	4.07	74	4.23	84	3.89	64	4.04	72	4.03	72
4	4.58	106	4.12	77	4.17	80	3.92	66	4.14	78	3.98	69
8	4.38	93	4.03	72	4.03	72	3.83	62	4.58	106	3.85	62
12	4.26	86	3.90	65	3.84	62	3.76	58	4.58	106	3.72	56
	April 26		April 27		April 28		April 29		April 30		May 1	
4											2.90	20
8	3.66	53									2.89	20
N			3.52	46	3.22	33	3.03	25	2.94	22	2.88	20
4	3.75	58									2.88	20
8											2.94	22
12	3.70	55	3.33	37	3.12	29	3.01	24	2.92	21	2.98	23
	May 2		May 3		May 4		May 5		May 6		May 7	
4	2.95	22	2.96	23	3.02	25	3.00	24	3.03	25	3.67	54
8	2.92	21	2.92	21	2.97	23	3.00	24	3.08	27	3.87	64
N	2.97	23	2.90	20	2.95	22	3.01	24	3.20	32	4.21	82
4	3.07	27	2.91	21	3.00	24	3.04	26	3.94	67	4.18	80
8	3.08	27	3.00	24	3.03	25	3.05	26	4.07	74	3.98	69
12	3.02	25	3.04	26	3.02	25	3.01	24	3.80	60	3.95	68
	May 8		May 9		May 10		May 11		May 12		May 13	
4	4.05	73	3.82	61	4.14	78	6.81	275	5.30	150	4.18	80
8	4.08	74	3.76	58	5.21	144	6.87	281	5.00	130	4.10	75
N	4.06	74	3.72	56	5.92	197	6.80	274	4.73	113	4.46	68
4	3.97	68	3.75	58	5.77	186	6.55	250	4.53	99	4.22	64
8	4.01	71	3.75	58	5.83	190	6.14	215	4.39	92	4.02	61
12	3.90	65	3.88	64	6.45	242	5.69	180	4.28	86	3.87	56

Supplemental Record.—Apr. 16, 3:30 a.m., 21.50 ft., 3,990 sec.-ft.; 6:30 p.m., 21.67 ft., 4,080 sec.-ft.; Apr. 21, 3:30 p.m., 4.07 ft., 74 sec.-ft.; Apr. 22, 5:30 p.m., 4.11 ft., 77 sec.-ft.; 6:00 p.m., 4.18 ft., 81 sec.-ft.; Apr. 24, 10 p.m., 4.66 ft., 111 sec.-ft.; May 5, 6:00 p.m., 3.08 ft., 27 sec.-ft.; May 6, 6:00 p.m., 4.12 ft., 77 sec.-ft.; May 7, 2:00 p.m., 4.24 ft., 84 sec.-ft.; May 8, 5:30 p.m., 3.93 ft., 66 sec.-ft.; 6:00 p.m., 4.06 ft., 74 sec.-ft.; May 13, 11 a.m., 4.02 ft., 71 sec.-ft.

Heart River at Lehigh, N. Dak.

Location.—Lat. 46°52', long. 102°43', in NE¼ sec. 7, T. 139 N., R. 95 W., at county highway bridge in Lehigh, 150 feet downstream from Northern Pacific Railway bridge, and about 10 miles upstream from Green River.

Drainage area.—453 square miles.

Gage-height record.—Graph based on twice-daily wire-weight gage readings except May 15 to June 24, June 26-30, when average of usually twice-daily readings was used. No record May 27 to June 5.

Discharge record.—Stage-discharge relation defined by current meter measurements below 5,000 second-feet and extended to peak stage. Stage-discharge relation affected by ice Apr. 1-15. Shifting control method used Apr. 20 to June 30. Discharge for period of no gage-height record computed on basis of records for station near South Heart.

Maxima.—April-May 1950: Discharge, 5,980 second-feet 12 p.m. Apr. 15 (gage height, 17.90 feet, from high-water mark).
1943 to March 1950: Discharge, 5,420 second-feet Mar. 25, 1943; gage height, 17.7 feet from floodmark Mar. 25, 1943, and Mar. 13, 1945. The flood of Apr. 15, 1950 is the greatest known.

Mean discharge, in second-feet, 1950

Day	April	May	June	Day	April	May	June	Day	April	May	June
1	40	36	3.6	11	68	284	1.7	21	203	26	1.3
2	50	40	3.4	12	350	253	1.7	22	136	26	1.3
3	44	41	3.2	13	860	118	1.7	23	127	24	1.3
4	35	42	2.9	14	1,250	88	1.7	24	134	12	1.7
5	30	41	2.6	15	3,090	63	1.7	25	139	7.4	29
6	25	46	2.3	16	4,460	43	1.9	26	89	5.8	4.6
7	30	72	2.1	17	3,210	27	1.9	27	71	5.0	4.9
8	40	106	2.1	18	1,890	24	1.9	28	62	4.5	6.1
9	60	102	1.9	19	781	23	1.9	29	44	4.2	1.7
10	100	216	1.7	20	334	24	1.6	30	38	4.0	1.0
								31	-	3.8	-
Mean monthly discharge, in second-feet									593	58.4	3.21
Runoff, in acre-feet									35,280	3,590	191
Runoff, in inches									1.46	0.15	0.008

Gage height, in feet, and discharge, in second-feet, at indicated time, 1950

Hour	Gage height	Discharge	Gage height	Discharge	Gage height	Discharge	Gage height	Discharge	Gage height	Discharge	Gage height	Discharge
	April 14		April 15		April 16		April 17		April 18		April 19	
2			12.89	1,760	17.20	5,490	15.13	4,070				
4	12.07	1,050	12.95	1,880	15.70	4,460	15.00	3,980	12.20	2,280	9.44	1,060
6			13.12	2,020	15.44	4,280	14.84	3,880				
8	12.13	1,130	13.45	2,180	15.38	4,240	14.40	3,590	11.90	2,120	8.90	895
10			13.80	2,370	15.35	4,220	13.87	3,250				
N	12.30	1,220	14.10	2,600	15.35	4,220	13.55	3,050	11.45	1,900	8.50	775
2			14.50	2,850	15.38	4,240	13.30	2,900				
4	12.24	1,340	14.90	3,200	15.50	4,320	13.05	2,750	11.03	1,690	8.03	642
6			16.50	5,000	15.60	4,390	12.88	2,650				
8	12.78	1,470	15.50	4,320	15.50	4,320	12.78	2,600	10.55	1,480	7.38	485
10			16.60	5,070	15.38	4,240	12.63	2,520				
12	12.82	1,650	17.90	5,980	15.26	4,160	12.50	2,440	10.00	1,260	7.00	403
	April 20		April 21		April 22		April 23		April 24		April 25	
4	6.70	336	6.12	220	5.65	146			5.63	120		
8	6.55	305	6.02	204	5.55	131	5.62	128	5.60	116	5.90	152
N	6.68	325	5.98	197	5.55	129			5.54	109		
4	6.86	357	5.96	191	5.58	130	5.63	126	5.50	103	5.62	120
8	6.80	344	5.95	187	5.60	130			6.30	201		
12	6.42	272	5.80	166	5.61	130	5.64	123	6.17	184	5.44	103
	April 26		April 27		April 28		April 29		April 30		May 1	
4					4.90	66			4.46	37		
8	5.30	92	5.01	72	4.85	63	4.63	49	4.48	39	4.42	35
N					4.80	59			4.49	40		
4	5.12	78	4.99	71	4.79	59	4.44	36	4.46	38	4.44	37
8					4.80	60			4.44	36		
12	5.04	73	4.94	68	4.76	57	4.44	36	4.42	35	4.37	33
	May 2		May 3		May 4		May 5		May 6		May 7	
4	4.33	30										
8	4.34	31	4.45	38	4.51	43	4.45	40	4.48	42	4.80	67
N	4.44	37										
4	4.60	49	4.48	41	4.48	42	4.47	41	4.56	48	4.96	79
8	4.63	51										
12	4.57	46	4.50	42	4.46	40	4.48	42	4.66	56	5.12	94
	May 8		May 9		May 10		May 11		May 12		May 13	
4			5.18	100			6.28	244				
8	5.25	107	5.15	98	6.15	222	6.34	253	6.52	286	5.34	120
N			5.12	95			6.52	284				
4	5.30	112	5.10	94	6.23	236	6.70	318	6.17	228	5.14	100
8			5.20	103			6.75	327				
12	5.22	104	5.50	135	6.28	244	6.70	318	5.78	174	5.08	94

Supplemental record.—Apr. 20 6:00 p.m., 6.88 ft., 359 sec.-ft.; Apr. 24 6:00 p.m., 6.34 ft., 205 sec.-ft.

Heart River near Richardton, N. Dak.

Location.—Lat. 46°44'46", long. 102°18'27", in NE¼ sec. 29, T. 138 N., R. 92 W., at bridge on State Highway 8, half a mile downstream from Blacktail Creek and 9½ miles south of Richardton. Datum of gage is 2,153.67 feet above mean sea level, datum of 1929.

Drainage area.—1,310 square miles.

Gage-height record.—Water-stage recorder graph except 8 p.m. Apr. 16 to 2 a.m. Apr. 17 (when record is based on partial record and high-water mark) and 11 a.m. Apr. 18 to June 30 (for which a graph was drawn based on once or twice-daily readings of the outside wire-weight gage).

Discharge record.—Stage-discharge relation defined by current-meter measurements below 19,000 second-feet and extended to peak stage. Affected by ice Apr. 1-17. Shifting control method used May 12-25.

Maxima.—April-May 1950: Discharge, 23,400 second-feet 11 p.m. Apr. 16 (gage height, 28.05 feet, from high-water mark in gage house).

1903-22, 1943 to March 1950: Discharge, 11,700 second-feet Mar. 25, 1943 (gage height, 24.2 feet, from floodmarks).

The flood of July 5, 1938, reached a stage of about 26.0 feet, from information by local resident (discharge 16,000 second-feet, revised).

Remarks.—No appreciable diversion or regulation above station.

Mean discharge, in second-feet, 1950

Day	April	May	June	Day	April	May	June	Day	April	May	June
1	277	181	38	11	811	508	33	21	705	119	30
2	247	185	35	12	811	808	31	22	570	100	23
3	229	182	32	13	1,450	568	35	23	442	88	20
4	291	184	29	14	3,350	347	26	24	424	78	22
5	234	180	32	15	7,040	252	24	25	433	70	37
6	261	178	31	16	16,300	198	22	26	380	62	58
7	368	188	28	17	17,000	167	20	27	275	56	45
8	330	225	42	18	7,540	145	22	28	233	46	42
9	182	263	51	19	2,560	132	26	29	210	44	36
10	430	325	41	20	1,220	121	30	30	189	45	28
								31	-	42	-
Mean monthly discharge, in second-feet									2,160	196	32.3
Runoff, in acre-feet									128,500	12,070	1,920
Runoff, in inches									1.84	0.17	0.03

Gage height, in feet, and discharge, in second-feet, at indicated time, 1950

Hour	Gage height	Dis-charge	Gage height	Dis-charge	Gage height	Dis-charge	Gage height	Dis-charge	Gage height	Dis-charge	Gage height	Dis-charge
	April 14		April 15		April 16		April 17		April 18		April 19	
2	12.68	2,730	16.26	4,930	25.18	13,600	27.07	19,500				
4	12.81	2,890	17.06	5,490	25.04	13,400	26.87	18,100	23.10	10,400	13.67	3,300
6	13.16	3,080	17.35	5,700	25.04	13,400	26.50	17,600				
8	13.48	3,180	17.74	5,970	25.11	13,500	26.38	17,100	21.19	8,610	12.93	2,860
10	13.76	3,320	17.81	6,020	25.61	14,800	26.54	17,700				
N	16.40	3,440	17.88	6,070	25.73	15,200	26.55	17,700	19.05	6,940	12.21	2,470
2	15.18	3,550	18.62	6,620	25.66	14,800	26.42	17,300				
4	14.40	3,640	19.48	7,260	26.53	17,700	26.24	16,700	17.77	5,990	11.54	2,120
6	14.15	3,620	20.68	8,190	26.73	18,400	25.94	15,800				
8	13.98	3,530	22.38	9,280	27.16	19,900	25.60	14,800	16.60	5,170	11.07	1,880
10	14.46	3,790	23.80	10,400	27.93	22,900	25.17	13,700				
12	15.23	4,250	24.95	12,700	27.93	22,900	24.59	12,500	14.45	3,770	10.62	1,680
	April 20		April 21		April 22		April 23		April 24		April 25	
4	10.15	1,470	8.44	726	8.25	651						
8	9.82	1,320	8.38	702	8.17	621	7.63	441	7.57	423	7.62	438
N	9.56	1,200	8.36	694	8.03	570						
4	9.30	1,080	8.34	686	7.89	522	7.61	435	7.56	420	7.62	438
8	9.05	972	8.31	674	7.80	492						
12	8.72	838	8.28	662	7.73	471	7.59	429	7.59	429	7.55	417
	April 26		April 27		April 28		April 29		April 30		May 1	
4												
8	7.49	399	7.08	284	6.90	237	6.81	214				
N									6.70	189	6.66	180
4	7.39	369	6.97	254	6.87	230	6.77	205				
8												
12	7.25	330	6.92	242	6.85	224	6.73	196	6.67	182	6.67	182
	May 2		May 3		May 4		May 5		May 6		May 7	
4												
8												
N	6.69	187	6.66	180	6.69	187	6.66	180	6.65	178	6.67	182
4												
8												
12	6.68	185	6.68	185	6.66	180	6.65	178	6.66	180	6.78	207
	May 8		May 9		May 10		May 11		May 12		May 13	
4							7.57	423	8.58	798		
8							7.67	453	8.68	854	8.03	614
N	6.84	222	7.00	262	7.20	316	7.78	486	8.70	878		
4							7.93	536	8.60	838	7.75	515
8							8.13	606	8.43	770		
12	6.94	247	7.07	281	7.45	387	8.38	702	8.30	718	7.48	432

Supplemental record.—Apr. 14, 1:30 a.m., 12.82 ft., 2,680 sec.-ft.; 2:30 a.m., 1,259 ft., 2,760 sec.-ft.; 8:30 a.m., 13.90 ft., 3,220 sec.-ft.; 11 a.m., 16.03 ft., 3,380 sec.-ft.; 12:30 p.m., 16.72 ft., 3,460 sec.-ft.; 5:30 p.m., 14.27 ft., 3,690 sec.-ft.; Apr. 15, 9:30 p.m., 23.83 ft., 10,100 sec.-ft.; 10:30 p.m., 23.69 ft., 11,100 sec.-ft.; Apr. 16, 1 a.m., 25.44 ft., 13,300 sec.-ft.; 9 a.m., 25.83 ft., 14,200 sec.-ft.; 11 p.m. 28.05 ft., 23,400 sec.-ft.; Apr. 17, 3 a.m., 26.77 ft., 18,500 sec.-ft.; 11 a.m., 26.59 ft., 17,900 sec.-ft.

Heart Butte Reservoir near Glen Ullin, N. Dak.

Location.—Lat. 46°35'48", long. 101°48'34", in SW¼NE¼ sec. 13, T. 136 N., R. 89 W., 10 miles upstream from Heart Butte Creek, 14 miles south of Glen Ullin, and 14 miles north of Elgin. Datum of gage is mean sea level, datum of 1929 (Bureau of Reclamation bench mark).

Drainage area.—1,760 square miles.

Gage-height record.—Computed on basis of graph drawn through gage readings, which were made from one to three times a day, except on Apr. 2, 8, 9, May 6, 7, 14, 28, 30, June 4, 11, 17, 18, 23, 24, 25, 28. Gage read to tenths prior to Apr. 20 and to hundredths thereafter.

Maxima.—April-May 1950: Contents, 148,490 acre-feet 12:30 p.m. Apr. 19 (elevation, 2,081.74 feet).

Remarks.—Reservoir is formed by earth-filled dam; storage began Sept. 29, 1949; dam completed Dec. 9, 1949. Total capacity is 423,000 acre-feet at maximum pool, elevation 2,118.2 feet. Dead storage is 6,800 acre-feet below lowest point of outlet, elevation 2,030.0 feet. Active conservation storage is 68,700 acre-feet between elevation 2,030.0 feet and crest of spillway, elevation 2,064.5 feet. Figures given herein represent total contents. Controlled releases are through 4 foot by 5 foot slide gate. The spillway is uncontrolled "glory hole" type and discharges through a conduit 14 feet in diameter. The reservoir is for flood control, irrigation and incidental water supply.

Cooperation.—Gage-height record and capacity table furnished by Bureau of Reclamation.

Elevation,* in feet, and contents, in acre-feet, at 12 p.m. of indicated day, 1950

Day	April		May		June	
	Feet	Acre-feet	Feet	Acre-feet	Feet	Acre-feet
1	41.1	18,660	67.43	85,580	63.52	72,020
2	41.4	19,100	66.98	83,950	63.40	71,620
3	41.6	19,400	66.67	82,840	63.36	71,490
4	41.9	19,850	66.47	82,120	63.33	71,390
5	42.3	20,460	66.32	81,590	63.27	71,190
6	43.1	21,720	-	-	63.20	70,960
7	43.9	23,030	66.03	80,580	63.32	71,360
8	-	-	66.05	80,640	63.48	71,880
9	44.6	24,210	66.01	80,500	63.34	71,420
10	44.9	24,730	65.97	80,360	63.17	70,860
11	45.2	25,250	65.91	80,160	63.12	70,700
12	45.8	26,320	65.88	80,050	63.09	70,600
13	46.3	27,230	65.83	79,880	63.09	70,600
14	48.4	31,280	65.76	79,630	63.09	70,600
15	56.1	49,500	65.64	79,210	63.13	70,730
16	67.9	87,300	65.49	78,690	63.10	70,630
17	77.6	127,900	65.23	77,790	-	-
18	81.6	147,760	65.13	77,440	63.08	70,560
19	81.5	147,240	64.94	76,800	63.05	70,460
20	80.6	142,630	64.76	76,180	62.97	70,200
21	79.53	137,250	64.64	75,780	62.96	70,170
22	78.35	131,480	64.48	75,230	62.95	70,140
23	77.08	125,400	64.34	74,160	-	-
24	75.92	120,120	64.18	74,220	-	-
25	74.58	114,150	64.01	73,650	62.84	69,780
26	73.18	108,140	63.88	73,210	62.84	69,780
27	71.70	102,000	63.75	72,780	62.85	69,820
28	70.36	96,650	63.64	72,410	62.80	69,650
29	69.04	91,570	63.55	72,120	62.73	69,420
30	68.09	88,000	63.59	72,250	62.70	69,320
31	-	-	63.53	72,050	-	-
Change in Contents, Acre-feet		+70,060		-15,950		-2,730
Change in Contents, Equivalent Mean Second-feet		+ 1,177		- 259		- 45.9

Elevation,* in feet, and contents, in acre-feet, at indicated time, 1950

Hour	Feet	Acre-feet	Feet	Acre-feet	Feet	Acre-feet	Feet	Acre-feet	Feet	Acre-feet	Feet	Acre-feet
	April 14		April 15		April 16		April 17		April 18		April 19	
4												
8	46.5	27,600	50.2	35,030	59.8	60,190	71.7	102,000	79.7	138,100	81.7	148,280
N												
4	47.0	28,540	53.0	41,470	63.9	73,280	74.9	115,560	81.2	145,700	81.7	148,280
8												
12	48.4	31,280	56.1	49,500	67.9	87,300	77.6	127,900	81.6	147,760	81.5	147,240
	April 20		April 21		April 22		April 23		April 24		April 25	
4												
8	81.2	145,700	80.25	140,860	79.15	135,380	77.92	129,420	76.68	123,600	75.53	118,360
N												
4	80.8	143,650	79.90	139,100	78.78	133,560	77.47	127,280	76.37	122,170	75.01	116,040
8												
12	80.6	142,630	79.53	137,250	78.35	131,480	77.08	125,460	75.92	120,120	74.58	114,150

*Add 2,000 to obtain elevation above mean sea level.

Heart Butte Reservoir near Glen Ullin, N. Dak.--Continued

Elevation,* in feet, and contents, in acre-feet, at indicated time, 1950

Hour	Feet	Acre-feet	Feet	Acre-feet	Feet	Acre-feet	Feet	Acre-feet	Feet	Acre-feet	Feet	Acre-feet
	April 26		April 27		April 28		April 29		April 30		May 1	
4												
8	74.11	112,110	72.72	106,200	71.25	100,180	69.91	94,900	68.66	90,130	67.84	87,080
N												
4	73.63	110,050	72.23	104,170	70.83	98,510	69.45	93,130	68.35	88,980	67.62	86,270
8												
12	73.18	108,140	71.70	102,000	70.36	96,650	69.04	91,570	68.09	88,000	67.43	85,580

Supplemental record.- Apr. 19, 12:30 p.m, 81.74 ft., contents, 148,490 acre-ft.
*Add 2,000 to obtain elevation above mean sea level.

Heart River below Heart Butte Dam near Glen Ullin, N. Dak.

Location.—Lat. 46°36'50", long. 101°48'05", in NE¼ sec. 13, T. 136 N., R. 89 W., 0.5 mile downstream from Heart Butte Dam, 10 miles upstream from Heart Butte Creek, 14 miles south of Glen Ullin, and 14 miles north of Elgin.
Drainage area.—1,760 square miles.
Gage-height record.—Water-stage recorder graph.
Discharge record.—Stage-discharge relation defined by current-meter measurements. Stage-discharge relation affected by ice Apr. 1-18.
Maxima.—April-May 1950: Discharge, 3,840 second-feet 10 p.m. Apr. 19; gage height, 7.55 feet, affected by ice, 2:30 a.m. Apr. 17.
1943 to March 1950: Discharge, 25,000 second-feet Mar. 24, 1947 (gage height, 21.5 feet, former site and datum, from floodmark, affected by ice).
Remarks.—Flow regulated by Heart Butte Reservoir after Sept. 29, 1949. Small diversions above station for irrigation.

Mean discharge, in second-feet, 1950

Day	April	May	June	Day	April	May	June	Day	April	May	June
1	0	1,470	108	11	4	781	86	21	3,760	417	76
2	1	1,130	109	12	50	774	82	22	3,720	398	76
3	3	904	105	13	6	783	57	23	3,660	410	76
4	3	777	102	14	39	761	60	24	3,560	342	79
5	4	688	92	15	66	682	55	25	3,460	378	79
6	10	588	102	16	272	626	79	26	3,360	330	79
7	5	513	92	17	3,370	561	79	27	3,270	307	79
8	3	508	92	18	3,680	514	76	28	3,160	293	79
9	3	591	92	19	3,790	483	76	29	2,940	201	82
10	3	737	86	20	3,800	442	76	30	2,090	115	67
								31	-	87	-
Mean monthly discharge, in second-feet									1,603	567	82.6
Runoff, in acre-feet									95,390	34,890	4,910
Runoff, in inches									1.02	0.37	0.05

Gage height, in feet, and discharge, in second-feet, at indicated time, 1950

Hour	Gage height	Dis-charge	Gage height	Dis-charge	Gage height	Dis-charge	Gage height	Dis-charge	Gage height	Dis-charge	Gage height	Dis-charge
	April 14		April 15		April 16		April 17		April 18		April 19	
2	1.40	0	2.25	70	1.77	5	7.25	3,040	6.58	3,600	6.83	3,740
4	1.38	0	2.22	62	1.70	3	7.00	3,240	6.62	3,620	6.84	3,750
6	1.38	0	2.17	51	1.63	2	6.88	3,330	6.64	3,640	6.85	3,760
8	1.38	0	2.12	41	1.57	1	6.75	3,390	6.72	3,670	6.86	3,780
10	1.45	0	2.10	36	1.61	2	6.62	3,430	6.79	3,700	6.86	3,780
N	1.73	3	2.43	119	2.01	38	6.41	3,450	6.77	3,680	6.87	3,790
2	2.00	15	2.55	164	2.08	54	6.25	3,480	6.77	3,680	6.87	3,790
4	2.45	126	2.44	122	1.98	29	6.24	3,490	6.77	3,680	6.88	3,800
6	2.41	112	2.21	62	1.83	9	6.32	3,510	6.81	3,720	6.89	3,810
8	2.33	89	1.98	14	3.35	488	6.37	3,530	6.82	3,730	6.90	3,820
10	2.30	82	1.90	9	4.95	1,480	6.44	3,560	6.83	3,740	6.92	3,840
12	2.28	76	1.84	6	6.02	2,340	6.51	3,580	6.82	3,730	6.91	3,830
	April 20		April 21		April 22		April 23		April 24		April 25	
4												
8												
N	6.88	3,800	6.84	3,750	6.80	3,710	6.75	3,660	6.66	3,560	6.56	3,450
4												
8												
12	6.87	3,790	6.82	3,730	6.80	3,710	6.71	3,610	6.62	3,510	6.53	3,420
	April 26		April 27		April 28		April 29		April 30		May 1	
4							6.20	3,090				
8							6.18	3,070	5.30	2,230	4.48	1,540
N	6.47	3,360	6.38	3,270	6.27	3,160	6.15	3,040				
4							6.02	2,910	4.94	1,910	4.28	1,380
8							5.83	2,720				
12	6.42	3,310	6.33	3,220	6.21	3,100	5.63	2,530	4.70	1,720	4.08	1,240
	May 2		May 3		May 4		May 5		May 6		May 7	
4							3.25	704				
8	3.97	1,160					3.26	710	3.08	609		
N			3.57	893	3.38	778	3.24	698			2.88	504
4	3.88	1,100					3.23	693	2.99	561		
8							3.13	637				
12	3.73	996	3.47	832	3.28	721	3.15	648	2.95	540	2.88	504
	May 8		May 9		May 10		May 11		May 12		May 13	
4			2.90	514	3.20	676						
8			2.92	524	3.20	676						
N	2.89	509	2.92	524	3.42	802	3.38	778	3.37	773	3.40	790
4			3.24	698	3.41	796						
8			3.20	676	3.40	790						
12	2.89	509	3.20	676	3.40	790	3.38	778	3.37	773	3.38	778

Supplemental record.—Apr. 17, 2:30 a.m., 7.55 ft., 4,430 sec.-ft.; May 9, 1:30 p.m., 2.90 ft., 514 sec.-ft.; 2 p.m., 3.30 ft., 732 sec.-ft.; May 10, 11:30 a.m., 3.22 ft., 687 sec.-ft.

Heart River near Lark, N. Dak.

Location.—Lat. 46°36'00", long. 101°22'30", in S½ sec. 9, T. 136 N., R. 85 W., at bridge on State Highway 31, 1 mile downstream from Muddy Creek and 10 miles north of Lark.

Drainage area.—2,810 square miles; 1,760 square miles affected by storage in Heart Butte Reservoir.

Gage-height record.—Water-stage recorder graph, except for periods Apr. 1 to 12 m. Apr. 17 and 10 p.m. Apr. 19 to 1 p.m. Apr. 21, for which a graph was drawn based on daily wire-weight gage readings.

Discharge record.—Stage-discharge relation defined by current-meter measurements below 9,200 second-feet and extended to peak stage on basis of contracted-opening measurement including discharge over road. Stage-discharge relation affected by ice Apr. 1 to 6 a.m. Apr. 17.

Maxima.—April-May 1950: Discharge, 29,200 second-feet 9 p.m. Apr. 17 (gage height, 20.70 feet).

1946 to March 1950: Discharge, 10,400 second-feet Mar. 25, 1947, affected by ice (gage height, 15.85 feet).

Remarks.—Flow partly regulated by Heart Butte Reservoir (see page 46). Small diversions above station for irrigation.

Mean discharge, in second-feet, 1950

Day	April	May	June	Day	April	May	June	Day	April	May	June
1	45	1,840	145	11	350	1,780	180	21	5,910	547	103
2	60	1,480	130	12	320	1,660	162	22	5,960	511	103
3	90	1,250	139	13	350	1,400	154	23	5,390	481	100
4	130	1,080	137	14	430	1,260	145	24	4,810	492	110
5	250	990	136	15	1,140	1,070	120	25	4,170	411	122
6	550	913	129	16	5,060	934	112	26	3,710	418	122
7	650	868	202	17	22,000	830	108	27	3,440	369	112
8	550	970	868	18	23,200	732	106	28	3,310	354	106
9	500	1,140	394	19	14,000	682	104	29	3,170	339	103
10	450	1,520	227	20	7,840	611	103	30	2,550	251	101
								31	-	156	-
Mean monthly discharge, in second-feet									4,013	882	163
Runoff, in acre-feet									238,800	54,230	9,690
Runoff, in inches									1.59	0.36	0.06

Gage height, in feet, and discharge, in second-feet, at indicated time, 1950

Hour	Gage height	Dis-charge	Gage height	Dis-charge	Gage height	Dis-charge	Gage height	Dis-charge	Gage height	Dis-charge	Gage height	Dis-charge
	April 14		April 15		April 16		April 17		April 18		April 19	
2					12.00	3,500	15.20	9,910				
4					13.80	5,050	16.50	13,000	20.20	26,700		
6			7.10	620	13.42	4,870	17.95	17,500			17.40	16,300
8					13.00	4,720	18.80	21,000	19.93	25,400		
10					12.75	4,650	19.27	22,800				
N	6.82	410	7.80	900	12.57	4,700	19.52	23,800	19.38	23,200	16.47	13,700
2					12.52	4,790	19.63	24,200				
4					12.55	5,020	20.38	27,600	18.71	20,600		
6			9.00	1,460	12.70	5,370	20.46	28,000			15.61	11,700
8					13.05	5,940	20.55	28,400	18.40	19,600		
10					13.55	6,750	20.68	29,100				
12	6.98	530	10.90	2,620	14.30	8,120	20.62	28,800	18.13	18,600	14.85	10,200
	April 20		April 21		April 22		April 23		April 24		April 25	
4			11.98	6,010	12.12	6,170	11.63	5,620				
8	13.75	8,340	11.39	5,910	12.05	6,090	11.59	5,580	11.00	4,930	10.38	4,250
N			11.78	5,790	12.00	6,030	11.49	5,470				
4	12.83	7,050	11.75	5,760	11.89	5,910	11.27	5,230	10.84	4,750	10.18	4,050
8			11.90	5,920	11.71	5,710	11.18	5,130				
12	12.05	6,090	12.02	6,050	11.61	5,600	11.09	5,030	10.59	4,480	10.08	3,950
	April 26		April 27		April 28		April 29		April 30		May 1	
4												
8	9.88	3,750	9.60	3,470	9.48	3,350	9.35	3,220				
N									8.60	2,530	7.76	1,800
4	9.78	3,650	9.54	3,410	9.41	3,280	9.30	3,170				
8												
12	9.63	3,500	9.52	3,390	9.36	3,230	9.15	3,020	8.15	2,120	7.55	1,630
	May 2		May 3		May 4		May 5		May 6		May 7	
4												
8												
N	7.33	1,460	7.01	1,240	6.77	1,070	6.62	982	6.50	910	6.42	862
4												
8												
12	7.19	1,360	6.88	1,150	6.72	1,040	6.58	958	6.44	874	6.44	874
	May 8		May 9		May 10		May 11		May 12		May 13	
4			6.92	1,170	7.06	1,270	7.60	1,670	7.57	1,650		
8	6.47	892	6.91	1,170	7.21	1,380	7.67	1,730	7.62	1,690	7.26	1,410
N			6.85	1,120	7.39	1,500	7.81	1,840	7.66	1,720		
4	6.67	1,010	6.82	1,100	7.69	1,740	7.89	1,900	7.58	1,690	7.20	1,370
8			6.86	1,130	7.75	1,790	7.79	1,820	7.52	1,610		
12	6.87	1,140	6.97	1,210	7.63	1,690	7.64	1,700	7.44	1,540	7.12	1,310

Heart River near Mandan, N. Dak.

Location.—Lat. 46°50', long. 100°59', in NE¼NW¼ sec. 25, T. 139 N., R. 82 W., at bridge on U. S. Highway 10, 3 miles west of Mandan and 4 miles downstream from Sweetbriar Creek. Datum of gage is 1,638.70 feet above mean sea level, datum of 1929, and 1,632.03 feet above Northern Pacific Railway datum.
Drainage area.—3,360 square miles; 1,760 square miles affected by storage in Heart Butte Reservoir.
Gage-height record.—Water-stage recorder graph, except for period Apr. 1-15, for which a graph was drawn based on twice-daily wire-weight gage readings.
Discharge record.—Stage-discharge relation defined by current-meter measurements. Stage-discharge relation affected by ice Apr. 1-15. Shifting-control method used Apr. 16.
Maxima.—April-May 1950: Discharge, 30,500 second-feet 4 a.m. Apr. 19 (gage height, 23.64 feet).
1924, 1928-33, 1937 to March 1950: Discharge, 21,400 second-feet Mar. 27, 1943 (gage height, 24.7 feet).
Remarks.—Flow partly regulated by Heart Butte Reservoir (see page 46). Small diversions above station for irrigation.

Mean discharge, in second-feet, 1950

Day	April	May	June	Day	April	May	June	Day	April	May	June
1	80	2,960	269	11	500	2,790	434	21	9,910	888	182
2	110	2,380	218	12	450	2,790	350	22	9,630	800	163
3	150	2,060	187	13	500	2,340	289	23	8,360	720	148
4	190	1,800	180	14	713	1,940	257	24	7,520	660	175
5	360	1,570	173	15	2,200	1,740	233	25	6,110	685	204
6	770	1,450	175	16	10,200	1,520	204	26	5,160	596	185
7	900	1,310	286	17	21,200	1,350	187	27	4,630	614	187
8	800	1,300	2,270	18	28,400	1,260	175	28	4,270	538	163
9	700	1,540	1,440	19	27,900	1,160	180	29	4,050	502	152
10	620	2,190	755	20	16,400	1,010	185	30	3,760	474	150
								31	-	430	-
Mean monthly discharge, in second-feet									5,885	1,399	339
Runoff, in acre-feet									350,200	86,020	20,140
Runoff, in inches									1.95	0.48	0.11

Gage height, in feet, and discharge, in second-feet, at indicated time, 1950

Hour	Gage height	Discharge	Gage height	Discharge	Gage height	Discharge	Gage height	Discharge	Gage height	Discharge	Gage height	Discharge
	April 14		April 15		April 16		April 17		April 18		April 19	
2	8.33	770					19.40	15,800	22.60	25,900		
4	8.51	840	7.87	930	14.60	7,500	20.35	18,300	22.81	26,700	23.64	30,500
6	8.53	880					20.75	19,400	23.00	27,500		
8	8.30	840	8.05	1,060	15.70	9,040	21.05	20,400	23.13	28,100	23.45	29,600
10	7.80	710					21.40	21,400	23.20	28,400		
N	7.43	620	8.65	1,370	16.18	9,770	21.55	21,900	23.24	28,600	23.15	28,200
2	7.15	570					21.60	22,100	23.26	28,700		
4	6.94	530	10.26	2,440	17.25	11,500	21.95	23,300	23.45	29,600	22.79	26,700
6	7.12	600					22.04	23,700	23.49	29,800		
8	7.39	690	11.85	3,980	18.22	13,200	22.13	24,000	23.54	30,000	22.45	25,300
10	7.59	770					22.05	23,700	23.57	30,200		
12	7.70	820	13.45	6,000	18.96	14,800	22.45	25,300	23.60	30,300	21.96	23,400
	April 20		April 21		April 22		April 23		April 24		April 25	
4	21.35	21,200	16.50	10,800	15.52	9,520	14.88	8,760	14.11	7,880		
8	20.45	18,600	16.15	10,300	15.87	9,960	14.66	8,490	14.02	7,780	12.59	6,290
N	19.50	16,100	15.78	9,840	16.02	10,200	14.47	8,280	13.88	7,630		
4	18.30	13,500	15.31	9,270	15.67	9,700	14.35	8,140	13.64	7,360	12.13	5,840
8	17.30	11,900	15.15	9,080	15.33	9,300	14.24	8,020	13.37	7,070		
12	16.83	11,200	15.24	9,190	15.08	9,000	14.15	7,920	13.19	6,890	11.80	5,530
	April 26		April 27		April 28		April 29		April 30		May 1	
4												
8	11.48	5,230	10.88	4,690	10.45	4,320	10.14	4,050	9.95	3,890		
N											8.78	2,950
4	11.27	5,040	10.70	4,530	10.32	4,210	10.11	4,030	9.70	3,690		
8												
12	11.09	4,880	10.60	4,440	10.24	4,140	10.10	4,020	9.29	3,360	8.32	2,600
	May 2		May 3		May 4		May 5		May 6		May 7	
4												
8					7.25	1,840	6.84	1,580	6.69	1,480	6.45	1,340
N	7.98	2,350	7.55	2,050								
4					7.11	1,750	6.78	1,540	6.59	1,420	6.32	1,270
8												
12	7.78	2,210	7.36	1,920	6.98	1,670	6.77	1,530	6.54	1,390	6.33	1,270
	May 8		May 9		May 10		May 11		May 12		May 13	
4			6.57	1,410	7.22	1,820	8.13	2,460	8.73	2,910	8.08	2,420
8	6.33	1,270	6.63	1,440	7.40	1,940	8.29	2,580	8.77	2,950	8.12	2,460
N			6.68	1,470	7.68	2,140	8.62	2,830	8.68	2,880	8.04	2,400
4	6.38	1,300	6.90	1,620	8.09	2,430	8.84	3,000	8.47	2,720	7.90	2,300
8			7.08	1,730	8.32	2,600	8.92	3,070	8.22	2,530	7.76	2,200
12	6.51	1,370	7.15	1,780	8.32	2,600	8.82	2,990	8.12	2,460	7.64	2,110

Green River near Gladstone, N. Dak.

Location.—Lat. 46°53'20", long. 102°38'20", in SW¼ sec. 36, T. 140 N., R. 95 W., at bridge on U. S. Highway 10, 3 miles northwest of Gladstone, and 3 miles upstream from mouth.
Drainage area.—356 square miles.
Gage-height record.—Graph drawn on basis of one or more wire-weight readings daily for period Apr. 2 to May 15; one daily reading May 16 to June 30, except for following days when no readings were made: Apr. 1, 23, May 11, 17, 25, 27, 28, 30, June 27 and 29.
Discharge record.—Stage-discharge relation defined by current-meter measurements. Stage-discharge relation affected by ice Apr. 1-15. Discharge for period of no gage-height record computed on basis of adjacent gage-height record and interpolation.
Maxima.—April-May 1950: Discharge, 5,260 second-feet 12 p.m. Apr. 15 (gage height, 18.3 feet from floodmark).
1945 to March 1950: Discharge, 3,780 second-feet Apr. 5, 1949 (gage height, 16.9 feet).
Remarks.—No diversion or regulation above station.

Mean discharge, in second-feet, 1950

Day	April	May	June	Day	April	May	June	Day	April	May	June
1	46	43	12	11	206	215	10	21	142	26	7.2
2	44	40	11	12	383	174	9.6	22	108	24	7.2
3	43	40	10	13	852	142	9.1	23	91	23	6.4
4	40	42	9.6	14	1,530	92	8.3	24	84	21	7.2
5	42	46	7.9	15	3,470	64	7.9	25	72	20	16
6	42	49	7.5	16	4,640	50	8.3	26	62	18	15
7	105	58	7.9	17	2,560	43	12	27	56	17	12
8	204	65	13	18	731	36	13	28	50	16	10
9	301	75	12	19	353	28	12	29	48	15	9.8
10	244	163	12	20	221	28	8.3	30	44	14	9.6
								31	-	12	-
Mean monthly discharge, in second-feet									560	54.8	10.1
Runoff, in acre-feet									33,350	3,370	599
Runoff, in inches									1.76	0.18	0.03

Gage height, in feet, and discharge, in second-feet, at indicated time, 1950

Hour	Gage height	Dis-charge	Gage height	Dis-charge	Gage height	Dis-charge	Gage height	Dis-charge	Gage height	Dis-charge	Gage height	Dis-charge
	April 14		April 15		April 16		April 17		April 18		April 19	
2	10.00	1,190	14.68	2,620	18.24	5,210	16.12	3,690				
4	10.10	1,210	14.98	2,760	18.10	5,100	15.83	3,520				
6	10.18	1,230	14.98	2,770	17.92	4,960	15.50	3,320				
8	10.23	1,250	14.87	2,720	17.77	4,840	15.08	3,100	7.45	771	5.31	380
10	10.28	1,260	14.64	2,630	17.66	4,750	14.45	2,790				
N	10.42	1,290	15.40	3,010	17.54	4,660	13.40	2,350				
2	11.00	1,440	15.98	3,340	17.38	4,550	13.07	2,220				
4	11.65	1,610	16.60	3,760	17.28	4,480	12.80	2,130	6.42	578	4.89	309
6	12.50	1,840	17.50	4,420	17.07	4,330	12.34	1,990				
8	13.18	2,040	17.88	4,760	16.86	4,180	11.20	1,660				
10	13.73	2,230	18.13	5,040	16.64	4,030	10.20	1,410				
12	14.22	2,430	18.30	5,260	16.38	3,850	9.40	1,220	5.82	470	4.64	269
	April 20		April 21		April 22		April 23		April 24		April 25	
4												
8	4.44	239	3.83	149							3.26	74
N					3.53	108			3.35	85		
4	4.21	204	3.69	130							3.21	68
8												
12	4.00	173	3.62	120	3.43	95	3.37	87	3.32	81	3.20	67
	April 26		April 27		April 28		April 29		April 30		May 1	
4												
8	3.17	64										
N			3.10	56	3.05	50	3.03	48	2.98	43	2.98	43
4	3.13	59										
8												
12	3.11	57	3.08	54	3.03	48	3.01	46	2.98	43	2.97	42
	May 2		May 3		May 4		May 5		May 6		May 7	
4												
8												
N	2.94	39	2.95	40	2.97	42	3.02	47	3.03	48	3.11	57
4												
8												
12	2.93	38	2.96	41	3.00	45	3.02	47	3.07	53	3.18	65
	May 8		May 9		May 10		May 11		May 12		May 13	
4												
8			3.19	66								
N	3.18	65			3.94	165			3.98	172	3.78	145
4			3.26	74								
8												
12	3.18	65	3.50	104	4.30	218	4.12	192	3.88	158	3.58	121

Supplemental record.—Apr. 15, 5 a.m., 15.0 ft., 2,770 sec.-ft.

Muddy Creek near Almont, N. Dak.

Location.—Lat. 46°41'40", long. 101°27'55", in SW¼ sec. 7, T. 137 N., R. 85 W., at bridge on county road, 2 miles downstream from Hailstone Creek, 3 miles southeast of Almont, and about 12 miles above mouth.

Drainage area.—456 square miles.

Gage-height record.—Graph based on once-daily readings of wire-weight or staff gage to hundredths, except Apr. 10, when no readings were obtained, Apr. 16-21, when readings were estimated by observer to nearest foot, May 10-13, when readings were estimated to nearest tenth of a foot. Datum of temporary gage uncertain Apr. 22-27. Record for period Apr. 16-21 verified by stage graph at Almont constructed from observations of Weather Bureau observer.

Discharge record.—Stage-discharge relation defined by current-meter measurements below 2,300 second-feet and extended to peak stage on basis of slope-area measurement and logarithmic plotting. Stage discharge relation affected by ice Apr. 1-16.

Maxima.—April-May 1950: Discharge, 20,200 second-feet 12 m. Apr. 17 (gage height, 30.7 feet, from floodmarks).

1945 to March 1950: Discharge, 2,250 second-feet Mar. 24, 1948 (gage height, 19.20 feet, affected by ice).

Remarks.—No regulation or diversion.

Mean discharge, in second-feet, 1950

Day	April	May	June	Day	April	May	June	Day	April	May	June
1	22	84	8.2	11	160	643	9.6	21	575	37	3.7
2	28	96	7.8	12	140	707	8.9	22	596	33	3.6
3	40	117	7.2	13	170	534	8.2	23	331	25	3.4
4	60	132	7.0	14	250	400	7.8	24	185	21	4.5
5	120	130	7.0	15	1,000	160	7.3	25	115	17	5.2
6	250	126	6.8	16	3,000	84	6.7	26	96	16	6.4
7	300	140	6.8	17	15,000	73	6.4	27	91	14	5.8
8	250	215	8.0	18	6,980	63	5.5	28	113	11	4.4
9	250	400	170	19	2,860	60	5.2	29	87	9.6	3.6
10	200	546	47	20	1,460	46	4.5	30	82	8.7	3.5
								31	-	8.4	-
Mean monthly discharge, in second-feet									1,160	160	13.0
Runoff, in acre-feet									69,050	9,830	774
Runoff, in inches									2.84	0.40	0.03

Apple Creek Basin

Apple Creek near Menoken, N. Dak.

Location.—Lat. 46°47'35", long. 100°39'15", on line between secs. 4 and 9, T. 138 N., R. 79 W., at bridge on former U. S. Highway 10, 4 miles upstream from Hay Creek, 6.3 miles west of Menoken, and 6.4 miles east of Bismarck.
Drainage area.—1,520 square miles.
Gage-height record.—Graph based on twice-daily readings of wire-weight or staff gage Apr. 1-23, once-daily readings thereafter.
Discharge record.—Stage-discharge relation defined by current-meter measurements. Stage-discharge relation affected by ice Apr. 1-17.
Maxima.—April-May 1950: Discharge, 6,750 second-feet 2 p.m. Apr. 18 (gage height, 17.07 feet).
1945 to March 1950: Discharge, 2,340 second-feet Apr. 7, 1948 (gage height, 15.80 feet).
Remarks.—Small diversions above station for irrigation.

Mean discharge, in second-feet, 1950

Day	April	May	June	Day	April	May	June	Day	April	May	June
1	41	1,010	487	11	270	1,030	205	21	3,320	1,020	93
2	55	978	479	12	280	1,210	213	22	3,220	954	82
3	70	959	452	13	300	1,830	196	23	2,930	932	77
4	82	934	353	14	406	2,390	179	24	2,380	891	76
5	150	965	322	15	728	1,680	156	25	1,880	828	76
6	500	920	313	16	2,000	1,350	123	26	1,440	824	79
7	550	846	292	17	4,980	1,220	108	27	1,330	772	78
8	390	894	233	18	5,590	1,150	161	28	1,200	706	80
9	300	917	213	19	4,340	1,120	144	29	1,150	693	80
10	250	919	207	20	3,740	1,060	115	30	1,070	638	78
								31	-	548	-
Mean monthly discharge, in second-feet									1,498	1,038	192
Runoff, in acre-feet									89,140	63,840	11,400
Runoff, in inches									1.10	0.79	0.14

Gage height, in feet, and discharge, in second-feet, at indicated time, 1950

Hour	Gage height	Dis-charge	Gage height	Dis-charge	Gage height	Dis-charge	Gage height	Dis-charge	Gage height	Dis-charge	Gage height	Dis-charge
	April 14		April 15		April 16		April 17		April 18		April 19	
2			14.42	562	15.47	1,120	16.49	3,840	16.68	5,020		
4	13.08	351	14.64	606	15.64	1,300	16.68	4,520	16.72	5,180	16.58	4,630
6			14.80	648	15.82	1,550	16.80	5,010	16.78	5,420		
8	13.23	371	14.93	690	16.00	1,880	16.89	5,430	16.85	5,720	16.54	4,490
10			14.99	720	16.08	2,130	16.94	5,640	16.92	6,040		
N	13.37	391	15.07	754	16.07	2,170	16.98	5,810	16.99	6,360	16.50	4,350
2			15.08	774	16.02	2,140	16.99	5,920	17.07	6,750		
4	13.50	420	15.03	789	16.02	2,220	16.95	5,820	17.00	6,400	16.48	4,280
6			14.98	786	16.03	2,330	16.63	4,680	16.77	5,380		
8	13.83	460	14.98	815	16.03	2,390	16.59	4,470	16.68	5,020	16.40	4,000
10			15.06	858	16.12	2,640	16.60	4,610	16.66	4,940		
12	14.21	522	15.21	942	16.30	3,210	16.63	4,820	16.64	4,860	16.33	3,760
	April 20		April 21		April 22		April 23		April 24		April 25	
4	16.32	3,720					16.15	3,170				
8	16.34	3,790	16.19	3,290	16.19	3,290	16.16	3,200	15.89	2,450	15.61	1,980
N	16.36	3,860					16.08	2,960				
4	16.35	3,820	16.19	3,290	16.15	3,170	16.02	2,780	15.83	2,330	15.45	1,790
8	16.29	3,620					15.98	2,670				
12	16.24	3,450	16.20	3,320	16.12	3,080	15.93	2,540	15.73	2,160	15.26	1,610
	April 26		April 27		April 28		April 29		April 30		May 1	
4			14.79	1,350	14.47	1,240						
8	15.04	1,460	14.80	1,350	14.38	1,210	14.20	1,160	13.89	1,080	13.57	1,010
N			14.79	1,350	14.31	1,190						
4	14.90	1,390	14.74	1,330	14.28	1,180	14.16	1,150	13.78	1,060	13.54	1,010
8			14.65	1,290	14.25	1,170						
12	14.81	1,350	14.56	1,260	14.23	1,170	14.03	1,120	13.66	1,030	13.53	1,010
	May 2		May 3		May 4		May 5		May 6		May 7	
4	13.47	994			13.20	946	13.17	941	13.30	963	12.61	852
8	13.41	983	13.29	961	13.16	939	13.27	958	13.19	944	12.56	844
N	13.35	972			13.12	932	13.35	972	13.06	923	12.51	836
4	13.31	965	13.27	958	13.08	926	13.40	981	12.90	897	12.50	835
8	13.31	965			13.06	923	13.43	987	12.75	873	12.59	848
12	13.30	963	13.23	951	13.10	929	13.38	977	12.68	862	12.67	860
	May 8		May 9		May 10		May 11		May 12		May 13	
4											15.00	1,440
8	12.82	884	13.06	923	12.96	907	13.49	998	14.23	1,170	15.20	1,560
N											15.40	1,740
4	12.96	907	13.00	913	13.04	919	13.72	1,050	14.49	1,240	15.61	1,980
8											15.82	2,310
12	13.06	923	12.96	907	13.26	956	13.98	1,110	14.80	1,350	15.94	2,570
	May 14		May 15		May 16		May 17		May 18		May 19	
4	16.00	2,720										
8	15.95	2,600	15.38	1,720	14.86	1,380	14.42	1,220	14.20	1,160	14.04	1,120
N	15.87	2,410										
4	15.80	2,270	15.22	1,580	14.63	1,290	14.38	1,210	14.10	1,140	14.08	1,130
8	15.69	2,100										
12	15.59	1,960	15.10	1,500	14.49	1,240	14.31	1,190	14.03	1,120	13.98	1,110

Cannonball River Basin

Cannonball River near New Leipzig, N. Dak.

Location.—Lat. 46°20', long. 101°57', in SW¼ sec. 11, T. 133 N., R. 90 W., at bridge on State Highway 49, 2½ miles south of New Leipzig and 8 miles downstream from Thirty Mile Creek.

Drainage area.—1,180 square miles.

Gage-height record.—Water-stage recorder graph, except for periods 3 a.m. Apr. 17 to 9 a.m. Apr. 26 for which a graph was drawn based on four estimates of stage on Apr. 17, 18, highwater mark in gage well and time of crest from observer, four or more daily gage readings Apr. 19-22; and two or more daily readings thereafter, and May 1-16 for which a graph was drawn based on one or more daily readings of the outside gage.

Discharge record.—Stage-discharge relation defined by current-meter measurements below 11,100 second-feet and extended to peak stage on basis of a slope-area determination of the 1943 flood and slope-area and contracted-opening determinations of the 1950 flood. Gage heights, used to hundredths 6 p.m. Apr. 16 to May 13; half tenths between 6.9 and 9.4 foot, tenths above and hundredths below May 14 to June 30. Stage-discharge relation affected by ice Apr. 1-16 (5 p.m.).

Maxima.—April-May 1950: Discharge, 51,800 second-feet at 12 p.m. Apr. 17 (gage height, 34.0 feet, floodmark in well).

1943 to March 1950: Discharge, 15,000 second-feet Mar. 25, 26, 1943 (gage height, 26.9 feet, from floodmarks), by slope-area method.

Remarks.—Some small diversions and storage above station.

Mean discharge, in second-feet, 1950

Day	April	May	June	Day	April	May	June	Day	April	May	June
1	120	215	60	11	80	595	50	21	2,710	133	35
2	100	237	58	12	80	634	46	22	2,160	118	35
3	90	244	53	13	100	595	45	23	1,430	106	33
4	90	230	51	14	120	452	44	24	1,000	94	36
5	90	217	50	15	800	318	43	25	646	87	40
6	150	227	50	16	5,800	249	41	26	461	84	39
7	200	296	52	17	37,100	210	40	27	349	79	35
8	170	324	261	18	32,200	186	41	28	285	74	35
9	130	401	76	19	12,900	162	41	29	258	71	34
10	100	567	53	20	5,490	147	38	30	229	65	33
								31	-	62	-
Mean monthly discharge, in second-feet									3,515	241	51.6
Runoff, in acre-feet									209,100	14,830	3,070
Runoff, in inches									3.32	0.24	0.05

Gage height, in feet, and discharge, in second-feet, at indicated time, 1950

Hour	Gage height	Dis-charge	Gage height	Dis-charge	Gage height	Dis-charge	Gage height	Dis-charge	Gage height	Dis-charge	Gage height	Dis-charge
	April 14		April 15		April 16		April 17		April 18		April 19	
2					14.70		26.80	14,900	33.80	50,000	27.25	15,800
4			8.66		15.42		28.40	18,700	33.45	46,800	26.90	15,000
6	7.93				16.20		29.80	23,800	33.00	43,100	26.55	14,400
8			8.77		15.10		31.20	30,700	32.50	39,200	26.20	13,800
10					15.30		32.45	38,800	31.80	34,300	25.85	13,300
N	8.04		9.18		19.40		33.00	43,100	31.10	30,100	25.50	12,800
2					18.00	5,700	33.25	45,100	30.45	26,800	25.20	12,400
4			9.79		18.62	6,200	33.50	47,300	29.80	23,800	24.80	12,000
6	8.24				20.37	7,630	33.70	49,100	29.10	21,000	24.40	11,500
8			11.93		21.60	8,740	33.85	50,400	28.55	19,200	23.85	11,000
10					22.86	9,960	33.95	51,400	28.05	17,600	23.00	10,100
12	8.53		14.55		24.65	11,800	34.00	51,800	27.65	16,600	22.15	9,250
	April 20		April 21		April 22		April 23		April 24		April 25	
4	20.20	7,480	14.00	3,030	13.28	2,610	11.20	1,590				
8	18.40	6,020	13.37	2,660	12.84	2,390	11.00	1,510	9.97	1,080		
N	17.00	4,960	12.84	2,390	12.18	2,060	10.75	1,410			8.78	636
4	16.10	4,330	12.94	2,440	11.88	1,910	10.56	1,330	9.58	932		
8	15.35	3,840	13.35	2,640	11.61	1,780	10.42	1,280				
12	14.65	3,420	13.60	2,790	11.38	1,660	10.27	1,210	9.22	788	8.45	526
	April 26		April 27		April 28		April 29		April 30		May 1	
4												
8												
N	8.20	459	7.70	346	7.40	284	7.24	257	7.04	226	6.93	214
4												
8												
12	7.95	401	7.50	304	7.30	268	7.16	245	6.98	221	6.91	210
	May 2		May 3		May 4		May 5		May 6		May 7	
4	6.88	207										
8	7.00	228										
N	7.12	251	7.07	245	6.98	230	6.90	217	6.92	223	7.30	300
4	7.13	253										
8	7.13	253										
12	7.10	247	7.03	238	6.94	223	6.87	212	7.07	251	7.46	333
	May 8		May 9		May 10		May 11		May 12		May 13	
4												
8					8.50	590	8.55	606			8.56	617
N	7.42	327	7.63	374					8.68	644		
4					8.36	559	8.53	601			8.43	582
8												
12	7.33	308	8.36	548	8.35	551	8.54	604	8.66	639	8.24	533

Cannonball River at Breien, N. Dak.

Location.—Lat. 46°23', long. 100°56', in sec. 36, T. 134 N., R. 82 W., at bridge on State Highway 6, 950 feet downstream from Louise Creek and 0.5 mile south of Breien. Datum of gage is 1,676.54 feet above mean sea level, datum of 1929.

Drainage area.—4,066 square miles.

Gage-height record.—Water-stage recorder graph, except for periods Apr. 1-15, 9 p.m. Apr. 18 to May 26. Graph based on once-daily readings of wire-weight gage Apr. 1-15, Apr. 25 to May 26. For period 9 p.m. Apr. 18 to Apr. 24, graph based on daily readings of staff gage at overflow bridge 1200 feet north, floodmarks, and information from a resident living nearby.

Discharge record.—Stage-discharge relation defined by current-meter measurements below 16,000 second-feet and extended to peak stage on basis of slope-area and contracted-opening measurements. Stage-discharge relation affected by ice Apr. 1-5.

Maxima.—April-May 1950: Discharge, 94,800 second-feet 2 a.m. Apr. 19 (gage height, 22.30 feet, from high-water mark in gage well).

1934 to March 1950: Discharge 30,900 second-feet (revised) Mar. 27, 1943 (gage height, 17.4 feet, from floodmark).

Remarks.—Some diversions above station. Some storage in several small lakes above station.

Mean discharge, in second-feet, 1950

Day	April	May	June	Day	April	May	June	Day	April	May	June
1	160	1,370	318	11	1,860	1,570	688	21	23,700	750	179
2	650	1,460	298	12	1,570	1,730	426	22	15,200	655	170
3	4,000	1,620	278	13	1,450	1,680	334	23	10,100	595	162
4	5,500	1,460	266	14	1,920	1,640	278	24	7,000	565	158
5	7,000	1,450	256	15	7,950	1,540	249	25	4,960	518	433
6	5,440	1,630	246	16	17,300	1,420	218	26	3,380	468	712
7	7,900	1,870	235	17	25,400	1,230	207	27	2,540	422	535
8	4,770	1,630	256	18	32,700	1,050	204	28	2,060	404	368
9	3,050	2,460	682	19	63,100	968	194	29	1,710	386	274
10	2,300	1,740	460	20	36,000	885	185	30	1,510	364	218
								31	-	342	-
Mean monthly discharge, in second-feet									10,070	1,157	316
Runoff, in acre-feet									599,400	71,150	18,820
Runoff, in inches									2.76	0.33	0.09

Gage height, in feet, and discharge, in second-feet, at indicated time, 1950

Hour	Gage height	Dis-charge	Gage height	Dis-charge	Gage height	Dis-charge	Gage height	Dis-charge	Gage height	Dis-charge	Gage height	Dis-charge
	April 14		April 15		April 16		April 17		April 18		April 19	
2	4.08	1,600	8.46	5,340	13.32	13,200	16.82	27,100	16.42	24,700	22.30	94,800
4	4.12	1,620	9.06	6,010	13.78	14,400	17.20	29,500	16.74	26,600	22.18	92,500
6	4.13	1,630	9.51	6,550	14.17	15,300	17.20	29,500	16.90	27,600	21.68	83,300
8	4.05	1,580	9.76	6,870	14.30	15,700	17.08	28,700	16.97	28,000	20.88	69,700
10	3.98	1,540	9.97	7,140	14.45	16,200	16.82	27,100	16.97	28,000	20.32	61,000
N	4.00	1,550	10.18	7,410	14.68	16,800	16.52	25,300	16.89	27,500	19.92	55,400
2	4.07	1,590	10.45	7,790	14.86	17,400	16.25	23,700	16.80	27,000	19.64	51,700
4	4.23	1,700	10.96	8,540	15.15	18,500	16.10	22,900	16.72	26,500	19.40	48,800
6	4.58	1,950	11.50	9,400	15.45	19,700	16.02	22,500	16.77	26,800	19.22	46,700
8	5.26	2,420	12.09	10,400	15.69	20,800	16.02	22,500	17.50	31,600	19.05	44,800
10	5.96	2,980	12.60	11,400	15.86	21,700	16.03	22,600	20.36	61,600	18.90	43,300
12	7.46	4,310	13.13	12,700	16.15	23,200	16.14	23,100	22.00	89,100	18.76	41,900
	April 20		April 21		April 22		April 23		April 24		April 25	
4												
8												
N	18.08	35,900	16.18	23,300	14.04	15,000	11.80	9,900	9.85	6,940	8.10	4,950
4												
8												
12	17.27	30,000	15.10	18,300	13.00	12,400	10.80	8,260	8.96	5,840	7.24	4,110
	April 26		April 27		April 28		April 29		April 30		May 1	
4												
8												
N	6.34	3,300	5.40	2,530	4.73	2,050	4.23	1,700	3.94	1,510	3.70	1,370
4												
8												
12	5.74	2,800	5.06	2,280	4.46	1,860	4.06	1,590	3.78	1,420	3.60	1,310
	May 2		May 3		May 4		May 5		May 6		May 7	
4	3.56	1,290	4.21	1,690					3.81	1,440	4.51	1,900
8	3.58	1,300	4.11	1,620	3.84	1,450	3.84	1,450	3.83	1,450	4.46	1,860
N	3.78	1,420	4.12	1,620					3.98	1,540	4.46	1,860
4	4.06	1,590	4.12	1,620	3.84	1,450	3.84	1,450	4.34	1,780	4.50	1,890
8	4.19	1,670	4.04	1,570					4.51	1,900	4.47	1,870
12	4.24	1,710	3.98	1,540	3.84	1,450	3.82	1,440	4.54	1,920	4.32	1,760
	May 8		May 9		May 10		May 11		May 12		May 13	
4	4.06	1,590	5.42	2,550			4.14	1,640	4.16	1,650		
8	3.94	1,510	5.81	2,860	4.30	1,750	4.08	1,600	4.30	1,750	4.21	1,690
N	3.95	1,520	5.63	2,710			3.96	1,530	4.34	1,780		
4	4.02	1,560	5.33	2,470	4.19	1,670	3.94	1,510	4.34	1,780	4.17	1,660
8	4.26	1,720	4.94	2,200			3.97	1,530	4.32	1,760		
12	4.72	2,040	4.60	1,960	4.14	1,640	4.04	1,570	4.30	1,750	4.16	1,650

Cedar Creek near Pretty Rock, N. Dak.

Location.—Lat. 46°02', long. 101°49', in S½ sec. 33, T. 130 N., R. 89 W., at county highway bridge, 7 miles north of Keldron, S. Dak., 10½ miles south of Pretty Rock, and 15 miles downstream from Timber Creek.

Drainage area.—1,260 square miles.

Gage-height record.—Water-stage recorder graph, except for period 7 a.m. Apr. 17 to 3 p.m. Apr. 21, for which a graph was drawn based on floodmark in gage house and time of crest from local residents, hydrographer's estimate of stage on Apr. 18, and observed inside gage readings on Apr. 19, 20.

Discharge record.—Stage-discharge relation defined by current-meter measurements below 7,720 second-feet and extended to peak stage on basis of slope area measurement. Stage-discharge relation affected by ice Apr. 1-16. Gage heights used to hundredths Apr. 17 to May 13; half tenths between 4.8 and 6.5 feet, tenths above and hundredths below these limits May 14 to June 30.

Maxima.—April-May 1950: Discharge, 48,000 second-feet at 9 p.m. Apr. 17 (gage height, 26.5 feet from floodmark in gage house).

1943 to March 1950: Discharge, 4,450 second-feet Apr. 10, 1944 (gage height, 14.9 feet).

Flood of Mar. 24, 1943 reached a stage of 21.8 feet, from floodmarks (discharge 14,300 second-feet).

Remarks.—Small diversions above station.

Mean discharge, in second-feet, 1950

Day	April	May	June	Day	April	May	June	Day	April	May	June
1	10	246	57	11	50	323	75	21	6,050	125	36
2	15	250	55	12	40	362	60	22	3,700	113	32
3	20	278	50	13	40	378	55	23	2,060	102	31
4	30	258	49	14	50	428	49	24	1,440	94	31
5	40	234	47	15	1,000	401	45	25	882	86	128
6	50	222	47	16	4,000	304	42	26	643	80	75
7	100	230	47	17	28,700	228	41	27	501	74	48
8	80	242	245	18	34,000	187	39	28	380	72	41
9	60	282	296	19	13,900	161	39	29	315	68	37
10	50	306	111	20	8,440	137	38	30	277	63	35
								31	-	57	-
Mean monthly discharge, in second-feet									3,564	206	66.0
Runoff, in acre-feet									212,100	12,680	3,930
Runoff, in inches									3.16	0.19	0.06

Gage height, in feet, and discharge, in second-feet, at indicated time, 1950

Hour	Gage height	Dis-charge	Gage height	Dis-charge	Gage height	Dis-charge	Gage height	Dis-charge	Gage height	Dis-charge	Gage height	Dis-charge
	April 14		April 15		April 16		April 17		April 18		April 19	
2					13.49		18.84	7,770	26.30	45,500		
4			6.37		13.53		20.00	9,500	26.15	43,700	22.55	17,200
6					13.50		21.57	13,600	26.00	41,800		
8			7.26		13.39		22.40	16,500	25.80	39,800	21.95	14,800
10					13.92		23.60	22,300	25.50	36,900		
N			7.70		14.47		24.60	29,000	25.20	34,000	21.45	13,200
2					13.72		25.40	35,900	24.90	31,200		
4			8.72		14.22		26.00	41,800	24.60	29,000	21.05	12,000
6					15.17		26.30	45,500	24.30	26,800		
8			10.47		16.78		26.48	47,800	23.90	24,000	20.70	11,100
10					18.30		26.48	47,800	23.50	21,800		
12	5.45		13.40		18.77		26.40	46,800	23.20	20,100	20.30	10,100
	April 20		April 21		April 22		April 23		April 24		April 25	
4	20.00	9,500	17.85	6,740	15.15	4,620	10.53	2,330	8.91	1,670	7.09	1,020
8	19.65	8,880	17.45	6,380	14.37	4,130	10.07	2,140	8.62	1,560	6.82	924
N	19.30	8,360	17.05	6,030	13.37	3,600	9.76	2,010	8.35	1,460	6.63	861
4	19.95	7,900	16.70	5,750	12.50	3,190	9.45	1,890	7.98	1,330	6.48	813
8	18.55	7,440	16.25	5,390	11.74	2,860	9.25	1,810	7.62	1,200	6.33	765
12	18.20	7,070	15.70	5,000	11.10	2,570	9.12	1,760	7.30	1,090	6.20	725
	April 26		April 27		April 28		April 29		April 30		May 1	
4												
8	5.99	660										
N			5.43	494	5.00	375	4.75	312	4.61	277	4.47	244
4	5.83	612										
8												
12	5.65	588	5.20	428	4.87	342	4.68	294	4.54	261	4.43	235
	May 2		May 3		May 4		May 5		May 6		May 7	
4												
8												
N	4.47	244	4.63	282	4.53	258	4.42	233	4.36	219	4.41	230
4												
8												
12	4.61	277	4.58	270	4.47	244	4.39	226	4.38	224	4.44	237
	May 8		May 9		May 10		May 11		May 12		May 13	
4												
8												
N	4.44	237	4.64	285	4.75	312	4.83	332	4.97	367	4.98	370
4												
8												
12	4.52	256	4.72	304	4.68	294	4.84	334	5.02	380	5.07	393

Supplemental record.—Apr. 17, 9 p.m., 26.5 ft., 48,000 sec.-ft.

Beaver Creek Basin

Beaver Creek at Linton, N. Dak.

Location.—Lat. 46°15'40", long. 100°14'00", on line between sections 17 and 18, T. 132 N., R. 76 W., at bridge on U. S. Highway 83, 0.7 mile south of Linton and a mile upstream from Spring Creek.
Drainage area.—832 square miles.
Gage-height record.—Graph drawn on basis of two or more wire-weight gage readings daily for periods Apr. 1 to June 1, June 28, 29, once-daily readings June 2-27, 30.
Discharge record.—Stage-discharge relation defined by current-meter measurements. Stage-discharge relation affected by ice Apr. 1-5.
Maxima.—April-May 1950: Discharge, 3,680 second-feet 3 a.m. Apr. 7 (gage height, 16.50 feet 10 p.m. Apr. 7).
August 1949 to February 1950: Continuous low flow.
Remarks.—Small diversions above station for irrigation.

Mean discharge, in second-feet, 1950

Day	March	April	May	June	Day	March	April	May	June	Day	March	April	May	June
1	0.1	620	117	65	11	0.4	1,150	811	37	21	2.0	541	235	24
2	.1	980	125	60	12	.4	1,230	918	35	22	3.0	419	194	23
3	.1	1,310	191	60	13	.4	1,100	804	34	23	6.0	330	174	23
4	.1	1,730	364	58	14	.4	1,110	662	32	24	29	272	148	22
5	.2	2,520	357	52	15	.6	1,780	528	31	25	260	227	127	348
6	.4	3,190	382	48	16	1.0	2,180	395	28	26	300	197	113	240
7	.4	3,280	261	46	17	1.4	2,390	319	27	27	300	160	103	761
8	.4	3,150	325	44	18	1.5	1,650	263	27	28	400	143	93	420
9	.4	2,330	517	40	19	1.5	1,080	239	26	29	280	135	85	191
10	.4	1,340	691	38	20	1.6	731	256	25	30	210	126	76	130
										31	280	-	70	-
Mean monthly discharge, in second-feet											67.2	1,247	321	99.8
Runoff, in acre-feet											4,130	74,180	19,720	5,940
Runoff, in inches											0.09	1.67	0.44	0.13

Gage height, in feet, and discharge, in second-feet, at indicated time, 1950

Hour	Gage height	Dis-charge	Gage height	Dis-charge	Gage height	Dis-charge	Gage height	Dis-charge	Gage height	Dis-charge	Gage height	Dis-charge
	March 27		March 28		March 29		March 30		March 31		April 1	
4	8.63	300	9.90	400	9.33	300	8.03	220	7.79	210	10.82	560
8	8.60	290	10.46	420	9.13	280	7.86	210	7.99	220	11.20	620
N	8.58	290	10.65	430	8.92	280	7.76	200	8.33	260	11.24	640
4	8.60	290	10.46	420	8.75	280	7.67	200	8.70	300	11.08	650
8	8.82	310	10.18	390	8.53	260	7.62	190	9.26	370	11.10	660
12	9.24	340	9.74	340	8.27	240	7.65	190	9.85	440	11.55	740
	April 2		April 3		April 4		April 5		April 6		April 7	
4	12.13	850	13.64	1,290	14.02	1,490	15.30	2,420	15.48	2,870	16.20	3,520
8	12.46	920	13.75	1,320	14.2.	1,590	15.09	2,410	15.30	2,950	15.90	3,020
N	12.68	980	13.60	1,290	14.35	1,700	15.12	2,480	15.18	3,080	15.83	2,970
4	12.84	1,040	13.50	1,300	14.47	1,820	15.05	2,540	15.45	3,310	16.17	3,210
8	13.00	1,100	13.65	1,360	14.66	1,980	15.37	2,750	15.93	3,660	16.47	3,420
12	13.32	1,190	13.80	1,400	14.98	2,200	15.48	2,840	16.08	3,660	16.43	3,390
	April 8		April 9		April 10		April 11		April 12		April 13	
4												
8	16.20	3,230	15.00	2,460	12.45	1,340	11.49	1,070	12.23	1,280	11.56	1,090
N												
4	16.02	3,100	14.50	2,200	12.05	1,220	11.90	1,180	11.95	1,200	11.63	1,110
8												
12	15.64	2,840	13.74	1,830	11.70	1,120	12.26	1,290	11.69	1,120	11.58	1,100
	April 14		April 15		April 16		April 17		April 18		April 19	
4	11.51	1,080	13.78	1,840	14.53	2,220	15.30	2,640	13.99	1,940	11.83	1,160
8	11.43	1,060	13.99	1,940	14.44	2,170	15.17	2,560	13.68	1,800	11.67	1,120
N	11.36	1,040	13.68	1,800	14.36	2,130	14.92	2,410	13.34	1,670	11.60	1,100
4	11.33	1,030	13.35	1,670	14.36	2,130	14.64	2,270	12.88	1,480	11.42	1,060
8	11.80	1,150	13.35	1,670	14.50	2,200	14.41	2,160	12.49	1,360	11.10	975
12	13.00	1,530	13.85	1,880	15.05	2,490	14.18	2,040	12.12	1,250	10.75	890
	April 20		April 21		April 22		April 23		April 24		April 25	
4												
8	10.13	766	9.03	557	8.25	432	7.60	340	7.15	280	6.79	237
N												
4	9.70	680	8.81	522	8.02	399	7.44	318	7.00	262	6.59	217
8												
12	9.33	606	8.56	482	7.80	368	7.28	296	6.90	250	6.48	206
	April 26		April 27		April 28		April 29		April 30		May 1	
4												
8	6.41	200	6.13	175	5.64	137	5.58	135	5.42	124	5.32	118
N												
4	6.35	194	5.71	144	5.80	150	5.55	132	5.46	127	5.28	116
8												
12	6.28	188	5.58	135	5.74	146	5.51	130	5.38	122	5.22	112

Beaver Creek at Linton, N. Dak.—Continued

Gage height, in feet, and discharge, in second-feet, at indicated time, 1950

Hour	Gage height	Dis-charge	Gage height	Dis-charge	Gage height	Dis-charge	Gage height	Dis-charge	Gage height	Dis-charge	Gage height	Dis-charge
	May 2		May 3		May 4		May 5		May 6		May 7	
4	5.22	112	5.97	163	7.50	326			7.82	371	7.60	340
8	5.29	116	6.06	170	7.90	382	7.65	347	7.85	375	6.92	252
N	5.40	123	6.17	179	8.00	396			7.90	382	6.60	218
4	5.46	127	6.32	192	7.92	385	7.71	355	7.97	392	6.50	208
8	5.64	139	6.70	228	7.85	375			8.00	396	6.68	226
12	5.83	152	7.10	274	7.79	367	7.80	368	7.90	382	6.98	260
	May 8		May 9		May 10		May 11		May 12		May 13	
4	7.31	299	8.19	423	10.00	740	10.02	744	11.04	960	10.42	824
8	7.45	319	8.47	467	9.86	712	10.28	796	11.02	955	10.32	804
N	7.48	323	8.71	506	9.72	684	10.41	822	10.90	925	10.34	808
4	7.53	330	9.00	552	9.59	658	10.48	836	10.81	902	10.34	808
8	7.70	354	9.36	612	9.60	660	10.62	864	10.71	882	10.20	780
12	7.94	388	9.77	694	9.76	692	10.85	912	10.56	852	10.02	744

Supplemental record.—Mar. 28, 10 a.m., 10.60 ft., 430 sec.-ft.; Apr. 1, 6 a.m., 11.13 ft., 610 sec.-ft.; 6 p.m., 11.03 ft., 650 sec.-ft.; Apr. 5, 3 a.m., 15.40 ft., 2,430 sec.-ft.; 6 a.m., 15.06 ft., 2,380 sec.-ft.; 3 p.m., 15.04 ft., 2,480 sec.-ft.; Apr. 7, 3 a.m., 16.25 ft., 3,680 sec.-ft.; 6 a.m., 15.95 ft., 3,200 sec.-ft.; 10 p.m., 16.50 ft., 3,440 sec.-ft.; Apr. 12, 4 a.m., 12.29 ft., 1,300 sec.-ft.; Apr. 15, 6 a.m., 14.04 ft., 1,970 sec.-ft.; Apr. 16, 3 a.m., 14.48 ft., 2,190 sec.-ft.; 6 a.m., 14.58 ft., 2,240 sec.-ft.; Apr. 17, 5:30 a.m., 15.30 ft., 2,640 sec.-ft.

Grand River Basin

North Fork Grand River at Haley, N. Dak.

Location.—Lat. 45°57', long. 103°07', in NE¼ sec. 36, T. 129 N., R. 100 W., at bridge on county road about 300 feet south of Post Office at Haley, and half a mile north of the South Dakota State line.
Drainage area.—509 square miles.
Gage-height record.—Wire-weight gage read once daily except Apr. 7-21 when it was read two or more times a day. Daily mean gage heights computed from graph based on gage readings Apr. 2 to May 13.
Discharge record.—Stage-discharge relation defined by current-meter measurements below 5,000 second-feet and extended to peak stage on basis of slope-area measurement. Affected by ice Apr. 1-15. Shifting control used June 27-30.
Maxima.—April-May 1950: Discharge, 11,300 second-feet 3-7 p.m., Apr. 15 (gage height, 17.10 feet).
1908-17, 1945 to March 1950: Discharge observed, 5,810 second-feet, Mar. 31, 1913, discharge measurement (gage height, 9.85 feet, datum then in use).
Remarks.—No known regulation or diversion.

Mean discharge, in second-feet, 1950

Day	April	May	June	Day	April	May	June	Day	April	May	June
1	2	50	15	11	840	627	11	21	236	30	9.6
2	2	53	14	12	820	231	11	22	196	24	8.2
3	2	60	12	13	1,000	134	11	23	161	24	7.9
4	2	84	10	14	3,130	84	11	24	161	23	7.9
5	2	96	11	15	9,160	57	11	25	173	23	9.0
6	140	138	12	16	9,300	62	11	26	165	22	8.2
7	730	282	12	17	4,020	86	11	27	109	20	7.9
8	1,600	398	12	18	1,550	65	11	28	77	18	7.6
9	1,000	241	12	19	627	43	9.6	29	63	20	6.9
10	900	643	11	20	324	36	9.6	30	57	18	6.6
								31	-	14	-
Mean monthly discharge, in second-feet									1,218	120	10.3
Runoff, in acre-feet									72,490	7,350	611
Runoff, in inches									2.67	0.27	0.02

Gage height, in feet, and discharge, in second-feet, at indicated time, 1950

Hour	Gage height	Dis-charge	Gage height	Dis-charge	Gage height	Dis-charge	Gage height	Dis-charge	Gage height	Dis-charge	Gage height	Dis-charge
	April 14		April 15		April 16		April 17		April 18		April 19	
2	11.98	1,750	14.90	6,030								
4	12.12	1,900	15.07	6,470	16.95	10,900	14.25	5,400	11.33	1,990		
6	12.32	2,090	15.25	6,930								
8	12.47	2,270	15.48	7,510	16.87	10,700	13.74	4,640	11.18	1,890	8.49	697
10	12.68	2,500	15.98	8,680								
N	12.89	2,770	16.42	9,670	16.47	9,780	13.18	3,880	10.78	1,620		
2	13.13	3,080	16.98	11,000								
4	13.44	3,500	17.10	11,300	15.84	8,370	12.68	3,280	10.08	1,240	7.97	541
6	13.78	3,990	17.10	11,300								
8	14.34	4,820	17.09	11,300	15.32	7,310	12.07	2,630	9.49	997		
10	14.58	5,280	17.08	11,200								
12	14.74	5,640	17.07	11,200	14.78	6,300	11.64	2,240	9.08	874	7.54	414
	April 20		April 21		April 22		April 23		April 24		April 25	
4												
8	7.26	337	6.88	245	6.67	200	6.48	166	6.43	157	6.52	173
N												
4	7.10	296	6.78	223	6.63	193	6.40	152	6.48	166	6.53	174
8												
12	6.97	265	6.73	212	6.56	180	6.40	152	6.50	169	6.55	178
	April 26		April 27		April 28		April 29		April 30		May 1	
4												
8	6.53	174	6.16	115	5.86	78						
N							5.70	61	5.67	58	5.56	49
4	6.46	162	6.03	98	5.83	74						
8												
12	6.33	141	5.93	86	5.79	70	5.68	59	5.60	52	5.58	50
	May 2		May 3		May 4		May 5		May 6		May 7	
4			5.65	56	5.87	79						
8			5.67	58	5.94	87	5.98	92	6.21	122	6.91	251
N	5.61	53	5.68	59	5.94	87						
4			5.70	61	5.95	88	6.03	98	6.34	142	7.17	314
8			5.72	63	5.95	88						
12	5.64	56	5.76	67	5.96	89	6.10	107	6.62	191	7.38	369
	May 8		May 9		May 10		May 11		May 12		May 13	
4	7.46	391	7.06	286	7.33	355	9.12	886	7.05	284		
8	7.52	408	6.82	231	7.83	499	8.70	760	6.91	251	6.34	142
N	7.57	422	6.71	208	8.38	664	8.23	619	6.78	223		
4	7.55	416	6.68	202	8.92	826	7.76	478	6.67	200	6.22	124
8	7.45	388	6.76	219	9.22	916	7.45	388	6.57	182		
12	7.28	342	6.98	267	9.27	931	7.23	329	6.48	166	6.11	108

Supplemental record.—Apr. 14, 6:50 p.m., 13.99 feet, 4,290 sec.-ft.; 7 p.m., 14.15 ft., 4,520 sec.-ft.; Apr. 15, 3 p.m., 17.10 ft., 11,300 sec.-ft.; 7 p.m., 17.10 ft., 11,300 sec.-ft.; May 8, 2 p.m., 7.59 ft., 428 sec.-ft.; May 9, 2 p.m., 6.67 ft., 200 sec.-ft.

North Fork Grand River near White Butte, S. Dak.

Location.—Lat. 45°48'10", long. 102°21'35", in NW¼NW¼ sec. 11, T. 21 N., R. 14 E., at county highway bridge, a quarter of a mile upstream from nearest tributary, 9¾ miles south of White Butte, and 13 miles upstream from confluence with South Fork.

Drainage area.—1,190 square miles.

Gage-height record.—Water-stage recorder graph 12 p.m. Apr. 2, to 5 a.m. Apr. 3, 8 p.m. Apr. 3 to 12 p.m. Apr. 7, 3 a.m. Apr. 15 to 5 a.m. Apr. 16. Graph drawn on basis of fragmentary recorder record and once- or twice-daily wire-weight gage readings rest of period Apr. 1 to May 25. Daily readings May 26 to June 30. No reading May 29, June 6.

Discharge record.—Stage-discharge relation defined by current-meter measurements below 4,300 second-feet and extended to peak stage on basis of logarithmic plotting and slope-area measurement. Affected by ice Apr. 1-15. Shifting-control method used June 24-30.

Maxima.—April-May 1950: Discharge, 30,900 second-feet 2 p.m. Apr. 16 (gage height, 20.0 feet, from floodmarks).
1945 to March 1950: Discharge observed, 7,040 second-feet Mar. 24, 1947 (gage height, 12.35 feet).

Remarks.—No regulation or diversion.

Mean discharge, in second-feet, 1950

Day	April	May	June	Day	April	May	June	Day	April	May	June
1	50	260	51	11	1,600	588	45	21	1,350	119	26
2	90	258	48	12	1,100	762	41	22	1,330	111	27
3	150	276	46	13	900	450	44	23	998	99	25
4	350	280	42	14	1,200	317	37	24	730	101	25
5	250	280	44	15	4,300	259	34	25	542	85	26
6	300	294	38	16	22,800	215	34	26	452	77	22
7	650	304	31	17	21,800	181	30	27	400	70	21
8	500	371	46	18	8,770	157	31	28	354	68	20
9	850	480	38	19	3,390	171	29	29	312	64	19
10	1,200	474	44	20	1,800	148	30	30	281	59	18
								31	-	56	-
Mean monthly discharge, in second-feet									2,627	240	33.7
Runoff, in acre-feet									156,300	14,750	2,010
Runoff, in inches									2.46	0.23	0.03

Gage height, in feet, and discharge, in second-feet, at indicated time, 1950

Hour	Gage height	Dis-charge	Gage height	Dis-charge	Gage height	Dis-charge	Gage height	Dis-charge	Gage height	Dis-charge	Gage height	Dis-charge
	April 14		April 15		April 16		April 17		April 18		April 19	
2			9.39		14.23	9,540						
4	8.48		9.57		14.78	10,600						
6			9.76		16.00	13,200						
8	8.48		9.43		17.20	17,060	19.00	25,200	14.40	9,800	9.65	3,740
10			9.01		18.60	23,200						
N	8.51		9.43	3,540	19.76	29,500						
2			10.35	4,360	20.00	30,900						
4	8.73		10.88	4,880	19.97	30,700	17.65	18,800	12.72	7,280	8.55	2,770
6			11.13	5,160	19.93	30,500						
8	9.00		12.69	7,240	19.87	30,100						
10			13.33	8,200	19.78	29,600						
12	9.30		13.82	8,930	19.68	29,000	16.05	13,400	11.04	5,050	7.97	2,270
	April 20		April 21		April 22		April 23		April 24		April 25	
4												
8	7.42	1,810	6.88	1,370	7.04	1,500	6.52	1,090	6.11	777	5.77	574
N												
4	7.25	1,670	6.69	1,220	6.70	1,230	6.30	915	5.99	699	5.65	510
8												
12	7.10	1,550	6.88	1,370	6.60	1,150	6.18	826	5.82	601	5.60	485
	April 26		April 27		April 28		April 29		April 30		May 1	
4												
8	5.54	458	5.43	412	5.30	365	5.16	317	5.07	287		
N											4.98	259
4	5.50	440	5.37	390	5.25	348	5.13	307	5.04	278		
8												
12	5.48	432	5.30	365	5.20	330	5.10	297	5.00	265	4.97	256
	May 2		May 3		May 4		May 5		May 6		May 7	
4												
8												
N	4.97	256	5.05	281	5.05	281	5.04	278	5.10	297	5.10	297
4												
8												
12	5.00	265	5.04	278	5.04	278	5.07	287	5.10	297	5.18	323
	May 8		May 9		May 10		May 11		May 12		May 13	
4									6.30	915		
8							5.50	440	6.23	862		
N	5.30	365	5.62	495	5.57	472			6.10	770	5.50	440
4							5.92	657	5.97	687		
8									5.85	618		
12	5.48	432	5.63	500	5.53	454	6.25	878	5.74	557	5.30	365

Supplemental record.—Apr. 15, 7 a.m., 9.93 ft., 3,100 sec.-ft.; 9 a.m., 8.99 ft., 3,100 sec.-ft.

Grand River at Shadehill, S. Dak.

Location.—Lat. 45°46', long. 102°11', in SE¼ sec. 19, T. 21 N., R. 16 E., at bridge on State Highway 73 at Shadehill, 1 mile downstream from Shadehill Dam, 5 miles downstream from confluence of North Fork and South Fork, and 12 miles south of Lemmon. Datum of gage is 2,186.46 feet above mean sea level, datum of 1929.

Drainage area.—3,120 square miles.

Gage-height record.—Water-stage recorder graph 5 a.m. Apr. 4 to 6 p.m. Apr. 7, 10 a.m. Apr. 9 to 12 p.m. Apr. 10, 8 a.m. Apr. 11 to 2 a.m. Apr. 12, 10 a.m. to 2 p.m. Apr. 12, 7 p.m. Apr. 14 to 10 a.m. Apr. 15, 6 p.m. to 11 p.m. Apr. 15, 3 p.m. Apr. 19 to 10 p.m. Apr. 26, 10 p.m. May 8 to 5 p.m. May 13, 8 p.m. May 31 to June 30; graph based on partial recorder record, twice-daily readings of wire-weight gage, high-water marks, weather records, and other pertinent data for rest of period.

Discharge record.—Stage-discharge relation defined by current-meter measurements below 52,000 second-feet and extended to peak stage on basis of contract-opening and slope-area measurements. Affected by ice Apr. 1-14.

Maxima.—April-May 1950: Discharge, 58,000 second-feet 7 p.m. Apr. 16 (gage height, 21.0 feet, from floodmarks upstream from bridge - 19.06 feet, from floodmark in gage well, unreliable).

1904-06, 1943 to March 1950: Discharge, 18,000 second-feet Apr. 7, 1944; gage height, 18.7 feet Feb. 20, 1943 (ice jam).

Remarks.—Small diversions above station. Low water flow affected by construction operations at Shadehill Dam prior to June 30, 1950, and by storage thereafter.

Mean discharge, in second-feet, 1950

Day	April	May	June	Day	April	May	June	Day	April	May	June
1	160	491	123	11	2,510	1,470	106	21	2,450	326	79
2	153	524	108	12	2,000	1,460	90	22	2,540	256	73
3	162	605	105	13	1,630	1,000	82	23	2,130	235	71
4	704	882	99	14	1,970	758	80	24	1,720	200	66
5	1,840	762	94	15	9,830	617	70	25	1,320	178	75
6	2,360	653	94	16	42,500	512	75	26	1,060	165	65
7	4,160	883	106	17	37,300	440	110	27	843	160	65
8	6,370	869	121	18	21,600	572	101	28	706	146	70
9	3,150	985	99	19	8,230	410	76	29	609	135	79
10	2,340	961	108	20	3,610	368	82	30	517	123	40
								31	-	126	-
Mean monthly discharge, in second-feet									5,549	557	87.1
Runoff, in acre-feet									330,200	34,260	5,180
Runoff, in inches									1.98	0.21	0.03

Gage height, in feet, and discharge, in second-feet, at indicated time, 1950

Hour	Gage height	Dis-charge	Gage height	Dis-charge	Gage height	Dis-charge	Gage height	Dis-charge	Gage height	Dis-charge	Gage height	Dis-charge
	April 14		April 15		April 16		April 17		April 18		April 19	
2												
4	7.40	1,680	10.66	5,240	17.89	21,200	19.85	46,000	16.30	25,300	13.30	11,100
6												
8	7.36	1,640	12.50	7,850	19.28	34,100	19.06	41,200	16.10	24,200	12.62	8,750
10												
N	7.10	1,440	13.68	9,790	20.55	51,000	18.26	36,300	15.79	22,500	12.00	7,700
2												
4	7.53	1,780	14.90	12,100	20.90	56,400	17.53	31,900	15.25	19,900	11.22	6,530
6												
8	8.42	2,600	15.61	13,700	20.98	57,700	17.00	29,100	14.70	17,200	10.60	5,680
10												
12	9.42	3,760	16.78	16,800	20.57	51,200	16.61	27,000	14.07	14,300	9.97	4,910
	April 20		April 21		April 22		April 23		April 24		April 25	
4	9.48	4,330	7.98	2,680	7.70	2,400	7.55	2,250	7.10	1,830		
8	9.02	3,800	7.85	2,550	7.91	2,610	7.56	2,260	7.00	1,740	6.57	1,360
N	8.73	3,480	7.70	2,400	8.05	2,750	7.43	2,130	7.00	1,740		
4	8.45	3,180	7.57	2,270	8.00	2,700	7.34	2,050	6.92	1,670	6.42	1,240
8	8.27	2,980	7.55	2,250	7.78	2,480	7.26	1,970	6.84	1,600		
12	8.12	2,820	7.58	2,280	7.58	2,280	7.20	1,920	6.76	1,520	6.36	1,190
	April 26		April 27		April 28		April 29		April 30		May 1	
4												
8	6.24	1,100										
N			5.87	839	5.66	701	5.51	611	5.32	506	5.30	495
4	6.13	1,020										
8												
12	5.99	923	5.77	770	5.58	653	5.42	561	5.30	495	5.27	480
	May 2		May 3		May 4		May 5		May 6		May 7	
4											5.74	751
8											6.03	951
N	5.37	534	5.48	594	6.08	986	5.74	751	5.55	635	6.02	944
4											5.98	916
8											6.02	944
12	5.40	550	5.63	683	5.92	874	5.61	671	5.61	671	5.97	909
	May 8		May 9		May 10		May 11		May 12		May 13	
4	5.92	874			6.07	979	6.52	1,320	6.82	1,580		
8	5.87	839	6.09	993	6.03	951	6.77	1,530	6.82	1,580	6.16	1,040
N	5.86	832			6.00	930	6.78	1,540	6.75	1,520		
4	5.85	825	6.05	965	6.00	930	6.82	1,580	6.64	1,420	6.02	944
8	5.95	895			5.99	923	6.75	1,520	6.50	1,300		
12	6.09	993	6.10	1,000	6.25	1,110	6.75	1,520	6.38	1,200	5.90	860

Supplemental record.—Apr. 16, 7 p.m., 21.0 ft., 58,000 sec.-ft.

Grand River near Wakpala, S. Dak.

Location.—Lat. 45°39'55", long. 100°38'20", in NW¼ SE¼ sec. 26, T. 20 N., R. 28 E., at bridge on U. S. Highway 12, 5 miles west of Wakpala, 8 miles upstream from Deep Bank Creek, and 21 miles upstream from mouth.
Drainage area.—5,510 square miles.
Gage-height record.—Water-stage recorder graph except for May 26 to June 12, when record is from once-daily wire-weight gage readings. No gage readings on May 27, 29, 31, June 2, 4, 6, 8, 12.
Discharge record.—Stage-discharge relation defined by current-meter measurements. Stage-discharge relation affected by ice Apr. 1-3; discharge computed on basis of gage heights and weather records. Discharge for days of no gage-height record was interpolated. Shifting-control method used Apr. 4-18, Apr. 23 to June 30. Gage heights used to hundredths.
Maxima.—April-May 1950: Discharge, 82,200 second-feet Apr. 18 (gage height, 22.75 feet).
1911-18, 1928 to March 1950: Discharge, 32,000 second-feet Apr. 9, 10, 1944 (gage height, 19.5 feet).
Remarks.—Small diversion above station.

Mean discharge, in second-feet, 1950

Day	April	May	June	Day	April	May	June	Day	April	May	June
1	900	1,290	264	11	4,790	2,800	448	21	10,400	1,140	210
2	1,400	1,270	255	12	4,300	2,060	390	22	5,800	858	210
3	5,000	1,230	246	13	4,460	2,490	337	23	4,710	700	185
4	7,470	1,240	230	14	4,840	2,380	294	24	4,260	570	165
5	6,590	1,210	210	15	7,430	1,750	264	25	3,580	507	185
6	7,200	1,880	200	16	12,900	1,330	228	26	2,900	416	200
7	10,100	2,160	185	17	15,700	1,220	222	27	2,180	380	175
8	12,800	2,500	240	18	50,200	1,100	216	28	1,670	344	180
9	9,480	4,060	616	19	55,700	1,100	200	29	1,580	320	195
10	6,740	4,800	710	20	32,700	1,070	190	30	1,360	294	185
								31	-	280	-
Mean monthly discharge, in second-feet									9,971	1,444	261
Runoff, in acre-feet									593,300	88,760	15,540
Runoff, in inches									2.02	0.30	0.05

Gage height, in feet, and discharge, in second-feet, at indicated time, 1950

Hour	Gage height	Dis-charge	Gage height	Dis-charge	Gage height	Dis-charge	Gage height	Dis-charge	Gage height	Dis-charge	Gage height	Dis-charge
	April 14		April 15		April 16		April 17		April 18		April 19	
2	8.92	4,680	9.55	5,580	12.66	11,100	14.42	14,800	15.62	17,200	21.15	62,900
4	8.91	4,670	9.68	5,770	12.95	11,700	14.58	15,100	15.81	17,600	20.94	61,600
6	8.88	4,630	9.79	5,940	13.08	12,000	14.60	15,100	16.19	18,500	20.68	60,000
8	8.88	4,630	9.97	6,210	13.23	12,300	14.73	15,400	17.61	22,900	20.40	58,200
10	8.88	4,630	10.25	6,660	13.38	12,600	14.79	15,500	20.17	37,600	20.13	56,500
N	8.89	4,640	10.53	7,110	13.59	13,000	14.86	15,700	22.30	75,300	19.85	54,800
2	8.95	4,720	10.86	7,670	13.78	13,400	14.98	15,900	22.75	82,200	19.64	53,500
4	9.03	4,830	11.18	8,230	14.00	13,900	15.08	16,100	22.63	80,300	19.56	53,000
6	9.17	5,030	11.47	8,760	14.10	14,100	15.10	16,200	22.37	76,400	19.51	52,700
8	9.34	5,270	11.88	9,530	14.22	14,300	15.20	16,400	21.95	70,600	19.24	51,000
10	9.42	5,380	12.08	9,920	14.22	14,300	15.33	16,600	21.65	67,000	18.89	48,900
12	9.49	5,490	12.35	10,500	14.32	14,600	15.47	16,900	21.38	64,600	18.51	46,600
	April 20		April 21		April 22		April 23		April 24		April 25	
4	17.69	41,700	12.07	13,400	9.80	6,510	9.06	4,840	8.94	4,610	8.51	3,800
8	16.96	37,500	11.38	10,900	9.61	6,050	9.00	4,710	8.85	4,420	8.42	3,640
N	16.10	32,800	10.97	9,620	9.50	5,800	8.94	4,580	8.74	4,200	8.36	3,540
4	15.28	28,400	10.62	8,620	9.35	5,460	8.92	4,540	8.64	4,020	8.31	3,460
8	14.25	23,100	10.29	7,730	9.19	5,100	8.95	4,610	8.53	4,000	8.31	3,460
12	13.19	18,000	9.98	6,950	9.15	5,010	8.92	4,540	8.56	3,870	8.17	3,220
	April 26		April 27		April 28		April 29		April 30		May 1	
4	8.09	3,110	7.64	2,400	7.18	1,760	7.12	1,680	6.89	1,400	6.80	1,290
8	7.99	2,950	7.57	2,300	7.10	1,660	7.10	1,660	6.88	1,390	6.80	1,290
N	7.95	2,880	7.50	2,190	7.06	1,600	7.07	1,620	6.85	1,350	6.79	1,280
4	7.89	2,790	7.42	2,070	6.95	1,460	7.00	1,520	6.84	1,340	6.78	1,270
8	7.82	2,680	7.32	1,930	7.22	1,810	6.93	1,440	6.83	1,330	6.78	1,270
12	7.75	2,560	7.24	1,820	7.15	1,720	6.92	1,420	6.84	1,340	6.79	1,280
	May 2		May 3		May 4		May 5		May 6		May 7	
4	6.77	1,270	6.74	1,230	6.76	1,260	6.71	1,200	6.82	1,360	7.24	2,160
8	6.76	1,260	6.73	1,220	6.75	1,240	6.72	1,210	7.12	1,890	7.26	2,220
N	6.78	1,280	6.72	1,210	6.75	1,240	6.71	1,200	7.19	2,060	7.20	2,070
4	6.76	1,260	6.72	1,210	6.76	1,260	6.71	1,200	7.27	2,240	7.25	2,190
8	6.78	1,280	6.77	1,270	6.76	1,260	6.71	1,200	7.21	2,090	7.27	2,240
12	6.77	1,270	6.77	1,270	6.75	1,240	6.71	1,200	7.21	2,090	7.30	2,300
	May 8		May 9		May 10		May 11		May 12		May 13	
4	7.24	2,160	7.28	2,250	8.58	5,610	7.70	3,290	7.20	2,070	7.32	2,320
8	7.28	2,250	7.51	2,790	8.41	5,320	7.63	3,090	7.21	2,090	7.42	2,550
N	7.42	2,550	8.08	4,340	8.21	4,730	7.52	2,800	7.19	2,060	7.44	2,610
4	7.55	2,880	8.39	5,270	8.02	4,170	7.41	2,540	7.19	2,060	7.42	2,550
8	7.51	2,790	8.53	5,590	7.93	3,910	7.31	2,310	7.19	2,060	7.39	2,490
12	7.37	2,440	8.59	5,730	7.80	3,560	7.20	2,070	7.18	2,030	7.43	2,580

South Fork Grand River near Cash, S. Dak.

Location.—Lat. 45°38'55", long. 102°38'45", in NE¼SW¼SE¼ sec. 33, T. 20 N., R. 12 E., at county highway bridge, 1 mile upstream from Little Nasty Creek, 4 miles north of Cash, and 16 miles downstream from Big Nasty Creek.
Drainage area.—1,350 square miles.
Gage-height record.—Water-stage recorder graph 6 p.m. to 11 p.m. Apr. 4, 7 a.m. Apr. 5 to 10 p.m. Apr. 7, 4 p.m. Apr. 9 to 6 p.m. Apr. 10, 2 p.m. Apr. 14 to 9:30 a.m. Apr. 17, 3 p.m. Apr. 18 to 12 m. Apr. 19, 9 a.m. May 10 to 12 m. May 11; graph based on partial recorder record and frequent gage readings rest of period Apr. 4 to May 20; daily wire-weight gage readings Apr. 1-3, May 22 to June 30; except no record Apr. 2, 20, 22, 23, Apr. 28 to May 1, May 7, 14, 21, 28, 30, June 4, 11, 18, 25.
Discharge record.—Stage-discharge relation defined by current-meter measurements below 14,000 second-feet and extended to peak stage on basis of slope-area measurement. Affected by ice Apr. 1-5. Shifting-control method used Apr. 14, 15, 20, 21, May 6-17. Discharge for period of no gage-height record computed by interpolation, weather records, and by comparison with stations nearby.
Maxima.—April-May 1950: Discharge, 27,000 second-feet 8 p.m. Apr. 15 (gage height, 15.40 feet).
1945 to March 1950: Daily discharge, 5,000 second-feet Mar. 23, 1947; gage height observed, 14.35 feet Mar. 22, 1947 (ice jam).
Remarks.—No regulation or diversions.

Mean discharge, in second-feet, 1950

Day	April	May	June	Day	April	May	June	Day	April	May	June
1	110	350	39	11	703	392	40	21	426	80	32
2	100	476	37	12	730	228	35	22	450	68	30
3	120	507	36	13	574	183	37	23	500	62	26
4	700	398	35	14	1,410	150	46	24	563	58	24
5	1,630	311	34	15	13,600	125	50	25	528	51	25
6	1,850	462	33	16	15,600	131	81	26	390	51	27
7	4,820	450	30	17	7,120	242	50	27	256	49	71
8	3,340	411	51	18	3,260	150	45	28	240	45	50
9	1,660	292	62	19	1,210	109	38	29	220	44	35
10	840	400	41	20	621	89	35	30	200	44	27
								31	-	43	-
Mean monthly discharge, in second-feet									2,126	208	40.1
Runoff, in acre-feet									126,500	12,800	2,380
Runoff, in inches									1.76	0.18	0.03

Gage height, in feet, and discharge, in second-feet, at indicated time, 1950

Hour	Gage height	Dis-charge	Gage height	Dis-charge	Gage height	Dis-charge	Gage height	Dis-charge	Gage height	Dis-charge	Gage height	Dis-charge
	April 14		April 15		April 16		April 17		April 18		April 19	
2	4.48	531	8.87	4,360	14.81	23,000	12.54	11,000	9.28	4,440	6.84	1,860
4	4.56	534	9.60	5,160	14.39	20,300	12.17	9,710	9.07	4,180	6.59	1,630
6	4.67	606	10.59	6,500	13.82	16,900	11.69	8,400	8.85	3,940	6.38	1,440
8	4.79	656	11.32	7,850	13.43	14,800	11.24	7,380	8.62	3,680	6.16	1,240
10	4.95	726	12.15	9,860	13.16	13,500	10.90	6,700	8.39	3,430	6.02	1,120
N	5.14	819	12.75	11,800	13.05	13,000	10.71	6,340	8.17	3,190	5.91	1,020
2	5.36	909	13.12	13,300	13.01	12,800	10.52	6,030	7.93	2,930	5.89	1,000
4	5.90	1,260	13.72	16,400	13.07	13,100	10.32	5,750	7.71	2,710	5.86	976
6	7.02	2,370	14.40	20,400	13.20	13,700	10.12	5,470	7.59	2,590	5.83	950
8	7.56	2,970	15.40	27,000	13.30	14,200	9.91	5,190	7.39	2,390	5.80	925
10	7.94	3,380	15.35	26,600	13.15	13,500	9.70	4,940	7.22	2,220	5.76	891
12	8.34	3,820	15.10	24,900	12.92	12,500	9.49	4,690	7.03	2,030	5.72	857
	April 20		April 21		April 22		April 23		April 24		April 25	
4												
8												
N	5.50	568	5.40	420					5.33	561	5.31	547
4												
8												
12	5.53	492	5.30	370			5.39	603	5.28	528	5.22	492
	April 26		April 27		April 28		April 29		April 30		May 1	
4												
8												
N	5.02	385	4.68	254								
4												
8												
12	4.81	297	4.56	220							5.00	375
	May 2		May 3		May 4		May 5		May 6		May 7	
4			5.24	504								
8			5.20	480					5.06	405		
N	5.24	504	5.18	469	5.02	385	4.84	308				
4			5.27	522					5.34	568		
8			5.33	561								
12	5.27	522	5.22	492	4.90	330	4.81	297	5.32	528	5.26	452
	May 8		May 9		May 10		May 11		May 12		May 13	
4					4.89	233	5.60	540				
8					5.10	297	5.35	405				
N	5.24	415	5.02	290	5.37	405	5.25	362	4.79	220	4.58	180
4					5.44	436	5.17	326				
8					5.74	632	5.09	300				
12	5.16	362	4.86	227	5.64	568	5.01	276	4.66	194	4.53	178

Supplemental record.—Apr. 15, 12:30 p.m., 12.68 ft., 11,500 sec.-ft.; May 10, 7 p.m., 5.74 ft., 632 sec.-ft., 11 p.m., 5.60 ft., 540 sec.-ft.; May 11, 2 a.m., 5.70 ft., 610 sec.-ft.

Moreau River Basin

Moreau River at Bixby, S. Dak.

Location.—Lat. 45°08'35", long. 102°33'25", in NW¼SE¼ sec. 29, T. 14 N., R. 13 E., 300 feet (revised) below county highway bridge, a quarter of a mile east of Bixby and 2⅔ miles downstream from Bixby Dam site. Datum of gage is 2431.02 feet above mean sea level (Bureau of Reclamation bench mark).
Drainage area.—1,570 square miles.
Gage-height record.—Water-stage recorder graph except for periods 9 p.m. Apr. 6 to 1 a.m. Apr. 7, 5-9 a.m. Apr. 7, 3 p.m. Apr. 7 to 9 a.m. Apr. 8, 1-8 a.m. Apr. 15, 1-8 p.m. May 10, for which graph was projected from adjacent record.
Discharge record.—Stage-discharge relation defined by current-meter measurements. Affected by ice Apr. 1-6. Shifting-control method used Apr. 10-13, Apr. 17 to May 3, May 15 to June 30.
Maxima.—April-May 1950: Discharge, 10,500 second-feet 5 p.m. Apr. 16 (gage height, 14.65 feet).
1904-6, 1948 to March 1950: Discharge, 5,420 second-feet Mar. 23, 1949 (gage height, 11.0 feet, observer's estimate).
Remarks.—No regulation or diversion at present.

Mean discharge, in second-feet, 1950

Day	April	May	June	Day	April	May	June	Day	April	May	June
1	200	105	26	11	901	1,410	24	21	363	48	18
2	1,300	123	23	12	729	824	20	22	295	43	14
3	2,900	178	21	13	871	291	18	23	326	39	13
4	2,710	484	21	14	2,530	146	33	24	313	35	11
5	2,730	744	20	15	8,490	108	33	25	266	34	40
6	2,960	650	18	16	9,420	89	21	26	203	34	33
7	6,590	852	18	17	4,880	77	22	27	160	32	21
8	5,740	687	22	18	2,260	69	19	28	131	29	94
9	3,900	542	20	19	1,180	59	17	29	119	28	138
10	1,500	947	20	20	602	53	16	30	110	26	74
								31	-	30	-
Mean monthly discharge, in second-feet									2,156	284	29.6
Runoff, in acre-feet									128,300	17,490	1,760
Runoff, in inches									1.53	0.21	0.02

Gage height, in feet, and discharge, in second-feet, at indicated time, 1950

Hour	Gage height	Discharge	Gage height	Discharge	Gage height	Discharge	Gage height	Discharge	Gage height	Discharge	Gage height	Discharge
	April 2		April 3		April 4		April 5		April 6		April 7	
4	6.76	600	12.83	2,900	8.40	2,490	9.18	3,190	8.26	2,480	11.43	5,920
8	7.00	750	13.05	3,100	7.98	2,190	8.50	2,650	8.11	2,370	12.27	6,960
N	7.51	1,000	9.30	3,200	8.07	2,260	8.14	2,390	8.22	2,450	12.75	7,610
4	8.50	1,600	8.17	2,300	8.90	2,900	8.18	2,420	8.85	3,030	12.33	7,040
8	9.55	2,300	8.90	2,800	9.02	3,020	8.52	2,680	9.57	3,780	11.90	6,480
12	12.40	2,500	9.46	3,300	9.25	3,230	8.49	2,650	10.50	4,870	11.53	6,040
	April 8		April 9		April 10		April 11		April 12		April 13	
4	11.30	5,760	10.72	5,110	6.73	1,720	5.72	1,050	5.32	796	5.24	784
8	11.25	5,700	10.20	4,570	6.52	1,580	5.43	889	5.16	708	5.16	752
N	11.32	5,780	9.45	3,860	6.25	1,400	5.38	850	5.15	702	5.15	762
4	11.30	5,760	8.83	3,310	6.19	1,360	5.26	779	5.11	686	5.16	784
8	11.23	5,680	8.14	2,740	6.10	1,290	5.32	806	5.07	670	5.80	1,150
12	11.10	5,530	7.34	2,150	6.00	1,220	5.40	845	5.24	774	5.94	1,250
	April 14		April 15		April 16		April 17		April 18		April 19	
4	6.07	1,330	12.50	7,260	13.79	9,140	11.10	5,530	7.67	2,600	6.10	1,450
8	6.84	1,810	13.23	8,300	13.89	9,280	11.22	5,660	7.38	2,400	5.85	1,270
N	7.40	2,190	13.64	8,910	14.29	9,920	10.92	5,400	7.25	2,290	5.66	1,150
4	8.28	2,850	13.87	9,260	14.64	10,500	10.00	4,490	7.06	2,130	5.51	1,040
8	9.22	3,650	14.02	9,490	14.05	9,540	8.90	3,520	6.69	1,860	5.38	950
12	11.10	5,530	13.99	9,440	11.90	6,480	8.15	2,930	6.34	1,610	5.27	867
	April 20		April 21		April 22		April 23		April 24		April 25	
4	5.12	762	4.43	409	4.08	315	4.17	351				
8	4.95	650	4.33	378	4.03	298	4.15	344	4.10	332	3.92	279
N	4.79	560	4.24	351	3.97	279	4.08	318				
4	4.67	503	4.17	340	3.93	266	4.04	305	4.00	298	3.85	257
8	4.62	481	4.11	322	4.00	288	4.07	315				
12	4.53	442	4.09	318	4.10	322	4.10	325	3.98	291	3.77	234
	April 26		April 27		April 28		April 29		April 30		May 1	
4												
8	3.70	220	3.47	170	3.28	133	3.20	120	3.13	110	3.10	105
N												
4	3.57	187	3.40	155	3.25	128	3.19	118	3.12	108	3.08	102
8												
12	3.49	170	3.33	142	3.20	120	3.17	116	3.10	105	3.19	118
	May 2		May 3		May 4		May 5		May 6		May 7	
4	3.18	117	3.55	182	3.96	279	5.24	867	4.69	575	5.13	806
8	3.18	117	3.50	172	4.23	374	5.17	828	4.76	610	5.18	834
N	3.20	120	3.45	161	4.46	468	5.03	752	4.80	630	5.25	872
4	3.20	120	3.47	165	4.60	530	4.89	675	4.86	660	5.27	884
8	3.24	126	3.57	187	4.96	713	4.80	630	5.01	740	5.28	889
12	3.43	161	3.78	243	5.19	840	4.70	580	5.10	790	5.23	862

Moreau River at Bixby, S. Dak.—Continued

Gage height, in feet, and discharge, in second-feet, at indicated time, 1950

Hour	Gage height	Dis-charge	Gage height	Dis-charge	Gage height	Dis-charge	Gage height	Dis-charge	Gage height	Dis-charge	Gage height	Dis-charge
	May 8		May 9		May 10		May 11		May 12		May 13	
4	5.14	812	4.83	645	4.42	451	6.09	1,340				
8	5.00	735	4.63	545	4.90	680	6.08	1,340	5.38	944	4.09	322
N	4.85	655	4.58	521	5.50	1,010	6.26	1,450				
4	4.71	585	4.60	530	5.87	1,210	6.38	1,520	4.85	655	3.83	240
8	4.69	575	4.45	464	6.20	1,410	6.27	1,450				
12	4.85	655	4.40	442	6.18	1,400	6.03	1,310	4.39	438	3.62	185

Supplemental record:

Apr. 2, 9 p.m., 12.45 ft., 2,600 sec.-ft.; 11 p.m., 12.25 ft., 2,400 sec.-ft.;

Apr. 3, 12:30 a.m., 13.35 ft., 3,300 sec.-ft.; 11 a.m., 13.53 ft., 3,500 sec.-ft.;
2 p.m., 8.01 ft., 2,200 sec.-ft.; 5 p.m., 10.54 ft., 2,400 sec.-ft.;
6.30 p.m., 8.77 ft., 2,700 sec.-ft.; 10 p.m., 10.42 ft., 3,100 sec.-ft.;
11 p.m., 9.53 ft., 3,300 sec.-ft.;

Apr. 4, 2 a.m., 9.50 ft., 3,380 sec.-ft.; 2 p.m., 8.04 ft., 2,240 sec.-ft.;
6 p.m., 9.39 ft., 3,320 sec.-ft.; 10 p.m., 8.84 ft., 2,890 sec.-ft.;

Apr. 5, 1:30 a.m., 9.55 ft., 3,500 sec.-ft.; 2 p.m., 8.12 ft., 2,380 sec.-ft.;

Apr. 6, 1:30 p.m., 8.21 ft., 2,440 sec.-ft.;

Apr. 7, 1 p.m., 12.74 ft., 7,600 sec.-ft.;

Apr. 9, 3 p.m., 8.88 ft., 3,350 sec.-ft.;

Apr. 10, 3 p.m., 6.16 ft., 1,340 sec.-ft.;

Apr. 13, 2 a.m., 5.29 ft., 806 sec.-ft.; 5 p.m., 5.21 ft., 818 sec.-ft.;

Apr. 14, 2 a.m., 5.90 ft., 1,230 sec.-ft.;

Apr. 15, 1 a.m., 11.85 ft., 6,420 sec.-ft.;

Apr. 16, 6 a.m., 13.77 ft., 9,100 sec.-ft.; 5 p.m., 14.65 ft., 10,500 sec.-ft.;
6 p.m., 14.63 ft., 10,500 sec.-ft.;

Apr. 17, 5 a.m., 11.05 ft., 5,480 sec.-ft.;

May 1, 7 p.m., 3.06 ft., 100 sec.-ft.

Moreau River near Faith, S. Dak.

Location.—Wire-weight gage, lat. 45°11'50", long. 102°09'10", in NW¼NW¼ sec. 10, T. 14 N., R. 16 E., at bridge on State Highway 73, 2¾ miles downstream from Rabbit Creek and 13½ miles northwest of Faith. Prior to Oct. 5, 1949 at bridge ¼ mile upstream, at same datum.

Drainage area.—2,660 square miles.

Gage-height record.—Once-daily readings below 4.4 ft. gage height and two or more above. Graph drawn for periods Apr. 1 to May 28 and June 28-30.

Discharge record.—Stage-discharge relation defined by current-meter measurements. Stage-discharge relation affected by ice Apr. 1-2. Shifting-control method used Apr. 10-14, 23-29, May 3-14.

Maxima.—April-May 1950: Discharge, 23,000 second-feet 1 a.m. Apr. 17 (gage height, 18.0 feet, from floodmarks).
1943 to March 1950: Discharge, 26,000 second-feet Apr. 9, 1944 (gage height, 20.9 feet at former site, from floodmark) by slope-area method.

Remarks.—No regulation or diversion.

Mean discharge, in second-feet, 1950

Day	April	May	June	Day	April	May	June	Day	April	May	June
1	300	269	55	11	1,990	1,730	50	21	1,060	136	36
2	1,840	267	50	12	1,610	1,720	41	22	877	119	33
3	4,180	288	50	13	1,300	893	36	23	806	100	35
4	5,060	407	48	14	2,850	522	50	24	784	91	33
5	4,460	747	43	15	10,800	364	62	25	691	86	38
6	4,840	804	43	16	18,300	286	43	26	571	72	80
7	8,950	848	36	17	16,900	266	60	27	503	67	91
8	8,420	1,150	53	18	7,380	540	45	28	392	65	43
9	7,140	1,080	53	19	3,550	184	36	29	316	60	36
10	3,920	1,040	50	20	1,730	156	36	30	277	60	167
								31	-	57	-
Mean monthly discharge, in second-feet									4,060	467	51.1
Runoff, in acre-feet									241,600	28,710	3,040
Runoff, in inches									1.70	0.20	0.02

Gage height, in feet, and discharge, in second-feet, at indicated time, 1950

Hour	Gage height	Dis-charge	Gage height	Dis-charge	Gage height	Dis-charge	Gage height	Dis-charge	Gage height	Dis-charge	Gage height	Dis-charge
	April 2		April 3		April 4		April 5		April 6		April 7	
4	5.82	400	8.02	3,920	9.95	6,180	8.10	4,010	8.66	4,630	10.52	6,930
8	6.02	500	7.15	3,030	9.46	5,570	8.25	4,180	8.30	4,230	11.25	7,880
N	7.22	1,200	7.32	3,200	8.97	4,980	8.58	4,540	8.34	4,270	12.22	9,160
4	8.70	2,500	7.94	3,830	8.37	4,310	8.70	4,670	8.90	4,900	13.08	10,400
8	10.00	4,000	9.55	5,680	8.08	3,990	8.86	4,850	9.42	5,520	13.50	11,000
12	8.95	4,500	10.05	6,320	8.05	3,960	8.90	4,900	9.94	6,170	13.18	10,500
	April 8		April 9		April 10		April 11		April 12		April 13	
4	12.25	9,200	11.18	7,780	9.05	5,080	6.48	2,220	5.80	1,660	5.24	1,260
8	11.60	8,330	11.10	7,680	8.58	4,540	6.28	2,040	5.75	1,620	5.12	1,190
N	11.31	7,950	10.84	7,340	7.98	3,820	6.16	1,940	5.75	1,620	5.15	1,210
4	11.34	7,990	10.52	6,930	7.38	3,160	6.05	1,850	5.74	1,610	5.25	1,280
8	11.26	7,890	10.02	6,280	7.05	2,800	5.96	1,780	5.70	1,580	5.40	1,400
12	11.24	7,860	9.62	5,760	6.75	2,490	5.88	1,710	5.46	1,410	5.62	1,570
	April 14		April 15		April 16		April 17		April 18		April 19	
4	5.90	1,810	10.82	7,320	16.12	15,300	17.86	22,400	12.23	9,170		
8	6.21	2,100	12.15	9,060	16.38	17,000	17.23	19,800	11.40	8,070	8.00	3,900
N	6.58	2,460	13.55	11,100	16.44	17,200	16.00	16,000	10.70	7,160		
4	7.32	3,200	14.58	12,700	17.02	19,000	15.25	14,100	10.15	6,440	7.20	3,080
8	8.15	4,060	15.25	14,100	17.62	21,300	14.23	12,100	9.56	5,890		
12	9.26	5,330	15.75	15,300	17.95	22,800	13.20	10,600	8.95	4,960	6.42	2,360
	April 20		April 21		April 22		April 23		April 24		April 25	
4												
8	5.82	1,870	4.68	1,070	4.36	878	4.21	801	4.21	806	4.06	730
N												
4	5.38	1,530	4.62	1,030	4.35	872	4.21	801	4.15	774	3.92	665
8												
12	4.95	1,230	4.45	930	4.28	834	4.21	801	4.09	746	3.80	610
	April 26		April 27		April 28		April 29		April 30		May 1	
4												
8	3.68	555	3.57	504	3.35	391	3.22	328				
N									3.11	274	3.10	270
4	3.72	580	3.55	494	3.31	373	3.17	302				
8												
12	3.65	545	3.52	476	3.26	346	3.14	290	3.10	270	3.09	266
	May 2		May 3		May 4		May 5		May 6		May 7	
4							3.95	705			4.12	806
8			3.10	270	3.27	350	4.02	746	4.12	806	4.12	806
N	3.09	266					4.06	768			4.15	828
4			3.16	298	3.39	409	4.07	774	4.12	806	4.20	862
8							4.09	790			4.27	906
12	3.10	270	3.20	319	3.77	605	4.10	796	4.12	806	4.34	954

Moreau River near Faith, S. Dak.—Continued

Gage height, in feet, and discharge, in second-feet, at indicated time, 1950

Hour	Gage height	Discharge	Gage height	Discharge	Gage height	Discharge	Gage height	Discharge	Gage height	Discharge	Gage height	Discharge
	May 8		May 9		May 10		May 11		May 12		May 13	
4	4.40	996			4.29	918	5.13	1,540	5.59	1,950	4.57	1,120
8	4.45	1,030	4.55	1,100	4.29	918	5.35	1,730	5.60	1,950	4.35	966
N	4.55	1,100			4.38	984	5.52	1,880	5.43	1,800	4.18	850
4	4.78	1,280	4.45	1,030	4.52	1,080	5.46	1,830	5.22	1,610	4.04	757
8	4.86	1,340			4.70	1,210	5.42	1,790	5.01	1,460	3.93	695
12	4.90	1,300	4.32	942	4.89	1,370	5.48	1,840	4.81	1,300	3.83	640

Supplemental record.—Apr. 3, 9:30 a.m., 7.06 ft., 2,940 sec.-ft.; 10 p.m., 9.92 ft., 6,150 sec.-ft.; Apr. 4, 1:30 a.m., 10.10 ft., 6,380 sec.-ft.; 10 a.m., 9.40 ft., 5,500 sec.-ft.; Apr. 5, 2 p.m., 8.74 ft., 4,710 sec.-ft.; 11 p.m., 8.93 ft., 4,940 sec.-ft.; Apr. 6. 10 a.m., 8.26 ft., 4,190 sec.-ft.; Apr. 16, 1:30 p.m., 16.45 ft., 17,200 sec.-ft.; Apr. 17, 1 a.m., 18.00 ft., 23,000 sec.-ft.; May 8, 6:30 p.m., 4.87 ft., 1,350 sec.-ft.; May 10, 7 a.m., 4.27 ft., 906 sec.-ft.; May 11, 2 p.m., 5.55 ft., 1,910 sec.-ft.; 3 p.m., 5.48 ft., 1,840 sec.-ft.; May 12, 7 a.m., 5.62 ft., 1,970 sec.-ft.

Moreau River near Eagle Butte, S. Dak.

Location.—Lat. 45°11'20", long. 101°13'05", in NW¼NW¼SW¼ sec. 8, T. 14 N., R. 24 E., at bridge on State Highway 63, 4 miles downstream from Meadow Creek, and 13 miles north of Eagle Butte.

Drainage area.—4,320 square miles.

Gage-height record.—Water-stage recorder graph Apr. 8, 13-19, May 9 to June 30. Once-daily wire-weight gage readings, or graph based on gage readings, was used Apr. 1, 4-7, 9, 11, 20, 25, May 6. No gage-height record Apr. 2, 3, 10, 12, 21-24, Apr. 26 to May 5, May 7, 8.

Discharge record.—Stage-discharge relation defined by current-meter measurements below 12,000 second-feet and extended to peak on basis of contracted-opening measurement. Shifting-control method used May 11 to June 30. Discharge for periods of no gage-height record was interpolated or computed on basis of weather records and records for station at Promise. Gage heights used to hundredths.

Maxima.—April-May 1950: Discharge, 22,200 second-feet Apr. 18 (gage height, 20.23 feet), by contracted-opening method.

1943 to March 1950: Discharge observed, 27,000 second-feet (revised) Apr. 9, 1944 (gage height, 23.0 feet), by slope-area method.

Mean discharge, in second-feet, 1950

Day	April	May	June	Day	April	May	June	Day	April	May	June
1	5,000	850	102	11	4,880	2,010	70	21	5,000	306	102
2	5,500	900	89	12	3,500	1,850	77	22	3,500	274	86
3	6,000	800	86	13	2,920	2,060	72	23	2,500	240	79
4	7,000	800	79	14	3,070	1,380	72	24	2,200	208	66
5	7,360	1,000	77	15	8,240	912	66	25	1,850	180	66
6	8,510	1,360	72	16	14,800	665	59	26	1,600	155	59
7	11,200	1,500	72	17	19,600	537	138	27	1,300	146	63
8	12,300	2,500	79	18	21,500	449	160	28	1,000	141	55
9	10,100	4,000	72	19	12,800	380	117	29	800	130	59
10	7,700	3,020	63	20	6,760	344	109	30	800	114	109
								31	-	102	-
Mean monthly discharge, in second-feet									6,460	946	82.5
Runoff, in acre-feet									384,400	58,140	4,910
Runoff, in inches									1.67	0.25	0.02

Gage height, in feet, and discharge, in second-feet, at indicated time, 1950

Hour	Gage height	Dis-charge	Gage height	Dis-charge	Gage height	Dis-charge	Gage height	Dis-charge	Gage height	Dis-charge	Gage height	Dis-charge
	April 14		April 15		April 16		April 17		April 18		April 19	
2	7.42	2,940	8.42	4,120	13.92	11,700	17.67	17,900	19.36	20,700	18.21	18,800
4	7.41	2,930	8.69	4,450	14.28	12,300	17.93	18,300	19.51	21,000	16 06	16,700
6	7.40	2,920	8.97	4,780	14.63	12,900	18.21	18,800	19.71	21,300	15.94	15,000
8	7.41	2,930	9.25	5,120	15.10	13,600	18.46	19,200	19.84	21,500	15.22	13,800
10	7.43	2,950	9.70	5,700	15.51	14,300	18.67	19,600	20.03	21,900	14.61	12,800
N	7.41	2,930	10.54	6,820	15.94	15,000	18.82	19,800	20.12	22,000	14.13	12,100
2	7.40	2,920	11.04	7,520	16.35	15,600	18.96	20,100	20.19	22,100	13.64	11,300
4	7.48	3,010	11.65	8,370	16.75	16,300	19.05	20,200	20.15	22,100	13.17	10,600
6	7.59	3,130	12.17	9,100	16.99	16,700	19.10	20,300	20.10	22,000	12.82	10,000
8	7.77	3,340	12.70	9,870	17.17	17,000	19.18	20,400	19.85	21,600	12.50	9,570
10	7.97	3,580	13.13	10,500	17.26	17,200	19.23	20,500	19.55	21,100	12.12	9,030
12	8.22	3,880	13.53	11,100	17.46	17,500	19.30	20,600	19.02	20,200	11.80	8,580
	April 20		April 21		April 22		April 23		April 24		April 25	
4	11.23	7,780										
8	10.74	7,100										
N	10.34	6,540										
4	10.07	6,180										
8	9.90	5,960										
12	9.75	5,760										
	April 26		April 27		April 28		April 29		April 30		May 1	
4												
8												
N												
4												
8												
12												
	May 2		May 3		May 4		May 5		May 6		May 7	
4												
8												
N												
4												
8												
12												
	May 8		May 9		May 10		May 11		May 12		May 13	
4			7.87	3,460	7.81	3,390	6.91	2,380	6.04	1,560	6.65	2,040
8			8.18	3,840	7.60	3,140	6.73	2,190	6.27	1,740	6.78	2,150
N			8.50	4,220	7.40	2,920	6.54	2,010	6.55	1,980	6.78	2,140
4			8.68	4,440	7.31	2,820	6.35	1,840	6.61	2,020	6.75	2,100
8			8.61	4,350	7.21	2,710	6.19	1,690	6.61	2,020	6.63	1,980
12			8.42	4,120	7.10	2,600	6.07	1,590	6.60	2,000	6.44	1,820

Moreau River at Promise, S. Dak.

Location.—Lat. 45°20', long. 100°36', in sec. 17, T. 16 N., R. 29 E., at county highway bridge, 170 feet downstream from Chicago, Milwaukee, St. Paul and Pacific Railroad bridge, 0.5 mile downstream from Virgin Creek, and three-quarters of a mile north of Promise.

Drainage area.—5,223 square miles.

Gage-height record.—Water-stage recorder graph used Apr. 21, 22, May 25 to June 2. Graph based on once or twice-daily wire-weight gage readings and fragments of recorder record was used Apr. 1-20, Apr. 23 to May 24, and June 3-30. No gage reading Apr. 18. Gage readings for Apr. 19, 20 are from auxiliary staff gage at railroad bridge 170 feet upstream from reference gage.

Discharge record.—Stage-discharge relation defined by current-meter measurements below 15,200 second-feet and extended to peak stage on basis of contracted-opening measurement. Stage-discharge relation affected by ice Apr. 1, 2. Shifting-control method used May 16 to June 30. Discharge for day of no gage-height record, Apr. 18, was computed from graph drawn on basis of gage-height record for adjoining days. Gage heights used to hundredths.

Maxima.—April-May 1950: Discharge, 20,900 second-feet Apr. 19 (gage height, 21.8 feet), by contracted-opening method.

1928 to March 1950: Discharge, 29,500 second-feet Mar. 25, 1947 (gage height, 24.4 feet, from floodmark), by velocity-area studies.

Mean discharge, in second-feet, 1950

Day	April	May	June	Day	April	May	June	Day	April	May	June
1	4,800	1,000	178	11	7,450	3,650	113	21	6,610	488	89
2	6,400	1,150	168	12	5,250	3,040	106	22	4,260	426	83
3	8,930	1,060	158	13	4,300	2,370	98	23	3,100	340	82
4	11,500	920	150	14	4,830	1,950	90	24	2,410	323	77
5	11,600	1,040	139	15	6,010	1,240	83	25	2,050	291	75
6	11,200	1,240	130	16	10,800	840	82	26	1,790	255	70
7	13,300	2,760	124	17	14,800	652	77	27	1,480	247	66
8	13,400	5,700	126	18	17,000	568	76	28	1,270	228	62
9	12,700	5,800	122	19	20,100	512	87	29	970	216	59
10	10,100	5,270	119	20	15,200	464	119	30	950	199	58
								31	-	185	-
Mean monthly discharge, in second-feet									7,819	1,430	102
Runoff, in acre-feet									465,200	88,110	6,080
Runoff, in inches									1.67	0.32	0.02

Gage height, in feet, and discharge, in second-feet, at indicated time, 1950

Hour	Gage height	Discharge	Gage height	Discharge	Gage height	Discharge	Gage height	Discharge	Gage height	Discharge	Gage height	Discharge
	April 14		April 15		April 16		April 17		April 18		April 19	
2	9.83	4,130	11.10	5,400	13.70	8,130	18.11	13,800	19.45	16,000	20.90	18,800
4	9.90	4,200	11.12	5,420	14.35	8,840	18.26	14,000	19.55	16,200	21.10	19,200
6	10.01	4,310	11.20	5,500	14.89	9,470	18.40	14,200	19.61	16,300	21.26	19,600
8	10.16	4,460	11.30	5,600	15.41	10,100	18.52	14,400	19.69	16,500	21.43	20,000
10	10.38	4,680	11.46	5,760	15.80	10,600	18.63	14,600	19.78	16,600	21.55	20,300
N	10.63	4,930	11.61	5,910	16.13	11,000	18.76	14,800	19.85	16,800	21.65	20,500
2	10.80	5,100	11.74	6,040	16.48	11,400	18.89	15,000	19.91	16,900	21.70	20,600
4	10.93	5,230	11.91	6,210	16.83	11,900	19.00	15,200	19.97	17,000	21.75	20,800
6	11.01	5,310	12.12	6,420	17.18	12,400	19.11	15,400	20.01	17,100	21.77	20,800
8	11.06	5,360	12.38	6,680	17.48	12,800	19.20	15,600	20.20	17,400	21.80	20,900
10	11.08	5,380	12.70	7,030	17.72	13,200	19.29	15,700	20.43	17,900	21.74	20,800
12	11.08	5,380	13.13	7,500	17.93	13,500	19.38	15,900	20.70	18,400	21.68	20,600
	April 20		April 21		April 22		April 23		April 24		April 25	
4	21.44	20,000	13.41	7,810	10.58	4,880	8.93	3,290	8.20	2,630	7.61	2,140
8	20.93	18,900	12.77	7,110	10.28	4,580	8.79	3,160	8.02	2,470	7.56	2,100
N	19.40	15,900	12.21	6,510	9.92	4,220	8.69	3,070	7.92	2,390	7.50	2,050
4	16.70	11,700	11.72	6,020	9.62	3,920	8.63	3,020	7.82	2,310	7.44	2,000
8	15.35	10,000	11.23	5,530	9.36	3,670	8.52	2,920	7.75	2,250	7.40	1,970
12	14.38	8,880	10.88	5,180	9.12	3,460	8.37	2,780	7.69	2,200	7.34	1,920
	April 26		April 27		April 28		April 29		April 30		May 1	
4	7.30	1,890	6.88	1,580	6.54	1,350	6.00	1,030	5.81	925	5.89	965
8	7.24	1,840	6.80	1,520	6.49	1,320	5.95	1,000	5.84	940	5.89	965
N	7.19	1,800	6.73	1,470	6.41	1,280	5.89	965	5.87	955	5.92	982
4	7.11	1,740	6.67	1,430	6.34	1,230	5.83	935	5.88	960	6.00	1,030
8	7.03	1,680	6.61	1,400	6.25	1,180	5.81	925	5.88	960	6.04	1,050
12	6.97	1,640	6.58	1,380	6.10	1,090	5.81	925	5.89	965	6.09	1,080
	May 2		May 3		May 4		May 5		May 6		May 7	
4	6.13	1,110	6.21	1,160	5.73	885	5.93	988	6.13	1,110	7.39	1,960
8	6.19	1,140	6.19	1,140	5.78	910	5.99	1,020	6.14	1,110	7.87	2,350
N	6.22	1,160	6.09	1,080	5.80	920	6.02	1,040	6.20	1,150	8.30	2,720
4	6.23	1,170	5.96	1,010	5.83	935	6.08	1,080	6.34	1,230	8.80	3,170
8	6.24	1,170	5.82	930	5.87	955	6.10	1,090	6.62	1,400	9.28	3,600
12	6.24	1,170	5.75	895	5.90	970	6.12	1,100	6.99	1,650	9.76	4,060
	May 8		May 9		May 10		May 11		May 12		May 13	
4	10.19	4,490	12.50	6,810	10.62	4,920	9.77	4,070	8.80	3,170	8.18	2,610
8	10.62	4,920	11.82	6,120	11.40	5,700	9.50	3,800	8.73	3,110	8.02	2,470
N	11.28	5,580	11.25	5,550	11.60	5,900	9.23	3,560	8.69	3,070	7.89	2,360
4	12.00	6,300	10.95	5,250	11.15	5,450	9.06	3,400	8.62	3,010	7.74	2,240
8	12.80	7,140	10.72	5,020	10.62	4,920	8.96	3,310	8.50	2,900	7.61	2,140
12	13.02	7,380	10.60	4,900	10.12	4,420	8.87	3,230	8.35	2,760	7.55	2,090

Cheyenne River Basin

Cheyenne River near Eagle Butte, S. Dak.

Location.—Lat. 44°42', long. 101°13', in SE¼ sec. 32, T. 9 N., R. 24 E., at bridge on State Highway 63, 0.5 mile upstream from Hermaphrodite Creek, and 21 miles south of Eagle Butte.
Drainage area.—24,500 square miles.
Gage-height record.—Water-stage recorder graph Apr. 2-25, May 3-16, May 22 to June 3, June 21-30. Once daily wire-weight gage readings used for remainder of period except for Apr. 27, 30, May 2, 18, 21, June 4-7, 11, 15, 17, 18, 20, when no readings were taken.
Discharge record.—Stage-discharge relation defined by current-meter measurements. Shifting-control method used Apr. 1, 2, 13-26, May 11 to June 30. Discharge for periods of no gage-height record was interpolated or computed on basis of weather records. Gage heights used to hundredths below 6.3 feet and to half tenths above.
Maxima.—April-May 1950: Discharge, 14,500 second-feet Apr. 8 (gage height, 7.53 feet). 1928 to March 1950: Discharge observed, 104,000 second-feet May 24, 1933 (gage height, 15.00 feet), from rating curve extended above 30,000 second-feet.

Mean discharge, in second-feet, 1950

Day	April	May	June	Day	April	May	June	Day	April	May	June
1	7,150	771	575	11	6,350	6,500	340	21	2,870	1,300	360
2	7,400	770	542	12	4,460	3,950	340	22	2,110	1,180	390
3	7,150	1,650	468	13	4,610	3,650	355	23	1,660	1,100	450
4	6,550	2,830	430	14	3,950	3,140	336	24	1,400	1,020	422
5	8,850	2,210	400	15	6,650	2,680	320	25	1,190	942	385
6	6,650	2,290	380	16	12,000	1,900	309	26	1,050	910	375
7	8,250	2,520	360	17	12,000	1,510	300	27	950	852	395
8	13,100	3,580	336	18	9,750	1,300	320	28	852	762	360
9	10,400	4,220	327	19	7,650	1,100	345	29	771	712	345
10	7,950	9,750	340	20	4,420	1,450	350	30	770	652	355
								31	-	610	-
Mean monthly discharge, in second-feet									5,630	2,187	377
Runoff, in acre-feet									335,000	134,500	22,430
Runoff, in inches									0.26	0.10	0.02

Bad River Basin

Bad River near Fort Pierre, S. Dak.

Location.—Lat. 44°19'40", long. 100°23'00", in NW¼ sec. 10, T. 4 N., R. 31 E., at highway bridge, 2⅔ miles south of Fort Pierre, and 5 miles upstream from mouth. Datum of gage is 1,427.83 feet above mean sea level, datum of 1929.
Drainage area.—3,107 square miles.
Gage-height record.—Graph based on once or twice daily wire-weight gage readings. Crest gage height determined from floodmarks.
Discharge record.—Stage-discharge relation defined by current-meter measurements. Shifting-control method used Apr. 8 to May 6, May 8-12, June 16-30. Gage heights used to half tenths between 4.1 and 5.3 feet Apr. 1 to May 9, and between 4.7 and 6.4 feet May 10 to June 30; used to hundredths below and to tenths above these limits.
Maxima.—April-May 1950: Discharge, 16,700 second-feet Apr. 2 (gage height, 23.4 feet, from floodmark).
1928-32, 1934 to March 1950: Discharge, 34,200 second-feet May 1, 1942 (gage height, 27.8 feet, from floodmark).
Maximum stage known, 30.89 feet, from floodmarks, in April 1927 (discharge, 50,000 second-feet, from rating curve extended above 33,000 second-feet).

Mean discharge, in second-feet, 1950

Day	April	May	June	Day	April	May	June	Day	April	May	June
1	15,700	41	22	11	488	3,410	8	21	156	72	4.2
2	13,700	39	20	12	524	2,060	8	22	111	64	4.2
3	9,860	42	20	13	524	1,230	6	23	92	56	4.9
4	5,140	43	15	14	524	637	6	24	87	50	6
5	3,050	46	14	15	640	343	4.9	25	69	44	6
6	2,350	730	12	16	640	222	4.6	26	57	35	7
7	2,300	2,300	11	17	488	151	3.9	27	50	33	6
8	1,540	5,390	12	18	370	124	4.2	28	43	37	6
9	801	5,940	14	19	239	108	4.6	29	42	32	4.9
10	562	5,380	11	20	189	81	4.6	30	41	30	4.2
								31	-	26	-
Mean monthly discharge, in second-feet									2,012	929	8.64
Runoff, in acre-feet									119,800	57,120	514
Runoff, in inches									0.72	0.34	0.003

White River Basin

White River near Oacoma, S. Dak.

Location.—Lat. 43°43'45", long. 99°28'55", in NW¼ NW¼ sec. 17, T. 103 N., R. 72 W., at bridge on State Highway 47, 4 miles upstream from mouth, 6 miles southwest of Oacoma, and 19 miles downstream from Black Dog Creek.
Drainage area.—10,200 square miles.
Gage-height record.—Graph based on once or twice daily wire-weight gage readings. No gage reading on Apr. 10.
Discharge record.—Stage-discharge relation defined by current-meter measurements below 4,700 second-feet from Apr. 5 to June 30. Stage-discharge relation affected by ice Apr. 1-4; discharge computed on basis of three discharge measurements, gage heights, and gage reader's and hydrographer's notes. Gage heights used to half tenths between 2.4 and 4.8 feet gage height, hundredths below and tenths above. Shifting-control method used May 15 to June 15. Discharge for day of no gage-height record, Apr. 10, was interpolated.
Maxima.—April-May 1950: Daily discharge, 16,500 second-feet Apr. 1, affected by backwater from ice.
1928 to March 1950: Discharge, 35,300 second-feet May 8, 1942; gage height, 17.6 feet, from floodmark, Mar. 31, 1950 (ice jam).
Remarks.—Some diversions above station.

Mean discharge, in second-feet, 1950

Day	April	May	June	Day	April	May	June	Day	April	May	June
1	16,500	381	331	11	860	2,350	216	21	615	650	381
2	11,500	355	307	12	910	5,370	198	22	580	615	272
3	8,000	355	285	13	910	4,790	191	23	520	550	209
4	6,000	355	259	14	860	2,890	184	24	491	520	174
5	4,980	520	243	15	810	1,550	306	25	462	491	165
6	3,210	2,300	235	16	860	1,450	289	26	381	407	161
7	2,720	3,540	219	17	1,030	1,260	181	27	355	381	161
8	1,900	4,310	191	18	1,180	1,100	181	28	355	381	161
9	1,550	5,470	177	19	910	860	276	29	355	355	144
10	1,200	9,350	198	20	688	725	381	30	355	355	147
								31	-	355	-
Mean monthly discharge, in second-feet									2,370	1,950	227
Runoff, in acre-feet									140,900	119,700	13,530
Runoff, in inches									0.26	0.22	0.02

Niobrara River Basin

Niobrara River near Spencer, Nebr.

Location.—Lat. 42°48', long. 98°39', in N½ sec. 30, T. 33 N., R. 11 W., at bridge on U. S. Highway 281, 600 feet downstream from Spencer power plant dam, and 5 miles southeast of Spencer. Datum of gage is 1,478.65 feet above mean sea level, datum of 1929.
Drainage area.—10,400 square miles.
Gage-height record.—Water-stage recorder operated continuously throughout period except Mar. 8-16 when twice-daily staff readings were made, and Mar. 1-4 and June 4 when there was no record.
Discharge record.—Discharge was computed Mar. 1-6, during period of ice effect, on basis of weather records, engineers notes, and comparison with other Niobrara River stations, Mar. 7 to June 4 by applying mean daily gage heights to rating table with shift adjustments based on measurements, and June 5-30 by mechanical integration with adjustments based on measurements.
Maxima.—March-June 1950: Discharge not determined; occurred on Mar. 5-6.
1927-36, 1940-50: Discharge, 21,500 second-feet June 14, 1943, from power house records.
Remarks.—Records poor. Spencer Reservoir upstream from gage has only minor effect on flood flows.

Mean discharge, in second-feet, 1950

Day	March	April	May	June	Day	March	April	May	June
1	2,000	6,620	1,740	1,520	16	1,550	2,690	1,830	1,440
2	2,000	8,480	1,630	1,440	17	1,760	2,540	1,560	1,420
3	2,000	6,000	1,660	1,430	18	2,120	2,330	1,940	1,570
4	5,000	3,970	1,690	1,300	19	2,190	2,010	1,970	1,510
5	10,000	3,660	2,220	1,100	20	1,930	1,790	1,710	1,370
6	15,000	3,520	2,770	1,190	21	1,520	1,660	1,780	1,340
7	7,990	3,460	2,560	1,190	22	1,320	1,600	1,600	1,300
8	2,640	2,790	3,460	1,140	23	1,960	1,480	1,520	1,240
9	1,160	2,540	3,100	1,190	24	3,630	1,500	1,480	1,240
10	1,520	2,310	3,130	1,160	25	7,360	1,530	1,600	1,220
11	1,680	2,240	2,880	1,130	26	11,600	1,530	1,570	1,180
12	1,960	2,540	2,400	1,120	27	9,370	1,420	1,560	1,200
13	2,250	2,180	2,090	1,130	28	6,160	1,400	1,630	1,190
14	2,120	2,160	1,760	1,210	29	3,620	1,630	1,630	1,190
15	1,620	2,440	1,640	1,460	30	3,330	1,710	1,560	1,170
					31	3,800	-	1,530	-
Mean monthly discharge, in second-feet						3,941	2,724	1,974	1,276
Runoff, in acre-feet						242,300	162,100	121,400	75,950
Runoff, in inches						0.44	0.29	0.22	0.14

James River Basin

James River at Jamestown, N. Dak.

Location.—Lat. 46°54', long. 98°41', in SE¼ sec. 36, T. 140 N., R. 64 W., 80 feet downstream from Asylum bridge at southeast corner of Jamestown, 2.5 miles downstream from Pipestem Creek.
Drainage area.—2,740 square miles.
Gage-height record.—Water-stage recorder graph.
Discharge record.—Stage-discharge relation defined by current-meter measurements. Stage discharge relation affected by ice Apr. 1-5, 7-13.
Maxima.—April-May 1950: Discharge, 6,390 second-feet, 4 a.m. May 13 (gage height, 15.82 feet).
1928-33, 1937-38, 1943 to March 1950: Discharge, 3,250 second-feet Apr. 23, 1948; gage-height, 14.31 feet Apr. 24, 1948, at site 80 feet upstream.
Remarks.—Flow regulated by Arrowood and Jim Lakes (capacity 16,000 acre-feet).

Mean discharge, in second-feet, 1950

Day	April	May	June	Day	April	May	June	Day	April	May	June
1	250	1,320	906	11	900	3,490	384	21	5,180	3,270	165
2	350	1,240	809	12	1,200	5,700	470	22	5,250	2,760	159
3	420	1,190	700	13	1,400	6,170	528	23	4,720	2,370	144
4	550	1,250	644	14	1,510	5,500	345	24	4,060	2,130	134
5	900	1,380	577	15	1,840	5,040	298	25	3,580	1,990	243
6	1,420	1,440	525	16	3,230	4,310	255	26	3,150	1,760	304
7	1,700	1,310	489	17	5,280	3,850	234	27	2,540	1,550	285
8	1,300	1,310	474	18	5,840	3,630	229	28	2,050	1,370	231
9	680	1,570	442	19	5,260	3,590	201	29	1,710	1,210	189
10	540	1,980	384	20	4,720	3,600	177	30	1,480	1,060	159
								31	-	979	-
Mean monthly discharge, in second-feet									2,434	2,559	369
Runoff, in acre-feet									144,800	157,300	21,980
Runoff, in inches									0.99	1.08	0.15

Gage height, in feet, and discharge, in second-feet, at indicated time, 1950

Hour	Gage height	Dis-charge	Gage height	Dis-charge	Gage height	Dis-charge	Gage height	Dis-charge	Gage height	Dis-charge	Gage height	Dis-charge
	April 14		April 15		April 16		April 17		April 18		April 19	
2												
4	10.77	1,510	11.22	1,650	13.40	2,620	15.15	4,440				
6												
8	10.73	1,500	11.37	1,690	13.82	2,950	15.47	5,170	15.69	5,860	15.54	5,370
10												
N	10.54	1,450	11.47	1,720	14.17	3,250	15.59	5,520				
2												
4	10.60	1,460	11.88	1,860	14.49	3,560	15.63	5,660	15.68	5,830	15.47	5,170
6												
8	10.91	1,550	12.54	2,120	14.70	3,800	15.70	5,900				
10												
12	11.12	1,620	13.03	2,380	14.87	4,010	15.73	6,020	15.62	5,620	15.36	4,880
	April 20		April 21		April 22		April 23		April 24		April 25	
4												
8	15.27	4,680	15.42	5,030	15.52	5,310						
N							15.30	4,740	14.89	4,040	14.49	3,560
4	15.26	4,660	15.55	5,400	15.49	5,220						
8												
12	15.32	4,790	15.56	5,430	15.42	5,030	15.11	4,370	14.69	3,790	14.35	3,420
	April 26		April 27		April 28		April 29		April 30		May 1	
4												
8	14.18	3,260	13.40	2,620								
N					12.33	2,030	11.39	1,700	10.62	1,470	10.00	1,310
4	13.97	3,070	13.15	2,450								
8												
12	13.68	2,830	12.85	2,280	11.88	1,860	11.00	1,580	10.30	1,390	9.73	1,240
	May 2		May 3		May 4		May 5		May 6		May 7	
4	9.65	1,220			9.46	1,180	10.06	1,320	10.58	1,460	10.28	1,380
8	9.66	1,230	9.50	1,190	9.58	1,210	10.05	1,320	10.54	1,450	10.12	1,340
N	9.69	1,240			9.71	1,240	10.15	1,350	10.47	1,430	10.00	1,310
4	9.75	1,250	9.42	1,170	9.91	1,290	10.45	1,420	10.46	1,430	9.90	1,290
8	9.74	1,250			10.03	1,320	10.58	1,460	10.44	1,420	9.75	1,250
12	9.66	1,230	9.44	1,170	10.06	1,320	10.58	1,460	10.39	1,410	9.63	1,220
	May 8		May 9		May 10		May 11		May 12		May 13	
4	9.58	1,210			11.53	1,740	13.16	2,460	15.46	5,140	15.82	6,390
8	9.66	1,230	10.84	1,530	11.83	1,840	13.74	2,880	15.61	5,580	15.81	6,340
N	9.93	1,290			12.19	1,970	14.47	3,540	15.69	5,860	15.79	6,260
4	10.20	1,360	11.11	1,610	12.52	2,110	14.95	4,120	15.72	5,980	15.75	6,100
8	10.39	1,410			12.78	2,240	15.14	4,420	15.76	6,140	15.70	5,900
12	10.55	1,450	11.33	1,680	12.92	2,310	15.29	4,720	15.81	6,340	15.65	5,720
	May 14		May 15		May 16		May 17		May 18		May 19	
4											14.40	3,470
8	15.60	5,550	15.48	5,200	15.14	4,420	14.78	3,900	14.60	3,680	14.37	3,440
N											14.48	3,550
4	15.56	5,430	15.38	4,930	15.00	4,190	14.69	3,790	14.51	3,580	14.60	3,680
8											14.64	3,730
12	15.53	5,340	15.25	4,640	14.87	4,010	14.64	3,730	14.47	3,540	14.66	3,750

James River at LaMoure, N. Dak.

Location.—Lat. 46°21'20", long. 98°18'15", at northeast corner of sec. 11, T. 133 N., R. 61 W. at bridge on State Highway 13, 12 miles upstream from Cottonwood Creek. Datum of gage is 1,300 feet above mean sea level, adjustment of 1929.
Drainage area.—5,380 square miles.
Gage-height record.—Graph based on one or more daily readings of distance from reference point to water surface except May 2, 5-8, 10, 13 when no readings were made.
Discharge record.—Stage-discharge relation defined by current-meter measurements.
Maximum.—April-May 1950: Discharge, 5,730 second-feet, 2-8 p.m. May 16 (elevation, 1,305.34 feet).
Remarks.—Observations of water surface elevation and 16 discharge measurements furnished by Corps of Engineers, U. S. Army.

Mean discharge, in second-feet, 1950

Day	April	May	June	Day	April	May	June	Day	April	May	June
1	-	2,900	1,310	11	-	2,360	-	21	4,050	4,180	-
2	-	2,570	-	12	-	2,670	-	22	4,470	3,820	-
3	-	2,230	-	13	-	3,040	-	23	4,560	3,750	-
4	-	1,920	-	14	-	3,500	-	24	4,670	3,580	
5	-	1,720	-	15	-	4,730	-	25	4,840	3,310	-
6	-	1,680	-	16	-	5,660	-	26	4,580	3,020	-
7	-	1,900	-	17	-	5,650	-	27	4,220	2,720	-
8	-	1,930	-	18	-	5,480	-	28	3,860	2,490	-
9	-	2,050	-	19	3,270	5,110	-	29	3,550	2,200	-
10	-	2,170	-	20	3,520	4,550	-	30	3,230	1,860	-
								31	-	1,630	-

Mean discharge, in second-feet Apr. 19 to June 1 3,328
Runoff, in acre-feet Apr. 19 to June 1 290,400
Runoff, in inches Apr. 19 to June 1 ..... 1.01

Gage height, in feet, and discharge, in second-feet, at indicated time, 1950

Hour	Gage height	Discharge	Gage height	Discharge	Gage height	Discharge	Gage height	Discharge	Gage height	Discharge	Gage height	Discharge
	April 14		April 15		April 16		April 17		April 18		April 19	
2												
4												
6												
8											3.30	3,230
10												
N												
2												
4											3.42	3,310
6												
8												
10												
12									3.18	3,160	3.52	3,380
	April 20		April 21		April 22		April 23		April 24		April 25	
4												
8	3.33	3,460	4.14	3,880	4.32	4,450	4.69	4,550	4.74	4,620	4.89	4,860
N											4.90	4,880
4	3.78	3,570	4.45	4,230	4.66	4,500	4.70	4,560	4.78	4,690	4.88	4,850
8												
12	3.92	3,690	4.57	4,380	4.68	4,530	4.72	4,590	4.85	4,800	4.83	4,770
	April 26		April 27		April 28		April 29		April 30		May 1	
4												
8	4.75	4,640	4.49	4,280	4.18	3,920	3.82	3,610	3.37	3,230	2.85	2,960
N												
4	4.67	4,520	4.40	4,170	4.06	3,800	3.68	3,500	3.21	3,180	2.66	2,850
8												
12	4.58	4,390	4.30	4,050	3.93	3,690	3.52	3,380	3.03	3,070	2.48	2,740
	May 2		May 3		May 4		May 5		May 6		May 7	
4												
8	2.28	2,630	1.64	2,280	1.00	1,960	0.49	1,740	0.33	1,660	0.57	1,780
N												
4	2.07	2,520	1.43	2,170	0.80	1,870	.40	1,700	.35	1,680	.70	1,830
8												
12	1.86	2,400	1.23	2,060	.62	1,800	.34	1,670	.44	1,720	.81	1,870
	May 8		May 9		May 10		May 11		May 12		May 13	
4												
8	0.91	1,910	1.15	2,020	1.39	2,140	1.69	2,310	2.23	2,610	2.89	2,980
N												
4	1.00	1,960	1.24	2,070	1.47	2,190	1.84	2,390	2.45	2,730	3.10	3,110
8												
12	1.07	1,990	1.32	2,110	1.57	2,240	2.02	2,490	2.66	2,850	3.31	3,240
	May 14		May 15		May 16		May 17		May 18		May 19	
4												
8	3.52	3,380	4.55	4,360	5.30	5,640	5.32	5,680	5.24	5,520	5.08	5,200
N			4.81	4,740	5.33	5,710						
4	3.77	3,570	5.08	5,200	5.34	5,730	5.29	5,620	5.21	5,460	4.99	5,040
8												
12	4.10	3,840	5.22	5,480	5.33	5,710	5.27	5,580	5.15	5,340	4.86	4,820

James River at LaMoure, N. Dak.—Continued

Gage height, in feet, and discharge, in second-feet, at indicated time, 1950

Hour	Gage height	Discharge	Gage height	Discharge	Gage height	Discharge	Gage height	Discharge	Gage height	Discharge	Gage height	Discharge
	May 20		May 21		May 22		May 23		May 24		May 25	
4												
8 N	4.74	4,620	4.44	4,220	4.13	3,870	3.98	3,730	3.84	3,620	3.50	3,370
4	4.63	4,460	4.38	4,150	3.98	3,730	4.04	3,790	3.72	3,530	3.35	3,260
8					3.94	3,700						
12	4.52	4,320	4.27	4,020	3.94	3,700	4.00	3,750	3.63	3,460	3.19	3,160

James River at Columbia, S. Dak.

Location.—Lat. 45°37'05", long. 98°19'30", in NW¼NW¼ sec. 29, T. 125 N., R. 62 W., at county highway bridge, half a mile west of Columbia, and 2 miles upstream from Elm River. Auxiliary high-water staff gage at same datum on right bank, an eighth of a mile from bridge, and 50 feet downstream from highway.
Drainage area.—7,050 square miles.
Gage-height record.—Graph based on twice-daily wire-weight or staff gage readings.
Discharge record.—Stage-discharge relation defined by current-meter measurements from Apr. 18 to June 30. Stage-discharge relation affected by ice and backwater from Elm River Apr. 1-18; discharge computed on basis of gage heights, weather records, gage reader's and hydrographer's notes, and records for Elm River at Westport. Gage heights used to hundredths. Shifting-control method used Apr. 19 to May 2, May 7 to June 30.
Maxima.—April-May 1950: Discharge, 5,420 second-feet May 24, 25 (gage height, 16.89 feet).
1945 to March 1950: Discharge, 1,950 second-feet May 9, 10, 1948; gage height observed, 15.59 feet May 10, 1948.
Remarks.—Frequent backwater and occasional reverse flow caused by Elm River.

Mean discharge, in second-feet, 1950

Day	April	May	June	Day	April	May	June	Day	April	May	June
1	5	2,430	3,320	11	0	3,420	1,610	21	780	3,730	1,140
2	2	2,530	3,200	12	2	3,200	1,550	22	940	3,760	1,030
3	0	3,320	2,870	13	5	3,340	1,540	23	1,140	4,420	953
4	-5	3,560	2,530	14	25	3,320	1,490	24	1,400	5,370	903
5	-25	3,700	2,310	15	100	3,400	1,430	25	1,660	5,140	865
6	-50	3,830	2,150	16	250	3,450	1,410	26	1,920	4,920	800
7	-100	3,830	1,820	17	350	3,200	1,380	27	2,050	4,380	769
8	-80	4,020	1,650	18	450	3,020	1,270	28	2,200	4,130	757
9	-40	3,760	1,560	19	612	3,400	1,180	29	2,360	3,760	747
10	-10	3,500	1,570	20	678	3,400	1,220	30	2,400	3,670	716
								31	-	3,530	-
Mean monthly discharge, in second-feet									634	3,692	1,525
Runoff, in acre-feet									37,720	227,000	90,720
Runoff, in inches									0.10	0.60	0.20

James River near Stratford, S. Dak.

Location.—Lat. 45°14'30", long. 98°23'25", in SW¼SW¼SW¼ sec. 35, T. 121 N., R. 63 W., at county highway bridge, 6¾ miles southwest of Stratford, and 6¾ miles upstream from Mud Creek. Station established Mar. 9, 1950. Prior to May 17, 1950, at site 12½ miles upstream at different datum.
Drainage area.—9,990 square miles.
Gage-height record.—Wire-weight gage read once daily, except Apr. 9, May 10, 13-15, 18-23, 25, June 12, when no readings were made. Record for May 17 to June 30 computed on basis of readings at present site. Records prior to May 17 computed on basis of readings at site 12½ miles upstream.
Discharge record.—Stage-discharge relation defined by current-meter measurements. Stage-discharge relation affected by ice Apr. 1-8; discharge computed on basis of gage heights, weather records, and records for stations nearby. Discharge for periods of no gage-height record was interpolated or computed on basis of records for stations nearby. Shifting-control method used, May 17. Gage heights used to half tenths above 10.1 feet and to tenths below, from Apr. 1 to May 16; and to half tenths above 15.8 feet and to tenths below, from May 17 to June 30.
Maxima.—April-May 1950: Daily discharge, 5,300 second-feet May 13; gage height not determined.
Remarks.—Records for the two sites used should be equivalent.

Mean discharge, in second-feet, 1950

Day	April	May	June	Day	April	May	June	Day	April	May	June
1	35	975	4,240	11	235	5,080	2,370	21	507	4,100	1,520
2	60	1,040	4,100	12	255	5,270	2,200	22	528	4,100	1,360
3	80	1,200	3,960	13	296	5,300	2,020	23	551	4,200	1,360
4	100	1,560	3,680	14	318	5,200	2,020	24	577	4,390	1,360
5	120	1,730	3,400	15	340	5,000	1,910	25	577	4,550	1,280
6	140	2,360	3,400	16	375	4,890	1,800	26	607	4,830	1,220
7	150	3,020	3,000	17	388	4,390	1,700	27	607	5,130	1,220
8	180	3,320	2,870	18	417	4,200	1,700	28	641	5,130	1,220
9	190	3,480	2,490	19	468	4,100	1,600	29	764	4,980	1,150
10	215	4,300	2,370	20	487	4,000	1,520	30	860	4,680	1,150
								31	-	4,540	-
Mean monthly discharge, in second-feet									369	3,905	2,173
Runoff, in acre-feet									21,950	240,100	129,300
Runoff, in inches									0.04	0.45	0.24

James River at Ashton, S. Dak.

Location.—Lat. 44°59'55", long. 98°28'50", in NW¼NE¼ sec. 36, T. 118 N., R. 64 W., at county highway bridge half a mile east of Ashton, 4 miles upstream from Snake Creek and 10 miles upstream from Turtle Creek.
Drainage area.—11,000 square miles.
Gage-height record.—Graph based on once-daily wire-weight gage readings prior to May 8, and twice-daily readings thereafter. No gage reading Apr. 16, 23.
Discharge record.—Stage-discharge relation defined by current-meter measurements Apr. 14 to June 30. Discharge for days of no gage-height record was interpolated. Stage-discharge relation affected by ice and backwater from Snake and Turtle Creeks Apr. 1-11; discharge computed on basis of gage heights, weather records, gage reader's and hydrographer's notes, and records for Turtle Creek at Redfield and West Branch Snake Creek near Athol. Gage heights used to tenths. Shifting-control method used Apr. 12 to May 11, May 20 to June 7, June 28-30.
Maxima.—April-May 1950: Discharge, 5,170 second-feet May 18, 19; gage height, 19.14 feet May 19.
1945 to March 1950: Discharge observed, 1,110 second-feet May 16, 17, 1948; gage height observed, 13.78 feet Mar. 25, 26, 1948, affected by backwater from Turtle Creek.
Remarks.—Occasional backwater and reverse flow caused by Snake and Turtle Creeks.

Mean discharge, in second-feet, 1950

Day	April	May	June	Day	April	May	June	Day	April	May	June
1	0	461	4,240	11	280	1,060	2,770	21	307	4,750	1,660
2	10	477	4,160	12	307	1,900	2,620	22	321	4,630	1,580
3	25	494	4,080	13	321	2,820	2,530	23	340	4,520	1,520
4	50	528	3,930	14	257	3,480	2,390	24	365	4,420	1,470
5	100	562	3,790	15	235	4,080	2,260	25	381	4,330	1,440
6	150	579	3,660	18	245	4,630	2,130	26	413	4,240	1,400
7	180	596	3,480	17	257	5,020	2,010	27	429	4,240	1,350
8	200	613	3,360	18	257	5,170	1,940	28	429	4,330	1,300
9	220	664	3,140	19	269	5,170	1,830	29	445	4,330	1,260
10	260	786	2,930	20	294	4,880	1,760	30	445	4,420	1,220
								31	-	4,330	-
Mean monthly discharge, in second-feet									260	2,984	2,440
Runoff, in acre-feet									15,460	183,500	145,200
Runoff, in inches									0.03	0.31	0.25

James River near Redfield, S. Dak.

Location.—Lat. 44°55'15", long. 98°25'45", in SW¼NW¼ sec. 28, T. 117 N., R. 63 W., at county highway bridge, 4½ miles downstream from Turtle Creek and 5¼ miles northeast of Redfield. Station established Mar. 3, 1950.
Drainage area.—14,800 square miles.
Gage-height record.—Graph based on once or twice-daily wire-weight gage readings. No gage readings on Apr. 2, 9, 16, 23, 30, May 7, 21, 28, 30, June 4, 11, 18, 25.
Discharge record.—Stage-discharge relation defined by current-meter measurements. Stage-discharge relation affected by ice Apr. 1-8; discharge computed on basis of two discharge measurements and gage heights. Discharge for days of no gage-height record was interpolated. Gage heights used to tenths.
Maximum.—April-May 1950: Discharge observed, 5,290 second-feet May 22 (gage height, 20.68 feet).

Mean discharge, in second-feet, 1950

Day	April	May	June	Day	April	May	June	Day	April	May	June
1	2,500	569	4,630	11	752	1,140	2,900	21	520	5,050	1,760
2	2,400	586	4,490	12	694	1,520	2,790	22	520	5,230	1,700
3	2,330	603	4,350	13	713	2,360	2,650	23	520	5,230	1,610
4	2,330	603	4,140	14	694	3,160	2,500	24	504	5,110	1,550
5	2,190	639	3,970	15	639	3,730	2,360	25	489	4,940	1,500
6	1,920	675	3,810	16	603	4,260	2,190	26	489	4,780	1,440
7	1,730	713	3,540	17	569	4,840	2,090	27	504	4,680	1,380
8	1,410	752	3,420	18	552	4,890	1,990	28	520	4,680	1,330
9	1,170	772	3,270	19	536	5,000	1,890	29	552	4,680	1,300
10	969	878	3,050	20	520	4,940	1,830	30	569	4,730	1,250
								31	-	4,730	-
Mean monthly discharge, in second-feet									1,014	3,112	2,556
Runoff, in acre-feet									60,310	191,300	152,100
Runoff, in inches									0.08	0.24	0.19

James River at Huron, S. Dak.

Location.—Lat. 44°21'55", long. 98°11'45", in SW¼SE¼NE¼ sec. 6, T. 110 N., R. 61 W., at city dam, 150 feet downstream from Chicago and North Western Railway bridge, 150 feet upstream from bridge on U. S. Highway 14, at Huron. Staff gage at highway bridge 150 feet downstream, for use above 13.5 feet gage height, when dam is drowned out, was replaced by wire-weight gage at highway bridge on May 26, 1950. Datum of gage is 1,223.44 feet above mean sea level, datum of 1929.
Drainage area.—16,800 square miles.
Gage-height record.—Graph based on once or twice-daily gage readings. Staff gage at dam was used Apr. 1 to May 19, staff gage at highway bridge was used May 20-27, and wire-weight gage was used May 28 to June 30.
Discharge record.—Stage-discharge relation defined by current-meter measurements. Stage-discharge relation affected by backwater from ice Apr. 1-12, and by backwater from return flow June 3-27; discharge computed on basis of ten discharge measurements. Stage-discharge relation affected by flow through drain pipes in dam Apr. 25 to May 14; discharge computed on basis of gage heights and computed flow through the pipes. Shifting-control method used Apr. 13-24, June 28-30. Gage-heights used to half tenths between 8.6 and 8.9 feet, to hundredths below and to tenths above.
Maxima.—April-May 1950: Daily discharge, 4,840 second-feet May 24-26. Gage height observed, 14.30 feet May 24, 25.
1928-32, 1943 to March 1950: Discharge observed, 4,630 second-feet Mar. 27, 1948 (gage height, 14.48 feet).
Maximum stage known, 16.5 feet Mar. 22, 1922.
Remarks.—Some small diversions above station for water supplies. Stage and discharge affected by wind at time.

Mean discharge, in second-feet, 1950

Day	April	May	June	Day	April	May	June	Day	April	May	June
1	1,990	590	4,690	11	1,360	950	3,300	21	512	4,620	1,850
2	2,390	545	4,690	12	1,030	1,020	3,180	22	536	4,690	1,850
3	2,580	710	4,620	13	890	1,310	3,080	23	536	4,760	1,770
4	2,650	710	4,620	14	890	1,780	2,900	24	512	4,840	1,690
5	2,650	755	4,550	15	792	2,460	2,780	25	770	4,840	1,530
6	2,840	755	4,270	16	876	3,130	2,580	26	485	4,840	1,530
7	2,960	730	3,990	17	737	3,570	2,460	27	465	4,760	1,530
8	2,840	755	3,800	18	711	3,920	2,320	28	485	4,760	1,450
9	2,520	940	3,620	19	659	4,270	2,200	29	590	4,760	1,360
10	1,990	915	3,460	20	536	4,480	1,990	30	570	4,690	1,360
								31	-	4,690	-
Mean monthly discharge, in second-feet									1,312	2,792	2,834
Runoff, in acre-feet									78,050	171,700	168,600
Runoff, in inches									0.09	0.20	0.20

James River near Forestburg, S. Dak.

Location.—Lat. 43°58'45", long. 98°04'05", in SW¼SW¼NW¼ sec. 20, T. 106 N., R. 60 W., at county highway bridge 3¾ miles southeast of Forestburg, 4½ miles downstream from Chicago, Milwaukee, St. Paul and Pacific Railroad bridge, and 5¼ miles downstream from Sand Creek. Station established Mar. 10, 1950.
Drainage area.—18,600 square miles.
Gage-height record.—Graph based on once-daily wire-weight gage readings. No gage readings June 11, 24.
Discharge record.—Stage-discharge relation defined by current-meter measurements. Stage-discharge relation affected by ice Apr. 1-6; discharge computed on basis of one discharge measurement and gage heights. Discharge for days of no gage-height record was interpolated. Shifting control method used June 2-30. Gage heights used to tenths.
Maximum.—April-May 1950: Discharge observed, 5,180 second-feet May 27, 30 (gage height, 15.06 feet).

Mean discharge, in second-feet, 1950

Day	April	May	June	Day	April	May	June	Day	April	May	June
1	2,220	581	4,970	11	2,640	811	4,000	21	765	3,060	2,500
2	2,270	581	4,970	12	2,890	811	3,810	22	696	3,470	2,310
3	2,400	581	4,770	13	2,640	973	3,720	23	650	4,020	2,140
4	2,640	581	4,770	14	2,180	1,050	3,630	24	627	4,590	2,000
5	2,790	581	4,590	15	1,750	1,230	3,470	25	627	4,970	1,860
6	2,790	719	4,420	16	1,440	1,570	3,320	26	650	4,970	1,750
7	2,940	811	4,270	17	1,290	1,940	3,180	27	650	4,970	1,640
8	3,000	811	4,140	18	1,100	2,220	3,000	28	627	4,970	1,510
9	3,000	811	4,140	19	973	2,500	2,840	29	581	4,970	1,440
10	3,060	811	4,140	20	903	2,740	2,640	30	581	5,180	1,380
								31	-	4,970	-
Mean monthly discharge, in second-feet									1,712	2,350	3,244
Runoff, in acre-feet									101,900	144,500	193,000
Runoff, in inches									0.10	0.15	0.19

James River near Scotland, S. Dak.

Location.—Lat. 43°11'00", long. 97°37'55", in SW¼ SW¼ sec. 30, T. 97 N., R. 57 W., 50 feet upstream from county highway bridge, 500 feet upstream from Dawson Creek, and 5 miles northeast of Scotland.
Drainage area.—21,550 square miles.
Gage-height record.—Water-stage recorder graph.
Discharge record.—Stage-discharge relation defined by current-meter measurements. Gage heights used to tenths.
Maxima.—April-May 1950: Discharge, 6,280 second-feet Apr. 1 (gage-height, 15.89 feet). 1928 to March 1950: Discharge, 10,800 second-feet May 15, 1942 (gage height, 15.5 feet, from floodmark).

Mean discharge, in second-feet, 1950

Day	April	May	June	Day	April	May	June	Day	April	May	June
1	6,160	1,050	3,200	11	3,560	1,380	4,360	21	2,790	2,560	3,640
2	6,160	1,010	3,640	12	3,420	1,330	4,240	22	2,500	2,390	3,490
3	6,040	985	4,000	13	3,300	1,310	4,240	23	2,110	2,290	3,420
4	5,680	1,030	4,360	14	3,250	1,330	4,120	24	1,740	2,290	3,300
5	5,200	1,090	4,600	15	3,200	1,360	4,120	25	1,520	2,360	3,200
6	4,720	1,130	4,600	16	3,160	1,380	4,000	26	1,330	2,420	3,070
7	4,360	1,180	4,720	17	3,160	1,420	4,000	27	1,220	2,500	2,990
8	4,000	1,270	4,600	18	3,110	1,570	4,000	28	1,110	2,600	2,910
9	3,800	1,380	4,480	19	3,030	2,500	3,900	29	1,070	2,710	2,790
10	3,640	1,400	4,480	20	2,950	2,710	3,800	30	1,070	2,750	2,640
								31	-	2,950	-
Mean monthly discharge, in second-feet									3,280	1,790	3,830
Runoff, in acre-feet									195,100	110,400	227,900
Runoff, in inches									0.17	0.10	0.20

Pipestem Creek near Buchanan, N. Dak.

Location.—Lat. 47°04', long. 98°55', in SE¼ sec. 33, T. 142 N., R. 65 W., at bridge on county road 4½ miles west of Buchanan.
Drainage area.—925 square miles.
Gage-height record.—Graph based on two or more daily readings of wire-weight gage Apr. 15-21, May 10-18, one or more daily readings on other days.
Discharge record.—Stage-discharge relation defined by current-meter measurements. Stage-discharge relation affected by ice Apr. 1-16.
Maxima.—April-May 1950: Discharge, 4,480 second-feet 4 a.m. Apr. 17; gage height, 11.89 feet 10 p.m. Apr. 9 (affected by ice).
Remarks.—Small diversions above station for irrigation.

Mean discharge, in second-feet, 1950

Day	April	May	June	Day	April	May	June	Day	April	May	June
1	0	162	69	11	700	2,790	21	21	1,250	499	13
2	5	160	60	12	760	3,360	21	22	928	394	12
3	20	177	49	13	850	2,840	21	23	712	323	12
4	100	176	46	14	896	2,320	20	24	546	268	12
5	500	171	40	15	1,070	1,690	20	25	419	217	12
6	800	118	28	16	1,870	1,230	20	26	309	185	14
7	500	158	26	17	3,960	957	18	27	249	154	16
8	200	270	28	18	3,630	755	16	28	221	121	14
9	400	344	25	19	2,560	728	14	29	199	107	13
10	600	937	22	20	1,720	778	14	30	177	97	13
								31	-	80	-
Mean monthly discharge, in second-feet									872	728	23.6
Runoff, in acre-feet									51,870	44,760	1,410
Runoff, in inches									1.05	0.91	0.03

Gage height, in feet, and discharge, in second-feet, at indicated time, 1950

Hour	Gage height	Discharge	Gage height	Discharge	Gage height	Discharge	Gage height	Discharge	Gage height	Discharge	Gage height	Discharge
	April 14		April 15		April 16		April 17		April 18		April 19	
2					9.91	1,260						
4					9.96	1,290	10.77	4,480				
6					10.03	1,370						
8			9.55	981	10.18	1,480	10.71	4,320	10.54	3,900	10.01	2,880
10					10.46	1,740						
N	9.62	896			10.58	1,870	10.58	3,990			9.78	2,560
2					10.60	1,940						
4			9.73	1,130	10.73	2,140	10.50	3,800	10.36	3,490		
6					10.71	2,250					9.50	2,220
8					10.60	2,340	10.49	3,780				
10					10.59	2,650						
12	9.54	931	9.89	1,250	10.67	3,000	10.49	3,780	10.21	3,200	9.30	2,000
	April 20		April 21		April 22		April 23		April 24		April 25	
4												
8	9.10	1,790										
N			8.48	1,230	7.94	920	7.44	710	6.88	543	6.36	420
4	8.95	1,640										
8												
12	8.78	1,480	8.22	1,060	7.70	810	7.13	620	6.63	479	6.03	357
	April 26		April 27		April 28		April 29		April 30		May 1	
4												
8			5.30	249	5.08	223						
N	5.70	305					4.86	199	4.63	176	4.49	162
4			5.26	244	5.02	216						
8												
12	5.45	269	5.21	238	4.96	210	4.76	189	4.55	168	4.45	158
	May 2		May 3		May 4		May 5		May 6		May 7	
4							4.66	179	4.14	129	4.05	120
8	4.43	157	4.65	178	4.60	173	4.68	181	4.00	116	4.20	134
N							4.65	178	3.96	112	4.39	153
4	4.47	160	4.67	180	4.64	177	4.56	169	3.94	111	4.63	176
8							4.45	158	3.95	112	4.86	199
12	4.54	167	4.64	177	4.66	179	4.30	144	3.98	114	5.08	223
	May 8		May 9		May 10		May 11		May 12		May 13	
4	5.32	252	5.50	276	7.04	588	9.46	2,180	10.30	3,360		
8	5.46	270	5.62	293	7.18	630	9.70	2,460	10.31	3,380	10.02	2,900
N	5.53	280	5.83	325	7.41	704	10.02	2,900	10.34	3,440		
4	5.56	284	6.08	366	7.92	905	10.20	3,180	10.32	3,400	9.91	2,740
8	5.55	283	6.35	418	8.87	1,570	10.30	3,360	10.28	3,320		
12	5.49	275	6.68	491	9.26	1,960	10.32	3,400	10.18	3,150	9.80	2,590
	May 14		May 15		May 16		May 17		May 18		May 19	
4												
8	9.65	2,400	9.07	1,760	8.54	1,280	8.08	985	7.52	742	7.42	707
N												
4	9.51	2,230	8.89	1,590	8.38	1,160	7.96	925	7.48	728	7.48	728
8												
12	9.34	2,040	8.71	1,420	8.23	1,070	7.81	854	7.50	735	7.57	760

Elm River at Westport, S. Dak.

Location.—Lat. 45°39'15", long. 98°29'45", in SW¼NW¼ sec. 12, T. 125 N., R. 64 W., at bridge on U. S. Highway 281, a quarter of a mile north of Westport, three-quarters of a mile upstream from Chicago, Milwaukee, St. Paul and Pacific Railroad bridge, 8 miles downstream from Willow Creek, and 22½ miles upstream from mouth.
Drainage area.—1,680 square miles.
Gage-height record.—Graph based on once- or twice-daily wire-weight gage readings. No gage readings Apr. 17, 25, 28.
Discharge record.—Stage-discharge relation defined by current-meter measurements. Stage-discharge relation affected by ice Apr. 1-13; discharge computed on basis of three discharge measurements, gage heights, and weather records. Shifting-control method used Apr. 15 to May 4, May 7 to June 30. Gage heights used to half tenths between 5.9 and 6.9 feet.
Maxima.—April-May 1950: Discharge observed, 1,870 second-feet May 11 (gage height, 10.79 feet).
1945 to March 1950: Discharge observed, 2,870 second-feet Mar. 29, 1948, from rating curve extended above 1,800 second-feet; gage height, 14.0 feet, from flood-mark, Mar. 25, 1948 (ice jam).

Mean discharge, in second-feet, 1950

Day	April	May	June	Day	April	May	June	Day	April	May	June
1	170	64	39	11	300	1,820	16	21	286	206	7
2	300	68	33	12	420	1,420	15	22	232	219	7
3	450	66	30	13	436	1,000	15	23	194	272	6
4	760	66	28	14	440	690	14	24	138	194	6
5	1,050	194	26	15	440	484	14	25	105	182	6
6	1,150	655	22	16	314	389	11	26	90	138	8
7	750	725	21	17	220	272	10	27	90	96	5
8	480	1,080	20	18	206	206	11	28	80	76	3.6
9	440	1,510	18	19	219	206	9	29	67	66	3.2
10	400	1,740	16	20	300	194	8	30	57	54	3.0
								31	-	47	-
Mean monthly discharge, in second-feet									353	464	14.4
Runoff, in acre-feet									20,990	28,560	854
Runoff, in inches									0.23	0.32	0.01

Turtle Creek at Redfield, S. Dak.

Location.—Lat. 44°52'55", long. 98°30'45", in SW¼SE¼ sec. 3, T. 116 N., R. 64 W., at bridge on U. S. Highway 281, at north edge of Redfield, and 4¾ miles upstream from mouth.
Drainage area.—1,540 square miles.
Gage-height record.—Graph based on once or twice-daily wire-weight gage readings. No gage readings on Apr. 10, 29, May 2, 7, 27, June 4, 18.
Discharge record.—Stage-discharge relation defined by current-meter measurements. Stage-discharge relation affected by ice Apr. 1, 2; discharge computed on basis of one discharge measurement and gage heights. Shifting-control method used Apr. 6 to June 30. Gage heights used to half-tenths between 5.5 and 7.5 feet, hundredths below and tenths above.
Maxima.—April-May 1950: Discharge observed, 1,900 second-feet Apr. 3 (gage height, 10.35 feet).
1945 to March 1950: Discharge observed, 3,160 second-feet Mar. 23, 1948 (gage height, 12.38 feet).

Mean discharge, in second-feet, 1950

Day	April	May	June	Day	April	May	June	Day	April	May	June
1	1,880	71	61	11	330	103	12	21	110	600	8
2	1,560	66	56	12	370	176	10	22	96	905	4.7
3	1,760	66	48	13	330	318	10	23	83	590	2.7
4	1,620	56	45	14	280	292	10	24	77	385	2.7
5	1,430	71	45	15	235	245	10	25	56	280	8
6	1,360	90	39	16	215	205	10	26	35	225	10
7	1,120	100	33	17	195	167	9	27	32	186	10
8	805	103	37	18	195	150	9	28	31	167	7
9	670	110	25	19	158	133	10	29	31	125	2.7
10	415	110	17	20	125	110	10	30	56	96	.7
								31	-	71	-
Mean monthly discharge, in second-feet									522	206	18.8
Runoff, in acre-feet									31,060	12,640	1,120
Runoff, in inches									0.38	0.15	0.01

Vermillion River Basin

Vermillion River near Wakonda, S. Dak.

Location.—Lat. 42°59'20", long. 96°57'50", in SW¼NW¼ sec. 2, T. 94 N., R. 52 W., at bridge on State Highway 19, 3½ miles downstream from Frog Creek, 7¼ miles southeast of Wakonda, and 16½ miles downstream from Turkey Ridge Creek.
Drainage area.—1,670 square miles.
Gage-height record.—Graph based on once-daily wire-weight gage readings.
Discharge record.—Stage-discharge relation defined by current-meter measurements. Shifting-control method used throughout period. Gage heights used to half tenths between 4.2 and 5.1 feet; hundredths below and tenths above.
Maxima.—April-May 1950: Discharge observed, 875 second-feet May 21 (gage height, 11.15 feet).
1945 to March 1950: Discharge observed, 3,010 second-feet June 13, 1947 (gage height, 16.63 feet), from rating curve extended above 1,400 second-feet.

Mean discharge, in second-feet, 1950

Day	April	May	June	Day	April	May	June	Day	April	May	June
1	555	68	96	11	103	212	44	21	83	702	110
2	499	68	89	12	83	152	61	22	77	732	143
3	457	68	83	13	96	118	161	23	74	431	89
4	340	71	77	14	96	110	56	24	71	256	61
5	256	74	77	15	83	110	58	25	68	181	48
6	201	83	71	16	83	96	56	26	68	143	39
7	161	83	64	17	89	89	56	27	68	126	32
8	143	92	58	18	89	83	567	28	66	110	30
9	126	171	46	19	89	83	230	29	68	110	27
10	110	234	42	20	83	114	126	30	68	110	24
								31	-	110	-
Mean monthly discharge, in second-feet									148	167	90.7
Runoff, in acre-feet									8,830	10,290	5,400
Runoff, in inches									0.10	0.12	0.06

Big Sioux River Basin

Big Sioux River at Akron, Iowa

Location.—Lat. 42°49'40", long. 96°33'50", in W½ sec. 31, T. 93 N., R. 48 W., 300 feet downstream from county highway bridge in Akron, and 2¾ miles upstream from Union Creek. Datum of gage is 1,118.90 feet above mean sea level, datum of 1929.
Drainage area.—8,851 square miles.
Gage-height record.—Water-stage recorder graph.
Discharge record.—Stage-discharge relation defined by current-meter measurements. Shifting-control method used May 4 to June 23. Gage heights used to half tenths below 5.0 feet and to tenths above.
Maxima.—April-June 1950: Discharge, 5,450 second-feet June 18 (gage height, 13.40 feet).
1928 to March 1950: Discharge, 21,400 second-feet June 4, 1942 (gage height, 19.23 feet).

Mean discharge, in second-feet, 1950

Day	April	May	June	Day	April	May	June	Day	April	May	June
1	2,560	719	826	11	1,130	1,390	536	21	1,060	1,160	795
2	2,720	719	795	12	1,020	1,470	550	22	1,200	1,470	985
3	2,840	704	826	13	923	1,430	774	23	1,240	1,350	764
4	2,840	690	826	14	890	1,390	1,130	24	1,240	1,200	618
5	2,890	704	764	15	923	1,390	1,020	25	1,130	1,130	550
6	2,840	734	719	16	923	1,310	764	26	989	1,090	497
7	2,410	795	675	17	923	1,270	685	27	858	1,060	446
8	2,010	858	646	18	923	1,200	4,030	28	795	1,020	420
9	1,600	956	604	19	923	1,130	1,560	29	764	956	396
10	1,310	1,160	576	20	989	1,060	1,020	30	749	923	370
								31	-	858	-
Mean monthly discharge, in second-feet									1,450	1,070	839
Runoff, in acre-feet									86,500	66,040	49,920
Runoff, in inches									0.18	0.14	0.11

SUMMARY OF FLOOD STAGES AND DISCHARGES

The results of the determinations of maximum flood flows at existing stream-gaging stations and other places on streams in the area covered by this report are summarized and presented in table 5. The time of day in this table is for standard time. The reference number in this table is applicable to figure 2 and will aid in identifying the place where the discharge was determined. Figure 11 shows the comparative size of the 1950 floods with those of 1943 at four gaging stations west of the Missouri River. The 1943 floods were the maximum previously known for many areas west of the Missouri.

The discharges for the existing stream-gaging stations were determined by methods described in greater detail in the records for the stations in the section, Stages and discharges at stream-gaging stations. For existing stream-gaging stations the method of determination is designated "stage-discharge relation" because the determination is based on comprehensive studies of that subject that are conducted at such stations. When the recorded discharge was measured at miscellaneous points, a brief reference is generally made to the method of determination.

Figure 12 shows the flood discharges, in second-feet per square mile, which are listed in table 5, plotted against the corresponding drainage areas. In this connection it should be understood that except for a small number of items as indicated in the table, the discharges are given as observed and some may be affected by artificial storage, release of water resulting from failure of dams, or other similar factors, about which available information is presented in the preceding section, Stages and discharges at stream-gaging stations.

The basic data and computations for the determinations of discharge are filed in the district offices of the Geological Survey in the several districts where the floods occurred and may be examined in those offices.

Table 5.—Summary of flood stages and discharges

No. on fig. 2	Stream and place of determination	Drainage area (sq. mi.)	Period of record	Maximum previously known				Maximum during April-May 1950				Method of determination
				Date	Gage height (feet)	Discharge (sec.-ft.)	Sec.-ft. per sq. mi.	Date and hour	Gage height (feet)	Discharge (sec.-ft.)	Sec.-ft. per sq. mi.	
	MISSOURI RIVER MAIN STEM											
1	Missouri River near Williston, N. Dak.	164,500	1928-50	June 22, 1921 Apr. 4, 1930	20.8 -	- 231,000	1.40	11:30 a.m. Apr. 6 10 a.m. Apr. 17	11.97 -	- 110,000	0.67	Stage-discharge relation
2	Missouri River near Elbowoods, N. Dak.	179,800	1939-50	Mar. 26, 1947	23.2	260,000	1.45	8 p.m. Apr. 10 8:45 a.m. Apr. 15	17.30 -	- 161,000	0.90	Stage-discharge relation
3	Missouri River below Garrison Dam, N. Dak.	181,400	1948-50	Apr. 3, 1948	a94.55	210,000	1.16	8:30 p.m. Apr. 16	87.64	220,000	1.21	Stage-discharge relation
4	Missouri River at Bismarck, N. Dak.	186,400	1904-05 1927-50	Mar. 31, 1881 Apr. 3, 1943	31.6 -	- 282,000	1.51	11 p.m. Apr. 17	18.72	192,000	1.03	Stage-discharge relation
5	Missouri River near Mobridge, S. Dak.	208,700	1928-50	Mar. 28, 1943 Apr. 5, 1943	19.6 -	- 282,000	1.35	7 p.m. Apr. 19	17.14	251,000	1.20	Stage-discharge relation
6	Missouri River at Pierre, S. Dak.	243,500	1929-50	Apr. 1881 Apr. 6, 1943	23.0 19.65	- 281,000	1.15	12 m. Apr. 21	18.44	269,000	1.10	Stage-discharge relation
7	Missouri River at Chamberlain, S. Dak.	250,800	1928-29 1945-50	Apr. 7, 1943 Apr. 2, 1947	19.3 16.22	- 213,000	0.85	1-8 a.m. Apr. 22	18.80	250,000	1.00	Stage-discharge relation
8	Missouri River below Fort Randall Dam, S. Dak.	263,530	1947-50	Apr. 1881 June 26, 1947	21.5 11.54	- 178,000	0.68	4:30 a.m. Apr. 23	15.83	252,000	0.96	Stage-discharge relation
9	Missouri River at Yankton, S. Dak.	279,500	1930-50	Apr. 5, 1881 Apr. 8, 1943	30.5 -	- 282,000	1.01	4-7 a.m. Apr. 24	11.60	237,000	0.85	Stage-discharge relation
10	Missouri River at Sioux City, Iowa	314,600	1928-31 1938-50	Apr. 23, 1881 Apr. 10, 1943	22.5 18.72	- 212,000	0.67	4 a.m. Apr. 25	18.44	252,000	0.80	Stage-discharge relation
	LITTLE MUDDY CREEK BASIN											
11	Little Muddy Creek near Williston, N. Dak.	1,010	1904-09 1932-33 1946-50	Apr. 11, 1904	a10.3	b 4,340	4.30	9 p.m. Apr. 7	11.36	1,330	1.32	Stage-discharge relation
	LITTLE MISSOURI RIVER BASIN											
12	Little Missouri River near Alzada, Mont.	780	1911-25 1928-32 1935-50	Apr. 4, 1944	-	c 6,000	7.69	1:30 p.m. Apr. 3	12.15	1,970	2.53	Stage-discharge relation

13	Little Missouri River at Marmarth, N. Dak.	4,570	1938-50	Mar. 23, 1947	21.7	45,000	9.84	Apr. 7	14.2	21,000	4.60	Stage-discharge relation
14	Little Missouri River at Medora, N. Dak.	6,190	1903-8 1921-24 1928-34 1945-50	Mar. 23, 1947	20.5	65,000	10.5	Apr. 8	13.0	26,000	4.20	Stage-discharge relation
15	Little Missouri River near Watford City, N. Dak.	8,490	1934-50	Mar. 25, 1947	24.0	110,000	13.0	9 a.m. Apr. 9	21.42	60,000	7.07	Stage-discharge relation
16	Little Beaver Creek near Marmarth, N. Dak.	615	1938-50	June 22, 1944	a12.5	6,820	11.1	Apr. 7	11.44	4,600	7.48	Stage-discharge relation
17	Beaver Creek at Wibaux, Mont.	351	1938-50	Mar. 21, 1939	10.8	3,780	10.8	8 p.m. Apr. 8	9.58	1,120	3.19	Stage-discharge relation
	KNIFE RIVER BASIN											
18	Knife River near Golden Valley, N. Dak.	1,230	1903-19 1921-24 1943-50	Mar. 26, 27, 1943	26.7	11,500	9.35	12 p.m. Apr. 16	26.4	10,900	8.86	Stage-discharge relation
19	Knife River at Hazen, N. Dak.	2,352	1928-33 1937-50	Mar. 26, 27, 1943	26.3	d 26,500	11.3	10-11 a.m. Apr. 17	25.93	22,700	9.65	Contracted opening
20	Spring Creek at Zap, N. Dak.	545	1924, 1945-50	Apr. 7, 1949	16.0	2,890	5.30	9:30 a.m. Apr. 17	18.80	4,580	8.40	Stage-discharge relation
	HEART RIVER BASIN											
21	Heart River near South Heart, N. Dak.	315	1947-50	Mar. 31, 1949	17.75	2,400	7.62	6:30 p.m. Apr. 16	21.67	4,080	13.0	Stage-discharge relation
22	Heart River at Lehigh, N. Dak.	453	1943-50	Mar. 25, 1943	17.7	5,420	12.0	12 p.m. Apr. 15	17.90	5,980	13.2	Stage-discharge relation
23	Heart River near Richardton, N. Dak.	1,310	1903-22 1943-50	July 5, 1938	26.0	d 16,000	12.2	11 p.m. Apr. 16	28.05	23,400	17.9	Stage-discharge relation
25	Heart River below Heart Butte Dam near Glen Ullin, N. Dak.	1,760	1943-50	Mar. 24, 1947	21.5	25,000	14.2	2:30 a.m. Apr. 17	7.55	4,430	-	Stage-discharge relation
26	Heart River near Lark, N. Dak.	e 2,810	1946-50	Mar. 25, 1947	15.85	10,400	3.70	9 p.m. Apr. 17	20.70	29,200	-	Contracted opening
27	Heart River near Mandan, N. Dak.	e 3,360	1924 1928-33 1937-50	Mar. 27, 1943	24.7	21,400	6.37	4 a.m. Apr. 19	23.64	30,500	-	Stage-discharge relation
28	Green River near Gladstone, N. Dak.	356	1945-50	Mar. 1943 Apr. 5, 1949	20.0 16.9	- 3,780	10.6	12 p.m. Apr. 15	18.3	5,260	14.8	Stage-discharge relation

See footnotes at end of table, page 87.

Table 5.—Summary of flood stages and discharges—Continued

No. on fig. 2	Stream and place of determination	Drainage area (sq. mi.)	Period of record	Maximum previously known				Maximum during April-May 1950				
				Date	Gage height (feet)	Discharge (sec.-ft.)	Sec.-ft. per sq. mi.	Date and hour	Gage height (feet)	Discharge (sec.-ft.)	Sec.-ft. per sq. mi.	Method of determination
	HEART RIVER BASIN—Continued											
29	Government Creek near Richardton, N. Dak.	30.5	-	-	-	-	-	After 5 p.m. Apr. 16	-	4,300	141	Contracted opening
30	Antelope Creek near Carson, N. Dak.	221	1948-50	Mar. 25, 1943 Mar. 28, 1949	17.1 13.84	- 1,300	5.88	11:30 p.m. Apr. 16	17.95	11,100	50.2	Slope area
31	Muddy Creek near Almont, N. Dak.	456	1945-50	Mar. 24, 1948	19.20	2,250	4.93	12 m. Apr. 17	30.7	20,200	44.3	Slope area
32	Sweetbriar Creek near Sweetbriar, N. Dak.	157	-	-	-	-	-	Apr. 17	-	5,910	37.6	Contracted opening
	APPLE CREEK BASIN											
33	Apple Creek near Menoken, N. Dak.	1,520	1945-50	Apr. 7, 1948	15.80	2,340	1.54	2 p.m. Apr. 18	17.07	6,750	4.44	Stage-discharge relation
	LITTLE HEART RIVER BASIN											
34	Little Heart River near St. Anthony, N. Dak.	190.	-	-	-	-	-	9 p.m. Apr. 16	-	8,770	46.2	Contracted opening
	CANNONBALL RIVER BASIN											
35	Cannonball River at Regent, N. Dak.	590	-	-	-	-	-	Apr. 16	-	20,300	34.4	Slope area
36	Cannonball River near New Leipzig, N. Dak.	1,180	1943-50	Mar. 25, 26 1943	26.9	15,000	12.7	12 p.m. Apr. 17	34.0	51,800	43.9	Slope area and contracted opening
37	Cannonball River near Wade, N. Dak.	1,650	-	-	-	-	-	Apr. 18	-	44,000	26.7	Slope area
38	Cannonball River near Timmer, N. Dak.	3,650	1903-08 1911-18 1921-24 1928-34	June 10, 1932	12.66	8,600	2.36	Apr. 18	22.6	f 90,000	24.7	Stage-discharge relation
39	Cannonball River at Breien, N. Dak.	4,066	1934-50	Mar. 27, 1943	17.4	d 28,200	6.94	2 a.m. Apr. 19	22.30	94,800	23.3	Slope area and contracted opening
40	Thirty Mile Creek near Bentley, N. Dak.	258	-	-	-	-	-	Apr. 16	-	11,400	44.2	Contracted opening
41	Cedar Creek at Hettinger damsite, N. Dak.	530	-	-	-	-	-	Apr. 16	-	26,900	50.8	Slope area

	CANNONBALL RIVER BASIN—Continued											
42	Cedar Creek near Pretty Rock, N. Dak.	1,260	1943-50	Mar. 24, 1943	21.8	14,300	11.3	9 p.m. Apr. 17	26.5	48,000	38.1	Slope area
43	Cedar Creek near Swastika, N. Dak.	1,650	-	-	-	-	-	Apr. 18	-	43,800	26.5	Slope area
	BEAVER CREEK BASIN											
44	Beaver Creek at Linton, N. Dak.	832	1949-50	-	-	-	-	10 p.m. Apr. 7 3 a.m. Apr. 7	16.50 -	- 3,680	4.42	Stage-discharge relation
	GRAND RIVER BASIN											
45	North Fork Grand River at Haley, N. Dak.	509	1908-17 1945-50	Mar. 31, 1913	g 9.85	5,810	11.4	3-7 p.m. Apr. 15	17.10	11,300	22.2	Slope area
46	North Fork Grand River near White Butte, S. Dak.	1,190	1945-50	Mar. 24, 1947	12.35	7,040	5.92	2 p.m. Apr. 16	20.0	30,900	26.0	Slope area
47	Grand River at Shadehill, S. Dak.	3,120	1904-06 1943-50	Feb. 20, 1943 Apr. 7, 1944	18.7 -	- 18,000	5.77	7 p.m. Apr. 16	19.06	58,000	18.6	Slope area and contracted opening
48	Grand River near Wakpala, S. Dak.	5,510	1911-18 1928-50	Apr. 9, 10, 1944	19.5	32,000	5.81	Apr. 18	22.75	82,200	14.9	Stage-discharge relation
49	South Fork Grand River near Cash, S. Dak.	1,350	1945-50	Mar. 22, 1947 Mar. 23, 1947	14.35 -	- 5,000	3.70	8 p.m. Apr. 15	15.40	27,000	20.0	Slope area
	MOREAU RIVER BASIN											
50	Moreau River at Bixby, S. Dak.	1,570	1904-06 1948-50	Mar. 23, 1949	11.0	5,420	3.45	5 p.m. Apr. 16	14.65	10,500	6.69	Stage-discharge relation
51	Moreau River near Faith, S. Dak.	2,660	1943-50	Apr. 9, 1944	a 20.9	26,000	7.14	1 a.m. Apr. 17	18.0	23,000	8.65	Stage-discharge relation
52	Moreau River near Eagle Butte, S. Dak.	4,320	1943-50	Apr. 9, 1944	23.0	d 27,000	6.25	Apr. 18	20.23	22,200	5.14	Contracted opening
53	Moreau River at Promise, S. Dak.	5,223	1928-50	Mar. 25, 1947	24.4	29,500	5.65	Apr. 19	21.8	20,900	4.00	Contracted opening
	CHEYENNE RIVER BASIN											
54	Cheyenne River near Eagle Butte, S. Dak.	24,500	1928-50	1927 May 24, 1933	18.81 15.00	- 104,000	- 4.24	Apr. 8	7.53	14,500	0.59	Stage-discharge relation
	BAD RIVER BASIN											
55	Bad River near Fort Pierre, S. Dak.	3,107	1928-32 1934-50	Apr. 1927	30.89	50,000	16.1	Apr. 2	23.4	16,700	5.37	Stage-discharge relation

See footnotes at end of table, page 87.

Table 5.—Summary of flood stages and discharges—Continued

No. on fig. 2	Stream and place of determination	Drainage area (sq. mi.)	Period of record	Maximum previously known				Maximum during April-May 1950				Method of determination
				Date	Gage height (feet)	Discharge (sec.-ft.)	Sec.-ft. per sq. mi.	Date and hour	Gage height (feet)	Discharge (sec.-ft.)	Sec.-ft. per sq. mi.	
	WHITE RIVER BASIN											
56	White River near Oacoma, S. Dak.	10,200	1928-50	Mar. 31, 1950	17.6	-						Stage-discharge relation
				May 8, 1942	-	35,300	3.46	Apr. 1		c 16,500	1.62	
	NIOBRARA RIVER BASIN											
57	Niobrara River near Spencer, Nebr.	10,400	1908 1927-36 1940-50	June 14, 1943	-	21,500	2.07	12 midnight to 2 a.m. Apr. 2	3.25	9,220	0.89	Stage-discharge relation
	JAMES RIVER BASIN											
58	James River at Jamestown, N. Dak.	2,740	1928-33 1937-38 1943-50	Apr. 24, 1948	h 14.31	-						Stage-discharge relation
				Apr. 23, 1948	-	3,250	1.19	4 a.m. May 13	15.82	6,390	2.33	
59	James River at LaMoure, N. Dak.	5,380	-	-	-	-	-	2-8 p.m. May 16	5.34	5,730	1.06	Stage-discharge relation
60	James River at Columbia, S. Dak.	7,050	1945-50	May 10, 1948	15.59	-						Stage-discharge relation
				May 9, 10, 1948	-	1,950	0.28	May 24, 25	16.89	5,420	0.77	
61	James River near Stratford, S. Dak.	9,990	1950	-	-	-	-	May 13	-	c 5,300	0.53	Stage-discharge relation
62	James River at Ashton, S. Dak.	11,000	1945-50	Mar. 25, 26, 1948	13.78	-		May 19	19.14	-		Stage-discharge relation
				May 16, 17, 1948	-	1,110	0.10	May 18, 19	-	5,170	0.47	
63	James River near Redfield, S. Dak.	14,800	1950	-	-	-	-	May 22	20.68	5,290	0.36	Stage-discharge relation
64	James River at Huron, S. Dak.	d 16,800	1928-32 1943-50	Mar. 22, 1922	16.5	-		May 24-25	14.30	-		Stage-discharge relation
				Mar. 27, 1948	-	4,630	0.28	May 24-26	-	c 4,840	0.29	
65	James River near Forestburg, S. Dak.	18,600	1950	-	-	-	-	May 27, 30	15.06	5,180	0.28	Stage-discharge relation
66	James River near Scotland, S. Dak.	21,550	1928-50	May 15, 1942	15.5	10,800	0.50	Apr. 1	15.89	6,280	0.29	Stage-discharge relation
67	Pipestem Creek near Buchanan, N. Dak.	925	1950	Apr. 18, 1948	9.1	1,700	1.84	10 p.m. Apr. 9	11.89	-		Stage-discharge relation
								4 a.m. Apr. 17	-	4,480	4.84	
68	Elm River at Westport, S. Dak.	1,680	1945-50	Mar. 25, 1948	14.0	-						Stage-discharge relation
				Mar. 29, 1948	-	2,870	1.71	May 11	10.79	1,870	1.11	

	JAMES RIVER BASIN—Continued											
69	Turtle Creek at Redfield, S. Dak.	1,540	1945-50	Mar. 23, 1948	12.38	3,160	2.05	Apr. 3	10.35	1,900	1.23	Stage-discharge relation
	VERMILLION RIVER BASIN											
70	Vermillion River near Wakonda, S. Dak.	1,670	1945-50	June 13, 1947	16.63	3,010	1.80	May 21	11.15	875	0.52	Stage-discharge relation
	BIG SIOUX RIVER BASIN											
71	Big Sioux River at Akron, Iowa	8,851	1928-50	Sept. 26, 1926 June 4, 1942	19.4 19.23	- 21,400	2.42	June 18	13.40	5,450	0.62	Stage-discharge relation

a At former site.
b Estimated.
c Daily discharge.
d Revised.
e 1,760 square miles affected by storage in Heart Butte Reservoir.
f Computed on basis of records for station at Breien and slope area measurements at upstream points.
g Datum then in use.
h At site 80 feet upstream.

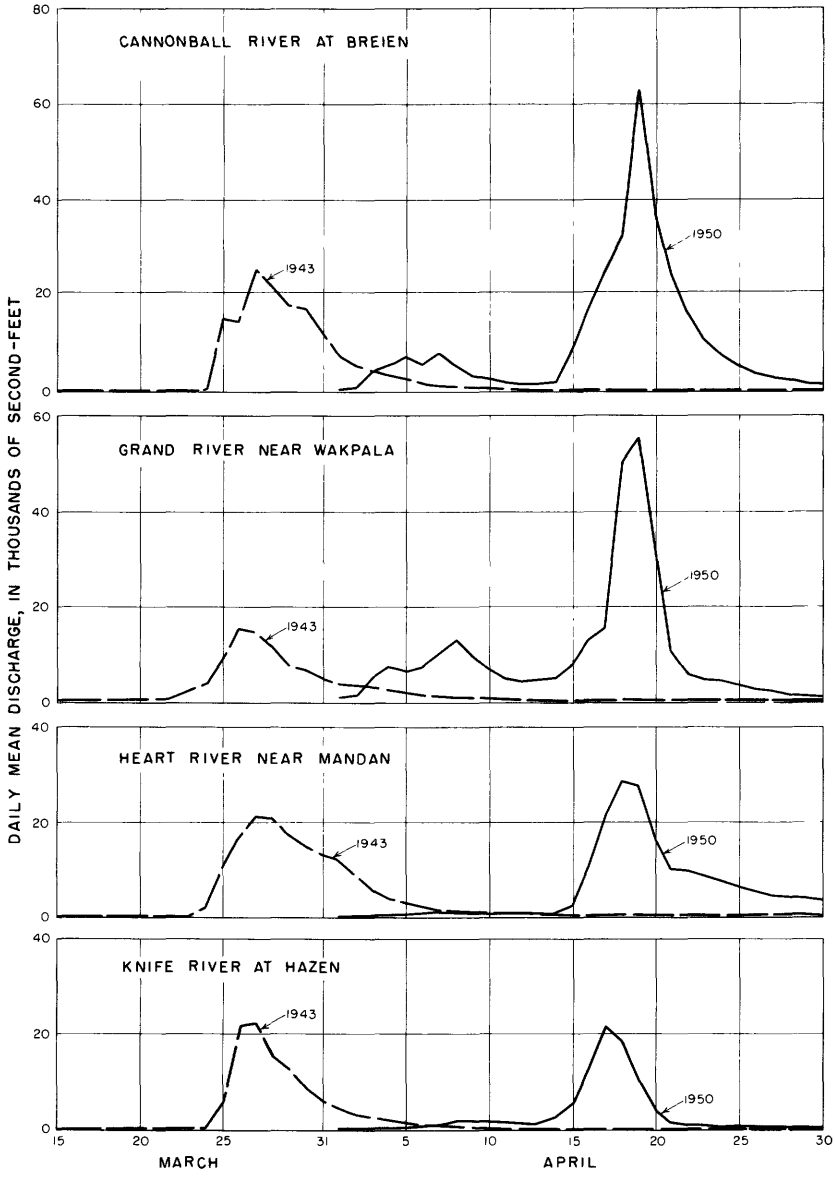

Figure 11.—Graphs of discharge for the floods of 1943 and 1950 at selected stream-gaging stations in the Missouri River Basin

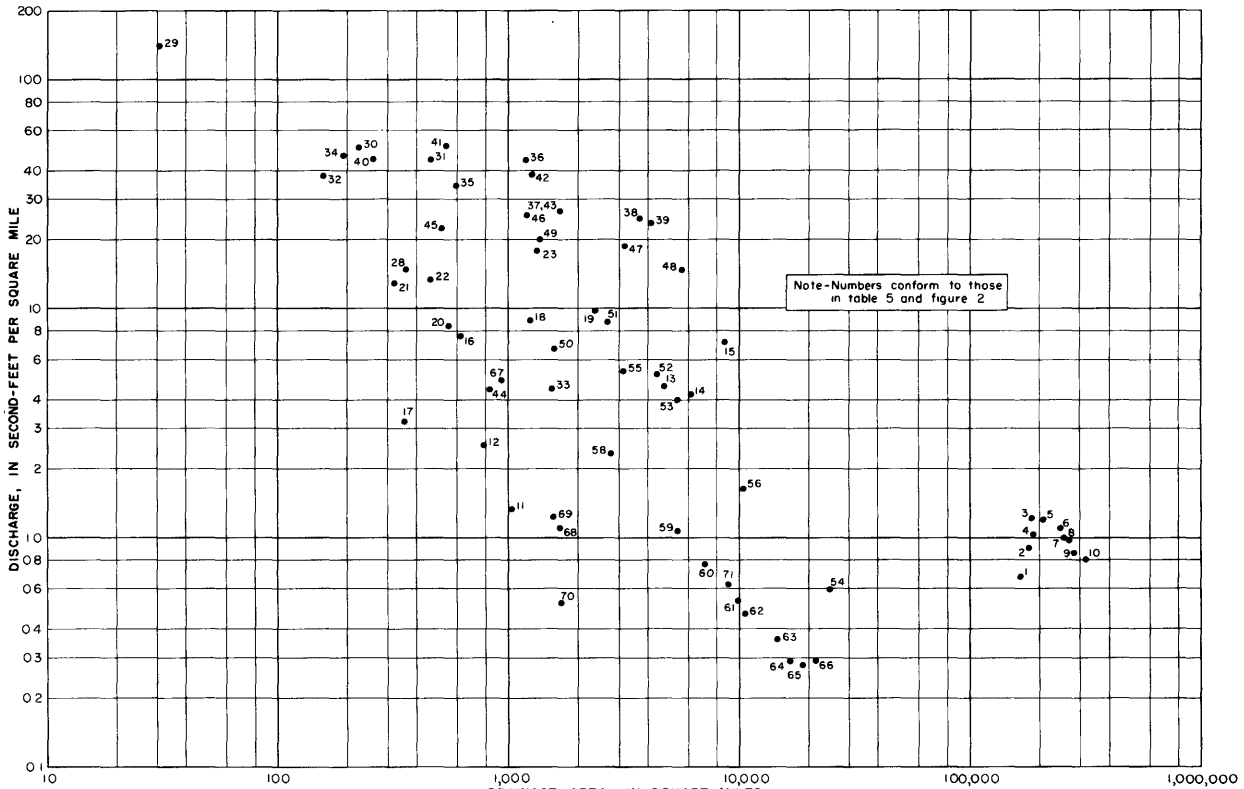

Figure 12.—Maximum discharges, in second-feet per squore mile, for various areas in Missouri River Basin in North Dakata and South Dakoto, April to May 1950, as given in table 5

FLOOD-CREST STAGES

Records of flood crest stages collected by the Corps of Engineers are presented in table 6. Data on a few crest stages collected by the Northern Pacific and the Minneapolis, St. Paul, and Sault Ste. Marie Railways have been inserted into the table.

The stage records of table 6 are of particular interest to those responsible for projects to be located above the maximum known flood level. Points of measurement are located both by distance above river mouth and by distance and direction from local features; this information is considered adequate for proper reference.

The flood crest height above or below arbitrary reference points at miscellaneous locations selected by the Geological Survey is listed in table 7.

RECORDS OF PREVIOUS FLOODS

Information on previous floods in the area has been compiled from newspaper accounts, government publications, railroad files, state and territorial histories, and from oral accounts of eyewitnesses. The search for information was not exhaustive and the material presented may be but a part of that available. The greater part of the area reported on is of recent settlement; no extensive colonization began until the completion of railroads into the area and until the subjugation of the Indians. Many sub-basins in the area were not settled until after 1890, and accounts of floods in these areas are of relatively recent ones. Previous flood data are listed by sub-basins in the following paragraphs.

Little Missouri River Basin

The Geological Survey has maintained gaging stations at a few locations and for scattered periods of time in the Little Missouri Basin since 1903. The actual gaging records show no outstanding floods for the headwater area above the North-South Dakota State line; the maximum peak discharge recorded at the Alzada, Mont., gage since 1903 is 6,000 sec.-ft. in 1944. Other records kept for shorter periods of time at locations on the lower river show that the 1947 floods were probably the highest basin-wide floods in the Little Missouri subbasin since settlement of the area. Scattered records from the files of the Northern Pacific Railway show that floods occurred in 1897 and 1900 at Medora, with the 1900 flood much the higher of the two.

Table 6.—Flood-crest stages
(Furnished by Corps of Engineers except as noted.)

Stream and location	Miles above mouth	Day and hour 1950	Altitude in feet
Missouri River Main Stem			
Missouri River			
Williston, N. Dak.	1,650.2	April 6	1,842.09
Elbowoods, N. Dak.	1,504.0	April 10	1,737.81
Garrison Dam, N. Dak.	1,455.0	April 15 5:15 p.m.	1,693.61
Washburn, N. Dak.	1,418.5	April 17 11:00 a.m.	1,672.0
Bismarck, N. Dak.	1,377.8	April 17	1,637.10
Grand River, S. Dak.	1,253.6	-	1,548.02
Mobridge, S. Dak.	1,250.6	April 19 7:00 p.m.	1,544.4
Moreau River, S. Dak.	1,230.5	-	1,527.29
Cheyenne River, S. Dak.	1,163.8	-	1,477.25
Oahe, 'Gage B', S. Dak.	1,122.8	-	1,438.90
Pierre, S. Dak.	1,117.6	April 21 Noon	1,432.85
Bad River, S. Dak.	1,116.4	-	1,431.57
Joe Creek, S. Dak.	1,076.1	-	1,394.95
Upper Big Bend, S. Dak.	1,062.3	April 21	1,383.7
Ft. Thompson, S. Dak.	1,032.6	-	1,357.68
Chamberlain, S. Dak.	1,012.9	April 22 1-8 a.m.	1,339.02
	999.2	-	1,326.2
	997.5	-	1,324.1
Geddes, S. Dak.	938.3	April 22 5:00 p.m.	1,267.2
Ft. Randall, S. Dak.	921.9	April 23 7:00 a.m.	1,251.92
	918.2	-	1,250.9
	914.4	-	1,245.9
	912.8	-	1,245.4
	909.5	-	1,243.2
Greenwood, S. Dak.	907.6	-	1,238.5
	904.3	-	1,236.6
	885.0	-	1,220.08
	883.2	-	1,217.60
	882.0	-	1,216.00
	881.2	-	1,216.15
	878.2	-	1,213.35
	875.1	-	1,210.35
	874.1	-	1,208.05
	873.7	-	1,208.03
	870.0	-	1,203.67
	862.0	-	1,193.58

Table 6.—Flood-crest stages—Continued

Stream and location	Miles above mouth	Day and hour 1950	Altitude in feet
Missouri River Main Stem—Con.			
Missouri River—Con.			
	851.4	-	1,185.49
	846.2	-	1,179.78
Yankton, S. Dak.	840.4	April 24 4-7 a.m.	1,171.05
	838.5	-	1,170.29
	834.6	-	1,164.64
	830.3	-	1,161.81
	824.6	-	1,157.11
	821.5	-	1,152.84
	816.8	-	1,147.15
	812.6	-	1,143.41
	811.3	-	1,140.98
	804.2	-	1,131.68
	799.0	-	1,128.17
	792.1	-	1,120.53
	788.8	-	1,119.47
	784.8	-	1,113.76
	780.4	-	1,108.62
	774.8	-	1,103.30
	762.0	-	1,097.01
Sioux City, Iowa	760.0	April 25	1,095.38
Shell Creek Basin			
Shell Creek at 'Soo Line' Railway bridge	-	-	a 1,823.0
Knife River Basin			
Knife River			
Marshall, N. Dak.	90.0	-	1,977.76
Dodge, N. Dak., 14 mi. south	77.7	-	1,925.21
Golden Valley gage, N. Dak.	62.2	April 16	1,873.15
Zap, N. Dak., 5 mi. south	45.8	April 16-17	1,817.52
Beulah, N. Dak., 1/4 mi. west	34.5	April 17 6:15 a.m.	1,777.59
Beulah, N. Dak.	34.0	April 17	1,776.44

See footnotes at end of table, page 98.

Table 6.—Flood-crest stages—Continued

Stream and location	Miles above mouth	Day and hour 1950	Altitude in feet
Knife River Basin—Con.			
Knife River—Con.			
Beulah, ¼ mi. east	33.5	April 17 10:50 a.m.	1,772.43
Hazen, N. Dak., ½ mi. west	23.0	April 17	1,739.36
Hazen, N. Dak., gaging station	22.0	April 17	1,738.24
Hazen, N. Dak., 1½ mi. east	19.0	April 17 4:20 p.m.	1,730.50
Hazen, N. Dak., 1½ mi. east	18.9	April 17 4:45 p.m.	1,729.66
Stanton, N. Dak., 4 mi. west	9.8	-	1,706.36
Spring Creek			
Werner, N. Dak.	56.2	-	2,090.59
Halliday, N. Dak.	47.3	-	2,044.49
Golden Valley, N. Dak., ½ mi. west	23.2	-	1,902.15
Zap, N. Dak., gaging station	11.0	April 17	1,338.15
Beulah, N. Dak., 2 mi. west	1.6	April 17 12:10 p.m.	1,786.00
Turtle River Basin			
Turtle River at 'Soo Line' Railway bridge	-	-	a 1,676.9
Heart River Basin			
Heart River			
South Heart, N. Dak., 2 mi. east	210.0	April 16	2,451.11
Lehigh, N. Dak.	190.0	April 16	2,346.31
Gladstone, N. Dak.	178.0	-	2,292.48
Richardton, N. Dak., 9½ mi. south	151.5	April 16	2,181.87
Glen Ullin, N. Dak., 17 mi. south	103.2	April 17	2,006.42
Carson, N. Dak., 11 mi. north	71.0	-	1,877.42
Lark, N. Dak., 10 mi. north	62.0	April 17	1,823.52

See footnotes at end of table, page 98.

Table 6.—Flood-crest stages—Continued

Stream and location	Miles above mouth	Day and hour 1950	Altitude in feet
Heart River Basin—Con.			
Heart River—Con.			
Flasher, N. Dak., 10 mi. north	48.0	-	1,780.76
Sweetbriar, N. Dak., 5 mi. southeast	26.0	-	1,692.79
Mandan, N. Dak., 3 mi. west	13.7	April 19	1,662.34
Apple Creek Basin			
Apple Creek, N. P. Ry. Bridge 190	-	-	b 1,645.2
Apple Creek, 'Soo Line' Ry. bridge X-415-A	-	-	a 1,642.93
McKenzie Slough	-	April 19	b 1,705.5
Cannonball River Basin			
Cannonball River			
New England, N. Dak., $\frac{1}{4}$ mi. south	250.0	April 16 8:45 a.m.	2,557.89
Havelock, N. Dak., $\frac{1}{2}$ mi. northeast	235.5	-	2,498.80
Regent, N. Dak., $\frac{1}{2}$ mi. northeast	220.2	April 16	2,444.34
Mott, N. Dak., 1 mi. southwest	202.0	-	2,386.05
Mott, N. Dak., Hwy. 8 bridge	200.7	April 17	2,378.07
Mott, N. Dak., $\frac{1}{2}$ mi. south	200.0	-	2,376.58
Burt, N. Dak. 2 mi. east	181.5	-	2,304.60
New Leipzig, N. Dak., 2 $\frac{1}{2}$ mi. south	168.0	April 17	2,256.91
Elgin, N. Dak., 4 mi. southwest	154.0	-	2,197.66
Elgin, N. Dak., 6 mi. south	140.0	-	2,139.17
Leith, N. Dak., 6 mi. southwest	130.0	-	2,095.31
Leith, N. Dak., 7 mi. south	123.5	-	2,068.76
Brisbane, N. Dak., 9 mi. southwest	117.0	-	2,036.02

See footnotes at end of table, page 98.

Table 6.—Flood-crest stages—Continued

Stream and location	Miles above mouth	Day and hour 1950	Altitude in feet
Cannonball River Basin—Con.			
Cannonball River—Con.			
Brisbane, N. Dak., 8 mi. south	99.7	-	1,979.70
Raleigh, N. Dak., 15 mi. southwest	86.0	-	1,917.12
Raleigh, N. Dak., 16 mi. south	77.8	-	1,879.37
Shields, N. Dak., 7 mi. southwest	65.2	-	1,833.31
Porcupine, N. Dak.	53.8	-	1,789.97
Timmer, N. Dak., 4 mi. south	38.5	-	1,734.89
Breien, N. Dak.	29.5	April 18	1,698.94
N. P. Ry. Bridge 17	-	-	b, c 1,690.5
Solen, N. Dak.	19.6	April 19	1,663.11
N. P. Ry. Bridge 7	-	-	b, c 1,650.5
N. P. Ry. Bridge 6	-	-	b, c 1,639.4
Cannonball, N. Dak., 2 mi. northwest	4.5	-	1,622.01
Cedar Creek			
Reeder, N. Dak., 12 mi. north	194.0	-	2,673.52
Haynes, N. Dak., 13 mi. north	146.0	-	2,491.45
Haynes, N. Dak., 11 mi. northeast	118.0	-	2,398.46
Lemmon, S. Dak., 8 mi. northeast	99.0	-	2,315.61
Pretty Rock, N. Dak., 10 mi. south	68.0	April 17	2,181,68
Leith, N. Dak., 24 mi. south	47.0	-	2,102.66
Watanga, S. Dak., 6 mi. north	37.0	-	2,063.48
Swastika, N. Dak., 2 mi. west	17.0	April 17	1,982.14
Raleigh, N. Dak., 19 mi. south	6.0	-	1,899.49
Beaver Creek Basin			
Beaver Creek at 'Soo Line' Railway bridge X-347	-	-	a 1,968.63

See footnotes at end of table, page 98.

Table 6.—Flood-crest stages—Continued

Stream and location	Miles above mouth	Day and hour 1950	Altitude in feet
James River Basin			
James River			
New Rockford, N. Dak.	661.0	-	1,512.81
Brantford, N. Dak., 2 mi. west	650.0	-	1,483.7
Grace City, N. Dak., 1½ mi. southwest	634.5	-	1,466.10
Carrington, N. Dak., 15 mi. east	625.0	April 20 8:00 a.m.	1,456.26
		May 12 3:45 p.m.	1,454.65
'Soo Line' Railway bridge	-	a May 15	a 1,444.51
Bordulac, N. Dak., 8 mi. east	617.0	--	1,443.7
Arrowood Lake Spillway, N. Dak.	609.0	April 20 7:00 p.m.	1,443.00
		May 13 10:00 p.m.	1,441.75
DePuy Spillway, N. Dak.	598.0	April 20	1,439.13
		May 13	1,438.57
Buchanan, N. Dak., 3⅝ mi. east	592.2	April 21 8:10 a.m.	1,434.94
		May 14 4:30 p.m.	1,434.25
Jamestown, N. Dak., 6 mi. north	584.0	April 21 1:00 p.m.	1,411.16
		May 15 7:15 a.m.	1,410.32
Jamestown, N. Dak., Nickeus Park	579.4	April 22 8:40 a.m.	1,399.81
		May 15 6:45 a.m.	1,399.15
Jamestown, N. Dak., 5th St., N.W.	578.8	April 21 8:00 p.m.	1,398.62
		May 15 9:00 a.m.	1,397.77
Northern Pacific main line	578.3	April 21	b 1,396.9
Jamestown, N. Dak., 2nd St., S.W.	578.2	April 17 3:00 p.m.	1,396.79
		May 13	1,396.97
Jamestown, N. Dak., U. S. Hwy. 10	577.4	April 17 8:00 p.m.	1,395.19
		May 13 5:45 a.m.	1,395.24

See footnotes at end of table, page 98.

Table 6.—Flood-crest stages—Continued

Stream and location	Miles above mouth	Day and hour 1950	Altitude in feet
James River Basin—Con.			
James River—Con.			
Jamestown, N. Dak., Asylum gage	576.0	April 17	1,391.01
		May 13 10:00 a.m.	1,391.10
Reeves, N. Dak., ½ mi. east	568.0	-	1,375.60
Ypsilanti, N. Dak., ½ mi. northwest	562.0	-	1,366.72
Montpelier, N. Dak.	555.0	April 19	1,354.18
		May 13 or 14	1,355.07
Adrian, N. Dak., .2 mi. north	550.7	April 19 10:37 a.m.	1,345.47
		May 14 10:20 a.m.	1,345.61
Adrian, N. Dak., 2½ mi. south	545.9	-	1,339.30
Dickey, N. Dak., 1½ mi southeast	539.4	-	1,327.44
Grand Rapids, N. Dak., ½ mi. east	532.0	May 15 1:00 p.m.	1,313.90
LaMoure, N. Dak., ¾ mi. west	523.0	April 25 12:45 p.m.	1,304.89
		May 16 7:00 p.m.	1,305.34
LaMoure, N. Dak., 2½ mi. southeast	519.0	-	1,304.59
Oakes, N. Dak., 1¼ mi. west	496.0	April 28 12:50 p.m.	1,295.06
		May 20 3:40 p.m.	1,295.65
Ludden, N. Dak., 1 mi. west	486.2	April 30 Midnight	1,293.77
		May 20 Midnight	1,294.30
North-South Dakota State Line	481.0	May 3	1,293.62
		May 21	1,293.90
Pipestem Creek			
Dover, N. Dak., 1 mi. east	61.0	-	1,572.90
Melville, N. Dak., 4½ mi. WSW	47.3	-	1,539.65

Table 6.—Flood-crest stages—Continued

Stream and location	Miles above mouth	Day and hour 1950	Altitude in feet
James River Basin—Con.			
Pipestem Creek—Con.			
N. P. Ry. Wilton Br. Bridge 3	-	April 18	b, c 1,520.69
Pingree, N. Dak., 3 mi. WNW	32.0	-	1,520.50
Buchanan, N. Dak., 4 mi. west	22.0	April 9 (ice jam)	1,478.78
		April 16	1,477.80
		May 12	1,477.40
Buchanan, N. Dak., 4 mi. south	19.3	-	1,458.22
Jamestown, N. Dak., 4 mi. southwest	5.7	April 17 6:15 p.m.	1,415.14
		May 12 5:20 p.m.	1,415.03
N. P. Ry. Main Line		April	b 1,404.1
Jamestown, N. Dak.	0.9	May 12 8:00 p.m.	1,399.67
Maple Creek			
'Soo Line' Railway bridge 3 mi. west of Fullerton	-	-	a 1,423.54

a Furnished by Minneapolis, St. Paul, and Sault Ste. Marie Railway.
b Furnished by Northern Pacific Railway.
c Northern Pacific Railway datum.

Table 7.—Maximum stages of 1950 floods in North Dakota as measured at miscellaneous points by the U. S. Geological Survey

Stream	Location	Reference Point	Ref. Pt. to Water Surface*	Date
Knife River	N. Dak. Highway 25 bridge near Hazen	S. W. bolt at bottom of S. W. end of railing.	-4.1 ft.	Apr. 16
Muddy Creek	U. S. Highway 10 bridge near Glen Ullin	Curb by handrail end post at left upstream end of bridge.	-3.5 ft.	Apr. 17
Hailstone Creek	N.P.R.R. bridge near New Salem	Downstream bolt holding truss pedestal on right downstream pier.	-3.1 ft.	Apr. 17
Sweetbriar Creek	Bridge 1/2 mile south of Sweetbriar	Anchor bolt in left upstream abutment.	-0.4 ft.	Apr. 17
Cannonball River	Bridge in Mott	N. E. corner, N. E. end bridge rail.	-2.0 ft.	Apr. 17
Cannonball River	Bridge at Burt	Top side of bottom flange at S. W. corner of bridge.	+2.4 ft.	Apr. 17
Cannonball River	Bridge near Bentley	Right end of upstream curb.	-3.6 ft.	Apr. 17
Cannonball River	Bridge south of Heil	Downstream end of high ledge on left pier.	About +4.5 ft.	Apr. 17-18
Cannonball River	N. Dak. Highway 31 bridge	Top of angle iron at left upstream pier.	About +3.0 ft.	Apr. 18
Thirty Mile Creek	N. Dak. Highway 21 bridge	Chiseled square on left downstream wingwall.	About +2.5 ft.	Apr. 17
Cedar Creek	Bridge 3 miles east and 13 miles north of Hettinger	Chiseled square on left upstream wingwall.	About +2.0 ft.	Apr. 17
Cedar Creek	Bridge 6 miles east and 12 miles north of Hettinger	Top of concrete bridge seat, right downstream wingwall.	About +7. ft.	Apr. 17
Cedar Creek	Bridge 8 miles east and 10-1/2 miles north of Hettinger	N. E. rivet in downstream shoeplate at right abutment.	About +4. ft.	Apr. 17
Cedar Creek	N. Dak. Highway 31 bridge	Bronze tablet in right downstream abutment.	About -4. ft.	Apr. 17

*Minus sign indicates water surface was below reference point, plus sign indicates water surface was above reference point.

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Scattered records from the files of the Chicago, Milwaukee, St. Paul and Pacific Railway show that the Little Missouri River at Marmarth reached about the same stage in the following flood events: Mar. 31, 1913; May 17, 1920; May 29, 1929; and Mar. 23, 1930. One outstanding flood resulted from heavy local rains in June 1929. Runoff was heaviest on Beaver Creek; the peak discharge was estimated as 33,000 sec.-ft. at Wibaux, Mont.

The towns of Wibaux, Mont., and Marmarth, N. Dak., have suffered flood damages in the past. Marmarth was flooded in 1913, 1920, 1921, and 1929 by the Little Missouri River, according to the "308 Report" on the stream (Congressional reports). Wibaux suffered heavy damage from the June 1929 flood on Beaver Creek. The 'Milwaukee' Railway records of floods at bridge AA-240 across Little Beaver Creek 2.3 miles west of Marmarth are as follows:

1920	3.8 feet below base of rail
May 29, 1929	3.2 feet below base of rail
1938	5.8 feet below base of rail
1950	5.4 feet below base of rail

Knife River Basin

Geological Survey records for the main stream of Knife River exist from 1903 to the present, with minor breaks. According to these records the only severe, basin-wide flood previous to the 1950 one was in 1943. The gaging records show the 1943 flood reached slightly higher stage and discharge than did the 1950 event. Northern Pacific Railway records taken on the bridge one mile east of Hazen show floods in 1913, 1930, and 1943; the 1913 flood reaching a stage practically the same as that of 1943. A flash flood over a small area at Hazen in July 1938, caused damage reported to be $300,000. Interviews with old settlers living near Hazen and Golden Valley indicate that the 1943 flood was the highest since 1884, which was as far back as they could remember. The only outstanding flood known on Spring Creek, tributary of Knife River, was in 1943, according to Northern Pacific Railway records.

Heart River Basin

The Heart River sub-basin has a longer recorded history than adjacent areas in western North Dakota because of the early settlements along the Northern Pacific Railway that paralleled the Heart River between Mandan and Dickinson. Accounts show that an outstanding flood occurred in the Heart River Basin in 1881. It caused severe damage to Mandan and destroyed 40 bridges along the newly built Northern Pacific line between Mandan and Medora. This flood was the result of snow-melt runoff from an exceptionally severe winter.

Mandan has been subjected to severe flooding many times. After the big flood of 1881 the next mention found of serious flooding in Mandan was in news accounts for April 1912, when the entire southern part of the city was covered with water. News accounts tell of track washouts along the Northern Pacific Heart River line in 1893 but no reference to the size of the flood could be found. Intermittent gaging records kept since 1924 of the Heart River at or near Mandan are available; the highest-gaged flood occurred in 1943. There is little doubt that the 1950 flood would have exceeded this except for the operation of Heart Butte Reservoir.

The 1950 floods on Heart River tributaries were the greatest since settlement of the area. News accounts of the 1950 flooding of Almont on Muddy Creek relate that the flooding of April 1950 was the first since the founding of the town. News reports and statements from old settlers indicate that this was true also for Sweetbriar Creek, Green River, and Antelope Creek.

Apple Creek Basin

Records furnished by the Northern Pacific Railway show that previous floods occurred on Apple Creek in 1887, 1897, and 1943. The railroad records show the 1887 flood to have reached 0.2 foot higher elevation than the 1950 flood at bridge 190 about 6 miles east of Bismarck. McKenzie Slough, which drains into Apple Creek, was high in 1893, 1894, 1897, and 1902, according to railroad records; the 1902 level, the previous high, was 1.0 foot below the maximum reached in 1950. Newspaper accounts relate that traffic on the Northern Pacific main line was suspended from March 25 to April 1, 1902 because of high water at McKenzie Slough, and that a track washout on Apple Creek closed the line again on April 7. The elevation of the tracks was raised 3.5 feet between 1902 and 1950; so, the current flood did not overtop the tracks.

Cannonball River Basin

Scattered periods of record for the Cannonball River near the mouth have been maintained by the Geological Survey since 1903. Figure 5, (see page 15) shows graphically the magnitude of annual floods, as gaged by the Geological Survey from 1903-50. News accounts mention severe flooding due to snow-melt runoff in 1912 at the towns of Mott and New England, N. Dak. Reportedly, two 'Milwaukee' Railway bridges were taken out near Mott by ice jams during this flood. No early news accounts of Cannonball River floods other than the one in the spring of 1912 and another on the upper reaches of the river on July 4 of the same year could be found. Apparently, the July 4, 1912 flood in the New England area, exceeded the 1950 flood if memory can be trusted. A flood in July 1937 reached about the same stage at New England as the 1950 flood.

Interviews with old settlers along the river disclosed no significant information. The Ed Sept residence on the left bank of the Cannonball River south of Heil was built in 1897. The 1950 flood was the first one to overtop the terrace on which the house stands, and it did so by about three feet. Old settlers at Breien stated the 1950 flood was the highest yet, but no information on floods before 1900 was available.

Northern Pacific Railway records for bridges across the Cannonball River along the Mandan-Mott branch line show the following:

Bridge 33, near Cannonball junction		
1883	1,603.5	(N. P. datum)
June 26, 1909	1,595.8	"
April 1912	1,597.08	"
April 1943	1,600.2	"
Bridge 6, five miles east of Solen		
April 1912	1,622.6	"
April 1950	1,639.4	"
Bridge 7, four miles east of Solen		
April 1912	1,628.4	"
April 1950	1,650.5	"
Bridge 17, one mile east of Breien		
April 1912	1,678.2	"
April 1950	1,690.5	"

Records taken by the Northern Pacific at bridge 77 across Thirty Mile Creek show high water as follows:

1912 and 1916	2,259.0	(N. P. datum)
1930	2,253.0	"

Records furnished by the Chicago, Milwaukee, St. Paul and Pacific Railway show the following observed flood heights on points on the Cannonball branch line:

Bridge AA-560, one mile south of Shields	
1902	9.2 feet below base of rail
1950	2.1 feet above base of rail
Bridge AA-628, three miles west of New Leipzig	
March 24, 1947	16.3 feet below base of rail
April 1950	11.0 feet below base of rail
Bridge AA-648, 0.9 mile west of Mott	
July 9, 1938	9.5 feet below base of rail
March 26, 1943	4.0 feet below base of rail
April 1944	9.5 feet below base of rail

Bridge AA-656, 0.4 mile west of Mott, N. Dak.
July 1937 3.8 feet below base of rail

Bridge AA-688, 1.0 mile east of New England, N. Dak.
July 1937 14.2 feet below base of rail
April 1950 14.5 feet below base of rail

Grand River Basin

Chicago, Milwaukee, St. Paul and Pacific Railway records:

Grand River:
Bridge AA-902, 3.2 miles west of Moreau Junction, S. Dak.
June 1937 13.3 feet below base of rail
April 1950 7.7 feet below base of rail

Flat Creek:
Bridge AA-170, 0.6 mile east of Haynes, N. Dak.
1944 1.4 feet below base of rail
April 16, 1950 0.8 feet below base of rail

Bridge AA-172, 0.3 mile east of Haynes, N. Dak.
1929 3.5 feet below base of rail
April 16, 1950 1.25 feet above base of rail

Bridge AA-174, 1.0 mile west of Haynes, N. Dak.
1929 3.1 feet below base of rail
April 16, 1950 2.2 feet below base of rail

Bridge AA-178, 3.7 miles west of Haynes, N. Dak.
Highest prior to 1928 7.0 feet below base of rail
1928 7.7 feet below base of rail
April 16, 1950 3.0 feet below base of rail

Bridge AA-180, 5.4 miles west of Haynes, N. Dak.
Sept. 1928 6.5 feet below base of rail
April 16, 1950 5.9 feet below base of rail

Bridge AA-182, 6.0 miles west of Haynes, N. Dak.
April 1944 6.5 feet below base of rail
April 16, 1950 5.0 feet below base of rail

Moreau River Basin

'Milwaukee' Railway records:

Bridge AA-1110, 1.0 mile east of Promise, S. Dak.
1916 2.2 feet below base of rail (ice jam)
1927 6.7 feet below base of rail
April 19, 1950 6.0 feet below base of rail

James River Basin

Records at Jamestown show that before 1950 serious flooding occurred on the James River in 1876, 1881, 1882, 1883, 1897, 1902, 1919, 1943, and 1948. Records of the relative stages of the floods are not all available; those that could be found or deduced are as follows:

Year	Elevation at N. P. bridge 93 *(mean sea level, 1929 datum)	Gage Reading U. S. G. S.
1883	1,400.3	-
1894	1,392.8	-
1897	1,398.1	15.8 ± 0.2
1902	-	13.8 ± 0.3
1919	-	14.9
1943	1,395.3	-
1950	1,396.9	15.8

*Furnished by Northern Pacific Railway.

A search through newspapers showed that the crest dates of some of the floods listed above were March 27, 1902, April 27, 1897, April 11, 1919, April 11, 1882, April 9, 1883. Mr. Horace Picard, one of the oldest inhabitants of Jamestown, recalled that the stages of the 1882 and 1883 floods were about the same. Accounts state the break up of ice that took place April 10, 1881, drove many townspeople out of Jamestown; except for that, no information on the size of the 1881 flood is available.

The causes of flooding along the James River at cities in South Dakota, such as Huron, bear very little relationship to causes of floods in North Dakota. Apparently, the years of heavy flooding in North Dakota were just average flow years in South Dakota. The highest floods in the James River Basin in South Dakota, according to a report published in 1934 by the Corps of Engineers, were in 1881, 1920, and 1922 (Congressional reports). An account of the 1881 flood says that the James River rose 20 feet at Huron. Flood records furnished by the Chicago, Milwaukee, St. Paul and Pacific Railway for points along the James River in South Dakota are:

Bridge O-418, 1.8 miles west of James, S. Dak.

1897	4.6 feet below base of rail
	(base of rail 1,284.6 feet above mean sea level)
April 1922	5.6 feet below base of rail
May 1950	3.9 feet below base of rail

Bridge Q-1156, 0.7 mile east of Forestburg, S. Dak.

1897	9.9 feet below base of rail
1950	14.0 feet below base of rail

Bridge R-916, 3.1 miles east of Mitchell, S. Dak.

March 1950	2.4 feet below base of rail

Missouri River, Main Stem

According to records kept by the U. S. Weather Bureau since 1881 of the Missouri River at Bismarck, floods on the main stem occurred in 1881, 1883, 1884, 1887, 1888, 1894, 1896, 1897, 1899, 1908, 1912, 1913, 1916, 1917, 1919, 1920, 1929, 1938, 1939, and 1943(Bavendick,1946). Floods on the Missouri River at Bismarck are generally associated with ice jams and occur frequently. The outstanding floods on the Missouri main stem in North Dakota were in 1852, 1866, 1867, 1881, 1887, 1897, 1899, 1910, 1917, 1938, 1939, and 1943 according to accounts and to records kept since 1881 at Bismarck.

The greatest known flood in the entire Missouri River Basin above Sioux City, Iowa, was that of 1881. The winter of 1880-81 was possibly the most severe experienced in North and South Dakota; it began with a blizzard on October 15, 1880. The snow from this October storm did not entirely melt before the next snowstorm added to the cover even in so far south an area as Yankton. By mid-winter deep snow covered much of the Dakotas, and by normal break-up time in March, the depth ranged from two to four feet. Indians with memory dating to 1800 could not recall any winter approaching that of '81 in severity. Trains stopped operating altogether on many lines; corn was substituted for coal in firing the boilers of the locomotives on the few that did operate. The breakup began at Fort Buford, N. Dak., on March 6 with a 20-foot rise. By March 27 the flood waters were flowing overbank at Yankton. Severe ice jams, associated with the mass of flowing water, caused a vast lake to submerge the town of Vermillion, S. Dak., and nearly every house in town was destroyed. For great severity and areal coverage the 1881 flood is unmatched; yet the 1950 flood probably exceeded it in a smaller area of intense flooding in North Dakota.

FLUCTUATIONS OF GROUND-WATER LEVELS

(Prepared by Geo. LaRocque, Jr., district engineer,
Ground Water Branch)

The Ground Water Branch, U. S. Geological Survey, as part of its program in the Missouri River Basin, has established numerous observation wells in the Grand River Valley of South Dakota and in the Heart,

Knife, and James River Valleys of North Dakota. Periodic measurement of the water level in most observation wells was begun in the fall of 1946; in many instances water-level measurements were made once in the spring, summer, and the fall of each of the succeeding years. Figure 13 shows the location of 25 typical observation wells. Figures 14, 15, and 16 show water-level fluctuations in these wells.

The area drained by the Grand, Cannonball, Heart, and Knife Rivers is predominantly underlain by soft sandstone or shale. Appreciable deposits of sand and gravel occur, however, in the alluvium that underlies the flood plains and in the unconsolidated materials that underlie the stream-built terraces above the flood plains. Commonly the alluvial deposits are coarse sand or finer materials. The James River rises in central North Dakota and drains an area that is almost wholly underlain by materials of glacial origin. The flood plain of the James River Valley and the immediately adjacent terraces are commonly underlain by sands and silts that in turn are underlain by gravel. In a few places the river is entrenched in glacial till; and large outwash plains, extensive lake deposits, kames, eskers, and minor depositional features occur in some places. The water-bearing deposits of the James River Valley generally have a much greater permeability than the water-bearing deposits of the Knife, Heart, and Grand River Valleys.

In general, the trend of ground-water fluctuations was upward during the period from the fall of 1946 to July 1950. Maximum ground-water levels were reached during or following the floods of the spring of 1950. (See figs. 14, 15, and 16.) In nearly all the observation wells the rise in ground-water level between the measurement in the fall of 1949 and the measurement made in July 1950 was greater than any previously recorded rise during a like period--fall to spring or summer. Rises in ground-water level in the James River Valley were generally greater than rises in the Grand, Heart, and Knife River Valleys. Maximum measured rises in ground-water levels were:

James River Valley	12.9 feet
Knife River Valley	7.1 feet
Heart River Valley	6.5 feet
Grand River Valley	9.1 feet

The observation wells in the James River Valley tap alluvial or glacial water-bearing deposits that are largely recharged by, and that largely discharge to, the James River by nearly direct lateral percolation. The observation wells in the Grand, Heart, and Knife River Valleys tap water-bearing alluvial or terrace deposits largely recharged by infiltration of seasonal precipitation and runoff from minor tributary areas, some recharge coming from the river during extremely high stages. The ground-water discharge from these deposits is in part regulated by river stage. In the James River Valley there was quantitatively less water available for the recharge of the ground-water bodies, but the period of possible recharge was much longer.

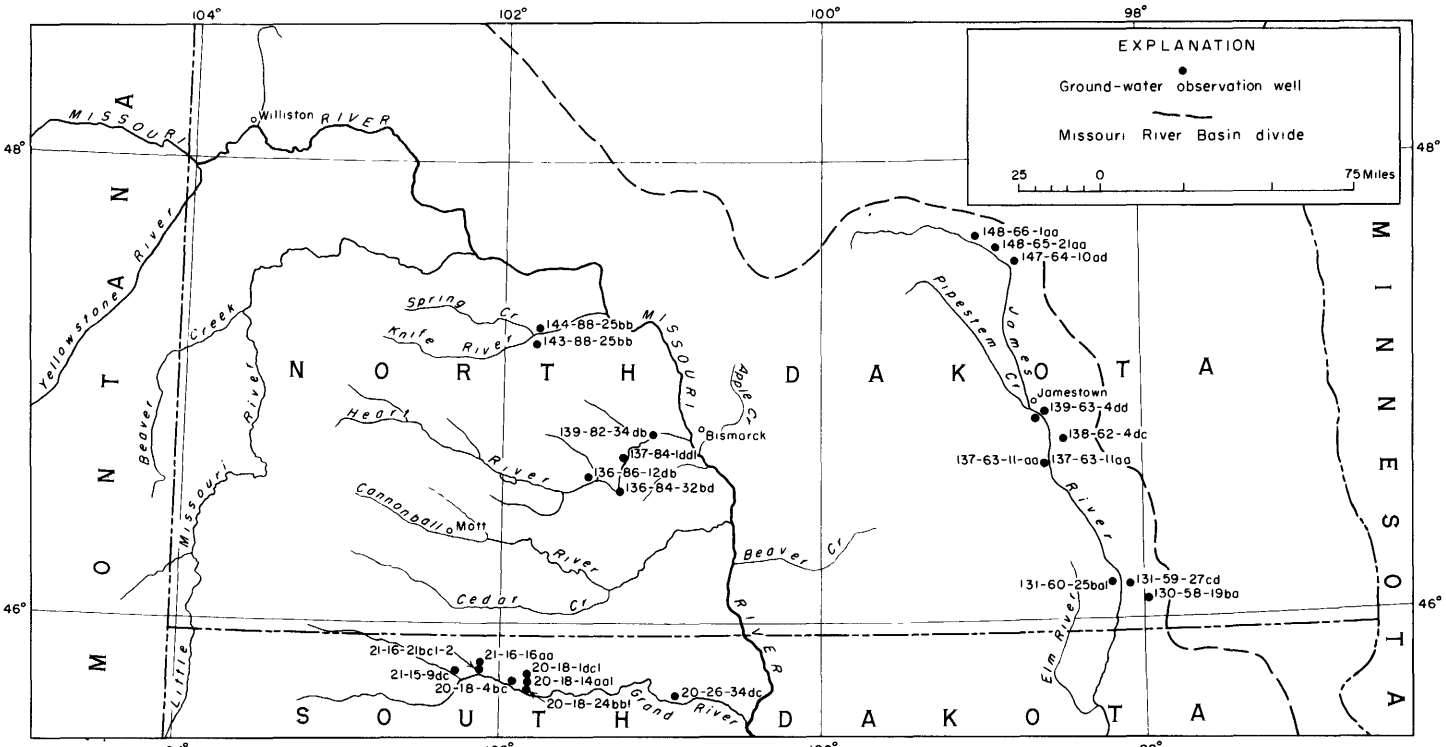

Figure 13.—Location of selected observation wells in the flooded area

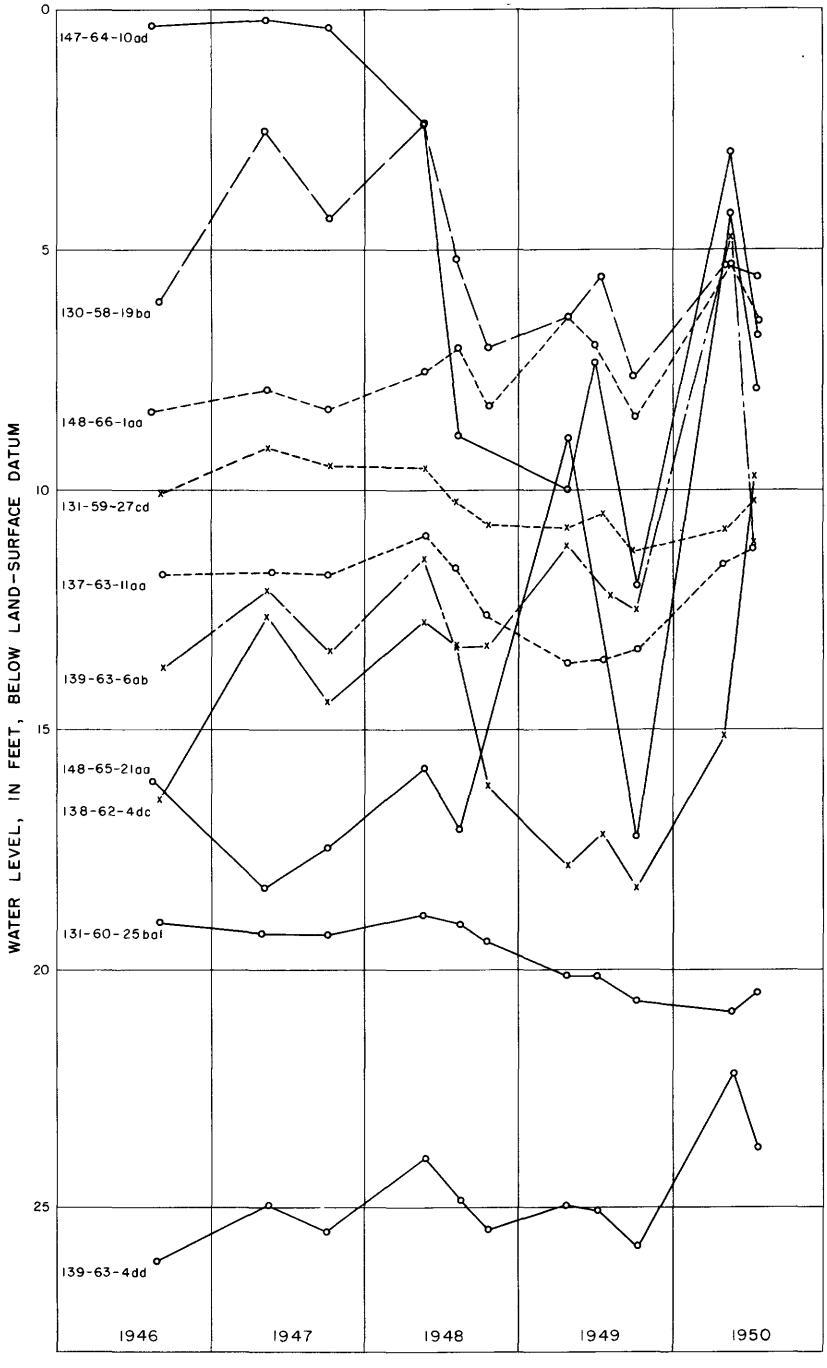

Figure 14.—Water-level fluctuations in 10 typical wells in James River Valley, N. Dak., 1946-50

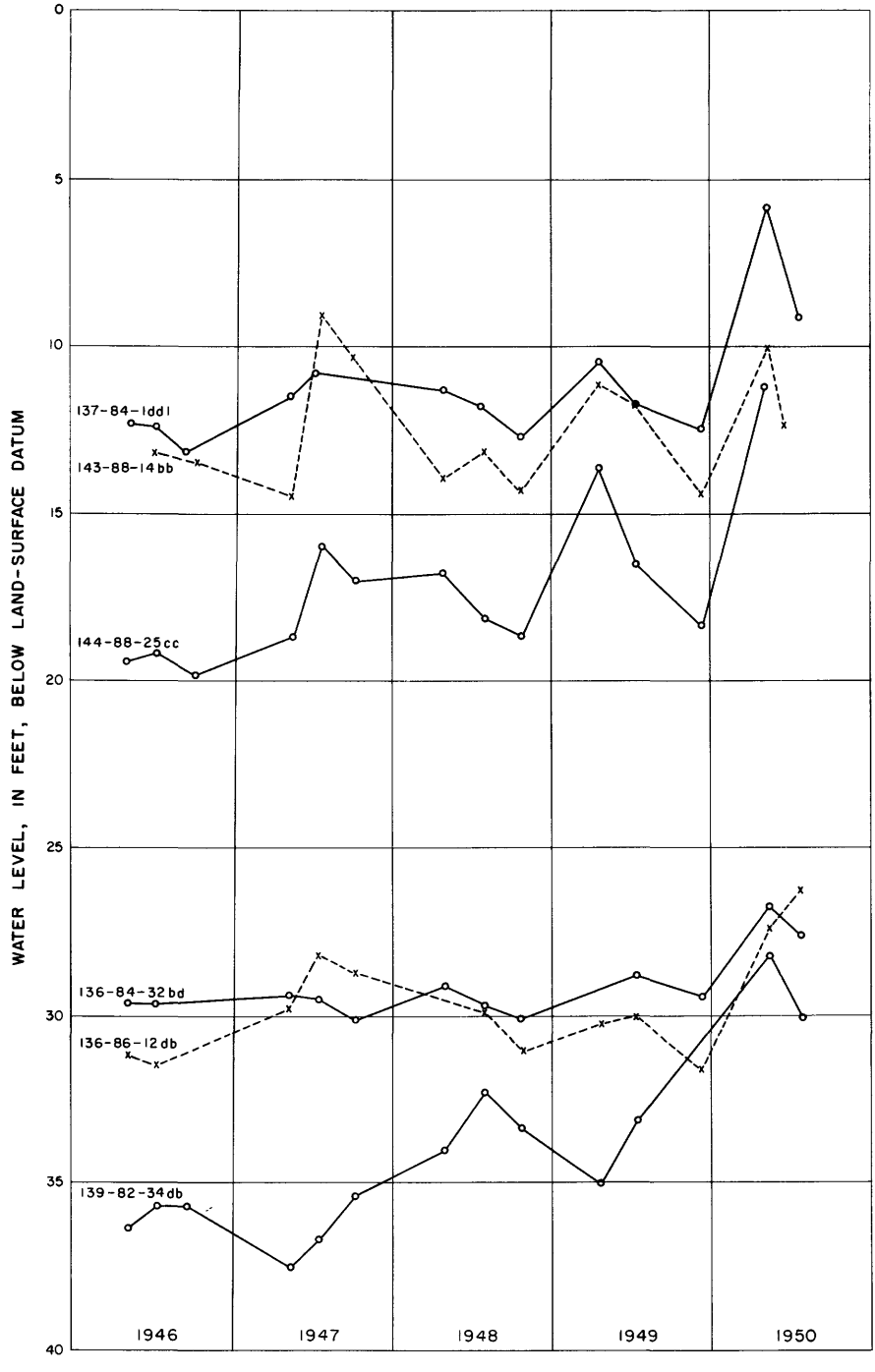

Figure 15.—Water-level fluctuations in six typical wells in Heart and Knife River Valleys, N. Dak., 1946-50

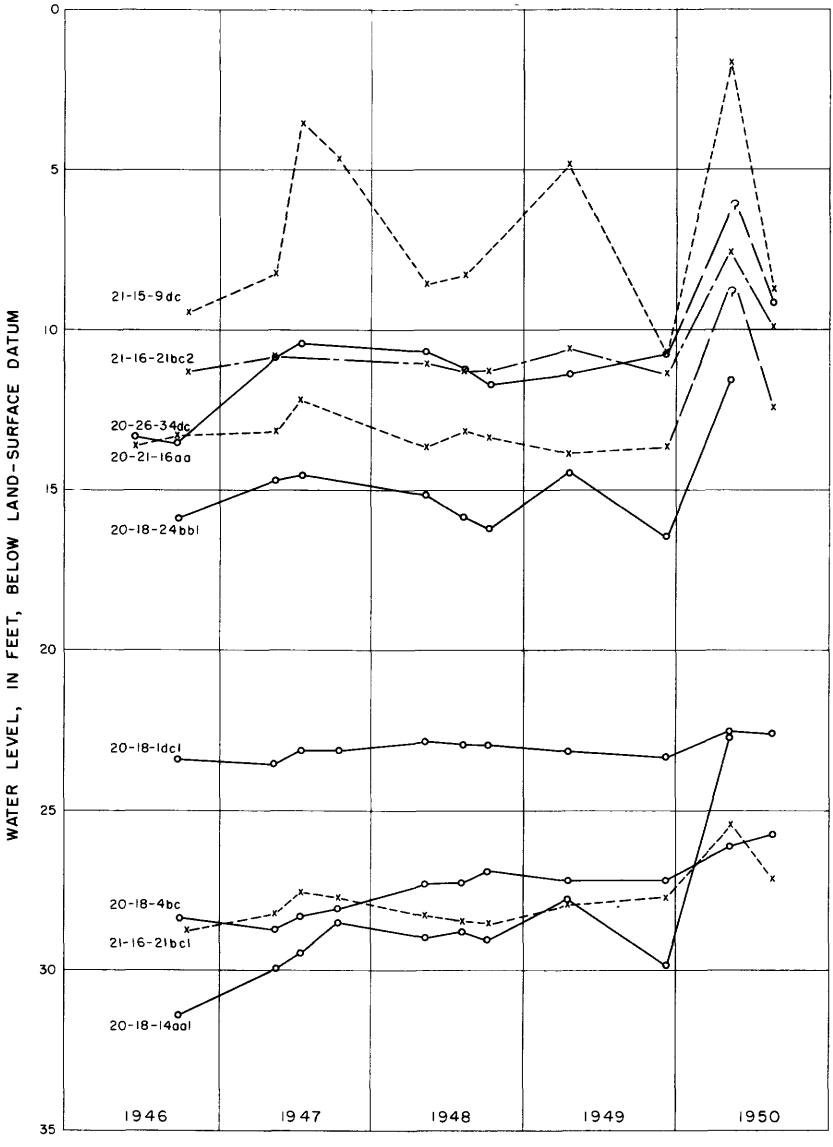

Figure 16.—Water-level fluctuations in nine typical wells in Grand River Valley, S. Dak., 1946-50

Thus, in the James River Valley, the greater rises in ground-water levels are believed to have been the result of the favorable combination of three of the primary factors controlling recharge: higher porosity and permeability, direct recharge from the river, and a longer period of recharge.

Because the Cannonball River is between the Grand and Heart Rivers, and because the flood in the Cannonball River was relatively greater, rises in the ground-water level in the Cannonball River Valley were probably greater than in the Grand and Heart River Valleys.

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——— 73d Cong., 1st sess., H. Doc. 83, p. 23. (James River)

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