

Floods of 1953

GEOLOGICAL SURVEY WATER-SUPPLY PAPER 1320



UNITED STATES DEPARTMENT OF THE INTERIOR

FRED A. SEATON, *Secretary*

GEOLOGICAL SURVEY

Thomas B. Nolan, *Director*

CONTENTS

[The letters in parentheses preceding the titles are those used to designate the separate chapters]

	Page
(A) Floods of June 1953 in northwestern Iowa.....	1
(B) Floods of May-June 1953 in Missouri River basin in Montana.....	69
(C) Floods of April-June 1953 in Louisiana and adjacent states.....	155
(D) Floods of January 1953 in western Oregon and northwestern California.....	321
(E) Summary of floods in the United States during 1953.....	341

Floods of June 1953 in Northwestern Iowa

FLOODS OF 1953

Prepared under the direction of J. V. B. WELLS, Chief, Surface Water Branch

GEOLOGICAL SURVEY WATER-SUPPLY PAPER 1320-A

*Prepared in cooperation with the States
of Iowa, Minnesota, Nebraska, and
South Dakota, and with the Corps of
Engineers, Department of the Army*



UNITED STATES DEPARTMENT OF THE INTERIOR

Douglas McKay, *Secretary*

GEOLOGICAL SURVEY

W. E. Wrather, *Director*

PREFACE

This report on the floods of June 1953 in northwest Iowa was prepared by the Geological Survey, Water Resources Division, C. G. Paulsen, Chief, under the general direction of J. V. B. Wells, Chief, Surface Water Branch.

The collection of basic records of stage and discharge in the area described in this report is a part of a continuous cooperative program with the organizations listed below:

Iowa: Iowa Geological Survey, H. G. Hershey, director and State geologist; Iowa State Conservation Commission, B. F. Stiles, director; city of Sioux City, K. C. Gaynor, city engineer; Corps of Engineers, Department of the Army.

Minnesota: State Department of Conservation, Division of Waters, S. A. Frellson, director; Corps of Engineers, Department of the Army.

Nebraska: Department of Roads and Irrigation, L. N. Ress, State engineer, through the Bureau of Irrigation, Water, and Drainage, D. S. Jones, Jr., chief; Corps of Engineers, Department of the Army.

South Dakota: Office of the State Engineer, D. W. Loucks, State Engineer; Corps of Engineers, Department of the Army.

The field work and the collection and tabulation of basic information on stage and discharge were done under the supervision of the district engineers: V. R. Bennion, Iowa; L. R. Sawyer, Minnesota; D. D. Lewis, Nebraska; and H. M. Erskine, South Dakota. The report was arranged and text prepared by the Lincoln special reports office, R. E. Oltman, engineer in charge.

The Corps of Engineers, the U. S. Weather Bureau, the Iowa Natural Resources Council, the city of Sioux City, the Chamber of Commerce, Spencer, Iowa, and many individuals supplied information included in this report.

CONTENTS

	Page
Abstract	1
Introduction.....	2
General description of the floods.....	4
The storm.....	4
The floods.....	5
Flood damages	16
Measurement of flood discharges	18
Stages and discharges at stream-gaging stations.....	19
Explanation of data	19
Upper Mississippi River basin	
Minnesota River:	
Blue Earth River near Rapidan, Minn.....	23
West Fork Des Moines River at Jackson, Minn...	24
West Fork Des Moines River at Estherville, Iowa...	25
West Fork Des Moines River at Humboldt, Iowa..	26
East Fork Des Moines River near Burt, Iowa ..	27
East Fork Des Moines River near Hardy, Iowa.	28
Raccoon River near Jefferson, Iowa.....	29
South Raccoon River at Redfield, Iowa.....	30
Raccoon River at Van Meter, Iowa.....	31
Missouri River basin	
Missouri River:	
Big Sioux River:	
Rock River near Rock Valley, Iowa.....	32
Dry Creek at Hawarden, Iowa.....	33
Big Sioux River at Akron, Iowa	34
Missouri River at Sioux City, Iowa	35
Perry Creek at 38th Street, Sioux City, Iowa ...	36
Floyd River at Merrill, Iowa	37
Floyd River at James, Iowa.....	38
Omaha Creek at Homer, Nebr.....	39
Little Sioux River near Lakefield, Minn.....	40
Jackson County ditch 11 near Lakefield, Minn..	41
Spirit Lake near Orleans, Iowa	42
Okoboji Lake at Lakeside Laboratory, near	
Milford, Iowa.....	43
Little Sioux River near Cherokee, Iowa	44
Mill Creek near Cherokee, Iowa.....	45
Little Sioux River at Correctionville, Iowa.....	46
Little Sioux River near Kennebec, Iowa	47
Maple River at Mapleton, Iowa.....	48
Little Sioux River near Turin, Iowa	49

	Page
Stages and discharges at stream-gaging stations-- Continued	
West Fork ditch at Holly Springs, Iowa.....	50
Monona-Harrison ditch near Turin, Iowa	51
Missouri River at Omaha, Nebr	52
Summary of flood stages and discharges.....	53
Flood-crest stages	57
Records of previous floods.....	63
Selected bibliography	65
Index.....	67

ILLUSTRATIONS

PLATE	1. Map of area flooded by Floyd River and major tributaries upstream from Sioux City, Iowa	In pocket
	2. Map showing location of flood-determination points	In pocket
FIGURE	1. Map showing area covered by report and area of intense flooding.....	3
	2. Isohyetal map showing precipitation during storm of June 7, 1953, in northwest Iowa.....	5
	3. Cumulative rainfall at eleven Iowa weather stations, June 7, 1953	6
	4. Map of area flooded at Sioux City, Iowa...	8
	5. Thick mud deposits left in suburban Leeds by Floyd River.....	9
	6. Main freight yards at Sioux City, Iowa, flooded by Floyd River	10
	7. View of stockyards at Sioux City, Iowa, after Floyd River flood.....	11
	8. Aerial view of Spencer, Iowa, showing Grand Avenue, the main street, closed by flood.....	14
	9. Graph of discharge for Floyd River at James, Iowa	21
	10. Graphs of discharge at selected gaging stations in flood area	22
	11. Relation of unit discharge to size of drainage basin.....	56
	12. Map showing location of flood-crest determinations in Little Sioux River basin.....	59

TABLES

	Page
TABLE 1. Summary of damages caused by June 1953 flood in Floyd River basin.....	17
2. Summary of flood stages and discharges..	54
3. Flood-crest stages, West Fork Des Moines River	58
4. Flood-crest stages, Big Sioux River basin..	60
5. Flood-crest stages, Floyd River	60
6. Flood-crest stages for Floyd River in Sioux City area	61
7. Flood-crest stages, Little Sioux River basin.....	61

FLOODS OF 1953

FLOODS OF JUNE 1953 IN NORTHWESTERN IOWA

ABSTRACT

The floods of June 1953 in northwest Iowa and adjacent areas were the greatest known since settlement of the area. For a few small drainage basins within the flooded area, peak discharges of the June floods may have been exceeded by peaks of previous floods, but the magnitude and areal extent of the June floods is unmatched. The estimated damages in the Floyd River basin, alone, were \$25,945,000, of which \$23,395,000 were from Sioux City. Fourteen deaths were caused by the flood in the Sioux City area. Outstanding features of the flood were the rapid movement of the flood crest in the Floyd River basin and the magnitude of both peak and volume throughout the flooded area.

The floods were caused by heavy rainfall on June 7 for 16 hours, with an intense downpour during the afternoon over an area where rainfall prior to June 7 had been very light. Between Hawarden and Lake Park, Iowa, the rain generally exceeded 7 inches, with a few unofficial measurements of 11 inches; the last rain before the great storm was on June 3 when less than 1 inch of rain fell.

In response to the heavy rain, tributaries of the Big Sioux River, Floyd River, Little Sioux River, Des Moines River, and Blue Earth River began to rise rapidly on June 7 and flooding on the main streams of the area followed. Movement of the flood crests was rapid on the Floyd River and flood stages and discharges throughout the flood area generally exceeded the previously known maxima. Elevations of the flood crests were determined at many points along the main streams, mainly by the Corps of Engineers and the Iowa Natural Resources Council, and were made available to the Geological Survey for inclusion in this report. A description of previous floods indicates that the flood of May 1892 was the greatest known flood on Floyd River prior to the greater flood of June 1953; other floods occurred in 1900, 1926, and 1934.

INTRODUCTION

A great storm, with heavy rainfall over a large area, centered over the northwest corner of Iowa on June 7, 1953. A few reliable, unofficial measurements of the storm precipitation totaled as much as 11 inches, with several official Weather Bureau measurements of 7 inches or more. Recording rain gages showed that rain began about 6 a. m. and stopped about 10 p. m., with a heavy downpour from 2 to 9 p. m. All streams in the area of heavy rainfall rose rapidly to unprecedented stages and discharges.

The Geological Survey in cooperation with other agencies operates 25 stream-measurement stations in the flood area and maintains 10 crest-stage gages--simple devices for recording high-water marks--in cooperation with the Iowa State Highway Commission, Highway Research Board; at these gages the peak stage and discharge of all floods are determined for use in studies of flood frequency and for basic information on the runoff characteristics of small drainage areas. After the flood of June 1953 in northwest Iowa, the Geological Survey collected data supplementary to that listed above, on peak discharges at miscellaneous ungaged sites.

Information and data collected by the Corps of Engineers of the Department of the Army, the Iowa Natural Resources Council, the Weather Bureau, the city engineering department of Sioux City, and the River Study Committee of Spencer, Iowa, are incorporated in this report. The Corps of Engineers sent men into the flooded area immediately after the flood to record statistics on flood damage, to collect supplemental data on rainfall, to mark high-water elevations along the streams at points that define the flood profile, and to determine the peak discharges from ungaged areas in the Floyd River basin supplementary to the work of the Geological Survey. The Omaha district office of the Corps of Engineers operates a stream-measuring station on Little Sioux River near Cherokee, Iowa, and one on Mill Creek near Cherokee.

Personnel of the Iowa Natural Resources Council set many flood-crest markers at important towns or highway crossings after the June flood. The United States Weather Bureau published a brief account of the meteorology, rainfall, and resulting flood associated with the storm of June 7 in the June 1953 issue of Climatological Data. The U. S. Weather Bureau maintains a river-stage station on the Floyd River at Merrill, Iowa, and gage readings from this station for June 7-12, with an isohyetal map prepared by the Weather Bureau are included in this report. The engineering department of Sioux City determined several high-water elevations within the city limits. This report also contains hydraulic and hydrologic data useful in the design of projects for which flood stages and discharges are a consideration. The data on stages and discharges are presented in greater detail than

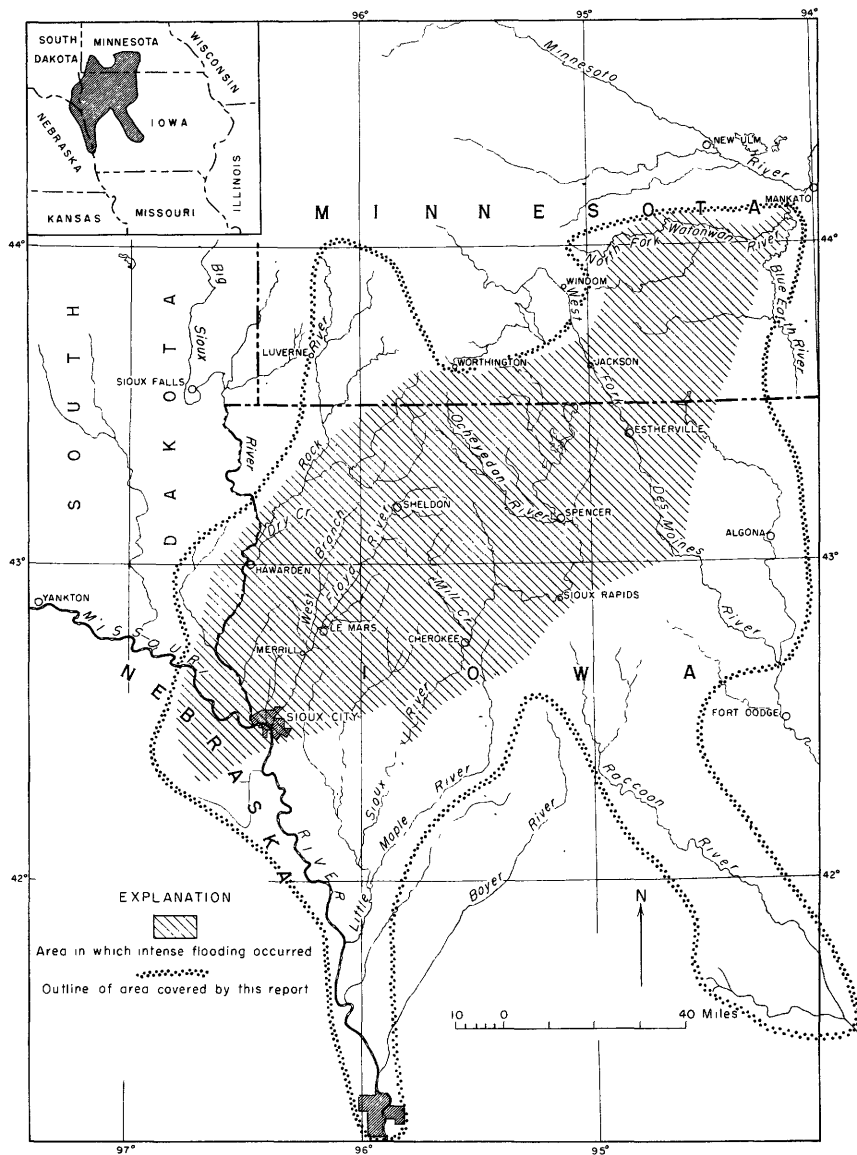


Figure 1.--Map showing area covered by the report and area of intense flooding during June 1953.

in reports of the annual series, Surface-Water Supply of the United States. The map in figure 1 outlines the area included in this report and the area in which intense flooding occurred.

GENERAL DESCRIPTION OF THE FLOODS

THE STORM

In the June 1953 Climatological Data, the U. S. Weather Bureau published this concise description of the storm:

"On the 7th of June 1953, a disturbance began to intensify over northeastern Colorado and during the afternoon and evening hours moved rapidly northeastward to southeastern Minnesota. As the storm center moved northeastward, the associated warm front moved slowly northward across Iowa. Heavy rains occurred over northwestern Iowa, with the axis of maximum fall extending from Hawarden to Lake Park. Along the axis, precipitation in excess of 7 inches was general, with the peak amounts occurring over northwestern O'Brien County where Sheldon reported an official measurement of 8.58 inches in approximately 14 hours and where unofficial falls of 11.00 and 10.75 inches were measured at Ritter. Flooding from creeks and rivers was general over the northwestern counties, with many localities reporting the most severe flooding within local history."

Figure 2, an isohyetal map of the storm prepared by the Weather Bureau from all reliable data, shows that the area of heavy rainfall extended from near Sioux City, Iowa, to New Ulm, Minn., with an average width of about 50 miles. Heaviest rainfall occurred in the headwaters of Otter Creek, Floyd River, and Little Sioux River. The time distribution of the rainfall is shown on figure 3, a plot of cumulative rainfall measured at 11 recording rain gages. Recording rain gages showed that 2.47 inches of rain fell between 2 and 3 p. m. near Hawarden, and 2.18 inches fell between 6 and 7 p. m. at Remsen. No rain fell on June 8.

Antecedent precipitation was light and probably was not an important factor in the storm runoff. Rainfall in northwest Iowa in May was less than average. On June 3 the area received less than 1 inch of rain, and there was no increase in discharge at any of the stream-measurement stations. Because the initial amounts of rain falling June 7 had to satisfy deficiencies in the soil moisture, it is doubtful if there was significant runoff before about 2 p. m.

High winds accompanied the storm in the vicinity of Spencer, Iowa. Trees were uprooted, storefronts blown in, and high waves on Spirit Lake and Okoboji Lake smashed docks and other recreation installations. Two tornadoes during the storm were reported.

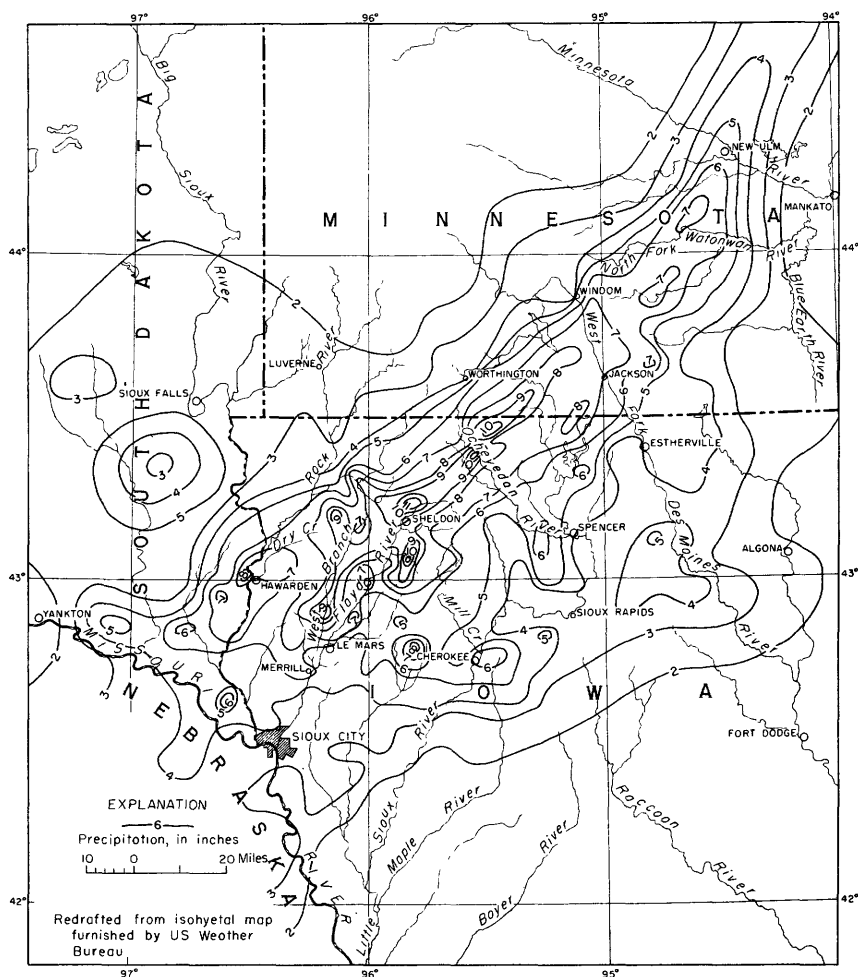


Figure 2.--Isohyetal map showing precipitation during the storm of June 7, 1953, in northwest Iowa.

THE FLOODS

The heavy rain caused all small streams of the flooded area (fig. 1) to rise to unprecedented stages and discharges by late afternoon of June 7. The first towns flooded by overflowing streams were Hawarden, Sioux Center, Alton, Sheldon, and Sibley. The business district of Hawarden was flooded by Dry Creek early on the evening of June 7, and total damages to stocks and structures was estimated to be about \$100,000. Inability of the storm sewers to carry off the local runoff caused major flooding of basements at Sheldon.

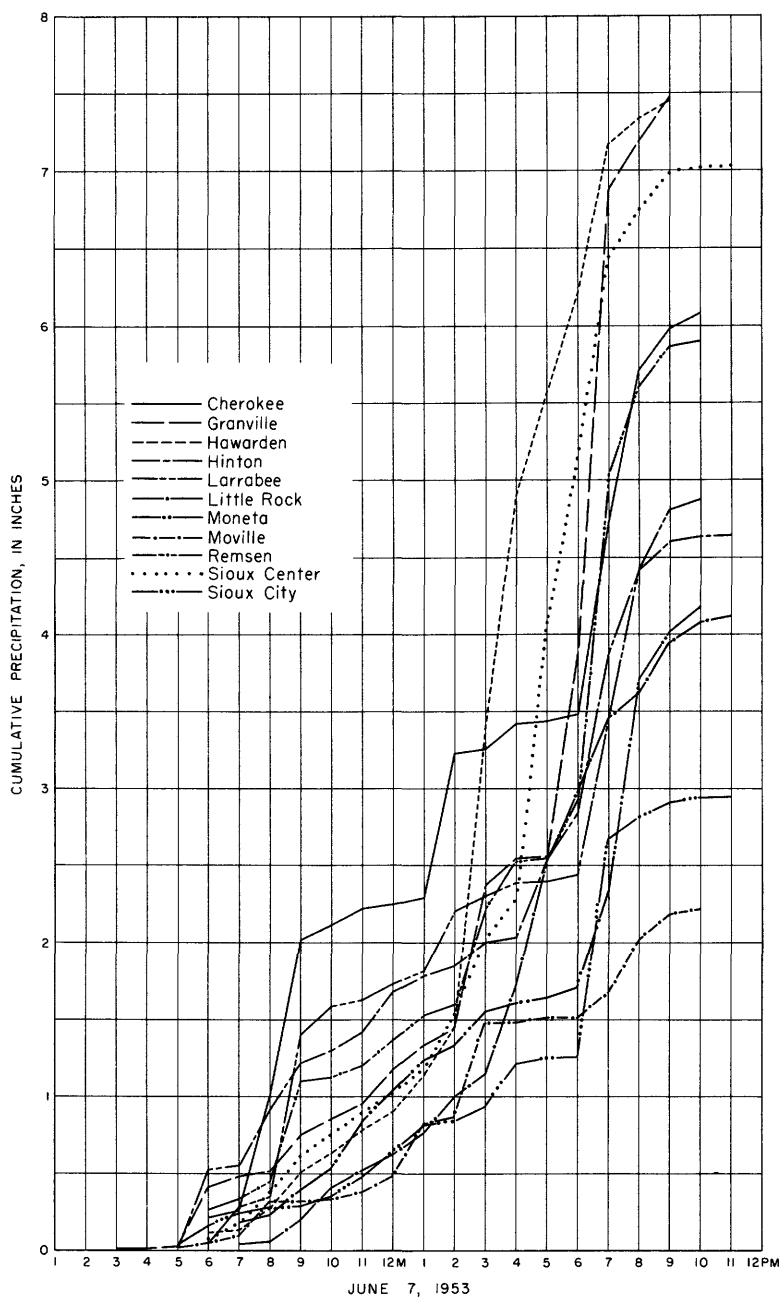


Figure 3.--Cumulative rainfall at eleven Iowa weather stations, June 7, 1953.

The flood on Floyd River was the most severe ever experienced in the basin. At 7 a. m. on June 8 the flood crest reached Merrill, just downstream from the junction of West Branch with Floyd River (pl. 1). The crest passed the gage of the Geological Survey at James at 12:30 p. m. and reached the mouth of the Floyd at Sioux City about 5 p. m. Although reports of the heavy rain in the headwaters of Floyd River had been received in Sioux City, the flood threat to the city was not recognized until about 10 a. m. on June 8, when word was received that the northeast suburbs were being flooded.

The Leeds area of Sioux City, shown on figure 4, was flooded about 10 a. m., June 8, and the business district and many residential blocks were covered with about 5 feet of water at time of the crest. Leeds was essentially a backwater area so damage was limited to immersion and silting. The floodwaters left thick mud deposits in the slack-water areas; figure 5 shows the Leeds business district after the flood had receded.

The Springdale section of Sioux City was inundated about 10:30 a. m., and water began ponding between the Floyd River levees and the left edge of the valley. Many large warehouses located along United States Highway No. 75 were flooded and costly stocks were damaged. The Floyd River channel through Sioux City had been straightened, enlarged, and leveed many years before 1953. When the levees were overtopped about noon of June 8, the river flowed through the entire valley; in some places the main channel carried the majority of the flow, in others the main flow left the channel and flowed across the valley floor causing serious scour. From Grand Avenue to the Floyd River mouth the main channel is lined with concrete and designed for a carrying capacity of 25,000 to 30,000 cfs, but is estimated to have been effective for about 17,000 cfs during the June flood. The river cut across the bend at Fifth Street and the greater part of the flow went through the railway yards that parallel the Grand Avenue viaduct. Figure 6 shows the appearance of the freight yards after the flood had receded a few feet. In the stockyards the overflow scoured a hole through the railroad tracks leaving many freight cars in a tangled mass (fig. 7). Owing to prompt action in moving them, only a few cattle were lost in the stockyards. From Fourth Street to the Missouri River the Floyd River spread out laterally westward at the crest to reach nearly to the Perry Creek channel, flooding the City Auditorium and main business district.

Fourteen people were drowned in Sioux City although adequate warnings of the flood were given. Many of those drowned had stayed in their homes during previous floods and thought the June 1953 flood would be no higher than the others. The flood reached the ridgepole of many homes in the lowest parts of the flood plain.



Figure 5. --Thick mud deposits left by the Floyd River in suburban Leeds. Photograph by George Newman, Sioux City, Iowa.



Figure 6. --Main freight yards at Sioux City, Iowa, flooded by the Floyd River. Photograph by George Newman, Sioux City, Iowa.



Figure 7. --View of stockyards at Sioux City, Iowa, after the Floyd River flood. Note the tangled mass of freight cars in the foreground.
Photograph by George Newman, Sioux City, Iowa.

Flood damage to the homes, stores, factories, warehouses, stockyards, and railway equipment within Sioux City was high. The Corps of Engineers have estimated the total damages in Sioux City as \$23,395,000. The flood water receded so that the flow was confined to the stream channels by June 9, and extended, expensive cleanup operations began. Tons of debris and silt were removed from the flood area. The bridge on United States Highway 75 near Second Street was destroyed by the flood. Much of the concrete channel lining collapsed when undermined by floodwaters returning to the channel during the recession. Highway traffic through the Sioux City flood area was resumed shortly after the recession began, but rail traffic was delayed several days until tracks could be cleared and repaired.

The Sioux City water-supply service was partially interrupted when the Lowell Street pumping plant was flooded. Storage in the city reservoir dropped to about $2\frac{1}{2}$ million gallons on June 11 compared to normal storage of 25 million gallons. Water was restricted to essential uses only, until the flooded pumps could be restored to operation. Gas service to Leeds and some other flooded suburban areas was interrupted for a few days because of broken mains. Telephone service between Sioux City and Morningside was interrupted for several days.

There was no shortage of food after the flood at Sioux City. The American Red Cross and other organizations aided many flood victims with food, shelter, and clothing. More than 300 families received rehabilitation assistance from the Red Cross. Emergency housing for flood victims was established by the Red Cross in the Trinity College buildings.

In the Floyd River basin upstream from Sioux City, flood damage to railways, highways, portions of towns located on the flood plain, and agricultural lands was variable. Few rural farmsteads are located in the Floyd flood plain; floods have occurred so frequently that the valley bottom has been left unoccupied. The towns of Alton, Le Mars, Merrill, and Hinton were partially flooded; damages at each have been estimated by the Corps of Engineers as \$14,000, \$35,000, \$11,000, and \$55,000, respectively. The Illinois Central, the Chicago, St. Paul, Minneapolis & Omaha, and the Great Northern Railway tracks are laid parallel to Floyd River or West Branch for many miles; flood damage to right-of-way was severe and took many days to repair. An eastbound passenger train on the Illinois Central was marooned by floodwaters at Le Mars on June 7 at 6:15 p. m.; the passengers were removed and sheltered in the town overnight. Traffic on the Illinois Central tracks was restored June 13 and on the Chicago, St. Paul, Minneapolis & Omaha tracks about June 25. The Floyd River flood was unusually damaging to highway crossings and bridges. For several days after the recession began, the only highway open across the Floyd

valley above Sioux City was the county road at the Geological Survey gage at James. Many bridges were almost completely destroyed, many bridges were left standing with no approach fill. United States Highway 75, which extends parallel to Floyd River from Sioux City to Le Mars, was submerged for many miles at time of flood crest; traffic was resumed on June 8, the damage amounting to scoured road shoulders at a few locations.

The damage to crops and farmland was not as severe as could have been expected. About 90 percent of the flooded area in the Floyd River basin, as shown on plate 1, is cropped. A large part of the valley floor is in pasture, which was not badly damaged by the flood. The corn crop, where not damaged by erosion, was, in most places, not injured by the short immersion during the flood. Some land was damaged by erosion and deposition. The damage to a farmstead located just east of the Geological Survey gage at James, if typical, indicates why so few farm homes are located on the flood plain. The farm house was flooded to a depth of about 4 feet, the contents of a large home freezer were ruined as was much of the furniture, a machine shed was destroyed, two relatively new automobiles were carried nearly half a mile down the valley, and all stored grains were spoiled. After the flood the owner moved his house and buildings about 1,000 feet east to the edge of the flood plain.

Peak flows from West Branch and from Floyd River must have reached the junction at Merrill at nearly the same time; the Geological Survey gage at James showed a single crest. Channel storage had some effect in lowering the crest discharges as the flood passed down the Floyd River. Highest unit discharges in the Floyd River basin occurred in the area of heavy rainfall in the headwater area; a unit discharge of 313 cfs per square mile was measured on Floyd River at Sheldon.

The rain in the headwaters of the Little Sioux River was accompanied by high winds, and two tornadoes were reported (p. 4). Waves, 6 feet high, damaged all shore structures on the west and south shores of Spirit Lake and Okoboji Lake north of Spencer. Rainfall at Spencer was so intense the evening of June 7 that water stood knee deep in the main business district because the surface drainage and storm sewers were overloaded. Flooding on Little Sioux River above Spencer and on Ocheyedan River reached alltime highs. Ocheyedan River enters Little Sioux River at Spencer; the flood from Ocheyedan River reached Spencer on the morning of June 8 and the rise of floodwaters was rapid. At 10 a. m. no overflow was noted at Spencer; at noon the river was out of its banks and level with the pavement on Grand Avenue. The crest at Spencer is estimated to have occurred about 6:30 p. m. with overflow spread out from the left end of Grand Avenue bridge south to the Junction of highways 71



Figure 8.--Aerial view of Spencer, Iowa, showing Grand Avenue, the main street closed by the flood. Photograph by Spencer Daily Reporter.

and 18, with maximum depth of 3.5 feet on Grand Avenue at Seventh Street. Figure 8 shows appearance of the flood at Spencer near the time of crest. The crest at Spencer remained nearly stationary until 3 a. m. on June 9, the Little Sioux River above Spencer cresting later than the Ocheyedan. The overflow at Spencer drove 225 families from their homes, damaged business property along South Grand Avenue, and left much debris on public and private property. The flood of April 6, 1951, at Spencer was the highest known prior to June 8, 1953; the 1953 flood exceeded the 1951 flood by 3.58 feet at a measuring point at 700 West Fourth Street. Total flood damage at Spencer has been estimated as \$248,200.¹

No large towns are situated along the Little Sioux River between Spencer and Cherokee, and flood damage in this reach of channel was confined to agricultural land, bridges and highways, and low lying portions of the small towns of Gillett Grove, Sioux Rapids, and Peterson. At some low points between Spencer and Cherokee, the flooded area was more than a mile wide and was submerged for many hours because of the slow-traveling flood crest. Farmland and crops were damaged by immersion, erosion, and deposition.

At Cherokee there were two flood crests--one from Mill Creek on June 8, and the second from Little Sioux River on June 11. The later crest flooded the south and east parts of Cherokee but not to as great a depth as the great flood of June 1891.

The Little Sioux flood passed slowly down the river from Cherokee, cresting at Correctionville the afternoon of June 12 and closing U. S. Highway 20 to traffic when the bridge approaches were submerged. Flooding of farmland continued as the Little Sioux River rose to flood crest along the reach from Correctionville to the Missouri River. Below the mouth of West Fork ditch (west branch of the Little Sioux River), the crest of the main flood from Little Sioux River was lower than the initial flood brought down by the ditch.

At Jackson, Minn., the West Fork Des Moines River began to overflow about 7:30 p. m., June 7, and soon caused damaging flooding in residential and business districts. The flood forced about 100 people from their homes in the south part of Jackson. The powerplant, located on the river, had about 20 inches of water on the main floor. The crest came early in the morning of June 8 and was the worst ever reported for Jackson. The city water system was in danger of being contaminated, and for a few days during and after the flood the residents were asked to boil drinking water. The West Fork Des Moines flood was not severe at Windom, Minn., located upstream from Jackson.

At Estherville, Iowa, West Fork Des Moines River reached a record high stage in midafternoon of June 8 and the crest

¹Report No. 1, River Study Committee, Chamber of Commerce, Spencer, Iowa.

was prolonged. Sufficient warning of the flood was given so that an emergency dike could be constructed between the city light plant and the river. The floor of the light plant buckled because of hydrostatic pressure. About 15 houses were flooded.

At Emmetsburg, some basements were flooded when the West Fork Des Moines River crested. Damage by overflow to farmlands was largely limited to Emmet and Palo Alto Counties.

Little flooding occurred on East Fork Des Moines River.

Headwaters of the Raccoon River received moderately heavy rainfall during the storm on June 7. At the time the crest from the headwaters was near the middle of the Raccoon drainage basin on June 9, heavy rains centered over that area with some falls of 4 inches or more. The resulting minor flood soon covered farmland in Guthrie and Dallas Counties and reached Des Moines on June 12 causing flooding in residential areas. The Raccoon River flood did not cause serious overflows on the Des Moines River.

Tributaries of Blue Earth River in Minnesota, affected by the storm of June 7, rose rapidly to near-record stages and discharges. Watonwan River near Garden City reached a stage of 18.6 feet on June 9. The crest discharge on Blue Earth River near Rapidan was below the record high of 1951 but was the second highest for the period of record.

FLOOD DAMAGES

After the flood, the Corps of Engineers made a thorough survey of the Floyd River basin to collect statistics on flood damages. From this data, plate 1 and figure 4, maps of the area flooded during June 1953 in the Floyd River basin, have been prepared. Detailed estimates of the damage to agriculture and lands in the Floyd River basin were prepared and a block-by-block tabulation of statistics was made for Sioux City. Table 1 is a listing of the flood damages for the entire Floyd River basin. Following are some of the miscellaneous statistics collected by the Corps of Engineers from the Sioux City area:

Persons forced from homes by flood.....	4,620
Homes flooded	1,183
Homes destroyed by flood	137
Damage to homes and personal property, estimated.....	\$3,611,000
Retail business places flooded	337
Wholesale business places flooded.....	102
Manufacturing plants flooded	84

Damage to business places, estimated..	\$13,127,000
Loss in wages and profit, estimated.....	\$3,057,000
Damage to gas, electric, and telephone utilities, estimated	\$470,000
Damage to Floyd River flood control works (concrete channel lining and levees), estimated	\$2,114,000
Damage to city streets and municipal property, estimated	\$358,000
Minor miscellaneous damages and expense to welfare agencies	\$183,000

TABLE 1. --Summary of damages caused by June 1953 flood in Floyd River basin

[Furnished by Corps of Engineers]

Sub-area	Flood damages							
	Agricultural		Transportation			Urban	Other	Total
	Acres flooded	Damage	Rail-roads	High-ways	Bridges			
Sioux City.....	-----	\$43,000	\$475,000	-----	-----	\$22,877,000	-----	\$23,395,000
Floyd River above Sioux City.....	15,400	508,000	402,000	\$78,000	\$333,000	115,000	\$170,000	1,606,000
West Branch.....	7,640	224,000	17,000	23,000	8,000	0	0	272,000
Mink Creek.....	1,380	41,000	41,000	5,000	10,000	0	0	97,000
Plymouth Creek.....	330	17,000	0	1,000	1,000	0	0	19,000
Willow Creek.....	2,370	69,000	17,000	18,000	34,000	0	0	138,000
Deep Creek.....	2,450	73,000	38,000	15,000	54,000	0	0	180,000
Little Floyd River.	1,310	38,000	10,000	7,000	12,000	0	0	67,000
Secondary tribu- taries.....	15,400	171,000	-----	-----	-----	-----	-----	171,000
Total.....	46,280	\$1,184,000	\$1,000,000	\$147,000	\$452,000	\$22,992,000	\$170,000	\$25,945,000

The Soil Conservation Service made a detailed study of soil and erosion losses in the eleven northwest soil-conservation districts of Iowa. The following information has been abstracted from reports for the Little Sioux River basin:

Total crop losses, Cherokee and Wood-bury Counties	\$330,000
Additional loss, due to sedimentation	\$4,500

The overall study for eleven northwest counties indicated nearly \$600,000 damage to farm property, largely fences; nearly \$2,000,000 in crops lost owing to silt cover; about \$500,000 in crops covered by infertile overwash, such as sand and gravel; and direct water damage to crops along upper reaches of main streams of nearly \$2,000,000.

Statistics on flood damage in the Des Moines River basin are lacking.

Information on flood damage in the Blue Earth River basin, furnished by the Corps of Engineers, St. Paul, Minn., district is as follows:

<u>Item</u>	<u>Damage</u>
Crop damage on 22,540 acres flooded by direct stream overflow.....	\$162,400
Other agricultural damage (fences, farm buildings, weed infestation, and machinery).....	104,200
Indirect losses (loss of business in area, due to decreased crop production).....	35,700
Road and bridge damage	50,000
Urban damage:	
St. James, Minn	200,000
Garden City, Minn	6,000
Madelia, Minn	3,000
Butterfield, Minn	25,000
Other towns.....	16,000
Railroad damage	200,000
Total damage by streams.....	\$802,300
Additional damage caused by rainfall inundation and poor drainage	\$2,936,000

MEASUREMENT OF FLOOD DISCHARGES

The usual method of determining the discharge at gaging stations is by using a stage-discharge rating that is based on current-meter measurements. If the crest of a flood greatly exceeds the range of a previously established rating at a gaging station, it is necessary to determine the discharge at or near the crest in order to extend the stage-discharge rating. If, for various reasons, it is impossible to obtain a current-meter measurement at a gaging station during a flood, the peak discharge is determined by an indirect method such as the slope-area method, the contracted-opening method, or some other. Descriptions of these methods, as used by the Geological Survey for previous floods, are given in Water-Supply Papers 773-E, 796-G, 798, 799, 800, 810, 843, and 888.

During the flood, the peak discharge could not be obtained by the usual method at a few gaging stations. At these gaging stations and at crest-stage stations and miscellaneous ungaged sites, where the determination of peak discharge was required, indirect methods were used, mainly the slope-area and contracted-opening methods. Several peak discharges were computed by the modified method explained in Geological Survey Circular 284, "Computation of peak discharge at contractions."

In much of the flood area the peak discharges from small drainage areas occurred shortly after the heaviest rainfall, and rain continued after the flood crest. Many high-water marks on the ground were washed away by the continuing rain, and the lack of numerous marks made the surveying of slope area or other type observation difficult. Sufficient reliable marks were found by diligent search on the part of engineers of the Geological Survey who reached the flood area on June 8 and began collecting the field data for the observations. For Floyd River at James, an engineer of the Geological Survey was at the site at time of crest, marking the high-water marks for future reference. The quality of field data used in the computation of peak discharges was good and the results are reliable.

STAGES AND DISCHARGES AT STREAM-GAGING STATIONS

EXPLANATION OF DATA

The records collected at each gaging station consist of: a record of gage heights, either as recorded by an observer, or from the trace of an automatic water-stage recorder; observations of discharge, usually by current-meter measurements, for occasional high floods by indirect methods; and general information useful in computing the record of daily flow from the records of discharge observations and gage heights.

The data tabulated on the following pages for each stream-gaging station operated by the Geological Survey consist of: a station description, a table of daily mean discharges for May and June 1953, and a tabulation of gage heights and discharges for intervals during days of rapidly changing stage and discharge. The gage heights and discharges for intervals of a day are given in sufficient detail to allow accurate reproduction of the flood hydrograph. The records furnished by the Corps of Engineers for two gaging stations consist of a station description and stages and discharges for intervals of days defining the flood hydrograph only.

The station description includes information on the type, location, datum, drainage area above gage, gage-height and discharge records, and current and previous flood maxima. The information on gage-height and discharge records includes details on the methods used to define the gage heights, the basis for the rating curve used during the flood period, and mention of periods for which shifting-control methods were used.

Daily mean discharges for May and June 1953 are tabulated below the station description. The period May-June 1953

includes ample data on the antecedent streamflow, the rise resulting from heavy rains of June 7, and the recession to completely define the flood hydrograph. Volume for runoff is given in both acre-feet and depth in inches over the drainage basin. Figures 9 and 10 show the hydrographs for selected stream-gaging stations for the flood caused by the rain of June 7.

Following the table of daily mean discharge is a tabulation of gage heights and discharges for selected intervals of a day. Central standard time is the basis throughout. The interval used for listing of information was selected to allow full definition of the hydrograph without inclusion of unnecessary data. Data for each station are generally listed from June 7 until the recession can be well defined by the daily mean discharges. For a few records, gage heights and discharges at intervals of a day have been listed for other than the period following June 7; this has been done to show the details of minor rises outside the major flood period reported on.

Only records for stream-gaging stations in or adjacent to the flood area are given. The report contains discharge records from two major river basins, the upper Mississippi and the Missouri. These two river basins are Parts 5 and 6, respectively, of the series of annual reports entitled "Surface Water Supply of the United States." The new downstream order of listing the records (in effect starting with the 1951 annual reports) has been used. Thus, the first record appearing in this report is for Blue Earth River near Rapidan, Minn., followed by that for West Fork Des Moines River at Jackson, Minn.

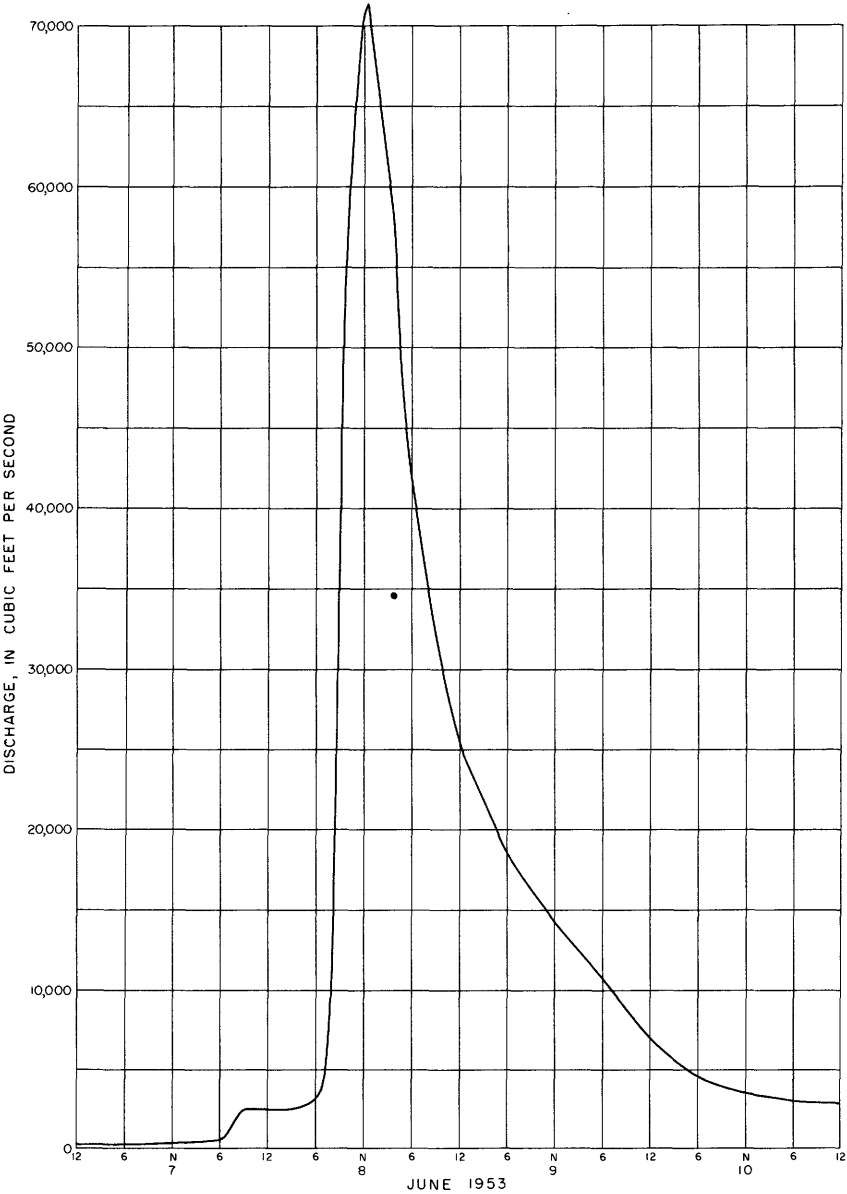


Figure 9.--Graph of discharge for the Floyd River at James, Iowa, June 7-10, 1953.

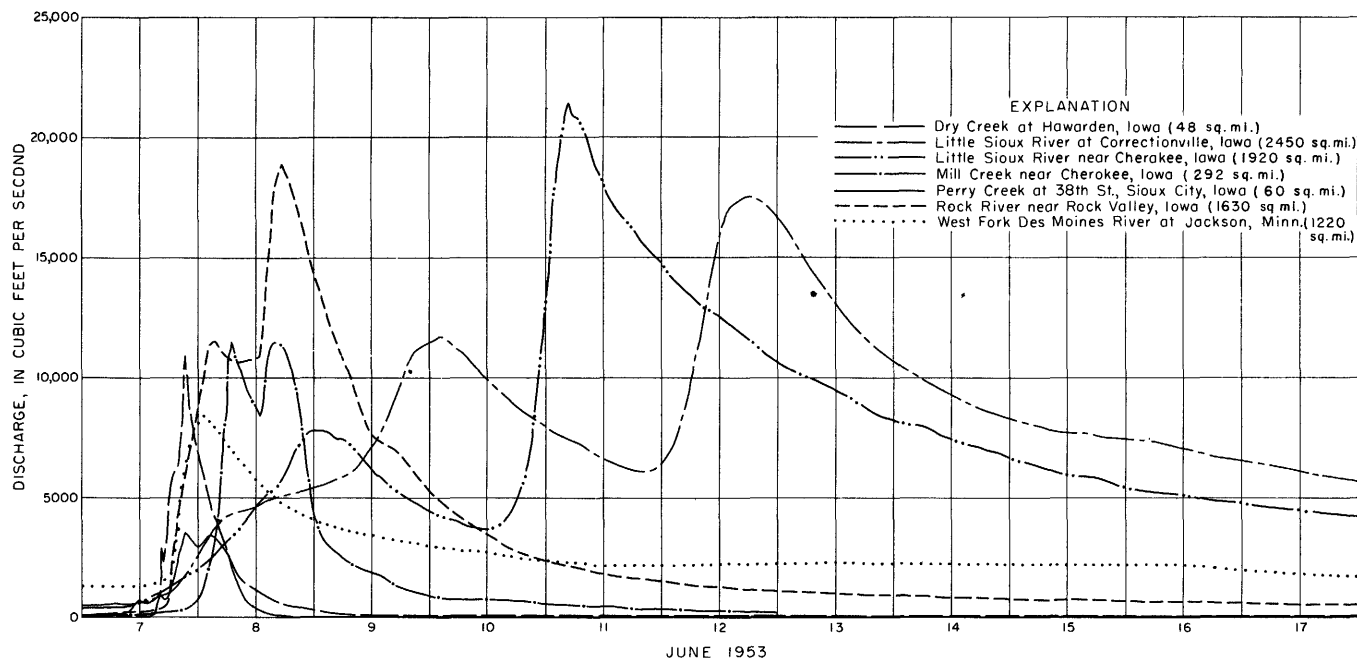


Figure 10. --Graphs of discharge at selected gaging stations in flood area, June 7-17, 1953.

BLUE EARTH RIVER NEAR RAPIDAN, MINN.

Location. --Lat 44°05'44", long. 94°06'33", in SE 1/4 SE 1/4 sec. 6, T. 107 N., R. 27 W., on left bank, 0.2 mile downstream from Northern States Power Co. power plant, 2 miles west of Rapidan, 3 1/2 miles downstream from Watonwan River, and 7-3/4 miles upstream from Le Sueur River.

Drainage area. --2,430 sq mi, approximately.

Gage-height record. --Water-stage recorder graph.

Discharge record. --Stage-discharge relation defined by current-meter measurements.

Maxima. --May-June 1953: Discharge, 19,700 cfs 9 p. m. June 9 (gage height, 12.91 ft), 1909-10, 1939-45, 1949 to April 1953: Discharge, 26,100 cfs Apr. 8, 1951 (gage height, 14.97 ft), from rating curve extended above 16,000 cfs by logarithmic plotting.

Remarks. --Flow regulated by Rapidan Reservoir (capacity 2,980 acre-ft).

Mean discharge, in cubic feet per second, 1953

Day	May	June	Day	May	June	Day	May	June
1	2,130	4,160	11	1,730	11,200	21	814	2,450
2	2,650	3,450	12	1,620	10,800	22	830	1,990
3	3,170	3,130	13	1,580	9,190	23	762	1,840
4	3,170	2,670	14	1,340	7,000	24	797	1,540
5	3,040	2,430	15	1,210	5,650	25	4,890	1,620
6	2,670	2,180	16	1,150	4,660	26	5,850	1,460
7	2,450	2,140	17	966	4,020	27	6,170	1,640
8	2,130	3,680	18	998	3,590	28	7,140	1,540
9	2,010	15,000	19	886	3,100	29	6,030	1,740
10	1,680	15,300	20	926	2,480	30	5,250	1,540
						31	4,900	-----
Monthly mean discharge, in cubic feet per second.....							2,611	4,440
Runoff, in acre-feet.....							160,500	264,200
Runoff, in inches.....							1.24	2.04

Gage height, in feet, and discharge, in cubic feet per second, at indicated time, 1953

Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge
	May 24										
6	2.95	830	6	6.34	4,910	9	4.62	2,490	1	12.21	17,600
N	2.83	741	9	6.52	5,200	12	4.56	2,420	2	12.42	18,300
6	2.83	741	N	7.22	6,410		June 8		3	12.70	19,100
9	2.83	741	3	7.52	6,950	3	4.56	2,420	4	12.86	19,600
11	2.86	762	4	7.98	7,800	6	4.58	2,450	5	12.79	19,400
12	4.00	1,770	6	7.80	7,460	8	4.62	2,490	6	12.84	19,500
	May 25		9	7.68	7,230	9	5.48	3,600	9	12.91	19,700
1	5.53	3,670	12	7.56	7,020	10	5.73	3,960	12	12.73	19,200
2	6.18	4,660		May 28		11	6.00	4,370		June 10	
3	6.39	4,990	6	7.63	7,140	N	5.98	4,340	3	12.38	18,100
6	6.30	4,850	N	7.84	7,540	3	5.88	4,190	6	12.05	17,200
N	6.20	4,690	6	7.59	7,070	6	5.85	4,140	9	11.69	16,100
6	6.17	4,640	12	7.31	6,570	9	5.95	4,300	N	11.34	15,100
8	6.30	4,850		May 30		10	6.55	5,250	3	10.98	14,200
9	6.84	5,740	6	6.74	5,570	12	6.65	5,420	4	10.92	14,100
10	7.39	6,710	8	6.71	5,520		June 9		5	10.50	13,000
12	7.32	6,590	9	6.11	4,550	2	6.87	5,790	6	10.54	13,100
	May 26		10	5.34	3,410	3	8.22	8,260	9	10.37	12,700
6	7.21	6,390	11	6.23	4,740	4	9.02	9,790	12	10.17	12,300
N	6.98	5,980	N	6.27	4,800	5	9.01	9,770		June 11	
3	6.65	5,420	6	6.41	5,030	6	9.09	9,930	3	9.88	11,600
6	6.65	5,420	12	7.11	6,210	7	10.00	11,800	6	9.50	10,800
9	6.45	5,090		June 7		8	10.49	13,000	9	9.65	11,100
12	6.47	5,120	6	4.26	2,060	9	10.98	14,200	N	9.68	11,100
	May 27		N	4.10	1,880	10	11.24	14,900	6	9.62	11,000
3	6.25	4,770	3	4.10	1,880	11	11.77	16,300	12	9.59	10,900
			6	4.65	2,530	N	11.90	16,700			

WEST FORK DES MOINES RIVER AT JACKSON, MINN.

Location. --Lat 43°37'10", long. 94°59'10", in SW 1/4 sec. 24, T. 102 N., R. 35 W., on right bank in Jackson, 200 ft downstream from dam at power plant. Datum of gage is 1,287.75 ft above mean sea level, datum of 1929.

Drainage area. --1,220 sq mi, approximately.

Gage-height record. --Water-stage recorder graph except for periods 9:15 p. m. June 7 to 8:25 a. m.

June 10 for which graph was drawn based on three inside staff gage readings, floodmark, and adjoining portions of the recorder graph, and June 19-30 when gage heights were partly estimated on basis of pen trace and outside staff gage readings

Discharge record. --Stage-discharge relation defined by current-meter measurements below 3,600 cfs and extended above on basis of contracted opening determinations of peak flow.

Maxima. --May-June 1953: Discharge, 8,360 cfs 1:30 a. m. June 8 (gage height, 17.43 ft, from floodmark), by contracted-opening measurement.

1909-13, 1930 to April 1953: Discharge, 4,380 cfs Apr. 10, 1951 (gage height, 14.73 ft).

Remarks. --Flood flow not materially affected by artificial or natural storage. Low and medium flows affected by storage in Yankton, Long, Shetek, and Heron Lakes.

Mean discharge, in cubic feet per second, 1953

Day	May	June	Day	May	June	Day	May	June
1	716	2,480	11	814	2,260	21	576	1,370
2	794	2,300	12	827	2,220	22	494	1,230
3	825	1,970	13	734	2,260	23	456	1,150
4	859	1,790	14	649	2,240	24	449	1,070
5	895	1,610	15	639	2,160	25	1,510	1,090
6	903	1,420	16	616	2,000	26	2,690	981
7	898	2,270	17	579	1,830	27	2,610	1,070
8	887	6,020	18	546	1,670	28	1,820	1,110
9	851	3,490	19	522	1,510	29	2,130	1,050
10	827	2,680	20	532	1,400	30	2,500	966
						31	2,620	-----

Monthly mean discharge, in cubic feet per second.....	1,057	1,884
Runoff, in acre-feet.....	64,990	112,100
Runoff, in inches.....	1.00	1.72

Gage height, in feet, and discharge, in cubic feet per second, at indicated time, 1953

Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge
		May 24			May 27			May 31			
6	5.56	441	3	12.58	3,030	N	11.82	2,630	9	14.52	4,400
N	5.54	437	6	12.38	2,920	12	11.75	2,600	12	14.20	4,140
6	5.53	434	9	12.16	2,800			June 6	3	13.93	3,920
9	5.50	427	N	11.86	2,650	12	8.81	1,320	6	13.69	3,730
12	6.29	622	3	11.54	2,490			June 7	9	13.48	3,580
		May 25	6	11.18	2,320	3	8.77	1,310	N	13.29	3,440
3	7.60	960	9	10.80	2,140	6	8.67	1,280	3	13.10	3,320
6	8.58	1,250	12	10.48	2,000	9	8.63	1,270	6	12.92	3,220
9	9.13	1,430			May 28	N	8.69	1,290	9	12.74	3,120
N	9.54	1,580	3	10.18	1,870	3	9.11	1,420	12	12.57	3,020
3	9.84	1,710	6	9.96	1,770	6	9.51	1,570			June 10
6	10.16	1,860	9	9.79	1,690	7	10.84	2,160	3	12.39	2,920
9	10.42	1,970	N	9.91	1,740	8	13.25	3,420	6	12.23	2,840
12	10.64	2,070	3	10.07	1,820	9	15.63	5,660	9	12.06	2,750
		May 26	6	10.12	1,840	10	16.48	6,930	N	11.89	2,660
3	11.00	2,240	9	10.15	1,850	11	16.90	7,560	3	11.73	2,580
6	11.33	2,380	12	10.20	1,880	12	17.21	8,020	6	11.58	2,510
9	11.69	2,560			May 29			June 8	9	11.44	2,440
N	12.05	2,740	6	10.48	2,000	1:30	17.43	8,360	12	11.33	2,380
3	12.38	2,920	N	10.80	2,140	3	17.28	8,130			June 11
6	12.59	3,030	6	11.05	2,260	6	16.70	7,260	6	11.14	2,300
9	12.70	3,100	12	11.27	2,360	9	16.20	6,510	N	11.03	2,250
11	12.71	3,100			May 30	N	15.73	5,800	6	10.95	2,210
12	12.69	3,090	N	11.60	2,520	3	15.28	5,150	12	10.94	2,210
			12	11.78	2,610	6	14.88	4,700			

WEST FORK DES MOINES RIVER AT ESTHERVILLE, IOWA

Location. --Lat 43°24'00", long. 94°50'45", in SE 1/4 SW 1/4 sec. 10, T. 99 N., R. 34 W., on right bank in city park, 1,200 ft downstream from bridge on State Route 9 at Estherville, and 2.5 miles upstream from Brown Creek.

Drainage area. --1,408 sq mi.

Gage-height record. --Water-stage recorder graph.

Discharge record. --Stage-discharge relation defined by current-meter measurements.

Maxima. --May-June 1953: Discharge, 10,800 cfs 2-4 p. m. June 8; gage height, 15.53 ft 3 p. m.

June 8.

1951 to April 1953: Discharge, 4,880 cfs Apr. 6, 1952 (gage height, 11.82 ft).

Mean discharge, in cubic feet per second, 1953

Day	May	June	Day	May	June	Day	May	June
1	849	2,600	11	882	3,120	21	634	1,500
2	948	2,500	12	882	2,650	22	602	1,400
3	1,010	2,260	13	832	2,500	23	552	1,290
4	1,010	2,020	14	734	2,500	24	502	1,180
5	1,010	1,820	15	684	2,400	25	708	1,150
6	1,010	1,660	16	668	2,260	26	1,510	1,050
7	981	1,660	17	651	2,100	27	2,420	1,080
8	981	7,560	18	602	1,940	28	2,600	1,220
9	915	6,420	19	568	1,780	29	2,020	1,180
10	915	4,060	20	568	1,660	30	2,140	1,050
						31	2,450	-----
Monthly mean discharge, in cubic feet per second,.....							1,059	2,252
Runoff, in acre-feet,.....							65,130	134,000
Runoff, in inches,.....							0.87	1.78

Gage height, in feet, and discharge, in cubic feet per second, at indicated time, 1953

Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge
		May 25	6	8.20	2,400			June 8	11	14.62	9,180
3	3.04	502	12	7.72	2,180	1	8.27	2,450	12	14.47	9,000
6	3.04	502			May 29	2	8.49	2,550			
9	3.09	519	6	7.35	2,060	3	8.72	2,650	1	14.32	8,640
N	3.36	602	N	7.18	1,980	4	8.93	2,750	3	13.97	8,100
3	3.82	750	4	7.15	1,980	5	9.28	2,980	6	13.50	7,300
6	4.35	915	12	7.25	1,980	6	9.92	3,380	9	13.07	6,740
9	4.72	1,050			May 30	7	11.06	4,400	N	12.66	6,210
12	5.05	1,150	6a	7.40	2,060	8	12.40	5,830	3	12.32	5,710
		May 26	6p	7.81	2,220	9	13.52	7,300	6	11.99	5,350
6	5.57	1,360			June 7	10	14.37	8,820	9	11.72	5,020
N	5.99	1,500	1	6.09	1,540	11	14.83	9,540	12	11.47	4,800
6	6.43	1,660	6	5.96	1,500	N	15.22	10,300			June 10
12	6.92	1,860	9	5.93	1,460	1	15.42	10,600	6	11.03	4,300
		May 27	N	6.09	1,540	2	15.52	10,800	N	10.68	4,030
6	7.57	2,140	2	6.28	1,620	3	15.53	10,800	6	10.37	3,770
N	8.32	2,450	6	6.49	1,700	4	15.49	10,800	12	10.12	3,530
6	8.90	2,750	8	6.57	1,740	5	15.42	10,600			June 11
12	9.12	2,860	9	7.40	2,060	6	15.31	10,400	6a	9.77	3,310
		May 28	10	7.73	2,180	7	15.19	10,300	6p	9.25	2,920
1	9.12	2,860	11	7.87	2,260	8	15.07	10,100			June 12
6	8.99	2,800	12	8.03	2,300	9	14.92	9,720	6a	8.83	2,700
N	8.69	2,650				10	14.77	9,540	6p	8.57	2,600

EAST FORK DES MOINES RIVER NEAR BURT, IOWA

Location. --Lat $43^{\circ}12'30''$, long. $94^{\circ}10'30''$, in NW 1/4 NE 1/4 sec. 20, T. 97 N., R. 28 W., on right bank, 30 ft downstream from highway bridge, 0.8 mile upstream from Buffalo Creek, 2.5 miles north-east of Burt, and 4 miles downstream from Mud Creek.

Drainage area. --466 sq mi.

Gage-height record. --Water-stage recorder graph.

Discharge record. --Stage-discharge relation defined by current-meter measurements. Shifting-control method used May 2-8.

Maxima. --May-June 1953: Discharge, 1,060 cfs 5 a. m. June 13 (gage height, 10.36 ft). 1951 to April 1953: Discharge, 1,680 cfs Mar. 31, 1952 (gage height, 11.42 ft).

Mean discharge, in cubic feet per second, 1953

Day	May	June	Day	May	June	Day	May	June
1	286	120	11	378	900	21	190	625
2	364	120	12	357	1,020	22	185	550
3	425	128	13	315	1,060	23	196	477
4	450	128	14	287	1,020	24	196	428
5	450	124	15	280	965	25	196	392
6	444	120	16	256	920	26	180	364
7	436	128	17	232	860	27	168	357
8	413	406	18	220	805	28	163	392
9	385	696	19	208	745	29	153	392
10	343	819	20	196	688	30	138	371
						31	124	
Monthly mean discharge, in cubic feet per second.....							278	537
Runoff, in acre-feet.....							17,090	31,970
Runoff, in inches.....							0.69	1.29

Gage height, in feet, and discharge, in cubic feet per second, at indicated time, 1953

Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge
	June 7		4	6.65	238	6	8.66	531	N	9.40	700
6	5.51	115	6	6.97	274	8	8.78	560	6	9.53	745
N	5.58	124	8	7.36	329	10	8.88	580	12	9.64	775
6	5.71	133	10	7.71	378	12	8.98	600			
12	6.12	174	N	8.02	420				N	9.81	820
	June 8		2	8.30	468	6	9.22	650	12	9.91	860
2	6.37	202	4	8.50	504						

EAST FORK DES MOINES RIVER NEAR HARDY, IOWA

Location.--Lat 42°48'10", long. 94°08'00", in NW 1/4 NE 1/4 sec. 10, T. 92 N., R. 28 W., near center of span on downstream side of highway bridge, 4 1/2 miles west of Hardy, 6 miles northeast of Dakota City, 7 1/2 miles downstream from Lotts Creek, and 12 miles upstream from mouth.

Drainage area. --1,230 sq mi, approximately.

Gage-height record. --Graph based on once- or twice-daily wire-weight gage readings June 7-9. Daily wire-weight gage readings for all other periods.

Discharge record. --Stage-discharge relation defined by current-meter measurements. Shifting-control method used June 16-30.

Maxima. --May-June 1953: Discharge, 1,340 cfs 8 p.m. June 9, (gage height, 7.33 ft from graph based on gage readings).

1940 to April 1953: Discharge, 13,000 cfs June 23, 1947 (gage height, 15.4 ft).

Mean discharge, in cubic feet per second, 1953

[illegible]

Gage height, in feet, and discharge, in cubic feet per second, at indicated time, 1953

Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge
		June 6	6	3.67	308	10	6.90	1,180	8	7.33	1,340
12	3.53	286	8	3.70	318	12	6.97	1,220	12	7.30	1,320
		June 7	10	3.78	339			June 9			June 10
N	3.55	286	N	3.93	371	4	7.06	1,260	6	7.20	1,290
12	3.60	297	2	4.90	584	8	7.10	1,260	N	7.20	1,290
		June 8	4	5.78	820	N	7.17	1,290	6	7.24	1,290
2	3.60	297	6	6.37	1,010	4	7.27	1,320	12	7.27	1,320
4	3.63	308	8	6.70	1,120						

Location. --Lat 41°59'20", long. 94°22'30", in NW 1/4 sec. 20, T. 83 N., R. 30 W., on right bank, 50 ft downstream from bridge on State Route 17, 2 miles south of Jefferson, and 3-1/2 miles upstream from Hardin Creek.

Drainage area. --1,630 sq mi, approximately.

Gage-height record. -- Water-stage recorder graph.

Discharge record. -- Stage-discharge relation defined by current-meter measurements.

Maxima. -- May-June 1953: Discharge, 3,220 cfs 5 p. m. June 10 (gage height, 9.80 ft). 1940 to April 1953: Discharge, 29,100 cfs June 23, 1947 (gage height, 22.3 ft).

[illegible]

SOUTH RACCOON RIVER AT REDFIELD, IOWA

Location. --Lat 41°34'30", long. 94°10'40", in SW 1/4 sec. 3, T. 78 N., R. 29 W., on left bank, 10 ft upstream from highway bridge at Redfield, 0.8 mile downstream from bridge on U. S. Highway 6, 1 mile downstream from Middle Raccoon River, and 14.5 miles upstream from mouth.

Drainage area. --995 sq mi.

Gage-height record. --Water-stage recorder graph except May 26 to June 3, June 13-26, 29-30 when intake was plugged; graph based on observer's gage readings and shape of recorder graph.

Discharge record. --Stage-discharge relation defined by current-meter measurements.

Maxima. --May-June 1953: Discharge, 21,300 cfs 4 p. m. June 10 (gage height, 23.08 ft).
1940 to April 1953: Discharge, 23,800 cfs June 12, 1947 (gage height, 24.3 ft).

Mean discharge, in cubic feet per second, 1953

Day	May	June	Day	May	June	Day	May	June
1	897	274	11	437	10,000	21	333	458
2	780	262	12	395	2,600	22	362	433
3	711	258	13	362	1,710	23	399	403
4	666	376	14	345	1,210	24	2,680	390
5	620	598	15	345	944	25	1,200	433
6	598	476	16	337	780	26	688	545
7	554	329	17	329	757	27	541	934
8	510	812	18	321	643	28	458	976
9	467	643	19	317	554	29	395	446
10	433	14,100	20	301	523	30	362	366
						31	313	
Monthly mean discharge, in cubic feet per second.....							563	1,441
Runoff, in acre-feet.....							34,620	85,750
Runoff, in inches.....							0.65	1.62

Gage height, in feet, and discharge, in cubic feet per second, at indicated time, 1953

Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge
	May 24		12	6.87	1,940	2	22.65	20,300		June 12	
1	3.93	480		May 25		3	22.98	21,100	4	8.80	3,110
2	3.92	476	3	6.21	1,550	4	23.08	21,300	8	8.15	2,720
3	3.90	467	6	5.81	1,350	5	22.97	21,100	N	7.80	2,480
4	3.90	467	9	5.56	1,250	6	22.75	20,700	4	7.50	2,300
5	3.92	476	N	5.36	1,130	7	22.53	20,100	8	7.25	2,120
6	4.00	510	3	5.18	1,060	8	22.26	19,700	12	7.03	2,000
7	4.50	734	6	5.02	967	9	21.97	19,100		June 27	
8	6.45	1,660	9	4.86	897	10	21.70	18,500	6	4.18	598
9	7.75	2,480	12	4.73	850	11	21.43	17,900	N	4.01	514
10	8.95	3,250		June 10		12	21.13	17,300	2	4.02	519
11	10.50	4,300	1	4.05	532		June 11		4	4.12	554
N	11.40	5,000	2	5.20	1,060	2	20.42	16,000	6	4.56	757
1	11.90	5,410	3	9.80	3,810	4	19.60	14,500	8	6.92	1,940
2	12.20	5,680	4	12.40	5,860	6	18.68	13,100	10	7.89	2,540
3	12.00	5,500	5	14.50	7,950	8	18.05	12,100	12	7.47	2,300
4	11.40	5,000	6	15.70	9,270	10	17.57	11,600		June 28	
5	10.60	4,370	7	16.70	10,500	N	16.56	10,300	2	7.22	2,120
6	9.70	3,740	8	17.65	11,600	2	15.30	8,830	4	6.08	1,500
7	8.95	3,250	9	18.58	12,900	4	14.17	7,620	6	5.06	990
8	9.40	2,840	10	19.38	14,200	6	13.08	6,500	8	4.70	826
9	7.92	2,540	11	20.20	15,600	8	11.64	5,160	N	4.58	780
10	7.50	2,300	N	21.03	17,100	10	10.50	4,300	6	4.28	643
11	7.18	2,120	1	22.00	19,100	12	9.67	3,740	12	4.10	554

RACCOON RIVER AT VAN METER, IOWA

Location.--Lat 41°32'00", long. 93°56'50", in SW 1/4 sec. 22, T. 78 N., R. 27 W., on right bank, 10 ft upstream from highway bridge, 0.3 mile northeast of Van Meter, 1 mile downstream from South Raccoon River, and 30 miles upstream from Des Moines River. Datum of gage is 841.16 ft above mean sea level, datum of 1929.

Drainage area.--3,410 sq mi, approximately.

Gage-height record.--Water-stage recorder graph except June 13, 14, 23-26 when intakes were partially plugged; graph based on observer's gage readings and shape of recorder graph.

Discharge record.--Stage-discharge relation defined by current-meter measurements.

Maxima.--May-June 1953: Discharge, 26,000 cfs 3 a.m. June 11 (gage height, 19.42 ft).

1915 to April 1953: Discharge, 46,800 cfs June 13, 1947 (gage height, 21.4 ft, in gage well; 21.6 ft, from outside floodmark).

Mean discharge, in cubic feet per second, 1953

Day	May	June	Day	May	June	Day	May	June
1	2,490	1,240	11	1,960	32,400	21	1,200	1,610
2	2,490	1,120	12	1,840	9,700	22	1,280	1,420
3	2,760	1,020	13	1,720	5,850	23	1,350	1,310
4	3,030	980	14	1,610	4,550	24	3,950	1,160
5	3,030	1,390	15	1,500	3,660	25	3,340	1,120
6	2,940	1,390	16	1,420	3,030	26	2,260	1,200
7	2,850	1,090	17	1,390	2,670	27	1,960	2,850
8	2,490	1,460	18	1,310	2,400	28	1,800	4,750
9	2,310	1,720	19	1,280	2,040	29	1,650	3,950
10	2,080	14,100	20	1,240	1,840	30	1,500	3,750
						31	1,350	
Monthly mean discharge, in cubic feet per second.....							2,045	3,559
Runoff, in acre-feet.....							125,700	211,800
Runoff, in inches.....							0.69	1.16

Gage height, in feet, and discharge, in cubic feet per second, at indicated time, 1953

Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge
May 24											
4	4.60	1,650	6	6.95	3,750	4	16.65	17,700	4	14.15	13,100
8	5.11	2,040	8	6.62	3,390	6	17.10	18,700	6	13.12	11,400
10	5.48	2,400	10	6.39	3,210	8	18.40	21,700	8	12.28	10,100
N	6.25	3,030	N	6.22	3,030	10	19.00	24,000	10	11.66	9,180
1	7.42	4,150	6	5.87	2,760	12	19.28	25,500	N	11.25	8,480
2	8.37	5,190	12	5.66	2,580				2	10.91	8,080
3	9.00	5,850	June 10			2	19.40	26,000	4	10.63	7,720
4	9.37	6,310	1	5.00	1,960	4	19.40	26,000	6	10.42	7,480
5	9.72	6,660	2	6.45	3,210	6	19.27	25,500	8	10.22	7,240
6	9.82	6,770	3	7.62	4,350	8	19.08	24,500	10	10.00	7,000
7	9.80	6,770	4	8.28	5,080	10	18.86	23,600	12	9.80	6,770
8	9.70	6,660	5	10.00	7,000	N	18.62	22,400	June 27		
9	9.57	6,540	6	11.60	9,040	2	18.33	21,400	4	4.47	1,540
10	9.30	6,200	7	12.57	10,600	4	18.05	20,500	N	5.20	2,130
11	8.97	5,850	8	13.35	11,800	6	17.73	19,900	2	5.55	2,490
12	8.62	5,410	9	13.95	12,800	8	17.35	19,300	4	6.05	2,850
May 25			10	14.43	13,500	10	16.84	18,100	6	7.50	4,250
2	7.90	4,650	11	14.80	14,200	12	16.12	16,700	8	8.92	5,740
4	7.35	4,150	N	15.13	14,700	June 12			10	8.80	5,630
			2	15.80	16,100	2	15.18	14,900	12	8.04	4,750

ROCK RIVER NEAR ROCK VALLEY, IOWA

Location. --Lat 43°11'55", long. 96°20'10", in NE 1/4 sec. 25, T. 97 N., R. 47 W., on downstream side of bridge on U. S. Highway 18, 1.8 miles west of Rock Valley, and 17 miles upstream from mouth.

Datum of gage is 1,216.00 ft above mean sea level (Iowa Highway Commission benchmark).

Drainage area. --1,630 sq mi, approximately.

Gage-height record. --Water-stage recorder graph. No gage-height record May 10-14, 16-18.

Discharge record. --Stage-discharge relation defined by current-meter measurements. Discharge for periods of no gage-height record estimated on basis of weather records and records for nearby stations. Shifting-control method used June 8-27.

Maxima. --May-June 1953: Discharge, 18,900 cfs 5:30 p. m. June 8 (gage height, 15.99 ft).

1948 to April 1953: Discharge, 17,300 cfs Mar. 31, 1952 (gage height, 15.30 ft).

Flood of 1897 reached a stage of 17.0 ft (discharge not determined), from information by Iowa Highway Commission.

Mean discharge, in cubic feet per second, 1953

Day	May	June	Day	May	June	Day	May	June
1	515	484	11	700	1,760	21	257	314
2	619	386	12	550	1,250	22	298	295
3	790	344	13	480	1,000	23	257	276
4	805	300	14	430	830	24	241	254
5	711	273	15	396	687	25	238	236
6	603	260	16	320	599	26	412	223
7	498	1,530	17	280	504	27	2,830	436
8	428	13,400	18	260	452	28	1,500	2,050
9	371	8,740	19	249	402	29	885	2,900
10	450	3,600	20	236	356	30	679	1,520
						31	611	-----
Monthly mean discharge, in cubic feet per second.....							577	1,522
Runoff, in acre-feet.....							35,500	90,570
Runoff, in inches.....							0.41	1.04

Gage height, in feet, and discharge, in cubic feet per second, at indicated time, 1953

Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge
		June 7	11	12.85	7,760	1	14.40	10,800			June 9
6	5.30	238	12	13.35	8,920	2	14.95	13,000	6	14.40	10,800
N	5.35	252				3	15.53	16,200	N	13.13	7,610
3	5.43	273	1	13.78	10,000	4	15.85	18,100	6	12.73	6,810
4	5.72	356	2	14.10	11,100	5	15.96	18,700	12	11.83	5,320
5	5.86	399	3	14.20	11,500	5:30	15.99	18,900			June 10
6	6.70	715	4	14.20	11,500	6	15.96	18,700	6	11.15	4,290
7	9.42	2,620	6	14.06	10,900	7	15.88	18,300	N	10.50	3,460
8	10.90	4,360	8	13.95	10,600	8	15.78	17,700	6	9.87	2,800
9	11.70	5,620	10	14.00	10,700	10	15.50	16,000	12	9.42	2,360
10	12.30	6,630	N	14.13	10,800	12	15.17	14,200			

DRY CREEK AT HAWARDEN, IOWA

Location. --Lat 42°59'30", long. 96°28'10", in NE 1/4 NE 1/4 sec. 2, T. 94 N., R. 48 W., on left bank, 6 ft downstream from bridge on State Route 10 at east edge of Hawarden, and 1.7 miles upstream from mouth. Datum of gage is 1, 170. 42 ft above mean sea level, datum of 1929 (Corps of Engineers bench-mark).

Drainage area. --48 sq mi, approximately.

Gage-height record. --Water-stage recorder graph except June 6-7, 14-17 for which graph was drawn based on once-daily wire-weight gage readings. Once-daily wire-weight gage readings used May 28 to June 5.

Discharge record. --Stage-discharge relation defined by current-meter measurements below 860 cfs and by contracted-opening determination of peak flow. Discharge for period May 8 to June 7, June 29-30, when stage-discharge relation affected by flow under concrete control, computed on basis of four current-meter measurements. Shifting-control method used May 8-11, June 29.

Maxima. --May-June 1953: Discharge, 10, 900 cfs 9:30 p. m. June 7 (gage height, 17.57 ft).

1948 to April 1953: Discharge, 1, 020 cfs Mar. 30, 1952 (gage height, 14.14 ft).

Flood of September 1926 reached a stage of 18.0 ft (discharge not determined), and flood of 1934 reached a stage of 15.8 ft (discharge not determined), from information by Iowa Highway Commission.

Mean discharge, in cubic feet per second, 1953

Day	May	June	Day	May	June	Day	May	June
1		3.4	11	26	31	21	10	9.2
2	26	3.2	12	18	24	22	11	8.1
3	23	4.4	13	14	21	23	11	7.4
4	22	3.7	14	12	18	24	9.7	7.1
5	16	3.4	15	10	14	25	14	7.4
6	11	2.8	16		11	26	8.6	6.8
7	8.1	2,050	17	8.5	11	27	5.7	6.8
8	7.8	1,920	18	7.6	12	28	5.5	8.4
9	7.2	123	19	8.2	11	29	5.2	7.9
10	14	42	20	15	10	30	3.8	7.6
						31	3.1	-----
Monthly mean discharge, in cubic feet per second.....							12.0	147
Runoff, in acre-feet.....							739	8,720
Runoff, in inches.....							0.29	3.41

Gage height, in feet, and discharge, in cubic feet per second, at indicated time, 1953

Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge
12	4.38	June 6	4	14.00	1,000	10	17.31	9,160	8	11.48	521
		2.5	4:30	15.64	2,880	11	17.03	7,550	12	9.90	319
6	4.38	June 7	5	15.31	2,280	12	16.90	6,900	6	8.00	145
		2.5	6	16.45	5,180	4	16.00	3,800			90
N	4.38	2.5	7	16.70	6,100			1,810	N	7.15	69
1	4.39	2.6	8	16.74	6,260	8	15.00	1,070	6	6.72	57
2	5.26	12	9	17.15	8,200	N	14.20	733	12	6.52	
3	5.68	22	9:30	17.57	10,900	4	12.70				

BIG SIOUX RIVER AT AKRON, IOWA

Location. --Lat 42°49'40", long. 96°33'50", in W 1/2 sec. 31, T. 93 N., R. 48 W., on left bank, 300 ft downstream from highway bridge in Akron, and 2-3/4 miles upstream from Union Creek. Datum of gage is 1,118.90 ft above mean sea level, datum of 1929.

Drainage area. --8,851 sq mi.

Gage-height record. --Water-stage recorder graph.

Discharge record. --Stage-discharge relation defined by current-meter measurements. Shifting-control method used June 8-11.

Maxima. --May-June 1953: Discharge, 21,800 cfs 10 a. m. June 8 (gage height, 19.33 ft).

October 1928 to April 1953: Discharge, 33,000 cfs Apr. 1, 1952 (gage height, 19.75 ft), from rating curve extended above 20,000 cfs on basis of velocity-area study.

Mean discharge, in cubic feet per second, 1953

Day	May	June	Day	May	June	Day	May	June
1	1,810	1,640	11	2,320	9,520	21	1,640	1,290
2	2,000	1,430	12	2,340	4,530	22	1,540	1,210
3	2,250	1,330	13	2,520	3,100	23	1,480	1,160
4	2,530	1,250	14	2,550	2,610	24	1,380	1,130
5	2,630	1,150	15	2,350	2,290	25	1,330	1,090
6	2,630	1,090	16	2,220	2,030	26	1,270	1,050
7	2,560	2,340	17	2,110	1,810	27	1,920	1,110
8	2,470	16,100	18	2,060	1,650	28	4,740	2,140
9	2,330	13,400	19	1,950	1,510	29	3,570	4,780
10	2,260	13,700	20	1,820	1,400	30	2,430	5,430
						31	1,930	
Monthly mean discharge, in cubic feet per second.....							2,224	3,476
Runoff, in acre-feet.....							135,700	206,800
Runoff, in inches.....							0.29	0.44

Gage height, in feet, and discharge, in cubic feet per second, at indicated time, 1953

Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge
12	5.87	June 6 1,070	8	13.64	5,860	10	19.33	21,800	6	17.97	13,400
			10	14.38	6,620	N	19.24	20,900	12	18.28	14,700
6	5.91	June 7 1,080	12	14.94	7,290	6	18.74	17,200	N	June 10 18.16	14,100
					June 8 8,250	12	18.28	14,700			15,000
N	5.98	1,110	2	15.67	9,820	6	17.91	June 9 13,100	6	17.81	12,700
2	6.72	1,400	4	16.59	14,200			12,600	12	17.43	11,600
4	8.72	2,460	6	18.19		N	17.77				
6			8	19.08	19,600						

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, on right bank on upstream side of bridge on U. S. Highway 77 at Sioux City, 2.5 miles downstream from Big Sioux River. Datum of gage is 1,076.96 ft above mean sea level, datum of 1929.

Drainage area. --314,600 sq mi, approximately.

Gage-height record. --Water-stage recorder graph.

Discharge record. --Stage-discharge relation defined by current-meter measurements. Shifting-control method use May 1 to June 30.

Maxima. --May-June 1953: Discharge, 109,000 cfs 7 p.m. June 25; gage height, 9.19 ft 4-8 p.m. June 19. 1928-31, 1938 to April 1953: Discharge, 441,000 cfs Apr. 14, 1952 (gage height, 24.28 ft).

Remarks. --Flow partly regulated by Fort Peck and Fort Randall Reservoirs.

Mean discharge, in cubic feet per second, 1953

Day	May	June	Day	May	June	Day	May	June
1	28,800	28,400	11	45,600	50,100	21	31,600	90,400
2	42,100	27,700	12	44,800	60,400	22	30,800	85,500
3	49,900	27,100	13	42,900	69,500	23	29,700	87,600
4	79,600	27,200	14	42,300	70,000	24	28,700	92,600
5	94,100	28,700	15	40,600	62,800	25	28,000	105,000
6	88,100	31,700	16	35,000	60,000	26	27,700	104,000
7	71,400	39,600	17	32,100	53,900	27	27,200	93,800
8	62,300	49,100	18	31,900	57,200	28	27,900	87,800
9	55,900	55,200	19	31,200	90,900	29	29,600	90,000
10	49,100	48,500	20	30,700	92,700	30	29,500	84,600
						31	27,800	--
Monthly mean discharge, in cubic feet per second.....							42,480	65,070
Runoff, in acre-feet.....							2,612,000	3,872,000
Runoff, in inches.....							0.16	0.23

Gage height, in feet, and discharge, in cubic feet per second, at indicated time, 1953

Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge
		June 7	N	5.02	40,400	6	6.28	52,500			June 11
6	4.61	36,400	6	7.88	56,300	12	6.03	50,700	6	5.38	47,900
N	4.81	38,000	12	7.63	63,100			June 10	N	5.52	49,500
6	5.35	42,300			June 9	6	5.80	49,200	6	5.76	52,200
12	6.18	49,200	6	6.89	57,100	N	5.64	48,400	12	5.95	54,400
		June 8	N	6.54	54,400	6	5.45	47,300			
6	5.46	43,700				12	5.38	47,300			

PERRY CREEK AT 38th STREET, SIOUX CITY, IOWA

Location. --Lat 42°32', long. 96°25', in SW 1/4 sec. 9, T. 89 N., R. 47 W., on upstream handrail of bridge on 38th Street in Sioux City, 3.6 miles upstream from mouth. Datum of gage is 1,117.04 ft above mean sea level (city of Sioux City benchmark).

Drainage area. --60 sq mi, approximately.

Gage-height record. --Wire-weight gage read once daily. Graph based on gage readings below 4.95 ft and water-stage recorder graph at high stages used June 7, 8.

Discharge record. --Stage-discharge relation defined by current-meter measurements. Shifting-control method used May 1-20, June 12-30.

Maxima. --May-June 1953: Discharge, 3,470 cfs 9:30 p.m. June 7 (gage height, 12.56 ft).

1946 to April 1953: Discharge, 7,780 cfs Sept. 10, 1949 (gage height, 21.80 ft).

Flood of July 7, 1944, reached a stage of about 25.5 ft, from floodmarks (discharge, 9,600 cfs, by contracted-opening method, by Corps of Engineers).

Mean discharge, in cubic feet per second, 1953

Day	May	June	Day	May	June	Day	May	June
1	43	15	11	40	25	21	199	18
2	38	15	12	28	22	22	84	17
3	33	16	13	24	22	23	82	19
4	34	14	14	22	23	24	60	32
5	20	13	15	20	23	25	33	24
6	19	13	16	20	22	26	26	23
7	17	916	17	20	22	27	23	22
8	17	1,120	18	20	20	28	20	20
9	15	54	19	18	19	29	19	18
10	53	29	20	17	18	30	18	16
						31	17	-----
Monthly mean discharge, in cubic feet per second.....							35.5	87.7
Runoff, in acre-feet.....							2,180	5,220
Runoff, in inches.....							0.68	1.63

Gage height, in feet, and discharge, in cubic feet per second, at indicated time, 1953

Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge
June 7											
6	1.81	14	6	4.86	743	2:45	12.40	3,410	2	2.97	180
8	2.27	47	7	6.75	1,320	3	12.38	3,400	4	2.74	126
9	2.95	174	8	10.65	2,710	4	11.93	3,220	6	2.60	98
10	3.60	365	9	11.98	3,240	5	11.20	2,930	8	2.52	84
11	4.40	605	10	12.56	3,470	6	10.25	2,550	10	2.47	75
N	4.97	776	11	12.44	3,430	7	8.60	1,940	12	2.43	69
1	4.25	560	12	11.00	2,850	8	7.05	1,420	June 9		
2	4.50	635	June 8			9	5.45	920	6	2.35	57
3	5.10	815	1	11.46	3,030	10	4.50	635	N	2.32	53
4	5.56	953	2	12.26	3,350	11	4.00	485	6	2.30	50
5	5.20	845				N	3.40	305	12	2.27	47

FLOYD RIVER AT MERRILL, IOWA

Location. --Lat 42°43', long. 96°14', in sec. 1, T. 91 N., R. 46 W., at county highway bridge east of Merrill, 500 ft downstream from West Branch Floyd River. Datum of gage is 1,154.36 ft above mean sea level.

Drainage area. --810 sq mi, approximately.

Gage-height record. --Wire-weight and staff gages read frequently during flood period.

Maxima. --May-June 1953: Gage height, 16.0 ft 7 a. m. June 8.

1907-33 (May-July only), 1934 to April 1953 (fragmentary): Gage height, 20.0 ft Sept. 16, 1926, site and datum then in use.

Remarks. --Records furnished by U. S. Weather Bureau.

Gage height, in feet, at indicated time, 1953

Hour	Gage height	Hour	Gage height	Hour	Gage height
	June 7	6:10	16.4		June 10
6p	5.7	7:30	16.2	8	13.5
	June 8		June 9	1:30	12.7
7	18.0	6	15.5	6	11.9
N	17.5	N	15.0		June 12
3	16.6	6	14.2	7a	7.4

FLOYD RIVER AT JAMES, IOWA

Location.--Lat 42°34'40", long. 96°18'40", in NW 1/4 NW 1/4 sec. 32, T. 90 N., R. 46 W., on left bank, 6 ft downstream from bridge on Plymouth County highway J at James, 9.5 miles upstream from mouth, and 14 miles downstream from West Branch Floyd River. Datum of gage is 1,102.59 ft above mean sea level, datum of 1929.

Drainage area.--918 sq mi.

Gage-height record.--Water-stage recorder graph except for periods May 1-2, 23, 25, June 5, 7, 9-20 for which graph was drawn based on once-daily wire-weight gage readings, and June 21-30 when once-daily wire-weight readings were used. No gage-height record May 24, May 26 to June 4, June 6.

Discharge record.--Stage-discharge relation defined by current-meter measurements below 15,600 cfs and by contracted-opening, flow-over-embankment determination of peak flow. Discharge for days of no gage-height record estimated on basis of weather records and records for nearby stations.

Maxima.--May-June 1953: Discharge, 71,500 cfs 12:30 p.m. June 8 (gage height, 25.3 ft, from flood-marks at downstream side of bridge).

1934 to April 1953: Discharge, 13,900 cfs Mar. 31, 1952 (gage height, 20.32 ft).

Mean discharge, in cubic feet per second, 1953

Day	May	June	Day	May	June	Day	May	June
1	446	245	11	508	2,250	21	1,040	363
2	467	232	12	462	1,310	22	1,510	324
3	477	221	13	339	1,030	23	789	300
4	499	210	14	288	870	24	533	315
5	460	201	15	267	815	25	419	297
6	402	194	16	252	760	26	351	288
7	348	751	17	237	596	27	524	288
8	308	32,400	18	233	520	28	590	288
9	279	15,000	19	255	467	29	410	298
10	326	4,070	20	232	405	30	317	300
						31	271	-----
Monthly mean discharge, in cubic feet per second.....							446	2,187
Runoff, in acre-feet.....							27,450	120,100
Runoff, in inches.....							0.56	2.66

Gage height, in feet, and discharge, in cubic feet per second, at indicated time, 1953

Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge
12	8.10	June 6 189	3	16.74	2,590	3	24.87	61,700	N	19.30	3,600
		June 7	4	16.86	2,690	4	24.62	57,200	6	18.90	3,120
N	9.40	368	5	17.04	2,840	5	24.00	46,000	12	18.45	2,760
6	8.12	191	6	17.34	3,140	6	23.70	41,800	June 11		
N	9.40	368	7	18.04	3,980	9	23.00	32,000			
6	11.40	740	8	20.25	11,000	12	22.32	25,400	N	17.13	2,490
7	12.14	904	9	23.29	36,100	June 9			6	16.27	2,020
8	15.64	1,960	10	24.56	56,100				12	15.26	1,670
9	16.54	2,460	11	25.05	65,200	6	21.50	18,500	June 12		
12	16.56	2,480	N	25.27	70,800	N	20.90	14,300			
1	16.56	June 8 2,480	12	25.30	71,500	6	20.40	10,800	6	14.37	1,420
		June 8 2,520	12:30	25.30	71,500	12	20.00	7,000	N	13.68	1,260
2	16.64	2,520	1	25.21	69,200	June 10			6	13.30	1,170
			2	25.05	65,200				12	13.02	1,110
						6	19.67	4,680			

Location. --Lat 42°20'. long. 96°29', in SE 1/4 sec. 11, T. 27 N., R. 8 E., on right pier on downstream side of bridge on main street of Homer. Datum of gage is 1,082.43 ft above mean sea level, datum of 1929 (preliminary).

Gage-height record. --Water-stage recorder graph except May 27-31 when twice-daily wire-weight gage readings were used; June 1 to 5 p. m. June 2, 10 a. m. June 8 to 5 p. m. June 10 when no gage-height record was obtained (daily mean gage heights partly estimated June 2, 8, 10); and June 28-30 when no gage-height record was obtained.

Discharge record. --Stage-discharge relation defined by current-meter measurements below 50 cfs and extended to peak stage on basis of slope-area determination; shifting-control method used. Discharge for periods of no gage-height record June 2, 9, 28-30 estimated on basis of weather records and trend of flow.

1946 to April 1953: Discharge, 5,950 cfs May 23, 1952 (gage height, 20.22 ft, site and datum then in use).

Greatest known flood occurred June 4, 1940 (stage about 32.5 ft, present site and datum).

[illegible]

Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge
		June 7									
4	1.31	28	9	12.43	3,300	4:30	12.52	3,340	10	4.05	428
N	1.67	57	11	11.97	3,120	6	12.12	3,180	N	3.16	255
6	1.87	77	12	11.84	3,070	7	10.34	2,470	3	2.61	166
7	3.40	307		June 8		8	7.78	1,580	9	2.14	101
8	11.15	2,800	1	11.86	3,070	9	5.45	810	12	2.05	89

LITTLE SIOUX RIVER NEAR LAKEFIELD, MINN.

Location. --Lat 43°37'10", long. 95°16'30", in SE 1/4 sec. 21. T. 102 N., R. 37 W., on left bank at upstream side of bridge on township highway, a quarter of a mile upstream from Jackson County ditch 11, and 6.7 miles southwest of Lakefield. Datum of gage is 1,405.28 ft above mean sea level, datum of 1929.

Drainage area. --17.1 sq mi.

Gage-height record. --Water-stage recorder graph.

Discharge record. --Stage-discharge relation only fairly defined by current-meter measurements below 170 cfs and extended to peak stage on basis of contracted-opening, flow-over-road measurement of combined flow of Little Sioux River and Jackson County ditch. Stage-discharge relation affected by back-water from aquatic vegetation June 7-15.

Maxima. --May-June 1953: Discharge, 2,550 cfs 9 p. m. June 7 (gage height, 10.20 ft), by contracted-opening, flow-over-road measurement.

1948 to April 1953: Discharge, 224 cfs Apr. 5, 1951 (gage height, 5.51 ft); gage height, 6.30 ft Mar. 30, 1952 (backwater from ice).

Remarks. --No regulation or diversions.

Mean discharge, in cubic feet per second, 1953

Day	May	June	Day	May	June	Day	May	June
1	19	40	11	6.7	90	21	5.3	11
2	23	25	12	6.7	78	22	8.0	10
3	22	17	13	6.7	69	23	8.0	8.7
4	19	12	14	6.0	61	24	8.0	7.4
5	16	10	15	4.6	52	25	13	8.7
6	13	8.7	16	4.6	42	26	36	7.4
7	11	473	17	4.0	30	27	46	59
8	10	563	18	3.6	17	28	41	96
9	8.0	168	19	3.2	13	29	46	97
10	6.7	107	20	3.6	11	30	62	81
						31	55	
Monthly mean discharge, in cubic feet per second.....							17.0	75.8
Runoff, in acre-feet.....							1,040	4,510
Runoff, in inches.....								

Gage height, in feet, and discharge, in cubic feet per second, at indicated time, 1953

Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge
		June 7									
6	3.19	7.4	9	10.20	2,550	9	6.68	383			June 9
N	3.21	8.7	10	10.07	2,420	10	6.50	344	6	5.56	187
3	3.34	17	11	9.86	2,210	N	6.30	305	N	5.40	163
5	3.85	53	12	9.68	2,030	3	6.14	274	6	5.27	149
6	6.73	396			June 8	6	6.01	249	12	5.14	133
7	7.38	553	2	9.22	1,570	9	5.90	234			June 10
8	9.63	1,980	3	8.93	1,300	12	5.77	214	N	4.91	100
			6	7.66	629				12	4.73	96

JACKSON COUNTY DITCH 11 NEAR LAKEFIELD, MINN.

Location.--Lat 43°37'10", long. 95°16'10", in SW 1/4 sec. 22, T. 102 N., R. 37 W., on left bank, 600 ft upstream from mouth and 6.5 miles southwest of Lakefield. Datum of gage is 1,404.47 ft above mean sea level, datum of 1929.

Drainage area.--7.69 sq mi.

Gage-height record.--Water-stage recorder graph except for periods 7:40 to 11:40 p. m. June 7 for which graph was drawn based on floodmark and adjoining periods of record, and 4:10 a. m. June 19 to 7:10 p. m. June 21 for which graph was drawn based on partial record.

Discharge record.--Stage-discharge relation defined by current-meter measurements below 120 cfs and extended to peak stage on basis of contracted-opening, flow-over-road determination of combined flow of Jackson County ditch and Little Sioux River. Stage-discharge relation affected by backwater from Little Sioux River May 25 to June 5.

Maxima.--May-June 1953: Discharge, 1, 150 cfs 9 p. m. June 7 (gage height, 10.91 ft, from floodmark), by contracted-opening, flow-over-road measurement.

1948 to April 1953: Discharge, 150 cfs June 27, 1951 (gage height, 5.76 ft); gage height, 6.53 ft Apr. 1, 1951 (backwater from ice).

Remarks.--No regulation or diversion.

Mean discharge, in cubic feet per second, 1953

Day	May	June	Day	May	June	Day	May	June
1	12	4.1	11	2.9	46	21	2.2	3.8
2	11	2.8	12	2.6	33	22	2.3	3.4
3	11	2.2	13	2.2	26	23	2.4	3.3
4	9.5	2.2	14	2.2	21	24	2.8	3.2
5	8.2	2.2	15	2.1	16	25	4.6	3.5
6	6.7	2.3	16	2.0	13	26	5.3	3.3
7	5.4	280	17	1.9	11	27	5.5	28
8	4.5	472	18	1.8	7.9	28	4.6	26
9	4.0	195	19	1.8	6.0	29	5.3	21
10	3.2	109	20	1.9	4.4	30	5.8	16
						31	5.3	

Monthly mean discharge, in cubic feet per second.....	4.61	45.6
Runoff, in acre-feet.....	284	2,710
Runoff, in inches.....		

Gage height, in feet, and discharge, in cubic feet per second, at indicated time, 1953

Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge
6	3.03	June 7	8	10.62	1,090	9	7.49	453	N	6.11	196
N	3.15	2.0	9	10.91	1,150	N	6.94	349	6	6.02	180
3	3.56	3.2	10	10.79	1,130	3	6.65	294	12	5.91	162
4	4.35	7.7	11	10.62	1,090	6	6.50	266			
5	4.78	21	12	10.40	1,040	9	6.38	244	6	5.78	141
6	7.07	373				12	6.30	230	N	5.55	106
7	7.67	488	3	9.69	895				6	5.35	78
7	9.32	818	6	8.42	638	6	6.18	208	12	5.20	61

SPIRIT LAKE NEAR ORLEANS, IOWA

Location.--Lat 43°28', long. 95°07', in NW 1/4 sec. 20, T. 100 N., R. 36 W., on west shore, 2.6 miles northwest of Orleans.

Gage-height record.--Water-stage recorder graph.

Maxima.--May-June 1953: Gage height, 15.27 ft June 14, 16.

1933 to April 1953: Gage height, 15.74 ft June 19, 1944.

Daily mean gage height, in feet, 1953

Day	May	June	Day	May	June	Day	May	June
1	14.04	14.21	11	14.18	15.14	21	14.15	15.22
2	14.08	14.21	12	14.18	15.20	22	14.17	15.21
3	14.11	14.23	13	14.17	15.24	23	14.17	15.18
4	14.12	14.23	14	14.16	15.27	24	14.17	15.13
5	14.14	14.21	15	14.15	15.26	25	14.18	15.11
6	14.15	14.22	16	14.15	15.27	26	14.18	15.08
7	14.16	14.64	17	14.14	15.26	27	14.18	15.15
8	14.17	14.88	18	14.14	15.26	28	14.20	15.17
9	14.16	14.98	19	14.12	15.25	29	14.22	15.15
10	14.17	15.06	20	14.12	15.22	30	14.22	15.12
						31	14.21	-----
Monthly mean gage height, in feet.....							14.16	14.96
Runoff, in acre-feet.....							-----	-----
Runoff, in inches.....							-----	-----

Gage height, in feet, at indicated time, 1953

Hour	Gage height	Hour	Gage height	Hour	Gage height	Hour	Gage height
	June 5	10	14.26	N	14.73		June 8
12	14.21	12	14.29	2	14.74	4	14.84
	June 6		June 7	4	14.76	8	14.86
4	14.20	2	14.35	6	14.77	N	14.87
8	14.20	4	14.39	8	14.78	4	14.89
N	14.20	6	14.48	10	14.79	8	14.92
4	14.20	8	14.64	12	14.80	12	14.95
8	14.21	10	14.72				

OKOBOJI LAKE AT LAKESIDE LABORATORY, NEAR MILFORD, IOWA

Location.--Lat 43°22'40", long. 95°10'40", in W 1/2 sec. 23, T. 99 N., R. 37 W., at pumping station of Lakeside Laboratory on west shore, 4 miles northwest of Milford.

Gage-height record.--Water-stage recorder graph except for May 29 when record is based on graph compared to Spirit Lake near Orleans station.

Maxima.--May-June 1953: Gage height, 5.15 ft June 13-14.

1933 to April 1953: Maximum gage height, 5.42 ft June 15, 1945.

Daily mean gage height, in feet, 1953

Day	May	June	Day	May	June	Day	May	June
1	4.32	4.35	11	4.37	5.13	21	4.32	5.01
2	4.35	4.33	12	4.38	5.14	22	4.34	4.98
3	4.36	4.36	13	4.36	5.15	23	4.33	4.95
4	4.36	4.36	14	4.35	5.15	24	4.33	4.92
5	4.37	4.34	15	4.34	5.14	25	4.35	4.94
6	4.37	4.32	16	4.34	5.12	26	4.33	4.91
7	4.36	4.44	17	4.33	5.10	27	4.32	5.04
8	4.36	4.99	18	4.32	5.08	28	4.35	5.09
9	4.35	5.08	19	4.30	5.08	29	4.37	5.07
10	4.38	5.10	20	4.31	5.04	30	4.37	5.05
						31	4.35	-----
Monthly mean gage height, in feet.....							4.35	4.89
Runoff, in acre-feet.....							-----	-----
Runoff, in inches.....							-----	-----

Gage height, in feet, at indicated times, 1953

Hour	Gage height	Hour	Gage height	Hour	Gage height	Hour	Gage height
12	June 6 4.32	6	4.32	4	4.45		June 8
		8	4.33	6	4.49	6	4.97
	June 7	10	4.36	8	4.50	N	5.00
2	4.32	N	4.39	10	4.82	6	5.02
4	4.32	2	4.42	12	4.91	12	5.05

LITTLE SIOUX RIVER NEAR CHEROKEE, IOWA

Location. --Lat 42°49', long. 95°30', in sec. 1, T. 92 N., R. 40 W., on downstream handrail of bridge, 5 miles north of Cherokee. Datum of gage is 1,171.42 ft above mean sea level, datum of 1929.

Drainage area. --1,920 sq mi, approximately.

Gage-height record. --Graph drawn on basis of frequent tape gage readings.

Discharge record. --Stage-discharge relation defined by current-meter measurements.

Maxima. --May-June 1953: Discharge, 21,400 cfs 5 a. m. June 11 (gage height, 17.48 ft).

1949 to April 1953: Discharge, 16,100 cfs Apr. 6, 1951 (gage height, 16.45 ft).

Cooperation. --Records furnished by Corps of Engineers, Department of the Army.

Gage height, in feet, and discharge, in cubic feet per second, at indicated time, 1953

Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge
June 7											
1	3.60	393	3	12.50	5,430	5	15.68	13,680	8	13.28	6,888
2	3.60	393	4	12.40	5,304	6	15.62	13,340	9	13.27	6,888
3	3.60	393	5	12.32	5,172	7	15.57	13,340	10	13.26	6,888
4	3.60	393	6	12.25	5,052	8	15.52	13,000	11	13.22	6,682
5	3.60	393	7	12.16	5,052	9	15.47	13,000	12	13.19	6,682
6	3.60	393	8	12.10	4,926	10	15.43	12,680			
7	3.63	393	9	12.00	4,800	11	15.40	12,680	6	13.00	6,270
8	3.68	412	10	11.90	4,696		15.37	12,680	N	12.82	5,934
9	3.78	444	11	11.81	4,592	1	15.31	12,360	6	12.70	5,766
10	3.90	470	12	11.70	4,488	2	15.27	12,360	12	12.53	5,430
11	4.10	524				3	15.22	12,040			
N	4.35	580	1	11.62	4,384	4	15.17	12,040	6	12.34	5,178
1	4.65	668	2	11.52	4,280	5	15.12	11,720	N	12.20	5,052
2	5.00	794	3	11.43	4,190	6	15.07	11,720	6	12.12	4,926
3	5.30	895	4	11.36	4,190	7	15.00	11,400	12	11.97	4,800
4	5.68	1,043	5	11.26	4,100	8	14.94	11,400			
5	5.85	1,081	6	11.20	4,010	9	14.90	11,106	6	11.85	4,592
6	6.12	1,201	7	11.10	3,920	10	14.84	10,812	N	11.67	4,488
7	6.40	1,327	8	11.00	3,830	11	14.80	10,812	6	11.53	4,280
8	6.70	1,455	9	10.92	3,750	12	14.75	10,518	12	11.40	4,190
9	6.96	1,589	10	10.85	3,670						
10	7.23	1,717	11	10.82	3,670	1	14.70	10,518	6	11.28	4,100
11	7.73	1,899	N	10.83	3,670	2	14.67	10,518	N	11.18	4,010
12	8.05	2,040	1	10.87	3,750	3	14.62	10,224	6	11.10	3,920
			2	10.95	3,750	4	14.58	10,224	12	10.97	3,830
			3	11.10	3,920	5	14.56	10,224			
1	8.45	2,232	4	11.36	4,190	6	14.52	9,930	6	10.85	3,670
2	8.80	2,430	5	11.66	4,488	7	14.50	9,930	N	10.60	3,510
3	9.12	2,584	6	12.00	4,800	8	14.46	9,930	6	10.30	3,298
4	9.46	2,800	7	12.45	4,350	9	14.42	9,652	12	10.04	3,100
5	9.76	2,980	8	12.95	6,102	10	14.40	9,652			
6	10.10	3,166	9	13.52	7,300	11	14.38	9,652	6	9.80	2,980
7	10.42	3,364	10	14.16	9,096	N	14.33	9,374	N	9.55	2,860
8	10.73	3,590	11	14.90	11,106	1	14.30	9,374	6	9.38	2,746
9	11.10	3,920	12	15.65	13,340	2	14.26	9,374	12	9.18	2,638
10	11.42	4,190				3	14.22	9,096			
11	11.63	4,384	1	16.35	15,780	4	14.18	9,096	6	9.03	2,530
N	11.88	4,696	2	16.90	18,100	5	14.13	8,818	N	8.87	2,480
1	12.08	4,926	3	17.24	19,660	6	14.08	8,818	6	8.73	2,380
2	12.22	5,052	4	17.42	20,820	7	14.04	8,540	12	8.52	2,280
3	12.35	5,178	5	17.48	21,400	8	14.00	8,540			
4	12.47	5,430	6	17.43	20,820	9	13.96	8,540	6	8.37	2,232
5	12.65	5,598	7	17.37	20,820	10	13.93	8,292	N	8.16	2,136
6	12.85	5,934	8	17.30	20,240	11	13.90	8,292	6	8.00	2,040
7	13.10	6,476	9	17.21	19,660	12	13.86	8,292	12	7.83	1,946
8	13.32	6,888	10	17.12	19,080						
9	13.48	7,300	11	17.02	18,500	1	13.84	8,044	6	7.67	1,899
10	13.65	7,548	N	16.90	18,100	2	13.82	8,044	N	7.47	1,805
11	13.73	7,796	1	16.80	17,700	3	13.80	8,044	6	7.32	1,717
12	13.75	7,796	2	16.72	17,300	4	13.80	8,044	12	7.18	1,673
			3	16.62	16,900	5	13.78	8,044			
1	13.72	7,796	4	16.56	16,900	6	13.75	8,044	6	7.07	1,629
2	13.70	7,796	5	16.48	16,500	7	13.70	7,796	N	6.95	1,585
3	13.67	7,796	6	16.40	16,140	8	13.67	7,796	6	6.85	1,498
4	13.62	7,548	7	16.35	15,780	9	13.60	7,548	12	6.75	1,498
5	13.56	7,548	8	16.28	15,780	10	13.57	7,548			
6	13.50	7,300	9	16.20	15,420	11	13.55	7,548	6	6.67	1,455
7	13.42	7,094	10	16.12	15,060	N	13.50	7,300	N	6.60	1,412
8	13.32	6,888	11	16.06	15,060	1	13.48	7,300	6	6.55	1,412
9	13.22	6,682	12	16.00	14,700	2	13.46	7,300	12	6.44	1,327
10	13.12	6,476				3	13.40	7,094			
11	13.00	6,270	1	15.92	14,360	4	13.38	7,094	6	6.32	1,285
N	12.85	5,934	2	15.86	14,360	5	13.37	7,094	N	6.14	1,201
1	12.76	5,934	3	15.80	14,020	6	13.35	7,094	6	6.08	1,201
2	12.63	5,598	4	15.73	13,680	7	13.30	6,888	12	6.04	1,161

MILL CREEK NEAR CHEROKEE, IOWA

Location.---Lat 42°47', long. 95°33', in SE 1/4 NE 1/4 sec. 15, T. 92 N., R. 40 W., on downstream handrail of bridge on U. S. Highway 59, 2 miles north of Cherokee. Datum of gage is 1,179.89 ft above mean sea level, datum of 1929.

Drainage area.---292 sq mi.

Gage-height record.---Graph drawn on basis of frequent wire-weight gage readings.

Discharge record.---Stage-discharge relation defined by current-meter measurements.

Maxima.---May-June 1953: Discharge, 11,500 cfs 7 a.m. and 4 to 5 p.m. June 8 (gage height, 14.30 ft).

1949 to April 1953: Discharge, 3,050 cfs Mar. 28, 1951 (gage height, 9.10 ft).

Flood of June 24, 1891, reached a stage of 31.0 ft, from floodmarks.

Cooperation.---Records furnished by Corps of Engineers, Department of the Army.

Gage height, in feet, and discharge, in cubic feet per second, at indicated time, 1953

Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge
		June 6									
1	2.00	18	7	3.67	320	1	7.28	1,800	7	4.45	540
2	2.00	18	8	3.83	345	2	7.18	1,730	8	4.43	511
3	2.00	18	9	4.02	395	3	7.02	1,610	9	4.37	511
4	2.00	18	10	4.30	482	4	6.85	1,500	10	4.34	482
5	2.00	18	11	4.70	602	5	6.60	1,390	11	4.32	482
6	2.00	18	12	5.30	809	6	6.32	1,240	N	4.28	482
7	2.00	18				7	6.13	1,150	1	4.25	482
8	2.00	18	1	6.30	1,240	8	5.97	1,100	2	4.21	453
9	2.00	18	2	7.40	1,860	9	5.87	1,060	3	4.18	453
10	2.00	18	3	8.80	2,670	10	5.77	1,010	4	4.15	453
11	2.00	18	4	10.10	3,910	11	5.67	971	5	4.12	424
12	2.00	18	5	12.20	6,580	12	5.60	928	6	4.08	424
N	2.00	18	6	14.00	10,600				7	4.04	395
1	2.00	18	7	14.30	11,500	1	5.53	885	8	4.02	395
2	2.00	18	8	14.10	10,900	2	5.48	885	9	3.98	395
3	2.00	18	9	13.85	10,100	3	5.45	847	10	3.94	370
4	2.00	18	10	13.50	9,270	4	5.42	847	11	3.90	370
5	2.00	18	11	13.35	9,030	5	5.40	847	12	3.87	370
6	2.00	18	N	13.20	8,560	6	5.38	847			
7	2.05	22	1	13.22	8,560	7	5.35	847	1	3.72	320
8	2.08	24	2	13.75	10,100	8	5.33	809	2	3.68	320
9	2.10	25	3	14.15	11,200	9	5.32	809	3	3.63	295
10	2.12	27	4	14.30	11,500	10	5.31	809	4	3.58	295
11	2.15	30	5	14.30	11,500	11	5.28	809	5	3.54	270
12	2.20	34	6	14.20	11,200	N	5.26	809	6	3.50	270
		June 7	7	13.95	10,600	1	5.23	771	7	3.45	270
1	2.22	37	8	13.62	9,540	2	5.20	771	8	3.42	249
2	2.30	46	9	13.05	8,090	3	5.16	771	9	3.38	249
3	2.35	53	10	12.30	6,750	4	5.13	733	10	3.34	228
4	2.42	63	11	11.55	5,660	5	5.10	733	11	3.30	228
5	2.48	72	12	10.65	4,420	6	5.08	733	N	3.28	228
6	2.55	83				7	5.02	695	1	3.24	207
7	2.63	96	1	9.95	3,810	8	4.96	695	2	3.20	207
8	2.72	108	2	9.50	3,370	9	4.92	664	3	3.18	207
9	2.82	126	3	9.18	3,130	10	4.86	664	4	3.14	186
10	2.90	145	4	8.87	2,750	11	4.82	633	5	3.12	186
11	2.97	155	5	8.60	2,670	12	4.76	633	6	3.08	186
N	3.03	165	6	8.37	2,530				7	3.04	165
1	3.10	186	7	8.16	2,390	1	4.72	602	8	3.02	165
2	3.17	207	8	7.95	2,250	2	4.67	602	9	2.98	165
3	3.23	207	9	7.77	2,120	3	4.62	571	10	2.94	155
4	3.30	228	10	7.60	1,990	4	4.58	571	11	2.90	145
5	3.40	249	11	7.42	1,860	5	4.54	540	12	2.87	136
6	3.52	270	N	7.33	1,800	6	4.52	540			

LITTLE SIOUX RIVER AT CORRECTIONVILLE, IOWA

Location. --Lat 42°28', long. 95°47', in N 1/2 sec. 1, T. 88 N., R. 43 W., on right bank, 10 ft upstream from bridge on U. S. Highway 20, 0.2 mile upstream from Bacon Creek, 0.5 mile west of Correctionville, and 0.8 mile downstream from Pierson Creek. Datum of gage is 1,096.49 ft above mean sea level, datum of 1929.

Drainage area. --2,450 sq mi, approximately.

Gage-height record. --Water-stage recorder graph.

Discharge record. --Stage-discharge relation defined by current-meter measurements.

Maxima. --May-June 1953: Discharge, 17,500 cfs 6 p. m. June 12 (gage height, 22.09 ft).

1918-25, 1928-32, 1936 to April 1953: Discharge, 17,900 cfs Apr. 7, 1951 (gage height, 22.58 ft).

Mean discharge, in cubic feet per second, 1953

Day	May	June	Day	May	June	Day	May	June
1	1,220	587	11	1,210	6,750	21	706	2,960
2	1,380	566	12	1,090	13,600	22	734	2,600
3	1,550	556	13	1,010	13,400	23	724	2,300
4	1,660	552	14	962	9,350	24	762	2,020
5	1,730	545	15	918	7,790	25	822	4,240
6	1,740	552	16	890	7,000	26	776	3,190
7	1,660	880	17	834	6,060	27	720	2,200
8	1,550	4,500	18	822	5,170	28	682	2,530
9	1,420	7,780	19	772	4,110	29	654	2,300
10	1,320	9,940	20	727	3,440	30	629	2,250
						31	594	-----
Monthly mean discharge, in cubic feet per second.....							1,041	4,324
Runoff, in acre-feet.....							64,000	257,300
Runoff, in inches.....							0.49	1.97

Gage height, in feet, and discharge, in cubic feet per second, at indicated time, 1953

Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge
	June 6		7	20.70	11,000		June 14		4	16.60	4,980
12	7.85	562	10	20.50	10,300	6	20.36	9,890	6	16.73	5,080
	June 7		4	20.08	9,180	N	20.12	9,270	8	16.85	5,180
6	7.85	562	8	19.75	8,520	6	19.86	8,720	10	16.93	5,240
N	8.00	615	12	19.40	7,950	12	19.63	8,310	12	16.95	5,260
3	8.13	660		June 11			June 15			June 26	
5	8.86	934	2	19.24	7,710	6	19.44	8,010	1	16.90	5,220
7	9.30	1,110	4	19.08	7,480	N	19.25	7,720	2	16.73	5,080
9	10.20	1,500	6	18.92	7,270	6	19.13	7,550	3	16.15	4,660
12	12.30	2,540	8	18.76	7,060	12	19.05	7,440	4	15.60	4,270
	June 8		10	18.58	6,840		June 16		5	15.12	3,960
1	13.06	2,920	N	18.41	6,630	6	18.92	7,270	6	14.65	3,720
2	13.81	3,300	2	18.20	6,400	N	18.72	7,010	7	14.18	3,480
3	14.48	3,630	4	18.04	6,240	6	18.50	6,740	8	13.82	3,300
4	14.94	3,860	6	17.91	6,120	12	18.27	6,480	9	13.44	3,110
5	15.35	4,100	8	17.81	6,030		June 17		10	13.20	2,990
6	15.50	4,200	10	17.83	6,050	6	18.05	6,250	11	12.95	2,860
8	15.72	4,350	12	18.09	6,290	N	17.84	6,060	N	12.75	2,760
10	15.93	4,500		June 12		6	17.62	5,860	2	12.46	2,620
N	16.13	4,640	2	18.69	6,970	12	17.38	5,640	4	12.28	2,530
2	16.29	4,750	4	19.38	7,920		June 18		6	12.15	2,460
4	16.47	4,880	6	20.21	9,490	6	17.12	5,410	8	12.05	2,420
6	16.69	5,050	8	20.93	11,800	N	16.86	5,190	10	11.97	2,380
8	16.85	5,180	10	21.43	13,800	6	16.54	4,930	12	11.89	2,340
10	17.00	5,300	N	21.79	15,700	12	16.16	4,660		June 27	
12	17.14	5,430	2	21.98	16,900		June 25		4	11.72	2,250
	June 9		4	22.05	17,300	1	11.05	1,920	8	11.52	2,150
3	17.35	5,620	6	22.09	17,500	2	11.05	1,920	N	11.35	2,060
6	17.59	5,830	8	22.07	17,400	3	11.65	2,220	4	11.34	2,060
9	18.03	6,230	10	22.02	17,100	4	12.65	2,720	8	11.78	2,280
N	18.80	7,110	12	21.97	16,800	5	13.80	3,290	12	12.25	2,520
3	19.50	8,100		June 13		6	14.80	3,790		June 28	
6	20.30	9,720	4	21.76	15,600	7	15.38	4,120	4	12.48	2,630
9	20.77	11,200	8	21.52	14,200	8	15.63	4,290	8	12.50	2,640
12	20.84	11,400	N	21.27	13,100	9	15.86	4,450	N	12.36	2,570
	June 10		4	21.04	12,200	10	15.99	4,540	4	12.17	2,480
2	20.90	11,600	8	20.83	11,400	11	16.10	4,620	8	12.02	2,400
2:30	20.90	11,700	12	20.63	10,700	N	16.23	4,710	12	11.92	2,350
4	20.87	11,500				2	16.41	4,840			

LITTLE SIOUX RIVER NEAR KENNEBEC, IOWA

Location. --Lat 42°05', long. 96°00', in S 1/2 sec. 18, T. 84 N., R. 44 W., on left bank, 15 ft downstream from bridge on county highway A, 1.3 miles south of Kennebec, 5.5 miles northeast of Onawa, and 6.5 miles upstream from Maple River. Datum of gage is 1,027.89 ft above mean sea level, datum of 1929 (Corps of Engineers benchmark).

Drainage area. --2,730 sq mi, approximately.

Gage-height record. --Water-stage recorder graph.

Discharge record. --Stage-discharge relation defined by current-meter measurements. Discharge for period of backwater from Maple River June 25 estimated on basis of records for Maple River at Mapleton. Shifting-control method used May 1-7, May 15 to June 7.

Maxima. --May-June 1953: Discharge, 11,500 cfs 7 p. m. June 14 (gage height, 23.97 ft).

1939 to April 1953: Discharge 12,000 cfs Apr. 11, 1951; gage height, 25.03 ft Aug. 7, 1945.

Mean discharge, in cubic feet per second, 1953

Day	May	June	Day	May	June	Day	May	June
1	1,260	710	11	1,450	9,070	21	888	3,150
2	1,390	713	12	1,320	7,150	22	898	2,760
3	1,590	674	13	1,220	9,840	23	892	2,480
4	1,700	660	14	1,150	11,200	24	888	2,250
5	1,770	644	15	1,110	10,800	25	954	3,190
6	1,820	644	16	1,090	9,300	26	951	4,080
7	1,810	705	17	1,040	7,070	27	902	2,480
8	1,760	2,350	18	976	5,790	28	864	2,460
9	1,650	5,510	19	948	4,790	29	818	2,470
10	1,550	8,380	20	909	3,800	30	772	2,350
						31	730	-----
Monthly mean discharge, in cubic feet per second.....							1,196	4,249
Runoff, in acre-feet.....							73,530	252,800
Runoff, in inches.....							0.50	1.74

Gage height, in feet, and discharge, in cubic feet per second, at indicated time, 1953

Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge
	June 6			June 10			June 15			June 20	
12	8.27	657	4	20.00	7,200	6	23.83	11,300	11	13.72	2,750
	June 7		8	21.05	8,250	7	23.97	11,400	N	13.38	2,610
N	8.32	674	N	21.63	8,830	12	23.85	11,300	1	13.20	2,540
8	8.48	730	4	21.82	9,020		June 15		2	13.20	2,540
10	8.84	839	8	21.90	9,100	6	23.75	11,200	3	13.30	2,580
12	9.07	920	12	22.11	9,320	N	23.40	10,800	4	13.58	2,690
	June 8			June 11		6	23.17	10,500	5	14.08	2,900
2	8.99	892	4	22.22	9,440	12	22.82	10,100	6	14.38	3,050
4	9.07	920	8	22.25	9,480		June 23		7	14.60	3,160
6	9.45	1,050	N	22.11	9,320	12	12.71	2,340	8	14.83	3,280
8	10.22	1,300	4	21.80	9,000		June 24		9	15.08	3,410
10	11.30	1,680	8	21.38	8,580	N	12.30	2,180	10	15.35	3,570
N	12.60	2,140	12	20.73	7,930	9	12.12	2,110	11	15.80	3,860
2	13.80	2,680		June 12		10	12.23	2,150	12	16.00	4,000
4	14.60	3,150	4	19.96	7,160	11	13.80	2,780		June 26	
6	15.37	3,580	8	19.45	6,700	12	14.53	3,120	6	16.62	4,460
8	15.86	3,900	N	19.21	6,490		June 25		N	16.87	4,650
10	16.26	4,280	4	19.57	6,810	1	15.00	3,360	1	16.88	4,660
12	16.62	4,450	8	20.41	7,610	2	15.55	3,690	5	15.85	3,900
	June 9		12	21.13	8,330	3	16.05	3,730	8	15.00	3,360
4	17.15	4,870		June 13		4	16.46	3,720	10	14.53	3,120
8	17.68	5,290	6	22.23	9,450	5	16.80	3,640	12	14.16	2,940
N	18.00	5,550	N	22.67	9,940	6	16.60	3,510		June 27	
4	18.32	5,810	6	23.05	10,400	7	15.75	3,360	N	12.95	2,440
8	18.66	6,090	12	23.44	10,800	8	15.25	3,180	6	12.65	2,320
12	19.08	6,470		June 14		9	14.80	3,020	12	12.36	2,200
			6	23.70	11,100	10	14.22	2,880			

MAPLE RIVER AT MAPLETON, IOWA

Location. --Lat 42°09', long. 95°48', in SE 1/4 sec. 23, T. 85 N., R. 43 W., in center of river on downstream side of pier of bridge on State Route 175, 80 ft downstream from Chicago & North Western Railway bridge, 0.8 mile southwest of Mapleton, 12.5 miles northeast of Turin, and 16 miles upstream from mouth.

Drainage area. --661 sq mi.

Gage-height record. --Water-stage recorder graph.

Discharge record. --Stage-discharge relation defined by current-meter measurements below 4,000 cfs and extended to peak stage by logarithmic plotting.

Maxima. --May-June 1953: Discharge, 11,500 cfs 1:30 a.m. June 25 (gage height, 17.66 ft).

1941 to April 1953: Discharge, 13,400 cfs June 27, 1952; gage height, 22.1 ft June 12, 1950.

Mean discharge, in cubic feet per second, 1953

Day	May	June	Day	May	June	Day	May	June
1	404	200	11	323	593	21	278	170
2	644	189	12	294	424	22	320	154
3	619	186	13	273	347	23	329	141
4	598	189	14	259	302	24	323	239
5	526	175	15	259	275	25	400	2,810
6	461	162	16	281	619	26	308	825
7	404	207	17	314	359	27	275	820
8	365	991	18	278	259	28	254	425
9	338	1,830	19	278	221	29	240	470
10	335	1,540	20	262	192	30	232	317
						31	210	-----
Monthly mean discharge, in cubic feet per second.....							345	521
Runoff, in acre-feet.....							21,190	31,000
Runoff, in inches.....							0.60	0.88

Gage height, in feet, and discharge, in cubic feet per second, at indicated time, 1953

Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge
		June 6	4	7.92	1,290			June 24	9	8.11	1,410
12	5.05	157	8	7.38	1,020	6	5.04	154	10	7.98	1,330
		June 7	12	6.99	827	N	4.99	141	11	7.85	1,260
3	5.05	157			June 11	6	4.97	136	12	7.73	1,200
6	5.09	167	6	6.59	644	9	4.96	134			
9	5.10	170	N	6.39	564	10	4.99	141	6	7.03	846
N	5.15	184	6	6.24	512	11	6.00	430	N	6.80	738
3	5.18	192	12	6.14	478	12	12.00	4,360	6	6.78	729
6	5.15	184			June 12			June 25	12	6.88	775
9	5.26	213	6	6.05	447	1	16.50	9,750			
12	6.53	619	N	5.98	423	1:30	17.66	11,500	6	7.13	895
		June 8	6	5.91	400	2	17.20	10,800	N	7.23	945
1	6.73	706	12	5.84	378	3	14.00	6,460	6	6.89	779
3	6.39	564			June 15	4	11.50	3,910	12	6.33	544
6	6.26	519	12	5.50	278	5	10.25	2,820			
9	6.19	495			June 16	6	9.88	2,560	6	5.99	427
N	6.71	697	4	5.53	286	7	9.69	2,420	N	5.84	378
3	7.79	1,220	8	5.64	317	8	9.34	2,180	6	5.85	381
6	8.33	1,540	N	7.19	925	9	9.00	1,940	12	6.15	481
9	8.62	1,710	2:30	7.39	1,020	10	8.70	1,760			
12	8.69	1,750	4	7.33	995	11	8.53	1,660	6	6.19	495
		June 9	8	6.88	775	N	8.49	1,630	N	6.18	491
6	8.76	1,800	12	6.36	554	1	8.50	1,640	6	6.08	457
N	8.79	1,810			June 17	2	8.52	1,650	12	5.88	391
6	8.89	1,870	6	5.86	384	3	8.55	1,670			
12	8.99	1,930	N	5.69	332	4	8.53	1,660	6	5.72	341
		June 10	6	5.59	302	5	8.46	1,620	N	5.62	311
4	9.06	1,980	12	5.52	283	6	8.43	1,600	6	5.53	286
8	8.96	1,920			June 23	7	8.35	1,550	12	5.46	267
N	8.53	1,660	12	4.96	134	8	8.22	1,470			

LITTLE SIOUX RIVER NEAR TURIN, IOWA

Location. --Lat 41°58', long. 95°58', on line between secs. 28 and 33, T. 83 N., R. 44 W., near center of span on upstream side of bridge on Brown's grade, 1 mile east of gaging station on Monona-Harrison ditch near Turin, 2.4 miles downstream from equalizer ditch connecting Little Sioux River and Monona-Harrison ditch, 3.5 miles downstream from Maple River, 3.8 miles south of Turin, 6.5 miles northeast of Blencoe, and 16.5 miles upstream from mouth. Datum of gage is 1,020.00 ft above mean sea level, datum of 1929 of Engineers benchmark).

Drainage area. --4,460 sq mi, approximately (combined area above this station and above station on Monona-Harrison ditch, 1 mile west).

Gage-height record. --Wire-weight gage read once daily except May 21, 22, June 7, 8. Graph drawn on basis of gage readings June 9-18.

Discharge record. --Stage-discharge relation defined by current-meter measurements. Discharge for periods of no gage-height record estimated on basis of weather records and records for stations on nearby streams. Shifting-control method used May 1 to June 6, June 8, 17-30.

Maxima. --May-June 1953: Discharge, 788 cfs about 12p.m. June 14 (gage height, about 18.35 ft).

1939 to April 1953: Discharge, 6,620 cfs Aug. 8, 1945; gage height observed, 26.0 ft Mar. 4, 1949 (ice jam), from floodmark.

Remarks. --Part or all of flow is diverted into Monona-Harrison ditch (see p. 51) through an equalizer ditch at a point 2.4 miles above station.

Mean discharge, in cubic feet per second, 1953

Day	May	June	Day	May	June	Day	May	June
1	4.3	1.0	11	2.8	515	21	2.6	0.2
2	4.3	1.2	12	2.7	156	22	2.5	.2
3	4.2	1.3	13	2.9	448	23	2.4	.2
4	3.3	1.2	14	2.8	726	24	12	.2
5	4.0	1.4	15	2.8	730	25	1.6	12
6	2.4	1.2	16	2.8	527	26	1.4	.2
7	2.4	1.2	17	2.8	150	27	1.8	.6
8	2.7	1.6	18	2.7	9.1	28	2.4	.7
9	3.3	207	19	2.7	.2	29	2.4	.4
10	2.9	650	20	2.7	.2	30	2.4	.4
						31	1.2	-----
Monthly mean discharge, in cubic feet per second.....							3.04	138
Runoff, in acre-feet.....							187	8,220
Runoff, in inches.....							*0.46	*1.30

* Computed from combined flow of this station and Monona-Harrison ditch.

Gage height, in feet, and discharge, in cubic feet per second, at indicated time, 1953

Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge
June 9			June 11			June 13			June 16		
8	15.22	97	8	17.48	573	6	16.52	347	8	17.50	578
4	16.25	285	4	16.93	441	N	17.00	458	4	17.15	494
12	17.05	470	12	16.30	396	6	17.42	559	12	16.57	358
June 10			June 12			June 14			June 17		
4	17.43	561	4	15.83	193	12	17.74	636	8	15.78	183
8	17.75	638	8	15.38	110	8	18.03	708	4	15.00	74
N	18.03	708	N	15.25	90	4	18.23	758	12	14.25	26
4	18.09	722	4	15.30	97	12	18.35	788	June 18		
8	18.02	705	8	15.56	141	June 15			8	13.73	10
12	17.87	668	12	15.95	219	8	18.23	758	4	13.25	3.6
						4	18.04	710	12	12.93	1.5
						12	17.83	658			

WEST FORK DITCH AT HOLLY SPRINGS, IOWA

Location. --Lat 42°16', long. 96°05', on line between secs. 9 and 16, T. 86 N., R. 45 W., near center of span on upstream side of bridge on State Route 141 at west edge of Holly Springs, 12 miles upstream from Wolf Creek, 16.5 miles north of Onawa, and 22 miles southeast of Sioux City. Datum of gage is 1,052.82 ft above mean sea level, datum of 1929 (Corps of Engineers benchmark).

Drainage area. --395 sq mi.

Gage-height record. --Wire-weight gage read once daily and oftener at high stages. Graph based on wire-weight gage readings June 7-11.

Discharge record. --Stage-discharge relation defined by current-meter measurements.

Maxima. --May-June 1953: Discharge, 5,050 cfs about 3 p.m. June 9 (gage height, 18.89 ft, from floodmark).

1939 to April 1953: Discharge, 6,600 cfs Aug. 6, 1945 (gage height, 22.4 ft, from floodmark).

Mean discharge, in cubic feet per second, 1953

Day	May	June	Day	May	June	Day	May	June
1	219	74	11	132	422	21	101	128
2	233	70	12	124	373	22	109	124
3	292	75	13	118	299	23	136	124
4	238	69	14	109	272	24	162	120
5	194	67	15	119	191	25	158	116
6	174	70	16	124	174	26	118	161
7	156	203	17	95	161	27	108	188
8	148	1,450	18	106	153	28	93	148
9	143	4,020	19	99	148	29	87	143
10	136	1,640	20	102	143	30	76	125
						31	85	-----
Monthly mean discharge, in cubic feet per second.....							139	382
Runoff, in acre-feet.....							8,520	22,710
Runoff, in inches.....							0.40	1.08

Gage height, in feet, and discharge, in cubic feet per second, at indicated time, 1953

Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge
		June 6			June 8			June 10			June 11
12	5.21	73	6	9.86	961	3	18.89	5,050	3	8.92	711
		June 7	N	11.30	1,400	6	18.44	4,770	6	8.42	594
6	5.23	75	6	12.80	1,910	9	17.74	4,320	9	8.08	521
9	5.27	79	12	14.25	2,490	12	16.98	3,870	12	7.90	485
N	5.55	109			June 9	3	16.10	3,380	6	7.64	433
6	6.97	307	6	16.00	3,330	6	14.65	2,670	N	7.56	417
12	8.38	585	N	18.20	4,610	9	12.60	1,840	6	7.48	401
						N	10.62	1,190	12	7.40	386

MONONA-HARRISON DITCH NEAR TURIN, IOWA

Location. --Lat 41°58', long. 95°59', on line between secs. 29 and 32, T. 83 N., R 44 W., on downstream handrail near center of bridge on Brown's grade, 1 mile west of gaging station on Little Sioux River near Turin, 1.5 miles downstream from equalizer ditch connecting Little Sioux River and Monona-Harrison ditch, 4 miles southwest of Turin, 5.5 miles northeast of Blencoe, and 13 miles upstream from mouth. Datum of gage is 1,020.00 ft above mean sea level, datum of 1929 (Corps of Engineers benchmark).

Drainage area. --4,460 sq mi, approximately (combined area above this station and above station on Little Sioux River, 1 mile east).

Gage-height record. --Wire-weight gage read once daily. Graph based on once-daily gage readings June 7-27.

Discharge record. --Stage-discharge relation defined by current-meter measurements. Shifting-control method used June 28-30.

Maxima. --May-June 1953: Discharge, 12,200 cfs 2-4 p. m. June 10 (gage height, 18.47 ft, from flood-mark).

1939 to April 1953: Discharge, 17,000 cfs Mar. 27, 1951; gage height, 25.6 ft Mar. 4, 1949 (ice jam), from floodmarks.

Remarks. --At times part or all of flow of Little Sioux River (see p. 48) is diverted into Monona-Harrison ditch through an equalizer ditch which connects the two channels 1.5 miles above station.

Mean discharge, in cubic feet per second, 1953

Day	May	June	Day	May	June	Day	May	June
1	2,080	948	11	2,160	9,870	21	1,310	3,840
2	2,400	965	12	2,000	8,260	22	1,350	3,310
3	2,610	934	13	1,780	9,730	23	1,400	2,930
4	2,820	912	14	1,680	10,900	24	1,390	2,710
5	2,720	860	15	1,570	11,000	25	1,560	4,950
6	2,690	870	16	1,560	9,880	26	1,390	5,730
7	2,620	965	17	1,560	8,040	27	1,240	3,660
8	2,510	3,830	18	1,460	6,600	28	1,220	3,220
9	2,360	9,060	19	1,420	5,450	29	1,160	3,190
10	2,120	11,700	20	1,280	4,610	30	1,090	3,100
						31	1,020	-----
Monthly mean discharge, in cubic feet per second.....							1,791	5,067
Runoff, in acre-feet.....							110,100	301,500
Runoff, in inches.....							-----	-----

Gage height, in feet, and discharge, in cubic feet per second, at indicated time, 1953

Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge
12	5.52	June 6 902	12	14.32	June 9 7,000	8	16.10	9,070			June 15
		June 7			June 9	12	15.62	8,490	6	17.70	11,100
N	5.57	920	2	15.00	7,750			June 12	N	17.64	11,100
6	5.69	962	4	15.28	8,000	4	15.22	8,010	6	17.50	10,900
8	5.76	986	6	15.50	8,350	8	15.12	7,890	12	17.30	10,600
10	6.10	1,120	N	16.10	9,070	N	15.20	7,990			June 16
12	6.72	1,410	6	16.72	9,860	4	15.46	8,300	6	17.07	10,300
		June 8	12	17.33	10,600	8	15.73	8,630	N	16.78	9,930
2	7.40	1,750			June 10	12	16.00	8,950	6	16.42	9,470
4	8.00	2,050	4	17.76	11,200			June 13	6	16.04	9,000
6	8.66	2,380	8	18.16	11,800	6	16.33	9,350			June 17
8	9.30	2,760	N	18.42	12,100	N	16.63	9,740	6	15.63	8,510
10	9.93	3,200	4	18.44	12,200	6	16.94	10,100	N	15.20	7,990
N	10.55	3,640	8	18.16	11,800	12	17.20	10,500	6	14.81	7,540
2	11.18	4,140	12	17.73	11,200			June 14	6	14.52	7,220
4	11.83	4,660			June 11	6	17.40	10,700			June 18
6	12.44	5,150	4	17.27	10,600	N	17.57	11,000	6	14.22	6,890
8	13.05	5,700	8	16.93	10,100	6	17.67	11,100	N	13.95	6,600
10	13.68	6,330	N	16.84	10,000	12	17.71	11,200	6	13.64	6,290
			4	16.54	9,620				12	13.36	6,010

Supplemental record.---June 10, about 2 p.m., 18.47 ft, 12,200 cfs; June 15, about 2 a.m., 17.72 ft, 11,200 cfs.

MISSOURI RIVER AT OMAHA, NEBR.

Location. --Lat 41°15'40", long. 95°55'15", in sec. 23, T. 15 N., R. 13 E., on right bank, left side of concrete floodwall, beneath Ak-Sar-Ben Bridge in Omaha. Datum of gage is 958.24 ft above mean sea level, datum of 1929

Drainage area. --322,800 sq mi, approximately.

Gage-height record. --Water-stage recorder graph.

Discharge record. --Stage-discharge relation defined by current-meter measurements. Shifting-control method used May 1 to June 30.

Maxima. --May-June 1953: Discharge, 112,000 cfs 7:30 p. m. June 26 (gage height, 13.69 ft).

1928 to April 1953: Discharge, 396,000 cfs Apr. 18, 1952 (gage height, 30.20 ft).

Remarks. --Flow partly regulated by Fort Peck and Fort Randall Reservoirs.

Mean discharge, in cubic feet per second, 1953

Day	May	June	Day	May	June	Day	May	June
1	31,900	29,900	11	47,300	71,000	21	32,600	101,000
2	34,200	29,100	12	44,900	66,500	22	34,000	97,100
3	40,500	29,600	13	45,900	76,500	23	33,700	85,300
4	49,800	29,400	14	43,000	85,700	24	33,300	86,400
5	81,700	29,200	15	41,600	82,600	25	32,400	99,500
6	95,200	31,300	16	40,800	72,900	26	31,900	107,000
7	84,000	34,700	17	36,000	66,300	27	31,000	111,000
8	67,800	56,200	18	32,700	56,900	28	30,200	101,000
9	59,300	79,400	19	32,100	59,800	29	30,000	95,800
10	54,400	84,100	20	31,900	94,200	30	31,500	94,100
						31	31,900	-----

Monthly mean discharge, in cubic feet per second.....	43,470	71,450
Runoff, in acre-feet.....	2,673,000	4,252,000
Runoff, in inches.....	-----	-----

Gage height, in feet, and discharge, in cubic feet per second, at indicated time, 1953

Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge
		June 6			June 8			June 10			June 11
12	5.21	32,900	6	6.38	42,200	N	10.78	81,700	12	10.32	78,100
		June 7				6	11.44	88,800			
6	5.23	33,300	N	8.52	59,800	12	11.28	87,100	6	9.83	73,600
N	5.36	34,300	6	9.59	69,700			June 10	N	9.47	70,300
6	5.50	35,500	12	9.30	67,400	6	10.97	84,100	6	9.19	67,800
12	5.88	38,400			June 9	N	11.22	87,000	12	9.01	66,200
			6	9.54	69,800	6	10.78	82,600			

SUMMARY OF FLOOD STAGES AND DISCHARGES

Table 2 summarizes the maximum stages and discharges for the current flood, the maxima for the period of operation of the gaging station prior to May 1, 1953; and the maxima, if known, for the period prior to collection of records. Central standard time is the basis throughout. Reference numbers refer to plate 2 and figure 11, and will aid in identifying the location of the observation. Plate 2 is a map showing the location of flood-determination points; figure 11, a plot of the relation of unit discharge to size of drainage basin. The peak discharges for stream-gaging stations have been determined by the methods described in detail in the section on page 18, and for crest-stage gages and miscellaneous ungaged points, the method of determination is shown by a headnote. Gaging stations may be identified by an entry in the "Period of record" column; for all other points, only a leader is shown. The discharges are given as observed; for information on possible regulation or diversion, see the individual record in the section "Stages and discharges at stream-gaging stations."

TABLE 2.--Summary of flood stages and discharges

[Maximum discharges for the floods of June 1953 were obtained from gaging-station records, except as otherwise indicated by the following symbols: A, contracted-opening measurement; B, slope-area measurement; C, flow-over-embankment measurement. See plate 2 for location of numbered places]

No.	Stream and place of determination	Drainage area (square miles)	Period of record	Maximum flood previously known				Maximum during flood of June 1953			
				Date	Gage height (feet)	Discharge (cfs)	Cfs per square mile	Date and hour	Gage height (feet)	Discharge (cfs)	Cfs per square mile
1	Watowan River near Garden City, Minn.	b 812	1940-45	May 21, 1944	9.84	5,620	6.92	June 9, 3 p.m.	a 18.6	17,700	21.8
2	Blue Earth River near Rapidan, Minn.	2,430	1909-10, 1939-45, 1949-53	Apr. 8, 1951	14.97	26,100	10.7	June 9, 9 p.m.	12.91	19,700	8.11
3	West Fork Des Moines River at Jackson, Minn.	b 1,220	1909-13, 1930-53	Apr. 10, 1951	14.73	4,380	3.59	June 8, 1:30 a.m.	a 17.43	8,360	6.85
4	West Fork Des Moines River at Estherville, Iowa.	1,408	1951-53	Apr. 6, 1952	11.82	4,880	3.47	June 8, 2-4 p.m.	c 15.53	10,800	7.67
5	West Fork Des Moines River at Humboldt, Iowa.	2,312	1940-53	June 23, 1947	12.2	11,000	4.76	June 13, 12m. to 12 p.m.	d e 9.64	6,280	2.72
6	East Fork Des Moines River near Burt, Iowa.	466	1951-53	Mar. 31, 1952	11.42	1,680	3.61	June 13, 5 a.m.	10.36	1,060	2.27
7	East Fork Des Moines River near Hardy, Iowa.	b 1,230	1940-53	June 23, 1947	15.4	13,000	10.6	June 9, 8 p.m.	7.33	1,340	1.09
8	Raccoon River near Jefferson, Iowa....	b 1,630	1940-53	June 23, 1947	22.3	29,100	17.9	June 10, 5 p.m.	9.80	3,220	1.98
9	South Raccoon River at Redfield, Iowa.	995	1940-53	June 12, 1947	a 24.3	23,800	23.9	June 10, 4 p.m.	23.08	21,300	21.4
10	Raccoon River at Van Meter, Iowa.....	b 3,410	1915-53	June 13, 1947	a 21.6	46,800	13.7	June 11, 3 a.m.	19.42	26,000	7.62
11	Otter Creek north of Sibley, Iowa.....	13.1	-----	-----	-----	-----	-----	June 7	-----	952A	72.7
12	Unnamed Creek (tributary to Otter Creek), Iowa.	1.53	-----	-----	-----	-----	-----	June 7	-----	503A	329
13	Otter Creek at Sibley, Iowa.....	31.0	-----	-----	-----	-----	-----	June 7	-----	5,430A	175
14	Unnamed Creek (tributary to Otter Creek), Iowa.	4.32	-----	-----	-----	-----	-----	June 7	-----	4,290A	993
15	Unnamed Creek (tributary to Otter Creek), Iowa.	7.07	-----	-----	-----	-----	-----	June 7	-----	2,840A	402
16	Otter Creek near Ashton, Iowa.....	88.7	-----	-----	-----	-----	-----	June 7	-----	17,800B	201
17	Rock River near Rock Valley, Iowa....	b 1,630	1948-53	Mar. 31, 1952	f 15.30	17,300	10.6	June 8, 5:30 p.m.	15.99	18,900	11.6
18	Dry Creek at Hawarden, Iowa.....	b 48	1948-53	Mar. 30, 1952	g 14.14	1,020	21.2	June 7, 9:30 p.m.	17.57	10,900	227
19	Big Sioux River at Akron, Iowa.....	8,851	1928-53	Apr. 1, 1952	19.75	33,000	3.73	June 8, 10 a.m.	19.33	21,800	2.46
20	Missouri River at Sioux City, Iowa....	b 314,600	1928-31, 1938-53	Apr. 14, 1952	24.28	441,000	1.40	June 25, 7 p.m.	9.19	109,000	.35
21	Perry Creek near Merrill, Iowa.....	7.95	-----	-----	-----	-----	-----	June 7	-----	2,540A	319
22	Unnamed Creek (tributary to Perry Creek), Iowa.	1.69	-----	-----	-----	-----	-----	June 7	-----	634A	375
23	Unnamed Creek (tributary to Perry Creek), Iowa.	.27	-----	-----	-----	-----	-----	June 7	-----	168A	622
24	Perry Creek near Hinton, Iowa.....	30.6	-----	-----	-----	-----	-----	June 7	-----	4,980A	163
25	Perry Creek at 38th Street, Sioux City, Iowa.	b 60	1946-53	Sept. 10, 1949	h 21.80	7,780	130	June 7, 9:30 p.m.	12.56	3,470	57.8
26	Floyd River at Sheldon, Iowa.....	b 80.5	-----	-----	-----	-----	-----	June 7	-----	25,200A	313
27	Little Floyd River near Sheldon, Iowa.	b 40	-----	-----	-----	-----	-----	June 7	-----	20,900A	522
28	Floyd River at Alton, Iowa.....	b 300	-----	-----	-----	-----	-----	June 7 or 8	-----	45,500A	152
29	Floyd River at Le Mars, Iowa.....	481	-----	-----	-----	-----	-----	June 8	-----	60,000A,C	125

TABLE 2.--Summary of flood stages and discharges--Continued

No.	Stream and place of determination	Drainage area (square miles)	Period of record	Maximum flood previously known				Maximum during flood of June 1953			
				Date	Gage height (feet)	Dis-charge (cfs)	Cfs per square mile	Date and hour	Gage height (feet)	Dis-charge (cfs)	Cfs per square mile
30	Plymouth Creek near Merrill, Iowa.....	^b 11	-----	-----	-----	-----	-----	June 8	-----	^j 3,250A	295
31	Floyd River above West Branch, near Merrill, Iowa.	^b 520	-----	-----	-----	-----	-----	June 8	-----	^j 52,000B	100
32	West Branch Floyd River at Dalton, Iowa.	224	-----	-----	-----	-----	-----	June 8	-----	30,500A	136
33	Mink Creek near Burnsville, Iowa.....	^b 25	-----	-----	-----	-----	-----	-----	-----	^j 13,700A	548
34	West Branch Floyd River below Mink Creek, near Merrill, Iowa.	289	-----	-----	-----	-----	-----	June 8	-----	^j 34,800B	120
35	Floyd River at James, Iowa.....	^b 918	1934-53	Mar. 31, 1952	^k 20.32	13,900	15.1	June 8, 12:30 p.m.	25.3	71,500	77.9
36	Omaha Creek at Homer, Nebr.....	^b 170	1946-53	May 23, 1952	^k 20.22	5,950	35.0	June 8, 4:30 a.m.	12.52	3,340	19.6
37	Little Sioux River near Lakefield, Minn.	17.1	1948-53	Apr. 5, 1951	ⁿ 6.30	224	13.1	June 7, 9 p.m.	10.20	2,550	149
38	Jackson County ditch 11 near Lakefield, Minn.	7.69	1948-53	June 27, 1951	^p 6.53	150	19.5	June 7, 9 p.m.	^a 10.91	1,150	149
39	Spirit Lake near Orleans, Iowa.....	-----	1933-53	June 19, 1944	15.74	-----	-----	June 14, 16	15.27	-----	-----
40	Okoboji Lake at Lakeside Laboratory, near Milford, Iowa.	-----	1933-53	June 15, 1945	5.42	-----	-----	June 13-14	5.15	-----	-----
41	Little Sioux River near Spencer, Iowa	555	-----	-----	-----	-----	-----	June 9, 3 a.m.	-----	9,400A	16.9
42	Ocheyedan River near Spencer, Iowa....	451	-----	-----	-----	-----	-----	June 8, 2:30 p.m.	-----	26,000A	57.6
43	Little Sioux River at Spencer, Iowa....	1,030	1936-42	Sept. 16, 1938	^q 14.97	5,000	4.85	June 8, 6 p.m.	^a 20.28	^r 30,000	29.1
44	Little Sioux River at Sioux Rapids, Iowa.	1,580	-----	-----	-----	-----	-----	June 10, 7:30 a.m.	-----	22,700A	14.4
45	Little Sioux River near Cherokee, Iowa J.	^b 1,920	1949-53	Apr. 6, 1951	16.45	16,100	8.39	June 11, 5 a.m.	17.48	21,400	11.1
46	Mill Creek near Cherokee, Iowa J.....	292	1949-53	Mar. 28, 1951	^s 9.10	3,050	10.4	June 8, 7 a.m. and 4-5 p.m.	14.30	11,500	39.4
47	Little Sioux River at Correctionville, Iowa.	^b 2,450	1918-25, 1928-32, 1936-53	Apr. 7, 1951	22.58	17,900	7.31	June 12, 6 p.m.	22.09	17,500	7.14
48	Little Sioux River near Kennebec, Iowa	^b 2,730	1939-53	Apr. 11, 1951	^t 25.03	12,000	4.40	June 14, 7 p.m.	23.97	11,500	4.21
49	Maple River at Mapleton, Iowa.....	661	1941-53	June 27, 1952	^u 22.1	13,400	20.3	June 25, 1:30 a.m.	^b 17.66	11,500	17.4
50	Little Sioux River near Turin, Iowa....	^b v 4,460	1939-53	Aug. 8, 1945	^u 26.0	6,620	-----	June 14, 12 p.m.	^a 18.35	788	-----
51	West Fork ditch at Holly Springs, Iowa	395	1939-53	Aug. 6, 1945	^u 22.4	6,600	16.7	June 9, 3 p.m.	^a 18.89	5,050	12.8
52	Monona-Harrison ditch near Turin, Iowa	^b v 4,460	1939-53	Mar. 27, 1951	^u 25.6	17,000	-----	June 10, 2-4 p.m.	^b 18.47	12,200	-----
53	Missouri River at Omaha, Nebr.....	^b 322,800	1928-53	Apr. 18, 1952	30.20	396,000	1.23	June 26, 7:30 p.m.	13.73	112,000	0.35

^a From floodmark.^b Approximately.^c Occurred 3 p.m. June 8.^d Observed.^e Occurred 6 p.m. June 13.^f Flood of 1897 reached a stage of 17.0 ft; discharge not determined.^g Flood of September 1926 reached a stage of 18.0 ft, flood of 1934 reached a stage of 15.8 ft; discharge not determined.^h Flood of July 7, 1944, reached a stage of 25.5 ft, from floodmarks; discharge, 9,600 cfs, by contracted-opening method, by Corps of Engineers.^j Furnished by Corps of Engineers.^k Site and datum then in use.^m Flood of June 4, 1940, reached a stage of 32.5 ft; discharge not determined.ⁿ Occurred Mar. 30, 1952; affected by ice backwater.^p Occurred Apr. 1, 1951; affected by ice backwater.^q Flood of Apr. 6, 1951, reached a stage of 16.7 ft; discharge, about 10,600 cfs. Flood of 1936 reached a stage of 15.4 ft.^r Estimated on basis of flows of Ocheyedan and Little Sioux Rivers.^s Flood of June 24, 1891, reached a stage of 31.0 ft, from floodmarks.^t Occurred Aug. 7, 1945.^u Occurred June 12, 1950.^v Combined drainage area of Little Sioux River and Monona-Harrison ditch.^w Occurred Mar. 4, 1949; affected by ice backwater.

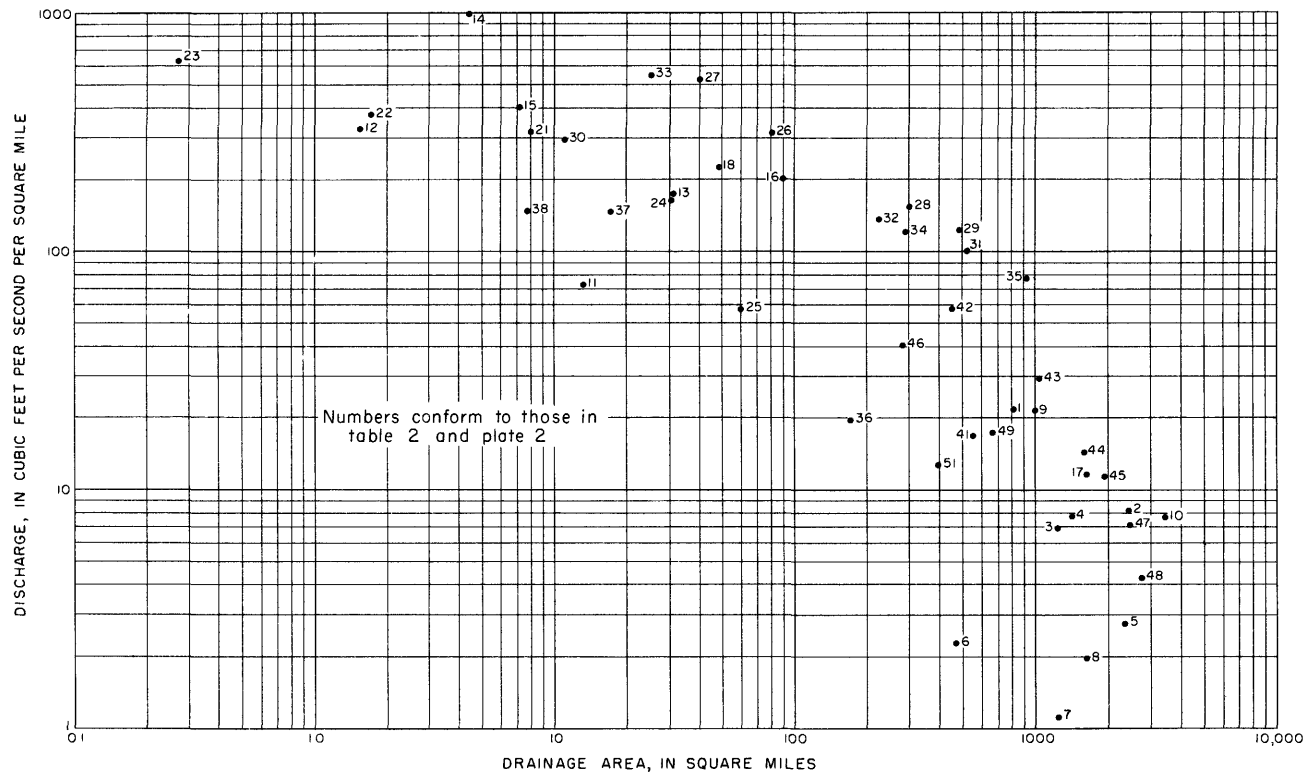


Figure 11. --Relation of unit discharge to the size of the drainage basin during floods of 1953.

FLOOD-CREST STAGES

Records of the flood-crest elevations for major streams in the area flooded during June 1953 are presented in this section. These records are useful as a guide for the design of structures to be built on or adjacent to the flood plain, and to determine the time of travel of the flood wave. The flood-crest elevations of June 1953 are the highest known over much of the area covered by this report; hence, the elevations recorded for the current flood will serve as valuable references for many years. Some of the stages for Sioux City may have been abnormal because of backwater effects of local cross currents in that portion of the flow that left the main channel. Because the flood resulted from what was essentially a single burst of excessive rainfall, the indicated travel times of the flood waves will also be useful information in hydrologic studies.

Tables 3 to 7 contain data on flood-crest stages along the West Fork Des Moines River, the Big Sioux River, Floyd River, at Sioux City, and the Little Sioux River basin, respectively. Plate 1 and figures 4 and 12 show locations of the places where stages were noted.

The list on page 62 shows the location of flood-crest reference marks not referred to sea level datum. Descriptions of these reference marks and the distance from the mark to the flood-crest is on file at the district offices of the Corps of Engineers in Rock Island, Ill., and Omaha, Nebr., and the Geological Survey district office in Iowa City, Iowa.

TABLE 3. --Flood-crest stages, West Fork Des Moines River

[Data on miles above mouth from House Document 682, 71st Congress, 3d sess. Data on elevation, where source is not otherwise indicated, is furnished by Iowa Natural Resources Council]

Location	Miles above mouth	Day and hour 1953	Elevation in feet (datum of 1929)
Windom, Minn.:			
Bridge on State Route 60.....	.....	June 7 or 8	^a 1,344.18
Left downstream bridge abutment in NE 1/4 sec. 1, T. 104 N., R. 36 W.	.....	.....do.....	^a 1,340.36
Left upstream pier of bridge in SW 1/4 sec. 19, T. 104 N., R. 35 W.	.....	.....do.....	^a 1,338.43
Left upstream pier of bridge at line between secs. 16 and 17, T. 103 N., R. 35 W.	.....	.....do.....	^a 1,326.21
Left downstream pier of bridge in SE 1/4 sec. 28, T. 103 N., R. 35 W.	.....	.....do.....	^a 1,320.90
Jackson, Minn.:			
Upstream side of bridge on U. S. Highway 16.....	.....	June 8	^a 1,308.46
Downstream side of bridge on U. S. Highway 16.....	.....	.....do.....	^a 1,307.71
Upstream side of State Street bridge.....	.....	.....do.....	^a 1,306.68
Downstream side of Ashley Street bridge.....	.....	.....do.....	^a 1,306.12
Downstream from powerplant dam.....	.....	.....do.....	^a 1,305.24
At U. S. Geological Survey recording gage.....	.....	.....do.....	^a 1,305.18
Right upstream pier of bridge on county road.....	.....	.....do.....	^a 1,304.68
Left downstream pier of bridge at line between secs. 7 and 8, T. 101 N., R. 34 W.	.....	.....do.....	^a 1,293.26
Petersburg, Minn.:			
Left downstream bridge abutment.....	.....	.....do.....	^a 1,286
Estherville, Iowa			
Upstream face, left wing wall of 4th Street bridge, marked "EM 1".	406.5	June 8, 2 p.m.	1,263.54
Downstream side of tree, 23 ft streamward and 4 ft upstream from southwest corner of municipal powerplant.	405.8	June 8, 3 p.m.	1,263.65
Near southeast corner of administration building of municipal treatment plant marked "INRC June 1953".	405.3	June 8	1,261.96
Left upstream pier of bridge on State Route 17.....	404.2	.....do.....	^b 1,257.93
Right upstream end of truss of bridge at line between secs. 30 and 31, T. 99 N., R. 33 W., marked "INRC June 1953".	400.8	.....do.....	1,250.67
Left upstream wing wall of bridge in sec. 7, T. 98 N., R. 33 W., marked "INRC June 1953".	397.8	June 9	1,242.27
Left upstream cylindrical pier of truss span bridge in sec. 29, T. 98 N., R. 33 W., marked "EM 7 INRC June 1953".	394.3	.....do.....	^c 1,234.4+
Right downstream abutment of Chicago Rock Island & Pacific Railway bridge in sec. 9, T. 97 N., R. 33 W.	389.8	.....do.....	^c 1,226.7±
Left upstream wing wall of bridge in sec. 27, T. 97 N., R. 33 W.	385.8	.....do.....	1,218.74
Left upstream wing wall of main channel bridge on U. S. Highway No. 18 at line between secs. 14 and 23, T. 96 N., R. 33 W.	380.3	June 9, 10 p.m.	^c 1,208.88
Left upstream side of approach span of bridge in sec. 35, T. 96 N., R. 33 W.	377.2	.....do.....	^c 1,200.32
Right upstream pier of bridge on State Route 17, east line sec. 12, T. 95 N., R. 33 W.	374.7	June 11	^c 1,194.30
Right downstream wing wall of bridge in sec. 21, T. 95 N., R. 32 W.	371.2	.....do.....	^c 1,182.88
Right upstream pier of bridge in sec. 29, T. 95 N., R. 31 W.	366.1	.....do.....	1,164.80
Left downstream wing wall of bridge at line between secs. 5 and 8, T. 94 N., R. 31 W.	364.0	.....do.....	1,157.97
Left abutment of bridge in sec. 17, T. 94 N., R. 31 W.....	362.5	June 12	1,152.85
Left upstream abutment of bridge at line between secs. 20 and 29, T. 94 N., R. 31 W.	361.0	-----	1,148.89
Right downstream abutment of bridge at line between secs. 1 and 2, T. 93 N., R. 31 W.	357.3	-----	1,138.50
Right downstream abutment of bridge in sec. 1. T. 93 N., R. 31 W.	355.1	June 12	1,128.20
Right upstream wing wall of bridge in sec. 25, T. 93 N., R. 31 W.	350.3	.....do.....	1,124.98
Left downstream wing wall of Chicago Burlington & Quincy Railway bridge in sec. 6, T. 92 N., R. 30 W.	346.6	.....do.....	1,119.14
Right downstream wing wall of bridge on State Route 287, at line between secs. 8 and 17, T. 92 N., R. 30 W.	344.9	.....do.....	1,114.85
Left downstream wing wall of bridge in sec. 23, T. 92 N., R. 30 W.	340.5	.....do.....	1,105.07
Left upstream end of dam in sec. 29, T. 92 N., R. 29 W.....	336.7	.....do.....	1,097.8
Left abutment of bridge in sec. 29, T. 92 N., R. 29 W.....	336.5	.....do.....	1,088.21
Left downstream wing wall of bridge in sec. 34, T. 92 N., R. 29 W.	333.5	.....do.....	1,080.7
Right upstream pier of bridge on State Route 3, at line between sec. 34, T. 92 N., R. 29 W., and sec. 3, T. 91 N., R. 29 W.	332.9	June 13	1,080.19
At Humboldt powerplant intake in sec. 2, T. 91 N., R. 29 W.....	331.5	June 13, 6 p.m.	1,076.90
Left wing wall below Humboldt powerplant dam.....	331.5	.....do.....	1,068.52

^a Furnished by Corps of Engineers.

^b Furnished by Iowa Natural Resources Council from Iowa State Highway Commission benchmark.

^c Furnished by Iowa Natural Resources Council from Palo Alto County benchmark.

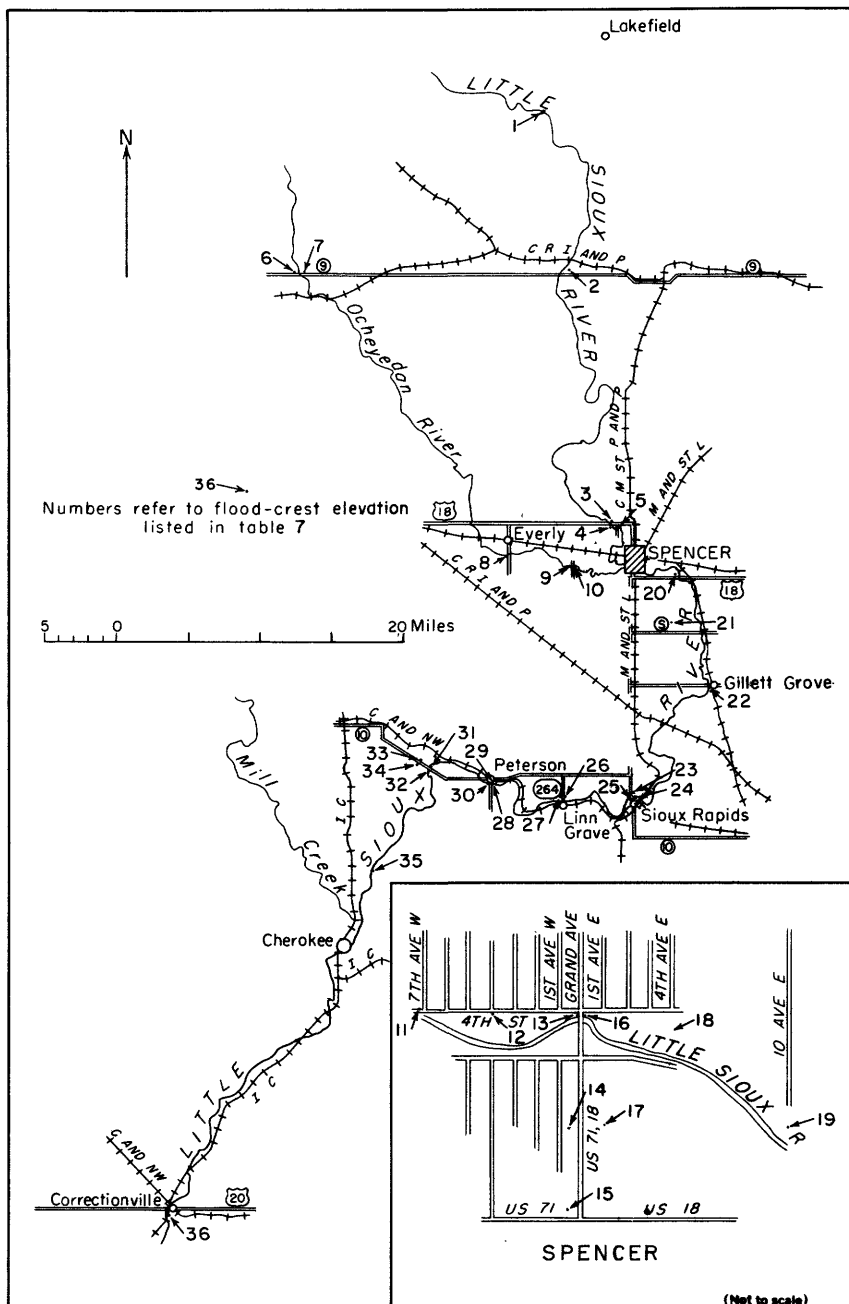


Figure 12. --Map showing location of flood-crest determinations in Little Sioux River basin.

TABLE 4.--Flood-crest stages, Big Sioux River Basin

Stream	Location	Day and hour 1953	Elevation in feet (datum of 1929)
Otter Creek	NE 1/4 sec. 15, T. 98 N., R. 42 W., at Ashton, Chicago & Northwestern Ry. depot.	.....	1,448.70
Rock River	NE 1/4 sec. 25, T. 97 N., R. 47 W., at U.S.G.S. recording gage.	June 8, 5:30 p.m.	^a 1,231.99
Dry Creek	NE 1/4 NE 1/4 sec. 2, T. 94 N., R. 48 W., at U.S.G.S. recording gage.	June 7, 9:30 p.m.	1,187.99
Big Sioux River	W 1/2 sec. 31, T. 93 N., R. 48 W., at U.S.G.S. recording gage.	June 8, 10 a.m.	1,138.23

^a Iowa State Highway Commission datum.

TABLE 5.--Flood-crest stages, Floyd River

[See plate 1 for location of marks]

Location	Day and hour, 1953	Elevation in feet (datum of 1929)
Upstream side of road on U. S. Highway 18, on south line sec. 25, T. 97 N., R. 43 W.	June 7	1,382.64
Downstream side of road at above location.....	....do.....	1,381.05
At Alton, downstream side of road on State Route 33, in NE 1/4 sec. 2, T. 94 N., R. 44 W.	June 8, 1:30 a.m.	1,301.50
At Alton, 300 ft downstream from above location, and 200 feet upstream from Chicago & Northwestern Railway bridge.	....do.....	1,301.33
At Alton, 400 ft downstream from C. & N.W. Ry. bridge in NE 1/4 sec. 2, T. 94 N., R. 44 W.	....do.....	1,297.11
Upstream side of road and 300 ft east of C. & N.W. Ry. in SE 1/4 sec. 21, T. 94 N., R. 44 W.	.....	^a 1,274.25
300 ft east and 300 ft downstream from bridge on county road near Southeast corner sec. 21, T. 94 N., R. 44 W.	.....	1,273.92
Upstream side of road east of C. & N.W. Ry. and a quarter of a mile west of bridge in SW 1/4 sec. 6, T. 93 N., R. 44 W.	.....	1,250.42
At Seney, near quarter corner on south line sec. 23, T. 93 N., R. 45 W.	.....	^a 1,230.56
Upstream side of U. S. Highway 75 at farm entrance a quarter of a mile right of bridge in sec. 9, T. 92 N., R. 45 W.	.....	^a 1,209.45
Downstream side of U. S. Highway 75, 500 ft left of bridge in sec. 9, T. 92 N., R. 45 W.	.....	^a 1,204.56
Upstream side of bridge on State Route 5 at south line sec. 8, T. 92 N., R. 45 W.	.....	1,203.82
Left upstream wing wall of above bridge.....	.....	1,202.26
Left downstream corner of abutment of above bridge.....	.....	1,202.15
Downstream side of State Route 5 at north line sec. 17, T. 92 N., R. 45 W.	.....	1,201.62
At intersection of U. S. Highway 75 and county road near quarter corner on west line sec. 20, T. 92 N., R. 45 W.	.....	^a 1,193
At Merrill, 300 ft east of C. & N.W. Ry. depot near north line sec. 11, T. 91 N., R. 46 W.	.....	1,172.24
At Hinton, at upstream side of road near quarter corner on west line sec. 9, T. 90 N., R. 46 W.	.....	^a 1,142.95
At James, at U.S. Geological Survey recording gage in NW 1/4 NW 1/4 sec. 32, T. 90 N., R. 46 W.	June 8, 12:30 p.m.	1,127.9

^a Furnished by Iowa Natural Resources Council.

TABLE 6. --Flood-crest stages for Floyd River in Sioux City area

[See figure 4 for location of marks]

Location	Obtained by	Elevation in feet (datum of 1929)
At KSCJ radio transmitter.....	City engineer.....	1,118.33
Upstream side, 41st Street bridge.....	do.....	1,115.16
Upstream side, 18th Street bridge.....	do.....	1,110.17
Upstream side, 7th Street bridge.....	do.....	1,109.12
South side of Hardy Construction Company building at 2201 Fifth Street...	U.S. Geol. Survey.	1,108.82
Northwest corner of Sioux Bee Honey building on upstream side of Plymouth Street.	do.....	1,108.76
Southwest corner of above building.....	do.....	1,108.62
Right side of above building.....	do.....	1,108.62
Intersection of 6th and Wall Streets.....	City engineer.....	1,108.52
Right downstream corner of house at 2409 Fifth Street.....	U.S. Geol. Survey.	1,108.45
Intersection of 4th and Lafayette Streets.....	City engineer.....	1,108.33
Upstream side of bridge at 2d and Fairmount Streets.....	do.....	1,108.32
Fleming washing machine shop at 4th and Iowa Streets.....	do.....	1,106.11
Upstream side of Chicago & Northwestern Railway bridge at mouth of Floyd River.	do.....	1,093.25
Missouri River at Interstate bridge (U.S. Geol. Survey gage).....	U.S. Geol. Survey.	1,084.84

TABLE 7. --Flood-crest stages, Little Sioux River basin

[See figure 12 for numbered location of marks]

No.	Location	Day and hour 1953	Elevation in feet (datum of 1929)
Little Sioux River			
1	At U.S. Geological Survey recording gage in SE 1/4 sec. 21, T. 102 N., R. 37 W.	June 7, 9 p.m.	1,415.48
2	Upstream side and 2,000 ft left of bridge on State Route 9, in SW 1/4 sec. 33, T. 100 N., R. 37 W.	.....do.....	^a 1,392.26
3	Upstream side of bridge on U.S. Highway 18, in SW 1/4 sec. 27, T. 97 N., R. 37 W.	June 9, 3 a.m.	1,326.36
4	Downstream side of above bridge, in NE 1/4 sec. 34, T. 97 N., R. 37 W.	.....do.....	1,325.41
5	Left downstream wing wall of bridge on county road in NW 1/4 sec. 35, T. 97 N., R. 37 W.	.....do.....	^a 1,325.27
Ocheyedan River			
6	Right upstream pier of bridge on State Route 9, in SW 1/4 sec 31, T. 100 N., R. 40 W.	June 7, 11 p.m...	^a 1,505.4
7	Upstream side of State Route 9, in SW 1/4 sec. 33, T. 100 N., R. 40 W.	.....do.....	^a 1,504.1
8	Upstream side of right approach to bridge on county road at east line of sec. 9, T. 96 N., R. 38 W.	June 8, 10:30 a.m.	^a 1,353.07
9	Upstream side of right approach to bridge on county road near southwest corner sec. 16, T. 96 N., R. 37 W.	June 8, 2:30 p.m.	^a 1,326.34
10	Downstream side of bridge on county road near southwest corner sec. 16, T. 96 N., R. 37 W.	.....do.....	1,324.53
At Spencer, Iowa:			
11	At 700 West 4th Street.....	.....do.....	^b 1,315.89
12	At Clay County garage at south end of 4th Ave. W.....	.....do.....	^b 1,315.29
13	Left upstream wing wall of Grand Ave. bridge.....	June 8, 6 p.m.	^b 1,314.84
14	At southwest corner of Spencer Lumber Co. building.....	.....do.....	^b 1,314.86
15	At entrance to Garmy's Cafe.....	.....do.....	^b 1,314.87
16	Left downstream wing wall of Grand Ave. bridge.....	.....do.....	^b 1,314.74
17	West end of Case Implement Co. building.....	.....do.....	^b 1,314.52
18	At sewage-lift station on left bank at 4th Ave. E.....	.....do.....	^b 1,313.22
19	At rendering plant on left bank at 10th Ave. E.....	.....do.....	^b 1,310.78
20	Upstream and 300 ft right from bridge on U. S. Highway 18, in SW 1/4 sec. 15, T. 96 N., R. 36 W.	June 8	^a 1,303.68
21	Downstream from road and opposite Warren farm house on county road S, in NW 1/4 sec. 3, T. 95 N., R. 36 W.	.....do.....	^a 1,292.50
22	At Gillett Grove, left downstream side of road at bridge in NE 1/4 sec. 25, T. 95 N., R. 36 W.	June 9, 2 a.m.	^a 1,280.77
At Sioux Rapids, Iowa:			
23	Right upstream side of road at bridge on U. S. Highway 71, in NW 1/4 sec. 2, T. 93 N., R. 37 W.	June 10, 3 a.m.	1,257.71

TABLE 7.--Flood-crest stages, Little Sioux River basin--Continued

[See figure 12 for numbered location of marks]

No.	Location	Day and hour 1953	Elevation in feet (datum of 1929)
24	At Sioux Rapids--Continued At intersection of Park Street and U. S. Highway 71, in sec. 1, T. 93 N., R. 37 W.	June 10, 3 a.m.	^a 1,257.61
25	Downstream side of bridge on U. S. Highway 71, in NW 1/4 sec. 2, T. 93 N., R. 37 W.	....do.....	1,256.4
26	At Linn Grove, upstream side of road and 300 ft right of bridge on State Route 264, in SE 1/4 sec. 5, T. 93 N., R. 37 W.	June 10	^a 1,244.47
27	At Linn Grove, downstream side of road and 300 ft right of bridge on State Route 264.	....do.....	^c 1,244.26
28	At Petersen: 85 ft upstream from bridge to Wanata State Park, in SW 1/4 sec. 33, T. 94 N., R. 38 W.	....do.....	^c 1,229.48
29	Right upstream abutment of above bridge.....	....do.....	^a 1,229.00
30	Right downstream side of road at above bridge.....	....do.....	^c 1,228.70
31	Left upstream abutment of bridge on State Route 10, in NE 1/4 sec. 32, T. 94 N., R. 38 W.	....do.....	^a 1,225.70
32	Left downstream abutment of above bridge.....	....do.....	^a 1,225.67
33	Upstream side of road on State Route 10, NE 1/4 sec. 27, T. 94 N., R. 39 W.	....do.....	1,216.19
34	Downstream side of road at above location.....	....do.....	1,215.78
35	At Corps of Engineers gage near Cherokee, in sec. 36, T. 93 N., R. 40 W.	June 11, 5 a.m.	^c 1,188.90
36	At U. S. Geological Survey recording gage near Correctionville, in N 1/2 sec. 1, T. 88 N., R. 43 W.	June 12, 6 p.m.	1,118.58

^a Furnished by Iowa Natural Resources Council.^b Furnished by city of Spencer.^c Furnished by Corps of Engineers.

Location of flood-crest reference marks

[Elevation of flood crest not determined]

Location	Structure	Authority
West Fork Des Moines River:		
Sec. 21, T. 100 N., R. 34 W.....	bridge	Corps. of Engineers, Rock Island, Ill.
Sec. 34, T. 100 N., R. 34 W.....	....do.....	Do.
State Route 9 in Estherville.....	....do.....	Do.
State Route 345 east of Graettinger.....	....do.....	Do.
County road T in Bradgate.....	....do.....	Do.
Otter Creek:		
NW 1/4 sec. 30, T. 100 N., R. 41 W.....	....do.....	U.S. Geol. Survey
Sec. 11, T. 99 N., R. 42 W.....	....do.....	Do.
Sec. 1, T. 98 N., R. 42 W.....	....do.....	Do.
SW 1/4 sec. 5, T. 97 N., R. 43 W.....	....do.....	Corps. of Engineers, Omaha, Nebr.
NW 1/4 sec. 7, T. 97 N., R. 43 W.....	....do.....	Do.
SE 1/4 sec. 1, T. 97 N., R. 44 W.....	....do.....	Do.
NW 1/4 sec. 1, T. 97 N., R. 44 W.....	....do.....	Do.
SW 1/4 sec. 35, T. 98 N., R. 44 W.....	....do.....	Do.
North line sec. 34, T. 98 N., R. 44 W.....	....do.....	Do.
NW 1/4 sec. 28, T. 98 N., R. 44 W.....	....do.....	Do.
Little Rock River:		
South line sec. 10, T. 98 N., R. 44 W.....	....do.....	Do.
SW 1/4 sec. 16, T. 98 N., R. 44 W.....	....do.....	Do.
SW 1/4 sec. 12, T. 98 N., R. 45 W.....	....do.....	Do.
SW 1/4 sec. 21, T. 98 N., R. 45 W.....	....do.....	Do.
South line sec. 30, T. 98 N., R. 45 W.....	power pole	Do.
West line sec. 36, T. 98 N., R. 46 W.....	bridge	Do.
Dry Creek:		
West line sec. 20, T. 96 N., R. 46 W.....	....do.....	Do.
NW 1/4 sec. 30, T. 96 N., R. 46 W.....	....do.....	Do.
West line sec. 25, T. 96 N., R. 47 W.....	....do.....	Do.
SE 1/4 sec. 27, T. 96 N., R. 47 W.....	....do.....	Do.
West line sec. 34, T. 96 N., R. 47 W.....	....do.....	Do.
South line sec. 33, T. 96 N., R. 47 W.....	....do.....	Do.
West line sec. 4, T. 95 N., R. 47 W.....	....do.....	Do.
South line sec. 5, T. 95 N., R. 47 W.....	....do.....	Do.
West line sec. 8, T. 95 N., R. 47 W.....	telephone pole	Do.
South line sec. 7, T. 95 N., R. 47 W.....	tree	Do.
SW 1/4 sec. 18, T. 95 N., R. 47 W.....	bridge	Do.
South line sec. 19, T. 95 N., R. 47 W.....	....do.....	Do.
SW 1/4 sec. 30, T. 95 N., R. 47 W.....	....do.....	Do.
Perry Creek:		
Sec. 1, T. 91 N., R. 47 W.....	....do.....	U.S. Geol. Survey
State Route 29.....	....do.....	Do.

RECORDS OF PREVIOUS FLOODS

Gaging stations have been operated in the flooded area for several years; but for the study of flood frequencies, the records are not of great value because of the short period covered. Many great floods occurred in the area prior to the systematic collection of gaging-station records; descriptive information, in most cases, is all that is available for a study of these floods.

Data on three intense storms that caused notable floods in the area are contained in a report "Storm rainfall in the United States" prepared in 1945 by the Corps of Engineers, Department of the Army. These storms are:

<u>Location of center</u>	<u>Date</u>	<u>Maximum storm rainfall</u> (inches)
Larrabee, Iowa	June 23-27, 1891.....	13.0
Primghar, Iowa.....	July 14-17, 1900.....	13.60
Boyden, Iowa	Sept. 17-19, 1926.....	24

Descriptions of major floods in the Floyd River basin have been given front page coverage in newspapers published in Sioux City because much of the commercial and industrial activity of the city is located on the Floyd River flood plain. The first major flood on the Floyd River at Sioux City occurred May 18-19, 1892. It was the greatest previously known flood and twenty-five people were drowned at Sioux City. Other notable floods occurred at Sioux City in 1900, 1926, and 1934. In 1940, because of the repeated floods, improvement of the Floyd River channel was started. These improvements consisted of enlargement and straightening of the channel, lining a channel reach of about 1 mile upstream from the mouth with concrete, and construction of levees. Because of the channel improvements and cultural development on the flood plain, the flood-crest elevations at a common point may not show the true relative magnitude of great floods on Floyd River at Sioux City. The crest elevations of major floods at the intersection of Fourth and Lafayette Streets (see fig. 4) are:

<u>Date</u>	<u>Elevation in feet</u> (datum of 1929)
May 18-19, 1892.....	1,104.68
Sept. 17-19, 1926.....	1,101.77
June 7-8, 1934.....	1,102.57
June 8, 1953.....	1,108.33

The flood of May 1892 on Floyd River at Merrill was from 1 to 2 feet lower than the 1953 stage. A small community, Lynn, just upstream from Sioux City was destroyed by the 1892 Floyd River flood and was not rebuilt. The flood at Sioux City in 1926 caused 6 deaths, flooded 600 homes, and caused property damage estimated at \$246,710. A good description of this flood at Sioux City has been published (Spencer, 1926). The Corps of Engineers have estimated the peak discharge for the floods in 1926 and 1934 on Floyd River at Alton as 38,800 cfs and 34,600 cfs, respectively; the 1953 peak discharge was measured at 45,500 cfs.

The September storm in 1926 also caused great floods on Dry Creek and lower Big Sioux River. Damage was severe at Hawarden, on Dry Creek; 350 houses and buildings were flooded, 3 bridges were destroyed, and total damage was estimated to be \$275,000. This storm also covered the upper end of Raccoon River drainage and caused damage to crops, highways, and bridges.

Little information is available on great floods in the Little Sioux River basin. The intense storm of June 23-27, 1891, caused extensive overflow on farmland and towns located along the river. Mill Creek is reported to have reached a stage of 31 feet at the Corps of Engineers gage site on June 24, 1891. There is no information on the size of the 1891 flood on Little Sioux River at Spencer; judging by the isohyetal map of the storm, flood flows on upper Little Sioux River may not have been great. Gaging-station records at Spencer were collected by the Geological Survey from 1936 to 1942. The flood of April 6, 1951, reached a stage of 16.7 feet (discharge estimated at 10,000 cfs) on the Geological Survey gage; the Little Sioux River above Ocheyedan River was estimated to have had a peak discharge of 4,240 cfs during this flood. There is no historical information on great floods in the portions of West Fork Des Moines River and Minnesota River affected by the 1953 flood.

Special reports (Schwob, 1953; Prior, 1949) are available on magnitude and frequency of floods in Iowa and Minnesota. These reports contain an analysis on a regional basis of the floods measured at Geological Survey gaging stations. Graphs show the mean annual flood in cubic feet per second and the magnitude of floods of various recurrence intervals.

The flood-frequency report for Iowa (Schwob, 1953), prepared prior to the June 1953 flood, offers an interesting measure of comparison for the size of the June 1953 flood. Using the graphs (area E) in that report, and the highest of the June 1953 floods the following comparisons have been obtained.

Magnitude and frequency of Iowa floods

Drainage area (sq mi)	Mean annual flood (cfs)	50-year flood (cfs)	June 1953 floods
500	2,800	7,840	60,000
1,000	3,800	10,600	68,000
5,000	7,900	22,100	30,000

For drainage areas of 1,000 square miles or less magnitudes of the June 1953 flood were so great that it will take many more years of records to establish reliable recurrence intervals for the 1953 floods.

SELECTED BIBLIOGRAPHY

- Congressional Documents; 1930, 71st Cong., 3d sess., H. Doc. 682.-----1932, 72d Cong., 1st sess., H. Doc. 189.
- Corps of Engineers, Department of the Army, 1945, Storm rainfall in the United States.
- Kindsvater, C. E., Carter, R. W., and Tracy, H. J., 1953, Computation of peak discharge at contractions; U. S. Geol. Survey Circ. 284.
- Prior, C. H., 1949, Magnitude and frequency of floods in Minnesota: Minnesota Dept. of Cons., Bull. 1.
- Schwob, H. H., 1953, Iowa floods, magnitude and frequency: Iowa Highway Research Board, Bull. 1.
- Spencer, R. E., 1926, Rivers and floods: Monthly Weather Rev., v. 54, no. 9, p. 400-401.
- U. S. Geological Survey, 1953, Water Resources Review, June.
- U. S. Weather Bureau, 1953, Climatological Data, Iowa: v. 64, no. 6.
- _____, 1953, Climatological Data, Minnesota: v. 59, no. 6.

INDEX

	Page
Akron, Iowa, Big Sioux River at.....	34
Bibliography, selected	65
Big Sioux River, at Akron, Iowa.....	34
Blue Earth River, near Rapidan, Minn.....	23
Burt, Iowa, East Fork Des Moines River near.....	27
Cherokee, Iowa, Little Sioux River near.....	44
Mill Creek near.....	45
Correctionville, Iowa, Little Sioux River at.....	46
Damages, flood.....	16-18
Dry Creek, at Hawarden, Iowa.....	33
East Fork Des Moines River, near Burt, Iowa.....	27
near Hardy, Iowa	28
Estherville, Iowa, West Fork Des Moines River at...	25
Flood-crest stages.....	57-62
Big Sioux River basin	60
Floyd River	60
Floyd River in Sioux City area	61
Little Sioux River basin	61-62
West Fork Des Moines River	58
Flood damages	16-18
Flood discharges, measurement of.....	18-19
Floods, general description of.....	4-16
Flood stages and discharges, summary of	53-56
Floyd River, at James, Iowa	38
at Merrill, Iowa.....	37
Hardy, Iowa, East Fork Des Moines River near.....	28
Hawarden, Iowa, Dry Creek at.....	33
Holly Springs, Iowa, West Fork ditch at.....	50
Homer, Nebr., Omaha Creek at.....	39
Humboldt, Iowa, West Fork Des Moines River at.....	26
Introduction.....	2-4
Jackson County ditch 11, near Lakefield, Minn.....	41
Jackson, Minn., West Fork Des Moines River at.....	24
James, Iowa, Floyd River at.....	38
Jefferson, Iowa, Raccoon River near	29
Kennebec, Iowa, Little Sioux River near.....	47
Lakefield, Minn., Jackson County ditch 11 near	41
Little Sioux River near	40
Little Sioux River, at Correctionville, Iowa	46
near Cherokee, Iowa.....	44
near Kennebec, Iowa.....	47
near Lakefield, Minn	40
near Turin, Iowa.....	49
Maple River, at Mapleton, Iowa	48
Mapleton, Iowa, Maple River at	48
Merrill, Iowa, Floyd River at.....	37
Mill Creek, near Cherokee, Iowa	45

	Page
Milford, Iowa, Okoboji Lake at Lakeside Laboratory near	43
Missouri River, at Omaha, Nebr.....	52
at Sioux City, Iowa	35
Monona-Harrison ditch, near Turin, Iowa.....	51
Okoboji Lake, at Lakeside Laboratory, near Milford, Iowa	43
Omaha, Nebr., Missouri River at.....	52
Omaha Creek, at Homer, Nebr	39
Orleans, Iowa, Spirit Lake near.....	42
Perry Creek, at 38th Street, Sioux City, Iowa.....	36
Previous floods, records of	63-65
Raccoon River, at Van Meter, Iowa	31
near Jefferson, Iowa.....	29
Rapidan, Minn., Blue Earth River near	23
Redfield, Iowa, South Raccoon River at.....	30
Rock River, near Rock Valley, Iowa	32
Rock Valley, Iowa, Rock River near	32
Sioux City, Iowa, Missouri River at.....	35
Perry Creek at 38th Street	36
South Raccoon River, at Redfield, Iowa	30
Spirit Lake, near Orleans, Iowa.....	42
Stream-gaging stations, stages and discharges at	19-52
Turin, Iowa, Little Sioux River near.....	49
Monona-Harrison ditch near	51
Van Meter, Iowa, Raccoon River at	31
West Fork Des Moines River, at Estherville, Iowa...	25
at Humboldt, Iowa	26
at Jackson, Minn.....	24
West Fork ditch, at Holly Springs, Iowa	50