

GB
1225
.18
C37
1967

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
WATER RESOURCES DIVISION

FLOODS IN ROCK RIVER BASIN, IOWA

By

Philip J. Carpenter, Hydraulic Engineer
United States Geological Survey

Prepared in cooperation with the
IOWA STATE HIGHWAY COMMISSION

Open-file Report

Iowa City, Iowa
September 1967

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
WATER RESOURCES DIVISION

FLOODS IN ROCK RIVER BASIN, IOWA

By

Philip J. Carpenter, Hydraulic Engineer
United States Geological Survey

Prepared in cooperation with the
IOWA STATE HIGHWAY COMMISSION

Open-file Report

Iowa City, Iowa
September 1967

CONTENTS

	Page
Abstract-----	1
Introduction-----	3
Purpose and scope-----	3
Acknowledgments-----	3
Basin description-----	4
Flood history-----	6
Basic data-----	7
Data analysis-----	9
Flood frequency-----	9
Profiles-----	11
Discussion-----	13
References-----	16
Appendix (gaging-station records)-----	17
Rock River at Rock Rapids, Iowa-----	18
Rock River near Rock Valley, Iowa-----	24

ILLUSTRATIONS

	Page
Figure 1. Map of Rock River basin-----	5
2. Rock River flood-frequency curves-----	12
Plate 1. Rock River profiles mile 0 to mile 20-----	12
2. Rock River profiles mile 20 to mile 40-----	12
3. Rock River profiles mile 40 to mile 49.8-----	12

TABLES

	Page
Table 1. Drainage area of the principal tributaries to the Rock River and of the main stem Rock River in Iowa-----	8

FLOODS IN ROCK RIVER BASIN, IOWA

By Philip J. Carpenter

ABSTRACT

This report contains flood information for the Rock River Basin in Iowa. Data on water-surface elevation, discharge, runoff volume, time distribution of runoff, and average frequency of flooding are presented for the Rock River in Iowa.

Six water-surface profiles with corresponding discharges are given for the Rock River from the mouth to the Iowa-Minnesota State line. Three profiles represent known floods that occurred March 29-30, 1962 (maximum flood of record with an estimated average frequency of occurrence of slightly less than once in 30 years), September 7-8, 1964, and April 2, 1965. Two profiles represent the computed 25- and 50-year recurrence-interval floods. One profile represents the low-flow condition of August 3, 1966. Elevation-discharge relationships at any point along the Rock River in Iowa can be determined from the elevations and corresponding discharges shown on the profiles.

Detailed gage heights and discharges for the March 29-30, 1962, and April 2, 1965, floods at the gaging stations on the Rock River at Rock Rapids and near Rock Valley, Iowa, are included. Flood hydrographs reconstructed from the gage heights and discharges can be used in studies of runoff volume and time distribution of runoff for the two floods.

A method of determining flood magnitude and frequency along the Rock River in Iowa is described in the report.

INTRODUCTION

Purpose and Scope

The purpose of this report is to present the available flood information for the Rock River basin in Iowa that can be used for planning, designing, and operating structures across the Rock River and on its flood plain and for appraising the severity of floods in the basin. Information provided includes:

- (1) A description of the physical characteristics and flood history of the basin.
- (2) Basic physical and streamflow data for the Rock River.
- (3) A discussion of the magnitude and frequency of floods along the Rock River.
- (4) Profiles of three actual floods including the maximum flood of record, a profile of a low-flow condition, and profiles of the computed 25- and 50-year recurrence-interval floods, all for the Rock River.
- (5) Detailed gage heights and discharges of two floods of record for the Rock River at Rock Rapids and near Rock Valley, Iowa.

The discussion section of this report outlines some possible uses and limitations affecting the application of flood information presented.

Acknowledgments

This report is the third of a series resulting from a cooperative program with the Iowa State Highway Commission through the Iowa Highway Research Board. Collection of basic information and preparation of the report were by the U.S. Geological Survey. The stream-gaging stations for which records are used in the study **are** operated and maintained through cooperative

agreements between the U.S. Geological Survey and the City of Rock Rapids, the U.S. Corps of Engineers, and the Iowa Geological Survey.

BASIN DESCRIPTION

The Rock River basin is located in the southwestern corner of Minnesota and the northwestern corner of Iowa (fig. 1). The center of the basin lies approximately 70 miles north of Sioux City, Iowa. The drainage area is 1,688 square miles (Larimer, 1957, p. 367), of which 770 square miles are in Iowa. It is the largest tributary basin in the Big Sioux River basin. Parts of Lyon, Sioux, Osceola, and O'Brien Counties constitute the Iowa portion of the basin.

The maximum width of the triangular-shaped basin is 40 miles and the overall length is approximately 75 miles. The basin is oriented in a north-south direction. The Rock River, which rises in Minnesota, flows in a relatively straight south-southwesterly course to its junction with the Big Sioux River.

The topography of the basin in Iowa is the result of (1) the action of the many glaciers which have intermittently covered the area, (2) the deposition of loess (wind-blown silts) occurring after the last glacial advance, and (3) the subsequent erosion. The topography is marked by isolated steep-sided hills and noncontributing areas in the northeast and flat to moderately rolling uplands in the remainder of the area. The hills bordering the Rock and Little Rock Rivers range in height from 60 to 110 feet. The total relief is 350 feet. Loess soils cover approximately 79 percent of the area. Sand and gravel deposits are found in the glacial valleys.

The Rock River basin in Iowa is predominantly a rural agricultural area with about 97 percent of the land area in farms (U.S. Bureau of the

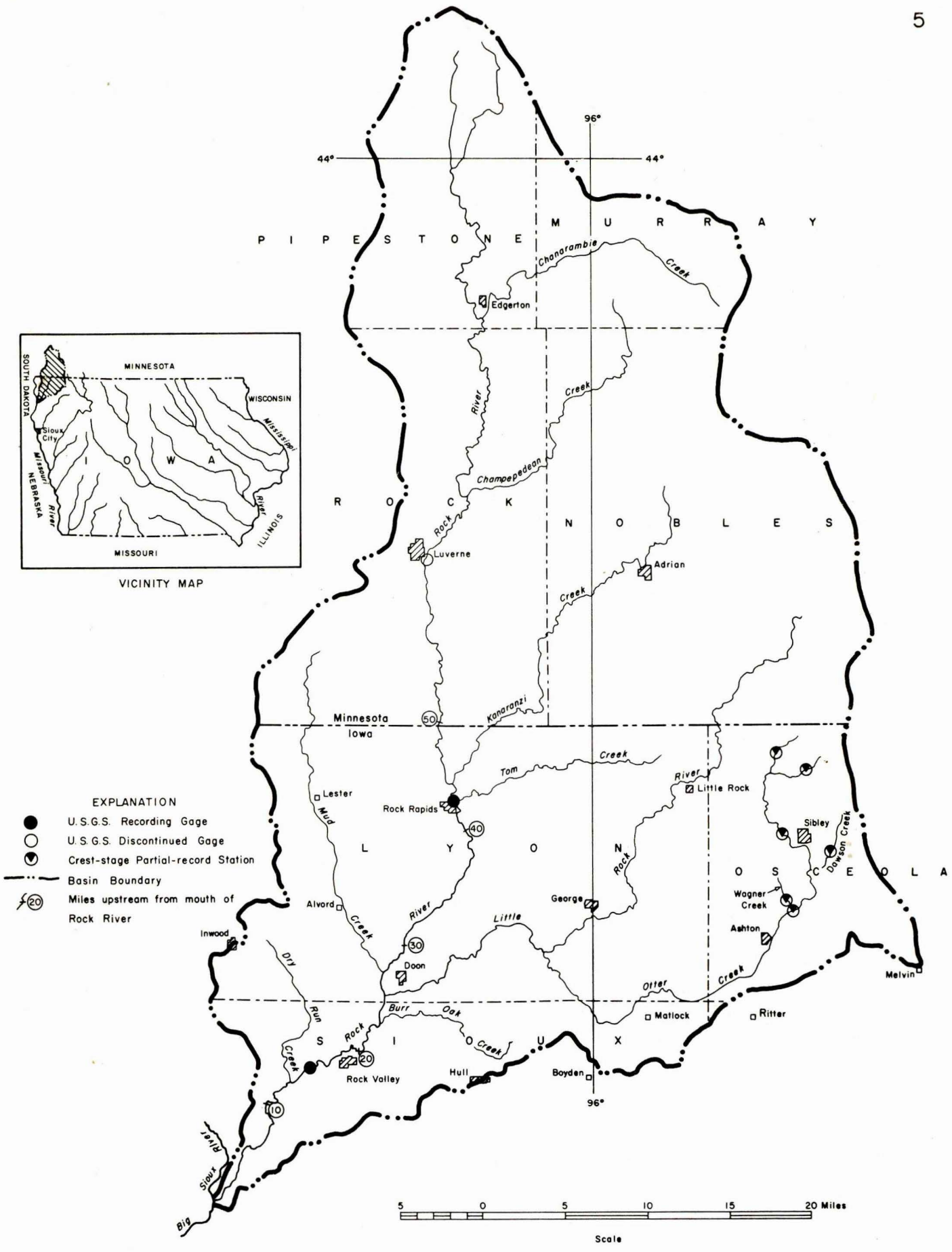


Figure 1. Map of Rock River basin.

Census, 1961, p. 114-117). Towns range in population from 100 to 2,900. The total population of the basin area is about 24,000, with 13,000 located in the cities (Rand-McNally and Company, 1966, p. 174-177). Municipal and industrial uses of water have no effect on floodflows. No known flood-control structures affecting major floodflows have been built.

The Rock River basin in Iowa has a temperate climate. The yearly average temperature for the 1931-60 period was 47°F (U.S. Weather Bureau, 1965, p. 210). The 1931-60 normal annual precipitation ranged from 25.3 inches in the west to 27.2 inches in the east (Schwob, 1966, pt. 1, p. 3). The 1931-60 annual snowfall ranged from 32.4 inches in the south to 35.1 inches in the north (U.S. Weather Bureau, 1964, p. 25-29).

FLOOD HISTORY

Very little is known about the floods in the basin prior to 1948 when a stream-gaging station was established at Rock Valley, Iowa. The flood of 1897 reached a stage of 17.0 feet, gage datum, or 1,228.81 feet above mean sea level, datum of 1929, (discharge not determined) at Rock Valley, Iowa, according to the Iowa Highway Commission. In June 1914 a discharge of 11,600 cubic feet per second (26.4 cubic feet per second per square mile) was recorded on the Rock River at Luverne, Minnesota (gage height, 13.0 feet or 1,437.58 feet above mean sea level, datum of 1929). The drainage area at Luverne is 440 square miles. At Boyden, Iowa, which is near the Little Rock River, a rainfall of 24 inches was recorded in less than 18 hours September 17-18, 1926 (U.S. Army, Corps of Engineers, 1945, MR 4-25). There is no record of the flood magnitude resulting from this storm. On June 7, 1953, a 24-hour rainfall at Ritter, Iowa ($4\frac{1}{4}$ miles southwest of Ashton, Iowa), was recorded unofficially as 11.40 inches (Iowa Natural Resources Council, 1956, p. 37). This storm produced an average precipitation varying from 2 inches

in the north to 8 inches in the south of the Iowa part of the Rock River basin. A discharge of 18,900 cubic feet per second was recorded at Rock Valley, Iowa, on June 8, 1953. On June 17-19, 1954, 4 to 6 inches of rain fell on the Rock River basin in Iowa. This was followed by 1 to 5 inches on June 20-22, 1954. A discharge of 19,200 cubic feet per second at Rock Valley, Iowa, was recorded on June 21, 1954. Data for the maximum flood of record for the Rock River at Rock Rapids and near Rock Valley, Iowa, are given in the appendix.

BASIC DATA

The Rock River has a total length of about 100 miles with 49.8 miles in Iowa. The channel slope in Iowa ranges from 5.6 feet per mile at the mouth to 6.5 feet per mile at the Iowa-Minnesota State line (Schwob, 1966, pt. 1, p. 16). Pertinent data for the principal tributaries to the Rock River in Iowa are listed in table 1.

Two streamflow-gaging stations are currently operated on the Rock River at Rock Rapids and near Rock Valley, Iowa, respectively. The station descriptions for these stations are included in the appendix. A continuous record of gage height and periodic measurements of discharge are obtained. Daily, monthly, and yearly discharges and monthly and yearly runoff values for the two stations are computed and published in U.S. Geological Survey reports (issued annually).

Detailed gage heights and discharges for floods of March 1962 and April 1965 are given in the appendix. Using the detailed gage heights and discharges, the elevation and discharge hydrographs may be reconstructed. The reconstructed hydrographs may be used in studies of runoff volume and time distribution of runoff of the March 1962 and April 1965 floods.

Table 1.--Drainage area of the principal tributaries to the Rock River
and of the main stem Rock River in Iowa

Stream	Miles upstream from mouth of Rock River	Bank of entry	Drainage area, square miles	Drainage area of main stem downstream from tributary, square miles	Percent of total area
Rock River at state line	49.8	-	558	-	33.1
Kanaranzi Creek	43.9	Left	205	777	12.1
Tom Creek	42.45	Left	62.1	851	3.7
Mud Creek	27.05	Right	138	1,049	8.1
Little Rock River	25.30	Left	474	1,524	28.1
Dry River Creek	14.10	Right	51.4	1,656	3.1
Rock River at mouth	0	-	1,688	-	100

Discharge measurements made at two miscellaneous sites in addition to records at the gaging-station sites were used to compute the discharges for the flood profiles along the Rock River in Iowa. The locations of the two miscellaneous sites are as follows:

NW $\frac{1}{4}$ sec. 6, T. 95 N., R. 47 W., Sioux County, 6 miles north of Hawarden, Iowa, and at county highway bridge;
SE $\frac{1}{4}$ sec. 16, T. 96 N., R. 47 W., Sioux County and at County "S" Road bridge.

High-water marks for the flows of March 29-30, 1962, September 7-8, 1964, and April 2, 1965, were obtained at all bridges and at the dam at Rock Rapids, Iowa, within 48 hours of the peak stage. Marks were set to define the water-surface elevation above and below all the bridges. Supplemental marks were set between bridges to aid in the profile definition. All marks have been referenced to mean sea-level datum, datum of 1929, by leveling. Elevations determined are of third-order accuracy.

Six crest-stage gages are operated by the U.S. Geological Survey in the Iowa part of the Rock River basin (fig. 1). Data for floods at these gages are presented by Schwob (1966, pt. 2, p. 53, 224-226, 262, 332) and are not included in this report.

DATA ANALYSIS

Flood Frequency

The computation and tabulation of the 25- and 50-year recurrence interval floods for the Rock River in Iowa, shown on the profile sheets (pls. 1-3), were based upon the flood-frequency report by Schwob (1966, pt. 1, p. 1-26). In that report a multiple regression analysis of past floods was used to compute the mean annual flood. The regression equation applicable to the Rock River in Iowa is as follows:

$$\text{MAF} = 0.000009856 A^{0.856} S^{0.806} P^{3.926}$$

in which

MAF = mean annual flood in cubic feet per second

A = drainage area in square miles

S = slope in feet per mile between points 10 and 85 percent of the stream length above the point of interest. Length is measured along the main channel and upstream tributary with the largest drainage area to the divide

P = 1931-60 normal annual precipitation for the basin above the point in interest.

To compute the discharge for a selected recurrence interval (R.I.) the mean annual flood (MAF) is multiplied by a ratio as follows (Schwab, 1966, pt. 1, p. 8, region II):

<u>R.I.</u>	<u>Ratio to MAF</u>
2	0.83
5	1.85
10	2.55
25	3.55
50	4.50

Following is an example of the computation of the 50-year recurrence-interval flood at Rock Valley:

Area A

Region II

Drainage area (A) = 1,600 square miles

Slope (S) = 5.79 feet per mile

Precipitation (P) = 25.9 inches

$$\begin{aligned} \text{MAF} &= 0.000009856 (1,600)^{0.856} (5.79)^{0.806} (25.9)^{3.926} \\ &= 7,920 \text{ cubic feet per second} \end{aligned}$$

50-year flood = MAF (4.50)

= 7,920 (4.50)

= 35,600 cubic feet per second.

Schwob's report provides tables and graphs which facilitate the computations.

Figure 2 shows the frequency curves for the gaging stations on the Rock River at Rock Rapids and near Rock Valley, Iowa, and the 25- and 50-year flood discharges along the Rock River are presented on the profile sheets (pls. 1-3).

The regression equation can also be used to obtain the recurrence interval of a known flood. The known flood discharge is divided by the computed mean annual flood discharge to obtain the ratio to the mean annual flood. The proper recurrence interval is then obtained from a plot of recurrence interval versus ratio to mean annual flood (defined from data presented in the above table). The recurrence intervals for the flood of March 1962 have been computed to be 26 years at Rock Valley, Iowa, and 28 years at Rock Rapids, Iowa.

Profiles

Profiles of the floods of March 29-30, 1962, September 7-8, 1964, and April 2, 1965, of the low-flow condition of August 3, 1966, and of the 25- and 50-year recurrence-interval floods for the Rock River in Iowa are shown on the profile sheets (pls. 1-3). High-water marks and mileages define the water-surface profiles. River mileages, determined along the low-water channel from U.S. Department of Agriculture soil maps, represent distances upstream from the mouth of the Rock River.

Discharge measurements made at the two miscellaneous sites and peak discharges for the gaging stations at Rock Rapids and near Rock Valley, Iowa, were used to develop discharge-area relationships for the three known floods and the low flow. Peak discharges (determined from the above discharge-area relationships) for points of major drainage-area change are tabulated on the profile sheet. Elevation-discharge relations upstream and downstream of all bridges along the Rock River were prepared from the peak

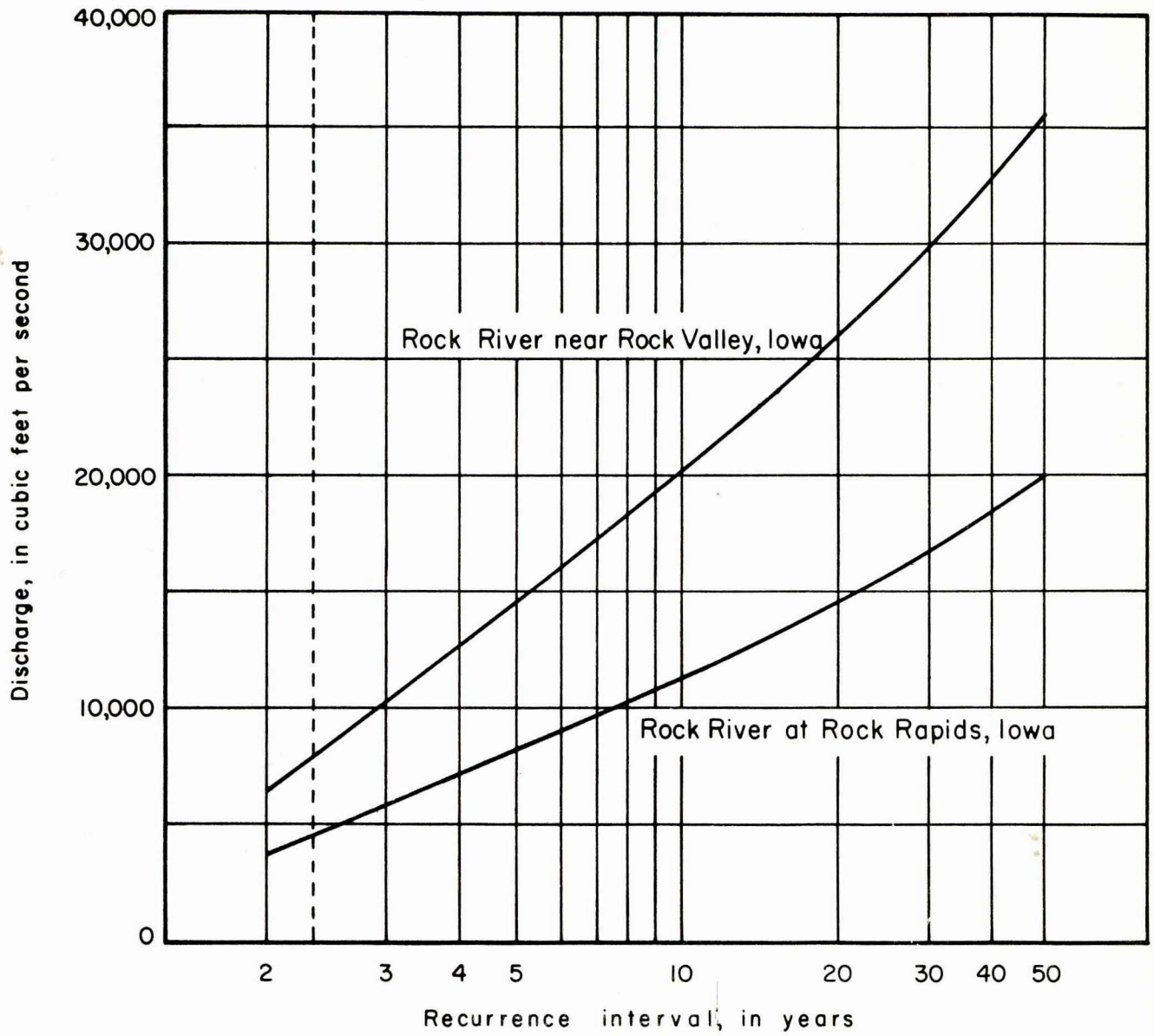


Figure 2. Rock River flood-frequency curves.

ROCK RIVER PROFILES

ELEVATION, IN FEET, ABOVE MEAN SEA LEVEL (1929 GENERAL ADJUSTMENT)

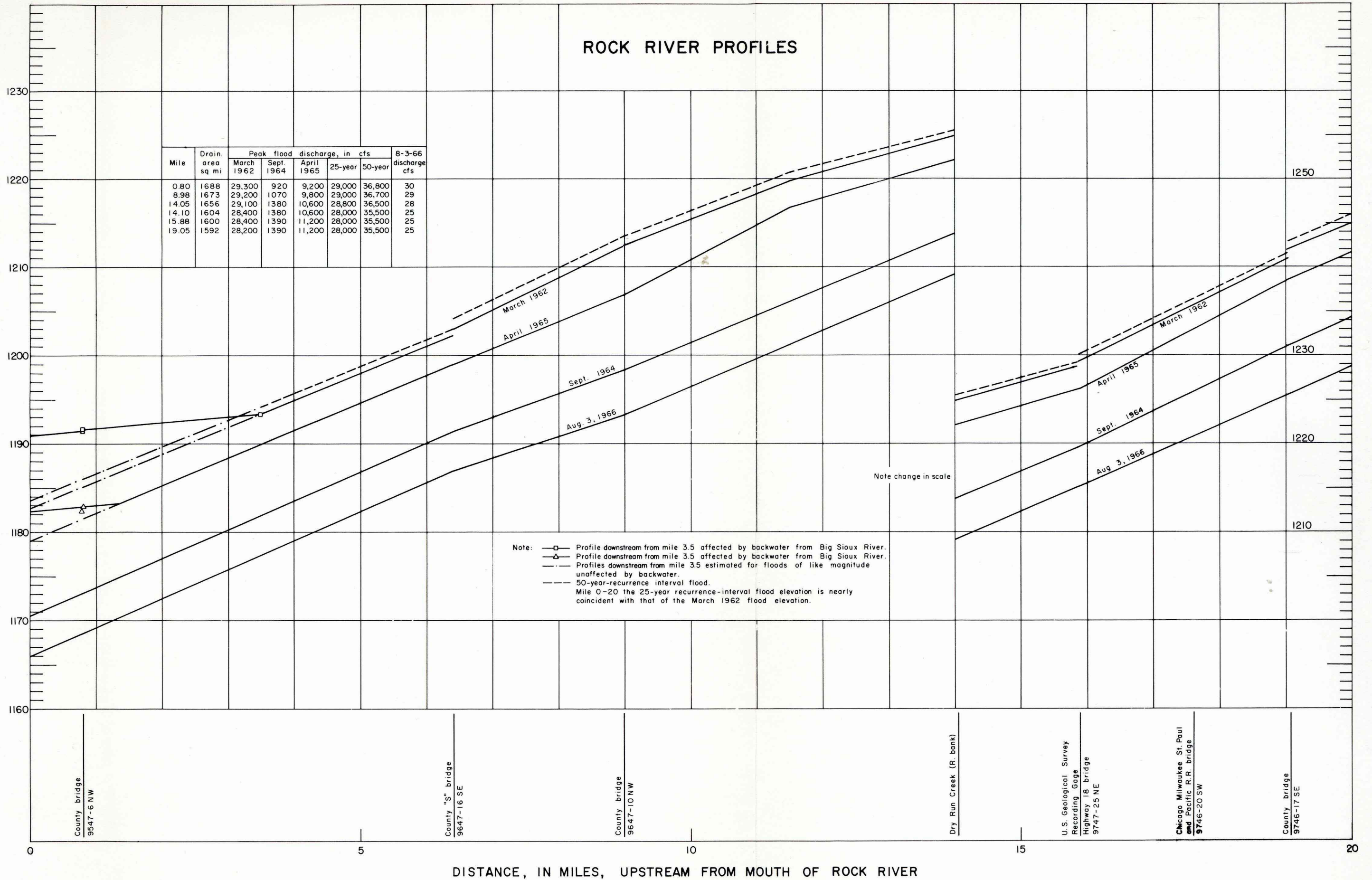
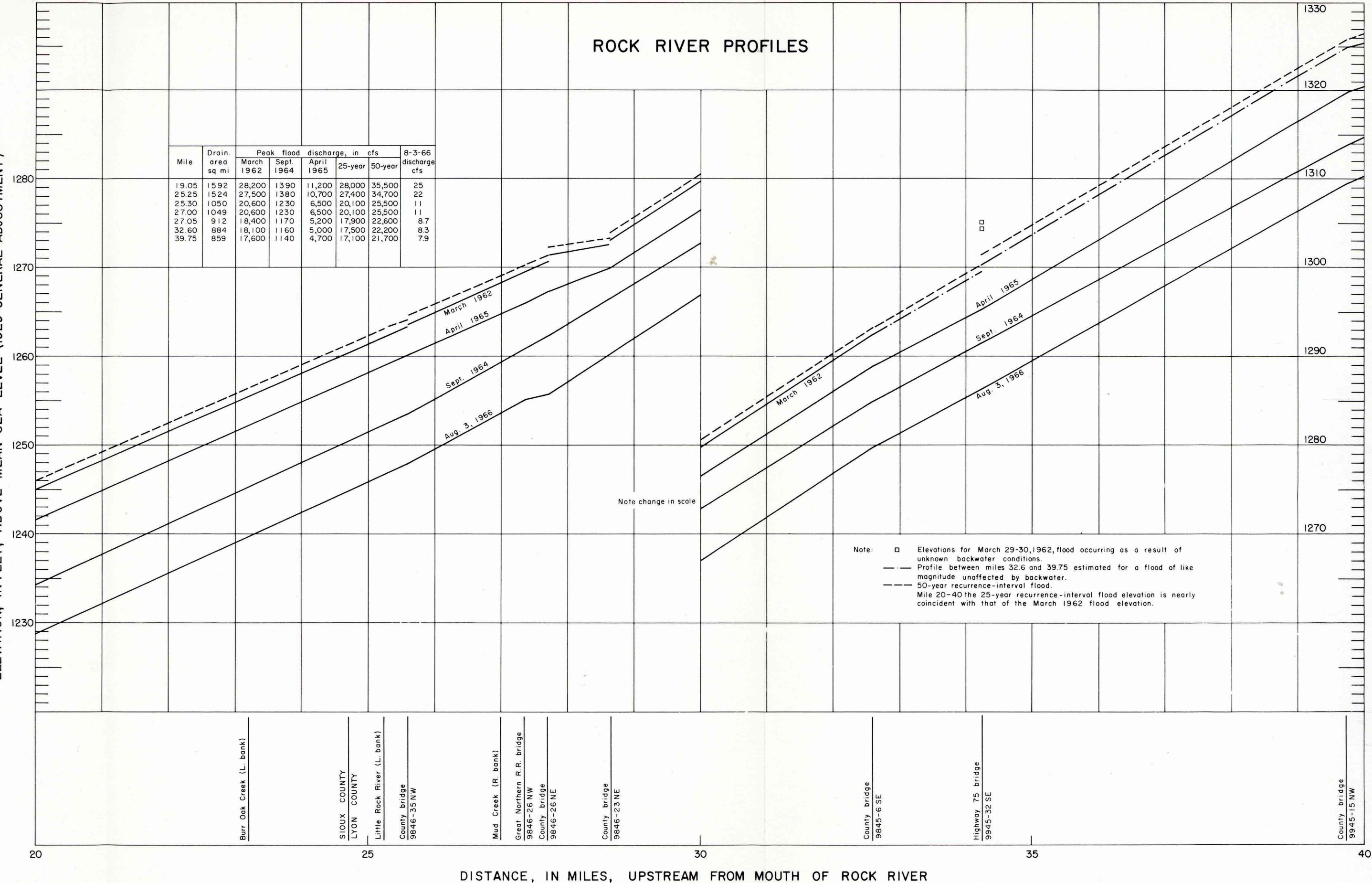


Plate I. Rock River profiles, mile 0 to mile 20.

ROCK RIVER PROFILES

ELEVATION, IN FEET, ABOVE MEAN SEA LEVEL (1929 GENERAL ADJUSTMENT)

Mile	Drain area sq mi	Peak flood discharge, in cfs					8-3-66 discharge cfs
		March 1962	Sept. 1964	April 1965	25-year	50-year	
19.05	1592	28,200	1390	11,200	28,000	35,500	25
25.25	1524	27,500	1380	10,700	27,400	34,700	22
25.30	1050	20,600	1230	6,500	20,100	25,500	11
27.00	1049	20,600	1230	6,500	20,100	25,500	11
27.05	912	18,400	1170	5,200	17,900	22,600	8.7
32.60	884	18,100	1160	5,000	17,500	22,200	8.3
39.75	859	17,600	1140	4,700	17,100	21,700	7.9



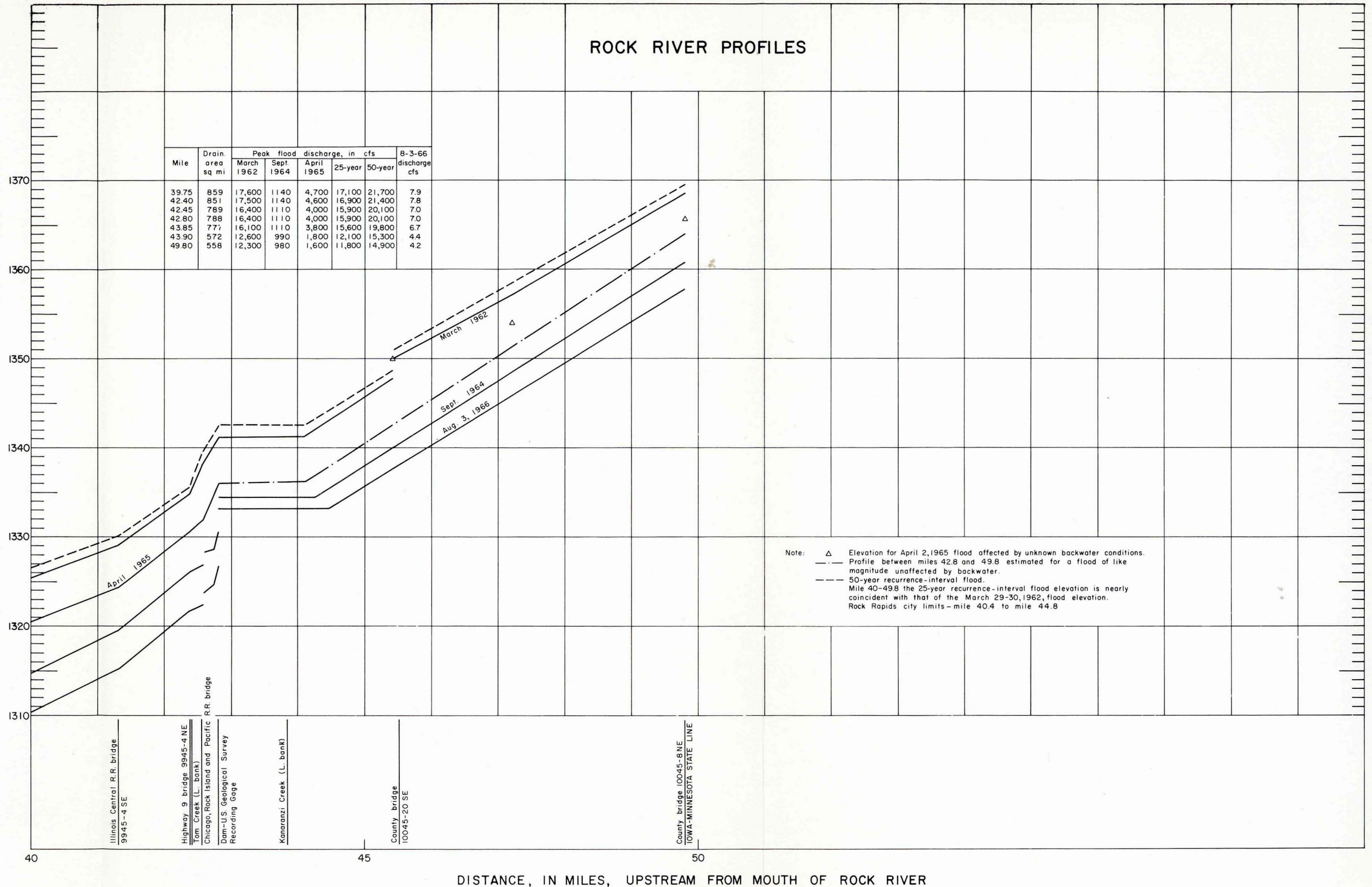
Burr Oak Creek (L. bank)
 SIOUX COUNTY
 LYON COUNTY
 Little Rock River (L. bank)
 County bridge 9846-35 NW
 Mud Creek (R. bank)
 Great Northern R.R. bridge 9846-26 NW
 County bridge 9846-26 NE
 County bridge 9846-23 NE
 County bridge 9845-6 SE
 Highway 75 bridge 9945-32 SE
 County bridge 9945-15 NW

DISTANCE, IN MILES, UPSTREAM FROM MOUTH OF ROCK RIVER

Plate 2. Rock River profiles, mile 20 to mile 40.

ROCK RIVER PROFILES

ELEVATION, IN FEET, ABOVE MEAN SEA LEVEL (1929 GENERAL ADJUSTMENT)



Note: Δ Elevation for April 2, 1965 flood affected by unknown backwater conditions.
 - - - Profile between miles 42.8 and 49.8 estimated for a flood of like magnitude unaffected by backwater.
 - - - 50-year recurrence-interval flood.
 Mile 40-49.8 the 25-year recurrence-interval flood elevation is nearly coincident with that of the March 29-30, 1962, flood elevation.
 Rock Rapids city limits - mile 40.4 to mile 44.8

Plate 3. Rock River profiles, mile 40 to mile 49.8.

elevations and corresponding discharges of the known flows. These relations were extended to include the discharge of the 50-year recurrence-interval flood and were used to determine the 25- and 50-year recurrence-interval flood elevations along the profiles. Discharges for the 25- and 50-year recurrence-interval floods at the points of major drainage-area change are tabulated on the profile sheets.

Near the mouth of the Rock River the profiles for the floods of March 1962 and April 1965 were probably affected by backwater from the Big Sioux River. This backwater condition was verified by analysis utilizing the profile for the flood of 1922 on the Big Sioux River (U.S. Congress, House of Representatives, 1932, Chart 31) and the peak and daily discharges and corresponding elevations for the gages on the Big Sioux River at Brandon, South Dakota, and Akron, Iowa. The flood profiles near the mouth of the Rock River for the 25- and 50-year floods were estimated for the condition of no backwater.

At various times and places, as indicated on the profile sheets, backwater conditions due to unknown causes (probably ice jams) were present. High-water marks that were obviously affected were not used to define the profile but are shown as points on the profile sheets. Along the reaches affected by backwater, the profiles were estimated for floods of like magnitude unaffected by backwater.

DISCUSSION

Elevation, discharge, runoff volume, time distribution of runoff, and frequency information for the Rock River basin in Iowa presented in this report is useful for planning, designing, and operating structures across the Rock River and on its flood plain; flood-plain management along the Rock River; and appraising the severity of floods in the basin. Data for the

outstanding flood of March 1962 and the lesser floods of September 1964 and April 1965 are presented. These and other data are used to construct profiles for the 25- and 50-year recurrence-interval floods. A method of flood-frequency computation is summarized. Some uses of the data and information presented in this report are as follows:

- (1) The profiles of known floods can be used to locate on the ground the past flood elevations and to determine the corresponding discharges at any point along the river.
- (2) The elevation and discharge data presented on the profiles can be used to construct elevation-discharge relationships for the range in elevation and discharge covered at any site along the river.
- (3) The flood-frequency information presented can be used to estimate the frequency and magnitude of floods at any site along the river.
- (4) The tabulated gage heights and discharges, presented in the appendix, for the March 1962 and April 1965 floods can be used to analyze the flood-hydrograph characteristics of runoff volume and time distribution for these floods.

The user of this report is cautioned that the elevation-discharge data presented herein are representative of the physical conditions of the basin at the time of the various floods. The profiles for the 25- and 50-year recurrence-interval floods inherently assume that these physical conditions remain unchanged. Changes in the basin can alter the flood magnitude for a given frequency. Examples of these changes might include extensive urbanization, implementation of conservation practices, and construction of large detention structures. Changes in the channel conditions immediately downstream from a site can affect materially the elevation-discharge relationship. Examples of such changes include the construction of dams, constricting

bridges, or levees; changing of the flood-plain cover; and straightening of the channel. Temporary changes in channel conditions can cause variation in the water-surface profiles as evidenced by erratic plotting of some of the high-water marks. Examples of temporary changes include ice and debris jams which produce backwater conditions and may cause the flood elevations to plot higher than the normal profile.

REFERENCES

- Iowa Natural Resources Council, 1956, An inventory of water resources and water problems, Floyd-Big Sioux River basins, Iowa: Bull. no. 4, p. 37.
- Larimer, O. J., 1957, Drainage areas of Iowa streams: Iowa Highway Research Board Bull. no. 7, p. 367.
- Rand-McNally and Company, 1966, Commercial atlas and marketing guide: 97th ed., Chicago, New York, and San Francisco, p. 174-177.
- Schwob, H. H., 1966, Magnitude and frequency of Iowa floods: Iowa Highway Research Board Bull. no. 28, pt. 1, p. 1-26; pt. 2, p. 53, 224-226, 262, 332.
- U.S. Army, Corps of Engineers, 1945, Storm rainfall in the United States, MR 4-25.
- U.S. Bureau of Census, 1961, U.S. census of agriculture 1959: v. 1, counties, pt. 16, Iowa, p. 114-117.
- U.S. Congress, House of Representatives, 1932, Big and Little Sioux Rivers, Iowa and South Dakota: U.S. 72nd Cong., 1st sess., House Doc. 189, Chart 31.
- U.S. Geological Survey, issued annually since 1961, Water resources data for Iowa, pt. 1, surface water records: U.S. Geol. Survey open-file reports.
- U.S. Weather Bureau, 1964, Climatic summary of the United States - supplement for 1951 through 1960, Iowa: Climatograph of the United States no. 86-11, p. 24-29.
- _____ 1965, Climatological data for Iowa, annual summary 1965: v. 75, no. 13, p. 210.

APPENDIX

Contained in the following pages are the gaging-station records covering the 1962 and 1965 flood periods for gaging stations on Rock River at Rock Rapids and near Rock Valley, Iowa. The station description contains statements on the location, drainage area, record available, gage-height and discharge records, and maxima for the 1962 and 1965 flood periods as well as the remaining period of record.

Following each station description are tables of daily discharges for three-month periods which include the 1962 and 1965 floods. These tables also give the monthly mean flow and the monthly runoff in inches and acre-feet.

The next two tables give the stages and discharges of the flood hydrographs for the March 1962 and April 1965 floods. On days when the stage and discharge were affected by ice in the stream, only the daily discharge is shown.

6-4832.7 Rock River at Rock Rapids, Iowa

Location.--Lat $43^{\circ}26'13''$, long $96^{\circ}09'58''$, in NE $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 33, T. 100 N.

R. 45 W., on right bank at upstream side of dam on north side of city park in Rock Rapids, a third of a mile upstream from Tom Creek, half a mile northeast of junction of U.S. Highway 75 and State Highway 9, and 42.8 miles upstream from mouth (U.S. Geological Survey river profile).

Drainage area.-- 788 sq mi.

Records available.--August 1959 to September 1966.

Gage-height record.--Water-stage recorder. Datum of gage is 1,331.55 ft above mean sea level, datum of 1929.

Discharge record.--Stage-discharge relation defined by current meter measurements. Backwater from ice March 1-29, 1962, March 1-5, 13-28, April 1, 4, 5, 1965.

Maxima.--March-May 1962: Discharge, 16,400 cfs March 29 (gage height, 9.56 ft).

March-May 1965: Discharge, 11,400 cfs April 7 (gage height, 7.58 ft).

1959 to February 1962, June 1962 to February 1965: Discharge, 15,500 cfs March 30, 1960 (gage height, 8.86 ft).

Rock River at Rock Rapids, Iowa--Continued
Daily discharge, in cubic feet per second, 1962

Day	March	April	May	Day	March	April	May
1	19	6,570	328	16	19	880	256
2	19	3,450	288	17	19	952	212
3	19	2,660	248	18	19	1,270	184
4	19	4,730	219	19	19	1,650	191
5	19	5,280	198	20	19	1,070	328
6	19	4,400	178	21	19	1,030	395
7	19	4,070	157	22	19	916	780
8	19	2,470	157	23	20	724	3,050
9	19	1,550	157	24	20	560	3,250
10	20	1,140	150	25	20	450	1,100
11	21	1,200	150	26	25	377	724
12	21	1,220	150	27	50	368	620
13	21	880	150	28	1,000	413	653
14	20	928	219	29	12,000	440	1,430
15	19	928	377	30	11,000	377	1,030
				31	8,970	-	620
Mean-----					1,082	1,765	579
Runoff, In.-----					1.58	2.50	0.85
Runoff, Ac-ft-----					66,510	105,000	35,600

Rock River at Rock Rapids, Iowa--Continued
Daily discharge, in cubic feet per second, 1965

Day	March	April	May	Day	March	April	May
1	3.0	2,600	160	16	600	343	1,020
2	2.5	3,390	147	17	430	298	1,300
3	2.5	2,710	141	18	115	256	692
4	2.5	3,500	129	19	70	240	499
5	2.8	4,000	153	20	28	209	399
6	4.1	8,310	167	21	26	188	389
7	4.1	8,890	209	22	24	174	449
8	4.1	3,220	202	23	22	167	399
9	4.1	2,500	202	24	21	167	352
10	4.1	1,500	1,150	25	20	181	489
11	5.4	1,340	728	26	20	195	874
12	30	1,130	409	27	20	224	788
13	75	692	289	28	20	209	576
14	85	521	224	29	20	195	429
15	240	419	240	30	125	174	352
				31	1,000	-	307
Mean-----					97.7	1,600	447
Runoff, In.-----					0.14	2.27	0.65
Runoff, Ac-ft-----					6,010	95,190	27,500

Rock River at Rock Rapids, Iowa--Continued
 Gage height, in feet, and discharge, in cubic
 feet per second, at indicated time, 1962

Hour	Gage Height	Discharge	Hour	Gage Height	Discharge
	March 26			March 30	
2400	1.71	(Daily 25)	0300	7.98	12,000
			0500	7.32	10,400
	March 27		0700	6.84	9,210
0800	1.72	(Daily 50)	0800	6.64	8,730
1200	1.76		0900	6.54	8,490
2400	2.29		1000	6.62	8,680
			1200	7.10	9,850
	March 28		1600	8.00	12,100
0900	2.53	(Daily 1,000)	1700	8.05	12,200
1400	3.05		1900	8.00	12,100
2200	4.06		2100	7.78	11,600
2400	4.95		2400	7.25	10,200
				March 31	
0100	4.59	(Daily 12,000)	0300	6.77	9,040
0200	5.52		0900	6.48	8,340
0300	6.20	8,010	1600	6.93	9,430
0500	6.38	8,440	2200	6.62	8,830
0700	6.75	9,330	2400	6.38	8,440
1000	7.66	11,600		April 1	
1300	8.50	13,700	0600	5.65	6,690
1500	9.10	15,200	2100	5.40	6,090
1600	9.33	15,800	2400	4.90	4,950
1800	9.50	16,200		April 2	
1900	9.56	16,400	0600	4.40	3,850
2000	9.53	16,300	2000	3.82	2,700
2200	9.40	16,000	2400	3.77	2,600
2400	8.93	14,800			

() Ice affected, daily discharge only

Rock River at Rock Rapids, Iowa--Continued
 Gage height, in feet, and discharge, in cubic
 feet per second, at indicated time, 1965

Hour	Gage Height	Discharge	Hour	Gage Height	Discharge
2400	March 30 2.24	(Daily 125)	1200	April 5 *4.38	(Daily 4,000)
0800	March 31 2.12	(Daily 1,000)	2200	5.25	
1200	2.51		2400	5.76	5,620
1800	3.18			April 6	
2400	4.03		0200	6.07	7,310
	April 1		0600	6.52	8,350
1100	4.37	(Daily 2,600)	0700	6.61	8,510
1200	3.97		0900	6.65	8,610
2400	3.98	3,010	1100	6.71	8,750
	April 2		1200	6.81	8,990
0200	4.05	3,150	1400	6.75	8,850
0600	4.42	3,890	1600	6.68	8,680
0830	4.47	4,000	2000	6.48	8,200
1200	4.42	3,890	2100	6.46	8,150
1800	4.00	3,050	2200	6.46	8,150
2400	3.71	2,490	2300	6.51	8,320
	April 3		2400	6.64	8,680
0200	3.66	2,360		April 7	
0400	3.62	2,260	0100	6.82	9,160
0500	3.61	2,230	0300	7.30	10,400
0800	3.64	2,280	0400	7.46	10,900
1400	3.87	2,680	0500	7.56	11,200
1630	4.05	3,030	0600	7.58	11,400
1700	4.01	2,950	0700	7.51	11,200
1930	4.20	3,330	1000	7.21	10,500
2400	4.25	3,430	1300	6.74	9,310
	April 4		2000	5.56	6,470
1000	4.37	(Daily 3,500)	2400	4.95	5,060
1700	4.77				
1800	5.48				
2000	4.96				
2200	*4.70				
2400	*4.56				

Rock River at Rock Rapids, Iowa--Continued
 Gage height, in feet, and discharge, in cubic
 feet per second, at indicated time, 1965

Hour	Gage Height	Discharge	Hour	Gage Height	Discharge
	April 8			April 10	
0300	4.55	4,200	0600	3.28	1,810
0500	4.32	3,760	1200	3.09	1,500
0700	4.16	3,440	1800	2.97	1,310
0900	4.05	3,220	2100	2.93	1,250
1100	3.94	3,000	2400	2.90	1,210
1300	3.86	2,840			
1500	3.82	2,760		April 11	
1800	3.78	2,680	0400	2.90	1,210
2100	3.75	2,620	0700	2.94	1,270
2400	3.76	2,640	1200	3.03	1,410
	April 9		1300	3.04	1,420
0500	3.82	2,760	1800	3.05	1,440
0600	3.83	2,780	2000	3.04	1,420
0700	3.82	2,760	2400	3.00	1,360
0900	3.80	2,720			
1100	3.77	2,660		April 12	
1500	3.67	2,460	0600	2.94	1,270
2100	3.49	2,140	1200	2.85	1,140
2400	3.41	2,020	1800	2.74	986
			2400	2.65	860

* Estimated

() Ice affected, daily discharge only

6-4835. Rock River near Rock Valley, Iowa

Location.--Lat $43^{\circ}12'05''$, long $96^{\circ}20'15''$, in NE $\frac{1}{4}$ NE $\frac{1}{4}$ 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 15.9 miles (revised) upstream from mouth (U.S. Geological Survey river profile).

Drainage area.--1,600 sq mi.

Records available.--June 1948 to September 1966.

Gage-height record.--Water-stage recorder. Datum of gage is 1,211.81 ft above mean sea level, datum of 1929.

Discharge record.--Stage-discharge relation defined by current meter measurements. Backwater from ice March 1-28, 1962, March 1-31, 1965 (no gage-height record March 1, 2, 4, 5, 8-14, 16-21, 23-26, 1962, March 1, 2, 5-10, 18, 21-24, 26-29, 1965).

Maxima.--March-May, 1962: Discharge, 28,400 cfs March 30 (gage height, 16.91 ft).

March-May, 1965: Discharge, 15,700 cfs April 7 (gage height, 14.94 ft).

1948 to February 1962, June 1962 to February 1965: Discharge, 19,200 cfs June 21, 1954 (gage height, 15.86 ft).

Rock River near Rock Valley, Iowa--Continued
Daily discharge, in cubic feet per second, 1962

Day	March	April	May	Day	March	April	May
1	30	13,900	795	16	30	1,860	518
2	30	9,650	728	17	30	1,790	449
3	30	5,860	660	18	30	1,860	400
4	30	8,350	594	19	30	2,160	400
5	30	10,400	555	20	30	2,160	416
6	30	8,950	500	21	30	1,760	555
7	30	7,850	466	22	30	1,720	700
8	30	6,500	449	23	32	1,480	1,850
9	30	4,260	483	24	32	1,240	3,500
10	32	3,110	432	25	32	1,040	2,930
11	34	2,660	432	26	40	915	1,330
12	34	2,660	416	27	200	865	1,020
13	34	2,320	416	28	6,200	865	915
14	32	2,000	416	29	17,800	915	1,130
15	30	2,000	483	30	23,500	890	1,860
				31	17,800	-	1,100
Mean-----					2,139	3,733	868
Runoff, In.-----					1.54	2.60	0.63
Runoff, Ac-ft-----					131,500	222,100	53,350

Rock River near Rock Valley, Iowa--Continued
Daily discharge, in cubic feet per second, 1965

Day	March	April	May	Day	March	April	May
1	20	7,310	393	16	1,700	955	715
2	15	9,680	361	17	1,200	814	2,370
3	12	6,660	333	18	600	706	1,760
4	10	8,710	314	19	300	622	1,150
5	10	10,000	314	20	150	556	920
6	10	12,700	356	21	100	505	900
7	12	15,200	378	22	50	468	838
8	15	10,300	402	23	40	438	890
9	20	4,930	396	24	35	420	786
10	50	3,740	457	25	30	424	1,040
11	150	2,820	1,060	26	30	482	1,750
12	300	2,680	674	27	30	512	1,960
13	600	1,900	488	28	30	516	1,460
14	1,100	1,390	408	29	30	471	1,100
15	1,400	1,140	399	30	100	432	905
				31	1,000	-	790
Mean-----					295	3,583	841
Runoff, In.-----					0.21	2.50	0.61
Runoff, Ac-ft-----					18,150	213,200	51,700

Rock River near Rock Valley, Iowa--Continued
 Gage height, in feet, and discharge, in cubic
 feet per second, at indicated time, 1962

Hour	Gage Height	Discharge
	March 27	
2400	10.32	(Daily 200)
	March 28	
0900	11.85	(Daily 6,200)
1000	12.25	
1100	13.15	
1300	12.94	
1600	13.30	
2400	14.80	13,000
	March 29	
0800	15.65	17,400
1400	15.74	18,100
2400	16.21	21,800
	March 30	
0200	16.30	22,600
0800	16.83	27,700
0930	16.91	28,400
1200	16.82	27,600
1400	16.64	25,800
1800	16.02	20,100
2100	15.76	18,200
2400	15.77	18,300
	March 31	
1000	15.93	19,400
2400	15.18	14,800
	April 1	
1200	15.10	14,400
2400	14.54	11,900
	April 2	
1000	14.16	10,200
2400	13.32	7,100

() Ice affected, daily discharge only

Rock River near Rock Valley, Iowa--Continued
 Gage height, in feet, and discharge, in cubic
 feet per second, at indicated time, 1965

Hour	Gage Height	Discharge	Hour	Gage Height	Discharge
	March 30			April 4	
1800	6.21	(Daily 100)	0400	13.29	8,220
2400	8.02		2000	13.66	9,370
	March 31		2400	13.72	9,580
0200	8.11	(Daily 1,000)		April 5	
0600	8.59		2400	13.91	10,500
1100	9.83			April 6	
1400	8.79		1200	14.46	13,000
1700	9.17		2400	14.72	14,200
2000	9.91			April 7	
2400	10.36	3,910	1030	14.94	15,700
	April 1		1800	14.87	15,400
0600	11.50	5,270	2400	14.74	14,700
0900	11.91	5,790		April 8	
1200	12.61	6,990	0200	14.61	14,000
1500	12.99	7,920	0800	14.13	11,900
1700	13.40	9,160	1100	13.84	10,800
2000	13.78	10,500	1500	13.32	9,020
2200	13.89	10,900	1700	12.99	8,080
2300	13.86	10,800	2100	12.45	6,780
2400	13.89	11,000	2400	12.04	6,060
	April 2			April 9	
0100	13.91	11,200	0600	11.39	5,180
0500	13.55	9,960	1200	11.02	4,720
1000	13.34	9,230	2400	10.80	4,450
1100	13.36	9,300		April 10	
1300	13.52	9,860	2400	9.48	3,040
1500	13.59	10,100		April 11	
1600	13.57	10,000	0600	9.23	2,800
2400	13.00	8,100	1200	9.14	2,720
	April 3		2400	9.32	2,880
1200	12.24	6,190		April 12	
1600	12.12	5,830	0600	9.35	2,910
2000	12.32	6,130	2400	8.65	2,300
2400	12.78	6,970			

() Ice affected, daily discharge only

STATE LIBRARY OF IOWA



3 1723 02106 6808