Bulletin No. 28
IOWA HIGHWAY RESEARCH BOARD
Part One

MAGNITUDE AND FREQUENCY OF IOWA FLOODS

by
Harlan H. Schwob
Hydraulic Engineer
UNITED STATES GEOLOGICAL SURVEY

Prepared by the
U. S. GEOLOGICAL SURVEY
Water Resources Division
in cooperation with the
IOWA STATE HIGHWAY COMMISSION

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Magnitude and Frequency Of Iowa Floods

by Harlan H. Schwob

ABSTRACT

Iowa stream-gaging station records at 147 regular gaging stations and partial-record sites were analyzed to produce flood magnitude and frequency relations. An index flood which is the mean annual flood and two composite frequency curves are used to predict the flood-frequency curve for interior streams of the State.

The index flood was determined by a multiple correlation. The independent variables found to be significant are size of drainage basin, stream slope, and the normal annual precipitation for the 1931-60 period. The regression equations for two areas were determined—a large central area and a combination of areas in the northeastern and southwestern parts of the State. All three independent variables were used in the central area. Only area and slope were found necessary in the remainder of the State.

The ratio to the index flood at selected recurrence intervals was determined from each of the gaging-station flood-frequency curves. The median of the ratios for the long term perid (1916-65) is used to define the two composite curves.

Maximum flood discharges at gaging stations and miscellaneous sites are tabulated and related to their frequency of occurrence. Together with the analysis previously described they form part one of a two part report. Basic data in the form of flood peak stages and discharges for each year of record at each gaging station are published in part two of the report.

INTRODUCTION

The purpose of this report is to present a method for determining the magnitude and frequency of Iowa floods based upon streamflow records in Iowa and nearby regions in adjacent states. Records of peak discharges at continuous and partial-record gaging stations have been used for this purpose. The records have been analyzed by statistical processes and correlated with physical factors to produce flood-frequency relations. Records of maximum known floods at gaged and ungaged sites are also included. This report updates and revises that by Schwob (1953).

The report has been prepared primarily for the bridge engineer. However, it will also be of use in other studies. Among these are flood-plain zoning, planning of levee systems, design of dams and reservoirs, and hydrologic studies of future flood occurrences. Flood frequency is a useful concept in the economic analysis of hydraulic structures. However, any project that involves the possible loss of life or great property damage will require additional information. For these, the basis for design may be the maximum probable flood or some other flood of very rare occurrence whose frequency cannot be determined by the methods given in this report.

The design of bridges ordinarily is not involved with loss of life or great property damage. Thus the use of a concept of the average frequency of occurrence of floods and consideration of the useful life of the bridge may form the basis for a satisfactory design. Rarely is a modern bridge or culvert a total loss or even severely damaged by the occurrence of floods moderately exceeding the design flood. Flood-frequency estimates based on relatively short-term records will therefore meet the needs of the bridge engineer. Even the longest record for Iowa (64 years, Cedar River at Cedar Rapids) is statistically a short-term record. Since 1902 the number of regular gaging stations has been increasing until today (1966) 129 lake and stream gages are being operated and more are planned.

This report has been published in two parts—Part One containing the text and accompanying illustrations and Part Two containing the flood records at gaging stations. Part One contains the methodology for computing frequency curves at any place in the State. Part Two contains the basic streamflow data which are the basis for the analyses reported in Part One.

Acknowledgments

The analyses contained in this report are based on streamflow records collected at continuous and partial-record gaging stations operated in cooperation with various Federal, State, and local agencies. The published records are contained in the annual series of U. S. Geological Survey Water-Supply Papers prior to 1961 and in the annual series of reports, "The Surface Water Records of Iowa" since 1961. The cooperating agencies are identified in these publications.

The Iowa State Highway Commission through the Iowa Highway Research Board provided fi-

nancial support for the collection of flood records at partial-record stations, for the analysis of the data, and for the preparation of this report. The report was published by the Iowa Highway Research Board.

M. A. Benson, hydraulic engineer in the Washington office of the U. S. Geological Survey, provided technical advice and assistance in making the multiple correlation analyses.

Description of the Area

Iowa is located in the midcontinent region of the United States. It is bounded on the east by the Mississippi River, on the west by the Missouri and Big Sioux Rivers, on the north by the State of Minnesota, and on the south by the State of Missouri. It has an area of 56,239 square miles. Brief descriptions of selected characteristics of topography, climate, and streams are contained in the following paragraphs.

Topography

The surface configuration of the State was produced by the action of continental glaciers, streams, and wind. A small unglaciated area in the northeast corner of the State has rugged terrain, steep rock bluffs, and deeply incised streams. Much of the remainder of the State has been subjected to the action of one or more of the great glaciers. In this region the topography ranges from flat to moderately rolling. A mantle of loess of variable thickness covers much of the western half of the State and steep bluffs composed of this material occur along the Missouri River. Elevations range from about 500 feet in the southeast to more than 1,600 feet above mean sea level in the northwestern part of the State. A few natural lakes occur in the north-central and northwestern part of the State. Many artificial ponds and lakes have been constructed in all parts of Iowa.

Climate

Temperatures in Iowa range from less than -30°F to more than 100°F. The average annual temperature ranges from about 47°F in the north to about 53°F in the south. The average number of days without killing frost varies from 135 days in the northwestern part to 175 days per year in the southeast corner of the State.

Normal annual precipitation ranges from about 25 inches in the northwest corner to about 35 inches in the east-central part of the State (Plate 1). Weather Bureau records indicate that a rainfall of 13 inches in 24 hours has occurred at least once during the period of data collection (at Primghar, July 14, 1900). A rainfall in excess of 10 inches in 24 hours is almost a yearly occurrence at one or more places in the State.

Streams

Interior Iowa streams drain areas ranging up to 14,467 square miles (Des Moines River). The Missouri River and its tributaries drain 17,379 square miles in the western third of the State. The remainder, 38,860 square miles, is drained by the Mississippi River and its tributaries. Drainage areas for streams 5 square miles or greater have been published by the Iowa Highway Research Board (Larimer, 1957).

FREQUENCY OF FLOODS

Several methods are in use for making flood-frequency analyses. Cruff and Rantz (1965) made a study and comparison of six methods of analysis of records for streams in two coastal regions of California. They concluded that the index-flood and multiple correlation methods were preferred when historical data were available. A combination of these methods is used in this report.

Dalrymple (1960) has described the index-flood method and regionalization techniques. Benson (1962 and 1964) used multiple correlation methods in developing flood-frequency relations for two different areas of the United States (New England, western Gulf of Mexico basins). The reader is referred to these reports for more detailed explanations of the methods used in this report.

Flood-Frequency Curves

Any gaging-station record of sufficient length may be used to produce a flood-frequency curve. This curve will be applicable only at or very near the site of the gaging station and its reliability is related to the length of record. Extension of the record of peaks for frequency purposes is commonly made by correlation with flood peaks for nearby stations having longer records. In the

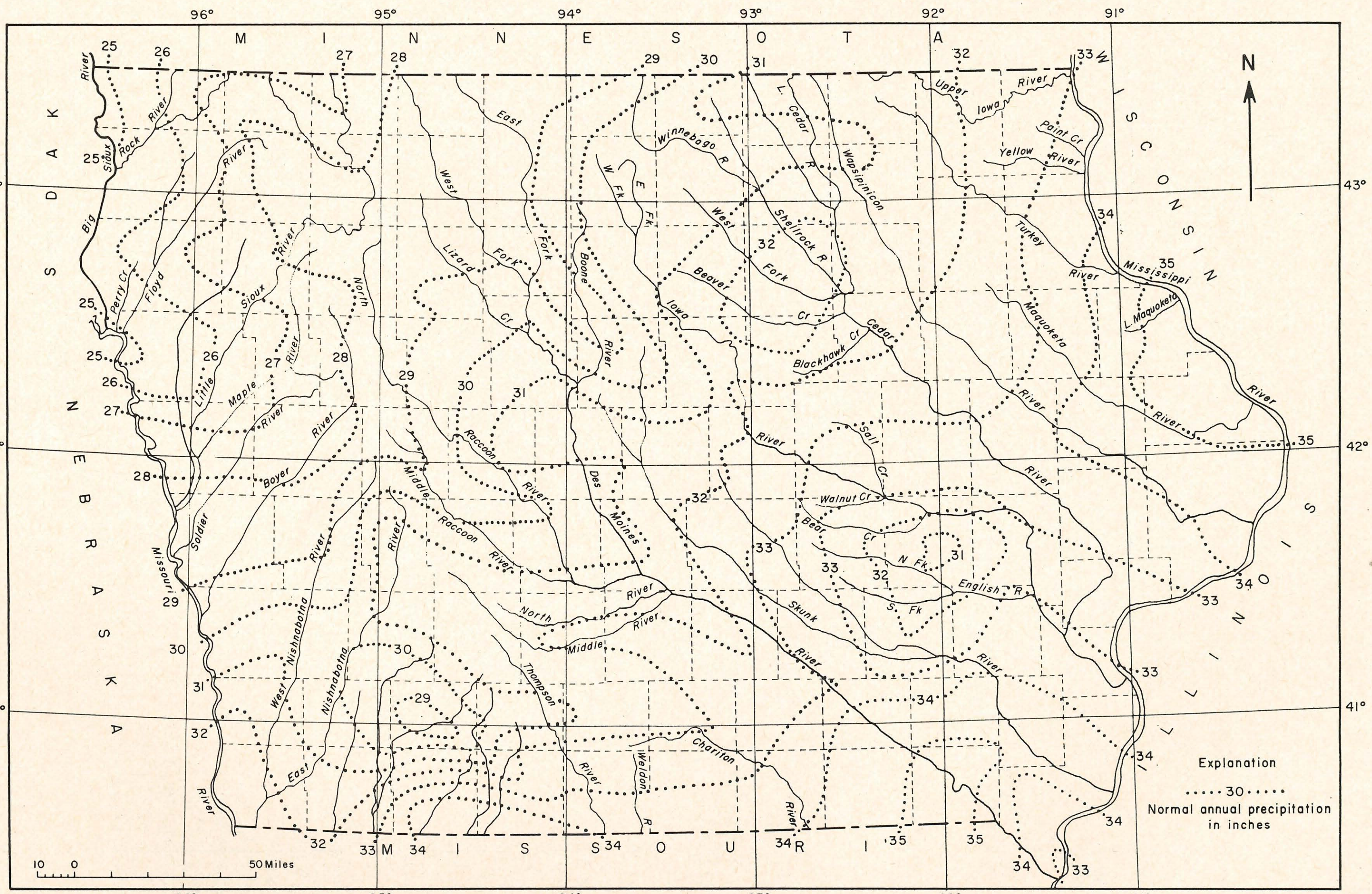


Plate 1. Isohyetal map of Iowa normal annual precipitation.

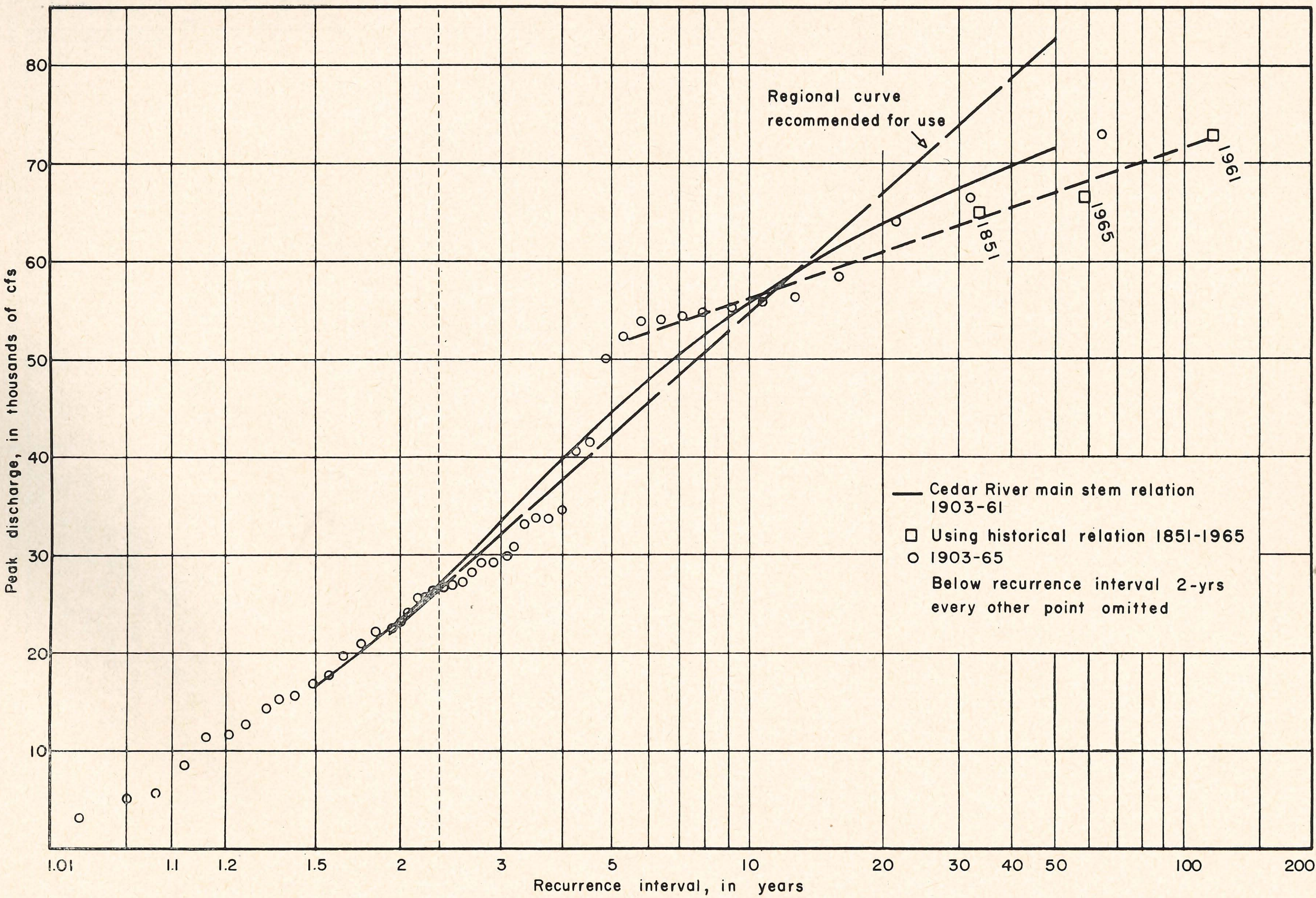


Figure 1. Flood-frequency curve for Cedar River at Cedar Rapids, Iowa.

annual flood series, used in this report, the highest momentary peak discharge in each year is listed in an array and numbered beginning with one for the largest peak in the array, number two for the second largest, etc. The plotting position for each item in the array is then determined from the formula.

$$RI = \frac{N + 1}{M}$$

in which

RI = recurrence interval, years

N = number of items in the array of peaks

M = order number in the array

The above formula is also used for the partial-duration series in which the array includes all peaks above a selected base and N exceeds the number of years of record. In either case, the magnitude of each flood is plotted against the computed recurrence interval on suitable graph paper and a smooth curve averaging the plotted points is drawn to produce the flood-frequency curve. In drawing the curve less weight is given the floods near the extremes because their true plotting positions may vary considerably from the computed value.

Flood-frequency curves for the Cedar River at Cedar Rapids are shown in figure 1. These were selected for illustration because (1) they are based on the longest record in the State, (2) they illustrate several treatments of historical flood data, and (3) they include data showing an unusual plotting pattern. The illustration also shows the kind of graph paper generally used by the Geological Survey in flood-frequency work.

The record of streamflow at Cedar Rapids is continuous since October 1902 and is the longest continuous record within the State.

A discharge for the 1851 flood at Cedar Rapids has been estimated from a high-water mark and the stage-discharge relation defined by streamflow measurements during the early period of gage operation. It is reported to be the greatest flood known prior to the start of gaging operations. The estimated flood discharge of 65,000 cubic feet per second (cfs) for 1851 was exceeded by the 1961 and 1965 floods. Thus the plotting positions of the two highest floods in the period 1851-1965 can be computed in two ways. The 1961 flood, for example, is the highest in the period of continuous record ($N = 63$) and the highest since 1851 ($N = 115$), giving recurrence intervals of 64 and 116 years, respectively. The 1965 flood is the second highest in the two periods with computed recurrence intervals of 32 and 58 years, respectively. The 1851 flood-discharge estimate is the third highest in the historical period with a recurrence interval of 38.7 years. These plotting positions are shown on figure 1. Because the discharge for the 1851 flood is an estimate and because its gage height was slightly higher than that of the 1961 flood, the plotting positions of the 1961 and 1965 floods for the historical period are somewhat questionable.

The continuous-line curve is the special flood-frequency relation for the main stem Cedar River used in the bulletin "Cedar River Basin Floods" (Schwob 1963). The short-dash curve represents the trend of the higher floods using the historical data. The long-dash curve represents the relation computed using the regional approach described subsequently and is the curve recommended for use.

The abscissa of the graph paper used in figure 1 is graduated to fit the statistical theory of extreme values. On this type of paper many flood-frequency relations tend to plot as straight lines or as gentle curves. A plotting paper with the same abscissa scale and a logarithmic ordinate scale is sometimes used to plot flood-frequency curves. Flood data for the partial-duration series are commonly plotted on semi-logarithmic graph paper.

Regionalized Frequency Relations

Two relations are used in this report to define the flood-frequency curve at any gaged or ungaged site. One relation associates recurrence interval with a ratio to an index flood. Conversion of flood magnitudes to ratios removes the factor of drainage area size and permits regionalization of the flood data. The other relation associates size of the index flood to measurable characteristics of the watershed.

The Index Flood

The index flood used in this report is the mean

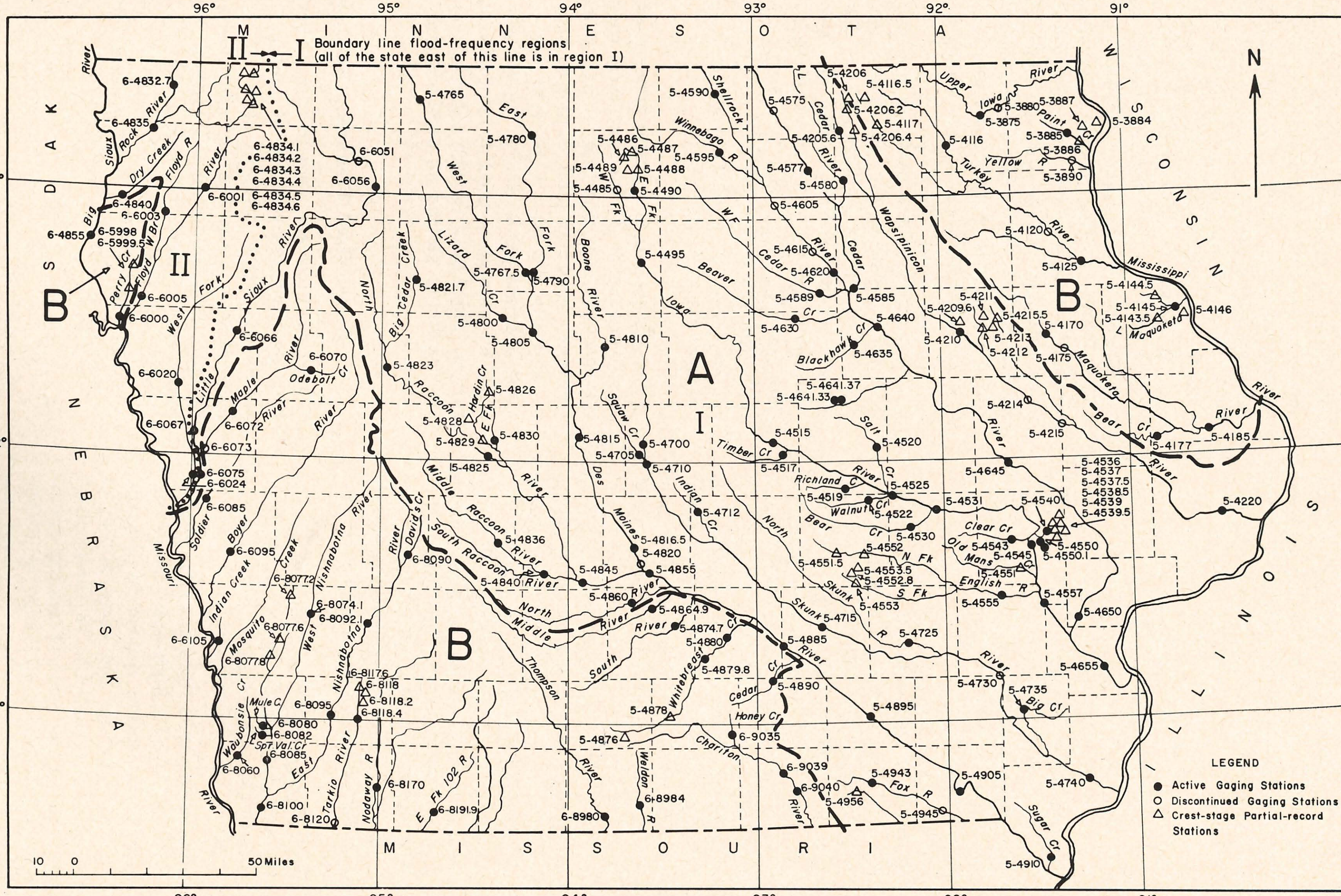


Plate 2. Map of Iowa showing gaging stations, index flood areas A and B, and flood-frequency regions I and II.

annual flood (MAF). It is defined as the flood having a recurrence interval of 2.33 years (Dalrymple 1960). For this report it has been determined by multiple correlations using an electronic computer. The dependent variable in the computations was the mean annual flood from the individual gaging-station flood-frequency curves adjusted to the 1916-65 period. This adjustment was made by first preparing flood-frequency curves for the 147 available records for the 1940-62 period. Of these 147 stations, 26 spanned or could be extended to the 1916-65 period. For these stations two frequency curves were prepared, one for the 1916-65 period and the other for the 1940-62 period. The average ratio of the 1916-65 to the 1940-62 mean annual floods for the 26 stations was 0.90. This ratio was used to adjust the remainder of the short-term mean annual floods to the long-term period. Thus, the mean annual floods for 147 stations for the period 1916-65 were available for use as the dependent variable in the multiple correlations. The 147 gaging stations were fairly well distributed over the State as indicated on plate 2. Size of drainage area ranged from 0.3 to 14,000 square miles.

The independent variables used in the multiple correlations were:

A— Drainage area in square miles.

S— The main-channel slope in feet per mile between points 10 percent and 85 percent of L above the point of interest. L is the length in miles measured along the main channel, and the upstream tributary with the largest drainage area, to the divide.

P—The normal annual precipitation in inches over the basin for the 1931-60 period.

The regression equation using all stations was,

$$MAF = .000377A^{.819}\ S^{.711}\ P^{2.982}$$

The multiple correlation coefficient was 0.92 and the standard error of estimate for the dependent variable was 41.4 percent. All variables were significant at the one percent level. However, the relation did not serve to predict the index flood equally well for all areas of the State. Two general areas appeared to have differing relations. These areas are indicated on plate 2 by the letters A and B within the dashed-line outlines.

The A area and combined B areas furnished the data for two additional multiple correlations. The independent variables were the same as previously used. The A area contained 107 gaging-station records, the B area, 40 records.

The computed results for the two areas are expressed by the equations:

$$\text{(A)}\ MAF = 0.000009856\ A^{.856}\ S^{.806}\ P^{3.926}$$

$$\text{(B)}\ MAF = 50.22\ A^{.707}\ S^{.367}$$

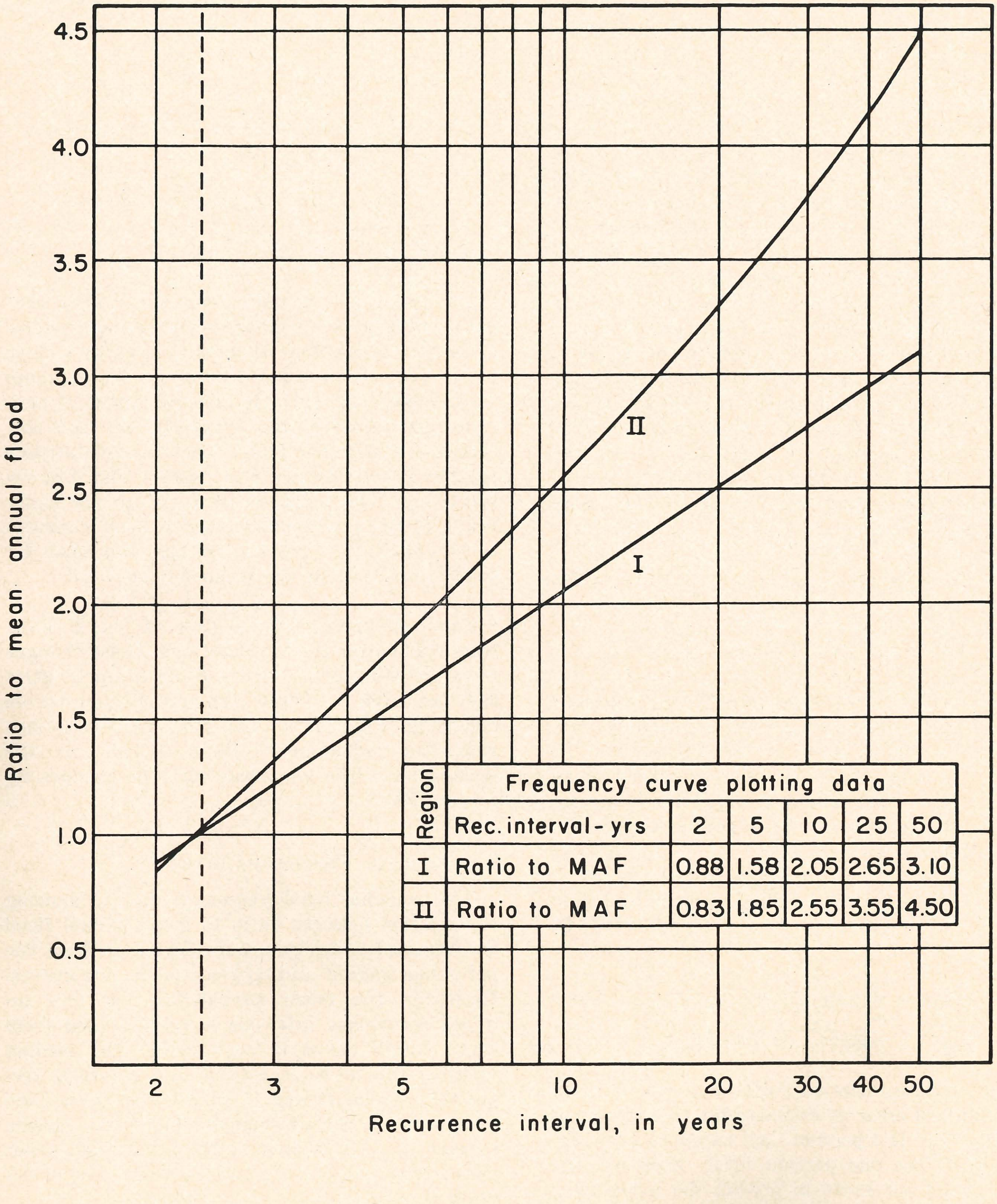
Precipitation was dropped from the B-area computation because a slightly better standard error of estimate resulted when only area and slope were used. The standard error of the estimate of the dependent variable and coefficient of multiple correlation for the A relation are 37.9 percent and 0.94 respectively. These same statistics for the B relation are 30.4 percent and 0.94 respectively. The independent variables are significant at the one percent level in both computations. The two formulas are recommended for use in determining the mean annual flood.

Small changes in the outline of the B areas were made after the computations. These changes were the result of a study of basin characteristics that indicated the seven gaging-stations involved belong in the B area. The multiple correlations were not recomputed. Plate 2 indicates the boundaries of the two areas with the changes incorporated.

The Regional Frequency Curves

Two regional flood-frequency curves, showing the relation between ratio to mean annual flood and recurrence interval, were developed from the individual gaging station flood-frequency curves. Ratios to the mean annual flood at five selected recurrence intervals were computed from each station curve in each area. The median value of the ratios in each of the two-flood frequency regions (I and II on plate 2) were then used to define the two curves. These two regions consist of a small area in the northwest corner of the State (region II) and the remainder of the State (region I).

Figure 2 is a plot of the two curves defined by



Region	Frequency curve plotting data					
	Rec. interval - yrs	2	5	10	25	50
I	Ratio to MAF	0.88	1.58	2.05	2.65	3.10
II	Ratio to MAF	0.83	1.85	2.55	3.55	4.50

Figure 2. Regional flood-frequency curves for Iowa.

the adjusted medians. It will ordinarily be unnecessary for the user to scale values of the ratio from the curves. Instead, the ratios for the selected recurrence intervals given in figure 2 may be used. If intermediate values are required it may then be necessary that they be scaled from figure 2 or discharge values obtained from a flood-frequency curve prepared by the user. Plotting points for a flood-frequency curve are computed by the use of the applicable equation to determine the mean annual flood and multiplying this value successively by the adjusted medians of the regional flood-frequency curve (fig. 2).

An investigation was made to determine if the size of drainage area was related to the size of the ratio-to-mean annual flood at the 50-year recurrence interval. However, no significant relationship was found and it is assumed that the curves of figure 2 applies for all sizes of drainage area.

Records for gaging stations in adjoining states were used to supplement the Iowa records. They were used to extend short Iowa records by correlation and in preliminary studies of the mean annual flood. However, the data necessary for including them in the multiple correlation were unavailable. The 1965 flood peaks were generally not available for inclusion in the study of the long-period flood-frequency relation.

The Independent Variables

The solution of the applicable regression equation provides the mean annual flood, or index flood, at a point of interest. The independent variables used in the equation need to be determined at this point.

Drainage area can be determined from the bulletin by Larimer (1957) or from the best maps available. Large-scale topographic maps are the most desirable.

The slope of the main stream is a second variable that must be used in the regression equation. It is the slope, in feet per mile, between points on the streambed 10 percent and 85 percent of the length to the drainage divide above the point of interest. It was determined by a combination of methods. For large streams, 0.25-mile chords on the U. S. Geological Survey 1:250,000 scale series maps were used to determine length. For small streams topographic maps or soil maps were used. Elevation from which the slope was computed were determined from maps whenever possible. For streams less than 100 square miles in drainage area, elevations were obtained by rough leveling if large-scale topographic maps were not available. The slopes of the larger rivers (those draining 700 or more square miles) can be determined from figures 3 to 11. Determination of the mileage of the point of interest with respect to that of one or more of the identification points[1] shown below the graphs will indicate the slope from the graph to be used in the regression equation. Slopes for smaller streams must be obtained from topographic maps or by leveling. The break in the slope graph of the Iowa River (fig. 4) is caused by the large amount of fall in the stream between Alden and Iowa Falls. Corps of Engineers' profiles used to derive the slope indicate a fall of approximately 80 feet in ten miles. The slope curve between the mouth of the South Fork Iowa River and mile 290 has been computed to give a reasonable index flood when used in the regression equation for area A.

The third variable (used only in area A) is the average normal precipitation in inches on the basin above the point of interest. This is the normal computed by the Weather Bureau for the 1931-60 period. The normal annual precipitation for small basins can be determined from the isohyetal map prepared from Weather Bureau climatological reports (pl. 1). For the larger basins the average normal annual precipitation above any point can be determined from figures 3 to 11.

Use of the Relations

The regression equation and figure 2 are to be used for preparing flood-frequency curves for drainage areas from 1 to 15,000 square miles. Because they are based on data from many gaging stations, they are believed to better represent the relations even at long-term gaging stations. Flood-frequency curves for the Mississippi, Missouri, and Big Sioux Rivers cannot be determined from the relations in this report. Flood-frequency relations for the Big Sioux River as determined by McCabe and Crosby (1959) are shown on figure 12. The Missouri River is regulated by a series

[1]At county bridges on local roads used as identification points the landline location is in the form of an index number—NE¼ Sec. 5, T.99N., R.9W., is indicated as 9909-5NE.

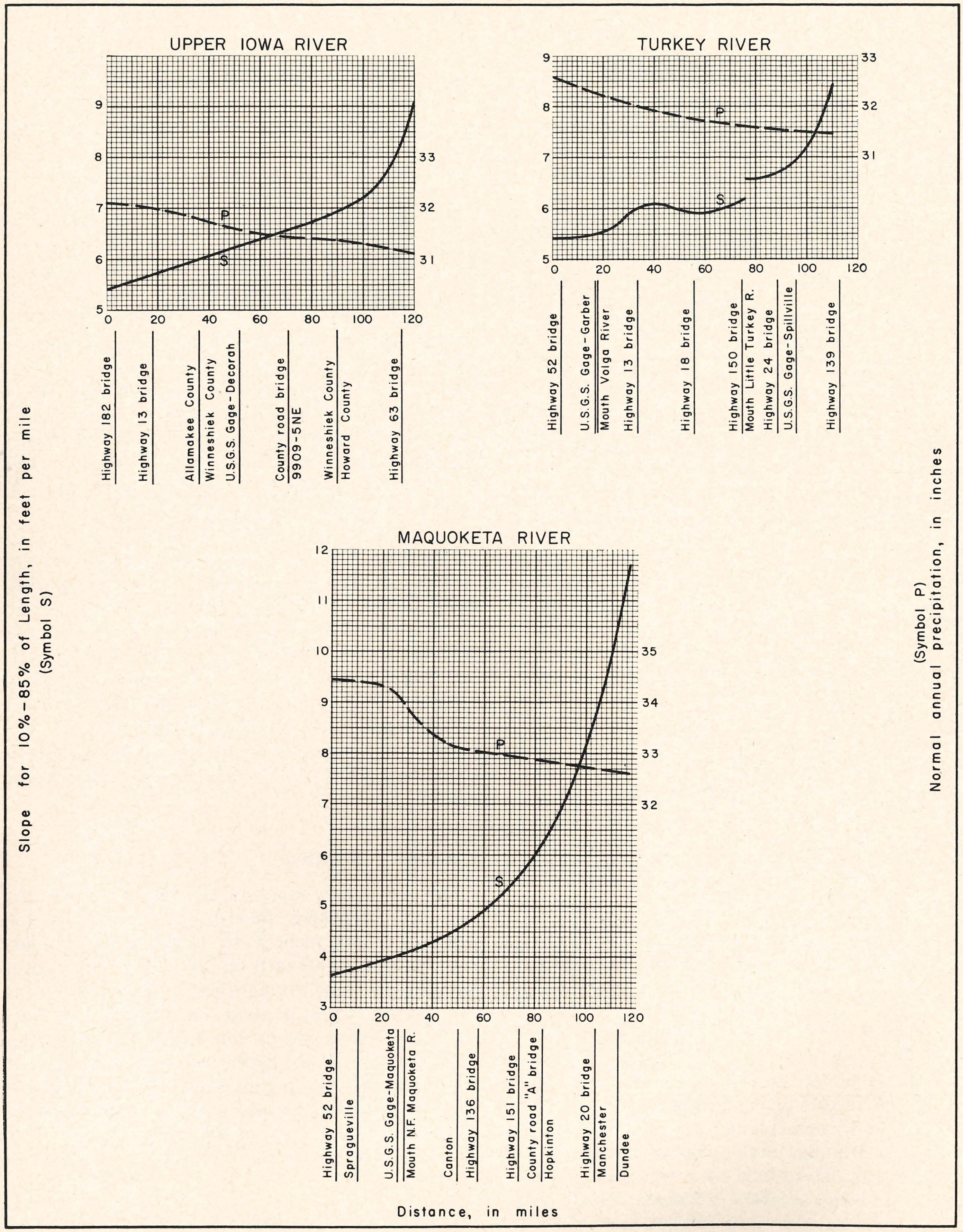


Figure 3. Slope and normal precipitation data for Upper Iowa, Turkey and Maquoketa Rivers.

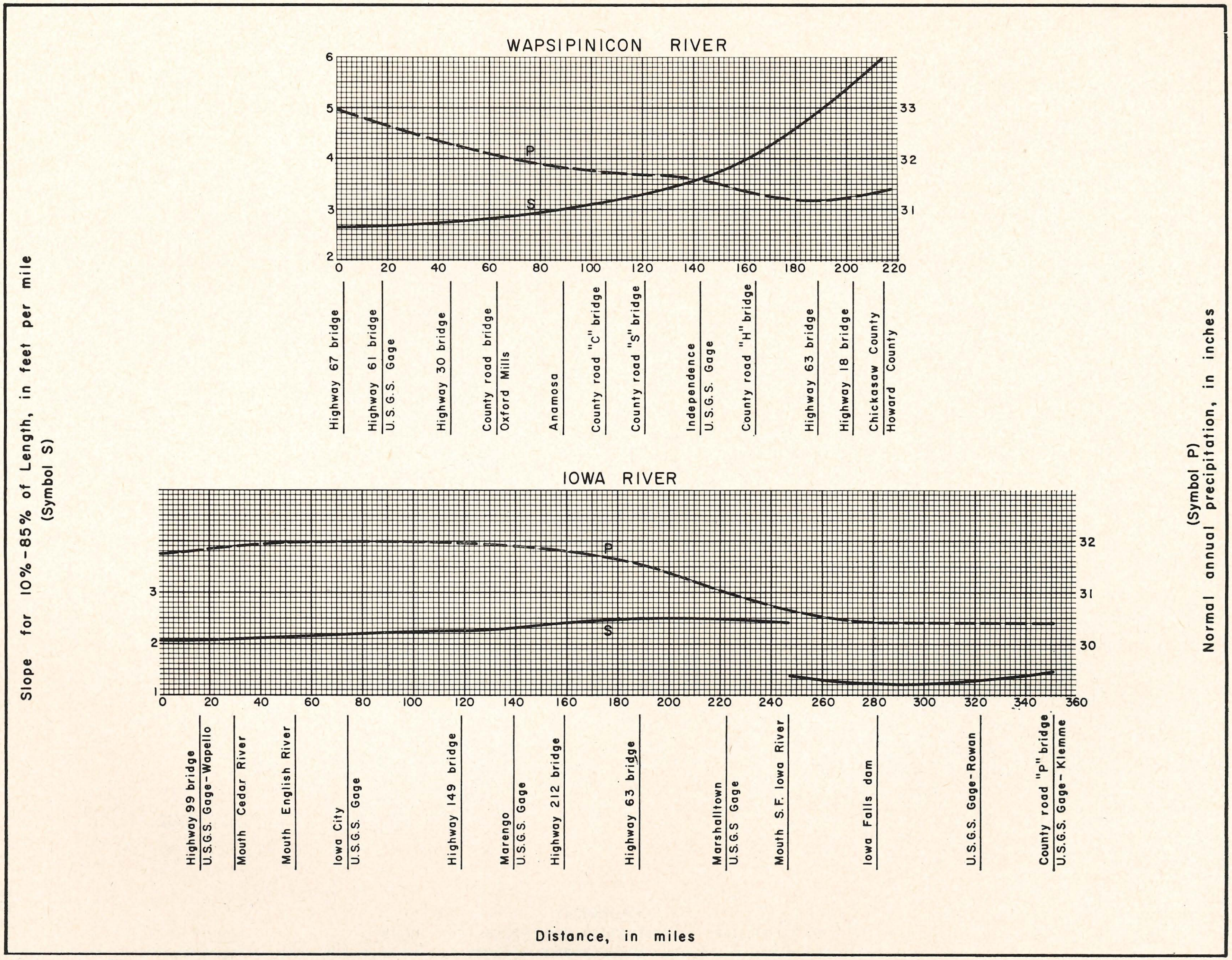


Figure 4. Slope and normal precipitation data for Wapsipinicon and Iowa Rivers.

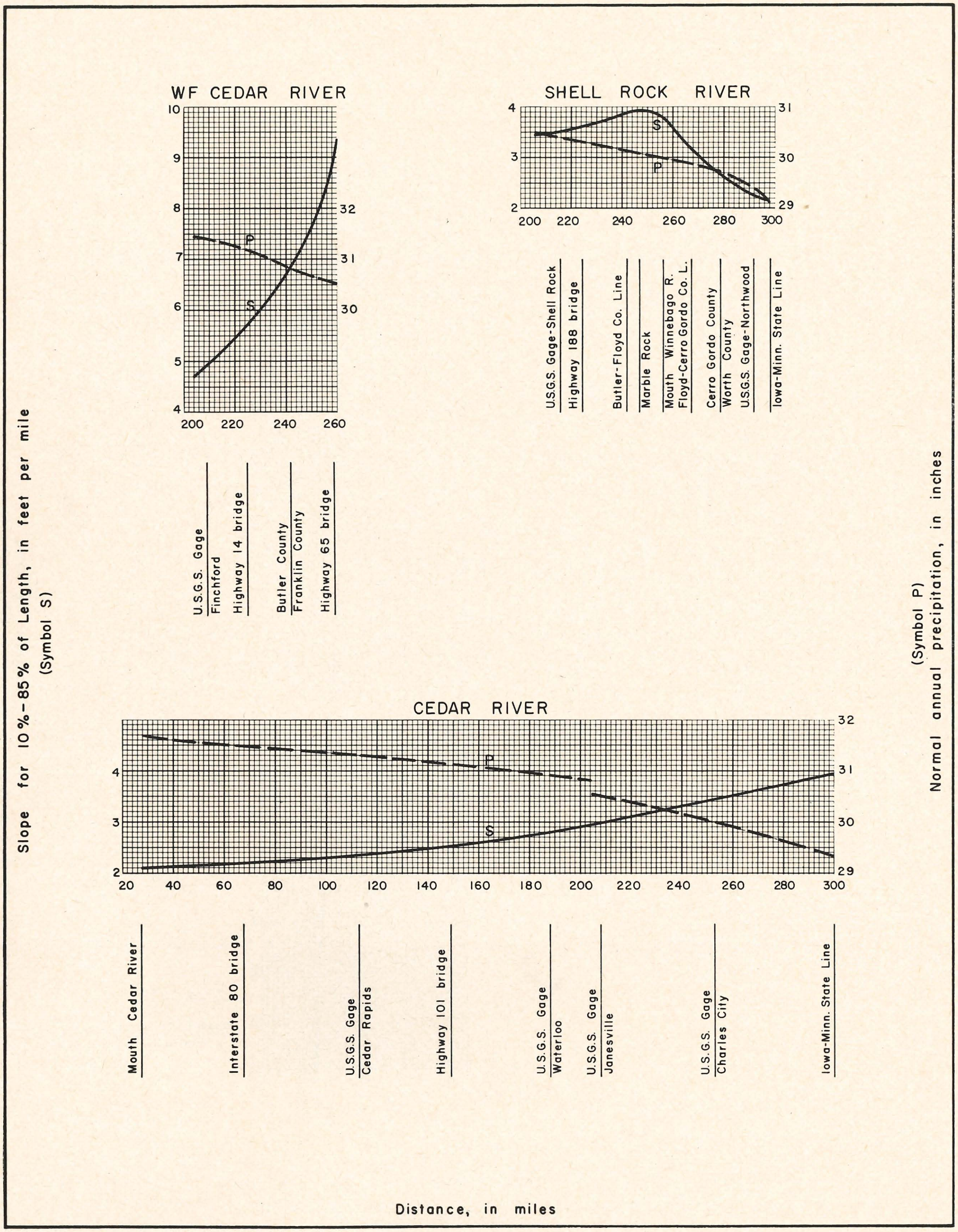


Figure 5. Slope and normal precipitation data for West Fork Cedar, Shell Rock, and Cedar Rivers.

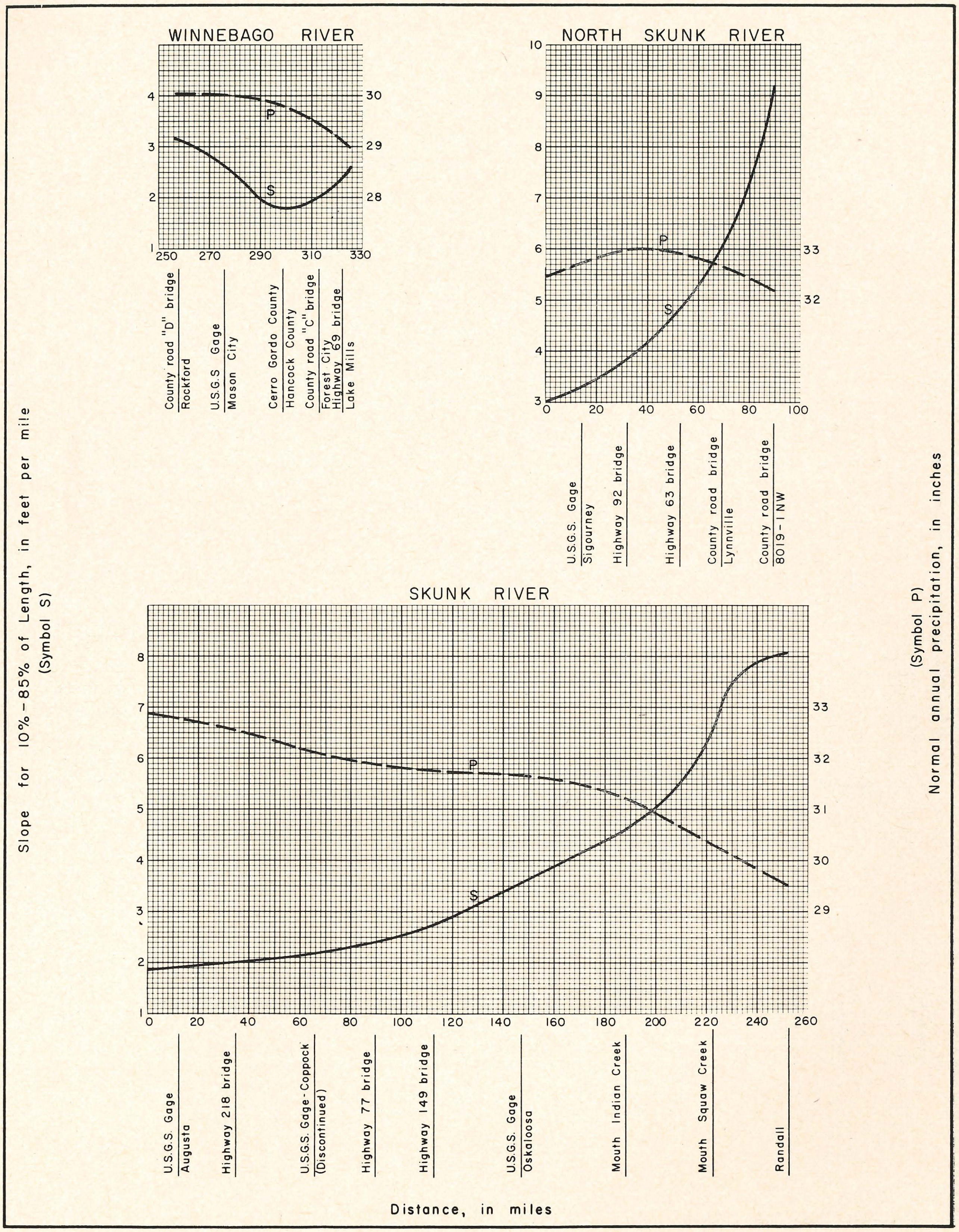


Figure 6. Slope and normal precipitation data for Winnebago, North Skunk, and Skunk Rivers.

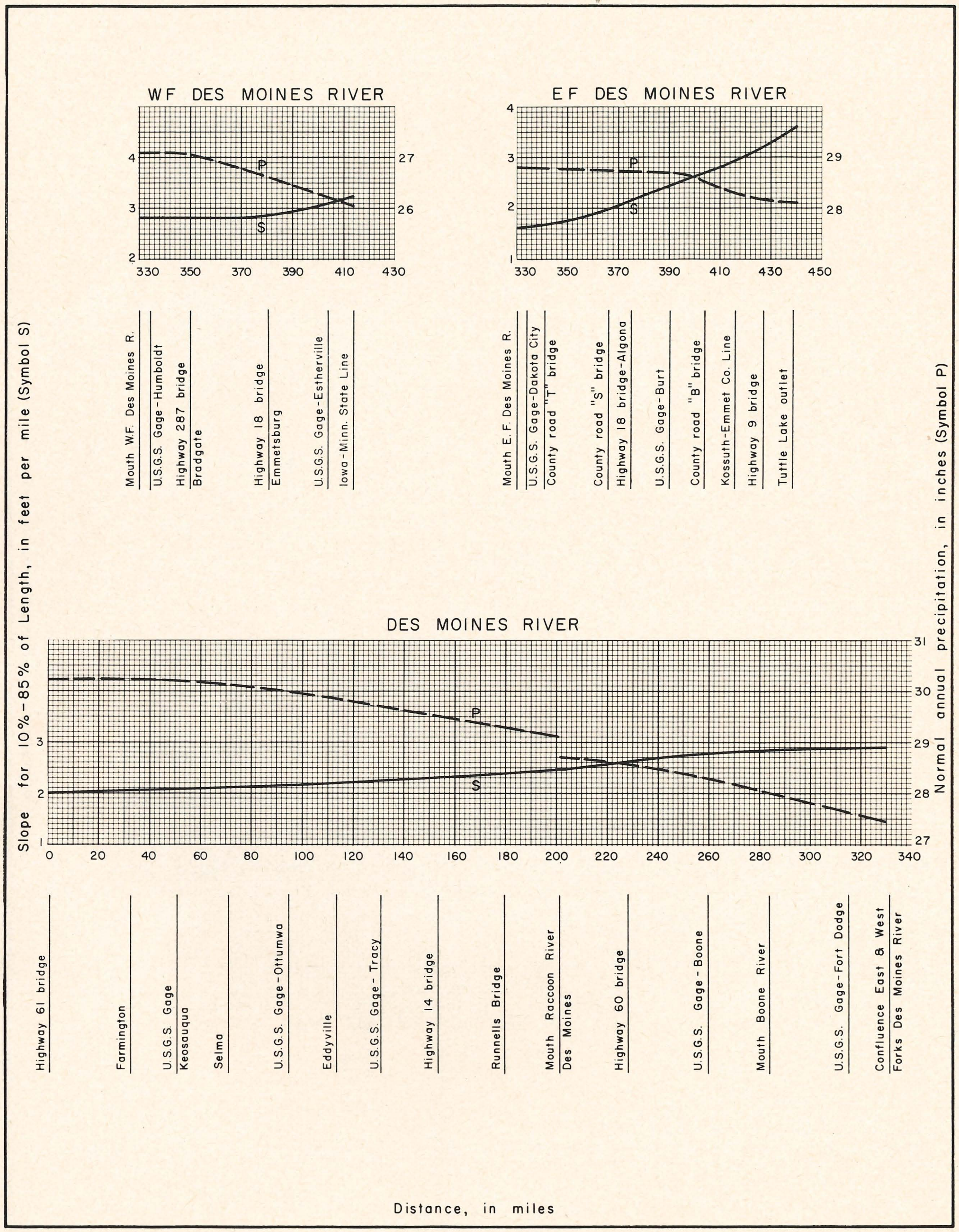


Figure 7. Slope and normal precipitation data for West Fork, East Fork, and main stem Des Moines River.

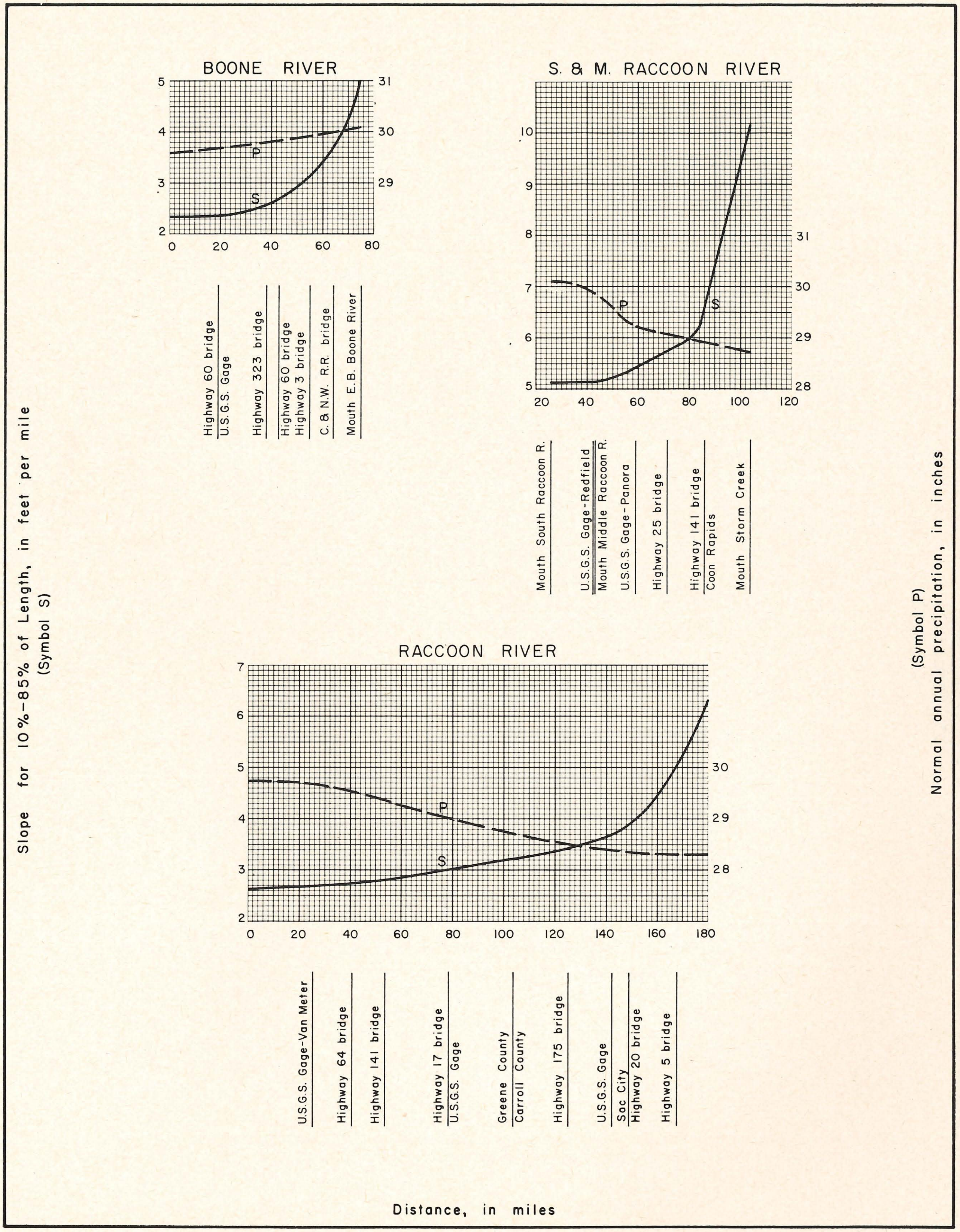


Figure 8. Slope and normal precipitation data for Boone, South Raccoon, and Raccoon Rivers.

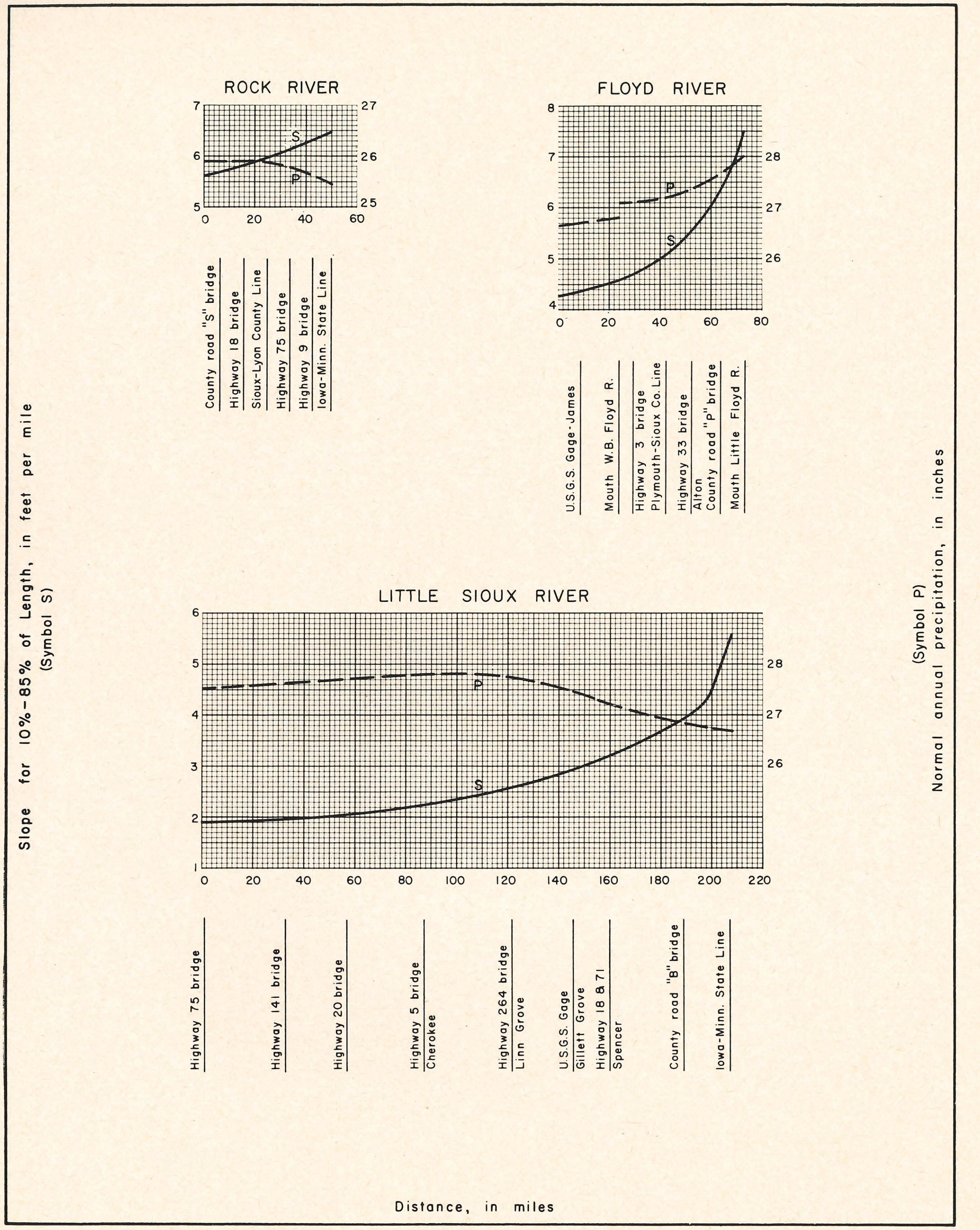


Figure 9. Slope and normal precipitation data for Rock, Floyd, and Little Sioux Rivers.

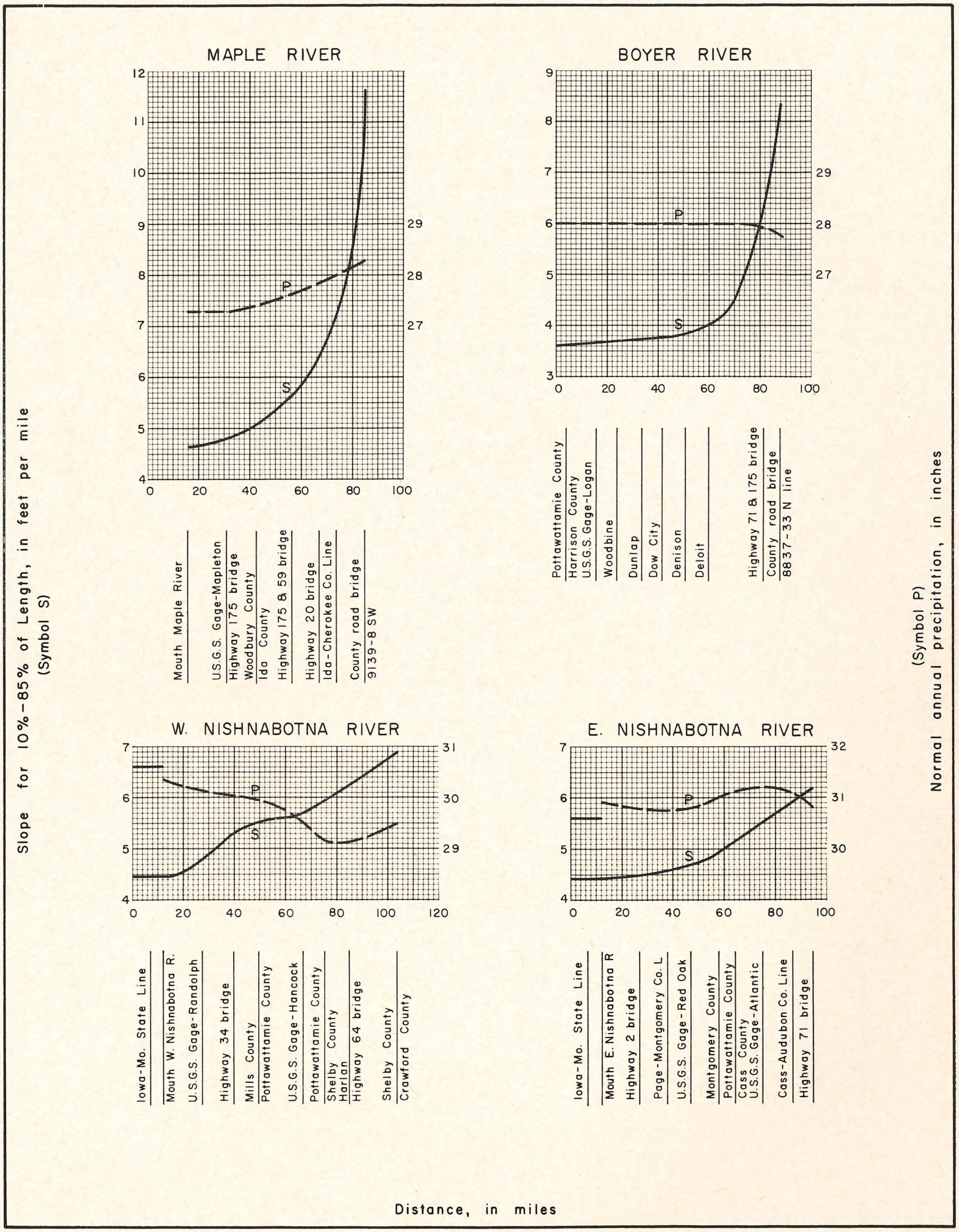


Figure 10. Slope and normal precipitation data for Maple, Boyer, and Nishnabotna Rivers.

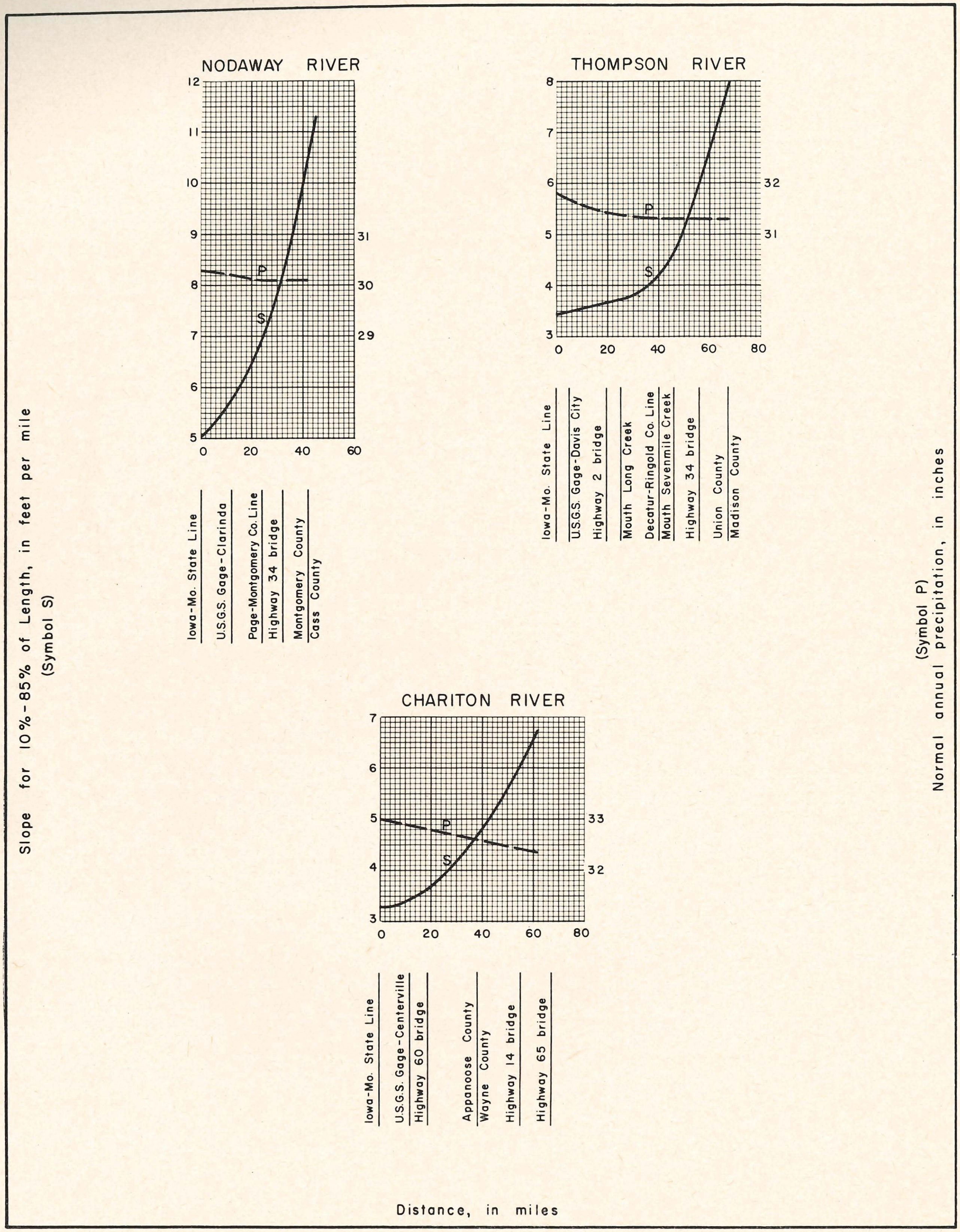


Figure 11. Slope and normal preciptation data for Nodaway, Thompson, and Chariton Rivers.

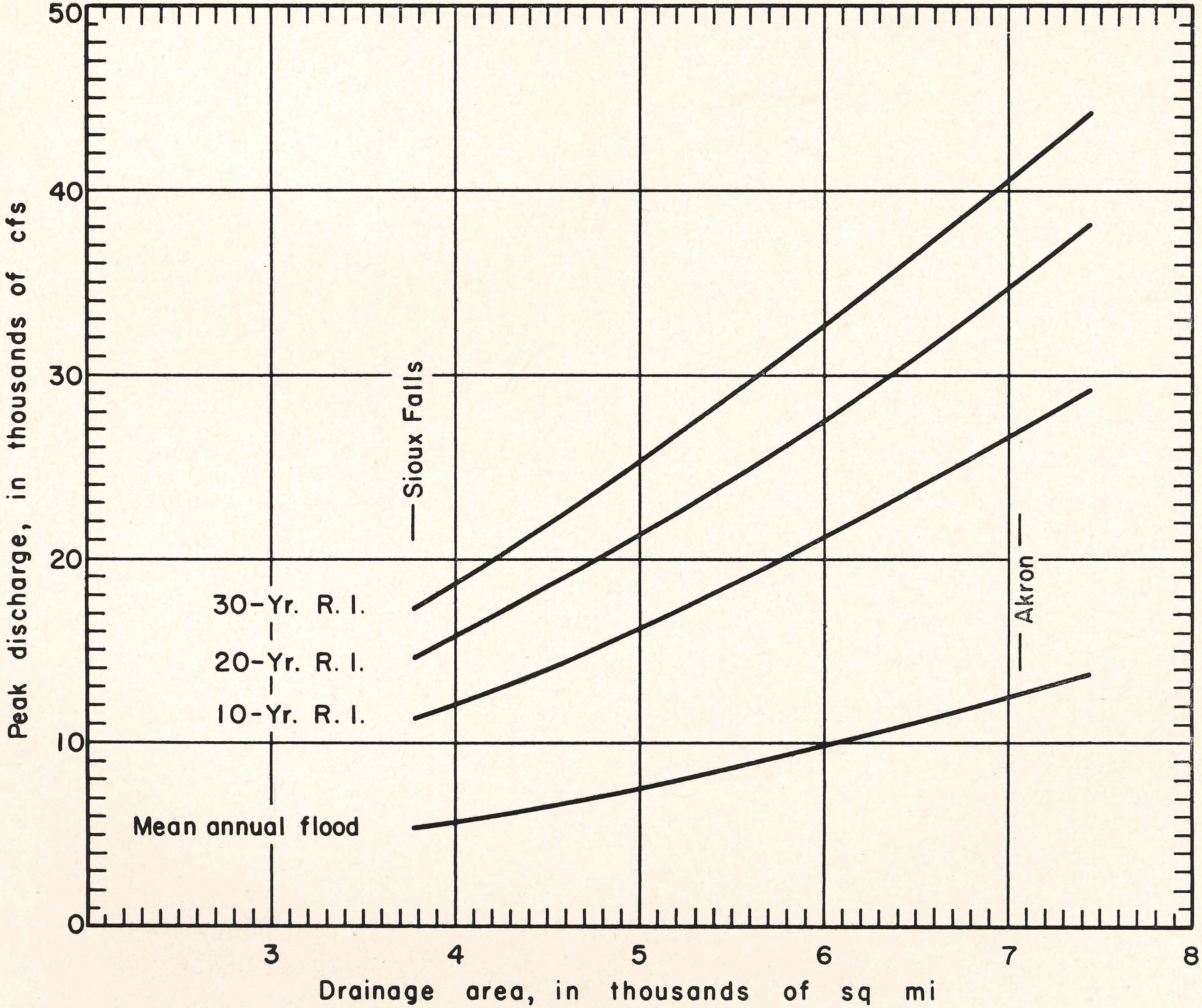


Figure 12. Flood-frequency curves for Big Sioux River.

of dams upstream from Iowa and normal frequency relations do not apply. The Mississippi River flood-frequency relations will be included in a report on the 1965 floods in the Upper Mississippi River basin which is now in preparation.

Certain types of drainage basins are not well represented in the data used. Urban basins are an example. Wiitala (1961) in a study of two Michigan streams (one urbanized, one relatively free of urban development) found that mean-annual flood peaks from the urbanized area were two to three times greater in magnitude than those from the unurbanized area.

Other limitations on the use of the relations in this report are imposed by the works of man. One is the regulation caused by flood-control reservoirs such as that on the Iowa River above Coralville, Iowa. This reservoir affects peak discharges on the Iowa River from its site to the mouth. Therefore, the flood-frequency relations herein, computed for virtually unregulated flow, cannot be used. Special studies involving the proposed method of operation in conjunction with the flow from uncontrolled areas will be necessary if flood-frequency relations are required. In addition to the Coralville Reservoir, reservoirs are under construction or proposed on several other streams.

Another limitation would be imposed if a large proportion of a small drainage area is controlled by a farm pond or a lake. Little is known of the extent of farm-pond type of development or its effect on peak flow. The general effect of lake storage is to reduce the magnitude of peak flows.

The regression equations will require a somewhat laborious solution in order to compute the mean annual flood. Table 1 provides the solution for a part of the equation for area A. Four significant figures are shown although three are adequate. The other variables in the equation for area A and the variables in the equation for area B have a wide range. For this reason it is impractical to tabulate them in a similar manner. Graphs of relation for these have been constructed for the user on large-scale logarithmic graph paper. The graphs will provide solutions for each variable consistent with slide-rule accuracy and adequate for the solution of the regression equations. They are shown as Figures 13-16.

TABLE 1. Values of $0.000009856\ P^{3.926}$ in the regression equation for area A

Precipitation, in inches	.0	.1	.2	.3	.4	.5	.6	.7	.8	.9
25	3.033	3.083	3.133	3.183	3.235	3.285	3.335	3.386	3.437	3.488
26	3.539	3.595	3.652	3.708	3.764	3.820	3.877	3.934	3.991	4.048
27	4.105	4.168	4.231	4.294	4.357	4.420	4.483	4.546	4.610	4.673
28	4.736	4.805	4.874	4.943	5.013	5.083	5.153	5.223	5.293	5.363
29	5.433	5.510	5.586	5.663	5.740	5.817	5.894	5.971	6.048	6.126
30	6.204	6.290	6.376	6.462	6.547	6.633	6.719	6 804	6.890	6.976
31	7.062	7.155	7.249	7.343	7.436	7.530	7.624	7.717	7.811	7.905
32	8.000	8.102	8.203	8.305	8.407	8.510	8.612	8.715	8.817	8.920
33	9.022	9.135	9.248	9.361	9.474	9.587	9.700	9.813	9.926	10.04
34	10.15	10.27	10.39	10.51	10.62	10.74	10.86	10.99	11.12	11.25
35	11.37	11.50	11.63	11.76	11.89	12.02	12.15	12.28	12.42	12.56

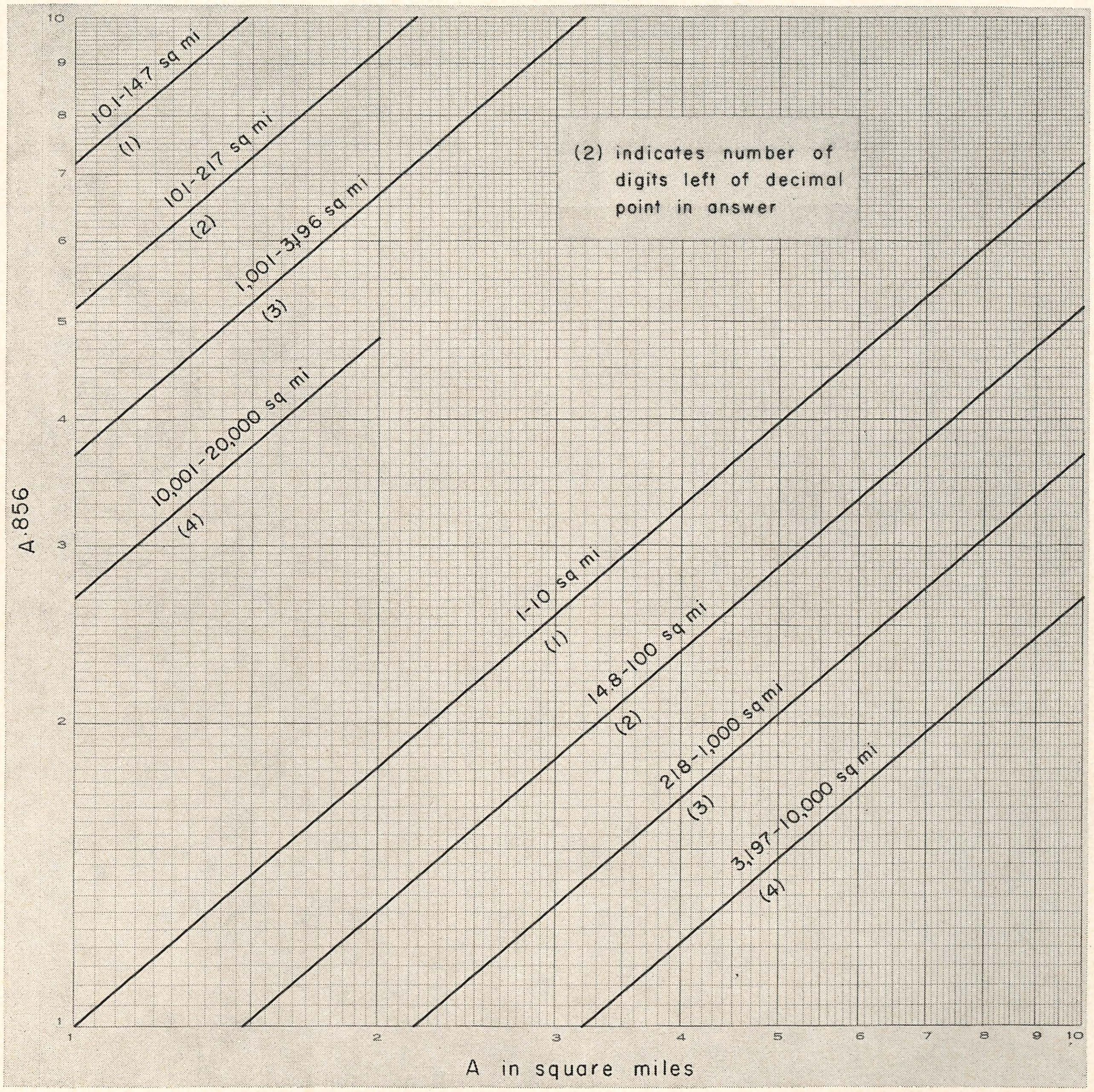


Figure 13. Graph of solution of $A^{.856}$ for area A.

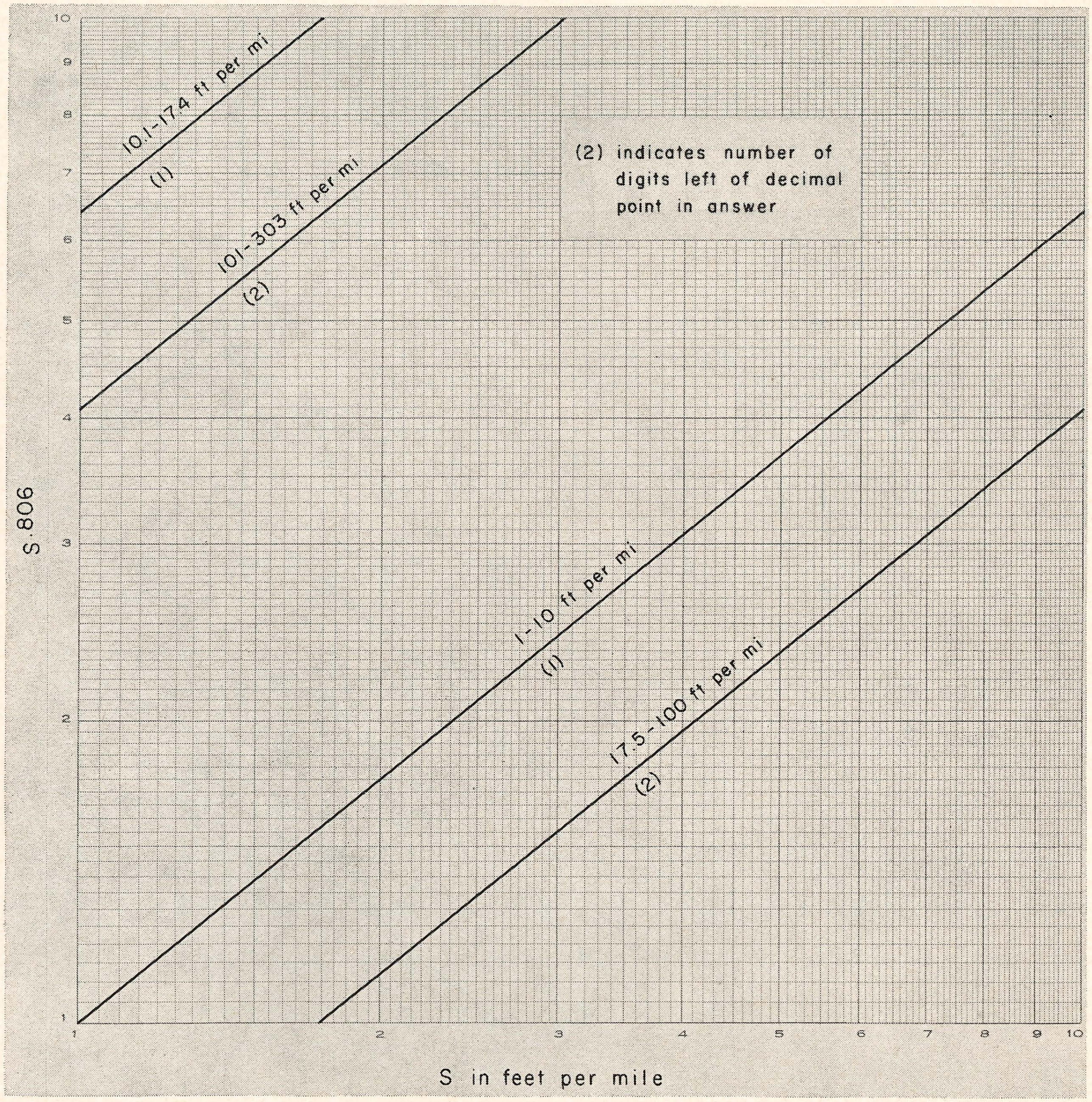


Figure 14. Graph of solution of $S^{.806}$ for area A.

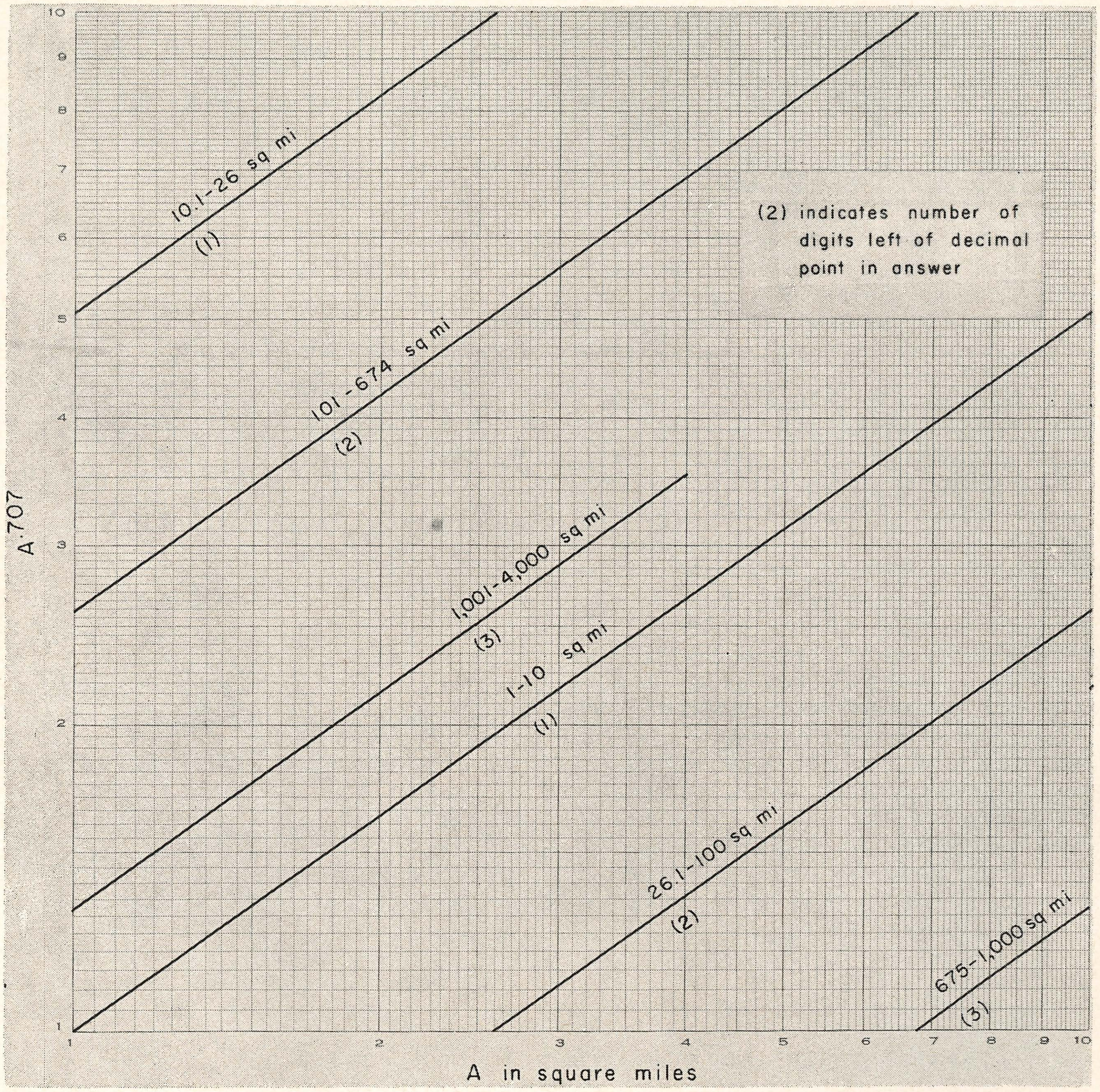


Figure 15. Graph of solution of $A^{.707}$ for area B.

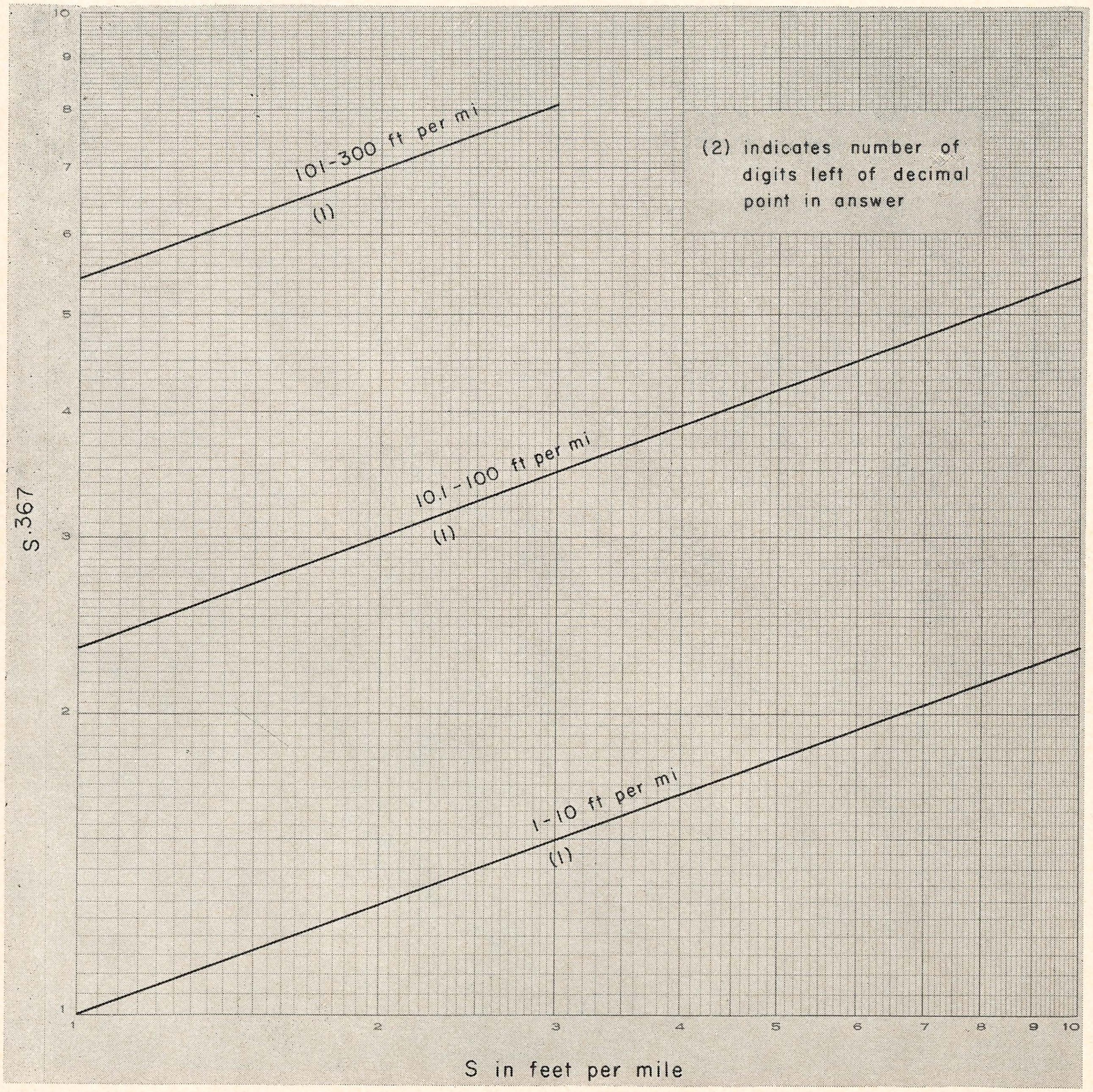


Figure 16. Graph of solution of $S^{.367}$ for area B.

The following is an example of computations for a fictitious small-stream site first in area A and region I then transposed to area B and region I. The length of the stream, as determined from a county soil map, is 5.6 miles and the drainage area 10.0 square miles. Levels to points in the streambed 0.56 miles and 4.76 miles upstream from the site (10 and 85 percent of L) indicate a fall between these points of 42.0 feet or a slope of 10.0 feet per mile. Plate I furnishes an average normal precipitation of 31.6 inches. The following computations of the data would be made:

$A^{.856} = 10.0^{.856} = 7.18$

$S^{.806} = 10.0^{.806} = 6.40$

$P^{3.926}$ x constant = (from table 1) = 7.62

MAF = 7.18 x 6.40 x 7.62 = 350 cfs

2-yr RI = 350 x 0.88 = 308 cfs

5-yr RI = 350 x 1.58 = 553 cfs

10-yr RI = 350 x 2.05 = 718 cfs

25-yr RI = 350 x 2.65 = 928 cfs

50-yr RI = 350 x 3.10 = 1080 cfs

In area B using the same drainage area and slope the results would be:

$A^{.707} = 10.0^{.707} = 5.09$

$S^{.367} = 10.0^{.367} = 2.33$

Constant = 50.22

MAF = 50.22 x 5.09 x 2.33 = 596 cfs

50-yr RI = 596 x 3.10 = 1850 cfs

DISCUSSION

This report has been prepared primarily for the highway engineer. The basic data available do not justify the extension of the curves to frequencies beyond the 50-year recurrence interval. The reciprocal of the recurrence interval when multiplied by 100 is the percent chance of ocurrence in any one year. This indicates, for example, that there is a two percent chance of the 50-year flood occurring in any year. Thus there is no implied regularity of occurrence in the use of the term, recurrence interval.

The methods of analyses used in this report involve both graphical and mathematical processes. The flood events analyzed are highly variable and the sample is small compared to the infinite population of events. For this reason the sampling errors may be large. Supposedly less subjective methods of analysis have been advocated by many. These methods generally involve fitting a predetermined type of curve by mathematical processes to the station data. However, because many of the flood records are short, the number of station records that can be used with these methods is curtailed. Many of the short records are for small drainage areas for which estimates of the magnitude and frequency of floods are especially in demand. The processes applied herein do use these short records although it is realized that large sampling errors may be inherent in them. The residuals for the short records from small drainage areas are randomly distributed and thus the regression equations are assumed to be applicable. However, more and longer records from this type of stream would be desirable in confirming this assumption.

Stage-frequency relations are sometimes desirable in place of, or in addition to, discharge-frequency relations. Such relations can be prepared for a gaging-station site but are generally subject to some possibility of errors in predicting future stages. At some gaging stations, the relation of stage to discharge is not always constant in time. Thus, in many of the tables of flood peaks at gaging stations in this report identical gage heights may indicate different peak discharges at a specific station. This poses a problem for stage-frequency curve preparation, the solution of which is sometimes unsatisfactory—converting the discharge-frequency to stage-frequency by using the current stage-discharge relation can be employed. However, any lack of stability in the relation limits its applicability for defining future flood events. Ice effect during winter floods is a similar problem. The occurrence and amount of the backwater caused by ice is completely unpredictable.

For some projects structural failure caused by floods would involve loss of life or great property damage; therefore alternate criteria for design should be investigated. The maximum flood data in tables 2 and 3 show great floods of the past compared to the 50-year recurrence-interval flood. The data provide a clue to the possibilities for the future occurrence of great floods as well as a comparison with the 50-year flood. Table 2 shows the maximum flood of record at each gaging station and the recurrence interval, or ratio to the 50-year flood if the peak is greater than that flood. Table 3 presents similar information for peak discharges at locations other than gaging stations. Recurrence intervals or ratios have been computed for the peak flows if the slope data were available for use in the regression equations.

Table 2.—Maximum know floods at gaging stations in Iowa

Station number	Gaging station	Drainage area (sq mi)	Period of known floods (water years)	Flood-Freq. region and hydro-logic area	Slope and precipitation		Mean annual flood (cfs)	Maximum floods			
					S (ft./mi.)	P (inches)		Date	Gage height (ft)	Discharge	
										(cfs)	Recurrence interval (years)
	Upper Iowa River Basin										
5–3875	Upper Iowa River at Decorah	511	1951–65	I B	6.25	——	8,070	Mar. 27, 1961	13.08	20,000	20
5–3880	Upper Iowa River near Decorah	568	1914, 1919-27, 1933–51	I B	6.13	——	8,640	May 29, 1941	15.2	28,500	*1.06
	Wexford Creek basin										
5–3884	Wexford Creek near Harpers Ferry	11.9	1953–65	I B	96.0	——	1,560	July 2, 1962	7.03	2,290	4.3
	Paint Creek basin										
5–3885	Paint Creek at Waterville	42.8	1951, 1953–65	I B	29.5	——	2,480	Aug. 5, 1951	17.35	9,100	*1.18
5–3886	Paint Creek near Waterville	56.0	1951, 1953–65	I B	27.4	——	2,910	Aug. 5, 1951	17.00	10,800	*1.20
5–3887	Little Paint Creek tributary near Waterville	1.09	1953–65	I B	87.4	——	276	June 28, 1959	4.34	404	4.2
	Yellow River basin										
5–3890	Yellow River at Ion	221	1935–51	I B	13.4	——	5,910	May 29, 1941	15.2	21,200	*1.16
	Turkey River basin										
5–4116	Turkey River at Spillville	177	1947, 1956–65	I B	6.93	——	3,960	June —, 1947	18.4	10,000	21
5–4116.5	Crane Creek tributary near Saratoga	4.06	1953–65	I B	25.8	——	446	Aug. 31, 1962	6.32	1,830	*1.32
5–4117	Crane Creek near Lourdes	75.8	1953–65	I B	8.22	——	2,320	Aug. 31, 1962	15.70	11,900	*1.65
5–4120	Turkey River at Elkader	891	1916, 1933–42	I B	6.04	——	11,900	June 1, 1916	34.3	a30,000	21
5–4125	Turkey River at Garber	1,545	1902, 1914–16, 1919–27, 1929–30, 1932–65	I B	5.58	——	16,900	Feb. 23, 1922	28.06	32,300	8.1
	Little Maquoketa River basin										
5–4143.5	Little Maquoketa River near Graf	41.5	1952–65	I B	38.2	——	2,660	July 8, 1951	15.78	7,220	28
5–4144.5	North Fork Little Maquoketa River near Rickardsville	22.8	1951–65	I B	26.4	——	1,520	Oct. 30, 1961	11.43	4,320	34
5–4145	Little Maquoketa River near Durango	130	1925, 1935–65	I B	22.1	——	4,880	June 15, 1925	c22.1	a29,000	*1.92
5–4146	Little Maquoketa River tributary at Dubuque	1.51	1951–65	I B	127	——	398	July 31, 1957	7.98	1,120	32

Table 2.—Maximum known floods at gaging stations in Iowa—Continued

Station number	Gaging station	Drainage area (sq mi)	Period of known floods (water years)	Flood-Freq. region and hydro-logic area	Slope and precipitation		Mean annual flood (cfs)	Maximum floods			
					S (ft./mi.)	P (inches)		Date	Gage height (ft)	Discharge (cfs)	Discharge Recurrence interval (years)
	Maquoketa River basin										
5-4170	Maquoketa River near Manchester	305	1925, 1928–30, 1933–65	I B	8.10	——	6,170	June 15, 1925	——	d25,400	*1.33
5-4175	Maquoketa River near Delhi	347	1929, 1933–40	I B	7.10	——	6,460	Mar. 14, 1929	89.82	e7,360	2.8
5-4177	Bear Creek near Monmouth	61.3	1958–64	I B	8.24	——	2,000	Sept. 21, 1965	13.76	7,340	*1.18
5-4185	Maquoketa River near Maquoketa	1,553	1903, 1914–65	I B	4.10	——	15,200	June 27, 1944	24.70	48,000	*1.02
	Wapsipinicon River basin										
5-4205.6	Wapsipinicon River near Elma	95.2	1959–65	I A	6.47	31.4	1,660	Mar. 29, 1962	b14.84	a5,700	*1.11
5-4206	Little Wapsipinicon River tributary near Riceville	.90	1953–65	I A	70.7	31.3	207	Aug. 31, 1962	4.94	703	*1.10
5-4206.2	Little Wapsipinicon River near Acme	7.76	1953–65	I A	21.3	31.3	497	Aug. 31, 1962	8.96	2,380	*1.54
5-4206.4	Little Wapsipinicon River at Elma	37.3	1953–65	I A	9.73	31.0	977	Aug. 31, 1962	13.05	5,740	*1.90
5-4209.6	Harter Creek near Independence	617	1952–63	I A	32.0	32.4	650	May 5, 1962	9.96	2,280	*1.13
5-4210	Wapsipinicon River at Independence	1,048	1933–65	I A	3.58	31.6	8,180	June 14, 1947	h18.74	21,500	24
5-4211	Pine Creek tributary near Winthrop	.334	1953–65	I A	87.2	32.5	122	June 24, 1959	8.67	304	20
5-4212	Pine Creek near Winthrop	28.3	1950–65	I A	14.0	32.4	1,230	Sept. 21, 1950	21.70	14,500	*3.80
5-4213	Pine Creek tributary No. 2 at Winthrop	.704	1953–65	I A	62.8	32.5	177	June 24, 1959	7.12	443	20
5-4214	Wapsipinicon River near Central City	1,263	1929, 1941–50	I A	3.33	31.7	9,160	June 15, 1947	19.3	22,500	18
5-4215	Wapsipinicon River near Stone City	1,324	1892, 1903–13	I A	3.10	31.8	9,140	July —, 1892	28.0	32,000	*1.13
5-4215.5	Buffalo Creek above Winthrop	68.2	1957–65	I A	9.60	32.5	1,950	Mar. 30, 1960	18.59	5,350	30
5-4220	Wapsipinicon River near DeWitt	2,330	1935–65	I A	2.69	32.7	14,700	June 27, 1944	12.07	26,000	6.5
	Iowa River basin										
5-4485	West Branch Iowa River near Klemme	112	1948–58	I A	1.17	30.2	410	June 21, 1954	14.97	1,920	*1.51
5-4486	East Branch Iowa River above Hayfield	2.23	1953–65	I A	12.6	30.3	99	Apr. 6, 1965	7.31	220	13
5-4487	East Branch Iowa River near Hayfield	7.94	1952–65	I A	8.00	30.3	203	June 18, 1954	13.01	457	14
5-4488	East Branch Iowa River near Garner	45.1	1952–65	I A	3.26	30.4	441	Mar. 26, 1961	12.81	1,120	22
5-4489	East Branch Iowa River tributary near Garner	5.98	1952–65	I A	10.5	30.4	201	June 17, 1954	6.71	206	2.4
5-4490	East Branch Iowa River near Klemme	133	1944, 1948–65	I A	1.44	30.4	576	June 19, 1954	c11.2	5,960	*3.34
5-4495	Iowa River near Rowan	429	1941–65	I A	1.31	30.4	1,450	June 21, 1954	14.88	8,460	*1.88

Table 2.—Maximum known floods at gaging stations in Iowa—Continued

Station number	Gaging station	Drainage area (sq mi)	Period of known floods (water years)	Flood-Freq. region and hydro-logic area	Slope and precipitation: S (ft./mi.)	Slope and precipitation: P (inches)	Mean annual flood (cfs)	Maximum floods: Date	Maximum floods: Gage height (ft)	Maximum floods: Discharge (cfs)	Maximum floods: Discharge Recurrence interval (years)
	Iowa River basin—continued										
5–4515	Iowa River at Marshalltown	1,564	1903, 1915-27, 1929-30, 1933-65	I A	2.67	31.0	8,430	June 4, 1918	17.74	42,000	*1.61
5–4517	Timber Creek near Marshalltown	118	1950-65	I A	7.56	32.3	2,510	June 18, 1950	15.77	4,940	8.9
5–4519	Richland Creek near Haven	56.1	1950-65	I A	9.20	33.2	1,730	Mar. 30, 1960	12.39	3,650	11
5–4520	Salt Creek near Elberon	201	1944, 1946–65	I A	8.00	33.4	4,730	June 18, 1947	17.6	35,000	*2.39
5–4522	Walnut Creek near Hartwick	70.9	1950-65	I A	9.20	33.1	2,090	Sept. 3, 1958	15.67	4,930	16
5–4525	Iowa River at Belle Plaine	2,455	1918, 1940–59	I A	2.45	31.8	12,800	June 5, 1918	17.9	43,000	*1.08
5–4530	Bear Creek at Ladora	189	1946–65	I A	7.02	32.6	3,670	Mar. 30, 1960	14.60	10,500	35
5–4531	Iowa River near Marengo	2,794	1957–65	I A	2.30	31.9	13,600	Mar. 31, 1960	19.21	30,800	14
5–4536	Rapid Creek below Morse	7.84	1951–65	I A	20.7	33.1	611	May 23, 1965	25.48	2,750	*1.45
5–4537	Rapid Creek tributary No. 4 near Oasis	1.55	1951–65	I A	40.3	33.0	258	July 20, 1953	18.23	956	*1.20
5–4537.5	Rapid Creek sourthwest of Morse	14.8	1951–65	I A	18.7	33.0	958	May 23, 1965	29.42	4,260	*1.43
5–4539	Rapid Creek tributary near Oasis	0.93	1951–65	I A	51.0	33.0	201	July 18, 1956	18.32	809	*1.30
5–4539.5	Rapid Creek tributary near Iowa City	3.38	1951–65	I A	29.8	32.7	380	July 18, 1956	24.35	1,850	*1.57
5–4540	Rapid Creek near Iowa City	24.6	1938–65	I A	13.7	33.0	1,150	May 23, 1965	14.10	6,100	*1.71
5–4543	Clear Creek near Coralville	98.1	1953–65	I A	7.0	32.0	1,940	May 29, 1962	13.31	5,390	31
5–4545	Iowa River at Iowa City	3,271	1851, 1881, 1903–65	I A	2.19	32.0	f15,300	June —, 1851	a24.1	70,000	*1.48
5–4550	Ralston Creek at Iowa City	3.01	1925–65	I A	35.6	32.8	402	July 18, 1956	9.06	1,690	*1.36
5–4550.1	South Branch Ralston Creek at Iowa City	3.20	1964–65	I A	——	——	——	Sept. 21, 1965	8.15	780	——
5–4551	Old Mans Creek near Iowa City	201	1951–65	I A	3.91	31.5	2,110	May 29, 1962	14.52	12,000	*1.83
5–4551.5	North Fork English River near Montezuma	34.0	1953–65	I A	5.67	32.9	734	May 24, 1953	13.25	4,240	*1.86
5–4552	North Fork English River near Guernsey	68.7	1953–65	I A	7.59	32.6	1,630	May 24, 1953	11.70	7,000	*1.38
5–4552.8	South Fork English River tributary near Barnes City	2.51	1953–65	I A	20.0	32.7	214	July 18, 1959	8.55	793	*1.20
5–4553	South Fork English River near Barnes City	11.5	1953–65	I A	10.7	32.6	469	July 27, 1961	12.26	1,790	*1.23
5–4553.5	South Fork English River tributary No. 2 near Montezuma	.523	1953–65	I A	34.6	32.3	83	July 27, 1961	13.65	344	*1.34
5–4555	English River at Kalona	573	1930, 1940–65	I A	4.20	31.9	5,760	Sept. 21, 1965	21.45	20,000	*1.12
6–4557	Iowa River at Lone Tree	4,293	1957–65	I A	2.13	32.0	f18,800	Sept. 21, 1965	20.27	31,200	5.7
5–4575	Cedar River near Mitchell	826	1933–42, 1961–62	I A	3.76	29.6	5,390	Mar. 27, 1961	93.6	20,500	*1.23

Table 2.—Maximum known floods at gaging stations in Iowa—Continued

Station number	Gaging station	Drainage area (sq mi)	Period of known floods (water years)	Flood-Freq. region and hydro-logic area	Slope and precipitation: S (ft./mi.)	Slope and precipitation: P (inches)	Mean annual flood (cfs)	Maximum floods: Date	Maximum floods: Gage height (ft)	Maximum floods: Discharge (cfs)	Maximum floods: Discharge Recurrence interval (years)
	Iowa River basin– continued										
5-4577	Cedar River near Charles City	1,054	1946–53, 1961–62, 1965	I A	3.45	30.0	6,500	Mar. 27, 1961	21.53	28,000	*1.39
5-4580	Little Cedar River near Ionia	306	1954–65	I A	5.05	31.1	3,530	Mar. 27, 1961	15.58	10,800	47
5-4585	Cedar River at Janesville	1,661	1905–06, 1915–21, 1923–27, 1933–42, 1945–65	I A	2.96	30.5	9,050	Mar. 28, 1961	16.33	27,000	*1.32
5-4589	West Fork Cedar River at Finchford	846	1929, 1946–65	I A	5.0	31.4	8,690	June 27, 1951	17.28	31,900	*1.18
5-4590	Shell Rock River near Northwood	300	1946–65	I A	2.24	29.4	1,450	Apr. 8, 1965	12.07	3,400	16
5-4595	Winnebago River at Mason City	526	1933–65	I A	2.56	30.0	2,820	Mar. 30, 1933	15.7	10,800	*1.24
5-4605	Shell Rock River at Marble Rock	1,318	1934–53, 1961–62	I A	4.1	30.1	9,170	Mar. 28, 1961	12.7	32,000	*1.12
5-4615	Shell Rock River near Clarksville	1,626	1915–27, 1933–34, 1961–62	I A	3.63	30.3	10,300	Mar. 28, 1961	——	33,400	*1.04
5-4620	Shell Rock River at Shell Rock	1,746	1856, 1953–65	I A	3.60	30.4	10,900	1856	17.7	a45,000	*1.33
5-4630	Beaver Creek at New Hartford	347	1946–65	I A	7.6	32.2	6,270	June 13, 1947	13.5	18,000	36
5-4635	Black Creek at Hudson	303	1952–65	I A	6.2	31.9	4,570	Mar. 31, 1960	b16.93	a9,000	8.9
5-4640	Cedar River at Waterloo	5,146	1929, 1933, 1941–65	I A	2.80	30.9	24,200	Mar. 29, 1961	21.86	76,700	*1.02
5-4641.33	Half Mile Creek near Gladbrook	1.33	1963–65	I A	64.6	32.3	309	July 9, 1965	9.24	307	2.3
5-4641.37	Four Mile Creek near Traer	19.5	1963–65	I A	12.1	32.3	788	Mar. 1, 1965	11.91	600	<2.0
5-4645	Cedar River at Cedar Rapids	6,510	1851, 1903–65	I A	2.34	31.3	26,700	Mar. 31, 1961	19.66	73,000	29
5-4650	Cedar River at Conesville	7,785	1929, 1940–65	I A	2.14	31.6	28,700	Apr. 2, 1961	16.62	70,800	19
5-4655	Iowa River at Wapello	12,499	1915–65	I A	2.07	31.8	f45,000	June 18, 1947	16.14	94,000	10
	Skunk River basin										
5-4700	Skunk River near Ames	315	1921–27, 1930, 1933–65	I A	7.34	30.0	4,250	June 10, 1954	13.66	8,630	10
5-4705	Squaw Creek at Ames	204	1918–27, 1965	I A	8.87	31.2	3,960	June 4, 1918	14.5	6,900	6.3
5-4710	Skunk River below Squaw Creek near Ames	556	1944, 1953–65	I A	6.63	30.3	6,880	May 19, 1944	13	10,000	4.2
5-4712	Indian Creek near Mingo	276	1958–65	I A	6.36	30.9	3,800	May 7, 1960	15.07	5,860	4.7
5-4715	Skunk River at Oskaloosa	1,635	1944, 1946–65	I A	3.63	31.7	12,200	May —, 1944	25.8	37,000	46
5-4725	North Skunk River near Sigourney	730	1944, 1946–65	I A	3.29	32.7	6,410	Mar. 31, 1960	25.33	27,500	*1.38
5-4730	Skunk River at Coppock	2,916	1903, 1914–50	I A	2.22	32.1	14,200	May 24, 1944	22.3	41,500	39
5-4735	Big Creek near Mt. Pleasant	106	1956–65	I A	5.32	34.3	2,190	Sept. 21, 1965	18.22	6,150	32
5-4740	Skunk River at Augusta	4,303	1903, 1915–65	I A	1.92	32.8	19,200	Apr. 3, 1960	25.00	51,000	26

Table 2.—Maximum known floods at gaging stations in Iowa—Continued

Station number	Gaging station	Drainage area (sq mi)	Period of known floods (water years)	Flood-Freq. region and hydrologic area	Slope and precipitation S (ft./mi.)	Slope and precipitation P (inches)	Mean annual flood (cfs)	Maximum floods: Date	Maximum floods: Gage height (ft)	Maximum floods: Discharge (cfs)	Maximum floods: Discharge Recurrence interval (years)
	Des Moines River basin										
5-4765	West Fork Des Moines River at Estherville	1,372	1952–65	I A	3.08	26.2	4,370	June 8, 1953	15.53	10,800	19
5-4767.50	West Fork Des Moines River at Humboldt	2,256	1940–65	I A	2.85	27.1	7,180	Apr. 8, 1965	13.90	14,400	9.3
5-4780	East Fork Des Moines River near Burt	462	1952–65	I A	2.50	28.7	2,080	Apr. 6, 1965	14.21	5,000	18
5-4790	East Fork Des Moines River at Dakota City	1,308	1938, 1940–65	I A	1.67	28.7	3,710	June 21, 1954	16.95	18,800	*1.63
5-4800	Lizard Creek near Clare	257	1940–65	I A	4.45	28.9	2,060	June 23, 1947	16.0	10,000	*1.56
5-4805	Des Moines River at Fort Dodge	4,190	1905–06, 1914–27, 1947–65	I A	2.87	27.6	13,600	Apr. 8, 1965	17.79	35,600	24
5-4810	Boone River near Webster City	844	1918, 1932, 1940–65	I A	2.38	29.7	3,780	June 10, 1918	i19.1	21,500	*1.83
5-4815	Des Moines River near Boone	5,511	1903, 1905–29, 1931, 1933–65	I A	2.80	28.3	18,000	June 22, 1954	25.35	57,400	*1.03
5-4816.5	Des Moines River near Saylorville	5,841	1954, 1962–65	I A	2.48	28.7	18,200	June 24, 1954	j24.5	60,000	*1.06
5-4820	Des Moines River at Des Moines	6,245	1902–03, 1906, 1915–61	I A	2.46	28.7	19,100	June 24, 1954	30.16	60,200	*1.02
5-4821.7	Big Cedar Creek near Varina	80.0	1960–65	I A	5.55	28.7	872	Aug. 3, 1962	13.68	2,080	16
5-4823	North Raccoon River near Sac City	713	1958–65	I A	3.50	28.4	3,840	Sept. 1, 1962	18.12	10,800	32
5-4825	North Raccoon River near Jefferson	1,619	1940–65	I A	2.98	29.0	7,300	June 23, 1947	22.3	29,100	*1.28
5-4826	Hardin Creek at Farnhamville	43.7	1952–65	I A	2.43	30.4	339	Aug. 26, 1954	10.48	2,000	*1.90
5-4828	Happy Run at Churdan	7.58	1952–65	I A	6.50	30.5	169	Mar. 25, 1962	8.57	150	2.0
5-4829	Hardin Creek near Farlin	101	1951–65	I A	3.26	30.5	891	Mar. 29, 1951	12.97	2,270	22
5-4830	East Fork Hardin Creek near Churdan	24.0	1952–65	I A	8.40	31.0	595	May 5, 1960	8.92	413	<2.0
5-4836	Middle Raccon River at Panora	440	1953, 1958–65	I A	5.45	29.2	4,000	June 10, 1953	14.3	a14,000	*1.13
5-4840	South Raccoon River at Redfield	988	1940–65	I A	5.12	29.9	8,570	July 2, 1958	29.04	35,000	*1.32
5-4845	Raccoon River at Van Meter	3,441	1915–65	I A	2.71	29.7	14,000	June 13, 1947	21.4	41,200	40
5-4855	Des Moines River below Raccoon River at Des Moines	9,879	1940–65	I A	2.45	29.1	29,700	June 26, 1947	j20.8	77,000	23
5-4860	North River near Norwalk	349	1940–65	I A	7.11	31.6	5,550	June 13, 1947	25.3	32,000	*1.86
5-4864.9	Middle River near Indianola	503	1940–65	I B	5.68	——	7,760	June 13, 1947	26.4	34,000	*1.41
5-4874.7	South River near Ackworth	460	1940–65	I B	6.68	——	7,860	June 5, 1947	24.6	34,000	*1.40
5-4876	South Whitebreast Creek near Osceola	28.0	1953–65	I B	17.0	——	1,500	Sept. 6, 1964	13.51	1,790	2.9
5-4878	Whitebreast Creek at Lucas	128	1953–65	I B	7.9	——	3,310	May 22, 1959	16.98	11,900	*1.16
5-4879.8	Whitebreast Creek near Dallas	342	1963–65	I B	4.78	——	5,540	Mar. 17, 1965	22.49	6,640	3.0
5-4880	Whitebreast Creek near Knoxville	380	1945–62	I B	4.48	——	5,810	June 6, 1947	19.6	14,000	18

Table 2.—Maximum known floods at gaging stations in Iowa—Continued

Station number	Gaging station	Drainage area (sq mi)	Period of known floods (water years)	Flood-Freq. region and hydrologic area	Slope and precipitation: S (ft./mi.)	Slope and precipitation: P (inches)	Mean annual flood (cfs)	Maximum floods: Date	Maximum floods: Gage height (ft)	Maximum floods: Discharge (cfs)	Maximum floods: Discharge Recurrence interval (years)
	Des Moines River basin—continued										
5–4885	Des Moines River near Tracy	12,479	1903, 1920–65	I A	2.24	29.7	36,600	June 14, 1947	k26.5	155,000	*1.36
5–4890	Cedar Creek near Bussey	374	1946, 1948–65	I B	5.74	——	6,290	June —, 1946	28.05	31,500	*1.62
5–4895	Des Moines River at Ottumwa	13,374	1903, 1917–65	I A	2.16	30.0	39,000	May 31, 1903	19.4	a140,000	*1.16
5–4905	Des Moines River at Keosauqua	14,038	1903–06, 1910–65	I A	2.08	30.2	40,700	June 1, 1903	27.8	146,000	*1.16
5–4910	Sugar Creek near Keokuk	105	1905, 1922–31, 1958–65	I A	5.76	33.9	2,210	June 9, 1905	c20.6	a33,000	*4.82
	Fox River basin										
5–4943	Fox River at Bloomfield	87.7	1953–65	I A	8.30	34.1	2,600	May 6, 1960	24.02	8,600	*1.07
5–4945	Fox River at Cantril	161	1920, 1941–51	I A	6.82	34.4	3,860	June 8, 1946	18.9	16,500	*1.38
	Wyaconda River basin										
5–4956	South Wyaconda River near West Grove	4.69	1953–65	I A	26.9	34.4	565	Aug. 5, 1959	9.64	1,970	*1.12
	Big Sioux River basin										
6–4832.7	Rock River at Rock Rapids	788	1960–65	II A	6.33	25.6	4,460	Mar. 29, 1962	9.56	16,400	28
6–4834.1	Otter Creek north of Sibley	11.9	1952–65	II A	6.13	27.3	152	Mar. 31, 1962	8.49	1,410	*2.06
6–4834.2	Schutte Creek near Sibley	1.43	1952–65	II A	25.6	27.5	82	June 7, 1953	4.14	503	*1.36
6–4834.3	Otter Creek at Sibley	29.9	1952–65	II A	10.0	27.3	502	June 7, 1953	9.82	5,400	*2.39
6–4834.4	Dawson Creek near Sibley	4.35	1952–65	II A	38.9	27.3	288	June 7, 1953	6.21	4,290	*3.30
6–4834.5	Wagner Creek near Ashton	7.09	1952–65	II A	21.9	27.7	291	June 7, 1953	5.37	2,840	*2.17
6–4834.6	Otter Creek near Ashton	88.0	1952–65	II A	9.65	27.5	1,260	June 7, 1953	12.16	17,400	*3.07
6–4835	Rock River near Rock Valley	1,600	1949–65	II A	5.79	25.9	7,920	Mar. 30, 1962	16.91	28,400	26
6–4840	Dry Creek at Hawarden	48.4	1949–65	II A	9.08	25.4	528	June 7, 1953	17.57	10,900	*4.58
6–4855	Big Sioux River at Akron	9,030	1929–64	m—	——	——	12,500	Mar. 31, 1962	22.08	54,300	n1.32
	Perry Creek basin										
6–5998	Perry Creek near Merrill	7.88	1953–65	II B	20.4	——	652	June 7, 1953	9.51	2,540	33
6–5999.5	Perry Creek near Hinton	30.7	1953–65	II B	14.3	——	1,490	June 7, 1953	17.93	4,980	21
6–6000	Perry Creek at 38th Street, Sioux City, Iowa	65.1	1944, 1946–65	II B	15.5	——	2,640	July 7, 1944	25.5	9,600	27

Table 2.—Maximum known floods at gaging stations in Iowa—Continued

Station number	Gaging station	Drainage area (sq mi)	Period of known floods (water years)	Flood-Freq. region and hydro-logic area	Slope and precipitation		Mean annual flood (cfs)	Maximum floods			
					S (ft./mi.)	P (inches)		Date	Gage height (ft)	Discharge	
										(cfs)	Recurrence interval (years)
	Floyd River basin										
6–6001	Floyd River at Alton	265	1953, 1956–65	II A	5.49	27.4	1,250	June 7-8, 1953	——	a45,500	*8.09
6–6003	West Branch Floyd River near Struble	181	1956–65	II A	6.10	26.0	1,300	Mar. 28, 1962	15.63	8,060	*1.38
6–6005	Floyd River at James	882	1935–65	II A	4.38	26.7	4,280	June 8, 1953	25.30	71,500	*3.70
	Monona-Harrison ditch basin										
6–6020	West Fork ditch at Holly Springs	399	1939–65	II A	6.50	26.6	2,940	Mar. 28, 1962	22.46	12,400	42
6–6024	Monona-Harrison ditch near Turin	900	1958–65	II A	——	——	g—	June 2, 1963	16.87	12,400	——
	Little Sioux River basin										
6–6051	Little Sioux River at Spencer	990	1937–42, 1953, 1965	I A	3.26	27.2	4,000	June 8, 1953	20.28	30,000	*2.42
6–6056	Little Sioux River at Gillett Grove	1,334	1953, 1958–65	I A	2.98	27.5	5,070	Apr. 7, 1965	18.67	20,200	*1.28
6–6066	Little Sioux River at Correctionville	2,500	1919–25, 1929–32, 1937–65	I A	1.99	27.7	6,390	Apr. 7, 1965	25.86	29,800	*1.50
6–6067	Little Sioux River near Kennebec	2,738	1940–65	I A	1.93	27.6	6,590	Apr. 8, 1965	26.50	29,700	*1.45
6–6070	Odebolt Creek near Arthur	39.3	1951, 1958–65	I B	16.1	——	1,870	Aug. 30, 1962	13.78	5,200	31
6–6072	Maple River at Mapleton	669	1942–65	I B	4.83	——	8,890	June 20, 1954	20.4	15,600	6.3
6–6073	Maple River at Turin	734	1936, 1939–41	I B	4.65	——	9,460	June 4, 1940	19.4	2,920	<2.0
6–6075	Little Sioux River near Turin	3,526	1959–65	I A	——	——	g—	Apr. 8, 1965	26.05	27,100	——
	Soldier River basin										
6–6085	Soldier River at Pisgah	407	1940–65	I B	8.11	——	7,570	June 12, 1950	28.17	22,500	41
	Boyer River basin										
6–6095	Boyer River at Logan	871	1918–25, 1938–65	I B	3.56	——	9,570	June 16, 1957	22.67	23,600	19
	Indian Creek basin										
6–6105	Indian Creek at Council Bluffs	7.99	1955–65	I B	47.7	——	902	Sept. 7, 1965	15.36	2,980	*1.06
	Waubonsie Creek basin										
6–8060	Waubonsie Creek near Bartlett	30.4	1946–65	I B	21.0	——	1,720	May 8, 1950	37.8	14,500	*2.72

Table 2.—Maximum known floods at gaging stations in Iowa—Continued

Station number	Gaging station	Drainage area (sq mi)	Period of known floods (water years)	Flood-Freq. region and hydro-logic area	Slope and precipitation S (ft./mi.)	Slope and precipitation P (inches)	Mean annual flood (cfs)	Maximum floods Date	Maximum floods Gage height (ft)	Maximum floods Discharge (cfs)	Maximum floods Discharge Recurrence interval (years)
	Nishnabotna River basin										
6–8074.1	West Nishnabotna River at Hancock	609	1960–65	I B	5.65	——	8,780	Mar. 1, 1965	b20.44	a18,000	10
6–8077.2	Middle Silver Creek near Avoca	3.21	1953–65	I B	22.6	——	360	Aug. 13, 1958	11.80	815	14
6–8077.6	Middle Silver Creek near Oakland	25.7	1933–65	I B	10.2	——	1,170	Sept. 5, 6, 1958	12.28	1,450	3.1
6–8077.8	Middle Silver Creek near Treynor	42.7	1953–65	I B	9.1	——	1,600	Sept. 5, 6, 1958	16.01	2,600	5.3
6–8080	Mule Creek near Malvern	10.6	1954–65	I B	34.6	——	979	Aug. 21, 1954	15.84	2,070	11
6–8082	Spring Valley Creek near Tabor	7.65	1956–64	I B	34.4	——	776	July 30, 1958	15.48	4,150	*1.72
6–8085	W. Nishnabotna River at Randolph	1,326	1949–65	I B	4.78	——	14,400	May 9, 1950	21.93	29,600	10
6–8090	Davids Creek near Hamlin	26.0	1952–65	I B	15.6	——	1,380	July 2, 1958	19.35	22,700	*5.31
6–8092.1	East Nishnabotna River near Atlantic	432	1961–65	I B	5.56	——	6,890	Mar. 1, 1965	20.43	20,500	42
6–8095	East Nishnabotna River at Red Oak	894	1917–25, 1936–65	I B	4.68	——	10,800	June 13, 1947	23.23	36,200	*1.08
6–8100	Nishnabotna River above Hamburg	2,806	1922–23, 1929–65	I B	4.44	——	23,700	June 24, 1947	26.03	55,500	16
	Tarkio River basin										
6–8117.6	Tarkio River near Elliot	10.7	1952–65	I B	18.0	——	775	May 28, 1962	11.68	1,490	8.2
6–8118	East Tarkio Creek near Stanton	4.66	1952–65	I B	21.0	——	456	Aug. 28, 1958	12.21	1,960	*1.39
6–8118.2	Tarkio River tributary near Stanton	.67	1952–65	I B	32.4	——	136	July 15, 1956	4.88	318	16
6–8118.4	Tarkio River at Stanton	49.3	1952–65	I B	11.2	——	1,920	July 22, 1964	18.66	7,230	*1.21
6–8120	Tarkio River at Blanchard	200	1934–40	I B	4.3	——	3,610	Mar. 12, 1939	——	9,980	30
	Nodaway River basin										
6–8170	Nodaway River at Clarinda	762	1918–25, 1936–65	I B	5.84	——	10,400	June 13, 1947	25.3	31,100	43
	Platte River basin										
6–8191.9	East Fork One Hundred and Two River near Bedford	92.1	1960–65	I B	6.29	——	2,420	Jan. 12, 1960	15.95	5,400	13
	Grand River basin										
6–8980	Thompson River at Davis City	701	1885, 1918–26, 1941–65	I B	3.51	——	8,170	Aug. 8, 1885	22.8	30,000	*1.18
6–8984	Weldon River near Leon	104	1959–65	I B	12.0	——	3,350	Aug. 6, 1959	25.27	48,600	*4.68

Table 2.—Maximum known floods at gaging stations in Iowa—Continued

Station Number	Gaging station	Drainage area (sq mi)	Period of known floods (water years)	Flood-Freq. region and hydro-logic area	Slope and precipitation		Mean annual flood (cfs)	Maximum floods			
					S (ft./mi.)	P (inches)		Date	Gage height (ft)	Discharge (cfs)	Discharge Recurrence interval (years)
	Chariton River basin										
6–9035	Honey Creek near Russell	13.2	1952–62	I B	12.2	——	779	May 1, 1959	11.26	4,100	*1.70
6–9039	Chariton River near Rathbun	551	1957–65	I B	3.7	——	7,010	Mar. 31, 1960	25.3	21,800	50
6–9040	Chariton River near Centerville	708	1938–59	I B	3.42	——	8,300	June 20, 1946	24.2	21,700	24

* Ratio of flood to that of 50–year frequency.
a About.
b Affected by ice.
c Maximum stage known.
d Determined by Prof. F. A. Nagler, University of Iowa, maximum known.
e Discharge measurement.
f Flow regulated by Coralville Dam since September 17, 1958.
g Flow affected by diversion ditch.
h Maximum stage since at least 1901.
i Maximum stage known since 1896.
j Maximum stage known since at least 1893.
k Maximum stage known since 1851.
m Main stem Big Sioux River relationship.
n Ratio of flood to that of 30–year flood.

Table 3.—Maximum known floods at miscellaneous sites

Stream and vicinity	Location	Drainage area (sq. mi.)	Flood-Freq. region and hydrologic area	Slope and precipitation: S ft./mi.	Slope and precipitation: P (inches)	Mean annual flood (cfs)	Maximum Flood: Date	Maximum Flood: Discharge (cfs)	Maximum Flood: Discharge Recurrence interval (years)
	Upper Iowa River basin								
Dry Run near Decorah, Iowa	SW¼ Sec. 20 T. 98 N., R. 8 W., 2 miles southwest of Decorah	20.1	I B	—	—	—	May 29, 1941	14,000±	—
Dry Run at Decorah, Iowa	Hwy 52 at Decorah, Iowa	21.0	I B	—	—	—	Mar. 15, 1919	16,000±	—
Trout Creek near Decorah, Iowa	NE¼ Sec. 27 T. 98 N., R. 8 W., about 1.5 miles southeast of Decorah, Iowa	37.6	I B	—	—	—	May 29, 1941	20,000±	—
Trout Run near Decorah, Iowa	NW¼ Sec. 26, T. 98 N., R. 8 W., about 2 miles southeast of Decorah, Iowa	11.6	I B	—	—	—	May 29, 1941	10,300±	—
Upper Iowa River near Dorchester, Iowa	NW¼ Sec. 1, T 90 N., R. 6 W., at bridge on State Highway 13, 3.5 miles south of Dorchester, Iowa	770	I B	5.68	—	10,400	May 30, 1941	30,400±	38
	Cota Creek basin								
Cota Creek tributary near Harpers Ferry, Iowa	Near west line Sec. 23, T. 97 N., R. 3 W., ½ mile west of Harpers Ferry, Iowa	0.78	I B	—	—	—	Aug. 5, 1951	336±	—
	Paint Creek basin								
Paint Creek at Waukon, Iowa	At dam in City Park at South edge of Waukon, Iowa	1.83	I B	—	—	—	Aug. 5, 1951	757±	—
Paint Creek tributary near Waterville, Iowa	In NE¼ Sec. 23, T. 97 N., R. 4 W., about 1 mile east of Waterville, Iowa	3.45	I B	—	—	—	Aug. 5, 1951	1,500±	—
	Turkey River basin								
Little Volga River near Maynard, Iowa	Near N¼ corner Sec. 36, T. 92 N., R. 9 W., at bridge on county road about 2 miles southeast of Maynard, Iowa	17.5	I B	—	—	—	May 5, 1962	4,520±	—
Little Volga River at Maynard, Iowa	Near NW corner Sec. 23, T.92 N., R. 9W., at bridge on State Highway 150 in Maynard, Iowa	25.5	I B	—	—	—	May 5, 1962	5,270±	—
Volga River at Volga, Iowa	North line Sec. 10, T. 92 N., R. 6 W., at Volga, Iowa	261	I B	9.37	—	5,810	Mar. 13, 1929	3,740	<2.0
Honey Creek at Littleport, Iowa	NE¼ Sec. 36, T.92 N., R.5 W., at south edge of Littleport, Iowa	13.0	I B	—	—	—	May 31, 1958	12,000±	—
Wayman Creek at Garber, Iowa	SW¼ Sec. 26, T.92 N., R.4 W., at east edge of Garber, Iowa	6.98	I B	—	—	—	May 31, 1958	15,500±	—

Table 3.—Maximum known floods at miscellaneous sites—Continued

Stream and vicinity	Location	Drainage area (sq. mi.)	Flood-Freq. region and hydrologic area	Slope and precipitation: S ft./mi.)	Slope and precipitation: P (inches)	Mean annual flood (cfs)	Maximum Flood: Date	Maximum Flood: Discharge (cfs)	Maximum Flood: Discharge Recurrence interval (years)
	Little Maquoketa River basin								
Middle Fork Little Maquoketa River near Rickardsville, Iowa	SE¼ Sec. 32, T.90N., R.1 E., about 1.5 miles east of Rickardsville, Iowa	30.0	I B	35.4	——	2,040	July 8, 1951	8,160	*1.29
Union Park Creek near Dubuque, Iowa	NW¼ Sec. 11, T.89 N., R.2 E., about ¼ mile upstream from Highway 3 bridge near north city limits of Dubuque	1.07	I B	101.	——	280	July 9, 1919	3,000	*3.45
	Catfish Creek basin								
Granger Creek tributary near Dubuque, Iowa	Near center Sec. 23, T.88 N., R.2 E., at culvert on U. S. Highway 61, 4¼ miles south of Dubuque, Iowa	0.65	I B	——	——	——	July 4, 1961	903±	——
Catfish Creek near Dubuque, Iowa	NW¼ Sec. 1, T.88 N., R.2 E., about 2 miles south of Dubuque, Iowa	40.5	I B	34.3	——	2,530	Aug. 16, 17, 1918	28,000	*3.57
	Maquoketa River basin								
Deep Creek near Delmar, Iowa	In SW¼ Sec. 28, T.83 N., R.3 E., 3.5 miles south and 0.5 mile west of Delmar, Iowa	9.71	I B	——	——	——	Aug. 18, 1954	1,570±	——
Williams Creek near Charlotte, Iowa	Near SE corner Sec. 6, T.82 N., R.4 E., 5 miles southwest of Charlotte, Iowa	2.04	I B	——	——	——	Aug. 18, 1954	1,960±	——
Deep Creek at Charlotte, Iowa	In SE¼ Sec. 27, T.83 N., R.4 E., at west city limits of Charlotte on State Highway 136	41.9	I B	——	——	——	Aug. 18, 1954	4,370±	——
	Wapsipinicon River basin								
Wapsipinicon River near Fredricksburg, Iowa	In NE¼ Sec. 15, T.94 N., R.13 W., 8 miles west of Fredricksburg, Iowa	296	I A	5.15	31.2	3,530	Mar. 29, 1962	9,800±	30
East Fork Otter Creek near Oelwein, Iowa	Near W¼ corner Sec. 34, T.92 N., R.9 W., at State Highway 150 bridge, 3 miles north of Oelwein, Iowa	6.62	I A	——	——	——	Apr. 29, 1951	2,590±	——
Otter Creek near Hazelton, Iowa	At south line Sec. 21, T.90 N., R.9 W., about 2 miles south of Hazelton, Iowa	64.2	I A	11.4	32.1	2,020	Apr. 29, 1951	9,900±	*1.58
Malone Creek at Independence, Iowa	In SW¼ Sec. 35, T.89 N., R.9 W., on U.S. Highway 20 bridge at Independence, Iowa	9.32	I A	——	——	——	Sept. 21, 1950	4,910±	——

Table 3.—Maximum known floods at miscellaneous sites—Continued

Stream and vicinity	Location	Drainage area (sq. mi.)	Flood-Freq. region and hydrologic area	Slope and re cipitation S ft./mi.	Slope and re cipitation P (inches)	Mean annual flood (cfs)	Maximum Flood Date	Maximum Flood Discharge (cfs)	Maximum Flood Discharge Recurrence interval (years)
	Duck Creek basin								
Duck Creek near Davenport, Iowa	Near West Line, Sec. 13, T.78 N., R.2 E., 2.5 miles west of City Limits	16.1	I A	9.93	33.9	689	July 19 1963,	820±	2.9
	Blackhawk Creek basin								
Blackhawk Creek at Davenport, Iowa	In SW¼ Sec. 33, T.78 N., R.3 E., 300 feet downstream from South Concord Street Bridge	6.73	I A	26.3	33.8	706	Aug. 4, 1965	1,590±	14
	Mad Creek basin								
Mad Creek at Muscatine, Iowa	In SE¼ Sec. 26, T.77 N., R.2 W., at Isett Avenue entrance to H. J. Heinz Plant at Muscatine, Iowa	16.5	I A	23.7	32.0	1,130	June 30, 1961	8,460±	*2.41
	Iowa River basin								
Beaver Creek near Eldora, Iowa	At E¼ corner Sec. 11, T.87 N., R.20 W., at bridge on Highway 57, 2 miles west of Eldora, Iowa	52.6	I A	9.33	31.3	1,320	Sept. 21, 1950	2,850±	12
South Fork Iowa River near New Providence, Iowa	Near north quarter corner of Sec. 27, T.87 N., R.20 W., 3 miles north of New Providence at Highway 299 bridge	223	I A	3.74	30.7	2,010	Sept. 20, 1950	3,750±	7.5
Honey Creek near Hubbard, Iowa	Near NW corner Sec. 3, T.86 N., R.21 W., about 0.5 miles southeast of Hubbard, Iowa	39.1	I A	10.6	30.3	1,000	Sept. 21, 1950	1,030±	2.4
Honey Creek near Bangor, Iowa	Near west quarter corner of Sec. 16, T.85 N., R. 19 W., at County Road "L" bridge about 1 mile east of Bangor, Iowa	95.6	I A	10.4	31.0	2,310	June 11, 1954	3,350	4.2
Minerva Creek near Clemons, Iowa	Near center of Sec. 5, T.84 N., R.19 W., at County Road bridge about 3½ miles east of Clemons, Iowa	148	I A	12.1	31.0	3.790	June 10, 1954	5,700	4.5
Cub Creek near Victor, Iowa	Near E¼ corner Sec. 28, T.80 N., R.13 W., 3 miles southwest of Victor, Iowa	7.40	I A	——	——	——	Jan. 12, 1960	758±	——
South Branch Ralston Creek tributary at Iowa City, Iowa	At culvert at Friendship Street, in east Iowa City, Iowa	.39	I A	——	——	——	July 14, 1962	298±	——
South Branch Ralston Creek at 1st Avenue in Iowa City, Iowa	At culvert at 1st Avenue, in east Iowa City, Iowa	3.02	I A	——	——	——	July 14, 1962	872±	——

Table 3.—Maximum known floods at miscellaneous sites—Continued

Stream and vicinity	Location	Drainage area (sq. mi.)	Flood-Freq. region and hydrologic area	Slope and recipitation: S ft./mi.)	Slope and recipitation: P (inches)	Mean annual flood (cfs)	Maximum Flood: Date	Maximum Flood: Discharge (cfs)	Maximum Flood: Discharge Recurrence interval (years)
	Iowa River basin—continued								
South Branch Ralston Creek at Iowa City, Iowa	At College Street in east Iowa City, Iowa	4.42	I A	——	——	——	July 14, 1962	1,150±	——
Ralston Creek at Gilbert Street, Iowa City, Iowa	Immediately upstream from Gilbert Street bridge in Iowa City, Iowa	8.1	I A	24.9	32.6	688	Sept. 21, 1965	2,080±	45
North Fork English River at Guernsey, Iowa	Near SE corner Sec. 16, T.79 N., R.13 W., at bridge, ¾ mile southwest of Guernsey, Iowa	81.5	I A	5.63	32.6	1,490	Jan. 12, 1960	3,970±	26
Jordan Creek near Deep River, Iowa	Near E ¼ corner Sec. 28,T. 79 N., R.13 W., at culvert, 3 miles northeast of Deep River, Iowa	2.06	I A	——	——	——	Jan. 12, 1960	426±	——
Deep River near Deep River, Iowa	In SE ¼ Sec. 4, T.78 N., R.13 W., ¼ mile northeast of Deep River, Iowa	30.5	I A	13.1	32.4	1,240	Jan. 12, 1960	1,790±	4.1
Bulgers Run near Riverside, Iowa	In SE ¼ Sec. 11, T.77 N., R. 7 W., at highway 22 bridge	5.86	I A	——	——	——	Sept. 21, 1965	3,080±	——
Little Cedar River at New Haven, Iowa	Near SE corner Sec. 19, T.98 N., R.15 W., at State Highway 9 bridge at New Haven, Iowa	193	I A	6.51	31.2	2,970	Mar. 26, 1961	10,200±	*1.11
West Fork Cedar River near Dumont, Iowa	Near SE corner Sec. 27, T.92 N., R.18 W., at State Highway 3 bridge, 1.5 miles east of Dumont, Iowa	299	I A	6.43	31.0	4,140	June 19, 1954	19,500±	*1.52
Boylan Creek tributary near Aredale, Iowa	In SE ¼ Sec. 17, T.93 N., R.18 W., about 2 miles northeast of Aredale, Iowa	.75	I A	——	——	——	Apr. 25, 1960	908±	——
Boylan Creek near Bristow, Iowa	Near W ¼ corner Sec. 24, T.92 N., R.18 W., at Chicago, Great Western RR bridge	56.5	I A	7.29	31.9	1,240	Apr. 29, 1951	10,900±	*2.84
Daily Creek near Allison, Iowa	On South line Sec. 32, T.92 N., R.17 W., about 3 miles southwest of Allison, Iowa	16.0	I A	——	——	——	June 26, 1951	13,600±	——
Feddeke Creek near Allison, Iowa	Near SE corner Sec. 35, T.92 N., R.17 W., at bridge on county road, 1 mile southwest of Allison, Iowa	3.05	I A	——	——	——	June 25, 26, 1951	2,690±	——
Feddeke Creek at Highway 14 bridge near Allison, Iowa	Near E ¼ corner Sec. 1, T.91 N., R.17 W., at State Highway 14 bridge, 2 miles south of Allison, Iowa	5.21	I A	——	——	——	June 25, 1951	4,970±	——
Feddeke Creek tributary near Allison, Iowa	Near SW corner Sec. 29, T.92 N., R.16 W., on State Highway 3 near Allison, Iowa	.30	I A	——	——	——	June 25, 1951	798±	——
McClure Creek tributary near Allison, Iowa	Near SW corner Sec. 27, T.92 N., R. 16 W., at culvert on State Highway 3, 3.5 miles east of Allison, Iowa	.026	I A	——	——	——	June 26, 1951	46.3±	——

Table 3.—Maximum known floods at miscellaneous sites—Continued

Stream and vicinity	Location	Drainage area (sq. mi.)	Flood-Freq. region and hydrologic area	Slope and precipitation: S ft./mi.	Slope and precipitation: P (inches)	Mean annual flood (cfs)	Maximum Flood: Date	Maximum Flood: Discharge (cfs)	Maximum Flood: Discharge Recurrence interval (years)
	Iowa River basin—continued								
Willow Creek at Mason City, Iowa	At 1st Avenue, northwest in Mason City, Iowa	e79	I A	——	——	——	Mar. 27, 1961	2,820	——
Winnebago River at Rockford, Iowa	In NW¼ Sec. 15, T.95 N., R.18 W., at bridge at southwest edge of Rockford, Iowa	700	I A	3.14	30.0	4,250	Mar. 27, 1961	d16,500	*1.25
Flood Creek near Rockford, Iowa	In SW¼ Sec. 10 T.95 N., R.17 W., at bridge on county road 5 miles east of Rockford, Iowa	57.9	I A	6.23	31.0	993	May 10, 1963	3,980±	*1.29
Flood Creek near Marble Rock, Iowa	At NW corner Sec. 28, T.94 N., R.16 W., at bridge on county road, 6 miles southeast of Marble Rock, Iowa	120	I A	6.22	31.1	1,870	May 10, 1963	6,120±	*1.06
Blackhawk Creek near Grundy Center, Iowa	In NE¼ Sec. 14, T.87 N., R.18 W., at State Highway 14 bridge, 7 miles west of Grundy Center, Iowa	13.5	I A	13.3	31.8	578	Aug. 13, 1957	1,340	15
Blackhawk Creek near Morrison, Iowa	In NW¼ Sec. 14, T.87 N., R.16 W., at bridge 1 mile northwest of Morrison, Iowa	82.0	I A	9.12	31.9	2,040	Mar. 30, 1960	2,600	3.3
Blackhawk Creek near Reinbeck, Iowa	In SW¼ Sec. 21, T.87 N., R.15 W., at bridge ¾ mile north of Reinbeck, Iowa.	135	I A	7.53	31.9	2,660	Mar. 30, 1960	4,040	4.6
Lime Creek near Independence, Iowa	Near SW¼ corner Sec. 11, T.88 N., R.10 W., about 5 miles southwest of Independence, Iowa	7.92	I A	——	——	——	June 2, 1951	1,450±	——
Lime Creek at Brandon, Iowa	In SE¼ Sec. 27, T.87 N., R.10 W., at bridge on State Highway 283, ¼ mile east of Brandon, Iowa	37.6	I A	——	——	——	June 2, 1951	14,800±	——
Bear Creek tributary near Independence, Iowa	In NE¼ Sec. 18, T.88 N., R.9 W., about 2 miles southwest of Independence, Iowa	.38	I A	——	——	——	June 2, 1951	365±	——
Bear Creek near Independence, Iowa	Near E line Sec. 17, T.88 N., R.9 W., at bridge on county road 1.5 miles south of Independence, Iowa	2.57	I A	——	——	——	June 2, 1951	2,750±	——
Cedar River at Vinton, Iowa	In SE¼ Sec. 16, T.85 N., R.10 W., at bridge on State Highway 101 at north edge of Vinton, Iowa	6,038	I A	2.52	31.1	25,800	Mar. 30, 1961	74,100±	36
Cedar River at Interstate Highway 80 near Rochester, Iowa	In SE¼ Sec. 13, T.79 N., R.3 W., at Interstate Highway 80 bridge, 1.5 miles south of Rochester, Iowa	7,245	I A	2.20	31.5	28,600	Apr. 1, 1961	d71,700	20
North Fork Long Creek near Ainsworth, Iowa	In SW¼ Sec. 22, T.75 N., R.6 W., at bridge on U. S. Highway 218, 1.5 miles southwest of Ainsworth, Iowa	30.2	I A	5.97	33.5	744	Sept. 21, 1965	2,050±	30

Table 3.—Maximum known floods at miscellaneous sites—Continued

Stream and vicinity	Location	Drainage area (sq. mi.)	Flood-Freq. region and hydrologic area	Slope and precipitation: S ft./mi.	Slope and precipitation: P (inches)	Mean annual flood (cfs)	Maximum Flood: Date	Maximum Flood: Discharge (cfs)	Maximum Flood: Discharge Recurrence interval (years)
	Iowa River basin—continued								
South Fork Long Creek near Washington, Iowa	In SE¼ Sec. 14, T.75 N., R.7 W., at State Highway 92 about 4 miles east of Washington, Iowa	16.4	I A	—	—	—	Aug. 25, 1951	2,720	—
	Skunk River basin								
Skunk River near Randall, Iowa	Near SE corner Sec. 24, T.86 N., R.23 W., about 1 mile east of Randall, Iowa	163	I A	8.08	29.5	2,470	June 10, 1954	13,600±	*1.78
Drainage Ditch No. 5 near Ellsworth, Iowa	In SW¼ Sec. 27, T.87 N., R.23 W., on State Highway 175 about 3 miles east of Ellsworth. Iowa	5.27	I A	—	—	—	June 10, 1954	501±	—
Spring Creek tributary near Oskaloosa, Iowa	On west line of Sec. 21, T.75 N., R.15 W., near east edge of Oskaloosa, Iowa	.75	I A	—	—	—	July 3, 1957	396±	—
Coal Creek tributary near What Cheer, Iowa	Near S¼ corner Sec. 28, T.77 N., R.13 W., about 2 miles north of What Cheer, Iowa	3.28	I A	—	—	—	July 3, 1951	1,080±	—
Coal Creek at What Cheer, Iowa	Near E¼ corner Sec. 9, T.76 N., R.13 W., at west side of What Cheer, Iowa	11.7	I A	—	—	—	July 3, 1951	3,100±	—
Rock Creek tributary near Sigourney, Iowa	Near SE corner Sec. 29, T.76 N., R.12 W., at county bridge	a.2	I A	—	—	—	July 2, 1951	169±	—
Dutch Creek near Keota, Iowa	Near E¼ corner Sec. 36, T.76 N., R.10 W., 1.5 miles south of Keota, Iowa	2.97	I A	—	—	—	Apr. 19, 1955	659±	—
Crooked Creek at Keota, Iowa	Near E¼ corner Sec. 23, T.76 N., R. 10 W., at north edge of Keota, Iowa	19.3	I A	—	—	—	Apr. 19, 1955	2,760±	—
	Big Devil Creek basin								
Big Sugar Creek near Viele, Iowa	In SE¼ Sec. 9, T.67 N., R.5 W., about 4.5 miles southwest of Ft. Madison, Iowa	109	I A	5.11	34.1	2,130	June 10, 1905	60,000±	*9.08
Panther Creek near Viele, Iowa	In NE¼ Sec 16, T.67 N., R.5 W., about 5 miles southwest of Ft. Madison, Iowa	15.6	I A	15.8	34.3	1,010	June 10, 1905	7,300±	*2.33
Little Devil Creek near Fort Madison, Iowa	In SW¼ Sec. 2, T.67 N., R.5 W., about 2¾ miles west of Fort Madison, Iowa	20.3	I A	16.6	34.0	1,270	Aug. 6, 1959	9,260±	*2.35
Little Devil Creek near Fort Madison, Iowa	In NW¼ Sec. 15, T.67 N., R.5 W., about 4 miles southwest of Fort Madison, Iowa at mouth of Little Devil Creek	25.7	I A	14.0	34.0	1,360	June 10, 1905	a10,700	*2.54
Big Devil Creek near Fort Madison, Iowa	In SW¼ Sec. 15, T.67 N., R.5 W., at Highway 61 bridge, 4 miles southwest of Fort Madison, Iowa	151	I A	5.00	34.1	2,740	Aug. 6, 1959	13,600±	*1.60

Table 3.—Maximum known floods at miscellaneous sites—Continued

Stream and vicinity	Location	Drainage area (sq. mi.)	Flood-Freq. region and hydro-logic area	Slope and precipitation: S ft./mi.)	Slope and precipitation: P (inches)	Mean annual flood (cfs)	Maximum Flood: Date	Maximum Flood: Discharge (cfs)	Maximum Flood: Discharge Recurrence interval (years)
	Skunk River basin—continued								
Big Devil Creek at Santa Fe Railroad bridge near Fort Madison, Iowa	In NE¼ Sec. 22, T.67 N., R.5 W., about 4 miles southwest of Fort Madison, Iowa	152	I A	4.94	34.1	2,740	June 10, 1905	80,000±	*9.42
	Des Moines River basin								
West Fork Des Moines River at Emmetsburg, Iowa	In NW¼ Sec. 26, T.96 N., R.33 W., 1 mile west of City limits of Emmetsburg	1,672	I A	2.88	26.6	5,240	Apr. 11, 1965	d12,000	14
West Fork Des Moines River near Ottosen, Iowa	In SE¼ Sec. 1, T.93 N., R.31 W., at State Highway 44, 3 miles west of Ottosen, Iowa	2,018	I A	2.83	27.0	6,410	Apr. 12, 1965	d14,000	12
East Fork Des Moines River at Algona, Iowa	In NW¼ Sec. 2, T.95 N., R.29, W., at bridge on Highway 169 at north edge of Algona, Iowa	882	I A	2.17	28.7	3,220	Apr. 9, 1965	d11,400	*1.14
Boone River tributary near Britt, Iowa	Near SE corner Sec. 14, T.96 N., R.26, W., 4 miles northwest of Britt, Iowa	0.056	I A	——	——	——	June 19 1954	62.2±	——
Boone River near Hutchins, Iowa	Near W¼ corner Sec. 11, T.95 N., R.26 W., about 2.5 miles south of Hutchins, Iowa	12.6	I A	——	——	——	June 19, 1954	1,100±	——
Boone River at tributary No. 2 near Britt, Iowa	Near S¼ corner Sec. 22, T.96, N., R.26 W., 5 miles west of Britt, Iowa	.94	I A	——	——	——	June 19, 1954	579±	——
Boone River near Goldfield, Iowa	In SW¼ Sec. 32, T.92 N., R.26 W., 1.5 miles west of Goldfield, Iowa on State Highway 3	443	I A	3.10	29.9	2,820	June 21, 1954	16,600±	*1.90
North Raccoon River tributary near Storm Lake, Iowa	Near SW corner Sec. 28, T.91 N., R.26, W., about 5 miles northeast of Storm Lake, Iowa	2.11	I A	——	——	——	June 1, 1954	433±	——
Outlet Creek tributary near Storm Lake, Iowa	Near S¼ corner Sec. 18, T.90 N., R.36 W., on State Highway 5, 4.5 miles southeast of Storm Lake, Iowa	.22	I A	——	——	——	June 1, 1954	226±	——
Outlet Creek tributary No. 2 near Storm Lake, Iowa	Near SE corner Sec. 18, T.90 N., R.36 W., on Highway 5, 5 miles southeast of Storm Lake, Iowa	.038	I A	——	——	——	June 1, 1954	53.8±	——
Outlet Creek near Storm Lake, Iowa	In SW¼ Sec. 17, T.90 N., R.36 W., on State Highway 5, 5.5 miles southwest of Storm Lake, Iowa	e6.58	I A	——	——	——	June 1, 1954	1,460±	——
Hardin Creek near Jefferson, Iowa	Sec. 10, T.83 N., R.30, W., at Old U. S. Highway 30 bridge, about 3 miles east of Jefferson, Iowa	162	I A	3.89	30.9	1,620	Mar. 29, 1951	3,200±	9

Table 3.—Maximum known floods at miscellaneous sites—Continued

Stream and vicinity	Location	Drainage area (sq. mi.)	Flood-Freq. region and hydro-logic area	Slope and precipitation S (ft./mi.)	Slope and precipitation P (inches)	Mean annual flood (cfs)	Maximum Flood Date	Maximum Flood Discharge (cfs)	Maximum Flood Discharge Recurrence interval (years)
	Des Moines River basin—continued								
South Raccoon River and Bear Grove Creek at Guthrie Center, Iowa	Near center Sec. 7, T.79 N., R.31 W., at State Highway 25, south edge of Guthrie Center, Iowa	111	I A	13.6	29.7	2,720	July 2, 1958	52,000±	*6.17
Storm Creek near Breda, Iowa	In SE¼ Sec. 23, T.85 N., R.35 W., about 6 miles southeast of Breda, Iowa	11.2	I A	——	——	——	May 1, 1951	637±	——
Walnut Creek near Grimes, Iowa	Near SW corner Sec 35, T.80 N., R.26 W., on U. S. Highway 6, 5.5 miles east of Dallas Center, Iowa	4.81	I A	27.0	30.8	378	June 27, 1952	699±	7.4
Walnut Creek near Dallas Center, Iowa	On south line near southwest corner, Sec. 2, T.79 N., R.26 W., about 6 miles southeast of Dallas Center, Iowa	12.4	I A	22.9	30.9	746	June 27, 1952	1,650±	12
Walnut Creek near Des Moines, Iowa	At NW corner, Sec. 30, T.79 N., R.25 W., about 10 miles northwest of Des Moines, Iowa	48.3	I A	13.6	31.0	1,600	June 27, 1952	d1,850	2.8
Four mile Creek tributary near Berwick, Iowa	In NE¼ Sec. 7, T. 79 N.,R.23 W., at culvert about 1 mile northwest of Berwick, Iowa	.79	I A	——	——	——	June 27, 1952	186±	——
Muchikinock Creek at Berwick, Iowa	In NE¼ Sec. 8, T.79 N., R.23 W., at north edge of Berwick, Iowa	11.9	I A	22.4	31.0	721	June 27, 1952	1,290±	6.8
Cedar Creek tributary near Winterset, Iowa	Near NE corner Sec. 32, T.76 N., R.28 W., about 4 miles west of Wint et, Iowa	.31	I B	——	——	——	June 21, 1952	271±	——
Cedar Creek tributary No. 2 near Winterset, Iowa	Near SW corner Sec. 35, T.76 N R.28 W., on State Highway 92, 2 miles west of Winterset, Iowa	1.02	I B	——	——	——	June 21, 1952	440±	——
Cedar Creek near Winterset, Iowa	Near S¼ corner Sec. 23, T.76 N., R.28 W., about 2 miles northwest of Winterset, Iowa	11.4	I B	41.6	——	1,100	June 21, 1952	2,060±	7.6
Cedar Creek near Patterson, Iowa	Near SE corner Sec. 23, T.76 N., R.27, W., 2.5 miles northwest of Patterson, Iowa	25.6	I B	31.8	——	1,770	June 21, 1952	4,000±	14
South Fork Middle River at Casey, Iowa	Near N¼ corner Sec. 2, T.77 N., R.32 W., 0.5 mile east of Casey, Iowa	35.5	I B	——	——	——	Sept. 5, 1958	23,900±	——
English Creek near Knoxville, Iowa	Near center Sec. 10, T.75 N., R.19 W., about 2.5 miles east of Knoxville, Iowa	92.5	I B	7.16	——	2,540	June 11, 1962	9,710±	*1.23
South Avery Creek near Blakesburg, Iowa	Near N¼ corner Sec. 30, T.72 N., R.15 W., at bridge on U. S. Highway 34, 3.5 miles north of Blakesburg, Iowa	33.1	I A	——	——	——	Sept. 21, 1965	10,300±	——
Bear Creek near Bidwell, Iowa	In NW¼ Sec. 29, T.72 N., R.14 W., at bridge on U. S. Highway 34, about 2.5 miles east of Bidwell, Iowa	19.5	I A	——	——	——	Sept. 21, 1965	6,710±	——

Table 3.—Maximum known floods at miscellaneous sites—Continued

Stream and vicinity	Location	Drainage area (sq. mi.)	Flood-Freq. region and hydrologic area	Slope and precipitation S (ft./mi.)	Slope and precipitation P (inches)	Mean annual flood (cfs)	Maximum Flood Date	Maximum Flood Discharge (cfs)	Maximum Flood Discharge Recurrence interval (years)
	Des Moines River basin—continued								
Bear Creek near Ottumwa, Iowa	In NW¼ Sec. 27, T.72 N., R.14 W., at bridge on U. S. Highway 34 near west edge of Ottumwa, Iowa	22.9	I A	——	——	——	Sept. 21, 1965	4,000±	——
Village Creek near Ottumwa, Iowa	Near NW corner Sec. 18, T.71 N., R.13 W., about 2 miles south of Ottumwa, Iowa	22.9	I A	——	——	——	June 11, 1962	1,370±	——
Soap Creek near Bloomfield, Iowa	In NE¼ Sec. 7, T.70 N., R.13 W., about 8.5 miles north of Bloomfield, Iowa	182	I A	6.97	34.7	4,470	May 6, 1960	23,900±	*1.72
Little Soap Creek near Ottumwa, Iowa	Near S¼ corner Sec. 24, T.71 N., R.14 W., about 5.5 miles south of Ottumwa, Iowa	28.2	I A	——	——	——	May 6, 1960	9,270	——
	Floyd River basin								
Floyd River at Sheldon, Iowa	In NE ¼ Sec. 36, T.97 N., R.43 W., at bridge on U. S. Highway 18 near west edge of Sheldon,,Iowa	80.5	II A	7.80	28.0	1,050	June 7, 1953	25,200±	*5.33
Little Floyd River at Sheldon, Iowa	In Sec. 10, T.96 N. R.42 W., about 3 miles southeast of Sheldon, Iowa	42.2	II A	——	——	——	June 8, 1953	20,900±	——
Floyd River at LeMars, Iowa	Near S¼ corner Sec. 8, T.92 N., R.45 W., at bridge on State Highway 3 at west edge of LeMars, Iowa	480	II A	4.72	27.1	2,870	June 8, 1953	60,000±	*4.64
Plymouth Creek near Merrill, Iowa	In Sec. 19, T.92 N., R.44 W	11.7	II A	——	——	——	June 8, 1953	3,250±	——
Floyd River near West Branch Floyd near Merrill, Iowa	In Sec. 1, T.91 N., R.46 W	528	II A	4.58	27.1	3,030	June 8, 1953	52,000±	*3.81
West Branch Floyd River at Dalton, Iowa	In SE¼ Sec. 12, T.92 N., R.46 W., at bridge on State Highway 3	224	II A	5.83	26.1	1,530	June 8, 1953	30,500±	*4.42
Mink Creek near Brunsville, Iowa	In Sec. 9, T.92 N., R.46 W	25.6	II A	——	——	——	June 7-8, 1953	13,700±	——
West Branch Floyd River below Mink Creek near Merrill, Iowa	In Sec. 35, T.92 N., R.46 W	275	II A	5.71	26.1	1,790	June 8, 1953	34,800±	*4.32
	Little Sioux River basin								
Little Sioux River near Spencer, Iowa	In SE¼ Sec. 27, T.97 N., R.37 W., at U. S. Highway 18 bridge 3.5 miles northwest of Spencer, Iowa	541	I A	3.42	27.1	2,460	June 9, 1953	9,400±	*1.23
Ocheyeden River near Spencer, Iowa	In SE¼ Sec. 16, T.96 N., R.37 W., 3 miles southwest of Spencer	426	I A	4.40	27.5	2,590	June 8, 1953	26,000±	*3.24

Table 3.—Maximum known floods at miscellaneous sites—Continued

Stream and vicinity	Location	Drainage area (sq. mi.)	Flood-Freq. region and hydro-logic area	Slope and precipitation S (ft./mi.)	Slope and precipitation P (inches)	Mean annual flood (cfs)	Maximum Flood Date	Maximum Flood Discharge (cfs)	Maximum Flood Discharge Recurrence interval (years)
	Little Sioux River basin—continued								
Little Sioux River at Sioux Rapids, Iowa	In SE¼ Sec. 1, T.93 N., R.37 W., at U. S. Highway 71 at Sioux Rapids, Iowa	1,519	I A	2.74	27.7	5,360	June 10, 1953	22,700±	*1.37
Little Sioux River at Linn Grove, Iowa	On State Highway 264 bridge at Linn Grove	1,548	I A	2.63	27.8	5,350	June 10, 1953	d22,500	*1.36
Little Sioux River above Mill Creek near Cherokee, Iowa	In NE¼ Sec. 1, T.92 N., R.40 W., 3 miles west of Cherokee city limits	1,861	I A	2.30	27.8	5,660	Apr. 6, 1965	d26,800	*1.53
Mill Creek near Cherokee, Iowa	At. U. S. Highway 59 bridge, 1½ miles north of Cherokee city limits	292	I A	5.86	28.0	2,530	June 8, 1953	d11,500	*1.47
Little Sioux River at Cherokee, Iowa	At State Highway 3 bridge at northeast edge of Cherokee, Iowa	2,171	I A	2.25	27.8	6,300	Apr. 6, 1965	d33,900	*1.73
Four Mile Creek near Quimby, Iowa	In NW¼ Sec. 14, T.90 N., R.41 W., at State Highway 31 bridge 1 mile southwest of Quimby, Iowa	8.28	I A	——	——	——	Aug. 9, 1961	7,460±	——
Stratton Creek near Washta, Iowa	In SW¼ Sec. 26, T.90 N., R.41 W., 2 miles east of Washta, Iowa	1.90	I A	——	——	——	Aug. 9, 1961	11,000±	——
Odebolt Creek at Ida Grove, Iowa	In SE¼ Sec. 14, T.87 N., R.40 W., in Ida Grove, Iowa	61.1	I B	12.45	——	2,330	Apr. 30, 1951	4,050±	6.3
	Soldier River basin								
East Soldier River tributary near Charter Oak, Iowa	In NW¼ Sec. 24, T.84 N., R.41 W., about 1 mile northeast of Charter Oak	0.045	I B	——	——	——	June 17, 1951	109±	——
	Boyer River basin								
Boyer River tributary near Odebolt, Iowa	In SE¼ Sec. 25, T.87 N., R.38 W., about 2 miles east of Odebolt, Iowa	0.39	I B	——	——	——	May 1, 1951	152±	——
Paradise Creek tributary near Charter Oak, Iowa	In SE¼ Sec. 33, T.84 N., R.40 W., about 4 miles southeast of Charter Oak, Iowa	.166	I B	——	——	——	June 17, 1951	406±	——
Willow Creek at Calhoun, Iowa	In SE¼ Sec. 19, T.79 N., R.43 W	129	I B	——	——	——	July 9, 1940	11,300±	——
Willow Creek at Missouri Valley, Iowa	In SE¼ Sec. 16, T.78 N., R.44 W., in Missouri, Valley, Iowa	144	I B	——	——	——	Aug. 12, 1950	10,200±	——
	Pigeon Creek basin								
Pigeon Creek at Crescent, Iowa	In Sec. 23, T.76 N., R.44 W	147	I B	——	——	——	June 4, 1917	3,020	——

Table 3.—Maximum known floods at miscellaneous sites—Continued

Stream and vicinity	Location	Drainage area (sq. mi.)	Flood-Freq. region and hydro-logic area	Slope and precipitation		Mean annual flood (cfs)	Maximum Flood		
				S (ft./mi.)	P (inches)		Date	Discharge (cfs)	Discharge Recurrence interval (years)
	Nishnabotna River basin								
Indian Creek near Hawthorne, Iowa	In NW¼ Sec. 17, T.72 N., R.39 W., 1½ miles west and 3 miles north of Hawthorne, Iowa	35.4	I B	12.1	—	1,560	Sept. 18, 1960	1,500±	2.2
Indian Creek at Emerson, Iowa	In SE¼ Sec. 24, T.72 N., R.40 W., at east edge of Emerson, Iowa	43.4	I B	11.6	—	1,770	Sept. 18, 1960	2,220±	3.2
Walnut Creek near Red Oak, Iowa	In NW¼ Sec. 13 T.72 N., R.39 W., about 3 miles northwest of Red Oak, Iowa	106	I B	7.71	—	2,870	Sept. 18, 1960	978±	<2.0
Crabapple Creek near Hawthorne, Iowa	In NW¼ Sec. 21, T.72 N., R.39 W., 2 miles north of Hawthorne, Iowa	10.2	I B	21.9	—	807	Sept. 18, 1960	1,530±	8
East Nishnabotna River near Audubon, Iowa	In SE¼ Sec. 23, T.80 N., R.35 W., 2.5 miles east of Audubon, Iowa	81.8	I B	6.89	—	2,290	July 2, 1958	20,500±	*2.89
Blue Grass Creek tributary near Audubon, Iowa	In NW¼ Sec. 4, T.80 N., R.35 W., about 3 miles north of Audubon, Iowa	.057	I B	—	—	—	July 2, 1958	143±	—
Crooked Creek near Anita, Iowa	In SE¼ Sec. 6, T.77 N., R.34 W., about 3 miles northwest of Anita, Iowa	23.9	I B	19.4	—	1,410	Apr. 12, 1964	7,530	*1.72
Troublesome Creek near Wiota, Iowa	In NW¼ Sec. 29, T.77 N., R.35 W., about 3 miles northwest of Wiota, Iowa	118	I B	7.88	—	3,130	Apr. 12, 1964	7,030±	13.5
East Nishnabotna River near Atlantic, Iowa	On line between Sec. 26, 25, T.76 N., R.27 W., about 4½ miles southwest of Atlantic, Iowa	437	I B	5.56	—	6,920	July 2, 1958	34,200±	*1.59
	Tarkio River basin								
Tarkio River above Stanton, Iowa	Near N¼ corner Sec. 33, T.72 N., R.37 W., 1 mile north of Stanton City limits	31.1	I B	13.0	—	1,460	Sept. 18, 1960	1,480±	2.35
Little Tarkio Creek at Stanton, Iowa	In SE¼ Sec. 33, T.72 N., R.37 W., at north city limits	11.8	I B	—	—	—	Sept. 18, 1960	2,280±	—

† Current-meter measurement and estimate of road overflow
* Ratio of peak discharge to that of 50-year flood
± Indirect measurement
a About
b Rating curve extension
d Rating curve extension
e Effective

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