METHOD FOR ESTIMATING THE MAGNITUDE AND FREQUENCY OF FLOODS AT UNGAGED SITES ON UNREGULATED RURAL STREAMS IN IOWA

BY OSCAR G. LARA

U.S. GEOLOGICAL SURVEY

WATER-RESOURCES INVESTIGATION REPORT 87-4132

PREPARED IN COOPERATION WITH THE

IOWA DEPARTMENT OF TRANSPORTATION,
HIGHWAY DIVISION,
HIGHWAY RESEARCH BOARD

IOWA CITY, IOWA

1987

DEPARTMENT OF THE INTERIOR

DONALD PAUL HODEL, SECRETARY

U.S. GEOLOGICAL SURVEY

DALLAS L. PECK, DIRECTOR

For additional information write to:

U.S. Geological Survey
Water Resources Division
Box 1230
Iowa City, Iowa 52244
Telephone:(319) 337-4191

Copies of this report can be purchased from:

U.S. Geological Survey
Books and Open-File Reports
Federal Center, Bldg. 810
Box 25425
Denver, Colorado 80225

CONTENTS

FIGURES

TABLES

FACTORS FOR CONVERTING INCH-POUND UNITS TO INTERNATIONAL SYSTEM (SI) UNITS

The following factors may be used to convert the inch-pound units published herein to the International System of Units (SI)

Multiply inch-pound units	By	To obtain SI units
miles	1.609	kilometers
square miles	2.590	square kilometers
cubic feet per second	0.02832	cubic meter per second

METHOD FOR ESTIMATING THE MAGNITUDE AND FREQUENCY OF FLOODS AT UNGAGED SITES ON UNREGULATED RURAL STREAMS IN IOWA

By Oscar G. Lara

ABSTRACT

This report provides techniques and procedures for estimating the probable magnitude and frequency of floods at ungaged sites on Iowa streams. Physiographic characteristics were used to define the boundaries of five hydrologic regions. Regional regression equations that relate the size of the drainage area to flood magnitude are defined for estimating peak discharges having specified recurrence intervals of 2, 5, 10, 25, 50, and 100 years. Regional regression equations are applicable to sites on streams that have drainage areas ranging from 0.04 to 5,150 square miles provided that the streams are not affected significantly by regulation upstream from the sites and that the drainage areas upstream from the sites are not mostly urban areas. Flood-frequency characteristics for the mainstems of selected rivers are presented in graphs as a function of drainage area.

INTRODUCTION

This report represents the fourth update in the last 33 years of the magnitude and frequency of floods in Iowa. Flood reports were updated to provide more dependable flood-data and more accurate and reliable methods for estimating the magnitude and frequency of floods. These estimates are needed to implement efficient flood-plain management strategies and for economical design of highway structures, levees, and buildings in the flood plain. Economic design criteria require the availability of adequate data with long periods of record, improved analytical methods, and better understanding of the flood hydrology of Iowa.

The first of three previous reports (Schwob, 1953) was limited to an analysis of the magnitude and frequency of floods that was based on data collected in Iowa before 1950. A second report (Schwob, 1963) included updated data and a method for estimating magnitude and frequency of floods at sites on ungaged rural streams that had drainage areas of 10 square miles or more. The third report (Lara, 1973) was prepared using data updated through 1972. This report also included a method for estimating the magnitude and frequency of floods at sites on ungaged rural streams that had drainage areas of two square miles or more.

The purpose of this report is to present a simple and effective method to estimate the magnitude and frequency of floods at ungaged sites on unregulated rural streams in Iowa. The regional flood-frequency equations and techniques presented in this report, which were defined from an updated data set, should provide flood estimates with increased reliability compared to previous reports.

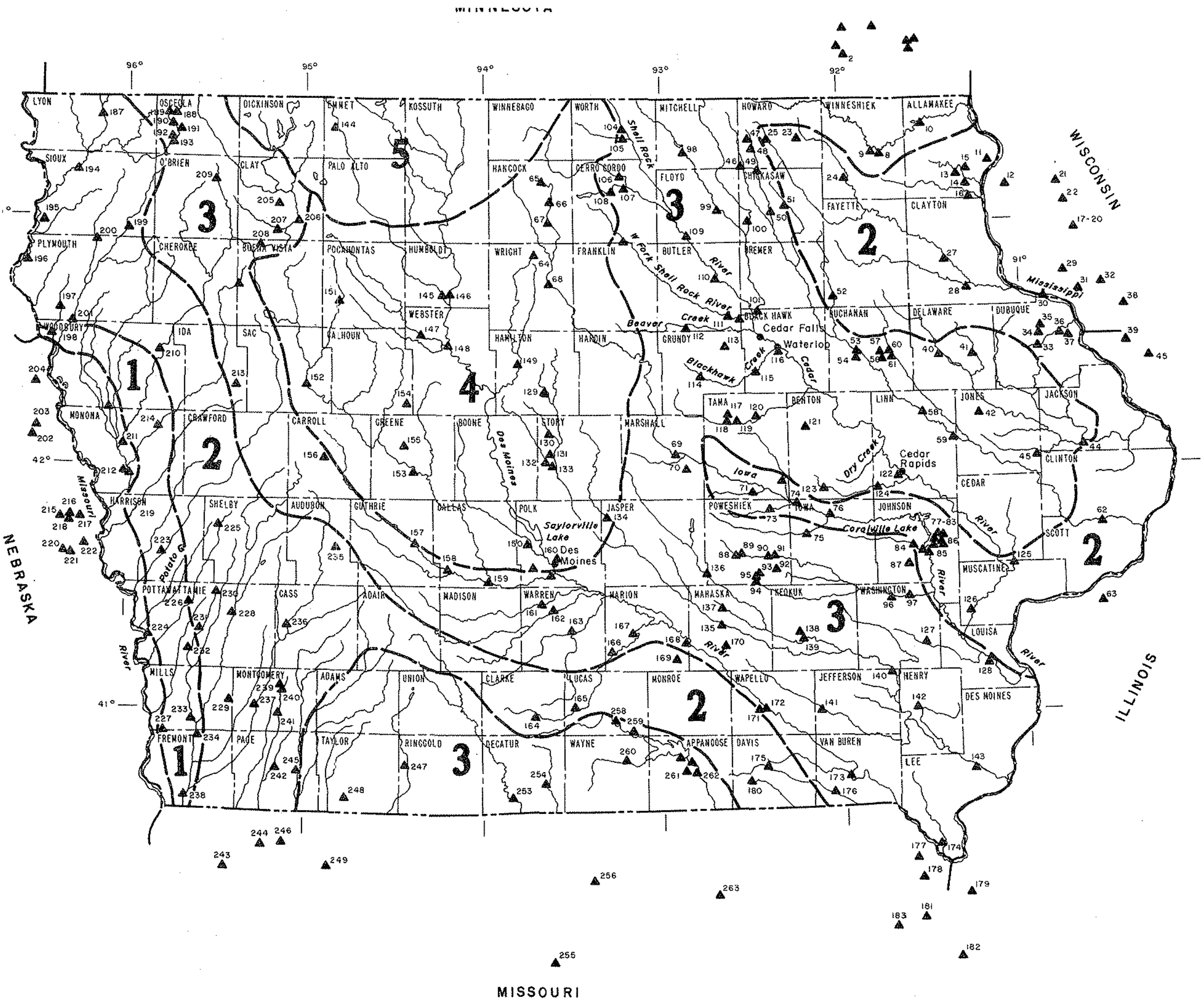
REGIONAL ANALYSIS

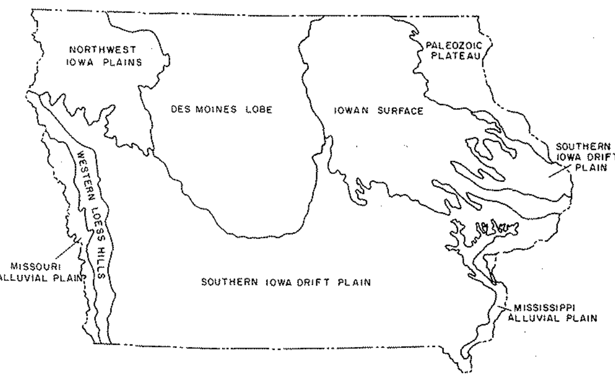
Methods of estimating flood magnitudes and frequencies applicable to an entire region rather than to a single gaging station are developed through regional analysis. Many structures are built across or adjacent to streams at sites where there is no record of streamflow. For this reason, methods are needed to extend information pertaining to flood magnitude and frequency based on gaging-station data from gaged to ungaged sites. Flood data for a single station are relatively short-term random samples and may not be representative of the long-term distribution of floods at that station. Combining records for stations in a hydrologically similar area decreases errors associated with relatively short-term nonrepresentative samples.

The magnitudes of floods in Iowa vary considerably from one region to another as a function of drainage basin efficiency. River basins with minimal drainage efficiency, such as those in north-central Iowa, are characterized by flat terrain. Streams draining these basins have considerably smaller peak discharges than do streams draining basins having steep terrain and well developed drainage systems, such as the basins in the Paleozoic Plateau Escarpment area of eastern Iowa (Prior, 1976). Typically, the discharge per square mile of a stream in the escarpment area is about 1230 cubic feet per second during a 100-year-flood, whereas the discharge per square mile of a stream in north-central Iowa is about 230 cubic feet per second during a 100-year flood. These two areas are about 100 miles apart and the climatic differences such as temperature, average precipitation, and relative humidity are not significant enough to account for the differences in flood magnitude. However, the physiographic differences between these two areas are significant (Prior, 1976, p.23, fig. 22).

The largest floods per unit area occur within 100 miles west of the Des Moines Lobe (north-central Iowa) along the rugged bluffs and steep ridges that border the Missouri River valley. Flood data collected in this area from both Iowa and Nebraska indicate that the discharge of a stream draining a 1-square-mile basin is as much as 1880 cubic feet per second during a 100-year flood. Therefore, it seems reasonable to delineate hydrologic regions based on the landform and physiographic characteristics of the State.

Five hydrologic regions have been identified and delineated in Iowa using physiographic regions of Iowa as a guide. Prior (1976) gives a detailed description of the physiographic regions of Iowa, discussing the shape of the land surface, materials that underlie the land surface, and the geologic history.





PHYSIOGRAPHIC AREAS
(modified from prior, 1976)

EXPLANATION

5 HYDROLOGIC-REGION BOUNDARY AND NUMBER

▲63 GAGING STATION AND SITE NUMBER USED IN THIS REPORT--See table 1 for description of gaging stations

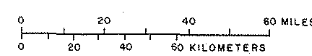


Figure 1.--Location of hydrologic regions and gaging stations used in this study.

Hydrologic Region 1

Hydrologic region 1 (fig. 1) extends north and south along the bluffs that border the Missouri River valley, with limits approximating those of the physiographic area known as the Western Loess Hills (Prior, 1976). The landscape has a corrugated appearance of alternating waves and troughs. Hills are sharp-featured, with narrow broken ridge-crests, intersecting spurs, and steep-sided slopes; the landscape is conducive to rapid runoff. The western border of the region is well defined and easily distinguished on topographic maps and in the field. The eastern border is more difficult to define and merges gradually with the landscape of hydrologic region 2.

Hydrologic Region 2

The bluff area that borders the Mississippi River valley is typical of the landscape in hydrologic region 2 (fig. 1). The landscape can vary from rugged to rolling topography, where runoff may be rapid, commonly causing flash flooding. Bluff-like areas are not only located in the vicinity of the Missisippi River, they also are present along the divide between the Mississippi River and Missouri River basins; in parts of the Iowa and Cedar River basins, in areas that border the Western Loess Hills, and in the headwater parts of basins of streams in south-central Iowa.

Hydrologic Region 3

Hydrologic region 3 is the largest hydrologic region (fig. 1). Most of the area in this region is typical of landscapes in Iowa. The topography of this region can be described as steeply to gently rolling hills interspersed with areas of more subdued topography. The area has a well-established drainage system. Physiographically, it covers most of the Iowan Surface, a large part of the Southern Iowa Drift Plain, and the Northwest Iowa Plains (Prior, 1976).

Hydrologic Region 4

This hydrologic region, which is located in west-central Iowa (fig. 1), is characterized by level terrain and a poorly developed drainage system. The region coincides approximately with the southern two-thirds of the Des Moines Lobe (Prior, 1976). Many clusters of ponds and marshes with no drainage outlets are present in this region. Small streams in level areas are shallow and sluggish.

Hydrologic Region 5

This hydrologic region in north-central Iowa (fig. 1) coincides approximately with the northern part of the Des Moines Lobe (Prior, 1976). The magnitude of floods in this region are the smallest per unit area in the State. This is due to the flat topography and flood-attenuating effect of abundant bogs, swales, and circular depressions.

FLOODS

Floods at Gaged Sites

The magnitude and frequency of floods at gaged sites are determined using flood-frequency curves. These curves relate maximum annual discharge peaks to probability of occurrence or recurrence interval. Probability of occurrence is the chance that a given flood magnitude will be equalled or exceeded in any year. If there is 1 chance in 10, the probability is .1. Recurrence interval is the reciprocal of the probability of occurrence. For example, a flood with a probability of occurrence of .01 in any year has a recurrence interval of 100 years. This does not mean that a 100-year flood will only occur every 100 years or 100 years from now. The 100-year flood is a flood of such magnitude that the odds are 1 in 100 (or 1 percent chance or .01 probability) that it will be exceeded in any year. Several 100-year floods could occur in a single year.

Flood-frequency curves for gaged sites were prepared using the guidelines for determining flood-flow frequencies published by the Interagency Advisory Committee on Water Data (1982). These guidelines were specifically developed for the analysis of annual flood-peak discharge in drainage basins where streams are not affected appreciably by regulation and where at least 10 years of systematic records have been collected. Special attention was given to using methods designed to increase the reliability of the frequency curves: the use of historic flood data, comparison between flood and storm records, and flood flow analysis at nearby hydrologically similar watersheds.

Flood discharges for selected recurrence intervals were determined from flood-frequency curves for each gaged site. A list of these flood discharges for all the gaging stations in Iowa and adjacent States (fig. 1) used for preparing this report is presented in table 1.

Regional Flood Frequency Equations

The historical record of flood peaks at 251 gaged stations in Iowa and adjacent States were used in the development of regional flood-frequency equations. All gaging stations were separated into groups representing the hydrologic regions shown on figure 1. A gaging station was included in the analysis of only one hydrologic region if more than two-thirds of the drainage area is in that region. If less than two-thirds of the drainage area is in any single hydrologic region, the station was used in the data set for both regions. Within each regional data set, a series of subsets of the flood discharges for recurrence intervals of 2, 5, 10, 25, 50, and 100 years were made. The resulting subsets were used to define the relation between flood discharge and drainage area for each recurrence interval in each of the five hydrologic regions.

Least-squares regression analysis was used to define relations between flood discharge and drainage area. The general form of the equations developed from this analysis are:

$$\text{Log } Q_t = b\text{Log } A + \text{Log } c.$$

On transformation the equation becomes:

$$Q_t = cA^b$$

where Q_t = the discharge for the selected recurrence interval, in cubic feet per second;
A = the drainage area, in square miles; and
b and c = regression equation coefficients.

Flood frequency equations for each of the five hydrologic regions are listed in table 2.

Previous flood reports (Schwob, 1963 and Lara, 1973) indicated that comparing the magnitude of floods to the drainage area and the slope of the main channel accounted for a large part of the variance in the magnitude of flood peaks. This study indicated that within the newly delineated hydrologic regions, the size of the drainage area and the slope of the main channel are significantly correlated. Therefore, the channel slope was not used as an independent variable for these equations.

The flood-frequency equations for each hydrologic region in Iowa (table 2) were developed using drainage area as the only independent variable. These equations explain from 71 to 95 percent of the variance in the flood discharges in all cases tested. An attempt was not made to identify other independent variables. It was assumed that most of the unexplained variance is due to spatial-sampling errors, varying lengths of station record, errors in the measurement of stage and discharge, uncertainties in the stage-discharge rating curves and the use of drainage area as the only independent variable. Unexplained variation is quantified as the standard error of estimate (table 2) and was calculated using methods described by Hardison (1971, p C231-C232).

Floods on Mainstems

Basin shape has a considerable affect on the magnitude of floods. Fan-shaped basins, with well-developed drainage rapidly drain excess runoff. Long and narrow basins with few tributary streams yield smaller flood peaks than basins of comparible size with different shapes.

Many major rivers in Iowa have fan-shaped basins along the upstream reaches and long, narrow basin shapes along the downstream reaches. The narrow basins along the downstream reaches markedly attenuate the magnitude of the flood peaks. A typical example of this is the Cedar River basin. Along the upstream reaches of the Cedar River, the Shell Rock River, West Fork Shell Rock River, and Beaver Creek all join the Cedar River upstream from Cedar Falls within a distance of about 7 river miles. About 11 river miles farther downstream, Blackhawk Creek enters the Cedar River at Waterloo. The combined drainage area of these tributary streams is about 3,400 square miles. The total drainage area of the Cedar River increases from 1,661 square miles at the gaging station in Janesville (site 101), to 5,146 square miles at the gaging station in Waterloo (site 116), about a 210-percent increase in drainage area in 19 river miles. Downstream from Waterloo, the basin is narrower with few tributary streams. The drainage area at the gaging station in Cedar Rapids (site 122) is 6,510 square miles, an increase in drainage area of about 26 percent in 182 river miles.

The extent of flood attenuation between the gaging stations in Waterloo (site 116) and Cedar Rapids (site 122) can be assessed by comparing the magnitude of the 100-year flood at each station (table 1). The discharge of a 100-year flood at Waterloo (44 years of record) is 97,100 cubic feet per second and that at Cedar Rapids (82 years of record) is 83,000 cubic feet per second, a 14 percent flood attenuation. Readers interested in comparing the effects of flood attenuation for a single flood may consult a companion report (Lara and Eash, 1987) where basic data collected in Iowa are tabulated.

Data on the magnitude and frequency of floods for major streams in Iowa with basin configurations similar to that of the Cedar River are presented in graphs that compare the magnitude of the peaks to drainage area. Graphs showing flood magnitude and frequency along the mainstem of seven rivers are shown in figures 2 to 8.

Maximum Floods

Previous flooding in Iowa needs to be considered when planning projects in flood plain areas where structural failures may be life threatening. Data for maximum flood and related information are shown in table 3. These data indicate maximum floods without reference to frequency of occurence at some stations; the ratio of the maximum flood to the computed 100-year flood is listed instead of recurrence interval. These data are intended as a guide for making estimates of the discharge of rare floods at a given stream site.

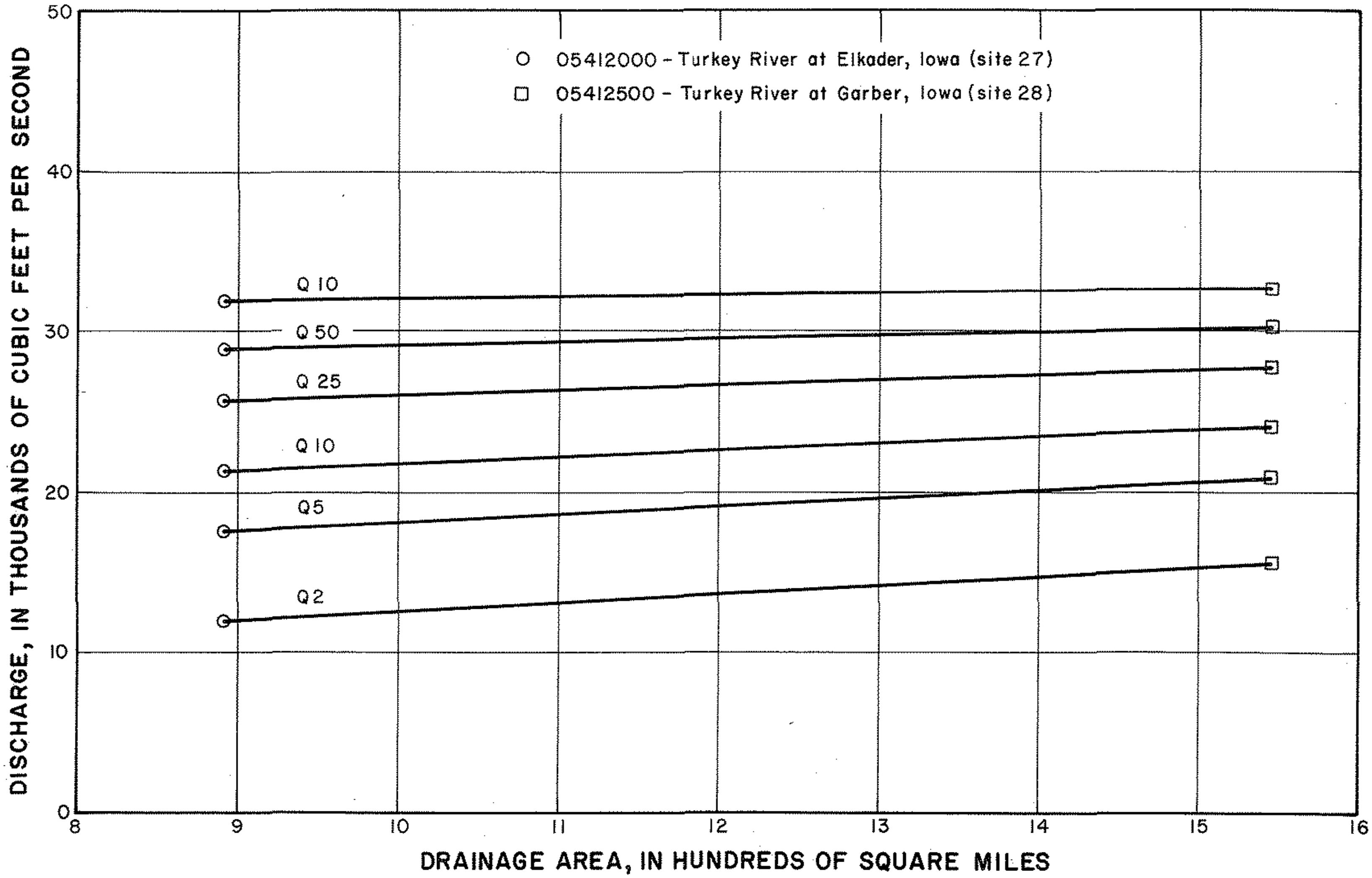


Figure 2.--Flood discharges for indicated recurrence intervals along mainstem of Turkey River from site 27 to site 28.

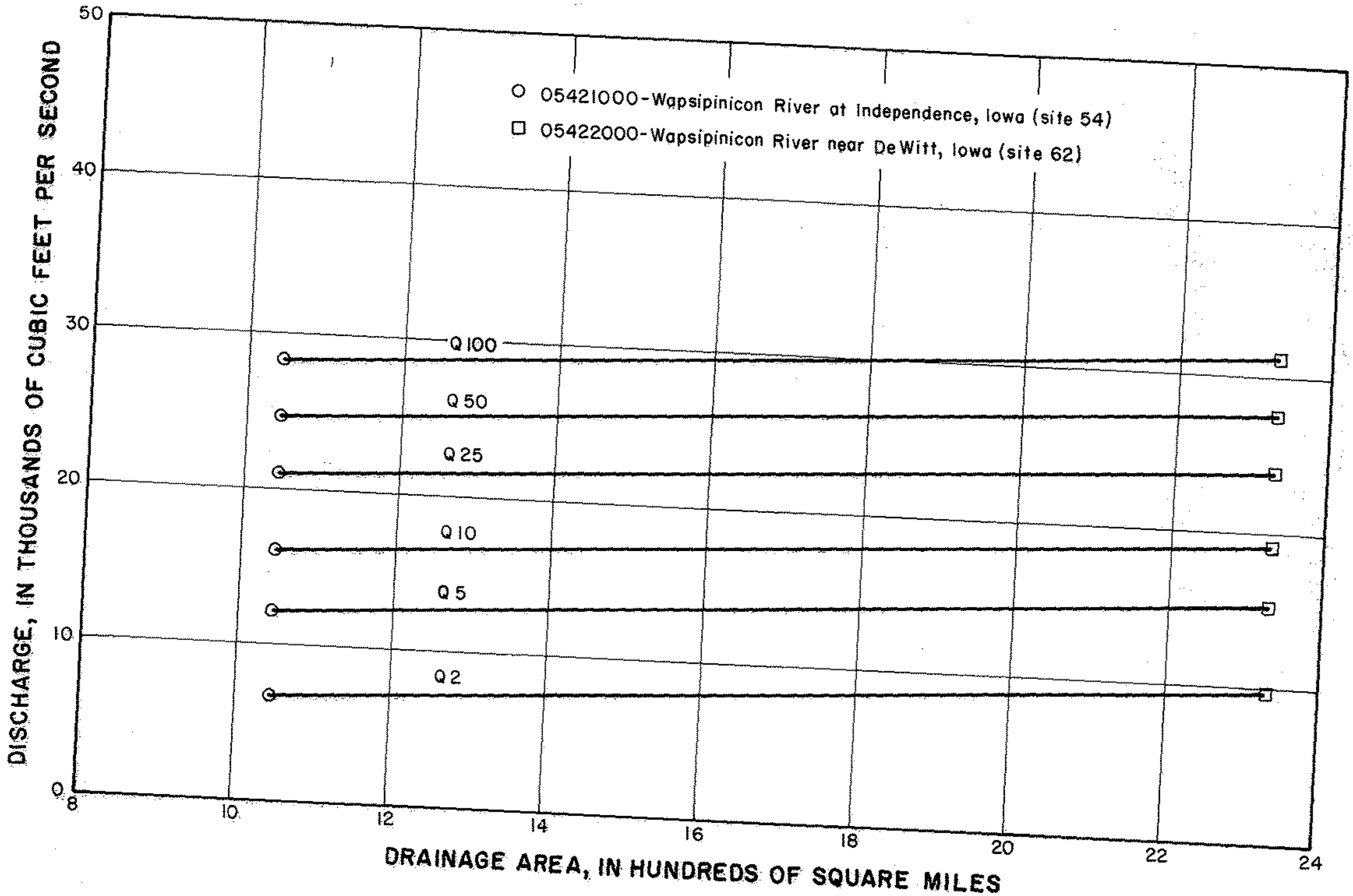


Figure 3.--Flood discharges for indicated recurrence intervals along mainstem of Wapsipinicon River from site 54 to site 62.

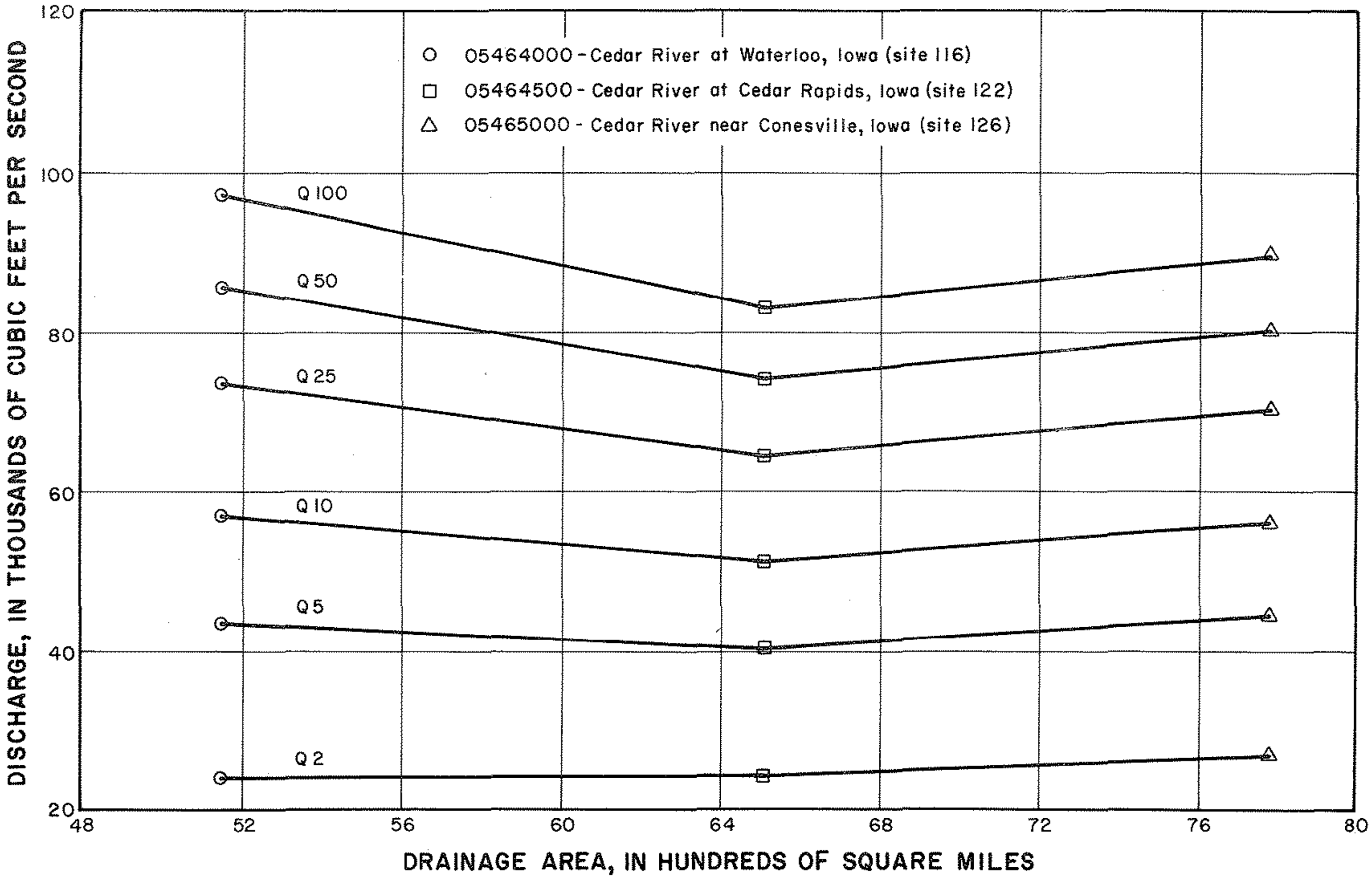


Figure 4.--Flood discharges for indicated recurrence intervals along mainstem of Cedar River from site 116 to site 126.

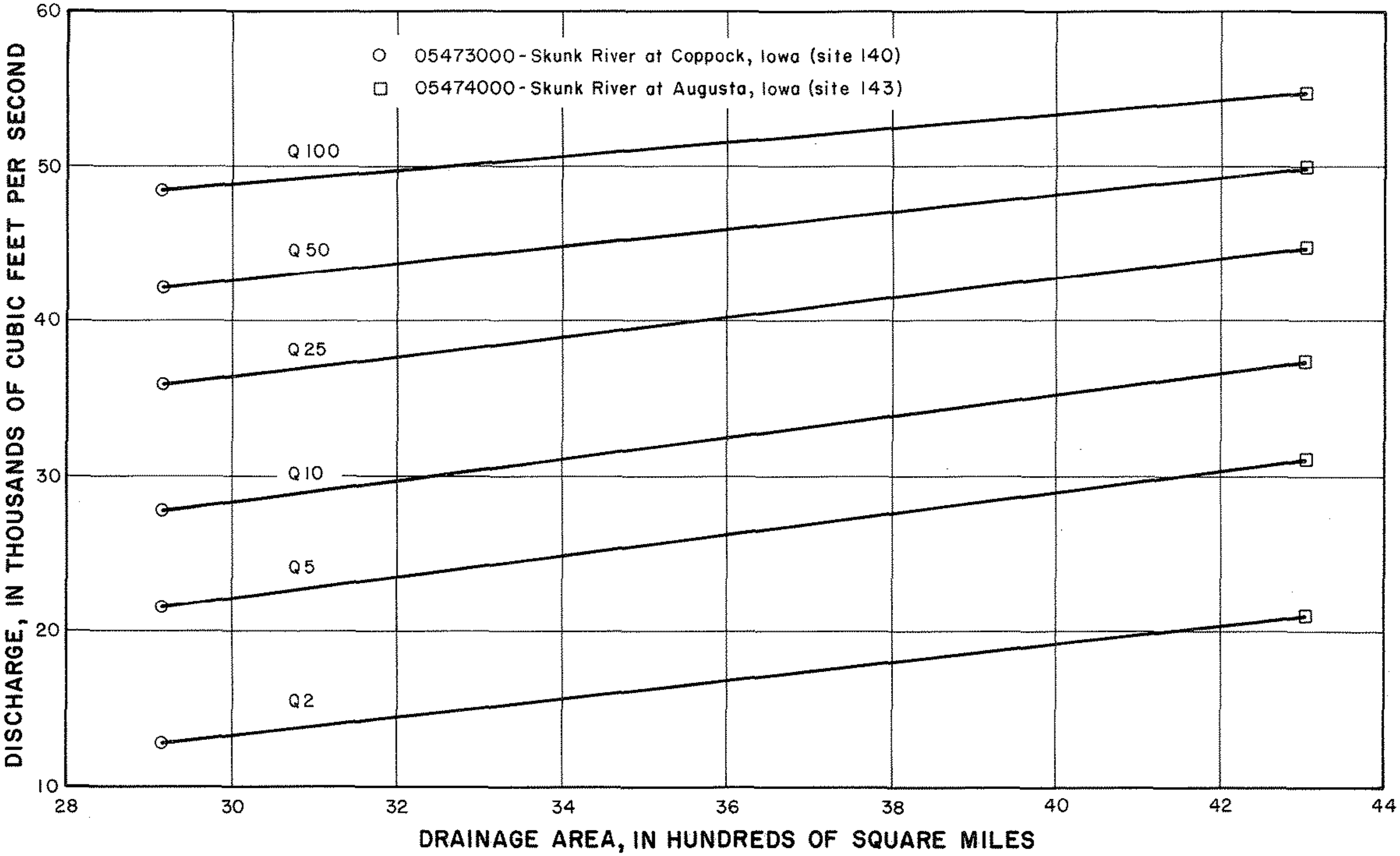


Figure 5.--Flood discharges for indicated recurrence intervals along mainstem of Skunk River from site 140 to site 143.

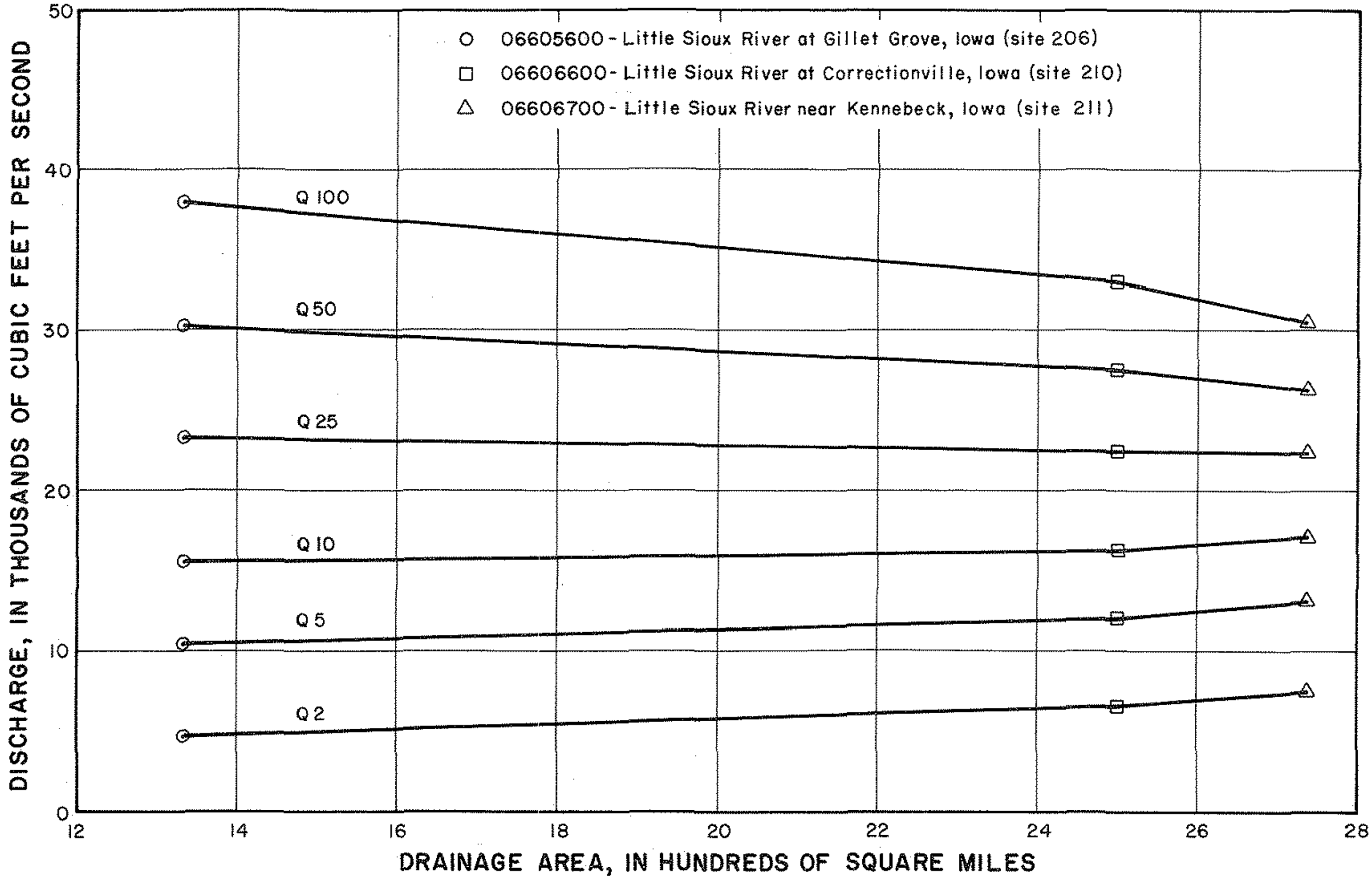


Figure 6.--Flood discharges for indicated recurrence intervals along mainstem of Little Sioux River from site 206 to site 211.

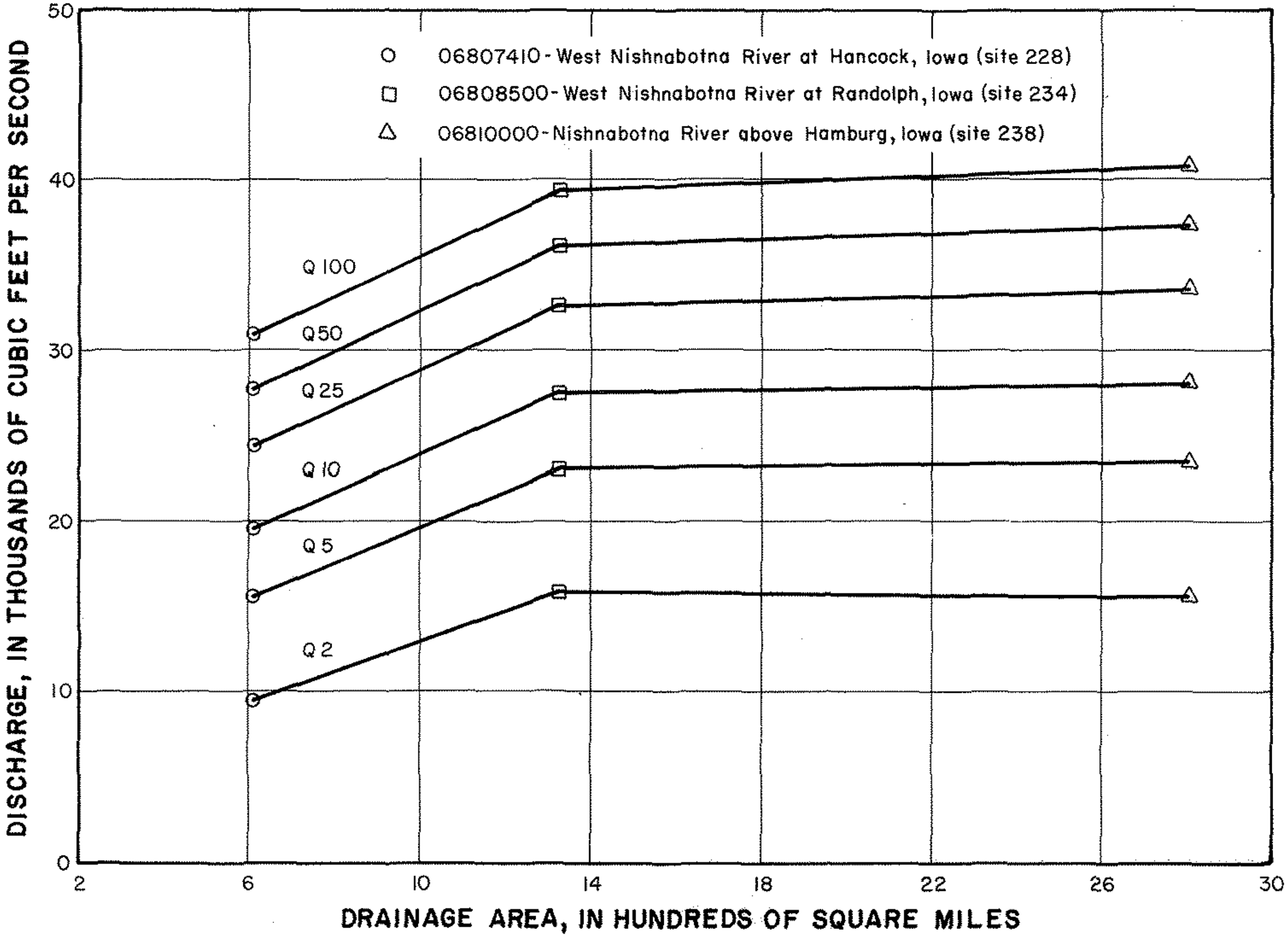


Figure 7.--Flood discharges for indicated recurrence intervals along mainstem of West Nishnabotna River from site 228 to site 238.

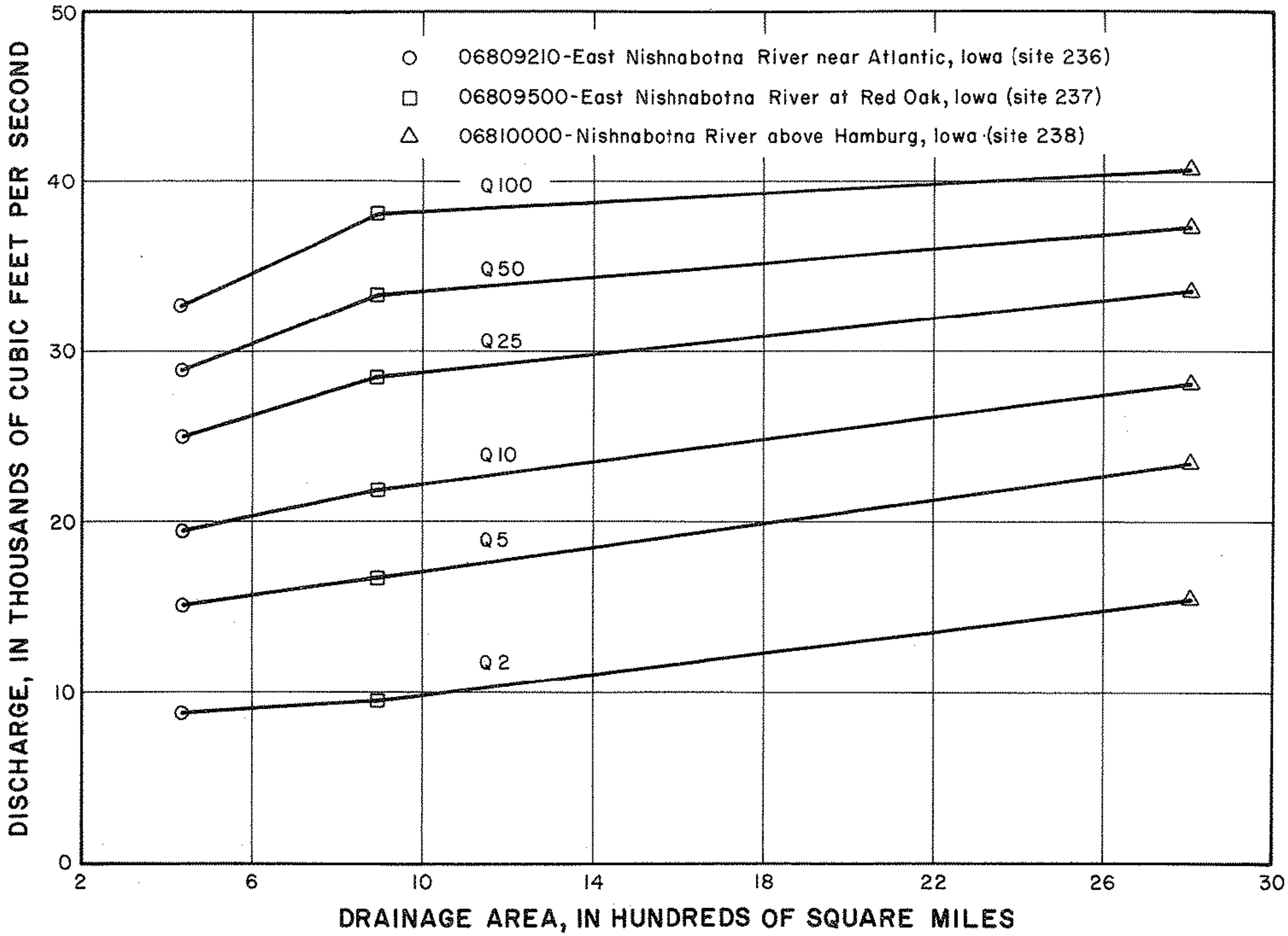


Figure 8.--Flood discharges for indicated recurrence intervals along mainstem of East Nishnabotna River from site 236 to site 238.

METHOD FOR ESTIMATING THE MAGNITUDE AND FREQUENCY OF FLOODS AT UNGAGED SITES

The flood-frequency equations presented in this report may be used to estimate the magnitude and frequency of floods in most unregulated rural streams in Iowa. These equations have been defined for streams with drainage areas ranging from 0.7 to 374 square miles in hydrologic region 1, from 0.08 to 1,670 square miles in hydrologic region 2, from 0.04 to 5,146 square miles in hydrologic region 3, from 7.9 to 3,440 square miles in hydrologic region 4, and from 45 to 2,256 square miles in hydrologic region 5. Techniques to estimate flood discharges on the Mississippi and Missouri rivers are described in reports by Patterson and Gamble (1968), Patterson (1966), and Matthai(1968).

To estimate the magnitude and frequency of a flood at an ungaged site proceed as follows:

1. Determine the size of the drainage area upstream from the site, in square miles. Drainage areas larger than 5 square miles are listed in Larimer (1957).

2. Determine the hydrologic region in which the site is located using figure 1. If the site is on the mainstem of the following rivers, obtain the flood discharge directly from figures 2 to 8: Turkey River downstream from Elkader at river mile 38 (site 27); Wapsipinicon River downstream from Independence at river mile 145 (site 54); Cedar River downstream from Waterloo at river mile 190 (site 116); Skunk River downstream from Coppock at river mile 68 (site 140); Little Sioux River downstream from Gillett Grove at river mile 124 (site 206); West Nishnabotna River downstream from Hancock at river mile 75 (site 228); East Nishnabotna River downstream from Atlantic at river mile 85 (site 236).

3. Select the appropriate set of equations from table 2 and compute the flood discharges.

Commonly the project site will be near a border of a hydrologic region. Such borders are not defined lines but transition zones where the physiographic characteristics of one hydrologic region gradually merge into the next. Within these transition zones, the selection of the appropriate set of equations from table 2 is a matter of judgement. If part of the stream begins in or flows across another hydrologic region, there may be the need to use equations from both regions and estimate a weighted average based on drainage-area ratios. Many examples of stations located in interregional transition zones are listed in table 1.

Limits of Application

The regional flood-frequency equations in this report have been derived from data on unregulated rural streams. Therefore, they are not applicable to regulated streams, such as the Des Moines River downstream from Saylorville Lake, the Iowa River downstream from Coralville Lake, or other streams where changes by people have appreciably altered the flow regime. Furthermore they are not applicable on sections of mainstems where the magnitudes of floods are attenuated due to drainage basin geometry or channel and valley storage.

Illustrative Examples

Example 1.-- Estimate the 50 and 100-year floods for Dry Creek at the road crossing in sec. 1, T. 84 N., R. 8 W., in Linn County.

Solution:

1. Drainage area (A) is 11.4 square miles (Larimer 1957, p.258).
2. Drainage area is located in hydrologic region 3 (fig. 1).
3. From table 2, the applicable equations are:

$$Q_{50} = 695A^{0.54} \text{ and}$$

$$Q_{100} = 851A^{0.53};$$

substituting 11.4 square miles for A,

$$Q_{50} = 2{,}590 \text{ cubic feet per second, and}$$

$$Q_{100} = 3{,}090 \text{ cubic feet per second.}$$

Example 2.-- Of interest to many users is the recurrence interval of previous floods of known magnitude. For instance, determine the recurrence interval of a peak discharge equal to 10,500 cubic feet per second on Potato Creek at a road crossing near the north county line, in Pottawattamie County.

Solution:

1. Drainage area (A) is 23.0 square miles (Larimer, 1957, p.340).

2. Drainage area is located in hydrologic region 1 (fig. 1).

3. Appropriate equations from table 2 are:

$$Q_2 = 211A^{0.62} = 1,470 \text{ cubic feet per second,}$$

$$Q_5 = 502A^{0.60} = 3,290 \text{ cubic feet per second,}$$

$$Q_{10} = 757A^{0.60} = 4,970 \text{ cubic feet per second,}$$

$$Q_{25} = 1140A^{0.57} = 6,810 \text{ cubic feet per second,}$$

$$Q_{50} = 1500A^{0.60} = 9,840 \text{ cubic feet per second, and}$$

$$Q_{100} = 1880A^{0.60} = 12,300 \text{ cubic feet per second.}$$

4. On log-probability paper, plot Q_t versus its recurrence interval, t, and fit a smooth curve through the points, as shown in figure 9. From this graph, the recurrence interval of 10,500 cubic feet per second is 65 years. In terms of probability, the chance of exceedence of this peak in a given year is 1 in 65 or 4.5 percent.

Example 3. What is the probability that the 10,500 cubic feet per second of example 2 will be exceeded in a 10-year period?

The probability of a flood being exceeded in n years is given by:

$$P_n = 1-(1-1/t)^n$$

where P = probability;
t = recurrence interval of flood, in years; and
n = time, in years.

Substituting for t and n, from example 2, in equation 1:

$$P_{10} = 1-(1-1/65)^{10} = 1-(0.985)^{10} \text{ or}$$

$$P_{10} = 1-0.856 = 0.144.$$

Therefore, the probability of the 10,500 cubic feet per second being exceeded one or more times in the 10-year period is .14. The probability of not having a flood of that magnitude in the 10-year period is .86.

Example 4. Estimate the 50- and 100-year floods for the Cedar River near the center of sec. 10, T. 85 N., R. 9 W., at the crossing of county road M bridge in Benton County.

Solution:

1. The drainage area of the Cedar River at this point is 6,135 square miles (Larimer, 1957).

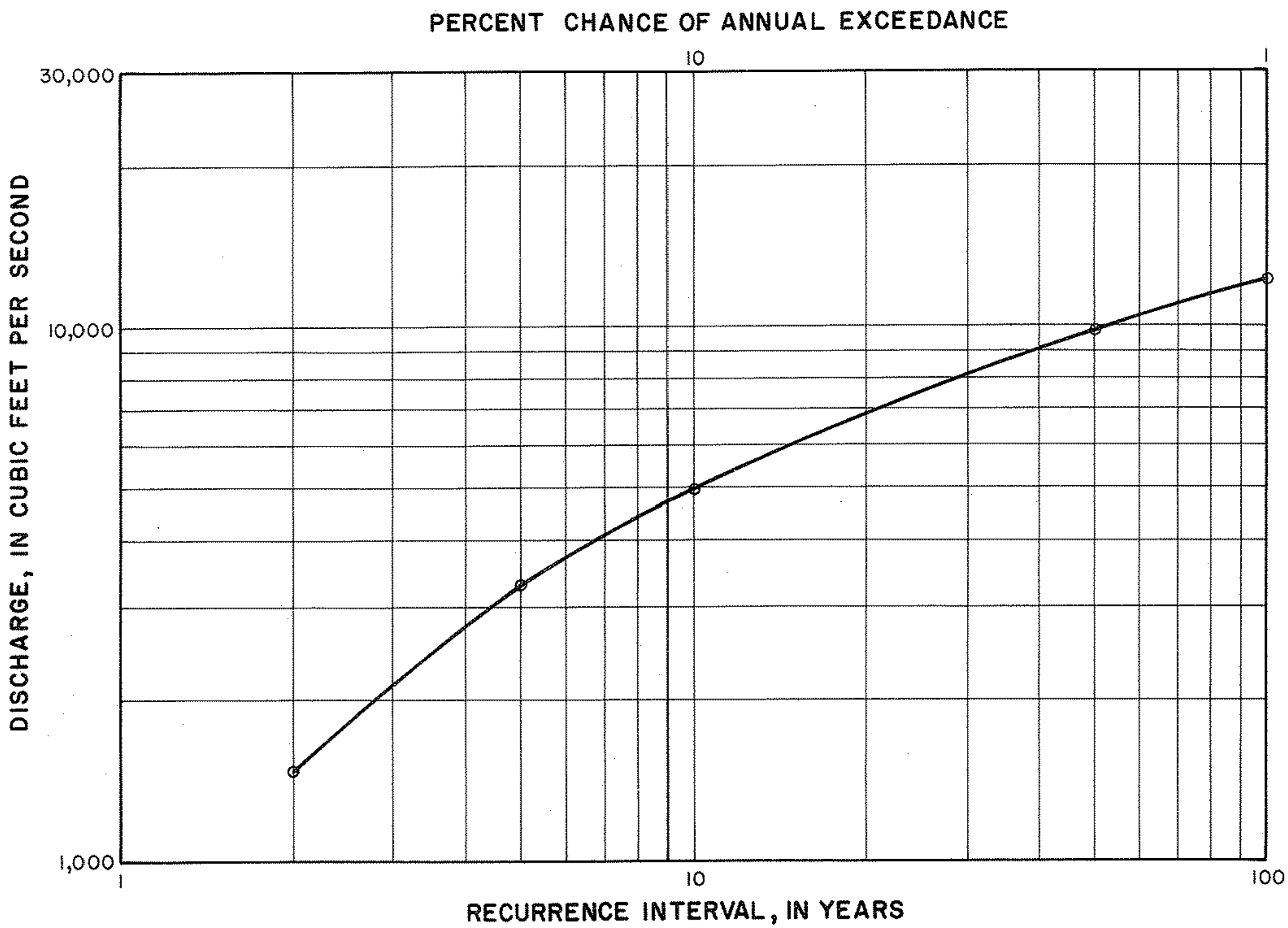


Figure 9.--Flood-frequency curve for Potato Creek.

2. From figure 4:

$$Q_{50} = 77{,}000 \text{ cubic feet per second}$$

$$Q_{100} = 87{,}000 \text{ cubic feet per second}$$

The examples illustrate the various ways of using and interpreting flood-frequency data. For a better undertanding of probability concepts for design, the reader is referred to Chow (1964), and Linsley and Franzini (1964).

SUMMARY

The report describes a method for estimating the magnitude and frequency of floods on unregulated streams in Iowa. Five hydrologic regions are defined on the basis of physiographic characteristics. Flood-frequency equations were developed by least-squares regression analysis using data for 251 gaged stations. Regression analysis of regionalized data relates flood discharage to the drainage-basin area and can be used to estimate flood discharage at ungaged sites for 2-, 5-, 10-, 25-, 50-, and 100-year recurrence intervals. Drainage-basin size was the most significant independent variable and it accounted for 71 to 95 percent of the variance in all cases. Discharge of selected mainstem streams where peak discharge is affected by factors of basin geometry was determined graphically. The method described in this report is only applicable to sites on ungaged streams that are not affected significantly by regulation upstream from the sites and that the areas upstream from the sites are not mostly in urban areas.

REFERENCES

Chow, V.T., 1964, Handbook of applied hydrology: New York, McGraw-Hill Book Co.

Hardison, C.L., 1971, Prediction error of regression estimates of streamflow characteristics at ungaged sites: U.S. Geological Survey Professional Paper 750-C, p. C228-C236

Interagency Advisory Committee on Water Data, 1982, Guidelines for determining flood flow frequency (2d ed., revised): Reston, Va., U.S. Geological Survey, Office of Water Data Coordination, Hydrology Subcommittee Bulletin 17B, appendices 1-14, 28 p.

Lara, O.G., 1973, Floods in Iowa--Technical manual for estimating their magnitude and frequency: Iowa Natural Resources Council Bulletin 11, 56 p.

Lara, O.G., and Eash, D.A., 1987, Floods in Iowa: Stage and discharge: U.S. Geological Survey Open-File Report 87-382, 786 p.

Larimer, O.J., 1957, Drainage area of Iowa streams: Iowa Highway Research Board Bulletin 7, 439 p.

Linsley, R.K., Franzini, J.B., 1964, Water resources engineering: New York, McGraw-Hill Book Co.

Matthai, H.F., 1968, Magnitude and frequency of floods in the United States-Part 6-B, Missouri River basin below Sioux City, Iowa: U.S. Geological Survey Water-Supply Paper 1680, 471 p.

Patterson, J.L., 1966, Magnitude and frequency of floods in the United States-Part 6-B, Missouri River basin above Sioux City, Iowa: U.S. Geological Survey Water-Supply Paper 1679, 471 p.

Patterson, J.L., and Gamble, C.R., 1968, Magnitude and frequency of floods in the United States, Part 5, Hudson Bay and Upper Mississippi River basins: U.S. Geological Survey Water-Supply Paper 1678, 546 p.

Prior, J.C., 1976, A regional guide to Iowa landforms: Iowa Geological Survey, Educational Series, 72 p.

Riggs, H.C., 1961, Frequency of natural events: American Society of Civil Engineers, V. 87, no. 1, p. 15-26.

Schwob, H.H., 1953, Iowa floods--Magnitude and frequency: Iowa Highway Research Board Bulletin 1, 171 p.

____________ 1966, Magnitude and frequency of Iowa floods: Iowa Highway Research Board Bulletin 28, Pt. I, Pt. II.

Table 1.--Flood discharges for selected recurrence intervals at gaging stations in Iowa and adjacent States

[P, partial record station; MS, mainstem station]

Site number	Station number		Station name	Hydrologic region	Drainage area, in square miles	Recurrence interval, in years: 2	5	10	25	50	100
1	05384000		Root River near Lanesboro,Minn.	3	615.00	8,680	14,100	17,500	21,700	24,600	27,400
2	05384150		Root River tributary near Whalan,Minn.	2	.08	28	68	106	155	232	304
3	05384300		Big Springs Creek near Arendahl,Minn.	3	.14	18	46	74	122	168	223
4	05384500	P	Rush Creek near Rushford,Minn.	3	129.00	2,470	5,100	7,280	10,500	13,100	15,900
5	05385000		Root River near Houston,Minn.	3	1,270.00	10,700	17,900	22,900	29,200	33,800	38,300
6	05385500		South Fork Root River near Houston,Minn.	3	275.00	2,790	5,850	8,510	12,600	16,100	20,100
7	05386000		Root River Below S Fork near Houston,Minn.	3	1,560.00	13,500	22,300	28,600	37,100	43,800	50,600
8	05387500		Upper Iowa River at Decorah,Iowa	3	511.00	6,490	11,000	14,100	18,000	20,900	23,800
9	05388000		Upper Iowa River near Decorah,Iowa	3	568.00	8,230	12,400	15,200	18,800	21,500	24,100
10	05388250		Upper Iowa River near Dorchester,Iowa	3	770.00	6,610	9,810	12,200	15,400	18,000	20,700
11	05388400	P	Wexford Creek near Harpers Ferry,Iowa	2	11.90	730	1,970	3,220	5,360	7,380	9,770
12	05388460		Du Charme Creek at Eastman,Wis.	3	.30	78	157	220	360	375	446
13	05388500		Paint Creek at Waterville,Iowa	2	42.80	2,240	3,560	4,510	5,780	6,760	7,770
14	05388600	P	Paint Creek near Waterville,Iowa.	2	56.00	2,140	3,690	4,850	6,440	7,690	9,010
15	05388700	P	Little Paint Creek trib near Waterville,Iowa	2	1.09	167	247	304	381	442	506
16	05389000		Yellow River at Ion,Iowa	2	221.00	8,010	12,500	15,600	19,500	22,400	25,300
17	05407032		Fennimore W-1,Wis.	3	.27	68	144	207	296	369	446
18	05407033		Fennimore W-2,Wis.	3	.04	15	33	50	74	94	117
19	05407034		Fennimore W-3,Wis.	3	.08	23	52	76	113	144	178
20	05407035		Fennimore W-4,Wis.	3	.52	83	182	266	392	497	611
21	05407100	P	Richland Creek near Plugtown,Wis.	3	19.20	591	1,190	1,670	2,330	2,850	3,390
22	05407200	P	Crooked Creek near Boscobel,Wis.	3	12.90	501	1,070	1,540	2,210	2,760	3,330
23	05411530	P	North Branch Turkey River near Cresco,Iowa	2	19.50	284	948	1,750	3,330	5,000	7,180
24	05411600		Turkey River at Spillville,Iowa	3	177.00	2,850	5,270	7,020	9,280	11,000	12,700
25	05411650	P	Crane Creek tributary near Saratoga,Iowa	2	4.06	632	1,180	1,580	2,120	2,520	2,930
26	05411700	P	Crane Creek near Lourdes,Iowa	2	75.80	2,100	4,510	6,450	9,190	11,400	13,600
27	05412000		Turkey River at Elkader,Iowa	2	891.00	12,000	17,600	21,300	25,700	28,900	31,900
28	05412500		Turkey River at Garber,Iowa	MS	1,545.00	15,700	21,000	24,100	27,800	30,300	32,700
29	05413400	P	Pigeon Creek near Lancaster,Wis.	2	6.93	553	1,190	1,730	2,530	3,200	3,870
30	05413500		Grant River at Burton,Wis.	2	269.00	7,530	13,700	18,100	23,800	28,000	32,200
31	05414000		Platte River near Rockville,Wis.	2	142.00	4,880	8,710	11,700	15,800	19,100	22,600
32	05414200	P	Bear Branch near Platteville,Wis.	2	2.72	406	729	965	1,270	1,510	1,750
33	05414350	P	Little Maquoketa River near Graf,Iowa	2	39.60	2,280	3,700	4,740	6,160	7,280	8,450
34	05414400	P	M Fk L Maquoketa R near Rickardsville,Iowa	2	30.20	1,070	2,500	3,950	6,460	8,920	12,000
35	05414450	P	N Fk L Maquoketa R near Rickardsville,Iowa	2	21.60	1,300	2,310	3,130	4,350	5,380	6,530
36	05414500	P	Little Maquoketa River near Durango,Iowa	2	130.00	6,580	11,000	14,500	19,600	23,900	28,600
37	05414600	P	Little Maquoketa River trib at Dubuque,Iowa	2	1.54	225	513	771	1,170	1,520	1,910
38	05414900	P	Pats Creek near Elk Grove,Wis.	2	8.50	567	1,180	1,680	2,390	2,690	3,550
39	05415000		Galena River near Bucombe,Wis.	2	125.00	5,390	8,330	10,400	13,100	15,200	17,300
40	05417000		Maquoketa River near Manchester,Iowa	3	305.00	4,670	7,870	10,200	13,200	15,600	17,900

Table 1.--Flood discharges for selected recurrence intervals at gaging stations in Iowa and adjacent States--Continued

Site number	Station number		Station name	Hydrologic region	Drainage area, in square miles	Recurrence interval, in years: 2	5	10	25	50	100
41	05417530	P	Plum Creek near Earlville, Iowa	3	41.10	1,350	2,240	2,880	3,730	4,380	5,050
42	05417590	P	Kitty Creek near Langworthy, Iowa	3	14.40	740	1,290	1,710	2,310	2,800	3,320
43	05417700		Bear Creek near Monmouth, Iowa	3	61.30	1,710	2,960	3,870	5,050	5,940	6,840
44	05418500		Maquoketa River near Maquoketa, Iowa	3	1,553.00	15,600	24,000	29,700	36,900	42,200	47,500
45	05418800		Mill Creek tributary near Scales Mound Ill.	2	.86	249	414	527	736	776	880
46	05420560		Wapsipinicon River near Elma, Iowa	3	95.20	2,380	5,160	7,450	10,700	13,400	16,200
47	05420600	P	L Wapsipinicon River trib near Riceville, Iow	3	.90	250	552	794	1,120	1,380	1,640
48	05420620	P	Little Wapsipinicon River near Acme, Iowa	3	7.76	471	918	1,300	1,900	2,420	3,010
49	05420640	P	Little Wapsipinicon River at Elma, Iowa	3	37.30	1,200	2,440	3,420	4,820	5,940	7,120
50	05420650	P	L Wapsipinicon River near New Hampton, Iowa	3	95.00	2,060	3,480	4,550	6,030	7,220	8,480
51	05420690	P	East Fk Wapsipinicon R at New Hampton, Iowa	3	30.30	1,800	3,880	5,600	8,090	10,100	12,300
52	05420850	P	Little Wapsipinicon River near Oran, Iowa	2	94.10	1,600	2,800	3,690	4,900	5,840	6,810
53	05420960	P	Harter Creek near Independence, Iowa	3	6.17	371	960	1,520	2,420	3,220	4,120
54	05421000		Wapsipinicon River at Independence, Iowa	3	1,048.00	6,730	12,200	16,100	21,000	24,700	28,300
55	05421100	P	Pine Creek tributary near Winthrop, Iowa	3	.33	84	170	238	334	412	494
56	05421200	P	Pine Creek near Winthrop, Iowa	2	28.30	1,180	2,430	3,570	5,430	7,150	9,180
57	05421300	P	Pine Creek tributary No. 2 at Winthrop, Iowa	1	.70	69	232	411	727	1,030	1,380
58	05421400		Wapsipinicon River at Central City, Iowa	3	1,263.00	9,710	13,500	16,000	19,000	21,200	23,300
59	05421500		Wapsipinicon River at Stone City, Iowa	3	1,324.00	7,990	11,600	14,100	17,400	19,900	22,500
60	05421550	P	Buffalo Creek above Winthrop, Iowa	2	68.20	1,590	3,790	5,980	9,730	13,300	17,700
61	05421600	P	Buffalo Creek near Winthrop, Iowa	2	71.40	1,510	4,050	6,720	11,400	16,000	21,700
62	05422000		Wapsipinicon River near Dewitt, Iowa	3	2,330.00	9,730	15,300	19,100	23,900	27,600	31,200
63	05448000		Mill Creek at Milan Ill.	2	62.40	2,790	5,330	7,250	8,790	11,900	13,900
64	05448500		West Branch Iowa River near Klemme, Iowa	4	112.00	507	985	1,370	1,920	2,370	2,850
65	05448700	P	East Branch Iowa River near Hayfield, Iowa	4	7.94	131	250	338	458	551	645
66	05448800	P	East Branch Iowa River near Garner, Iowa	5	45.10	408	669	849	1,080	1,250	1,420
67	05449000		East Branch Iowa River near Klemme, Iowa	4	133.00	1,020	2,060	2,940	4,230	5,310	6,500
68	05449500		Iowa River near Rowan, Iowa	4	429.00	2,150	3,900	5,190	6,910	8,230	9,560
69	05451500		Iowa River at Marshalltown, Iowa	3	1,564.00	8,470	14,300	18,500	24,000	28,100	32,200
70	05451700		Timber Creek near Marshalltown, Iowa	4	118.00	2,920	5,290	6,980	9,180	10,800	12,400
71	05451900		Richland Creek near Haven, Iowa	2	56.10	1,690	2,790	3,570	4,580	5,340	6,110
72	05452000		Salt Creek near Elberon, Iowa	3	201.00	4,460	9,100	13,300	20,100	26,400	33,700
73	05452200		Walnut Creek near Hartwick, Iowa	3	70.90	2,590	4,360	5,590	7,160	8,330	9,490
74	05452500		Iowa River near Belle Plaine, Iowa	3	2,455.00	10,600	18,900	25,100	33,600	40,200	47,000
75	05453000		Big Bear Creek at Ladora, Iowa	3	189.00	4,520	6,420	7,560	8,860	9,740	10,500
76	05453100		Iowa River at Marengo, Iowa	MS	2,794.00	13,600	20,600	24,900	30,100	33,700	37,100
77	05453600	P	Rapid Creek below Morse, Iowa	2	8.12	552	1,160	1,680	2,450	3,110	3,830
78	05453700	P	Rapid Creek tributary No. 4 near Oasis, Iowa	2	1.55	178	404	600	893	1,140	1,410
79	05453750	P	Rapid Creek southwest of Morse, Iowa	2	15.20	1,010	1,960	2,730	3,800	4,680	5,610
80	05453850	P	Rapid Creek tributary No. 3 near Oasis, Iowa	2	1.62	310	583	800	1,110	1,370	1,640

Table 1.--Flood discharges for selected recurrence intervals at gaging stations in Iowa and adjacent States--Continued

Site number	Station number	Station name	Hydrologic region	Drainage area, in square miles	Recurrence interval, in years: 2	5	10	25	50	100
81	05453900	P Rapid Creek tributary near Oasis,Iowa	2	.97	225	493	698	968	1,170	1,360
82	05453950	P Rapid Creek tributary near Iowa City,Iowa	2	3.43	438	900	1,270	1,770	2,170	2,590
83	05454000	Rapid Creek near Iowa City,Iowa	2	25.30	1,510	3,060	4,230	5,790	6,980	8,170
84	05454300	Clear Creek near Coralville,Iowa	2	98.10	1,850	3,580	4,960	6,960	8,590	10,300
85	05455000	Ralston Creek at Iowa City,Iowa	2	3.01	408	816	1,140	1,600	1,970	2,360
86	05455010	South Branch Ralston Creek at Iowa City,Iowa	2	2.94	418	732	954	1,240	1,450	1,660
87	05455100	P Old Mans Creek near Iowa City,Iowa	3	201.00	2,420	4,820	6,800	9,700	12,100	14,700
88	05455140	P North English River near Montezuma,Iowa	3	31.00	1,470	2,460	3,160	4,060	4,740	5,420
89	05455150	P North Fork English River near Montezuma,Iowa	3	34.00	1,810	3,100	4,020	5,200	6,090	6,980
90	05455200	P North English River near Guernsey,Iowa	3	68.70	2,640	4,150	5,150	6,390	7,290	8,150
91	05455210	P North English River at Guernsey,Iowa	3	81.50	3,940	5,110	5,820	6,640	7,210	7,750
92	05455230	P Deep River at Deep River,Iowa	3	30.50	1,120	2,090	2,910	4,140	5,210	6,400
93	05455280	P S Fk English R trib near Barnes City,Iowa	3	2.51	380	676	886	1,160	1,360	1,560
94	05455300	P South Fork English R near Barnes City,Iowa	3	11.50	529	987	1,350	1,870	2,300	2,760
95	05455350	P S English R trib No. 2 near Montezuma,Iowa	3	.52	40	93	145	233	316	416
96	05455500	English River at Kalona,Iowa	3	573.00	6,080	10,500	13,800	18,200	21,600	25,100
97	05455550	P Bulgers Run near Riverside,Iowa	3	6.31	1,600	2,190	2,550	2,970	3,250	3,520
98	05457500	Cedar River at Mitchell,Iowa	3	826.00	11,100	14,700	16,900	19,700	21,700	23,600
99	05457700	Cedar River at Charles City,Iowa	3	1,054.00	10,600	16,300	19,900	24,300	27,300	30,100
100	05458000	Little Cedar River near Ionia,Iowa	3	306.00	3,040	6,000	8,240	11,300	13,600	15,900
101	05458500	Cedar River at Janesville,Iowa	3	1,661.00	10,500	18,500	24,100	31,300	36,600	41,900
102	05458560	P Beaverdam Creek near Sheffield,Iowa	3	123.00	1,710	2,440	2,930	3,560	4,030	4,510
103	05458900	West Fork Cedar River at Finchford,Iowa	3	846.00	5,630	12,200	17,200	24,000	29,100	34,100
104	05459000	Shell Rock River near Northwood,Iowa	5	300.00	1,190	1,880	2,320	2,860	3,240	3,600
105	05459010	P Elk Creek at Kensett,Iowa	5	58.10	390	608	752	930	1,060	1,180
106	05459490	P Spring Creek near Mason City,Iowa	3	29.30	820	2,000	3,050	4,630	5,950	7,370
107	05459500	Winnebago River at Mason City,Iowa	4	526.00	3,370	5,650	7,310	9,530	11,200	13,000
108	05460100	P Willow Creek near Mason City	5	78.60	619	882	1,040	1,220	1,340	1,460
109	05460500	Shell Rock River at Marble Rock,Iowa	3	1,318.00	10,100	16,900	21,800	28,600	33,900	39,400
110	05461500	Shell Rock River near Clarksville,Iowa	3	1,626.00	9,140	16,200	21,700	29,200	35,300	41,600
111	05462000	Shell Rock River at Shell Rock,Iowa	3	1,746.00	8,770	16,700	22,600	30,400	36,300	42,200
112	05462750	P Beaver Creek tributary near Applington,Iowa	3	11.60	1,070	2,150	2,980	4,120	5,010	5,910
113	05463000	Beaver Creek at New Hartford,Iowa	3	347.00	3,930	8,450	11,900	16,600	20,200	23,700
114	05463090	P Black Hawk Creek at Grundy Center,Iowa	3	56.90	954	2,150	3,180	4,740	6,070	7,510
115	05463500	Blackhawk Creek at Hudson,Iowa	3	303.00	2,970	5,980	8,440	12,000	14,900	18,000
116	05464000	Cedar River at Waterloo,Iowa	3	5,146.00	24,000	43,400	56,800	73,500	85,500	97,100
117	05464130	Fourmile Creek near Lincoln,Iowa	3	13.78	437	771	1,000	1,290	1,500	1,700
118	05464133	Half Mile Creek near Gladbrook,Iowa	3	1.33	147	250	329	439	527	622
119	05464137	Fourmile Creek near Traer,Iowa	3	19.51	516	829	1,050	1,330	1,540	1,760
120	05464145	P Twelve Mile Creek near Traer,Iowa	3	43.80	778	1,070	1,270	1,540	1,750	1,960

Table 1.--Flood discharges for selected recurrence intervals at gaging stations in Iowa and adjacent States--Continued

Site number	Station number		Station name	Hydrologic region	Drainage area, in square miles	Recurrence interval, in years: 2	5	10	25	50	100
121	05464310	P	Pratt Creek near Garrison, Iowa	3	23.40	1,240	1,900	2,310	2,780	3,100	3,400
122	05464500		Cedar River at Cedar Rapids, Iowa	MS	6,510.00	24,200	40,300	51,100	64,400	73,900	83,000
123	05464560	P	Prairie Creek at Blairstown, Iowa	3	87.00	2,160	3,180	3,840	4,650	5,240	5,810
124	05464640		Prairie Creek at Fairfax, Iowa	3	178.00	3,140	5,110	6,460	8,180	9,440	10,700
125	05464880	P	Otter Creek at Wilton, Iowa	2	10.70	926	1,830	2,510	3,430	4,130	4,840
126	05465000		Cedar River near Conesville, Iowa	MS	7,785.00	27,000	44,500	56,100	70,200	80,100	89,600
127	05465150	P	North Fork Long Creek at Ainsworth, Iowa	3	30.20	774	1,240	1,590	2,070	2,450	2,860
128	05465500		Iowa River at Wapello, Iowa	MS	12,499.00	36,100	56,500	69,000	83,400	92,900	102,000
129	05469860	P	Mud Lake drainage ditch 71 in Jewell, Iowa	4	65.40	745	1,530	2,120	2,910	3,110	4,100
130	05469990	P	Keigley Branch near Story City, Iowa	4	31.00	525	990	1,370	1,930	2,400	2,910
131	05470000		South Skunk River near Ames, Iowa	4	315.00	3,160	4,760	5,740	6,880	7,660	8,380
132	05470500		Squaw Creek at Ames, Iowa	4	204.00	2,580	3,980	4,940	6,170	7,090	8,020
133	05471000		Skunk River below Squaw Creek near Ames, Iowa	4	556.00	6,060	8,570	10,000	11,600	12,600	13,500
134	05471200		Indian Creek near Mingo, Iowa	4	276.00	4,190	5,700	6,610	7,660	8,380	9,060
135	05471500		South Skunk River near Oskaloosa, Iowa	4	1,635.00	8,310	11,600	13,600	16,000	17,700	19,400
136	05472290	P	Sugar Creek near Searsboro, Iowa	3	52.70	1,400	2,250	2,880	3,750	4,440	5,170
137	05472390	P	Middle Creek near Lacey, Iowa	3	23.00	990	1,840	2,540	3,600	4,500	5,510
138	05472445	P	Rock Creek at Sigourney, Iowa	3	26.30	927	1,710	2,330	3,220	3,950	4,730
139	05472500		North Skunk River near Sigourney, Iowa	3	730.00	5,920	11,000	14,700	19,500	23,200	26,800
140	05473000		Skunk River at Coppock, Iowa	MS	2,916.00	12,800	21,600	27,800	36,000	42,200	48,500
141	05473300	P	Cedar Creek near Batavia, Iowa	3	252.00	5,370	9,510	12,900	17,700	21,900	26,400
142	05473500		Big Creek near Mount Pleasant, Iowa	3	106.00	2,020	3,890	5,350	7,360	8,950	10,600
143	05474000		Skunk River at Augusta, Iowa	MS	4,303.00	21,000	31,100	37,400	44,800	49,900	54,700
144	05476500		West Fork Des Moines R at Estherville, Iowa	5	1,372.00	2,230	4,910	7,310	11,100	14,400	18,100
145	05476750		West Fork Des Moines River at Humboldt, Iowa	5	2,256.00	4,240	8,040	10,800	14,300	16,900	19,400
146	05479000		East Fork Des Moines R at Dakota City, Iowa	5	1,308.00	3,980	7,990	11,200	15,600	19,100	22,700
147	05480000		Lizard Creek near Clare, Iowa	4	257.00	1,590	3,350	4,710	6,560	7,990	9,420
148	05480500		Des Moines River at Fort Dodge, Iowa	5	4,190.00	10,300	17,500	22,800	29,900	35,400	41,000
149	05481000		Boone River near Webster City, Iowa	4	844.00	5,230	8,930	11,600	15,000	17,600	20,200
150	05481950		Beaver Creek near Grimes, Iowa	4	358.00	2,870	4,390	5,360	6,550	7,400	8,210
151	05482170		Big Cedar Creek near Varina, Iowa	4	80.00	642	1,260	1,720	2,320	2,770	3,210
152	05482300		North Raccoon River near Sac City, Iowa	4	713.00	3,690	7,610	10,500	14,400	17,300	20,100
153	05482500		North Raccoon River near Jefferson, Iowa	4	1,619.00	7,090	12,600	16,400	21,100	24,500	27,700
154	05482600	P	Hardin Creek at Farnhamville, Iowa	4	43.70	544	1,030	1,410	1,920	2,320	2,730
155	05482900	P	Hardin Creek near Farlin, Iowa	4	101.00	687	1,260	1,700	2,290	2,750	3,230
156	05483349	P	Middle Raccoon R tributary at Carroll, Iowa	3	6.58	387	542	632	733	799	860
157	05483600		Middle Raccoon River at Panora, Iowa	4	440.00	4,760	7,190	8,850	11,000	12,600	14,200
158	05484000		South Raccoon River near Redfield, Iowa	3	988.00	10,200	16,200	20,100	25,000	28,500	31,900
159	05484500		Raccoon River at Van Meter, Iowa	4	3,441.00	14,400	23,000	28,800	36,200	41,600	47,000
160	05485640		Fourmile Creek at Des Moines, Iowa	3	92.70	2,880	4,490	5,560	6,900	7,880	8,850

Table 1.--Flood discharges for selected recurrence intervals at gaging stations in Iowa and adjacent States--Continued

Site number	Station number		Station name	Hydrologic region	Drainage area, in square miles	Recurrence interval, in years: 2	5	10	25	50	100
161	05486000		North River near Norwalk, Iowa	3	349.00	3,530	6,780	9,500	13,600	17,100	21,000
162	05486490		Middle River near Indianola, Iowa	3	503.00	7,250	10,900	13,400	16,600	19,100	21,600
163	05487470		South River near Ackworth, Iowa	2	460.00	11,100	17,300	21,200	25,800	29,100	32,200
164	05487600	P	South White Breast Creek near Osceola, Iowa	2	28.00	2,230	4,070	5,410	7,190	8,550	9,910
165	05487800	P	White Breast Creek at Lucas, Iowa	2	128.00	3,360	6,170	8,320	11,300	13,700	16,100
166	05487980		White Breast Creek near Dallas, Iowa	2	342.00	7,210	10,100	12,000	14,600	16,500	18,600
167	05488000		White Breast Creek near Knoxville, Iowa	2	380.00	6,330	9,760	12,000	14,800	16,700	18,700
168	05488500		Des Moines River near Tracy, Iowa	MS	12,479.00	32,500	50,100	62,500	79,000	91,600	105,000
169	05489000		Cedar Creek near Bussey, Iowa	1	374.00	8,710	17,200	24,800	36,900	48,000	61,000
170	05489150	P	Little Muchakinock Creek at Oskaloosa, Iowa	3	9.12	476	1,130	1,770	2,830	3,820	5,000
171	05489490	P	Bear Creek at Ottumwa, Iowa	2	22.90	2,240	3,350	4,040	4,840	5,400	5,910
172	05489500		Des Moines River at Ottumwa, Iowa	MS	13,374.00	35,500	54,800	68,300	85,800	99,000	112,000
173	05490500		Des Moines River at Keosauqua, Iowa	MS	14,038.00	38,200	58,900	73,600	92,900	108,000	123,000
174	05491000		Sugar Creek near Keokuk, Iowa	3	105.00	3,070	4,860	6,070	7,580	8,690	9,770
175	05494300		Fox River at Bloomfield, Iowa	2	87.00	2,710	4,970	6,650	8,890	10,600	12,400
176	05494500		Fox River at Cantril, Iowa	3	161.00	6,020	8,130	9,530	11,300	12,600	13,900
177	05495000		Fox River at Wayland, Mo.	2	400.00	6,390	11,000	14,400	19,000	22,600	26,300
178	05495100	P	Big Branch tributary near Wayland, Mo.	2	.70	123	280	420	710	831	1,050
179	05495200		Little Creek near Breckenridge Ill.	2	1.45	417	744	981	1,360	1,530	1,760
180	05495600	P	South Wyaconda River near West Grove, Iowa	1	4.69	587	1,370	2,070	3,120	4,020	5,000
181	05496000		Wyaconda River above Canton, Mo.	3	393.00	5,490	8,980	11,600	14,100	17,800	20,800
182	05496900		Homan Creek tributary near Quincy Ill.	2	.50	266	457	591	820	894	1,020
183	05497000		North Fabius River at Monticello, Mo.	3	452.00	8,130	11,900	14,200	16,500	19,000	20,800
184	05502020	P	Hadley Creek near Barry Ill.	2	40.90	4,390	6,380	7,640	9,710	10,200	11,100
185	05502040		Hadley Creek at Kinderhook Ill.	1	72.70	5,850	10,100	13,100	16,300	19,700	22,500
186	05502120		Kiser Creek tributary near Barry Ill.	1	.78	374	637	822	1,130	1,240	1,410
187	06483270		Rock River at Rock Rapids, Iowa	2	788.00	4,400	10,900	16,900	26,600	35,300	45,200
188	06483410	P	Otter Creek north of Sibley, Iowa	3	11.90	162	416	660	1,060	1,420	1,830
189	06483420	P	Schutte Creek near Sibley, Iowa	3	1.43	68	140	206	309	403	511
190	06483430	P	Otter Creek at Sibley, Iowa	2	29.90	280	906	1,670	3,190	4,830	7,030
191	06483440	P	Dawson Creek near Sibley, Iowa	3	4.35	258	818	1,490	2,830	4,280	6,200
192	06483450	P	Wagner Creek near Ashton, Iowa	3	7.09	218	723	1,330	2,530	3,810	5,480
193	06483460	P	Otter Creek near Ashton, Iowa	3	88.00	902	2,940	5,440	10,500	15,900	23,200
194	06483500		Rock River near Rock Valley, Iowa	2	1,592.00	6,440	14,500	21,300	30,800	38,500	46,500
195	06484000		Dry Creek at Hawarden, Iowa	2	48.40	786	2,200	3,680	6,220	8,640	11,500
196	06485500		Big Sioux River at Akron, Iowa	MS	8,424.00	9,960	22,500	33,200	49,200	62,500	76,800
197	06599950	P	Perry Creek near Hinton, Iowa	2	38.80	528	1,630	2,800	4,840	6,780	9,070
198	06600000		Perry Creek at 38th Street, Sioux City, Iowa	2	65.10	2,640	4,670	6,060	7,820	9,090	10,300
199	06600100		Floyd River at Alton, Iowa	2	268.00	1,820	5,420	9,300	16,200	23,000	31,100
200	06600300		West Branch Floyd River near Struble, Iowa	2	180.00	2,140	4,900	7,180	10,400	13,000	15,700

Table 1.--Flood discharges for selected recurrence intervals at gaging stations in Iowa and adjacent States--Continued

Site number	Station number		Station name	Hydrologic region	Drainage area, in square miles	Recurrence interval, in years: 2	5	10	25	50	100
201	06600500		Floyd River at James,Iowa	2	886.00	3,670	8,370	12,900	20,400	27,400	35,800
202	06600600	P	S Omaha Creek trib No. 1 near Walthill,Neb.	1	2.58	410	830	1,170	1,370	2,250	2,850
203	06600900	P	South Omaha Creek at Walthill,Neb.	1	51.20	2,180	5,160	7,960	9,760	16,600	21,300
204	06601000		Omaha Creek at Homer,Neb.	1	168.00	4,060	9,250	14,500	15,400	33,400	45,300
205	06605340	P	Prairie Creek near Spencer,Iowa	3	22.30	417	898	1,300	1,890	2,390	2,910
206	06605600		Little Sioux River at Gillett Grove,Iowa	3	1,334.00	4,750	10,500	15,600	23,400	30,300	38,000
207	06605750	P	Willow Creek near Cornell,Iowa	3	78.60	1,300	2,340	3,070	4,030	4,730	5,430
208	06605850		Little Sioux River at Linn Grove,Iowa	3	1,548.00	5,770	12,100	17,300	24,800	30,800	37,300
209	06605890	P	Waterman Creek at Hartley,Iowa	2	28.70	307	1,250	2,370	4,390	6,310	8,560
210	06606600		Little Sioux River at Correctionville,Iowa	MS	2,500.00	6,670	12,100	16,400	22,600	27,700	33,100
211	06606700		Little Sioux River near Kennebec,Iowa	MS	2,738.00	7,700	13,200	17,200	22,500	26,500	30,600
212	06606790	P	Maple Creek near Alta,Iowa	1	15.50	236	952	1,910	3,920	6,150	9,150
213	06607000		Odebolt Creek near Arthur,Iowa	3	39.30	994	2,010	2,890	4,240	5,430	6,760
214	06607200		Maple River at Mapleton,Iowa	3	669.00	6,560	11,900	15,700	20,500	24,100	27,600
215	06607700	P	South Branch Tekamah Creek near Craig,Neb.	1	2.54	590	1,210	1,750	2,340	3,360	4,220
216	06607800	P	S Branch Tekamah Creek trib near Tekamah,Neb	1	4.08	630	1,290	1,830	2,710	3,600	4,550
217	06607900	P	South Branch Tekamah Creek near Tekamah,Neb.	1	9.73	1,190	2,080	2,860	3,460	5,280	6,650
218	06608000		Tekamah Creek at Tekamah,Neb.	1	23.00	1,800	3,700	5,110	6,940	8,290	9,610
219	06608500		Soldier River at Pisgah,Iowa	2	407.00	8,800	14,700	18,700	23,700	27,300	30,900
220	06608800	P	New York Creek north of Spiker,Neb.	1	6.50	1,000	2,310	3,360	4,940	5,880	6,980
221	06608900	P	New York Creek east of Spiker,Neb.	1	13.90	840	2,480	4,400	5,920	12,100	17,300
222	06609000		New York Creek at Herman,Neb.	1	25.40	1,540	3,260	4,450	6,200	7,700	9,250
223	06609500		Boyer River at Logan,Iowa	3	871.00	12,000	17,900	21,300	25,100	27,400	29,500
224	06610500		Indian Creek at Council Bluffs,Iowa	1	7.99	561	1,520	2,480	4,110	5,640	7,440
225	06610520		Mosquito Creek near Earling,Iowa	2	33.00	3,110	6,170	8,590	12,000	14,700	17,500
226	06610600	P	Mosquito Creek at Neola,Iowa	2	131.00	5,650	11,000	15,400	22,100	27,800	34,100
227	06806000		Waubonsie Creek near Bartlett,Iowa	1	30.40	2,870	5,780	8,170	11,700	14,600	17,700
228	06807410		West Nishnabotna River at Hancock,Iowa	2	609.00	9,460	15,500	19,500	24,300	27,700	30,900
229	06807470	P	Indian Creek near Emerson,Iowa	2	37.30	788	1,870	2,930	4,740	6,470	8,550
230	06807720	P	Middle Silver Creek near Avoca,Iowa	2	3.21	380	678	885	1,150	1,340	1,520
231	06807760	P	Middle Silver Creek near Oakland,Iowa	2	25.70	912	1,280	1,530	1,840	2,080	2,310
232	06807780	P	Middle Silver Creek at Treynor,Iowa	2	42.70	1,440	2,060	2,470	2,990	3,380	3,770
233	06808000		Mule Creek near Malvern,Iowa	1	10.60	762	1,840	2,730	3,980	4,950	5,930
234	06808500		West Nishnabotna River at Randolph,Iowa	2	1,326.00	15,900	23,100	27,600	32,700	36,200	39,400
235	06809000		Davids Creek near Hamlin,Iowa	3	26.00	892	2,140	3,400	5,590	7,710	10,300
236	06809210		East Nishnabotna River near Atlantic,Iowa	2	436.00	8,830	15,200	19,500	25,000	28,900	32,800
237	06809500		East Nishnabotna River at Red Oak,Iowa	2	894.00	9,590	16,800	21,900	28,500	33,400	38,200
238	06810000		Nishnabotna River above Hamburg,Iowa	MS	2,806.00	15,600	23,500	28,200	33,700	37,400	40,800
239	06811760	P	Tarkio River near Elliot,Iowa	2	10.70	552	1,150	1,630	2,300	2,820	3,360
240	06811800	P	East Tarkio Creek near Stanton,Iowa	2	4.66	464	1,010	1,540	2,420	3,250	4,260

Table 1.--Flood discharges for selected recurrence intervals at gaging stations in Iowa and adjacent States--Continued

Site number	Station number	Station name	Hydrologic region	Drainage area, in square miles	Recurrence interval, in years: 2	5	10	25	50	100
241	06811840	Tarkio River at Stanton,Iowa	2	49.30	2,990	6,220	8,690	12,000	14,500	17,100
242	06811875	P Snake Creek near Yorktown,Iowa	2	9.10	911	1,400	1,710	2,070	2,320	2,550
243	06813000	Tarkio River at Fairfax,Mo.	3	508.00	7,310	12,000	14,800	18,000	20,000	21,800
244	06815550	Staples Branch near Burlington Junction,Mo.	2	.49	148	284	385	518	618	717
245	06817000	Nodaway River at Clarinda,Iowa	2	762.00	10,500	18,100	23,200	29,400	33,800	37,900
246	06817500	Nodaway River near Burlington Junction,Mo.	3	1,240.00	14,000	23,400	29,300	36,500	40,700	44,900
247	06818750	Platte River near Diagonal,Iowa	3	217.00	4,830	6,290	7,090	7,950	8,510	9,000
248	06819190	East Fork 102 River near Bedford,Iowa	3	92.10	4,210	6,460	7,960	9,820	11,200	12,500
249	06819500	One Hundred and Two River at Maryville,Mo.	3	515.00	7,680	12,100	15,000	18,200	21,200	23,700
250	06820500	Platte River near Agency,Mo.	3	1,760.00	15,200	24,500	31,500	40,300	48,600	56,700
251	06897500	Grand River near Gallatin,Mo.	3	2,250.00	25,100	38,200	46,500	56,100	63,200	69,800
252	06897700	P Grand River tributary near Utica,Mo.	3	1.44	356	488	571	670	742	811
253	06898000	Thompson River at Davis City,Iowa	3	701.00	7,620	11,600	14,300	17,800	20,400	23,000
254	06898400	Weldon River near Leon,Iowa	3	104.00	6,150	9,910	12,500	15,900	18,500	21,100
255	06899500	Thompson River at Trenton,Mo.	2	1,670.00	23,200	38,300	48,500	62,200	70,100	78,800
256	06900000	Medicine Creek near Gault,Mo.	3	225.00	6,050	10,300	13,100	16,900	19,300	21,800
257	06902500	Hamilton Branch near New Boston,Mo.	2	2.51	592	944	1,190	1,490	1,720	1,950
258	06903400	Chariton River near Chariton,Iowa	3	182.00	3,660	6,500	8,750	12,000	14,600	17,500
259	06903500	Honey Creek near Russell,Iowa	2	13.20	609	1,350	2,010	3,050	3,980	5,030
260	06903700	S Fork Chariton River near Promise City,Iowa	3	168.00	6,620	10,200	12,800	16,300	19,100	22,000
261	06903990	P Cooper Creek at Centerville,Iowa	3	47.80	2,420	3,970	5,040	6,400	7,400	8,390
262	06904000	Chariton River near Centerville,Iowa	3	708.00	5,670	11,300	15,900	22,600	28,100	34,100
263	06904500	Chariton River at Novinger,Mo.	3	1,370.00	9,690	14,900	18,300	22,500	25,500	28,500

October 1, 1987

IOWA DOT EXAMPLE FOR USING USGS REPORT 87-4132 IN AREAS WITH MIXED LANDFORMS

The reader should keep in mind that the hydrologic regions shown in the report are delineated based on the landform characteristics of the river basins. IT IS IMPORTANT, HOWEVER, TO RECOGNIZE THAT WITHIN THESE REGIONS SMALL WATERSHEDS MAY BE FOUND THAT HAVE THE LANDFORM CHARACTERISTICS AND THE FLOOD PRODUCING POTENTIAL TYPICAL OF OTHER REGIONS. For example, some of the roughest terrain in the State of Iowa borders the Des Moines River in Region 4. Small drainage basins located entirely or partially within this bluff area have the potential of producing floods more typical of Regions 1 or 2.

The figure, on page 2, shows a typical example of a small basin located in Region 4 in the vicinity of the Des Moines River bluffs. This small basin located about 1 mile north of Otho, Iowa, in Webster County drains about 3 square miles. Note that of the 3 square miles about 2.25 drain typical Region 4 landscape (poorly developed drainage and level terrain). The remaining 0.75 square miles drain a bluff like terrain more typical of Region 2.

In cases such as this 'judgement' should enter into the decision of selecting and using the appropriate sets of equations, and ultimately selecting a design discharge.

There are many methods to arrive at the design discharge of the above described land. The use of the following two methods is recommended:

1. Assume the 2.25 square mile area is Region 4 type terrain;

   $Q50 = 180 \times 2.25^{(0.66)} = 307$ cfs,

   and assume the 0.75 square mile area is Region 2 type terrain;

   $Q50 = 1020 \times 0.75^{(0.53)} = 876$ cfs.

   Then Q50 = 307 cfs + 876 cfs = 1183 cfs. We feel this is the preferred method for small (20 square miles or less) water sheds with mixed landforms.

2. From a storm size point of view the most proper method would be:

   $Q50 = 180 \times 3.0^{(0.66)} \times 2.25/3.00 = 278$ cfs for the Region 4 type terrain;

   and

   $Q50 = 1020 \times 3^{(0.53)} \times .75/3.0 = 456$ cfs for the Region 2 type terrain.

   Then Q50 = 278 cfs+ 456 cfs = 734 cfs. We feel that this is the preferred method for larger (20 square miles or greater) watersheds with mixed landforms. In meduim sized mixed landform watersheds it maybe better to look at both methods and use a weighted average.

In this case we would choose 1180 +/- cfs as the design discharge. Rather than calling the land all in region 4 and getting:

$$Q50 = 180 \times 3^{(0.66)} = 372 \text{ cfs.}$$

These or other methods of weighting may be used to select the proper discharge.

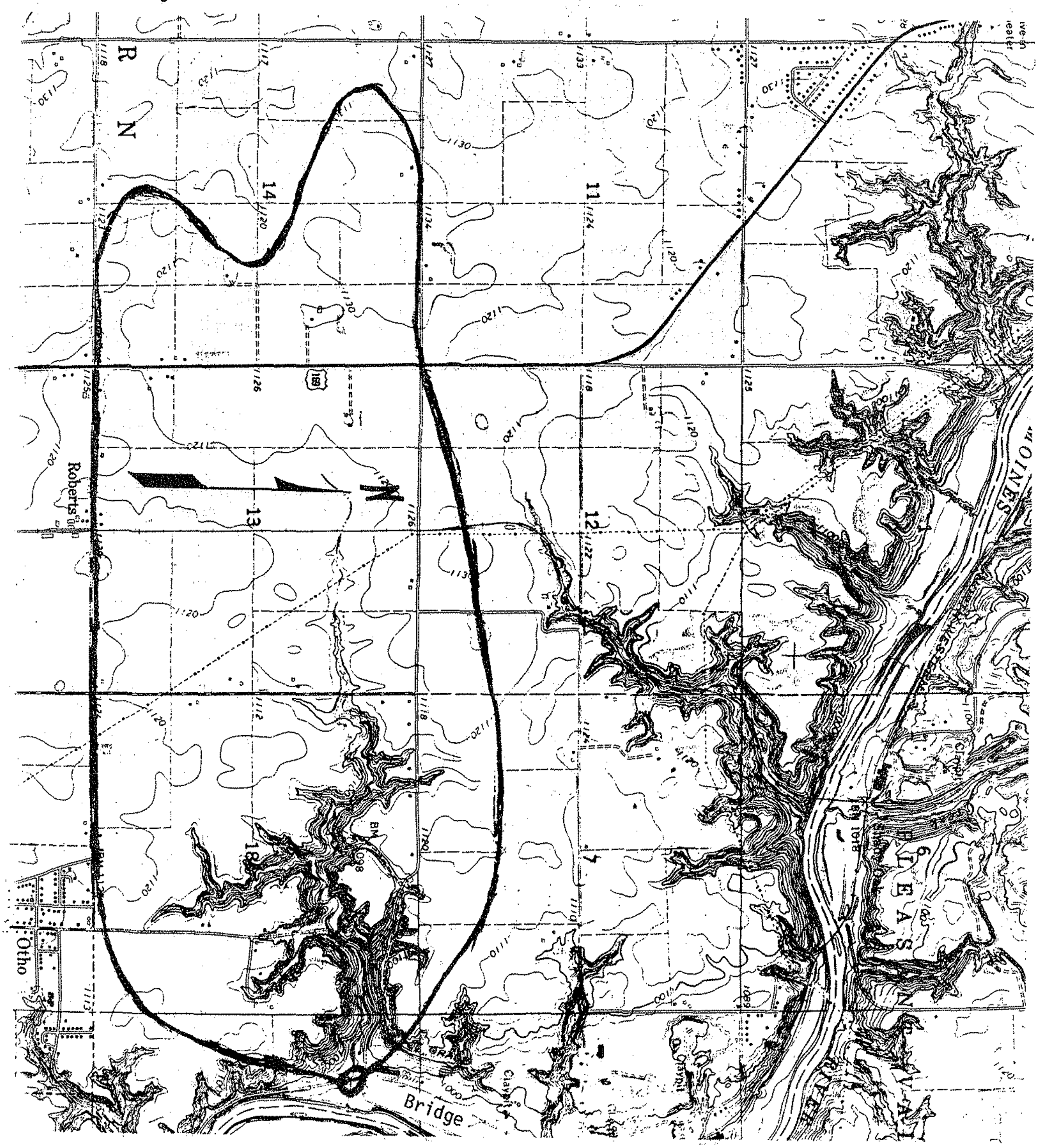


Table 2.--Regional flood-frequency equations

Hydrologic region 1
(19 stations)

Equation for indicated recurrence interval	Standard error (percent)
$Q_2 = 211A^{0.62}$	61
$Q_5 = 502A^{0.60}$	37
$Q_{10} = 757A^{0.60}$	28
$Q_{25} = 1{,}140A^{0.57}$	24
$Q_{50} = 1{,}500A^{0.60}$	21
$Q_{100} = 1{,}880A^{0.60}$	24

Hydrologic region 2
(81 stations)

Equation for indicated recurrence interval	Standard error (percent)
$Q_2 = 196A^{0.57}$	55
$Q_5 = 402A^{0.55}$	39
$Q_{10} = 570A^{0.55}$	34
$Q_{25} = 821A^{0.54}$	32
$Q_{50} = 1{,}020A^{0.53}$	33
$Q_{100} = 1{,}230A^{0.53}$	36

Hydrologic region 3
(119 stations)

Equation for indicated recurrence interval	Standard error (percent)
$Q_2 = 129A^{0.62}$	44
$Q_5 = 265A^{0.59}$	36
$Q_{10} = 381A^{0.57}$	35
$Q_{25} = 555A^{0.55}$	37
$Q_{50} = 695A^{0.54}$	39
$Q_{100} = 851A^{0.53}$	41

Hydrologic region 4
(24 stations)

Equation for indicated recurrence interval	Standard error (percent)
$Q_2 = 31A^{0.77}$	40
$Q_5 = 67A^{0.72}$	33
$Q_{10} = 98A^{0.70}$	31
$Q_{25} = 145A^{0.68}$	29
$Q_{50} = 180A^{0.66}$	30
$Q_{100} = 227A^{0.65}$	30

Hydrologic region 5
(8 stations)

Equation for indicated recurrence interval	Standard error (percent)
$Q_2 = 30A^{0.66}$	27
$Q_5 = 37A^{0.71}$	21
$Q_{10} = 41A^{0.74}$	20
$Q_{25} = 45A^{0.77}$	24
$Q_{50} = 47A^{0.79}$	24
$Q_{100} = 50A^{0.80}$	26

The following note was added by the Iowa D.O.T. and its use is recommended for sizing drainage structures used in connection with highway projects. See example dated October 1, 1987.

CAUTION!

Within each region there are small watersheds that have topography which produces runoff characteristic of another region. For small 20 sq. mi. ±) watersheds use the equation that fits the topography of the watershed. (See pages 4 & 5). In these cases DO NOT USE THE EQUATION THAT REPRESENTS THE REGION IN WHICH THAT WATERSHED LIES.

Table 3.--Characteristics of maximum floods at gaging stations in Iowa

[MS, mainstem station; H, historical flood; *, ratio of maximum flood to 100-year computed flood]

Site number	Station number	Station name	Hydrologic region	Years of record	Drainage area, in square miles	Maximum flood: Year	Maximum flood: Discharge, in cubic feet per second	Maximum flood: Recurrence interval, in years
8	05387500	Upper Iowa River at Decorah	3	32	511.00	1941 H	28,500	1.3 *
9	05388000	Upper Iowa River near Decorah	3	29	568.00	1941	28,500	1.2 *
10	05388250	Upper Iowa River near Dorchester	3	9	770.00	1941	30,400	1.1 *
11	05388400	Wexford Creek near Harpers Ferry	2	31	11.90	1978	8,100	1.6 *
13	05388500	Paint Creek at Waterville	2	21	42.80	1951 H	9,100	1.1 *
14	05388600	Paint Creek near Waterville	2	32	56.00	1974	19,000	2.0 *
15	05388700	Little Paint Creek trib near Waterville	2	31	1.09	1959	480	18
16	05389000	Yellow River at Ion	2	17	221.00	1941	21,200	40
23	05411530	North Branch Turkey River near Cresco	2	19	19.50	1969	4,440	24
24	05411600	Turkey River at Spillville	3	24	177.00	1947 H	10,000	34
25	05411650	Crane Creek tributary near Saratoga	2	23	4.06	1962	1,830	26
26	05411700	Crane Creek near Lourdes	2	32	75.80	1962	11,900	45
27	05412000	Turkey River at Elkader	2	10	891.00	1933	23,800	31
28	05412500	Turkey River at Garber	MS	64	1,545.00	1922	32,300	95
33	05414350	Little Maquoketa River near Graf	2	34	39.60	1951	7,220	32
34	05414400	M Fk L Maquoketa River near Rickardsville	2	31	30.20	1972	23,000	2.7 *
35	05414450	N Fk L Maquoketa River near Rickardsville	2	33	21.60	1972	7,180	100
36	05414500	Little Maquoketa River near Durango	2	49	130.00	1972	40,000	2.1 *
37	05414600	Little Maquoketa River trib at Dubuque	2	34	1.54	1972	1,250	44
40	05417000	Maquoketa River near Manchester	3	52	305.00	1925 H	25,400	1.5 *
41	05417530	Plum Creek near Earlville	3	19	41.10	1981	4,000	24
42	05417590	Kitty Creek near Langworthy	3	19	14.40	1981	5,000	1.6 *
43	05417700	Bear Creek near Monmouth	3	19	61.30	1965	7,340	100
44	05418500	Maquoketa River near Maquoketa	3	71	1,553.00	1944	48,000	1.2 *
46	05420560	Wapsipinicon River near Elma	3	26	95.20	1974	10,100	25
47	05420600	L Wapsipinicon River trib near Riceville	3	32	.90	1962	703	19
48	05420620	Little Wapsipinicon River near Acme	3	32	7.76	1962	2,380	18
49	05420640	Little Wapsipinicon River at Elma	3	32	37.30	1962	5,740	18
50	05420650	L Wapsipinicon River near New Hampton	3	19	95.00	1969	9,200	100
51	05420690	East Fk Wapsipinicon River at New Hampton	3	18	30.30	1969	11,000	1.3 *
52	05420850	Little Wapsipinicon River near Oran	2	19	94.10	1974	6,200	23
53	05420960	Harter Creek near Independence	3	12	6.17	1962	2,280	25
54	05421000	Wapsipinicon River at Independence	3	51	1,048.00	1968	26,800	33
55	05421100	Pine Creek tributary near Winthrop	3	33	.33	1968	334	21
56	05421200	Pine Creek near Winthrop	2	35	28.30	1968	24,200	3.0 *
57	05421300	Pine Creek tributary No. 2 at Winthrop	1	32	.70	1968	570	16
58	05421400	Wapsipinicon River at Central City	3	11	1,263.00	1947	22,500	13
59	05421500	Wapsipinicon River at Stone City	3	12	1,324.00	1892 H	32,000	38
60	05421550	Buffalo Creek above Winthrop	2	28	68.20	1968	14,100	100
61	05421600	Buffalo Creek near Winthrop	2	22	71.40	1968	14,800	1.1 *

Table 3.--Characteristics of maximum floods at gaging stations in Iowa--Continued

						Maximum flood		
Site number	Station number	Station name	Hydrologic region	Years of record	Drainage area, in square miles	Year	Discharge, in cubic feet per second	Recurrence interval, in years
62	05422000	Wapsipinicon River near Dewitt	3	50	2,330.00	1974	29,900	77
64	05448500	West Branch Iowa River near Klemme	4	10	112.00	1954	1,920	9
65	05448700	East Branch Iowa River near Hayfield	4	33	7.94	1954	457	12
66	05448800	East Branch Iowa River near Garner	5	33	45.10	1961	1,120	12
67	05449000	East Branch Iowa River near Klemme	4	35	133.00	1954	5,960	1.2 *
68	05449500	Iowa River near Rowan	4	43	429.00	1954	8,460	20
69	05451500	Iowa River at Marshalltown	3	66	1,564.00	1918	42,000	100
70	05451700	Timber Creek near Marshalltown	4	35	118.00	1977	12,000	1.2 *
71	05451900	Richland Creek near Haven	2	35	56.10	1974	7,000	1.1 *
72	05452000	Salt Creek near Elberon	3	39	201.00	1947	35,000	1.4 *
73	05452200	Walnut Creek near Hartwick	3	35	70.90	1983	7,100	75
74	05452500	Iowa River near Belle Plaine	3	20	2,455.00	1918 H	43,000	32
75	05453000	Big Bear Creek at Ladora	3	39	189.00	1960	10,500	33
76	05453100	Iowa River at Marengo	MS	28	2,794.00	1960	30,800	73
77	05453600	Rapid Creek below Morse	2	34	8.12	1972	2,800	28
78	05453700	Rapid Creek tributary No. 4 near Oasis	2	24	1.55	1953	956	19
79	05453750	Rapid Creek southwest of Morse	2	34	15.20	1972	4,300	32
80	05453850	Rapid Creek tributary No. 3 near Oasis	2	34	1.62	1972	1,200	35
81	05453900	Rapid Creek tributary near Oasis	2	34	.97	1956	809	25
82	05453950	Rapid Creek tributary near Iowa City	2	34	3.43	1972	2,000	45
83	05454000	Rapid Creek near Iowa City	2	47	25.30	1965	6,100	38
84	05454300	Clear Creek near Coralville	2	32	98.10	1982	13,000	1.4 *
85	05455000	Ralston Creek at Iowa City	2	60	3.01	1965	1,940	52
86	05455010	South Branch Ralston Creek at Iowa City	2	21	2.94	1972	1,070	17
87	05455100	Old Mans Creek near Iowa City	3	34	201.00	1982	13,500	100
88	05455140	North English River near Montezuma	3	12	31.00	1978	6,800	1.4 *
89	05455150	North Fork English River near Montezuma	3	23	34.00	1953	4,240	16
90	05455200	North English River near Guernsey	3	32	68.70	1953	7,000	74
91	05455210	North English River at Guernsey	3	20	81.50	1977	7,000	47
92	05455230	Deep River at Deep River	3	20	30.50	1970	6,200	83
93	05455280	S Fk English River trib near Barnes City	3	24	2.51	1970	900	14
94	05455300	South Fork English River near Barnes City	3	32	11.50	1982	2,200	37
95	05455350	S English River trib No. 2 near Montezuma	3	32	.52	1961	344	26
96	05455500	English River at Kalona	3	45	573.00	1965	20,000	39
97	05455550	Bulgers Run near Riverside	3	20	6.31	1965	3,080	57
98	05457500	Cedar River at Mitchell	3	11	826.00	1961	20,500	21
99	05457700	Cedar River at Charles City	3	20	1,054.00	1961 H	29,200	47
100	05458000	Little Cedar River near Ionia	3	30	306.00	1961	10,800	16
101	05458500	Cedar River at Janesville	3	64	1,661.00	1961	37,000	43
102	05458560	Beaverdam Creek near Sheffield	3	19	123.00	1979	4,400	49

Table 3.--Characteristics of maximum floods at gaging stations in Iowa--Continued

Site number	Station number	Station name	Hydrologic region	Years of record	Drainage area, in square miles	Maximum flood		
						Year	Discharge, in cubic feet per second	Recurrence interval, in years
103	05458900	West Fork Cedar River at Finchford	3	39	846.00	1951	31,900	1.1 *
104	05459000	Shell Rock River near Northwood	5	39	300.00	1965	3,400	19
105	05459010	Elk Creek at Kensett	5	19	58.10	1971	1,000	24
106	05459490	Spring Creek near Mason City	3	19	29.30	1980	4,500	87
107	05459500	Winnebago River at Mason City	4	52	526.00	1933	10,800	28
108	05460100	Willow Creek near Mason City	5	19	78.60	1969	1,100	13
109	05460500	Shell Rock River at Marble Rock	3	21	1,318.00	1933	36,400	80
110	05461500	Shell Rock River near Clarksville	3	16	1,626.00	1961	33,400	30
111	05462000	Shell Rock River at Shell Rock	3	31	1,746.00	1856 H	45,000	100
112	05462750	Beaver Creek tributary near Applington	3	19	11.60	1983	3,000	18
113	05463000	Beaver Creek at New Hartford	3	39	347.00	1947	18,000	95
114	05463090	Black Hawk Creek at Grundy Center	3	20	56.90	1969	7,000	100
115	05463500	Blackhawk Creek at Hudson	3	32	303.00	1969	19,300	1.2 *
116	05464000	Cedar River at Waterloo	3	44	5,146.00	1961	76,700	78
117	05464130	Fourmile Creek near Lincoln	3	14	13.78	1979	1,100	4
118	05464133	Half Mile Creek near Gladbrook	3	14	1.33	1979	611	29
119	05464137	Fourmile Creek near Traer	3	17	19.51	1979	1,450	5
120	05464145	Twelve Mile Creek near Traer	3	19	43.80	1979	3,800	18
121	05464310	Pratt Creek near Garrison	3	18	23.40	1982	10,800	2.6 *
122	05464500	Cedar River at Cedar Rapids	MS	82	6,510.00	1961	73,000	46
123	05464560	Prairie Creek at Blairstown	3	19	87.00	1970	4,600	10
124	05464640	Prairie Creek at Fairfax	3	16	178.00	1979	8,140	7
125	05464880	Otter Creek at Wilton	2	19	10.70	1982	3,450	32
126	05465000	Cedar River near Conesville	MS	45	7,785.00	1961	70,800	26
127	05465150	North Fork Long Creek at Ainsworth	3	20	30.20	1965	2,560	10
128	05465500	Iowa River at Wapello	MS	70	12,499.00	1947	94,000	55
129	05469860	Mud Lake drainage ditch 71 in Jewell	4	20	65.40	1975	2,100	14
130	05469990	Keigley Branch near Story City	4	20	31.00	1975	2,250	7
131	05470000	South Skunk River near Ames	4	59	315.00	1954	8,630	58
132	05470500	Squaw Creek at Ames	4	27	204.00	1975	11,300	1.6 *
133	05471000	Skunk River below Squaw Creek near Ames	4	27	556.00	1975	14,700	1.1 *
134	05471200	Indian Creek near Mingo	4	17	276.00	1966	7,380	38
135	05471500	South Skunk River near Oskaloosa	4	39	1635.00	1944 H	37,000	1.3 *
136	05472290	Sugar Creek near Searsboro	3	20	52.70	1974	4,600	24
137	05472390	Middle Creek near Lacey	3	20	23.00	1976	9,650	1.7 *
138	05472445	Rock Creek at Sigourney	3	20	26.30	1970	3,300	31
139	05472500	North Skunk River near Sigourney	3	39	730.00	1960	27,500	100
140	05473000	Skunk River at Coppock	MS	37	2,916.00	1944	41,500	45
141	05473300	Cedar Creek near Batavia	3	21	252.00	1965	26,000	70
142	05473500	Big Creek near Mount Pleasant	3	24	106.00	1973	10,500	1.1 *

Table 3.--Characteristics of maximum floods at gaging stations in Iowa--Continued

Site number	Station number	Station name	Hydrologic region	Years of record	Drainage area, in square miles	Maximum flood: Year	Maximum flood: Discharge, in cubic feet per second	Maximum flood: Recurrence interval, in years
143	05474000	Skunk River at Augusta	MS	70	4,303.00	1973	66,800	1.2 *
144	05476500	West Fork Des Moines River at Estherville	5	33	1,372.00	1969	16,000	73
145	05476750	West Fork Des Moines River at Humboldt	5	45	2,256.00	1969	18,000	27
146	05479000	East Fork Des Moines River at Dakota City	5	44	1,308.00	1938 H	22,000	1.1 *
147	05480000	Lizard Creek near Clare	4	42	257.00	1947	10,000	1.2 *
148	05480500	Des Moines River at Fort Dodge	5	52	4,190.00	1965	35,600	53
149	05481000	Boone River near Webster City	4	44	844.00	1918 H	21,500	1.2 *
150	05481950	Beaver Creek near Grimes,Iowa	4	24	358.00	1974	7,340	19
151	05482170	Big Cedar Creek near Varina,Iowa	4	25	80.00	1962	2,080	9
152	05482300	North Raccoon River near Sac City	4	26	713.00	1979	13,100	30
153	05482500	North Raccoon River near Jefferson	4	44	1,619.00	1947	29,100	100
154	05482600	Hardin Creek at Farnhamville	4	33	43.70	1954	2,000	37
155	05482900	Hardin Creek near Farlin	4	34	101.00	1979	2,330	8
156	05483349	Middle Raccoon River tributary at Carroll	3	15	6.58	1976	680	100
157	05483600	Middle Raccoon River at Panora	4	27	440.00	1953 H	14,000	1.2 *
158	05484000	South Raccoon River near Redfield	3	44	988.00	1958	35,000	1.1 *
159	05484500	Raccoon River at Van Meter	4	69	3,441.00	1947	41,200	33
160	05485640	Fourmile Creek at Des Moines	3	13	92.70	1977	05,380	14
161	05486000	North River near Norwalk	3	44	349.00	1947	32,000	1.8 *
162	05486490	Middle River near Indianola	3	44	503.00	1947	34,000	1.5 *
163	05487470	South River near Ackworth	2	45	460.00	1947	34,000	1.1 *
164	05487600	South White Breast Creek near Osceola	2	29	28.00	1981	11,800	1.4 *
165	05487800	White Breast Creek at Lucas	2	32	128.00	1981	15,500	100
166	05487980	White Breast Creek near Dallas	2	22	342.00	1982	37,300	2.1 *
167	05488000	White Breast Creek near Knoxville	2	17	380.00	1947	14,000	24
168	05488500	Des Moines River near Tracy	MS	64	12,479.00	1947	155,000	1.5 *
169	05489000	Cedar Creek near Bussey	1	37	374.00	1982	96,000	2.8 *
170	05489150	Little Muchakinock Creek at Oskaloosa	3	18	9.12	1970	4,500	100
171	05489490	Bear Creek at Ottumwa	2	20	22.90	1977	4,300	35
172	05489500	Des Moines River at Ottumwa	MS	68	13,374.00	1903 H	140,000	1.2 *
173	05490500	Des Moines River at Keosauqua	MS	77	14,038.00	1903	146,000	1.2 *
174	05491000	Sugar Creek near Keokuk	3	24	105.00	1905	33,000	3.5 *
175	05494300	Fox River at Bloomfield	2	21	87.00	1960	8,600	26
176	05494500	Fox River at Cantril	3	12	161.00	1946	16,500	1.4 *
180	05495600	South Wyaconda River near West Grove	1	20	4.69	1970	3,100	100
187	06483270	Rock River at Rock Rapids	2	15	788.00	1969	29,000	23
188	06483410	Otter Creek north of Sibley	3	33	11.90	1962	1,410	27
189	06483420	Schutte Creek near Sibley	3	29	1.43	1953	0503	68
190	06483430	Otter Creek at Sibley	2	32	29.90	1953	5,400	21
191	06483440	Dawson Creek near Sibley	3	28	4.35	1953	4,290	76

Table 3.--Characteristics of maximum floods at gaging stations in Iowa--Continued

Site number	Station number	Station name	Hydrologic region	Years of record	Drainage area, in square miles	Maximum flood: Year	Maximum flood: Discharge, in cubic feet per second	Maximum flood: Recurrence interval, in years
192	06483450	Wagner Creek near Ashton	3	20	7.09	1953	2,840	12
193	06483460	Otter Creek near Ashton	3	30	88.00	1979	18,000	35
194	06483500	Rock River near Rock Valley	2	36	1,592.00	1969	40,400	20
195	06484000	Dry Creek at Hawarden	2	21	48.40	1953	10,900	84
196	06485500	Big Sioux River at Akron	MS	56	8,424.00	1969	80,800	1.1 *
197	06599950	Perry Creek near Hinton	2	31	38.80	1953	4,980	11
198	06600000	Perry Creek at 38th Street, Sioux City	2	28	65.10	1944 H	9,600	30
199	06600100	Floyd River at Alton	2	29	268.00	1953 H	45,500	1.6 *
200	06600300	West Branch Floyd River near Struble	2	29	180.00	1962	8,060	7
201	06600500	Floyd River at James	2	49	886.00	1953	71,500	2.4 *
205	06605340	Prairie Creek near Spencer	3	19	22.30	1971	2,200	34
206	06605600	Little Sioux River at Gillett Grove	3	15	1,334.00	1965	20,200	8
207	06605750	Willow Creek near Cornell	3	19	78.60	1969	3,700	15
208	06605850	Little Sioux River at Linn Grove	3	13	1,548.00	1953 H	22,500	14
209	06605890	Waterman Creek at Hartley	2	19	28.70	1975	2,100	3
210	06606600	Little Sioux River at Correctionville	MS	57	2,500.00	1965	29,800	65
211	06606700	Little Sioux River near Kennebeck	MS	30	2,738.00	1965	29,700	84
212	06606790	Maple Creek near Alta	1	19	15.50	1969	5,300	68
213	06607000	Odebolt Creek near Arthur	3	19	39.30	1962	5,200	24
214	06607200	Maple River at Mapleton	3	43	669.00	1978	20,800	33
219	06608500	Soldier River at Pisgah	2	44	407.00	1950	22,500	18
223	06609500	Boyer River at Logan	3	52	871.00	1971	25,000	38
224	06610500	Indian Creek at Council Bluffs	1	22	7.99	1965	2,980	11
225	06610520	Mosquito Creek near Earling	2	15	33.00	1972	12,000	56
226	06610600	Mosquito Creek at Neola	2	33	131.00	1958	23,500	39
227	06806000	Waubonsie Creek near Bartlett	1	24	30.40	1950	14,500	100
228	06807410	West Nishnabotna River at Hancock	2	25	609.00	1972	26,400	30
229	06807470	Indian Creek near Emerson	2	19	37.30	1982	15,800	1.6 *
230	06807720	Middle Silver Creek near Avoca	2	32	3.21	1976	1,200	59
231	06807760	Middle Silver Creek near Oakland	2	32	25.70	1973	2,110	8
232	06807780	Middle Silver Creek at Treynor	2	29	42.70	1973	3,700	18
233	06808000	Mule Creek near Malvern	1	15	10.60	1954	2,070	5
234	06808500	West Nishnabotna River at Randolph	2	36	1,326.00	1967	35,500	65
235	06809000	Davids Creek near Hamlin	3	21	26.00	1958	22,700	5.2 *
236	06809210	East Nishnabotna River near Atlantic	2	24	436.00	1958 H	34,200	1.2 *
237	06809500	East Nishnabotna River at Red Oak	2	54	894.00	1972	38,000	49
238	06810000	Nishnabotna River above Hamburg	MS	57	2,806.00	1947	55,500	1.4 *
239	06811760	Tarkio River near Elliot	2	33	10.70	1982	2,500	24
240	06811800	East Tarkio Creek near Stanton	2	33	4.66	1967	4,790	95
241	06811840	Tarkio River at Stanton	2	27	49.30	1967	22,500	1.2 *

Table 3.--Characteristics of maximum floods at gaging stations in Iowa--Continued

Site number	Station number	Station name	Hydrologic region	Years of record	Drainage area, in square miles	Maximum flood: Year	Maximum flood: Discharge, in cubic feet per second	Maximum flood: Recurrence interval, in years
242	06811875	Snake Creek near Yorktown	2	19	9.10	1977	1,700	24
245	06817000	Nodaway River at Clarinda	2	54	762.00	1947	31,100	33
247	06818750	Platte River near Diagonal	3	16	217.00	1974	6,420	5
248	06819190	East Fork 102 River near Bedford	3	24	92.10	1974	9,980	44
253	06898000	Thompson River at Davis City	3	50	701.00	1885 H	30,000	1.1 *
254	06898400	Weldon River near Leon	3	26	104.00	1959	48,600	5.2 *
258	06903400	Chariton River near Chariton	3	19	182.00	1981	16,600	1.3 *
259	06903500	Honey Creek near Russell	2	11	13.20	1959	4,100	38
260	06903700	S Fork Chariton River near Promise City	3	17	168.00	1981	28,000	1.3 *
261	06903990	Cooper Creek at Centerville	3	17	47.80	1982	7,000	46
262	06904000	Chariton River near Centerville	3	22	708.00	1946	21,700	33