UNITED STATES
DEPARTMENT OF THE INTERIOR
WATER RESOURCES DIVISION
GEOLOGICAL SURVEY

LITTLE SIOUX RIVER BASIN FLOODS

By
Harlan H. Schwob
Hydraulic Engineer
U. S. Geological Survey

Prepared in cooperation with the

IOWA STATE HIGHWAY COMMISSION

Open-file Report
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ABSTRACT

Highway engineers and many others use flood stages and discharges in the design of bridges and other structures or operations on the flood plain of a stream. These data are provided in the form of gaging-station and other flood records and as flood profiles. Flood-frequency data are used to compute the 25- and 50-year recurrence interval discharges along the Little Sioux River from mile 24 to the Minnesota State line. The profiles of these two floods are computed and presented together with the profiles of the floods that occurred in 1965 and certain prior years. Less complete data are presented for the Ocheyedan and Maple Rivers, tributaries of the Little Sioux River.

Stage and discharge tabulations at 8 gaging stations for the 1965 flood can be used for volumetric computation. The same data can also be used to determine the time the flood was above a selected stage.

INTRODUCTION

Flood data are used by the highway engineer in the design of bridges, and by many others for planning and operations involving the protection of lives and property during floods. Evaluations of the flood potential at a site on a stream are based partly upon records of past stages and discharges. Discharge records of many streams are studied and used in the assessment of the discharge potential. However, flood elevations, or stages, for a given flood are dependent upon physical factors that are unique for a given site. Thus, records of past flood elevations, particularly of outstanding floods, are important in planning concerned with the occurrence of floods at a given site.

Purpose and Scope

The purpose of this report is to present data on the elevation and discharge of floods on the Little Sioux, Ocheyedan, and Maple Rivers in Iowa. These data are presented as profiles of several floods including the outstanding flood of 1965 (on the Little Sioux) and the computed profiles of the 25- and 50-year frequency floods. Peak-discharge data for these floods are shown on the profile sheets. Stage and discharge data for plotting hydrographs at gaging stations are shown in an appendix. Annual peak-stage and peak-discharge data for the period of record at gaging stations and the flood-frequency data for the State have been published by the Iowa Highway Research Board (Schwob, 1966). They are not republished in this report.

Limited information is available for a few of the smaller streams in the basin. This information is presented in the report. Brief descriptions of the meteorology connected with known outstanding floods are also presented.

Acknowledgments

This report is the second of a planned series resulting from a cooperative project with the Iowa State Highway Commission through the Iowa Highway Research Board. The first of the series was Bulletin 27, Iowa Highway Research Board (Schwob, 1963). Collection of the basic information and preparation of the report was by the U. S. Geological Survey.

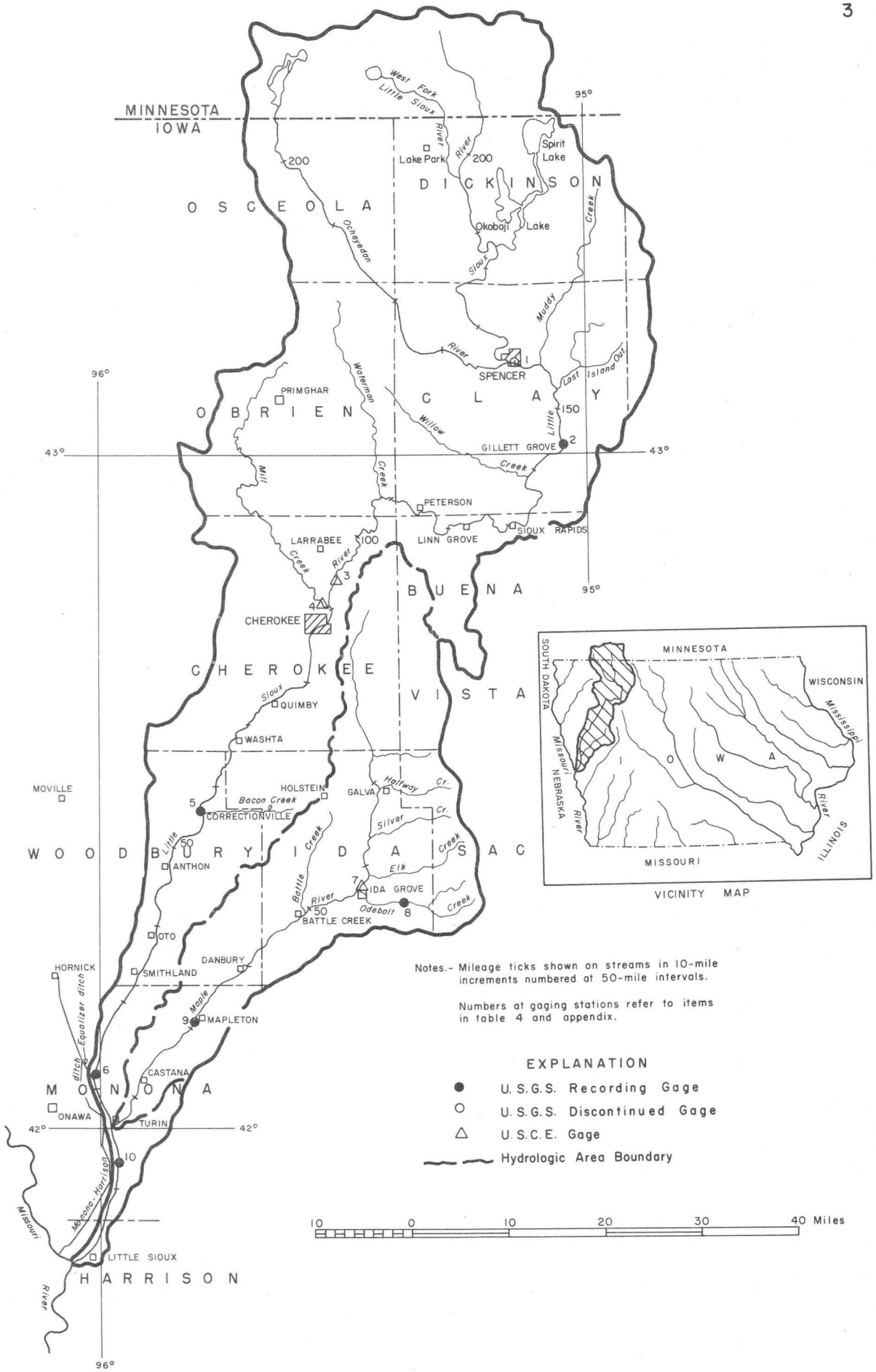


Plate 1. Map of Little Sioux River basin, Iowa-Minnesota.

The Corps of Engineers furnished basic data for the gaging stations they maintain in the basin and discharge measurements at some supplemental sites. The regular stream-gaging stations used in the study are maintained through cooperative agreements with many city, state, and federal agencies. This cooperation is explained in the U. S. Geological Survey annual publications "Water Resources Data for Iowa, Part 1, Surface Water Records" after 1960 and in Water-Supply Papers for years prior to 1961.

DESCRIPTION OF THE LITTLE SIOUX RIVER BASIN

Brief descriptions of the physical features and meteorology of the basin which affect flood flows are included in the following paragraphs. More complete descriptions are contained in the publications listed in the references.

Streams

The Little Sioux River and upper basin tributaries have sources in Minnesota along an east-west line about 11 miles north of the Iowa-Minnesota Boundary (see plate 1). Three major streams and one combination of lakes and streams drain 308 square miles at the State line. From west to east the streams and drainage area at the State line are: (1) the Ocheyedan River (50 square miles), (2) the West Fork Little Sioux River (115 square miles), (3) the Little Sioux River (101 square miles), and (4) the series of small lakes and short intermediate streams (42 square miles) which comprise the major part of the drainage area of Spirit and the Okoboji Lakes. Within Iowa the streams unite to form the main stem of the Little Sioux River at Spencer. The river then follows an irregular course trending southwesterly to its mouth at the Missouri River near the town of Little Sioux in Harrison County. At mile 16, near Turin, it is joined by its principal tributary, the Maple River. The drainage areas for selected points on the main stems and of the principal tributaries of the Little Sioux and Maple Rivers are shown in table 1. Below Smithland (mile 33.2), the Little Sioux River has been straightened and leveed by the Corps of Engineers. The Maple River has also been leveed and straightened by the same agency from the mouth to Castana (mile 22.3). At mile 21.3 an equalizer ditch joins the Little Sioux River on the right bank. This ditch serves to transfer floodwater between the Monona-Harrison

TABLE 1. Drainage areas of the principal tributaries at their mouths and of the main stems, Little Sioux and Maple Rivers

Stream	Miles above mouth of Little Sioux R.	Bank of Entry	Drainage area sq. mi.	Main stem below tributary	Percent of combined area contributed by tributary
		Little Sioux River			
Little Sioux R. at State Line	204.8	-	101	-	100
W. Fk. Little Sioux R.	197.2	R	175	301	58
Okoboji L. Outlet	183.4	L	151	485	31
Ocheyedan R.	160.6	R	434	989	44
Muddy Cr.	156.7	L	103	1,102	9.4
Lost Island Outlet	153.1	L	156	1,304	12
Willow Cr.	139.2	R	92.1	1,399	6.6
Waterman Cr.	108.0	R	140	1,803	7.8
Mill Cr.	90.6	R	294	2,163	13.6
Maple R.	16.0	L	742	4,394	16.9
Little Sioux R. Mouth	-	-	[a]4,500	-	-
		Maple River			
Maple R. at N. line Ida County	73.8	-	182	-	-
Unnamed Cr.	73.2	L	16.6	200	8.3
Halfway Cr.	69.2	L	24.3	241	10.1
Silver Cr.	63.5	L	31.2	301	10.4
Elk Cr.	58.9	L	38.5	362	10.6
Odebolt Cr.	56.6	L	61.4	428	14.3
Battle Cr.	49.5	R	52.2	513	10.2
Maple R. Mouth	16.0	-	742	-	-

[a]Approximate--includes Monona-Harrison ditch because of equalizer ditch at mile 21.3

ditch and the Little Sioux River, the direction of flow depending upon the relative flood stages in the two streams. The Monona-Harrison ditch which formerly emptied into the Little Sioux River near its mouth has been diverted directly into the Missouri River at a point about one mile upstream from the mouth of the Little Sioux River.

The greater part of the area in Iowa is fairly well drained by natural streams or by supplemental ditches and tile drains.

Topography

The upper part of the Little Sioux basin is in the area of recent glaciation (Ruhe, 1950). It is covered by glacial deposits and loess and is flat to undulating. Many lakes of various size dot the area. The Iowa Great Lakes consisting of Spirit and the two Okoboji Lakes are the largest of the lakes. As shown in table 1, their drainage area makes up 31 percent of the total drainage area at the junction of the outlet stream with the Little Sioux River.

The character of the topography changes rather abruptly, especially near the streams, in northeastern Cherokee County. Loess-covered hills with steep slopes predominate along the streams and the valley floor is relatively narrow until the river reaches Anthon. Near the lower ends of the Little Sioux and Maple Rivers the valleys widen and remain wide until the Little Sioux River enters the wide alluvial plain of the Missouri River. Except for the valleys' the drainage area for this region is rough. About 60 percent of the total drainage area of the Little Sioux River, including all of the Maple River basin, is in the more rugged terrain.

Cities and Towns

Seventeen Iowa cities and towns lie on or near the Little Sioux and Maple Rivers. The communities and their 1960 population are shown in table 2. In addition there are a few unincorporated communities in the lower end of the valley. All of the cities and towns listed are affected to some extent by the occurrence of large floods.

TABLE 2. Cities and towns on or near the Little Sioux and Maple Rivers in downstream order

Little Sioux River		Maple River	
Community	1960 Population	Community	1960 Population
Spencer	8,864	Galva	469
Sioux Rapids	962	Ida Grove	2,265
Linn Grove	330	Battle Creek	786
Peterson	565	Danbury	510
Cherokee	7,724	Mapleton	1,686
Quimby	369	Castana	230
Washta	310		
Correctionville	912		
Anthon	681		
Smithland	349		
Turin	163		

Climate

The Little Sioux basin has a temperate climate. Average yearly temperature for the 1931-60 period over the basin ranges between 46°F in the north to about 50° in the south. The 1931-60 average annual precipitation is shown by Schwob (1966) to be 27.5 inches for the Little Sioux River basin and 27.3 inches for the Maple River basin. Values of the normal precipitation for different points within the basins have a range of slightly less than one inch.

FLOOD HISTORY

Very little is known concerning floods that occurred in the basin prior to the start of gaging stations operations in 1919. The Iowa Natural Resources Council (Bul. 8, 1959) states that severe floods occurred on the Little Sioux River in 1851, 1881, 1891, 1902 and 1915. An account of the June 23, 24, 1891, flood is given in the "Annual Report of Iowa Weather and Crop Service, 1891". The account describes widespread destruction and suffering in Cherokee and vicinity caused by a rainstorm of about 12 inches in 12 hours. The resulting flood was apparently widespread in the basin. The flood at Cherokee was the second highest known (see table 3). At Correctionville a high-water mark for the 1891 flood is 3.5 feet higher than the 1965 flood which is the maximum for the period of gaging-station record. However, a local resident stated that the mark was high because of water released when a mill dam failed on Bacon Creek east of Correctionville. The discharge in 1891 is unknown so that comparisons with the 1965 flood discharge cannot be made. Accounts of the floods in 1851, 1881, 1902 and 1915 could not be located.

After the establishment of the gage at Correctionville in 1919, records show outstanding floods occurred at the station in 1944, 1945, 1951, 1953, 1954, 1960, 1961, 1962, 1963, and 1965. Those in 1953, 1954, 1962, and 1965 were particularly outstanding over much of the basin (see table 3).

The floods of June 1953 and 1954 have been described in detail in U. S. Geological Survey Water Supply Papers 1320-A and 1370-A. Brief summaries from these publications follow. On June 7, 1953, heavy rains fell in northwest Iowa. Although the heaviest amounts fell to the northwest of the basin, the upper end of the basin received amounts ranging up to 8 inches in a period of about 16 hours. The resulting flood discharge is still the greatest known in the reach of the Little Sioux River above Linn Grove (mile 122.3). In June 1954 a period of 8 days (June 15-22) had a rainfall total ranging from about 5 to 8 inches over the basin. Most of this rain fell on June 17-19 on the Little Sioux River basin. The resultant flood was lower in discharge than the 1953 and 1965 floods but still ranks as one of the major floods in the basin.

The floods of 1961, 1962, and 1965 were caused by similar meteorological phenomena. They were all spring floods resulting from snowmelt in combination with rain. The 1965 flood is the greatest of record along the lower part of the Little Sioux River. At Cherokee damages were estimated at $666,000 and 360 people were forced from their homes (U. S. Weather Bureau Climatological Data for Iowa, April 1965 and National Summary for April 1965). The stage was set for the flood by heavy snowfall, deep frost penetration, and sudden warming accompanied by rains. A snow survey on March 26-29 showed water equivalents in the basin of 6-8 inches at Spirit Lake, 2-3 inches from Spencer to Cherokee, and less than one inch in the southern portion (Climatological Data for Iowa for April 1965, National Summary). Warmer temperatures and rain aggregating about 2 inches during April 3-6 (above Cherokee) hastened the melting. The frost in the ground prevented infiltration and the consequent runoff produced record discharges in the basin below the south line of Clay County (mile 116). As indicated in table 4, peaks occurred nearly simultaneously at widely separated places along the stream.

Tabulations of time, gage height, and discharge for the 1965 flood at gaging stations are in the appendix. Similar data for the 1953 and 1954 floods are contained in Water-Supply Papers 1320-A and 1370-A. These data may be used to plot hydrographs of either gage height or discharge and to compute flood volumes.

TABLE 3. Flood-peaks at gaging stations in Little Sioux River basin in Iowa

No.	Gaging station	Mile	Period of flood record	Drainage area sq mi	Known outstanding flood peaks													
					June 1891		1944			1945			1951			1953		
					Date	Gage height ft	Date	Gage height ft	Discharge cfs	Date	Gage height ft	Discharge cfs	Date	Gage height ft	Discharge cfs	Date	Gage height ft	Discharge cfs
1	Little Sioux River at Spencer	160.3	1937-42, 1953,1965	990	--	--	--	--	--	--	--	--	--	--	--	6/8	20.20	30,000
2	Little Sioux River at Gillett Grove	146.1	1953, 1959-65	1,334	--	--	--	--	--	--	--	--	--	--	--	6/9	[a]17.87	[b]24,000
3	Little Sioux River near Cherokee	94.25	(d)	1,861	--	--	--	--	--	--	--	--	4/6	16.45	16,100	6/11	17.48	21,400
4	Mill Creek near Cherokee	93.3	(d)	292	6/24	[a]31.0	--	--	--	--	--	--	3/28	9.10	3,050	6/8	14.30	11,500
	Little Sioux River at Cherokee[e] (U.S. Weather Bur. gage) (Stage only)	86.6	1891-65	2,182	--	25.7	--	--	--	--	--	--	--	--	--	6/11	22.7	--
5	Little Sioux River at Correctionville	56.0	1891, 1919-25, 1929-32, 1937-65	2,500	6/23 or 6/24	[af]29.34	6/12	21.1	13,000	8/5	21.9	14,800	4/7	22.58	17,900	6/12	22.09	17,500
6	Little Sioux River near Kennebec	21.95	1940-65	2,738	--	--	6/13	24.85	10,600	8/7	25.0	8,590	4/11	24.33	12,000	6/14	23.97	11,500
7	Maple River near Ida Grove	58.1	(d)	364	--	--	--	--	--	--	--	--	3/12	14.50	(i)	6/9	10.90	1,750
8	Odebolt Creek near Arthur	61.6	1951, 1958-65	39.3	--	--	--	--	--	--	--	--	--	--	--	--	--	--
9	Maple River at Mapleton	30.9	1942-65	669	--	--	6/13	--	4,730	8/7	21.0	7,570	3/27	20.1	10,800	6/14 6/25	-- 17.66	[c]302 11,500
10	Little Sioux River near Turin	13.54	1959-65	[j]4,426 (prior to 1/15/58) 3,526 presently	--	--	6/12	(j)	4,040	8/8	(j)	6,620	3/27	(j)	2,850	6/14	(j)	788

No.	1954			1960			1961			1962			1963			1965		
	Date	Gage height ft	Discharge cfs	Date	Gage height ft	Discharge cfs	Date	Gage height ft	Discharge cfs	Date	Gage height ft	Discharge cfs	Date	Gage height ft	Discharge cfs	Date	Gage height ft	Discharge cfs
1	6/21	--	--	--	--	--	--	--	--	--	--	--	--	--	--	4/6	[a]17.37	16,700
2	--	--	--	3/30	13.78	5,140	3/26	16.93	12,900	3/31	15.70	9,680	6/1	--	[c]80	4/7	18.67	20,200
3	6/20	16.36	16,000	--	--	--	--	--	--	3/29	15.63	13,500	--	--	--	4/6	[a]18.83	26,800
4	6/19	13.00	9,050	--	--	--	--	--	--	3/28	14.53	11,000	--	--	--	4/6	13.37	10,400
	6/20	22.0	--	--	--	--	--	--	--	3/29	24.0	--	--	--	--	4/6	27.1	[b]33,700
5	6/21	23.36	20,900	3/29	22.57	16,000	3/29	22.32	16,400	3/30	23.14	19,800	6/2	21.54	13,500	4/7	25.86	29,800
6	6/22	26.18	13,500	3/30	[g]23.26	16,400	3/30	20.70	14,500	3/31	(h)	[b]19,000	6/2	23.00	15,700	4/8	26.50	29,700
7	6/19	16.70	--	3/29	15.60	(i)	3/15	10.00	--	3/28	15.40	--	6/2	14.45	8,750	4/1	14.70	8,000
8	--	--	--	3/29	[i]13.0	[b]700	3/27	--	[c]58	3/27	[i]11.98	[b]3,000	6/4	10.77	1,010	4/3	11.14	1,360
9	6/20	20.4	15,600	3/30	17.90	11,400	3/28	--	[c]1,220	3/28	16.05	13,500	6/4	15.50	12,000	4/1	12.14	9,240
10	6/22	(j)	7,920	3/30	25.08	23,900	3/30	21.02	14,000	3/29	23.97	24,400	6/2 6/5	23.30 19.65	19,400 12,600	4/8	26.05	27,100

a From floodmark
b About
c Mean daily discharge
d Gage operated by Corps of Engineers, records not published
e At Highway 59 bridge. Zero of gage 1150.0 msl
f May be high because of failure of local mill dam
g Datum of gage raised 0.87 ft 10/12/59
h Backwater from Maple River, max. gage height 22.40 on 3/28
i Affected by ice
j Extensive changes in Little Sioux and Monona-Harrison ditch

TABLE 4. Date and time of peaks of the 1953 and 1965 floods in the Little Sioux River Basin

Stream and locality	Mile	Drainage area sq. mi.	June 1953		April 1965	
			Day	Hour	Day	Hour
Little Sioux R.--Hwy 18 bridge 3.5 mi. NW Spencer	168.5	541	9	0300	-	-
Ocheyedan R.--Hwy 9 bridge 7 mi. NE Sibley	200.3	72	7	2300	-	-
Ocheyedan R.--E. line Sec. 9, T. 96 N., R. 38 W.	172.8	302	8	1030	-	-
Ocheyedan R.--near SW Cor. Sec. 16, T. 96 N., R. 37 W.	166	423	8	1430	-	-
Little Sioux R.--at Spencer at Hwy 18 and 71[a]	160.3	990	8	1800	6	1700
Little Sioux R.[a]--at Gillett Grove, site of present gage	146.1	1,334	9	0200	7	0500
Little Sioux R.--at Sioux Rapids, Hwy 71 bridge	130.1	1,518	10	0730	-	-
Little Sioux R.--Linn Grove, Hwy 264	122.3	1,548	10	-	-	-
Little Sioux R.--above Mill Cr. near Cherokee (CE gage)	94.2	1,861	11	0500	6	[b]1800
Mill Cr.--near Cherokee (CE gage)	93.3	292	8	0700 and 1630	1 6	0400 0500
Little Sioux R.--at Cherokee Hwy 59 (USWB gage)	86.6	2,182	11	-	6	[b]1400
Little Sioux R.[a]--Correctionville, USGS gage	56.0	2,500	12	1800	7	0730
Little Sioux R.[a]--USGS gage near Kennebec	21.95	2,738	14	1900	8	1800
Odebolt Cr.[a]--at USGS gage near Arthur	61.6	39.3	-	-	3	1800
Maple R.[a]--at Mapleton, USGS gage	30.9	669	25	0130	1 4 6	0130 0130 0800
Little Sioux R.--Hwy 141 at Smithland	33.17	2,686	-	-	8	1600
Little Sioux R.--near Rodney, 1/2 mile SE	30.94	2,700	-	-	8	1500
Little Sioux R.--near Turin, USGS gage	13.54	4,426(1953) 3,526(1965)	14	2400	8	1400

[a] Recording gage in 1965

[b] About

CE Corps of Engineers

USGS U. S. Geological Survey

USWB U. S. Weather Bureau

GPO 803-383-2

BASIC DATA

Gaging-station Records

Six complete-record gaging stations are presently operated by the U. S. Geological Survey on the streams in the basin. Additionally, one USGS discontinued gaging station and four non-recording stations operated by other agencies are located in the basin. Table 3 contains the available peak flood data at all 11 stations. The gage at Cherokee provides fragmentary flood-stage data that is shown only in table 3. The appendix to this report contains the station descriptions and the detailed 1965 flood data for eight of the listed stations. Information on floods prior to 1965 are contained in the surface-water reports of the USGS listed in the References.

Ice cover prevailed on most of the streams just prior to the 1965 flood peaks. The presence of ice affects the relation between stage and discharge, the effect being highly variable. On days when this effect was present only the daily mean discharges are given. During the open-water flood periods, the stages and discharges have been subdivided for selected days to permit the preparation of detailed hydrographs and the determination of flood volumes.

Auxiliary Measurements of Discharge

Discharge measurements were made at a number of sites to augment the flood information provided by gaging stations. The measurements in 1965 and those made in prior years have been used to compute the peak discharges at places between gaging stations. The results of the computations are tabulated on the profiles (Plates 2-16).

Highwater Marks

Highwater marks were obtained for several floods in the 1962-65 period along the Little Sioux River. These marks were generally set a few hours after the occurrence of the peak at many locations along the stream. Marks were set at all bridges to define the water-surface elevation above and below the bridges. They were also set at intermediate points where the distance between bridges was considered large. Marks for floods prior to this period have been obtained from published USGS reports--primarily those for the 1953 and 1954 floods.

Procedures for obtaining data on the 1962 flood on the Maple River were similar to those for the Little Sioux River. The 1965 flood was not outstanding on the Maple River and its profile was not obtained.

All marks were referenced to mean sea level datum, 1929 general adjustment, by leveling. Elevations determined are of third-order accuracy.

Mileage System

River mileages are in miles above the mouth of the Little Sioux River. Aerial photographs, soil maps, and county maps were used to determine the distances which were measured along the center of the normal channel. Bridges, creeks, and other easily identified points are indicated on the profile sheets. Proportionate adjustment by the user will permit him to adjust report mileages to those indicated by his map.

Flood-Frequency Information

The computation of the flood discharges tabulated on the profiles for the 25- and 50-year recurrence interval floods is based upon the report by Schwob (1966). In that report, multiple-regression studies used size of drainage area, main-channel slope in feet per mile, and normal annual precipitation as the independent variables to compute an index flood (the mean annual flood). The Little Sioux River and its tributaries, excepting the Maple River, lie in the hydrologic area "A" where all three independent variables are required. The Maple River and its tributaries lie in the "B" area where only drainage area and slope are used.

The regression formulas for the two areas are:

For area "A"

$$MAF = .000009856\ A^{.856}\ S^{.806}\ P^{3.926}$$

for area "B"

$$MAF = 50.22\ A^{.707}\ S^{.367}$$

in which

MAF = the mean annual flood or index flood in cubic feet per second (cfs).

A = drainage area in square miles.

S = slope in feet per mile between points 10 and 85 percent of the stream length above the point of interest.

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

The stream length is the distance along the main channel and the upstream tributary having the largest drainage area to the basin divide.

To compute the discharge for a selected recurrence interval (R.I.) the MAF is multiplied by a ratio from the following list (flood-frequency region I in source report).

R.I.	Ratio
2	0.88
5	1.58
10	2.05
25	2.65
50	3.10

FLOOD PROFILES

The basic data described were used to prepare flood profiles along the streams. Highwater marks defined the known peak elevations for each profile. The gaging-station records and supplemental discharge measurements provided the peak discharges tabulated on the profile sheets (Plates 2-16). The computed discharges and elevations for the 25- and 50-year recurrence interval floods have been used to prepare profiles for these two floods.

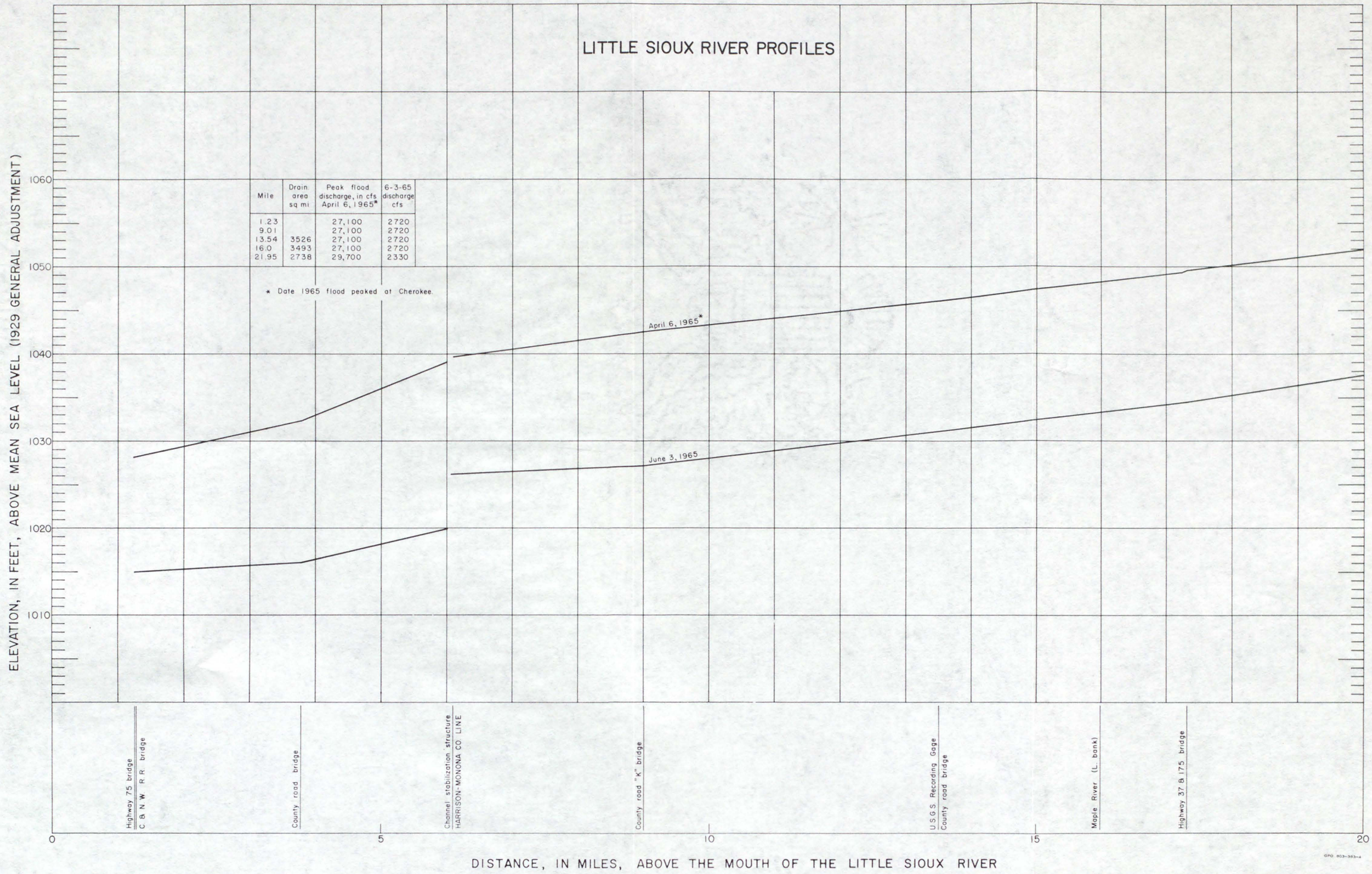
The profile elevations and the tabulated discharges provide the data for preparation of a partial elevation-discharge relation curve. Such a curve may be prepared for any point on the stream--the only requirement being that the profile elevations and the tabulated discharges are sufficient in number and distribution to adequately define the curve within the range of interest.

GPO 803-383-3

LITTLE SIOUX RIVER PROFILES

Mile	Drain. area sq mi	Peak flood discharge, in cfs April 6, 1965*	6-3-65 discharge cfs
1.23		27,100	2720
9.01		27,100	2720
13.54	3526	27,100	2720
16.0	3493	27,100	2720
21.95	2738	29,700	2330

* Date 1965 flood peaked at Cherokee.



GPO 803-383-4

Plate 2. Little Sioux River profiles, mile 0 to mile 20.

LITTLE SIOUX RIVER PROFILES

Mile	Drain area sq mi	Peak flood discharge, in cfs: March 1962	Sept. 1964	April 6* 1965	25-year	50-year	10 1,2-63 discharge cfs	6-3-65 discharge cfs
21.95	2738	19,000	2560	29,700	17,400	20,400	119	2330
33.17	2686	19,300	2550	29,700	17,400	20,400	108	—
37.81	2663	19,400	2600	29,700	17,400	20,400	105	—

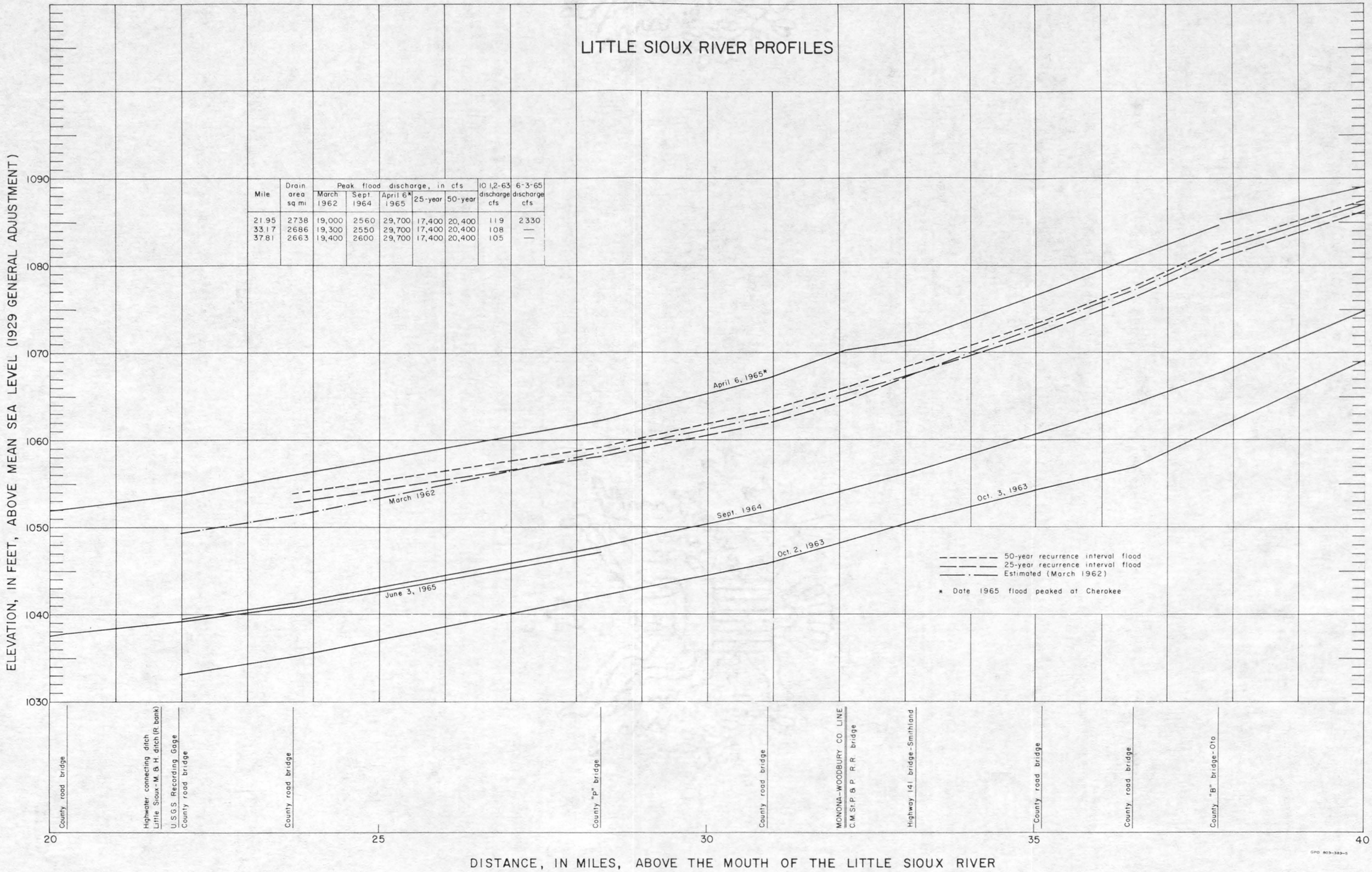


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Plate 3. Little Sioux River profiles, mile 20 to mile 40.

LITTLE SIOUX RIVER PROFILES

Mile	Drain. area sq mi	Peak flood discharge, in cfs					10-1,2-63 discharge cfs
		March 1962	Sept. 1964	April 6* 1965	25-year	50-year	
43.36	2624	19,500	2600	29,800	17,400	20,400	96
50.18	2554	19,700	2600	29,800	17,400	20,300	85
56.02	2500	19,800	2640	29,800	17,300	20,200	76
59.10	2439	20,000	2700	30,200	17,300	20,200	71

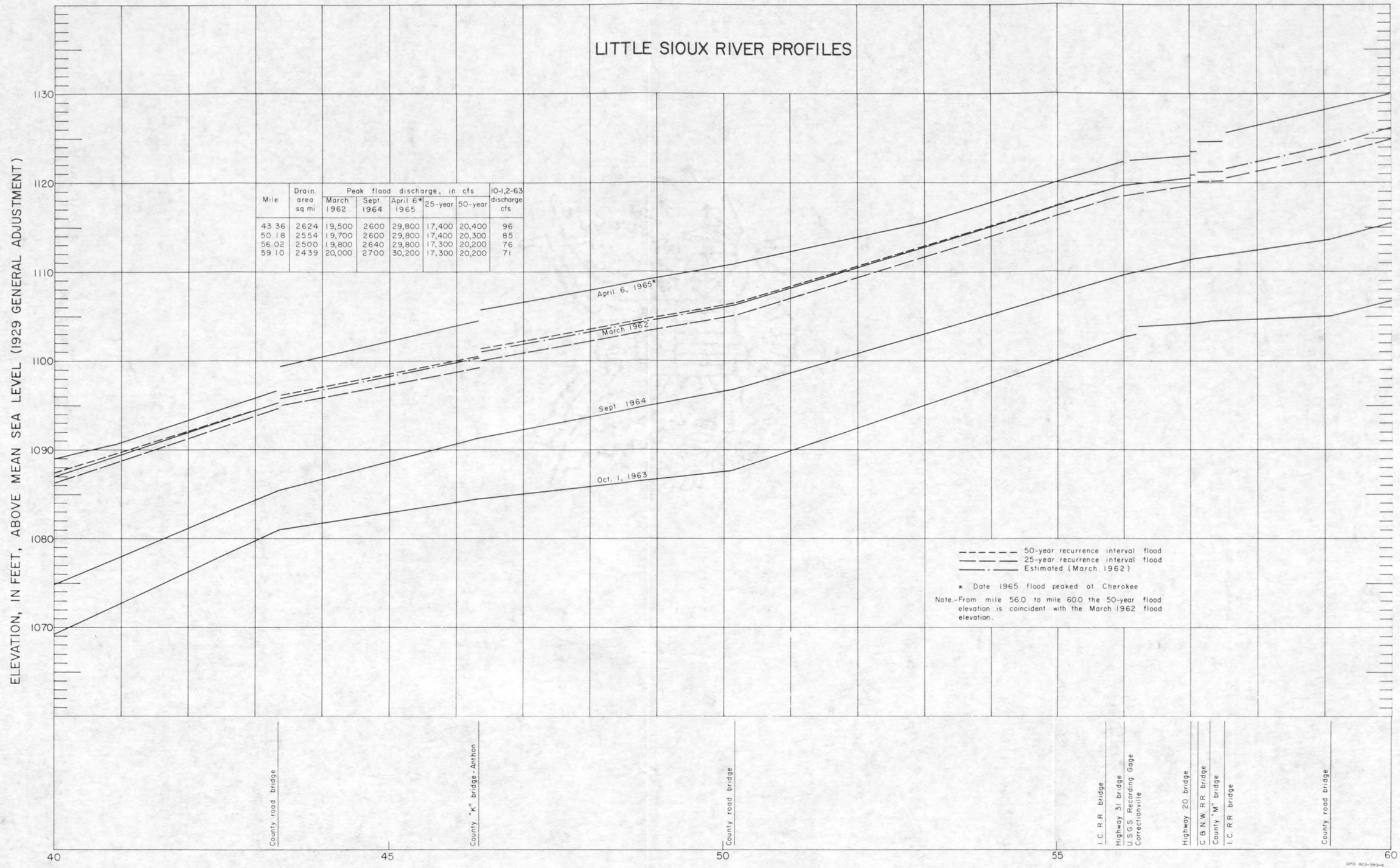

Plate 4. Little Sioux River profiles, mile 40 to mile 60.

LITTLE SIOUX RIVER PROFILES

Mile	Drain. area sq mi	Peak flood discharge, in cfs						10-1,2-63 discharge cfs
		1954	March 1962	Sept. 1964	April 6* 1965	25-year	50-year	
60.75	2437	—	20,100	2700	30,400	17,300	20,200	71
67.0	2383	20,300	20,600	2800	31,200	17,100	20,000	66
78.44	2269	19,700	21,500	2950	32,800	16,900	19,800	59

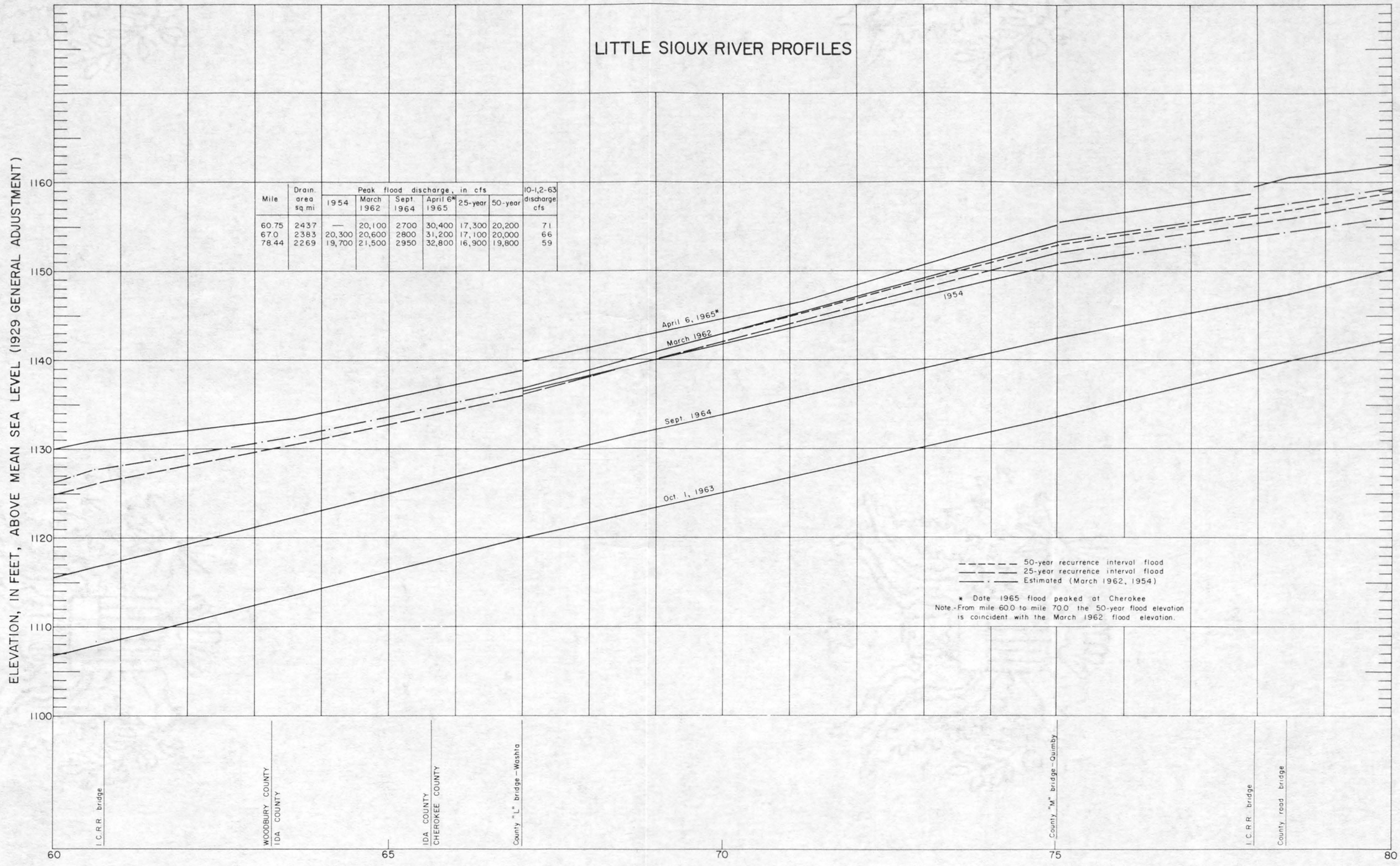

Plate 5. Little Sioux River profiles, mile 60 to mile 80.

LITTLE SIOUX RIVER PROFILES

Mile	Drain. area sq mi	Peak flood discharge, in cfs 1953	1954	March 1962	Sept. 1964	April 6* 1965	April 8* 1965	25-year	50-year	10-12-63 discharge cfs
81.02	2205	—	19,600	21,900	3000	33,100	—	16,900	19,800	55
87.50	2173	—	19,200	22,500	3200	33,700	23,800	16,700	19,600	55
90.60	2163	22,000	19,000	22,700	3300	34,000	23,800	16,700	19,600	55
90.65	1868	—	16,300	14,100	3250	27,000	23,000	15,000	17,600	44
98.80	1842	21,600	—	12,700	3250	26,200	23,700	15,000	17,600	43

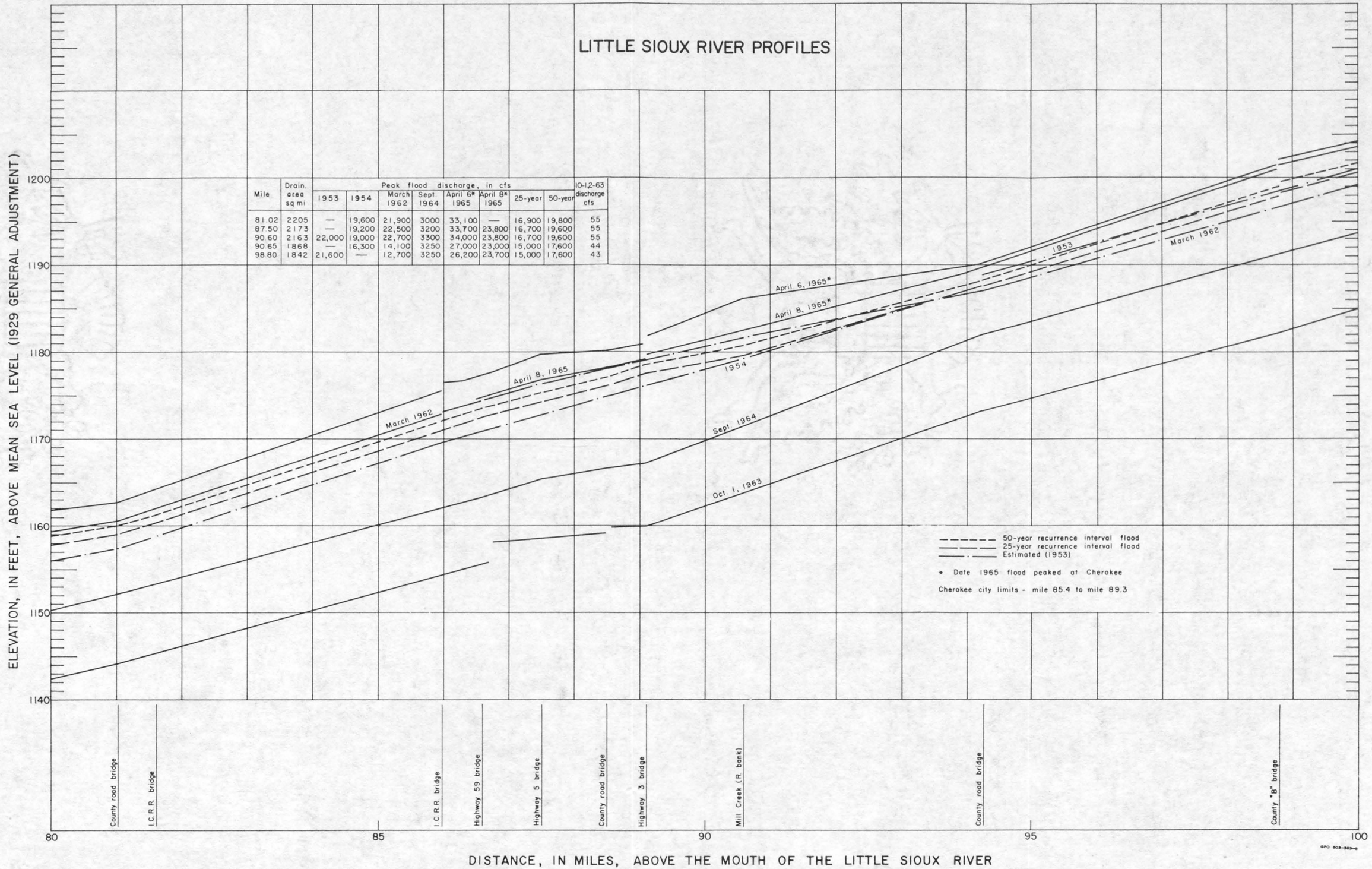

Plate 6. Little Sioux River profiles, mile 80 to mile 100.

LITTLE SIOUX RIVER PROFILES

Mile	Drain area sq mi	Peak flood discharge, in cfs							10-1,2-63 discharge cfs
		1953	March 1962	Sept. 1964	April 6* 1965	April 8* 1965	25-year	50-year	
108.00	1803	21,900	11,600	3300	24,100	22,600	15,000	17,600	42
108.05	1663	21,900	11,600	3250	22,900	22,000	14,100	16,500	37
112.90	1640	22,100	11,100	3200	22,700	21,800	14,100	16,500	37

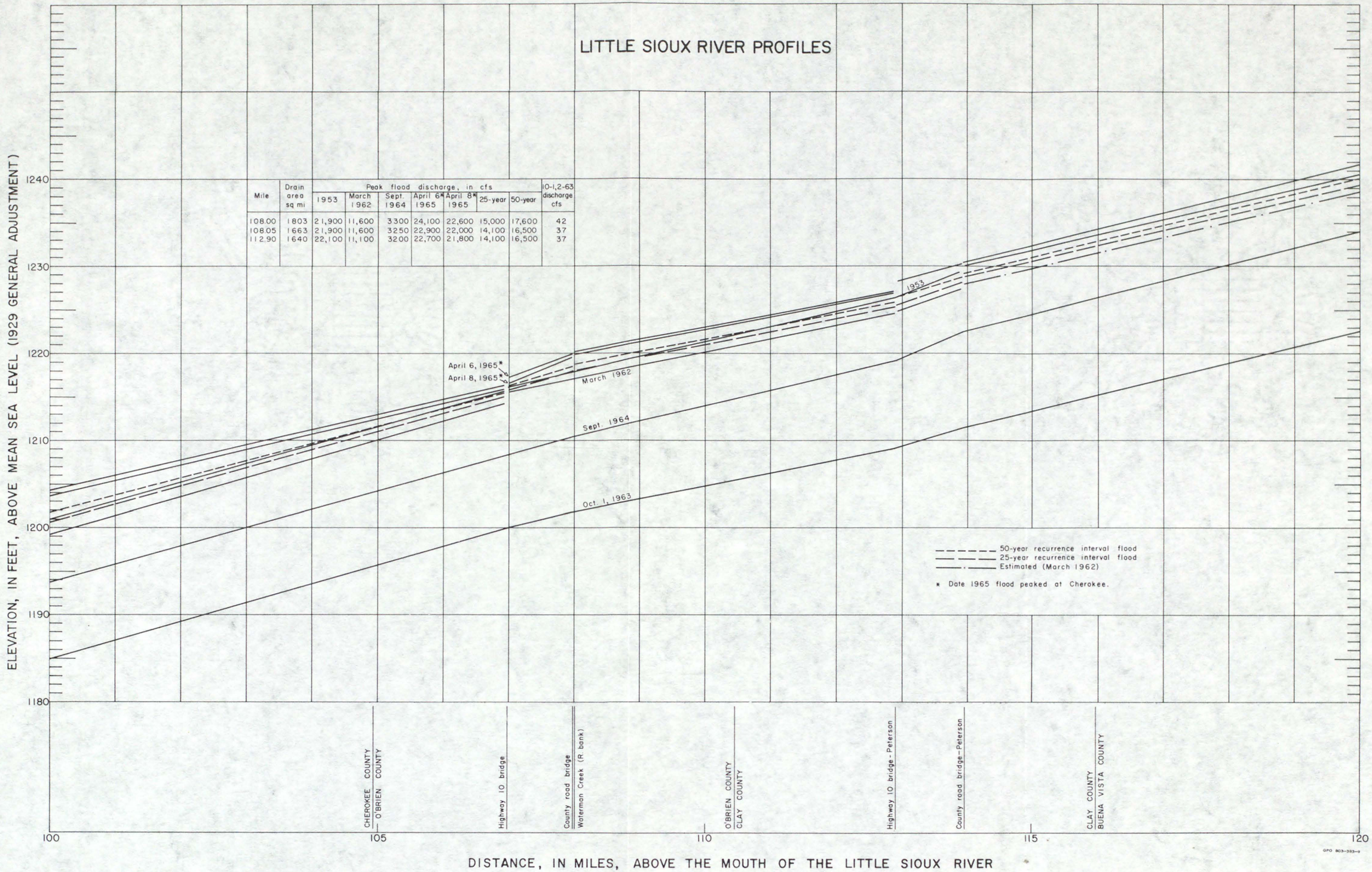

Plate 7. Little Sioux River profiles, mile 100 to mile 120.

LITTLE SIOUX RIVER PROFILES

Mile	Drain. area sq mi	Peak flood discharge, in cfs						10-1,2-63 discharge cfs
		1953	March 1962	Sept. 1964	April 8* 1965	25-year	50-year	
122.30	1548	22,500	10,500	3200	20,800	14,100	16,500	32
130.13	1519	22,700	10,100	3400	20,700	14,100	16,500	31
139.24	1491	23,200	9,800	3800	20,700	14,100	16,500	30
139.29	1399	23,200	9,800	3800	20,300	13,300	15,600	27

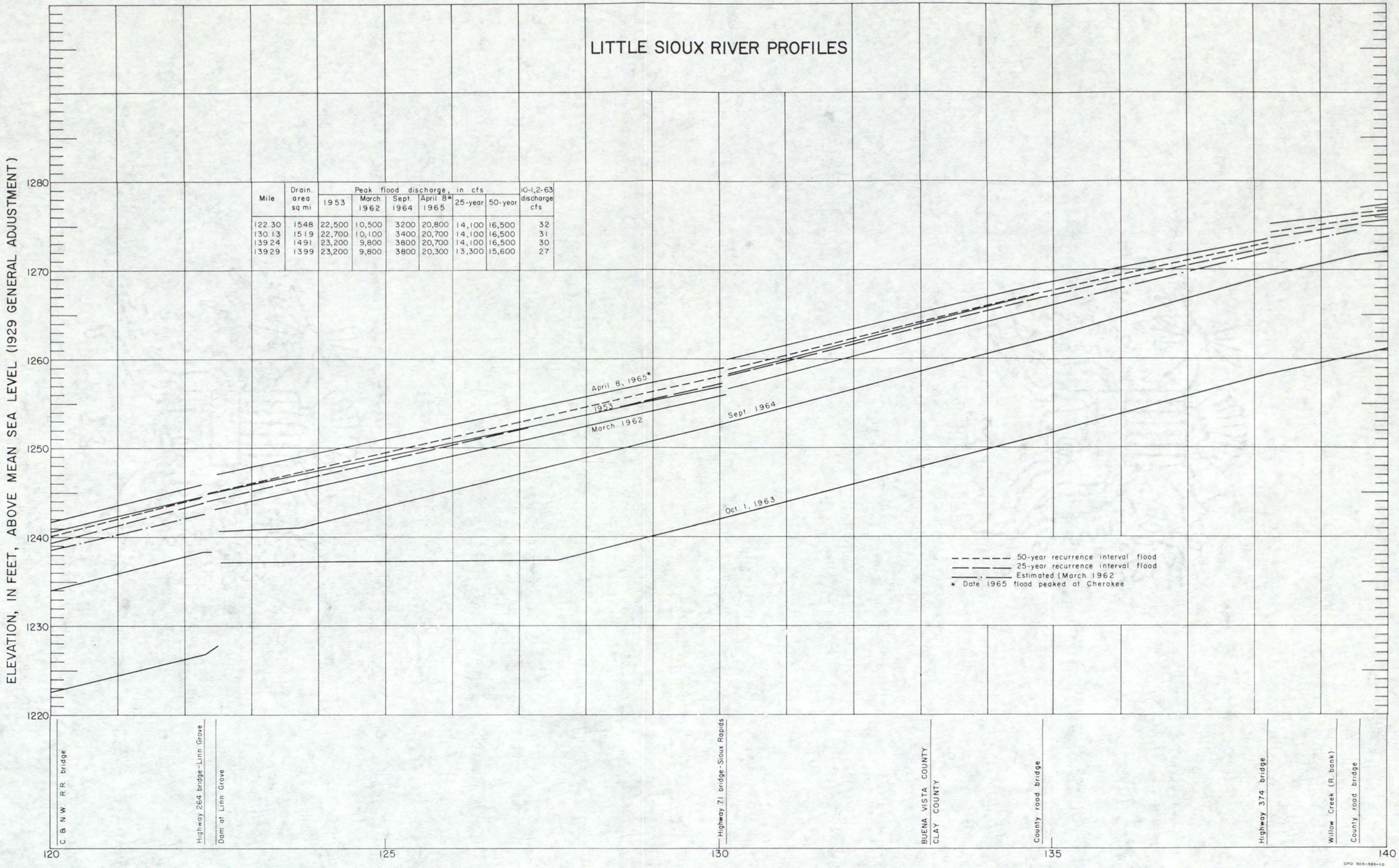

Plate 8. Little Sioux River profiles, mile 120 to mile 140.

LITTLE SIOUX RIVER PROFILES

Mile	Drain. area sq mi	Peak flood discharge, in cfs: 1953	March 1962	July 1962	Sept. 1964	April 8* 1965	25-year	50-year	10-1,2-63 discharge cfs
140.25	1393	23,300	9800		3850	20,300	13,300	15,600	27
153.05	1304	25,200	9200	4850	3900	20,100	13,000	15,200	24
153.10	1149	25,200	6600	4400	3400	18,500	11,800	13,800	18
156.75	1102	26,400	6100	4200	3200	18,000	11,400	13,400	16
156.80	999	26,400	5300	4100	3100	16,800	10,600	12,400	12

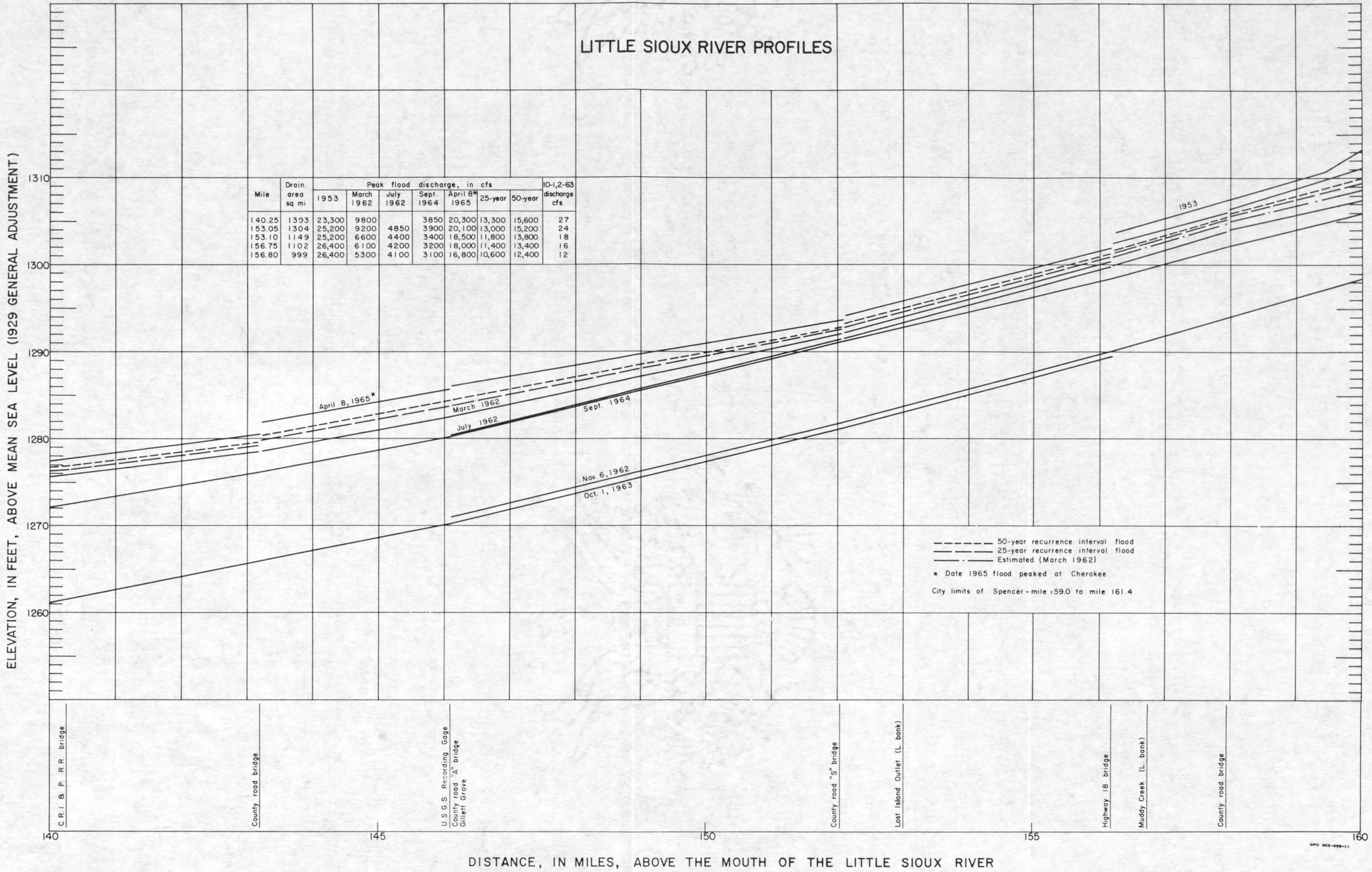

Plate 9. Little Sioux River profiles, mile 140 to mile 160.

LITTLE SIOUX RIVER PROFILES

Mile	Drain. area sq mi	Peak flood discharge, in cfs: 1953	March 1962	July 1962	Sept. 1964	April 8* 1965	25-year	50-year	11-6,7-62 discharge cfs
160.28	990	30,000	5300	4000	3000	16,700	10,400	12,200	77
160.60	989	30,000	5300	4000	3000	16,700	10,400	12,200	77
160.65	555	10,000	4450	3100	1900	7,200	6,440	7,530	42
168.48	541	9,400	4450	2400	1400	6,700	6,410	7,510	41
179.3	502	—	4250	1950	1150	5,800	6,230	7,300	38

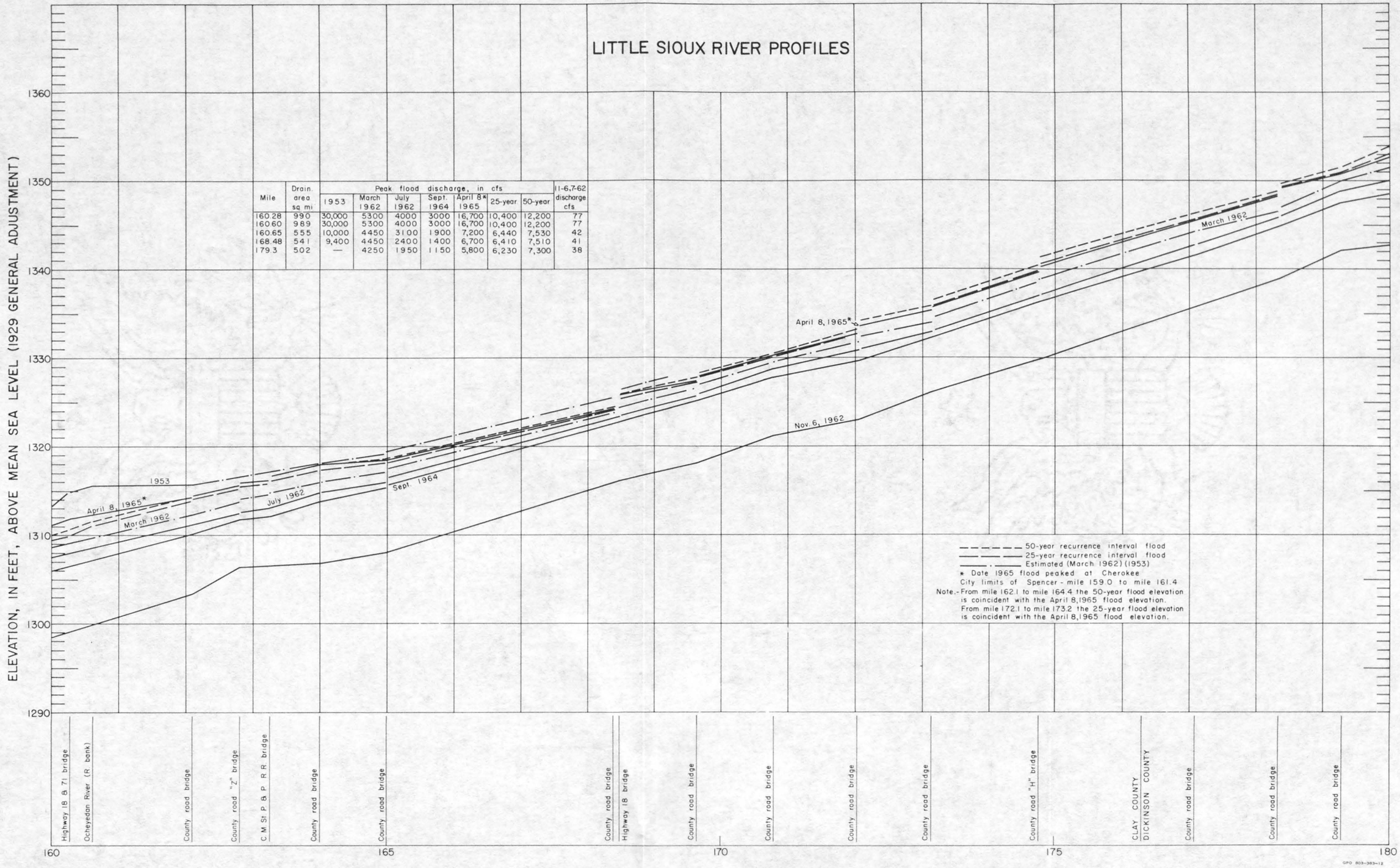

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Plate 10. Little Sioux River profiles, mile 160 to mile 180.

LITTLE SIOUX RIVER PROFILES

Mile	Drain. area sq mi	Peak flood discharge, in cfs: March 1962	July 1962	Sept. 1964	April 8* 1965	25-year	50-year	10-1,2-63 discharge cfs
183.35	485	3950	1800	1050	5400	6150	7200	36
183.40	334	3950	1800	1050	5400	4530	5300	25
191.78	310	3000	1450	900	—	4440	5200	23
197.22	294	2800	700	450	—	4400	5150	21
197.27	119	1100	300	126	—	2010	2350	8
199.80	116	1100	300	—	—	2010	2350	8

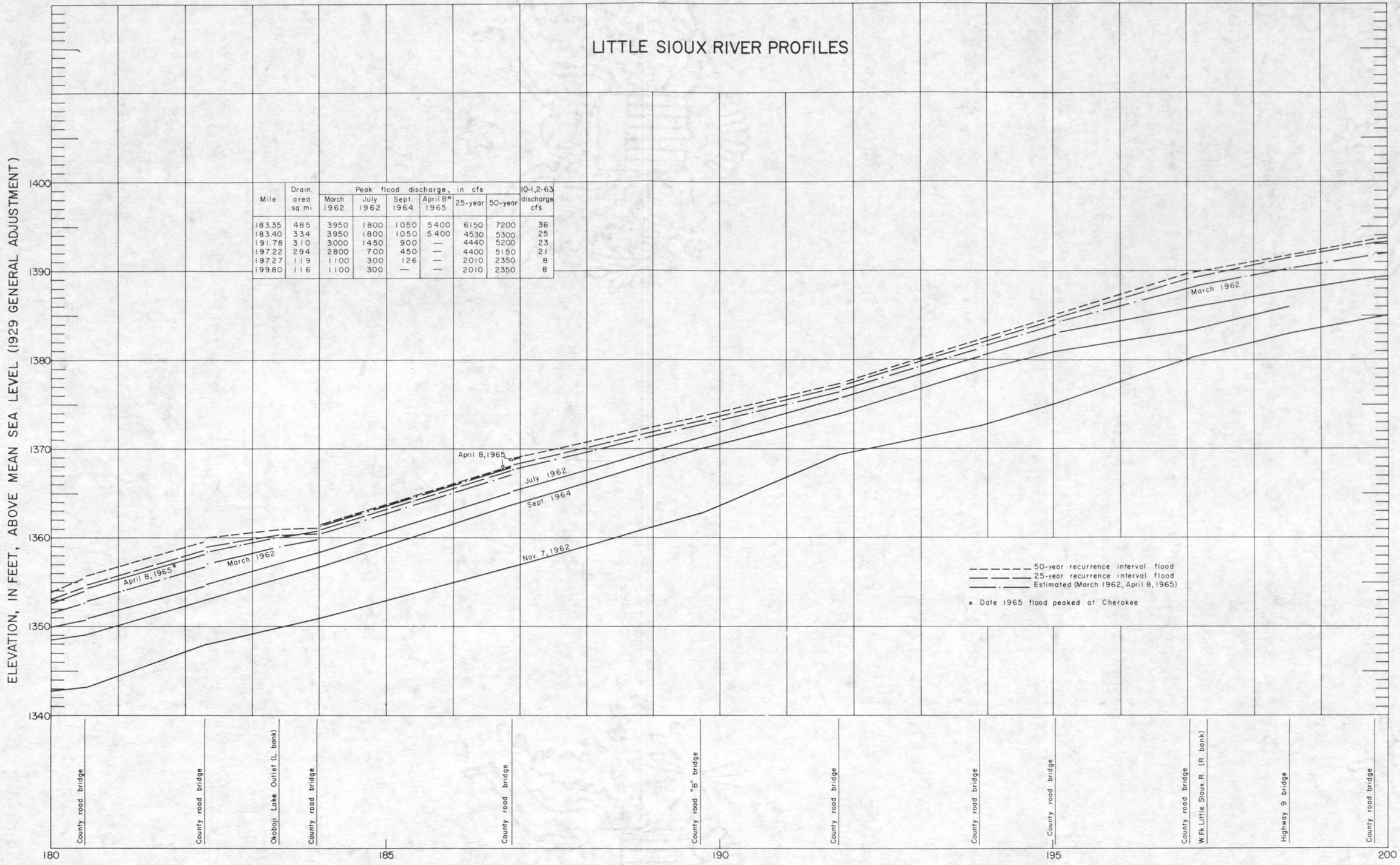

Plate 11. Little Sioux River profiles, mile 180 to mile 200.

LITTLE SIOUX RIVER PROFILES

Mile	Drain. area sq mi	Peak flood discharge, in cfs: March 1962	July 1962	25-year	50-year	11-7-62 discharge cfs
203.30	103	1000	200	2010	2350	6

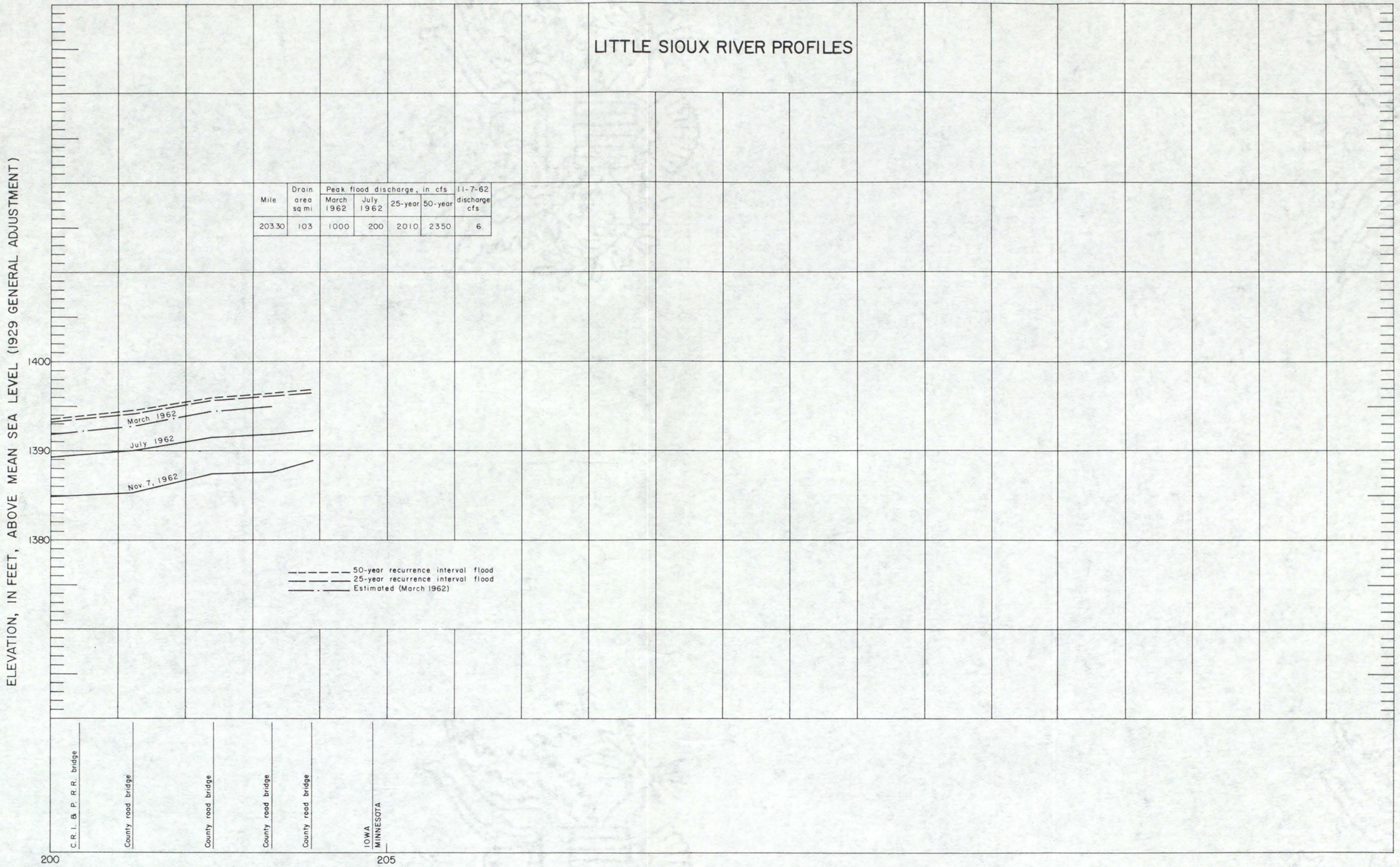

Plate 12. Little Sioux River profiles, mile 200 to mile 204.

MAPLE RIVER PROFILES

Mile	Drain. area sq mi	Peak flood discharge, in cfs: March 1962	25-year	50-year	10-29-63 discharge cfs
16.0	742	12,500	25,100	29,300	70
26.7	695	13,200	24,000	28,000	64

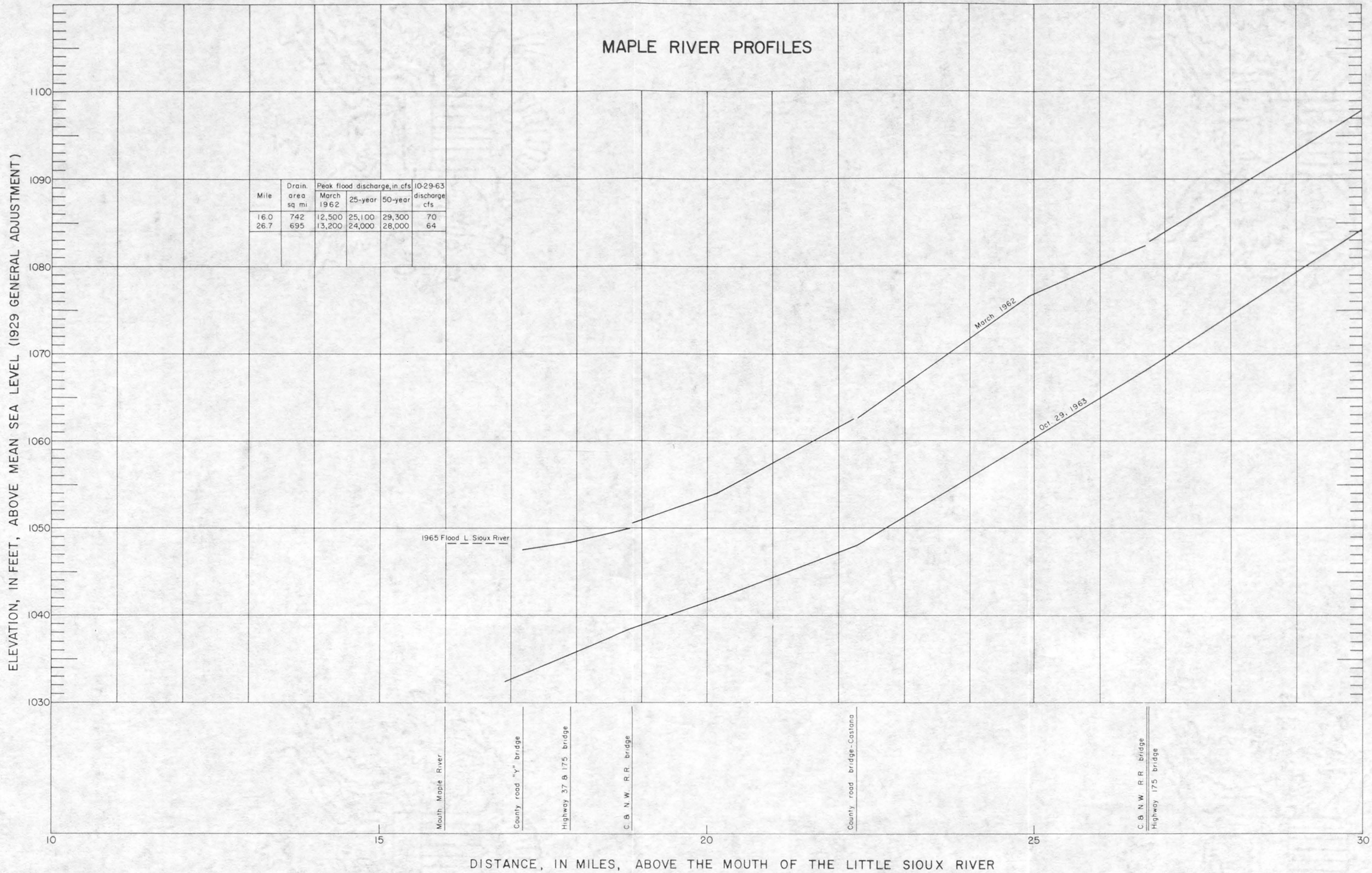

Plate 13. Maple River profiles, mile 17 to mile 30.

MAPLE RIVER PROFILES

Mile	Drain. area sq mi	Peak flood discharge, in cfs			10-29-63 discharge cfs
		March 1962	25-year	50-year	
37.1	622	14,100	22,400	26,300	56
37.15	597	14,300	21,800	25,500	52
39.9	588	14,400	21,700	25,400	49
49.45	513	15,800	20,300	23,700	39
49.5	461	16,400	18,800	22,000	32

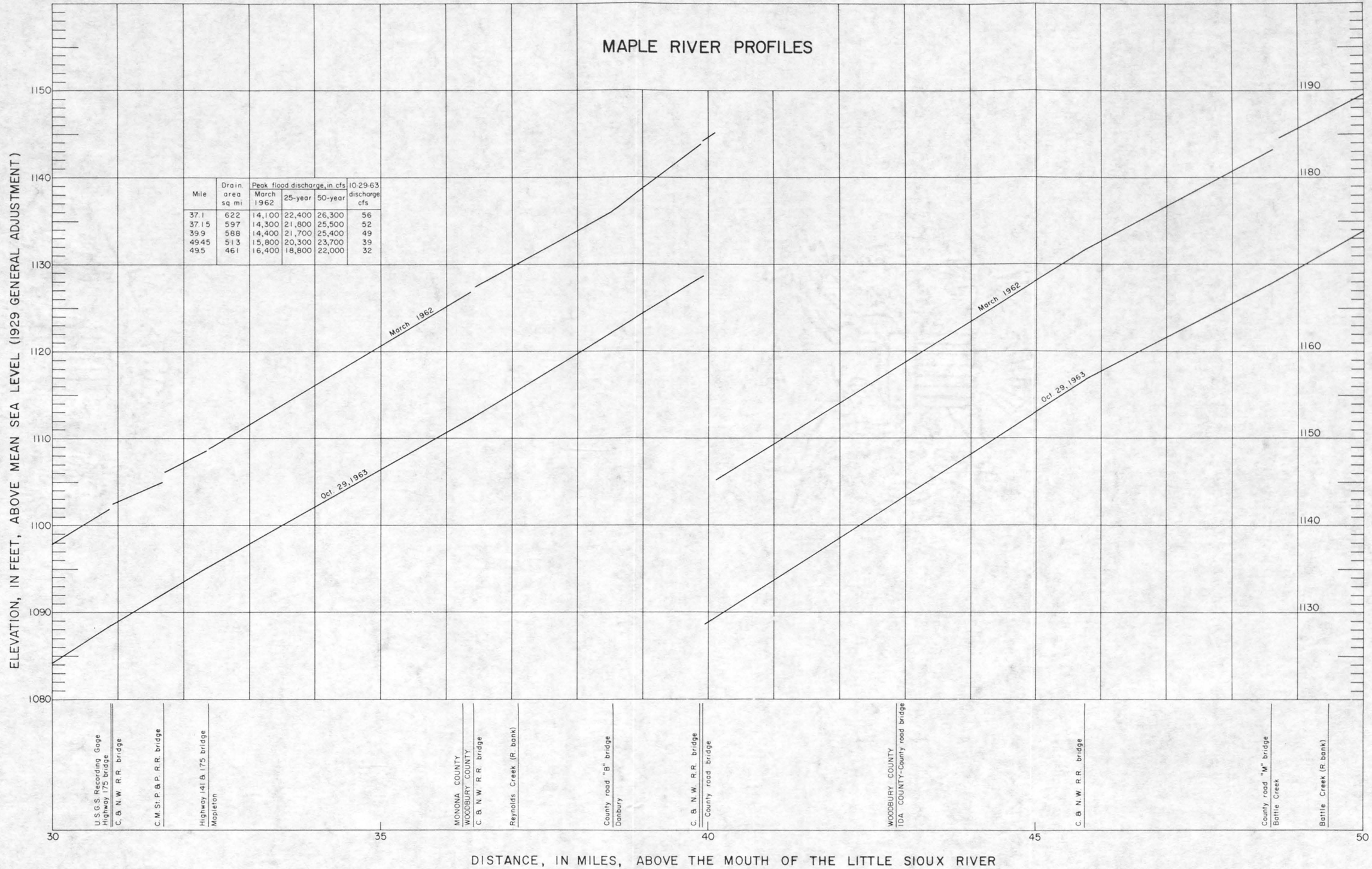

Plate 14. Maple River profiles, mile 30 to mile 50.

MAPLE RIVER PROFILES

Mile	Drain. area sq mi	Peak flood discharge, in cfs			10-29-63 discharge cfs
		March 1962	25-year	50-year	
56.6	428	17,000	18,100	21,200	29
56.65	366	16,200	16,300	19,000	21
58.95	362	16,300	16,200	19,000	21
59.0	323	14,500	14,900	17,500	16
63.45	301	13,500	14,600	17,000	15
63.5	269	12,100	13,500	15,800	10
66.8	247	10,500	12,900	15,000	9

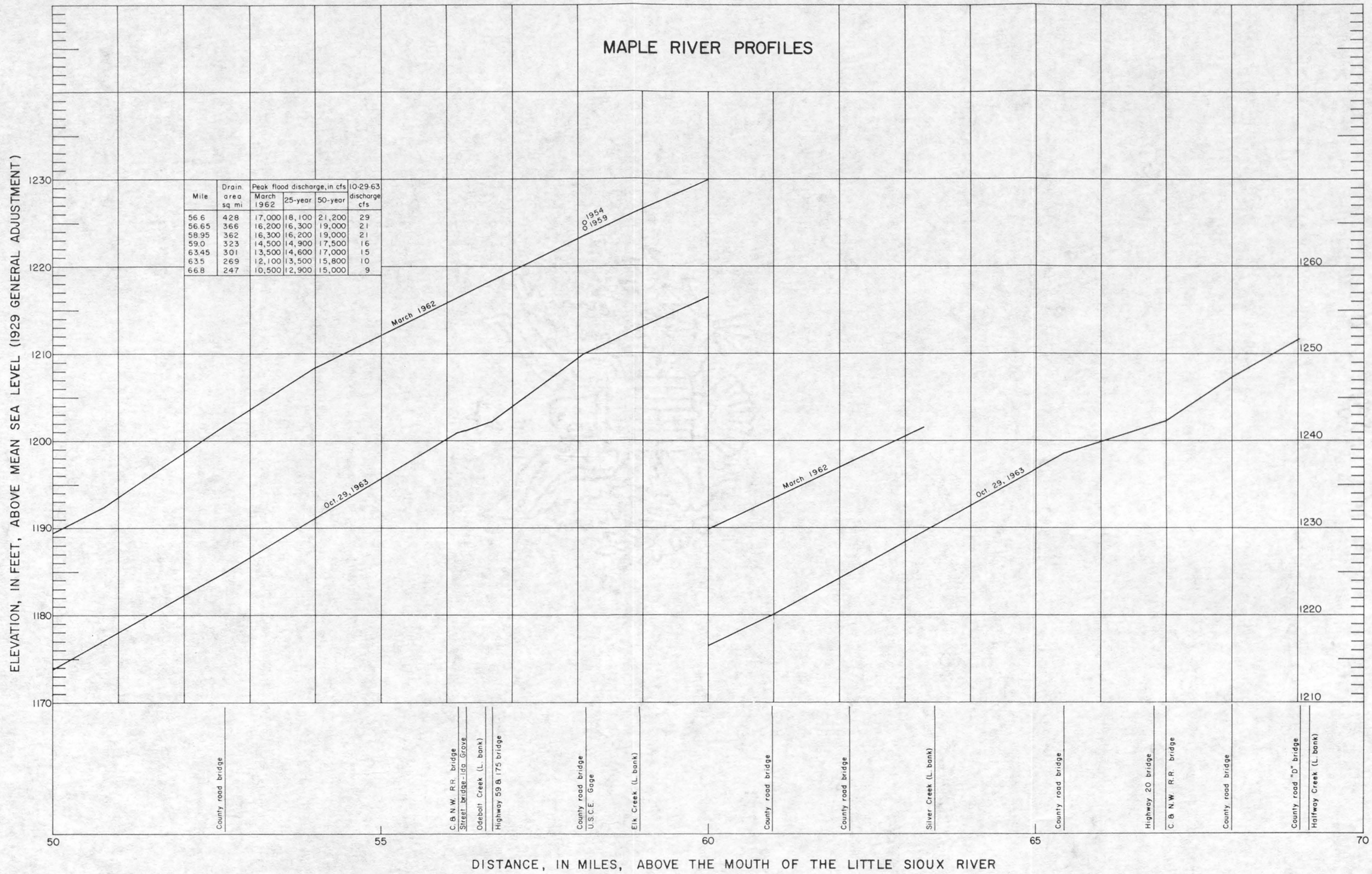

Plate 15. Maple River profiles, mile 50 to mile 69.

OCHEYEDAN RIVER PROFILES

Mile	Drain. area sq mi	Peak flood discharge in cfs: June 1953	Sept. 1964	25-year	50-year
160.6	434			8,640	10,100
164.85	426	26,000		8,240	9,640
168.45	417			8,000	9,360
168.50	325			6,440	7,530
171.25	303		1,200	5,990	7,000
172.80	300		1,200	5,960	6,980
174.35	268			5,350	6,260
178.55	256			5,040	5,900

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

1370
1360
1350
1340
1330
1320
1310
1300

upstream side of bridge 1953

Sept. 8-9, 1964

July 11, 1966 (low water)

1953

1953
Little Sioux River
50-yr
25-yr

Mouth Ocheyedan River
County road bridge
County road "Z" bridge
Stony Creek (L. bank)
County road bridge
County road bridge
County road "C" bridge
County road bridge
C. M. St. P. & P. R. R. bridge
County road bridge
Highway 18 bridge
County road bridge

160
165
170
175
180

DISTANCE, IN MILES, ABOVE THE MOUTH OF THE LITTLE SIOUX RIVER

Plate 16. Ocheyedan River profiles, mile 160 to mile 179.

DISCUSSION

The 1953 and 1965 floods were outstanding flood events on the Little Sioux and the Ocheyedan Rivers. The flood elevation and discharge data in this report for 1965 are a valuable record of these events. Lesser floods have provided data which combine with the data for more outstanding floods to produce information that can be used for many purposes.

Nearly all activities of man which take place on a flood plain can benefit from the flood data included in this report. For the Little Sioux River, the report can provide answers to one or more of several questions either directly or by computation. Among these questions are (1) how high have known floods gotten in the past, (2) how long do they remain above a critical stage for a selected activity, (3) what peak discharges and flood volumes have occurred, and (4) at what average frequency do large floods occur? The answers to the above questions can be obtained from (1) the flood profiles and gaging station records, (2) and (3) hydrographs plotted from the gaging-station records furnished in this report or in the included references, and (4) the flood-frequency data furnished on the profiles or in the included references to this report.

The data available on the Ocheyedan and Maple Rivers were insufficient for analysis as complete as that on the Little Sioux River. However, much useful information on these streams is contained in the report.

The elevation-discharge curves which can be obtained from the profiles represent flood-plain and channel conditions at the time of the floods. They will be changed if the conditions at or downstream from a selected site are altered significantly. A few of the events which will cause such changes are levee construction, new restrictive bridges, dams, large changes in the flood-plain cover, and channel straightening or improvement. The elevation-discharge curves may also be used to obtain new elevations for the 25- and 50-year recurrence interval flood, if the flood-frequency relationships are revised (if flood plain and channel conditions remain virtually stable).

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APPENDIX

The flood records which follow are data for the 1965 flood at gaging stations and miscellaneous sites in the Little Sioux River basin and, for the most part, are not available in other publications. Gaging-station records and lists of flood peaks are available in the publications listed in the References. The station data are arranged in the downstream order used in the reports on surface-water records published by the Geological Survey. The stations are numbered from 1 to 10 in accordance with the numbers shown on plate 1 and in table 3. The parenthetical number which immediately precedes the station name at most stations is the permanent identification number assigned by the U.S.G.S. Historical data, if available, are given in the maxima paragraph of the station descriptions.

1. (6-6051) Little Sioux River at Spencer, Iowa

(Gaging station discontinued 1942)

Location.--Lat 43°08', long 95°08', in sec. 18, T. 96 N., R. 36 W., at bridge on U. S. Highways 18 and 71 at Spencer, 3/4 mile downstream from Ocheyedan River, and at mile 160.3 (U. S. Geological Survey river profile).

Drainage area.--990 sq mi.

Gage-height record.--Peak stages from floodmarks after 1942. Datum of gage was 1294.56 ft above mean sea level, datum of 1929.

Discharge record.--1965 peak discharge determined from discharge measurement in 1965 and estimated on basis of flows of Ocheyedan and Little Sioux Rivers in June 1953.

Maxima.--March-May 1965: Discharge, 16,700 cfs Apr. 6 (gage height, 17.37 ft, from floodmark).

June 8, 1953: Discharge, 30,000 cfs (gage height, 20.20 ft, from floodmark).

2. (6-6056) Little Sioux River at Gillett Grove, Iowa

Location.--Lat 43°01'05", long 95°02'45", in SE¼NW¼ sec. 25, T. 95 N., R. 36 W., on left bank 5 ft downstream from county highway bridge, 0.2 mile northwest of Gillett Grove, 0.9 mile above Elk Creek, and at mile 146.1 (U. S. Geological Survey river profile).

Drainage area.--1,334 sq mi.

Gage-height record.--Water-stage recorder graph except Apr. 8-12. Datum of gage is 1,266.84 ft above mean sea level, datum of 1929.

Discharge record.--Stage-discharge relation defined by current-meter measurements below 19,400 cfs. Discharge Apr. 8-12 estimated on basis of weather records and records for nearby stations. Backwater from ice Mar. 1 to Apr. 5.

Maxima.--March-May 1965: Discharge, 20,200 cfs Apr. 7 (gage height, 18.67 ft).

June 1958 to February 1965. Discharge, 12,900 cfs Mar. 26, 1961 (gage height, 16.93 ft).

Flood of June 9, 1953, reached a stage of 17.87 ft, from floodmark (discharge, about 24,000 cfs).

Little Sioux River at Gillett Grove, Iowa--Continued

Discharge, in cubic feet per second, 1965

Day	March	April	May	Day	March	April	May
1	198	700	1,320	16	158	3,150	1,070
2	158	2,300	1,240	17	180	2,740	1,410
3	128	3,000	1,150	18	198	2,430	1,550
4	116	8,000	1,060	19	160	2,160	1,400
5	110	12,300	1,010	20	110	1,960	1,190
6	108	17,900	948	21	98	1,790	1,060
7	106	18,400	910	22	90	1,640	1,140
8	104	13,000	961	23	82	1,520	1,280
9	104	8,800	1,140	24	78	1,420	1,330
10	104	7,000	1,120	25	74	1,390	1,360
11	106	5,800	1,010	26	70	1,440	1,690
12	110	5,000	951	27	66	1,510	2,150
13	114	4,590	898	28	64	1,500	2,200
14	122	4,040	864	29	62	1,470	1,950
15	140	3,600	876	30	70	1,400	1,730
				31	210	-	1,590
Monthly mean					116	4,732	1,276
Runoff, in inches					0.10	3.96	1.10
Runoff, in acre-feet					7,140	281,600	78,460

Little Sioux River at Gillett Grove--Continued

Gage height, in feet, and discharge, in cubic feet per second at indicated time, 1965

Hour	Gage height	Discharge
	Apr. 5	
2400	17.83	16,500
	Apr. 6	
0600	18.10	17,600
1800	18.22	18,200
2400	18.52	19,500
	Apr. 7	
0500	18.67	20,200
1200	18.42	19,000
2400	17.52	15,300
	Apr. 24	
2400	9.10	1,390
	Apr. 25	
0600	9.08	1,380
2400	9.14	1,400
	Apr. 26	
0600	9.19	1,420
2400	9.40	1,480
	Apr. 27	
1200	9.49	1,520
2400	9.47	1,510
	May 6	
2400	7.45	921
	May 7	
0600	7.41	911
2200	7.39	905
2400	7.41	911
	May 8	
0800	7.49	931
1800	7.70	990
2400	7.89	1,040
	May 9	
0600	8.14	1,110
1400	8.33	1,170
2200	8.38	1,180
2400	8.38	1,180
	May 10	
0600	8.30	1,160
2400	7.94	1,060
	May 14	
2400	7.28	877
	May 15	
1200	7.24	866
2000	7.29	879
2400	7.40	908
	May 16	
0600	7.63	970
1200	7.97	1,070
1800	8.33	1,170
2400	8.64	1,250
	May 17	
0800	9.03	1,370
1400	9.27	1,440
2400	9.57	1,540
	May 18	
0600	9.64	1,570
1200	9.63	1,570
2400	9.47	1,510
	May 19	
1200	9.17	1,410
2400	8.77	1,290
	May 20	
1200	8.40	1,190
2400	8.07	1,090
	May 21	
0400	7.99	1,070
1400	7.90	1,050
2400	7.91	1,050
	May 22	
2400	8.57	1,230
	May 23	
2400	8.86	1,320
	May 24	
2400	8.93	1,340
	May 25	
0200	8.89	1,330
1200	8.94	1,340
1600	8.99	1,360
2400	9.32	1,460
	May 26	
0800	9.72	1,600
1600	10.14	1,770
2400	10.53	1,940
	May 27	
0800	10.84	2,110
1800	11.05	2,260
2400	11.08	2,280
	May 28	
1200	10.99	2,210
2400	10.79	2,080
	May 29	
1200	10.54	1,950
2400	10.28	1,830

3. Little Sioux River near Cherokee, Iowa

(Corps of Engineers gage)

Location.--Lat 42°49'10", long 95°31'35", in NW¼NE¼ sec. 1, T. 92 N., R. 40 W., on county road bridge 3.6 miles upstream from Mill Creek, 5 miles north and 2 miles east of Cherokee, and at mile 94.25 (U. S. Geological Survey river profile).

Drainage area.--1,861 sq mi.

Gage-height record.--Graph based on once-daily, or more frequent, staff-gage readings. Datum of gage is 1,171.35 ft above mean sea level, datum of 1929.

Discharge record.--Stage-discharge relation defined by current-meter measurements below 17,000 cfs. Records not published; daily records not computed. Backwater from ice prior to 1100 hours Apr. 5, 1965.

Maxima.--March-May 1965: Discharge, 26,800 cfs Apr. 6 (gage height, 18.83 ft).
June 11, 1953: Discharge, 21,400 cfs (gage height, 17.48 ft).

Little Sioux River near Cherokee--Continued

Gage height, in feet, and discharge, in cubic feet per second at indicated time, 1965

Hour	Gage height	Discharge	Hour	Gage height	Discharge
	Apr. 5			Apr. 10	
1100	16.50	15,700	0700	15.90	13,500
1500	16.60	16,100	1100	15.80	13,100
1900	16.75	[a]16,700	1500	15.60	12,400
2400	17.5	[a]17,000	1900	15.50	12,100
	Apr. 6			Apr. 11	
0300	18.0	[a]19,000	0700	15.00	10,600
0600	18.5	[a]21,500	1100	14,80	10,100
0900	18.8	[a]24,500	1500	14.70	9,880
1200	18.9	[a]25,500	1900	14.60	9,620
1800	18.83	26,800		Apr. 12	
2400	-	[a]25,600	0700	14.25	8,800
	Apr. 7		1100	14.20	8,680
0600	-	[a]23,900	1500	14.15	8,580
1200	-	[a]23,200	1900	14.10	8,470
1800	-	[a]22,600		Apr. 13	
2400	-	[a]22,300	0700	13.95	8,160
	Apr. 8		1100	13.90	8,050
0600	-	[a]22,300	1500	13.86	7,970
1200	-	[a]21,800	1900	13.80	7,850
1800	-	[a]21,100		Apr. 14	
2400	-	[a]20,400	0700	13.59	7,430
	Apr. 9		1100	13.55	7,350
1100	17.40	19,600	1500	13.48	7,220
1500	17.10	18,300	1900	13.41	7,090
1900	16.70	16,500			

[a] Estimated

4. (6-6063) Mill Creek near Cherokee, Iowa

(Corps of Engineers gage)

Location.--In SE¼NE¼ sec. 15, T. 92 N., R. 40 W., at Highway 59 bridge, 2.7 miles upstream from mouth, 1 3/4 miles north of Cherokee, and at mile 93.3 above mouth of Little Sioux River (U. S. Geological Survey river profile).

Drainage area.--292 sq mi.

Gage-height record.--Graph based on once-daily or more frequent wire-weight gage readings. Datum of gage is 1179.89 ft above mean sea level, datum of 1929.

Discharge record.--Stage-discharge relation defined by current-meter measurements. Records not published; daily records not computed.

Maxima.--March-May 1965: Discharge, 10,400 cfs Apr. 6 (gage height, 13.4 ft).

June 8, 1953: Discharge, 11,500 cfs (gage height, 14.30 ft).

Mill Creek at Cherokee--Continued

Gage height, in feet, and discharge, in cubic feet per second at indicated time, 1965

Hour	Gage height	Discharge	Hour	Gage height	Discharge
	Apr. 3			Apr. 7	
0000	6.4	1,220	0600	7.0	1,550
0600	6.5	1,270	0900	6.3	1,170
1200	6.8	1,430	1200	6.0	1,040
1800	7.5	1,910	2400	5.5	855
2400	8.5	2,800			
	Apr. 4			Apr. 8	
1200	10.6	5,440	1200	5.2	750
1500	10.9	5,860			
1800	10.6	5,440		Apr. 9	
2400	9.6	4,040	1200	5.2	750
	Apr. 5			Apr. 10	
0600	8.7	3,000	1200	5.1	720
1100	8.3	2,600			
1300	8.6	2,900		Apr. 11	
1800	10.4	5,160	1200	4.6	570
2400	12.9	9,400			
	Apr. 6			Apr. 12	
0300	13.4	10,400	1200	3.9	330
0600	13.4	10,400			
0900	13.0	9,600			
1200	12.2	8,060			
1800	10.5	5,300			
2400	8.8	3,100			

5. (6066) Little Sioux River at Correctionville, Iowa

Location.--Lat 42°28'20", long 95°47'50", in NE¼NW¼ sec. 1, T. 88 N., R. 43 W., on right bank 10 ft upstream from bridge on State Highway 31, 0.2 mile upstream from Bacon Creek, 0.5 mile west of Correctionville, 0.8 mile downstream from Pierson Creek, and at mile 56.0 (U. S. Geological Survey river profile).

Drainage area.--2,500 sq mi.

Gage-height record.--Water-stage recorder graph. Datum of gage is 1096.49 ft above mean sea level, datum of 1929.

Discharge record.--Stage-discharge relation defined by current-meter measurements. Backwater from ice Mar. 1 to Apr. 4.

Maxima.--March-May 1965: Discharge, 29,800 cfs Apr. 7 (gage height, 25.86 ft).

May 1918 to February 1965: Discharge 20,900 cfs June 21, 1954 (gage height 23.36 ft).

1891: gage height, 29.34 ft (discharge unknown, may have been affected by failure of dam on Bacon Creek).

Little Sioux River at Correctionville--Continued

Discharge, in cubic feet per second, 1965

Day	March	April	May	Day	March	April	May
1	1,500	3,000	2,030	16	1,500	6,350	1,310
2	600	6,000	1,950	17	3,000	5,580	1,440
3	500	7,500	1,840	18	1,100	4,790	1,410
4	400	9,000	1,730	19	1,000	4,030	1,530
5	370	17,900	1,630	20	900	3,560	1,700
6	360	24,700	1,520	21	800	3,200	1,830
7	350	27,900	1,420	22	700	2,910	1,840
8	350	24,200	1,420	23	600	2,670	1,840
9	350	22,400	1,340	24	500	2,450	1,910
10	350	18,000	1,320	25	460	2,320	2,340
11	370	14,300	1,380	26	430	2,220	3,270
12	420	11,300	1,420	27	410	2,140	3,020
13	500	9,150	1,360	28	400	2,100	2,750
14	600	7,920	1,270	29	400	2,090	2,750
15	800	7,180	1,230	30	450	2,070	2,920
				31	1,000	-	3,000
Monthly mean----------					693	8,631	1,862
Runoff, in inches----------					0.32	3.85	0.86
Runoff, in acre-feet----------					42,590	531,600	114,500

Little Sioux River at Correctionville--Continued

Gage Height, in feet, and discharge, in cubic feet per second at indicated time, 1965

Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge
	Apr. 1		0700	24.54	24,400		Apr. 12	
1200	19.7	Mean daily	0800	24.55	24,500	0600	20.74	11,800
1800	20.3	3,000	1230	24.50	24,300	1200	20.47	11,300
2400	20.5		1500	24.49	24,200	1800	20.20	10,700
	Apr.2		1600	24.50	24,300	2400	19.99	10,200
0600	20.8		1700	24.55	24,500		Apr. 13	
1200	21.1	Mean daily	1800	24.62	24,800	0600	19.76	9,450
1500	21.7	6,000	2000	24.85	25,700	1200	19.59	9,100
1800	21.6		2400	25.43	28,000	1800	19.42	8,740
2400	21.4			Apr. 6		2400	19.28	8,440
	Apr. 3		0200	25.65	28,900		Apr. 14	
0600	21.2		0400	25.80	29,500	0600	19.13	8,120
1000	21.0		0600	25.86	29,800	1200	19.04	7,900
1100	20.8	Mean daily	0700	25.86	29,800	1800	18.92	7,650
1200	20.6	7,500	0800	25.86	29,800	2400	18.85	7,550
1400	20.6		0900	25.86	29,800		Apr. 15	
1800	21.4		1100	25.84	29,600	0600	18.75	7,410
1900	21.4		1300	25.73	29,200	1200	18.60	7,200
2400	20.5		1400	25.66	28,100	1800	18.42	6.950
	Apr. 4		2000	25.24	24,900	2400	18.27	6,740
0100	20.4		2400	24.97	24,600		Apr. 16	
0600	20.1			Apr. 8		0600	18.13	6,540
0900	20.0		0300	24.82	24,400	1200	17.96	6,320
1000	20.2		0600	24.73	24,400	1800	17.82	6,170
1200	20.3	Mean daily	1200	24.55	24,500	2400	17.63	5,930
1300	20.2	9,000	1800	24.41	23,900		Apr. 17	
1400	20.4		2400	24.32	23,600	0600	17.41	5,760
1600	20.4			Apr. 9		1200	17.21	5,570
1800	20.6		0600	24.24	23,300	1900	16.98	5,360
2100	20.8		1200	24.06	22,600	2400	16.82	5,200
2400	21.20		1800	23.81	21,700		Apr. 18	
	Apr. 5		2400	23.49	20,400	0600	16.59	5,000
0000	21.20	12,400		Apr. 10		1200	16.37	4,790
0300	21.66	13,900	0600	23.13	19,100	1800	16.16	4,590
0700	22.25	16,000	1200	22.82	18,000	2400	15.94	4,380
0900	22.63	17,300	1800	22.51	16,900		Apr. 19	
1400	23.11	19,000	2400	22.19	15,900	0600	15.70	4,160
1600	23.28	19,600		Apr. 11		1200	15.50	3,990
1800	23.38	20,000	0600	21.90	15,100	1800	15.31	3,880
2000	23.40	20,100	1200	21.62	14,300	2400	15.10	3,770
2300	24.09	22,700	1800	21.33	13,500			
2400	24.18	23,100	2400	21.03	12,600			
	Apr. 6							
0030	24.18	23,100						
0200	24.39	23,900						
0300	24.46	24,100						

Little Sioux River at Correctionville--Continued

Gage height, in feet, and discharge, in cubic feet per second at indicated time, 1965

Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge
	Apr. 20			Apr. 21			Apr. 22	
0600	14.89	3,660	0600	14.18	3,280	0600	13.56	2,970
1200	14.69	3,550	1200	14.01	3,200	1200	13.39	2,900
1800	14.52	3,460	1800	13.85	3,120	1800	13.26	2,840
2400	14.34	3,360	2400	13.69	3,050	2400	13.15	2,790

6. (6-6067) Little Sioux River near Kennebec, Iowa

Location.--Lat 42°04'55", long 96°00'50", in SE¼SW¼ sec. 18, T. 84 N., R. 44 W., near left bank on downstream side of pier of bridge on Monona County Highway A, 1.1 miles south of Kennebec, 5.5 miles northeast of Onawa, 6.2 miles upstream from Maple River, and at mile 22.0 (U. S. Geological Survey river profile).

Drainage area.--2,738 sq mi.

Gage-height record.--Water-stage recorder graph. Datum of gage is 1027.02 ft above mean sea level (Monona County Highway Department benchmark).

Discharge record.--Stage-discharge relation defined by current-meter measurements. Backwater from ice Mar. 1 to Apr. 2.

Maxima.--March-May 1965: Discharge, 29,700 cfs Apr. 8 (gage height, 26.50 ft).

April 1939-February 1965: Discharge, about 19,000 cfs Mar. 31, 1962; gage height, 26.63 ft, June 21, 1954 (before levees broke in vicinity of gage).

Little Sioux River near Kennebec--Continued

Discharge, in cubic feet per second, 1965

Day	March	April	May	Day	March	April	May
1	2,000	4,500	2,120	16	3,000	7,150	1,240
2	1,500	7,500	2,070	17	3,600	6,100	1,380
3	1,000	11,500	1,950	18	4,000	5,090	1,360
4	900	13,000	1,780	19	3,000	4,560	1,400
5	800	14,000	1,650	20	2,500	4,070	1,530
6	700	18,000	1,560	21	2,200	3,660	1,780
7	650	22,200	1,460	22	2,000	3,340	1,660
8	600	27,900	1,500	23	1,800	3,050	1,750
9	550	25,600	1,380	24	1,500	2,780	1,710
10	500	22,400	1,290	25	1,200	2,590	1,960
11	450	18,500	1,300	26	1,000	2,420	2,730
12	480	14,300	1,370	27	1,000	2,290	3,160
13	600	11,100	1,380	28	1,000	2,210	2,760
14	1,000	9,060	1,300	29	1,000	2,170	2,620
15	1,800	7,940	1,250	30	1,200	2,160	2,680
				31	2,000	-	2,830
Monthly mean					1,469	9,371	1,804
Runoff, in inches					0.62	3.82	0.76
Runoff, in acre-feet					90,310	557,600	110,900

Little Sioux River near Kennebec--Continued

Gage height, in feet, and discharge, in cubic feet per second at indicated time, 1965

Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge
	Mar. 29			Apr. 3			Apr. 8	
1200	10.70	-	0000	19.43	10,300	0400	26.00	25,700
			0300	19.67	10,700	1000	26.28	28,400
	Mar. 30		0900	19.98	11,200	1600	26.45	29.400
0000	10.9		1200	20.06	11,200	1800	26.50	29,700
0300	11.0		1500	20.10	11,300	2000	26.48	29,600
0700	11.1		1600	20.17	11,300	2400	26.45	28,800
1200	10.9	Mean daily	1800	20.44	11,700			
1400	10.9	1,200	2000	20.95	12,500		Apr. 9	
1800	11.3		2400	21.61	13,600	0600	26.33	26,800
2000	12.5					1200	26.22	25,000
2230	14.8			Apr. 4		2100	26.00	24,100
2300	14.8		0300	21.85	14,000	2400	25.93	23,700
2400	15.2		0500	21.90	14,100			
			0600	21.89	14,000		Apr. 10	
	Mar. 31		0900	21.77	13,700	0600	25.84	23,300
0200	16.0		1200	21.51	13,100	1200	25.70	22,700
0400	16.5		1600	21.12	12,400	1500	25.12	20,700
0600	16.8		2000	21.00	12,100	1800	25.50	21,900
0900	17.0		2200	20.92	11,900	2400	25.20	20,900
1200	17.1	Mean daily	2400	20.96	12,000			
1400	17.2	2,000					Apr. 11	
1700	16.9			Apr. 5		0600	24.82	19,700
2000	18.0		0600	21.43	12,800	1200	24.37	18,500
2200	20.5		0900	21.71	13,300	1800	23.92	17,300
2230	21.6		1200	22.12	14,000	2400	23.52	16,300
2400	21.0		1500	22.46	14,700			
			1800	22.64	15,000		Apr. 12	
	Apr. 1		2100	22.90	15,500	1000	22.71	14,600
0030	20.9		2400	23.24	16,200	1600	22.22	13,600
0200	21.2					2400	21.63	12,600
0500	21.2	Mean daily		Apr. 6				
0800	21.0	4,500	0200	23.42	16,600		Apr. 13	
1200	20.9		0600	23.52	16,800	0800	21.00	11,500
2000	20.7		0900	23.70	17,300	1000	20.82	11,200
2400	21.0		1200	24.02	18,100	1600	20.45	10,600
			1800	24.35	18,900	1800	20.34	10,500
	Apr. 2		2400	24.82	20,200	2000	20.25	10,400
0030	21.1					2400	20.00	9,980
0100	21.0			Apr. 7				
0200	20.0	Mean daily	0400	25.03	21,000		Apr. 14	
0400	19.5	7,500	0800	25.32	21,700	0400	19.73	9,560
0600	19.3		1200	25.48	22,200	0800	19.49	9,230
1200	19.3		2400	25.83	24,200	1000	19.39	9,100
1800	19.1					2000	19.01	8,580
						2400	18.86	8,390

Little Sioux River near Kennebec--Continued

Gage height, in feet, and discharge, in cubic feet per second at indicated time, 1965

Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge
	Apr. 15			Apr. 18			Apr. 21	
0100	18.81	8,330	0300	16.19	5,420	0800	14.10	3,710
0300	18.79	8,320	0600	16.00	5,250	0900	14.10	3,710
0500	18.74	8,260	1200	15.78	5,040	1100	14.07	3,680
0700	18.64	8,130	1400	15.71	4,980	1300	13.98	3,610
0900	18.49	7,950	1600	15.68	4,950	1500	13.97	3,620
1100	18.39	7,850	2000	15.57	4,860	2000	13.87	3,550
1300	18.34	7,800	2400	15.47	4,780	2400	13.76	3,480
1700	18.30	7,760						
2200	18.21	7,670		Apr. 19			Apr. 22	
2400	18.13	7,580	0400	15.38	4,700	0200	13.75	3,460
			0700	15.35	4,670	0400	13.68	3,420
	Apr. 16		0800	15.36	4,670	0800	13.63	3,390
0900	17.78	7,200	0900	15.36	4,660	0900	13.64	3,390
1100	17.77	7,200	1200	15.25	4,570	1200	13.58	3,340
1300	17.70	7,120	1500	15.11	4,470	1400	13.52	3,310
1500	17.73	7,150	2000	15.03	4,410	2400	13.34	3,190
1700	17.67	7,080	2400	14.90	4,320			
2100	17.42	6,800					Apr. 23	
2400	17.31	6,670		Apr. 20		0600	13.22	3,120
			0600	14.74	4,200	1200	13.12	3,050
	Apr. 17		0700	14.68	4,150	1500	13.08	3,030
0600	17.06	6,380	1000	14.66	4,130	2100	12.94	2,950
0800	17.02	6,340	1600	14.43	3,960	2400	12.89	2,920
1400	16.73	6,010	1900	14.41	3,950			
1800	16.51	5,770	2100	14.36	3,910		Apr. 24	
2000	16.43	5,680	2400	14.29	3,850	0600	12.77	2,850
2200	16.40	5,650				1200	12.63	2,770
2400	16.30	5,540				1800	12.54	2,720
						2400	12.43	2,650

7. (6-6069) Maple River near Ida Grove, Iowa

(Corps of Engineers gage)

Location.--Lat 42°21'50", long 95°27'10", in SW¼NW¼ sec. 12, T. 87 N., R. 40 W., on county road bridge approximately one mile northeast of Ida Grove, and at mile 58.1 above mouth of Little Sioux River (U. S. Geological Survey river profile).

Drainage area.--364 sq mi.

Gage-height record.--Once-daily or more frequent wire-weight gage readings. Datum of gage is 1208.22 ft above mean sea level, datum of 1929.

Discharge record.--Stage discharge relation not defined except June 1963 and April 1965. Records not published; daily records not computed.

Maxima.--March-May 1965: Discharge, 8,000 cfs Apr. 1 (gage height, 14.70 ft).

1950-62: Gage heights only (see table 3).

8. (6-6070) Odebolt Creek near Arthur, Iowa

Location.--Lat 42°20'05", long 95°22'55", in SE¼NE¼ sec. 21, T. 87 N., R. 39 W., near center of span on downstream side of county highway bridge, 700 ft south of State Highway 175, 2 miles west of Arthur, 4.5 miles east of Ida Grove, and 5 miles upstream from mouth and Maple River.

Drainage.--39.3 sq mi.

Gage-height record.--Water-stage recorder graph except Mar. 2-10, 14, 17-30; Apr. 2, 4-14, May 27-31. Graph reconstructed from daily wire-weight gage readings Mar. 19, 30, Apr. 5. Datum of gage is 1,258.57 ft above mean sea level, datum of 1929.

Discharge record.--Stage-discharge relation defined by current-meter measurements below 5,130 cfs. Discharge Apr. 6-14, May 27-30 estimated on basis of weather records and records for nearby stations. Backwater from ice Mar. 1 to 1400^{h} Apr. 3.

Maxima.--March-May 1965: Discharge, 1,360 cfs Apr. 3 (gage height, 11.14 ft); gage height, 14.11 ft Mar. 31.

October 1957 to February 1965: Discharge, 5,200 cfs Aug. 30, 1962 (gage height, 13.78 ft).

Flood of July 3, 1951, reached a stage of 11.96 ft, from floodmark (discharge, 4,320 cfs, from contracted-opening measurement of peak flow).

Odebolt Creek near Arthur--Continued

Discharge, in cubic feet per second, 1965

Day	March	April	May	Day	March	April	May
1	50	400	8.8	16	30	14	43
2	12	350	8.5	17	16	14	30
3	9.0	600	8.2	18	11	13	27
4	7.4	440	8.2	19	8.8	13	25
5	7.2	411	8.2	20	7.6	12	22
6	7.4	230	7.7	21	6.8	13	22
7	7.8	142	8.7	22	6.2	12	45
8	8.6	84	84	23	6.0	13	50
9	11	64	21	24	5.8	13	89
10	15	50	14	25	5.8	14	152
11	20	41	12	26	5.8	13	246
12	25	30	11	27	6.0	12	100
13	30	24	10	28	6.8	12	46
14	31	20	9.2	29	8.2	10	38
15	32	16	110	30	40	9.5	32
				31	440	-	28
Monthly mean					28.5	103	42.7
Runoff, in inches					0.84	2.92	1.25
Runoff, in acre-feet					1,750	6,130	2,630

Odebolt Creek near Arthur--Continued

Gage height, in feet, and discharge, in cubic feet per second at indicated time, 1965

Hour	Gage height	Discharge
	Apr. 3	
0000	7.02	
0400	7.52	
0600	8.37	
0800	9.58	
1030	10.97	
1200	9.04	
1300	11.39	
1400	9.61	
1500	9.36	779
1800	11.14	1,360
2100	10.24	950
2200	9.66	830
2400	8.09	571
	May 6	
2400	3.99	7.42
	May 7	
1400	4.00	7.69
2100	3.98	7.15
2400	4.44	26.3
	May 8	
0100	4.53	33.7
0200	4.87	71.0
0300	5.16	111
0400	5.28	128
0500	5.60	190
0600	5.84	231
0800	5.46	163
1000	5.06	98.3
1200	4.82	66.0
1400	4.70	54.8
2400	4.47	28.1
	May 14	
2400	4.04	8.8
	May 15	
1400	4.09	10.5
1500	5.48	166
1600	6.87	400
1700	7.04	422
1800	6.85	397
2000	6.15	286
2100	5.60	197
2200	5.24	140
2300	4.99	98.3
2400	4.84	80.6
	May 16	
0400	4.55	52.2
1000	4.40	38.5
1600	4.34	34.4
2400	4.31	32.4
	May 21	
2400	4.09	19.8
	May 22	
0300	4.12	21.4
0500	4.35	35.1
0600	4.74	70.0
0700	4.90	87.4
1000	4.66	62.2
1200	4.65	61.2
1400	4.58	54.8
1600	4.39	37.8
2000	4.31	32.4
2400	4.28	30.5
	May 23	
1400	4.21	26.3
1800	4.23	27.5
1900	4.34	34.4
2000	4.93	91.0
2200	5.14	121
2300	5.69	210
2400	5.81	226
	May 24	
0200	5.69	210
0300	5.31	150
0400	4.99	101
0500	4.79	75.1
0600	4.66	62.2
1200	4.46	44.6
1800	4.48	46.1
2000	4.53	50.4
2100	4.69	65.0
2200	5.44	169
2300	5.68	208
2400	5.43	170
	May 25	
0400	5.11	117
0600	4.87	83.9
0800	4.70	66.0
1200	4.51	48.7
1800	4.61	57.6
1900	4.90	87.4
2000	6.83	394
2330	7.74	520
2400	7.68	511
	May 26	
0200	6.98	414
0300	6.59	363
0600	7.09	429
1100	6.15	286
1400	5.39	164
1800	4.89	86.2
2400	4.67	63.1

9. (6-6072) Maple River at Mapleton, Iowa

Location.--Lat 42°09"30", long 95°48'25", in SE¼SE¼ sec. 23, T. 85 N., R. 43 W., on right pier on downstream side of bridge on State Highway 175, 80 ft downstream from Chicago & Northwestern Railway Co. bridge, 0.5 mile southwest of Mapleton, 12.5 miles northeast of Turin, 16.0 miles upstream from mouth, and 30.9 miles upstream from mouth of Little Sioux River (U. S. Geological Survey river profile).

Drainage area.--669 sq mi.

Gage-height record.--Water-stage recorder graph except Mar. 2, 8, 9, 28, 29, Apr. 10-13, May 30, 31. Datum of gage is 1085.86 ft above mean sea level, datum of 1929.

Discharge record.--Stage-discharge relation defined by current-meter measurements. Backwater from ice Mar. 1-27, 30, discharge estimated on basis of weather records and records for nearby stations.

Maxima.--March-May 1965: Discharge, 9,240 cfs Apr. 1 (gage height 12.14 ft).

October 1941-February 1965: Discharge, 15,600 cfs June 20, 1954; gage height, 22.1 ft June 12, 1950.

Maple River at Mapleton--Continued

Discharge, in cubic feet per second, 1965

Day	March	April	May	Day	March	April	May
1	1,000	8,630	151	16	1,200	264	312
2	800	5,760	148	17	600	238	188
3	600	4,700	143	18	250	223	151
4	400	7,020	138	19	150	205	126
5	300	7,170	136	20	100	196	109
6	250	6,050	130	21	90	194	233
7	200	3,300	128	22	80	185	185
8	160	1,880	402	23	70	180	196
9	140	1,310	370	24	70	174	514
10	120	892	185	25	70	191	622
11	110	625	146	26	70	202	963
12	130	478	126	27	150	185	616
13	300	366	116	28	229	180	430
14	600	323	109	29	234	166	320
15	900	291	180	30	600	158	291
				31	4,490	-	258
Monthly mean----------					467	1,725	262
Runoff, in inches----------					0.80	2.88	0.45
Runoff, in acre-feet----------					28,690	102,600	16,110

Maple River at Mapleton--Continued

Gage height, in feet, and discharge, in cubic feet per second at indicated time, 1965

Hour	Gage height	Discharge
	Mar. 30	
0000	3.24	
0400	3.26	
0600	3.30	
0800	3.38	
0900	3.44	Mean daily
1100	3.37	600
1200	3.39	
1300	3.47	
1400	3.66	
1500	4.10	
1600	4.60	
1700	5.40	
1800	6.25	
2000	7.10	
2100	6.92	
2230	7.35	
2330	7.30	
2400	7.16	2,970
	Mar. 31	
0030	6.95	2,760
0200	6.68	2,540
0330	6.57	2,460
0600	6.55	2,440
0900	6.30	2,240
1000	6.31	2,250
1100	6.43	2,340
1230	6.48	2,380
1400	7.10	2,890
1500	7.95	3,660
1600	9.40	5,230
1700	10.60	6,740
1800	11.40	7,980
1900	11.68	8,460
2100	11.90	8,830
2300	12.03	9,050
2400	12.07	9,120
	Apr. 1	
0130	12.14	9,240
0400	12.01	9,020
0530	11.81	8,680
0600	11.85	8,740
0700	11.78	8,630
1000	11.78	8,630
1100	11.76	8,590
1200	11.70	8,490
1400	11.76	8,590
1500	11.74	8,560
1630	11.85	8,740
2230	11.43	8,030
2400	11.54	8,220
	Apr. 2	
0500	11.55	8,240
0600	11.42	8,010
0800	11.00	7,300
1000	10.27	6,300
1300	9.24	5,040
1600	8.45	4,150
2000	7.90	3,610
2400	7.45	3,200
	Apr. 3	
0400	6.85	2,680
0500	6.75	2,600
0630	6.67	2,540
0700	6.70	2,560
0930	6.79	2,630
1130	6.80	2,640
1300	6.92	2,740
1400	7.22	3,000
1500	8.25	3,950
1600	9.85	5,770
1700	11.05	7,380
1830	11.80	8,660
2000	11.82	8,690
2200	11.78	8,630
2330	11.87	8,780
2400	11.85	8,740
	Apr. 4	
0130	11.88	8,800
0400	11.61	8,340
0700	11.12	7,500
0900	10.88	7,130
1200	10.65	6,810
1400	10.50	6,600
2100	10.05	6,020
2400	10.36	6,420
	Apr. 5	
0100	10.50	6,600
0300	11.00	7,300
0600	11.50	8,150
0730	11.67	8,440
0900	11.55	8,240
1100	11.25	7,720
1300	11.07	7,420
1600	10.75	6,950
1830	10.50	6,600
2200	9.95	5,890
2400	10.15	6,140
	Apr. 6	
0400	10.50	6,600
0800	10.92	7,190
1100	10.50	6,600
1300	10.22	6,240
1800	9.57	5,430
2400	8.88	4,620
	Apr. 7	
0600	8.19	3,890
0900	7.83	3,550
1000	7.56	3,340
1500	7.45	3,200
1700	7.20	2,980
2100	6.44	2,350
2400	5.97	1,980
	Apr. 8	
0100	5.92	1,940
0200	6.24	2,180
0330	6.58	2,450
0600	6.18	2,130
0800	5.92	1,920
1100	5.74	1,780
1530	5.52	1,600
1700	5.63	1,670
2000	5.77	1,780
2400	5.66	1,700
	Apr. 9	
0400	5.48	1,560
0900	5.15	1,340
1400	4.92	1,200
2000	4.84	1,150
2100	4.85	1,160
2200	4.86	1,160
2400	4.81	1,130

10. (6-6075) Little Sioux River near Turin, Iowa

Location.--Lat 41°57'55", long 95°58'20", in NW¼NE¼ sec. 33, T. 83 N., R. 44 W., on downstream side of left pier of bridge on Brown's grade, 2.5 miles downstream from Maple River, 3.8 miles south of Turin, 6.2 miles northeast of Blencoe, and at mile 13.5 (U. S. Geological Survey river profile).

Drainage area.--3,526 sq mi. Prior to Jan. 15, 1958, 4,426 sq mi. (combined area of Little Sioux River and Monona-Harrison ditch).

Gage-height record.--Water-stage recorder graph except Apr. 22-26. Datum of gage is 1019.85 ft above mean sea level, datum of 1929 (Corps of Engineers benchmark).

Discharge record.--Stage-discharge relation defined by current-meter measurements. Backwater from ice Mar. 1-31. Discharge computed from wire-weight gage readings Apr. 22-26.

Maxima.--March-May 1965: Discharge, 27,100 cfs Apr. 8 (gage height, 26.05 ft).

January 1958-February 1965: Discharge, 24,400 cfs Mar. 29, 1962; gage height, 25.08 ft Mar. 30, 1960.

Little Sioux River near Turin--Continued

Discharge, in cubic feet per second, 1965

Day	March	April	May	Day	March	April	May
1	3,000	16,000	2,280	16	4,200	7,320	1,490
2	2,000	14,200	2,200	17	5,000	6,480	1,560
3	1,000	13,700	2,120	18	4,500	5,780	1,560
4	900	17,300	2,000	19	3,500	5,220	1,550
5	800	18,100	1,870	20	2,500	4,660	1,720
6	700	22,100	1,750	21	2,000	4,120	2,240
7	600	25,900	1,870	22	1,800	3,760	2,020
8	580	26,600	1,710	23	1,600	3,380	2,060
9	560	25,100	1,800	24	1,500	3,040	2,120
10	550	22,900	1,480	25	1,400	2,830	2,710
11	550	19,300	1,420	26	1,300	2,640	3,580
12	550	15,300	1,500	27	1,300	2,470	4,120
13	1,000	11,200	1,520	28	1,400	2,370	3,440
14	2,000	9,100	1,420	29	1,600	2,310	3,140
15	3,500	8,250	1,360	30	2,500	2,310	3,140
				31	10,000	-	3,280
Monthly mean					2,077	10,790	2,130
Runoff, in inches					0.68	3.41	0.70
Runoff, in acre-feet					127,000	642,100	131,000

Little Sioux River near Turin--Continued

Gage height, in feet, and discharge, in cubic feet per second at indicated time, 1965

Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge
	Mar. 30			Apr. 2			Apr. 6	
0000	13.8		0100	21.30	13,700	0100	24.27	20,800
0600	14.2		0200	21.95	15,000	0300	24.39	21,300
1200	14.3		0300	22.11	15,300	0500	24.42	21,400
1500	14.3		0400	22.14	15,400	0900	24.40	21,400
1800	14.8	Mean daily	0900	22.07	15,100	1200	24.45	21,700
2000	16.5	2,500	1000	21.93	15,000	1400	24.51	22,000
2100	15.9		1200	21.77	14,600	1800	24.71	22,800
2200	16.7		1500	21.37	13,900	2400	25.04	24,000
2230	19.5		2000	20.78	12,800			
2300	18.7		2100	20.80	12,800		Apr. 7	
2400	18.6		2400	20.68	12,600	0600	25.31	25,300
	Mar. 31			Apr. 3		0900	25.41	26,000
0100	19.0		0800	20.72	12,700	1200	25.50	26,400
0300	19.4		1000	20.80	12,800	1700	25.60	26,600
1200	20.3		1300	20.84	12,900	2100	25.60	26,400
1430	21.1	Mean daily	1500	20.90	13,000	2400	25.61	26,200
1500	21.0	10,000	1600	20.97	13,100			
1530	21.2		1700	21.15	13,500		Apr. 8	
1600	20.5		1800	21.53	14,200	0100	25.63	26,100
1800	21.5		2200	22.89	17,000	0400	25.76	26,200
2130	23.4		2400	23.20	17,700	0900	26.01	26,900
2200	23.2					1200	25.99	26,800
2400	23.9			Apr. 4		1400	26.05	27,100
			0200	23.37	18,100	2400	25.91	26,400
	Apr. 1		0400	23.48	18,400			
0000	23.90	19,400	0500	23.50	18,400		Apr. 9	
0300	23.71	18,900	0600	23.49	18,400	0300	25.86	26,200
0600	23.22	17,700	0800	23.42	18,200	1200	25.60	25,000
0900	22.53	16,200	1200	23.11	17,500	1800	25.43	24,300
1200	22.13	15,400	1500	22.79	16,700	2100	25.37	24,100
1500	21.86	14,800	1800	22.59	16,300	2400	25.35	24,100
1800	21.68	14,500	2100	22.51	16,100			
2100	21.50	14,100	2400	22.55	16,200		Apr. 10	
2400	21.29	13,700				0300	25.33	24,000
				Apr. 5		0600	25.25	23,700
			0300	22.59	16,300	1200	25.06	23,000
			0400	22.63	16,500	1800	24.83	22,200
			1400	23.49	18,500	2400	24.55	21,200
			1600	23.64	18,900			
			1800	23.72	19,200		Apr. 11	
			2100	23.79	19,400	0600	24.26	20,300
			2400	24.13	20,400	1200	23.87	19,300
						1800	23.49	18,400
						2400	23.09	17,400

Little Sioux River near Turin--Continued

Gage height, in feet, and discharge, in cubic feet per second at indicated time, 1965

Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge
	Apr. 12			Apr. 14			Apr. 17	
0600	22.65	16,400	0600	19.04	9,330	0200	17.01	6,800
1200	22.11	15,300	0900	18.98	9,240	1000	16.68	6,520
2000	21.43	13,800	1400	18.78	8,970	1600	16.51	6,380
2400	21.07	13,100	1800	18.64	8,770	1800	16.37	6,280
	Apr. 13		2400	18.51	8,590	2400	16.16	6,130
1000	20.19	11,300		Apr. 15			Apr. 18	
1900	19.56	10,200	0300	18.44	8,490	1200	15.65	5,740
2400	19.34	9,820	0600	18.40	8,430	2400	15.35	5,520
			0900	18.34	8,350			
			1100	18.28	8,280		Apr. 19	
			1200	18.32	8,320	0600	15.13	5,360
			2400	17.96	7,820	1800	14.75	5,070
						2400	14.59	4,950
				Apr. 16				
			0400	17.81	7,620		Apr. 20	
			0600	17.76	7,560	0400	14.43	4,830
			1200	17.53	7,260	0800	14.31	4,750
			1600	17.41	7,150	1000	14.22	4,680
			1800	17.41	7,150	1600	14.09	4,580
			2400	17.11	6,890	2000	13.94	4,480
						2400	13.82	4,400
							Apr. 21	
						1200	13.41	4,110
						2400	13.03	3,850