UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

FLOODS IN THE SKUNK RIVER BASIN, IOWA

Prepared in cooperation with the

HIGHWAY RESEARCH BOARD
HIGHWAY DIVISION
IOWA DEPARTMENT OF TRANSPORTATION

Open-file report WRD 79-272

Iowa City, Iowa

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Factors for converting English Units to International System (SI) Units

The following factors may be used to convert the English units published herein to the International System of Units (SI).

Multiply English units	By	To obtain SI units
	-Length-	
inches (in)	25.4	millimeters (mm)
feet (ft)	.3048	meters (m)
miles (mi)	1.609	kilometers (km)
	-Area-	
acres	4,047	square meters (m^2)
square miles (mi^2)	2.590	square kilometers (km^2)
	-Volume-	
gallons (gal)	0.003785	cubic meters (m^3)
cubic feet (ft^3)	.02832	cubic meters (m^3)
cfs-day (ft^3/s-day)	2,447	cubic meters (m^3)
acre-feet (acre-ft)	1,233	cubic meters (m^3)
	-Flow-	
cubic feet per second (ft^3/s)	0.02832	cubic meters per second (m^3/s)
	28.32	cubic decimeters per second (dm^3/s)

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INTRODUCTION

Purpose and Scope

Evaluation of flood hazards, and the planning, design, and operation of various facilities on flood plains require information on floods. This report provides information on flood stages and discharges, flood magnitude and frequency, and flood profiles for the Skunk River and some of its tributaries. It covers the Skunk - South Skunk Rivers to Ames, and the lower reaches of tributaries as follows: Squaw Creek, 8.2 miles; Indian Creek, 11.6 miles; North Skunk River, 83.2 miles; Cedar Creek, 55.8 miles; and Big Creek, 21.7 miles.

Acknowledgments

This report is the eighth in a series prepared in cooperation with the Highway Research Board, Highway Division, Iowa Department of Transportation. Various Federal, State, and local agencies cooperated in the collection of the streamflow records used in this report, acknowledgment of which is contained in the annual streamflow reports of the U.S. Geological Survey. The Corps of Engineers, U.S. Army, provided the data used to define the 1944 and 1965 flood profiles.

BASIN DESCRIPTION

The Skunk River basin is long and narrow, extending from near the center of the State southeastward to the Mississippi River (fig. 1). It covers 4,355 square miles and includes parts of 20 counties.

Land elevations range from 1200 ft. in the headwaters to 518 ft. above National Geodetic Vertical Datum of 1929 at the Mississippi River. Approximately the upper quarter of the basin, that which was covered by the Wisconsin glaciation, has a youthful topography with an incompletely developed drainage system. In the remainder of the basin, the topography is well-developed, the streams are mature, and the uplands are well-drained.

The channel of the South Skunk River has been straightened from near Ames downstream through Mahaska County. Through this reach and the reach from near Augusta to the Mississippi River the flood plain of the South Skunk and Skunk Rivers is as much as two miles wide. The flood plain is somewhat narrower from Mahaska County to near the mouth of Cedar Creek where the valley narrows to about a quarter of a mile. The narrow valley continues to near Augusta, about 13 miles upstream from the Mississippi. The channel of the North Skunk River has been artificially straightened through most of Jasper County.

Land use in the basin is predominantly agricultural. There are about 75 incorporated cities and towns, the largest of which are Ames (population, 43,561, recent special census) and Newton (population 15,619, 1970 census).

Normal annual precipitation (1941-70) varies from 31 inches in the headwaters to 35 inches in the lower basin. Average annual runoff varies similarly from about 6 to 8 inches.

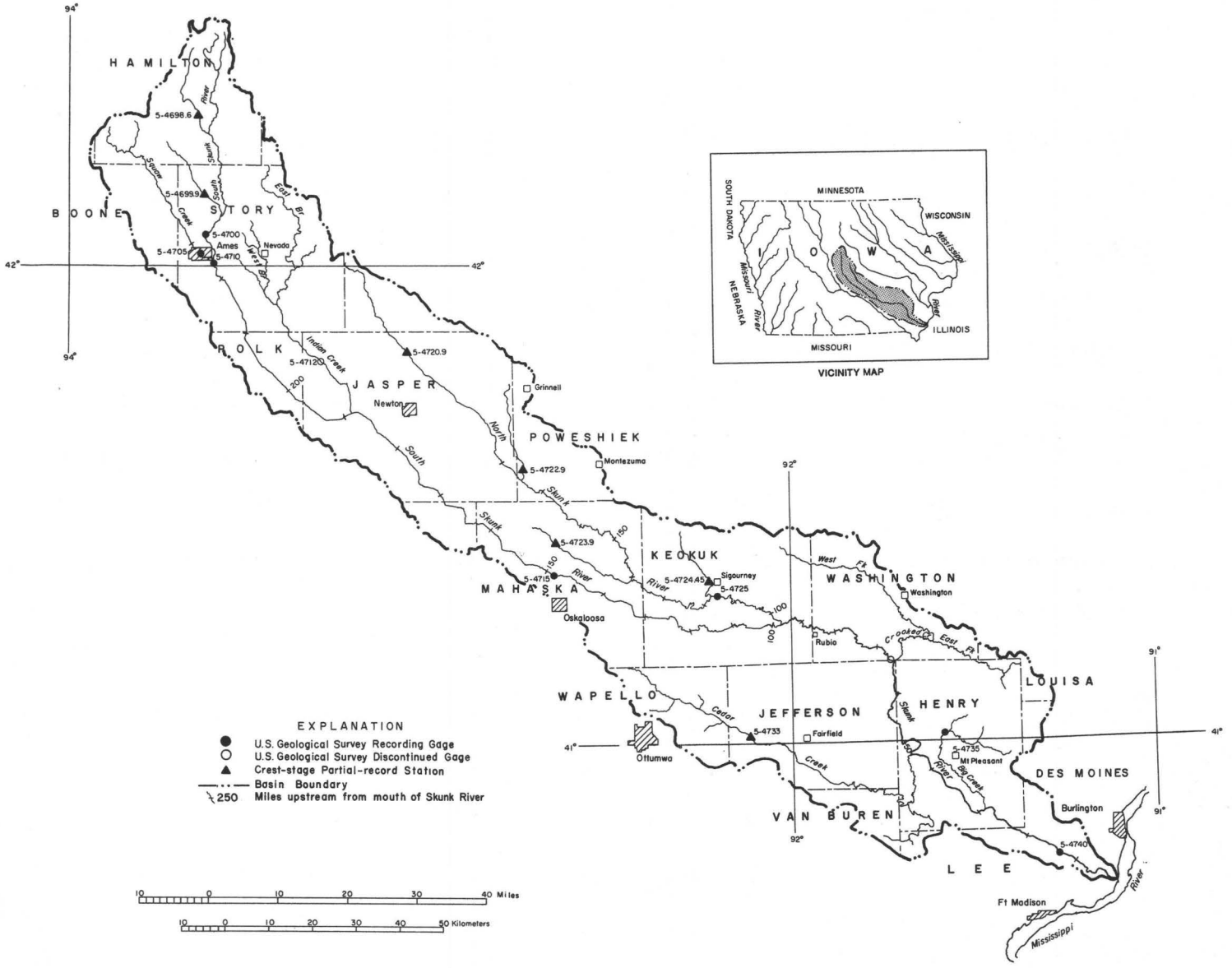

Figure 1. Map of Skunk River basin.

FLOOD HISTORY

Basinwide severe flooding seldom occurs in the Skunk River basin. This may be because of the shape of the basin and its orientation in relation to storm tracks. Floods occurred over much of the State in 1851, 1881, and May-June 1903 but little information is known about these floods in this basin. Since the beginning of streamflow records in the basin in 1913, the most outstanding basinwide flood was that of May 1944. Basinwide floods of lesser degree occurred in June 1947 and March-April 1960. The June 1947 floods were remarkable for their total volume of runoff and for the length of time flooding occurred. June 1947 runoff was 6.73 inches on the South Skunk River near Ames and 5.13 inches on the Skunk River at Augusta, record monthly runoffs for the two stations. The wettest 3-month period in the basin occurred March-through-May 1973, when 8.62 and 10.91 inches of runoff were recorded for the stations near Ames and at Augusta, respectively.

Notable floods occurred in the upper basin of the Skunk River in June 1918, June 1954, and June 1975. Except for the 1975 flood, these and other floods in the upper basin are described briefly in Corps of Engineers' flood plain information reports (1966, 1975). The June 1975 flood in Ames resulted in probably the greatest urban flood damage in the flood history of the Skunk basin. Lara and Heinitz (1976) describe this flood in considerable detail.

The flood of April 1973 in the lower basin coincided with a record flood on the Mississippi. The 1973 peak discharge at the Augusta gaging station is believed to be the greatest since 1851.

The random nature of flood occurrence is illustrated by the graph of annual flood peaks at the gaging station on the Skunk River at Augusta (fig. 2). Maximum recorded flood discharges at gaging stations in the Skunk River basin are given in table 1. A complete list of flood peaks for each station is included in the section on Gaging Station Records.

Table 1.--Maximum flood peaks at gaging stations in the Skunk River basin, Iowa

Station number	Gaging station	Period of flood record	Drainage area (mi^2)	Maximum flood			
				Date	Gage height (ft)	Discharge (ft^3/s)	Recurrence interval (yrs)
05469860	Mud L. dr. ditch 71 in Jewell	1966-77	65.4	6/27/75	90.04	2,300	18
05469990	Keigley Branch nr Story City	1966-77	31.0	6/14/76	91.47	1,550	37
05470000	South Skunk R. nr Ames	1921-27, 1930,1933-77	315	6/10/54	13.66	8,630	60
05470500	Squaw Cr. at Ames	1918-27, 1965-77	204	6/27/75	14.00	11,300	*
05471000	South Skunk R. blw Squaw Cr. nr Ames	1944, 1953-77	556	6/27/75	25.57	14,700	*
05471200	Indian Cr. nr Mingo	1958-75	276	6/12/66	16.41	7,380	12
05471500	South Skunk R. nr Oskaloosa	1944, 1946-77	1,635	5/44	25.80	37,000	*
05472090	North Skunk R. nr Baxter	1966-77	52.2	6/12/66	84.42	†	
05472290	Sugar Cr. nr Searsboro	1966-77	52.7	6/12/66	92.82	4,100	9
05472390	Middle Cr. nr Lacey	1966-77	23.0	4/24/76	90.06	9,650	*
05472445	Rock Cr. at Sigourney	1966-77	26.3	9/17/70	91.29	3,300	11
05472500	North Skunk R. nr Sigourney	1944, 1946-77	730	3/31/60	25.33	27,500	*
05473000	Skunk R. at Coppock	1903, 1914-50	2,916	5/24/44	22.27	41,500	50
05473300	Cedar Cr. nr Batavia	1965-77	252	9/21/65	92.80	26,000	*
05473500	Big Cr. nr Mt. Pleasant	1956-77	106	4/22/73	25.58	10,500	90
05474000	Skunk R. at Augusta	1903, 1915-77	4,303	4/23/73	27.05	66,800	*

* Greater than the 100-year flood discharge
† Discharge not determined

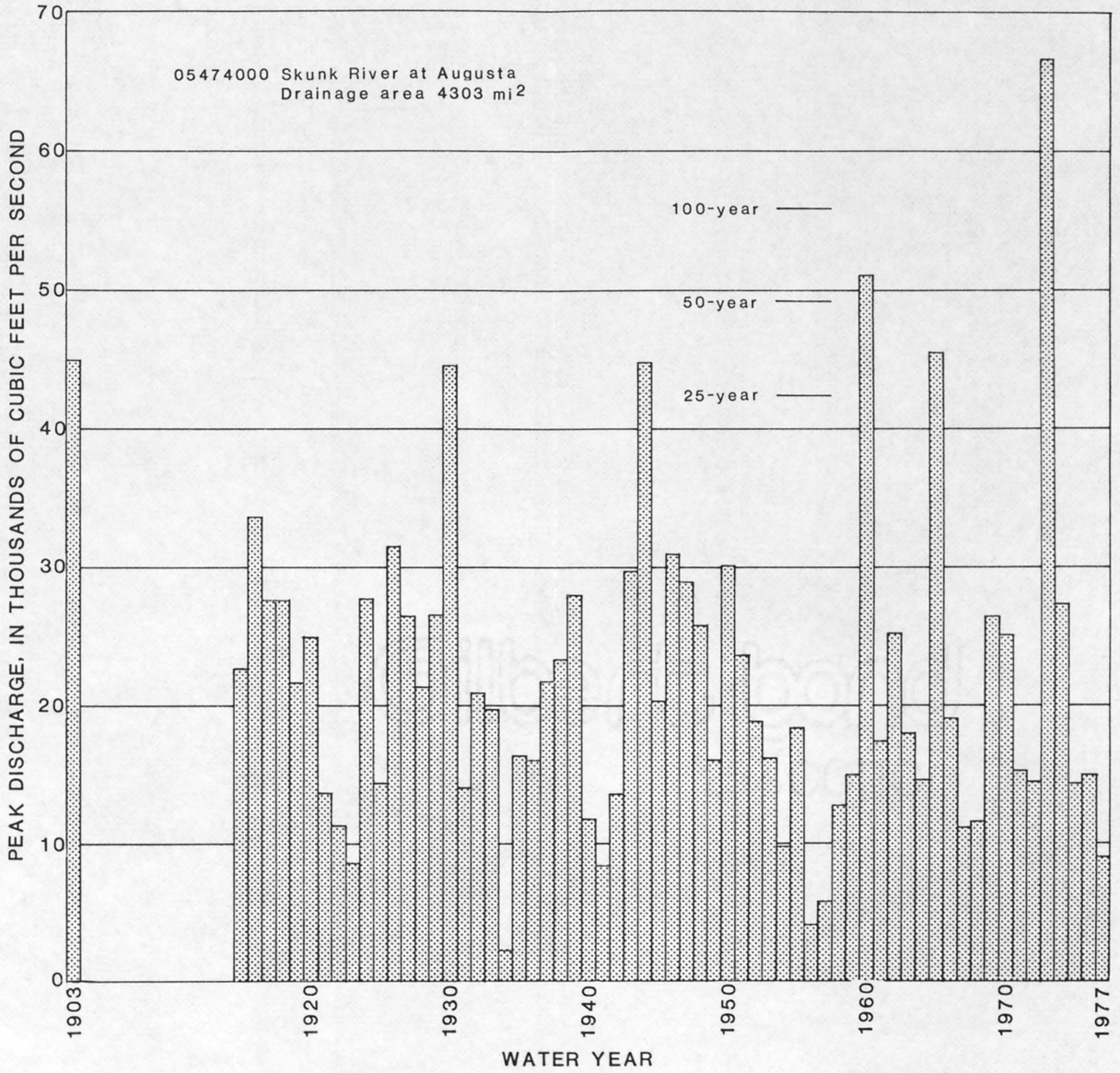

Figure 2. Annual peak discharges for the Skunk River at Augusta.

BASIC DATA

Gaging-station records are the primary means for analyzing and understanding the flood hydrology of the Skunk River basin. Flood information is obtained from the records of complete-record stations, which provide a continuous chronology of streamflow, and from crest-stage, partial-record stations which provide only flood-peak data above pre-selected levels. The stations in the Skunk basin are identified in figure 1 and table 1. Discharge records for them are published in the annual streamflow reports of the U.S. Geological Survey (U.S. Geol. Suvey). The data on flood-peak stages and discharges from these records have been compiled by Lara (1976) and are published in the section on Gaging-Station Records.

The derivation of discharge records at a gaging station depends basically upon the development of a relationship between water-surface elevations (stages) and the corresponding flow rates. The highwater portion of these stage-discharge relationships, or rating curves as they are sometimes called, tends to be relatively stable if the channel downstream from a gaging site remains unobstructed. Stage-discharge relationships for selected stations in the Skunk River basin are shown in figure 3. Similar relationships have been developed for the other gaging stations in the basin. Gaging stations are important control points in the definition of the flood profiles presented in this report.

In order to reference all the points along the profiles to a common datum, extensive leveling work was performed during which at least one bench mark and a reference point were established at each bridge in the profiled reaches. Bench mark and reference point descriptions and elevations are published in a 1977 open-file report (U.S. Geol. Survey).

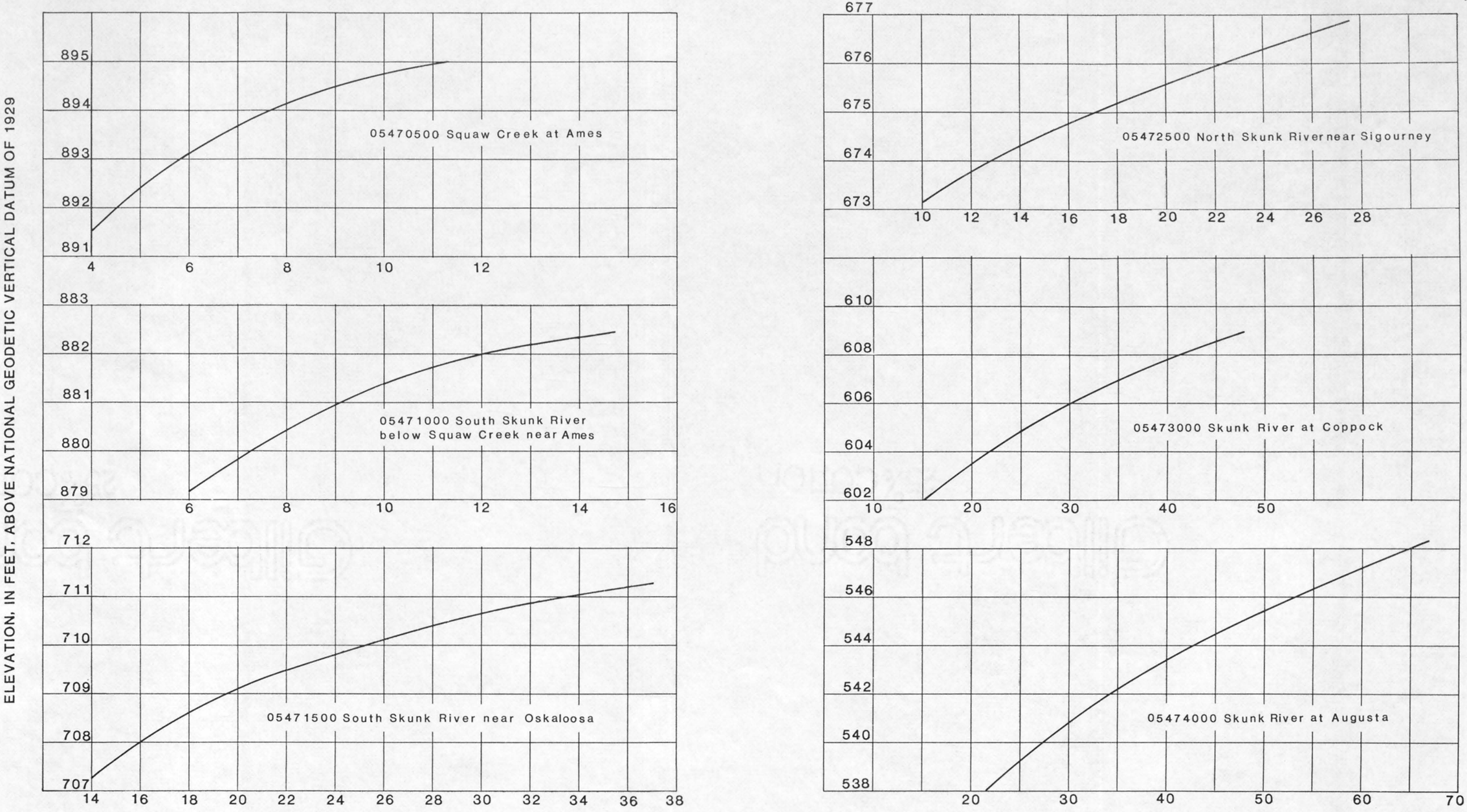

Figure 3. Stage-discharge relationships at selected gaging stations in the Skunk River basin.

FLOOD FREQUENCIES

The shape of the basin, and the physiographic differences between the upstream and downstream parts of the basins are factors contributing to the complexity of flood magnitude-frequency relations in the Skunk basin. A single simple relationship does not apply for the entire basin.

In the most recent statewide flood-frequency study, Iowa Natural Resources Council Bulletin 11, Lara (1973) divided the state into two regions having sharply different flood characteristics. The Skunk basin is in both regions. The part of the basin upstream from about the Polk-Story County line, is in Region II, and the remainder of the basin is in Region I. Flood discharges for specific frequencies (table 2) for all complete-record stations in Region I, except for the South Skunk River near Oskaloosa, were computed using the relations contained in Bulletin 11. For the Oskaloosa station, flood discharges were computed by prorating Region I and II relationships upon the basis of the proportion of the drainage area in each Region.

Subsequent to the publication of Bulletin 11, the U.S. Water Resources Council (1976) promulgated new guidelines for the analysis of floods. Using these guidelines, Lara and Heinitz (1976) developed new flood magnitude-frequency relationships for three gaging stations in the vicinity of Ames. The new guidelines were also used in computing flood magnitudes and frequencies for the station on Indian Creek near Mingo.

The families of curves in figure 4 represent an integration of the above concepts for the determination of flood magnitude and frequency along the profiled reaches of the Skunk, South Skunk, and North Skunk Rivers.

Table 2.--Discharge and frequency of flood flows for complete-record gaging stations in the Skunk River basin

Station No.	Station Name	Method *	Discharge, in ft^3/s, for indicated recurrence interval, in yrs.					
			2	5	10	25	50	100
05470000	South Skunk R. nr Ames	A	3,050	4,870	6,060	7,490	8,510	9,470
05470500	Squaw Cr. at Ames	A	2,380	3,770	4,680	5,770	6,530	7,270
05471000	South Skunk R. blw Squaw Cr. at Ames	A	4,750	7,370	9,050	11,000	12,500	13,800
05471200	Indian Cr. nr Mingo	B	4,200	5,900	7,000	8,400	9,300	10,500
05471500	South Skunk R. nr Oskaloosa	C	7,160	12,500	16,400	21,200	24,900	28,600
05472500	North Skunk R. nr Sigourney	D	5,690	10,200	13,700	18,400	22,200	26,000
05473000	Skunk R. at Coppock	D	12,400	21,200	27,500	35,600	41,700	47,600
05473500	Big Cr. nr Mount Pleasant	D	1,860	3,610	5,070	7,200	9,010	10,900
05474000	Skunk R. at Augusta	D	15,100	25,600	32,900	42,300	49,300	55,900

* Method used:

A - Region II model (Lara and Heinitz, 1976, fig. 20)
B - Bulletin 17 (U.S. Water Resources Council, 1976)
C - Region I, model 2 and Region II, proration by area (Lara, 1973, pp. 13, 14)
D - Region I, model 2 (Lara, 1973, p. 13)

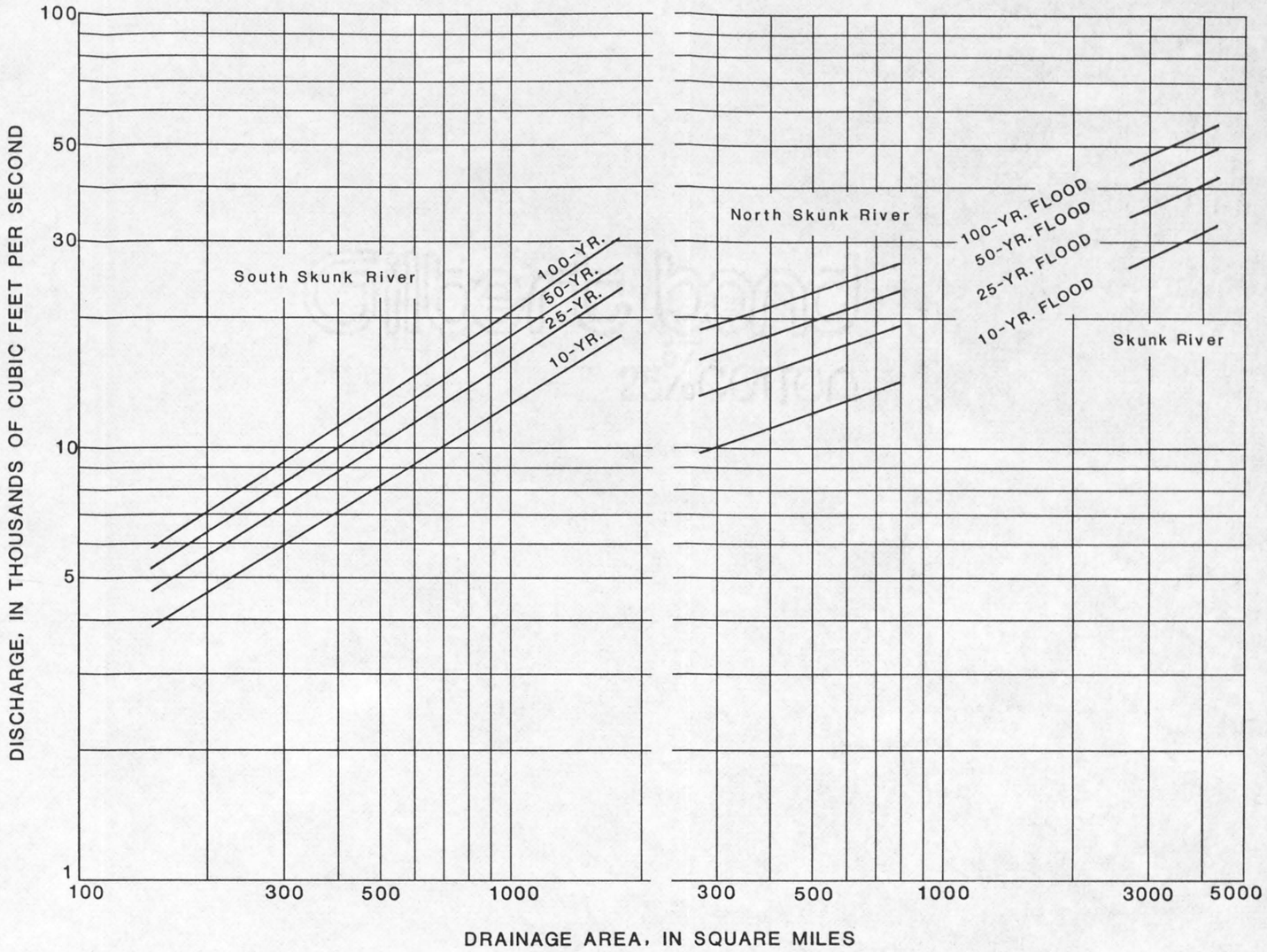

Figure4. Flood magnitude-frequency relationships along main stems of Skunk, South Skunk, and North Skunk Rivers.

FLOOD PROFILES

The following 24 illustrations, figs. 5-28, show the profiles of various floods that have occurred on the Skunk River and its principal tributaries. A profile for the computed 50-year flood along 64 miles of the North Skunk River is shown, and notations on the relative elevations of the 25- and 50-year floods appear on many of the figures.

The Corps of Engineers, U.S. Army, supplied the data for the 1944 and 1965 flood profiles. Except for the 50-year flood noted above, the remainder of the flood profiles were defined by field data obtained by the U.S. Geological Survey. To define these profiles, high-water marks located both upstream and downstream from bridges and at some intermediate points were identified and marked within a few days of passage of the flood peaks. The marks were later referenced to a common datum by leveling. Low-water profiles are also shown to indicate the approximate range of stage that applies along the profiled reaches.

Discharges at gaging stations for the various profiles are noted on the appropriate illustrations. For Cedar Creek, discharges for the April 1976 flood were taken from a discharge-drainage area relationship based on the rated discharge for the partial-record station near Batavia, and discharge measurements at several other locations made by field surveys after the flood.

River mileages, determined from the best available maps, are referenced to the mouth of the Skunk River at the Mississippi River. Bridges and a few other points are designated by an index number that helps to identify their location. For example, 7101-3 NW refers to a location in T.71 N., R.1 W., NW¼ sec.3.

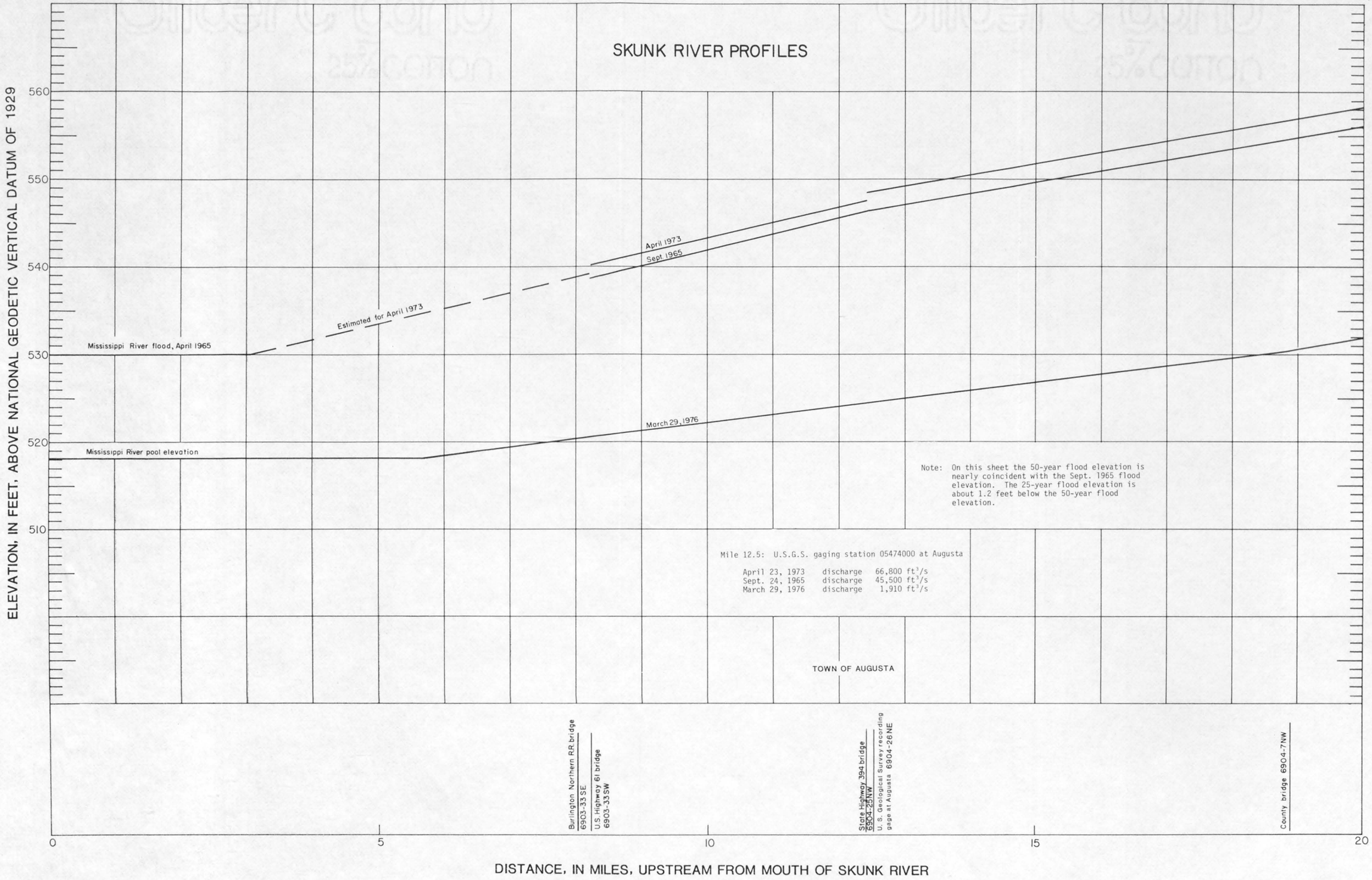

Figure 5. Skunk River profiles, mile 0 to mile 20.

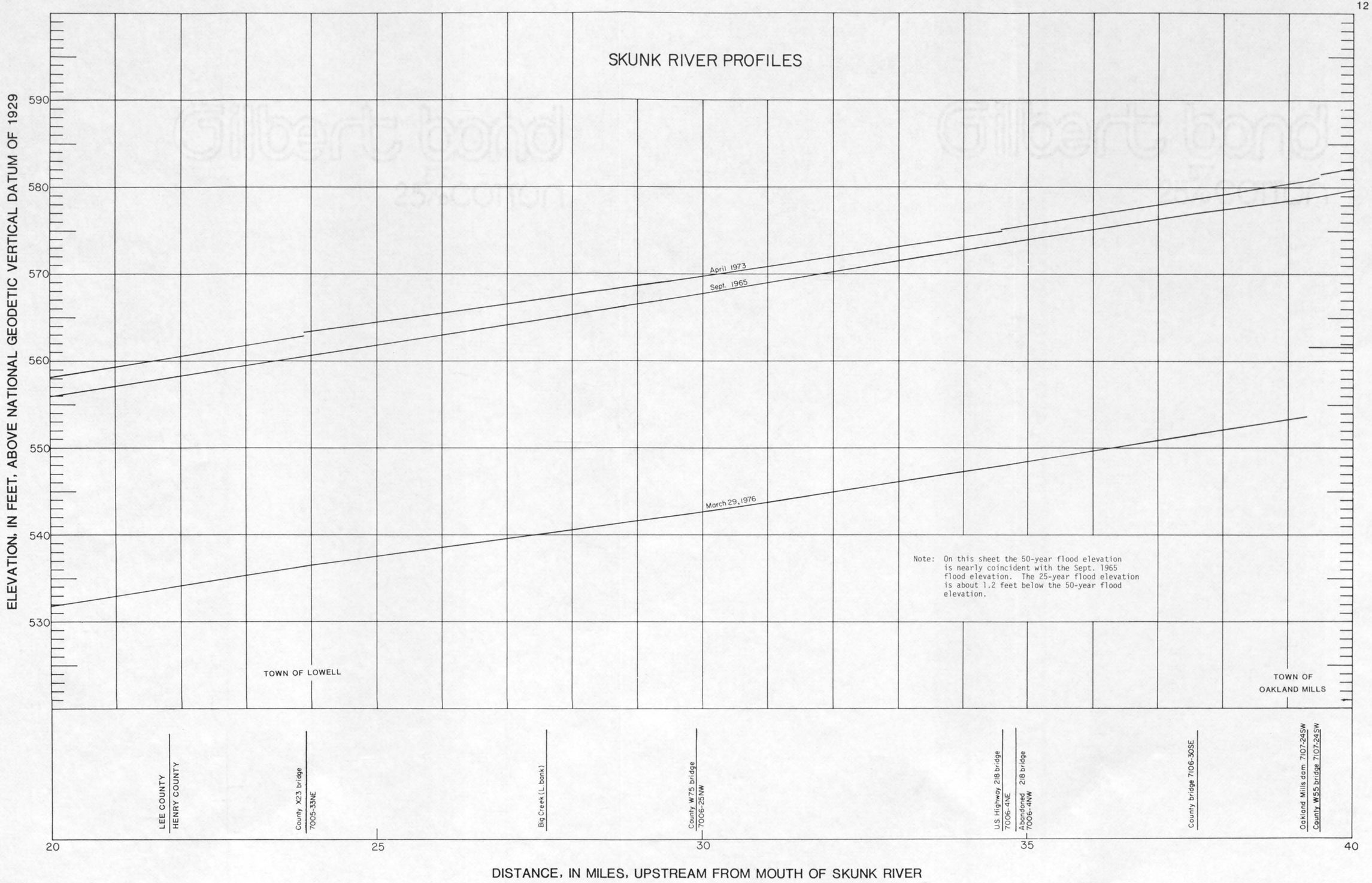

Figure 6. Skunk River profiles, mile 20 to mile 40.

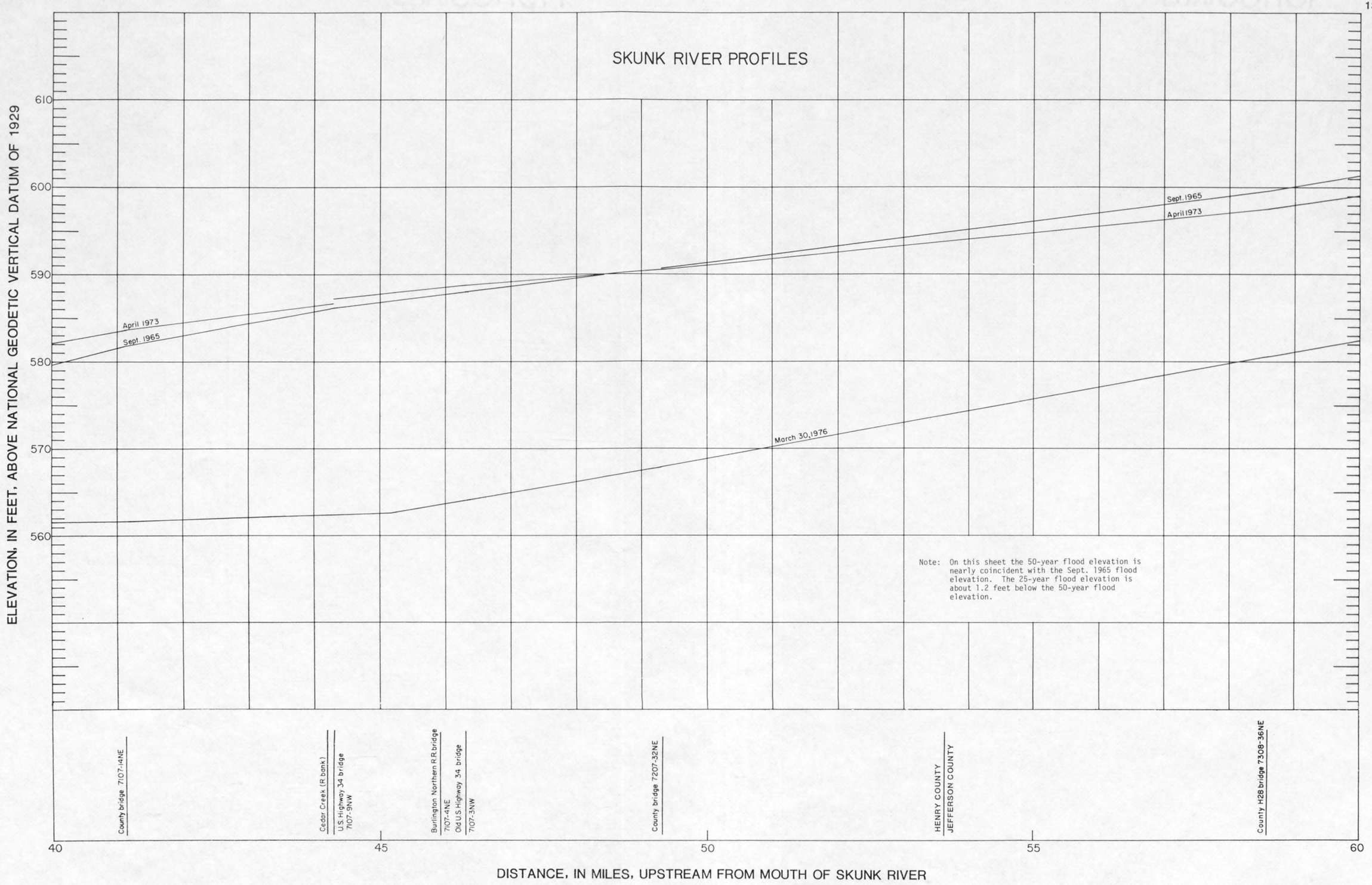

Figure 7. Skunk River profiles, mile 40 to mile 60.

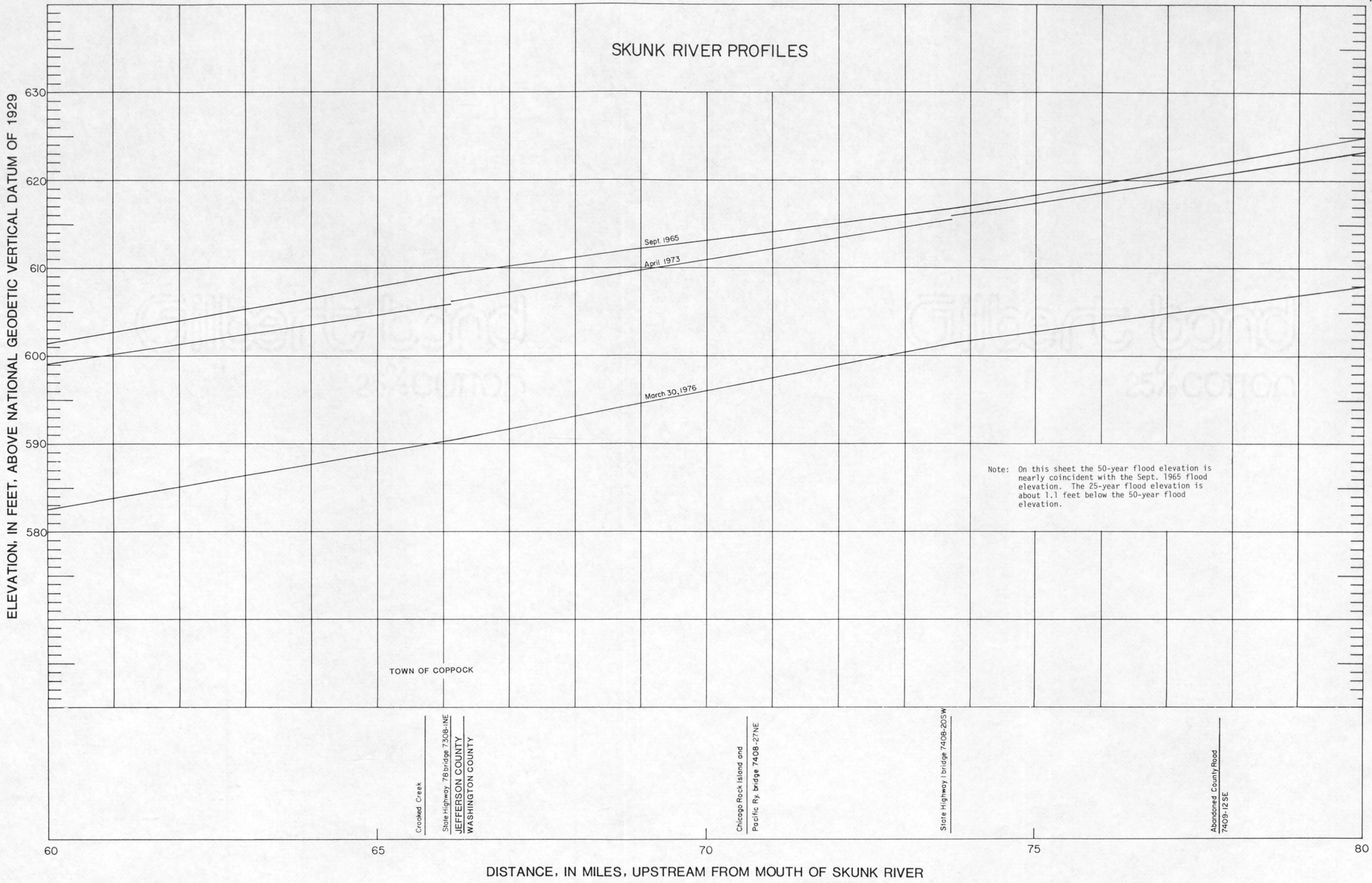

Figure 8. Skunk River profiles, mile 60 to mile 80.

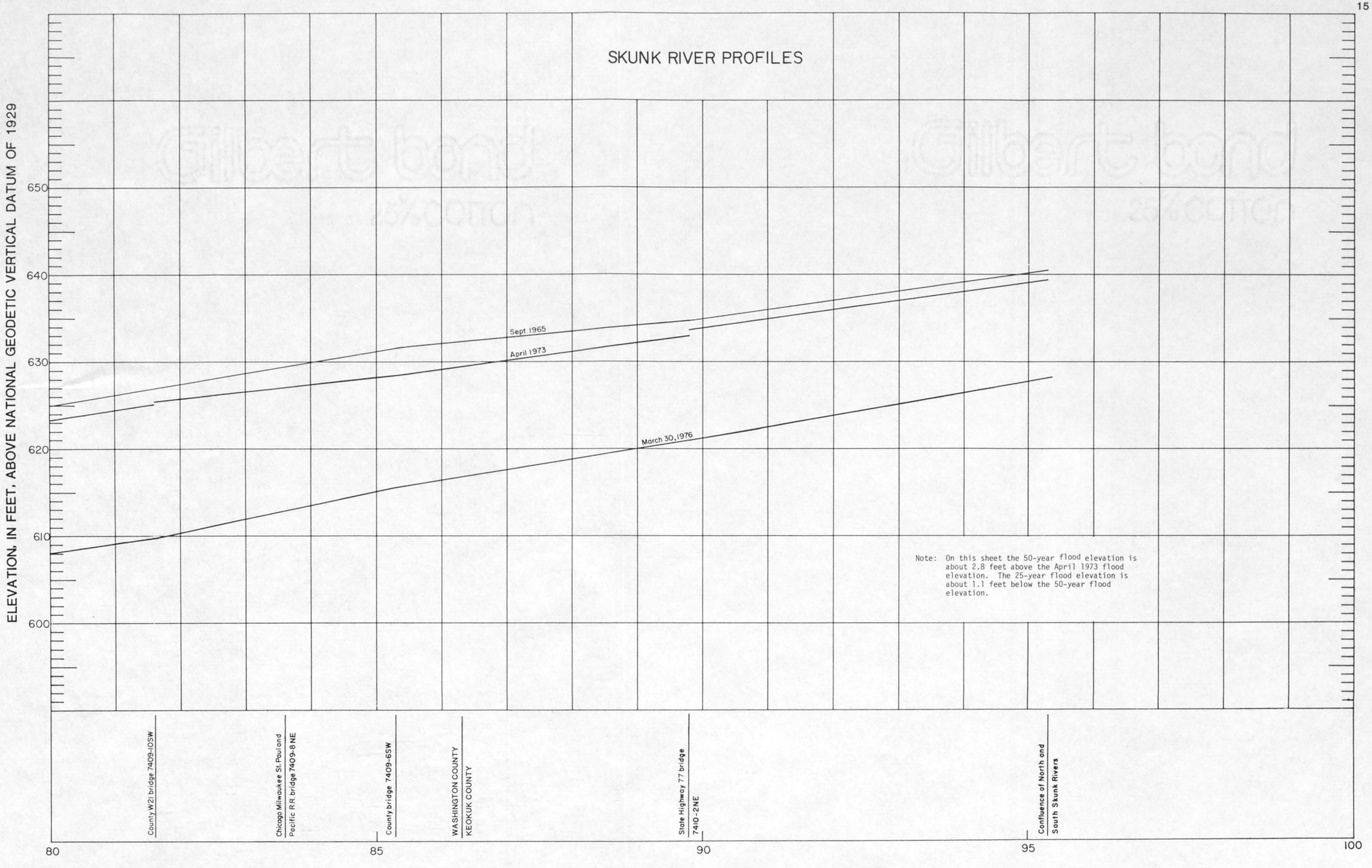

Figure 9. Skunk River profiles, mile 80 to mile 95.3.

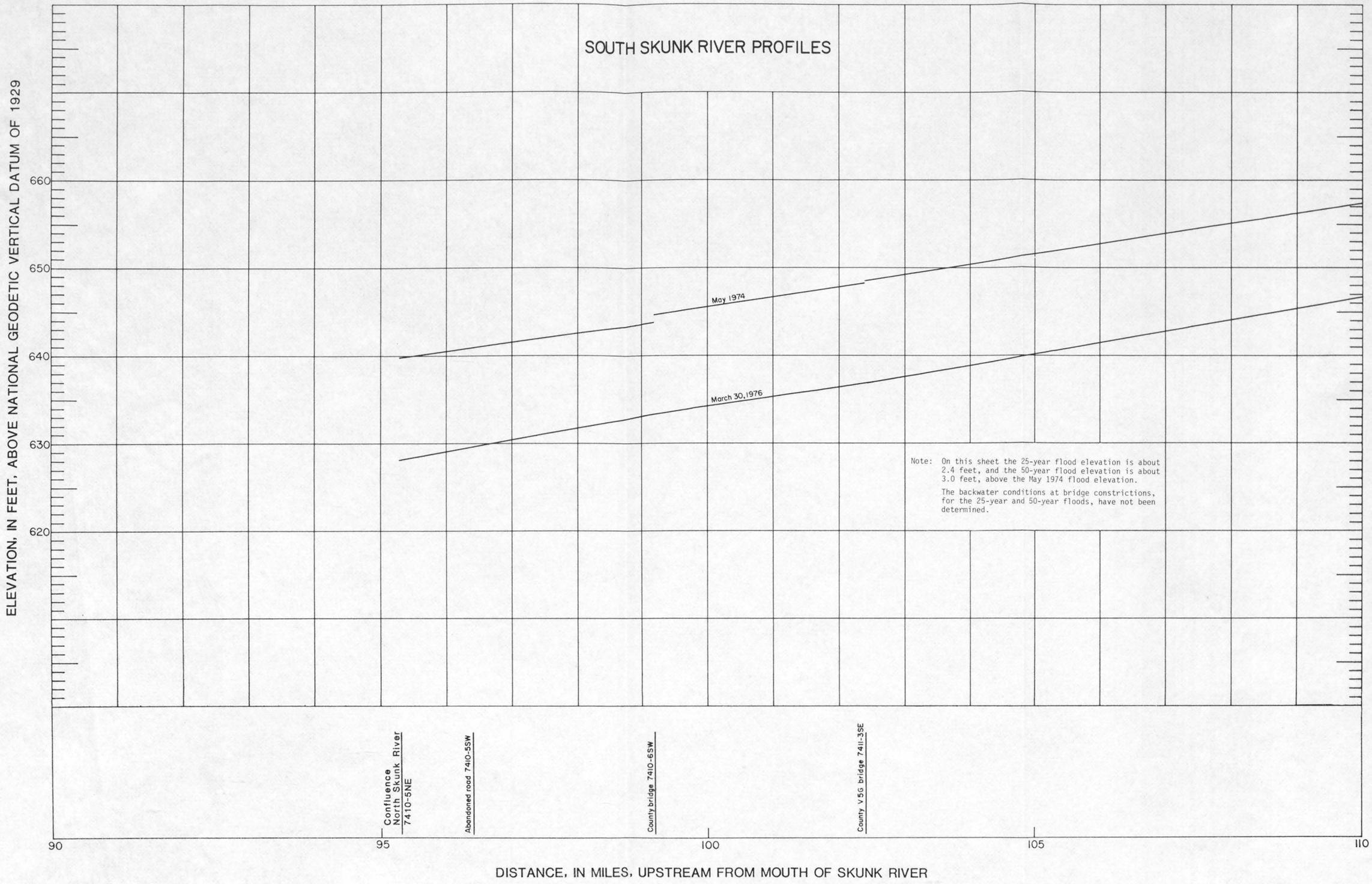

Figure 10. South Skunk River profiles, mile 95.3 to mile 110.

SOUTH SKUNK RIVER PROFILES

ELEVATION, IN FEET, ABOVE NATIONAL GEODETIC VERTICAL DATUM OF 1929

690
680
670
660
650
640

May 1974

March 30,1976

Note: On this sheet the 25-year flood elevation is about 2.4 feet, and the 50-year flood elevation is about 3.0 feet, above the May 1974 flood elevation.

State Highway 149 bridge
7412-2 SW

County bridge 7412-5 SE

Chicago, Milwaukee, St Paul and Pacific R.R. bridge

County bridge 7412-7 NW

County V33 bridge
7513-34 NE

110
115
120
125
130

DISTANCE, IN MILES, UPSTREAM FROM MOUTH OF SKUNK RIVER

Figure 11. South Skunk River profiles, mile 110 to mile 130.

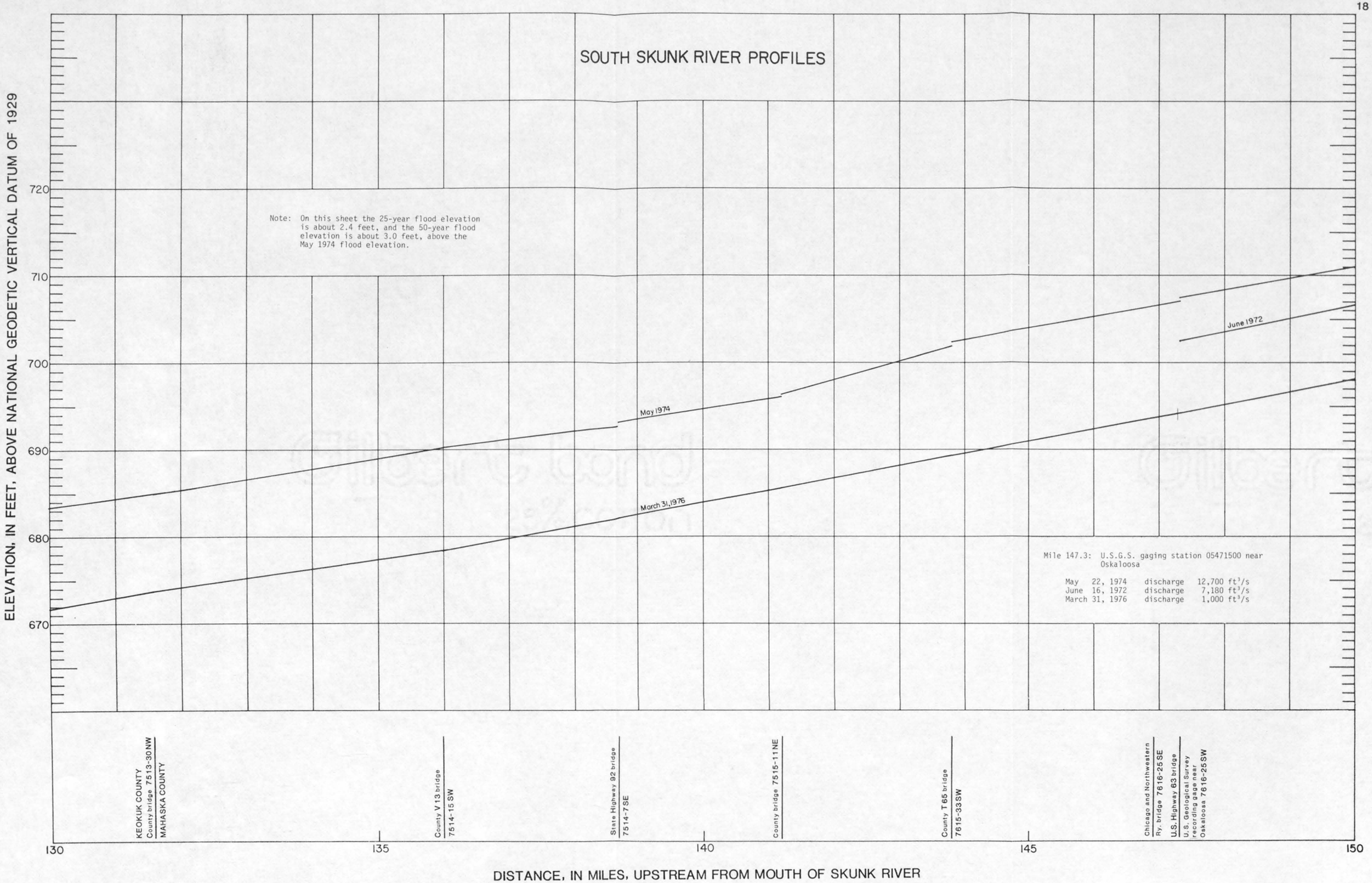

Figure 12. South Skunk River profiles, mile 130 to mile 150.

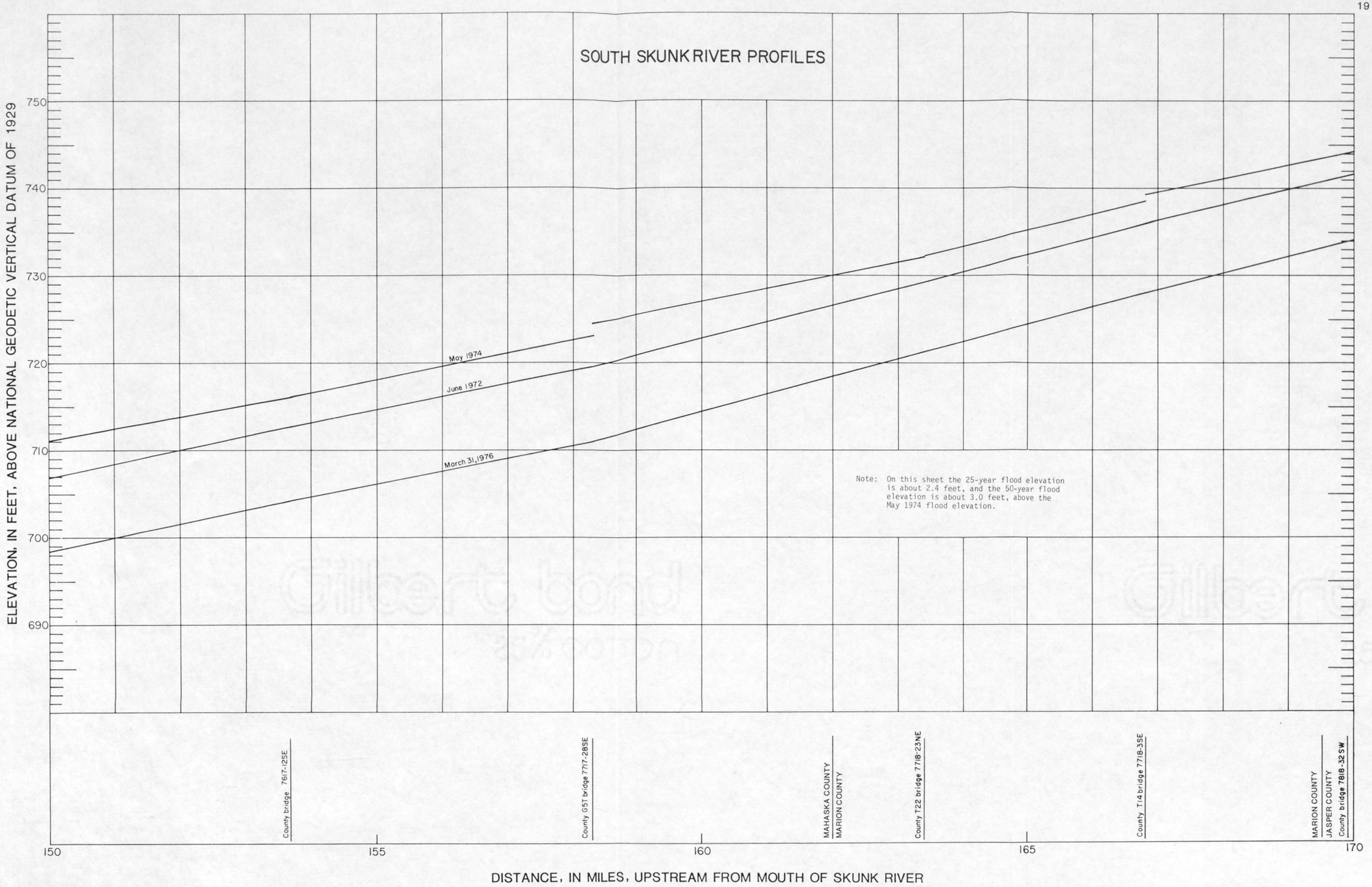

Figure 13. South Skunk River profiles, mile 150 to mile 170.