FLOODS OF MARCH 1982, INDIANA, MICHIGAN, AND OHIO

By D. R. Glatfelter, G. K. Butch, and J. A. Stewart

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GLOSSARY

Backwater. The resulting water surface upstream from an obstruction.

Continuous-record station. See gaging station.

Contributing drainage area. The portion of drainage area that contributes directly to surface runoff.

Crest-stage partial-record station. A particular stream location where limited peak data are collected systematically over a period of years.

Cubic foot per second (ft^3/s). The rate of discharge representing a volume of 1 cubic foot of water passing a given point in 1 second. This rate is equivalent to a 24-hour volume of 86,400 cubic feet or 646,317 gallons or 1.983471 acre-feet.

Cubic foot per second per square mile [$(ft^3/s)/mi^2$]. The number of cubic feet of water flowing per second per square mile of area drained.

Dike. An embankment constructed along a riverbank to prevent flooding.

Discharge. A volume of water passing a given point within a given period of time, in cubic feet per second.

Drainage area. Area of a stream basin upstream from a specified location, measured in a horizontal plane, enclosed by a topographic divide from which direct surface runoff from precipitation normally drains by gravity into the stream above the specified point. Drainage areas given in the report exclude the part of the total drainage area that does not contribute directly to surface runoff.

Drainage basin. Area drained by a given stream and its tributaries.

FEMA. Federal Emergency Management Agency.

Flood hydrograph. A graphical representation of stream discharge at a given point as a function of time.

Front. The transition zone between two air masses of different densities.

Gage height. The water-surface elevation referred to some arbitrary gage datum.

Gaging station. A particular site on a stream or lake where observations of gage height are continuously recorded.

Hydrograph. A graph showing relation of stage, discharge, or other characteristics of water to time.

Levee. See dike.

NWS. National Weather Service, National Oceanic and Atmospheric Administration, Department of Commerce.

Precipitation-distribution map. A map showing distribution of precipitation for a specified period drawn as lines of equal rainfall.

Recurrence interval. The average number of years within which a flood stage or discharge is statistically expected to be exceeded once. In terms of probability, there is a 2-percent chance that a 50-year flood will occur in any given year.

Snowmelt. Runoff from melting snow.

Snowpack. Accumulated snow on the ground at a given time.

Stage. See gage height.

Streamflow. See discharge.

Water equivalent. The depth of water that would result from the melting of a snowpack, in inches of water.

Water year. The period from October 1 to September 30.

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

Multiply inch-pound unit	By	To obtain SI unit
inch (in.)	2.54	centimeter (cm)
foot (ft)	0.3048	meter (m)
mile (mi)	1.609	kilometer (km)
acre	4,047	square meter (m^2)
square mile (mi^2)	2.590	square kilometer (km^2)
acre-foot (acre-ft)	1,233	cubic meter (m^3)
cubic foot per second (ft^3/s)	0.02832	cubic meter per second (m^3/s)
gallon (gal)	3.785	liter (L)
cubic foot per second per square mile [(ft^3/s)/mi^2]	0.01093	cubic meter per second per square kilometer [(m^3/s)/km^2]

Temperature in degrees Fahrenheit (°F) can be converted to degrees Celsius (°C) as follows:

$$°C = 5/9\ (°F-32)$$

FLOODS OF MARCH 1982, INDIANA, MICHIGAN, AND OHIO

By Dale R. Glatfelter, Gerard K. Butch, and James A. Stewart

ABSTRACT

Rapid melting of a snowpack containing 2 to 6 inches of water equivalent coinciding with moderate rainfall caused flooding in March 1982 across northern Indiana, southern Michigan, and northwestern Ohio. Millions of dollars in property damage and the loss of four lives resulted from the flooding.

Peak discharges at several gaging stations in each of the following river basins have recurrence intervals of 50 to greater than 100 years: Wabash, St. Joseph, River Raisin, Maumee, and Kankakee. Although the main stems in each of the other four river basins produced floods having high recurrence intervals, the Wabash River upstream from Huntington Reservoir produced peak discharges having less than a 5-year recurrence interval. Flooding in the Wabash River basin was primarily confined to the Little, Eel, and Tippecanoe Rivers, major tributaries draining from the north into the Wabash River.

The recurrence interval of flooding in the St. Joseph River basin in Michigan and Indiana was about 50 years. Peak discharges equaling or exceeding those of April 1950 were recorded at most gaging stations in the St. Joseph River basin. The highest stage and discharge for the period of record 1932-82 were recorded at the gaging station on the Elkhart River at Goshen, Indiana.

Peak discharges having recurrence intervals of 50 to greater than 100 years were recorded at gaging stations on the River Raisin in southeastern Michigan. The station near Monroe, Michigan, recorded the highest stage and discharge for the period of record 1938-82.

Flooding on most large streams in the Maumee River basin in northeastern Indiana and northwestern Ohio was the worst since the devastating flood of 1913. The Maumee River, fed by peak discharges having recurrence intervals of 20 years from southern tributaries and 50 years from northern tributaries, was the scene of major flood-fighting efforts, particularly in the vicinity of Fort Wayne, Indiana, where more than $20 million in damage was reported.

Peak discharges having recurrence intervals greater than 100 years were recorded at gaging stations on the Kankakee River and its major tributary, Yellow River. Flooding on Yellow River was the worst since October 1954. The Kankakee River at Shelby, Indiana, remained above flood stage from March 12 through May 6. This prolonged period of high water caused numerous breaks in the levee system, which flooded thousands of acres of farmland in northwestern Indiana.

INTRODUCTION

Purpose and Scope

The purpose of this report is to document meteorological conditions and resultant floods of March 1982 in northern Indiana, southern Michigan, and northwestern Ohio. Major emphasis is on the severity and the sequence of meteorological conditions from September 1981 to March 1982 that provided the potential for and triggered the floods. Surface-water data are presented in table 1 for 83 continuous-record stations and crest-stage partial-record sites whose locations are shown in figure 1. Selected hydrographs and descriptions of the flooding are presented for each of the five river basins delineated in figure 1. The hydrographs are based on gage-height records and the relation between gage height and discharge at each site.

Designation of time

Twenty-four hour and eastern standard time are used throughout the report. For example, 1410 hours is 2:10 p.m. e.s.t.

METEOROLOGICAL CONDITIONS

Meteorological Setting

Precipitation from September to December 1981 (100 to 150 percent of normal in northern Indiana, southern Michigan, and northwestern Ohio) resulted in moist soil at the onset of the first significant snowfall December 17. Additional snowfall the remainder of the month produced snow cover of 6 to 15 in. across the region.

Snow cover decreased during the first week of January 1982 as temperatures rose to above 40° F. Soil moisture increased as the unfrozen ground absorbed some of the melted snow. Rainfall of 0.5 to 1 in. during this time further saturated the soil and increased streamflow.

Record snowfall and low temperatures prevailed during the remainder of January. High winds removed snow cover from unprotected locations and caused heavy drifting in shielded areas. Exposed ground froze quickly as temperatures plunged to record lows of -10° to -20° F at many locations January 10 and remained near or below 0° F for almost 2 days. Another mass of cold air accompanied by high winds and temperatures near -20° F moved into the area January 17 and froze exposed soils to depths of 2 to 3 ft.

Moderate to heavy rainfall January 23 and 30 saturated and compacted the snowpack. Subzero temperatures after each rain formed an ice layer at least 1 inch thick between the snow and the ground surface.

Heavy snowfall January 31 to February 10 and temperatures below 32° F maintained an extensive snowpack. Temperatures as low as -20° F were recorded at many locations February 10. Depth of snow decreased by monthend as moderating temperatures and rainfall compacted the snowpack in most locations. Additional snow and rain March 1-9 added to a snowpack that already contained a high water equivalent.

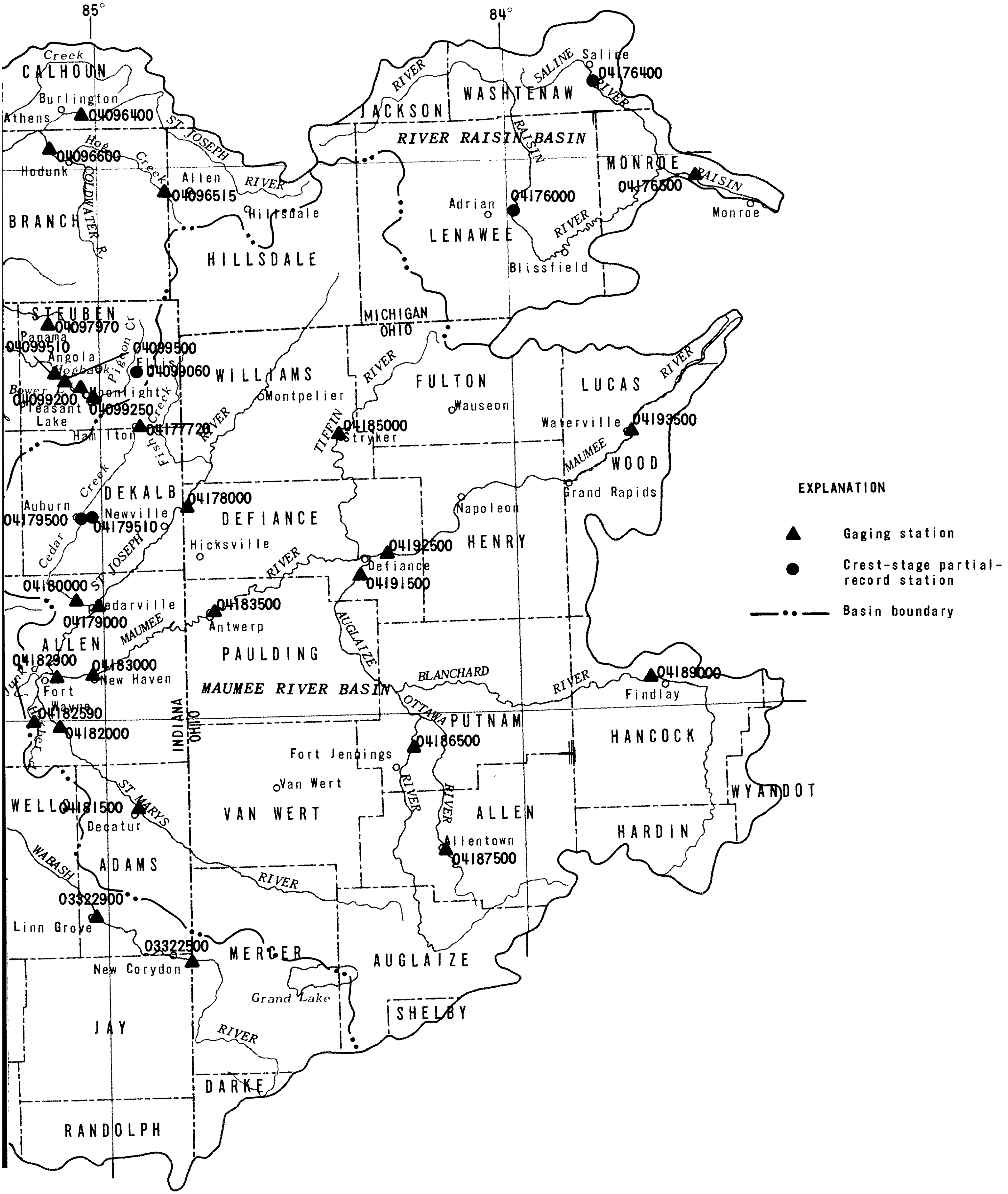
Water Equivalent of Snowpack

Water-equivalent measurements of a snowpack are uncommon in the area; however, supplemental snow surveys were made by the NWS (National Weather Service) to determine flood potential. A snow survey February 9 indicated water equivalent of 1.1 in. at Hicksville, Ohio; 1.5 in. at Van Wert, Ohio; 3.5 in. at Montpelier, Ohio; and 4.2 in. at Fort Wayne, Ind., and Wauseon, Ohio. Snow cover was 1 to 3 ft across the area at this time. A snow survey February 17 revealed water equivalent of 1.7 in. at Van Wert, Ohio; 2.3 in. at Napoleon, Ohio; 2.9 in. at Defiance, Ohio; 3.0 in. at Hicksville, Ohio; and 4.0 in. at Montpelier, Ohio, and Fort Wayne, Ind.

Rainfall and rising temperatures produced a partial snowmelt the last 2 weeks of February. Snowmelt was more significant in southern areas than elsewhere and produced bankfull stage on some streams. Water equivalent decreased to 1.4 in. at Van Wert, Ohio; 1.5 in. at Fort Wayne, Ind.; and 2.2 in. at Wauseon, Ohio, by February 26. However, the northern snowpack still contained excessive moisture; for example, the water-equivalent at Montpelier, Ohio, was measured to be 4.7 in. on February 26.

Rain and snow the first week of March increased the water equivalent 1 to 2 in. at most locations. Runoff into streams was minimal because of absorption by the snowpack. As much as 15 in. of snow and at least 1 in. of ice covering a frozen, saturated ground were reported by NWS March 5-10. Measured water equivalents during this time are shown in figure 2; where more than one measurement was available at a given location, the latest one is shown. Water equivalent was highest in the St. Joseph and River Raisin basins: 7.1 in. at Blissfield, 5.5 in. at Nottawa, and 5.4 in. at Hillsdale and Hamburg, all in Michigan. Because of the small number of measurements, a ratio of 1 in. of water equivalent to 3 in. of snow was used to estimate additional water equivalents for locations reporting only snow cover. This ratio was determined from sites where both water equivalent and snow depth had been measured. Estimated and measured water equivalents in figure 2 show 3 to 6 in. of water equivalent across the

Figure 1.-- Flood area and locations of streamflow data sites in Indiana, Michigan, and Ohio.


85°
84°
EXPLANATION
Gaging station
Crest-stage partial-record station
Basin boundary
RIVER RAISIN BASIN
MAUMEE RIVER BASIN
MICHIGAN
OHIO
INDIANA
OHIO
CALHOUN
JACKSON
WASHTENAW
BRANCH
HILLSDALE
LENAWEE
MONROE
STEUBEN
WILLIAMS
FULTON
LUCAS
WOOD
DEKALB
DEFIANCE
HENRY
ALLEN
PAULDING
PUTNAM
HANCOCK
WYANDOT
HARDIN
VAN WERT
ADAMS
MERCER
AUGLAIZE
SHELBY
JAY
DARKE
RANDOLPH
Athens
Burlington
Hodunk
Allen
Hillsdale
Saline
Adrian
Blissfield
Monroe
Panama
Angola
Ellis
Pleasant Lake
Moonlight
Hamilton
Montpelier
Wauseon
Stryker
Waterville
Grand Rapids
Napoleon
Auburn
Newville
Hicksville
Defiance
Cedarville
Antwerp
New Haven
Fort Wayne
Findlay
Fort Jennings
Van Wert
Allentown
Decatur
Linn Grove
New Corydon
Grand Lake
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04096600
04096515
04176400
04176000
04176500
04097970
04099510
04099500
04099060
04099200
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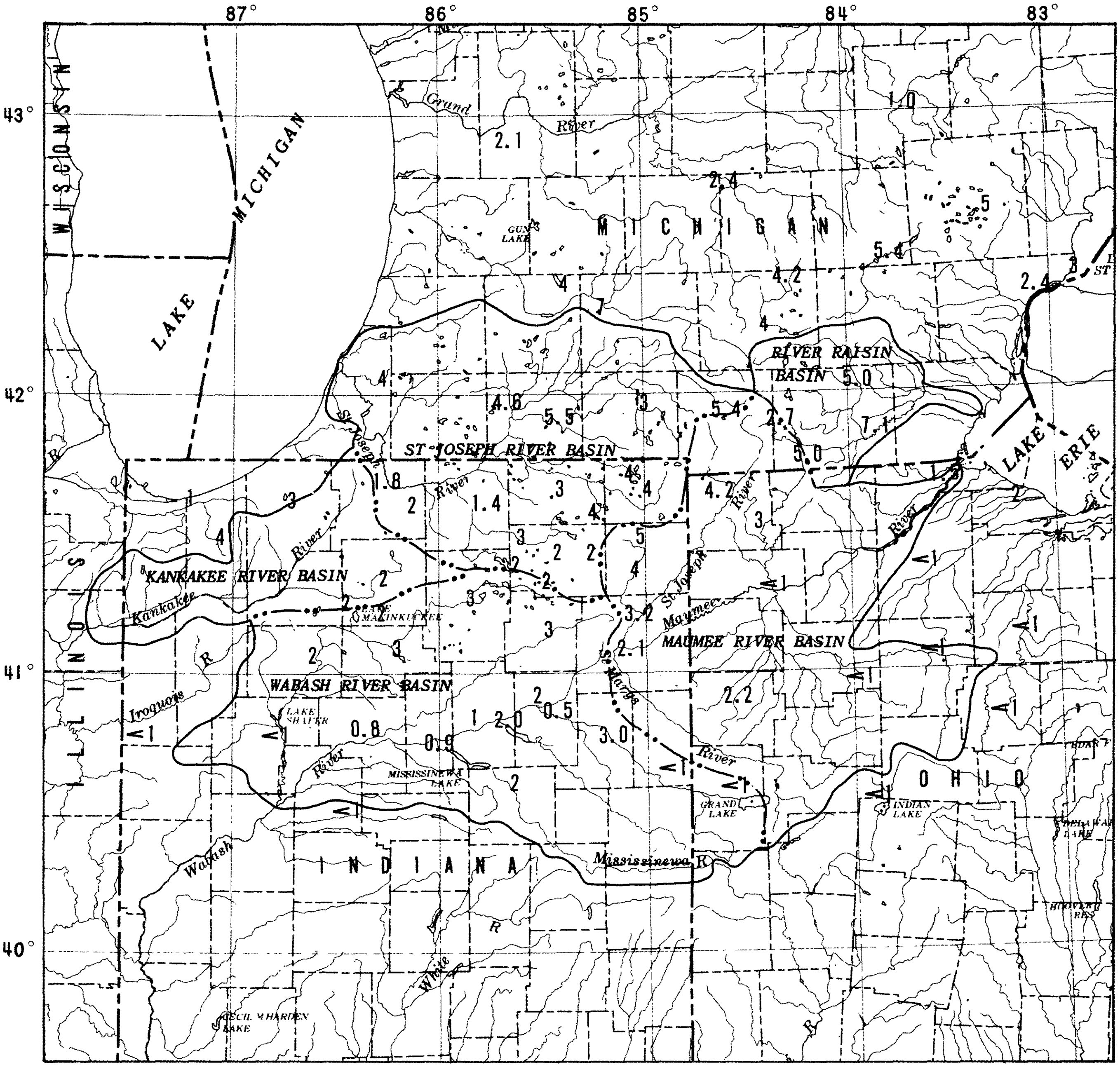
04183500
04182900
04183000
04189000
04182590
04182000
04186500
04181500
04187500
03322900
03322500
ST JOSEPH RIVER
COLDWATER R.
Hog Creek
SALINE RIVER
RIVER RAISIN
MAUMEE RIVER
TIFFIN RIVER
AUGLAIZE
BLANCHARD RIVER
OTTAWA RIVER
ST MARYS RIVER
WABASH RIVER
Cedar Creek
Fish Creek
Pigeon Cr



EXPLANATION

4.2 Measured water equivalent, in inches

5 Estimated water equivalent, in inches

—••— Basin boundary

Data from National Weather Service in Indianapolis, Ind., Fort Wayne, Ind., Ann Arbor, Mich., Cleveland, Ohio, and South Bend, Ind., (oral commun., March-July 1982)

Midwest Agricultural Weather Service Center, National Weather Service, National Oceanic and Atmospheric Administration, Purdue University, West Lafayette, Ind. (oral communs., April 1982)

National Oceanic and Atmospheric Administration, 1981-82 a, b, c

Figure 2.-- Water equivalent of snowpack, March 5-10.

River Raisin, much of the St. Joseph River, and the northern half of the Maumee River basins. Water equivalents of 2 to 4 in. were common in the Kankakee, northern Wabash, and parts of the southern Maumee River basins. These lower water equivalents are attributed to partial snowmelts in January, Febuary, and early March 1982, especially in the Wabash and southern Maumee River basins. The Kankakee River basin also contained low water equivalents because of fewer severe winter storms than elsewhere in the area.

Rainfall, March 10-12

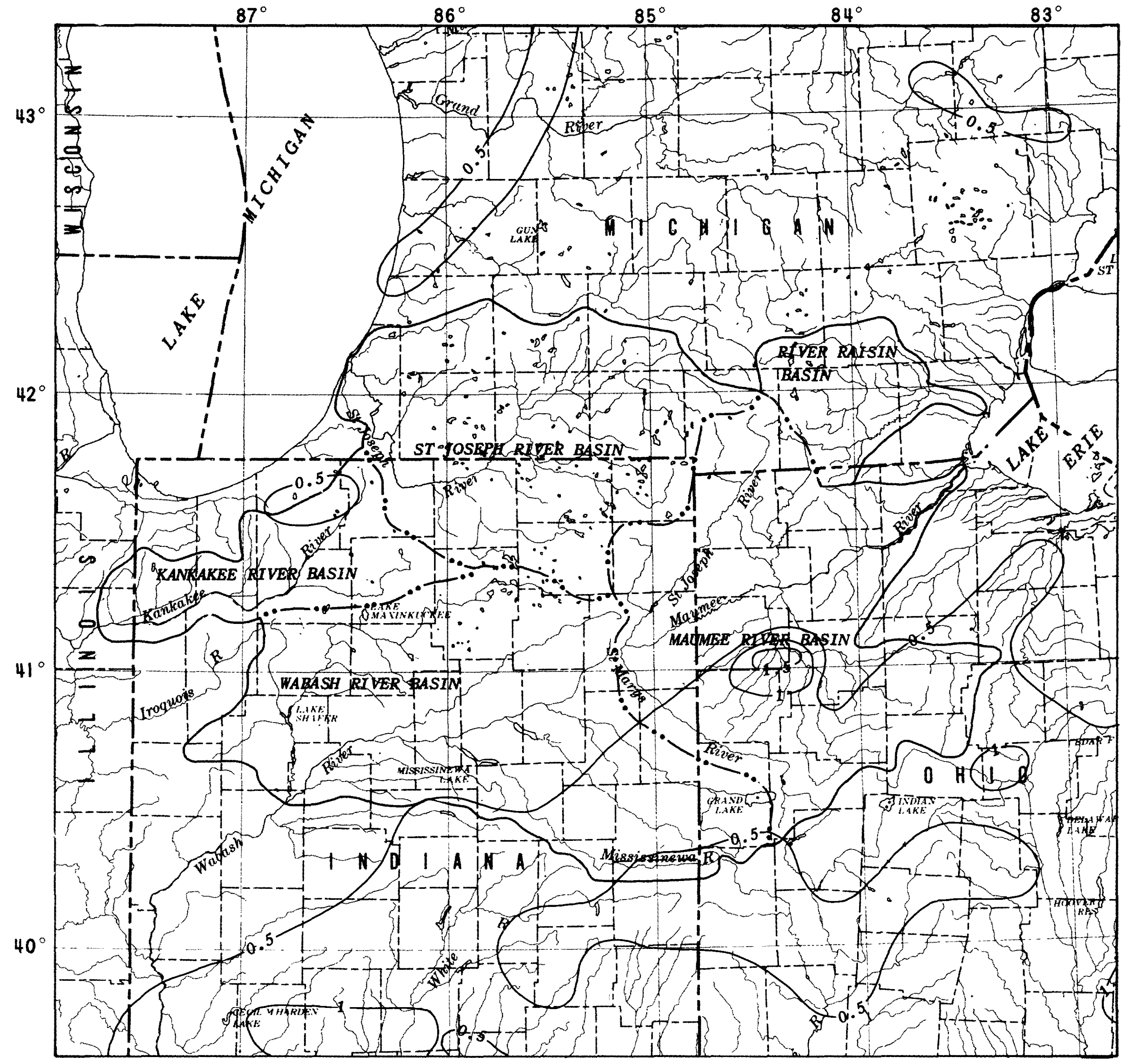
Rainfall totaling 0.5 to 1.5 in., coupled with temperatures above 40° F, started a snowmelt in the headwaters of the Wabash River and the southern half of the Maumee River basin March 10-12. A map of the 48-hour rainfall ending at 0700 hours March 12 is shown in figure 3. Northern basins generally received less than one-quarter inch of rain during this time. The lighter rain, lower temperatures, and deeper snowpack in these basins delayed snowmelt.

Passage of Warm Front

Temperatures increased substantially the evening of March 12 because of a well-defined windflow pattern associated with a storm in southern Canada. A major snowmelt developed late March 12 as the storm in Canada moved eastward and pulled warm, moist air northward from the Gulf of Mexico. This warm air was advected into the region faster than the snowpack could chill it, which resulted in the advancement of a warm front through the entire area. The positions of weather fronts across Indiana and adjacent states at 1900 hours March 12 and 0100 hours March 13 are shown in figure 4. The warm front across central Illinois, Indiana, and Ohio produced a striking contrast of temperatures the evening of March 12. Temperatures ranged from 68° F south of the front to 36° F north of the front. After passage of the warm front through the area, temperatures exceeded 50° F at most locations. Surface runoff from the melting snowpack was nearly 100 percent because the saturated soil was frozen.

Rainfall, March 12-13

Rainfall associated with the areal warming intensified melting of the snowpack already in progress. A map of the 24-hour rainfall ending at 0700 hours March 13 is shown in figure 5. The precipitation contributed less than 1 in. to the total runoff but, in conjunction with warm temperatures, rapidly melted much



Data prepared from National Oceanic and Atmospheric Administration, 1981-82 a, b, c

EXPLANATION

—0.5— Line of equal precipitation. Interval 0.5 inch

—••— Basin boundary

Figure 3.-- Rainfall, 0700 hours March 10 to 0700 hours March 12.

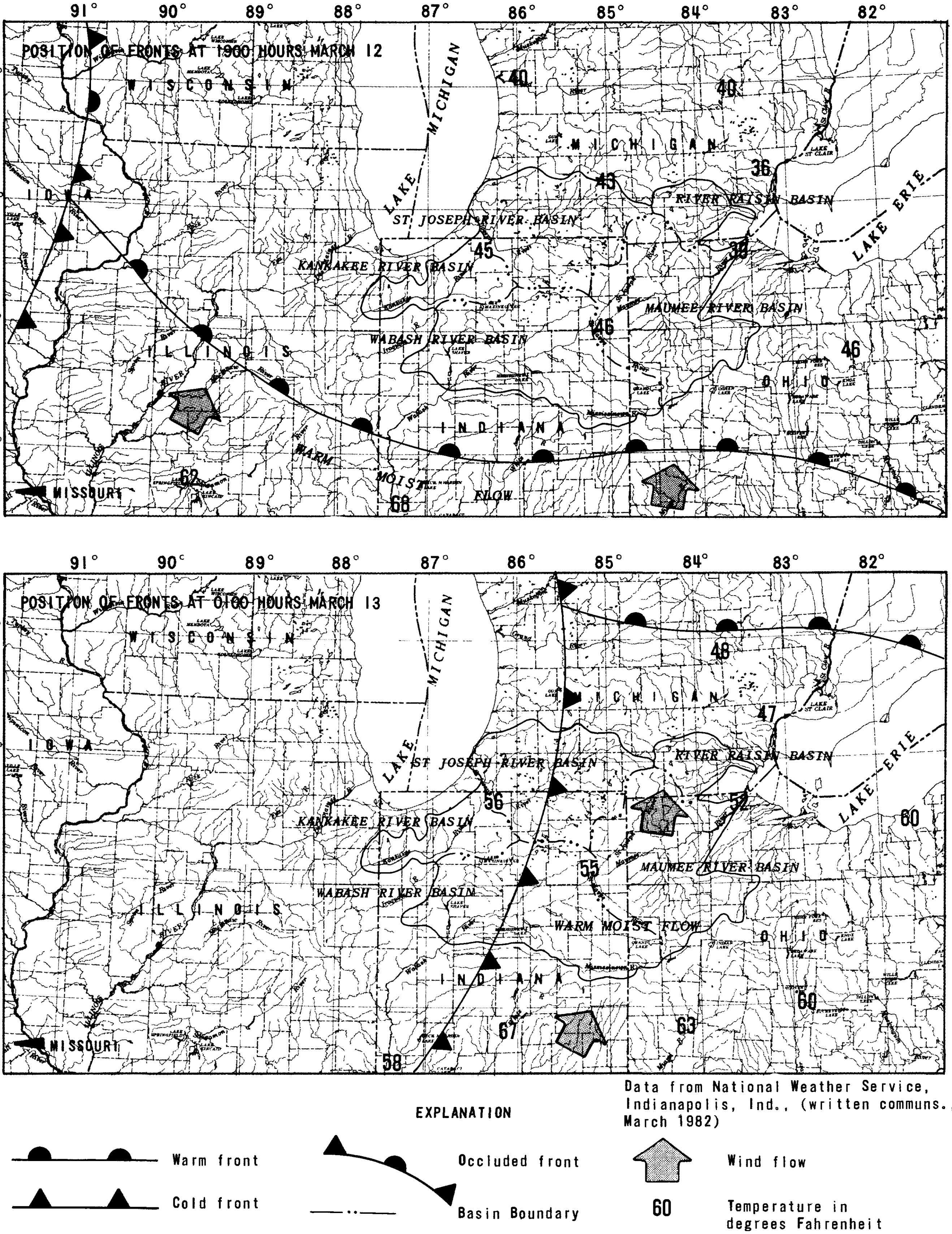
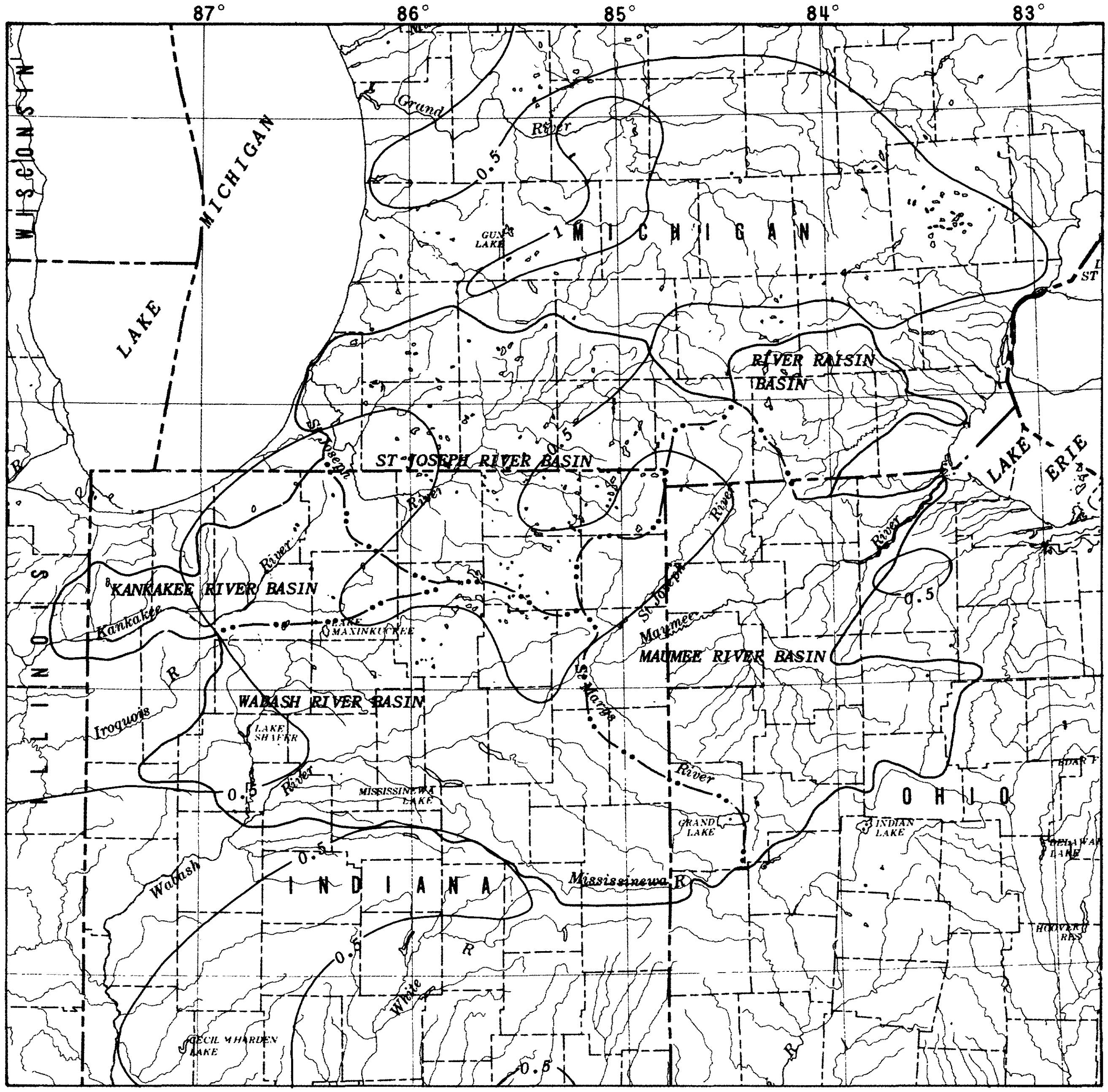


Figure 4.-- Passage of warm front, March 12-13.



Data prepared from National Oceanic and Atmospheric Administration, 1981-82 a, b, c

EXPLANATION

—0.5— Line of equal precipitation. Interval 0.5 inch

—••— Basin boundary

Figure 5.-- Rainfall, 0700 hours March 12 to 0700 hours March 13.

of the snowpack. Most of the snow in the Wabash, Kankakee, and southern Maumee River basins had melted by 0700 hours March 13. Several inches of snow remained in the St. Joseph River and River Rasin basins and delayed peaks on some streams within these basins.

Rainfall, March 15-17 and 19-20

Rainfall, generally ranging from 0.5 to 1.5 inches, was recorded in the area during the 48 hours ending at 0700 hours March 17. This rain maintained high streamflow and produced additional peaks on some streams. Distribution of rainfall March 15-17 is shown in figure 6.

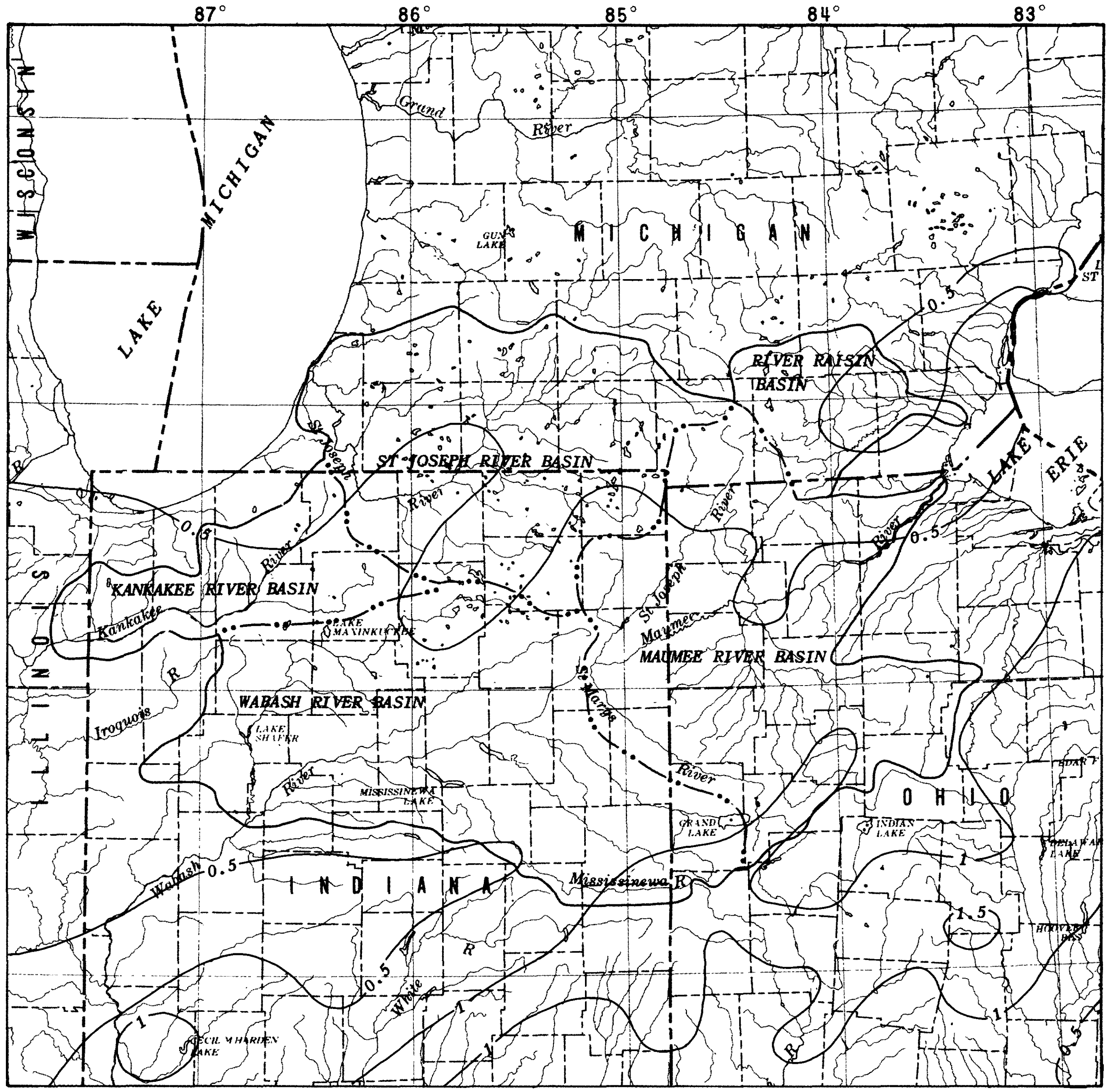
Distribution of rainfall in the 24 hours ending at 0700 hours March 20 is shown in figure 7. Runoff from this rain caused some streams to peak for the fourth time since melting began. However, the first and only peak for streams that characteristically have a broad flood peak was recorded about this time.

FLOODS

Magnitude and Frequency

Flood frequency is generally expressed in terms of the probability of occurrence of floods of a given magnitude (discharge). The probability of occurrence is the percent chance of a given flood magnitude being exceeded in any 1 year. The recurrence interval (the reciprocal of the probability of occurrence multiplied by 100) is the average number of years between exceedances of a given flood magnitude. The recurrence interval is an average interval, and the occurrence of floods is random in time; no schedule of regularity is implied. The occurrence of a flood having a 50-year recurrence interval (2-percent chance of occurrence) is no guarantee, therefore, that a flood of equal or greater magnitude will not occur the following year, or even the following week.

Discharge-frequency determinations in Indiana are coordinated by a memorandum of understanding between the U.S. Geological Survey, the U.S. Soil Conservation Service, the U.S. Army Corps of Engineers, and the Indiana Department of Natural Resources to assure consistency of estimates between the agencies. Recurrence intervals for the floods of March 1982 given in table 1 are estimates based on coordinated values from Indiana Department of Natural Resources (1981) for all streams having these values. For streams where flood



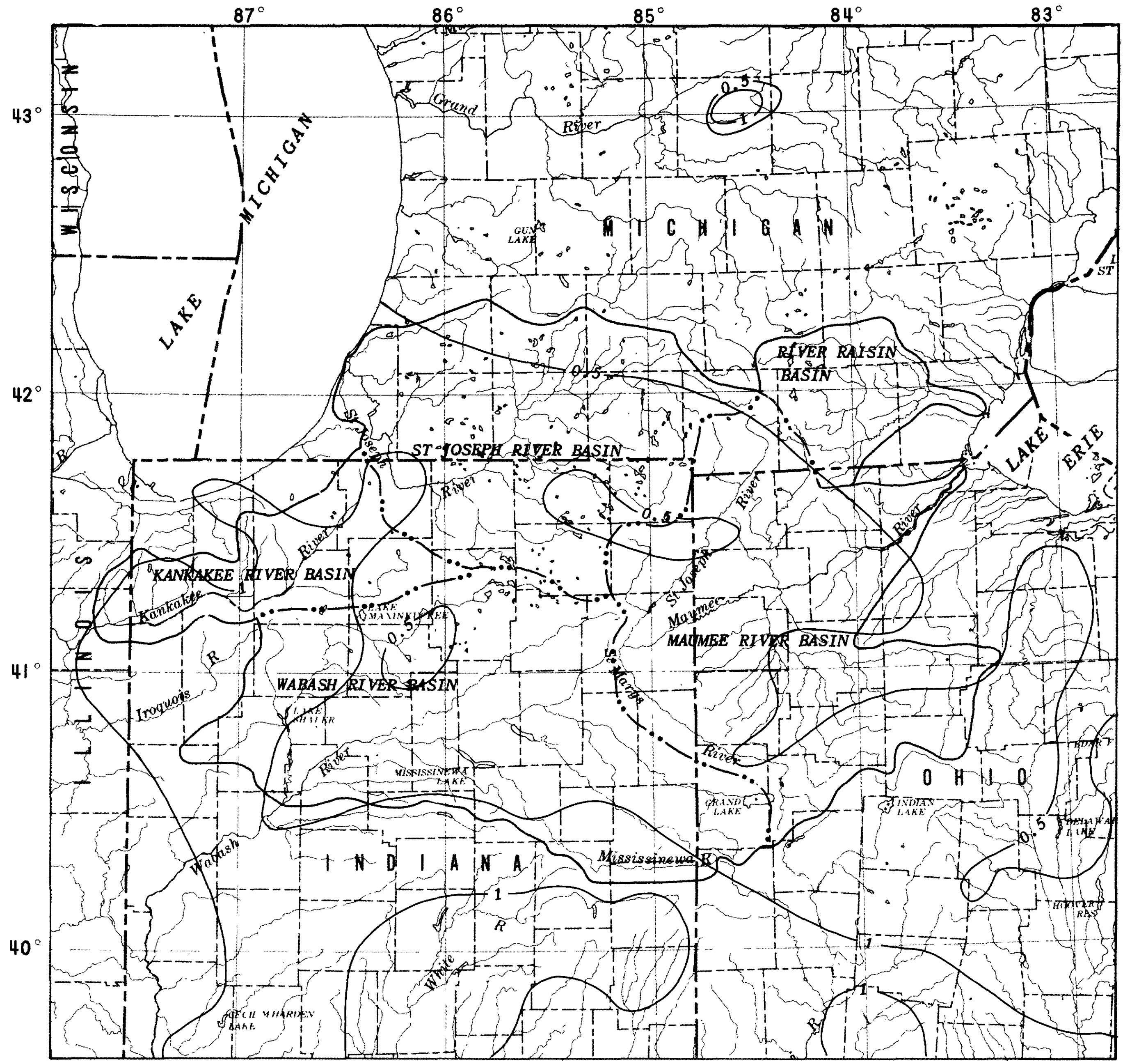
Data prepared from National Oceanic and Atmospheric Administration, 1981-82 a, b, c

EXPLANATION

—0.5— Line of equal precipitation. Interval 0.5 inch

—••— Basin boundary

Figure 6.-- Rainfall, 0700 hours March 15 to 0700 hours March 17.



Data prepared from National Oceanic and Atmospheric Administration, 1981-82 a, b, c

EXPLANATION

—0.5— Line of equal precipitation. Interval 0.5 inch

—•— Basin boundary

Figure 7.-- Rainfall, 0700 hours March 19 to 0700 hours March 20.

frequencies have not been coordinated and at least 10 years of peak data have been collected, a log-Pearson type III statistical analysis was done by techniques described in U.S. Water Resources Council (1981) to determine recurrence intervals of the peaks.

Rapid melting of an extensive snowpack covering northern Indiana, southern Michigan, and northwestern Ohio in March 1982 produced runoff equivalent to that common in small basins, but rare in large basins. In general, streams having small drainage areas produced peak discharges having low recurrence intervals, and streams having large drainage areas produced peak discharges having high recurrence intervals.

Wabash River Basin

Flooding in the Wabash River basin was primarily confined to the Little, Eel, and Tippecanoe Rivers, major tributaries draining from the north into the Wabash River. The snowpack south of the Wabash River was less extensive than the snowpack farther north, and contained less than 2 in. of water equivalent (fig. 2). Therefore, only data from those stations on northern tributaries or on the Wabash River are included in this report. Data on drainage area, period of record, maximum flood previously recorded, and the March 1982 flood are presented in table 1, and the locations of stations are shown in figure 1. Stations on the Wabash River downstream from Huntington Lake are not included in the analysis because the discharge is regulated.

Recurrence intervals for March 1982 peak discharges are less than 5 years at gaging stations on the Wabash River upstream from Huntington Lake despite the addition of 600 ft^3/s from Grand Lake in Ohio. These low recurrence intervals are typical of gaging stations south of the dense snowpack. Although the recurrence interval of the peak discharge recorded at the gaging station on the Wabash River near New Corydon, Ind. (03322500), is low, four distinct peaks between March 11 and 20 are shown in the hydrograph in figure 8. The March 11 peak was the result of rainfall and rising temperatures that affected only the Wabash and southern Maumee River basins. The passage of the warm front and associated rainfall generated a smaller peak on March 13. Subsequent peaks on March 16 and 20 were solely the result of rainfall.

A recurrence interval of 50 years is associated with the peak discharge of 5,700 ft^3/s recorded on March 14 at the gaging station on the Little River near Huntington, Ind. (03324000). The hydrograph for this station is shown in figure 9. High stages on the St. Marys River in Fort Wayne, Ind., caused interbasin flow from the Maumee River basin into the Wabash River basin. Backwater on Junk Ditch caused by these high stages was sufficient to overflow the basin divide and spill into the Little River system. Discharge measurements March 15 and March 17 showed that 320 ft^3/s and 525 ft^3/s were entering the Little River basin. Maximum amount of interbasin flow is unknown, as no continuous records are available for Junk Ditch.

The Eel River is an example of a stream with headwaters in the area of dense snowpack but with flow into an area of little or no snowcover. Hydrographs for the gaging stations on the Eel River at North Manchester, Ind. (03328000), and

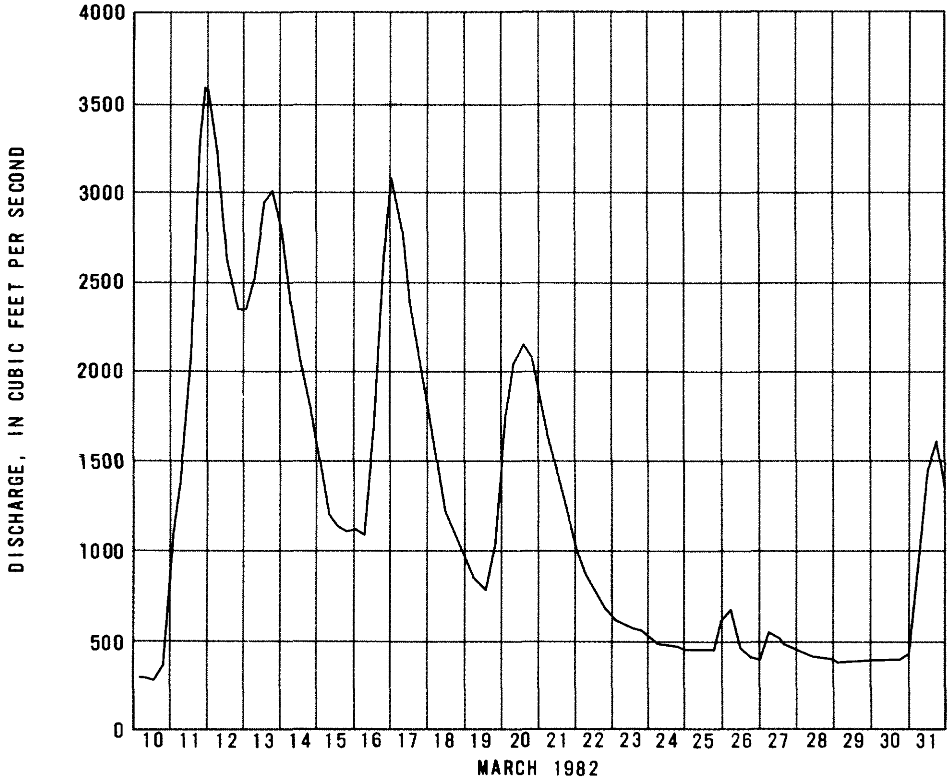


Figure 8.-- Discharge, Wabash River at New Corydon, Indiana.

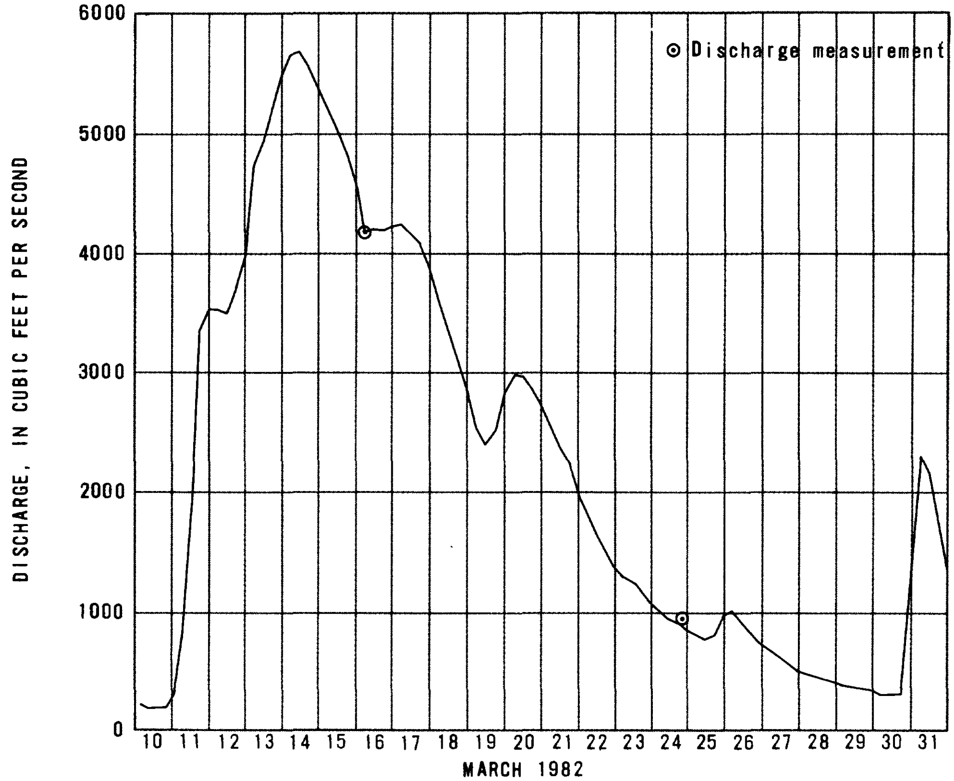


Figure 9.-- Discharge, Little River near Huntington, Indiana.

near Logansport, Ind. (03328500), are shown in figure 10. The peak discharge increased from 8,180 ft^3/s on March 13 at North Manchester to 13,400 ft^3/s on March 14 near Logansport. The recurrence interval of the peak discharges is 45 years at North Manchester and only 20 years near Logansport. This difference is attributed to low moisture content of the snowpack between the stations. Runoff from the melting snowpack was insufficient to maintain a discharge associated with a high recurrence interval.

Gaging stations on the Tippecanoe River at Oswego, Ind. (03330500), and at Ora, Ind. (03331500), recorded peak discharges of 950 and 8,460 ft^3/s. Hydrographs for both stations are shown in figure 11. Although the recurrence interval (100 years) of the peak discharge at Oswego is much larger than the recurrence interval (40 years) of the peak discharge downstream at Ora, the peak at Oswego occurred 6 days after the peak at Ora. The delay of the upstream peak at Oswego was caused by temporary storage and subsequent release of runoff by instream natural lakes. The hydrograph for the gaging station at Ora shows little effect from this storage and release because of the large drainage area between the two stations.

Generally, stations in the Wabash River basin having drainage areas less than 5.0 mi^2 recorded peak discharges having recurrence intervals less than 5 years; stations having drainage areas less than 20 mi^2 recorded peak discharges

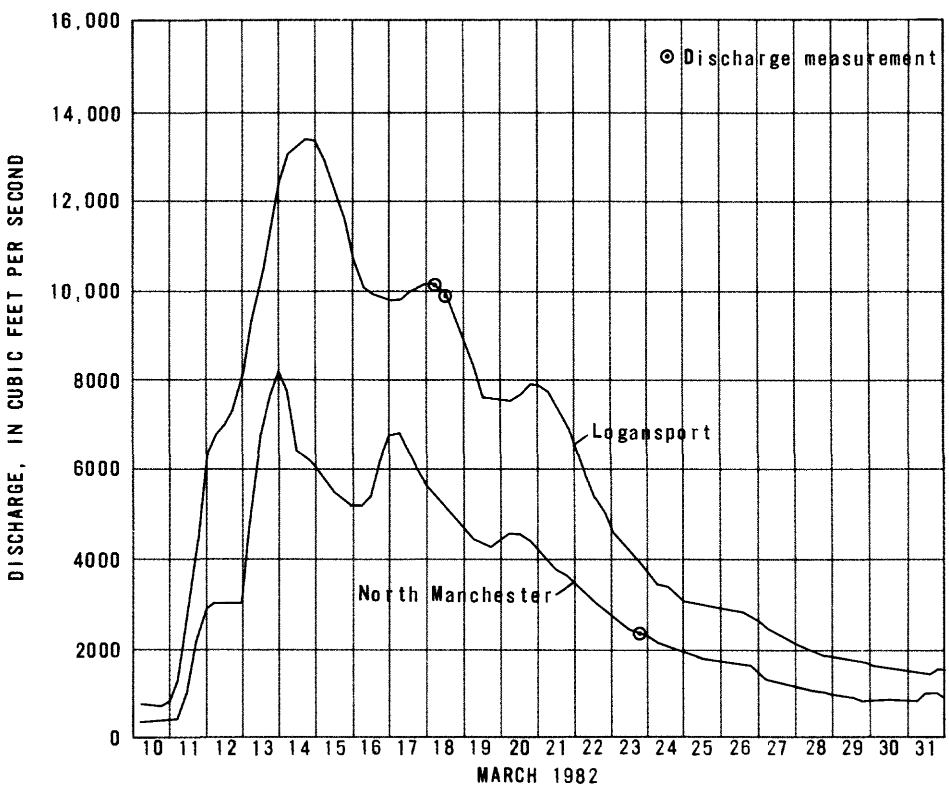


Figure 10.-- Discharge, Eel River at North Manchester and near Logansport, Indiana.

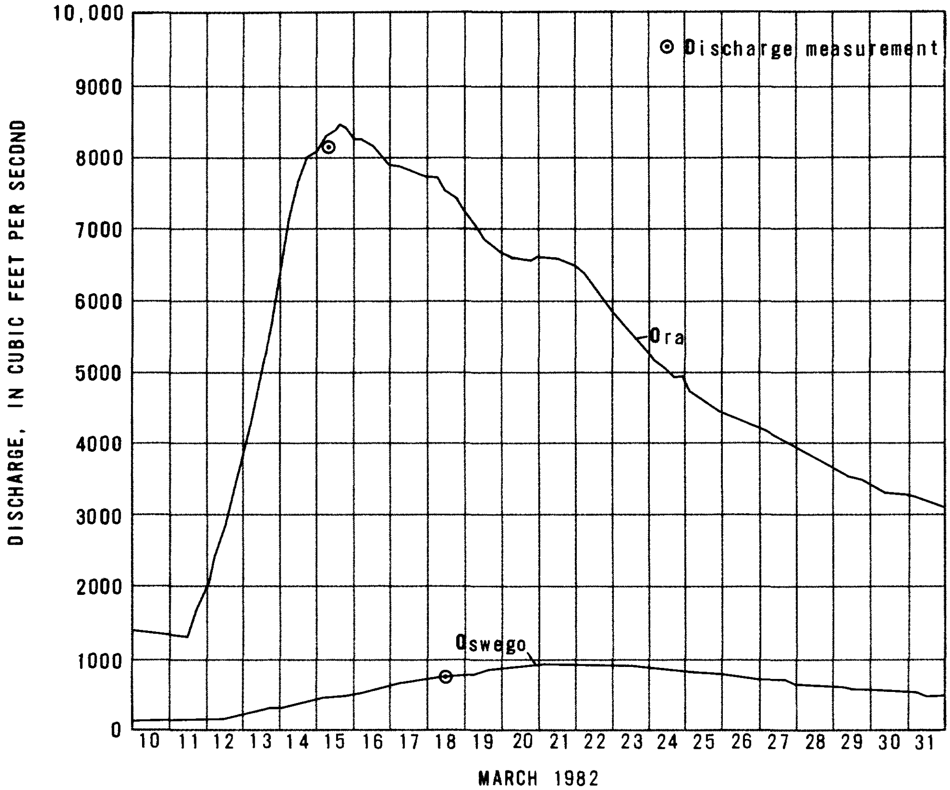


Figure 11.-- Discharge, Tippecanoe River at Oswego and at Ora, Indiana.

having recurrence intervals less than 20 years. Peak discharge data of the Wabash River basin shown in table 1 indicate that only streams draining greater than 100 mi^2 and within the area of moisture-laden snowpack recorded peak discharges having recurrence intervals greater than 20 years. An exception to this drainage area-recurrence interval relationship is that for Weesau Creek near Deedsville, Ind. (03328430), which has a drainage area of 8.87 mi^2 and a recorded peak having a noncoordinated recurrence interval of 50 years. The hydrograph for this station in figure 12 shows four distinct peaks resulting from rainfall and snowmelt. The peak discharge, 464 ft^3/s on March 13, was the result of snowmelt caused by passage of the warm front through the area accompanied by rainfall.

St. Joseph River Basin

Flooding in the St. Joseph River basin in Michigan and Indiana was caused by rapid melting of a dense snowpack on frozen ground. Highest discharges since the flood of April 1950 were recorded at gaging stations on the St. Joseph River in Michigan and Indiana (table 1). Even though flooding along the St. Joseph River was significant, the recurrence intervals of the peak discharges at the five mainstem stations are only 45 to 60 years. Hydrographs for four of the St. Joseph River gaging stations are shown in figures 13 and 14. Two hydrographs

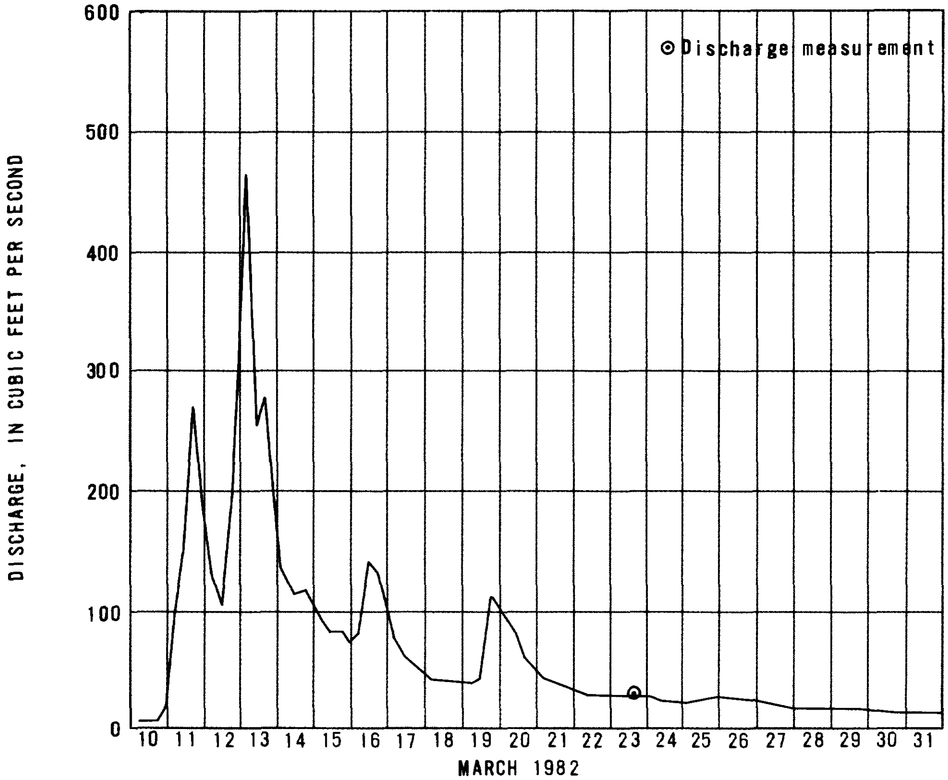


Figure 12.-- Discharge, Weesau Creek near Deedsville, Indiana.

are shown per figure to illustrate the increase in discharge contributed by tributaries between the stations. Hydrographs for tributary stations are shown in figures 15 to 18.

Data indicate that peak discharges in March 1982 have a greater recurrence interval at St. Joseph River tributary stations in the southern and central areas than in the remainder of the basin. Stations on Nottawa Creek near Athens, Mich. (04096900), Portage River near Vicksburg, Mich. (04097170), and Dowagiac River at Sumnerville, Mich. (04101800), all on southerly flowing tributaries having headwaters in the northern part of the basin, recorded peak discharges having recurrence intervals of only 10 to 15 years. Stations on Coldwater River near Hodunk, Mich. (04096600), Prairie River near Nottawa, Mich. (04097540), Fawn River near White Pigeon, Mich. (04098500), Pigeon River near Scott, Ind. (04099750), and Elkhart River at Goshen, Ind. (04100500), all on tributaries having headwaters in the eastern and southeastern parts of the basin, recorded peak discharges having recurrence intervals of 25 to 80 years.

The highest stage and discharge at the Elkhart River gaging station for the period of record 1932-82, 11.94 ft and 6,180 ft^3/s, were recorded March 14. These values exceeded the stage and discharge of April 1950, 10.15 ft and 5,440 ft^3/s. Three distinct peaks are shown on the hydrograph for this station (fig. 15). The first and highest peak was the result of snowmelt; subsequent peaks were the result of rainfall.

The two peaks recorded at the gaging station on the Paw Paw River at Riverside, Mich. (04102500), were 1,680 ft^3/s on March 14 and 2,650 ft^3/s on March 18 (fig. 16). Delayed snowmelt in the northernmost areas, simultaneous with rainfall March 15-17, was responsible for the timing of the higher peak.

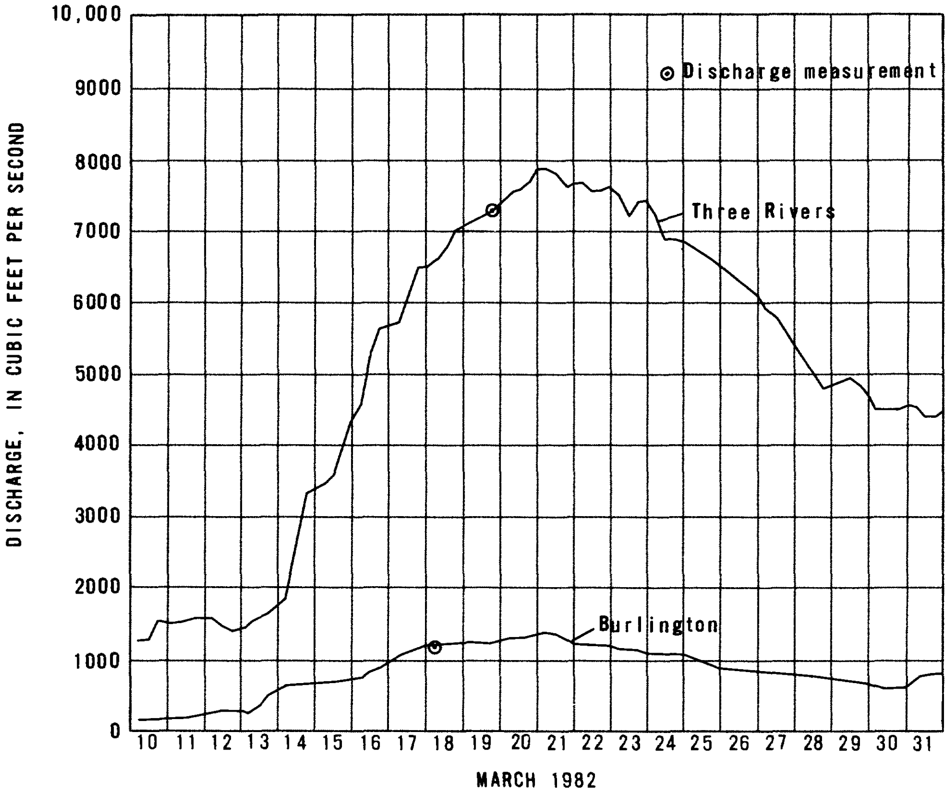


Figure 13.-- Discharge, St. Joseph River near Burlington and at Three Rivers, Michigan.

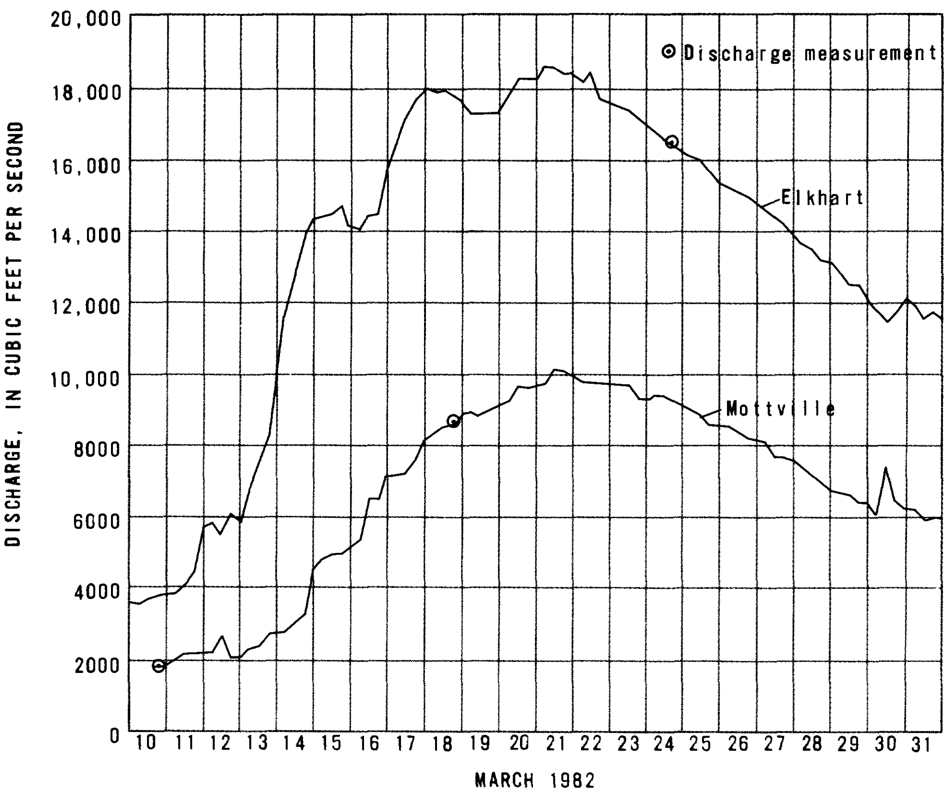


Figure 14.-- Discharge, St. Joseph River at Mottville, Michigan, and at Elkhart, Indiana.

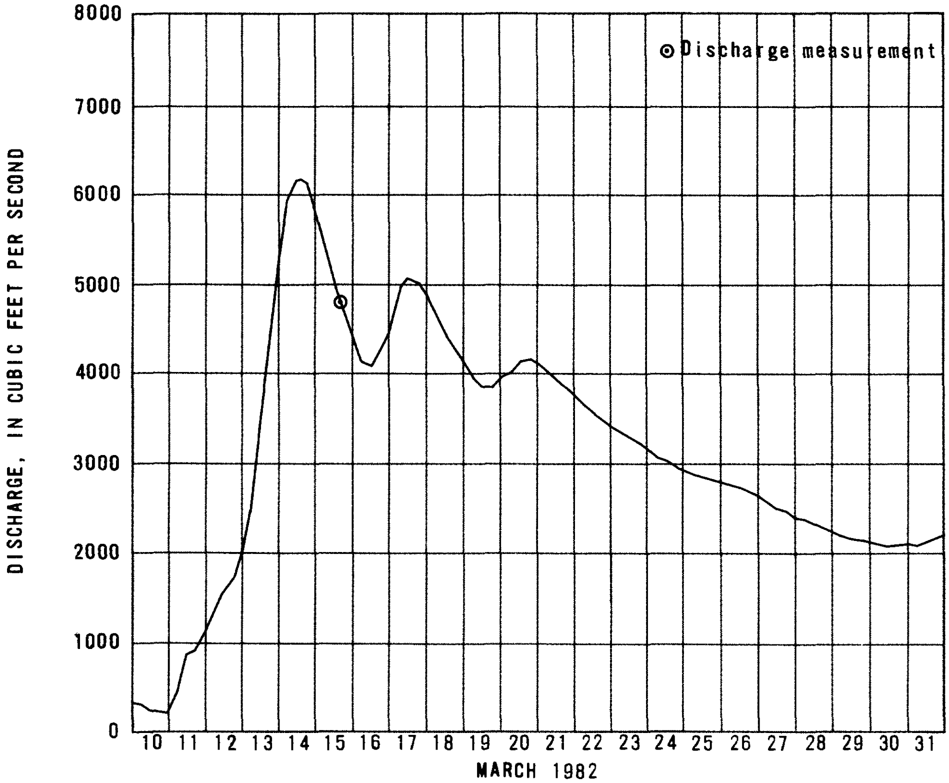


Figure 15.-- Discharge, Elkhart River at Goshen, Indiana.

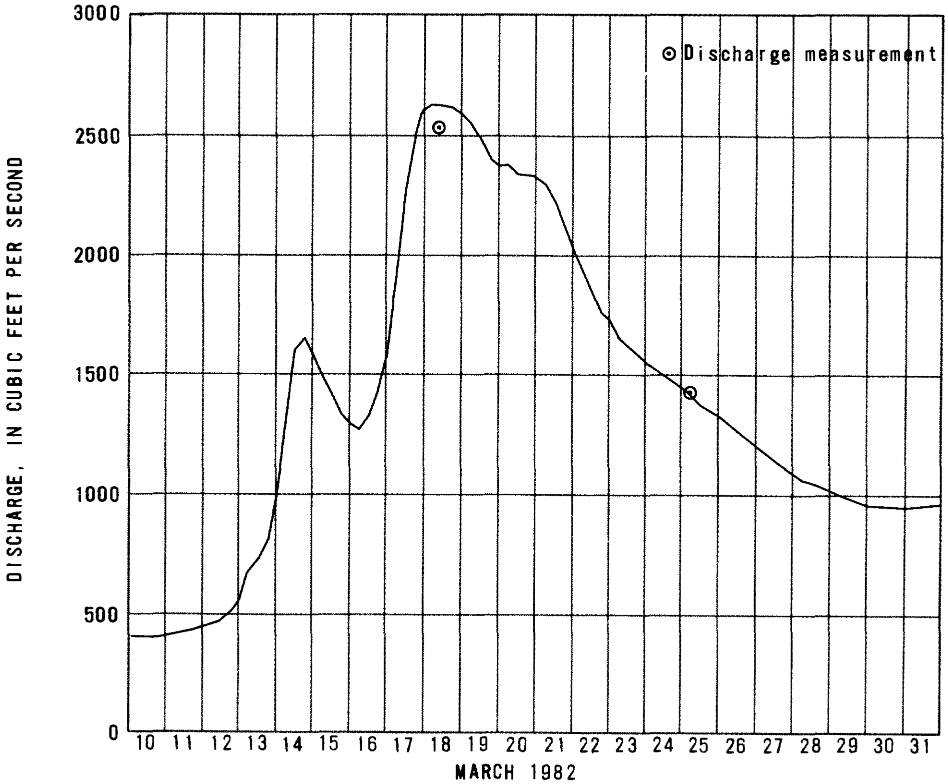


Figure 16.-- Discharge, Paw Paw River at Riverside, Michigan.

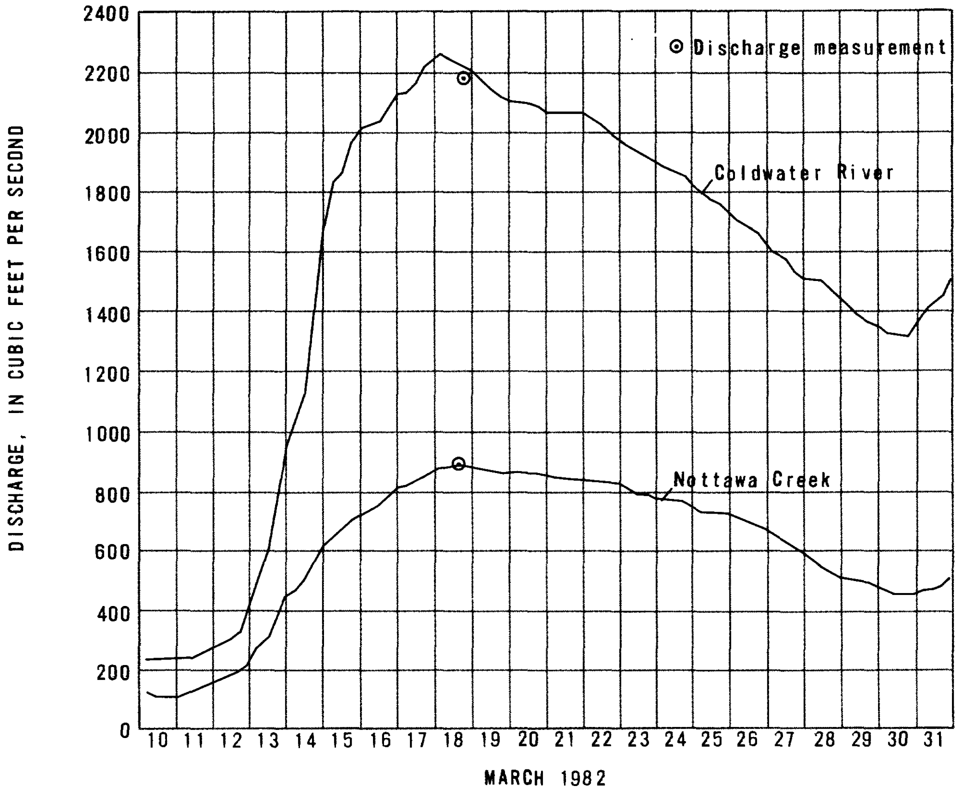


Figure 17.-- Discharge, Coldwater River near Hodunk and Nottawa Creek near Athens, Michigan.

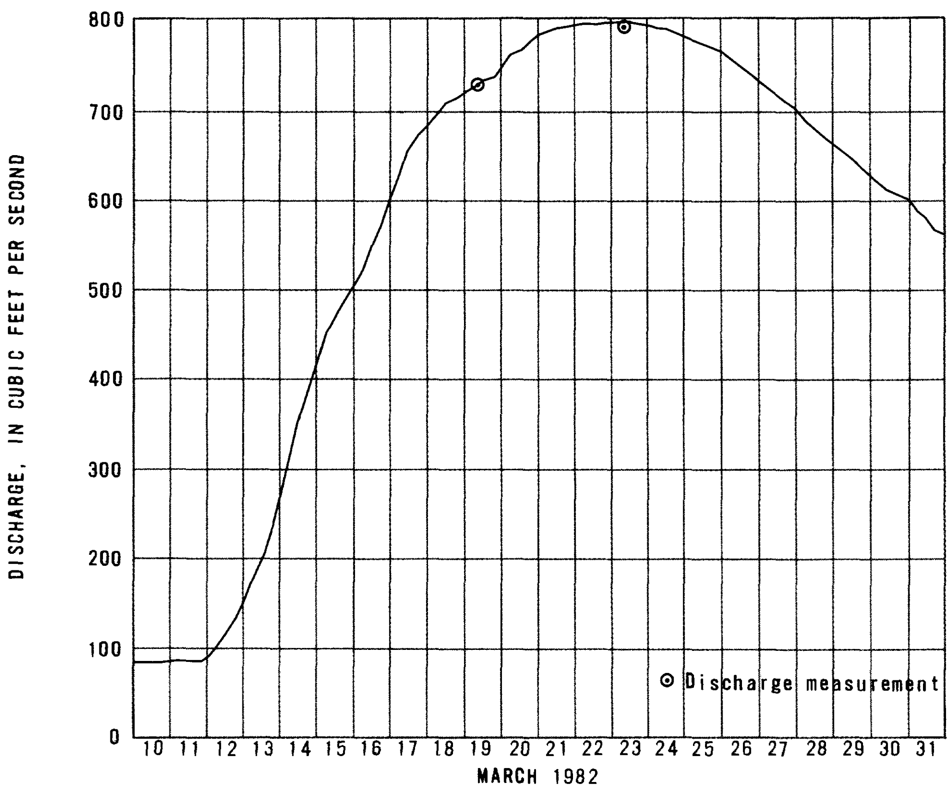


Figure 18.-- Discharge, Pigeon Creek near Angola, Indiana.

Hydrographs for Coldwater River, Nottawa Creek, and Pigeon Creek, tributaries draining the eastern part of the basin, are shown in figures 17 and 18. The one broad peak on each of these streams is due to slow runoff of the melting snow and the effect of many upstream natural lakes.

Property along lakes in Steuben and Lagrange Counties, Ind., was flooded in March 1982. About 1,100 houses and cottages were damaged by record high lake levels on Long Lake at Moonlight, Ind. (04099200), Bower Lake near Lake Pleasant, Ind. (04099250), Hogback Lake near Angola, Ind. (04099500), and other ungaged lakes in the Pigeon Creek chain. Lake levels were 1 to 2 feet higher than the previously recorded peak level of April 1950. Frequency analyses of yearly maximum lake levels showed recurrence intervals of 50 to 100 years for the 1982 lake levels. These recurrence intervals are confirmed by the recurrence interval of the peak discharge at the Pigeon Creek gaging station.

River Raisin Basin

Flooding in the River Raisin basin in southeastern Michigan was severe in March 1982. Data on drainage area, period of record, maximum flood previously recorded, and the March 1982 flood are presented in table 1 for stations in the River Raisin basin shown in figure 1. The recurrence intervals of peak discharges recorded at River Raisin gaging stations were greater than 100 years near Adrian, Mich. (04176000), and 50 years near Monroe, Mich. (04176500). The highest stage and discharge at the gaging station near Monroe for the period of record 1938-82, 11.16 ft and 15,300 ft^3/s, were recorded in March 1982. The 1982 peaks of stage and discharge surpassed those of September 1981, 10.22 ft and 14,500 ft^3/s. Peak stage, 11.16 ft, was caused by backwater from ice and was recorded March 15; peak instantaneous discharge, 15,300 ft^3/s, was recorded the following day. Because of the ice effect on the stage-discharge relationship, mean daily discharges for March 10-31 are plotted in the hydrograph for this station (fig. 19).

The Saline River, in the northeastern part of the basin, recorded a peak discharge of 1,990 ft^3/s at the gaging station near Saline, Mich. (04176400). Although the recurrence interval for this peak discharge is only 10 years, the 21 $(ft^3/s)/mi^2$ unit discharge at this tributary station exceeds the 14 $(ft^3/s)/mi^2$ and 15 $(ft^3/s)/mi^2$ peak unit discharges recorded at gaging stations on the River Raisin near Adrian, Mich., and near Monroe, Mich. These unit discharges indicate that runoff was higher in the eastern half of the basin than in the western half because water equivalents near the eastern half were higher than those in the western half (fig. 2). The 463-mi^2 drainage area of the River Raisin at the gaging station near Adrian, Mich., includes that part of the basin that had the lower water equivalents. The higher water equivalents in the eastern half of the basin explain the unit discharge increasing between the two mainstem stations even though the drainage area more than doubles between Adrian and Monroe.

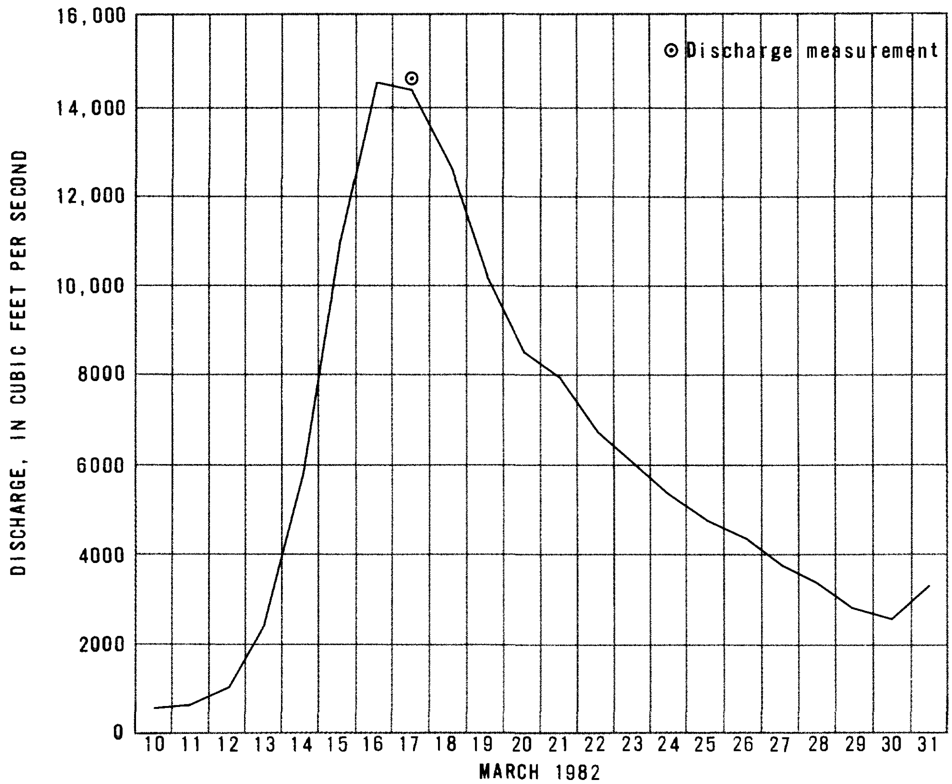


Figure 19.-- Mean daily discharge, River Raisin near Monroe, Michigan.

Maumee River Basin

Flooding in the Maumee River basin in Indiana and Ohio was the worst since the historic flood of March 1913. Rapid melting of a snowpack containing as much as 5 in. of water equivalent, particularly in the St. Joseph and Tiffin River basins, combined with moderate rainfall to cause flooding on major tributaries as well as the mainstem Maumee River. Data on drainage area, period of record, maximum flood previously recorded, and the March 1982 flood are presented in table 1 for stations in the Maumee River basin shown in figure 1.

A narrow belt along the western boundary of the Maumee River basin is drained by the St. Marys and St. Joseph Rivers. The St. Marys River, flowing from the south, and the St. Joseph River, flowing from the north, combine to form the Maumee River at Fort Wayne, Ind. Gaging stations on the St. Marys River recorded peak discharges with recurrence intervals of 20 to 25 years at Decatur, Ind. (04181500), and near Fort Wayne, Ind. (04182000). The hydrograph for the St. Marys River at Decatur is shown in figure 20. Peak flow at the gaging station on the St. Marys River near Fort Wayne was 12,600 ft^3/s on March 14, 3 days before the crest on the St. Joseph River.

Discharge from the St. Joseph River and its major tributary, Cedar Creek, contributed to the flooding in Fort Wayne. Headwaters of both streams are in the area where water equivalent was high (fig. 2). Rapid melting of the snowpack, supplemented by moderate rainfall, produced a peak discharge March 17 on the St. Joseph River: 9,190 ft^3/s near Newville, Ind. (04178000), and

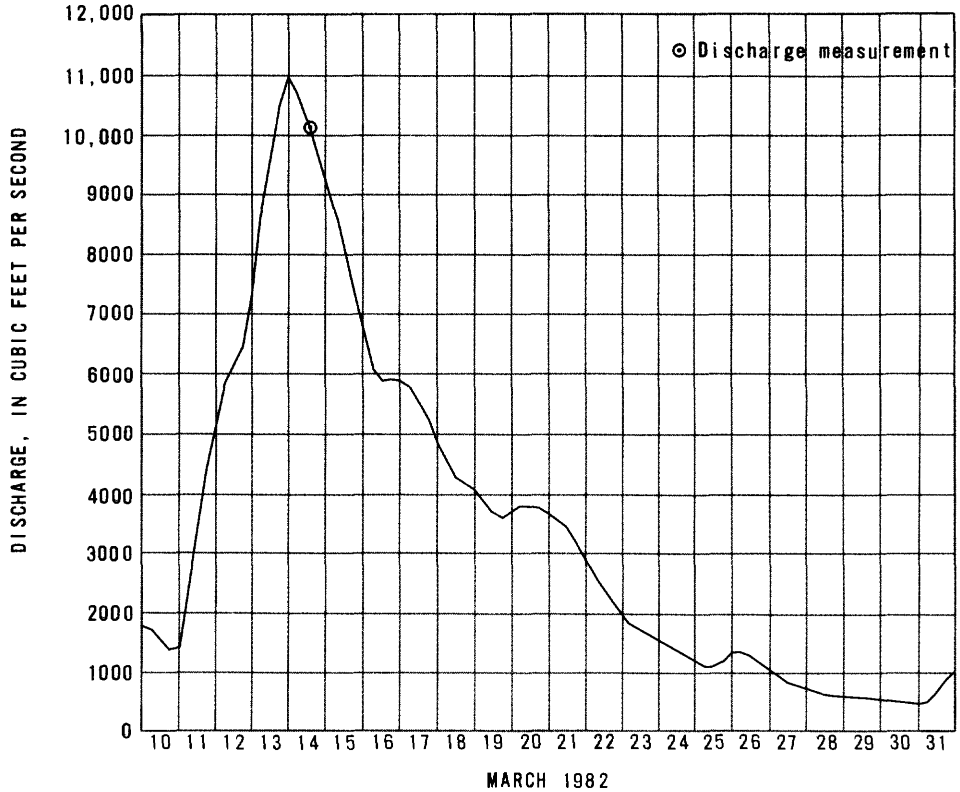


Figure 20.-- Discharge, St. Marys River at Decatur, Indiana.

14,500 ft^3/s at Cedarville, Ind. (04179000). Recurrence intervals for these peaks were 50 and greater than 100 years. Cedar Creek enters the St. Joseph River downstream from Cedarville. The gaging station on Cedar Creek near Cedarville, Ind. (04180000), recorded a peak discharge on March 14 of 5,340 ft^3/s having a recurrence interval of 45 years. March 14 is the same date as the peak on the St. Marys River. Hydrographs for gaging stations on the St. Joseph River and Cedar Creek are shown in figure 21. Examination of figures 20 and 21 shows that prolonged flooding on the Maumee River was caused not only by the magnitude of the peak discharges on the St. Marys River, Cedar Creek, and St. Joseph River but also by the timing of the peaks.

Flooding along the Maumee River downstream from the confluence of the St. Marys and the St. Joseph Rivers at Fort Wayne, Ind., received national attention and prompted a Presidential visit. Efforts of thousands of volunteers, many of them school children, who filled, transported, and placed sandbags to build or reinforce dikes, prevented much damage to the city. Damage still exceeded $20 million in Allen County, mostly in Fort Wayne.

The peak stage recorded in March 1982 at the gaging station on the Maumee River at Fort Wayne, Ind. (04182900), was only 0.2 ft lower than the devastating flood of March 1913, the worst flood known in the area. The flooding in Fort Wayne was compounded because the river remained above flood stage (15.0 feet) from March 12 through 26. The prolonged high stage saturated and strained the dikes protecting the city.

The peak discharge of 26,600 ft^3/s recorded on March 17 at the gaging station on the Maumee River at New Haven, Ind. (04183000), has a recurrence interval of 80 years. The hydrograph for this station is shown in figure 22. This

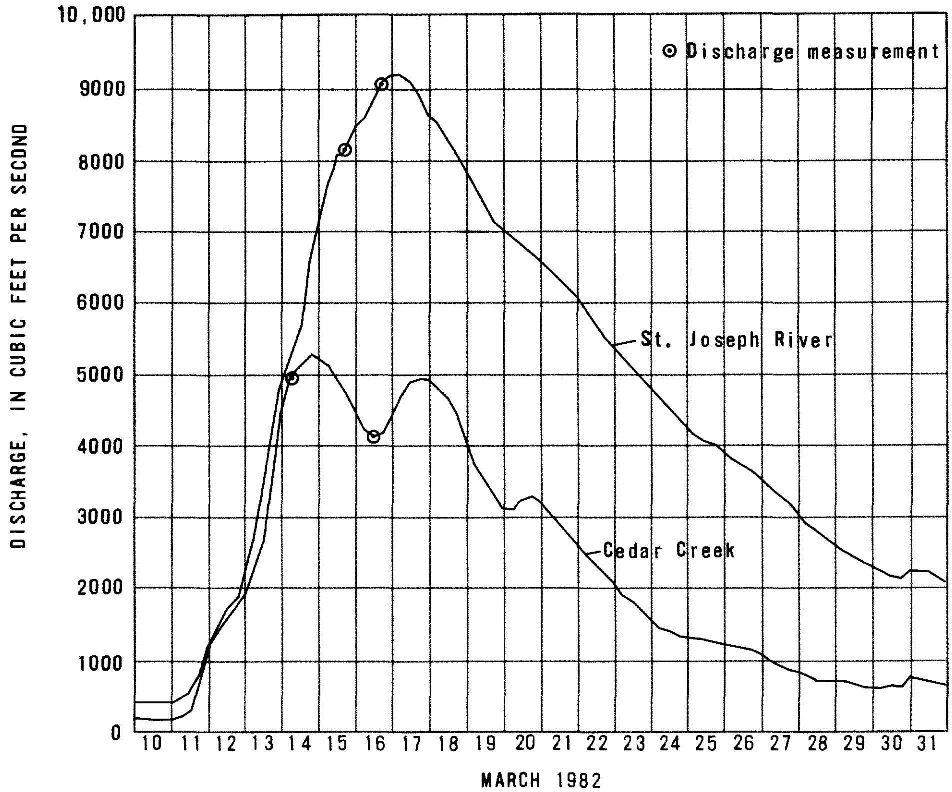


Figure 21.-- Discharge, St. Joseph River near Newville and Cedar Creek near Cedarville, Indiana.

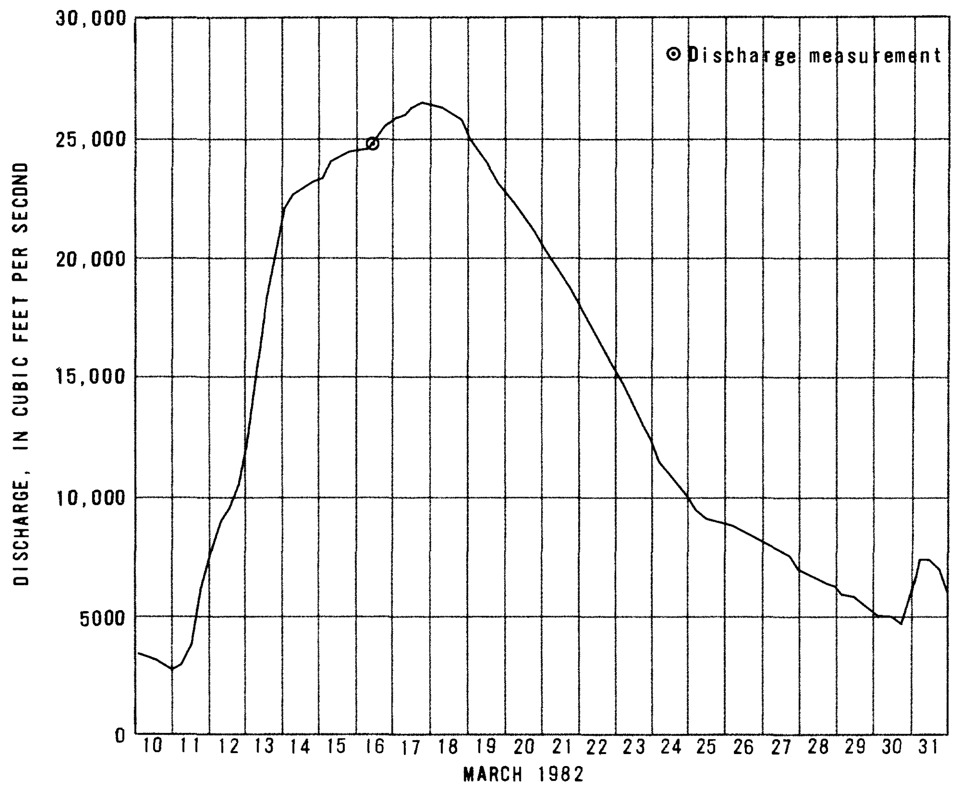


Figure 22.-- Discharge, Maumee River at New Haven, Indiana.

broad peak is the result of the magnitude and the timing of peak discharges on primary tributaries. The peak discharge of the Maumee River attenuated slightly as it moved downstream from New Haven to the gaging station at Antwerp, Ohio (04183500), where a peak discharge of 26,100 ft^3/s having a recurrence interval of 40 years was recorded.

Downstream from Antwerp two major tributaries enter the Maumee River, the Tiffin River from the north and the Auglaize River from the south. The peak discharge of 7,760 ft^3/s recorded at the gaging station on the Tiffin River at Stryker, Ohio (04185000), has a recurrence interval of 50 years, the same as that of the peak discharge recorded at the gaging station on the St. Joseph River near Newville, Ind. (04178000), to the west. This similarity and comparable unit discharges at these two stations indicate uniform runoff from the northern half of the Maumee River basin. The gaging station on the Auglaize River near Defiance, Ohio (04191500), recorded a peak discharge of 52,300 ft^3/s having a recurrence interval of 20 years, the same as that for the peak discharge recorded at the gaging station on the St. Marys River at Decatur, Ind. (04181500), to the west. This similarity and comparable unit discharges at these two stations indicate uniform runoff from the southern half of the Maumee River basin.

High flow of the Maumee River March 14-15, caused by Cedar Creek and the St. Marys River was substantially increased by peak discharges of the Tiffin and Auglaize Rivers. Timing of the peak discharge at gaging stations in the Tiffin and Auglaize River basins is shown in figures 23 and 24. The effect that the timing of these peak discharges had on streamflow in the Maumee River near Defiance, Ohio, is shown in the hydrograph of discharge of the Maumee River near Defiance, Ohio (fig. 25). Peak discharges recorded at gaging stations on the Maumee River near Defiance, Ohio (04192500), and at Waterville, Ohio (04193500), were 104,000 and 120,000 ft^3/s on March 15, 2 days before the river crested upstream at New Haven, Ind., and Antwerp, Ohio. Peak discharge from the St. Joseph River March 17, although causing the crest at New Haven and Antwerp, had minimal effect at downstream Maumee River stations.

Kankakee River Basin

Flooding was widespread on the Kankakee River and its major tributary, Yellow River. Streams draining less than 10 mi^2 produced peak discharges having low recurrence intervals because runoff similar to that associated with the March 1982 flood is more common in basins of this size. Gaging stations on the two tributaries having drainage areas greater than 10 mi^2 in the western half of the basin also recorded peak discharges having low recurrence intervals. These low recurrence intervals, however, are due to the low water equivalent of the snowpack in this general area (fig. 2). Therefore, only data from those gaging stations in the Kankakee River basin upstream from Momence, Ill., are included in this report. Data on drainage area, period of record, maximum flood previously recorded, and the March 1982 flood are presented in table 1 for stations in the Kankakee River basin shown in figure 1.

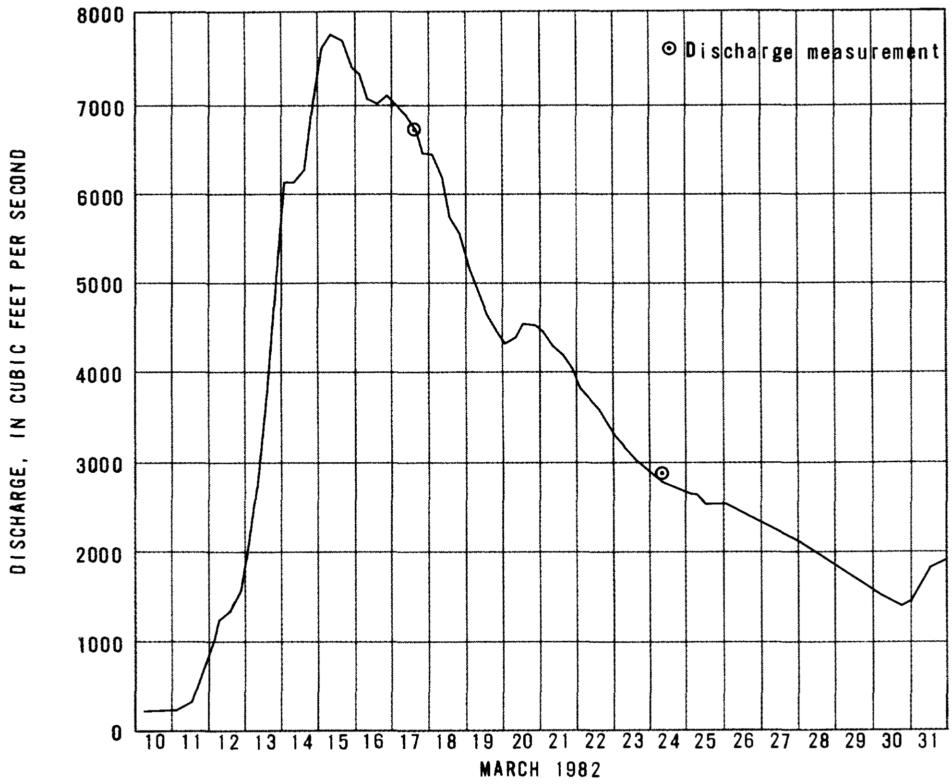


Figure 23.-- Discharge, Tiffin River at Stryker, Ohio.

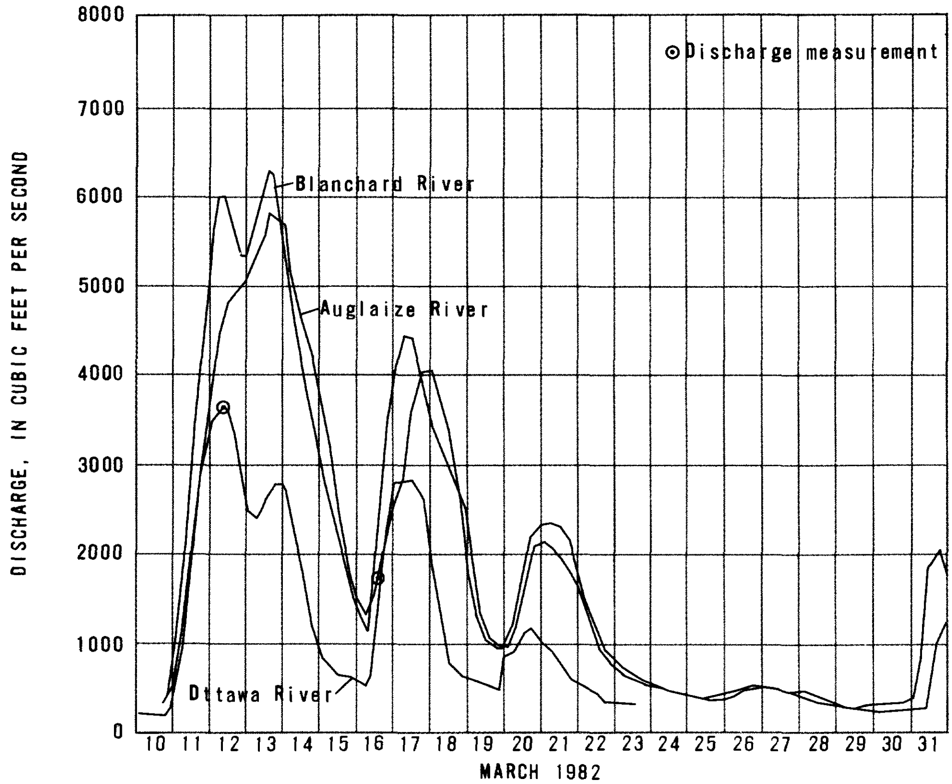


Figure 24.-- Discharge, Auglaize River near Fort Jennings, Ottawa River at Allentown, and Blanchard River near Findlay, Ohio.

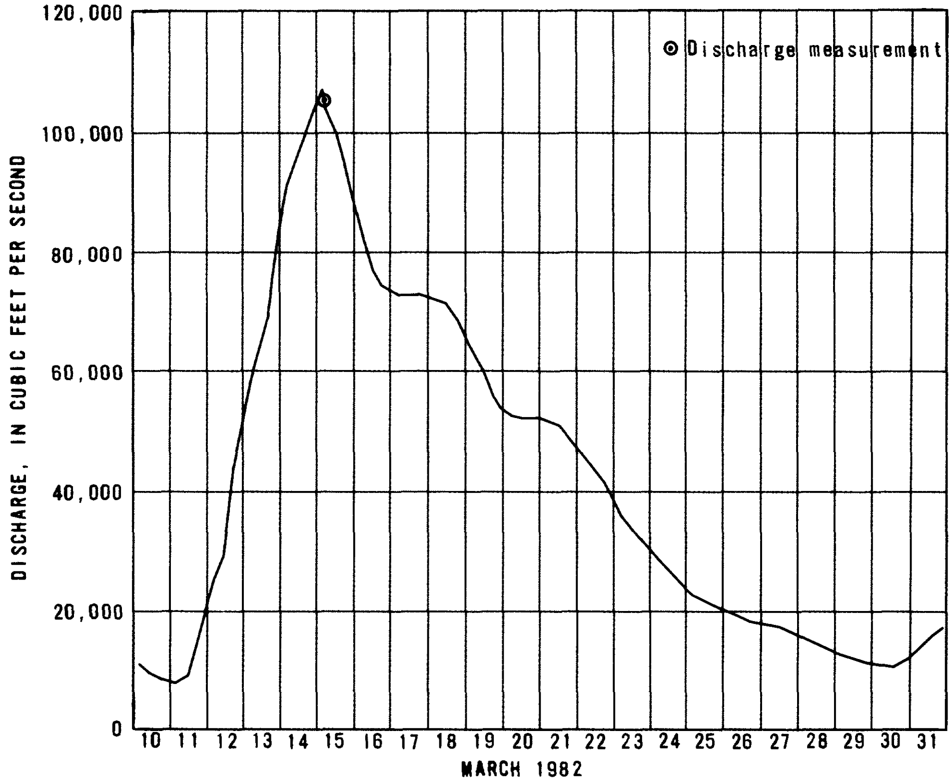


Figure 25.-- Discharge, Maumee River near Defiance, Ohio.

Damage caused by flooding on the Yellow River was extensive in Marshall County, particulary in the community of Plymouth. Peak discharges recorded at all stations on the Yellow River have recurrence intervals greater than 100 years. The peak discharge of 4,730 ft^3/s, recorded at the gaging station on the Yellow River at Plymouth, Ind. (05516500), was the second highest for the period of record 1949-82 and was exceeded only by the 5,390 ft^3/s recorded during the flood of October 1954. Hydrographs for Yellow River gaging stations in figure 26 have only one broad peak, owing to the flat topography and resultant slow overland runoff of the area.

The Kankakee River rose slowly but steadily along the entire leveed reach from near North Liberty, Ind., to the Illinois State line. Peaks of record for both stage and discharge were established at four gaging stations in this reach. Recurrence intervals of 100 years or more have been estimated for these peak discharges. The peak discharge of 1,920 ft^3/s recorded at the gaging station on the Kankakee River at Davis, Ind. (05515500), was the highest for the period of record 1932-82 and exceeded the 1,580 ft^3/s recorded in July 1981.

Although record gage heights were established on the Kankakee River and caused backwater on tributaries, flooding became most severe after breaks developed in the dikes along the river and its tributaries. Floodwaters flowing through the breaks inundated roads and farmland and damaged homes in many communities throughout the basin. For example, near LaCrosse, Ind., breaks in dikes along the Hanna Arm of the Tuesburg ditch allowed water to flood thousands of acres of farmland.

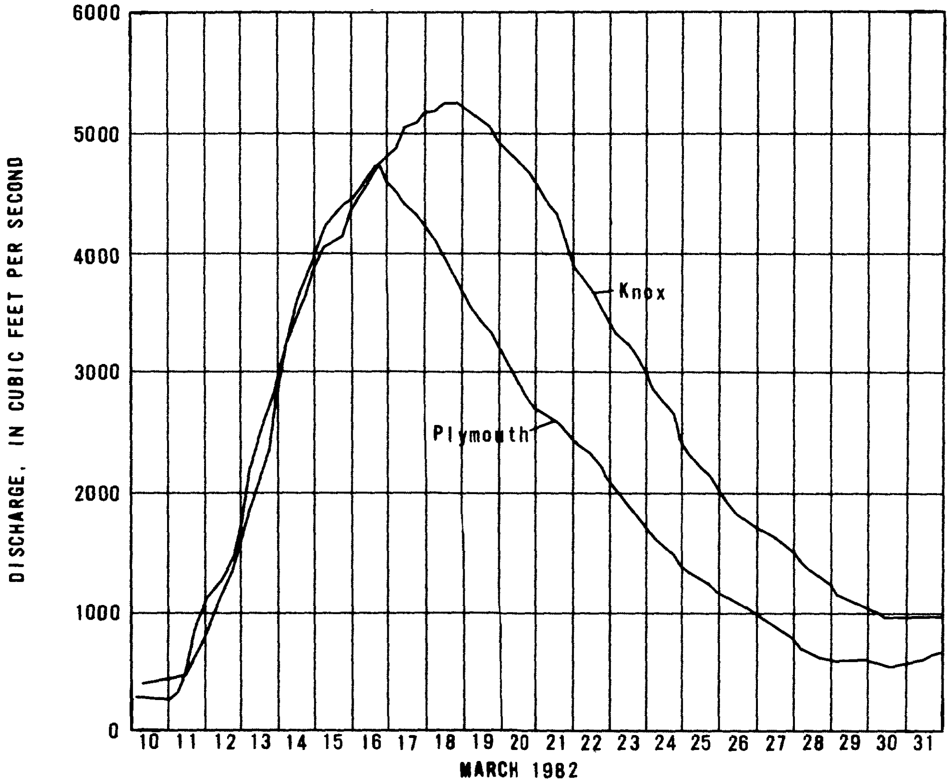


Figure 26.-- Discharge, Yellow River at Plymouth and at Knox, Indiana.

Water levels on the Kankakee River fluctuated as breaks developed in dikes and were subsequently repaired. Numerous discharge measurements were made at mainstem gaging stations to monitor streamflow in the main channel. Where possible, discharge measurements were also made of flows bypassing the gaging stations because of breaks in the dikes. Because of backwater and (or) breaks in the levee system, the maximum stage did not always coincide with maximum discharge at gaging stations on the Kankakee River. However, the river did remain above flood stage (9.0 ft) at the gaging station at Shelby, Ind. (05518000), from March 12 to May 6. Hydrographs plotted from mean daily discharges for March 10-31 at Kankakee River gaging stations are shown in figures 27-30. The difference between the measured main-channel discharge and that plotted in the hydrograph is the measured or estimated streamflow bypassing the gage owing to breaks in the dike.

The levee system ends at the Illinois State line. The gaging station on the Kankakee River at Momence, Ill. (05520500), recorded a peak discharge of 11,000 ft^3/s, third highest for the period of record 1915-82. The recurrence interval of this peak discharge is 50 years, as compared to 100 years for peak discharges at gaging stations on the Kankakee River upstream from Momence. Unit discharge of the Kankakee River, 5 $(ft^3/s)/mi^2$, remained constant between Davis, Ind., and Momence, Ill.

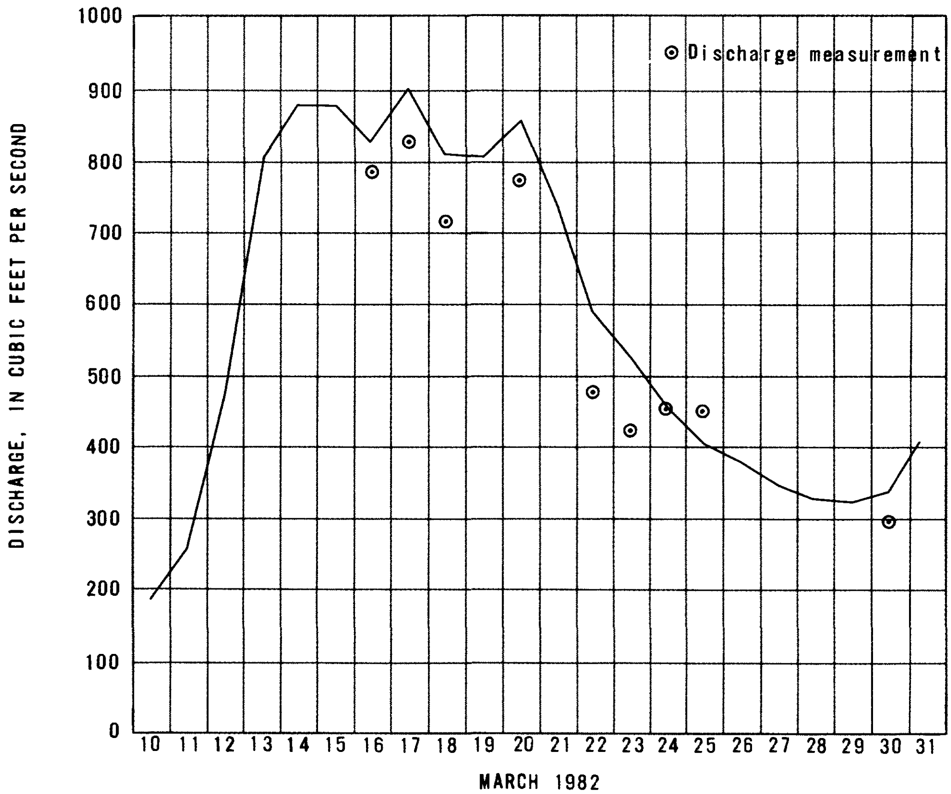


Figure 27.-- Mean daily discharge, Kankakee River near North Liberty, Indiana.

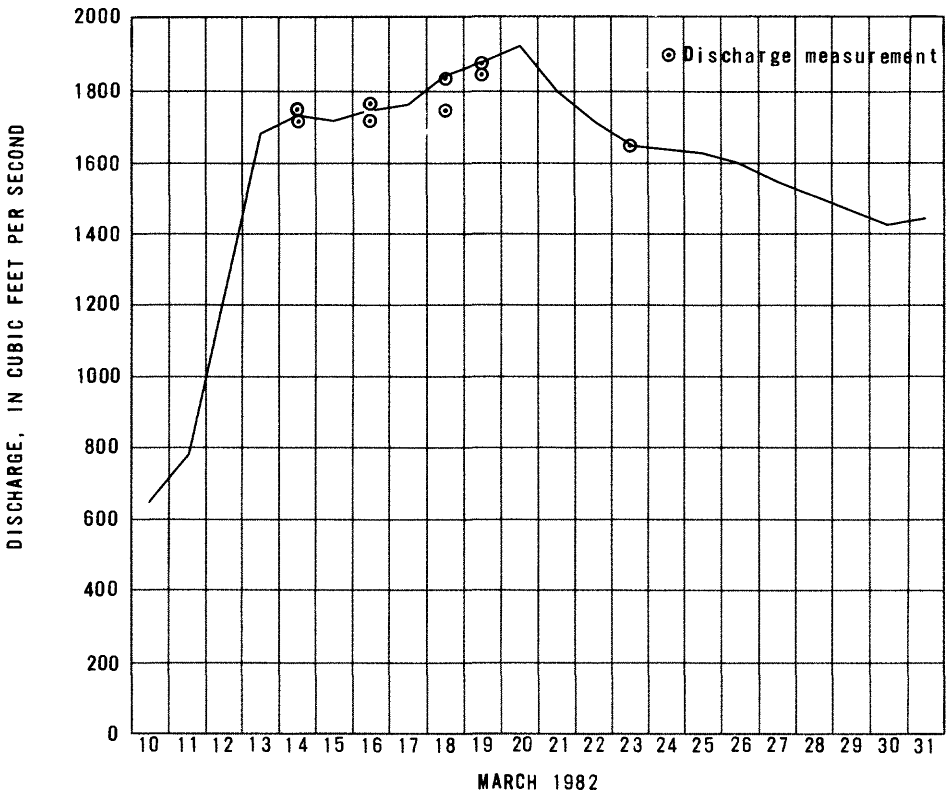


Figure 28.-- Mean daily discharge, Kankakee River at Davis, Indiana.

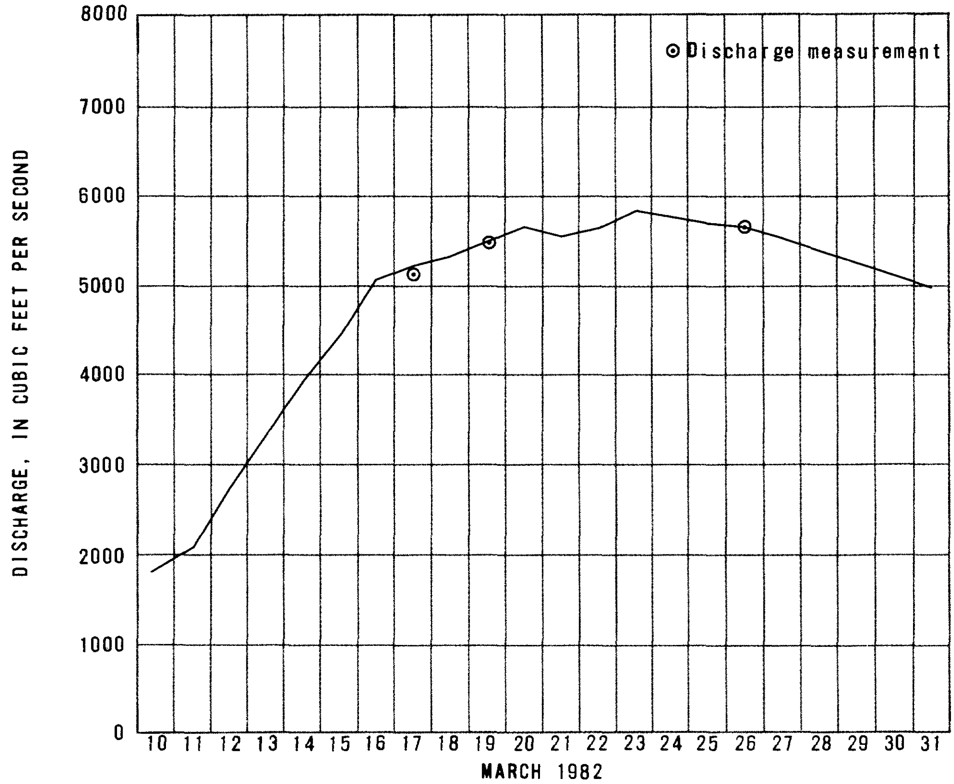


Figure 29.-- Mean daily discharge, Kankakee River at Dunns Bridge, Indiana.

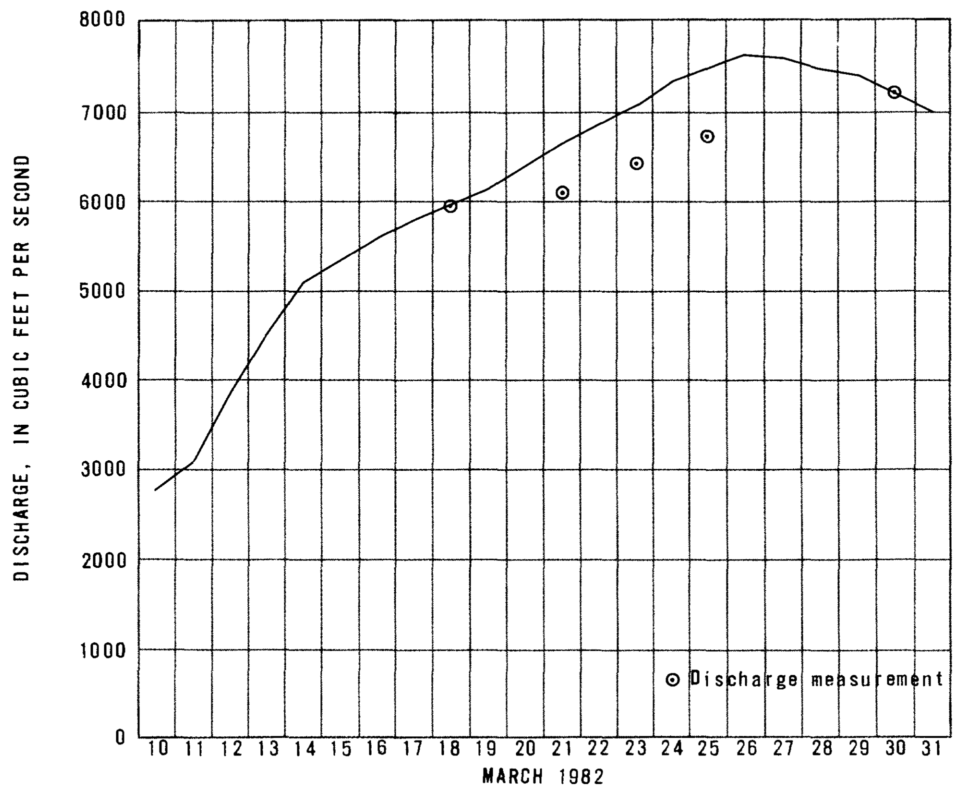


Figure 30.-- Mean daily discharge, Kankakee River at Shelby, Indiana.

FLOOD DAMAGE

Flooding of several rivers in Indiana, Michigan, and Ohio caused extensive damage in March 1982. Five counties in Indiana, two in Michigan, and seven in Ohio were declared Federal disaster areas. Damage caused by high stage on the Maumee River and its tributaries exceeded $20 million in the vicinity of Fort Wayne, Allen County, Ind. Approximately 9,000 people were evacuated because of flooding or potential dike failure in Fort Wayne. Floodwaters on the Maumee River were also responsible for three deaths in Ohio as the river crested from 7 to 10 ft above flood stage in the towns of Defiance, Napoleon, and Grand Rapids. Damage in Ohio was estimated by the Federal Emergency Management Agency to exceed $2 million.

Flooding of the Kankakee River and its major tributary, the Yellow River, caused considerable damage within LaPorte, Starke, and Marshall Counties, Ind. Breaks in the levees and backwater on tributaries flooded thousands of acres of farmland.

Isolated flooding was reported in the southeastern and southwestern parts of Michigan. One death resulted from flooding of the River Raisin in Monroe County in southeastern Michigan. Flooding of the Paw Paw and St. Joseph Rivers in Berrien County, southwestern Michigan caused extensive damage.

SUMMARY

Flooding in northern Indiana, southern Michigan, and northwestern Ohio was preceded by above-average autumnal precipitation; frozen, saturated ground; and rapid melting of a record winter snowfall. By early March, a snowpack containing water equivalent of 2 to 6 inches covered most of the area. Rainfall March 10-12 and the passage of a warm front through the area March 12-13 triggered rapid melting of the snowpack and generated the floods. Subsequent rainfall March 15-20 maintained high streamflow and produced additional peaks on some streams.

Streamflow data from 83 gaging stations and crest-stage partial-record sites are presented for five drainage basins affected by flooding.

In the Wabash River basin, flooding was most severe on major tributaries draining the northern half of the basin. Peak discharges having recurrence intervals of 40 to 100 years were recorded at gaging stations on the Little, Eel, and Tippeçanoe Rivers.

Flooding in the St. Joseph River basin was the worst since April 1950. Recurrence intervals of the peak discharge at the five mainstem gaging stations ranged from 45 to 60 years. Peaks of record were established at gaging stations on Prairie River, Fawn River, Pigeon Creek, and Elkhart River, southern tributaries to the St. Joseph River.

Major flooding in the River Raisin basin caused extensive damage in many communities in southeastern Michigan. Peak discharges having recurrence intervals of 50 to greater than 100 years were recorded at mainstem gaging stations in response to runoff from an extensive, dense snowpack.

Flooding in the Maumee River basin in Indiana and Ohio was the worst since 1913. Peak discharges having recurrence intervals of 50 to 100 years from the northern tributaries, St. Joseph and Tiffin Rivers, and 20 to 25 years from the southern tributaries, St. Marys and Auglaize Rivers, combined to produce flooding on the Maumee River. Flooding and property damage were extensive in Fort Wayne, Ind., and in Defiance, Napoleon, and Grand Rapids, Ohio.

Although peaks of record for both stage and discharge were established at most gaging stations on the Kankakee River, flooding became most severe after breaks developed in the dikes along the river and its tributaries. Flooding on Yellow River, the major tributary to the Kankakee River, was the worst since the flood of October 1954. Recurrence intervals in excess of 100 years have been estimated for peak discharges at all gaging stations on Yellow River and gaging stations on the Kankakee River from North Liberty to Shelby, Ind.

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Table 1.--Summary of peak stage and discharge data.

[R, river; nr, near; Cr, creek]

Station number	Station name	Contributing drainage area (mi^2)	Period of record (water years)	Maximum flood previously recorded: Date	Gage height (ft)	Discharge (ft^3/s)	Discharge [(ft^3/s)/mi^2]	Maximum during 1982 flood: Date	Gage height (ft)	Discharge (ft^3/s)	Discharge [(ft^3/s)/mi^2]	Recurrence interval (years)
	Wabash River Basin											
03322500	Wabash R nr New Corydon, Ind.	262	1952-82	01-22-59	20.47	8,720	33	03-11-82	17.50	3,580	14	[a]<5
03322900	Wabash R at Linn Grove, Ind.	453	1965-82	03-17-78	13.87	9,560	21	03-13-82	12.63	5,770	13	[a]<5
03324000	Little R nr Huntington, Ind.	263	1944-82	02-11-59 01-04-50	18.43 -----	----- 5,990	23	03-14-82	19.39	5,700	22	[a]50
03327790	Eel R tributary nr Columbia City, Ind.	.17	1973-82	06-04-80	7.71	50	294	03-13-82	6.21	11	65	<5
03327930	Koontz ditch nr Sidney, Ind.	2.50	1973-82	06-13-81	-----	375	150	03-13-82	-----	260	104	5
03328000	Eel R at North Manchester, Ind.	417	1930-82	02-27-36 12-22-67	14.00 -----	----- 7,940	19	03-13-82	13.72	8,180	20	[a]45
03328020	Otter Cr tributary nr North Manchester, Ind.	.92	1973-82	04-14-81	6.92	195	212	03-13-82	6.79	175	190	10
03328430	Weesau Cr nr Deedsville, Ind.	8.87	1971-82	03-03-79	5.86	284	32	03-13-82	7.37	464	52	50
03328500	Eel R nr Logansport, Ind.	789	1944-82	12-09-66	12.20	14,200	18	03-14-82	11.74	13,400	17	[a]20
03330290	Shanton ditch nr Pierceton, Ind.	.70	1973-82	06-13-81	6.52	35	50	03-13-82	5.42	10	14	<5
03330500	Tippecanoe R at Oswego, Ind.	113	1950-82	10-17-54	8.64	700	6	03-21-82	9.25	950	8	[a]100
03331110	Walnut Cr nr Warsaw, Ind.	19.6	1970-82	06-13-81	5.38	561	29	03-13-82	4.72	411	21	20
03331500	Tippecanoe R at Ora, Ind.	856	1944-82	06-15-81	15.08	8,660	10	03-15-82	14.98	8,460	10	[a]40
03332300	Little Indian Cr nr Royal Center, Ind.	35	1960-82	03-05-63	-----	500	14	03-13-82	6.75	329	9	<5
03332340	Weltzin ditch tributary nr Francesville, Ind.	.50	1973-82	03-21-78	7.98	68	136	03-13-82	5.29	9	18	<5
03332400	Big Monon Cr nr Francesville, Ind.	152	1960-82	12-25-65	15.14	2,750	18	03-13-82	15.66	1,910	12	<5
	St. Joseph River Basin											
04096400	St. Joseph R nr Burlington, Mich.	201	1963-82	03-06-76	5.31	1,030	5	03-21-82	5.78	1,340	7	45

Table 1.--Summary of peak stage and discharge data--Continued.

Station number	Station name	Contributing drainage area (mi^2)	Period of record (water years)	Maximum flood previously recorded				Maximum during 1982 flood				Recurrence interval (years)
				Date	Gage height (ft)	Discharge		Date	Gage height (ft)	Discharge		
						(ft^3/s)	[(ft^3/s)/mi^2]			(ft^3/s)	[(ft^3/s)/mi^2]	
				St. Joseph River Basin--Continued								
04096515	Hog Cr nr Allen, Mich.	48.7	1970-82	06-28-78	5.78	426	9	03-17-82	5.63	524	11	45
04096600	Coldwater R nr Hodunk, Mich.	293	1963-82	06-28-78	7.77	1,930	7	03-18-82	8.25	2,260	8	25
04096900	Nottawa Cr nr Athens, Mich.	162	1967-82	06-29-78	6.47	1,120	7	03-18-82	5.02	900	6	15
04097170	Portage R nr Vicksburg, Mich.	68.2	1947-51 1965-82	04-07-47	5.66	356	5	03-21-82	5.48	292	4	10
04097500	St. Joseph R at Three Rivers, Mich.	1,350	1952-82	03-07-76	9.08	5,810	4	03-21-82	10.69	8,180	6	60
04097540	Prairie R nr Nottawa, Mich.	106	1963-82	03-06-76	5.66	523	5	03-20-82	6.12	698	7	55
04097970	Lime Lake outlet at Panama, Ind.	13.8	1970-82	06-14-81	4.62	38	3	04-03-82	4.85	46	3	50
04098500	Fawn R nr White Pigeon, Mich.	192	1958-82	03-06-76	4.75	613	3	03-21-82	5.18	725	4	50
04099000	St. Joseph R at Mottville, Mich.	1,866	1924-82	04-27-50	10.76	10,700	6	03-21-82	9.81	10,100	5	[a]50
04099060	Pigeon Cr tributary nr Ellis, Ind.	1.22	1973-82	06-14-81	7.89	110	90	03-20-82	7.86	110	90	20
04099200	Long Lake at Moonlight, Ind.	67.9	1946-82	04-07-50	16.41	------	---	03-21-82	17.42	------	---	60
04099250	Bower Lake nr Pleasant Lake, Ind.	84.6	1946-70 1977-82	04-07-50	15.70	------	---	03-21-82	17.13	------	---	50
04099500	Hogback Lake nr Angola, Ind.	103	1946-73 1976-82	04-08-50	14.93	------	---	03-21-82	17.07	------	---	100
04099510	Pigeon Cr nr Angola, Ind.	83.5	1946-82	04-08-50	14.95	744	9	03-22-82	13.90	795	10	95
04099750	Pigeon R nr Scott, Ind.	307	1969-82	06-15-81	7.27	1,980	6	03-21-82	7.85	2,370	8	35
04099808	Little Elkhart R at Middlebury, Ind.	91.7	1980-82	07-26-81	9.58	1,690	18	03-17-82	9.40	1,560	17	----
04099850	Pine Cr nr Elkhart, Ind.	31.0	1980-82	07-26-81	9.73	177	6	03-14-82	7.18	509	16	----
04100165	Wible Lake inlet nr Kendallville, Ind.	2.47	1973-82	06-01-80	5.51	48	19	03-14-82	5.87	50	20	20
04100222	North Branch Elkhart R at Cosperville, Ind.	142	1972-82	04-07-78	7.41	682	5	03-23-82	8.12	919	6	40
04100252	Forker Cr nr Burr Oak, Ind.	19.2	1970-82	04-15-81	6.60	328	17	03-14-82	6.71	338	18	25

Table 1.--Summary of peak stage and discharge data--Continued

Station number	Station name	Contributing drainage area (mi^2)	Period of record (water years)	Maximum flood previously recorded				Maximum during 1982 flood				
				Date	Gage height (ft)	Discharge (ft^3/s)	Discharge [(ft^3/s)/mi^2]	Date	Gage height (ft)	Discharge (ft^3/s)	Discharge [(ft^3/s)/mi^2]	Recurrence interval (years)
	St.Joseph River Basin--Continued											
04100295	Rimmel Branch nr Albion, Ind.	10.7	1980-82	04-14-81	12.82	399	37	03-13-82	12.31	360	34	-----
04100465	Turkey Cr at Syracuse, Ind.	43.8	1970-82	06-14-81	5.37	170	4	03-19-82	5.06	154	4	5
04100500	Elkhart R at Goshen, Ind.	594	1932-82	04-04-50	10.15	5,440	9	03-14-82	11.94	6,180	10	[a]80
04101000	St. Joseph R at Elkhart, Ind.	3,370	1948-82	04-05-50	27.82	18,400	5	03-21-82	27.91	18,600	6	[a]45
04101500	St. Joseph at Niles, Mich.	3,666	1931-82	04-05-50	15.10	20,200	6	03-21-82	14.97	19,900	5	[a]45
04101800	Dowagiac R at Sumnerville, Mich.	255	1961-82	06-26-68	8.78	1,280	5	03-17-82	8.33	1,150	5	15
04102320	Paw Paw R nr Paw Paw, Mich.	195	1981-82	05-11-81	5.73	1,230	6	03-14-82	6.26	1,540	8	-----
04102420	Paw Paw R nr Hartford, Mich.	311	1981-82	02-21-81	9.76	1,760	6	03-17-82	10.37	2,500	8	-----
04102500	Paw Paw R at Riverside, Mich.	390	1952-82	03-09-79	10.11	2,830	7	03-18-82	10.11	2,650	7	45
	River Raisin Basin											
04176000	River Raisin nr Adrian, Mich.	463	1933-38 1954-82	04-30-56	14.87	5,580	12	03-15-82	15.77	6,660	14	>100
04176400	Saline R nr Saline, Mich.	94.6	1966-82	06-26-68	13.37	3,990	42	03-14-82	11.84	1,990	21	10
04176500	River Raisin nr Monroe, Mich.	1,042	1938-82	09-06-81	10.22	14,500	14	03-15-82 03-16-82	11.16 -----	Ice jam 15,300	15	50
	Maumee River Basin											
04177720	Fish Creek at Hamilton, Ind.	37.5	1970-82	03-23-78	10.79	497	13	03-17-82	11.52	603	16	35
04178000	St. Joseph R nr Newville, Ind.	610	1947-82	04-06-50	17.05	9,710	16	03-17-82	17.96	9,190	15	[a]50
04179000	St. Joseph R at Cedarville, Ind.	763	1956-82	03-24-78 05-01-56	18.62 -----	------ 10,100	13	03-17-82	21.94	14,500	19	[a]>100
04179500	Cedar Cr at Auburn, Ind.	87.3	1943-82	04-05-50	9.90	1,520	17	03-14-82	10.63	2,100	24	[a]>100

Table 1.--Summary of peak stage and discharge data--Continued

Station number	Station name	Contributing drainage area (mi^2)	Period of record (water years)	Maximum flood previously recorded				Maximum during 1982 flood				
				Date	Gage height (ft)	Discharge		Date	Gage height (ft)	Discharge		Recurrence interval (years)
						(ft^3/s)	[(ft^3/s)/mi^2]			(ft^3/s)	[(ft^3/s)/mi^2]	
	Maumee River Basin--Continued											
04179510	Cecil Metcalf ditch nr Auburn, Ind.	0.78	1973-82	06-13-81	-----	90	115	03-14-82	10.50	140	179	20
04180000	Cedar Cr nr Cedarville, Ind.	270	1947-82	04-05-50	11.67	4,870	18	03-14-82	12.98	5,340	20	[a]45
04181500	St. Marys R at Decatur, Ind.	621	1947-82	02-10-59	24.22	11,300	18	03-14-82	24.40	10,900	18	[a]20
04182000	St. Marys R nr Fort Wayne, Ind.	762	1931-82	02-11-59	19.42	13,600	18	03-14-82	19.66	12,600	17	[a]25
04182590	Harber ditch at Fort Wayne, Ind.	21.9	1965-82	06-13-81	11.67	916	42	03-14-82	12.25	900	41	10
04182900	Maumee R at Fort Wayne, Ind.	1,926	1907-82	03-26-13	26.10	------	---	03-17-82	25.93	------	---	-----
04183000	Maumee R at New Haven, Ind.	1,967	1947-82	03-24-78	23.58	22,400	11	03-17-82	25.49	26,600	14	[a]80
04183500	Maumee R at Antwerp, Ohio	2,129	1922-82	05-20-43	20.29	26,200	12	03-17-82	21.70	26,100	12	[a]40
04185000	Tiffin R at Stryker, Ohio	410	1922-28 1941-82	04-25-50	15.45	6,640	16	03-15-82	18.36	7,760	19	50
04186500	Auglaize R nr Fort Jennings, Ohio	332	1922-36 1941-82	01-23-59	20.30	12,000	36	03-13-82	15.05	5,850	18	<5
04187500	Ottawa R at Allentown, Ohio	160	1924-35 1943-82	01-22-59	10.88	7,740	48	03-12-82	8.70	3,640	23	<5
04189000	Blanchard R nr Findlay, Ohio	346	1924-36 1941-82	06-14-81	17.43	13,000	38	03-13-82	12.35	6,320	18	<5
04191500	Auglaize R nr Defiance, Ohio	2,318	1916-82	02-13-59 02-16-50 02-12-59	27.65 ----- -----	Ice jam 52,500 52,500	 23 23	03-14-82	27.39	52,300	23	20
04192500	Maumee R nr Defiance, Ohio	5,545	1925-36 1939-75 1979-82	02-16-50	13.70	87,100	16	03-15-82	15.87	104,000	19	>100
04193500	Maumee R at Waterville, Ohio	6,330	1900-01 1922-36 1939-82	02-16-50	14.52	94,000	15	03-15-82	17.18	120,000	19	90

Table 1.--Summary of peak stage and discharge data--Continued

Station number	Station name	Contributing drainage area (mi^2)	Period of record (water years)	Maximum flood previously recorded: Date	Gage height (ft)	Discharge (ft^3/s)	Discharge [(ft^3/s)/mi^2]	Maximum during 1982 flood: Date	Gage height (ft)	Discharge (ft^3/s)	Discharge [(ft^3/s)/mi^2]	Recurrence interval (years)
	Kankakee River Basin											
05515000	Kankakee R nr North Liberty, Ind.	116	1951-82	06-27-68 06-14-81	9.04 -----	------ 780	7	03-17-82	9.01	908	8	a>100
05515400	Kingsbury Cr nr LaPorte, Ind.	3.01	1971-82	07-26-81	6.83	73	24	03-13-82	6.31	63	21	10
05515500	Kankakee R at Davis, Ind.	400	1932-82	07-29-81	12.52	1,580	4	03-17-82 03-20-82	12.98 -----	------ 1,920	5	a>100
05516000	Yellow R nr Breman, Ind.	131	1955-82	05-15-78	17.68	2,750	21	03-16-82	15.17	2,800	21	a>100
05516150	Walt Kimble ditch nr Lapaz, Ind.	1.50	1973-82	03-18-77	9.85	265	177	03-13-82	10.08	290	193	15
05516500	Yellow R at Plymouth, Ind.	272	1949-82	10-12-54	17.13	5,390	20	03-16-82	16.37	4,730	17	a>100
05517000	Yellow R at Knox, Ind.	384	1944-82	10-15-54	13.75	5,660	15	03-18-82	13.25	5,280	14	a>100
05517400	West Arm Payne ditch nr North Judson, Ind.	2.58	1973-82	06-13-81	8.33	230	89	03-13-82	6.63	92	36	<5
05517500	Kankakee R at Dunns Bridge, Ind.	1,160	1949-82	10-22-54	13.20	5,300	5	03-20-82 03-23-82	13.38 -----	------ 5,870	5	a100
05517530	Kankakee R nr Kouts, Ind.	1,182	1975-82	06-18-81	13.59	4,630	4	03-24-82	14.52	6,420	5	>100
05517780	Cobb ditch nr Valpariso, Ind.	.39	1973-82	06-13-81	9.13	76	195	03-13-82	9.46	81	208	10
05517890	Cobb ditch nr Kouts, Ind.	30.3	1969-82	03-05-76	-----	777	26	03-13-82 03-13-82	17.71 -----	Ice Jam 751	25	10
05518000	Kankakee R at Shelby, Ind.	1,578	1923-82	06-22-81 12-21-27	12.51 -----	------ 7,200	5	03-24-82 03-26-82	12.98 -----	------ (b)	5	a>100
05519000	Singleton ditch at Schneider, Ind.	123	1949-82	06-25-75 03-05-76	12.37 -----	------ 3,550	29	03-13-82	11.41	1,910	16	a10
05520500	Kankakee R at Momence, Ill.	2,093	1915-82	03-06-79	10.51	16,000	8	03-20-82	6.03	11,000	5	a50

a From Indiana Department of Natural Resources (1981).
b Mean daily discharge was 7,650 ft^3/s.