FLOOD OF JULY 1-2, 1987, IN NORTH-CENTRAL OHIO

By Ronald I. Mayo and James P. Mangus

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CONVERSION FACTORS AND ABBREVIATIONS

For the convenience of readers who may prefer metric (International System) units rather than the inch-pound units used in this report, values may be converted by using the following factors:

Multiply inch-pound unit	By	To obtain metric unit
inch (in.)	25.4	millimeter (mm)
foot (ft)	0.3048	meter (m)
mile (mi)	1.609	kilometer (km)
square mile (mi^2)	2.590	square kilometer (km^2)
cubic foot per second (ft^3/s)	0.02832	cubic meter per second (m^3/s)
acre-foot	0.001233	cubic hectometer (hm^3)

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ABSTRACT

During the night of July 1 and early morning of July 2, 1987, an intense summer storm produced flooding on headwater streams of the Scioto, Sandusky, and Mohican Rivers in north-central Ohio. The heaviest flooding and resulting flood damage occurred in a five-county area in the north-central part of the state. From 3 to nearly 6 inches of rain fell in less than 10 hours on rain- saturated soil, and produced flooding that resulted in more than $20 million in damages. Estimated peak discharges for several of the small streams affected ranged from 1 to 2 1/2 times the magnitude of the 50-year flood of these sites.

INTRODUCTION

During the night of July 1 and early morning of July 2, 1987, an intense summer storm produced flooding on headwater streams of the Scioto, Sandusky and Mohican Rivers in north-central Ohio. This region (fig. 1) is designated by the National Weather Service (NWS) as the "Central Highlands." Flood damage was especially heavy in Shelby, Bellville, and Mansfield in Richland County; Bucyrus and Galion in Crawford County; Marion in Marion County; and Mt. Gilead in Morrow County. Immediately following the storm, Governor Celeste declared a state of emergency in these counties and in Delaware County. He then asked the President to declare these counties a disaster area so that Federal funds would be available for their rehabilitation. Following a review by the Federal Emergency Management Agency (FEMA), four of the counties were declared eligible; only Delaware County was excluded.

The purpose of this report is to present a compilation of hydrologic data obtained by NWS, the Ohio Department of Natural Resources (ODNR), FEMA, and the U.S. Geological Survey documenting the magnitude of the major floods resulting from the storm of July 1-2, 1987.

This report is the compilation of information from many local, state and federal agencies. The information on rainfall preceding and during the flood event was largely from an unpublished report (National Weather Service, 1987) by the NWS Forecast

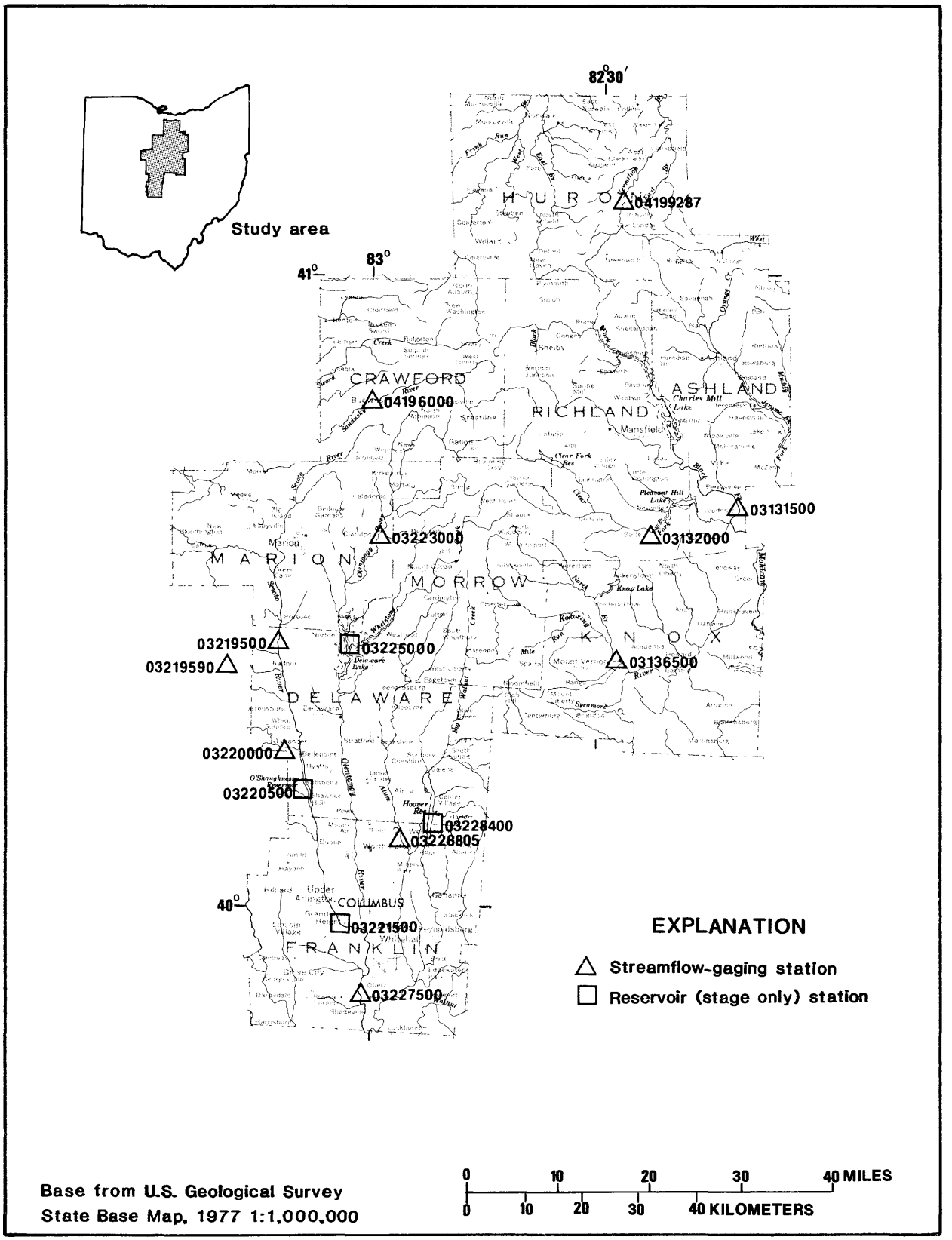

Figure 1.--Location of study area (data for streamflow and reservoir stations are presented in table 2).

office at the Cleveland Hopkins International Airport, titled "The Central Highlands Flood of July 1 and 2." Data for flood damage were taken from the "Flood Hazard Mitigation Plan, July 1987 Flood Disaster in North Central Ohio, FEMA 796-DR," prepared for FEMA, Region V, by ODNR in January 1988. High-water marks were located and surveyed and profiles plotted for the streams at Shelby, Bellville, and Mt. Gilead by ODNR personnel. Leonard Harstine, supervisor of the Water Inventory Unit, Division of Water, ODNR, assembled the rainfall data in table 1 and plotted the isohyetal map (fig. 3). An indirect determination of peak discharge for the flood of July 1987 made by the U.S. Geological Survey was used to determine the magnitude of the flood at Bellville.

WEATHER CONDITIONS PRECEDING THE FLOOD OF JULY 1-2, 1987

The Cleveland, Ohio, office of the National Weather Service reported that June was very wet across northern Ohio. Cleveland received 7.94 inches of rain, making it the fourth wettest June on record (4.45 inches above normal). Mansfield, in the Central Highlands area, received 8.87 inches of rain, which was almost 5.5 inches above normal. Akron and Toledo also had above-normal rainfall (National Weather Service, 1987).

On June 29, 1987, before the onset of three successive days of significant rain, 4.4 inches of rain could have fallen in the Central Highlands in a 3 to 6 hour period with no significant flooding, according to the NWS. The 24-hour rainfall totals at 7 a.m. on June 30 and July 1 were generally 0.25 to 1.5 inches across north-central and northwestern Ohio (National Weather Service, 1987).

On July 1, the new guidance offered by the NWS in Cincinnati that the Central Highlands could accommodate only 3.3 inches before significant flooding occurred. This lowered threshold value was directly related to the two previous days of rainfall, which had lowered the flash-flood guidance thresholds (National Weather Service, 1987).

The 24-hour totals of 4 to 5.5 inches that drenched the region ending 7 a.m. on July 2 could not be absorbed by the saturated soils, thus, most of this rain went directly into runoff.

PRECIPITATION AND RUNOFF DURING THE FLOOD

The Cleveland office of the NWS classified the storm that produced floods in north-central Ohio, July 1-2 as a winter-like cyclonic circulation, or "shars." The National Weather Service (1987) reports that, "occasionally during summer, a winter-like system produces rainfall along a relatively narrow band and is quite random in the specific location of heavy downpours.

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This storm had its origin in northern Oklahoma, where it caused more than 4 inches of rain. The storm was responsible for a similar amount of rainfall in southwestern Missouri near Springfield. The day before the north-central Ohio event, at least 6 inches fell in southern Illinois near Vandalia. During the morning and afternoon of July 1, about 5 inches fell near Indianapolis. Rain associated with this storm moved into western Ohio during the afternoon of July 1. A flood watch was issued at 5:30 p.m. An urban and small-stream flood warning was issued for the west-central and Miami Valley communities of Ohio at 5:50 p.m., for the upper Scioto River at 6:37 p.m., and for Marion County at 11:35 p.m. Flash-flood warnings were issued for Ashland, Crawford, and Knox Counties at 12:42 a.m. July 2, and for Morrow and Richland Counties at 12:45 a.m (National Weather Service, 1987).

The heaviest rain in the flood area in north-central Ohio appears to have fallen between 4:00 p.m. July 1 and 2:00 a.m. July 2. Maximum 24-hour rainfall from this storm system was 5.62 inches at Mt. Gilead. The intensity of this rainfall is shown by the recording rain gage at the Marion WMRN radio station (fig. 2). Distribution of rainfall during the flood event is show on the isohyetal map (fig. 3). Rainfall recorded at NWS stations in the Central Highlands and adjoining regions for the 2-day period preceding the July flood and for July 1 and 2 are listed in table 1.

EFFECTS OF THE FLOOD ON MUNICIPALITIES IN NORTH-CENTRAL OHIO

Damage from the storm of July 1-2, 1987 was heaviest in the five-county region consisting of Richland, Crawford, Marion, Morrow, and Delaware Counties, in north-central Ohio. A listing of the river and reservoir stages at gaging stations in the region (table 2) indicates that the effects from the storm were not widespread in Ohio. The flood damage area was not nearly as extensive as that for the storm of July 1969, or that of March 1913. However, several communities in this small region experienced the highest streamflow and most destruction since they were settled.

Based on data from city engineers, city service directors, the U.S. Department of Agriculture, the U.S. Army Corps of Engineers and newspapers in the region, FEMA reported (1988) that damages in the five-county area resulting from the storm of July 1-2 were as follows:

Type of damage	Losses
Private property	$13,000,000
Utilities	2,000,000
Agriculture	5,500,000

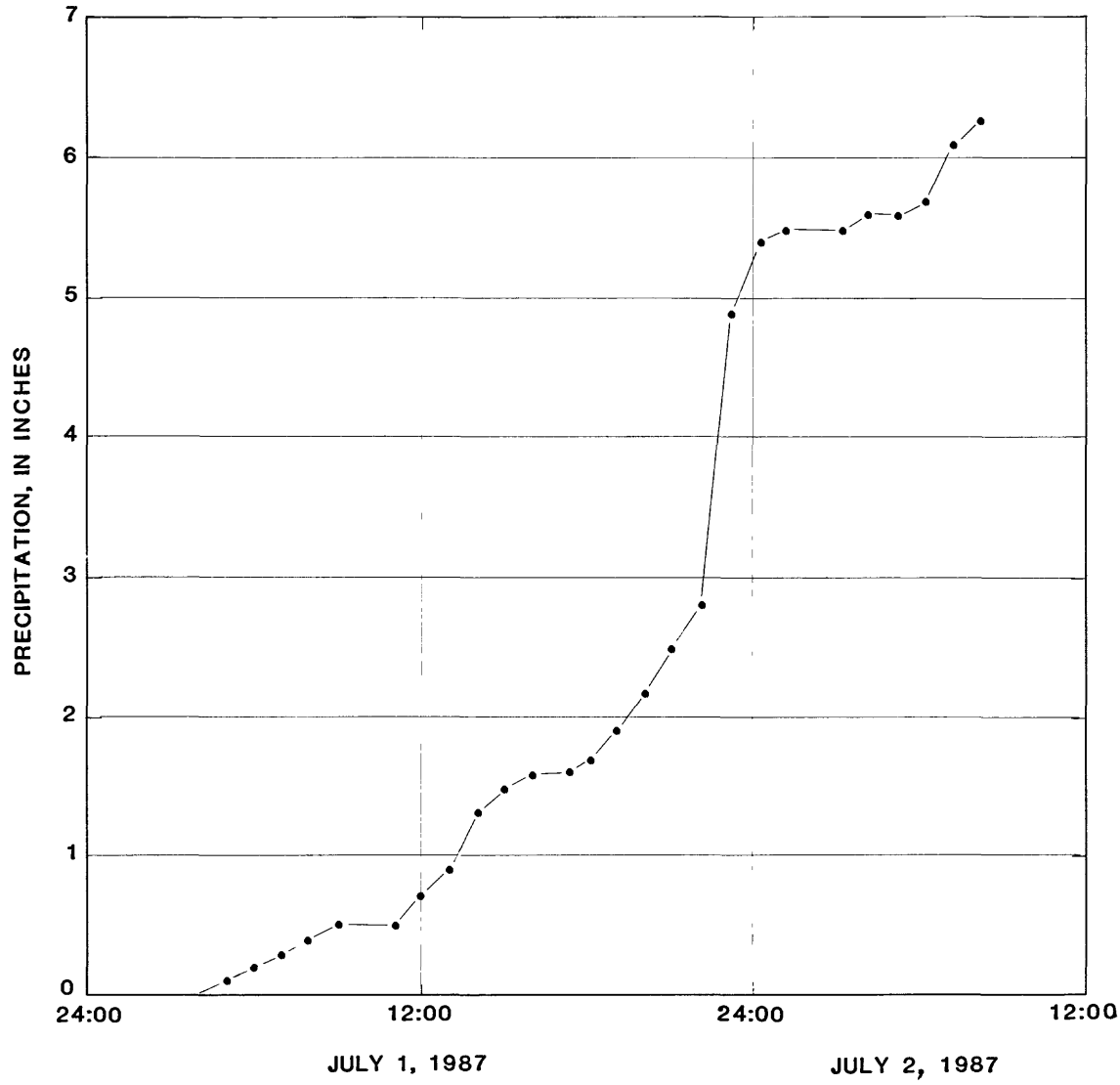

Figure 2.--Hourly precipitation at radio station WMRN in Marion, Ohio, July 1-2, 1987.

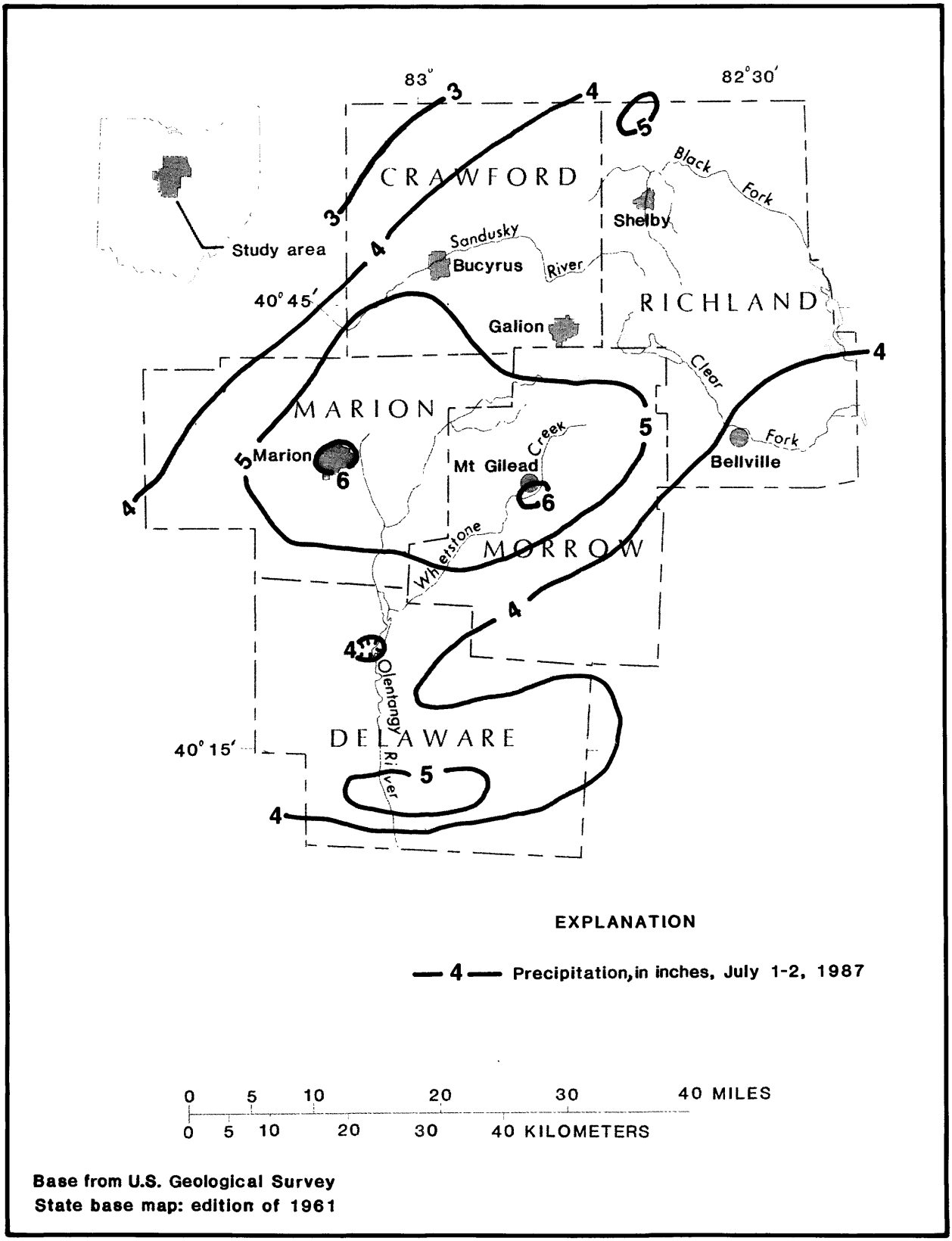

Figure 3.--Isohyetal lines for storm of July 1-2 1987, in north-central Ohio (data furnished by Ohio Department of Natural Resources, Division of Water).

Table 1.—*Records of precipitation, June 29 through July 2, 1987, in north-central Ohio*

[Data from National Weather Service, 1987; all figures in inches]

County	Precipitation station	Antecedent condition		Flood period		
		June 29	June 30	July 1	July 2	Total
Ashland	Ashland-WNCO Radio	—	0.90	.97	3.95	4.92
	Charles Mill Lake	—	.36	.19	4.45	4.64
	Mohicanville Dam	—	.26	.49	3.21	3.70
	Ruggles	—	.44	.69	2.86	3.55
Crawford	Bucyrus	—	.60	1.38	3.42	4.80
	Galion Water Works	—	1.16	.30	4.18	4.78
Delaware	Alum Creek	—	.42	3.11	2.20	5.31
	Delaware	—	.38	.98	3.20	4.18
	Delaware Dam	—	.24	.46	3.53	3.99
	Olentangy Wildlife	—	.25	.75	4.00	4.75
Franklin	Columbus-Morse Road	—	.11	.10	1.81	1.91
	Westerville	—	1.10	1.11	1.34	2.45
Hardin	Kenton	—	.95	.55	1.98	2.53
Huron	Clarksfield	—	.65	.32	1.52	1.84
	New London	.26	.56	.25	2.60	2.85
	Willard	.02	.59	.36	1.76	2.12
Knox	Fredericktown	—	.25	.10	2.48	2.58
Lorain	Wellington	.41	.20	2.51	.65	3.16
Licking	Utica	—	.08	.49	2.10	2.59
Marion	LaRue	.83	1.00	3.07	.87	3.94
	Marion-WMRN Radio	—	.78	.82	5.33	6.15
Medina	Chippewa Lake	—	.65	.56	2.50	3.06
Morrow	Mt. Gilead	—	.40	.25	5.81	6.06
Richland	Mansfield 5W	—	.47	1.02	2.07	3.09
	Mansfield WSO	1.01	1.27	2.99	1.02	4.01
	Pleasant Hill Lake	—	.47	.70	2.15	2.85
	Plymouth	—	.52	1.03	4.19	5.22
Seneca	Tiffin	—	.91	.19	.54	.73
Union	Marysville	—	.18	.95	3.45	4.40
Wayne	Wooster Exp. Sta.	.98	1.19	2.49	.19	2.68
Wyandot	Upper Sandusky	—	.62	.64	1.37	2.01

Table 2.--*Summary of flood stages and discharges of streams and reservoirs in north-central Ohio*

[Acre-ft, acre-feet; ft, feet; ft^3/s, cubic feet per second; mi^2, square miles; - - ,data of insufficient accuracy to compute ratio to 50-year flood. Data are from U.S. Geological Survey]

USGS number	Stream	Drainage area (mi^2)	Period of record	Maximum previously known			Maximum during present flood			
				Date	Gage height (ft)	Discharge (ft^3/s)	Date	Gage height (ft)	Discharge (ft^3/s)	Ratio to 50-year flood
				STREAMS IN OHIO RIVER BASIN						
03131500	Black Fork at Loudonville	349	1931-87	1969	14.11	8,460	7/3/87	12.39	5,910	1.0
03132000	Clear Fork at Butler	136	1946-75 1987	1959	9.43	14,300	7/3/87	10.87	21,300	2.4
03136500	Kokosing River at Mt. Vernon	202	1953-87	1959	18.19	38,000	8/3/87	9.04	6,900	0.4
03219500	Scioto River at Prospect	567	1913, 1915-87	1913	21.1	27,000	7/5/87	13.90	8,100	0.6
03219590	Bokes Creek nr Warrensburg	83.2	1982-87	1985	11.30	2,220	7/3/87	13.54	4,060	--
03220000	Mill Creek nr Bellepoint	178	1943-87	1959	13.85	20,300	7/3/87	8.63	5,170	0.4
03223000	Olentangy River Claridon	157	1947-87	1959	16.77	14,900	7/3/87	16.39	13,700	1.7
03227500	Scioto River at Columbus	1,629	1913, 1921-87	1913	25.9	138,000	7/2/87	20.75	22,300	0.3

STREAMS TRIBUTARY TO LAKE ERIE

04196000	Sandusky River nr Bucyrus	88.8	1926-35 1939-51 1954, 1974-81	1959	11.9	13,500	7/2/87	11.60	[a]10,000	--
04199287	Vermilion River nr Fitchville	112	1987	1969	[a]17.3	[a]24,000	7/2/87	14.8	[a]8,900	--

				Maximum previously known			Maximum during present flood		
	Reservoir	Drainage area (mi^2)	Period of record	Date	Gage height (ft)	Contents (acre-ft)	Date	Gage height (ft)	Contents (acre-ft)
03220500	O'Shaughnessy Reservoir nr Dublin	980	1913, 1925-87	1913	24.6	74,500	7/3/87	13.80	19,800
03221500	Griggs Reservoir nr Columbus	1,044	1921-87	1959	763.91	7,490	7/3/87	760.00	6,040
03225000	Delaware Reservoir nr Delaware	386	1951-83 1987	1959	944.75	113,000	7/3/87	941.51	90,560
03228400	Hoover Reservoir at Central College	190	1955-87	1975	897.26	83,260	7/3/87	896.30	79,860
03228804	Alum Creek Lake	122	1975-83 1987	1979	892.40	96,750	7/3/87	893.32	100,320

[a]Approximate

Richland County

Shelby

This community (population 9,500) is bisected by the Black Fork Mohican River, which flows northerly through the city. Black Fork drains a basin of 28.4 mi^2 (square miles) at this point. The 4+ inches of rainfall during this storm produced a flood peak in Shelby having a recurrence interval of 50 years. A 50-year flood can be expected to occur, on the average, once in 50 years. (Webber and Bartlett (1977) present methods to determine flood-frequency discharges on unregulated streams in Ohio.)

All of the streets crossing Black Fork within the city limits of Shelby were submerged by the flood waters. Only the Conrail railroad bridge downstream from Smiley Road and the B & O railroad bridge upstream from London-West Road remained above high water, the latter just barely survived inundation. The depth of water over these stream-crossing streets and bridges is shown in the flood profile in figure 4.

It was estimated that 300 homes and 60 businesses were damaged to some extent (Federal Emergency Management Agency, 1988). Several of the businesses were heavily damaged and one was completely destroyed. Central Elementary School and Shelby Junior High School had a combined loss estimated at $260,000. Total flood damage within the city was estimated at $10 million. Five hundred residents were evacuated during the flood.

Bellville

This village (population 1,750) is on the Clear Fork Mohican River. The stream meanders across the northern and eastern part of the village and is crossed three times by the B & O railroad and twice by streets, Hines Street and Main Street (State Routes 13 and 97). Clear Fork drains a basin of 115 mi^2 at Bellville.

The peak discharge of 21,300 ft^3/s (cubic feet per second) was recorded for the July 1987 flood at the U.S. Geological Survey gaging station on Clear Fork at Butler (station number 0312000; drainage area, 136 mi^2). This is 2.4 times the magnitude of a 50-year flood at this gaging station.

FEMA reported that 60 homes and 20 businesses were damaged. Bellville Elementary School had about 6 inches of water covering its first floor. Damage was estimated to be over $5 million. Between 50 and 100 residents were evacuated during the flood (Federal Emergency Management Agency, 1988). The profile of high water (fig. 5) shows the depth of water over streets and bridges in the village.

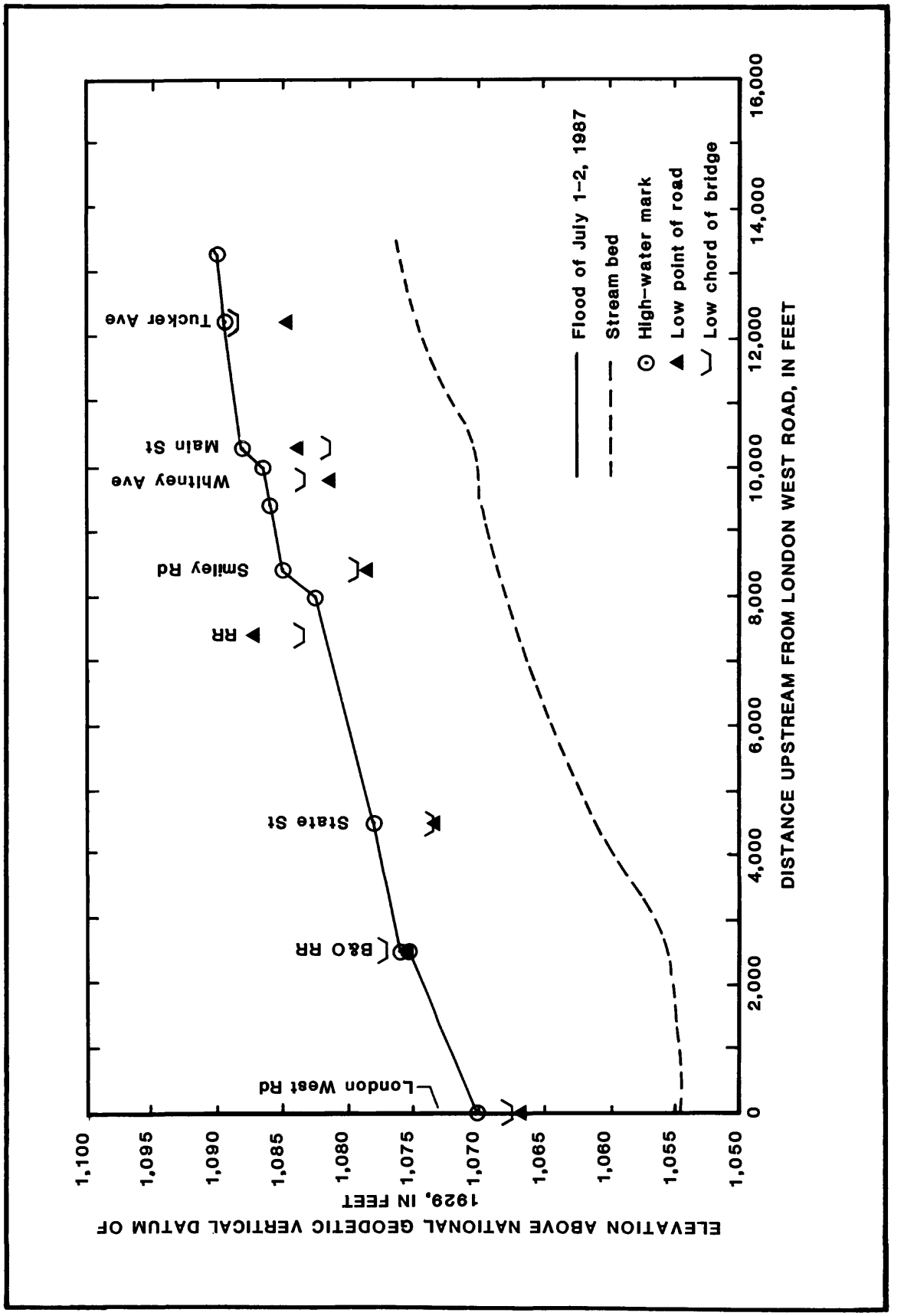

Figure 4.--Flood profile of Black Fork Mohican River at Shelby, Ohio (data furnished by Ohio Department of Natural Resources, Division of Water).

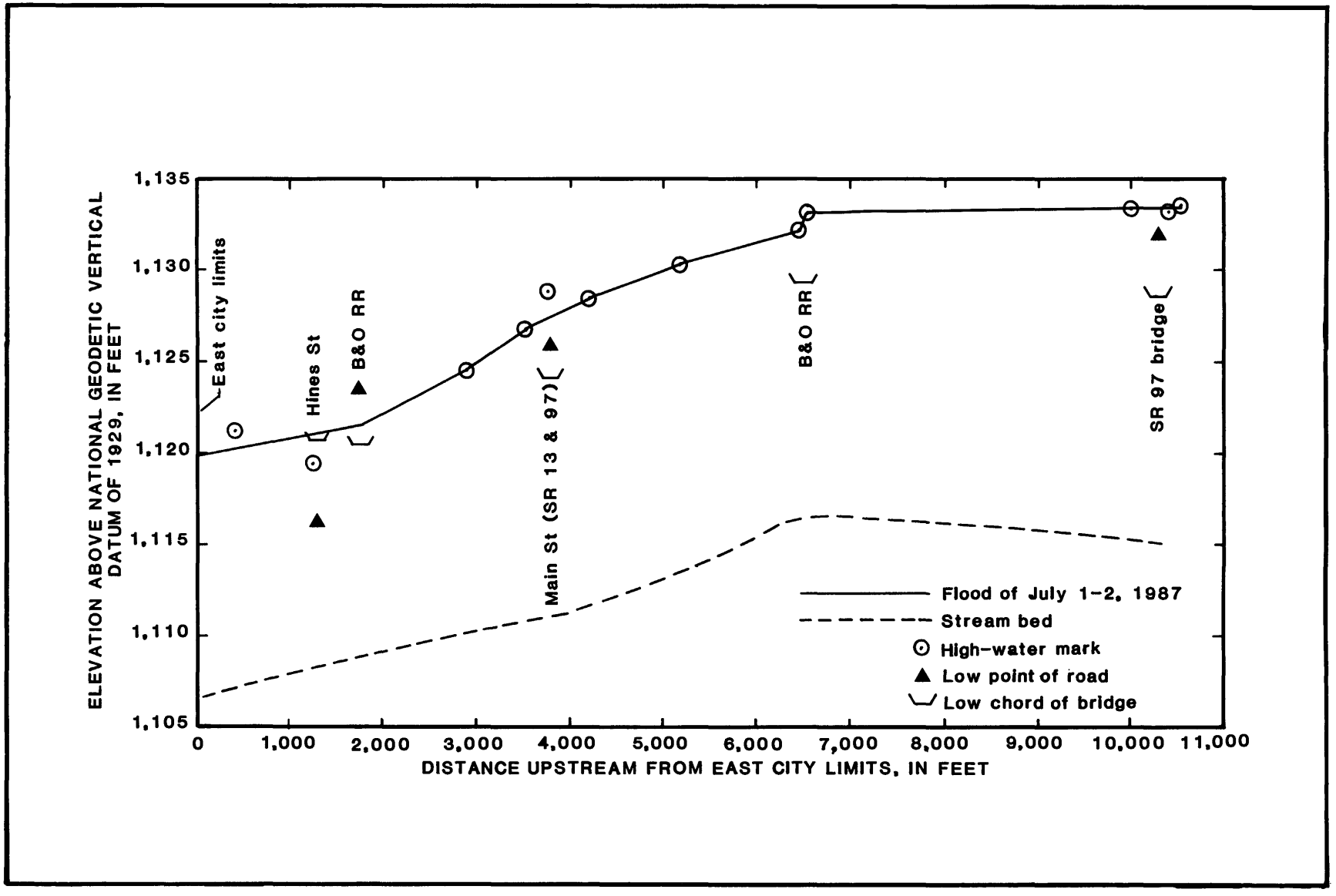

Figure 5.—Flood profile of Clear Fork Mohican River at Bellville, Ohio (data furnished by Ohio Department of Natural Resources, Division of Water).

Mansfield

The city (population, 54,000) is crossed at its northeastern corner by Rocky Fork (drainage area, 39 mi^2). The stream overflowed its banks during the July 1987 flood, which resulted in flood losses to at least one industrial plant and several residences (Federal Emergency Management Agency, 1988). Total flood damage was estimated by local officials at $2.2 million.

Crawford County

Bucyrus

The Sandusky River runs through the center of Bucyrus (population, 13,400) generally in a westerly direction. The peak discharge for the July 1 flood at the U.S. Geological Survey gaging station on the Sandusky River near Bucyrus (station number 04196000; drainage area, 88.8 mi^2) was estimated to be about 1.1 times the magnitude of the 50-year flood. This station is 1.5 miles west of the city. The city engineer said that this flood was about 3 or 4 feet lower in the city than the 1959 flood.

Flood damage in the downtown area was concentrated near North Sandusky and River Streets. Damage, largely to contents of buildings, was estimated at $1 million. An older neighborhood near Lane, Water, Stroll, and Clinton Streets had considerable damage. Most of the residences in this area had several feet of water on their first floors. The Lutz Apartments, consisting of 16 duplexes, also was damaged by the flood waters. The River Edge Mobile Home Park had extensive damage to all but one of the 21 homes in the park. Flood damages in Bucyrus were estimated to be between $6 and $7 million. (Federal Emergency Management Agency, 1988).

Galion

Galion (population, 12,300) is located near the headwaters of the Olentangy River (drainage area, 14.9 mi^2). The U.S. Geological Survey gaging station on the Olentangy River at Claridon (station number 03223000; drainage area, 157 mi^2) recorded a peak discharge for the July flood of 1.7 times the magnitude of the 50-year-flood.

Flood damage was concentrated in three areas of the city. The first area included a number of businesses and an apartment complex north of the intersection of Harding Way and North Portland Way. The second area consisted of about a half dozen homes located along Olentangy Court. The third area hit hard by the flood was along Charles Street near East Street. Here, two automobile dealerships lost 55 to 60 new cars having an estimated value of $500,000 (Federal Emergency Management Agency, 1988). Local officials estimated flood losses at $1-2 million.

Marion County

Marion

Marion (population, 37,000) is on high ground between the Scioto and Olentangy Rivers. Flooding, principally to basements and lower floors, was due to the overloading of storm sewers and the inability of storm sewers and the few small ditches that traverse the city to handle surface runoff from the storm. The intensity of the storm is shown by figure 2, which represents the rainfall record at Marion radio station WMRN for the period noon July 1 through midnight July 2.

According to local officials, most of streets in the city were flooded. About 5,000 homes had some flood damage and about 500 of these were extensively damaged. The Marion County Disaster office estimated flood damage at several million dollars (Federal Emergency Management Agency, 1988).

Morrow County

Mt. Gilead

Whetstone Creek (drainage area, 39 mi^2) flows in a westerly direction through the south edge of Mt. Gilead (population, 2,900). Local officials reported that the creek reached its highest stage since 1913 and exceeded the January 1959 flood by several feet. The rain gage at the Mt. Gilead Water Plant recorded "at least 6 inches of rain" for the 24-hour period on July 1.Whetstone Creek crosses only one principal street in town, Main Street (State Routes 42, 61), where flooding occurred. There are few houses near the crossing of Route 42 at the north side of the village, and Route 95 crosses the creek on a high-level bridge. The profile of Whetstone Creek through Mt. Gilead is shown in figure 6.

The July flood topped Main Street and bridge by about 1 foot, flooding out the Whetstone Mobile Home Park on the left bank just upstream from the bridge. Most of the 25 mobile homes in the park were damaged. A number of businesses downstream from the Main Street bridge suffered flooding up to several feet. Morrow County Fair-ground, 100 yards downstream from Main Street, had flood water several feet over the lower floors of its buildings, which resulted in structural damage and damage to contents. There also was extensive damage to the city's water supply and sanitary sewer lines and to the municipal garage. About 400 residential basements were flooded from sewerline backup. Flood damages were estimatedat $1-2 million.

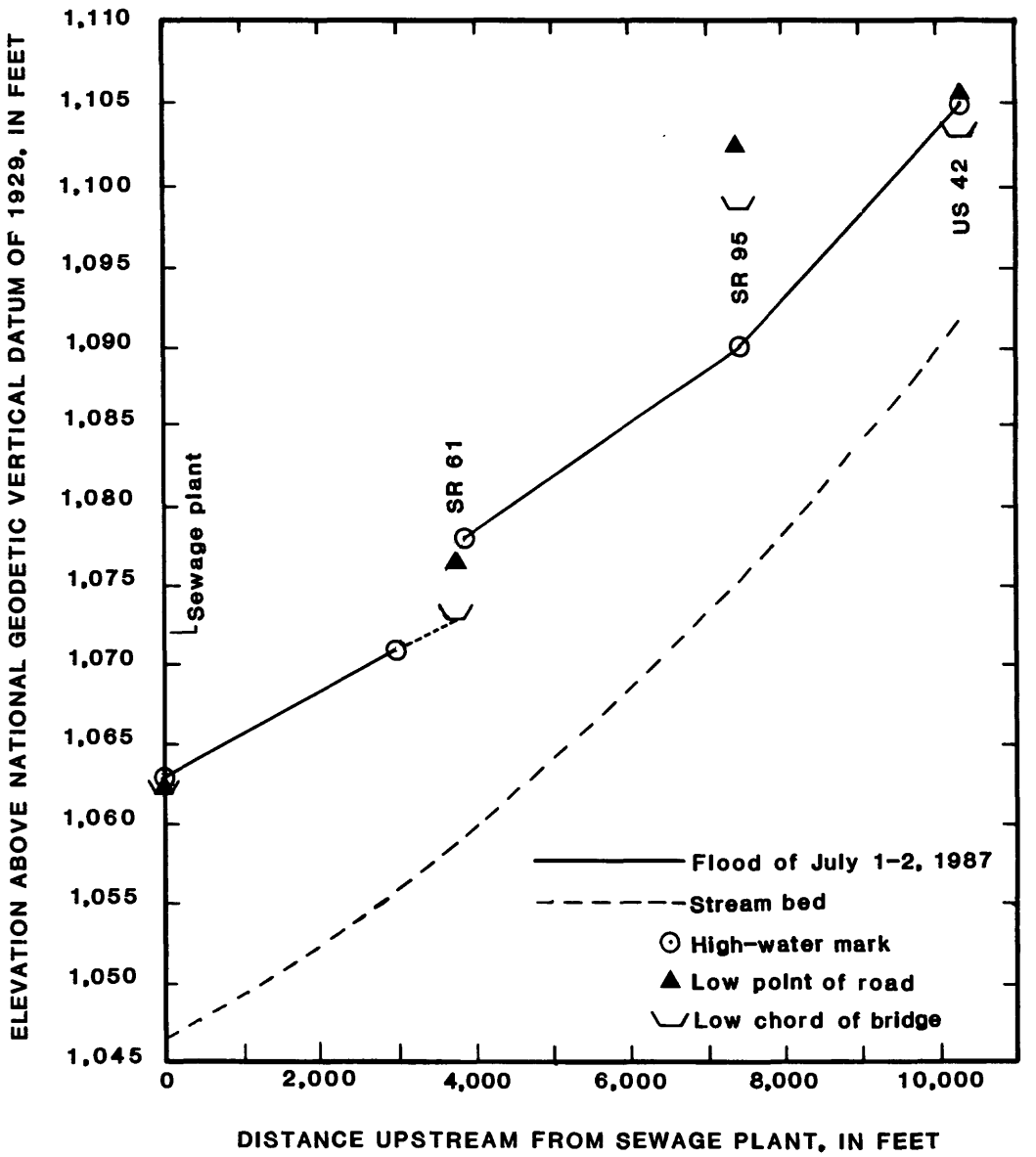

Figure 6.--Flood profile of Whetstone Creek at Mt.Gilead, Ohio (data furnished by Ohio Department of Natural Resources, Division of Water).

CONCLUSIONS

The storm of July 1-2, 1987, struck communities near the ridge line between several river systems and caused in excess of $20 million in damages. The drainage areas of the streams affected were generally small (15 to 115 mi^2) and the main-channel slopes of these streams are flat. Estimated peak discharges for several of the small streams affected ranged from 1 to 2 1/2 times the magnitude of the 50-year flood.

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