FLOODING AND SEDIMENTATION IN WHEELING CREEK BASIN, BELMONT COUNTY, OHIO

By James R. Kolva and G. F. Koltun

U.S. GEOLOGICAL SURVEY

Water-Resources Investigations Report 87-4053

Prepared in cooperation with the

OHIO DEPARTMENT OF NATURAL RESOURCES,

DIVISION OF RECLAMATION

Columbus, Ohio

1987

DEPARTMENT OF THE INTERIOR

DONALD PAUL HODEL, Secretary

U.S. GEOLOGICAL SURVEY

Dallas L. Peck, Director

For additional information write to:

District Chief
Water Resources Division
U.S. Geological Survey
975 W. Third Avenue
Columbus, OH 43212

Copies of this report can be purchased from:

U.S. Geological Survey
Books and Open-File Reports
Box 25425, Federal Center
Building 41
Denver, CO 80225

CONTENTS

ILLUSTRATIONS

TABLES

CONVERSION FACTORS

For the benefit of readers who prefer to use metric (International System) units, conversion factors for the inch-pound units used in this report are listed below:

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)
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)
cubic foot per second per square mile [$(ft^3/s)/mi^2$]	0.01093	cubic meter per second per square kilometer [$(m^3/s)km^2$]
ton	0.9072	megagram (Mg)
ton per square mile (ton/mi^2)	0.3503	megagram per square kilometer (Mg/km^2)

FLOODING AND SEDIMENTATION IN WHEELING CREEK BASIN, BELMONT COUNTY, OHIO

By James R. Kolva and G. F. Koltun

ABSTRACT

The Wheeling Creek basin, which is located primarily in Belmont County, Ohio, experienced three damaging floods and four less severe floods during the 29-month period from February 1979 through June 1981. Residents of the basin became concerned about factors that could have affected the severity and frequency of out-of-bank floods. In response to those concerns, the U.S. Geological Survey, in cooperation with the Ohio Department of Natural Resources, undertook a study to estimate peak discharges and recurrence intervals for the seven floods of interest, provide information on current and historical mining-related stream-channel fill or scour, and examine storm-period subbasin contributions to the sediment load in Wheeling Creek.

Streamflow data for adjacent basins, rainfall data, and, in two cases, flood-profile data were used in conjunction with streamflow data subsequently collected on Wheeling Creek to provide estimates of peak discharge for the seven floods that occurred from February 1979 through June 1981. Estimates of recurrence intervals were assigned to the peak discharges on the basis of regional regression equations that relate selected basin characteristics to peak discharges with fixed recurrence intervals. These estimates indicate that a statistically unusual number of floods with recurrence intervals of 2 years or more occurred within that time period.

Three cross sections located on Wheeling Creek and four located on tributaries were established and surveyed quarterly for approximately 2 years. No evidence of appreciable stream-channel fill or scour was observed at any of the cross sections, although minor profile changes were apparent at some locations. Attempts were made to obtain historical cross-section profile data for comparison with current cross-section profiles; however, no usable data were found.

Excavations of stream-bottom materials were made near the three main-stem cross-section locations and near the mouth of Jug Run. The bottom materials were examined for evidence of recently deposited sediments of mining-related origin. The only evidence of appreciable mining-related sediment deposition was found at Jug Run, and, to a lesser extent, at one main-stem site.

Suspended-sediment samples, discharge measurements, and bedload samples were collected at four sites on Wheeling Creek during four separate storm events. Approximate incremental sediment yields were computed so that subbasin contributions of sediment could be compared. The event site located farthest downstream consistently displayed the highest incremental sediment yield, which indicates that the corresponding subbasin contributed the most sediment on an area-weighted basis. Particle analyses of bedload samples and consideration of current land use suggest that probable major sources of sediment in that area are waste piles (which border the stream) left over from former deep mining and coal processing.

INTRODUCTION

Background

On February 26, 1979, August 11, 1980, and April 12, 1981, damaging floods occurred in the Wheeling Creek drainage basin, which is located primarily in Belmont County, Ohio (fig. 1). In addition, four less severe floods occurred in the basin during the 29 months from February 1979 through June 1981. Because of the recent frequency with which damaging floods have occurred, local residents and officials became concerned about factors that could have increased the frequency of out-of-bank flooding, as well as ways in which future flood damages might be alleviated.

Some residents believe that the frequency of damaging floods has increased recently because of a decrease in stream conveyance caused by rapid deposition of sediments originating from abandoned surface mines in the basin. In response to these concerns, a study was undertaken by the U.S. Geological Survey, in cooperation with the Ohio Department of Natural Resources, to assess the flooding and sedimentation problems in the basin.

Purpose and Scope

The objectives of this report are to (1) discuss the estimation of peak discharges and recurrence intervals for the 1979-81 floods in the Wheeling Creek basin; (2) provide information on current and historical mining-related stream-channel fill or scour; and (3) describe storm-period subbasin contributions to the sediment load in Wheeling Creek. The operation of a streamflow-gaging station located near the mouth of Wheeling Creek also is discussed. The data upon which this report is based consist of surveyed flood profiles for the two most severe floods; streamflow data collected from Captina and Short Creeks, two adjacent gaged streams; precipitation records for storms corresponding to each of the seven floods; and streamflow, sediment, bottom-material, and cross-section data collected on Wheeling Creek from November 1982 through July 1984.

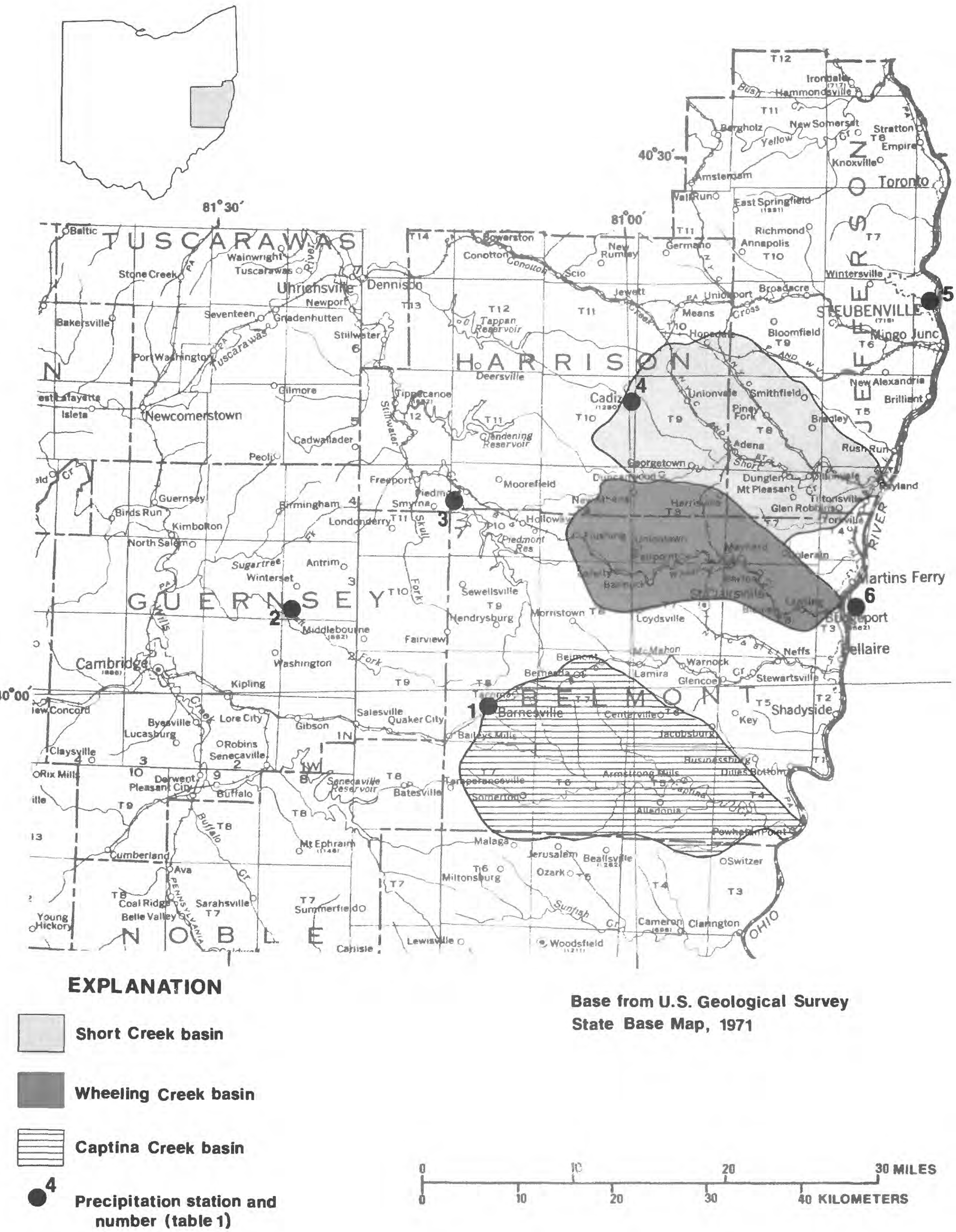

Figure 1.——Location of study area.

Description of the Area

The Wheeling Creek basin is located in parts of Belmont, Harrison, and Jefferson Counties in eastern Ohio (fig. 1). The drainage area of the basin is 107.7 square miles (mi^2). Wheeling Creek joins the Ohio River at Bridgeport, Ohio, opposite Wheeling, West Virginia. St. Clairsville, Ohio, the Belmont county seat, lies partly within the basin and is the largest urban area.

The climate of the basin is temperate; summers are warm to hot, and winters are moderately cold. Annual precipitation, approximately 40 inches per year, is distributed uniformly throughout the year. Floods can occur during any season. Severe storms in the narrow valleys of the basin can result in flash flooding (Wheeling Creek Watershed Action Committee Agency Task Force, 1983).

The topography of the basin is hilly and characterized by V-shaped valleys and broad, rounded ridges. The basin is unglaciated. The headwater tributaries have generally shallow, broad valleys. The valley of the main stem of Wheeling Creek is generally deep and narrow, but broadens toward the mouth. Relief on Wheeling Creek is approximately 360 feet from source to mouth, a distance of approximately 32 miles.

The geology of the basin is characterized by horizontally-layered sedimentary rock. Exposed strata include shale, sandstone, siltstone, limestone, and coal. These strata are part of the Conemaugh and Monongahela Formations of Pennsylvanian age and the Dunkard Group of Pennsylvanian and Permian age (Wheeling Creek Watershed Action Committee Agency Task Force, 1983).

The soils of the upper and middle parts of the basin generally are part of the Lowell-Westmoreland association and their related soils. The lower reaches of the basin contain soils of the Elkinsville-Nolin Variant-Brookside association. All of these soils are moderately erodible. Soils composed primarily of broken bedrock resulting from surface-mining activity also are present, especially in the upper reaches (Wheeling Creek Watershed Action Committee Agency Task Force, 1983).

The land use and land cover of the basin were investigated in 1979 by the Ohio Department of Natural Resources, Remote Sensing Unit, through its Ohio Capability Analysis Program. The results of that investigation (Wheeling Creek Watershed Action Committee Agency Task Force, 1983) show that:

34 percent of the area is forested.
15 percent is totally reclaimed surface mines.
13 percent is cropland.
12 percent is shrubs and brush.
8 percent is pasture.
4 percent is unreclaimed or partially reclaimed surface mines.
1 percent is active surface mines.
13 percent is in other uses, such as residences, industries, and bodies of water.

The upper part of the basin contains most of the surface-mined land, whereas much of the forested land is in the lower part of the basin (figs. 2 and 3).

Data-Collection Network

The data-collection network consisted of a streamflow gaging station, four sediment-event sampling sites, and seven stream cross-section sites. The streamflow-gaging station (U.S. Geological Survey station number 03111548) is located on the left bank of Wheeling Creek, 4.8 miles upstream from the mouth and 0.5 mile east of Blaine. The station was established in November 1982 and is still in operation. The sediment-event sampling sites were located near Bannock, Fairpoint, Barton, and at the gaging station, all on the main stem. Sediment-event samples were collected during May, October, and December 1983. The cross-section sites were located on Wheeling Creek at Lafferty, McCracken Run at Fairpoint, Crabapple Creek near Crabapple, Wheeling Creek below Maynard, Fall Run above Crescent, Steep Run at Barton, and Wheeling Creek at Goosetown (fig. 4). The cross sections were established in June 1982 and surveyed quarterly until July 1984.

Acknowledgments

The authors acknowledge the support of the Ohio Department of Natural Resources, Division of Reclamation, in this project. The authors also thank the U.S. Soil Conservation Service, the U.S. Army Corps of Engineers, the Ohio Department of Transportation, the U.S. Office of Surface Mining, the Wheeling Creek Watershed Action Committee, and the residents of Belmont County for their assistance.

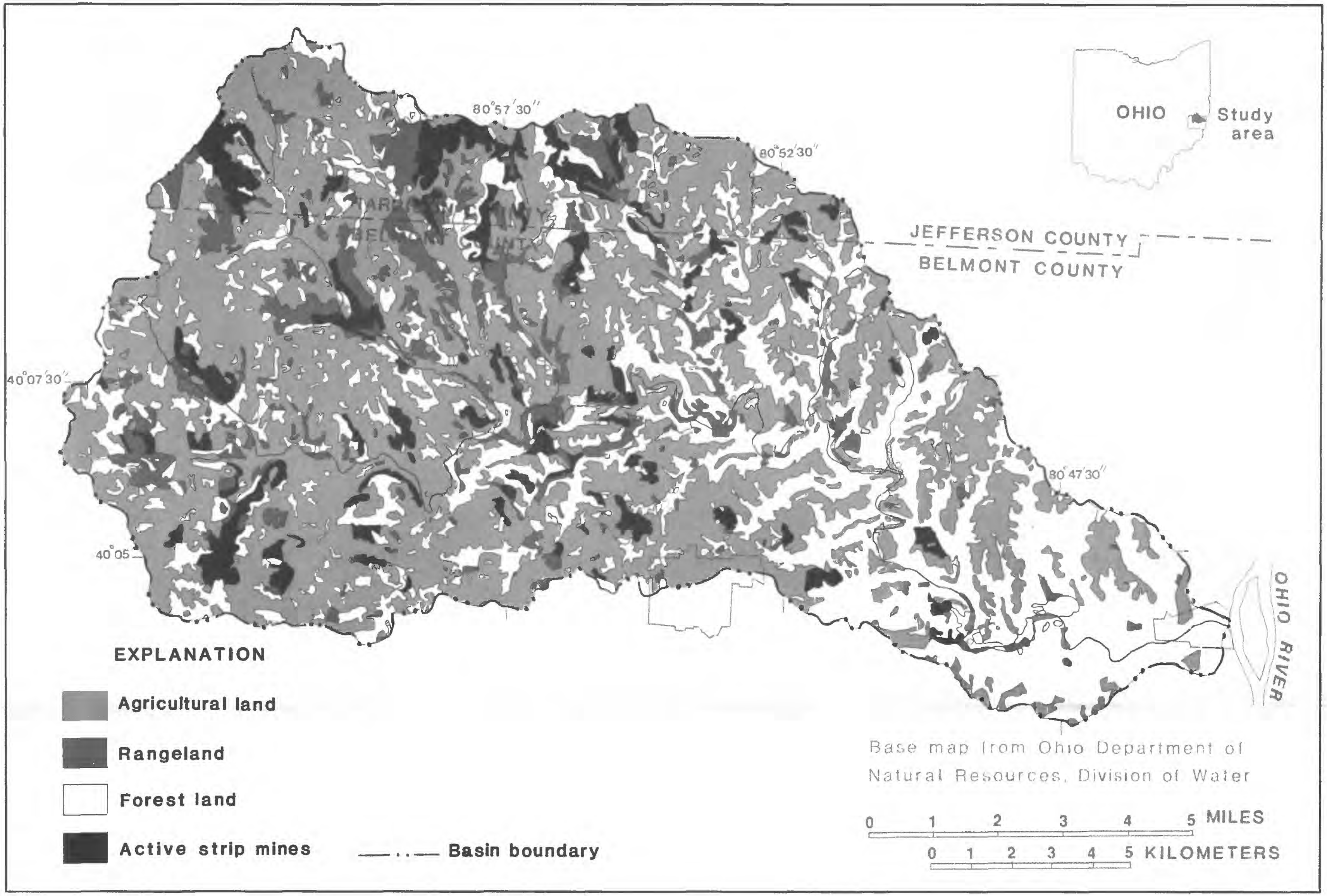

Figure 2.--Major land uses in Wheeling Creek basin.

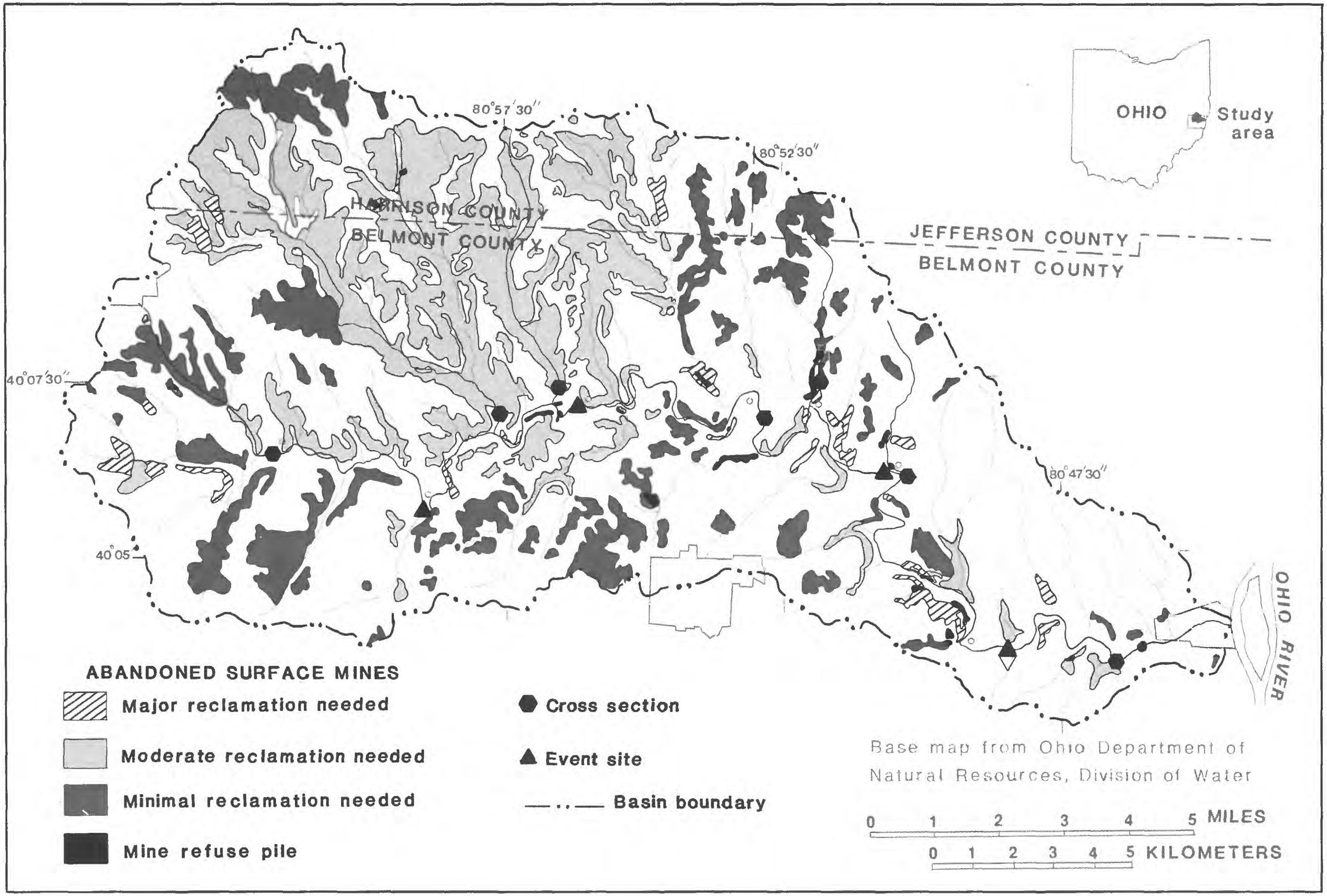

Figure 3.--Abandoned surface mines in Wheeling Creek basin.

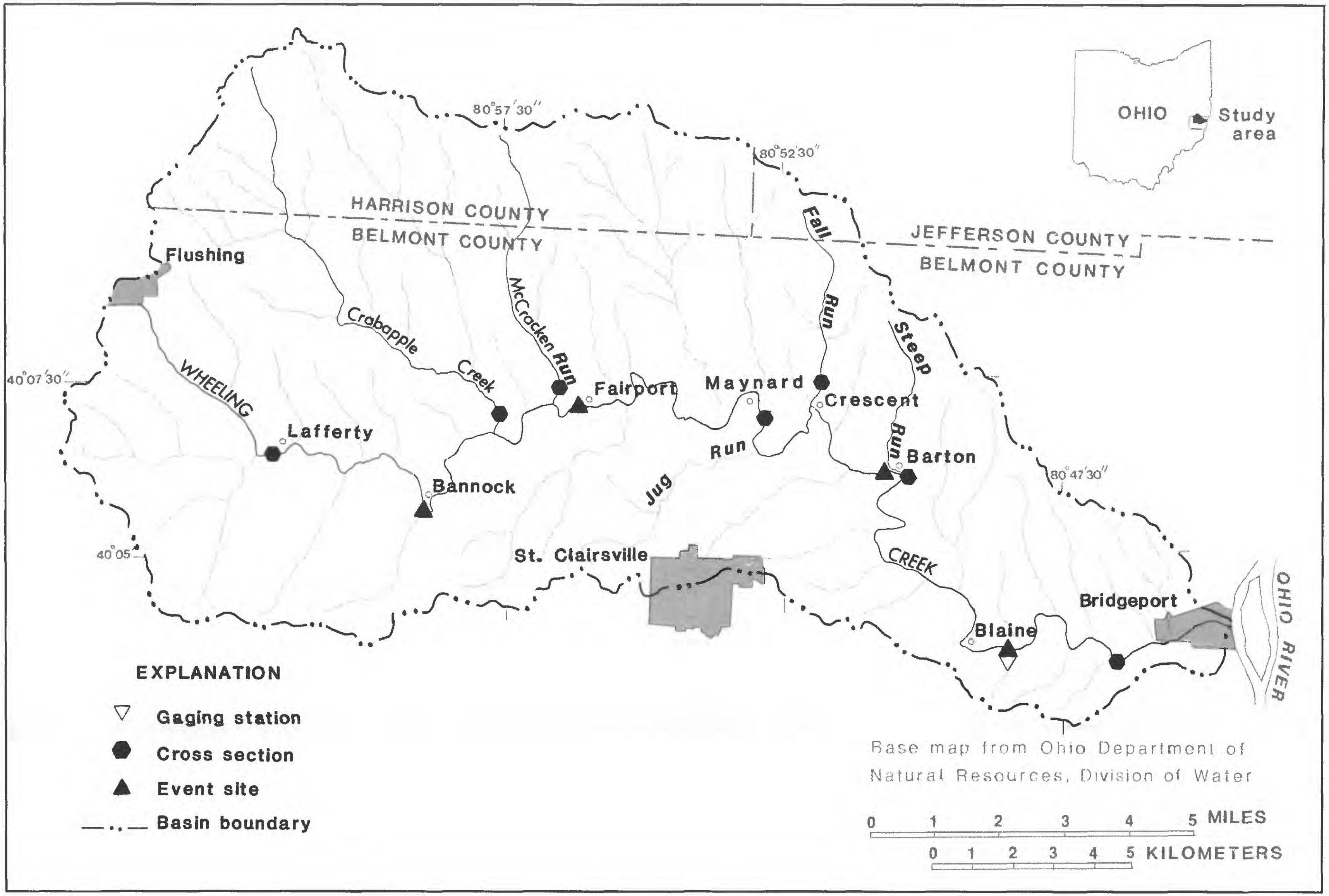

Figure 4.--Gaging station, event sites, and cross-section sites.

FLOODING IN WHEELING CREEK BASIN

In order to assess the influence of climate on the frequency of recent channel overflows, streamflow and precipitation data for the area surrounding Wheeling Creek were analyzed to provide estimates of the magnitudes and statistical characteristics of the seven floods that occurred from February 1979 through June 1981. Of primary concern were estimates of the recurrence intervals. A recurrence interval is a statistical measure of the likelihood that an event, such as a flood of a given magnitude, will be equaled or exceeded within a given time period. Flood-recurrence intervals generally are reported in terms of years. For example, a flood with a 10-year recurrence interval is likely to be equaled or exceeded in magnitude at intervals averaging 10 years in length.

Discharge data were not collected on Wheeling Creek during the Feburary 1979 through June 1981 period; consequently, it was necessary to estimate those flood-peak discharges by other means. These estimates were made by (1) establishing a streamflow-gaging station on Wheeling Creek so that peak discharges on Wheeling Creek could be correlated with peak discharges measured at gaging stations on Short and Captina Creeks, two adjacent streams for which long-term streamflow data have been gathered; (2) estimating peak discharges for Wheeling Creek for the floods that occurred from 1979 through 1981 from surveyed flood profiles, precipitation data, and streamflow data collected during that period at the Captina and Short Creek gaging stations; and (3) assigning approximate recurrence intervals to the estimated peak discharges using published regional regression equations for estimating various recurrence-interval peak discharges as a guide.

Peak discharges occurring on Wheeling Creek during the August 11-12, 1980, and April 12, 1981, floods were estimated from flood-profile data gathered by the U.S. Army Corps of Engineers. Peak-discharge estimates were obtained by comparing water-surface elevations at the current location of the streamflow-gaging station with an extended stage-discharge relation subsequently developed for that station.

Peak discharges for the remaining five floods were estimated from streamflow data collected during the flood periods for Captina and Short Creeks. Scatter plots of instantaneous peak discharges measured at the Wheeling Creek gage and the Captina and Short Creek gages were prepared. Comparison of the 1979-81 flood-peak discharges measured at Captina and Short Creeks with best-fit lines on the scatter plots yielded two sets of estimated flood-peak discharges for Wheeling Creek. The estimates derived from the Short Creek scatter plot were given more weight in selecting a single, final estimate because the Short Creek basin is closer geographically and more similar in size and land-use characteristics than is the Captina Creek basin.

Precipitation totals compiled for six National Weather Service reporting stations surrounding the Wheeling Creek basin (fig. 1) were considered to ensure that the discharges assigned to the seven Wheeling Creek flood events were plausible with respect to the magnitudes and distribution of rainfall for the seven storms associated with the floods. For five floods, the storm-rainfall total exceeded 2.5 inches at one or more of the six precipitation stations near the study area (table 1). For that geographic region, a 2.5-inch rainfall in a 24-hour period is expected to be equaled or exceeded in magnitude once every 2 years on the average (U.S. Department of Commerce, 1961). Antecedent conditions were a primary influence on the two other floods. Rainfall on snow resulted in the flood of February 26, 1979, whereas the flood peak of June 9-10, 1981, was higher than might be expected due to near saturation of soils by the storm of June 6.

Recurrence intervals were assigned to the estimated peak discharges on the basis of a flood-recurrence interval curve prepared for Wheeling Creek using the regional regression equations developed by Webber and Bartlett (1977). The regional regression equations relate certain basin characteristics to peak discharges with recurrence intervals of 2, 5, 10, 25, and 100 years. Estimated recurrence intervals for the 1979-81 floods for Wheeling, Captina, and Short Creeks are presented in table 2. To check the accuracy of the regional equations, peak discharges for various recurrence intervals were computed for Captina and Short Creeks and compared with estimates for those stations based on statistical analysis of long-term streamflow records. The differences between regression-derived estimates and the estimates prepared from the long-term streamflow records were within the reported standard errors for the regression equations.

It is apparent from table 2 and from the definition of recurrence interval that the 1979-81 period contained a statistically unusual number of significant floods. Consequently, any perceived increase in the frequency of channel overflow may possibly have been due to this statistical anomaly, and would not necessarily have been related to any loss in the channel's flood-carrying capacity.

SEDIMENTATION IN WHEELING CREEK BASIN

Changes in Cross-Section Profiles

Six cross sections were established and surveyed in June 1982, and an additional cross section was established and initially surveyed in October 1982. These seven cross sections were surveyed quarterly until July 1984 for a total of seven or eight surveys at each site. The surveys were made using a tag line to establish consistent stationing and a surveying level and rod to establish elevations from permanent reference marks.

Table 1.--Rainfall totals for selected stations near Wheeling Creek basin

[Compiled from National Oceanic and Atmospheric Administration, 1979-81; all values are in inches. Stations are shown by number in figure 1.]

Station	Number	Feb. 26, 1979	Aug. 11 through Aug. 12, 1980			Aug. 18 through Aug. 19, 1980			Apr. 12 through Apr. 13, 1981			June 6, 1981	June 9 through June 10, 1981			June 14, 1981
			Aug. 11	Aug. 12	Total	Aug. 18	Aug. 19	Total	Apr. 12	Apr. 13	Total		June 9	June 10	Total	
Barnesville--	1	1.31	5.12	0.76	5.88	1.56	1.05	2.61	1.74	1.27	3.01	2.28	0.76	1.46	2.22	>0.05
Middlebourne-	2	1.57	4.00	1.96	5.96	--	--	--	1.75	0.75	2.50	1.53	0	1.20	1.20	2.70
Piedmont-----	3	1.38	2.77	0.63	3.40	1.73	0.22	1.95	1.74	1.92	3.66	3.02	0.55	0.44	0.99	1.04
Cadiz--------	4	1.15	1.40	0.96	2.36	2.55	0.49	3.04	2.00	1.18	3.18	1.34	1.30	0.44	1.74	.84
Steubenville-	5	1.43	1.12	0.39	2.43	1.46	0.11	1.57	1.00	1.52	2.52	0	0.80	0.45	1.25	1.34
Wheeling-----	6	--	1.85	1.11	2.96	1.80	0.17	1.97	1.92	0.96	2.88	1.46	0.55	0.68	1.23	.62

Table 2.--Flood-peak data for Short Creek, Wheeling Creek, and Captina Creek

[ft^3/s, cubic feet per second]

Date	Short Creek		Wheeling Creek		Captina Creek	
	Peak discharge (ft^3/s)	Recurrence interval (years)	Estimated peak discharge (ft^3/s)	Estimated recurrence interval (years)	Peak discharge (ft^3/s)	Recurrence interval (years)
2-26-79	5,500	>10	3,600	5-10	9,500	5
8-11-80	2,000	<2	4,500	10-25	21,900	>100
8-18-80	3,880	>2	2,200	2-5	2,740	<2
4-12-81	3,490	>2	4,500	10-25	5,420	<2
6-06-81	1,900	<2	2,200	2-5	9,020	5
6-10-81	2,100	<2	2,100	2-5	7,460	>2
6-14-81	--	--	1,500	<2	5,260	<2

Sources of historical cross-section data were searched with little success. One cross section was found that had been surveyed by the Ohio Department of Transportation in 1968, however, stationing information was not sufficiently detailed to permit comparisons.

During this study no significant fill or scour of the stream channel was evident at any of the cross sections, although minor profile changes are apparent at some cross sections. This suggests that channel conveyance was not changing significantly as a result of changes in cross-section geometry. However, no major flood events occurred in the basin during the study period, and it is during such events that large-scale changes in channel geometry are most likely to occur.

Figures 5 to 11 show only those cross-section surveys where measurable changes occurred, as well as the first and last surveys of each section. Figure 12, in contrast, is an example of a cross-section profile plot (Fall Run above Crescent) showing profiles from all the surveys made at that site during the 2-year study.

Channel-Bed Excavations

Excavations of the Wheeling Creek stream bottom were made on July 12 and 13, 1984, to obtain information on the physical nature of the sediment deposits. In general, high percentages of coal and angular rock fragments in bottom materials indicate recent sediments from mining operations (C. R. Hupp and W. R. Osterkamp, U.S. Geological Survey, oral commun., 1984). Excavations were made near each of the cross-section sites on the main stem of Wheeling Creek (fig. 4) and near the mouth of Jug Run, which enters Wheeling Creek between Maynard and Crescent. Stream-bottom materials excavated with shovels were examined for coal content, angularity, and size.

The excavations yielded additional information on the nature of the stream-bottom materials. At Lafferty, the top 12 to 18 inches of the bed material consisted mostly of coal and angular rock fragments. At a depth of about 18 inches, a clay layer was found. Bedrock was 3 to 4 feet deep. At both Maynard and Goosetown, the bed material consisted almost totally of rounded cobbles down to a depth of about 3 feet. The excavation at Jug Run shows evidence of considerable mining-associated sediment deposition as indicated by a high proportion of angular rock fragments down to a depth of about 3 feet, the limit for hand digging.

The only evidence of appreciable mine-related sediment deposition was found in Jug Run and, to a lesser extent, at Lafferty. Maynard and Goosetown have "normal" stream-bottom materials, that is, rounded cobbles and pebbles.

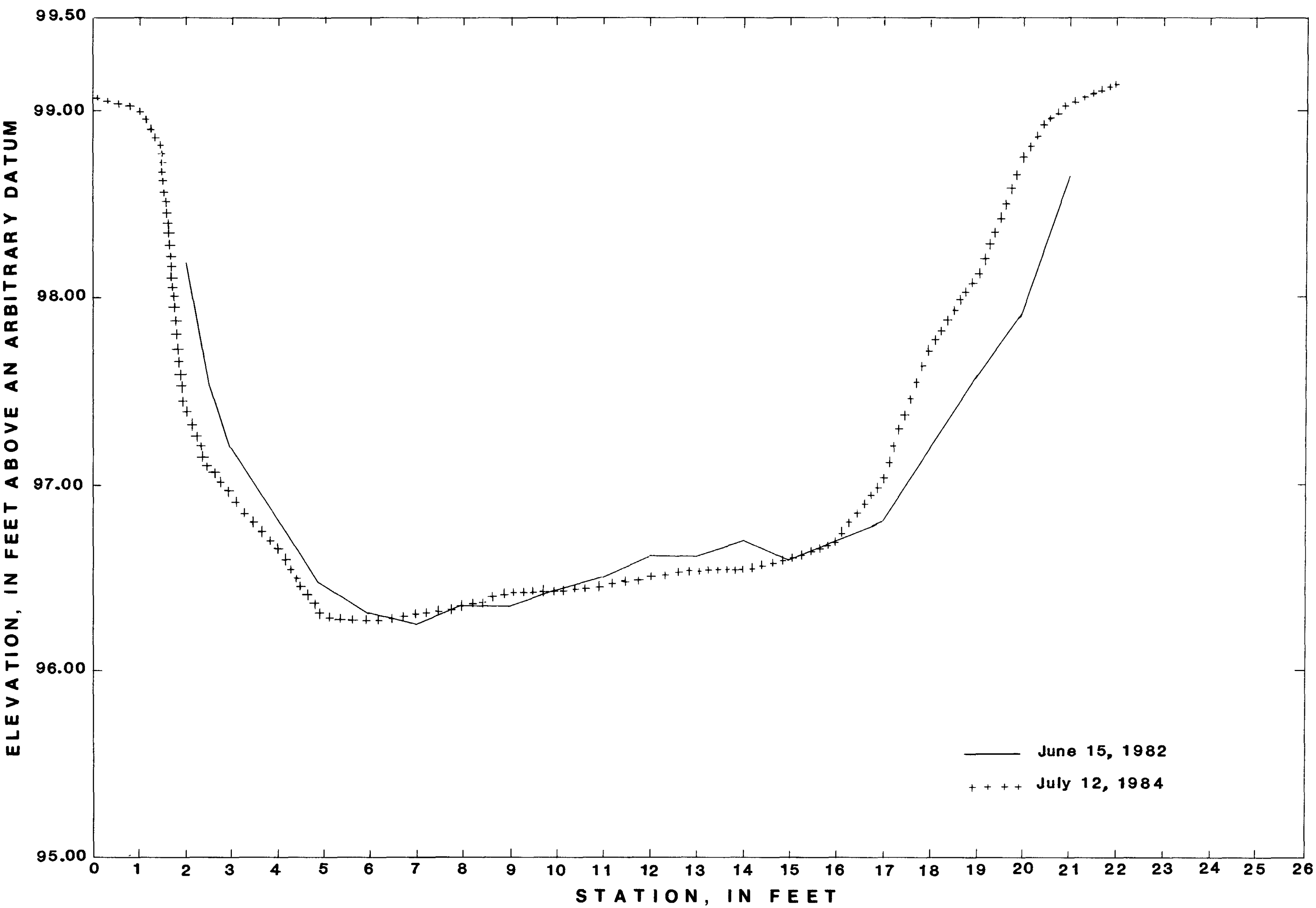

Figure 5.--Cross section of Wheeling Creek at Lafferty, Ohio.

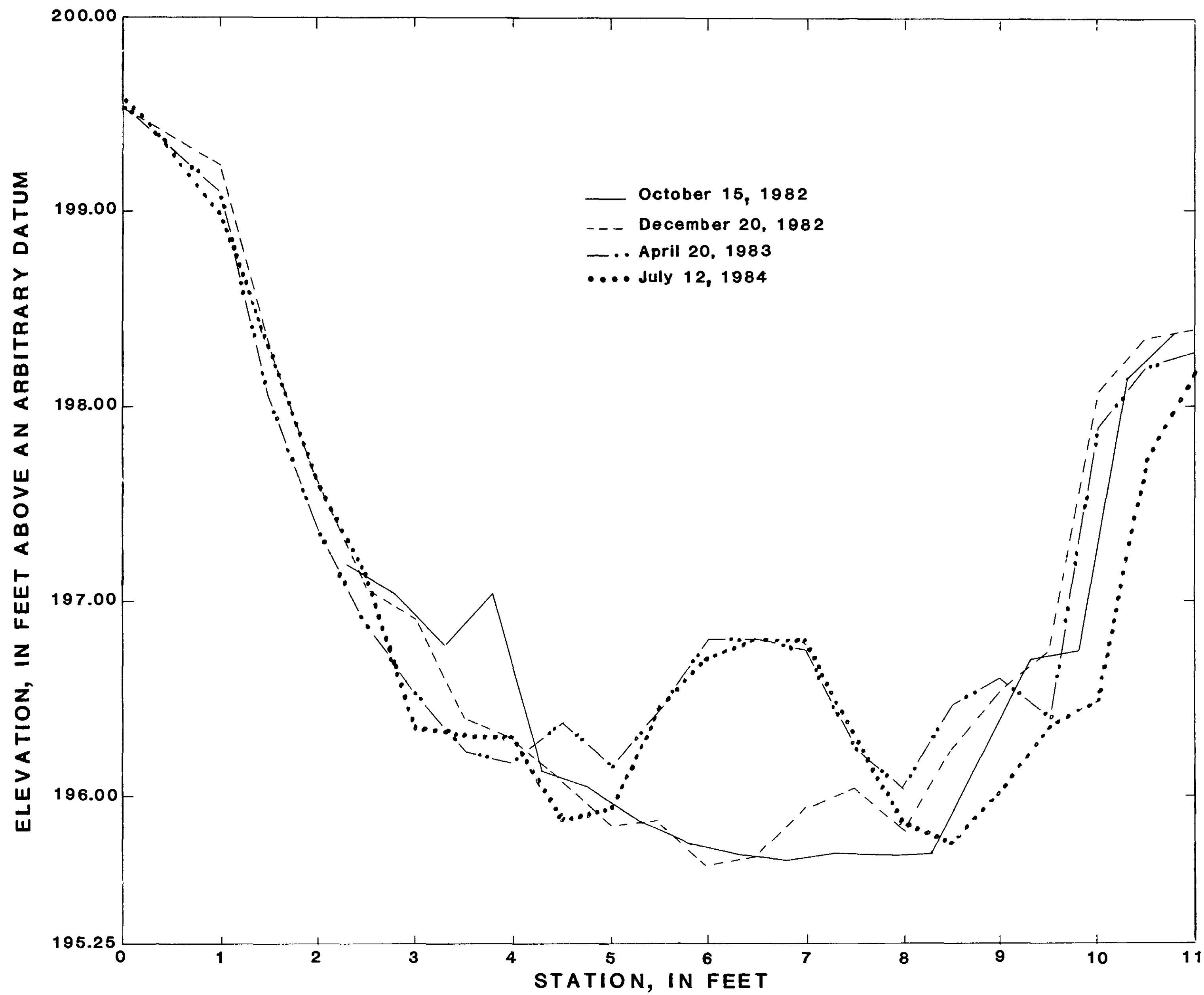

Figure 6.—Cross section of McCracken Run at Fairpoint, Ohio.

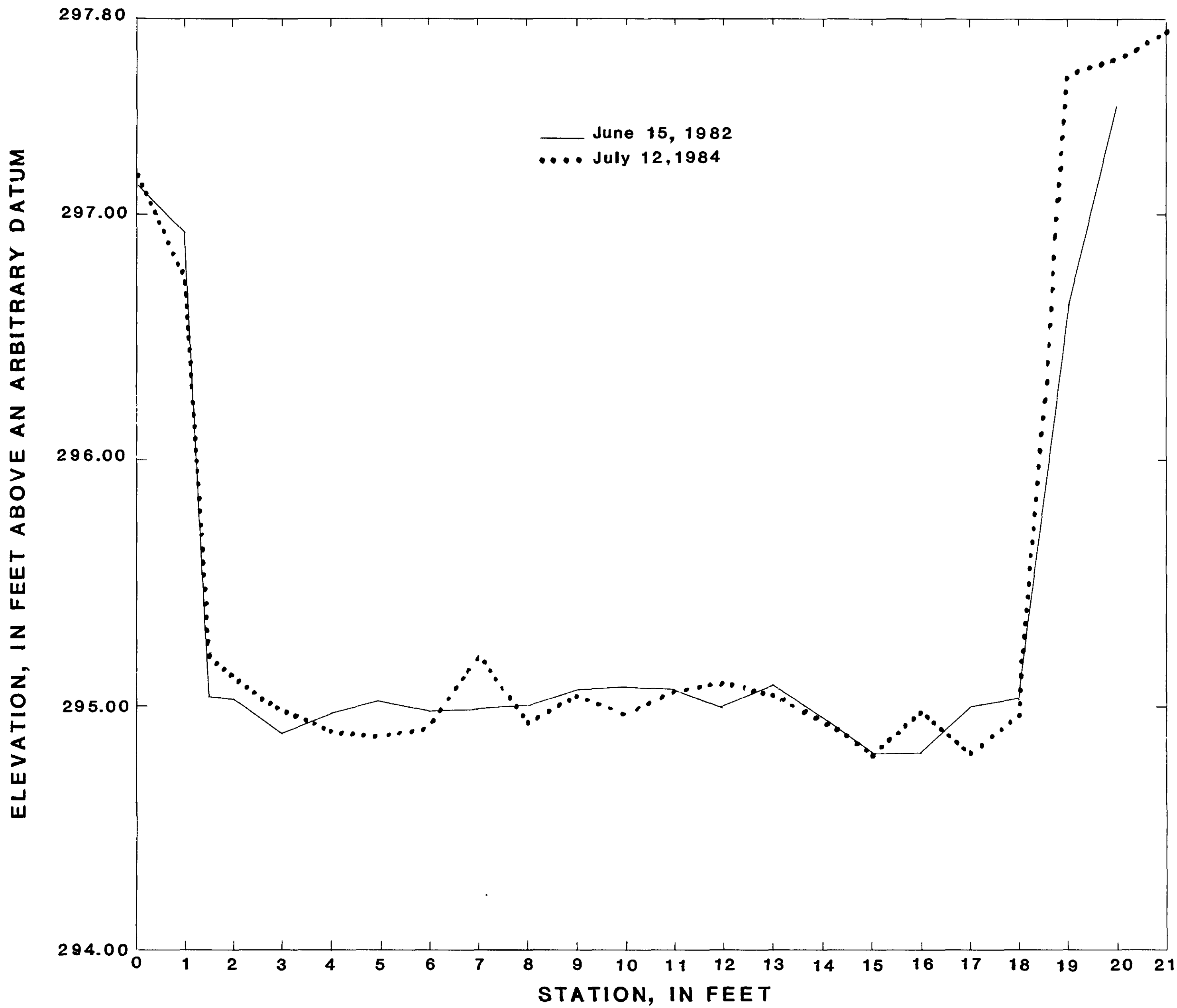

Figure 7.--Cross section of Crabapple Creek near Crabapple, Ohio.

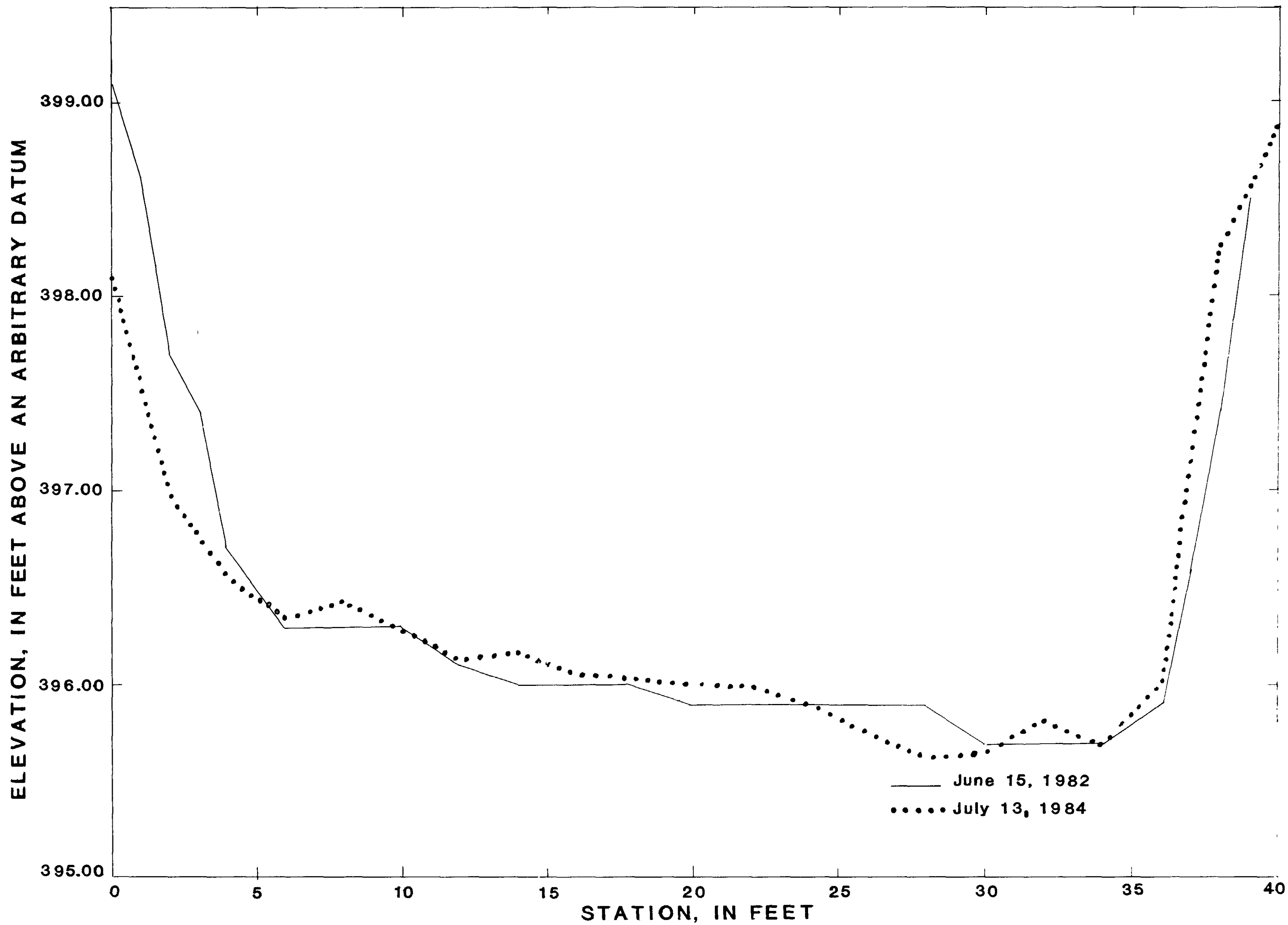

Figure 8.--Cross section of Wheeling Creek below Maynard, Ohio.

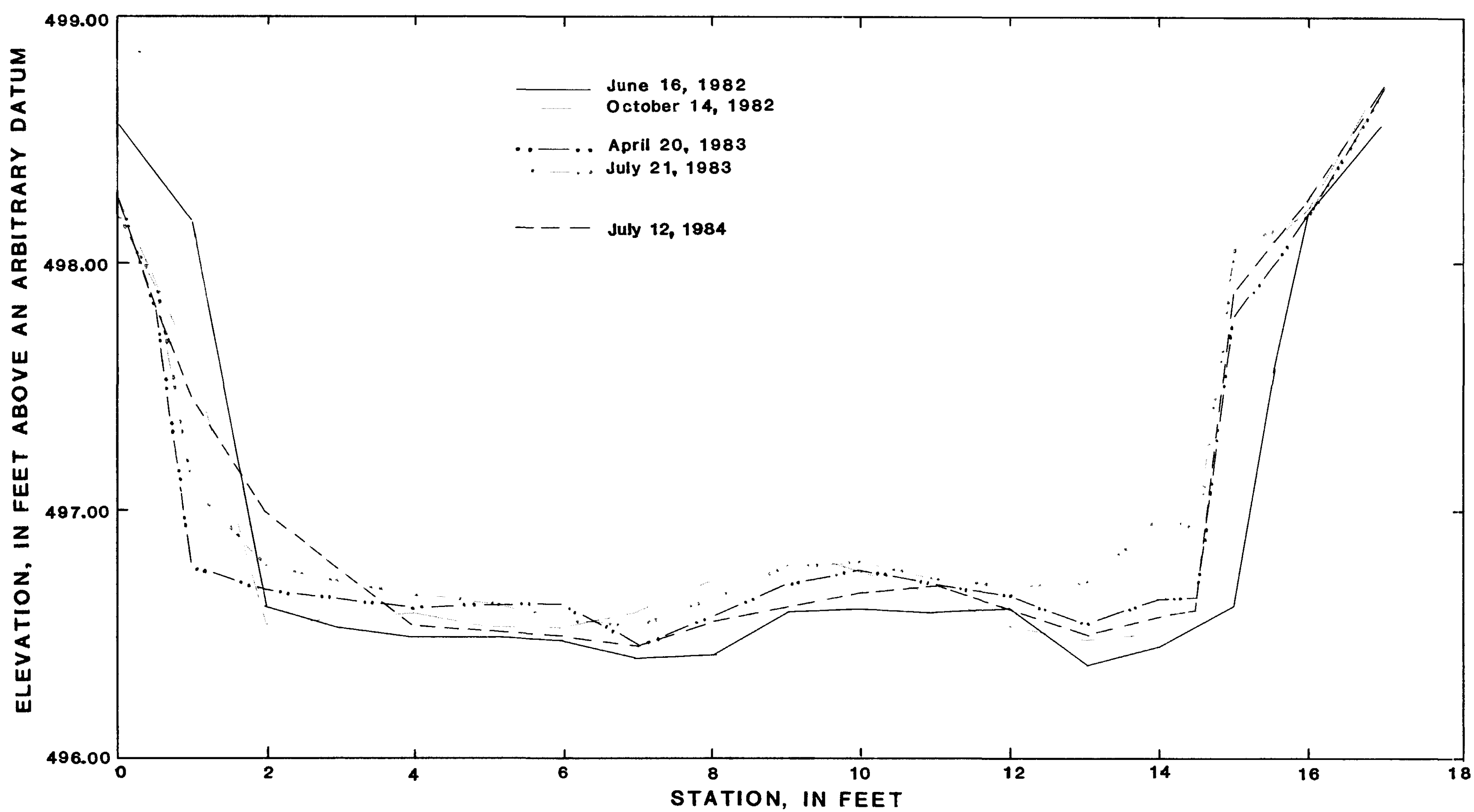

Figure 9.--Cross section of Fall Run above Cresent, Ohio.

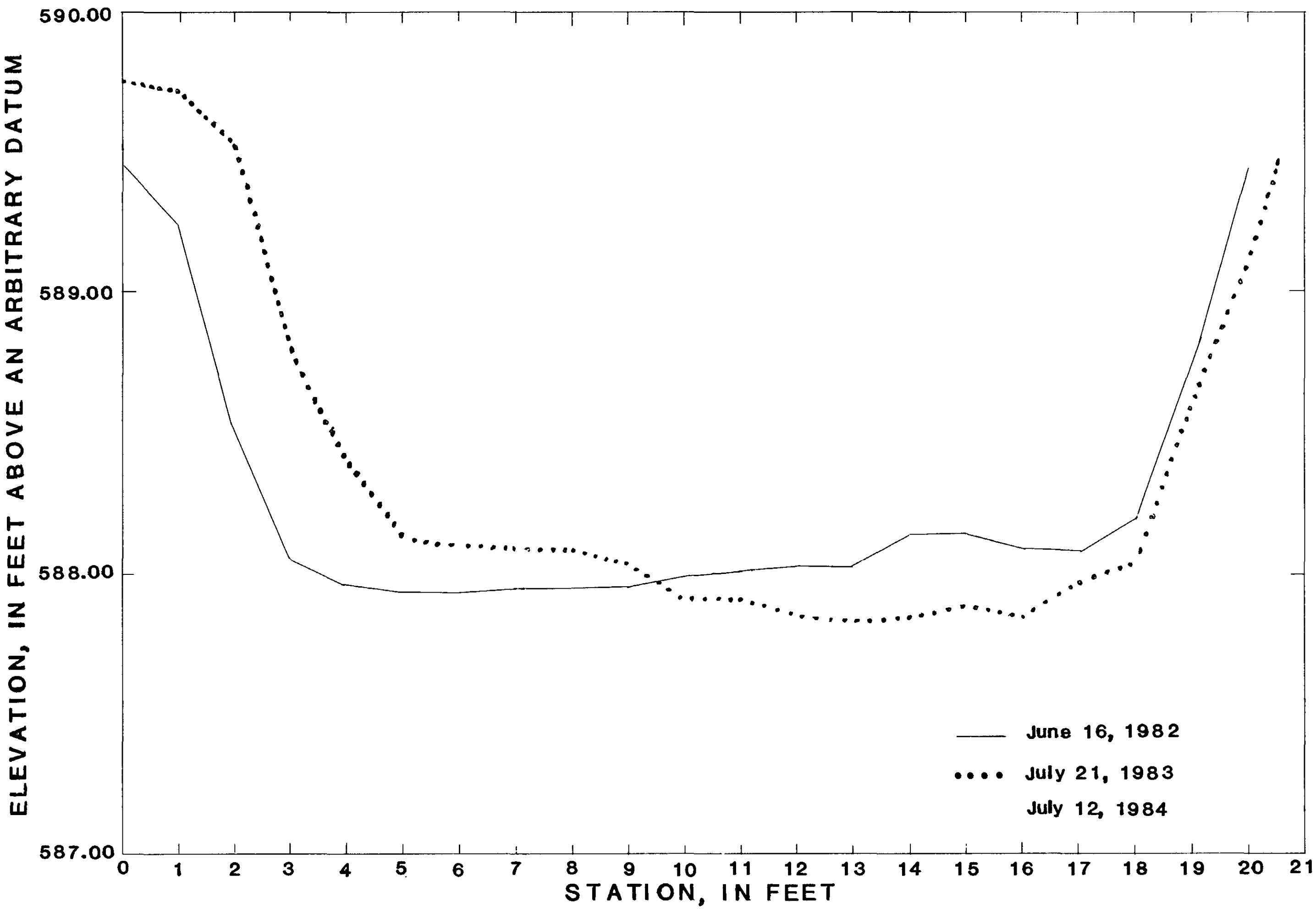

Figure 10.--Cross section of Steep Run at Barton, Ohio.

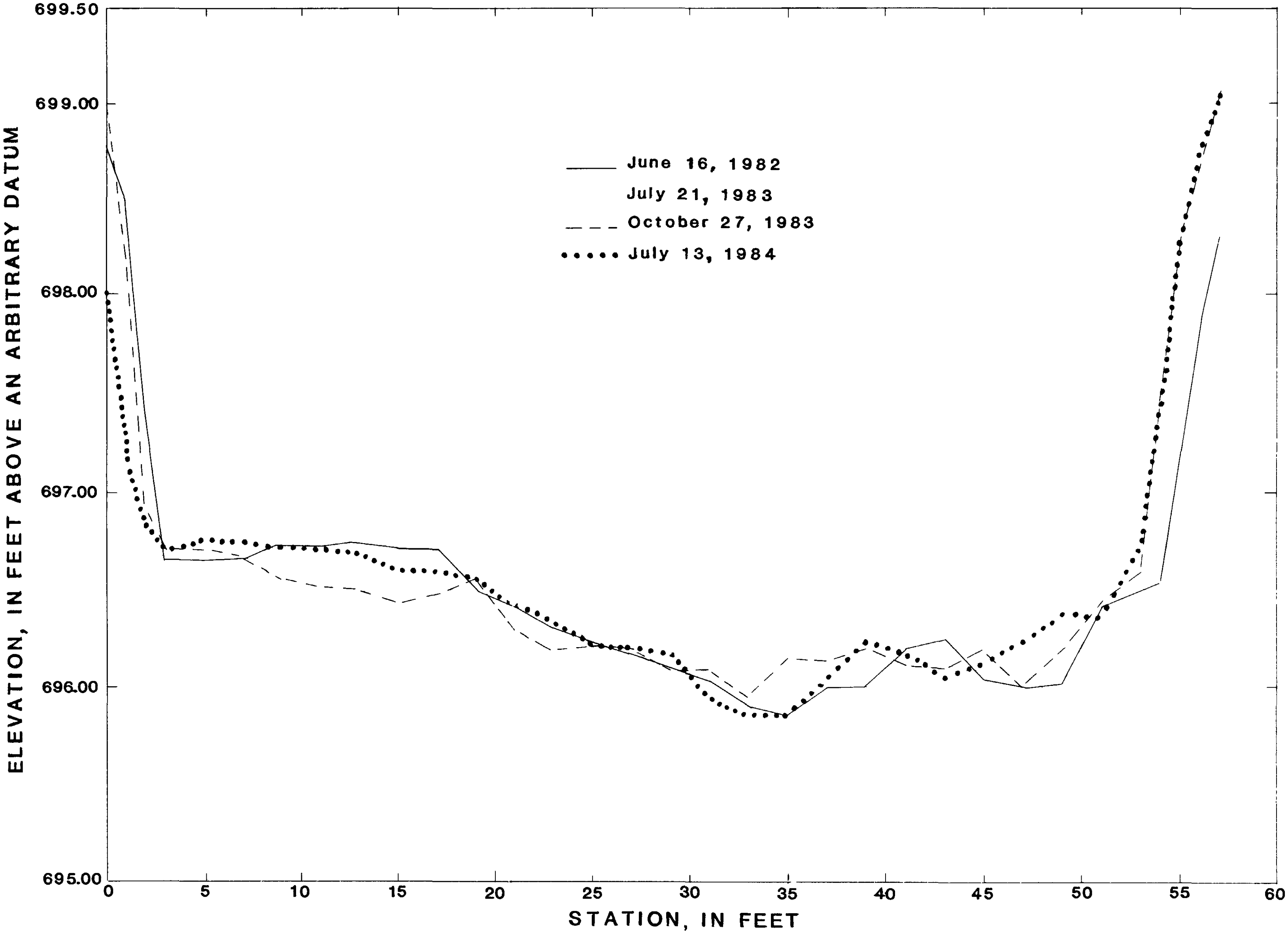

Figure 11.--Cross section of Wheeling Creek at Goosetown, Ohio.

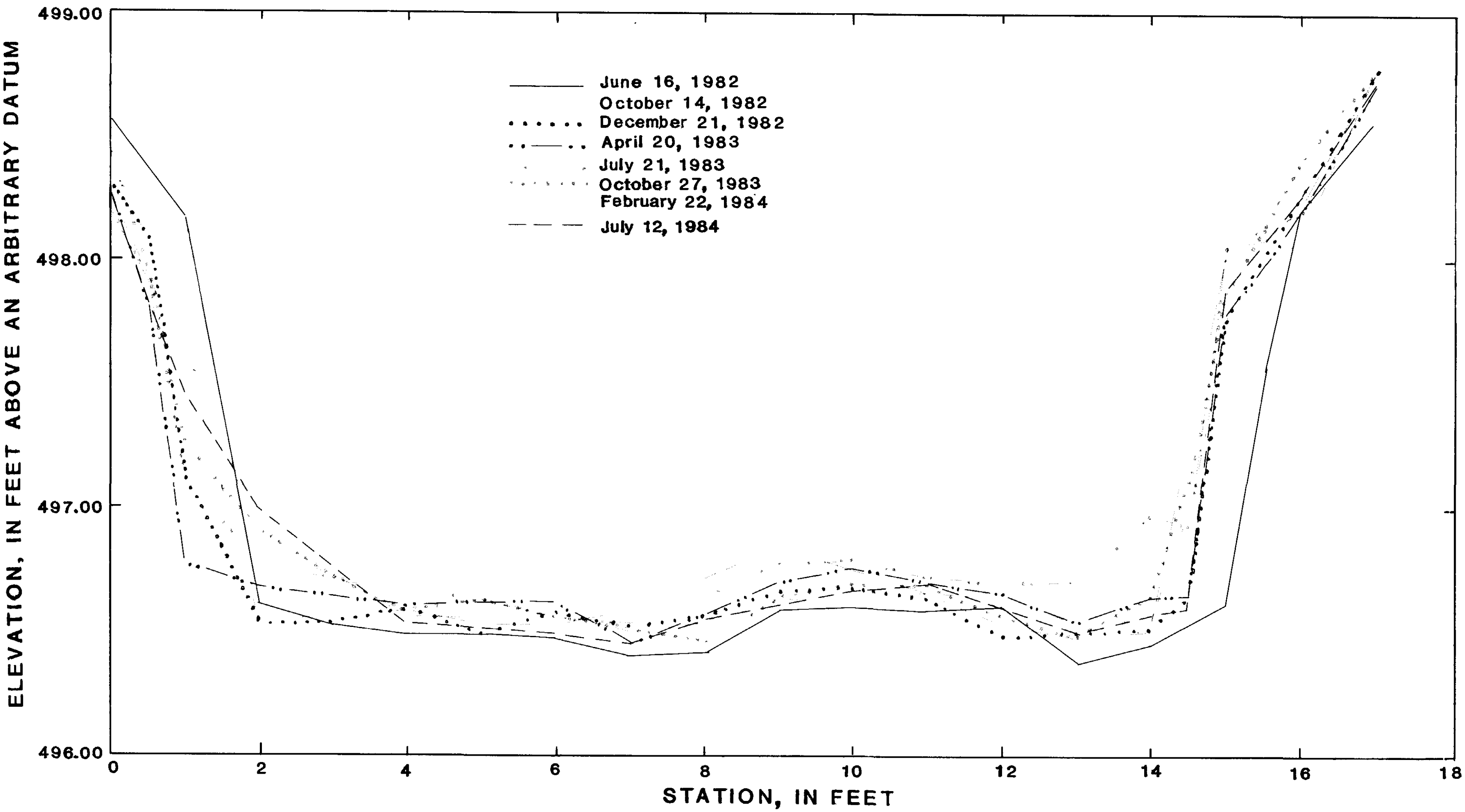

Figure 12.—Cross section of Fall Run above Cresent, Ohio (all measurements).

Sediment Loads During Storms

Suspended-sediment samples, discharge measurements, and bed-load samples were collected at four sites during four separate storm events. In contrast to suspended sediments, which are sediments transported in suspension, bedload is defined as sediments moving on or near the bed by saltation, rolling, and sliding.

The locations of the four sediment-event sites were chosen in order to divide the basin into four parts with approximately equal areas. In this way, the parts of the basin that delivered the most sediment to the sampling point could be determined. The cumulative drainage areas for the four sites are Bannock, 23.6 mi^2; Fairpoint, 50.9 mi^2; Barton, 84.8 mi^2; and Blaine, 104 mi^2. The site at Fairpoint was moved to the next bridge downstream for the last event on December 12, 1983, because of construction at the original site. The cumulative drainage area for the relocated Fairpoint site is 57.9 mi^2. Samples were collected May 2, May 22, October 23, and December 12, 1983.

Water-surface elevations were plotted against suspended-sediment concentrations, and a continuous concentration curve was drawn to fit. When necessary, days were subdivided using standard techniques for sediment analysis (Porterfield, 1972). A stage-discharge relation developed for each site from current-meter measurements was used to determine the discharge for each subdivision. From these data, a suspended-sediment load was determined for each event day at the four sites.

Bedload samples collected at the event sites were analyzed, and a bedload transport rate was determined. A bedload transport curve then was estimated, and total bedload for the day computed using techniques described by Graf (1983). This was added to the suspended-sediment load to obtain an approximate total sediment load for the event.

Some error is introduced if suspended-sediment load and bed load are added to arrive at a total sediment load (W. P. Carey, U.S. Geological Survey, written commun., 1980); however, bedload comprised less than 2 percent of the total load in all cases, and was near zero in many cases. Because the summed loads are used only for comparative purposes, total loads estimated in this manner were considered acceptable for purposes of this study.

Bedload samples were collected with a Helley-Smith[1] bedload sampler, either hand held or suspended from a bridge crane. Two transverses of twenty equally spaced intervals were sampled whenever possible.

---

[1] Bedload sampler developed by the U.S. Geological Survey and described by Helley and Smith, 1971.

Suspended-sediment samples were collected with DH-48[2] samplers when the stream could be waded, and with D-59 or D-49[2] samplers suspended from a rope or bridge crane when wading was impossible (Guy and Norman, 1970). The equal-width-increment method was used.

Results of analyses of suspended-sediment and bedload samples collected during storm events are shown in table 3. Values for incremental discharge (the discharge gained between a site and the last measured upstream point) and for the incremental sediment yield (the sediment load, in tons, gained between a site and the last measured upstream point divided by the incremental drainage area, in square miles) were computed and compared to determine which parts of the basin were yielding the most sediment.

During all four storms, the event site at Blaine (see fig. 4) had the highest incremental sediment yield. This indicates that intervening drainage between Blaine and Barton contributed the most sediment to the stream on an area-weighted basis. Because the lower part of the basin is primarily forested and has not been extensively surface mined, it is probable that the major sources of sediment are waste piles (which border the stream) left over from former deep mining and coal processing. A coal-separation analysis of bed-load material sampled on April 15, 1983, at Blaine revealed that 13.8 percent of the sample consisted of coal particles. In contrast, a bedload sample collected at Barton on the same day consisted of 6.4 percent coal particles. The coal-separation analyses were performed by the U.S. Geological Survey laboratory in Atlanta using standard techniques (Guy, 1969).

DATA OBTAINED AT THE GAGING STATION

The streamflow gaging station (Wheeling Creek below Blaine, station number 03111548) was established in November 1982. Continuous gage-height data were collected, as were daily suspended-sediment samples; additional suspended-sediment samples were collected during times of high flow. Water-discharge records were computed by standard methods (Kennedy, 1983).

Daily suspended-sediment records were computed on the basis of automatically collected daily suspended-sediment samples and samples collected manually during storm events. Suspended-sediment load was computed using a mean discharge determined for each day. For days with rapidly changing gage heights, sediment loads were calculated by the method of subdivision (Porterfield, 1972).

---

[2]Depth-integrated samplers developed by the U.S. Geological Survey and described by Guy and Norman, 1970.

Table 3.--Water-discharge and sediment data for significant storms in 1983

[ft^3/s, cubic feet per second; mg/L, milligrams per liter; mi^2, square miles; N, negligable]

Date and station name	Incremental drainage area (mi^2)	Incremental daily mean discharge (ft^3/s)	Incremental daily mean discharge per square mile [(ft^3/s)/mi^2]	Daily mean suspended-sediment concentration (mg/L)	Incremental daily suspended-sediment load (tons)	Incremental daily bed load (tons)	Estimated incremental total daily load (tons)	Estimated incremental total daily sediment yield (tons/mi^2)
May 2, 1983								
Bannock	23.6	152	6.44	358	185	N	185	7.84
Fairpoint	27.3	84	3.08	357	77	N	77	2.82
Barton	33.9	190	5.60	336	199	3.3	223	6.58
Blaine	19.2	25	1.30	562	399	2.3	479	24.9
May 22, 1983								
Bannock	23.6	206	8.73	512	378	N	378	16.0
Fairpoint	27.3	67	2.45	498	68	N	68	2.49
Barton	33.9	465	13.7	865	1,640	3.8	1,754	51.7
Blaine	19.2	41	2.13	4,640	12,500	4.9	12,500	651
Oct. 23, 1983								
Bannock	23.6	57.5	2.44	250	45	N	45	1.91
Fairpoint	27.3	66.5	2.44	310	69	N	69	2.52
Barton	33.9	67.0	1.98	455	128	.06	129	3.81
Blaine	19.2	47.0	2.45	852	318	[a]-0.01	318	16.5
Dec. 12, 1983								
Bannock	23.6	181	7.67	233	99	.4	105	4.45
Fairpoint	34.3	114	3.32	330	198	3.6	237	6.91
Barton	26.9	267	9.93	458	454	[a]-1.8	454	16.9
Blaine	19.2	23	1.20	725	439	5.6	550	28.6

[a]Negative incremental load may indicate net loss of mass between upstream site and this site.

Data for the gage have been published by the U.S. Geological Survey since December 1982 (Shindel and others, 1984). Mean daily discharges for the part of the 1983 water year during which the gage was in operation are shown in table 4 (at back of report). Sediment records for the part of the 1983 water year during which the gage was in operation are shown in table 5 (at back of report).

Future records from this station will be published in the U.S. Geological Survey's annual water-data reports for Ohio.

SUMMARY AND CONCLUSIONS

The U.S. Geological Survey undertook a project in cooperation with the Ohio Department of Natural Resources to investigate factors associated with what is described by residents of the Wheeling Creek basin as a recent increase in the frequency of out-of-bank flooding. Specifically, this report (1) discusses the estimation of peak discharges and recurrence intervals for the 1979-81 floods in the Wheeling Creek basin; (2) provides information on current and historical mining-related stream-channel fill or scour; and (3) discusses storm-period subbasin contributions to the sediment load in Wheeling Creek.

Peak-discharge recurrence intervals were estimated for seven floods that occurred on Wheeling Creek from February 1979 through June 1981. A statistically unusual number of significant floods was found to have occurred within that time period on Wheeling Creek, as well as on the adjacent Captina and Short Creeks.

Cross-section profiles were surveyed quarterly at seven locations in the Wheeling Creek basin. No evidence of appreciable channel scour or fill was observed at any of the cross sections, although minor profile changes were apparent at some locations. These results may not be representative of the long term because no large floods occurred during the study period. Attempts were made to obtain historical cross-section profile data for comparison with current cross-section profiles, however, no usable data were found.

Excavations of stream-bottom materials were made near the three main-stem cross-section locations and near the mouth of Jug Run, which enters Wheeling Creek between Maynard and Crescent. The bottom materials were examined for evidence of recently deposited sediments of mining-related origin. The only evidence of appreciable mine-related sediment deposition was found at Jug Run and, to a lesser extent, at Lafferty.

Suspended-sediment samples, discharge measurements, and bedload samples were collected at four sites during four separate storm events. Approximate incremental sediment yields were computed so that subbasin contributions of sediment could be compared. The Blaine event site consistently displayed the highest incremental sediment yield indicating that the intervening drainage between Blaine and Barton contributed the most sediment on an area-weighted basis. Particle analyses of bedload samples along with consideration of current land use suggests that probable major sources of sediment in that area are waste piles (which border the stream) left over from former deep mining and coal processing.

In summary, the number of floods that occurred from February 1979 through June 1981 with 2-year or greater recurrence intervals was greater than would be statistically expected on the average, which possibly accounts for any perceived increase in the frequency of out-of-bank flooding. No evidence was found to substantiate the hypothesis that the stream channel is now rapidly filling, nor in general is there evidence of appreciable fill in the recent past that can be directly associated with mining activities. Consequently, there is no current evidence that the stream has recently experienced a reduction in flood-carrying capacity due to mining-related sediment deposition. Of the areas studied, the intervening area between Blaine and Barton appears to contribute the most sediment to Wheeling Creek on an area-weighted basis. Probable major sources of sediments in that area are waste piles that border the stream.

SELECTED REFERENCES

Batten, W. G., and Hindall, S. M., 1980, Sediment deposition in the White River Reservoir, northwestern Wisconsin: U.S. Geological Survey Water-Supply Paper 2069, 30 p.

Colby, B. R., 1963, Fluvial sediments--a summary of source, transportation, deposition, and measurement of sediment discharge: U.S. Geological Survey Bulletin 1181-A, 47 p.

Graf, J. B., 1983, Measurement of bedload discharge in nine Illinois streams with the Helley-Smith sampler: U.S. Geological Survey Water-Resources Investigations Report 83-4136, 70 p.

Groves, C. J., 1982, Water, Ohio's remarkable resource: Ohio Department of Natural Resources, Division of Water, 27 p.

Guy, H. P., 1969, Laboratory theory and methods for sediment analysis: U.S. Geological Survey, Techniques of Water-Resources Investigations, book 5, chap. C1, 58 p.

Guy, H. P., and Norman, V. W., 1970, Field methods for measurement of fluvial sediment: U.S. Geological Survey Techniques of Water-Resources Investigations, book 3, chap. C2, 59 p.

Helley, E. S., and Smith, W., 1971, Development and calibration of a pressure difference bedload sampler: U.S. Geological Survey Open-File Report, 18 p.

Kennedy, E. J., 1983, Computation of continuous records of streamflow: U.S. Geological Survey, Techniques of Water-Resources Investigations, book 3, chap. A13, 53 p.

Kirby, William, 1981, Annual flood frequency analysis using U.S. Water Resources Council Guidelines (Program J407), WATSTORE User's Guide, vol. 4, chap. I, section C.

National Oceanic and Atmospheric Administration, 1979, Climatological Data--Ohio, February: U.S. Department of Commerce, v. 84, no. 2, 20 p.

----- 1980a, Climatological data--Ohio, August: U.S. Department of Commerce, v. 85, no. 8, 20 p.

----- 1980b, Climatological data--West Virginia, August: U.S. Department of Commerce, v. 88, no. 8.

----- 1981a, Climatological data--Ohio, April: U.S. Department of Commerce, v. 86, no. 4, 20 p.

----- 1981b, Climatological data--Ohio, June: U.S. Department of Commerce, v. 86, no. 6, 20 p.

----- 1981c, Climatological data--West Virginia, April: U.S. Department of Commerce, v. 89, no. 4.

----- 1981d, Climatological data--West Virginia, June: U.S. Department of Commerce, v. 89, no. 4.

Porterfield, George, 1972, Computation of fluvial-sediment discharge: U.S. Geological Survey, Techniques of Water-Resources Investigations, book 3, chap. C3, 66 p.

Shindel, H. L., Stewart, L. L., and Kolva, J. R., 1984, Water resources data--Ohio, water year 1983: U.S. Geological Survey Water-Data Report OH-83-1, 339 p.

U.S. Department of Commerce, Weather Bureau, 1961, Rainfall frequency atlas of the United States: Washington, D. C., U.S. Weather Bureau Technical Paper 40, 115 p.

U.S. Geological Survey, 1980, Water resources data for Ohio, water year 1979: U.S. Geological Survey Water-Data Report OH-79-1, 619 p.

----- 1981, Water resources data for Ohio, water year 1980: U.S. Geological Survey Water-Data Report OH-80-1, 502 p.

----- 1982, Water resources data for Ohio, water year 1981: U.S. Geological Survey Water-Data Report OH-81-1, 386 p.

U.S. Water Resources Council, Hydrology Committee, 1981, Guidelines for determining flood flow frequency: Bulletin 17B (various pagings).

Webber, E. E., and Bartlett, W. P., Jr., 1977, Floods in Ohio--magnitude and frequency: Ohio Department of Natural Resources, Division of Water, Bulletin 45, 74 p.

Wheeling Creek Watershed Action Committee Agency Task Force, 1983, Wheeling Creek watershed flooding and sedimentation investigation: Ohio Department of Natural Resources, 121 p.

White, W. F., and Lindholm, C. F., 1950, Water resources investigation relating to the Schuylkill River Restoration Project: Pennsylvania Department of Forests and Waters, 18 p.

Table 4.--Daily mean discharges for Wheeling Creek below Blaine (03111548), December 1982 through September 1983.

Day	Discharge, in cubic feet per second, water year October 1982 to September 1983, mean values											
	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1			54	98	70	73	140	166	144	121	46	34
2			46	89	293	70	140	451	138	86	39	28
3			41	84	413	66	345	459	138	72	31	25
4			38	76	190	65	244	571	206	70	29	23
5			36	80	140	66	208	352	144	93	40	22
6			55	75	126	68	206	288	134	69	43	16
7			42	71	120	70	267	253	117	59	35	16
8			36	68	106	144	507	228	113	53	32	15
9			33	63	98	155	772	214	106	50	31	14
10			30	66	96	155	692	195	102	50	28	13
11			31	86	94	182	429	179	95	50	28	12
12			31	74	96	172	326	171	93	49	28	24
13			78	62	86	153	294	162	88	49	26	106
14			148	62	87	142	284	153	85	46	23	39
15			111	62	91	134	1,000	628	81	43	23	20
16			325	60	112	126	410	454	88	43	21	22
17			122	68	136	112	313	261	80	42	21	31
18			75	60	112	114	264	220	76	42	25	22
19			80	83	103	379	230	267	78	45	28	16
20			128	94	96	261	207	310	104	42	25	16
21			97	108	91	261	191	250	85	45	23	22
22			76	89	88	203	182	779	76	62	22	24
23			303	91	86	167	171	520	69	46	20	20
24			230	80	81	153	209	313	64	76	20	18
25			144	56	83	140	179	258	62	50	20	15
26			167	53	78	132	158	223	59	43	20	15
27			241	51	73	151	146	200	56	39	20	15
28			214	51	73	244	138	182	65	38	22	14
29			147	49	---	187	140	188	78	36	25	13
30			120	68	---	155	162	182	88	35	21	13
31			106	84	---	149	---	160	---	38	23	---
Total			3,385	2,261	3,318	4,649	8,954	9,237	2,912	1,682	838	683
Mean			109	72.9	119	150	298	298	97.1	54.3	27.0	22.8
Maximum			325	108	413	379	1,000	779	206	121	46	106
Minimum			30	49	70	65	138	153	56	35	20	12

Table 5.--Sediment discharge for Wheeling Creek below Blaine (03111548), December 1982 through September 1983

Day	Mean discharge (ft^3/s)	Mean concen-tration (mg/L)	Sediment discharge (tons/d)	Mean discharge (ft^3/s)	Mean concen-tration (mg/L)	Sediment discharge (tons/d)	Mean discharge (ft^3/s)	Mean concen-tration (mg/L)	Sediment discharge (tons/d)
		October			November			December	
1							54	---	---
2							46	---	---
3							41	---	---
4							38	---	---
5							36	---	---
6							55	---	---
7							42	---	---
8							36	38	3.7
9							33	31	2.8
10							30	35	2.8
11							31	31	2.6
12							31	35	2.9
13							78	138	44
14							148	103	41
15							111	416	156
16							325	1,990	1,870
17							122	812	267
18							75	350	71
19							80	240	52
20							128	170	59
21							97	100	26
22							76	50	10
23							303	1,150	1,080
24							230	500	310
25							144	250	97
26							167	140	63
27							241	384	300
28							214	80	46
29							147	50	20
30							120	30	9.7
31							106	30	8.6
Total							3,385	---	4,545.1

Table 5.--Sediment discharge for Wheeling Creek below Blaine (03111548), December 1982 through September 1983--Continued

Day	Mean discharge (ft^3/s)	Mean concen-tration (mg/L)	Sediment discharge (tons/d)	Mean discharge (ft^3/s)	Mean concen-tration (mg/L)	Sediment discharge (tons/d)	Mean discharge (ft^3/s)	Mean concen-tration (mg/L)	Sediment discharge (tons/d)
		January			February			March	
1	98	30	7.9	70	90	17	73	70	14
2	89	30	7.2	293	737	838	70	70	13
3	84	30	6.8	413	304	379	66	60	11
4	76	30	6.2	190	100	51	65	65	11
5	80	30	6.5	140	70	26	66	65	12
6	75	30	6.1	126	60	20	68	60	11
7	71	30	5.8	120	50	16	70	70	13
8	68	30	5.5	106	40	11	144	574	279
9	63	30	5.1	98	30	7.9	155	335	146
10	66	30	5.3	96	30	7.8	155	90	38
11	86	30	7.0	94	30	7.6	182	95	47
12	74	30	6.0	96	30	7.8	172	85	39
13	62	30	5.0	86	30	7.0	153	72	30
14	62	30	5.0	87	30	7.0	142	70	27
15	62	30	5.0	91	30	7.4	134	70	25
16	60	30	4.9	112	85	33	126	70	24
17	68	30	5.5	136	330	121	112	70	21
18	60	30	4.9	112	125	38	114	70	22
19	83	30	6.7	103	58	16	379	552	629
20	94	30	7.6	96	60	16	261	110	78
21	108	30	8.7	91	60	15	261	100	70
22	89	30	7.2	88	65	15	203	70	38
23	91	30	7.4	86	65	15	167	50	23
24	80	30	6.5	81	70	15	153	40	17
25	56	35	5.3	83	70	16	140	40	15
26	53	40	5.7	78	65	14	132	40	14
27	51	45	6.2	73	65	13	151	50	20
28	51	50	6.9	73	65	13	244	178	123
29	49	50	6.6	---	---	---	187	50	25
30	68	60	11	---	---	---	155	40	17
31	84	70	16	---	---	---	149	40	16
TOTAL	2,261	---	207.5	3,318	---	1,750.5	4,649	---	1,868

Table 5.--Sediment discharge for Wheeling Creek below Blaine (03111548), December 1982 through September 1983--Continued

Day	Mean discharge (ft^3/s)	Mean concentration (mg/L)	Sediment discharge (tons/d)	Mean discharge (ft^3/s)	Mean concentration (mg/L)	Sediment discharge (tons/d)	Mean discharge (ft^3/s)	Mean concentration (mg/L)	Sediment discharge (tons/d)
		April			May			June	
1	140	40	15	166	60	27	144	100	39
2	140	44	17	451	562	860	138	100	37
3	345	175	162	459	335	424	138	100	37
4	244	94	62	571	450	694	206	1,030	600
5	208	70	39	352	100	95	144	400	156
6	206	50	28	288	80	62	134	260	94
7	267	78	59	253	80	55	117	200	63
8	507	384	667	228	80	49	113	400	122
9	772	841	1,920	214	75	43	106	200	57
10	692	245	454	195	75	39	102	100	28
11	429	100	116	179	70	34	95	100	26
12	326	80	70	171	70	32	93	100	25
13	294	70	56	162	65	28	88	100	24
14	284	76	60	153	60	25	85	100	23
15	1,000	145	443	628	1,910	3,610	81	100	22
16	410	65	72	454	1,230	1,630	88	100	24
17	313	70	59	261	600	423	80	100	22
18	264	85	61	220	170	101	76	100	21
19	230	80	50	267	592	492	78	100	21
20	207	80	45	310	990	829	104	100	28
21	191	85	44	250	500	337	85	100	23
22	182	85	42	779	4,640	14,600	76	100	21
23	171	85	39	520	2,220	3,220	69	100	19
24	209	85	48	313	1,610	1,360	64	90	16
25	179	85	41	258	1,300	906	62	80	13
26	158	85	36	223	910	548	59	70	11
27	146	78	31	200	500	270	56	70	11
28	138	62	23	182	400	197	65	75	13
29	140	60	23	188	300	152	78	80	17
30	162	62	27	182	200	98	88	80	20
31	---	---	---	160	100	43	---	---	---
TOTAL	8,954	---	4,809	9,237	---	31,283	2,912	---	1,633

☆U.S. Government Printing Office: 1987—750-872/62007

Table 5.--Sediment discharge for Wheeling Creek below Blaine (03111548), December 1982 through September 1983--Continued

Day	Mean discharge (ft^3/s)	Mean concen-tration (mg/L)	Sediment discharge (tons/d)	Mean discharge (ft^3/s)	Mean concen-tration (mg/L)	Sediment discharge (tons/d)	Mean discharge (ft^3/s)	Mean concen-tration (mg/L)	Sediment discharge (tons/d)
		July			August			September	
1	121	163	55	46	45	5.6	34	35	3.2
2	86	100	23	39	90	9.5	28	31	2.3
3	72	70	14	31	35	2.9	25	31	2.1
4	70	84	16	29	35	2.7	23	26	1.6
5	93	95	24	40	50	5.4	22	26	1.5
6	69	67	12	43	47	5.5	16	23	.99
7	59	44	7.0	35	42	4.0	16	15	.65
8	53	44	6.3	32	40	3.5	15	24	.97
9	50	44	5.9	31	40	3.3	14	25	.95
10	50	40	5.4	28	42	3.2	13	26	.91
11	50	40	5.4	28	42	3.2	12	22	.71
12	49	40	5.3	28	42	3.2	24	170	48
13	49	32	4.2	26	40	2.8	106	813	209
14	46	32	4.0	23	37	2.3	39	880	93
15	43	32	3.7	23	33	2.0	20	380	21
16	43	25	2.9	21	30	1.7	22	230	14
17	42	22	2.5	21	32	1.8	31	150	13
18	42	23	2.6	25	24	1.6	22	100	5.9
19	45	34	4.1	28	26	2.0	16	50	2.2
20	42	40	4.5	25	23	1.6	16	25	1.1
21	45	80	9.7	23	36	2.2	22	44	2.6
22	62	95	16	22	26	1.5	24	36	2.3
23	46	75	9.3	20	17	.92	20	29	1.6
24	76	90	18	20	17	.92	18	27	1.3
25	50	65	8.8	20	17	.92	15	24	.97
26	43	50	5.8	20	20	1.1	15	29	1.2
27	39	42	4.4	20	15	.81	15	35	1.4
28	38	40	4.1	22	14	.83	14	38	1.4
29	36	39	3.8	25	13	.88	13	36	1.3
30	35	37	3.5	21	12	.68	13	30	1.1
31	38	35	3.6	23	25	1.6	---	---	---
TOTAL	1,682	---	294.8	838	---	80.16	683	---	438.25
YEAR	37,919		46,909.31						