JOHNSTOWN-WESTERN PENNSYLVANIA STORM AND FLOODS OF JULY 19-20, 1977

Report prepared jointly by the U.S. Geological Survey
and the National Oceanic and Atmospheric Administration

U.S. DEPARTMENT OF THE INTERIOR • U.S. DEPARTMENT OF COMMERCE

GEOLOGICAL SURVEY PROFESSIONAL PAPER 1211

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By L. RAY HOXIT, ROBERT A. MADDOX, CHARLES F. CHAPPELL,
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GLOSSARY

Acre-foot (acre-ft). The quantity of water required to cover 1 acre to a depth of 1 foot. It is equal to 43,560 ft3 (cubic feet), 325,851 gal (gallons), or 1233 m3 (cubic meters).

Altimeter settling. The pressure required to make an altimeter indicate zero altitude at an elevation of 10 ft above mean sea level.

Cirrus anvil. High clouds that spread outward from the tops of thunderstorms.

Continuous-record station. A gaging site where a record of the flood hydrograph is collected systematically.

Convection. Vertical motions and mixing resulting when the atmosphere becomes thermodynamically unstable.

Crest-stage station. A stream-gaging site where only information on crest stage and peak discharge is collected systematically.

Cubic feet per second (ft3/s). A rate of discharge. One cubic foot per second is equal to the discharge of a stream of rectangular cross section 1 ft wide and 1 ft deep, flowing at an average velocity of 1 ft per second.

Cubic feet per second per square mile. ((ft3/s)/mi2). The average number of cubic feet of water per second flowing from each square mile of area drained by a stream, with the assumption that the runoff is distributed uniformly in time and area.

Current meter. An instrument for measuring the velocity of flowing water.

Datum of the gage. The elevation of the "zero" reading of a streamflow-gaging station above the National Geodetic Vertical Datum of 1929.

Dewpoint (or dewpoint temperature). The temperature to which a parcel of air must be cooled at constant pressure and constant water-vapor content in order for saturation to occur.

Drainage area of a stream at a specific location. The area, measured in a horizontal plane, that is enclosed by a topographic divide. Drainage area is given in square miles.

Echoes. In radar terminology, a general term for the appearance on a radar indicator of the electromagnetic energy returned from a target.

Equivalent potential temperature. The temperature an air parcel would have after undergoing the following processes: dry-adiabatic expansion until saturated, pseudo-adiabatic expansion until all moisture is precipitated out, then dry adiabatic compression to a pressure of 1,000 mb (millibars).

Flood-wave routing model. A mathematical model for determining the timing and shape of a flood wave at successive points along a stream.

Front. Boundary separating two different air masses.

Gage height. The water-surface elevation referred to some arbitrary gage datum. Gage height is often used interchangeably with the more general term "stage," although gage height is more appropriate when used with a reading on a gage.

Gaging station. A particular site on a stream, canal, lake, or reservoir where systematic observations of gage height or discharge are obtained.

Hydrograph. A graph showing gage height or stage, discharge, velocity, or other property of water with respect to time.

Inversion (temperature inversion). A layer in the atmosphere in which the temperature increases with height.

Isobar. A line of equal or constant barometric pressure.

Isotherm. A line of equal or constant temperature.

K Index. A stability index defined as

$$KI = (T_{850} - T_{500}) - (T - T_d)_{700} + T_{d850},$$

where T_{850} is the 850-mb temperature, T_{d850} is the 850-mb dewpoint temperature, T_{500} is the 500-mb temperature and $(T - T_d)_{700}$ is the difference between the 700-mb temperature and 700-mb dewpoint temperature.

Lifted index. A stability index based on the difference, in degrees Celsius, between the 500-mb environmental temperature and the temperature of a parcel of air lifted adiabatically from or near the surface to the 500-mb level.

Meso-high ("bubble high"). A small high pressure system with typical horizontal dimensions of 50–500 km. The high pressure is produced by the cold outflow from thunderstorms and is best defined near the Earth's surface.

Mesoscale. A general term used to define the intermediate scales of atmospheric motion, such as thunderstorms, squall lines, and hurricanes.

Millibars (mb). A pressure unit, equivalent to 1,000 dyn (dynes) per square centimeter, convenient for reporting atmospheric pressure.

Miscellaneous site. A site where data pertaining only to a specific hydrologic event are obtained.

National Geodetic Vertical Datum of 1929 (NGVD of 1929). A geodetic datum derived from a general adjustment of the first order level nets of both the United States and Canada, formerly called "Sea Level Datum of 1929" or "Mean Sea Level."

Precipitable water. The total atmospheric water vapor contained in a vertical column of unit-cross-sectional area extending from the surface up to a certain pressure level, usually 500 mb.

Radiosonde. A balloon-borne instrument package for measuring and transmitting meteorological data.

Rawinsonde. Meteorological data-collection system including a radiosonde and reflectors for measuring winds by radar.

Recurrence interval. In this report, the average interval of years within which a given flood discharge will be exceeded once.

Runoff. That part of the precipitation that appears in streams. Runoff, given in inches, is the depth to which the drainage area would be covered if the runoff for a given time period were uniformly distributed over the surface.

Sounding. A single complete radiosonde observation of the upper atmosphere.

Stage-discharge relation. The relation between stage or gage height and the flow rate of water in a channel.

Temperature. Expressed in degree Farenheit (°F), Celsius (°C), or kelvins (K). Relationships between these temperature scales are listed in the section titled Conversion Factors.

Time of day. Expressed in 24-hour time. For example, 12:30 a.m. is 0030 hours; 1:00 p.m. is 1300 hours. All time noted is eastern daylight time (EDT).

Trough. An elongated area of relatively low atmospheric pressure.

VIP. Video Integrator Processor.

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ABSTRACT

Dynamics associated with a weak mid-tropospheric short wave triggered widespread thunderstorms across Pennsylvania between the afternoon of July 19 and the morning of July 20, 1977. During this period, two major squall lines moved across the State. The western part of the outflow boundary produced by the second line became almost stationary in western Pennslyvania, resulting in 6 to 9 hours of nearly continuous thunderstorm activity. More than 6 inches of rain fell over a 400-square-mile-area of western Pennsylvania. In the hills just north and east of Johnstown, rainfall totals were high as 12 inches.

Flash flooding was severe as the storms moved slowly southeastward across the Allegheny, Susquehanna, and Potomac River basins. Runoff rates exceeding unit discharges of 1,000 cubic feet per second per square mile were determined for eight streams with drainage areas as large as 10 square miles. The greatest computed rate for natural conditions was 2,390 cubic feet per second per square mile for a site on Sandy Run, about 5 miles east of Johnstown. A unit discharge of 3,360 cubic feet per second per square mile was computed for a site downstream from Laurel Run Dam – the largest of seven earthfill, gravity-type dams that were breached. Floods were also severe on larger streams, such as the Conemaugh River at Seward, which had a peak discharge of 115,000 cubic feet per second from a drainage area of 715 square miles. Recurrence intervals for this discharge and for peak discharges at seven other gaging stations are estimated to be 100 years or more.

At least 78 deaths were attributed to the floods, and eight persons were still listed as missing 1 year later. Total damages in the eight-county flood area were extremely high and might exceed $330 million.

This report describes the storm and the associated flooding. Included are detailed analyses from surface raingages, National Weather Service radar, and synoptic charts. Descriptions of flooding are supported by peak stage and discharge data at 30 streamflow-gaging stations and 27 miscellaneous sites. A brief discussion of the deaths and damages resulting from the flood is also presented.

INTRODUCTION

A series of intense thunderstorms formed over western Pennsylvania during the evening and early morning of July 19–20, 1977. These storms, triggered by a mesoscale, quasi-stationary thunderstorm outflow boundary, produced an elongated northwest-southeast pattern of heavy rainfall. Regional topography probably played a role in focusing the heaviest rains in the mountains just north and east of Johnstown. In parts of Indiana and Cambria Counties, shown on the map in figure 1, as much as 12 in. of rain fell in 6 to 9 hours, resulting in some of the worst flooding ever known in the northeastern United States. Previously known maximum flood flows were surpassed at 12 of the 30 streamflow-gaging stations in the area. The flash floods that occurred on many small streams were especially severe, causing numerous deaths and much structural damage.

The steep terrain of the Johnstown area was a major factor contributing to the severity of much of the flooding. Undoubtedly, steep channel slopes resulted in destructively high velocities. Average stream velocities of 10–15 ft/s (feet per second) were common and, in some places, exceeded 20 ft/s. Runoff rates were also affected to some extent by both the steep channel slopes and hillsides. Many streams that drain areas less than 10 mi^2 (square miles) had peak runoff rates greater than 1,000 $(ft^3/s)/mi^2$ (cubic feet per second per square mile).

Some severe flooding also resulted from the failure of seven earthfill, gravity-type dams. The most disastrous failure occurred just north of Johnstown on Laurel Run, where about 40 persons are known to have lost their lives. Much destruction was also reported downstream from a breached dam on Sandy Run, several miles east of Johnstown. However, the effects of the dam failures on the peak-flood level in downtown Johnstown were not significant.

Peak stage and discharge data collected at 57 sites are compiled in this report to document the flooding. Flood-crest elevations are also provided for reaches of selected streams.

One of the most notable aspects of the flooding was the great monetary loss incurred over such a small area. Estimates of damage indicate the total physical losses may be in excess of $330 million in a 1,000-$mi^2$ area around Johnstown. The large losses can be attributed mostly to extensive industrial and commercial development on the flood plains.

ACKNOWLEDGMENTS

Meteorological data presented herein are mostly a condensation of an Environmental Research

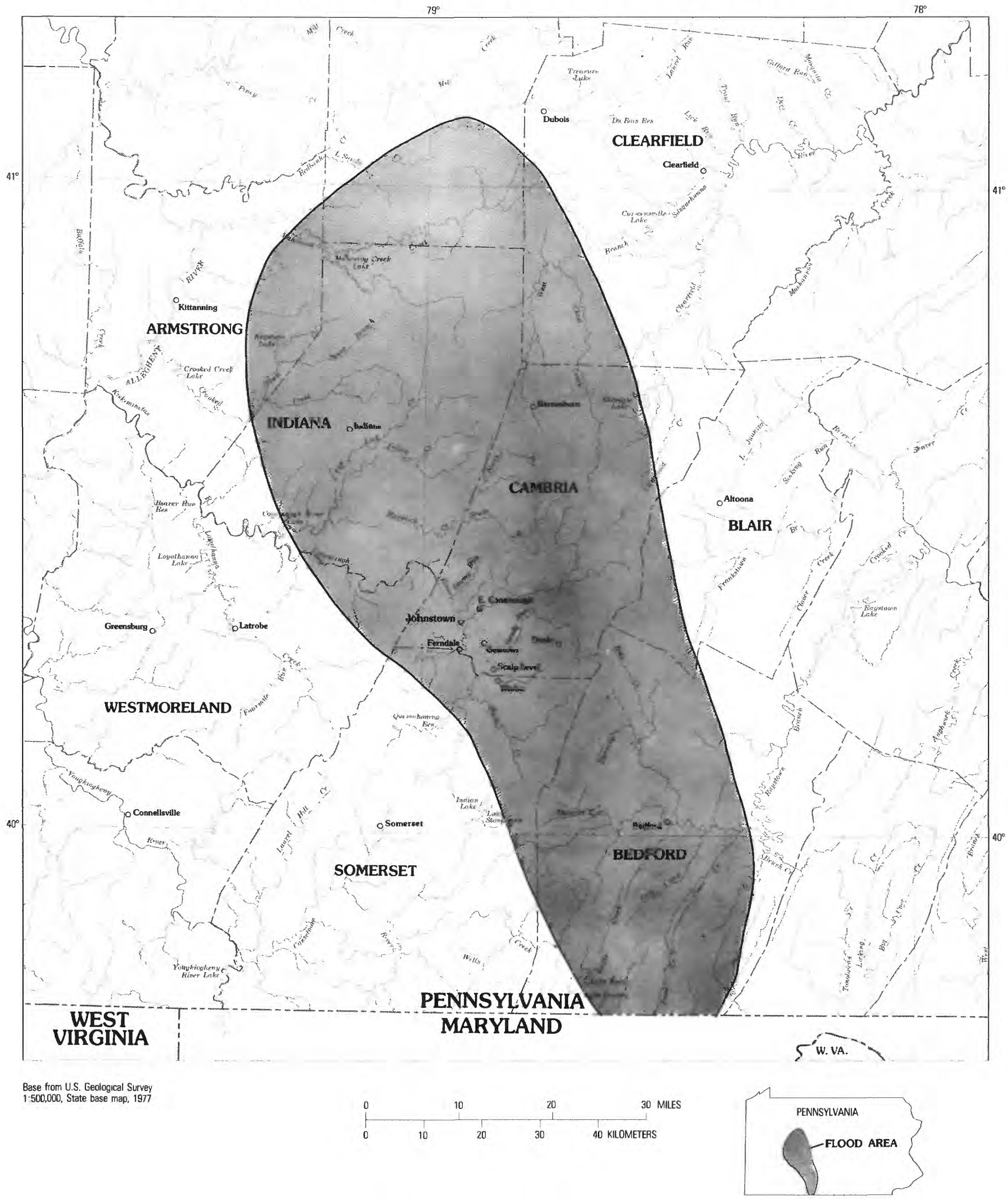


FIGURE 1.–Location of flood area in western Pennsylvania.

Laboratories Technical Report titled "Meteorological Analysis of the Johnstown, Pennsylvania Flash Flood, 19–20 July 1977" (Hoxit and others, 1978). This technical report resulted from a combined effort of the Environmental Research Laboratories (ERL), the National Weather Service (NWS), and the National Environmental Satellite Service (NESS).

Most of the hydrologic data were collected by the U.S. Geological Survey (USGS) as part of cooperative programs with the Pennsylvania Department of Environmental Resources and the U.S. Army Corps of Engineers. Some data collected by the cooperating agencies are also included and noted in the report.

The photographs were furnished by the Johnstown-Tribune Democrat or the Pennsylvania Air National Guard, as noted, or were taken by USGS personnel.

Information on flood damage was furnished by the Greater Johnstown Chamber of Commerce and the Pennsylvania House of Representatives. Casualty figures were provided by the American Red Cross.

CONVERSION FACTORS

The meteorological data in this report are presented using both the inch-pound units and International System (SI) units. Measures are expressed in the type of units most commonly used for the given application. The hydrological data uses inch-pound units entirely. Factors are provided in the following table for converting inch-pound to SI units. Inch-pound units may be converted from SI units by "dividing" the number of SI units by the factor listed in the table:

Multiply inch-pound units	*By*	*To obtain SI units*
	Length	
inch (in.)	25.4	millimeter (mm)
	2.54	centimeter (cm)
foot (ft)	0.3048	meter (m)
mile (mi)	1.609	kilometer (km)
nautical mile (nmi)	1.852	kilometer (km)
	Area	
square mile (mi^2)	2.590	square kilometer (km^2)
acre	4047	square meter (m^2)
	0.4047	square hectometer (hm^2)
	Volume	
cubic foot (ft^3)	28.32	cubic decimeter (dm^3)
	0.02832	cubic meter (m^3)
million gallons (10^6 gal)	3785	cubic meter (m^3)
acre-foot (acre-ft)	1233	cubic meter (m^3)
	Flow	
cubic foot per second (ft^3/s)	28.32	liter per second (l/s)
	28.32	cubic decimeter per second (dm^3/s)
	0.02832	cubic meter per second (m^3/s)
cubic foot per second per square square mile [$(ft^3/s)/mi^2$]	0.01093	cubic meter per second per square kilometer [$(m^3/s)/km^2$]
	Velocity	
foot per second (ft/s)	0.3048	meter per second (m/s)
knot (kn)	1.852	kilometer per hour (km/h)
	Pressure	
millibar (mb)	0.1	kilopascal (kPa)

Temperature data are expressed in degrees Fahrenheit (°F), degrees Celsius (°C), or kelvins (K). Following are several expressions that can be used to convert the data from one of these scales to another:

$$°F = 9/5\ °C + 32.0;\quad °C = 5/9\ (°F - 32.0)\ \text{or}\ °C = K - 273.16$$

Eastern daylight time (EDT) is used throughout this report. Greenwich Meridian Time, commonly used for meterological analyses, may be obtained by adding 4 hours to the times shown.

Elevations used in this report are referred to National Geodetic Vertical Datum (NGVD) of 1929, unless otherwise qualified. At gaging-station sites, elevations of the water surface may be obtained by adding the gage height to the datum of the gage given in table 4.

THE METEOROLOGY

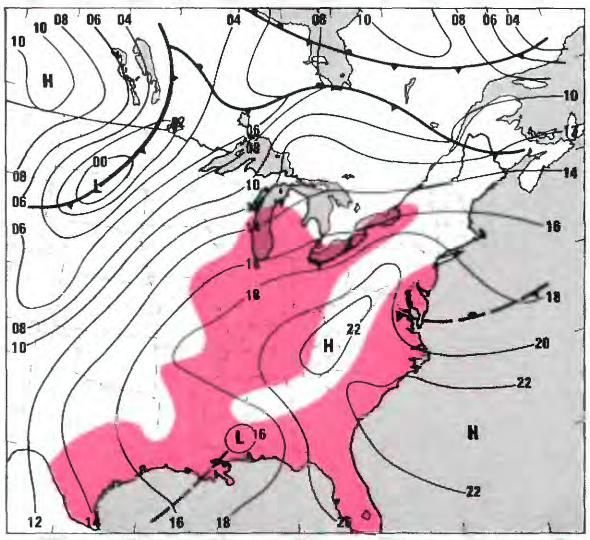
GENERAL METEOROLOGICAL CONDITIONS

The evolution of larger-scale processes beginning at 0800 EDT on July 19 and extending through 0800 EDT on July 20, before and during the intense rainfall over southwest Pennsylvania, is shown in figures 2 and 3. These standard meteorological analyses provide a general setting and background for the detailed mesoscale analyses presented in the next section.

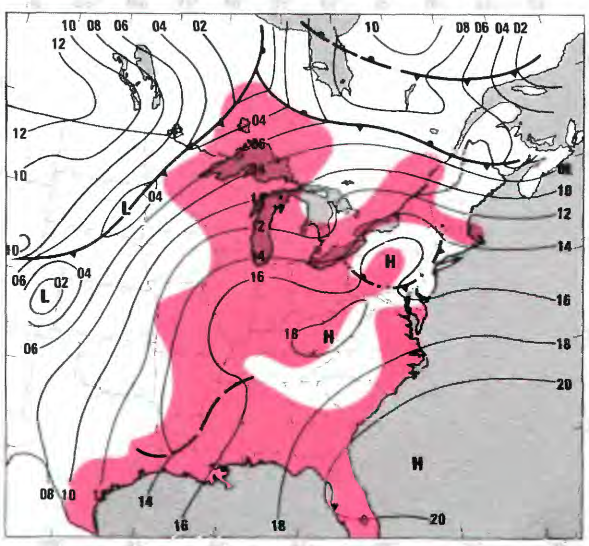
Most of the eastern United States was under general anticyclonic flow around a large subtropical high in the western Atlantic – a fairly typical midsummer pattern. The major storm track was across central Canada, and associated frontal systems lay across east-central Canada southwestward into the northern High Plains of the United States. Early on July 19, a weak surface trough, associated with an upper-level low pressure area, extended northeastward through Louisiana and Mississippi. This low pressure area moved slowly northwestward to the Arkansas region by 0800 EDT on July 20. A small, separate high-pressure area persisted during this period along the western slopes of the Appalachian Mountains in West Virginia and eastern Kentucky. Dewpoint temperatures of 70°F or greater extended northward into the Great Lakes region and into a small part of southeastern Canada. Low-level moisture flux into the Pennsylvania region was from the southwest.

Major thunderstorm outflow boundaries were generated in the Lake Erie region and moved southeastward across the mid-Atlantic States. A mesoscale high pressure system ("bubble high") was evident at both 2000 EDT on July 19 and 0800 EDT on July 20.

The flow pattern in the middle troposphere (500 mb) was again fairly typical for midsummer (fig. 3*A–C*). At 0800 EDT on July 19, a broad, large-scale ridge existed over the central and eastern United States. A weak



A 0800 EDT, JULY 19, 1977



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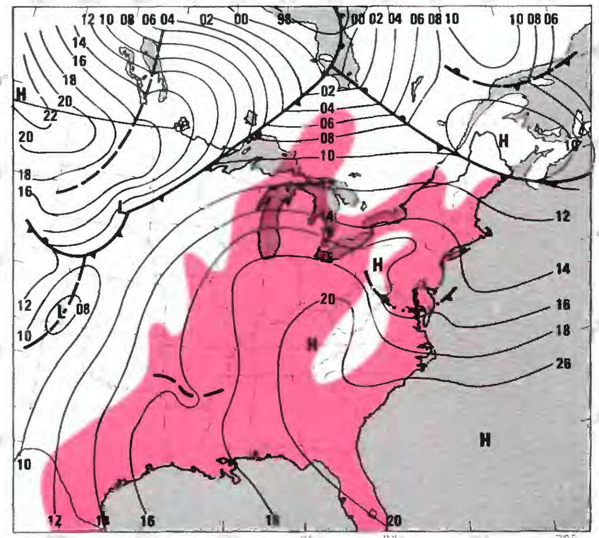


C 0800 EDT, JULY 20, 1977

EXPLANATION

Area where dewpoint temperatures exceed 70 degrees Fahrenheit

—16— Line of equal atmospheric pressure at sea level. −16=1016 millibars. Interval 2 millibars

Trough line

Cold Front-dashed where dissipating

Warm Front-dashed where dissipating

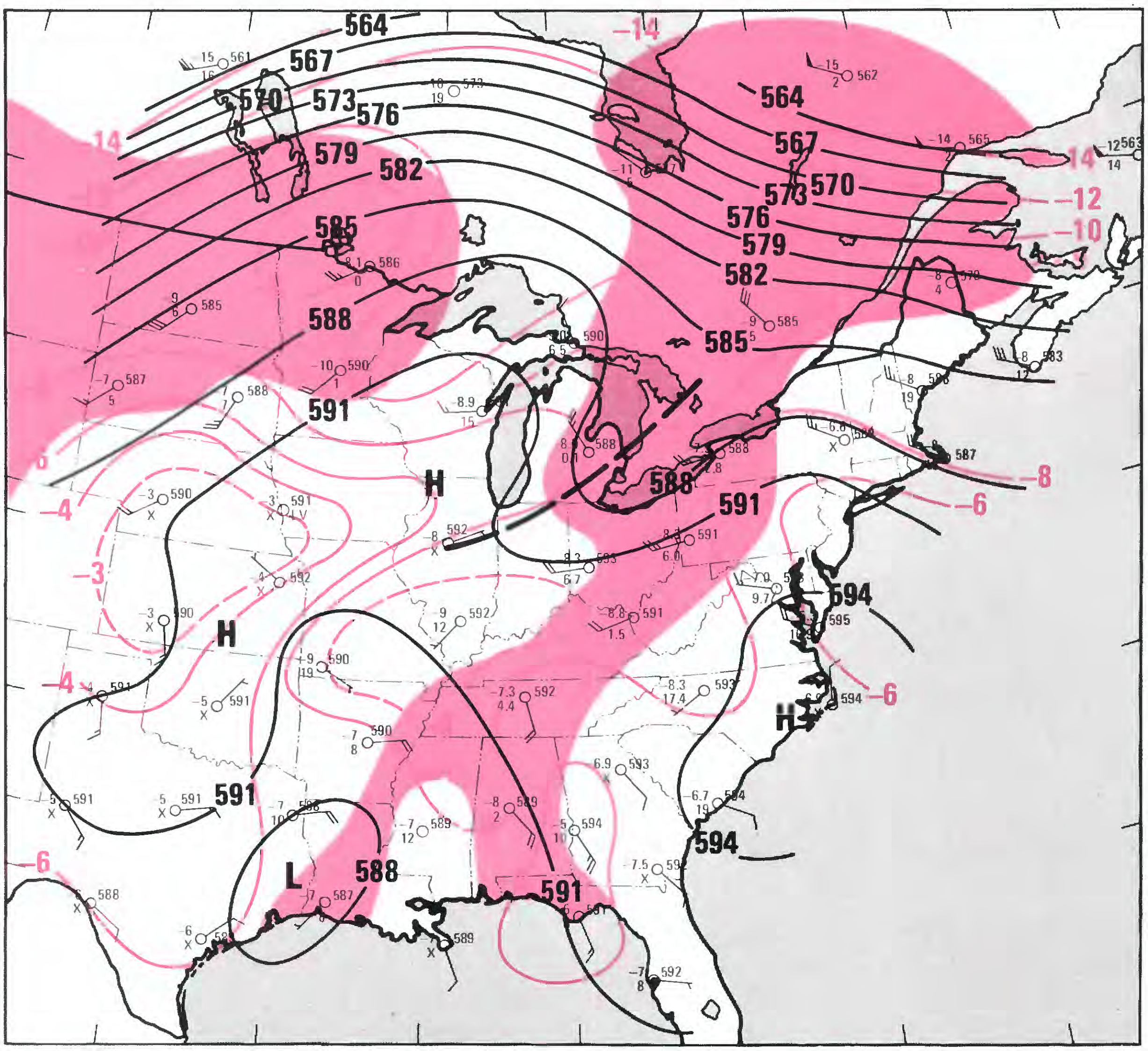
Stationary Front-dashed where dissipating

H Geographic center of high-Pressure System

L Geographic center of low-pressure system

Thunderstorm outflow boundary. Frontal symbols indicate whether cool thunderstorm air or warmer environmental air is advancing

FIGURE 2.—Surface analyses at indicated times. *A*, 0800 EDT, July 19, 1977. *B*, 2000 EDT, July 19, 1977. *C*,0800 EDT, July 20, 1977. Frontal positions, outflow boundaries, pressure centers, and isobars for 2-mb intervals (numbers represent the last two digits of pressure in millibars, 16 = 1,016 mb) are shown in black. Frontal symbols are added to conventional squall line notations to indicate whether cool thunderstorm, outflow, or warmer environmental air is advancing. Regions having dew points ≥ 70° are shaded in red.

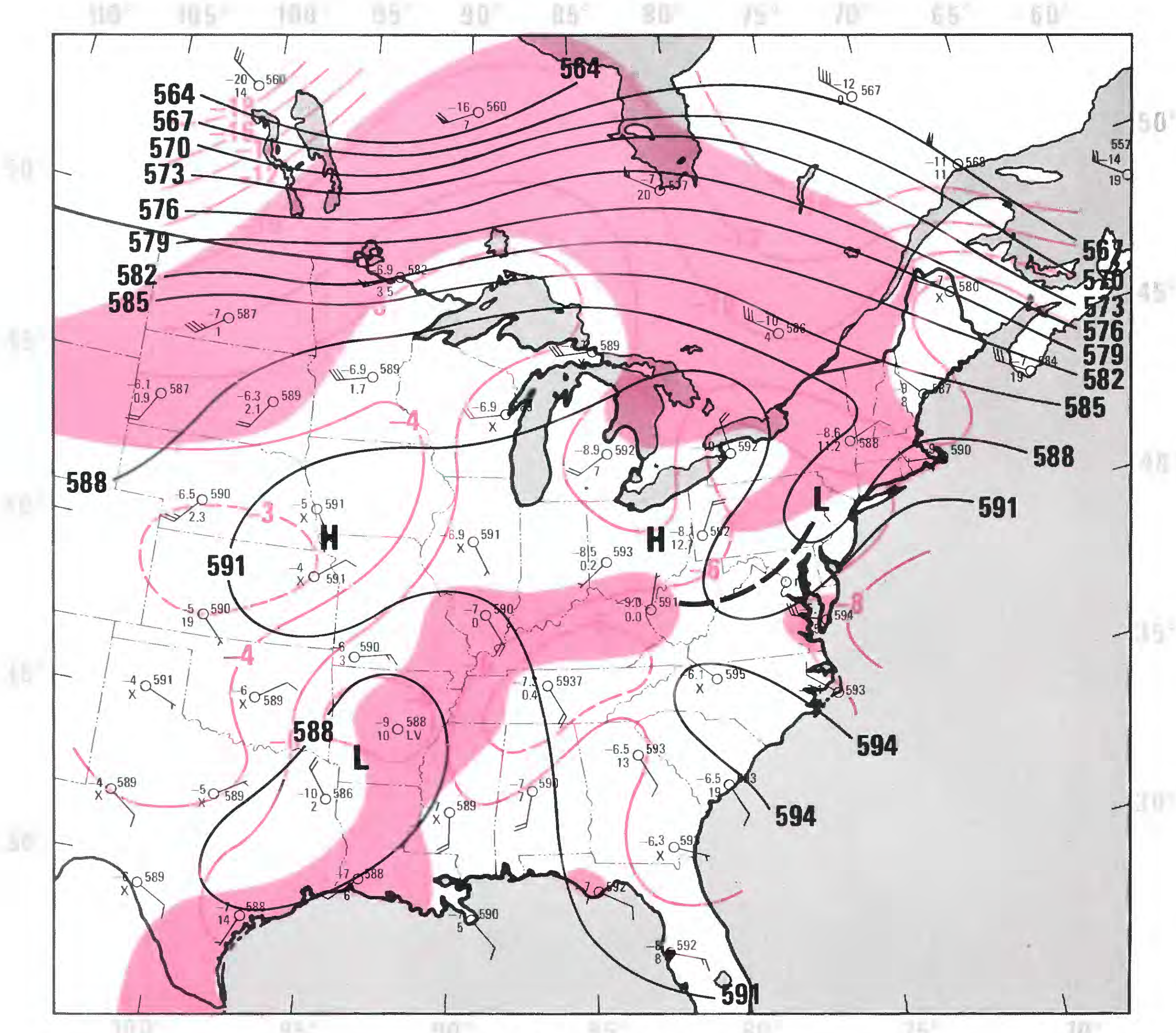


A 0800 EDT, JULY 19, 1977

FIGURE 3.–Five-hundred-millibar analyses at indicated times. *A*, 0800 EDT, July 19, 1977. *B*, 2000 EDT, July 19, 1977. *C*, 0800 EDT, July 20, 1977. (Figure 3*A* is shown above. Figures 3*B*, 3*C*, 3*D* are on following pages.)

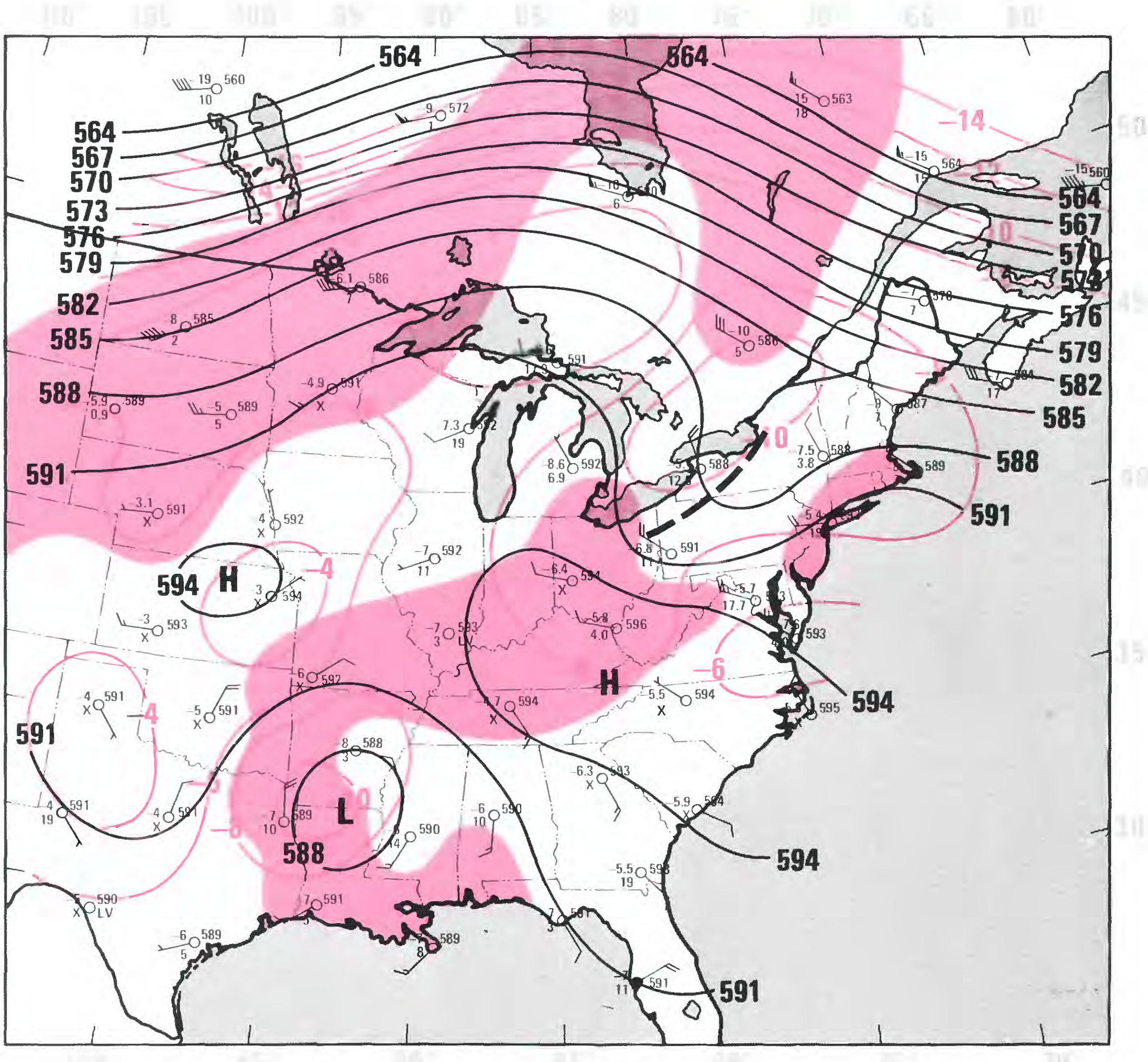
closed low pressure area over the southern Mississippi Valley and a short-wave trough (meso-α scale) over the eastern Greak Lakes region constituted small pertubations in this mean pattern. A moderately strong westerly current extended across southern Canada.

The short-wave over the Lake Huron and Lake Erie region at 0800 EDT on July 19 played a key role in the formation of the flash-flood-producing thunderstorms. This system moved east-southeast at 15–20 knots across Pennsylvania during the next 24 hours. The wave axis remained tilted (from northeast to southwest) throughout this period. Strong, warm advection in the lower troposphere was indicated to the west and northwest of the short-wave trough. As warmer air moved under the relatively cool air aloft, the atmosphere became more unstable. This flow regime was somewhat uncharacteristic, as low-level warm advection typically occurs in advance (east) of short-wave troughs embedded in



B 2000 EDT, JULY 19, 1977

FIGURE 3.—Continued.



C 0800 EDT, JULY 20, 1977

EXPLANATION

Area where dewpoint temperature was within 6-degrees Celsius of air temperature

—582— Contour showing altitude of 500-millibar surface. 582 = 5820 meters. Contour interval 30 meters. Datum is mean sea level

—-10— Line of equal air temperature. Interval 2 degrees Celsius

— — — Axis of Pressure Trough

H Geographic enter of highest altitude of 500-millibar surface

L Geographic center of lowest altitude of 500-millibar surface

-8.3 591 6.0 OBSERVATION STATION.—Upper left number is air temperature, in degrees Celsius. Lower left number is depression of dewpoint temperature, in degrees Celsius; X shown when depression greater than 30 degrees Celsius. Upper right number is altitude of 500-millibar surface, in meters; 581 = 5810 meters. Shaft indicates wind direction. Barbs on shaft indicate wind speed, in knots. Long barb = 10 knots; short barb = 5 knots; Flag = 50 knots; M indicates missing data

FIGURE 3.—Continued.

westerly flow. At the same time, the upward vertical motion in advance of the trough axis acted to destabilize the atmosphere further and to trigger widespread convection during the afternoon and evening of July 19.

Analyses of stability indices computed from standard rawinsonde data (fig. 4) shows the development of a very unstable air mass ahead of the advancing shortwave trough. By 2000 EDT on July 19, the air mass over eastern Pennsylvania was characterized by Lifted Index values of -4 or less and K Index values of ≥ 36. These values are comparable with those associated with outbreaks of severe thunderstorms.

Precipitable water in the surface to 500-mb layer was substantially greater than climatological mean values along and ahead of the upper-level trough axis (fig. 5). High precipitable-water values propogated southeastward and increased in areal coverage during July 19. Values greater than 4.4 cm were found over a wide area extending from northeastern Kentucky through much of New York by 2000 EDT on July 19. The 4.6 cm measured at Pittsburgh at 2000 EDT was approximately 172 percent of the July average documented by Lott (1976).

Data from three upper air soundings taken at Pittsburgh during this 24-hour period are shown in figure 6. Note that the winds shifted in the 850–400-mb layer from west-southwest to northwest and north as the short-wave trough passed. Abundant moisture up to almost 500 mb was evident in the 2000 EDT sounding (fig. 6B). The surface inversion evident in the temperature and moisture profiles at 2000 EDT resulted from earlier thunderstorms and was topped by strong, westerly winds immediately above. Strongest winds were in the 700–950-mb layer, and weak wind shear was present from the top of the inversion to nearly 300 mb.

Profiles of equivalent potential temperature at Pittsburgh (fig. 7) further show the unstable environment over western Pennsylvania. Equivalent potential temperatures of more than 360 K are characteristic of tropical boundary layer. The 2000 EDT sounding indicated a value of 362 K at the top of the surface inversion.

A conditionally unstable atmosphere, uncommonly high moisture content, and the slow moving short-wave trough all contributed to thunderstorm development over a rather large area on the afternoon and evening of July 19, 1977. This area included most of Pennsylvania and parts of several surrounding States. However, the atmospheric structure over this region differed in the following ways from that generally associated with a major tornado outbreak: (1) Moisture content was relatively high up to nearly 500 mb, which contrasts with the strong inversion and dry air above, often observed between 700 and 850 mb in the pre-tornado environment, and (2) wind shear was small in the convective cloud layer (from cloud base to nearly 300 mb). The precipitation efficiency of convective clouds in this environment is greater than for clouds embedded in the highly sheared environment commonly associated with tornadoes, strong surface winds, and large hail (Mauritz, 1972); that is, a greater percentage of the water vapor condensed in the updrafts eventually reaches the ground as precipitation.

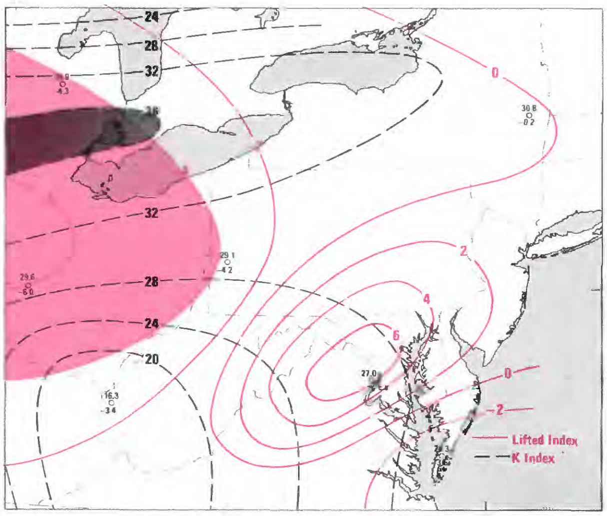
However, two important questions cannot be answered by the synoptic scale analyses just presented: (1) Why did the convective processes focus on a relatively small area around Johnstown, and (2) What distinguished this region from the surrounding region, which apparently had the same general potential for heavy thunderstorms? The answers to these questions may lie in the evolution of mesoscale weather processes preceding and during the storm.

MESOSCALE ANALYSIS

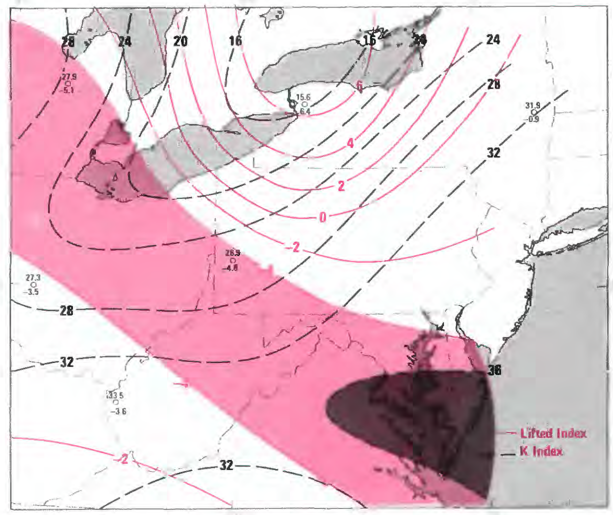
Surface and radar charts at 2-hour intervals for the period 1400 EDT, July 19, to 0400 EDT, July 20, are shown in figure 8. Analyses of the pressure fields (altimeter settings) and the major thunderstorm outflow boundaries were based on surface observations (both hourly and special), radar data, and satellite photographs. Small systematic errors in the altimeter settings were suspected at several stations (for example, Bradford, Pa., and Binghamton, N.Y.). However, no corrections were made, so that analyses would be based as closely as possible on information available under operational conditions.

Radar analyses are composites prepared from radarscope photographs taken at National Weather Service WSR-57 radar sites at Pittsburgh, Pa., Buffalo, N.Y., New York City, N.Y., Atlantic City, N.J., and Patuxent, Md. A small region of central Pennsylvania and southern New York was not covered by any of the 125-nmi-range scopes.

Geostationary Operational Environmental Satellite (GOES) imagery for the same general time period is shown in figure 9. Routine maintenance procedures were underway during the period 0030 to 0330 EDT on July 20, and satellite imagery was not available. Visible imagery is shown through 1800 EDT, July 19; the



A 0800 EDT, JULY 19, 1977



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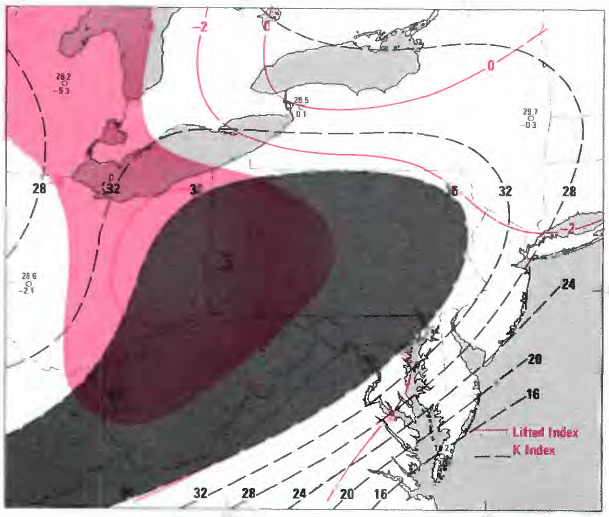
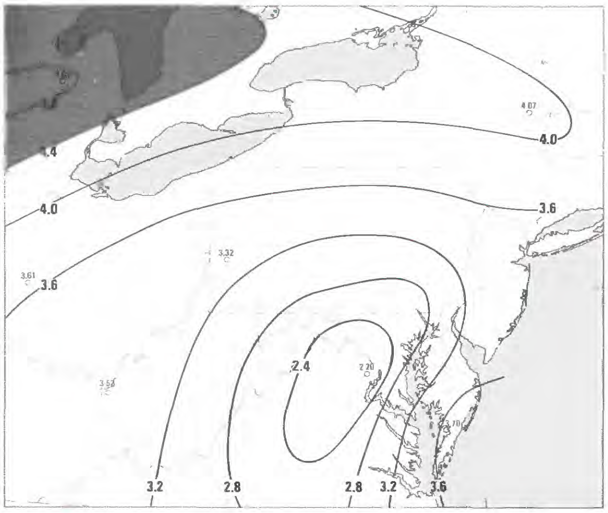


B 2000 EDT, JULY 19, 1977

FIGURE 4.—Stability indices at indicated times. Regions having K-Index values ≥ 36 are shaded. *A*, 0800 EDT, July 19, 1977. *B*, 2000 EDT, July 19, 1977. *C*, 0800 EDT, July 20, 1977.



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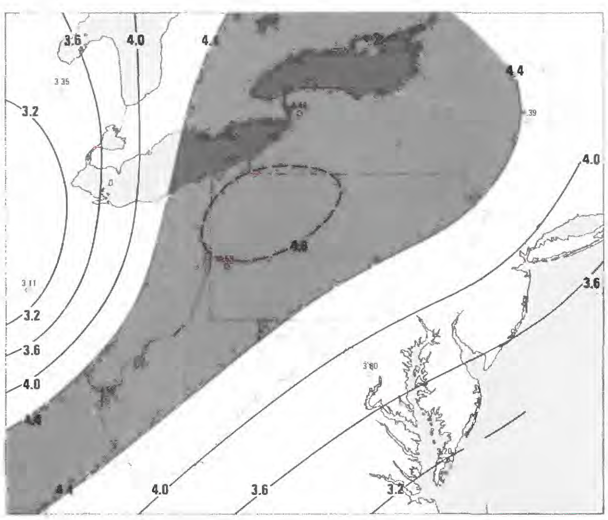

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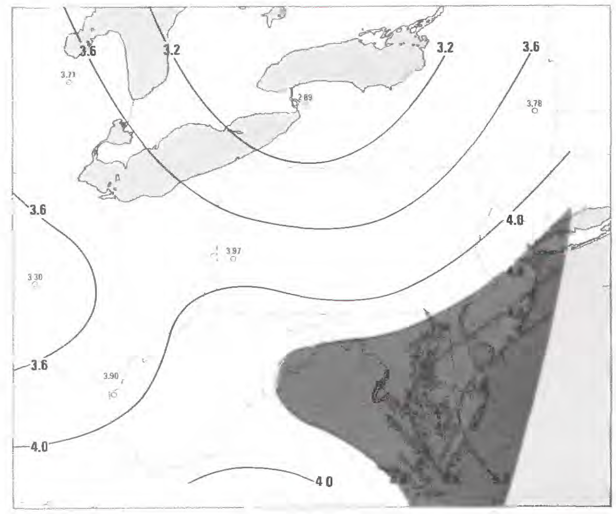
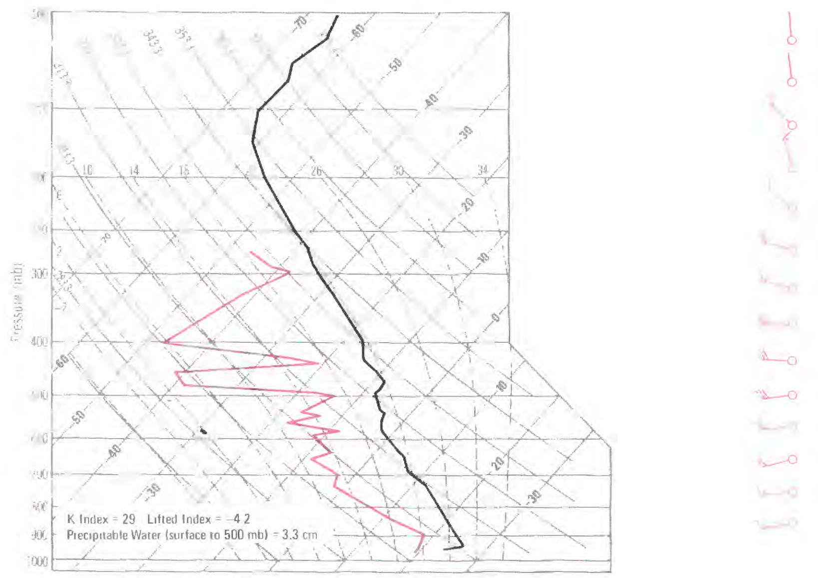


C 0800 EDT, JULY 20, 1977

FIGURE 5.–Precipitable water analyses (surface to 500 mb) in centimeters for indicated times. Regions having more than 4.4 cm are shaded. *A*, 0800 EDT, July 19, 1977. *B*, 2000 EDT, July 19, 1977. *C*, 0800 EDT, July 20, 1977.



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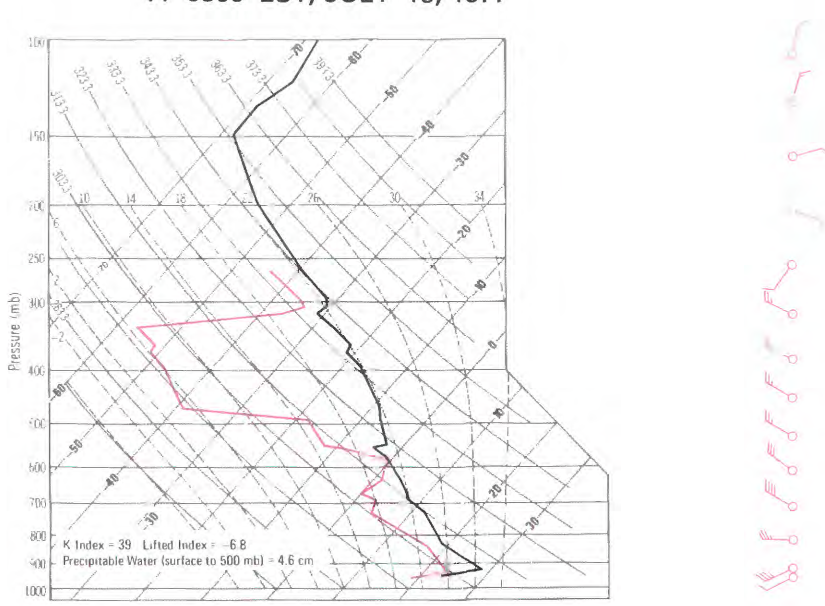
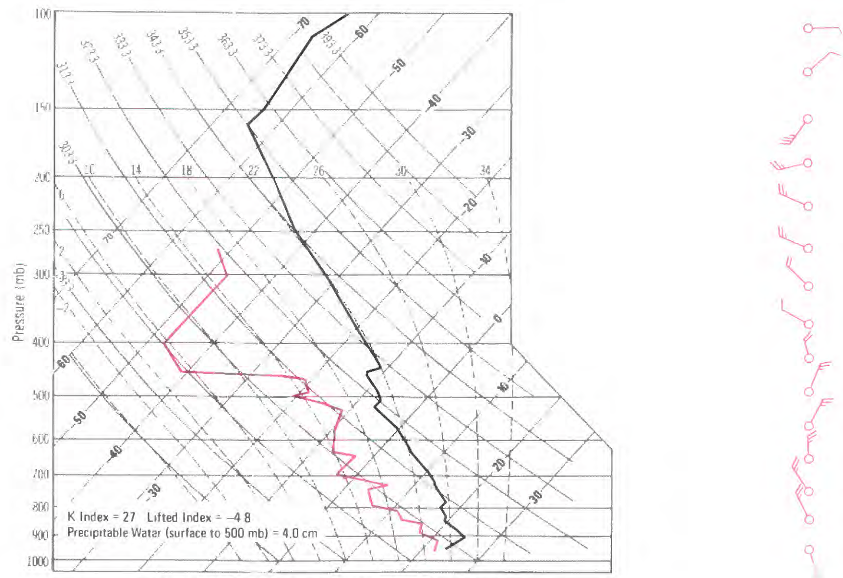


B 2000 EST, JULY 19, 1977

EXPLANATION

(red line)	Dewpoint temperature (left profile)
(black line)	Air temperature (right profile)
——10 ——	Moist-adiabat scale, in degrees Celsius
—303.3—	Dry-adiabat scale, in degrees Kelvin
——0——	Air temperature scale, in degrees Celsius
	Wind—Direction and speed observation. Shaft indicates wind direction; north is at top. Barbs on shaft indicate wind speed, in knots; long barb=10 knots; short barb=5 knots

FIGURE 6.—Plots of Pittsburgh rawinsonde data at indicated times. *A*, 0800 EDT, July 1977. *B*, 2000 EDT, July 19, 1977. *C*, 0800 EDT, July 20, 1977. Temperature profile in degrees Celsius is shown by solid lines. Red lines show plotted wind and dew point temperatures.



C 0800 EST, JULY 20, 1977

FIGURE 6.–Continued.

remainder of the satellite data are enhanced infrared imagery.

By early afternoon (1400 EDT, July 19), convective activity was already organized and widespread over northwestern Pennsylvania and southern New York (figs. 8*A* and 9*A*). Thunderstorms along the southern shore of Lake Erie in the morning (fig. 2*A*) had spread east-southeastward and expanded into a squall line extending from just north of Johnstown into south-central New York. In Johnstown, however, only a few hundreths of an inch of precipitation was recorded as this line moved through the area.

The cool outflow attending the first squall line extended in two arcs from near Lake Ontario southwestward to a meso-low pressure center over north-central Pennsylvania, then southwestward to near Johnstown before curving northwestward to near Youngstown, Ohio. An elongated meso-high, or "bubble"-high, pressure area was north of the outflow boundary, while an area of light precipitation was forming in extreme northwestern Pennsylvania, southwestern New York, and northeastern Ohio.

During the afternoon, this first line of convective storms and their associated cool outflow boundary continued to move eastward at 30–40 kn (fig. 10*A*). By 2000 EDT, the leading edge of cooler air extended from southwestern Vermont through extreme southeastern New York to the eastern Pennsylvania border. The southwestern part of the outflow boundary moved back toward the northeast and assumed the characteristic of a shallow mesoscale warm front.

At about 1600 EDT, an isolated thunderstorm formed just west of Pittsburgh. This storm moved southeastward at about 50 kn, affecting the Pittsburgh region from 1700 to 1800 EDT and dropping about half an inch of precipitation on Johnstown between 1800 and 1900 EDT. At 2000 EDT, the small meso-high produced by this storm had reached the area near Johnstown, and the storm was dissipating.

Meanwhile, clouds and precipitation over northwestern Pennsylvania had moved slowly southeastward and organized into a second major squall line. Several strong cells were indicated by Pittsburgh radar (fig. 8*C*, *D*), and the late afternoon satellite imagery indicated several overshooting tops embedded in the line (fig. 9C). By 2000 EDT, this activity had progressed into the northern parts of the Conemaugh River basin.

The behavior of the second squall line differed from the first in several ways. It propagated toward the southeast (instead of east) and at a slower speed than the first line. More importantly, the western section of the outflow boundary was nearly stationary along the Ohio-Pennsylvania border. The quasi-stationary character of this outflow boundary northeast of Pittsburgh continued during the remaining hourly analyses (figs. 8E-H).

By 2200 EDT, the first series of intense thunderstorms had moved across the Johnstown region (fig. 8E). A well-defined meso-high attending these storms was located slightly northwest of Johnstown, while the associated outflow boundary (second of the series) was oriented along the southern Pennsylvania border, northwestward to just east of Pittsburgh and Youngstown, Ohio. This boundary, produced by the cool downdrafts from the thunderstorms, remained quasi-stationary and nearly perpendicular to the low-level flow of moist air

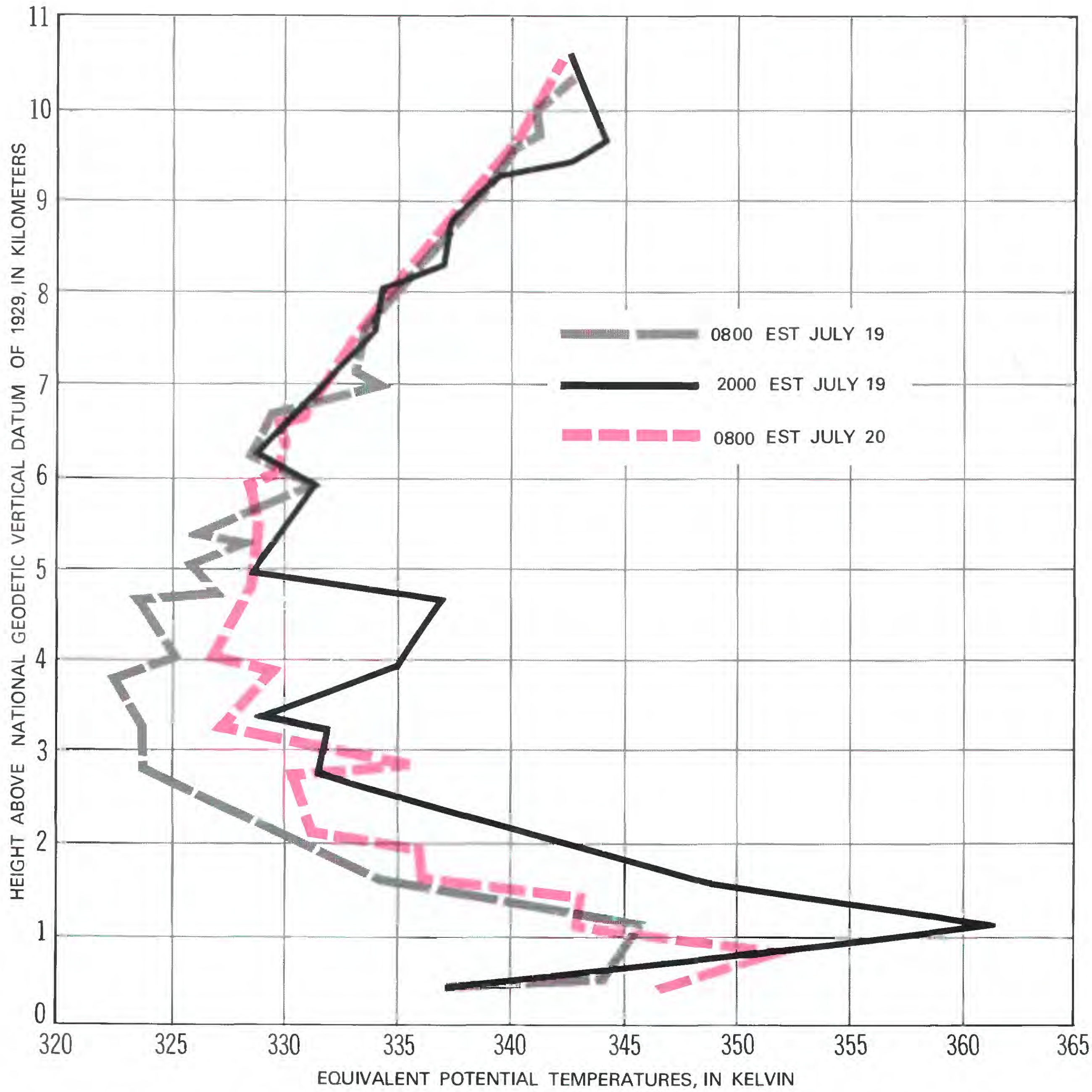


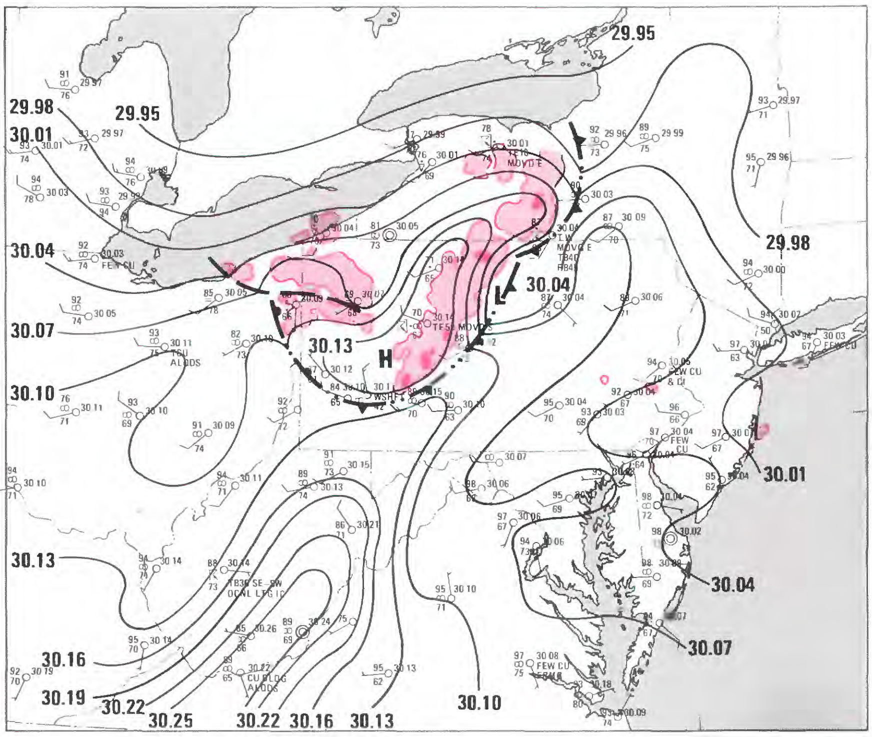
FIGURE 7.–Vertical profiles of equivalent potential temperatures in Kelvin, derived from the Pittsburgh rawinsonde data.

streaming into western Pennsylvania from Ohio. By 0000 EDT, July 20, a mesoscale "wake" low had formed in east-central Pennsylvania (fig. 8*F*).

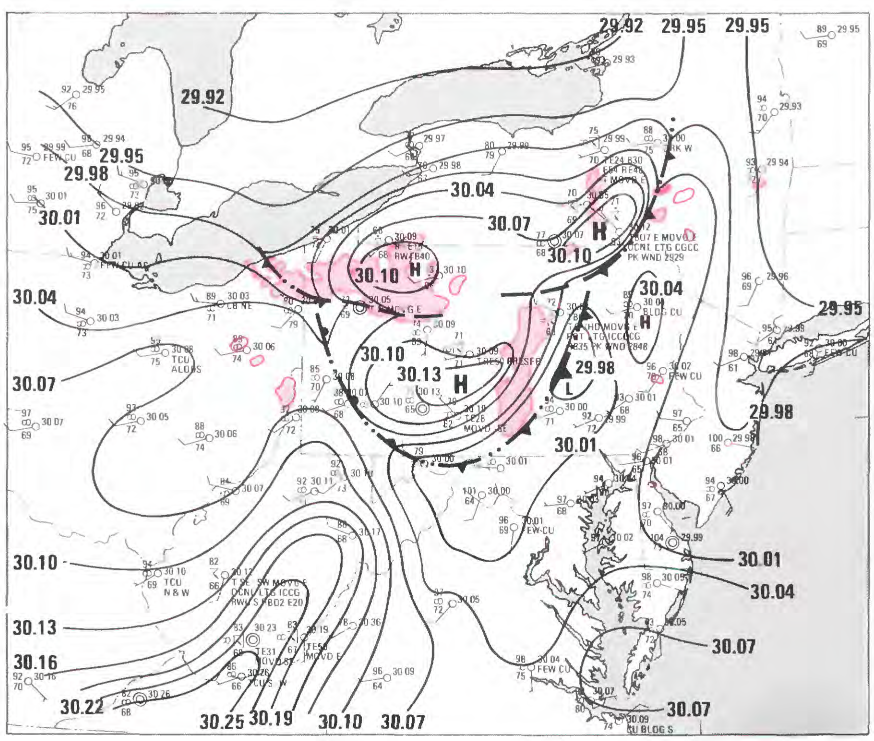
The two-hourly analyses and satellite photos, along with the summary analyses presented in figure 10B, illustrates the quasi-stationary and concentrated nature of the Johnstown flood-producing storms. As the warm, unstable air from the west was lifted over the cool outflow boundary, new thunderstorms were triggered. Once these storms formed, they moved with the mean midtropospheric flow southeastward over the Conemaugh River basin.

Maddox and others (1979) and Mogil and Groper (1976) have found that quasi-stationary thunderstorm outflow boundaries contribute to many flash floods. These boundaries, as in the Johnstown instance, focus the thunderstorm development and resulting heavy rains over relatively small regions. The part of these boundaries most likely to become stationary is that part parallel to the midtropospheric winds.

(Text continued on page 21.)



A 1400 EDT, JULY 19, 1977



B 1600 EDT, JULY 19, 1977

EXPLANATION

Area covered by radar echoes. Light shading = video intergrator processor (VIP) Level 1 or greater; dark shading = VIP Level 3 or greater

—30.10— Line of equal altimeter setting, in inches of mercury, interval 0.03 inch

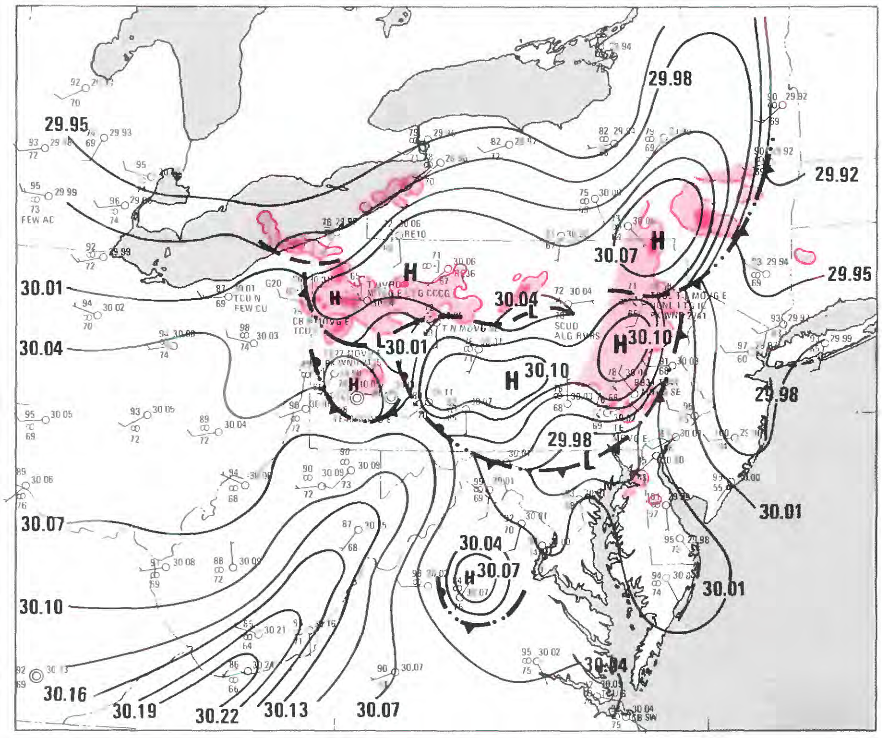
Thunderstorm outflow boundary. Frontal symbols indicate direction the boundary is moving

H Geographic center of high-pressure system

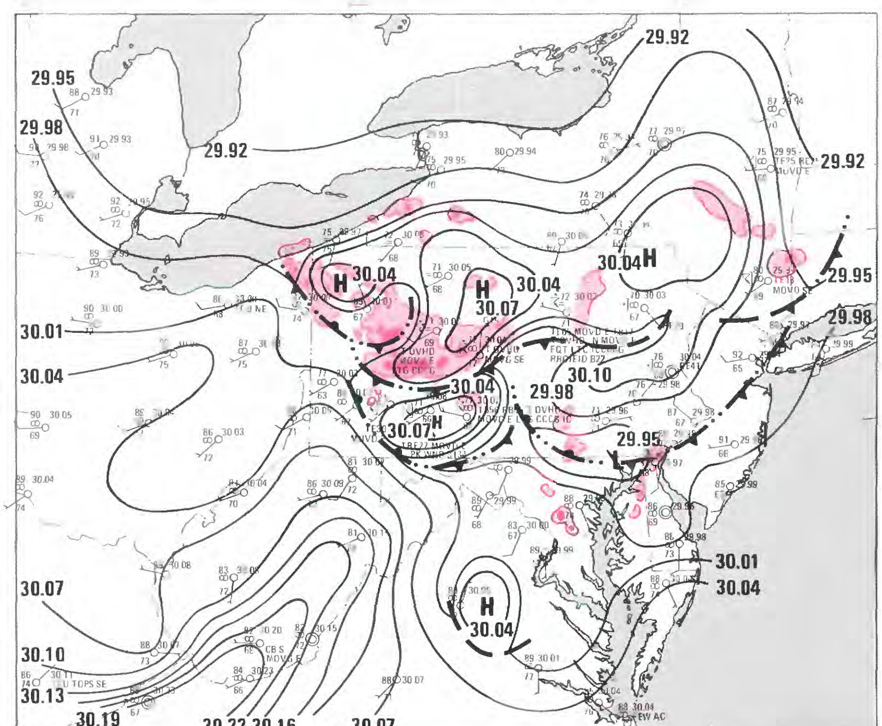
L Geographic center of low-pressure system

88 30.05 72 TE — Observing station upper left number is air temperature in degrees Fahrenheit. Lower left number is dewpoint temperature in degrees Fahrenheit. Upper right number is altimeter setting in inches of mercury. Middle left symbols indicate current weather conditions using standard meteorological surface weather code. Lower right often contains additional abbreviated comments about current weather

FIGURE 8.–Regional mesoscale analyses for indicated times. *A*, 1400 EDT, July 19, 1977. *B*, 1600 EDT, July 19, 1977. *C*, 1800 EDT, July 19, 1977. *D*, 2000 EDT, July 19, 1977. *E*, 2200 EDT, July 19, 1977. *F*, 0000 EDT, July 20, 1977. *G*, 0200 EDT, July 20, 1977. *H*, 0400 EDT, July 20, 1977. Outflow boundaries, pressure centers, pressure troughs, and pressure analysis (altimeter settings in intervals of 0.03 in.) are in black. Areas of shading indicate area covered by radio echoes (light shading, VIP level 1 or greater, and dark shadings, VIP level 3 or greater).

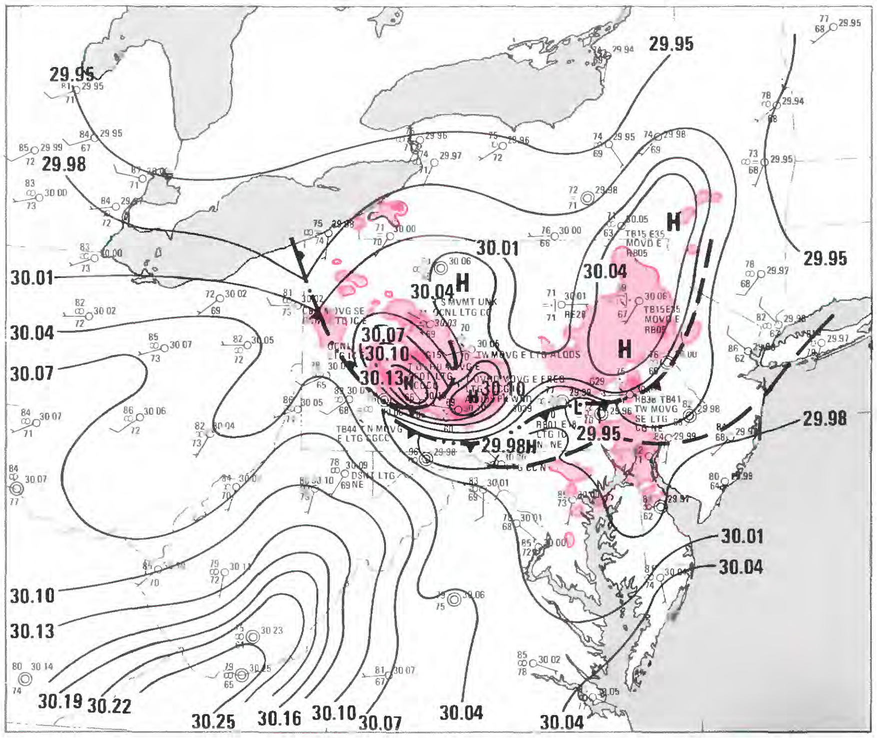


C 1800 EDT, JULY 19, 1977

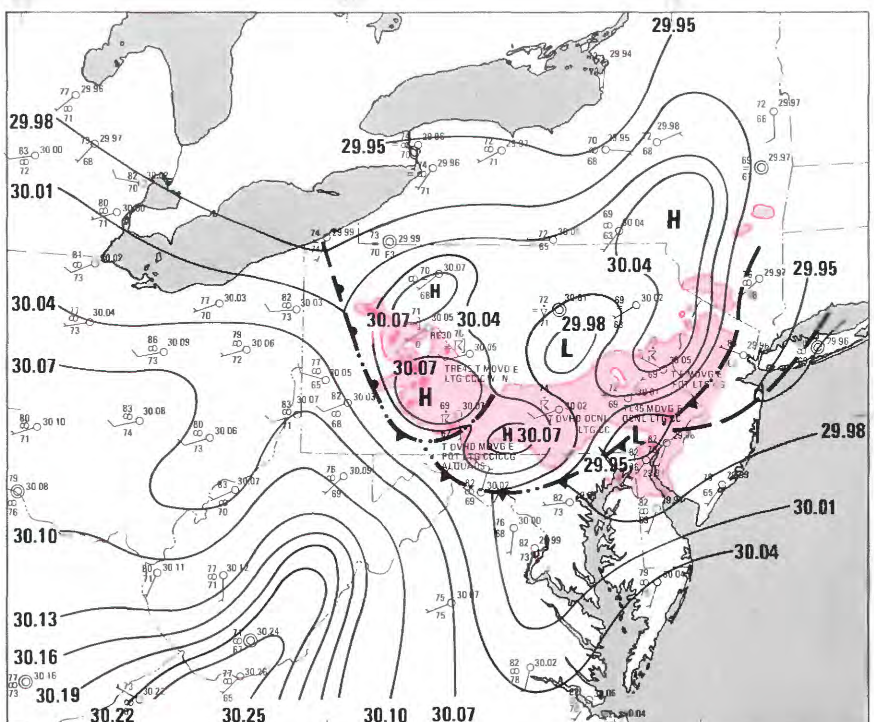


D 2000 EDT, JULY 19, 1977

FIGURE 8. – Continued.

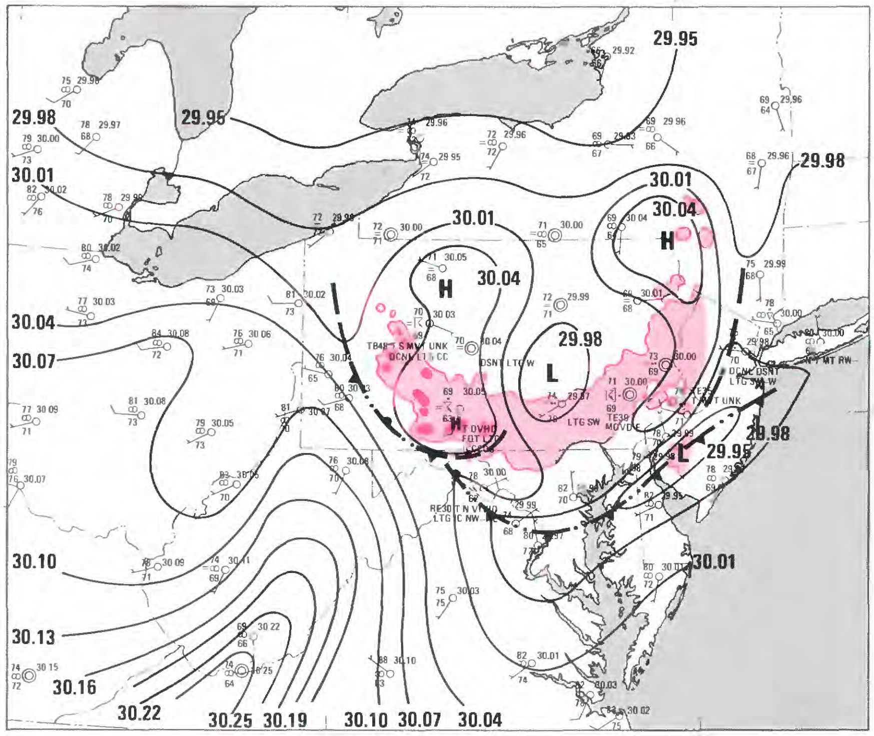


E 2200 EDT, JULY 19, 1977

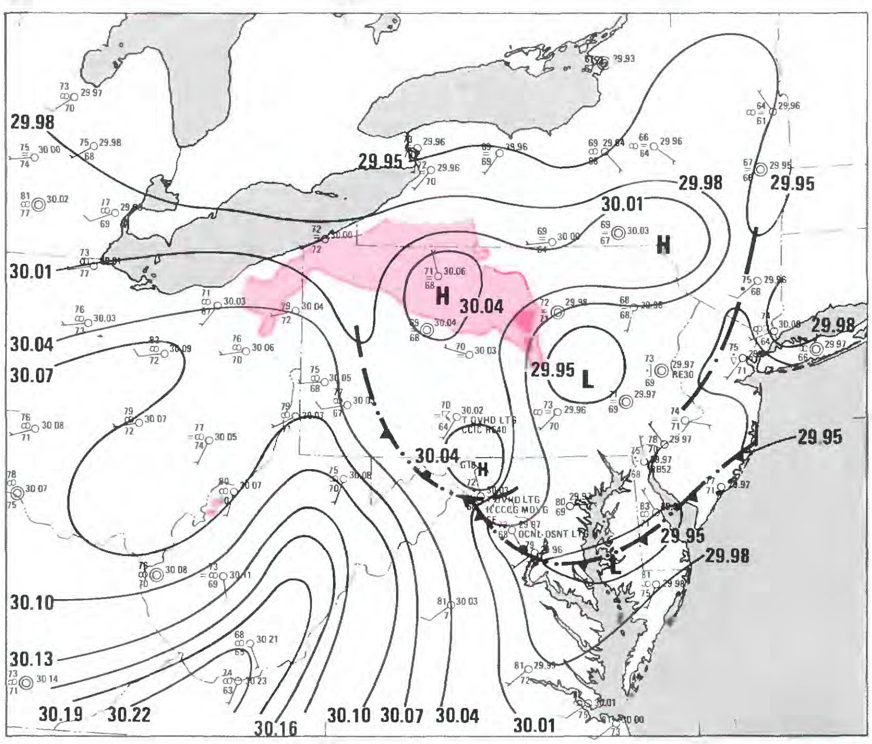


F 0000 EDT, JULY 20, 1977

FIGURE 8. – Continued.



G 0200 EDT, JULY 20, 1977



H 0400 EDT, JULY 20, 1977

FIGURE 8. – Continued.

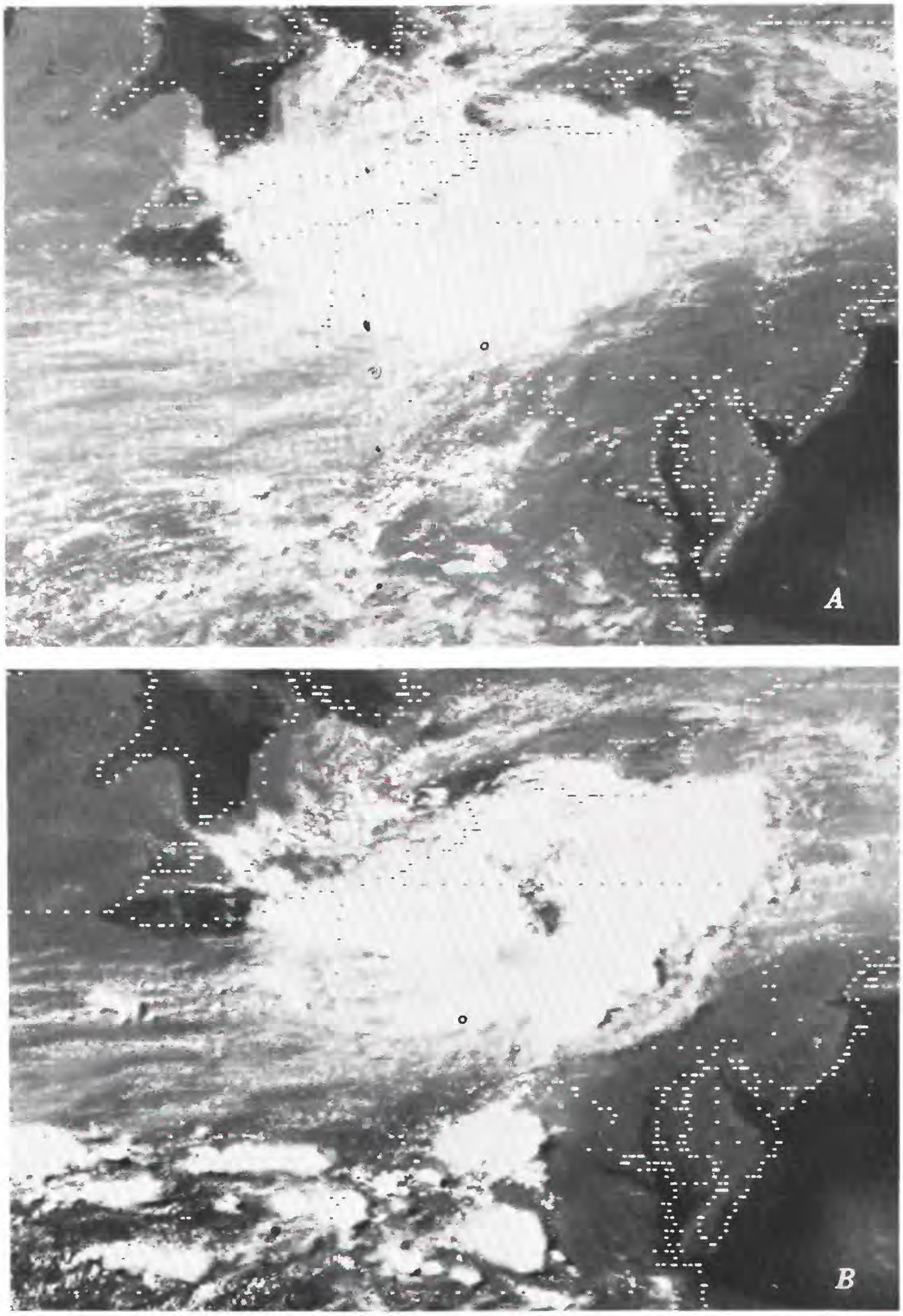


FIGURE 9.–Geostationary Operational Environmental Satellite (GOES) photographs for indicated times. Visible imagery 1400–1800 EDT, July 19 (1-km resolution at satellite subpoint). Enhanced infrared imagery 2000 EDT July 19 to 0400 EDT July 20 (2-km equivalent resolution at satellite subpoint). *A*, 1400 EDT, July 19, 1977. *B*, 1600 EDT, July 19, 1977. *C*, 1800 EDT, July 19, 1977. *D*, 2000 EDT, July 19, 1977. *E*, 2200 EDT, July 19, 1977. *F*, 0000 EDT, July 20, 1977. *G*, 0400 EDT, July 20, 1977.

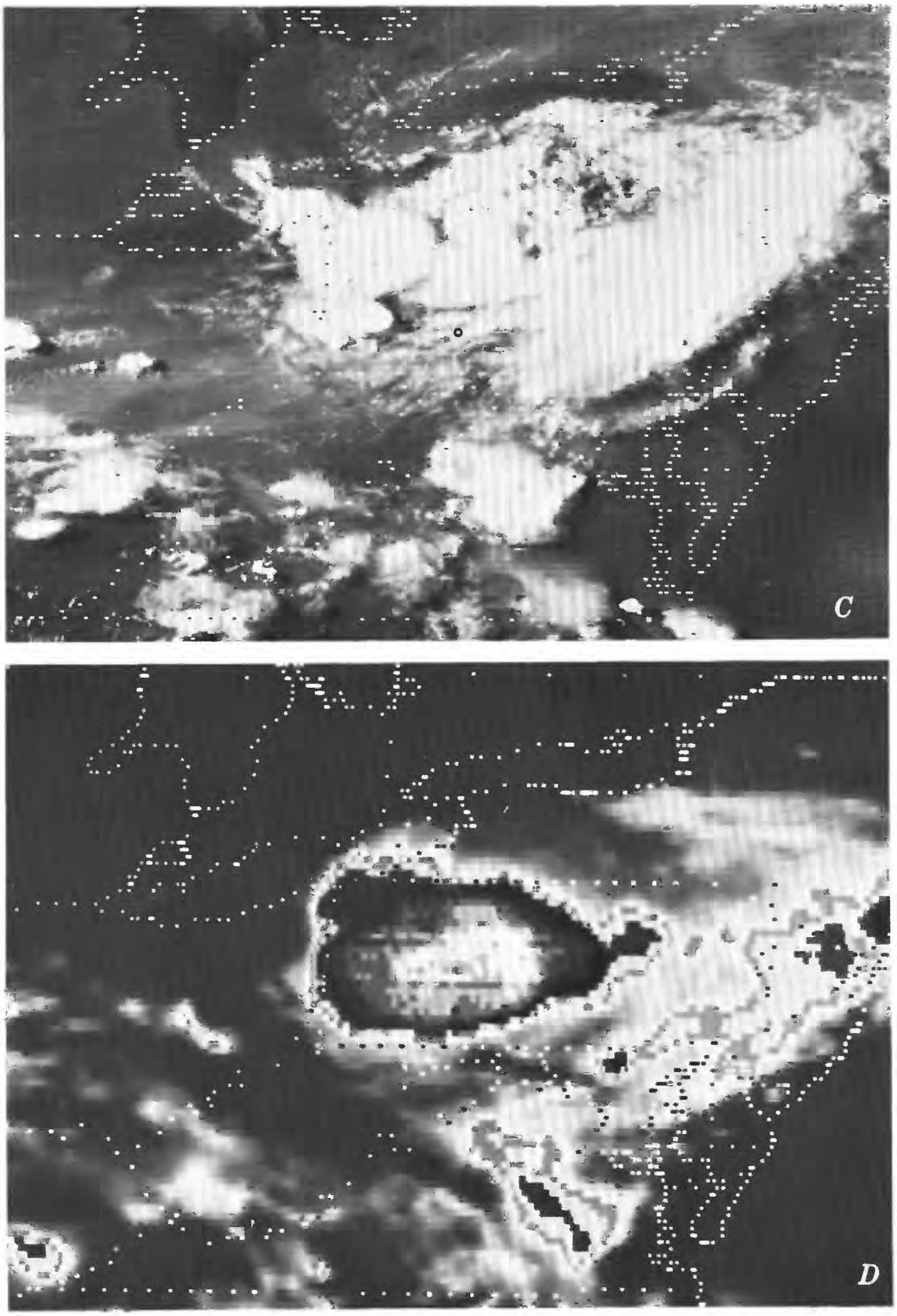
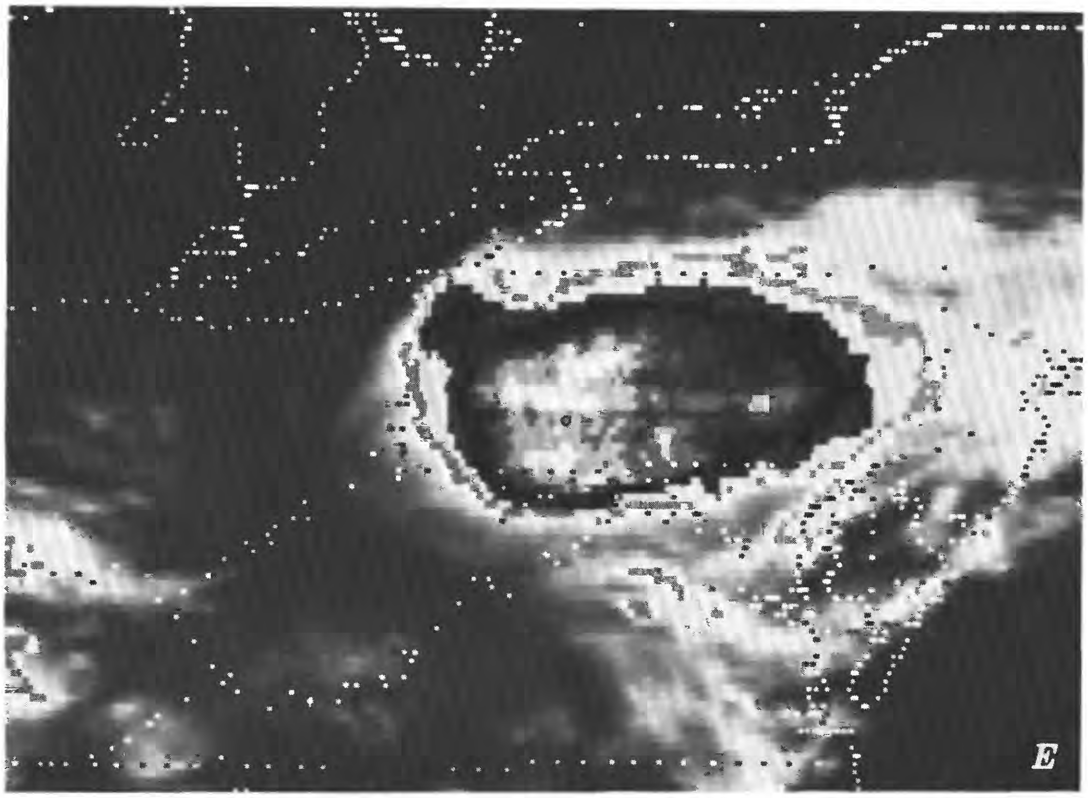


FIGURE 9. – Continued.



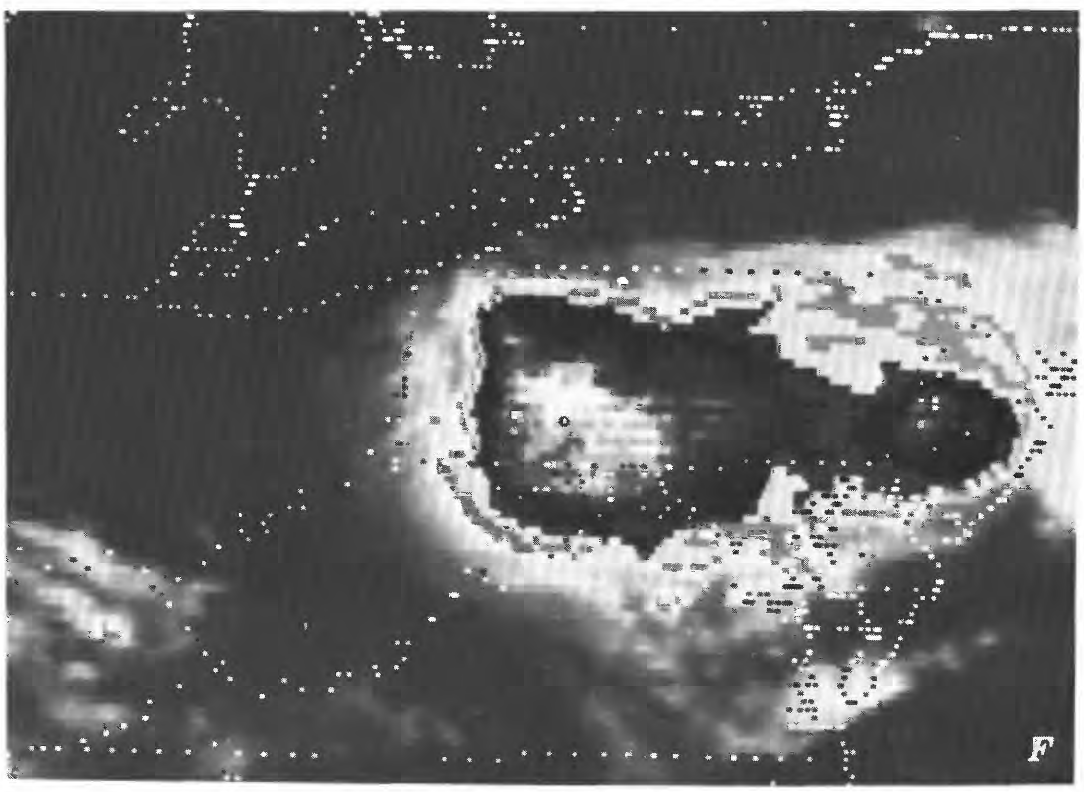


FIGURE 9.—Continued.

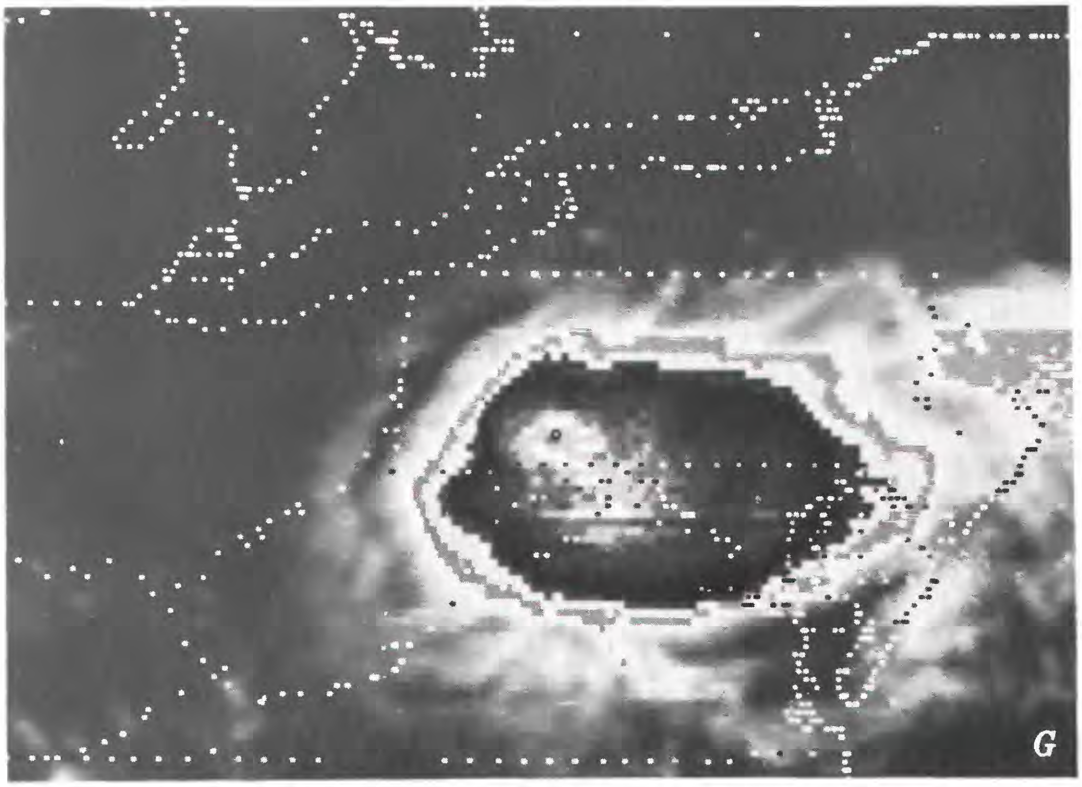


FIGURE 9.—Continued.

The thunderstorm cells moved roughly parallel to the outflow boundary and nearly perpendicular to the western slopes of the Allegheny Mountains. Orographic lift probably enhanced storm intensities and helped concentrate the heavy rain in the hills north and east of Johnstown. However, orography was probably not as important in triggering these thunderstorms as it was in causing the Big Thompson and Rapid City floods (Maddox and others, 1978).

Radar indicated that 12 separate thunderstorm cells moved over the Johnstown area between 2000 EDT, July 19, and 0500 EDT, July 20 (Greene and Saffle, 1978). The downdrafts and cool outflow from each successive cell reinforced and helped maintain the thermal and wind discontinuities along the outflow boundary.

As the short-wave trough moved to the east of Johnstown, drier, subsiding midtropospheric air moved into the region. Convective activity was suppressed, and the meso-high moved toward the southeast and slowly dissipated. Shortly after 0500 EDT, the heavy rain in Johnstown ended abruptly.

DISTRIBUTION OF RAINFALL

Temporal and spatial distributions of the rainfall over western Pennsylvania before and during the major flooding are now examined. Hourly and daily rainfall totals from the rain-gage network are shown, as well as rainfall estimates from the National Weather Service Digitized Radar Experiment (D/RADEX) radar facility at Pittsburgh (Greene and Saffle, 1978). D/RADEX values were computed and available during the storm. Many surface observations of rainfall were not available until after the flood.

(Text continued on p. 28.)

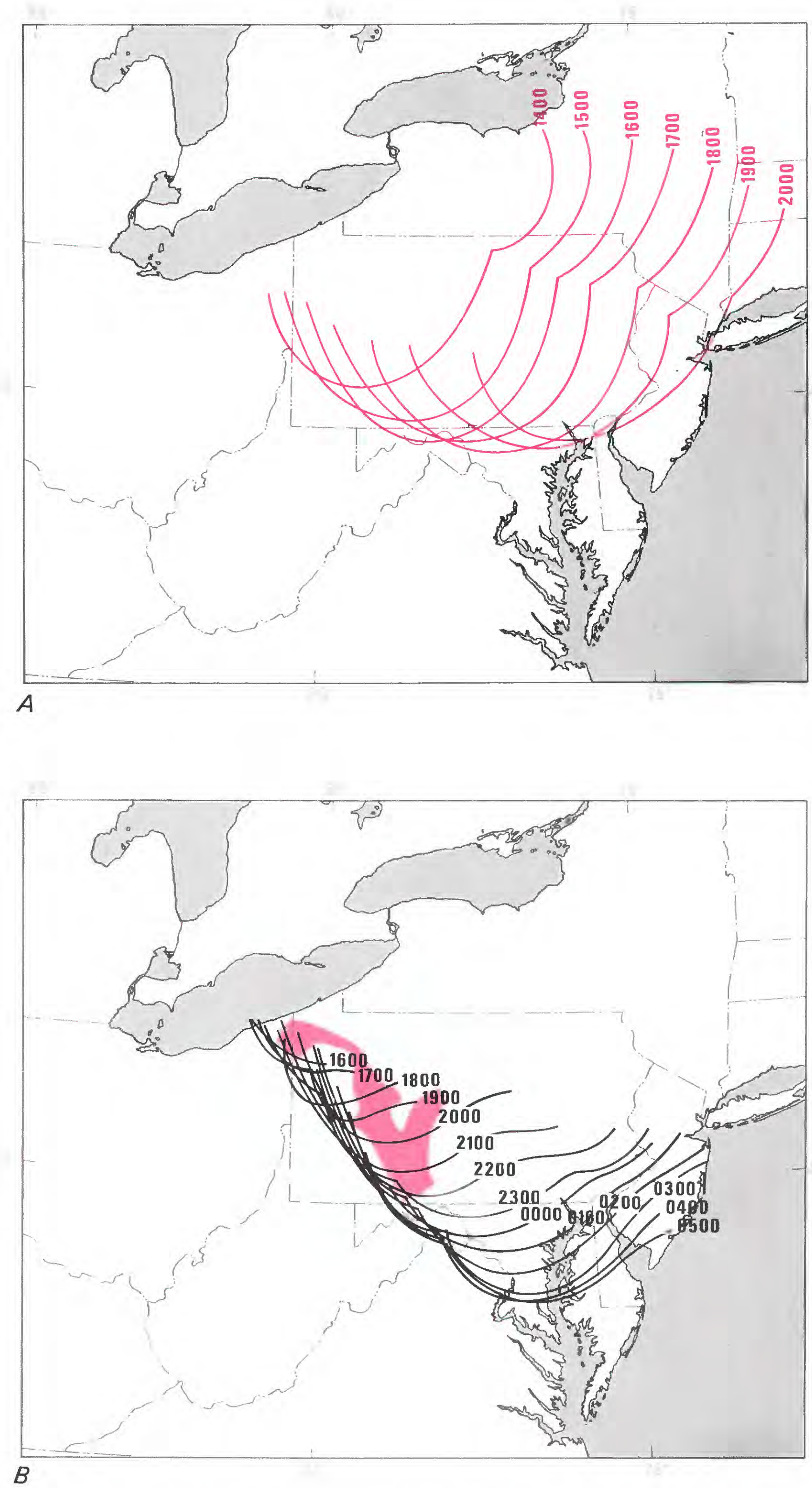
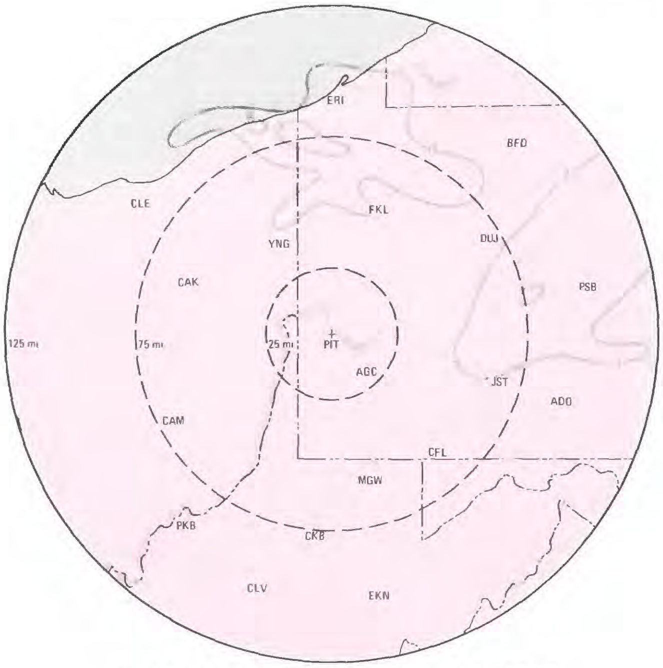
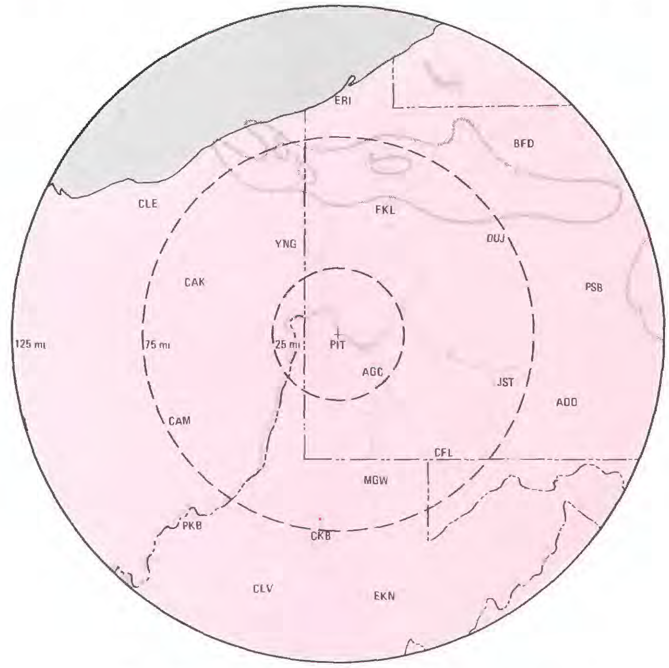


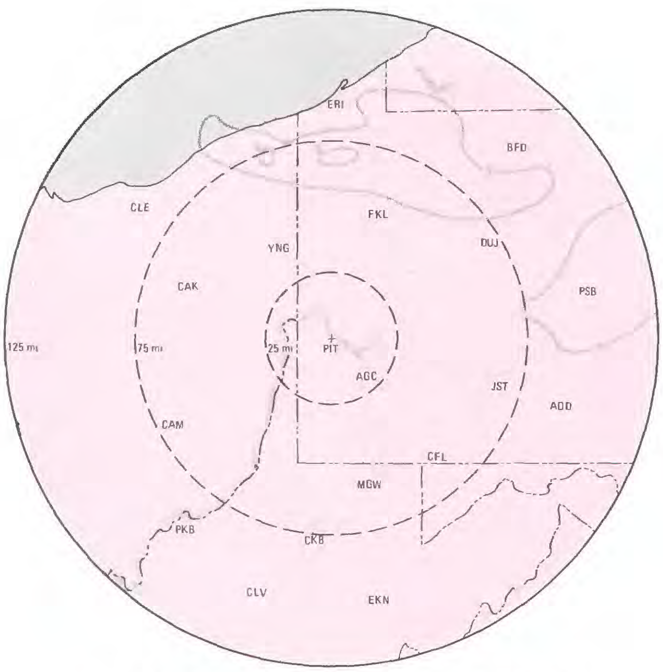
FIGURE 10.–Hourly positions of major thunderstorm outflow boundaries. *A*, First major boundary: 1400 EDT, July 19, 1977, to 2000 EDT, July 19, 1977. *B*, Second major boundary: 1600 EDT, July 19, 1977, to 0500 EDT, July 20, 1977; red shading defines region where 24-hr rainfalls exceeded 2 in.



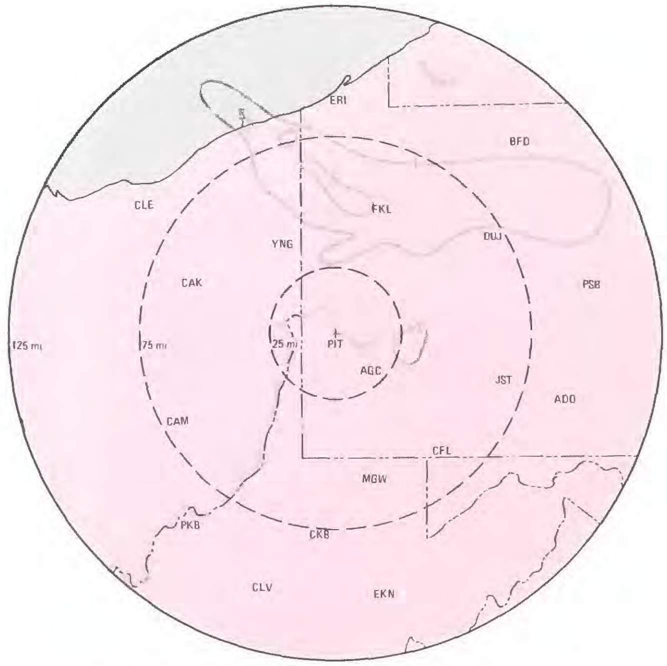
A 1400—1500 EDT, JULY 19, 1977



C 1600—1700 EDT, JULY 19, 1977

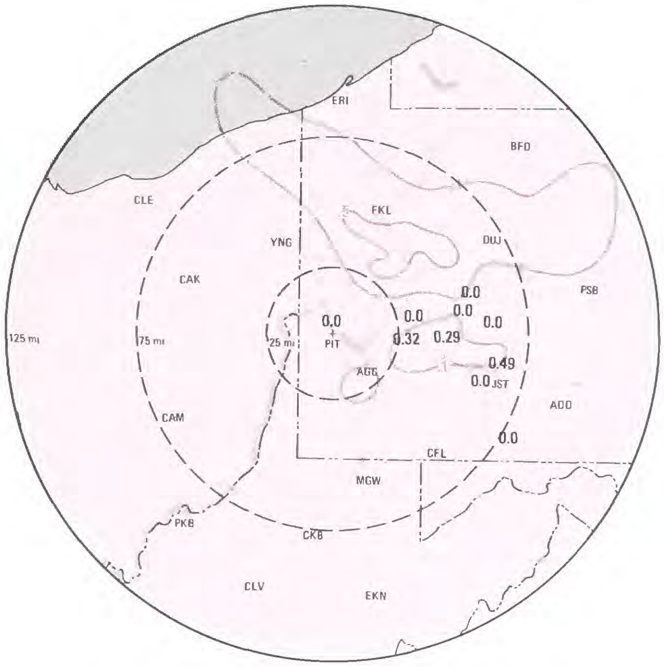


B 1500—1600 EDT, JULY 19, 1977

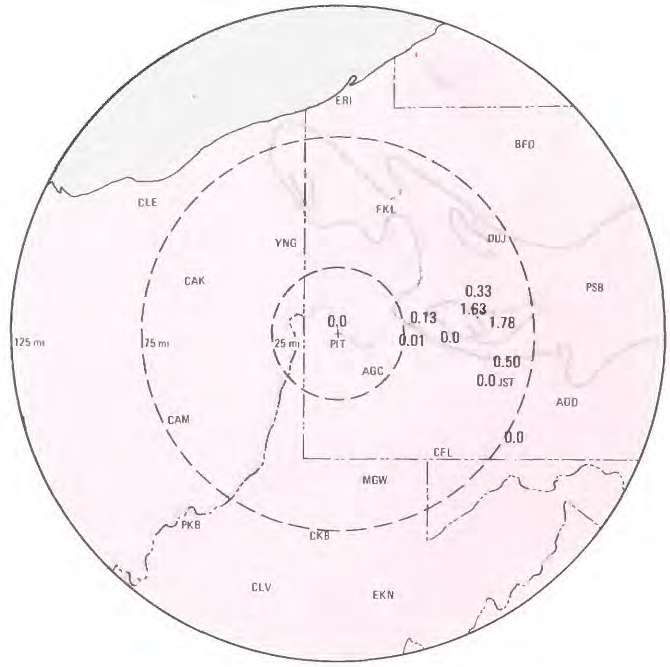


D 1700—1800 EDT, JULY 19, 1977

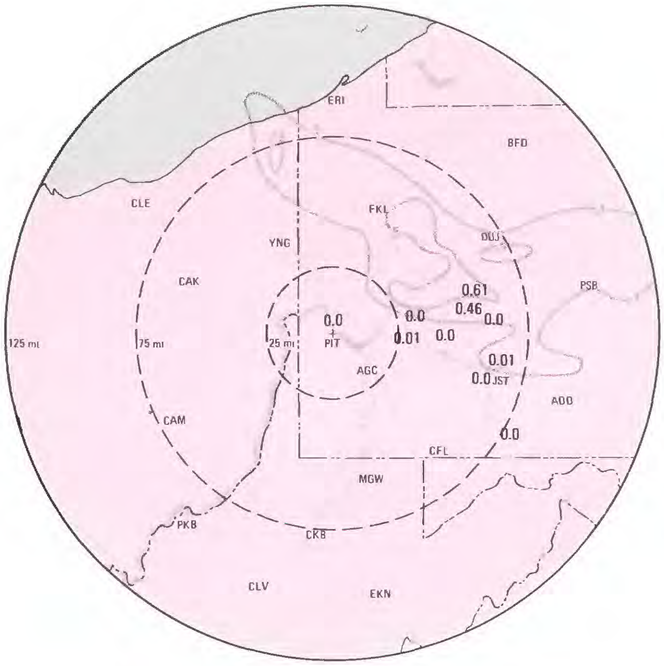
FIGURE 11. – Hourly rainfall analyses (in inches) for indicated times. Plotted data are observed rainfalls. Analyses show D/RADEX rainfall accumulations. *A*, 1400–1500 EDT, July 19, 1977. *B*, 1500–1600 EDT, July 19, 1977. *C*, 1600–1700 EDT, July 19, 1977. *D*, 1700–1800 EDT, July 19, 1977. *E*, 1800–1900 EDT, July 19, 1977. *F*, 1900–2000 EDT, July 19, 1977. *G*, 2000–2100 EDT, July 19, 1977. *H*, 2100–2200 EDT, July 19, 1977. *I*, 2200–2300 EDT, July 19, 1977. *J*, 2300–2400 EDT, July 19, 1977. *K*, 0000–0100 EDT, July 20, 1977. *L*, 0100–0200 EDT, July 20, 1977. *M*, 0200–0300 EDT, July 20, 1977. *N*, 0300–0400. EDT, July 20, 1977. *O*, 0400–0500 EDT, July 20, 1977. *P*, 0500–0600 EDT, July 20, 1977.



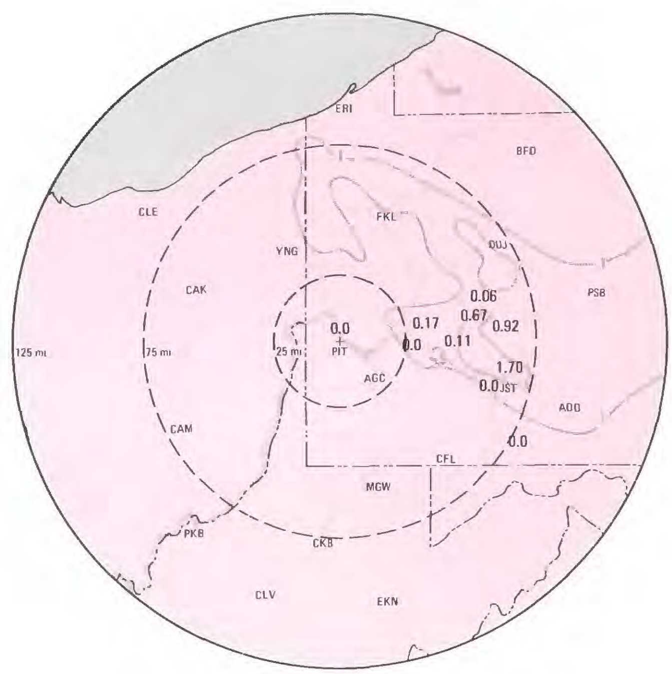
E 1800—1900 EDT, JULY 19, 1977



G 2000—2100 EDT, JULY 19, 1977

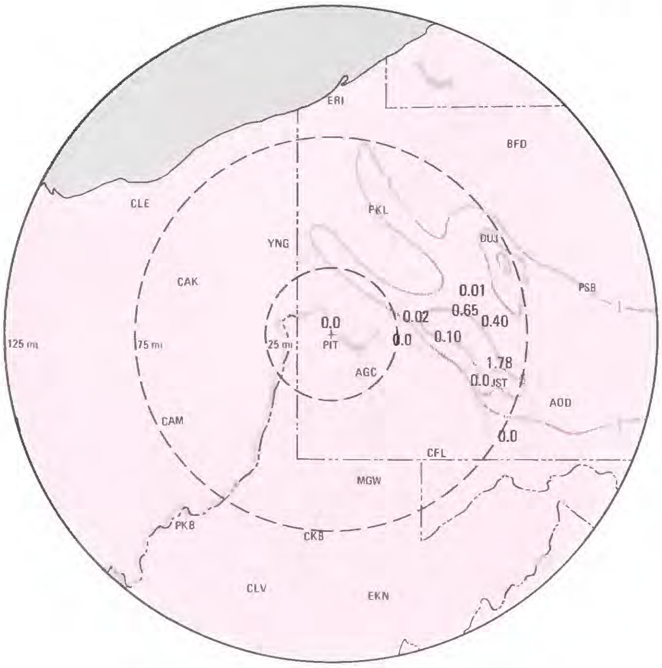


F 1900—2000 EDT, JULY 19, 1977

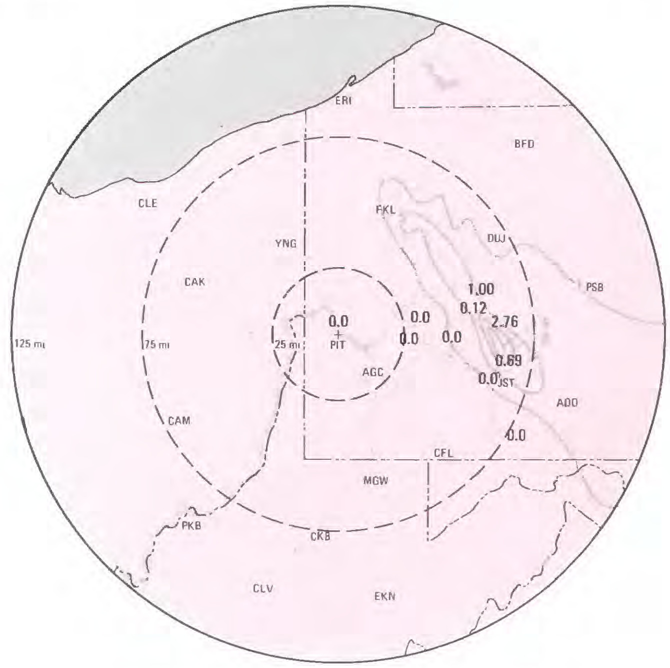


H 2100—2200 EDT, JULY 19, 1977

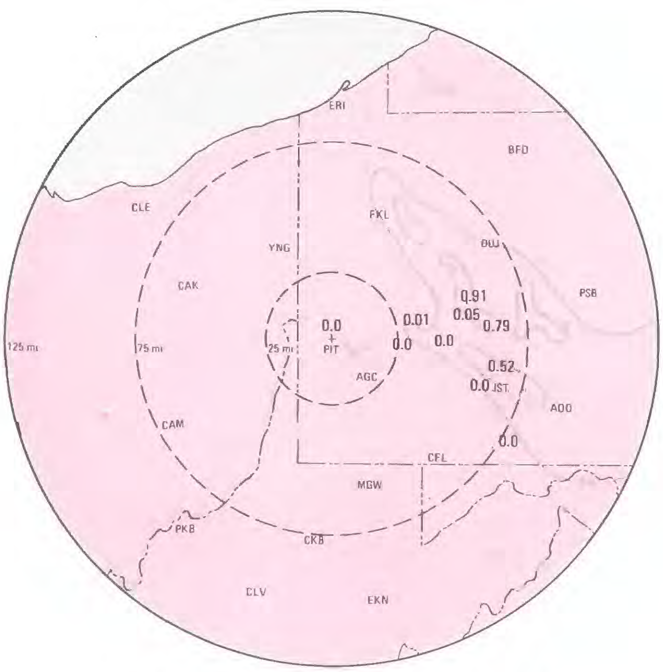
FIGURE 11.—Continued.



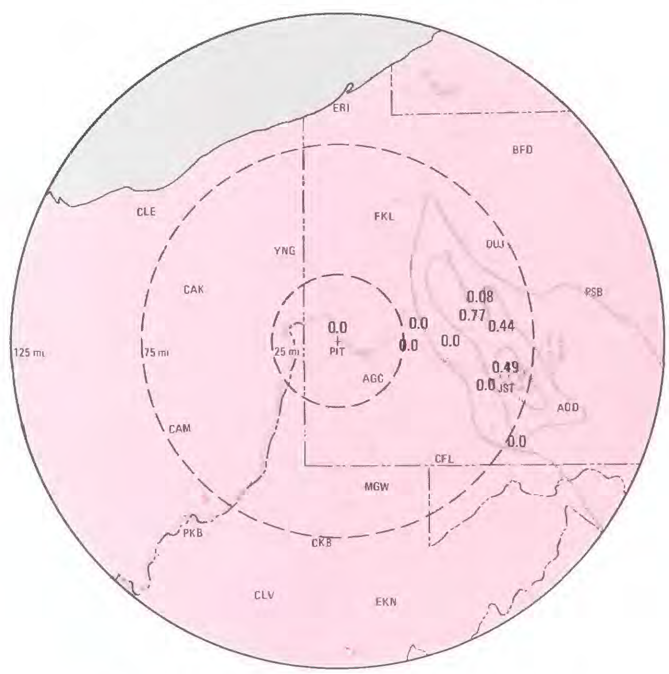
I 2200—2300 EDT, JULY 19, 1977



K 0000—0100 EDT, JULY 20, 1977

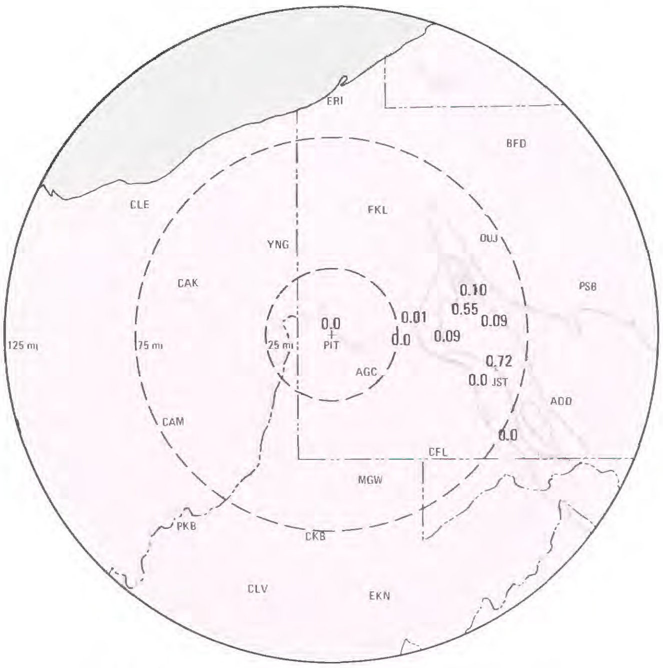


J 2300—2400 EDT, JULY 19, 1977

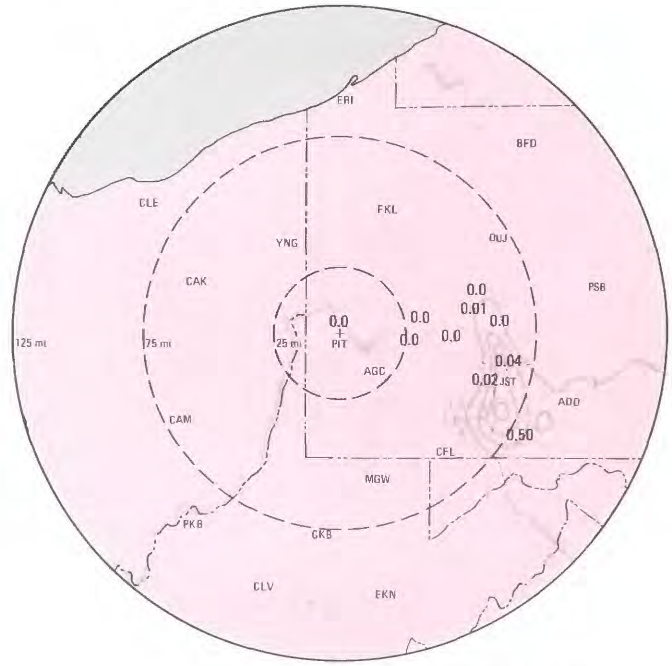


L 0100—0200 EDT, JULY 20, 1977

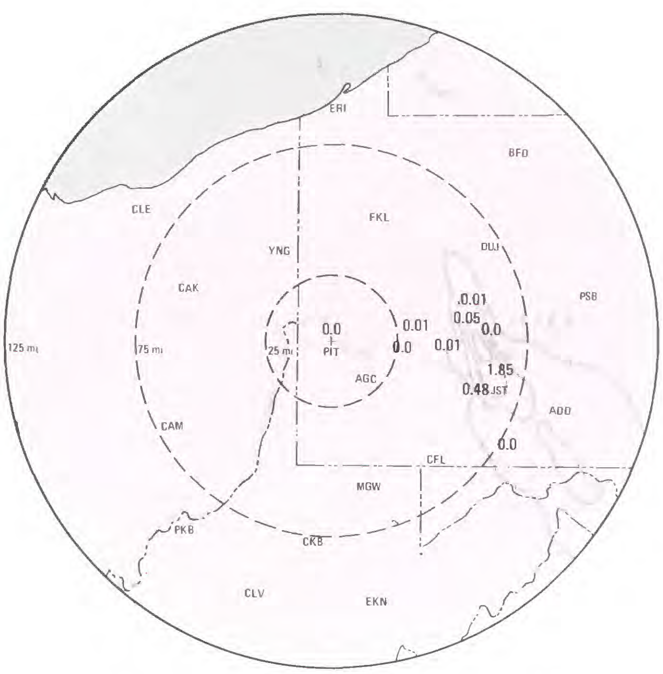
FIGURE 11. – Continued



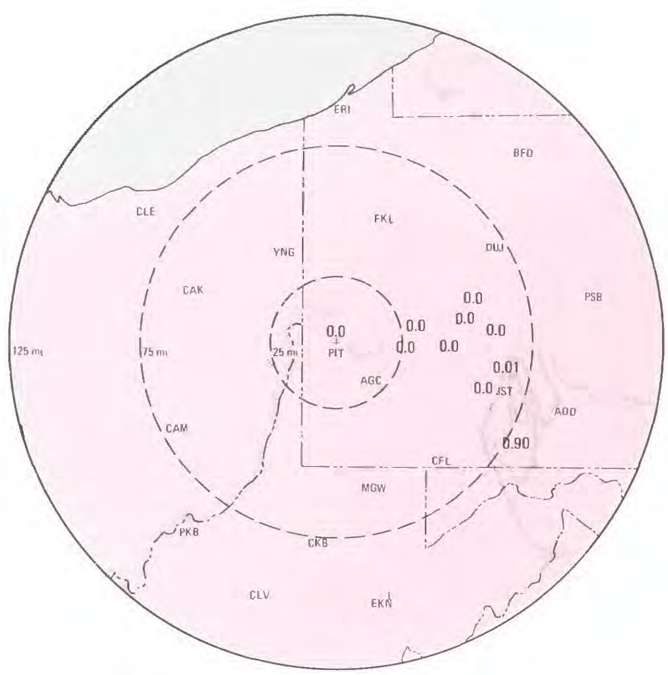
M 0200—0300 EDT, JULY 20, 1977



O 0400—0500 EDT, JULY 20, 1977

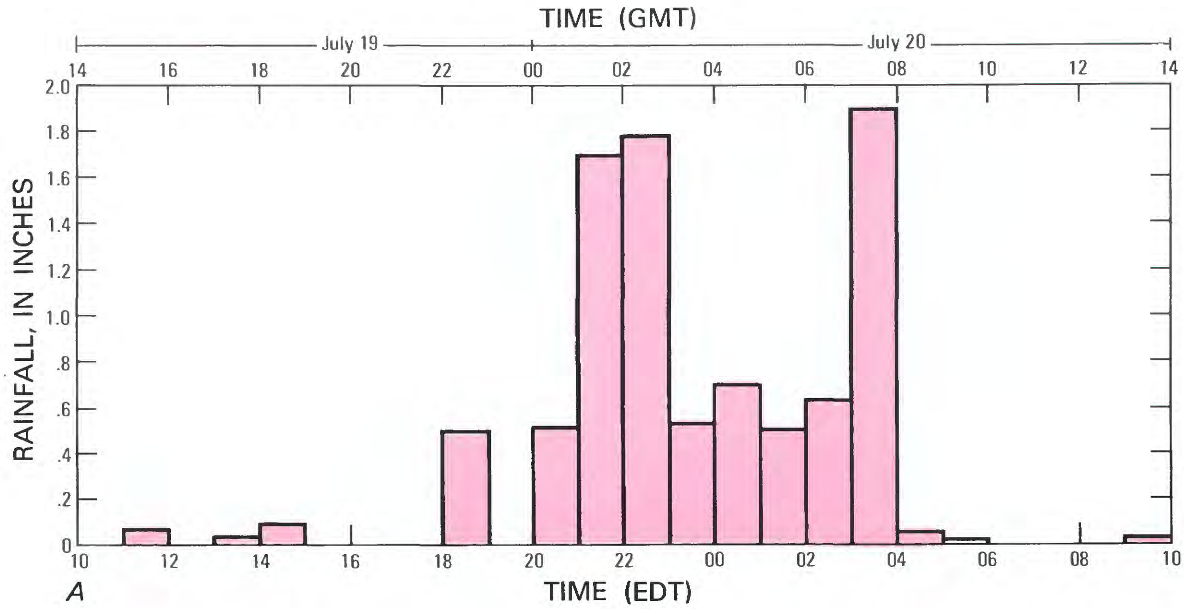


N 0300—0400 EDT, JULY 20, 1977



P 0500—0600 EDT, JULY 20, 1977

FIGURE 11.—Continued



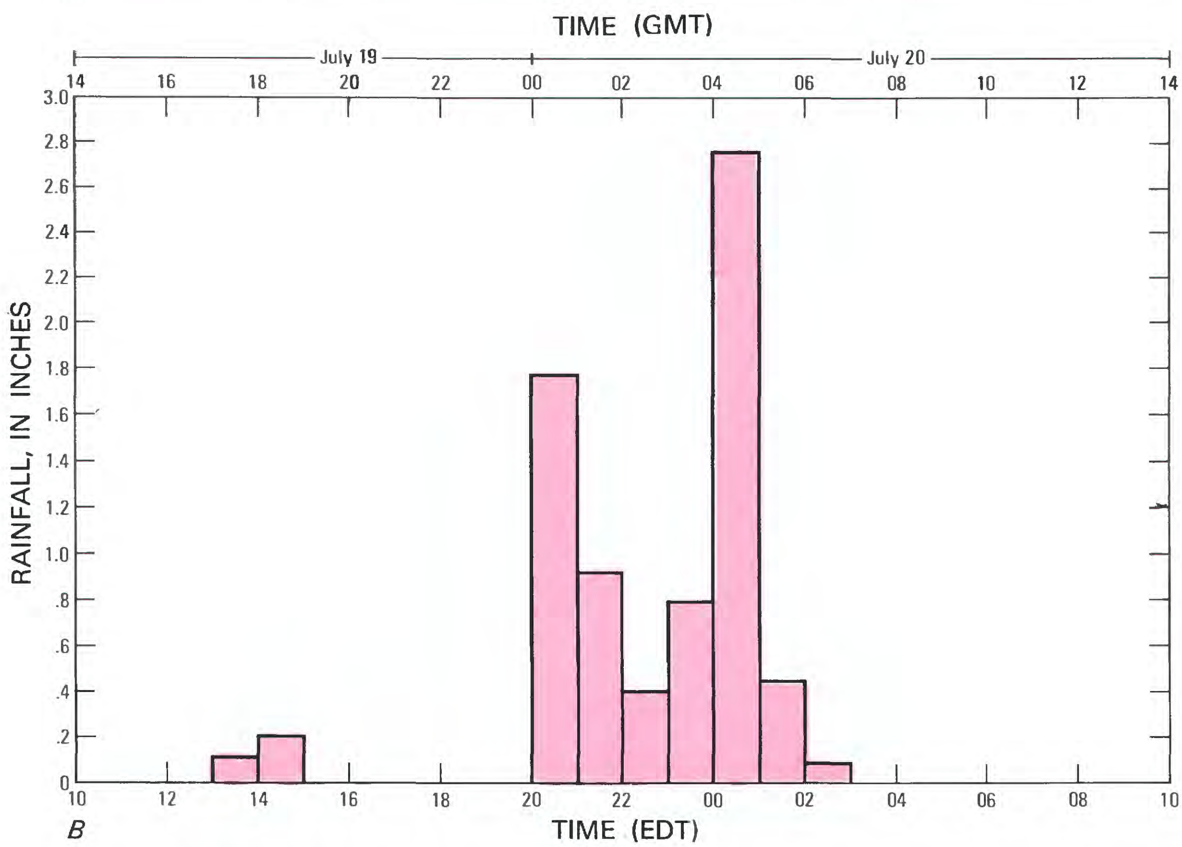


FIGURE 12.–Observed hourly rainfall at three stations within the heavy rainfall area. *A*, Public Safety Building, Johnstown, Pa. *B*, Strongstown, Pa. *C*, Dunlo, Pa.

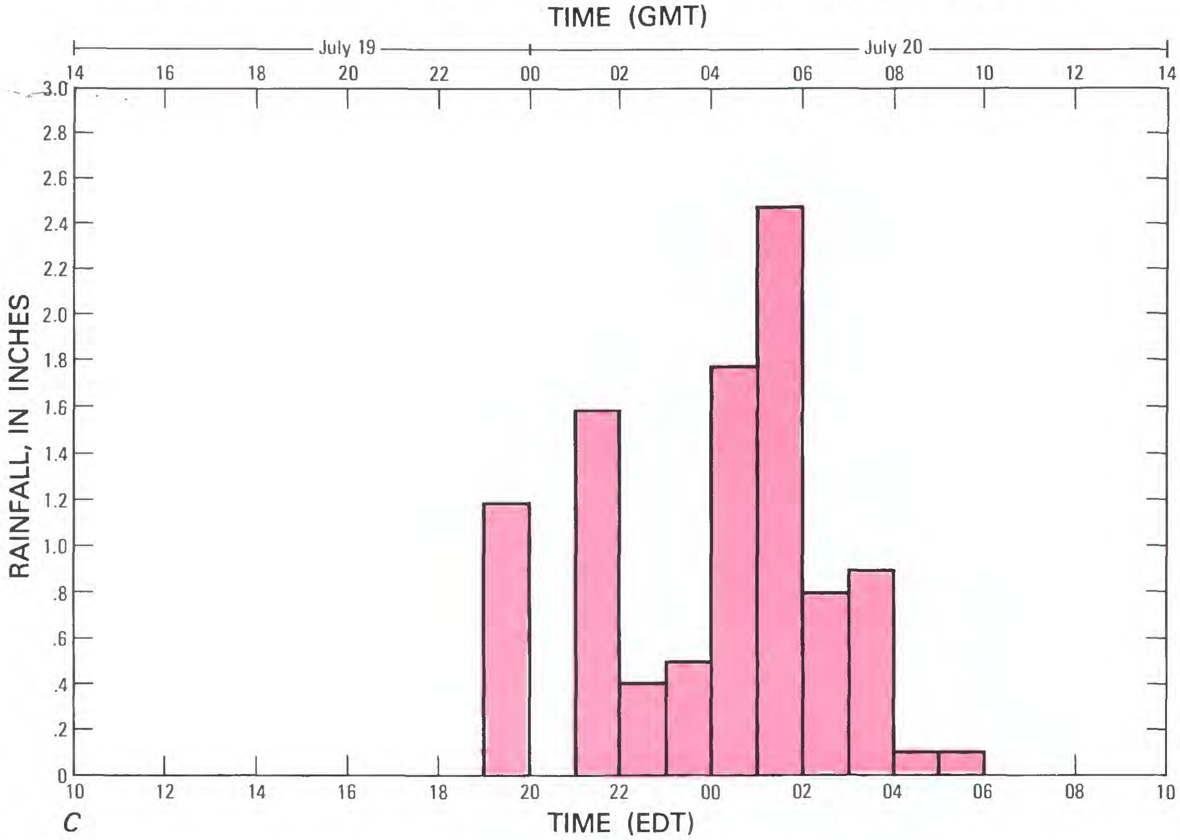


FIGURE 12.—Continued.

Analyses of the hourly rainfalls, obtained from D/RADEX for the period 1400 EDT, July 19, until 0600 EDT, July 20, are presented in figure 11. Hourly rainfalls observed at stations in and surrounding the Conemaugh River basin are plotted for the period 1800 to 0600 EDT.

During the afternoon, the hourly D/RADEX totals clearly show the eastward movement of the first squall line out of western Pennsylvania and the development and eastward extension of the second line over northwestern Pennsylvania.

As the second line moved into the Johnstown area during the late afternoon and early evening, spatial agreement between the hourly rainfall, estimated by radar, and observed amounts is reasonably good. Hourly rainfall totals at three stations (fig. 12) indicate that the bulk of the rain fell in 6–9 hours.

A comparison of 24-hour rainfall amounts from D/RADEX data with an isohyetal analysis of surface rain-gage data is shown in figures 13 and 14. The pattern of heavy rainfall is similar in both analyses. However, observed maximum totals are more than 12 in., whereas the maximum radar-determined accumulation is slightly more than 8 in. Figures 11 and 12 suggest that radar estimates were somewhat low during the early evening but compare more favorably with the observed values in the 0100 to 0600 EDT, July 20, time period.

Analyses presented in figures 12 and 14 show the intensity of the rain during the 6–9-hour period and the localized nature of the rainfall. For example, Nanty Glo, about 10 miles north of Johnstown, received approximately 12 inches of rain during the 24-hour period, whereas locations 30 miles to the southwest received little or none.

DISCUSSION AND SUMMARY

The July 19–20, 1977, flash floods in southwest Pennsylvania resulted when large-scale and mesoscale processes combined to focus excessive convective rains over a relatively small area. Circulation patterns associated with the large surface high off the Atlantic coast and the long-wave upper-tropospheric ridge over the eastern United States provided a conditionally unstable atmosphere having abundant moisture over a large area of the Ohio Valley and central Appalachian Mountain region. Dynamic processes associated with a slowly moving short-wave trough destabilized the atmosphere and acted to trigger and maintain organized convention during the morning and afternoon of July 19.

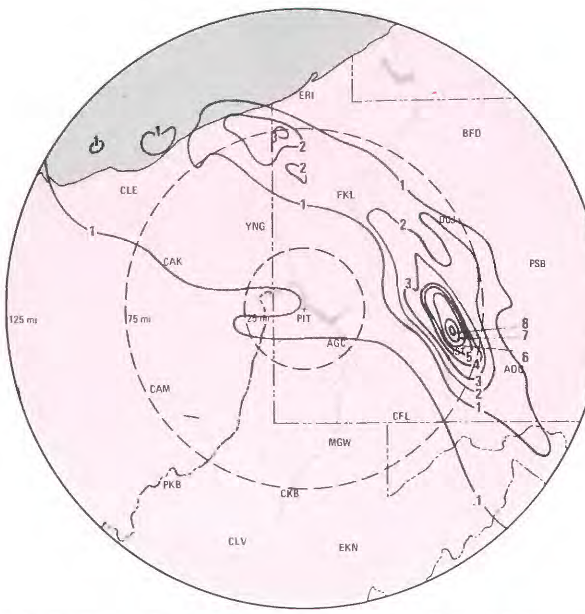


FIGURE 13.–Total rainfall (in inches) indicated by meteorological radar (D/RADEX). Time period 0800 EDT, July 19, to 0800 EDT, July 20, 1977.

In response to the convective activity during the afternoon and early evening, mesoscale pressure systems and low-level baroclinic zones were generated. In western Pennsylvania, the boundary separating the rain-cooled air generated by previous thunderstorms became quasi-stationary nearly perpendicular to the warm, moist, low-level flow streaming in from Ohio. As this unstable air ascended over the rain-cooled air, new thunderstorms were triggered, which then moved southeastward parallel to the outflow boundary. Each thunderstorm cell reinforced the temperature gradient along the outflow boundary and maintained the triggering mechanism in a quasi-stationary position. The storms moved upslope into the western parts of the Appalachian mountains, releasing maximum rainfall in the hills north and east of Johnstown. This process continued for several hours, subjecting the region to a series of storms.

The quasi-stationary nature of the storm was eventually terminated as the short-wave trough moved into eastern Pennsylvania. Advection of somewhat drier midtropospheric air and development of weak subsidence with the trough passage over western Pennsylvania eventually suppressed formation of new cells.

The meteorological conditions leading to the flood-producing rains around Johnstown were those present during most significant flash floods (Maddox and others, 1979). These storms commonly have several important characteristics: (1) very moist and conditionally unstable conditions, with precipitable water substantially above normal from the surface to 500 mb; (2) a weak short-wave trough (meso-α scale) moving through a large-scale ridge that provides lifting and air mass destabilization; (3) weak wind shear through much of the cloud layer, which contributes to high precipitation efficiencies; (4) topographic features, frontal boundaries, or cool outflow boundaries produced by earlier or existing convection, which trigger additional storms and focus heavy rain over a relatively small area; (5) several cells that typically move over the same area, and (6) the tendency for rainfall that produces flashfloods to occur at night.

THE FLOODS OF JULY 19–20, 1977

To document the extreme floods in western Pennsylvania on July 19–20, 1977, stream-stage and discharge data were collected at 57 sites in the Allegheny, Susquehanna, and Potomac River basins. Thirty of these sites are at gaging stations, where both stage and discharge data are available, and the remainder are miscellaneous sites, for which only peak discharges are available. Numbers have been assigned to these sites for locating them on a map (fig. 15) and referencing flood data. Floodmark data consisting of peak-flood elevations throughout selected reaches of 27 streams in the Mahoning Creek and Conemaugh River basins are also presented. Descriptions of the tables containing these data are provided in the section Summary of Flood Stages and Discharges.

RECURRENCE INTERVALS

Recurrence intervals were computed at all gaging stations for which at least 10 successive years of peakflow data were available; they provide an indication of the severity of flooding on the respective streams. The recurrence interval, as applied to flooding, is the average interval of years within which a given peak discharge will be exceeded once. It is inversely related to the chance of the given discharge being exceeded in any year. For example, a flood having a recurrence interval of 50 years, would have one chance in 50 (2 percent chance, or 0.02 probability) of being exceeded in any year. The occurrence of floods is erratic; a flood of a given magnitude may occur in any year, it may occur in successive years, or it may not occur within a period much greater than the designated interval. Recurrence intervals were computed using a log-Pearson type III distribution, a regionalized skew coefficient, and other guidelines of the U.S. Water Resources Council (1977).

DETERMINATION OF PEAK DISCHARGES

At 34 sites (27 miscellaneous sites and 7 gaging stations), peak discharges for the July 1977 flood were determined by indirect methods. These methods are based on principles that relate streamflow to observed water-surface elevations and to the hydraulic properties of a stream or a structure that crosses the stream. They include the (1) slope-area, (2) contracted-opening, (3) flow-over-dam, and (4) flow-through-culvert methods described in Dalrymple and Benson (1967), Matthai (1967), Hulsing (1967), and Bodhaine (1968), respectively. Peak discharges for the remaining gaged sites were determined from previously established stage-discharge relationships.

DESCRIPTIONS OF THE FLOODS

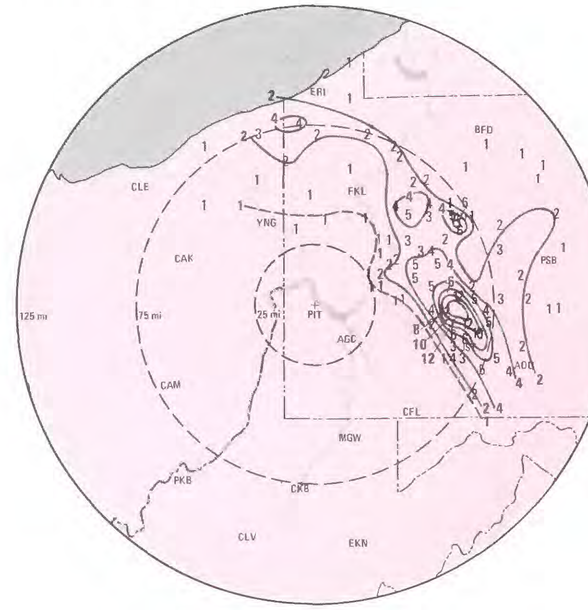
ALLEGHENY RIVER BASIN

Flooding was severe in much of a 70-mile long by 25-mile wide area along the Allegheny River basin's eastern divide. Allegheny River tributaries affected include Redbank, Mahoning, and Crooked Creeks. The Conemaugh River, a tributary to the Kiskiminetas River in the southeast part of the basin, had the worst flood.

The main stems of the Allegheny and Kiskiminetas Rivers were not flooded owing to flood-control reservoirs near the mouths of Mahoning and Crooked Creeks and the Conemaugh River. More than 200,000 acre-feet of runoff from this storm was stored in these three reservoirs.

Flooding was moderate in the Redbank Creek basin. At the gaging station on Big Run near Sprankle Mills (site 1), the peak discharge from a drainage area of 7.38 mi² was 960 ft³/s. Although this discharge is the highest since record collection began in 1963, its recurrence interval is estimated at only 15 years. The peak flow for the main stem of Redbank Creek at St. Charles (site 2) was 19,000 ft³/s. A recurrence interval of 5 years was estimated for this discharge.

Flooding was extreme in the upper half of the Mahoning Creek basin, where as much as 6 inches of rainfall was recorded. Stump Creek, at the town of Big Run (site 3) had a peak flow of 5,240 ft³/s from a drainage area of 26.8 mi², which corresponds to a unit discharge of 196 (ft³/s)/mi². On the main stem of Mahoning Creek at Punxsutawney (site 4), the peak flow was 12,700 ft³/s, the second highest flow since at least 1936. This is considerably less than the record discharge of 17,300 ft³/s during a flood in June 1972, but a change in the carrying capacity of the stream resulted in a peak stage for the



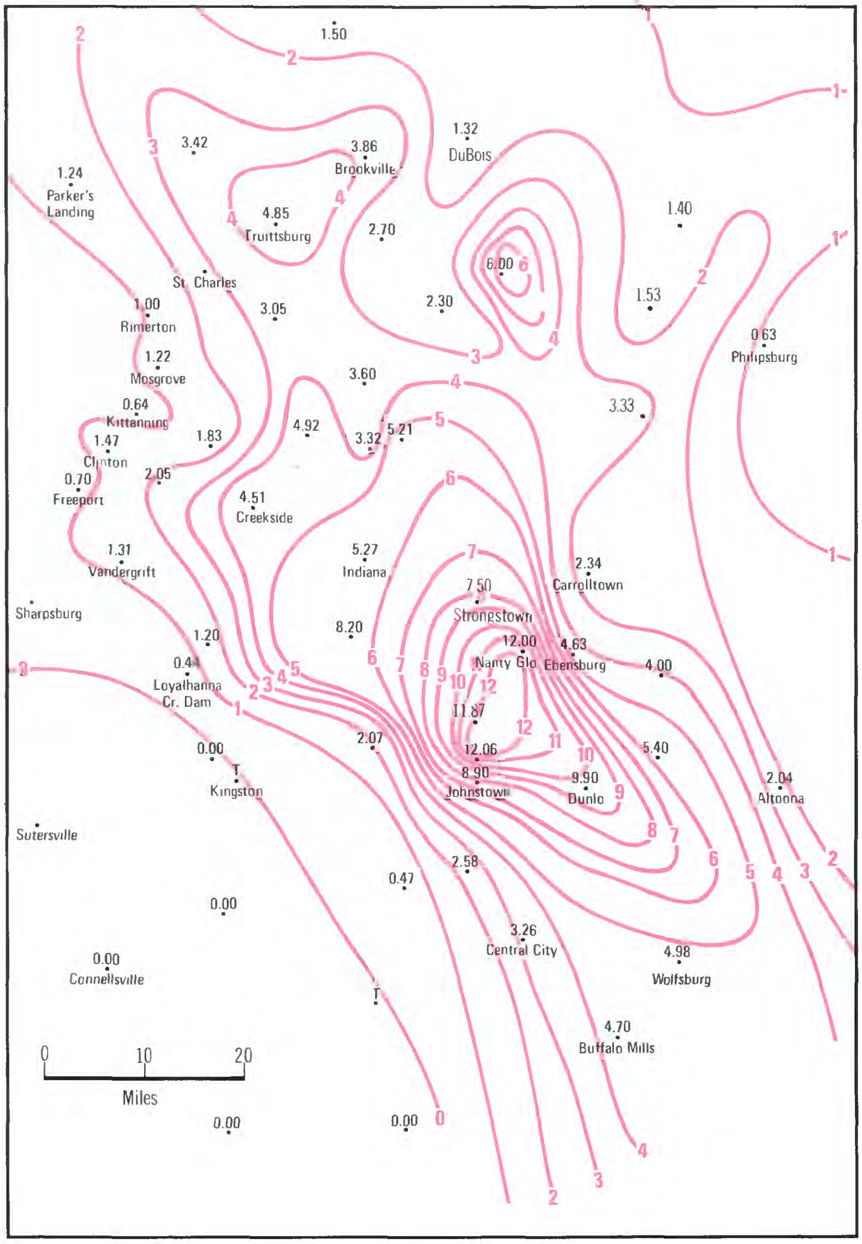
A

FIGURE 14.–Total observed rainfalls (in inches) from 0800 EDT, July 19, to 0800 EDT, July 20, 1977. *A*, Western Pennsylvania. *B*, Conemaugh River basin.

July 1977 flood that was 0.3 ft higher than the previous record. A recurrence interval of 40 years is estimated for the July 1977 peak discharge at this site. The peak flow of 5,770 ft³/s on Little Mahoning Creek at McCormick (site 5) was also the second highest for its period of record, which extends back to 1939. However, it is only 7 percent less than the previously known maximum discharge of 6,200 ft³/s, in June 1972. The July 1977 peak discharge at this site is estimated to have a recurrence interval of 20 years.

Downstream from Little Mahoning Creek, the peak flow of Mahoning Creek was greatly reduced by the effects of Mahoning Creek Lake. About 28,500 acre-feet of flood-control storage was utilized to reduce the peak flow below Mahoning Creek Dam (site 6) to 6,560 ft³/s on July 22.

Flooding was significant throughout the Crooked Creek basin. At Shelocta (site 7), in the central part of the basin, the peak discharge on Crooked Creek was estimated to be 9,940 ft³/s, or 85 (ft³/s)/mi² from a drainage area of 117 mi². Farther downstream at Idaho (site 8), the peak flow on Crooked Creek was 8,860 ft³/s, a unit discharge of 46 (ft³/s)/mi² from a drainage area of 191 mi². The recurrence interval for this peak is estimated at 10 years. A recurrence interval of about a year is estimated for the peak discharge of 4,150 ft³/s downstream from Crooked Creek Dam (site 9) on July 22. More than 17,000 acre-ft of flood runoff was stored in Crooked Creek Lake, which prevented flooding downstream.



B

FIGURE 14. – Continued.

CONEMAUGH RIVER BASIN

Peak flows on streams in the Conemaugh River basin, over which the storm centered, were among the greatest known in the Northeast. The relations of the 1977 peak discharges in the Conemaugh River basin to size of drainage areas are shown in figure 16 and are compared with those outside of the basin and to other known floods in the Northeast. On the main stem of the Conemaugh River and its three principal tributaries, Stony Creek, Little Conemaugh River, and Blacklick Creek, recurrence intervals of the peak discharges are estimated to be 100 years or more.

Many deaths and much property damage resulted from flooding in the lower half of the Stony Creek basin. Along Paint Creek and its tributaries, many homes were either destroyed or extensively damaged. (See fig. 17.)

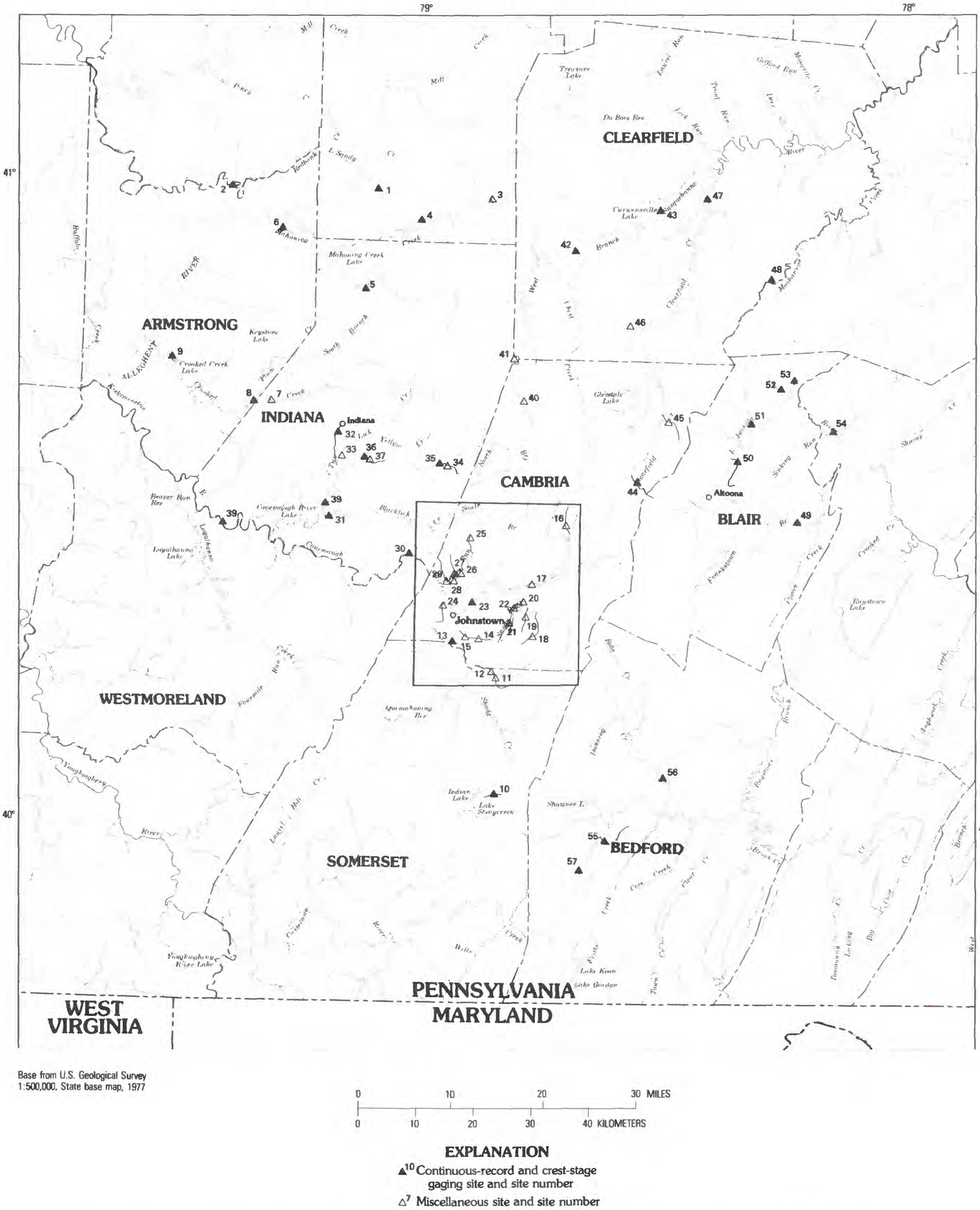


FIGURE 15.–Locations of flood-determination sites in western Pennsylvania. *A*, The general area. *B*, The Johnstown area.

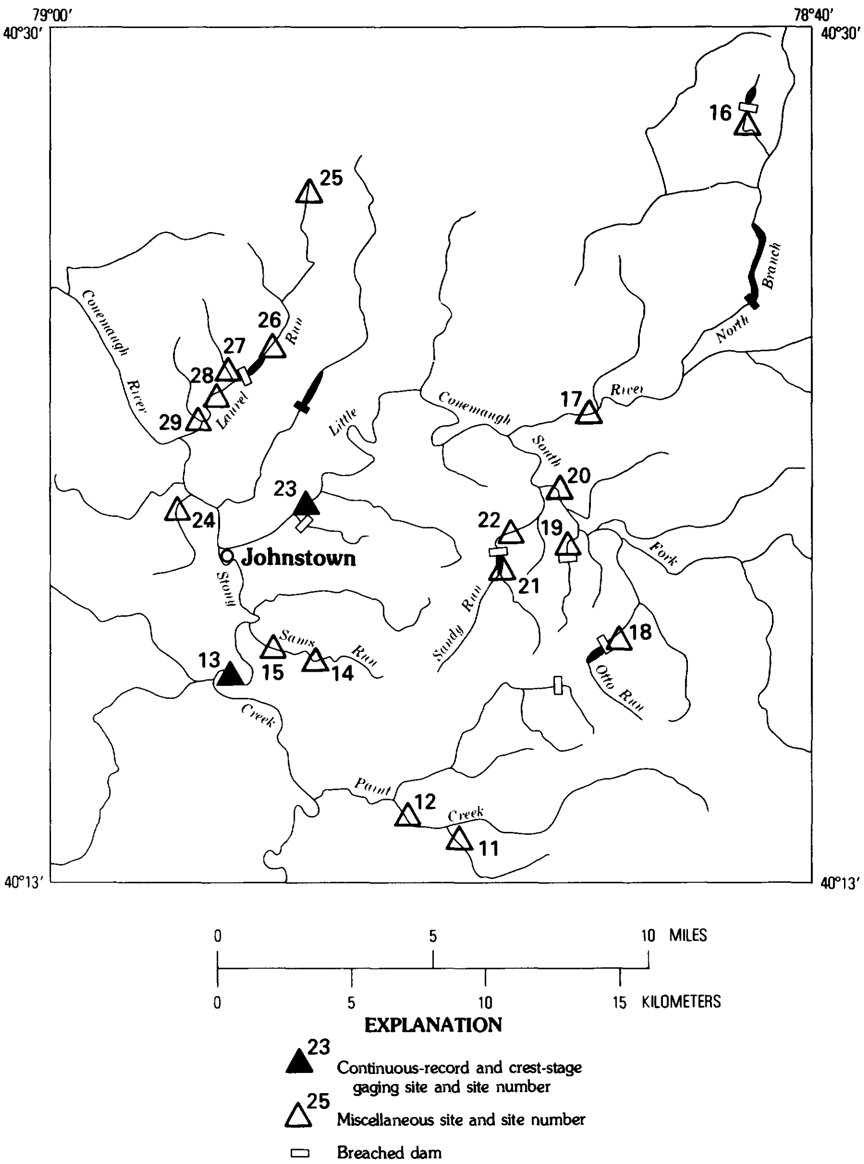


FIGURE 15.—Continued.

Seese Run, a tributary to Paint Creek, at Windber (site 11) had a peak flow of 5,760 ft^3/s, and Paint Creek at Windber (site 12) had a peak flow of 19,000 ft^3/s. Respectively, these flows correspond to unit discharges of 1,240 $(ft^3/s)/mi^2$ from a drainage area of 4.66 mi^2 and 872 $(ft^3/s)/mi^2$ from a drainage area of 21.8 mi^2.

On the main stem of Stony Creek at Ferndale (site 13), the peak discharge at the gaging station was 48,000 ft^3/s, the second highest since at least 1913. The estimated recurrence interval is 100 years, and the unit discharge is 106 $(ft^3)/mi^2$. Stage and discharge hydrographs for this site are shown in figure 18.

The peak flow on Sams Run, a tributary to Stony Creek, was 1,600 ft^3/s at Geistown (site 14). The unit discharge of 1,250 $(ft^3/s)/mi^2$ at Geistown was comparable to that on Paint Creek. The peak flow on Sams Run at Lorain (site 15) was 2,960 ft^3/s or 1,360 $(ft^3/s)/mi^2$.

Flooding of streams in the Little Conemaugh River basin was also extreme. Rainfall over the basin ranged from 4 in. in the upper end to the maximum reported amount of 12 in. near the lower end. The peak flow of the Little Conemaugh River at Summerhill (site 17), near the middle of the basin, was 8,670 ft^3/s from a drainage area of 91.1 mi^2, or a unit discharge of 95 $(ft^3/s)/mi^2$. Flooding along the South Fork Little Conemaugh River, which joins the little Conemaugh several miles downstream from Summerhill, was even more significant. At Fishertown (site 20) the peak flow of the South Fork was 24,000 ft^3/s from a drainage area of only 52.6 mi^2, which corresponds to a unit discharge of 456 $(ft^3/s)/mi^2$.

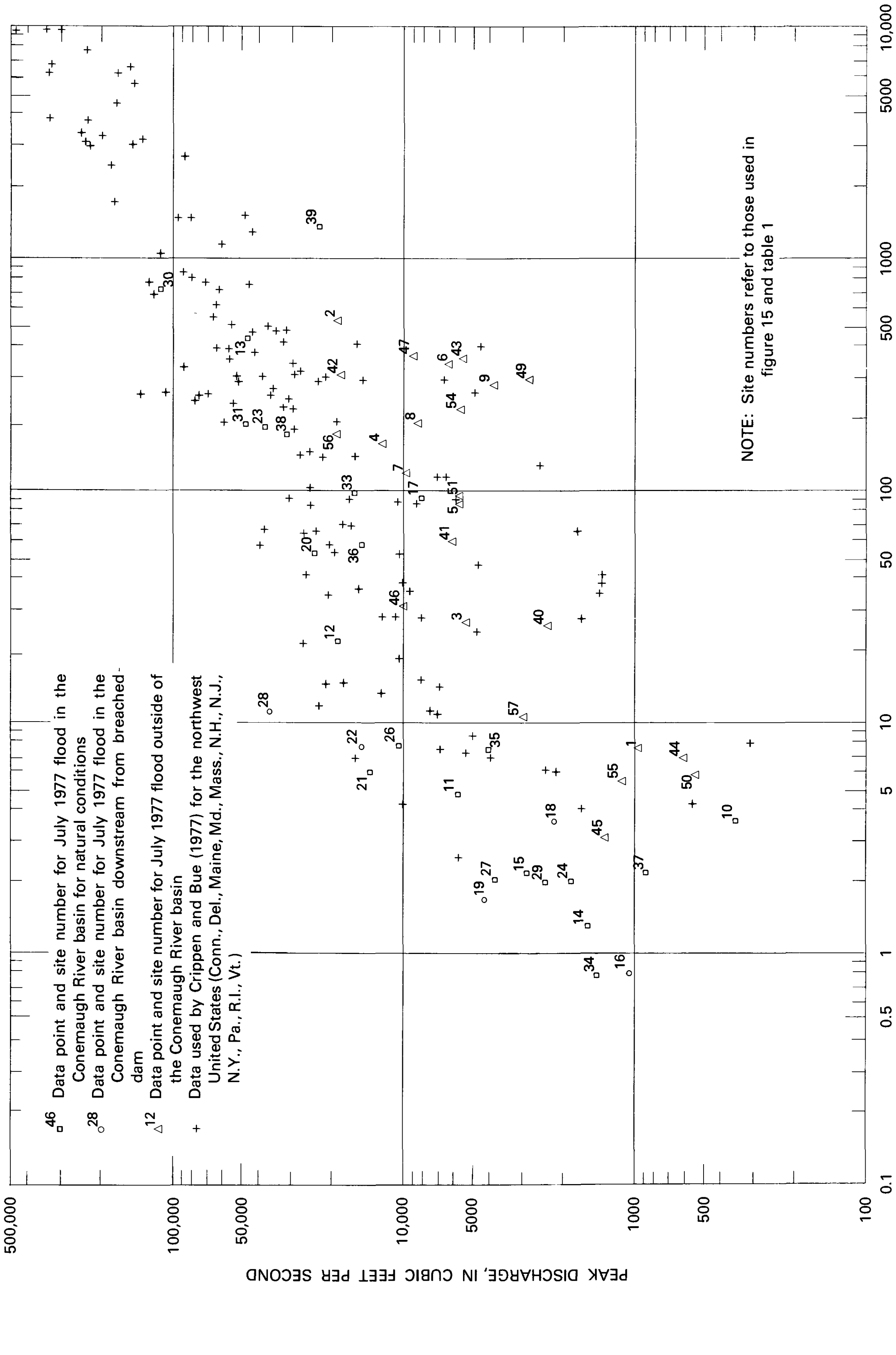


FIGURE 16.—Maximum discharge versus drainage area for flood of July 19–20, 1977, and for other known floods.

FIGURE 17.—Remains of several homes and a church along Little Paint Creek in Scalp Level. (Johnstown Tribune-Democrat photograph.)

Sandy Run, a tributary to the South Fork Little Conemaugh River, had the maximum known natural-runoff rate in the entire flood area—2,390 $(ft^3/s)/m^2$. This was determined for a site just upstream from a breached water-supply dam (fig. 19). The peak flow at this site (site 21) was 14,000 ft^3/s from a drainage area of 5.86 mi^2. The failure of the dam probably caused little modification of the natural peak discharge. One mile downstream from the dam (site 22), the peak flow was 15,300 ft^3/s, or only 10 percent greater than the upstream inflow. Additional information on this and six other dam failures is included in the section Breached Dams.

The peak flow of the Little Conemaugh River at East Conemaugh (site 23), about 9 miles downstream from the South Fork, was 40,000 ft^3/s, as shown by the discharge hydrograph in figure 20. This is 40 percent higher than the previously known maximum in 1936 and is probably the largest since 1889, when a large dam on the South Fork failed.

Johnstown, at the confluence of Stony Creek and the Little Conemaugh River, had its worst flood since March 1936. Four to 8 ft of water, and much debris, covered most of the downtown area (figs. 21–24). At the City Hall building, the peak-flood level was about 10 ft below that of the 1936 flood and about 17 ft below the level of the disastrous 1889 flood (fig. 25). Flooding along the Conemaugh River in the northern part of Johnstown was 3 to 7 ft below that of 1936.

After the 1936 flood, channel improvements were made on the lower 4 miles of Stony Creek, the lower 1½ miles of the Little Conemaugh River, and on the Conemaugh River for another 3½ miles. Without these improvements, the U.S. Army Corps of Engineers (1978) estimated that the 1977 flood in downtown Johnstown would have been about 11 ft higher, or 1 ft higher than the 1936 flood level.

Small streams in the northern part of Johnstown and in adjacent communities also experienced extremely high floodflows. For example, the peak flow of Elk Run in the Morrelville section of Johnstown (site 24) was 1,900 ft^3/s from a drainage area of 1.99 mi^2, or 955 $(ft^3/s)/mi^2$. Flood severity along one of several streams

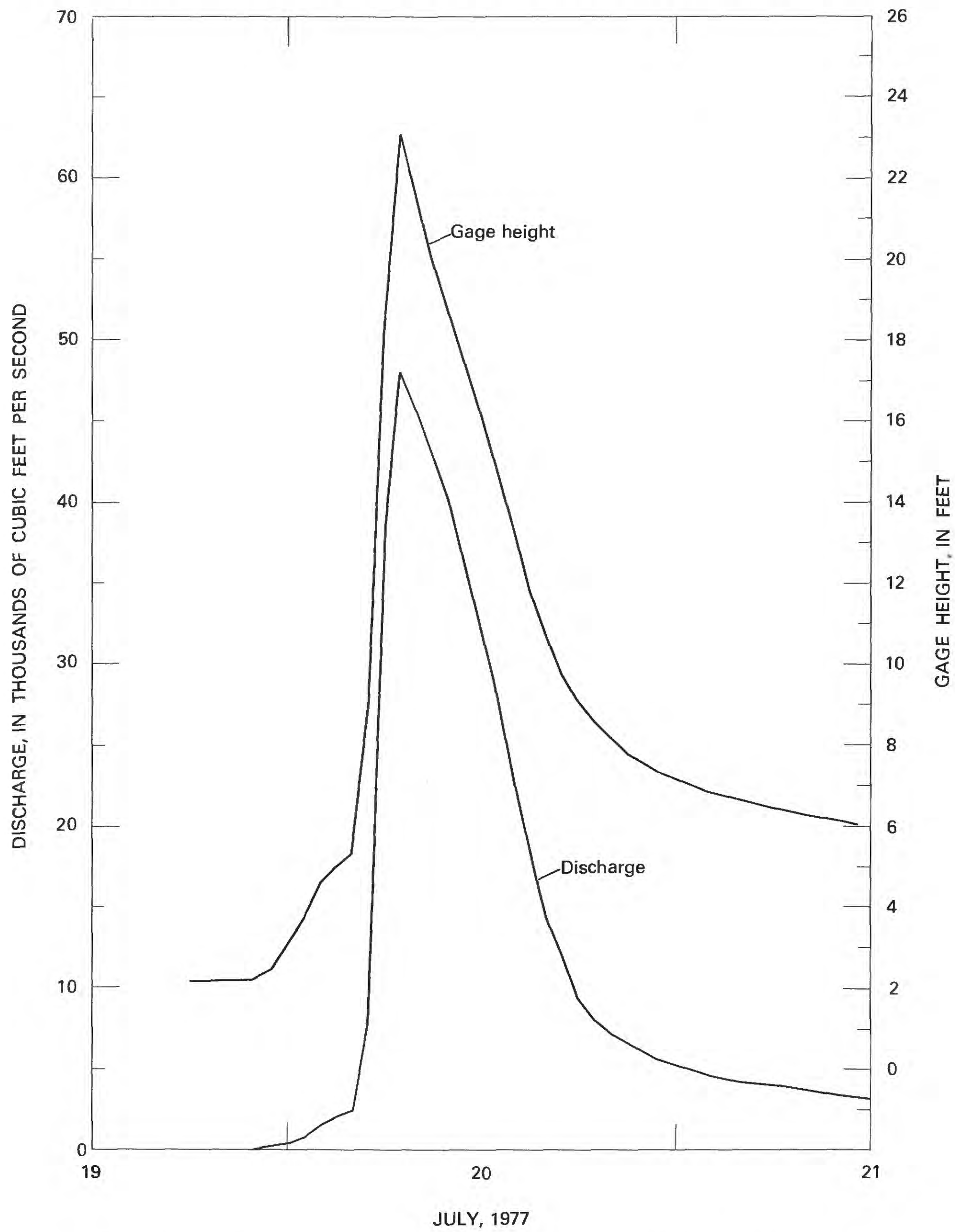


FIGURE 18.—Hydrographs of stage and discharge of Stony Creek at Ferndale (site 13).

just east of Johnstown is indicated by the destruction shown in figure 26.

Flooding was most disastrous downstream from Laurel Run Reservoir on Laurel Run, which flows into the Conemaugh River at the north end of Johnstown. High inflows, which exceeded the discharge capacity of the spillway, resulted in the overtopping and subsequent erosion of the dam's earthen embankment (fig. 27). About 2,000 ft upstream from the dam (site 26), the peak flow was estimated to be 10,500 ft^3/s from a drainage area of 7.56 mi^2. The peak discharge about a mile downstream from the dam (site 28) was computed to be 37,000 ft^3/s, more than three times as great as the upstream inflow. (See section Breached Dams for additional information.)

Red Run, a tributary to Laurel Run between the dam and the downstream measurement site, had the second highest of known natural-runoff rates. The peak flow at its mouth (site 27) was 4,000 ft^3/s, or a unit discharge of 2,000 $(ft^3/s)/mi^2$. However, its contribution at the time of

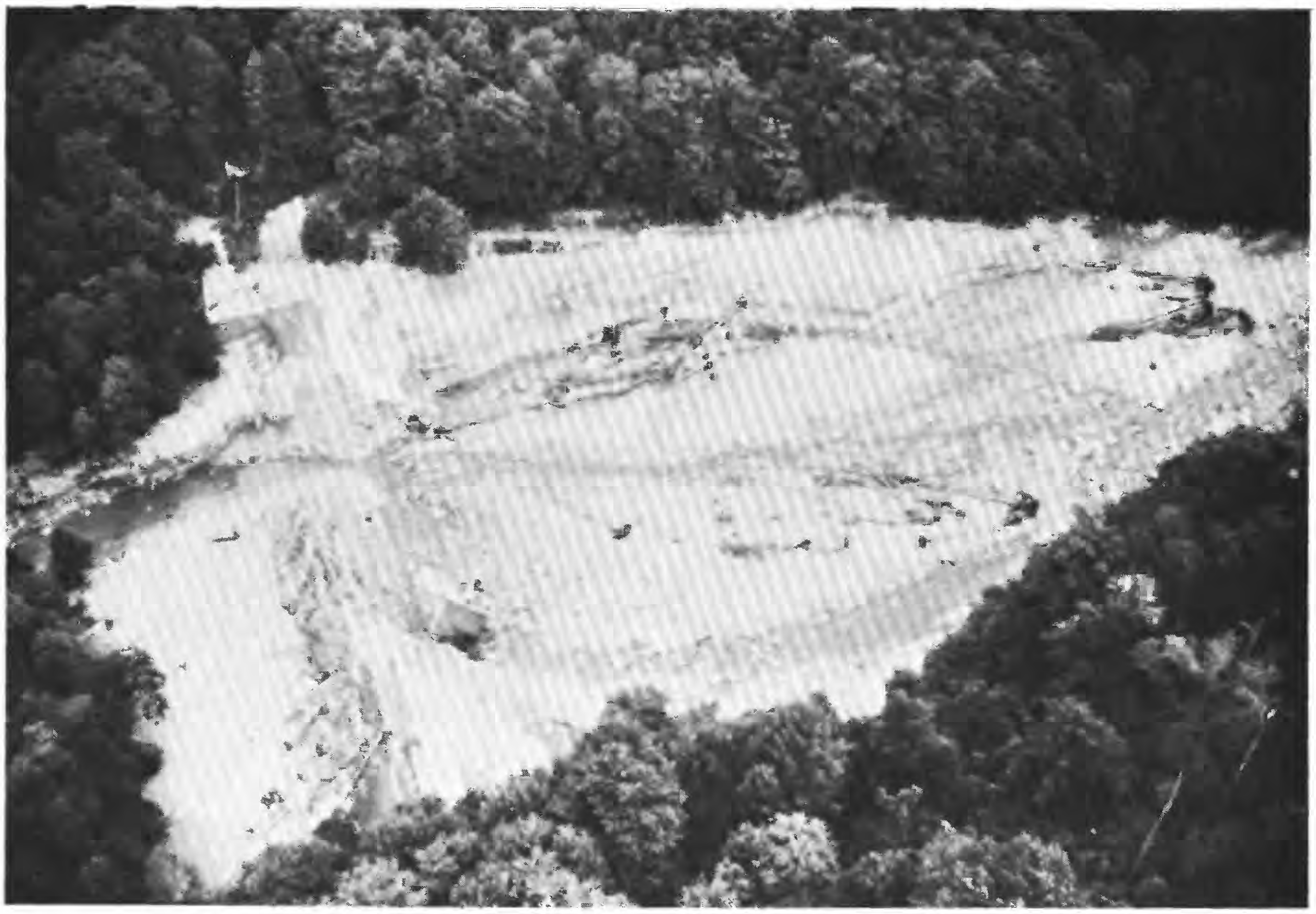


FIGURE 19.—Aerial view of breach in Sandy Run Dam (Pennsylvania Air National Guard photograph.)

the dam failure is considered to have been negligible. Another tributary to Laurel Run, Wildcat Run, had a peak discharge at its mouth (site 29) of 2,440 ft^3/s, or a unit discharge of 1,240 $(ft^3/s)/mi^2$ from a drainage area of 1.97 mi^2.

Flooding on the Conemaugh River between Johnstown and Conemaugh River Lake was also very severe. Flood levels were 3 to 6 ft higher than the previously known maximum levels of March 1936. The peak flow of 115,000 ft^3/s at Seward (site 30), which was about 50 percent greater than the peak of 1936, is equivalent to a unit discharge of 161 $(ft^3/s)/mi^2$. The recurrence interval for this peak flow is estimated to be greater than 100 years. Stage and discharge hydrographs for the July 1977 flood at Seward are shown in figure 28.

Severe flooding also occurred along Blacklick Creek, which empties into Conemaugh River Lake about 20 miles downstream from Seward. At Josephine (site 31), just upstream from Two Lick Creek, the peak flow was 45,700 ft^3/s or 238 $(ft^3s)/mi^2$ from a drainage area of 192 mi^2. This discharge has a recurrence interval greater than 100 years and is more than twice the maximum discharge during Hurricane Agnes in June 1972, the previous maximum since the gage was established in 1952.

Recurrence intervals greater than 100 years were estimated for the peak discharges at three other gaging sites in the Blacklick Creek basin. Peak discharges, drainage areas, and comparisons with the 1972 flood discharges (the previously known maximums at these sites) are as follows: Little Yellow Creek near Strongstown (site 35)–4,250, ft^3/s from a drainage area of 7.36 mi^2, 5.2 times greater; Yellow Creek near Homer City (site 36)–15,000 ft^3/s from a drainage area of 57.4 mi^2, 3.7 times greater; and Two Lick Creek at Graceton (site 38)–32,000 ft^3/s from a drainage area of 171 mi^2, 1.6 times greater.

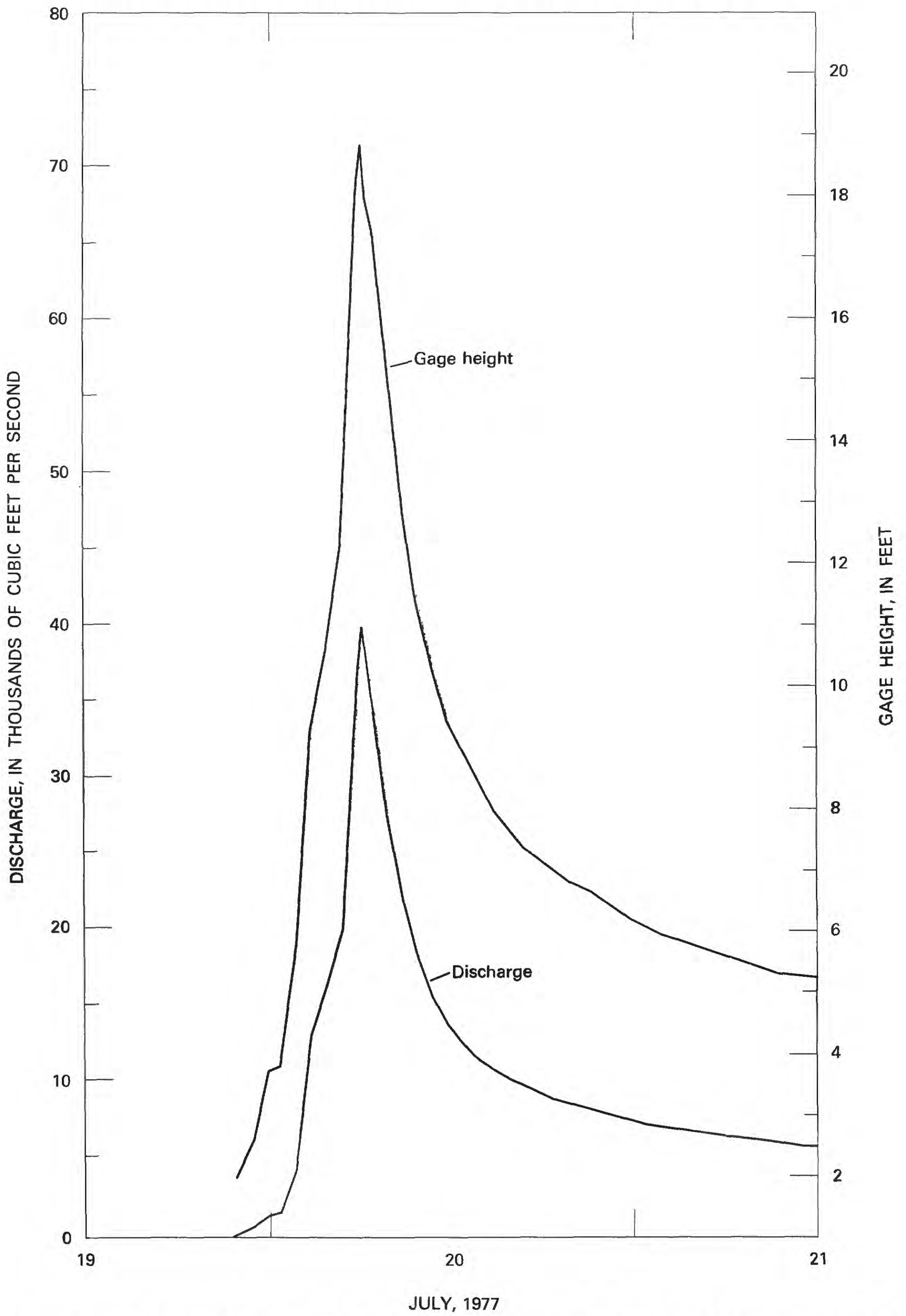


FIGURE 20.–Hydrographs of stage and discharge of Little Conemaugh River at East Conemaugh (site 23).

Discharge records before 1951 are not available at present gaging sites in the Blacklick Creek basin. However, flow records for a discontinued gage on Blacklick Creek at Blacklick (Jarvis and others, 1936) indicate that 1977 peak flows in at least the lower reaches of Blacklick and Two Lick Creeks were the highest since at least 1905, when the record began.

No flooding occurred downstream from Conemaugh

FIGURE 21. – Flooded business establishments in downtown Johnstown at Park Place. The peak stage was about 8 in. higher than the water level shown. (Johnstown Tribune-Democrat photograph.)

River Lake because of storage in the reservoir. The maximum discharge from the dam, determined at the gaging station 2 miles downstream (site 39), was 23,600 ft^3/s. This is 16 percent less than the flow the U.S. Army Corps of Engineers (1978) considers to be downstream bankfull capacity. More significantly, it corresponds to an 88 percent reduction of the peak reservoir inflow of 194,000 ft^3/s, as computed by the U.S. Army Corps of Engineers (1978). About 170,000 acre-feet of runoff was stored in the reservoir, utilizing 64 percent of the total available flood-control storage.

SUSQUEHANNA RIVER BASIN

Peak stages and discharges in the West Branch Susquehanna River basin, although significant, were generally much less than those during previous major floods. At Bower (site 42), the peak flow on the main-stem West Branch Susquehanna River was 19,200 ft^3/s, the fourth highest since at least 1889, when records were first collected. The estimated recurrence interval of this discharge is 30 years. The peak stage of 16.23 ft was 3.5 ft lower than the previously known maximum in March 1936. Significant flooding was also reported on two east bank tributaries, Chest and Clearfield Creeks. A recurrence interval of 15 years is estimated for the peak discharge of 602 ft^3/s on Bradley Run near Ashville (site 44), a tributary to Clearfield Creek. Peak flows on other Clearfield Creek tributaries farther downstream were even more significant, as illustrated in figure 16, for two ungaged sites, Brubaker Run at Dean (site 45) and North Witmer Run at Irvona (site 46). On the main stem of Clearfield Creek, downstream from these tributaries, the magnitude of flooding decreased rapidly. Near the mouth of Clearfield Creek, at Dimeling (site 47), the recurrence interval for the peak flow of 9,210 ft^3/s is only 4 years.

The elongated rainfall pattern by the storms of July 19–20, 1977 extended well into the Raystown Branch Juniata River basin and resulted in severe floods on several streams. The peak flow of Dunning Creek at Belden (site 56) was 19,400 ft^3/s from a drainage of 172 mi^2, the highest discharge since at least 1936. The recurrence interval of this flow is estimated to be greater than 100 years.

POTOMAC RIVER BASIN

Moderate to extreme flooding was reported on several small streams in the Potomac River basin, but because the area is so sparsely populated, damages were minor. A recurrence interval of 70 years is estimated for the peak flow of 3,000 ft^3/s on Little Wills Creek at Bard

FIGURE 22.–Flooding at Franklin Street United Methodist Church in Johnstown. (Johnstown Tribune-Democrat photograph.)

(site 57). The corresponding peak stage of 11.00 ft is about 2 ft higher than any other since the record began in 1961.

SUMMARY OF FLOOD STAGES AND DISCHARGES

Peak stage and discharge data for the sites shown in figure 15 are presented in table 1. Data for the maximum flood previously known are included for each of the gaged sites. The 8-digit numbers listed in the second column of the table are permanent USGS station numbers. These are the same as those used in the annual USGS Water Data Report for Pennsylvania and were assigned to each site according to its downstream order.

Additional stage and discharge data for many of the sites are included in table 4, which also includes detailed site locations, gage descriptions, and other pertinent facts about each site. Data in this table can be used to construct stage and discharge hydrographs for most gaged sites, generally for the period July 19–23, 1977. The volume of runoff for the specified periods is also shown.

Floodmark data are included in table 5 and can be used to estimate maximum flood levels along selected reaches of the following 27 streams in the Mahoning Creek and Conemaugh River basins:

Mahoning Creek basin:
- Mahoning Creek
  - Stump Creek

Conemaugh River basin:
- Conemaugh River
  - Stony Creek
    - Shade Creek
    - Paint Creek
      - Seese Run
        - Weaver Run
      - Little Paint Creek
    - Sams Run
    - Solomon Run
  - Little Conemaugh River
    - Spring Run
    - Trout Run
    - North Branch Little Conemaugh River
    - South Fork Little Conemaugh River
      - Sandy Run
    - St. Clair Run
    - Laurel Run
    - Blacklick Creek
      - North Branch Blacklick Creek
      - South Branch Blacklick Creek
      - Two Lick Creek
        - North Branch Two Lick Creek
        - Buck Run
        - Dixon Run
        - Yellow Creek

BREACHED DAMS

Extremely high flows in the Conemaugh River basin resulted in the failure of seven earthfill gravity-type dams. The locations of the breached dams are shown on the map in figure 15*B* and are given in table 2, which also gives the age and size of each structure. Peak discharges were determined at sites upstream and downstream from the Sandy Run and Laurel Run Dams and downstream from three other dams. Site numbers for referencing the peak-flow data are given in the last column of table 2.

Figure 29 and 30 show profiles of the maximum water-surface elevations downstream from Laurel and Sandy Run Dams. Floodmark data used to construct the profiles are included in table 5.

Because of the destruction and deaths caused by these failures and by others in the past, flooding caused by the Laurel Run Dam was analyzed in detail. Flood

TABLE 1.—*Summary of flood stages and discharges*

Site (fig. 15)	Station	Stream and place of determination	Drainage area (mi²)	Period	Maximum flood previously known: Month and year	Maximum flood previously known: Gage height (feet)	Maximum flood previously known: Discharge (ft³/s)	Flood of July 1977: Date	Flood of July 1977: Gage height (feet)	Flood of July 1977: Discharge (ft³/s)	Flood of July 1977: Unit discharge ((ft³/s)/mi²)	Flood of July 1977: Recurrence interval (years)
		Redbank Creek basin										
1	03031950	Big Run near Sprankle Mills	7.38	1963–77	Feb. 1966	6.23	822	19	6.22	960	130	15
					Feb. 1975	6.12	858					
2	03032500	Redbank Creek at St. Charles	528	1910–77	Mar. 1936	[1]18.60	50,000	20	14.72	19,500	37	5
		Mahoning Creek basin										
3	03033220	Stump Creek at Big Run	26.8	—	—	—	—	—	—	5,240	196	—
4	03034000	Mahoning Creek at Punxsutawney	158	1936–77	June 1972	15.94	17,300	20	16.22	12,700	80	40
5	03034500	Little Mahoning Creek at McCormick	87.4	1939–77	June 1972	13.20	6,200	20	12.77	5,770	66	20
					Feb. 1977	[2]14.03	—					
6	03036000	Mahoning Creek at Mahoning Creek Dam.	344	1938–77	Mar. 1942	8.10	[3]10,400	22	7.35	[3]6,560	19	3
		Crooked Creek basin										
7	03037300	Crooked Creek at Shelocta	117	—	—	—	—	—	—	9,940	85	—
8	03038000	Crooked Creek at Idaho	191	1936–77	Mar. 1936	18.6	19,400	20	13.38	[3]8,860	46	10
9	03039000	Crooked Creek at Crooked Cr. Dam	278	1909–77	Mar. 1936	17.86	21,000	22	7.65	4,150	15	1
		Conemaugh River Basin										
10	03039200	Clear Run near Buckstown	3.68	1961–77	Feb. 1961	[1]5.30	—	20	5.03	366	99	30
					June 1972	4.53	266					
11	03039910	Seese Run at Windber	4.66	—	—	—	—	—	—	5,760	1,240	—
12	03039914	Paint Creek at Windber	21.8	—	—	—	—	—	—	19,000	872	—
13	03040000	Stony Creek at Ferndale	451	1913–77	Mar. 1936	[1]30.26	[3]59,000	20	23.21	[3]48,000	106	100
14	03040016	Sams Creek at Geistown	1.28	—	—	—	—	—	—	1,600	1,250	—
15	03040018	Sams Run at Lorain	2.17	—	—	—	—	—	—	2,960	1,360	—
16	03040095	North Branch Little Conemaugh River tributary near Ebensburg.	.80	—	—	—	—	—	—	[4]1,040	1,300	—
17	03040300	Little Conemaugh River at Summerhill	91.1	—	—	—	—	—	—	8,670	95	—
18	03040420	Otto Run at Salix	3.70	—	—	—	—	—	—	[4]2,120	573	—
19	03040430	South Fork Little Conemaugh River tributary at St. Michael.	1.70	—	—	—	—	—	—	[4]4,300	2,530	—
20	03040500	South Fork Little Conemaugh River at Fishertown.	52.6	—	—	—	—	—	—	24,000	456	—
21	03040503	Sandy Run above Sandy Run Reservoir near St. Michael.	5.86	—	—	—	—	—	—	14,000	2,390	—
22	03040505	Sandy Run below Sandy Run Reservoir at St. Michael.	7.61	—	—	—	—	—	—	[4]15,300	2,010	—
23	03041000	Little Conemaugh River at East Conemaugh.	183	1936–77	Mar. 1936	—	[3]28,800	20	18.85	[3]40,000	219	>100
					June 1972	10.48	[3]16,600					
24	03041030	Elk Run at Morrellville	1.99	—	—	—	—	—	—	1,900	955	—
25	03041038	Laurel Run at Chickaree	.055	—	—	—	—	—	—	19	345	—
26	03041039	Laurel Run above Laurel Run Reservoir near Coopersdale.	7.56	—	—	—	—	—	—	10,500	1,390	—
27	03041040	Red Run near Coopersdale	2.00	—	—	—	—	—	—	4,000	2,000	—
28	03041043	Laurel Run below Laurel Run Reservoir near Coopersdale.	11.0	—	—	—	—	—	—	[4]37,000	3,360	—
29	03041046	Wildcat Run at Coopersdale	1.97	—	—	—	—	—	—	2,440	1,240	—
30	03041500	Conemaugh River at Seward	715	1936–77	Mar. 1936	22.95	[3]75,000	20	27.06	[3]115,000	161	>100
31	03042000	Blacklick Creek at Josephine	192	1952–77	June 1972	13.99	20,800	20	19.89	45,700	238	>100
32	03042170	Stoney Run at Indiana	4.39	1963–77	Sept. 1974	8.87	505	—	[5]10–11	—	—	—
33	03042180	Two Lick Creek near Homer City	95.5	—	—	—	—	—	—	16,500	173	—
34	03042198	Little Yellow Creek tributary at Strongstown.	.76	—	—	—	—	—	—	1,450	1,910	—
35	03042200	Little Yellow Creek near Strongstown	7.36	1959–77	June 1972	6.10	820	20	9.31	4,250	577	>100
36	03042280	Yellow Creek near Homer City	57.4	1967–77	Feb. 1971	[2]8.37	—	20	12.60	[3]15,000	261	>100
					June 1972	7.46	4,100					
37	03042282	Ferrier Run near Homer City	2.14	—	—	—	—	—	—	890	416	—
38	03042500	Two Lick Creek at Graceton	171	1951–77	June 1972	14.69	[3]19,600	20	18.65	[3]32,000	187	>100
39	03044000	Conemaugh River at Tunnelton	1,358	1939–77	Mar. 1945	21.0	[3]59,200	21	11.98	[3]23,600	17	3
		West Branch Susquehanna River basin										
40	01540600	West Branch Susquehanna River at Barnesboro.	25.8	—	—	—	—	—	—	2,400	93	—
41	01540650	West Branch Susquehanna River at Cherrytree.	58.8	—	June 1972	—	6,790	—	—	6,000	102	—
42	01541000	West Branch Susquehanna River at Bower.	315	1889–1977	Mar. 1936	19.74	31,500	20	16.23	19,200	61	30
43	01541200	West Branch Susquehanna River at Curwensville.	367	1955–77	Mar. 1964	14.19	15,700	23	8.47	[3]5,660	15	3
44	01541308	Bradley Run near Ashville	6.77	1967–77	June 1972	3.82	679	20	3.65	602	89	15
45	01541321	Brubaker Run at Dean	3.82	—	—	—	—	—	—	1,370	359	—
46	01541365	North Witmer Run at Irvona	30.8	—	—	—	—	—	—	10,000	325	—
47	01541500	Clearfield Creek at Dimeling	371	1913–77	Mar. 1936	[1]18.49	30,600	20	11.27	[3]9,210	25	4
48	01542000	Moshannon Creek at Osceola Mills	68.8	1940–77	June 1972	14.25	5,120	20	1.97	339	5	1

TABLE 1.—*Summary of flood stages and discharges*—Continued

Site (fig. 15)	Station	Stream and place of determination	Drainage area (mi²)	Maximum flood previously known: Period	Maximum flood previously known: Month and year	Maximum flood previously known: Gage height (feet)	Maximum flood previously known: Discharge (ft³/s)	Flood of July 1977: Date	Flood of July 1977: Gage height (feet)	Flood of July 1977: Discharge (ft³/s)	Flood of July 1977: Unit discharge ((ft³/s)/mi²)	Flood of July 1977: Recurrence interval (years)
		Juniata River basin										
49	01556000	Frankstown Branch Juniata River at Williamsburg.	291	1889–1977	June 1889	19.1	35,500	20	8.11	2,930	10	1
50	01556400	Sandy Run near Bellwood	5.58	1962–77	Sept. 1967	6.25	900	20	5.89	550	99	10
51	01556500	Little Juniata River at Tipton	93.7	1946–77	June 1972	9.24	6,140	20	9.07	5,580	60	10
52	01557100	Schell Run at Tyrone	1.68	1958–77	July 1969	3.00	225	20	1.97	45	27	1
53	01557500	Bald Eagle Creek at Tyrone	44.1	1936–77	Mar. 1936	[1]15	—	20	1.41	112	3	1
					Nov. 1950	[1]7.5	5,140	—	—	—	—	—
54	01558000	Little Juniata River at Spruce Creek	220	1936–77	Mar. 1936	19.1	39,800	20	7.52	5,760	26	3
55	01559700	Buffalo Run tributary near Manns Choice.	5.28	1961–77	Sept. 1967	4.26	1,010	20	5.12	1,120	212	20
56	01560000	Dunning Creek at Belden	172	1936–77	Mar. 1936	[6]17.8	16,900	20	14.15	19,400	113	>100
		Potomac River Basin										
57	01600700	Little Wills Creek at Bard	10.2	1961–77	Sept. 1967	8.91	1,100	20	11.00	3,000	294	70

[1] Different site or datum.
[2] Backwater from ice.
[3] Regulated by reservoirs upstream.
[4] Downstream of breached dam.
[5] Peaked 1–2 feet above gage.
[6] Backwater from Raystown Branch Juniata River.

FIGURE 23.—Flooding at Johnstown's Lee Hospital. The dark line across the center of the photograph shows the maximum flood level. (Johnstown Tribune-Democrat photograph.)

TABLE 2.—*Breached dams*

[Data furnished by the Pennsylvania Department of Environmental Resources]

Stream and location	Latitude	Longitude	Date built	Drainage area (mi²)	Surface area at normal pool elevation (acres)	Storage capacity at spillway elevation (10^6 gal)	Height (feet)	Number of site at which peak flow data are provided (see table 1)
Sandy Run near St. Michael	40°19′40″	78°48′10″	1915	5.6	8	15	28	21, 22
Laurel Run near Coopersdale	40°23′05″	78°54′55″	1914	7.9	22	101	42	26, 28
Otto Run at Salix	40°17′40″	78°45′35″	1956	1.9	2	2	19	18
South Fork tributary at St. Michael	40°19′30″	78°46′20″	Unknown	1.5	2	1	6	19
North Branch tributary near Ebensburg.	40°28′20″	78°41′30″	Unknown	.65	2.2	6	18	16
Peggys Run at Franklin	40°20′10″	78°53′00″	Unknown	1.1	<1	<1	12	None.
Little Paint Creek at Elton	40°16′50″	78°47′15″	Unknown	1.5	3	3	10	None.

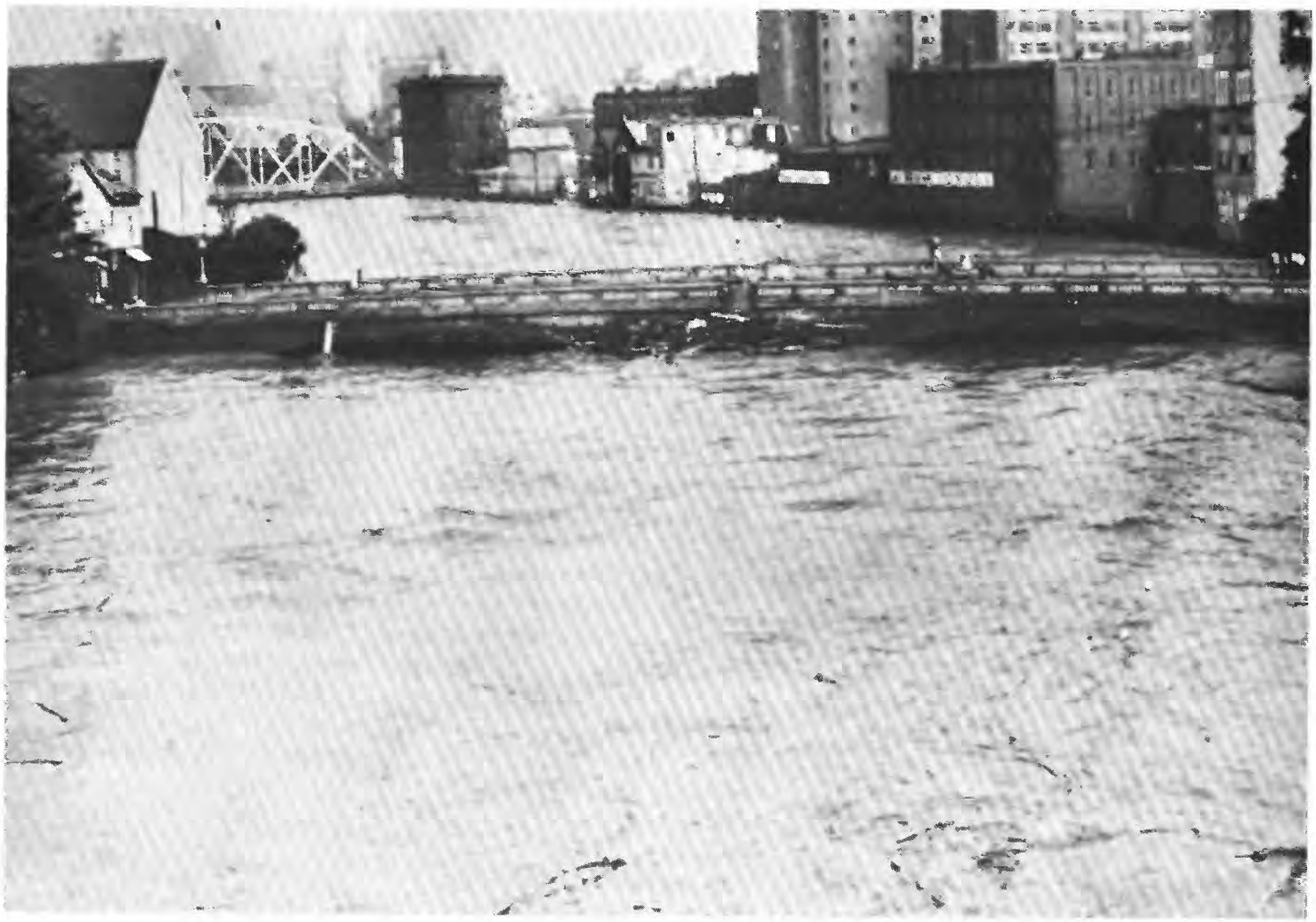


FIGURE 24.—Stony Creek near the height of the flood. View is of Haynes Street bridge looking downstream toward Johnstown's business district. (Johnstown Tribune-Democrat photograph.)

hydrographs describing inflow to the reservior and the flows of major tributaries were constructed from rainfall data collected in and near the Laurel Run basin. These data were used, along with reservoir and channel cross-sections, to verify a dam-break flood-wave-routing model. Armbruster (1978) gives a brief discussion of the model.

HISTORICAL FLOODS

Throughout its history, the area discussed in this report has had an uncommonly high frequency of flooding. The relatively narrow, steep-sided valleys characteristic of much of the area are probably a major factor contributing to its high flood potential. The

FIGURE 25.–Maximum heights of the 1889, 1936, and 1977 floods at Johnstown's City Hall at northeast corner of Main and Market Streets. (U.S. Geological Survey photograph.)

severity of floods just west of the Ohio River–Susquehanna River drainge divide has also been attributed to increased rainfall intensities resulting from orographic uplift. Other factors are the area's position relative to the tracks of most Northeastern United States storms and its proximity to a large source of moisture, the Great Lakes. Flood plain development has also increased the damage potential of flooding in many parts of the report area, especially in the Johnstown area, which has had three devasting floods within the last 90 years.

The May 31, 1889 flood, commonly referred to as "the Johnstown Flood", was one of the worst catastrophies ever in the United States. About 2,200 persons died, and nearly 1,000 persons were reported missing, and believed to have died as a result of the failure of an 80 ft high dam on the South Fork Little Conemaugh River, 13 miles upstream from Johnstown. Just before the failure, Johnstown and surrounding areas were experiencing severe floods as a result of 6 to 8 in. of storm rainfall the preceding day. Runoff from the storm had also caused the water level behind the South Fork Dam to rise far above normally safe levels. As the water level continued rising, leaks were reported in the dam's earthen embankment. Accounts of the failure (Shank, 1972) state that the leaks progressively worsened and that at about 3:00 p.m. (May 31), the dam suddenly burst, releasing about 20 million tons of water on the flooded valley below. The resulting flood wave estimated at 30 to 40 ft. Seven small towns were destroyed as the wave travelled the 13 miles to Johnstown in about 15 minutes. Downtown Johnstown, at the mouth of the Little Conemaugh River and directly in the path of the flood wave, was almost destroyed. A stone, multi-arched railroad bridge over the Conemaugh River in Johnstown was able to withstand the wave, which greatly reduced damages farther downstream.

Though overshadowed by the catastrophe at Johnstown, floods on other streams in the area on May 31 and June 1, 1889, were also severe. It was the highest known flood on the Frankstown Branch Juniata River at Williamsburg (site 49), where the peak stage was at least 0.5 ft higher than any that have occurred since 1889, and the second highest known on the West Branch Susquehanna River at Bower (site 42).

Flooding occurred frequently in the Johnstown area during the next four decades, but not until March 1936 was flooding severe and widespread enough to rival that in 1889. Nearly the entire Northeast was affected by floods during March 1936, which resulted from combinations of snowmelt and storm runoff.

Although there was some melting of the abnormally deep snowpack by the end of February 1936, the major thaw did not begin until March 9, initiated by unseasonably warm temperatures and 1 to 2 in. of rainfall. The snowmelt and runoff associated with the first storm did not cause flooding, but they did increase the potential for flooding. The second series of storms beginning on March 16 brought 5 to 8 in. of rain, most of which fell on March 17. Runoff from these storms, combined with further melting, produced floods comparable to that of 1889 in much of the area. Downtown Johnstown was inundated by 15 to 20 ft of water, the maximum known for a naturally produced flood. It was the greatest known flood on Stony Creek at Ferndale (site 13), where records are available since 1913, and also at seven gaging sites in the report area but outside the Conemaugh River basin.

At Johnstown, Stony Creek and the Little Conemaugh and Conemaugh Rivers were realigned and partly paved, so that flood flows equivalent to the March 1936 flood would be contained within their channel banks.

(Text continued on p. 54.)

FIGURE 26.–Destruction along an unnamed tributary to the Conemaugh River between the Coopersdale and Minersville sections of Johnstown. The drainage area above this site is about 0.5 mi^2. (Pennsylvania Air National Guard photograph.)

FIGURE 27.–(See caption on facing page.)

FIGURE 27.–Laurel Run Dam. *A*,The left photograph shows the view looking downstream through the breach. (Pennsylvania Air National Guard photograph). *B,* The right photograph shows the eroded downstream face of the dam. The breach is at the far end. (U.S. Geological Survey photograph.)

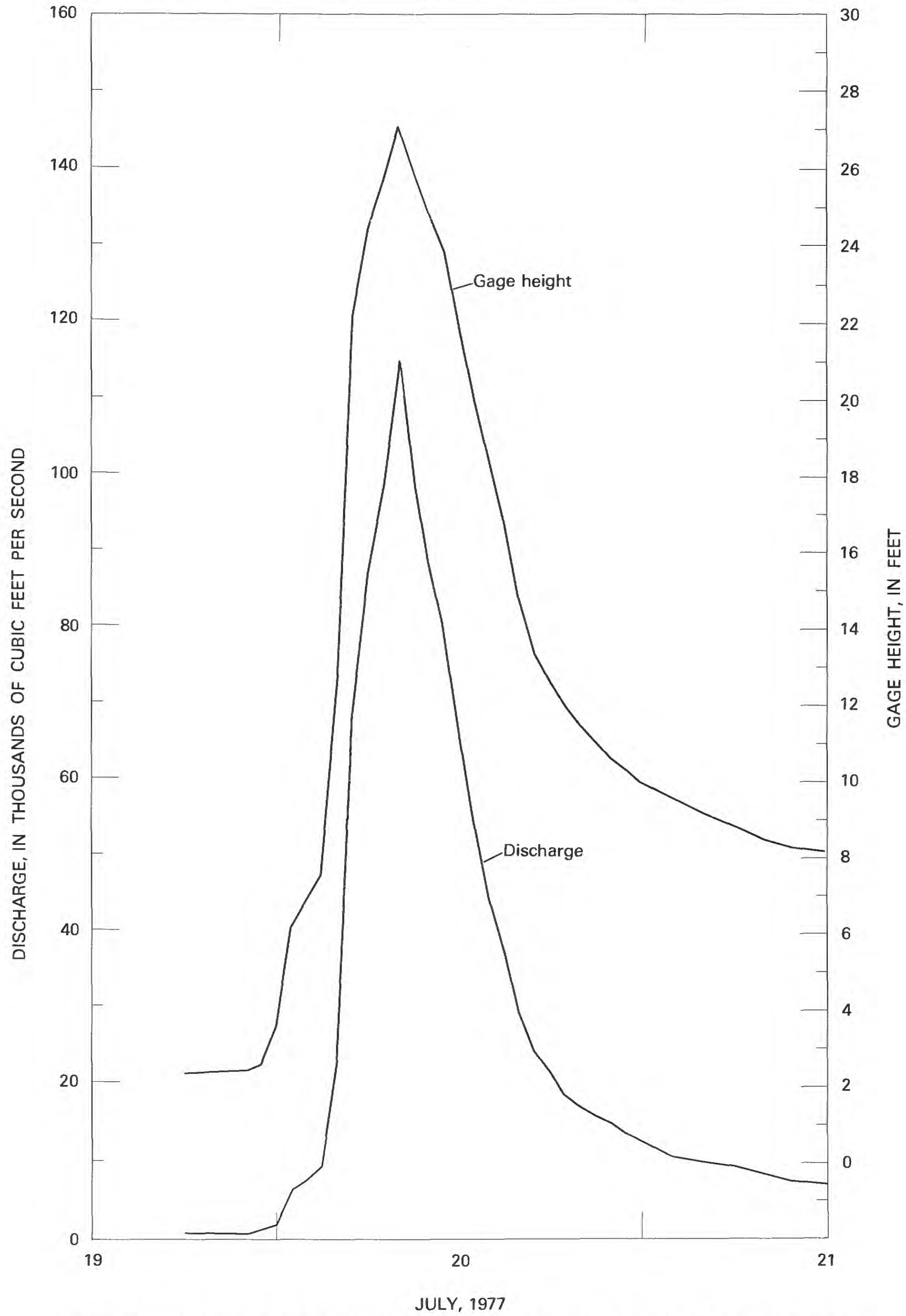


FIGURE 28.—Hydrographs of stage and discharge of the Conemaugh River at Seward (site 30).

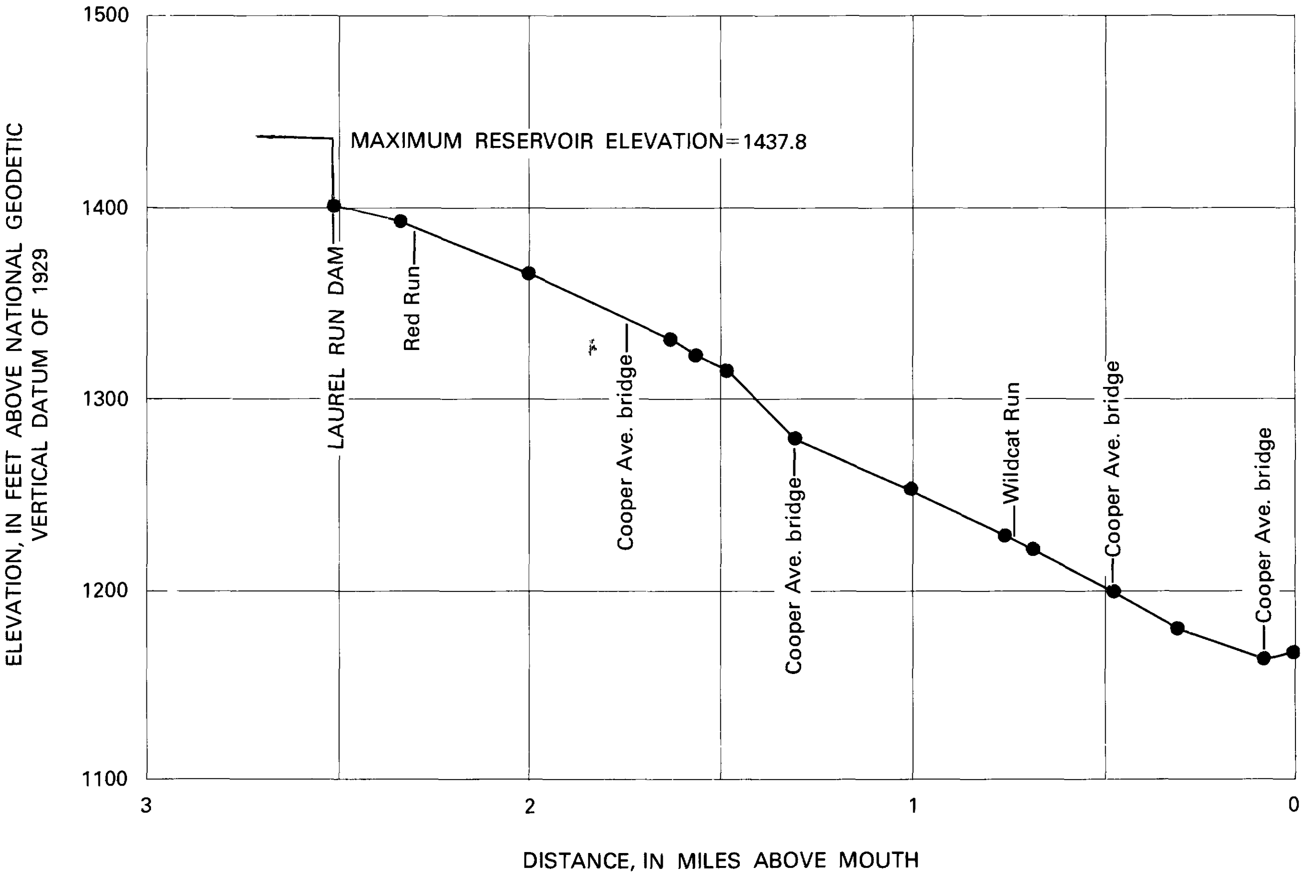


FIGURE 29.—Flood-crest profile below Laurel Run Dam.

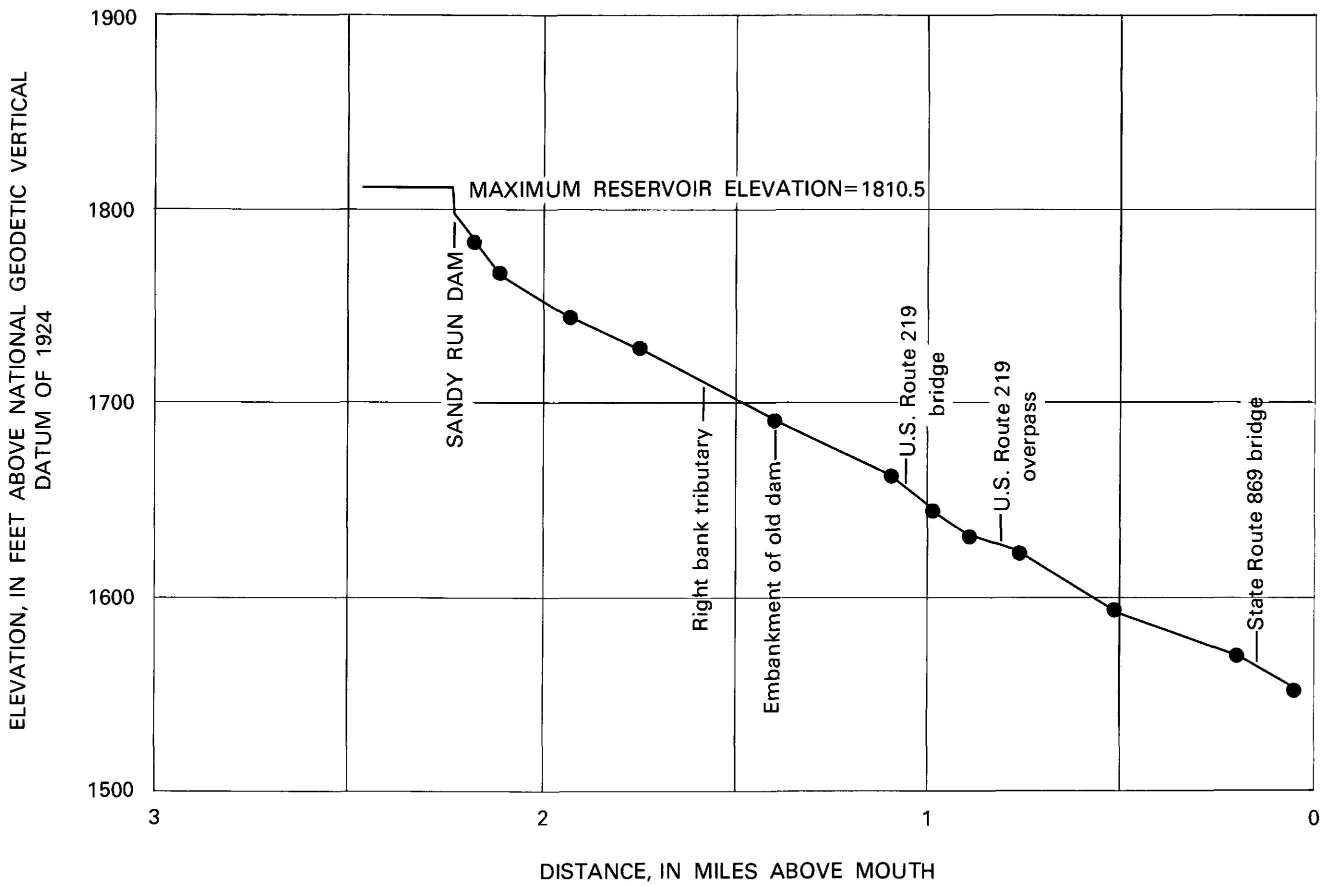


FIGURE 30.—Flood-crest profile below Sandy Run Dam.

FIGURE 31. – Flood damage downstream from the Laurel Run Dam. The foundations of two homes that were washed away are visible in the upper left corner (Pennsylvania Air National Guard photograph).

FIGURE 32.–Eastbound lanes of State Highway 56, near Johnstown's eastern corporate boundary, undermined by floodwaters from Solomon Run (Pennsylvania Air National Guard photograph).

FIGURE 33.—Home damaged by flooding from Solomon Run in the Walnut Grove section of Johnstown (Johnstown Tribune-Democrat photograph.)

FIGURE 34.-Flooding in the Hornerstown section of Johnstown (Johnstown Tribune-Democrat photograph.)

TABLE 3.-*Losses in individual severe floods in the United States since July 1902*

[Adapted from National Oceanic and Atmospheric Administration (1977) and includes only those floods resulting in 60 or more deaths or property losses in excess of $200 million]

Date	Location	Lives lost	Property damage (thousands of dollars)
May-June 1903	Kansas, lower Missouri, and upper Mississippi Rivers.	100	40,000
Mar. 1913	Ohio River and tributaries	467	147,000
Dec. 1913	Texas rivers	177	9,000
June 1921	Arkansas River in State of Colorado	120	25,000
Sept. 1921	Texas rivers	215	19,000
Spring, 1927	Mississippi Valley	313	284,000
Nov. 1927	New England rivers	88	45,578
May-June 1935	Republican and Kansas Rivers	110	18,000
Mar.-Apr. 1936	Rivers in Eastern United States	107	270,000
Jan.-Feb. 1937	Ohio and lower Mississippi River basins	137	417,685
Mar. 1938	Streams in Southern California	79	24,500
July 1939	Licking and Kentucky Rivers	78	1,715
May-July 1947	Lower Missouri and middle Mississippi River basins.	29	235,000
June-July 1951	Kansas and Missouri	28	923,224
Aug. 1955	Hurricane "Dianne" floods in the northeastern United States.	187	714,079
Dec. 1955	West Coast rivers	61	154,532
Dec. 1964	California and Oregon	40	415,832
June 1965	South Platte River basin	16	415,076
Jan.-Feb. 1969	Floods in California	60	399,233
Feb. 1972	Buffalo Creek, West Virginia	125	10,000
June 1972	Black Hills of South Dakota	237	164,947
June 1972	Hurricane "Agnes" floods in the eastern United States.	105	4,019,721
Spring, 1973	Mississippi River basin	33	1,154,770
June-July 1975	Red River of the North basin	<10	273,114
Sept. 1975	Hurricane "Eloise" floods in Puerto Rico and northeastern United States.	50	470,274
June 1976	Teton Dam failure in southeast Idaho	11	1,000,000
July 1976	Big Thompson River in Colorado	139	30,000
Apr. 1977	Southern Appalachian Mountains area	22	424,000
July 1977	Johnstown-Western Pennsylvania	78	330,000

Since its completion in 1943, this channelization was twice credited with preventing serious floods at Johnstown, once in October 1954 and again in June 1972.

DEATHS AND DAMAGES

The Great Johnstown Flood of 1977, as described by many residents, was among the more devasting floods in the history of the United States, as shown in table 3. It is especially noteworthy when one considers the size of the area affected. Most of the property damage occurred within a 200-mi² area, whereas other floods listed in table 3 generally occurred over areas that are 10-1,000 times larger.

Although damages have not been officially compiled in detail, the total may exceed the estimated $330 million (National Oceanic and Atmospheric Administration, 1977), as indicated by the following estimates. A spokesman for the Greater Johnstown Chamber of Commerce, reported that 640 dwelling units were destroyed and another 2,600 sustained major damages, a loss of about $26 million. Also, 405 business structures were destroyed, of which more than half were in downtown Johnstown, where business damages totalled $136 million. In addition, the Bethlehem Steel Corp., the area's largest employer, estimated that damages to its facilities would total $35-40 million.

A report by the Pennsylvania House of Representatives (1976) lists railroad damage at $20 million and states that damages to the area's utilities were in excess of $20 million, mostly properties of the Pennsylvania Electric Co. Other estimates of damage listed in the Johnstown Tribune-Democrat include $94 million of roadway and bridge repair and $62.7 million for repairs to public facilities. Also, 3,300 motor vehicles and 8.2 million pounds of food were estimated to have been destroyed. The photographs in figures 31-34 show scenes of the destruction in the Johnstown area.

At least 78 lives were lost as a direct result of the flood. Also, eight others, who were listed as missing 1 year later, probably died. Flooding along Laurel Run, downstream from the breached dam, was responsible for about half of the fatalilties. Many also died along Solomon Run, in the south part of Johnstown, and along the Conemaugh River near Seward.

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TABLES 4 AND 5

TABLE 4.—*Site descriptions and gage-height and discharge data.*

[Site numbers used in this table are the same as those used in table 1 and figure 15. Hydrologic Unit numbers are included in the site description for each continuous-record gaging station. This number designates a geographic area representing part or all of a surface drainage basin or distinct hydrologic feature as delineated by the Office of Water Data Coordination, U.S. Geological Survey (1974). If needed, hourly stage and discharge data for times other than those shown should be determined either graphically or by linear interpolation]

SITE 1.—03031950. Big Run near Sprankle Mills, Pa.

Location.—Lat 40°59'30", long 79°05'26", Jefferson County, Hydrologic Unit 05010006, on the right bank at the downstream side of a highway bridge 0.5 mi (0.8 km) downstream from McCracken Run and 1.3 mi (2.1 km) southeast of Sprankle Mills.
Gage.—Water-stage recorder and crest-stage gage. The altitude of the gage is 1,290 ft (393 m), from a topographic map.

Time	Gage height (ft)	Discharge (ft^3/s)	Time	Gage height (ft)	Discharge (ft^3/s)	Time	Gage height (ft)	Discharge (ft^3/s)
July 19:			July 20:			July 21:		
0600	2.12	6.2	0100	5.38	588	0200	2.57	45
1200	2.12	6.2	0200	5.69	706	0600	2.50	38
1400	2.22	12	0300	5.86	774	1200	2.41	30
1600	2.75	57	0400	5.71	714	1600	2.36	26
1700	2.68	50	0500	5.27	550			
1800	2.51	35	0600	4.37	304			
1900	2.41	26	0800	3.53	160			
2000	3.26	114	1000	3.29	126			
2100	5.66	674	1200	3.15	108			
2200	6.07	838	1400	2.99	90			
2230	6.22	960	1600	2.88	78			
2300	6.13	905	1800	2.78	67			
2400	5.69	706	2000	2.68	56			
			2200	2.63	51			
			2400	2.60	48			

Total runoff, in inches 1.96

SITE 2.—03032500. Redbank Creek at St. Charles, Pa.

Location.—Lat 40°59'40", long 79°23'40", Armstrong County, Hydrologic Unit 05010006, on the left bank 400 ft (120 m) downstream from a highway bridge on Legislative Route 03117 at St. Charles, 0.3 mi (0.5 km) downstream from Leatherwood Creek, and 3 mi (5 km) west of New Bethlehem. A water-quality sampling site is 400 ft (120 m) upstream.
Gage.—Water-stage recorder. Datum of the gage is 973.14 ft (296.613 m) NGVD, datum of 1912. Prior to July 10, 1940, a nonrecording gage was at a site 500 ft (150 m) upstream, at a datum 3.10 ft (0.94 m) higher.

Time	Gage height (ft)	Discharge (ft^3/s)	Time	Gage height (ft)	Discharge (ft^3/s)	Time	Gage height (ft)	Discharge (ft^3/s)
July 19:			July 20:			July 22:		
0100	4.74	830	0900	14.65	19,300	0200	7.77	3,800
0600	4.63	775	1000	14.50	18,800	0600	7.56	3,530
1200	4.51	715	1100	14.18	17,700	0800	7.42	3,350
1800	4.50	710	1200	13.78	16,400	1200	7.23	3,100
2000	4.54	730	1400	12.83	13,700	1800	6.88	2,660
2100	4.76	840	1600	11.94	11,400	2400	6.62	2,340
2200	5.19	1,070	1800	11.21	9,760	July 23:		
2300	5.82	1,560	2000	10.60	8,500	0600	6.40	2,100
2400	6.75	2,500	2200	10.03	7,450	1200	6.19	1,890
July 20:			2400	9.52	6,540	1800	5.97	1,680
0100	7.79	3,830	July 21:			2400	5.75	1,500
0200	8.98	5,570	0200	9.11	5,800	July 24:		
0300	10.86	9,020	0400	8.78	5,250	0600	5.55	1,340
0400	12.46	12,700	0600	8.52	4,830	1200	5.37	1,200
0500	13.23	14,800	1200	7.98	4,070	1800	5.21	1,090
0600	13.67	16,100	1800	7.79	3,830	2400	5.07	1,000
0700	14.15	17,500	2000	7.82	3,870			
0800	14.52	18,900	2200	7.90	3,970			
0830	14.72	19,500	2400	7.82	3,870			

Total runoff, in inches 1.65

TABLE 4.—*Site description and gage-height and discharge data*—Continued

SITE 3.—03033220. Stump Creek at Big Run, Pa.

Location.—Lat 40°58'39", long 78°50'48", Jefferson County, at the Baltimore and Ohio Railroad bridge 0.5 mi (0.8 km) upstream from the mouth, 1.0 mi (1.6 km) northeast of Big Run, and 5.6 mi (9.0 km) south of Sykesville.
Gage.—Miscellaneous site.

SITE 4.—03034000. Mahoning Creek at Punxsutawney, Pa.

[NOTE: Gage height and discharges are estimated beginning at 1800 hours on July 21]
Location.—Lat 40°56'21", long 79°00'31", Jefferson County, Hydrologic Unit 05010006, on the right bank 75 ft (23 m) downstream from Williams Run, 1.9 mi (3.1 km) downstream from Sawmill Run, and 2 mi (3 km) west of Punxsutawney
Gage.—Water-stage recorder. Datum of the gage is 1,206.14 ft (367.631 m) NGVD of 1929. (Corps of Engineers bench mark). Prior to October 1, 1946, the gage was at a site 2.9 mi (4.7 km) upstream, at a datum 13.30 ft (4.054 m) higher.

Time	Gage height (ft)	Discharge (ft^3/s)	Time	Gage height (ft)	Discharge (ft^3/s)	Time	Gage height (ft)	Discharge (ft^3/s)
July 19:			July 20:			July 21:		
0100	2.77	478	0100	6.42	2,970	0200	7.40	2,760
0600	2.68	442	0200	8.22	4,610	0600	6.60	2,240
1200	2.60	410	0300	10.20	6,740	1200	6.34	2,080
1300	2.58	403	0400	11.30	8,170	1800	6.00	1,900
1400	2.60	410	0500	12.52	8,860	2000	5.90	1,850
1600	2.89	526	0600	13.62	9,740	2200	6.25	2.030
1800	3.06	610	0700	14.78	11,200	2400	6.40	2,120
2000	3.26	710	0800	15.68	12,200	July 22:		
2100	3.58	878	0915	16.22	12,700	0600	5.95	1,880
2200	4.21	1,300	1000	16.13	12,400	1200	5.50	1,650
2300	4.92	1,790	1100	16.00	12,100	1800	5.10	1,450
2400	5.44	2,160	1200	15.57	11,200	2400	4.70	1,250
			1400	14.46	9,750	July 23:		
			1600	13.14	8,170	0600	4.40	1,100
			1800	11.78	6,780	1200	4.05	925
			2000	10.44	5,440	1800	3.70	750
			2200	9.22	4,320	2400	3.50	670
			2400	8.14	3,350			

Total runoff, in inches 3.16

SITE 5.—03034500. Little Mahoning Creek at McCormick, Pa.

Location.—Lat 40°50'10", long 79°06'37", Indiana County, Hydrologic Unit 05010006, on the left bank 200 ft (60 m) upstream from the highway bridge at McCormick, 1 mi (2 km) west of Georgeville, 1.7 mi (2.7 km) upstream from Ross Run, and 4 mi (6 km) southeast of Smicksburg.
Gage.—Water-stage recorder. Datum of the gage is 1,164.88 ft (355.055 m) NGVD of 1929. (Corps of Engineers bench mark). Prior to May 10, 1940, a nonrecording gage was at a site 200 ft (60 m) upstream, at the same datum.

Time	Gage height (ft)	Discharge (ft^3/s)	Time	Gage height (ft)	Discharge (ft^3/s)	Time	Gage height (ft)	Discharge (ft^3/s)
July 19:			July 20:			July 21:		
0100	2.00	58	1000	12.42	5,420	1400	5.19	767
0600	1.94	53	1100	12.68	5,680	1500	5.10	740
1200	1.89	48	1200	12.76	5,760	1600	5.75	960
1800	1.91	50	1230	12.77	5,770	1800	7.15	1,520
1900	1.92	51	1300	12.77	5,770	2000	7.64	1,720
2000	2.23	82	1400	12.68	5,680	2200	8.19	2,030
2100	2.33	94	1500	12.53	5,530	2400	8.80	2,400
2200	2.66	138	1600	12.30	5,300	July 22:		
2300	3.15	230	1700	12.00	5,000	0200	9.20	2,650
2400	3.97	425	1800	11.63	4,630	0230	9.21	2,660
July 20:			2000	10.69	3,750	0300	9.19	2,640
0100	5.69	896	2200	9.48	2,850	0400	9.04	2,540
0200	6.86	1,400	2400	8.24	2,060	0600	8.43	2,180
0300	7.70	1,750	July 21:			1200	6.43	1,230
0400	8.77	2,380	0200	7.15	1,520	1800	5.57	888
0500	9.81	3,080	0400	6.51	1,260	2400	4.92	686
0600	10.35	3,480	0600	6.14	1,120	July 23:		
0700	10.80	3,840	0800	5.85	1,000	0600	4.54	572
0800	11.32	4,320	1000	5.60	900	1200	4.27	498
0900	11.95	4,950	1200	5.39	827			

Total runoff, in inches 2.99

TABLE 4.—*Site description and gage-height and discharge data*—Continued

SITE 6.—03036000. Mahoning Creek at Mahoning Creek Dam, Pa.

Location.—Lat 40°55′39″, long 79°17′29″, Armstrong County, Hydrologic Unit 05010006, on the left bank at the downstream side of the highway bridge at McCrea Furnace, 700 ft (213 m) downstream from Camp Run, 0.9 mi (1.4 km) downstream from Mahoning Creek Dam, 1 mi (2 km) southwest of Eddyville, and 2.1 mi (3.4 km) upstream from Pine Run.
Gage.—Water-stage recorder. Datum of the gage is 1,003.39 ft (305.833 m) NGVD of 1929 (Corps of Engineers bench mark). Prior to February 1, 1940, a nonrecording gage was at the same site and datum.
Remarks.—Flow has been completely regulated since 1941 by Mahoning Creek Lake, 0.9 mi (1.4 km) upstream.

Time	Gage height (ft)	Discharge (ft^3/s)	Time	Gage height (ft)	Discharge (ft^3/s)	Time	Gage height (ft)	Discharge (ft^3/s)
July 19:			July 20:			July 22:		
0100	3.84	1,020	1200	3.55	815	0100	6.88	5,400
0600	3.83	1,010	1400	3.53	801	1200	6.88	5,400
1200	3.81	998	1600	3.89	1,060	1345	7.35	6,560
1300	3.20	590	1800	3.94	1,100	1400	7.35	6,560
1800	3.08	530	2000	4.86	1,930	1700	7.35	6,560
2400	3.31	656	2200	4.90	1,970	1800	6.85	5,330
July 20:			2400	4.93	2,000	2400	6.90	5,440
0100	3.49	773	July 21:			July 23:		
0200	4.32	1,420	0200	4.94	2,010	0600	6.99	5,660
0300	4.60	1,670	0400	4.95	2,030	1200	7.00	5,690
0400	4.13	1,250	0900	4.97	2,050	1800	7.00	5,690
0500	3.85	1,030	1000	5.74	3,080	2400	7.01	5,720
0600	3.75	955	1200	5.76	3,120	July 24:		
0800	3.68	906	1300	6.88	5,400	0600	7.01	5,720
1000	3.60	850	2400	6.88	5,400	1200	7.02	5,740
						1800	7.02	5,740
						2400	7.02	5,740

Total runoff, in inches 2.47

SITE 7.—03037300. Crooked Creek at Shelocta, Pa.

Location.—Lat 40°39′35″, long 79°18′40″, Indiana County, 0.4 mi (0.6 km) upstream from State Highway 156 bridge and 0.5 mi (0.8 km) northeast of intersection of U.S. Highway 422 and State Highway 156, at Shelocta.
Gage.—Miscellaneous site.

SITE 8.—03038000. Crooked Creek at Idaho, Pa.

[NOTE: Gage heights and discharges estimated from 1800 hours on July 20 to 1000 hours on July 21]
Location.—Lat 40°39′17″, long 79°20′56″, Armstrong County, Hydrologic Unit 05010006, on the right bank at the downstream end of the old bridge abutment at Idaho, 0.4 mi (0.6 km) downstream from Keystone Generating Station, 1.5 mi (2.4 km) downstream from Plum Creek, and 2.4 mi (3.9 km) west of Shelocta.
Gage.—Water-stage recorder and concrete weir control. Datum of the gage is 961.04 ft (292.925 m) NGVD of 1929. (Baltimore and Ohio Railroad bench mark).
Remarks.—Flow has been regulated to some extent since March 1968 by Keystone Lake, 7 mi (11 km) upstream, which has a usable capacity of 22,010 acre-ft (27.1 hm^3). Evaporation from the operation of a steam-electric plant 0.4 mi (0.6 km) upstream, which began during July 1967, can amount to as much as 30 ft^3/s (0.85 m^3/s).

Time	Gage height (ft)	Discharge (ft^3/s)	Time	Gage height (ft)	Discharge (ft^3/s)	Time	Gage height (ft)	Discharge (ft^3/s)
July 19:			July 20:			July 22:		
1200	2.48	51	1400	12.44	7,730	0200	7.52	3,510
1500	2.61	72	1500	12.79	8,150	0400	7.66	3,610
1800	2.76	102	1600	13.10	8,520	0600	7.75	3,680
1900	2.76	102	1700	13.38	8,860	0700	7.76	3,680
2000	2.80	111	1800	13.25	8,700	0800	7.73	3,660
2100	3.38	340	1900	13.04	8,450	0900	7.63	3,590
2200	4.33	951	2000	12.62	7,940	1000	7.46	3,480
2300	5.59	1,920	2100	12.01	7,260	1200	6.92	3,040
2400	6.85	2,980	2200	11.40	6,650	1400	6.28	2,500
July 20:			2300	10.78	6,030	1600	5.82	2,110
0100	7.48	3,480	2400	10.22	5,500	1800	5.50	1,850
0200	7.93	3,800	July 21:			2400	4.83	1,310
0300	8.30	4,060	0200	9.33	4,780	July 23:		
0400	8.68	4,330	0400	8.54	4,230	0600	4.45	1,040
0500	9.08	4,610	0600	7.77	3,690	1200	4.25	895
0600	9.54	4,930	0800	6.98	3,080	1800	4.05	755
0700	9.93	5,240	1000	6.19	2,420	2400	3.87	629
0800	10.30	5,570	1200	5.44	1,800	July 24:		
0900	10.67	5,920	1400	5.03	1,470	0600	3.74	544
1000	11.06	6,310	1500	4.95	1,410	1200	3.67	502
1100	11.44	6,690	1600	5.24	1,640	1800	3.56	436
1200	11.82	7,070	1800	6.18	2,410	2400	3.48	390
1300	12.13	7,380	2000	6.86	2,990			
			2200	7.11	3,190			
			2400	7.30	3,340			

Total runoff, in inches 2.65

TABLE 4.—*Site description and gage-height and discharge data*—Continued

SITE 9.—03039000. Crooked Creek at Crooked Creek Dam, Pa.

Location.—Lat 40°43′13″, long 79°30′42″, Armstrong County, Hydrologic Unit 05010006, on the right bank 0.4 mi (0.6 km) downstream from Crooked Creek Dam, 3.5 mi (5.6 km) south of Ford City, and 6.7 mi (10.8 km) upstream from mouth.
Gage.—Water-stage recorder. Datum of gage is 799.51 ft (243.691 m) NGVD of 1929. Prior to August 1, 1933, a nonrecording gage was at a site 2 mi (3 km) downstream, at a different datum. From July 31, 1933, to December 5, 1939, a nonrecording gage was at a site 1.5 mi (2.4 km) downstream, at a different datum.
Remarks.—Flow has been completely regulated since 1940 by Crooked Creek Lake, 0.4 mi (0.6 km) upstream, and since 1968, by Keystone Lake; the combined capacity of the lakes is 115,910 acre-ft (143 hm^3).

Time	Gage height (ft)	Discharge (ft^3/s)	Time	Gage height (ft)	Discharge (ft^3/s)	Time	Gage height (ft)	Discharge (ft^3/s)
July 19:			July 21:			July 23:		
0600	1.23	99	0200	4.09	1,260	0600	7.51	4,010
1200	1.23	99	0400	4.12	1,280	1200	7.44	3,940
1800	1.24	101	0600	4.17	1,310	1800	7.36	3,860
1900	1.24	101	0800	4.19	1,320	2400	7.28	3,780
2000	1.33	120	1000	5.36	2,140	July 24:		
2100	1.31	115	1200	5.40	2,170	0600	7.19	3,690
2200	1.28	109	1400	6.68	3,200	1200	7.07	3,570
2300	1.29	111	1600	6.70	3,220	1800	6.97	3,470
2400	1.29	111	1800	6.69	3,210	2400	6.85	3,350
July 20:			2000	6.68	3,200	July 25:		
0600	1.29	111	2200	6.68	3,200	0600	6.71	3,230
0800	1.31	115	2400	6.68	3,200	0900	6.63	3,160
1000	2.41	474	July 22:			1000	4.76	1,720
1200	2.42	478	0200	6.69	3,210	1100	4.83	1,770
1400	2.45	490	0400	6.69	3,210	1200	4.74	1,720
1600	3.91	1,160	0600	6.69	3,210	1300	3.79	1,090
1800	3.99	1,200	0800	6.69	3,210	1400	3.77	1,080
2000	4.01	1,220	1000	6.69	3,210	1600	3.79	1,090
2200	4.05	1,240	1200	6.72	3,240	1800	3.81	1,100
2400	4.09	1,260	1300	7.62	4,120	2000	3.84	1,110
			1400	7.65	4,150	2200	3.87	1,130
			1600	7.64	4,140	2400	3.90	1,150
			1800	7.62	4,120			
			2000	7.59	4,090			
			2200	7.59	4,090			
			2400	7.57	4,070			

Total runoff, in inches 2.23

SITE 10.—03039200. Clear Run near Buckstown, Pa.

Location.—Lat 40°02′49″, long 78°50′00″, Somerset County, Hydrologic Unit 05010007, on the left bank at the downstream side of the bridge on State Highway 160, 0.8 mi (1.3 km) south of Reels Corners and 2.3 mi (3.7 km) southeast of Buckstown.
Gage.—Water-stage recorder, crest-stage gage, and concrete control. Datum of the gage is 2,339.24 ft (713.00 m) NGVD of 1929. From July 6, 1960, to Aug. 31, 1964, a crest-stage gage was at a site 50 ft (15 m) upstream, at the same datum.

Time	Gage height (ft)	Discharge (ft^3/s)	Time	Gage height (ft)	Discharge (ft^3/s)	Time	Gage height (ft)	Discharge (ft^3/s)
July 19:			July 20:			July 20:		
0100	2.18	0.51	0400	2.38	1.7	1400	3.20	66
1200	2.18	.51	0500	3.81	23	1600	3.06	50
1800	2.17	.48	0530	5.03	366	1800	2.97	40
2200	2.16	.45	0600	4.68	296	2000	2.91	33
2300	2.31	1.1	0700	4.31	222	2200	2.86	28
2400	2.27	.88	0800	4.14	196	2400	2.82	24
July 20:			0900	3.92	163	July 21:		
0100	2.29	.99	1000	3.68	129	0600	2.74	17
0200	2.34	1.3	1100	3.53	108	1200	2.66	11
0300	2.34	1.3	1200	3.41	91	1600	2.62	8.8

Total runoff, in inches 0.76

SITE 11.—03039910. Seese Run at Windber, Pa.

Location.—Lat 40°13′44″, long 78°49′43″, Somerset County, at the bridge on State Highway 160 in Windber, 0.4 mi (0.6 km) upstream from the mouth.
Gage.—Miscellaneous site.

SITE 12.—03039914. Paint Creek at Windber, Pa.

Location.—Lat 40°14′33″, long 78°50′47″, Somerset County, along State Highway 56, 0.4 mi (0.6 km) upstream from State Highway 601 near the northwest corporate boundary.
Gage.—Miscellaneous site.

TABLE 4.—*Site description and gage-height and discharge data*—Continued

SITE 13.—03040000. Stoney Creek at Ferndale, Pa.

[NOTE: Gage heights and discharges are estimated beginning at 0800 hours on July 20]

Location.—Lat 40°17'08", long 78°55'15", Cambria County, Hydrologic Unit 05010007, on the right bank 50 ft (15 m) upstream from the highway bridge at Ferndale, 0.4 mi (0.6 km) doownstream from Bens Creek, 1.2 mi (1.9 km) upstream from the Johnstown city limits, and 5.2 mi (8.4 km) upstream from the confluence with the Little Conemaugh River.

Gage.—Water-stage recorder. Datum of the gage is 1,184.06 ft (360.901 m) NGVD of 1929. Prior to March 19, 1936, a nonrecording gage was at a site 3.5 mi (5.6 km) downstream, at a different datum. From December 8, 1938, to January 30, 1940, a nonrecording gage was at a site 50 ft (15 m) downstream, at the present datum.

Remarks. Regulation is by mine pumpage and reservoirs and by diversion above the station; the four largest reservoirs have a combined capacity of 42,360 acre-ft (52.2 hm³).

Time	Gage height (ft)	Discharge (ft³/s)	Time	Gage height (ft)	Discharge (ft³/s)	Time	Gage height (ft)	Discharge (ft³/s)
July 19:			July 20:			July 21:		
0100	2.26	97	0600	18.27	38,800	0600	6.50	4,050
0600	2.23	92	0700	23.21	48,000	1200	6.00	3,280
1200	2.19	84	0800	21.50	45,500	1800	5.64	2,530
1800	2.19	84	0900	20.10	43,000	2400	5.32	2,090
1900	2.26	97	1000	18.80	40,200	July 22:		
2200	2.27	99	1100	17.40	36,300	1200	4.79	1,520
2300	2.53	169	1200	16.10	32,300	2400	4.46	1,190
2400	2.99	350	1400	13.30	22,600	July 23:		
July 20:			1600	10.70	14,100	1200	4.18	924
0100	3.72	796	1800	9.15	9,710	2400	3.94	732
0200	4.64	1,640	2000	8.20	7,430			
0300	5.07	2,070	2200	7.58	6,060			
0400	5.38	2,420	2400	7.20	5,300			
0500	8.99	9,330						

Total runoff, in inches 1.98

SITE 14.—03040016. Sams Run at Geistown, Pa.

Location.—Lat 40°17'20", long 78°52'58", Cambria County, 0.4 mi (0.6 km) upstream from the corporate boundary at the State Highway 756 bridge in Geistown.

Gage.—Miscellaneous site

SITE 15.—03040018. Sams Run at Lorain, Pa.

Location.—Lat 40°17'42", long 78°54'04", Cambria County, in an artificial channel between city residence numbers 369 to 375 along State Highway 756 in Lorain.

Gage.—Miscellaneous site.

SITE 16.—03040095. North Branch Little Conemaugh River tributary near Ebensburg, Pa.

Location.—Lat 40°28'05", long 78°41'31", Cambria County, at a dirt road crossing 0.1 m: (0.2 km) downstream from the Tong Club dam, 1.2 mi (1.9 km) upstream from the mouth, 2.0 mi (3.2 km) southeast of Ebensburg, and 2.1 mi (3.4 km) west of Munster.

Gage.—Miscellaneous site.

SITE 17.—03040300. Little Conemaugh River at Summerhill, Pa.

Location.—Lat 40°22'19", long 78°46'00", Cambria County, at the State Highway 53 bridge southwest of Summerhill, 500 ft (150 m) upstream from the Conrail bridge, 0.6 mi (1.0 km) downstream from Laurel Run, and 1.5 mi (2.4 km) above South Fork Little Conemaugh River.

Gage.—Miscellaneous site.

SITE 18.—03040420. Otto Run at Salix, Pa.

Location.—Lat 40°17'43", long 78°45'30", Cambria County, at a bridge on a paved road 0.5 mi (0.8 km) southeast of Salix and 300 feet (90 m) downstream from a small reservoir.

Gage.—Miscellaneous site.

SITE 19—03040430. South Fork Little Conemaugh River tributary at St. Michael, Pa.

Location.—Lat 40°19'35", long 78°46'23", Cambria County, 400 ft (120 m) downstream from a reservoir, 0.6 mi (1.0 km) south of Saint Michael, 0.7 mi (1.1 km) upstream of mouth, and 2.8 mi (4.5 km) southeast of South Fork.

Gage.—Miscellaneous site.

SITE 20.—03040500. South Fork Little Conemaugh River at Fishertown, Pa.

Location.—Lat 40°20'54", long 78°46'32", Cambria County, at the old South Fork Reservoir dam site at Fishertown and 0.1 mi (0.2 km) upstream from U.S. Highway 219.

Gage.—Miscellaneous site.

SITE 21.—03040503. Sandy Run above Sandy Run Reservoir near St. Michael, Pa.

Location.—Lat 40°19'30", long 78°48'09", Cambria County, 0.2 mi (0.3 km) upstream from Sandy Run Reservoir and 1.8 mi (2.9 km) southwest of St. Michael.

Gage.—Miscellaneous site.

TABLE 4.—*Site description and gage-height and discharge data*—Continued

SITE 22.—03040505. Sandy Run below Sandy Run Reservoir at St. Michael, Pa.

Location.—Lat 40°20'10", long 78°47'21", Cambria County, just upstream from the U.S. Highway 219 bridge, 0.9 mi (1.4 km) west of St. Michael, and 0.9 mi (1.4 km) northeast of Sandy Run Dam.

Gage.—Miscellaneous site.

SITE 23.—03041000. Little Conemaugh River at East Conemaugh, Pa.

Location.—Lat 40°20'37", long 78°53'07", Cambria County, Hydrologic Unit 05010007, on the right bank 100 ft (30 m) downstream from the bridge on State Highway 271 at East Conemaugh, 0.3 mi (0.5 km) downstream from Clapboard Run, and 2.5 mi (4.0 km) upstream from the confluence with Stony Creek.

Gage.—Water-stage recorder. Datum of gage is 1,208.29 ft (368.287 m) NGVD of 1929. Prior to February 1, 1940, a nonrecording gage was at a site 100 ft (30 m) upstream, at the same datum.

Remarks.—Flow is regulated by reservoirs and by diversion above the station; the two most effective reservoirs have a combined capacity of 5,640 acre-ft (6.95 hm³).

Time	Gage height (ft)	Discharge (ft³/s)	Time	Gage height (ft)	Discharge (ft³/s)	Time	Gage height (ft)	Discharge (ft³/s)
July 19:			July 20:			July 22:		
1800	1.66	140	1100	10.21	15,500	0600	3.31	2,820
2100	1.66	140	1200	9.39	13,800	1200	2.95	2,280
2200	1.87	191	1400	8.45	11,900	1800	2.60	1,790
2300	2.62	542	1600	7.63	10,300	2400	2.35	1,460
2400	3.65	1,340	1800	7.16	9,400	July 23:		
July 20:			2000	6.80	8,740	0600	2.20	1,260
0100	3.75	1,460	2200	6.49	8,180	1200	2.03	1,040
0200	5.77	4,240	2400	6.16	7,590	1800	1.87	856
0300	9.27	13,000	July 21:			2400	1.92	904
0400	10.60	16,300	0300	5.84	7,010	July 24:		
0500	12.35	20,400	0600	5.58	6,540	0600	1.72	664
0600	18.09	37,100	0900	5.37	6,170	1200	1.68	618
0615	18.85	40,000	1200	5.19	5,840	1800	1.66	596
0700	17.45	34,700	1500	4.82	5,210	2400	1.64	574
0800	15.12	27,400	1800	3.77	3,530			
0900	12.86	21,700	2100	3.64	3,360			
1000	11.37	18,100	2200	3.67	3,420			
			2400	3.64	3,360			

Total runoff, in inches 4.70

SITE 24.—03041030. Elk Run at Morrellville, Pa.

Location.—Lat 40°20'33", long 78°56'39", Cambria County, just upstream from Fairview Ave. and St. Columbus Cemetery in Morrellville.

Gage.—Miscellaneous site.

SITE 25.—03041038. Laurel Run at Chickaree, Pa.

Location.—Lat 40°26'54", long 78°53'09", Cambria County, at a culvert on the road between Chickaree and Vintondale, 0.25 mi (0.40 km) northwest of Chickaree.

Gage.—Miscellaneous site.

SITE 26.—03041039. Laurel Run above Laurel Run Reservoir near Coopersdale, Pa.

Location.—Lat 40°23'16", long 78°54'34", Cambria County, at the inlet to Laurel Run Reservoir, 1,900 ft (580 m) upstream from the dam and 2.5 mi (4.0 km) north of Coopersdale.

Gage.—Miscellaneous site.

SITE 27.—03041040. Red Run near Coopersdale, Pa.

Location.—Lat 40°22'57", long 78°55'09", Cambria County, at the mouth, 0.3 mi (0.5 km) southwest of Laurel Run Dam and 2 mi (3 km) northeast of Coopersdale.

Gage.—Miscellaneous site.

SITE 28.—03041043. Laurel Run below Laurel Run Reservoir near Coopersdale, Pa.

Location.—Lat 40°22'45", long 78°55'07", Cambria County, 300 ft (90 m) downstream from the Cooper Ave. bridge, 0.9 mi (1.4 km) upstream from Wildcat Run, 1.6 mi (2.6 km) above the mouth, and 1.5 mi (2.4 km) northeast of Coopersdale.

Gage.—Miscellaneous site.

SITE 29.—03041046. Wildcat Run at Coopersdale, Pa.

Location.—Lat 40°22'10", long 78°55'58", Cambria County, at the mouth, 1.0 mi (1.6 km) north of Coopersdale and 300 ft (90 m) downstream from Cooper Ave.

Gage.—Miscellaneous site.

TABLE 4.—*Site description and gage-height and discharge data*—Continued

SITE 30.—03041500. Conemauigh River at Seward, Pa.

Location.—Lat 40°25'09", long 79°01'35", Westmoreland County, Hydrologic Unit 05010007, on the left bank at the upstream side of a bridge on State Highway 56 at Seward, 2.0 mi (3.2 km) downstream from Findley Run and 9 mi (14 km) northwest of Johnstown.
Gage.—Water-stage recorder. Datum of the gage is 1,076.01 ft (327.968 m) NGVD of 1929.
Remarks.—Flow is regulated by steel mills and by reservoirs above the station; the eight most effective reservoirs have a combined capacity of 51,850 acre-ft (63.9 hm³).

Time	Gage height (ft)	Discharge (ft³/s)	Time	Gage height (ft)	Discharge (ft³/s)	Time	Gage height (ft)	Discharge (ft³/s)
July 19:			July 20:			July 21:		
0100	2.47	529	1200	21.73	65,500	1200	8.02	7,260
0600	2.42	494	1300	19.90	54,500	1400	7.86	6,690
1200	2.37	459	1400	18.23	44,500	1600	7.72	6,380
1800	2.34	438	1500	16.74	37,300	1800	7.78	6.520
2200	2.38	466	1600	14.70	29,300	2000	7.72	6,380
2300	2.55	585	1700	13.29	24,400	2200	7.72	6,380
2400	3.61	1,690	1800	12.52	22,100	2400	7.85	6,670
July 20:			1900	11.88	18,800	July 22:		
0100	6.16	6,250	2000	11.38	17,500	0600	7.48	5,860
0200	6.83	7,730	2100	10.98	15,900	1200	7.13	5,160
0300	7.55	9,440	2200	10.60	15,200	1800	6.82	4,540
0400	12.76	23,100	2300	10.30	13,900	2400	6.52	3,940
0500	22.09	68,300	2400	9.98	12,900	July 23:		
0600	24.40	86,600	July 21:			0600	6.28	3,340
0700	25.65	98,000	0200	9.48	10,200	1200	6.12	3,060
0800	27.06	115,000	0400	9.08	9,990	1800	5.92	2,720
0900	25.85	99,500	0600	8.80	9,560	2400	5.78	2,660
1000	24.75	88,800	0800	8.46	8,260			
1100	23.74	80,100	1000	8.20	7,660			

Total runoff, in inches ________ 3.10

SITE 31—03042000. Blacklick Creek at Josephine, Pa.

Location.—Lat 40°28'24", long 79°11'01", Indiana County, Hydrologic Unit 05010007, on the right bank on the upstream side of an old concrete dam at Josephine, 0.9 mi (1.4 km) upstream from Two Lick Creek and 5 mi (8 km) northeast of Blairsville. A water-quality sampling site is 820 ft (250 m) downstream.
Gage.—Water-stage recorder and crest-stage gage. Datum of the gage is 975.82 ft (297.430 m) NGVD, datum of 1912. Prior to August 25, 1953, a nonrecording gage was at the same site and datum.
Remarks.—Some regulation at low flow is by mine pumpage above the station.

Time	Gage height (ft)	Discharge (ft³/s)	Time	Gage height (ft)	Discharge (ft³/s)	Time	Gage height (ft)	Discharge (ft³/s)
July 19:			July 20:			July 21:		
0100	4.06	251	1200	17.94	34,200	2200	6.70	1,600
0600	3.84	180	1300	17.34	31,200	2300	6.76	1,660
1200	3.62	118	1400	16.29	26,300	2400	6.91	1,810
1800	3.59	111	1500	14.55	19,300	July 22:		
2100	3.63	121	1600	13.65	16,300	0100	7.01	1,910
2200	4.16	289	1700	12.50	12,700	0200	7.00	1,900
2300	6.46	2,280	1800	11.80	10,800	0300	6.97	1,870
2400	10.87	10,600	1900	11.05	8,780	0800	6.83	1,730
July 20:			2000	10.35	7,260	1200	6.47	1,380
0100	11.90	13,200	2100	9.65	5,860	1800	6.19	1,150
0200	11.79	12,900	2200	9.05	4,730	2400	5.93	944
0300	11.90	13,200	2300	8.75	4,240	July 23:		
0400	12.55	15,000	2400	8.50	3,840	0600	5.74	804
0500	14.45	21,100	July 21:			1200	5.62	732
0600	16.15	27,100	0200	8.40	3,700	1800	5.47	642
0700	17.70	33,800	0400	7.93	3,040	2400	5.36	576
0800	19.15	41,300	0600	7.68	2,720	July 24:		
0830	19.89	45,700	0800	7.47	2,460	0600	5.25	515
0900	19.55	42,800	1000	7.29	2,250	1200	5.19	485
1000	19.00	39,500	1200	7.13	2,060	1800	5.14	460
1100	18.30	36,000	1800	6.80	1,700	2400	5.14	460

Total runoff, in inches ________ 4.93

SITE 32.—03042170. Stoney Run at Indiana, Pa.

Location.—Lat 40°36'31", long 79°09'49", Indiana County, at the southwest edge of Indiana, 300 ft (90 m) west of U.S. Highway 119 and 0.1 mi (0.2 km) below Marsh Run.
Gage.—Crest-stage.

TABLE 4.—*Site description and gage-height and discharge data*—Continued

SITE 33.—03042180. Two Lick Creek near Homer City, Pa.

Location.—Lat 40°33'51", long 79°09'42", Indiana County, at a bridge on U.S. Highway 219, 4.2 mi (6.8 km) south of Indiana.
Gage.—Miscellaneous site.

SITE 34.—03042198. Little Yellow Creek tributary at Strongstown, Pa.

Location.—Lat 40°33'33", long 78°56'19", Indiana County, at a highway culvert on U.S Highway 422, 2,000 ft (610 m) upstream from the mouth, 0.8 mi (1.3 km) northwest of Strongstown, and 1.5 mi (2.4 km) southeast of Nolo.
Gage.—Miscellaneous site.

SITE 35.—03042200. Little Yellow Creek near Strongstown, Pa.

Location.—Lat 40°33'45", long 78°56'44", Indiana County, Hydrologic Unit 05010007, on the right bank 100 ft (30 m) downstream from a concrete box culvert on U.S. Highway 422, 1.4 mi (2.3 km) northwest of Strongstown, 6 mi (10 km) upstream from the mouth, and 11 mi (18 km) southeast of Indiana.
Gage.—Water-stage recorder and crest-stage gage. Datum of the gage is 1,586.83 ft (483.666 m) NGVD. From August 25, 1959 to August 31, 1960, a low-flow gage and, from November 6, 1959 to August 31, 1960, a crest-stage gage were at a site 100 ft (30 m) upstream, at the same datum.

Time	Gage height (ft)	Discharge (ft³/s)	Time	Gage height (ft)	Discharge (ft³/s)	Time	Gage height (ft)	Discharge (ft³/s)
July 19:			July 20:			July 21:		
1400	1.61	3.7	0500	8.37	2,690	1800	4.53	120
1500	1.83	8.7	0600	7.19	1,390	2000	4.42	103
1600	1.92	12	0700	6.59	903	2200	4.35	93
1700	1.95	13	0800	6.08	600	2400	4.29	85
2000	1.89	10	0900	5.73	452	July 22:		
2100	4.31	252	1000	5.50	360	0600	4.15	68
2200	5.30	470	1200	5.14	252	1200	4.05	56
2300	5.60	560	1800	4.67	140	1800	3.96	47
2400	5.42	506	2400	4.45	108	2400	3.88	39
July 20:			July 21:			July 23:		
0100	7.84	2,040	0600	4.31	87	0600	3.84	36
0200	7.92	2,120	1200	4.17	70	1200	3.74	27
0300	7.57	1,770	1500	4.11	63	1800	3.69	23
0400	9.31	4,250	1600	4.41	102	2400	3.65	21

Total runoff, in inches ________ 3.65

SITE 36.—03042280. Yellow Creek near Homer City, Pa.

Location.—Lat 40°34'18", long 79°06'13", Indiana County, Hydrologic Unit 05010007, on the left bank, 0.3 mi (0.5 km) upstream from the Central Indiana County Water Authority dam and 3.5 mi (5.6 km) northeast of Homer City.
Gage.—Water-stage recorder. Altitude of the gage is 1,140 ft (347 m), from a topographic map.
Remarks.—Flows are not adjusted for the effect of Ferrier Run following a flood-induced break in the Ferrier Run diversion project. Ferrier Run now enters Yellow Creek between the dam (flow measurement site) and the gaging station, instead of downstream from the dam.

Time	Gage height (ft)	Discharge (ft³/s)	Time	Gage height (ft)	Discharge (ft³/s)	Time	Gage height (ft)	Discharge (ft³/s)
July 19:			July 20:			July 21:		
1200	2.62	48	0700	12.60	15,000	0200	7.02	3,330
1800	2.64	51	0800	12.25	14,000	0400	6.79	3,050
2000	2.65	53	0900	12.02	13,400	0600	6.57	2,780
2100	3.06	148	1000	11.61	12,300	1200	5.98	2,080
2200	3.79	455	1100	11.28	11,500	2400	5.40	1,500
2300	5.12	1,470	1200	10.85	10,500	July 22:		
2400	5.39	1,740	1400	10.01	8,620	1200	4.83	1,030
July 20:			1600	9.17	6,840	2400	4.31	686
0100	5.55	1,900	1800	8.59	5,760	July 23:		
0200	6.85	3,370	2000	8.11	4,980	1200	3.95	485
0300	8.21	5,140	2200	7.70	4,320	2400	3.69	366
0400	9.53	7,770	2400	7.39	3,850	July 24:		
0500	11.11	11,100				1200	3.50	290
0600	12.03	13,400				2400	3.36	236

Total runoff, in inches ________ 7.69

SITE 37.—03042282. Ferrier Run near Homer City, Pa.

Location.—Lat 40°34'18", long 79°06'13", Indiana County, at an artificial channel near the mouth near Yellow Creek near the Homer City gaging station, 3.5 mi (5.6 km) northeast of Homer City and 4.5 mi (7.2 km) southeast of Indiana.
Gage.—Miscellaneous site.

TABLE 4.–*Site description and gage-height and discharge data*–Continued

SITE 38.—03042500. Two Lick Creek at Graceton, Pa.

NOTE: [Gage heights and discharges estimated from 1600 hours on July 20 until 0600 hours on July 21.]

Location.–Lat 40°31′02″, long 79°10′19″, Indiana County, Hydrologic Unit 05010007, on the right bank 0.8 mi (1.3 km) upstream from a highway bridge on the road leading west from Graceton, 1.1 mi (1.8 km) downstream from Tearing Run, 1.5 mi (2.4 km) upstream from Cherry Run, and 8 mi (13 km) northeast of Blairsville. A water-quality sampling site is at a bridge 0.8 mi (1.3 km) downstream.

Gage.–Water-stage recorder. Datum of the gage is 981.63 ft (299.201 m) NGVD of 1929.

Remarks.–Diurnal fluctuation is caused by mine pumpage and by a sewage-disposal plant above the station. Flow has been regulated since December 1968 by Two Lick Creek Reservoir, 10 mi (16 km) upstream, which has a capacity of 16,240 acre-ft (20.0 hm³), and since July 1971, by Yellow Creek Lake, 11 mi (18 km) upstream.

Time	Gage height (ft)	Discharge (ft³/s)	Time	Gage height (ft)	Discharge (ft³/s)	Time	Gage height (ft)	Discharge (ft³/s)
July 19:			July 20:			July 21:		
0100	2.45	160	0800	17.75	29,500	1800	7.50	3.400
0600	2.42	151	0900	18.30	31,000	1900	7.71	3.610
1200	2.43	154	0930	18.65	32,000	2000	7.72	3,620
1400	2.46	163	1000	18.33	28,500	2100	7.55	3,450
1600	2.52	181	1100	18.08	27,000	2200	7.39	3,290
1700	2.55	190	1200	17.60	24,000	2400	7.16	3,080
1800	2.56	193	1400	17.00	21,600	July 22:		
1900	2.53	184	1600	15.80	17,800	0600	6.77	2,720
2000	2.97	320	1800	14.40	13,900	1200	6.50	2,480
2100	5.53	1,700	2000	12.90	10,700	1800	6.25	2,280
2200	8.55	4,460	2200	11.40	8,200	2400	4.15	795
2300	10.12	6,540	2400	10.30	6,650	July 23:		
2400	10.60	7,500	July 21:			0600	3.93	685
July 20:			0200	9.50	5,520	1200	3.70	590
0100	10.28	6,860	0400	9.08	5,050	1800	3.54	526
0200	10.34	6,980	0600	8.69	4,620	2400	3.40	470
0300	11.55	9,680	0700	8.50	4,410	July 24:		
0400	12.68	12,800	1200	7.73	3,630	0600	3.31	434
0500	13.79	16,200	1400	7.47	3,370	1200	3.23	402
0600	15.16	20,500	1600	7.25	3,160	1800	3.14	366
0700	16.78	26,300	1700	7.23	3.140	2400	3.08	343

Total runoff, in inches ______ 5.34

SITE 39.—03044000. Conemaugh River at Tunnelton, Pa.

Location.–Lat 40°27′16″, long 79°23′28″, Indiana County, Hydrologic Unit 05010007, on the right bank at the downstream side of a highway bridge at Tunnelton, 0.9 mi (1.4 km) downstream from Boatyard Run, 2.0 mi (3.2 km) downstream from Conemaugh River Dam, 3.8 mi (6.1 km) southeast of Saltsburg, and 5.5 mi (8.9 km) upstream from the confluence with Loyalhanna Creek.

Gage.–Water-stage recorder. Datum of the gage is 844.64 ft (257.446 m) NGVD of 1929. Prior to October 1, 1952, a nonrecording gage was at the same site and datum.

Remarks.–Flow has been regulated since 1971 by Yellow Creek Lake; since 1952, by Conemaugh River Lake, 2 mi (3 km) upstream, and by reservoirs above the station, the nine most effective of which have a combined capacity of 68,090 acre-ft (840.0 hm³). Evaporation from the operation of the Homer City and Conemaugh generating stations, which began during 1969 and 1970, respectively, can amount to as much as 45 ft³/s (1.3 m³/s).

Time	Gage height (ft)	Discharge (ft³/s)	Time	Gage height (ft)	Discharge (ft³/s)	Time	Gage height (ft)	Discharge (ft³/s)
July 19:			July 21:			July 24:		
1200	3.62	1,510	2200	11.89	23,300	0300	11.34	21,400
1800	3.61	1,500	2300	11.98	23,600	0600	11.29	21,200
2400	3.63	1,530	2400	11.98	23,600	0900	11.23	21,000
July 20:			July 22:			1000	10.31	18,100
0300	3.75	1,720	0600	11.97	23,600	1100	10.09	17,400
0600	3.88	1,950	0900	11.94	23,500	1200	10.05	17,300
0900	4.01	2,870	1200	11.91	23,400	1500	10.00	17,100
1200	4.56	3,170	1500	11.87	23,300	1800	9.96	17,000
1500	5.99	6,140	1800	11.84	23,100	2400	9.86	16,700
1800	7.34	9,450	2100	11.81	23,000	July 25:		
2100	8.62	12,800	2400	11.77	22,900	0600	9.76	16,400
2400	9.15	14,500	July 23:			1200	9.72	16,200
July 21:			0300	11.73	22,700	1300	8.78	13,300
0300	9.51	15,500	0600	11.69	22,600	1400	8.58	12,700
0600	9.99	17,100	0900	11.64	22,400	1500	7.60	10,100
0900	10.24	17,800	1200	11.59	22,300	1600	7.36	9,500
1200	10.35	18,200	1500	11.54	22,100	1800	7.33	9,420
1500	10.77	19,500	1800	11.50	22,000	2000	7.33	9,420
1800	11.27	21,200	2100	11.44	21,800	2200	7.32	9,400
2100	11.62	22,400	2400	11.39	21,600	2400	7.32	9,400

Total runoff, in inches ______ 2.82

SITE 40.—01540600. West Branch Susquehanna River at Barnesboro, Pa.

Location.–Lat 40°40′10″, long 78°47′29″, Cambria County, at the 22nd St. bridge in Barnesboro.

Gage.–Miscellaneous site.

TABLE 4.–*Site description and gage-height and discharge data*–Continued

SITE 41.—01540650. West Branch Susquehanna River at Cherry Tree, Pa.

Location.–Lat 40°43′34″, long 78°48′20″, Indiana County, at State Highway bridge 5H580 in Cherry Tree, 200 ft (60 m) downstream from Cush Cushion Creek.

Gage.–Miscellaneous site.

SITE 42.—01541000. West Branch Susquehanna River at Bower, Pa.

Location.–Lat 40°53′49″, long 78°40′38″, Clearfield County, Hydrologic Unit 02050201, on the right bank at the downstream side of the highway bridge at Bower, 4.6 mi (7.4 km) downstream from Chest Creek and Mahaffey.

Gage.–Water-stage recorder. Datum of the gage is 1,207.14 ft (367.936 m) NGVD of 1929. Prior to October 17, 1929, a nonrecording gage was at the same site and datum.

Time	Gage height (ft)	Discharge (ft³/s)	Time	Gage height (ft)	Discharge (ft³/s)	Time	Gage height (ft)	Discharge (ft³/s)
July 19:			July 20			July 21:		
0600	5.24	313	0500	15.50	17,000	2100	10.10	4,740
1200	5.14	278	0600	15.18	16,000	2200	10.27	5,000
1300	5.12	271	0700	14.98	15,400	2300	10.23	4,940
1400	5.13	274	0800	14.85	15,100	2400	10.15	4,820
1500	5.12	271	0900	14.82	15,000	July 22:		
1800	5.13	274	1200	14.83	15,000	0300	9.88	4,420
1900	5.16	285	1500	14.63	14,400	0600	9.39	3,740
2000	5.37	362	1800	14.52	14,100	0900	8.93	3,150
2100	5.65	474	2100	14.44	13,900	1200	8.64	2,800
2200	6.35	832	2400	14.32	13,600	1800	8.27	2,400
2300	9.60	4,030	July 21:			2400	7.84	1,980
2400	13.00	10,200	0300	14.02	12,700	July 23:		
July 20:			0600	13.10	10,400	1200	7.24	1,450
0100	16.12	18,900	0900	11.40	6,850	2400	6.84	1,150
0130	16.23	19,200	1200	10.35	5,120	July 24:		
0200	16.15	19,000	1500	9.77	4,270	1200	6.55	958
0300	15.98	18,500	1800	9.46	3,830	2400	6.30	802
0400	15.80	17,900	1900	9.55	3,960			
			2000	9.85	4,380			

Total runoff, in inches ______ 3.37

SITE 43—01541200. West Branch Susquehanna River at Curwensville, Pa.

Location.–Lat 40°57′41″, long 78°31′10″, Clearfield County, Hydrologic Unit 02050201, on the left bank 30 ft (9 m) downstream from the bridge on State Highway 453, 0.85 mi (1.37 km) downstream from Curwensville Lake, 1.1 mi (1.8 km) south of Curwensville, and 1.8 mi (2.9 km) upstream from Anderson Creek. A water-quality sampling site at bridge is 30 ft (9 m) upstream..

Gage.–Water-stage recorder. Datum of the gage is 1,124.52 ft (342.754 m) NGVD of 1929. Prior to August 24, 1956, a nonrecording gage and a crest-stage gage were 30 ft (9 m) upstream at same datum.

Remarks.–Flow is regulated by Curwensville Lake, 0.85 mi (1.37 km) upstream.

SITE 44.—01541308. Bradley Run near Ashville, Pa.

Location.–Lat 40°30′33″, long 78°35′02″, Cambria County, Hydrologic Unit 02050201, on the right bank 200 ft (60 m) downstream from the bridge on State Highway 53 at Syberton, 0.2 mi (0.3 km) upstream from the mouth and 4.5 mi (7.2 km) southwest of Ashville.

Gage.–Water-stage recorder. The altitude of the gage is 1,770 ft (539 m), from a topographic map.

SITE 45.—01541321. Brubaker Run at Dean, Pa.

Location.–Lat 40°37′20″, long 78°30′12″, Cambria County, at a culvert on State Highway 53 at Dean, 0.1 mi (0.2 km) upstream from the mouth.

Gage.–Miscellaneous site.

SITE 46.—01541365. North Witmer Run at Irvona, Pa.

Location.–Lat 40°46′12″, long 78°32′59″, Clearfield County at the mouth at Irvona.

Gage.–Miscellaneous site.

SITE 47.—01541500. Clearfield Creek at Dimeling, Pa.

Location–Lat 40°58′18″, long 78°24′22″, Clearfield County, Hydrologic Unit 02050201, on the right bank at the downstream side of the highway bridge at Dimeling, 600 ft (180 m) downstream from Little Clearfield Creek, and 4 mi (6 km) southeast of Clearfield.

Gage.–Water-stage recorder. Datum of the gage is 1,146.08 ft (349.325 m) NGVD of 1929. Prior to October 17, 1928, a nonrecording gage and from October 17, 1928, to October 25, 1967, a water-stage recorder were at a site 200 ft (60 m) upstream, all at the same datum.

Remarks.–Flow regulated by Glendale Lake, about 25 mi (40 km) upstream.

SITE 48.—01542000. Moshannon Creek at Osceola Mills, Pa.

Location.–Lat 40°50′58″, long 78°16′05″, Clearfield County, Hydrologic Unit 02050201, on the left bank 10 ft (3.0 m) upstream from the CONRAIL bridge at Osceola Mills and 0.1 mi (0.2 km) downstream from Trout Run.

Gage.–Water-stage recorder. Datum of the gage is 1,446.98 ft (441.040 m) NGVD of 1929.

SITE 49.—01556000. Frankstown Branch Juniata River at Williamsburg, Pa.

Location.–Lat 40°27′47″, long 78°12′00″, Blair County, Hydrologic Unit 02050302, on the left bank 10 ft (3 m) downstream from highway bridge at Williamsburg and 2.5 mi (4.0 km) upstream from Clover Creek.

Gage.–Water-stage recorder. Datum of gage is 831.78 ft (253.53 m) NGVD of 1929 (Penn Central Railroad bench mark). Prior to August 14, 1928, a nonrecording gage was at the same site and datum.

Remarks.–Regulation at low flow by a mill above the station.

TABLE 4.—*Site description and gage-height and discharge data*—Continued

SITE 50.—01556400. Sandy Run near Bellwood, Pa.

Location.—Lat 40°33′47″, long 78°20′35″, Blair County, at a bridge on a private road 0.6 mi (1.0 km) above the mouth and 2.5 mi (4.0 km) south of Bellwood.
Gage.—Crest-stage.

SITE 51.—01556500. Little Juniata River at Tipton, Pa.

Location.—Lat 40°37′40″, long 78°17′38″, Blair County, at Tipton, 100 ft (30 m) below the bridge on State Highway 220 and 150 ft (46 m) downstream from Tipton Run.
Gage.—Water-stage recorder and crest-stage. Datum of the gage is 946.76 ft (288.57 m) NGVD of 1929.

SITE 52.—01557100. Schell Run at Tyrone, Pa.

Location.—Lat 40°40′00″, long 78°15′00″, Blair County, 0.2 mi (0.3 km) above U.S. Highway 220 between 5th St. and Shippen St. in Tyrone.
Gage.—Water-stage recorder. Datum of the gage is 919.11 ft (280.14 m) NGVD of 1929.

SITE 53.—01557500. Bald Eagle Creek at Tyrone, Pa.

Location.—Lat 40°41′01″, long 78°14′02″, Blair County, Hydrologic Unit 02050302, on the left bank 0.2 mi (0.3 km) upstream from the plant of the West Virginia Pulp and Paper Co. at Tyrone, 0.2 mi (0.3 km) upstream from Laurel Run, and 1.3 mi (2.1 km) upstream from the mouth.
Gage.—Water-stage recorder. Datum of the gage is 921.80 ft (280.965 m) NGVD of 1929. From October 1, 1944 to November 15, 1950, a water-stage recorder and, from November 16, 1950 to November 30, 1952, a nonrecording gage were at a site 0.5 mi (0.8 km) downstream, at a datum 17.99 ft (5.483 m) lower.

SITE 54.—01558000. Little Juniata River at Spruce Creek, Pa.

Location.—Lat 40°36′45″, long 78°08′27″, Huntingdon County, Hydrologic Unit 02050302, on the right bank 150 ft (46 m) downstream from the CONRAIL bridge, 0.5 mi (0.8 km) northwest of village of Spruce Creek, and 0.5 mi (0.8 km) upstream from Spruce Creek. A water-quality sampling site is 0.4 mi (0.6 km) downstream.
Gage.—Water-stage recorder. Datum of the gage is 751.15 ft (228.951 m) NGVD of 1929.

SITE 55.—01559700. Buffalo Run tributary near Manns Choice, Pa.

Location.—Lat 39°58′40″, long 78°37′08″, Bedford County, Hydrologic Unit 02050303, at the left downstream end of the bridge on State Highway 96, 2,000 ft (610 m) upstream from the mouth, 2.3 mi (3.7 km) south of Manns Choice, and 11 mi (18 km) southwest of Bedford.
Gage.—Water-stage recorder and crest-stage gage. The altitude of the gage is 1,230 ft (375 m), from a topographic map.

Time	Gage height (ft)	Dis-charge (ft^3/s)	Time	Gage height (ft)	Dis-charge (ft^3/s)	Time	Gage height (ft)	Dis-charge (ft^3/s)
July 19:			July 20:			July 21:		
1200	0.39	0.34	0800	2.02	156	1200	0.69	14
1800	.38	.28	0900	1.66	102	1700	.64	11
2400	.48	.77	1000	1.37	67	2000	.69	14
July 20:			1100	1.23	53	2400	.65	12
0300	2.85	326	1200	1.15	45	July 22:		
0400	2.73	298	1500	.96	30	1200	.59	8.6
0500	3.47	495	1800	.85	23	2400	.55	6.9
0600	3.68	560	2100	.80	20	July 23:		
0620	5.12	1,120	2400	.77	18	1200	.52	5.7
0700	2.74	300				2400	.49	4.6
Total runoff, in inches								1.09

SITE 56.—01560000. Dunning Creek at Belden, Pa.

Location.—Lat 40°04′18″, long 78°29′34″, Bedford County, Hydrologic Unit 02050303, on the left bank 10 ft (3 m) upstream from a highway bridge, 0.8 mi (1.3 km) southeast of Belden, 3.8 mi (6.1 km) north of Bedford, and 4.3 mi (6.9 km) above the mouth.
Gage.—Water-stage recorder. Datum of the gage is 1,051.16 ft (320.394 m) NGVD of 1929.

Time	Gage height (ft)	Dis-charge (ft^3/s)	Time	Gage height (ft)	Dis-charge (ft^3/s)	Time	Gage height (ft)	Dis-charge (ft^3/s)
July 19:			July 20:			July 21:		
1200	1.33	21	1100	13.84	17,500	1800	4.07	944
1800	1.35	23	1115	14.15	19,400	2100	4.04	934
2100	1.35	23	1130	13.91	18,000	2400	4.54	1,110
2400	1.47	39	1200	13.83	17,500	July 22:		
July 20:			1300	13.75	17,000	0100	4.63	1,110
0100	1.66	71	1700	12.35	10,900	0300	4.45	1,040
0200	2.02	157	1800	11.99	9,770	0600	3.90	840
0300	3.59	756	2100	10.83	6,470	0900	3.61	724
0400	6.47	1,790	2400	9.79	4,520	1200	3.44	648
0500	8.59	3,190	July 21:			2400	2.95	440
0600	9.33	3,940	0300	8.43	3,050	July 23:		
0700	10.30	5,350	0600	6.48	1,790	1200	2.75	328
0800	11.34	7,820	0900	5.27	1,330	2400	2.56	261
0900	12.57	11,700	1200	4.71	1,160	July 24:		
1000	13.53	15,800	1500	4.32	1,030	1200	2.46	228
						2400	2.38	204

SITE 57.—01600700. Little Wills Creek at Bard, Pa.

Location.—Lat 39°55′35″, long 78°39′40″, Bedford County, at the bridge on State Highway 96 at Bard.
Gage.—Crest-stage. Datum of the gage is 1,264.2 ft (385.3 m) NGVD of 1929.

TABLE 5.—*Floodmark data*

[Elevations of selected floodmarks are provided in this table for defining flood profiles on reaches of 27 streams in the Mahoning Creek and Conemaugh River basins. Each elevation is referenced by a **stream mile**, which is the distance upstream from its mouth. The stream bank on which the floodmarks were located is given for many sites and is designated as right (R) or left (L) bank (determined as if one were facing downstream). Unless otherwise noted, the data in this table were furnished by the U.S. Army Corps of Engineers (1977)]

Stream and location	Stream mile	Elevation in feet above NGVD
Mahoning Creek		
North Point, at highway bridge	36.93	1,156.94
Hamilton (R)	40.95	1,174.2
At highway bridge	41.03	1,174.65
Valier, at highway bridge	43.63	1,184.92
At highway bridge between Valier and Fordham	45.22	1,194.32
Sportsburg(R)	50.09	1,216.5
Punxsutawney, at U.S. Geological Survey gaging station (R)	51.28	1,222.44
Railroad Bridge	52.70	1,229.38
#114 Water St. (R)	52.99	1,231.0
Punxsutawney (R)	53.07	1,230.40
At U.S. Highway 119 bridge	54.06	1,231.17
At Mahoning St. bridge	54.77	1,232.56
Cloe, at highway bridge	57.48	1,252.0
Bells Mills, at highway bridge	58.94	1,263.19
At highway bridge	59.88	1,270.88
At railroad bridge	60.63	1,275.70
Big Run, at Mill St. bridge	62.57	1,284.18
McCardy Rd. bridge	63.52	1,290.07
Stump Creek		
At State Highway 410 bridge	1.48	1,307.9
At road bridge near Cramer	2.71	1,312.3
Cramer, downstream from State Highway 952 bridge (L)	4.00	1,322.14
Upstream from State Highway 952 bridge (L)	4.03	1,323.41
Sykesville, at road bridge	6.09	1,335.8
Park St. bridge	7.05	1,341.97
Bridge at confluence of Sugarcamp Run	7.30	1,345.1
Stanley, at road bridge	9.16	1,365.7
Conemaugh River		
Blairsville, at old U.S. Highway 22 bridge	20.10	958.8
State Highway 217 bridge	21.45	958.6
Strangford, at mouth of Toms Run (L)	24.40	961.81
Robinson, downstream side of State Highway 259 bridge (R)	30.13	1,024.8
Upstream side of State Highway 259 bridge (R)	30.13	1,028.1
Bolivar RD #1 (L)	32.34	1,042.74
At downstream side of railroad bridge (L)	32.35	1,045.5
At upstream side of railroad bridge (L)	32.35	1.048.4
Along legislative Route 32008 at Crawford Road	34.43	1,060.6
New Florence, at downstream side of railroad bridge (L)	36.09	1,067.0
At upstream side of railroad bridge (L)	36.09	1,068.7
Huff, at small tributary (R)	37.59	1,073.23
New Florence, at highway bridge	37.68	1,072.2
At #209 9th St. (L)	38.01	1,076.5
At Seward Generating Plant, pump house (R)	39.23	1,082.83
Robindale (R)	41.00	1,093.0
Seward, at Penelec generating plant (R)	41.82	1,097.96

TABLE 5.—*Floodmark data*—Continued

Stream and location	Stream mile	Elevation in feet above NGVD
Conemaugh River—Continued		
Seward, at U.S. Geological Survey gaging station at upstream side of State Highway 56 bridge (L)	42.85	1,103.1
At brick house just upstream from State Highway 56 bridge (L)	42.89	1,104.20
Johnstown, at downstream side of railroad bridge at north corporate boundary	49.32	1,154.6
Upstream side of railroad bridge	49.32	1,156.9
Bethlehem Steel Co.'s wire mill (R)	50.35	1,158.74
State Highway 403 bridge	50.71	1,162.1
Church at corner of 8th Ave and Chestnut St. (L)	51.40	1,163.87
Downstream side of Fourth St. bridge	51.69	1,165.2
Upstream side of Fourth St. bridge	51.69	1,166.3
Church at corner of Fourth Ave. and Chestnut St. (L)	51.70	1,164.23
Footbridge at Roosevelt Blvd. and McConaughy St.	52.07	1,167.7
Along State Highway 56 at railroad overpass (L)	52.33	1,168.2
Stony Creek		
Johnstown, 50 ft downstream from Washington St. bridge (R)	0.03	1,170.5
Bridge to incline plane (R)	.38	1,171.4
State Highway 56 bridge	.57	1,172.1
Central High School (L)	.74	1,173.2
City Hall (R)	.86	1,172.3
#86 Haynes St. (L)	1.03	1,173.9
Corner of Horner St. and Poplar St. (R)	1.51	1,175.4
Central Ave. bridge	2.98	1,181.0
Johnstown (R)	3.42	1,183.0
Ferndale, downstream side of State Highway 403 bridge (L)	3.81	1,188.0
50 feet upstream from State Highway 403 bridge	3.83	1,191.0
Railroad bridge	4.19	1,192.8
Railroad bridge	5.13	1,203.5
#373 Michigan Ave. (R)	5.15	1,204.8
Fire Co. Building on Liberty Ave. (R)	5.40	1,206.3
At State Highway 403 bridge	5.91	1,212.8
Riverside RD #3 (R)	6.45	1,216.6
Krings (L)	7.44	1,238.6
Krings Road bridge	7.49	1,242.3
Ingleside, at sewage disposal plant (R)	8.97	1,288.4
At road bridge	10.70	1,329.82
Shade Creek		
Seanor, at highway bridge (L)	0.27	1,503.8
At railroad bridge	.86	1,528.2
Camp Hamilton, at Windber Area School District Building	3.02	1,646.8
Old mill building	3.16	1,653.8
At road bridge	5.20	1,777.0
Paint Creek		
At railroad bridge	0.06	1,325.3
Scalp Level, at confluence with Little Paint Creek (R)	2.52	1,660.4
Paint, at Main St. bridge over State Highway 56 (L)	2.63	1,665.3
Fire Dept building at #807 Main St. (R)	2.64	1,670.7
Paint Creek—Continued		
Paint—Continued		
Gas company plant on 3rd St. (R)	2.87	1,672.0
Windber, at #702 Lincoln St. (R)	3.14	1,676.0
#100 Tenth St. (R)	3.35	1,679.6
#301 12th St. (R)	3.50	1,684.1
12th St. bridge	3.51	1,686.3
Corner of 17th St. and Graham Ave. (L)	3.87	1,689.0
#705 Graham Ave. (L)	3.92	1,692.0
Somerset Ave. bridge	3.97	1,695.0
#1010 17th St. (R)	4.23	1,702.3
Seese Run		
Windber, at corner of 17th St. and Jefferson Ave. (R)	0.13	1,688.2
Windber (R)	.33	1,693.4
Downstream side of 22nd St. bridge (R)	.50	1,699.4
24th St. bridge	.67	1,707.8
#2604 Jackson Ave. (R)	.79	1,717.1
Corner of 28th St. and Jackson Ave. (R)	.97	1,725.7
Corner of Village St. and Jackson Ave. (R)	1.16	1,741.2
#3104 Graham Ave	1.26	1,746.1
Main St. bridge	1.66	1,780.3
State Highway 56 bridge	2.12	1,821.6
At Spruce St. bridge	2.24	1,833.0
At downstream side of Graham Ave. bridge	2.41	1,851.0
At upstream side of Graham Ave. bridge	2.42	1,852.3
Weaver Run		
Windber (R)	0.05	1,698.5
At State Highway 56 bridge	.06	1,700.9
Windber (R)	.10	1,701.2
Windber (L)	.43	1,713.4
At road bridge	.68	1,728.4
At wooden, road bridge	.88	1,743.3
Little Paint Creek		
Scalp Level (R)	0.03	1,660.4
At Methodist Church school building on Main St. (R)	.18	1,667.2
Railroad bridge	.27	1,674.1
Scalp Level (L)	.35	1,677.7
At coal company boiler house (R)	.67	1,704.5
Mine #40, at #1204 3rd St. (R)	.87	1,723.6
At road bridge	1.87	1,813.7
At transformer station (L)	2.51	1,885.2
At downstream side of State Highway 160 bridge	2.88	1,930.6
At upstream side of State Highway 160 bridge	2.88	1,933.0
Elton (R)	3.88	2,050.0
Elton (R)	4.01	2,061.3
Elton, at Villard St. bridge	4.33	2,062.5
Sams Run		
Johnstown, at railroad bridge	0.03	1,184.1
#77 Dupont St. (R)	.10	1,185.4
Corner of Ohio St. and Central Ave. (R)	.16	1,185.7
#534 Coleman Ave. (R)	.31	1,193.6
Corner of Ohio St. and Grove Ave. (R)	.33	1,206.2
#544 Grove Ave.	.36	1,209.2

TABLE 5.—*Floodmark data*—Continued

Stream and location	Stream mile	Elevation in feet above NGVD
Sams Run—Continued		
Johnstown—Continued		
Corner of Ohio St. and Grove Ave. (R)	.33	1,206.2
#544 Grove Ave.	.36	1,209.2
Corner of Ohio St. and Highland Ave. (R)	.49	1,223.3
Corner of Ohio St. and Forest Ave. (R)	.70	1,255.0
Forest Ave. bridge	.73	1,260.1
#239 Ohio St. (R)	.78	1,271.4
Woodland Ave. bridge	.78	1,274.3
Lorain, at #409 Valley St	1.00	1,308.9
#437 Valley St.	1.10	1,320.5
Solomon Run		
Johnstown, at #837 Horner St. (R)	0.03	1,192.7
#821 Oak St. (R)	.18	1,191.2
#722 Ash St. (R)	.27	1,204.6
#714 Von Lunen St. (R)	.37	1,217.0
#255 David St.	.52	1,230.6
Corner of Bedford St. and Cummins St.	.55	1,238.6
Walnut Grove, at #366 Arthur St. (R)	.76	1,248.9
#1005 Jacoby St. (R)	.91	1,264.8
Maple Park school building (R)	.97	1,277.9
Bridge between State Highway 56 and Bedford St.	1.01	1,289.0
#141 Purse St	1.05	1,292.0
#1088 Solomon St. (L)	1.08	1,300.7
#1139 Solomon St. (L)	1.19	1,316.2
Apartment building #6 (L)	1.39	1,342.2
Apartment building #9L (L)	1.53	1,360.4
#350 Solomon St. (L)	1.72	1,386.9
#1418 Solomon St. (L)	1.85	1,415.8
#1446 Solomon St. (L)	1.91	1,430.1
Little Conemaugh River		
Johnstown (R)	0.08	1,171.4
Johnstown, at Johns St. bridge	.14	1,172.1
Corner of Locust St. and Walnut St. (L)	.30	1,172.5
Walnut St. bridge	.31	1,173.9
Downstream side of railroad bridge	.38	1,173.6
Upstream side of railroad bridge	.38	1,178.9
Corner of Locust St. and Franklin St. (L)	.51	1,173.4
Johnstown (R)	.66	1,179.3
Johnstown (L)	.66	1,180.9
Downstream side of State Highway 271 bridge	1.09	1,187.8
Upstream side of State Highway 271 bridge	1.09	1,191.0
School, 300 ft downstream from railroad bridge	1.40	1,196.8
Downstream side of railroad bridge	1.44	1,199.9
50 ft upstream from State Highway 271 bridge	2.01	1,214.0
East Conemaugh, at #500 Railroad St. (R)	2.40	1,220.2
U.S. Geological Survey gaging station, 100 ft downstream from State Highway 271 bridge (R)	2.56	1,226.8
Along Railroad St. (R)	2.71	1,228.9
Along railroad tracks (R)	4.03	1,266.9
At downstream side of railroad bridge	4.87	1,289.4
At upstream side of railroad bridge	4.87	1,293.2
Along railroad tracks, 470 ft upstream from railroad bridge to slag dump (L)	5.13	1,316.8

TABLE 5.—*Floodmark data*—Continued

Stream and location	Stream mile	Elevation in feet above NGVD
Little Conemaugh River—Continued		
At Brookdale Mine #77 (R)	6.71	1,361.4
Mineral Point, downstream from highway bridge (R)	7.52	1,380.4
First house upstream from highway bridge (L)	7.57	1,379.3
Mineral Point (R)	7.90	1,385.2
At water supply dam	11.22	1,470.1
South Fork, at downstream side of railroad bridge	11.91	1,478.6
Upstream side of railroad bridge	11.91	1,479.2
Grant St. bridge	12.14	1,480.2
Ehrenfeld, at end of "A" St. (R)	12.84	1,497.6
Summerhill (R)	13.88	1,526.4
Summerhill (R)	14.28	1,531.6
Summerhill, at service station upstream from State Highway 53 bridge (R)	14.40	1,536.8
At railroad bridge	14.48	1,538.7
At downstream side of railroad bridge	14.85	1,540.2
At upstream side of railroad bridge	14.85	1,541.6
At downstream side of State Highway 53 bridge	14.96	1,541.7
At upstream side of State Highway 53 bridge	14.96	1,542.7
At State Highway 53 bridge	15.81	1,546.9
At downstream side of State Highway bridge	16.47	1,553.1
At upstream side of State Highway 160 bridge	16.47	1,554.7
Wilmore, at State Highway 160 bridge	17.47	1,556.7
Downstream side of railroad bridge	17.65	1,556.2
Upstream side of railroad bridge	17.65	1,560.2
Along Crooked St. (R)	18.09	1,564.2
Along State Highway 53 (R)	18.63	1,570.7
Along State Highway 53, upstream from Trout Run (R)	19.40	1,596.0
Portage, at State Highway 53 bridge	20.34	1,602.1
At downstream side of State Highway 160 bridge	20.81	1,610.8
At upstream side of State Highway 160 bridge	20.81	1,612.5
At road bridge upstream from Noels Creek	22.28	1,647.3
Oil City, at Bens Creek confluence (L)	23.53	1,734.1
At downstream side of railroad bridge	23.72	1,744.5
At upstream side of railroad bridge	23.72	1,747.1
Cassandra, at downstream side of highway bridge	24.10	1,774.4
Upstream side of highway bridge	24.10	1,778.6
At downstream side of railroad bridge	24.36	1,801.4
At upstream side of railroad bridge	24.36	1,803.6
Spring Run		
Portage, at road bridge, 950 ft upstream from mouth	0.19	1,607.8
State Highway 164 bridge	.31	1,616.7
Road bridge	.50	1,638.9
Trout Run		
Portage, at athletic field (L)	0.25	1,620.9
500 ft downstream from Caldwell Ave bridge (L)	.49	1,643.4
Downstream side of Caldwell Ave. bridge	.58	1,655.2
Upstream side of Caldwell Ave bridge	.58	1,658.0
Gillespie Ave. bridge	.67	1,668.6
Jefferson Ave. bridge	.76	1,679.8
Conemaugh Ave. bridge	.83	1,688.1
Sonman Ave. bridge	.91	1,700.5
State Highway 164 bridge	.97	1,709.5

TABLE 5.—*Floodmark data*—Continued

Stream and location	Stream mile	Elevation in feet above NGVD
North Branch Little Conemaugh River		
Wilmore, 50 ft downstream from railroad bridge	0.11	1,555.8
50 ft upstream from railroad bridge	.13	1,556.7
State Highway 53 bridge	.30	1,556.8
50 ft downstream from State Highway 160 bridge	.62	1,558.6
100 ft upstream from State Highway 160 bridge	.65	1,559.6
South Fork Little Conemaugh River		
South Fork, at Post Office (R)	.08	1,486.9
Maple St. bridge	.09	1,487.2
South Fork (R)	.40	1,495.7
Soukesburg, at downstream side of State Highway 53 bridge	1.68	1,547.5
Upstream side of State Highway 53 bridge	1.68	1,548.8
St. Michael, 80 ft downstream from railroad bridge	3.20	1,580.4
80 ft upstream from railroad bridge	3.23	1,582.3
Fire Dept. building (L)	3.39	1,584.3
Creslo, 80 ft upstream from road bridge (L)	3.80	1,598.6
Sidman, at Adams-Summerhill High School (L)	4.20	1,618.9
100 ft upstream from railroad bridge	4.57	1,642.3
40 ft downstream from State Highway 869 bridge	4.61	1,643.8
30 ft upstream from State Highway 869 bridge	4.62	1,647.3
Along road parallel to railroad tracks (R)	4.73	1,651.9
Allendale, 150 ft downstream from railroad bridge	5.99	1,760.1
50 ft upstream from railroad bridge	6.03	1,763.6
Along State Highway 869 (L)	6.60	1,814.5
Beaverdale, 50 ft downstream from State Highway 160 bridge	7.74	1,922.2
50 ft upstream from State Highway 160 bridge	7.74	1,922.2
Lloydell, 50 ft downstream from State Highway 869 bridge	8.53	2,029.3
50 ft upstream from State Highway 869 bridge	8.55	2,033.7
Sandy Run [Data collected and compiled by the U.S. Geological Survey]		
300 ft upstream from confluence with South Fork Little Conemaugh River near Soukesburg (R)	.06	1,551.7
150 ft upstream from road bridge (L)	.12	1,555.3
At downstream side of bridge on entrance road to U.S. Highway 219 South (L)	.20	1,570.5
800 ft upstream from Liberty Park pool (L)	.52	1,594.7
260 ft downstream from U.S. Highway 219 roadway culvert (L)	.77	1,623.6
760 ft downstream from U.S. Highway 219 bridge (R)	.90	1,630.0
230 ft downstream from U.S. Highway 219 bridge (R)	1.00	1,643.1
70 ft upstream from U.S. Highway 219 bridge (L)	1.10	1,662.2
600 ft upstream from U.S. Highway 219 bridge	1.20	1,668.5
At embankment of old dam (L)	1.40	1,689.0
400 ft downstream from 18″ culvert drain (R)	1.76	1,726.8

TABLE 5.—*Floodmark data*—Continued

Stream and location	Stream mile	Elevation in feet above NGVD
Sandy Run—Continued		
20 ft downstream from unnamed left bank tributary (L)	1.92	1,741.8
600 ft downstream from Sandy Run Dam (R)	2.11	1,766.0
350 ft downstream from Sandy Run Dam (R, L)	2.16	1,776.8
Centerline of Sandy Run Dam	2.23	----
50 ft upstream from centerline of dam (L)	2.24	1,810.4
140 ft upstream from centerline of dam (L)	2.25	1,810.5
St. Clair Run		
Johnstown, at confluence with Conemaugh River	0.00	1,162.1
Intersection of Beatty Ave. and Enterprise St. (L)	.22	1,164.8
Upstream side of Chandler St. bridge (R)	.30	1,175.7
Bachus St. bridge	.34	1,178.8
Corner of "I" St. and Bheam Ave. (R)	.45	1,188.9
Downstream side of Fairfield Ave. bridge	.60	1,207.4
Upstream side of Fairfield Ave. bridge	.61	1,211.5
Road bridge at corporate boundary	1.07	1,261.5
At unnamed left bank tributary	1.38	1,302.9
At road bridge	2.04	1,382.1
At downstream side of road bridge	2.58	1,486.1
At upstream side of road bridge	2.59	1,489.8
Laurel Run [Data collected and compiled by the U.S. Geological Survey]		
At confluence with Conemaugh River at Johnstown's north corporate boundary (L)	0.00	1,166.6
90 ft upstream from State Highway 403 bridge (R)	.08	1,164.1
90 ft upstream from State Highway 403 bridge (L)	.32	1,181.6
60 ft downstream from downstream side of Cooper Ave. bridge (R)	.47	1,199.0
60 ft upstream from upstream side of Cooper Ave. bridge (L)	.49	1,200.9
290 ft downstream from Wildcat Run (R)	.68	1,221.5
140 ft upstream from Wildcat Run (L)	.76	1,229.4
Along left bank	1.01	1,252.5
130 ft downstream from centerline of Cooper Ave. bridge (R)	1.28	1,278.6
At upstream side of Cooper Ave. bridge (R)	1.31	1,280.8
Along left bank	1.49	1,315.7
Along right bank	1.57	1,332.2
Along left bank	1.63	1,334.4
At upstream side of Cooper Ave. bridge (L)	1.73	1,349.3
At Methodist Church (R)	2.02	1,364.8
220 ft upstream from Red Run (L)	2.33	1,392.8
30 ft downstream from centerline of Laurel Run Dam (R)	2.51	1,400.8
Centerline of Laurel Run Dam	2.52	----
80 ft upstream from centerline of dam (R)	2.53	1,437.5
120 ft upstream from centerline of dam (R)	2.54	1,437.8
Blacklick Creek		
At road bridge to Blairsville	0.72	958.8
At Township Line bridge near Campbells Mills	6.37	958.9
At road bridge near Grafton	9.85	969.8
At U.S. Highway 119 bridge	10.78	976.0
Josephine (R)	11.29	994.8
Heshbon, at State Highway 259 bridge	17.93	1,254.3
Dias, at State Highway 56 bridge	21.33	1,309.2
Dilltown, at State Highway 403 bridge (L)	25.55	1,350.7
Along Dilltown-Vintondale Road (R)	27.97	1,357.5
Along Dilltown-Vintondale Road (L)	29.56	1,364.9
At new highway bridge near Wehrum	30.50	1,369.5

TABLE 5.—*Floodmark data*—Continued

Stream and location	Stream mile	Elevation in feet above NGVD
North Branch Blacklick Creek		
At highway bridge near Vintondale	0.05	1,392.5
Red Mill, at highway bridge	2.92	1,498.9
At U.S. Highway 422 bridge near mouth of Elk Creek	4.34	1,568.1
Adams Crossing bridge	5.61	1,613.2
South Branch Blacklick Creek		
Vintondale, at #1002 Main St. (R)	0.06	1,395.8
#119 Main St. (R)	.30	1,396.2
Church upstream from Main St. bridge (L)	.47	1,403.1
#637 Main St	.58	1,404.3
Twin Rocks, at road bridge	4.67	1,644.7
At highway bridge near Twin Rocks	5.13	1,659.4
Nanty Glo, at corner of Rodgers St. and Lloyd St	7.15	1,709.0
State Highway 271 bridge	7.27	1,713.7
#18 McCoy St. (R)	7.62	1,714.5
At road bridge near Beula	12.33	1,842.2
Two Lick Creek		
Coral, at highway bridge	2.26	985.0
Graceton, at highway bridge	4.00	994.3
U.S. Geological Survey gaging station (R)	4.79	1,000.3
Homer City	6.07	1,008.3
At FMC plant downstream from State Highway 56 bridge (L)	6.40	1,012.1
#50 Indiana St. (L)	6.85	1,015.4
Jacksonville St. bridge	6.95	1,017.9
Along old U.S. Highway 119 (L)	7.96	1,028.7
At old U.S. Highway 119 bridge	8.47	1,033.4
Along U.S. Highway 119 at bridge over Stoney Run (R)	9.51	1,046.9
Upper Two Lick, at first dwelling downstream from State Highway 954 bridge (L)	11.81	1,080.2
First dwelling upstream from State Highway 954 bridge (L)	11.83	1,084.0
Two Lick Station, at pump building at dam (R)	13.19	1,102.2
White Pine Park, at old U.S. Highway 422 (R)	15.90	1,188.8
At Allen Road bridge	18.16	1,189.4
At road bridge 0.5 miles upstream from Penn Run	20.42	1,195.1
Sample Run	21.69	1,208.2
At State Highway 286 bridge	22.38	1,215.8
Clymer, at first dwelling upstream from State Highway 286 bridge (R)	22.40	1,218.9
State Highway 403 bridge	22.69	1,219.4

TABLE 5.—*Floodmark data*—Continued

Stream and location	Stream mile	Elevation in feet above NGVD
Two Lick Creek—Continued		
Corner of 4th St. and Sherman St. (L)	22.86	1,220.1
State Highway 286 bridge	23.15	1,225.8
Diamondville, along Water St., at 2nd dwelling downstream from Diamondville bridge (R)	26.65	1,282.0
North Branch Two Lick Creek		
Wandin Junction (R)	0.13	1,303.5
Starford, at #408 City Ave	2.00	1,340.6
Road bridge	2.18	1,347.5
Lovejoy	2.54	1,369.5
Commodore, at #19 Smith St	3.32	1,399.2
Seamentown (R)	4.05	1,424.4
Seamentown (R)	4.20	1,425.6
Seamentown, at road bridge	4.22	1,428.6
Buck Run		
Buck Run, at double 5-ft diameter pipe culvert	1.26	1,324.5
At bridge on private road	1.35	1,330.7
At State Highway 286 bridge	1.89	1,373.9
At downstream side of road culvert	2.28	1,404.0
At upstream side of road culvert	2.28	1,407.1
Dixon Run		
Clymer, at #13 Lee St (L)	0.27	1,220.2
Penelec substation (R)	.38	1,220.6
Wilson St. bridge	.41	1,221.8
At bridge on rural road	1.55	1,244.7
Rembrant, at State Highway 403 bridge	2.10	1,250.0
Dixonville, at Dixonville Moose Lodge #833	2.87	1,264.6
Along State Highway 403 at bridge #6 (R)	3.42	1,273.4
Road bridge	3.82	1,277.9
Idamar, at 5-ft diameter pipe culvert	4.61	1,308.1
At wooden, road bridge	5.01	1,321.2
At private dwelling	5.74	1,370.4
Yellow Creek		
Homer City, at railroad bridge	0.30	1,015.9
#216 N. Main St. (R)	.39	1,020.7
#36 Maple Ave	.43	1,021.4
Private dwelling just downstream from Mazza St. bridge (R)	.72	1,027.2
22 N. Water St. (R)	.77	1,028.3
Water-works dam	.82	1,031.2
Water-works building (L)	.92	1,033.6
U.S. Highway 119 bridge	.93	1,034.1
Lucerne Mines, at railroad bridge	1.59	1,039.5
At State Highway 954 bridge	3.44	1,090.1
Heilwood, at State Highway 403 bridge	20.25	1,501.3