DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY

Prepared in cooperation with the
TENNESSEE DEPARTMENT OF TRANSPORTATION

WATER-RESOURCES INVESTIGATIONS REPORT 84-4365
(Sheet 1 of 3)

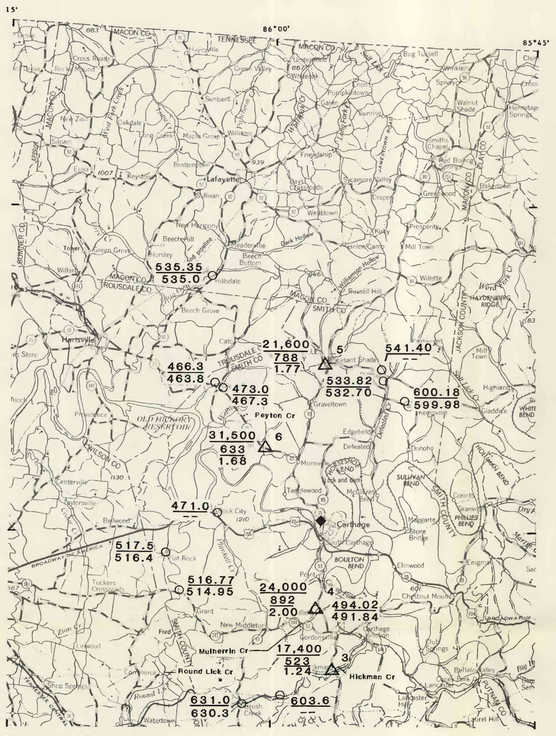


Figure 2.--Discharge data at miscellaneous sites, and water-surface elevations at selected bridge crossings in Smith and Macon Counties, Tenn. for the August 15-17, 1982 flood.

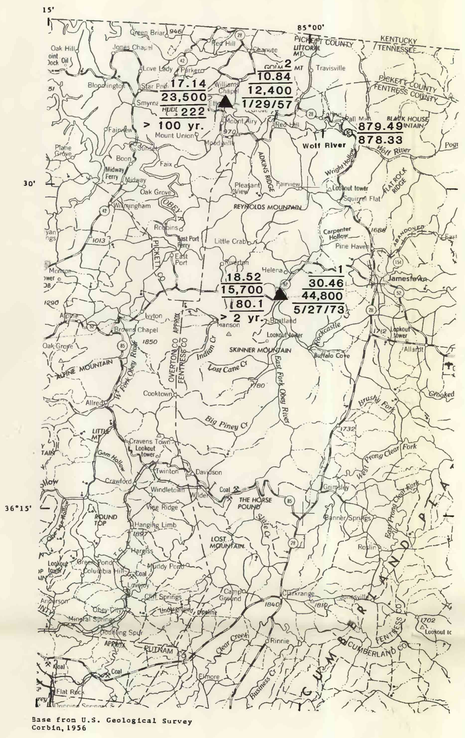


Figure 3.--Discharge data at gaging stations, and water surface elevations at a bridge crossing in Pickett and Fentress Counties, Tenn. for the August 31 to September 2, 1982 flood.

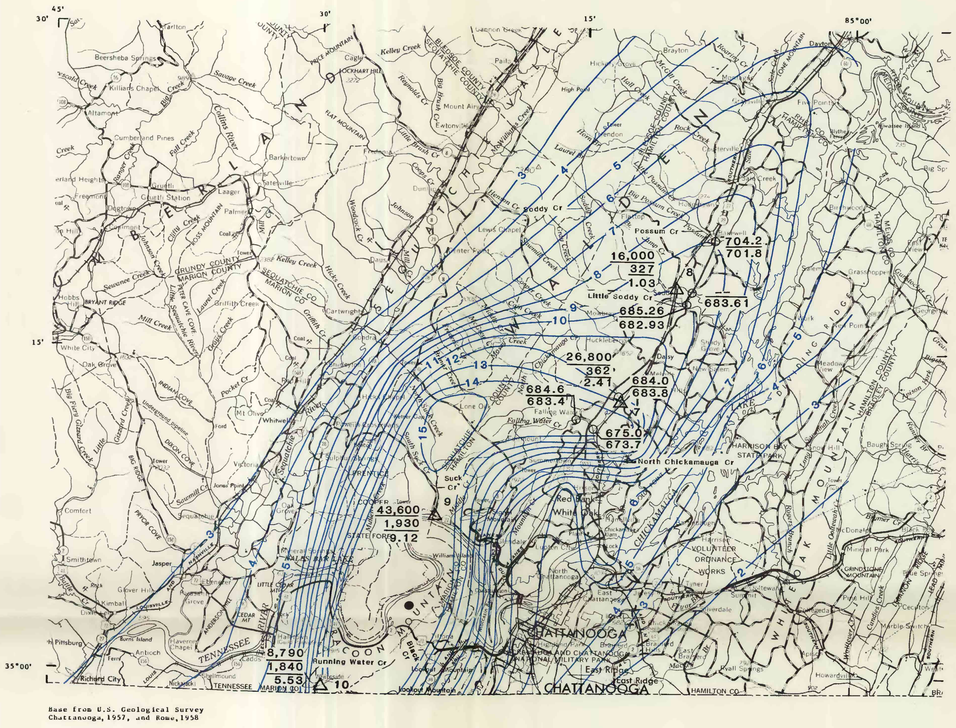


Figure 4.--Discharge data at miscellaneous sites, water-surface elevations at selected bridge crossings, and rainfall data in Hamilton, Rhea, Bledsoe, Sequatchie, and Marion Counties, Tenn. for the August 16, and 17, 1982 flood.

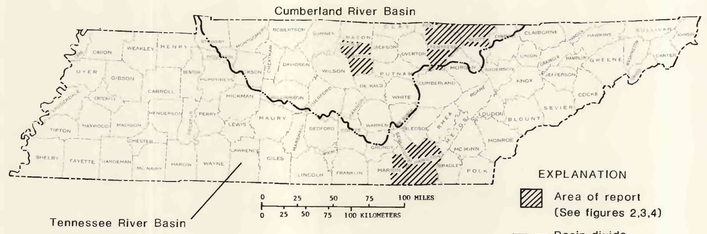


Figure 1.--Location of report area.

EXPLANATION

◆ Official weather station at Carthage

△ Miscellaneous discharge site

Summer 1982 flood data
Peak discharge — 43,600
Peak unit discharge — 1,930
Ratio of this flood to 100-year flood — 9.12
△ 9 — Map index number

○ 675.0 / 673.7 Miscellaneous flood elevation site. Upper number is elevation of flood upstream from bridge or culvert. Lower number is elevation of flood downstream from bridge or culvert. Dashed line (--) indicates data not available.

● Tennessee Valley Authority Raccoon Mountain pumped storage reservoir

Lines of equal rainfall, August 16-17, 1982 (modified from Tennessee Valley Authority). Interval 1 inch.

▲ Active gaging station

Summer 1982 flood data
Peak stage — 18.52
Peak discharge — 15,700
Peak unit discharge — 80.1
Recurrence interval — > 2yr.

Historical flood data
1 — Map index number
30.46 — Highest known stage
▲ 44,800 — Highest known discharge
5/27/73 — Date of highest known stage and discharge

> indicates recurrence interval more than number shown

Discharge data, in cubic feet per second ($ft^3/s$)
Peak unit discharge data, in cubic feet per second per square mile [$(ft^3/s)/mi^2$]
Stage data, in feet

Scale 1:250,000
5 0 5 10 MILES
5 0 5 10 KILOMETERS

Discharge data at gaging stations and miscellaneous sites, water-surface elevations at selected bridge crossings, and rainfall data

## INTRODUCTION

Intense rainfall in August and early September 1982 caused severe local flooding along many streams in central and eastern Tennessee. The purpose of this report is to document three outstanding floods by showing the distribution and amounts of rainfall, the magnitude and frequency of flood discharges at several sites in the area, and the extent of flooding along selected streams. This information can provide (1) a basis for formulating effective flood-plain zoning that could minimize existing and future flood problems and (2) a basis for designing and constructing drainage structures along roadways.

The report areas include Fentress, Smith, Hamilton, and parts of Sequatchie, Marion, Pickett, Scott, and Trousdale Counties in central and eastern Tennessee (fig. 1). Streams where major flooding occurred include Peyton, Hickman, Round Lick, and Mulherrin Creeks in Smith and Macon Counties (fig. 2); and Wolf River in Fentress and Pickett Counties (fig. 3); Soddy, Little Soddy, North Chickamauga, Possum, Black, and Suck Creeks in Hamilton County (fig. 4); and Running Water Creek in Marion County (fig. 4). The streams that were flooded in Hamilton and Marion counties are tributaries to the Tennessee River; the other streams that were flooded are tributaries to the Cumberland River.

### Acknowledgments

Acknowledgment is made to the U.S. Army Corps of Engineers, Nashville District, for providing flood profile and rainfall data for the Cumberland River basin. Acknowledgment is made to the Tennessee Valley Authority for providing flood profile and rainfall data for the Tennessee River basin. Acknowledgment is also made to the Tennessee Department of Transportation for providing aerial photographs taken during and after the floods and for providing elevation data at many sites.

### Additional Data

Additional information pertaining to past floods on streams in the report area can be obtained from the report by Randolph and Gamble (1976) and from the District Office of the U.S. Geological Survey, A-413 Federal Bldg.-U.S. Courthouse, Nashville, TN 37203.

## STORM RAINFALL

Rainfall data for the August and early September 1982 storms were collected by the U.S. Army Corps of Engineers, National Weather Service, and the Tennessee Valley Authority. Total accumulation and distribution of rainfall for the area near Chattanooga are shown by lines of equal value in figure 4. Data are not available to delineate equal rainfall lines for other areas where excessive amounts of rainfall occurred.

The National Weather Service station at Carthage, Tenn., recorded about 6.0 inches of rainfall between about 11:00 p.m. Aug. 15, 1982 and noon August 16, 1982, (fig. 5). Rainfall amounts recorded at 6-hour intervals by the U.S. Army Corps of Engineers at Cordell Hull Dam are similar to amounts recorded at Carthage. Rainfall intensities for the 100-year frequency taken from U.S. Department of Commerce, Weather Bureau Technical Paper No. 40 (1961) and the maximum August 16-17, 1982 storm rainfall intensities for various increments of time at Carthage are given in table 1.

Rainfall of 3- and 6-hours duration at Carthage during this storm exceeded the 100-year frequency. Rainfall of 5.7 inches fell during the 6-hour period from 6:00 a.m. until 12:00 noon on August 16, 1982. Normal rainfall for entire month of August at Carthage is approximately 4.0 inches.

The Tennesseee Valley Authority reported about 14.5 inches of rainfall in 10 hours in the vicinity of the Raccoon Mountain Pumped Storage Dam and Reservoir near Chattanooga with about 13.5 inches falling between 11:00 p.m. on August 16 and 6:00 a.m. on August 17, 1982 (fig. 6). The Tennessee Valley Authority recorded 8 to 9 inches of the total 14.5 inches of rainfall at two gages on Raccoon Mountain; remaining amounts exceeded equipment capacity and were estimated based on inflow and outflow of the storage reservoir. Maximum rainfall intensity of 4.99 inches per hour occurred between 2:00 a.m. and 3:00 a.m. on August 17.

## STORM RUNOFF

Runoff from the storms resulted in record-breaking floods on many streams in central and eastern Tennessee (table 2). Several long-time residents in areas where flooding was most severe reported that stream stages during the August 1982 floods were higher than any previous stage since at least the 1920's. The maximum stage and discharge of record were recorded at the Wolf River long-term (1942-82) gaging station near Byrdstown (fig. 3, map index No. 2) and was reported to be the highest stage since at least 1929. Peyton Creek (fig. 2, map index No. 5), in the town of Pleasant Shade, reached its highest stage since at least 1925, caused two deaths and devastating damage to crops and property. Peak runoff from the August and September 1982 storms exceeded the 100-year flood on many small streams in central and eastern Tennessee.

### Flood Frequency

As applied to annual floods, flood frequency, stated as a recurrence interval, is the average interval of time, in years, between occurrences of floods exceeding a specified magnitude. For example, a flood of 100-year recurrence interval has a 1 in 100 chance, on the average, of occurring in any given year. However, the fact that a major flood occurs in any year does not affect the probability of a flood as large or larger occurring within the same year or during the next year. The August and September 1982 flood discharges and 100-year flood discharge are given in table 2 for gaging stations and miscellaneous sites. Locations of the sites are shown on figures 2, 3, and 4.

Flood-frequency characteristics for East Fork Obey River near Jamestown (fig. 3, map index No. 1) and Wolf River near Byrdstown (fig. 3, map index No. 2) were derived by analyzing continuous streamflow records at the two stations and using certain modifications (Water Resources Council, 1967 and 1981). The flood-frequency curves (figs. 7 and 8) for these stations were computed by fitting a Pearson Type III distribution to the logarithms of annual peaks. The curve for Wolf River near Byrdstown was adjusted on the basis of historical flood-peak data. The curve for each station was adjusted to give weight to flood-frequency values calculated from regional regression equations derived for streams in Tennessee (Randolph and Gamble, 1976). An estimated magnitude of the 100-year flood discharge for each miscellaneous site was computed using the regression equations.

### Flood Height and Discharge

The height of a flood at a gaging station is usually stated as gage height, or stage, which is the elevation of the water surface above a selected datum plane. For this report, peak stages at gaging stations are reported as feet above the gage datum and as feet above sea level. Gage datum usually approximates the level of the streambed. Peak stages at miscellaneous sites are reported as feet above sea level (table 2). Peak stages upstream and downstream at selected bridge crossings are reported as feet above NGVD. The location of selected gaging stations, miscellaneous sites, and selected bridge crossings are shown on figures 2, 3, and 4. Flood stage hydrograph for Wolf River near Byrdstown (fig. 3, map index No. 2) is shown in figure 9.

The rate of discharge of a stream is the volume of water that passes a particular location in a specific period of time. The discharge rates at particular locations for the summer 1982 floods are expressed in cubic feet per second and represent the peak discharge which occurred at the maximum stage or elevation of the flood. Peak discharges for gaging stations and miscellaneous sites are shown in figures 2, 3, and 4 and are listed in table 2.

Peak discharges at miscellaneous sites were determined by indirect methods using standard hydraulic formulas for flow in open channels, flow over road embankments, and flow through contracted openings at bridges and culverts. Sites for indirect measurements were selected shortly after the floods. A survey at each site was made to determine (1) the water-surface profile as represented by high-water marks, (2) the cross-sectional properties of the stream channel and flood plain, (3) the geometry of the bridge, culvert or roadway embankment, and (4) roughness coefficients.

Peak unit discharge, which is expressed in cubic feet per second per square mile, is generally an indication of flood intensity. During the August 16-17, 1982 flood, the peak unit discharge at the indirect discharge measurement sites ranged from 327 cubic feet per second per square mile [$(ft^3/s)/mi^2$] for Soddy Creek at Soddy (fig. 4, map index No. 8) to 1,930 $(ft^3/s)/mi^2$ for Suck Creek near Chattanooga (fig. 4, map index No. 9). The computed peak unit discharge of the 100-year flood is 169 $(ft^3/s)/mi^2$ for Soddy Creek and 212 $(ft^3/s)/mi^2$ for Suck Creek. The discharge shown for Suck Creek may be a poor estimate because the high-water marks were poorly defined, two sections were used instead of three in the slope-area reach, and because of uncertainty about the effects of huge boulders in the main channel. During the August 31 to September 2, 1982 flood, the peak unit discharge at continuous-record gages ranged from 80.1 $(ft^3/s)/mi^2$ for East Fork Obey River near Jamestown (fig. 3, map index No. 1) to 222 $(ft^3/s)/mi^2$ for Wolf River near Byrdstown (fig. 3, map index No. 2).

Table 1.--Summary of rainfall intensities during the August 16-17, 1982 storm and 100-year rainfall frequency

| Duration, in hours | Rainfall intensities, in inches: 100-year frequency | National Weather Service station at Carthage, Tenn. |
|---|---|---|
| 1 | 2.9 | 1.8 |
| 2 | 3.8 | 3.3 |
| 3 | 4.1 | 4.4 |
| 6 | 4.8 | 5.7 |
| 12 | 5.8 | 5.8 |
| 24 | 6.7 | 6.1 |

## CONVERSION FACTORS

Analyses and compilations used in this report are in inch-pound units of measurements. Factors for converting inch-pound units to metric (SI) units are listed below.

| Multiply | By | To obtain |
|---|---|---|
| inch (in.) | 25.40 | millimeter (mm) |
| foot (ft) | 0.3048 | meter (m) |
| mile (mi) | 1.609 | kilometer (km) |
| square mile ($mi^2$) | 2.590 | square kilometer ($km^2$) |
| cubic foot per second ($ft^3/s$) | 0.02832 | cubic meter per second ($m^3/s$) |
| cubic foot per second per square mile [$(ft^3/s)/mi^2$] | 0.0109 | cubic meter per second per square kilometer [$(m^3/s)/km^2$] |

Table 2.--Summary of the summer 1982 floods in central and eastern Tennessee

| Map index No. | Station No. | Stream name and location | Contributing drainage area ($mi^2$) | Computed 100-year flood ($ft^3/s$) | Summer 1982 floods: Date of peak | Elevation of water surface (sea level) | Discharge ($ft^3/s$) | Remarks |
|---|---|---|---|---|---|---|---|---|
| 1 | 03414500 | East Fork Obey River near Jamestown. | 196 | a44,700 | 8/31 | 698.82 | 15,700 | Gage height = 18.52 |
| 2 | 03416000 | Wolf River near Byrdstown | 106 | a19,200 | 9/ 2 | 724.68 | 23,500 | Gage height = 17.14 |
| 3 | 03424840 | Hickman Creek at Hickman | 33.3 | 14,000 | 8/16 | | 17,400 | |
| 4 | 03424900 | Mulherrin Creek near Gordonsville. | 26.9 | 12,000 | 8/16 | 494.0 | 24,000 | Elevation on upstream side of bridge. |
| 5 | 03425032 | Peyton Creek below Pleasant Shade. | 27.4 | 12,200 | 8/16 | 539.6 | 21,600 | Elevation at section 1 |
| 6 | 03425050 | Peyton Creek at Riddleton | 49.8 | 18,700 | 8/16 | 471.9 | 31,500 | Elevation on upstream side of bridge. |
| 7 | 03566535 | North Chickamauga Creek at Mile Straight. | 74.0 | 11,100 | 8/17 | 682.4 | b26,800 | Elevation on upstream side of bridge. |
| 8 | 03566400 | Soddy Creek at Soddy | 49.0 | 8,270 | 8/17 | 745.1 | 16,000 | Elevation on upstream side of bridge. |
| 9 | 03569245 | Suck Creek near Chattanooga | 22.6 | 4,780 | 8/17 | 679.6 | b43,600 | Elevation about 500 feet upstream from bridge. |
| 10 | 03570470 | Running Water Creek at Whiteside. | 4.77 | 1,590 | 8/17 | | 8,790 | |

aComputed from annual peak flows using procedures in U.S. Water Resources Council Bulletin 17-B and adjusted to flood-frequency values estimated with regression equations.

bAccuracy of computed discharge is considered poor.

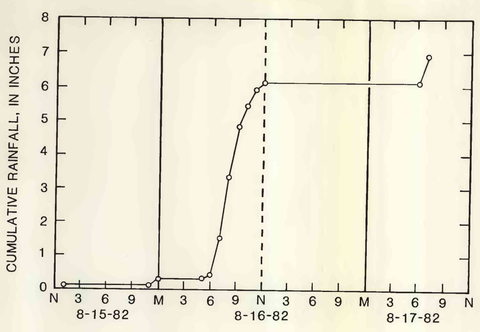


Figure 5.--Duration and intensity of rainfall at the National Weather Service station at Carthage, Smith County, Tenn.

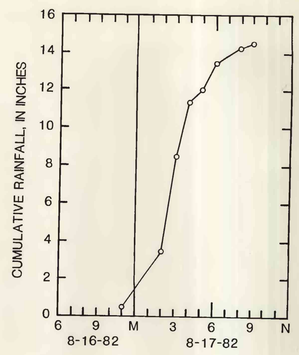


Figure 6.--Duration and intensity of rainfall in the vicinity of the Tennessee Valley Authority Raccoon Mountain Pumped Storage Dam and Reservoir in Marion County, about 7 miles west of Chattanooga, Tenn.

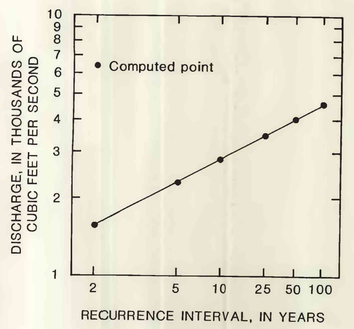


Figure 7.--Flood-frequency curve for East Fork Obey River near Jamestown, Fentress County, Tenn. (fig. 3, map index No. 1).

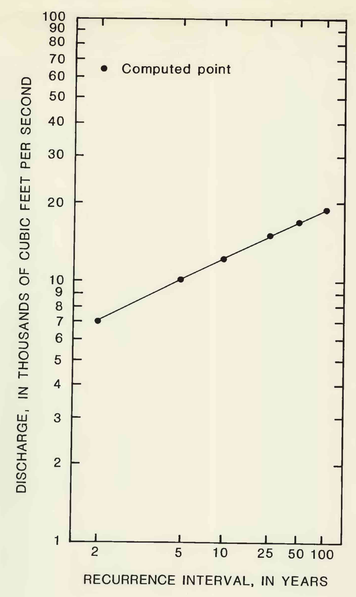


Figure 8.--Flood-frequency curve for Wolf River near Byrdstown, Pickett County, Tenn. (fig. 3, map index No. 2).

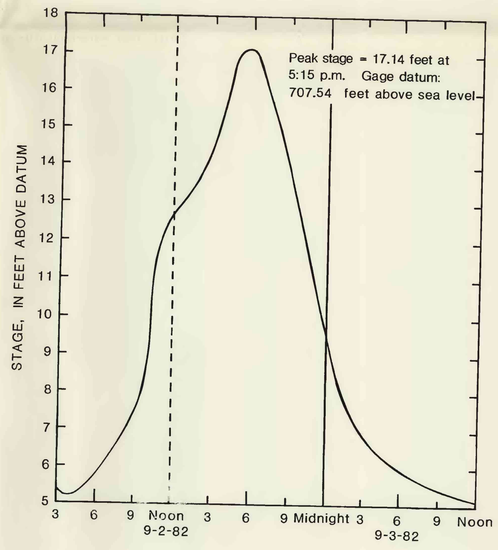


Figure 9.--Hydrograph of stage for Wolf River near Byrdstown, Pickett County, Tenn. (fig. 3, map index No. 2).

# FLOODS DURING THE SUMMER OF 1982 IN CENTRAL AND EAST TENNESSEE

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1986