

FLOOD OF AUGUST 18, 1986, NEWBERRY, SOUTH CAROLINA

By Noel M. Hurley, Jr.

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ABSTRACT

Intense rainfall on the morning of August 18, 1986, caused severe local flooding in the city of Newberry, Newberry County, South Carolina. The rainfall resulted from storms from a low-pressure system, which also caused heavy rain and hail in the central and coastal regions of South Carolina.

The report includes rainfall data and elevations of high-water marks obtained immediately after the flood for Scotts Creek and South Scotts Creek. Peak discharges were computed at one site on each stream and compared to peak discharges computed from a regional flood-frequency analysis.

The flood was caused by a 10.2 inch rainfall over a 7-hour period. A peak discharge of 2,800 cubic feet per second was indirectly computed for Scotts Creek at Nance Street, compared to 2,200 cubic feet per second computed for the 100-year flood by a regional flood-frequency analysis. A discharge of 2,000 cubic feet per second was computed for South Scotts Creek at Glenn Street. The computed 100-year flood by regional flood-frequency analysis for South Scotts Creek at Glenn Street is 1,560 cubic feet per second.

The flood resulted in the loss of two lives and damages estimated to be \$800,000.

These data can provide water-resources managers (1) a technical basis for making flood-plain management decisions that could minimize existing and future flood problems, (2) a basis for designing and constructing drainage structures along roadways, and (3) historical documentation for future reference.

INTRODUCTION

Intense rainfall on the morning of August 18, 1986, caused severe local flooding in the city of Newberry, Newberry County, South Carolina. The rainfall resulted from storms from a low-pressure system, which also caused heavy rain and hail in the central and coastal regions of South Carolina.

This report documents flooding on Scotts Creek and South Scotts Creek within the city of Newberry by showing the quantity of rainfall, the magnitude and frequency of flood discharges at two streamflow sites, and elevations of high-water marks obtained at road crossings of the creeks.

This report was prepared by the U.S. Geological Survey in cooperation with the city of Newberry and the South Carolina Water Resources Commission.

Special thanks and acknowledgments are extended to Mr. Arnold Miller, Newberry County Community Development Director, Mr. Al Harvey, Newberry City

Administrator, and local residents who provided information on flood damage. The National Weather Service at Columbia, South Carolina, provided rainfall data and the Newberry Observer supplied photographs of the flooding.

STUDY AREA

The study area consists of segments of Scotts Creek and South Scotts Creek within the city of Newberry, Newberry County, in the Central Piedmont region of South Carolina.

The location of the city of Newberry (on the inset) and the study area are shown in figure 1.

The study area along Scotts Creek extended from the downstream limit at O'Neal Street (drainage area, 4.17 square miles) upstream to Glenn Street (drainage area, 1.84 square miles) (fig. 1). The indirect discharge measurement site at Nance Street has a drainage area of 2.92 square miles. Approximately sixty percent of the Scotts Creek drainage basin upstream of Nance Street consists of urban/residential areas. The channel of Scotts Creek in the study area was being straightened and widened by the U.S. Army Corps of Engineers (Corps) from O'Neal Street to Nance Street at the time of the flood. Riprap had not been placed in the channel at the time of the flood. The channel slope in the study area is 0.7 percent. The reference mark locations and elevations in the appendix were provided by the Corps.

The study area on South Scotts Creek extended from the Southern Railroad culvert upstream to the Glenn Street culvert (fig. 1). The drainage areas of the basin at the Southern Railroad Culvert and Glenn Street are 2.09 and 1.86 square miles, respectively. Approximately 38 percent of the South Scotts Creek drainage basin upstream of the Glenn Street culvert consists of residential areas. The channel slope in the study area is 0.9 percent. Unlike the Scotts Creek channel, the South Scotts Creek channel was not widened and straightened.

FLOOD OF AUGUST 18, 1988

Flood Damage

Two people lost their lives while trying to escape from a stranded car during the August 18, 1986 flood (fig. 2). Also, several homes, a church, and at least ten businesses were damaged. The Charles Street bridge over Scotts Creek was destroyed as well as a tennis court located in a park between Academy and Drayton Streets. All roads in the study area crossing Scotts Creek were inundated (figs. 3 and 4). Also, all streets in the South Scotts Creek study area, except the Southern Railroad embankment, were inundated. Along South Scotts Creek, water flooded a home approximately 300 feet upstream of the Southern Railroad culvert to its second story window. Also, the flooding damaged the culvert under the Southern Railroad to the extent that the culvert was replaced by a trestle (fig. 5). The flood caused an estimated \$800,000 in damage.



Figure 2.--Scotts Creek at O'Neal Street bridge; two occupants of vehicle lost their life at the site (Photograph courtesy of The Newberry Observer).

Storm Rainfall

Rainfall data for the August 18, 1986, storm in Newberry were collected by the National Weather Service at the raingage located just downstream from Nance Street near the left bank of Scotts Creek in Newberry (fig. 1). Rainfall data were collected on August 18, 1986, from midnight¹ until the recorder jammed at 6:30 p.m. Water from Scotts Creek had entered the recording station during the flood and wet the recording tape. This wet tape caused the recorder to jam. The recording tape showed that 10.2 inches of rain fell at the gage during a 7-hour period from 2:45 a.m. to 9:45 a.m. (fig. 6). No rainfall fell from 9:45 a.m. to 6:30 p.m. when the recorder failed. The two streams in this study crested at about 8:00 a.m. on August 18, 1986.

In addition to the digital recording gage the National Weather Service operates, a nonrecording rainfall gage at the same location is manually checked daily at 5:00 p.m. by the Newberry Fire Department. On August 18, 1986, the recorded rainfall was 10.42 inches. Therefore, practically all the rainfall that caused the flood was recorded at the rainfall gaging station, even though the recorder jammed.

¹All times in this report are Daylight Savings Time.



Figure 3.--Flood Waters of Scotts Creek at College Street (Photograph courtesy of The Newberry Observer).



Figure 4.--Vehicle lodged under Caldwell Street bridge at Scotts Creek (Photograph courtesy of The Newberry Observer).



Figure 5.--Repair of Southern Railroad culvert at South Scotts Creek
(Photograph courtesy of The Newberry Observer).

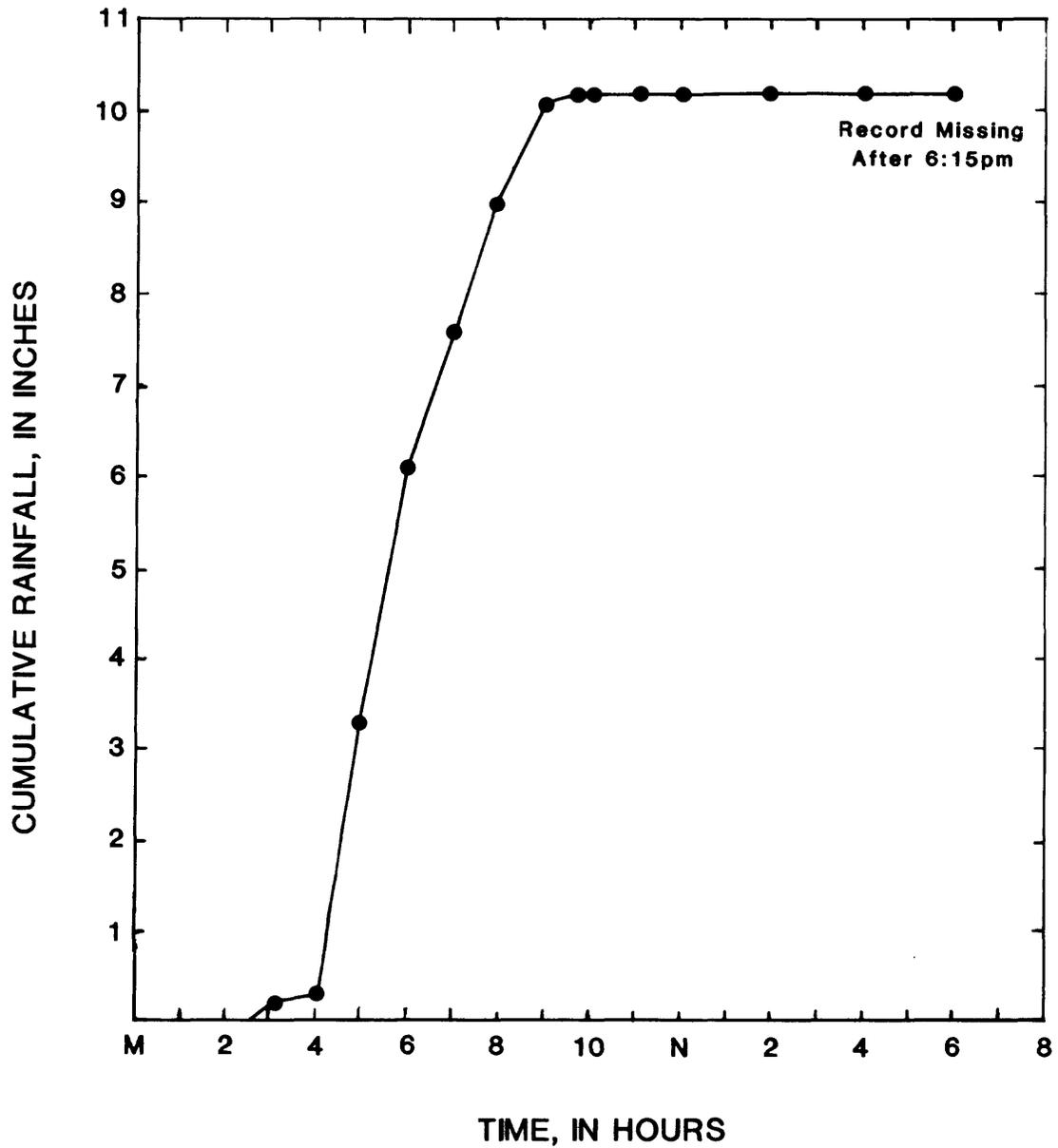


Figure 6.--Accumulated rainfall at National Weather Service gage for period midnight to 6:15 p.m., August 18, 1986.

Table 1 shows rainfall amounts with an expected recurrence interval of 100 years taken from U.S. Weather Bureau Technical Paper No. 40 (1961) and the maximum August 18, 1986, storm rainfall, for various increments of time for the recording gage at Newberry. Rainfall of the 2- to 12-hour duration at Newberry exceeded the 100-year recurrence interval rainfall during the August 18, 1986, storm.

It is ironic that the storm of August 18, 1986, occurred during a summer that set many records for low rainfall in South Carolina. Between 4:00 a.m. and 6:00 a.m. on August 18, 1986, 5.8 inches of rain fell at Newberry. By contrast, the normal rainfall for Newberry for the entire month of August is 3.93 inches (Bernie Palmer, National Weather Service, oral commun., February 10, 1987).

Table 1.--Summary of 100-year recurrence-interval rainfall and rainfall during the August 18, 1986, storm in Newberry, South Carolina, for selected time increments

Duration (hours)	Rainfall (inches)	
	100-year recurrence interval	National Weather Service Station at Newberry August 18, 1986
1	3.4	3.0
2	4.3	5.8
3	4.6	7.3
6	5.8	9.9
12	6.7	10.2
24	7.7	-- (recorder stopped at 6:30 p.m.)

High-Water Marks

High-water marks were flagged and surveyed by the U.S. Geological Survey immediately following the flood at several road crossings of Scotts Creek and South Scotts Creek.

The height of a flood is usually given above a selected datum plane. This datum may be arbitrary or a nationally recognized datum such as the National Geodetic Vertical Datum (NGVD), which is commonly called mean sea level. For this report, flood heights for Scotts Creek are reported as elevations above sea level, while flood heights for South Scotts Creek are referenced to an arbitrary datum.

Elevations and road locations of the high-water marks are shown in table 2. Road locations are shown in figure 1. Reference marks, established by the U.S. Army Corps of Engineers and the U.S. Geological Survey, used in the survey of high-water marks are described in the appendix.

Table 2.--High-water marks for Scotts and South Scotts Creeks

Location	Elevation ¹ (feet)	
	Downstream	Upstream
<u>Scotts Creek</u>		
O'Neal Street Bridge	441.81	444.72
Charles Street Bridge	444.77	448.58
Academy Street Bridge	449.18	449.32
Drayton Street Bridge	450.76	452.64
Harris Street Bridge	457.93	458.24
Nance Street Culvert	459.40	461.40
Caldwell Street Bridge	462.34	462.34
College Street Bridge	463.30	464.02
Lindsay Street Bridge	464.47	464.53
Calhoun Street Bridge	465.58	467.56
Mower Street Culvert	469.69	472.53
Glenn Street Bridge	473.78	477.11
<u>South Scotts Creek</u>		
Southern Railroad Culvert	99.05	113.40
Glenn Street Culvert	113.72	114.75

¹Elevations for Scotts Creek are referenced to NGVD. Elevations for South Scotts Creek at Southern Railroad culvert and Glenn Street culvert are referenced to an arbitrary datum established for RM 1, described in the appendix.

Computed Peak Discharges

Peak discharges were computed for Scotts Creek at Nance Street (drainage area, 2.92 square miles) and for South Scotts Creek at Glenn Street (drainage area, 1.86 square miles) using surveyed high-water marks and geometry of channels, culverts, and highway embankments. The flow through the culverts of Scotts Creek at Nance Street and South Scotts Creek at Glenn Street were analyzed by use of U.S. Geological Survey computer program A526 (Mathai and others, undated) and methods developed by Bodhaine (1968). Flow over Nance Street was analyzed by step-backwater procedure using WSPRO, a step-backwater computer program developed by the U.S. Geological Survey for the Federal Highway Administration (Shearman and others, 1986). The step-backwater method was used rather than the highway embankment method because an embankment did not exist where flow went over the highway. Flow over Glenn Street was computed using methods developed by Hulsing (1967).

The flood heights of Scotts Creek upstream and downstream of Nance Street were 461.4 feet and 459.4 feet above sea level, respectively. The minimum highway embankment elevation located 226 feet east of the culvert under Nance Street was 459.1 feet. The two-barrel 9.85 by 12.2 foot concrete box culvert was completely submerged at both ends. The unit discharge per square mile of drainage area was 959 (ft³/s)/mi².

The flood heights for South Scotts Creek upstream and downstream of Glenn Street were 114.76 and 113.72 feet, respectively. The minimum highway embankment elevation located 20 feet north of the Glenn Street culvert was 113.2 feet. The one-barrel 14.0 by 10.2 foot concrete box culvert was completely submerged at both ends. The unit discharge per square mile of drainage area was 1,080 (ft³/s)/mi².

Flood Frequency

The relation of flood-peak magnitude to the probability of occurrence, or recurrence interval, is referred to as a flood-frequency relation. As applied to annual floods, recurrence interval is the average interval of the time between floods that exceed the indicated magnitude.

For example, a flood with a 100-year recurrence interval may be expected to be equaled or exceeded, on the average, once in 100 years. Stated another way, it is a flood that has a 1 in 100 chance of occurring in any given year. However, the fact that a flood of this magnitude occurs in any given year does not reduce the probability of a flood of equal or greater magnitude occurring within the same year, or in consecutive years.

Peak discharges for various recurrence intervals were computed for Scotts Creek and South Scotts Creek (figs. 7 and 8) by using equations developed by Whetstone (1982) and adjusted for urbanization by using equations developed by Sauer and others (1983). Drainage area, streambed slope, percent imperviousness, storage, channel length, and basin development variables were determined from U.S. Geological Survey 7.5 minute series topographic maps of the Newberry East and Newberry West quadrangles and field inspection.

Figure 7 shows that the 100-year flood for Scotts Creek is a discharge of 2,200 ft³/s, compared to a peak discharge of 2,800 ft³/s computed for the August 18, 1986, flood.

Figure 8 shows that the 100-year flood for South Scotts Creek is a discharge of 1,560 ft³/s compared to a discharge of 2,000 ft³/s computed for the August 18, 1986, flood.

Long-time residents stated that stream stages during the August 18, 1986, flood were the highest observed in 50 to 60 years.

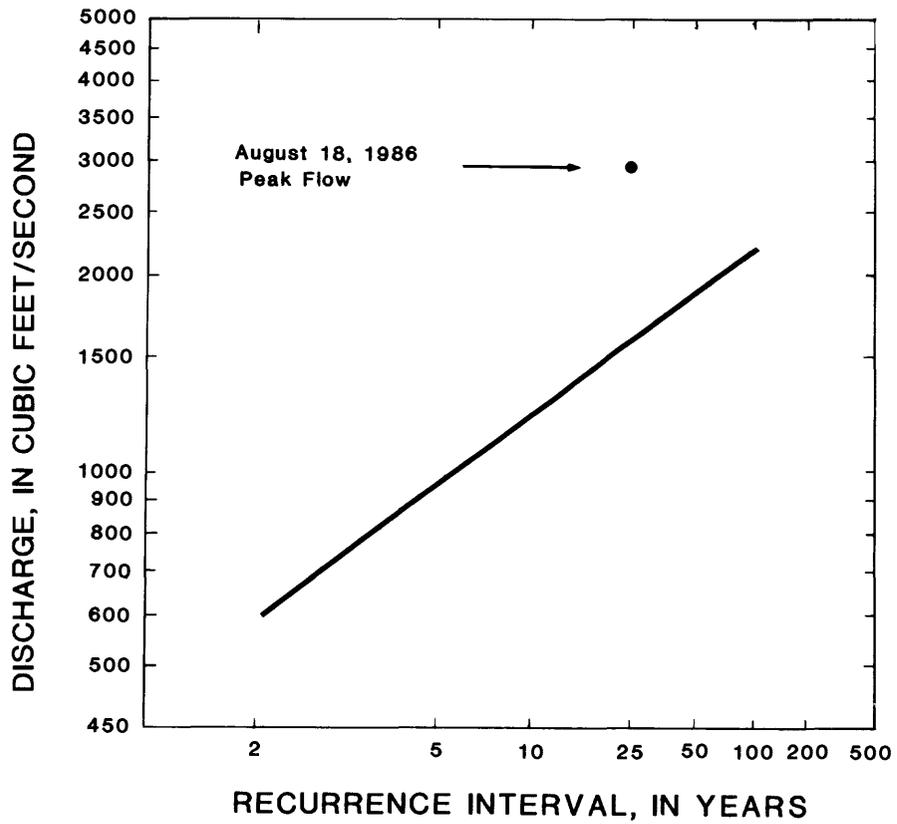


Figure 7.--Flood-frequency curve for Scotts Creek.

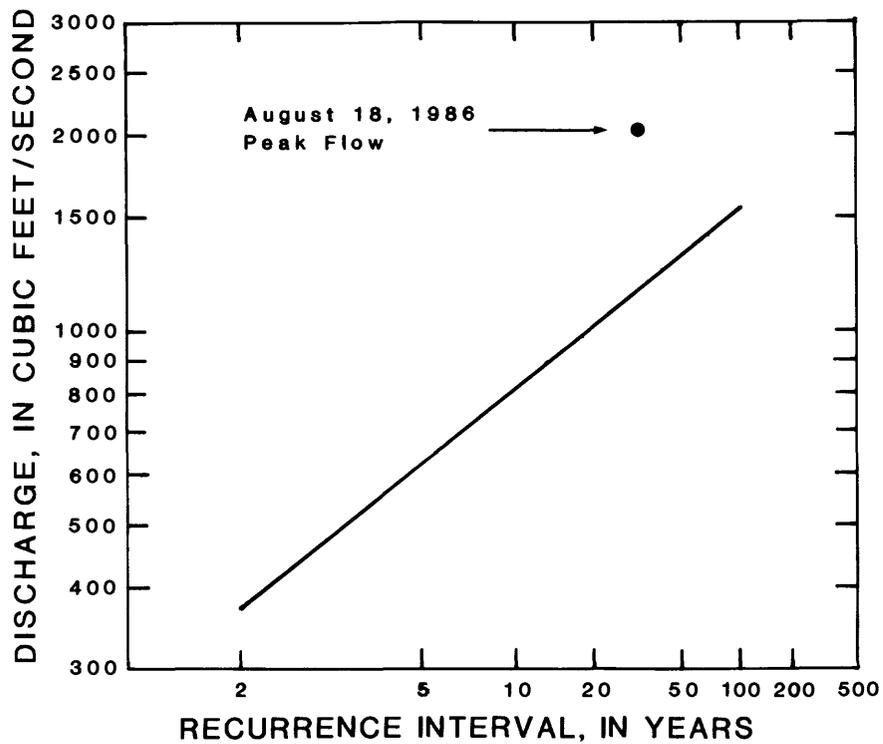


Figure 8.--Flood-frequency curve for South Scotts Creek.

SUMMARY

An intense rainfall of 10.2 inches in 7 hours on August 18, 1986 caused severe flooding on Scotts Creek and South Scotts Creek in Newberry, South Carolina. Two people lost their lives and several businesses and homes were damaged. The flood caused damages of an estimated \$800,000.

After the flood, the U.S. Geological Survey flagged, surveyed, and documented high-water marks at twelve locations on Scotts Creek and two locations on South Scotts Creek. A peak discharge of 2,800 ft³/s was computed by indirect methods for Scotts Creek at Nance Street for the August 18, 1986 flood, compared to 2,200 ft³/s computed for the 100-year peak discharge at Nance Street. A peak discharge of 2,000 ft³/s was computed by indirect methods for South Scotts Creek at Glenn Street, compared to 1,560 ft³/s computed for the 100-year peak discharge at Glenn Street.

These data can provide water-resources managers (1) a technical basis for making flood-plain management decisions that could minimize existing and future flood problems, (2) a basis for designing and constructing drainage structures along roadways, and (3) historical documentation for future reference.

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APPENDIX

Reference Mark Locations

Number	Description	Elevation ¹
RM A	Chiseled Square on northwest corner of bridge curb bridge curb at Charles Street and Scotts Creek.	447.25
RM B	Nail in bottlecap in centerline of Academy Street, 40 feet east of centerline of Scotts Creek.	444.76
RM D	Chiseled square on southeast corner of Harris Street bridge curb, at Scotts Creek.	459.43
RM E	Nail in bottlecap in centerline of Nance Street, 55 feet west of Scotts Creek centerline.	460.29
RM F	Nail in centerline of Caldwell Street, 20 feet west of centerline of Scotts Creek.	460.25
RM G	Nail in bottlecap in centerline of College Street (U.S. Hwy. 76), 25 feet west of Scotts Creek centerline.	461.97
RM H	Nail in bottlecap in centerline of Calhoun Street, 80 feet west of Scotts Creek centerline.	464.91
RM I	Nail in bottlecap in centerline of Mower Street, 40 feet west of Scotts Creek centerline.	471.04
RM J	Chiseled square in southwest corner of Glenn Street bridge curb over Scotts Creek.	476.37
RM L	Chiseled square on southeast wingwall of old O'Neal Street bridge over Scotts Creek.	438.51
RM 1	Chiseled square in top of downstream end of culvert pipe at South Scotts Creek and Clarkson Avenue.	100.00
RM 2	Chiseled square on southeast corner of headwall of Glenn Street culvert at South Scotts Creek.	110.99

¹ Descriptions and elevations of RM's A through L were provided by the U.S. Army Corps of Engineers and are referenced to National Geodetic Vertical Datum of 1929.

RM 1 was described by the U.S. Geological Survey and arbitrarily assigned an elevation of 100.00 feet. The elevation of RM 2 is relative to the arbitrary elevation of 100.00 feet assigned to RM 1.