FLOODS ON SELECTED STREAMS IN THE VICINITY OF AUGUSTA, GEORGIA, OCTOBER 12-13, 1990

By Glen W. Hess and Timothy C. Stamey

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CONVERSION FACTORS

Multiply	*By*	*To obtain*
	Length	
inch (in.)	25.4	millimeter
foot (ft)	0.3048	meter
mile (mi)	1.609	kilometer
	Flow	
cubic foot per second (ft^3/s)	0.02832	cubic meter per second

VERTICAL DATUM

Sea Level.--In this report, "sea level" refers to the National Geodetic Vertical Datum 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.

ACRONYMS

USGS	U.S. Geological Survey
COE	U.S. Army Corps of Engineers
FEMA	Federal Emergency Management Agency

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ABSTRACT

Flooding in the vicinity of Augusta, Georgia, during the period October 12-13, 1990, was caused by 8 to 11 inches of rainfall that occurred during the period October 10-12. Severe flooding occurred on Butler, Spirit, and Little Spirit Creeks causing several roads and dams to be inundated; and limited flooding occurred on the Savannah River in the vicinity of Augusta. Several dams failed along Butler and Spirit Creeks. Flood damage was estimated to be $40 million, and one fatality occurred. High-water elevations were obtained for Butler, Spirit, and Little Spirit Creeks and the Savannah River. Peak discharges were determined at 15 sites using indirect computation methods and established elevation-discharge relations. Computed recurrence intervals of the floods at these sites ranged from 5 years to greater than 100 years.

INTRODUCTION

During the period October 10-12, 1990, a storm produced 8 to 11 in. of rainfall in the vicinity of Augusta, Ga., and Aiken and Clarks Hill, S.C. As a result, severe flooding occurred during the period October 12-13, 1990, in the basins of Butler Creek, Spirit Creek, and Little Spirit Creek; and limited flooding occurred on the Savannah River in the vicinity of Augusta, Ga. Several roads and dams were inundated or breached by flood waters; and magnified the severity of the flooding in these areas. Immediately following the flood, the U.S. Geological Survey (USGS), in cooperation with the U.S. Army Corps of Engineers (COE), Savannah District, documented the severity of the flooding and obtained high-water marks on Butler, Spirit and Little Spirit Creeks, and Savannah River, and other selected streams in the Augusta, Ga., area, which includes parts of South Carolina. Flood data obtained from this severe flood will be useful to Federal and State officials for (1) the design of roadway structures, (2) flood-plain management, (3) establishing flood-insurance rates, and (4) urban planning. Benchmarks used to survey flood elevations are provided in a supplemental data section at the back of the report.

This report describes and documents the flooding at selected sites and reaches of streams in the vicinity of Augusta, Ga., during October 12-13, 1990. Location and elevation of high-water marks, flood profiles, peak discharges, and recurrence intervals are presented for Butler Creek, Spirit Creek, Little Spirit Creek, and Savannah River, and other selected streams in the affected areas of Georgia and South Carolina. The authors appreciate the assistance in data collection provided by personnel of the COE, Savannah District. Also, the authors appreciate the assistance of the National Weather Service, Atlanta, Ga., for providing the rainfall data for this report.

DESCRIPTION OF STORMS

The flooding in the vicinity of Augusta, Ga. (plate 1), on October 12-13, 1990, was produced by the combination of two tropical systems and a slow-moving cold front. On October 10, a slow-moving cold front was located along a line extending from central Tennessee southwestward into Alabama and the Gulf of Mexico; and remnants of tropical storm Klaus was spreading into a series of rainstorms stretching from the Bahamas to North Carolina. These combined climatic conditions resulted in 1 to 3 in. of rain in the Augusta, Richmond County, Ga., area for the 24-hour period ending at 8:00 a.m. on October 11. At the same time, the remnants of tropical storm Klaus that were near the Florida Keys strengthened to create tropical storm Marco. By the morning of October 11, the cold front had stalled along a line from central Virginia to the Atlanta, Ga., area. Meanwhile, the other remnants of tropical storm Klaus continued moving northeastward into South Carolina and North Carolina, and tropical storm Marco was moving northward toward Georgia. By 8:00 p.m. on October 11, tropical storm Marco had moved northward and merged with the northern remnants of tropical storm Klaus and the stalled cold front. As a result of these three weather systems colliding, 7 to 8 in. of rainfall occurred in the Augusta area during the 24-hour period ending at 8:00 a.m. on October 12. Thus, a total of 8 to 11 in. of rainfall occurred in the Augusta, Ga., area during a 48-hour period. Similar 48-hour rainfall totals of 8 to 11 in. were also reported at nearby Aiken and Clarks Hill, S.C.

DESCRIPTION OF FLOODS

The excessive rainfall during October 10-12, 1990, resulted in major flooding in many of the small streams in the vicinity of Augusta, Ga. Peak discharges, flood elevations, recurrence intervals of floods, and flood damages are described for selected streams in the area.

Peak Discharges and Frequency

Peak discharges at 12 of the 15 selected sites (table 1) were computed using indirect measurements that are based on geometry of dams, highways, culverts, and bridges. Peak flows over dams and highways were computed using methods developed by Hulsing (1967); flow through culverts was determined using methods described by Bodhaine (1968); and peak flows were computed at bridges using methods developed by Matthai (1967). Peak discharges were determined for McBean Creek, Stevens Creek and the Savannah River from previously developed elevation-discharge relations (Kennedy, 1984). Peak discharges may be substantially increased by upstream dam failures caused by floodwaters, and conversely, substantially reduced by upstream storage of floodwaters in lakes and ponds. The effect on the peak discharges was not determined at the sites where storage was substantial and dam failures occurred.

The flood-frequency associated with a peak discharge is the probability of its occurrence in any one year. The flood recurrence interval (the reciprocal of the probability of occurrence) is the average time interval, in years, between floods that equal or exceed the indicated magnitude. For example, a flood with a 100-year recurrence interval may be expected to be equaled or exceeded an average of once in 100 years. Stated another way, it is a flood that has a 1-percent probability of occurring in any given year. However, this does not imply that it will be 100 years before another event of that magnitude occurs, but the recurrence interval is an average of the number of years between events. For sites where the recurrence interval exceeds 100 years, the ratio of the peak discharge to the 100-year flood discharge is given in table 1 rather than the recurrence interval. For example, a ratio value of 1.7 indicates that the peak discharge was 1.7 times greater than the 100-year flood discharge. The ratio is given only to show the magnitude of the discharge relative to the 100-year flood, and does not indicate that the flood had a recurrence interval of 170 years. When at least 10 years of flood-discharge data are available, flood-frequency relations are computed using annual maximum discharges and methods described in "Guidelines for Determining Flood Flow Frequency", Bulletin 17B of the U.S. Water Resources Council (1981). In the absence of long-term-discharge stations, flood-frequency relations may be computed from regional equations developed with data from nearby long-term discharge stations. The regionalized equations are derived for free-flowing streams that are not affected by storage in lakes or by dam failures. Recurrence intervals are estimated (table 1) using methods described by the U.S. Water Resources Council (1976, 1981); and Price (1979); Whetstone (1982); Inman (1988); and Sanders and others (1990).

Table 1.--*Summary of elevations, discharges, and recurrence intervals for the flood of October 12-13, 1990, for selected sites in the vicinity of Augusta, Georgia*

[Site locations are in Georgia, except where noted; >, greater than; <, less than; --, not determined]

Map number (plate 1)	Name, location, and site number (where available)	Drainage area (square miles)	Headwater elevation (feet above sea level)	Peak discharge (cubic feet per second)	Recurrence interval (years)
11	Butler Creek at Old Savannah Road	36.7	124.22	[1]/4,150	--
1	Butler Creek at Old U.S. Highways 78 & 278 (02196820)	7.50	283.88	4,700	>100 [2,3]/(1.8)
32	Horn Creek near Colliers, S.C. (02196250)	13.9	[4]/14.80	2,900	[5]/16
24	Little Spirit Creek at Old Waynesboro Road	4.97	173.42	3,530	>100 [2,6]/(3.5)
30	McBean Creek near McBean (02197190)	41.4	[4]/7.52	3,160	>100 [2,6]/(1.6)
29	Raes Creek Tributary No. 1 at Boy Scout Road (02196605)	1.67	205.68	3,690	>100 [2,3]/(1.0)
28	Rocky Creek at State Highway Spur 56	18.0	122.90	1,500	[3]/5
27	Rocky Creek tributary at U.S. Highways 78 and 278 at Augusta (02196760)	1.56	191.90	1,110	>100 [2,3]/(1.0)
26	Savannah River below New Savannah Bluff Lock and Dam (02197000)	7,508	119.38	[7]/59,100	[8]/7
44	Site No. 7 at Savannah River site (02197342), S.C.	12.5	[4]/6.47	1,740	--
45	Site C -004 at Savannah River site (021973426), S.C.	0.83	[4]/4.69	355	--
22	Spirit Creek at State Highway 56	72.0	129.40	[1]/8,570	--
14	Spirit Creek at U.S. Highway 1	17.2	248.96	[1]/6,730	--
33	Stevens Creek near Modoc, S.C. (02196000)	545	234.86	27,900	[5]/25
31	Upper Three Runs near New Ellenton, S.C. (02197300)	87.0	[4]/8.49	635	>100 [2,5]/(1.2)

[1]/Peak discharge affected by dam failure.
[2]/Value is the ratio of maximum discharge to the 100-year discharge.
[3]/From methods described by Inman (1988).
[4]/Gage height.
[5]/From methods described by Whetstone (1982).
[6]/From methods described by Price (1979).
[7]/Peak discharge regulated by upstream dams.
[8]/From Sanders and others (1990).

Headwater elevations, peak discharges, and recurrence intervals for the flood of October 12-13 are presented for the 15 sites in table 1. Recurrence intervals range from 5 years to greater than 100 years. The recurrence intervals on Butler and Rocky Creeks indicate that larger recurrence interval peaks occurred in the upper end of the drainage basins (plate 1 and table 1). Peak discharges were increased by several dam failures in the respective basins of Butler and Spirit Creeks (table 1).

High-Water Marks and Flood Profiles

High-water marks left by the flood of October 12-13, 1990, were identified immediately following the flood from field surveys at road crossings along Butler, Spirit, and Little Spirit Creeks, and along a reach of the Savannah River. Elevations of these high-water marks were determined by standard surveying techniques using benchmarks established by the Federal Emergency Management Agency (FEMA) (1987), and are described in the Supplemental Data section at the back of this report. The flood elevations are useful to determine the relations between property elevations and the October 12-13, 1990, flood elevations (plate 1 and table 1). The flood elevations along Butler, Spirit, and Little Spirit Creeks and the Savannah River are listed in table 2.

Flood Damage

The heavy rainfall in the vicinity of Augusta, Ga., flooded several streets and homes during October 12-13, 1990. Newspaper reports stated that an estimated $40 million in damages occurred in the Augusta, Ga., area (The Augusta Chronicle, 1990). More than 700 people were evacuated from low-lying areas and one fatality occurred (The Augusta Chronicle, 1990).

Several roads were inundated and closed along Butler Creek (the bridge at Old U.S. Highways 78 and 278) and Spirit Creek (bridges at Willis Foreman and Windsor Spring Roads, U.S. Highway 25, Old Waynesboro and Goshen Roads, and Georgia Highway 56). Bridges on Little Spirit Creek were not indundated, and flooding along the Savannah River generally was limited to low-lying areas. Because of the severity of the flood, ponds and reservoirs on Butler, Spirit, and Little Spirit Creeks were filled to, or near, maximum capacity, and some dams were overtopped or breached (table 3).

SUMMARY

The flooding in the vicinity of Augusta, Ga., during the period October 12-13, 1990, was caused by 8 to 11 inches of rainfall during the period October 10-12. Severe flooding occurred on Butler, Spirit, and Little Spirit Creeks which resulted in several roads and dams being inundated and several dam failures. Also, limited flooding occurred on the Savannah River in the vicinity of Augusta. Flood damage was estimated to be $40 million, and one fatality occurred. Peak discharges and recurrence intervals were determined at 15 sites. Recurrence intervals ranged from 5 years to greater than 100 years. The effect on peak discharges was not determined where lake storage was substantial and where dam failures occurred. High-water marks were obtained along reaches of Butler, Spirit, and Little Spirit Creeks and the Savannah River.

Table 2.--*Peak water-surface elevations along streams, October12-13,1990, in the vicinity of Augusta, Georgia*

[--, not determined]

Map number (plate 1)	Site location	Location in reference to stream crossing	Stream distance above mouth (feet)	Drainage area (square miles)	Peak water-surface elevation (feet above sea level)
		BUTLER CREEK			
1	Old U.S. Highways 78 and 278	upstream	73,500	7.4	283.88
2	U.S. Highways 78 and 278	upstream downstream	72,700	7.5	283.88 277.80
3	Lombards Mill Pond	upstream	54,400	18.8	218.68
4	Old U.S. Highway 1	upstream downstream	54,200	18.9	216.42 215.59
5	U.S. Highway 1	upstream downstream	53,600	19.1	214.72 212.64
6	Windsor Spring Road	upstream downstream	42,400	26.9	189.01 188.67
7	U.S. Highway 25	upstream downstream	31,400	29.7	167.92 166.80
8	Norfolk-Southern Railroad	upstream downstream	29,500	30.2	159.68 157.78
9	State Highway 56	upstream downstream	24,100	32.1	154.00 152.60
10	New Savannah Road	upstream downstream	14,600	36.6	125.65 124.28
11	Old Savannah Road	upstream downstream	13,100	36.7	124.22 123.00
12	Savannah River levee	upstream downstream	1,000	73.0	122.32 119.38

Table 2.--*Peak water-surface elevations along streams, October12-13,1990, in the vicinity of Augusta, Georgia*--Continued

[--, not determined]

Map number (plate 1)	Site location	Location in reference to stream crossing	Stream distance above mouth (feet)	Drainage area (square miles)	Peak water-surface elevation (feet above sea level)
		SPIRIT CREEK			
13	Fort Gordon golf course pond	upstream	90,200	17.1	252.35
14	U.S. Highway 1	upstream downstream	90,000	17.2	248.96 245.95
15	Willis Foreman Road	upstream downstream	68,000	48.2	206.05 205.38
16	Windsor Spring Road	upstream downstream	63,200	49.3	200.89 198.52
17	Norfolk Southern Railroad	upstream downstream,	60,500	51.4	194.69 194.49
18	Richmond Factory Pond	upstream	55,900	55.1	192.73
19	U.S. Highway 25	upstream downstream	55,800	55.2	189.95 187.50
20	Old Waynesboro Road	upstream downstream	37,300	66.6	159.42 157.50
21	Goshen Road	upstream downstream	30,500	69.4	148.92 146.88
22	State Highway 56	upstream downstream	17,000	72.0	129.40 127.37

Table 2.--*Peak water-surface elevations along streams, October12-13,1990, in the vicinity of Augusta, Georgia*--Continued

[--, not determined]

Map number (plate 1)	Site location	Location in reference to stream crossing	Stream distance above mouth (feet)	Drainage area (square miles)	Peak water-surface elevation (feet above sea level)
		LITTLE SPIRIT CREEK			
23	Hancock Mill Pond	upstream	26,400	12.8	178.88
24	Old Waynesboro Road	upstream downstream	26,200	12.9	173.42 172.97
25	State Highway 56	upstream downstream	900	28.3	123.04 123.04
		SAVANNAH RIVER			
34	Augusta City Head Gates	downstream	206.0	7,150	132.50
35	Interstate 20	upstream	204.9	--	131.90
36	U.S. Highway 25 (Thirteenth Street)	downstream	200.6	--	129.60
37	U.S. Highway 1 (Fifth Street)	downstream	199.6	--	128.90
38	Prep Phillips Road	no crossing	198.5	--	128.10
39	Prep Phillips Road	no crossing	197.7	--	127.60
40	Prep Phillips Road	at Horse Creek	196.8	--	127.40
41	State Highway 28 (Sandbar Ferry)	upstream	195.8	--	126.60
42	Peridot Intake Structure	no crossing	194.3	--	125.70
43	Farm Road	no crossing	191.5	--	123.20
26	New Savannah Bluff Lock and Dam	downstream	187.4	7,508	119.38

Table 3.--*Status of dams after the flooding of October 12-13, 1990, in the vicinity of Augusta, Georgia*
[--, not applicable]

Name and location	Not overtopped or breached	Overtopped only	Overtopped and breached
Fort Gordon water-supply lake on Butler Creek at Fort Gordon, Ga.	Yes	--	--
Boardman Pond on tributary to Butler Creek at Fort Gordon, Ga.	--	--	Yes
Lombard Mill Pond on Butler Creek near Fort Gordon, Ga.	--	Yes	--
Thomas Lake on Spirit Creek at Fort Gordon, Ga.	--	--	Yes
Maxwell Lake on Spirit Creek at Fort Gordon, Ga.	--	--	Yes
Wilkerson Lake on Spirit Creek at Fort Gordon, Ga.	--	--	Yes
Scout Lake on Spirit Creek at Fort Gordon, Ga.	Yes[1/]	--	--
Mirror Lake on tributary to Spirit Creek at Fort Gordon, Ga.	Yes	--	--
Fort Gordon golf course pond on Spirit Creek at Fort Gordon, Ga.	Yes	--	--
Richmond Factory Pond on Spirit Creek near Augusta, Ga.	--	--	Yes
McDade Pond on Spirit Creek near Augusta, Ga.	Yes[1/]	--	--
Hancock Mill Pond on Little Spirit Creek near Augusta, Ga.	Yes	--	--

[1/]Dam was in disrepair and did not have storage capacity on October 11, 1990.

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SUPPLEMENTAL DATA

BENCHMARKS IN THE VICINITY OF AUGUSTA, GEORGIA

[FEMA, Federal Emergency Management Agency; RM, river mile.
Note: Benchmark information furnished by FEMA (1987)]

Map number (plate 1)	FEMA reference mark number	Elevation (feet above sea level)	Description
19	RM 1	194.23	Nail in power pole 89 ft left on centerline of U.S. Highway 25 on right bank upstream at bridge over Spirit Creek
24	RM 2	174.47	Standard brass tablet set in downstream right headwall of culvert over Little Spirit Creek at Old Waynesboro Road stamped "50WHC 1961"
21	RM 3	146.81	Centerline of bridge on right bank crossing Spirit Creek at Goshen Road
12	RM 4	139.48	Nail on downstream right bank of concrete footing of bridge and gate structure over Butler Creek at Savannah River levee
2	RM 9	278.80	Chiseled cross in top of southwest downstream right corner of headwall of culvert for Butler Creek at U.S. Highways 78 and 278
14	RM 87	255.39	Northwest corner,upstream left, of old U.S. Highway 1 bridge over Spirit Creek
9	RM 111	160.14	Chiseled cross in top of concrete rail on east side of State Highway 56 over Butler Creek
8	RM 112	164.60	Top of rail on top of north downstream headwall timber on east left side of Norfolk-Southern Railway bridge over Butler Creek
7	RM 113	178.17	Chiseled cross in top of concrete corner rail in southeast corner of U.S. Highway 25 bridge over Butler Creek
6	RM 118	199.81	Top of bolthead on southeast downstream right corner curb radius of Windsor Spring Road bridge over Butler Creek

SUPPLEMENTAL DATA--Continued

BENCHMARKS IN THE VICINITY OF AUGUSTA, GEORGIA--Continued

[FEMA, Federal Emergency Management Agency; RM, river mile.
Note: Benchmark information furnished by FEMA (1987)]

Map number (plate 1)	FEMA reference mark number	Elevation (feet above sea level)	Description
5	RM 122	221.10	Chiseled cross in top of eastern downstream right bank of most downstream U.S. Highway 1 bridge over Butler Creek
11	RM 131	127.47	Chiseled cross in top of southeast corner of left bulkhead of Old Savannah Road over Butler Creek
20	RM 133	162.86	Top of northeast concrete rail of bridge at Old Waynesboro Road over Spirit Creek
17	RM 136	210.56	Top of concrete abutment at northeast corner of Norfolk Southern Railway trestle over Spirit Creek
16	RM 137	198.06	Top of northeast curb at Windsor Spring Road bridge over Spirit Creek
15	RM 138	205.60	Top of northwest concrete curb on Willis Foreman Road bridge over Spirit Creek
25	RM 142	143.31	Northwest corner of concrete grave slab for Herbert Wilson in cemetary on east side of State Highway 56 about 500 ft south of Little Spirit Creek
22	RM 143	127.96	Top of northeast corner of concrete rail for State Highway 56 bridge over Spirit Creek