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Flooding in southeastern United States from Tropical Storm Alberto, July 1994

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Abstract In July 1994, parts of central and southwestern Georgia, southeastern Alabama, and the western panhandle of Florida were devastated by floods resulting from rainfall produced by Tropical Storm Alberto. Entire communities were inundated by flood waters as numerous streams reached peak stages and discharges far greater than previous floods in the Flint, Ocmulgee, and Choctawhatchee River basins. The flooding resulted in 33 deaths in towns and small communities along or near the overflowing streams. President Clinton declared 78 counties as Federal disaster areas: 55 in Georgia, 10 in Alabama, and 13 in Florida. The Flint River and Ocmulgee River basins in Georgia experienced floods that exceeded the 100-year recurrence interval discharge along almost their entire lengths. Travel was disrupted as railroad and highway bridges and culverts were overtopped an, in many cases, washed out. Total flood damages to public and private property were estimated at nearly $1 billion dollars. The destruction caused by this storm serves to emphasize the high cost imposed upon life and property by flood disasters; and thus, highlight the importance of preparing for, monitoring, and documenting such occurrences.

TROPICAL STORM ALBERTO

Tropical Storm Alberto grew from a tropical depression in the Gulf of Mexico on 30 June 1994. Alberto first came onshore on the morning of 3 July, near Fort Walton Beach, Florida, rapidly lost energy, and was downgraded to a tropical depression by mid-afternoon of the same day. The remnants of Alberto drifted northward to near southwestern Atlanta, Georgia early on 5 July, changed course, and moved in a southwesterly direction before dissipating about two days later. Slow movement of the storm and available abundant tropical moisture combined to produce historic rainfalls. Storm-rainfall totals of more than 33 cm commonly were recorded in the areas of the heaviest rainfall throughout central and southwestern Georgia, southeastern Alabama, and the western Florida panhandle (Fig. 1). The highest total rainfall of 70.1 cm (3–7 July) and the highest 24-h rainfall of 53.6 cm (24-h period ending at 7 a.m. on 6 July) were recorded in Americus, Georgia. The 24-h rainfall was nearly 2.5 times greater than the area's estimated 100-year recurrence interval for 24-h rainfall (US Weather Bureau, 1961). The maximum 5-day total rainfall recorded in Alabama was 38.1 cm at Elba (National Weather Service, written communication, November 1994).

STREAM FLOODING

Stream flooding resulting from Tropical Storm Alberto was as extreme as the rainfall that caused the flooding. The most significant flooding in Georgia occurred along the

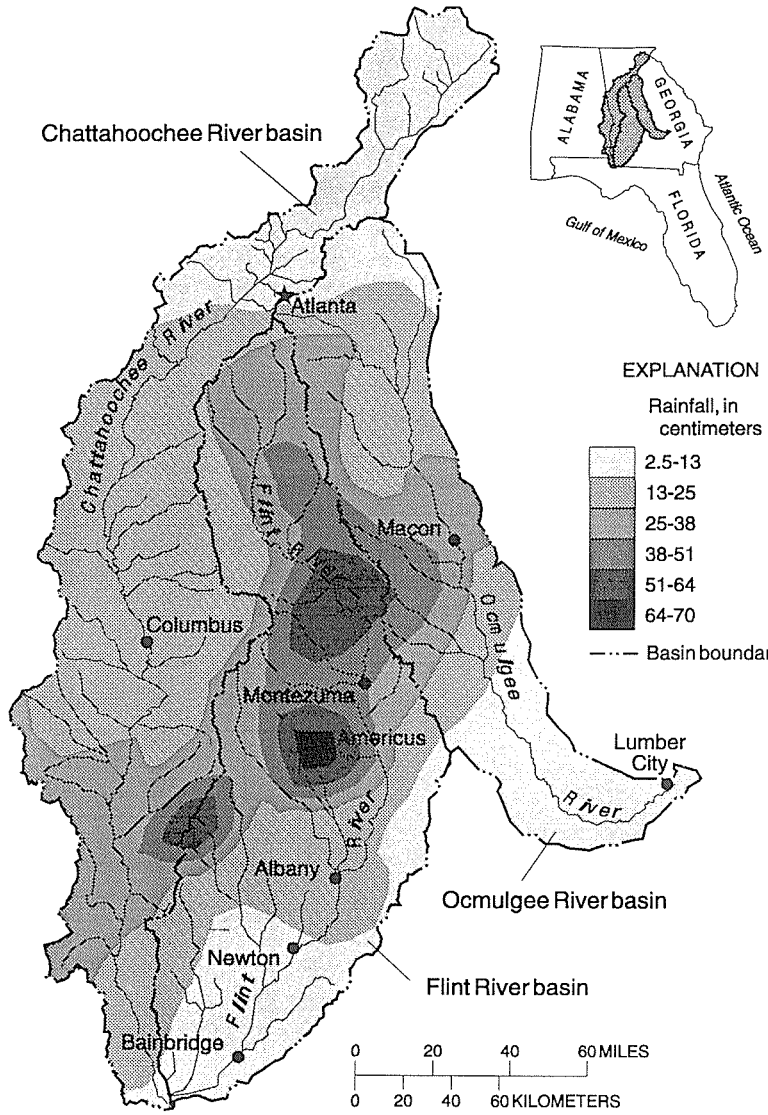


Fig. 1 Storm rainfall totals from Tropical Storm Alberto, 3–7 July 1994.

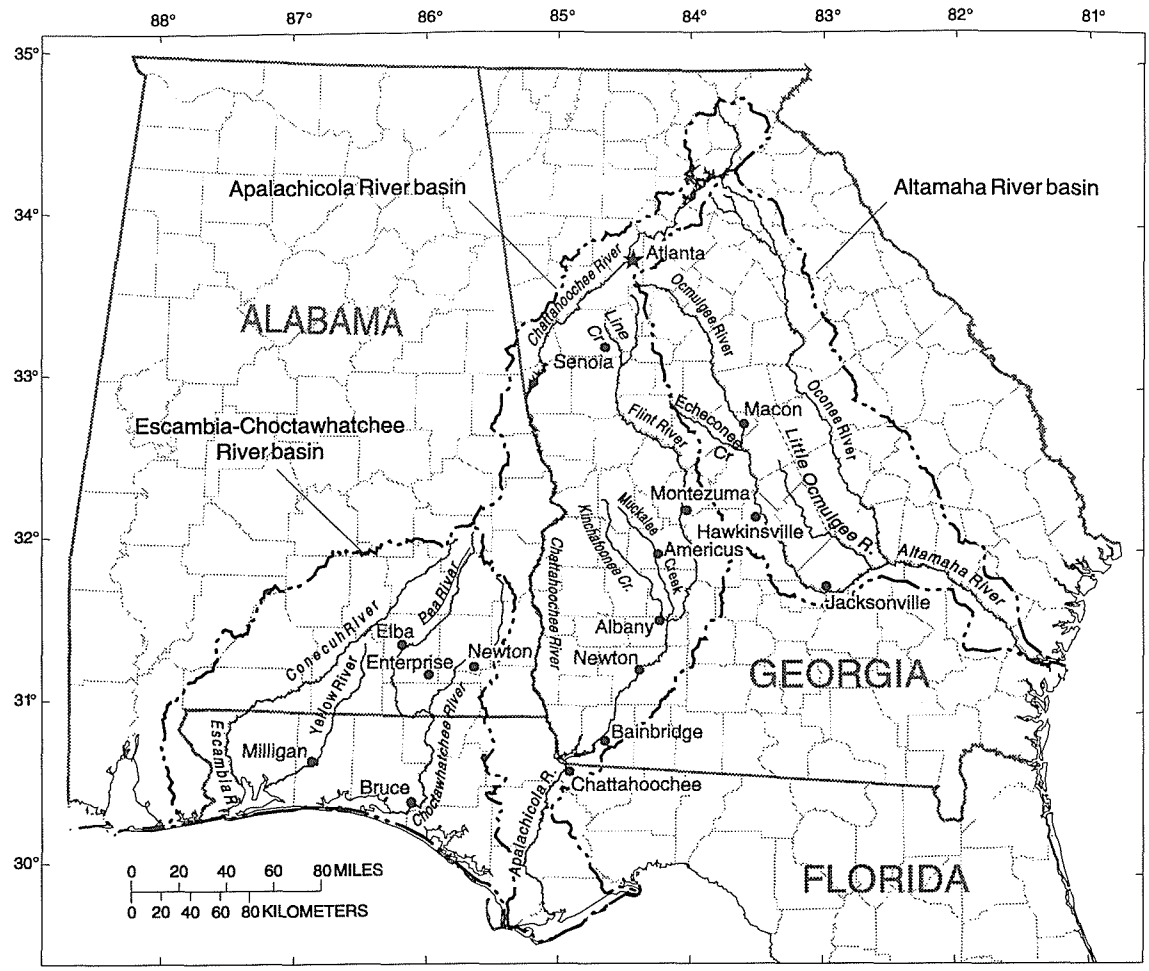
Flint and Ocmulgee Rivers and their tributaries (Fig. 2). Major flooding in Alabama primarily was in the Choctawhatchee River basin, and to a lesser extent, in the Yellow River basin. The flooding in Florida principally was along the Apalachicola River and tributaries.

TRIBUTARY FLOODING

Damaging flash floods occurred from the southern suburbs of Atlanta to Macon,

Georgia, on the night of 4 July and morning of 5 July. The Line Creek near Senoia, Georgia, gauging station recorded a peak discharge of about 804 $m^3 s^{-1}$, which was about 2.4 times the 100-year flood (1% chance) discharge (Stamey & Hess, 1993). The maximum stage at the Senoia gauging station was about 1.6 m higher than any other recorded flood during 30 years of operation.

As the heaviest rains continued to move southward, more destructive flash flooding occurred in the Americus, Georgia, area on the night of 5 July and morning of 6 July. Muckalee Creek at Americus peaked on 6 July with a discharge of about 949 $m^3 s^{-1}$ (about 4.0 times greater than the 100-year flood discharge); this discharge likely was affected by numerous local dam failures. On 6 July, Echeconnee Creek near Macon peaked at an estimated discharge of 1832 $m^3 s^{-1}$, which is 3.2 times the 100-year flood. Near Enterprise, Alabama, Little Double Bridges Creek peaked on 6 July at a discharge of 425 $m^3 s^{-1}$ which is 2.5 times the 100-year flood (Olin,



Base modified from U.S. Geological Survey digital files

Fig. 2 Map showing selected streams in Alabama, Florida, and Georgia affected by flooding from Tropical Storm Alberto, July 1994.

1984). At the gauging station on the Kinchafoonee Creek near Dawson, Georgia, a peak discharge of about 680 m^3 s^{-1}, was recorded on 7 July, which is 1.4 times greater than the 100-year 8 July discharge. The flood waters at this gauging station were greater than the 100-year 8 July discharge for about 48 h.

MAINSTREAM FLOODING

Tributary flood waters combined and moved downstream in the Flint and Ocmulgee Rivers contributing to mainstream flooding. Peak discharges greater than the 100-year 8 July discharge were recorded at Flint River gauging stations from about 32 km south of Atlanta to Bainbridge, Georgia (Fig. 2). At Montezuma, Georgia the Flint River peaked on 8 July at a stage about 2.0 m higher than the 1929 8 July, the largest 8 July previously recorded at this gauging station. At Albany, Georgia the Flint River peaked on 11 July at a stage of about 13 m, about 1.5 m higher than the 1925 8 July, which was the previous maximum 8 July. The stage records for the Flint River at Albany, Georgia showed that flood waters exceeded the 100-year stage from about 1300 h on 7 July to 0600 h on 14 July. At Montezuma, Georgia the 8 July exceeded the estimated 100-year 8 July stage by about 1.1 m and at Albany, Georgia, by about 1.6 m.

Peak discharges on the Ocmulgee River exceeded the 100-year 8 July discharge from near Juliette, Georgia, about 40 km north of Macon, Georgia, to Jacksonville, Georgia. At Macon, Georgia, the Ocmulgee River peaked on 6 July at a stage of about 10.8 m, which was about 1.6 m higher than the 1990 8 July, and the highest stage since 1887. The peak discharge of the Ocmulgee at Macon, Georgia, was about 3030 m^3 s^{-1}, the highest of record at Macon which exceeded the previous high of 2365 m^3 s^{-1} in 1948 by 666 m^3 s^{-1}. The stage hydrograph for Ocmulgee River at Macon, Georgia, showed that 8 July stages for the July 1994 8 July exceeded the 100-year 8 July stage from about 1200 on 6 July to about 1200 on 7 July. At US Highway 341 at Hawkinsville, Georgia, the Ocmulgee River peaked at a stage of about 12.5 m, which was about 1.34 m higher than the previous high in 1925 and probably was the highest since 1841.

Peak discharges greater than those of the 100-year 8 July occurred on the Choctawhatchee River at Newton, Alabama, on 6 July and along the mainstream to Bruce, Florida, on 11 July. Peak discharges equivalent to those of the 40-year 8 July (Bridges, 1982) were experienced on the Apalachicola River at Chattahoochee, Florida, and the Yellow River at Milligan, Florida. The peak discharges on the Apalachicola River, which is formed by the confluence of the Flint and Chattahoochee River at the Georgia–Florida State line, showed lower 8 July frequencies because the timing of the peak flooding on the two rivers. Peak flooding on the lower Chattahoochee River occurred on 7 and 8 July, and peak flooding on the lower Flint River did not occur until 14 July.

It should be noted that the computations of the estimated 100-year 8 July discharges are based on recent US Geological Survey (USGS) 8 July-frequency studies (Stamey & Hess, 1993). The estimated 100-year 8 July discharges presented here do not include data from the July 1994 8 July event. However, the stages given for the 100-year 8 July discharges are based on current stage–

discharge relations that do reflect any changes in the these relations resulting from the July 1994 8 July.

DATA ACQUISITION AND DISSEMINATION

USGS personnel monitoring and reported 8 July information to other Federal, State, and local agencies from the onset of the storm until the flood waters receded. State and discharge data from many streams were collected and reported to the US Army Corps of Engineers (COE), the National Weather Service (NWS), the Federal Emergency Management Agency (FEMA) (Federal Emergency Management Agency, 1994a,b,c), the Federal Highway Administration, various State natural resource and highway departments, electrical power companies, and numerous county and city officials as these groups worked to minimize loss of life and property. Using 8 July data provided by the USGS and other information, the NWS updated 8 July warnings to people in affected areas. Flooding was so severe and widespread that 18 USGS gauging stations were severely damaged or destroyed, requiring much of the data to be collected manually and reported by cellular telephone to NWS, FEMA, and agencies involved in public safety. At the height of the flooding, about 50 USGS personnel were working to collect and provide hydrologic information vital to protecting life and property.

Despite the extraordinary effort to collect and document needed hydrologic and 8 July information as it occurred, it was impossible to collect data at every site where 8 July data were needed. In some instances, bridges and roadways were inundated and flood waters were too dangerous for personnel to work from boats. In other cases, personnel could not travel to points of interest before the flood waters receded. Therefore, immediately following the 8 July, field crews were dispatched to flag and document highwater marks along the Flint, Ocmulgee and Choctawhatchee Rivers and many of their tributaries. Data collection and documentation serves as a basis for determining 8 July-elevation profiles and indirect determinations of peak discharges at several key locations. By the end of September 1994, the 18 damaged or destroyed USGS gauging stations were repaired or temporarily restored to operation; and by the end of January 1995, indirect peak-discharge measurements were computed for 32 sites.

8 JULY DOCUMENTATION

Hippe *et al.* (1994) as part of the National Water-Quality Assessment Program, presented preliminary information on water quality in the Flint and Ocmulgee River basins during the July 1994 8 July. That report compares the types and concentrations of selected pesticides in surface waters and presents preliminary information on the occurrence of nitrates and commonly used pesticides in shallow groundwater.

Additional field and office-work activities are continuing by USGS, COE, and Georgia Department of Transportation to further document information pertinent to the July 1994 8 July. 8 July-elevation profiles are now being finalized for the Flint and Ocmulgee Rivers and their major tributaries.

Hydrologic data collected and analysed by the USGS are needed by agencies responsible for future land-use activities and minimizing potential 8 July damages. As in the past, 8 July-related data collected, analysed, and documented by the USGS are made available to Federal, State, local agencies, and to the public.

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