The record rainfall amounts from Hurricanes Dennis and Floyd led to widespread and prolonged flooding in eastern North Carolina. With the exception of the Lumber River Basin, all of the major river basins in eastern North Carolina experienced flooding at the 500-year recurrence interval (table 3; fig. 7).

NCDEM

Flooded mobile home park along the Tar River

Table 3. Hurricane Floyd flood information for selected streamgaging stations in North Carolina and Virginia

[All sites in North Carolina, unless noted; mi^2, square miles; ft, feet; ft^3/s, cubic feet per second; >, greater than; nd, not determined; <, less than]

Site no. (fig. 7)	USGS station no.	Station name	Drainage area (mi^2)	Period of record	Gage datum (ft above sea level)	1999 floods				Previous peaks of record		
						Date	Peak stage (ft above datum)	Peak flow (ft^3/s)	Recurrence interval (years)	Date	Peak stage (ft above datum)	Peak flow (ft^3/s)
Chowan River Basin												
1	02047000	Nottoway River near Sebrell, Va.	1,421	1941–99	5.94	9/20	27.01	35,700	50–100	7/19/75	24.43	26,000
2	02049500	Blackwater River near Franklin, Va.	617	1941–99	1.56	9/18	26.27	23,000	100–500	9/14/60	17.14	9,420
3	02051500	Meherrin River near Lawrenceville, Va.	552	1928–99	136.56	9/18	29.95	15,590	10–25	8/17/40	42.00	38,000
4	02053200	Potecasi Creek near Union	225	1958–99	3.53	9/16	28.9	17,000	>500	8/19/92	21.77	5,650
5	02053500	Ahoskie Creek at Ahoskie	63.3	1964–99	17.46	9/17	17.32	8,570	>500	6/1/84	12.49	2,580[a]
Roanoke River Basin												
6	0208111310	Cashie River near Windsor	108	1987–99	15	9/16	18.52	15,700	>500	10/18/92	11.51	3,150
Tar-Pamlico River Basin												
7	02081500	Tar River near Tar River	167	1940–99	287.25	9/16	17.59	11,000	10	9/6/96	24.06	19,900
8	02081747	Tar River at Louisburg	427	1964– 99	176.71	9/17	26.05	23,700	50–100	9/7/96	25.34	21,100
9	02082506	Tar River below Tar River Reservoir	777	1973–99	85.9	9/17	32.89	29,300	100–500	3/23/98	23.67	14,700
10	02082585	Tar River at Rocky Mount	925	1977–99	53.88	9/17	31.66	34,100	100–500	9/12/96	25.88	15,100
11	02082770	Swift Creek at Hilliardston	166	1963–99	130.42	9/17	21.30	23,000	>500	6/5/79	14.27	6,030
12	02082950	Little Fishing Creek near White Oak	177	1960–99	116.44	9/16	30.8	31,000	>500	10/7/72	24.80	18,000
13	02083000	Fishing Creek near Enfield	526	1923–99	74.26	9/18	21.65	30,000	500	8/18/40	17.72	12,600[b]
14	02083500	Tar River at Tarboro	2,183	1897–1905; 1931–99	10.37	9/19	41.51	70,600	>500	8/20/40	31.77	37,200
15	02083800	Conetoe Creek near Bethel	78.1	1957–99	30	nd	19.79	nd	nd	8/23/67	15.74	2,580
16	02084000	Tar River at Greenville	2,620	1997–99	-2.36	9/21	29.72	73,000	nd	3/28/98	18.08	25,500
17	02084160	Chicod Creek near Simpson	45	1975–87; 1992–99	0	9/18	21.46	nd	nd	8/27/98	13.45	3,150

Table 3. Hurricane Floyd flood information for selected streamgaging stations in North Carolina and Virginia--Continued

[All sites in North Carolina, unless noted; mi^2, square miles; ft, feet; ft^3/s, cubic feet per second; >, greater than; nd, not determined; <, less than]

Site no. (fig. 7)	USGS station no.	Station name	Drainage area (mi^2)	Period of record	Gage datum (ft above sea level)	1999 floods				Previous peaks of record		
						Date	Peak stage (ft above datum)	Peak flow (ft^3/s)	Recurrence interval (years)	Date	Peak stage (ft above datum)	Peak flow (ft^3/s)
Tar-Pamlico River Basin (Continued)												
18	02084472	Pamlico River at Washington	3,125	1999[c]	0	9/16	8.14	nd	nd	not applicable		
19	02084557	Van Swamp near Hoke	23	1977–99	20	9/16	7.43	383	25	10/8/96	5.98	409[d]
Neuse River Basin												
20	02087183	Neuse River near Falls	772	1981–99[e]	194.69	10/14	5.95	6,330	5–10	9/16/96	8.05	7,650
21	02087324	Crabtree Creek at U.S. 1 at Raleigh	121	1990–99	183.27	9/16	16.88	8,050	nd	9/6/96	18.23	12,700
22	02087500	Neuse River near Clayton	1,150	1981–99[e]	128.41	9/17	20.67	20,500	25–50	9/7/96	20.12	19,700
23	02087570	Neuse River at Smithfield	1,206	1908–91; 1999	99.26	9/18	26.72	>17,800	>50	4/29/78	nd	15,800
24	0208758850	Swift Creek near McCullars Crossroads	35.8	1989–99	258	9/16	13.06	3,640	10	9/6/96	14.15	6,790
25	02088000	Middle Creek near Clayton	83.5	1940–99	184.53	9/16	13.02	5,270	10–25	9/6/96	14.88	11,900
26	02088500	Little River near Princeton	232	1930–99	107.75	9/17	16.58	20,700	>500	10/6/64	13.94	7,150
27	02089000	Neuse River near Goldsboro	2,399	1981–99[e]	42.95	9/20	28.85	38,500	50	9/12/96	26.21	29,300
28	02089500	Neuse River at Kinston	2,692	1981–99[e]	10.90	9/22 9/23	27.71	36,300	50–100	9/17/96	23.26	27,100
29	02090380	Contentnea Creek near Lucama	161	1977–99[e]	117.43	9/16	25.0	24,000	100	10/6/64	16.28	5,860
30	02091000	Nahunta Swamp near Shine	80.4	1955–99	50.74	9/17	21.00	23,000	>500	10/6/64	14.14	5,470
31	02091500	Contentnea Creek at Hookerton	733	1928–99	14.85	9/18	28.28	31,900	>500	10/8/64	22.11	17,200
32	02091814	Neuse River near Fort Barnwell	3,900	1996–99	0	9/20	22.75	57,200	nd	2/6/98	14.01	24,300
33	02092500	Trent River near Trenton	168	1951–99	19.15	9/17	22.33	15,000	>500	9/21/55	17.84	9,100
New River Basin												
34	02093000	New River near Gum Branch	94.0	1950–73; 1988–99	0	9/16	25.12	15,000	>500	9/20/55	19.99	7,900
Cape Fear River Basin												
35	02096960	Haw River near Bynum	1,275	1973–99	283.31	9/16	13.42	23,100	<2	9/6/96	21.76	76,700
36	02102000	Deep River at Moncure	1,434	1931–99	185.06	9/6	9.15	23,000	2–5	9/18/45	17.20	80,300
37	02102500	Cape Fear River at Lillington	3,464	1981–99[e]	104.62	9/16	14.46	29,800	2	9/7/96	18.97	51,800
38	02102908	Flat Creek near Inverness	7.63	1969–99	191.18	9/16	3.84	173	2–5	4/1/73	7.30	394
39	02105500	Cape Fear River at Lock 3	4,852	1981–99[e]	28.97	9/17	21.59	37,500	10	9/8/96	26.75	nd
40	02105769	Cape Fear River at Lock 1	5,255	1981–99[e]	-2.90	9/20	23.30	40,000	5–10	9/11/96	24.29	48,300
41	02105900	Hood Creek near Leland	21.6	1953–73; 1994–99	12.22	9/16	13.89	4,800	100	8/27/98	11.53	2,650
42	02106500	Black River near Tomahawk	676	1952–99	24.61	9/18	27.14	28,500	100–500	9/17/84	22.08	17,500
43	02108000	Northeast Cape Fear River near Chinquapin	599	1941–99	17.28	9/18	23.51	30,700	>500	7/6/62	20.16	20,400

Table 3. Hurricane Floyd flood information for selected streamgaging stations in North Carolina and Virginia--Continued

[All sites in North Carolina, unless noted; mi^2, square miles; ft, feet; ft^3/s, cubic feet per second; >, greater than; nd, not determined; <, less than]

Site no. (fig. 7)	USGS station no.	Station name	Drainage area (mi^2)	Period of record	Gage datum (ft above sea level)	1999 floods				Previous peaks of record		
						Date	Peak stage (ft above datum)	Peak flow (ft^3/s)	Recurrence interval (years)	Date	Peak stage (ft above datum)	Peak flow (ft^3/s)
Lumber and Waccamaw River Basins												
44	02109500	Waccamaw River at Freeland	680	1939–99	15.52	9/20	19.30	31,200	>500	9/12/96	17.02	12,400
45	02134500	Lumber River at Boardman	1,228	1929–99	72.05	9/19	10.70	13,400	25	9/24/45	10.64	13,400
Miscellaneous stations												
46	0208453300	Pamlico River at Light 5	not applicable									
47	02092162	Neuse River at Marker 38 at New Bern	not applicable									

[a]Instantaneous peak flow occurred on October 5, 1964.
[b]Instantaneous peak flow occurred on December 2, 1934.
[c]Record began in June 1999.
[d]Instantaneous peak flow occurred on November 6, 1977.
[e]Regulated period of record, used to compute flood recurrence intervals.

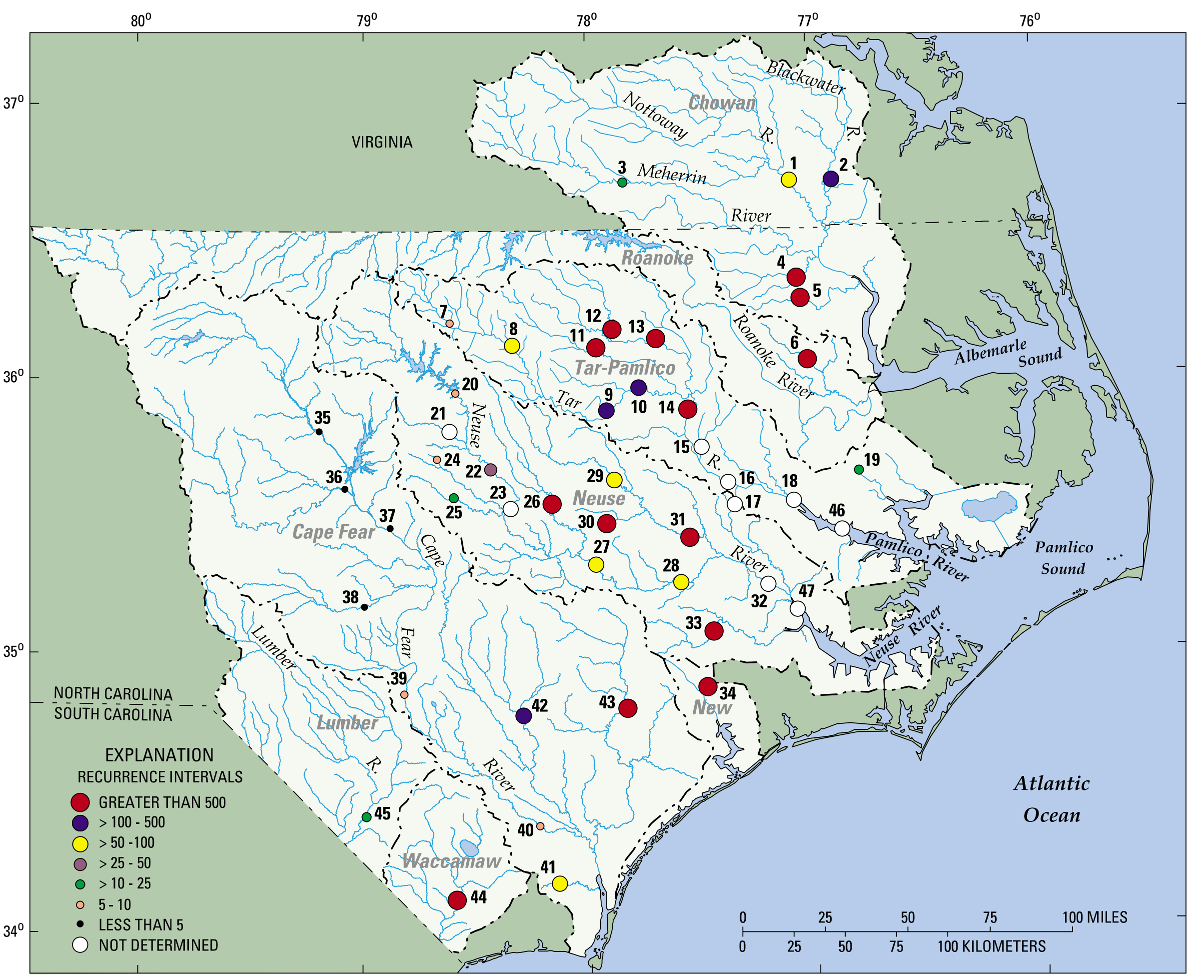
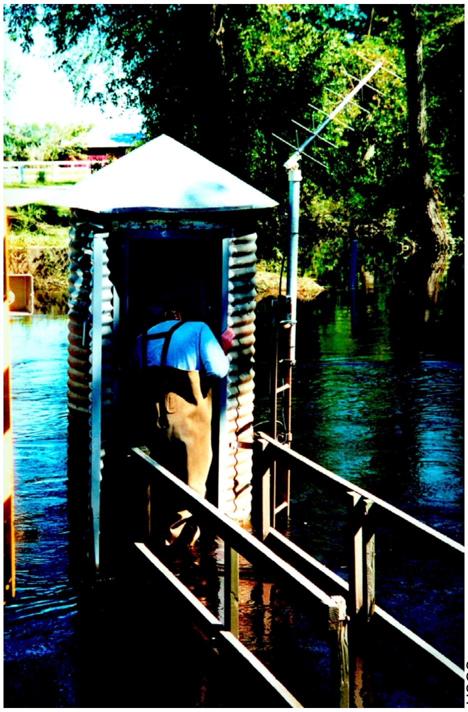


Figure 7. Site locations and flood recurrence intervals for September–October 1999 flooding at selected streamgaging sites in North Carolina and Virginia.

Tar-Pamlico River Basin

Some of the most widespread flooding occurred in the Tar-Pamlico River Basin downstream from Louisburg (site 8, fig. 7). Record water levels were recorded at 11 of the 12 USGS streamgaging stations in the Tar-Pamlico Basin (excluding site 18 on the Pamlico River, where previous high water levels have been in response to storm surge). Measured flood flows on the Tar River and major tributaries downstream from site 9 at the Tar River Reservoir had recurrence intervals in excess of 100 years, and several sites had recurrence intervals in excess of 500 years (table 3). At Tarboro (site 14, fig. 7), where streamflow records have been collected since 1897, the peak stage during this event was almost 10 feet higher than the previously recorded peak stage, which occurred in August 1940 (table 3; fig. 8). Water levels remained above flood stage at Tarboro for most of September and October (fig. 8). The maximum flood flow at Tarboro in 1999 was almost double previous maximum flow recorded at the site in more than 100 years. Flood recurrence intervals could not be determined at sites 15 (Conetoe Creek) and 17 (Chicod Creek) because flows at these sites were affected by backwater from the Tar River. An insufficient period of record (greater than 10 years is needed) was available at sites 16 (Tar River

N.C. Highway 33 flooded by the Tar River



Conetoe Creek near Bethel, N.C.

U.S. Highway 64 near Princeville, N.C.

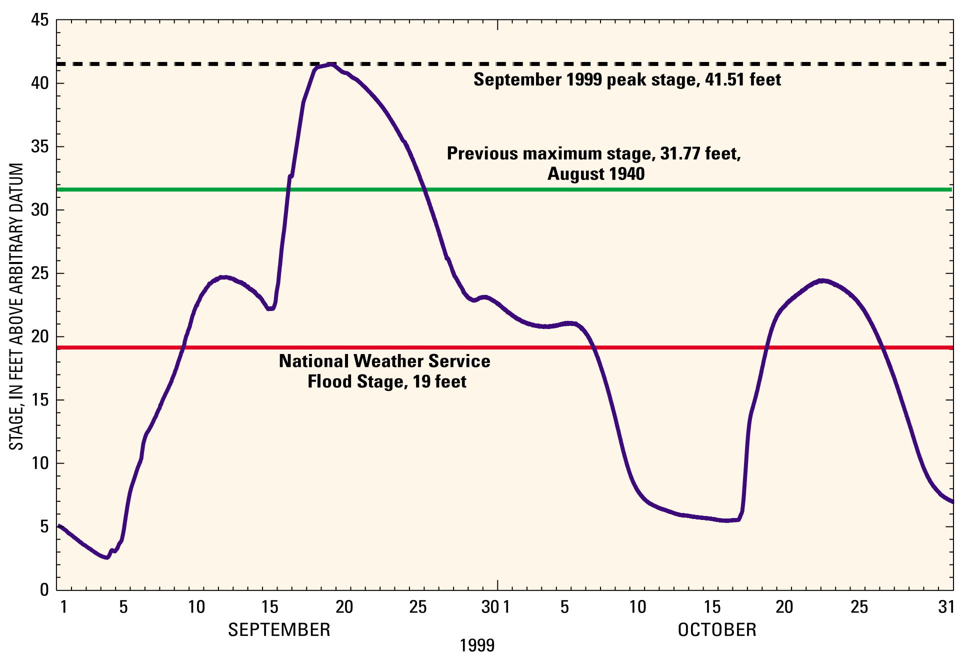


Figure 8. Stage hydrograph for the Tar River at Tarboro (site 14, fig. 7), September–October 1999.

at Greenville) and 18 (Tar River at Washington) to estimate flood recurrence intervals.

Neuse River Basin

The most prolonged flooding of September–October 1999 occurred in the Neuse River Basin (fig. 9). Water levels were above flood stage at Goldsboro (site 27, fig. 7) from September 7 until the end of October, and the water level at Kinston (site 28, fig. 7) was still 1.5 feet above flood stage at the end of October. There are 16 USGS streamgaging stations in the Neuse River Basin downstream from and including Clayton (site 22, fig. 7); not all sites are included in table 3 and figure 7. New records for maximum water levels were established at 14 of the 16 sites, except at Swift Creek (site 24) and Middle Creek (site 25), which are the westernmost of the 16 gages. This means that, with the exception of Swift Creek and Middle Creek, all of the record water levels recently established by Hurricane Fran downstream from Clayton were exceeded as a result of Hurricane Floyd (for example, at Goldsboro, fig. 9). Flood recurrence intervals were greater than 500 years for the Little River (site 26), Nahunta Swamp (site 30), Contentnea Creek at Hookerton (site 31), and the Trent River (site 33); maximum water levels recorded at these sites exceeded previously established maximum values by 2.6 feet (site 26, with 80 years of record) to almost 7.2 feet at site 30, where more than 40 years of streamflow data have been recorded (table 3).

Contributions to streamflow from the upper Neuse Basin (upstream from Falls Dam) were small relative to contributions downstream from Clayton (fig. 10). During September, flow at Falls Dam accounted for about 10 percent of the total flow volume at Goldsboro and about 8 percent of the total monthly flow volume at Kinston. In contrast, the drainage area at Falls Dam represents about 32 percent of the total drainage area at Goldsboro and about 29 percent of the drainage area at Kinston. During October, the volume of water released from Falls Dam was equivalent to about 26 percent of the total flow volume at Goldsboro and about 22 percent of the total flow volume at Kinston. Hence, in both September and October, the volume of flow contributed by Falls

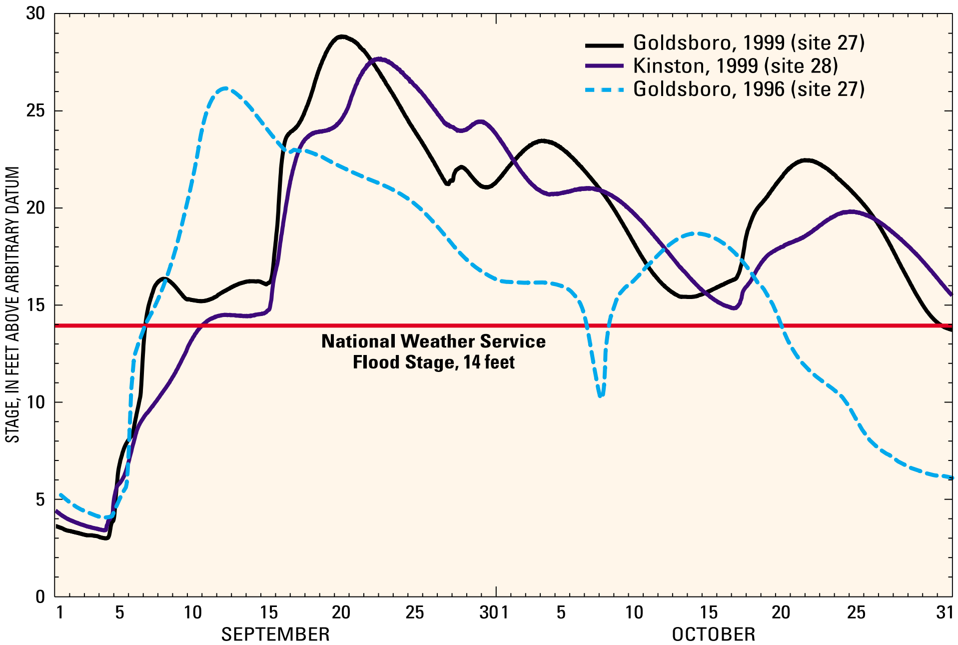


Figure 9. Stage hydrographs for the Neuse River at Kinston, September–October 1999, and near Goldsboro, September–October 1996 and 1999.

Storm surge flooding in Dare County

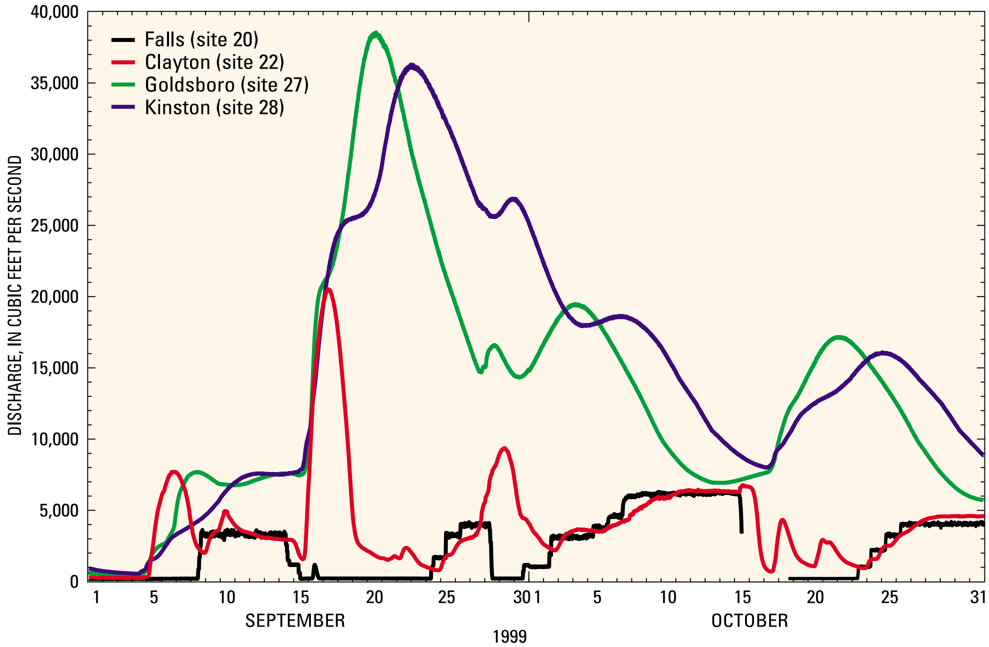


Figure 10. Streamflow in the Neuse River at four locations between Falls Dam and Kinston, September–October 1999.

Dam to the total flow at Goldsboro and Kinston was less than might be expected if the Neuse River were unregulated and if contributions to streamflow were proportional to drainage area. Another way to express the difference between flow contributions from the upper Neuse River Basin and the basin downstream from Falls Dam is in equivalent inches of runoff. The flow from Falls Dam during September was equivalent to 1.9 inches of runoff from the 772-mi^2 drainage basin upstream from the dam. The runoff from the 1,920-mi^2 portion of the Neuse Basin between Falls Dam and Kinston during September was 8.5 inches. In comparison, the average *annual* runoff for the entire Neuse River Basin upstream from Kinston for the period 1983–99 (the period after the completion of Falls Dam) was about 14 inches.

USGS

Neuse River flooding in Goldsboro, N.C. Acoustic Doppler current profiler used for discharge measurements shown in the foreground on the boat bow.

Cape Fear River Basin

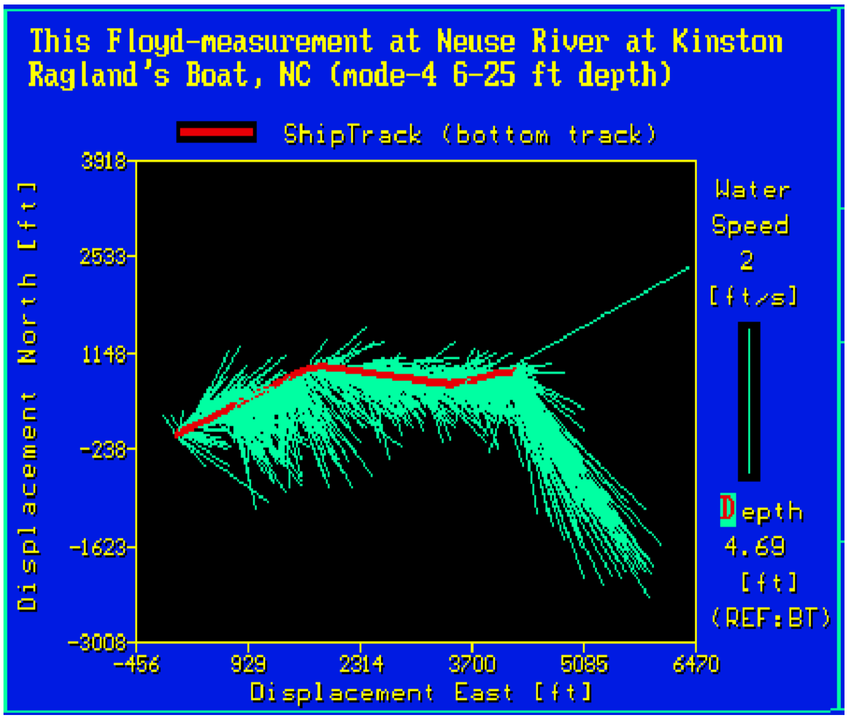
Flooding was much less widespread in the Cape Fear River Basin than in the Tar-Pamlico and Neuse River Basins. The most severe flooding occurred near Wilmington and along the Black and Northeast Cape Fear Rivers, near the location where Hurricane Floyd made landfall. New maximum water-level records were established on Hood Creek (site 41), Black River (site 42), and Northeast Cape Fear River (site 43), and flood recurrence intervals at those sites were between 100 and in excess of 500 years (table 3). On the Northeast Cape Fear River, the September 1999 maximum water level exceeded the previous record by almost 3.4 feet, and the peak flow was 50 percent greater than the previously recorded peak flow, which occurred in 1962 (table 3).

Other River Basins

The number of streamgages in northeastern North Carolina is small relative to those in the Tar-Pamlico and Neuse River Basins, so the extent and magnitude of flooding in that region is not as easily determined.

However, several streams in the Chowan River Basin experienced 50- to greater than 500-year flood flows (table 3; fig. 7). The previously recorded maximum water levels were exceeded at Potecasi Creek (site 4) and Ahoskie Creek (site 5) in North Carolina, as well as on the Nottoway (site 1) and Blackwater (site 2) Rivers in Virginia near the North Carolina–Virginia State line (fig. 7). The previously recorded maximum water level on the Cashie River (site 6) was exceeded by 7 feet during Hurricane Floyd, and the flood recurrence interval was greater than 500 years.

The high rainfall amounts in southeast North Carolina (table 1) had a dramatic effect on the Waccamaw River (site 44; fig. 7), where streamflow has been recorded for 60 years (table 3). The maximum streamflow recorded following Hurricane Floyd was more than 2.5 times greater than the highest streamflow ever recorded at the site (table 3), and the flood-flow recurrence interval was greater than 500 years. The previous highest streamflow occurred as a result of Hurricane Fran in 1996. The maximum streamflow in the Lumber River at Boardman (site 45) was approximately equal to the highest previously recorded flow (in 1945) at the site, which has 70 years of record. The highest previously recorded water level for the New River (site 34) was established in 1955 as a result of Hurricane Ione (fig. 5; table 3). However, the maximum water level for the New River resulting from Hurricane Floyd rainfall exceeded that from Hurricane Ione by more than 5 feet (table 3), and peak flow resulting from Hurricane Floyd was almost double the 1955 peak flow.



Data from ADCP discharge measurement at Neuse River at Kinston, N.C. Blue-green lines show velocity direction and magnitude (scale at left) along the boat path (shiptrack, red line). Total measured discharge was 27,300 ft^3/s, and total length of measurement was 4,310 feet.

FLOOD RECURRENCE INTERVALS

A statistical technique called frequency analysis is used to estimate the probability of occurrence of a flood peak having a given magnitude. The recurrence interval (sometimes called the return period) of a peak flow is the probability that the flow will be equaled or exceeded in any given year. For example, there is a 1 in 100 (or one percent) chance that a streamflow of at least 45,500 ft^3/s will occur during any year on the Tar River at Tarboro (site 14, table 3; fig. 7). Thus, a peak flow of 45,500 ft^3/s at site 14 is said to have a 100-year recurrence interval, or to be the 100-year flood. This is not to say that a flow of 45,500 ft^3/s will occur only once during the next 100 years, but rather that there is a 1 in 100 chance that a flow of 45,500 ft^3/s will be equaled or exceeded during any given year. Moreover, from a statistical point of view, the fact that a 100-year flood occurs one year does not affect the probability of such a flood occurring the following year.

The standard procedures (Hydrology Subcommittee of the Interagency Advisory Committee on Water Data, 1982) used to compute flood recurrence intervals from data collected at a streamgaging site are based on a number of assumptions, including the following:

- Distribution of the logarithms of the annual peak flows can be approximated by the Pearson Type-III distribution;
- Annual peak flows are independent;

- No trend is present in the record of annual peak flows; and
- No major changes, such as construction of an impoundment, have occurred in the watershed upstream from the site of interest.

The period of record that is used to compute flood recurrence intervals at a gaging station has a substantial effect on the computed recurrence intervals. For example, recurrence intervals for gaging stations in North Carolina were recently computed by using all available data through September 1996 (Pope and Tasker, 1999). For the Tar River at Tarboro (fig. 11), Pope and Tasker (1999) used data for the period 1897–1996. The period of record used by Pope and Tasker (1999) in the analysis for the Neuse River at Kinston (fig. 12) was 1981–1996, although records have been collected at the site since 1928. The reason for using only the record since 1981 is that construction of Falls Dam, and thus, effects on streamflow, began that year (the dam was closed in 1983). Consequently, data prior to 1981 represent a hydrologic condition different from that after closure of the dam. Following Hurricane Floyd, flood recurrence intervals were recomputed for selected gaging stations in eastern North Carolina to provide the best information for mitigation and rebuilding (U.S. Geological Survey, 2000).

At Tarboro, the 100-year flood that was computed by using the 1897–1999 record was about 10 percent greater than the 100-year flood that was computed by using the 1897–1996 record (table 4). However, at Kinston, the effects of the 3 additional years of record resulted in an increase in the computed 100-year flood flow of more than 40 percent (table 4). The change in the computed 100-year flood flow at Kinston was larger than that at Tarboro because (1) the period of record is shorter at Kinston, and the inclusion of three more flood peaks adds a larger percentage to the period of record at Kinston than at Tarboro; and (2) not only did Hurricane Floyd occur during 1997–99, giving the highest flow during the regulated period (1981–present), but also, the fourth highest flood during the regulated flow period occurred in 1998 (fig. 12).

The length of record used to compute recurrence intervals represents a balance between the needs to (1) reduce variance in the computed recurrence intervals and (2) avoid bias in the distribution of annual peak flows (Committee on American River Flood Frequencies, 1999). It is fairly well established that decadal to centennial variations occur in climate

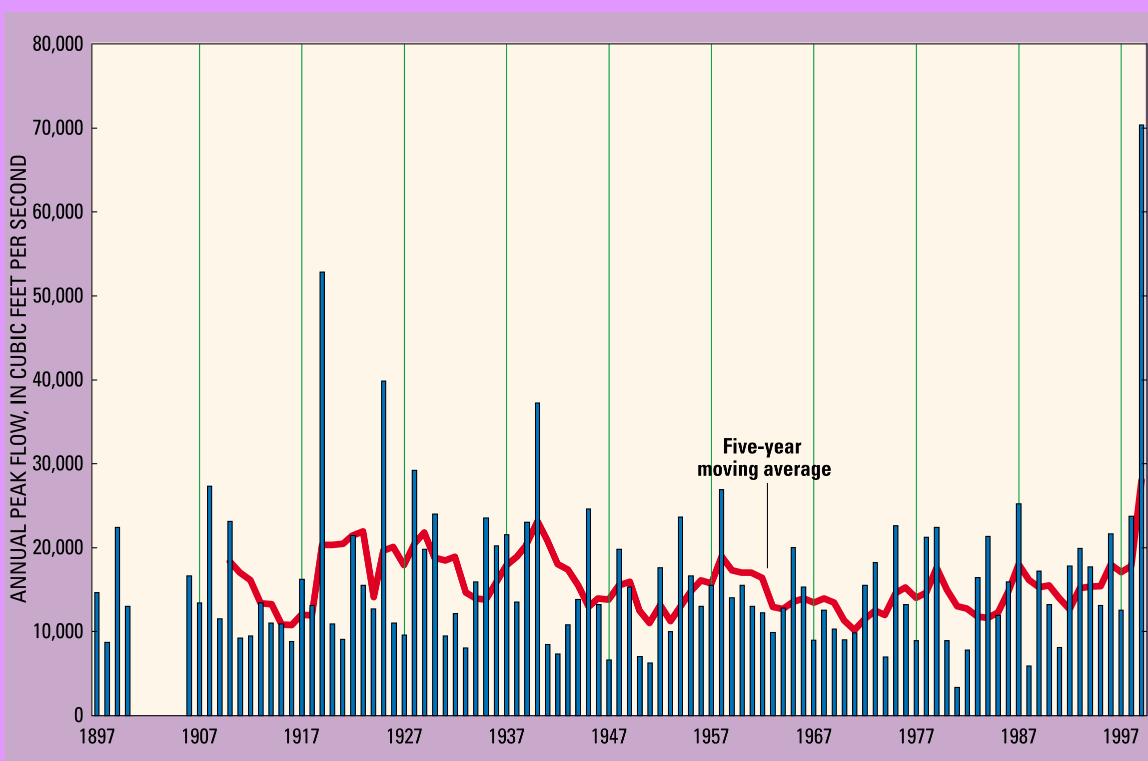


Figure 11. Annual peak flows, Tar River at Tarboro, 1897–1999.

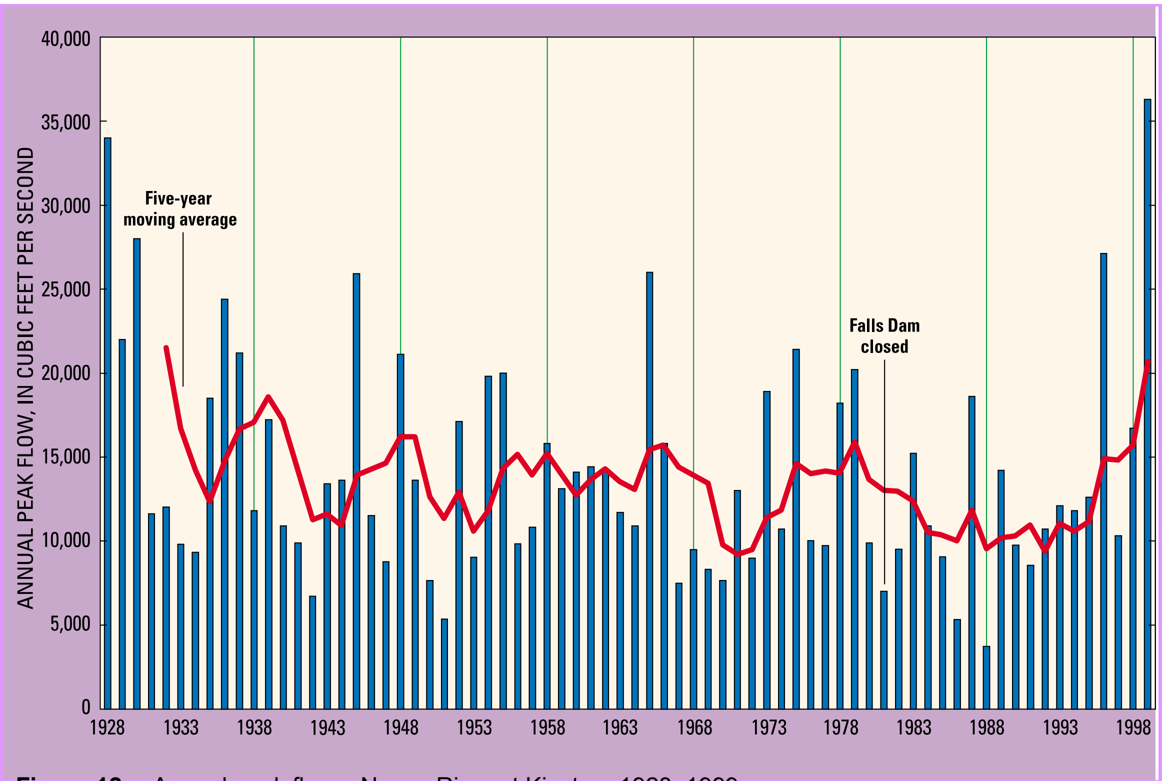


Figure 12. Annual peak flows, Neuse River at Kinston, 1928–1999.

(perhaps now superimposed on long-term human-induced trends) that affect hydrologic conditions (National Research Council, 1998). Consequently, the longer periods of record may include periods during which flood risk is different from the current period or the future design period. For example, four of the five largest floods during the last 102 years at Tarboro occurred during the period 1919–40 (fig. 11). However, there is no indication that a long-term trend in annual peak flows at Tarboro exists (fig. 11). Likewise, at Kinston, 5 of the 11 flood peaks greater than 20,000 ft^3/s occurred during the 10-year period 1928–37 (fig. 12).

On the other hand, a longer period of record reduces the variance in the estimated recurrence intervals. The 90-percent confidence band for the 100-year flood flow estimated for the Tar River at Tarboro is fairly narrow (table 4). However, the 90-percent confidence band for the 100-year flood estimate for the Neuse River at Kinston, where 19 years of record were used in the analysis, is quite large and represents a range in stage of **more than 5 feet**. In the relatively flat topography of the Coastal Plain, this uncertainty in the 100-year flood elevation can translate to a large uncertainty in the delineation of the regulatory 100-year floodplain.

Table 4. Effect of period of record on computed 100-year flood magnitude, Tar River at Tarboro and Neuse River at Kinston, N.C.

[ft^3/s, cubic feet per second; —, not computed]

	Tar River at Tarboro		Neuse River at Kinston	
Period of record	1897–1996	1897–1999	1981–1996	1981–1999
Computed 100-year flood flow, in ft^3/s	41,300	45,500	28,200	40,500
90-percent confidence band, in ft^3/s	—	39,100–53,500	—	29,300–68,700

Freshwater Delivery to Pamlico Sound

Pamlico Sound is a relatively shallow lagoonal estuary with a mean depth of 16 feet and a surface area of 2,060 mi^2 (Giese and others, 1985). The Sound is bounded on the seaward side by the Outer Banks, a barrier island system that restricts water exchange with the Atlantic Ocean through four small inlets. The Chowan River, Roanoke River, and several small rivers drain to Albemarle Sound, which then drains southward to Pamlico Sound or to the Atlantic Ocean through one of the four inlets. Sixty percent of the total Pamlico Sound drainage area is in the basin that drains to Albemarle Sound (table 5).

The ratio of the volume of Pamlico Sound (920 billion cubic feet [ft^3]) to the average annual inflow (32,000 cubic feet per second [ft^3/s]) from the entire basin, including the Albemarle Sound drainage, yields a theoretical freshwater replacement time of about 11 months. Actual residence time is likely longer for many locations in Pamlico Sound because of restricted circulation, the short-circuiting of some inflows, and the position of the tidal inlets relative to the major freshwater inflows. Long water residence times, small tidal amplitude (1.0–1.5 feet), and slow-flowing tributaries make Pamlico Sound an effective trap for dissolved and particulate matter.

Freshwater inflow to Pamlico Sound was estimated for September and October 1999. Flows were determined from data collected at the USGS network of streamgages in North Carolina and Virginia (fig. 7) and from estimates of flow from ungaged areas. Streamflow from 67.7 percent of the land area draining to Pamlico Sound is gaged. Rainfall on the surface of Albemarle Sound and Pamlico Sound was estimated from raingage and Doppler radar measurements, and the rainfall volume was converted to a flow rate for comparison with streamflow. The volume of freshwater inflow as a percentage of Pamlico Sound volume was computed by converting the monthly mean flow rate to a total volume for the month, and then dividing the freshwater inflow volume by the volume of Pamlico Sound. Normal inflow was computed from long-term monthly mean streamflow records. The period of streamflow record at the various streamgages used in the analysis ranged from about 15 years to more than 100 years.

Freshwater inflow volume to the head of the Pamlico River estuary (near site 18, fig. 7) during the month of September was more than 90 percent of the mean annual flow volume (table 5; Bales and Robbins, 1995). Freshwater inflow to the Neuse River estuary (near site 47, fig. 7) was slightly less than inflow to the Pamlico River estuary, with

Table 5. Estimated monthly mean freshwater flow from basins draining to Pamlico Sound, N.C., September and October 1999

[mi^2, square miles; ft^3/s, cubic feet per second]

Basin	Drainage area (mi^2) [percentage of total Pamlico Sound drainage]	September 1999		October 1999	
		Monthly mean flow (ft^3/s)	Inflow volume as a percentage of Pamlico Sound volume: actual [normal]	Monthly mean flow (ft^3/s)	Inflow volume as a percentage of Pamlico Sound volume: actual [normal]
Albemarle Sound subbasin					
Roanoke	9,776 [32]	20,040	5.65 [1.70]	13,410	3.90 [1.87]
Chowan	4,929 [16]	35,750	10.1 [0.57]	9,210	2.68 [0.71]
Other drainage to Albemarle Sound	2,722 [9]	19,720	5.56 [0.31]	5,930	1.73 [0.39]
Rainfall on the surface of Albemarle Sound	933 [3]	12,950	3.65 [0.47]	1,660	0.48 [0.47]
Subtotal for Albemarle Sound subbasin	18,360 [60]	88,460	25.0 [3.05]	16,800	8.79 [3.44]
Neuse	5,598 [17]	45,060	12.7 [1.17]	29,920	8.71 [0.90]
Tar-Pamlico	4,302 [14]	47,280	13.3 [0.61]	15,030	4.38 [0.60]
Other drainage to Pamlico Sound	560 [2]	6,140	1.73 [0.13]	2,220	0.65 [0.10]
Rainfall on the surface of Pamlico Sound	2,060 [7]	22,120	6.23 [1.55]	5,360	1.56 [1.54]
TOTAL	30,880 [100]	209,000	58.9 [6.50]	82,700	24.1 [6.58]

September inflow equivalent to 55–60 percent of annual inflow (table 5; Robbins and Bales, 1995). Estimated mean water residence time was about 7 days for the Pamlico and Neuse River estuaries during September, compared to a long-term annual average of 72 and 68 days for these estuaries, respectively (Bales and Robbins, 1995; Robbins and Bales, 1995).

During September–October 1999, the total freshwater inflow volume to Pamlico Sound was equivalent to about 83 percent of the total volume of the Sound, whereas under normal conditions inflow volume during these 2 months is equivalent to about 13 percent of the volume of the Sound (table 5; Giese and others, 1985). This means that by the end of October much of the water that was in the Sound at the beginning of September could have been displaced by floodwaters.

In September alone, the freshwater inflow to Pamlico Sound was about an order of magnitude greater than normal (table 5). Although the Roanoke River Basin comprises almost one-third of the total Pamlico Sound drainage area, freshwater inflow from this basin accounted for only about 10 percent of the total inflow to the Sound because of (1) the presence of a large flood-control reservoir near the downstream end of the basin and (2) the paths of the hurricanes, which avoided much of the basin (fig. 2). On the other hand, the Neuse and Tar-Pamlico River Basins, which together compose about 31 percent of the Pamlico Sound drainage area, contributed about 44 percent of the inflow to the Sound in September, and more than half of the inflow to the Sound in October. This is particularly important because both of these rivers drain directly to Pamlico Sound and because these rivers are known to carry relatively high loads of nutrients and other contaminants (North Carolina Department of Environment, Health, and Natural Resources, 1993, 1994; Harned and others, 1995).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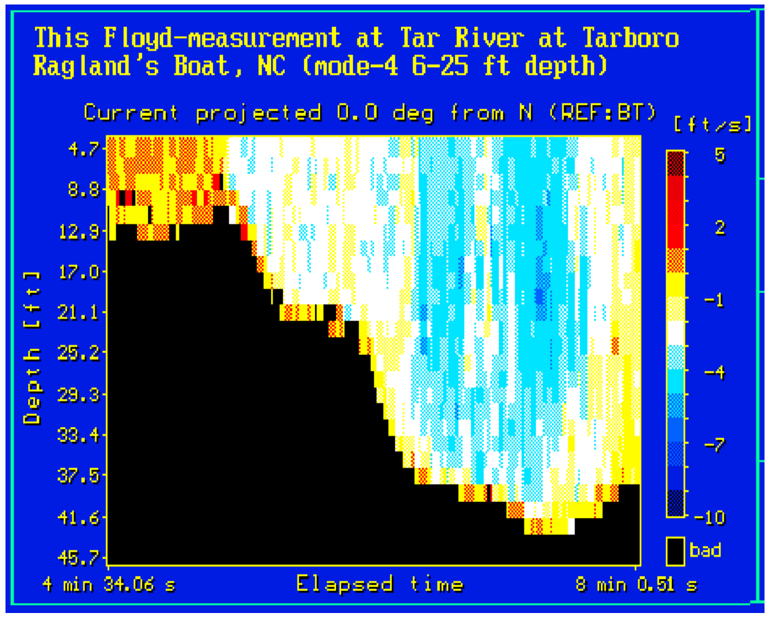
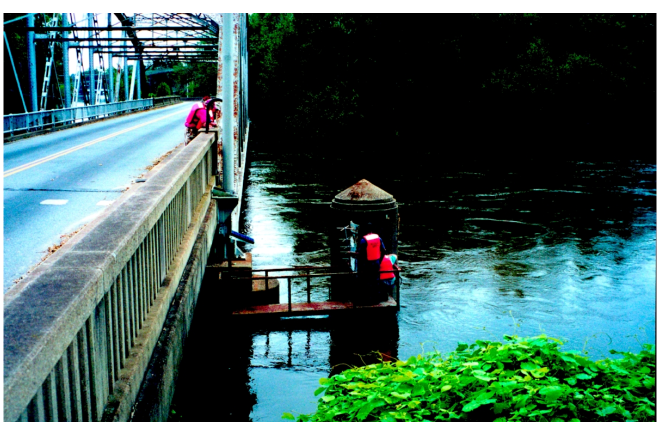
USGS staff making a discharge measurement using an acoustic Doppler current profiler on the Tar River



Results of ADCP measurement at Tar River at Tarboro, N.C., showing cross-sectional distribution of velocity. Negative velocities in the center of the channel are about 5 feet per second and are oriented downstream. Note upstream eddies along the left edge. Total measured discharge was 33,600 ft^3/s, and the width of the measured cross section was 1,120 feet.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Tar River at Greenville, N.C.