Low-Flow Characteristics and Discharge Profiles for Selected Streams in the Cape Fear River Basin, North Carolina, through 1998

By J. Curtis Weaver and Benjamin F. Pope

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Multiply	By	To obtain
	Length	
inch (in.)	25.4	millimeter
foot (ft)	0.3048	meter
mile (mi)	1.609	kilometer
	Area	
acre	4,047	square meter
acre	0.4047	hectare
square mile (mi^2)	2.590	square kilometer
	Flow	
gallon per minute (gal/min)	0.06309	liter per second
million gallons per day (Mgal/d)	0.04381	cubic meter per second
cubic foot per second (ft^3/s)	0.02832	cubic meter per second
cubic foot per second per square mile [$(ft^3/s)/mi^2$]	0.01093	cubic meter per second per square kilometer

Temperature: Temperature is given in degrees Fahrenheit (°F), which can be converted to degrees Celsius (°C) by using the following equation:

$$°C = 5/9 (°F - 32)$$

Sea level: In this report, "sea level" refers to the National Geodetic Vertical Datum of 1929 (NGVD 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.

Latitude/Longitude: All latitude and longitude coordinates in this report are referenced to the North American Datum of 1927.

Acronyms:

7Q2	7-day, 2-year low-flow discharge
7Q10	7-day, 10-year low-flow discharge
W7Q10	winter 7-day, 10-year low-flow discharge
30Q2	30-day, 2-year low-flow discharge
DWQ	North Carolina Division of Water Quality
GIRAS	geographic information retrieval and analysis system
GIS	geographic information system
HA	hydrologic area
MOVE.1	Maintenance of Variance Extension
NPDES	National Pollutant Discharge Elimination System
USEPA	U.S. Environmental Protection Agency
USGS	U.S. Geological Survey

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ABSTRACT

An understanding of the magnitude and frequency of low-flow discharges is an important part of evaluating surface-water resources and planning for municipal and industrial economic expansion. Low-flow characteristics are summarized in this report for 67 continuous-record gaging stations and 121 partial-record measuring sites in the Cape Fear River Basin of North Carolina. Records of discharge collected through the 1998 water year were used in the analyses. Flow characteristics included in the summary are (1) average annual unit flow; (2) 7Q10 low-flow discharge, the minimum average discharge for a 7-consecutive-day period occurring, on average, once in 10 years; (3) 30Q2 low-flow discharge; (4) W7Q10 low-flow discharge, similar to 7Q10 discharge except that only flow during November through March is considered; and (5) 7Q2 low-flow discharge.

Low-flow characteristics in the Cape Fear River Basin vary widely in response to changes in geology and soil types. The area of the basin with the lowest potentials for sustained base flows is underlain by the Triassic basin in parts of Durham, Wake, and Chatham Counties. Typically, these soils are derived from basalt and fine-grained sedimentary rocks that allow very little infiltration of water into the shallow aquifers for storage and later release to streams during periods of base flow. The area of the basin with the highest base flows is the Sand Hills region in parts of Moore, Harnett, Hoke, and Cumberland Counties. Streams in the Sand Hills have the highest unit low flows in the study area as well as in much of North Carolina. Well-drained sandy soils in combination with higher topographic relief relative to other areas in the Coastal Plain contribute to the occurrence of high potentials for sustained base flows.

A number of sites in the upper part of the Cape Fear River Basin underlain by the Carolina Slate Belt and Triassic basin, as well many sites in lower areas of the Coastal Plain (particularly the Northeast Cape Fear River Basin), have zero or minimal (defined as less than 0.05 cubic foot per second) 7Q10 discharges. In this area, the poorly sustained base flows are reflective of either (1) thin soils that have very little storage of water to sustain streams during base-flow periods (Carolina Slate Belt), or (2) soils having very low infiltration rates (Triassic basin). As a result, there is insufficient water stored in the surficial aquifers for release to streams during extended dry periods. Within the part of the study area underlain by the Carolina Slate Belt, streams draining basins 5 square miles or less may have zero or minimal 7Q10 discharges. The part of the study area underlain by the Triassic basin has a higher drainage-area threshold at 35 square miles, below which streams will likely have zero or minimal 7Q10 discharges.

Occurrences of zero or minimal 7Q10 discharges in the Coastal Plain were noted, though on a more widespread basis. In this area, low flows

are more likely affected by the presence of poorly drained soils in combination with very low topographic relief relative to other areas in the Coastal Plain, particularly the Sand Hills. In eastern Harnett County and northeastern Cumberland County, basins with less than 3 square miles may be prone to having zero or minimal 7Q10 discharges. Soils in this area have been described as a mixture of sandy and clay soils. In the Northeast Cape Fear River Basin, particularly on the western side of the river, streams draining less than 8 square miles may have zero or minimal 7Q10 discharges. The poorly drained clay soils along with very little topographic relief results in the low potential for sustained base flows in this part of the study area.

Drainage area and low-flow discharge profiles are presented for 13 streams in the Cape Fear River Basin; these profiles reflect a wide range in basin size, characteristics, and streamflow conditions. In addition to the Haw River and Cape Fear River main stem, profiled tributaries include North Buffalo Creek, Buffalo Creek (including South Buffalo Creek), and Reedy Fork in Guilford County; Big Alamance Creek in Guilford and Alamance Counties; Rocky River (tributary to the Deep River) in Chatham County; Upper Little River in Lee and Harnett Counties; Little River in Moore, Hoke, Harnett, and Cumberland Counties; Rockfish Creek in Hoke and Cumberland Counties; Six Runs Creek in Sampson County; Black River (including Great Coharie Creek) in Sampson and Bladen Counties; Rockfish Creek in Duplin County; and Northeast Cape Fear River in Duplin, Pender, and New Hanover Counties. At the mouths of streams profiled, the drainage areas range from about 44 to about 9,100 square miles. Low-flow discharge profiles for each stream include 7Q10, 30Q2, W7Q10, and 7Q2 discharges with contributions from major tributaries included.

INTRODUCTION

The need for a better understanding of low-flow hydrology and for improved techniques in determining low-flow characteristics of streams has become more critical as demands for sustained, high-quality water supplies and effective waste assimilation have increased. The simultaneous occurrence of the increased demands and recent droughts in North Carolina since the mid-1980's have heightened awareness of the importance of determining low-flow characteristics.

Low flow, also referred to as base flow or sustained fair-weather flow, is composed largely of ground-water discharge from aquifers into streams. Ground-water discharges have large spatial and temporal variations that are highly dependent on topographic, geologic, and climatic conditions. The high variability of such conditions across North Carolina—and sometimes even within a drainage basin or along the same stream—results in complex low-flow hydrology. Moreover, the characterization of low-flow hydrology is further complicated by withdrawals, point-source discharges, impoundments, and development within the drainage basin. Low flows in North Carolina typically occur at the conclusion of the growing season in late summer and early autumn, due to evaporation from surface-water bodies and use of ground water by crops and other plants. Additionally, higher temperatures during the summer and early autumn seasons cause increased water use which, in turn, causes a higher demand for withdrawals from streams and reservoirs.

An understanding of low-flow characteristics is crucial in the evaluation of water-supply potential and reservoir-release requirements, the determination and regulation of wastewater discharges to streams, and the maintenance of aquatic habitats in streams. Where sufficient discharge records are available at continuous- and partial-record sites, application of statistical techniques, such as those described by Riggs (1972), form the basis for determining low-flow characteristics. However, the number of sites for which sufficient record exists to determine low-flow characteristics is far outnumbered by those locations where little or no record is available for developing low-flow estimates.

Low-flow characteristics are defined by a set of discharges that are statistically derived values having an associated duration and recurrence interval or probability of occurrence. An example of a widely used low-flow statistic is the 7-day, 10-year low-flow discharge (hereafter referred to as 7Q10 discharge). The annual minimum average streamflow for a 7-consecutive-day period will be at or below the

7Q10 discharge, on average, one time in 10 years. If the 7Q10 discharge is 5 cubic feet per second (ft^3/s), then the annual minimum average streamflow for a 7-consecutive-day period would be 5 ft^3/s or lower, on average, one time in 10 years, five times in 50 years, or 10 times in 100 years. A recurrence interval of 10 years implies that the annual minimum average streamflow for a 7-consecutive-day period will exceed the 7Q10 discharge, on average, in 9 of 10 years. Stated another way, the probability is 10 percent (the inverse of the recurrence interval) that the lowest average 7-consecutive-day flow in any year will be less than the 7Q10 discharge (Giese and Mason, 1993).

In North Carolina, other low-flow statistics used by State regulatory agencies in determining permitting limits for withdrawals from and discharges to streams include the 30-day, 2-year (30Q2) low-flow discharge; winter 7-day, 10-year (W7Q10) low-flow discharge; and 7-day, 2-year (7Q2) low-flow discharge. The W7Q10 discharge, or "winter 7Q10," is defined in a similar manner as the 7Q10 discharge except that only flow during the months of November through March is considered in the analysis.

In 1991, the Division of Water Quality (DWQ, formerly the Division of Environmental Management) of the North Carolina Department of Environment and Natural Resources, began using a basinwide approach in its assessment and management of water quality and, in particular, the permitting of point-source discharges. This approach has been applied sequentially to each of the 17 major river basins in the State (fig. 1) so that all point-source discharges in a basin are permitted simultaneously. The process is repeated for each basin at 5-year intervals. In conjunction with the basinwide approach, the U.S. Geological Survey (USGS), in cooperation with the DWQ, has conducted studies to define low-flow characteristics and develop flow profiles for selected streams in a number of river basins (Weaver, 1996, 1997, 1998).

In addition to providing information on low-flow characteristics for streams in the Cape Fear River Basin and other river basins to the DWQ, other agencies, and interested organizations, the determination of low-flow characteristics allows for an expanded knowledge of low-flow hydrology and the factors that affect low flows in one region as compared to another. As many factors become better understood through improved and detailed mapping applications, a potential future product of this expanded knowledge is the development of statistical relations using explanatory variables gleaned from detailed maps to estimate low-flow discharges at ungaged sites.

Purpose and Scope

This report presents low-flow characteristics for selected streams in the Cape Fear River Basin of North Carolina. Low-flow statistics at streamgaging stations are summarized, and drainage area and low-flow discharge profiles for selected streams in the Cape Fear River Basin are presented. Descriptions of selected basin characteristics, such as impoundments, flow diversions (water-supply withdrawals and return point-source discharges), climate, geology, soils, and land use, are provided, including a discussion of their effects

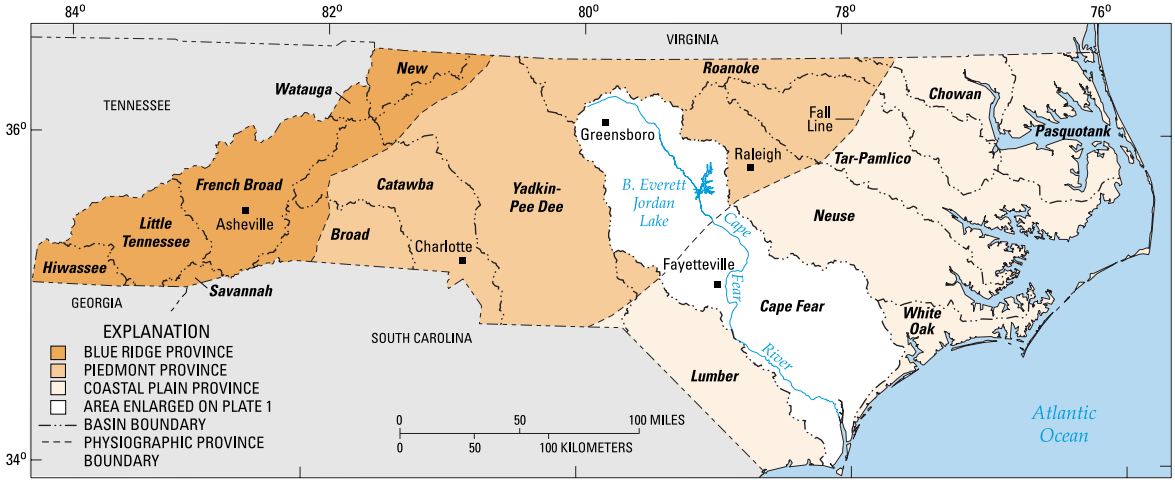


Figure 1. Locations of major river basins, the Cape Fear River Basin, and physiographic provinces in North Carolina.

on low flows. This report also presents an inventory of sites in the study area where records of discharges and(or) stage have been collected as of the 1998 water year (table 6, p. 81–129); selected site attributes are listed for each site.

Low-flow statistics are summarized for 67 continuous-record gaging stations and for 121 partial-record measuring sites; statistics include the average annual unit flow and the 7Q10, 30Q2, W7Q10, and 7Q2 discharges. The number of zero-flow days for continuous-record sites and zero-flow discharge measurements for partial-record sites also are included. Although, the period of record varies from site to site, records of discharge collected through the 1998 water year were used in the analyses for this report. Summaries of the low-flow characteristics include those at sites in the Deep River Basin (and based on records of discharge collected through the 1995 water year) that were recently published for a previous investigation (Weaver, 1997).

Drainage area and low-flow discharge profiles are presented for 13 selected streams in the Cape Fear River Basin. These 13 streams were selected by the DWQ and USGS on the basis of water-quality issues and basin characteristics. The selected streams include North Buffalo Creek, Buffalo Creek (including South Buffalo Creek), Reedy Fork, Big Alamance Creek, Rocky River (tributary to the Deep River), Upper Little River, Little River, Rockfish Creek (Hoke and Cumberland Counties), Six Runs Creek, Black River (including Great Coharie Creek), Rockfish Creek (Duplin County), Northeast Cape Fear River, and the Cape Fear River (including the Haw River; pl. 1). Discharge profiles show the relation of 7Q10, 30Q2, W7Q10, and 7Q2 discharges to river miles for these streams.

While low-flow characteristics are presented for many sites in the Cape Fear River Basin, no techniques are presented for estimating low-flow discharges at ungaged locations in the study area, similar to those presented by Giese and Mason (1993). Low-flow discharges at ungaged locations can be estimated by examining the unit low flows at the nearby sites for which low-flow characteristics are presented in this report (tables 7 and 8, p. 130–140). The selection of nearby sites for use as index sites should be based on, to the extent possible, similarities in basin characteristics of the ungaged and index sites.

Previous Low-Flow Studies

Prior to World War II, low-flow characteristics of North Carolina streams were determined only for continuous-record gaging stations. With the economic expansion after World War II, the USGS began to receive an increasing number of requests for hydrologic information for sites where no data previously had been collected (Yonts, 1971). Thus, the USGS expanded its data-collection program in the late 1940's to include partial-record measuring sites where discharge measurements were made on a periodic basis. Discharge measurements made under base-flow conditions along with observations of zero flow became the foundation of data used in the initial assessments of low-flow characteristics of streams in North Carolina. With data available from the network of partial-record measuring sites, the USGS began to respond to requests for low-flow characteristics on a site-specific basis, including those for ungaged sites.

A number of studies have been conducted to investigate low flows for streams in North Carolina. Goddard (1963) presented low-flow characteristics for many continuous-record gaging stations in North Carolina, along with drainage area and 7Q10 discharge profiles developed for selected main-stem rivers. Yonts (1971) reported base-flow measurements made at over 2,200 continuous-record gaging stations and partial-record measuring sites throughout the State.

Giese and Mason (1993) evaluated low-flow characteristics at 122 continuous-record gaging stations and 396 partial-record measuring sites with drainage areas ranging between 1 and 400 square miles (mi^2) and streamflows unaffected by regulation or diversions. Sites were characterized on the basis of similarity in their ranges of low-flow discharges and potential to sustain base flow. Ten hydrologic areas (HA's) were delineated, and regression equations, which related low flows to basin characteristics, were derived to determine flow characteristics at ungaged sites (fig. 2). Equations for only 4 of the 10 areas—HA10, representing the mountains and western Piedmont; HA3, the Sand Hills; and HA5 and HA9, the eastern and central Piedmont, respectively—had standard errors that were considered small enough to permit use of the equations in estimating low-flow characteristics at the ungaged sites.

Evett (1994) investigated the effects of urbanization and land-use changes on low flows. Relations of decreasing low flows with increasing urbanization were detected from data at selected

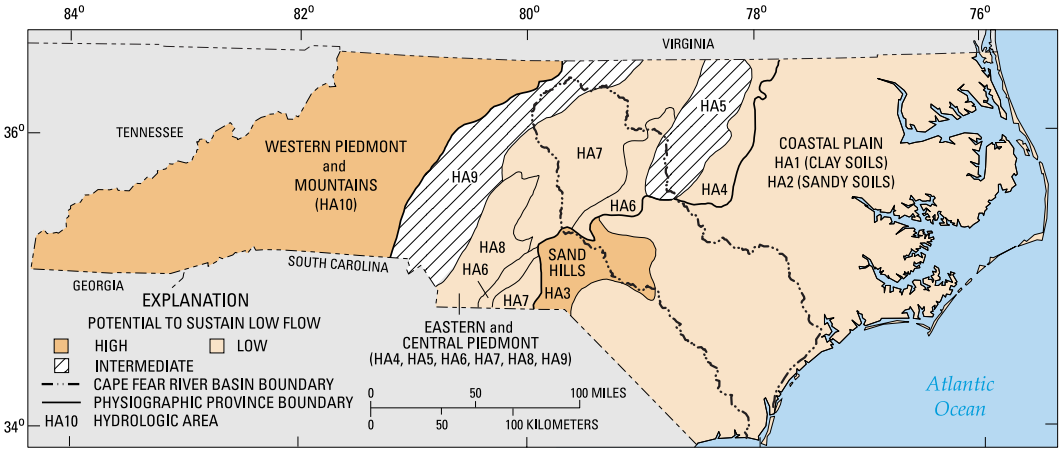


Figure 2. Hydrologic areas of similar potential to sustain low flows in North Carolina.

continuous-record gaging stations in the Asheville, Charlotte, Greensboro, and Raleigh municipalities (fig. 1) as well as gaging stations in nearby rural areas. However, Evett described the results as being statistically inconclusive.

Weaver (1996) conducted a study of low-flow characteristics in the Roanoke River Basin as part of the DWQ's program of basinwide assessment and management of water quality in major river basins of North Carolina. Low-flow characteristics were summarized for 82 streamflow sites in North Carolina (79 sites) and Virginia (3 sites), and profiles of drainage area and low-flow discharge were developed for 10 selected streams. Total drainage areas for the profiled streams range from 22 mi^2 to about 9,700 mi^2. Low-flow discharges for each stream include 7Q10, 30Q2, W7Q10, and 7Q2 discharges in a continuous profile, and contributions from major tributaries also are included.

Weaver (1997) also investigated low-flow characteristics in the Deep River Basin in the central Piedmont Province of North Carolina. The Deep River is tributary to the Cape Fear River and drains slightly over 1,440 mi^2 in parts of Guilford, Randolph, Moore, and Chatham Counties (pl. 1). Low-flow characteristics were summarized for 7 continuous-record gaging stations and 23 partial-record measuring sites. Drainage-area and low-flow discharge profiles were developed for the Deep River and were presented in a similar manner as those for the Roanoke River Basin (Weaver, 1996). Because the Deep River is part of the Cape Fear River Basin, the summary of low-flow characteristics at continuous-record gaging stations and partial-record measuring sites in this subbasin are republished in this report. However, the drainage-area and low-flow discharge profiles developed for the Deep River and associated discussions of low-flow characteristics (Weaver, 1997) are not republished in this report.

Continuing the series of basinwide low-flow investigations, Weaver (1998) summarized low-flow characteristics for 50 continuous-record gaging stations and 113 partial-record measuring sites in the Neuse River Basin. Drainage-area and low-flow discharge profiles were developed for 10 selected streams in the basin. Total drainage areas for the profiled streams range from 9 to about 5,600 mi^2. As with the previous basins, low-flow discharges for each stream include 7Q10, 30Q2, W7Q10, and 7Q2 discharges in a continuous profile with contributions from major tributaries. The methods used by Weaver (1996, 1997, and 1998) are the same methods used for this study, and the presentation of results is similar to the presentation of results for the Roanoke, Deep, and Neuse River Basins.

Acknowledgments

The authors acknowledge the staffs of the North Carolina Divisions of Water Quality and Water Resources for their assistance in compiling information about point-source discharge permits, water withdrawals, and impoundments. Additional information provided by many superintendents and operators at local water-treatment plants, as well as local and industrial wastewater-treatment facilities in the Cape Fear River Basin, was helpful in the

assessment of flow modifications on low-flow characteristics.

DESCRIPTION OF THE CAPE FEAR RIVER BASIN

The Cape Fear River Basin drains an area of about 9,100 mi^2 in eastern North Carolina. The basin is the largest of the three river basins (including the Neuse and Tar River Basins) located entirely within North Carolina. The Cape Fear River begins as the Haw River near the boundary between Forsyth and Guilford Counties, and flows in a general southeasterly direction through the Piedmont and Coastal Plain Provinces before entering the Atlantic Ocean near Fort Caswell in Brunswick County (pl. 1).

Much of the Cape Fear River Basin is characterized by rolling and hilly topography in the headwaters in the Piedmont Province, which gradually changes to gentle, rolling terrain with little relief, to nearly level land surfaces in the Coastal Plain Province. Elevations range from approximately 900 to 1,000 feet (ft) above sea level along the basin boundary at the Forsyth/Guilford County line to near sea level at Wilmington and points downstream.

The Cape Fear River Basin includes parts of 7 of the 10 hydrologic areas identified by Giese and Mason (1993; fig. 2). Hydrologic areas in the central and eastern Piedmont (fig. 2) have varying levels of potential for sustaining base flow, with median 7Q10 discharges in HA9, HA8, HA7, and HA6 of 0.064, 0.001, 0.005, and 0.0 cubic foot per second per square mile ($[ft^3/s]/mi^2$), respectively (Giese and Mason, 1993). Giese and Mason (1993) identified a correlation between the potential to sustain base flow and well yields reported by Daniel (1989), who related rock type to well yields. Thus, these hydrologic areas were delineated primarily on the basis of geology.

The hydrologic area defined by Giese and Mason (1993) as having the lowest potential for sustained base flow is HA6 (Triassic basin). Zero flow could be expected to occur in small streams within this hydrologic area. Some sites that lie within HA6 in the Cape Fear River Basin were determined to have no potential for sustained base flows.

The areas of the Cape Fear River Basin within the Coastal Plain are in HA1 (clay soils), HA2 (sandy soils), and HA3 (Sand Hills); the geology in the Coastal Plain is defined by alternating layers of sand, silt, clay, and limestone (Giese and Mason, 1993). Streams in HA1 and HA2 have low potential to sustain base flow, whereas those in HA3 have moderate to high potential for sustained base flows. Giese and Mason (1993) reported that median 7Q10 discharges for sites in HA1, HA2, and HA3 are 0.0, 0.006, and 0.318 $(ft^3/s)/mi^2$, respectively. They report that the presence of sandy soils in both HA2 and HA3 emphasizes the importance of topographic relief on low-flow characteristics within the Coastal Plain. In HA2 (as well as HA1), low topographic relief results in low hydraulic gradients in the water table, which provides little potential to move ground water toward streams. In HA3 (Sand Hills), higher topographic relief results in larger hydraulic gradients and correspondingly higher potentials for sustained base flows. The patterns of low-flow characteristics determined for Coastal Plain streams in the Cape Fear River Basin were found to be consistent with those determined by Giese and Mason (1993).

The effects of geology and soils can be seen in the flow-duration curves (fig. 3) for two sites in the study area that have nearly identical basin sizes and similar average precipitation but different low-flow characteristics. Average annual rainfall across the two basins is 45 to 50 inches (in.). Base flows at Rockfish Creek at Raeford (site 520, pl. 1) are higher than those at Little Coharie Creek near Roseboro (site 572, pl. 1). Flows at site 520 were about 55 ft^3/s or greater 95 percent of the time, whereas flows at site 572 were 7.0 ft^3/s or greater 95 percent of the time (fig. 3). Differences between base flows at the two sites increase as the exceedance level increases. The area drained by site 520 is located in HA3, the Sand Hills hydrologic area, which has sand as the primary aquifer material (Giese and Mason, 1993) as well as somewhat higher topographic relief than other areas in the Coastal Plain (see previous paragraph). Site 572 drains an area within HA2 (sandy soils) where the streams have somewhat lower topographic relief. This comparison provides an excellent example of the effect that geology and soils can have on flow characteristics for two streams located near each other.

Drainage System

The Cape Fear River Basin consists of seven subbasins in the system of hydrologic units defined in the USGS National Water Data Network, including the New River subbasin (hydrologic unit 03030001) in

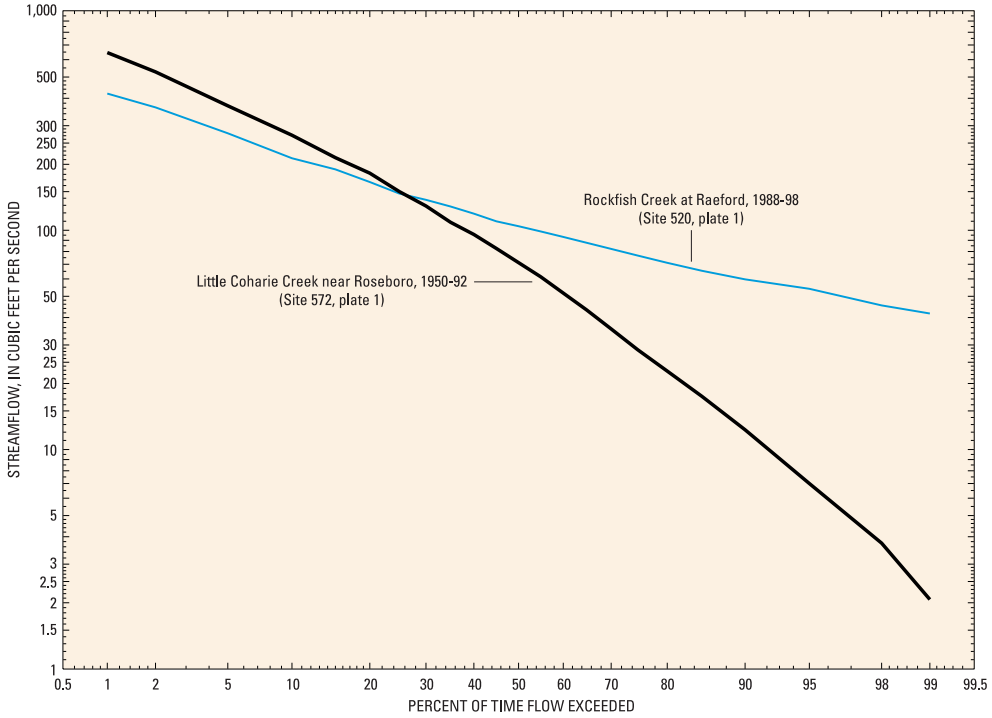


Figure 3. Flow-duration curves for Rockfish Creek at Raeford (site 520) and Little Coharie Creek near Roseboro (site 572) in the Cape Fear River Basin, North Carolina.

Onslow County and easternmost Pender and New Hanover Counties (Seaber and others, 1987). In this report, however, the Cape Fear River Basin study area is limited to the six USGS hydrologic units 03030002–03030007 (table 1; fig. 4). The cumulative drainage area of these six subbasins is about 9,100 mi^2.

Table 1. Code, name, and drainage area of USGS hydrologic units in the Cape Fear River Basin, North Carolina (from Seaber and others, 1987)

[USGS, U.S. Geological Survey; mi^2, square mile. Not listed in the table is hydrologic unit 03030001 (New River, 613 mi^2), which drains directly to the Atlantic Ocean]

USGS hydrologic unit code (fig. 4)	Name	Drainage area (mi^2)
03030002	Haw [River]	1,690
03030003	Deep [River]	1,430
03030004	Upper Cape Fear [River]	1,630
03030005	Lower Cape Fear [River]	1,030
03030006	Black [River]	1,570
03030007	Northeast Cape Fear [River]	1,740
	Total	9,090

Major Rivers and Tributaries

The Cape Fear River begins as the Haw River in eastern Forsyth County in the Piedmont of North Carolina. The river becomes the Cape Fear at the confluence of the Haw and Deep Rivers in Chatham County (pl. 1). Of the major rivers in North Carolina that drain toward the east coast (Chowan, Roanoke, Tar-Pamlico, Neuse, Cape Fear), the Cape Fear River is the only river that drains directly to the Atlantic Ocean.

The length of the Cape Fear River is nearly 290 miles (mi) from the headwaters of the Haw River to the mouth of the Cape Fear near Fort Caswell; the drainage area of the Cape Fear River Basin at its mouth is about 9,100 mi^2. At Wilmington, where the Cape Fear River changes from a riverine to an estuarine reach, the drainage area is nearly 8,700 mi^2, which includes the Northeast Cape Fear River. Major tributaries to the Cape Fear River include Reedy Fork (256 mi^2) in Guilford County; Big Alamance Creek (262 mi^2) in Guilford and Alamance Counties; New Hope Creek/River (345 mi^2) in Orange, Durham, and Chatham Counties; Deep River (1,440 mi^2) from Guilford to Chatham / Lee Counties; Upper Little River (220 mi^2) in Lee and Harnett Counties; Little River (482 mi^2) in Moore, Hoke, Harnett, and Cumberland Counties; Rockfish Creek (310 mi^2) in Hoke and

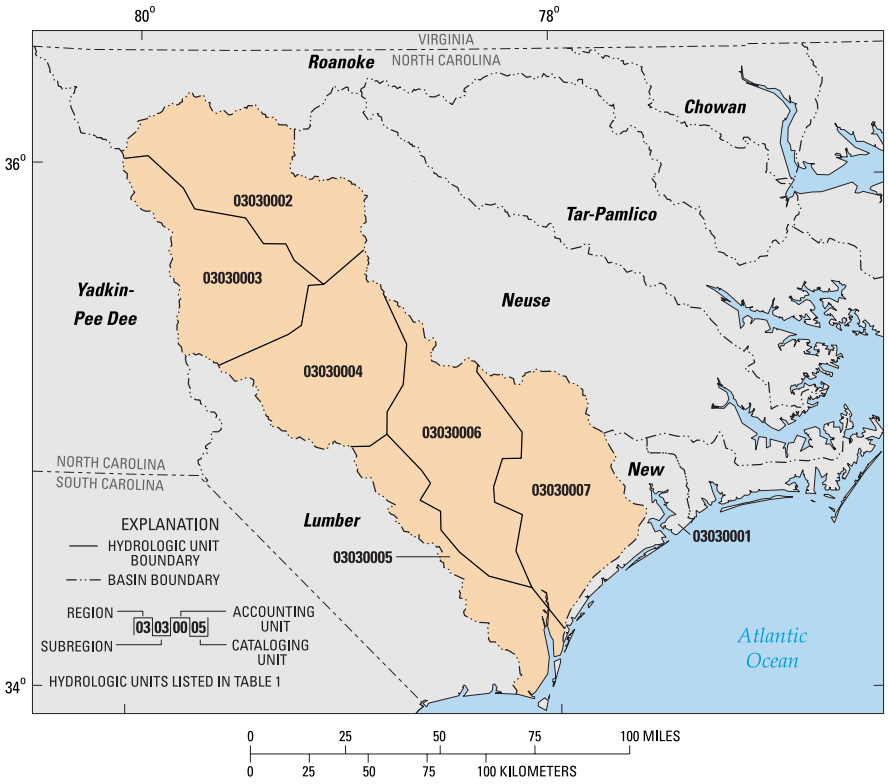


Figure 4. Hydrologic units in the Cape Fear River Basin, North Carolina.

Cumberland Counties; Black River (1,534 mi^2) in Pender and Sampson Counties; and the Northeast Cape Fear River (approximately 1,700 mi^2) in Duplin, Pender, and New Hanover Counties (pl. 1).

Tides from the Atlantic Ocean affect flows in the lower reaches of the Cape Fear and Northeast Cape Fear Rivers as well as in other streams in the lower part of the basin, including the Black River. Tidal effects on the Cape Fear River extend up to Lock 1 near Kelly (site 559, pl. 1), located about 35 mi upstream from Wilmington (Giese and others, 1985). Prior to construction of the lock, tides affected flows further inland, possibly as far as 50 to 75 mi upstream from Wilmington. Giese and others (1985) reported that flows on the Northeast Cape Fear River are affected by tides as far inland as the confluence of the river and Holly Shelter Creek near Burgaw, about 50 mi upstream from the mouth of the river. However, recent installation of a stage-only site on the Northeast Cape Fear River near Burgaw (USGS station 02108566) provides data that indicate tidal fluctuations as far inland as this site. Tidal influences in the Black River are reported to be as far inland as the county boundary between Bladen and Pender Counties near Atkinson (Giese and others, 1985).

Results from the investigation by Giese and others (1985) provide some insight into the flows that occur in tidally affected reaches, including low-flow frequency analyses of the outflow at the mouths of the Cape Fear and Northeast Cape Fear River estuaries. While some understanding of low-flow characteristics in tidally affected reaches is available through previous investigations, techniques for determining low flows in these hydrologically complex reaches have not been completely identified and thus remain subject to continued research and development, particularly standard techniques that could be applied to all rivers and streams affected by tides. With little or no additional data currently (2001) available to aid in further assessment of low-flow characteristics for tidally affected reaches in the basin, the low-flow discharge profiles provided in this report for the Cape Fear, Black, and Northeast Cape Fear Rivers extend downstream to the upstream limit of tidal influence.

Major Flow Modifications

Previous discussions have alluded to the complex nature of low-flow hydrology as a result of geologic, topographic, and climatic factors. An

additional factor affecting low-flow characteristics is major flow modifications. Flow modifications can be classified in two general categories—impoundments and diversions of flow. The ongoing addition and, in some instances, removal of these modifications results in continual changes to the low-flow characteristics, and renders an additional level of complexity to the efforts to determine low-flow characteristics.

Impoundments

Impoundments result from the construction of dams on streams to store water for a variety of purposes, including water supply, recreation, irrigation, and cooling water. The effects of impoundments on downstream low-flow characteristics vary. Changes in streamflow patterns can result from water storage, diversions of water (for supply purposes) that commonly occur within the impoundments, and to a smaller extent, evaporation from the impoundments. Post-impoundment flow durations for downstream flows, particularly below major impoundments, generally are different from pre-impoundment conditions. The most common, and usually most obvious, difference is the reduction in peak discharges observed in post-impoundment flows. Some impoundments also serve to augment downstream flows during droughts and, thus, increase low flows observed below a dam relative to pre-impoundment conditions.

Approximately 1,100 impoundments with dams having structural heights exceeding 15 ft were identified in the Cape Fear River Basin (North Carolina Department of Environment, Health, and Natural Resources, unpub. data, 1993). The vast majority of these dams are in the upper half of the study area (hydrologic units 03030002–03030004, fig. 4). The topography of stream channels and adjacent floodplains in these hydrologic units provides more suitable locations for building dams. Many are privately owned impoundments having relatively small surface areas at the spillway level; these impoundments primarily are used as (1) farm ponds, which provide water for irrigation and help reduce sediment discharges to streams; (2) recreational lakes at campgrounds and park facilities; or (3) landscape features (ponds) in developed areas.

A number of impoundments in the Cape Fear River Basin cause widespread inundation of the river valley immediately upstream from the dam. The impoundment having the largest surface area is B. Everett Jordan Lake, locally known and referred to in this report as Jordan Lake (14,300 acres), in Chatham, Orange, Durham, and Wake Counties (pl. 1; North Carolina Department of Environment, Health, and Natural Resources, 1992). Constructed in the late 1970's and early 1980's, the inundation extends about 4 mi up the Haw River and about 20 mi up the New Hope River toward Durham.

Other major impoundments having surface areas exceeding 200 acres in the study area are Lake Brandt (410 acres) and Lake Townsend (1,610 acres) on Reedy Fork in Guilford County, Lake Mackintosh (1,200 acres) on Big Alamance Creek and Burlington Reservoir (750 acres) on Stony Creek in Alamance County, Cane Creek Reservoir (500 acres) on Cane Creek and University Lake (205 acres) on Morgan Creek in Orange County, Oak Hollow Reservoir (720 acres) on West Fork Deep River in Guilford County, and Shearon Harris Lake (4,150 acres) on Buckhorn Creek in Chatham and Wake Counties (pl. 1; North Carolina Department of Environment, Health, and Natural Resources, 1992). With the exception of Shearon Harris Lake, these lakes are owned and operated by nearby municipalities and are used primarily for water supply, flood control, and recreation. Shearon Harris Lake is owned by a regional utility company and is a source of cooling water used in power production. In addition to the impounded lakes, a number of "Carolina Bay" or natural lakes occur in the lower part of the basin, notably in Bladen County (North Carolina Department of Environment, Health, and Natural Resources, 1992). These natural lakes receive little or no input from streams or other sources of overland runoff but are sustained by precipitation and ground-water recharge from underlying aquifers. Five such lakes with surface areas greater than 200 acres are in Bladen County—Salters Lake, Jones Lake, White Lake, Bay Tree Lake (also called Black Lake), and Singletary Lake.

Minimum-flow releases are assigned to some dams to ensure that a sustained level of flow occurs in the stream reaches below the dams. In North Carolina, State agencies that can be involved in the determination and assignment of minimum-flow releases are the North Carolina Division of Land Resources (Dam Safety Program), Division of Water Resources, Division of Water Quality, Wildlife Resources Commission, and on rare occasions, the North Carolina Utilities Commission (James Mead, Division of Water Resources, oral commun., November 27, 2000).

Federal agencies that may be involved in the determination of minimum-flow releases are the Federal Energy Regulatory Commission, U.S. Fish and Wildlife Service, U.S. Forest Service, and the U.S. Army Corps of Engineers. Such determinations are made to address issues concerning available downstream flows, as well as maintenance of water quality and aquatic habitats.

Minimum-flow releases can occur in one of two forms: (1) a release based on operations that involve the opening and closing of gates at the dam to adjust magnitudes of discharges, or (2) a release based on the structural characteristics of the dam's flow-release system, such as a riser-barrel orifice commonly found in smaller impoundments. Not all impoundments in the Cape Fear River Basin have assigned minimum-flow releases. Variations in the presence of minimum-flow releases at impoundments within the basin apparently reflect the age of a dam more than any other factor. Increased awareness of environmental concerns in recent decades has resulted in revised procedures for maintaining downstream flows. A summary of selected dams and minimum-flow releases is provided in table 2.

Not all impoundments on streams result in the inundation of the river valley behind the dam. Many smaller structures exist to temporarily store water for power production or to maintain the water level behind the dam in order to keep a water-supply intake under the water surface. While some of these structures have been assigned minimum-flow releases, many of the structures are operated in a run-of-river mode in which outflow below the dam must be the same as inflow upstream from the dam. The effects these structures have on low-flow characteristics vary and are primarily a function of the storage patterns at the dams.

Diversions

Diversions, collectively defined in this report as water-supply withdrawals and return point-source discharges, have the effect of immediately altering downstream low flows by an amount equal to the diversion rate. Withdrawals commonly are made by municipalities and by some major industries. Additionally, some withdrawals are made for agricultural and livestock operations. Until 1999, the State of North Carolina required registration of all withdrawals equal to or exceeding 1 million gallons per day (Mgal/d), or approximately 1.5 ft^3/s. Changes in State legislation, however, now require registration of nonagricultural withdrawals equal to or exceeding 100,000 gallons per day (approximately 0.15 ft^3/s); agricultural withdrawals exceeding 1 Mgal/d must be registered (Woodrow L. Yonts, North Carolina Division of Water Resources, oral commun., September 2000). In the Cape Fear Basin study area, a total of 63 registered withdrawals were identified (Kenneth Ashe, North Carolina Division of Water Resources, unpub. data, June 2000). Because the State requires that decreased flows downstream from withdrawals must be sufficient to sustain downstream uses during drought conditions, including the assimilation of treated effluent, knowledge of low-flow characteristics is important.

Point-source discharges to streams are permitted through the issuance of National Pollutant Discharge Elimination System (NPDES) permits. In North Carolina as well as in other States, permits that set limits for discharges of treated effluent are based, in part, on the 7Q10 discharge. In a similar manner to withdrawals, flows upstream from the discharge point must be sufficient to assimilate the treated effluent while maintaining other uses of the stream. As of 2000, the DWQ issued about 350 NPDES permits for point-source discharges to more than 260 facilities in the Cape Fear River Basin (Andy McDaniel, North Carolina Division of Water Quality, unpub. data, February 2000). Some dischargers, particularly industrial facilities, have more than one discharge outfall as part of their operations. The number of NPDES permits continuously changes as a result of the addition and rescission of permitted discharges in the basin. In the most recent basinwide report on water quality in the Cape Fear River Basin (North Carolina Division of Environment and Natural Resources, 1996), 54 permit holders (29 municipal and 25 industrial) are designated by the DWQ as major dischargers. The major dischargers are generally defined as facilities discharging more than 1 Mgal/d or facilities having discharges that include high levels of toxicants or metals (Charles Weaver, North Carolina Division of Water Quality, oral commun., July 2000).

Data describing major withdrawals and point-source discharges in the study area were obtained from different State agencies that monitor flow diversions. For selected facilities, average surface-water withdrawals and point-source discharges reported for calendar year 1998 were compiled and are summarized in table 3 (p. 74–80), which lists the magnitudes of streamflow changes in the affected streams. In most

Table 2. Summary of selected dams and minimum-flow releases in the Cape Fear River Basin, North Carolina

[mi^2, square miles; ft^3/s, cubic feet per second; —, no minimum-flow release specified; n/d, not determined. See Weaver (1997) for a list of dams on the Deep River]

County	Dam name or nearby location	Stream	River mile[a]	Drainage area, (mi^2)	Minimum-flow release,[b] (ft^3/s)	Remarks
Guilford	Lake Brandt	Reedy Fork	27.6	70.0	—	
Guilford	Lake Townsend	Reedy Fork	20.2	105	—	While no minimum-flow release has been specified, seepage from the dam has been recognized as maintaining downstream flows.
Alamance	Altamahaw	Haw River	246.4	188	—	Upstream from site 21; results in diurnal fluctuations in flow, particularly during low-flow periods.
Alamance	Glencoe	Haw River	238.8	480[c]	57	Required to operate in run-of-river mode.
Alamance	Back Creek Reservoir	Back Creek	n/d	67.7	2.0–5.0	Minimum-flow releases is 5.0 ft^3/s if reservoir contents greater than 40 percent of normal; 2.0 ft^3/s when contents less than 40 percent.
Alamance	Lake Mackintosh	Big Alamance Creek	10.4	129	7.2–9.0	Minimum-flow releases vary as indicated when reservoir contents range between 67 and 100 percent of normal.
Alamance	Swepsonville	Haw River	228.3	697	—	Downstream from site 94; abandoned dam and no known effects on low-flow characteristics at this location.
Alamance	Saxapahaw	Haw River	222.0	1,016	10	Upstream from site 132; minimum-flow release set to address flow availability concerns in part of channel immediately downstream from dam.
Orange	Cane Creek Reservoir	Cane Creek	n/d	31.4	0.22–3.0	Minimum-flow release of 0.22 ft^3/s occurs at all times. Where inflows are between 0.22 and 3.0 ft^3/s, release is equal to inflow. Where inflows exceed 3.0 ft^3/s, release is 3.0 ft^3/s.
Chatham	Bynum	Haw River	203.9	1,265	80	Required to operate in run-of-river mode.
Orange	University Lake	Morgan Creek	n/d	30[c]	—	Upstream from site 236.
Chatham	B. Everett Jordan Lake Dam	Haw River	193.9	1,689	40[d]	At site 254; flow releases at the dam typically range from 130 to 200 ft^3/s.
Lee	Buckhorn Dam	Cape Fear River	183.6	3,228	—	Abandoned dam.[e]
Chatham	Shearon Harris Lake	Buckhorn Creek	n/d	71[c]	—[f]	Lake is a cooling-water reservoir.
Bladen	William O. Huske Lock and Dam (#3)	Cape Fear River	112.5	4,852	—	At site 549; primarily used for maintenance of navigation in lower reaches of Cape Fear River.
Bladen	Lock and Dam #1	Cape Fear River	57.2	5,255	—	At site 559; primarily used for maintenance of navigation in lower reaches of Cape Fear River.

[a] Where river miles are listed, zero miles is at mouth of indicated stream.

[b] Unless otherwise noted, minimum-flow release data and information (listed in Remarks) pertaining to dams are from North Carolina Division of Water Resources.

[c] Approximate drainage area.

[d] Information provided by U.S. Army Corps of Engineers who owns and operates dam at Jordan Lake. Flow releases from dam are adjusted in response to Deep River flows to meet target discharge at the Cape Fear River at Lillington (site 438). The target flow is 600 ft^3/s with a 50 ft^3/s margin allowed.

[e] USGS annual water data reports indicate that Buckhorn Dam was completed and filled in 1908. Hydroelectric power operation stopped December 31, 1962.

[f] Information provided by Carolina Power and Light Company who owns and operates dam at Shearon Harris Lake. During parts of the year (about 6 months), there is no flow over the spillway.

instances, point-source discharges were paired with corresponding surface-water withdrawals for a given facility, typically a short distance on the same stream upstream from the discharge point. Some of the larger municipalities, such as Greensboro and Fayetteville, have multiple withdrawals and point-source discharges. For each facility, the NPDES permit number and current permitted flow rate also are listed.

Some of the facilities that discharge into streams do not obtain water directly through surface-water withdrawals. In these cases, withdrawals are made from ground-water wells (primarily in the Coastal Plain) or are transferred from other facilities that withdraw water from either surface- or ground-water sources. Another form of withdrawal listed with the State agencies is that made by large mining operations, which remove ground water from mining pits as part of the quarry operation. In the study area, withdrawals by quarry operations in Guilford and Harnett Counties are registered with the State; however, these are not listed in table 3 because withdrawal and point-source discharge rates are not documented. Also not listed in table 3 are withdrawals and point-source discharges for a number of farming or agricultural-research operations that withdraw water primarily for irrigation purposes. Most of these withdrawals are from ground-water wells or small ponds located on property owned by the operations.

The City of Greensboro has the largest municipal withdrawals and wastewater discharges in the Cape Fear River Basin (table 3). In 1998, the City withdrew an average of 38.6 Mgal/d from Reedy Fork through Lakes Brandt and Townsend in northern Guilford County and discharged an average 32.5 Mgal/d into North and South Buffalo Creeks in Greensboro. Other major municipal withdrawals are made by the Cities of High Point and Fayetteville. The 1998 average withdrawal for High Point was 13.9 Mgal/d from the Deep River through High Point Municipal Lake; the average point-source discharge from the City's two wastewater-treatment plants was 16.1 Mgal/d, which includes treated wastewater from nearby smaller municipalities (table 3). Nearly 80 percent of High Point's return discharge is released into Richland Creek, a tributary to the Deep River. The remaining 20 percent is discharged into Rich Fork Creek in the Yadkin-PeeDee River Basin. The City of Fayetteville withdrew an average of 27.1 Mgal/d from the Cape Fear River and Little Cross Creek in 1998 and returned an average of 24.5 Mgal/d by way of two point-source discharges into the Cape Fear River (table 3). The City of Durham's water supply is in the Neuse River Basin; however, the City has a point-source discharge into New Hope Creek in the Cape Fear River Basin. In 1998, the City of Durham and Durham County, which receives treated water from the City, discharged an average of 10.4 and 4.4 Mgal/d, respectively (table 3). Considering the existence of consumptive losses between withdrawals and return discharges, this indicates an interbasin transfer of about 15 Mgal/d from the Neuse River Basin. During the 1998 water year, 22.5 ft^3/s of water (equivalent to 14.5 Mgal/d) was transferred by the City of Durham from the Neuse River Basin into the Cape Fear River Basin (U.S. Geological Survey, 1999). Another interbasin transfer occurs in western Wake County via a joint withdrawal by the Towns of Cary and Apex from Jordan Lake for water supply; the wastewater treated by these municipalities is discharged to Crabtree and Middle Creeks, two streams within the Neuse River Basin. In 1998, nearly 18 ft^3/s (11.6 Mgal/d, table 3) was withdrawn from Jordan Lake and a total of 17.2 ft^3/s (11.1 Mgal/d, table 3) was discharged into the Neuse River Basin.

While municipal diversions predominate throughout the study area, large diversions by industry also occur at a number of locations in the basin. The Cape Fear River Basin, particularly in the lower parts of the study area, has the highest occurrence of diversions of any of the major river basins in North Carolina (Charles Weaver, North Carolina Division of Water Quality, oral commun., July 2000). The largest withdrawal and return discharge in the study area is nearly 1,400 Mgal/d from the Cape Fear River in Brunswick County by a regional power company that uses the water for cooling purposes at a nuclear powerplant and returns all of the water to the Atlantic Ocean near the mouth of the Cape Fear River (table 3). This same company also has large withdrawals and discharges for power-production operations in Brunswick, Chatham, and Wake Counties. Large industrial withdrawals and(or) return discharges also occur in Bladen, Columbus, and Brunswick Counties (table 3). While the individual diversion amounts by major industrial facilities generally vary from 5 to nearly 40 Mgal/d, there is very little reported differences between the withdrawals and return discharges made by most of the industrial facilities.

In general, the effects of diversions on low-flow characteristics may be significant at sites located

between the withdrawal and return discharge points; however, the effects do not appear to be significant where a site is located downstream from both withdrawal and return discharges. In the Coastal Plain where many facilities obtain water from deep aquifers, point-source discharges supplement flows to streams. Further discussion on assessing the effects of diversions is included in the section, **Low-flow Characteristics in the Cape Fear River Basin**.

Climate

The climate in the Cape Fear River Basin, as throughout most of North Carolina, consists of long, hot, humid summers and short, mild winters with periods of more moderate, milder conditions during the spring and autumn seasons. The average annual temperature (1961–90) in the study area ranges from 58 °F in the headwaters of the Cape Fear River Basin to about 63 °F in the area of the basin near the mouth of the Cape Fear River near Fort Caswell. The average monthly temperature ranges from a minimum of about 35 °F in January to a maximum of about 80 °F in July (National Oceanic and Atmospheric Administration, 1996). In all areas of the Cape Fear River Basin, temperature extremes in the summer reach levels exceeding 90 °F for long periods of consecutive days.

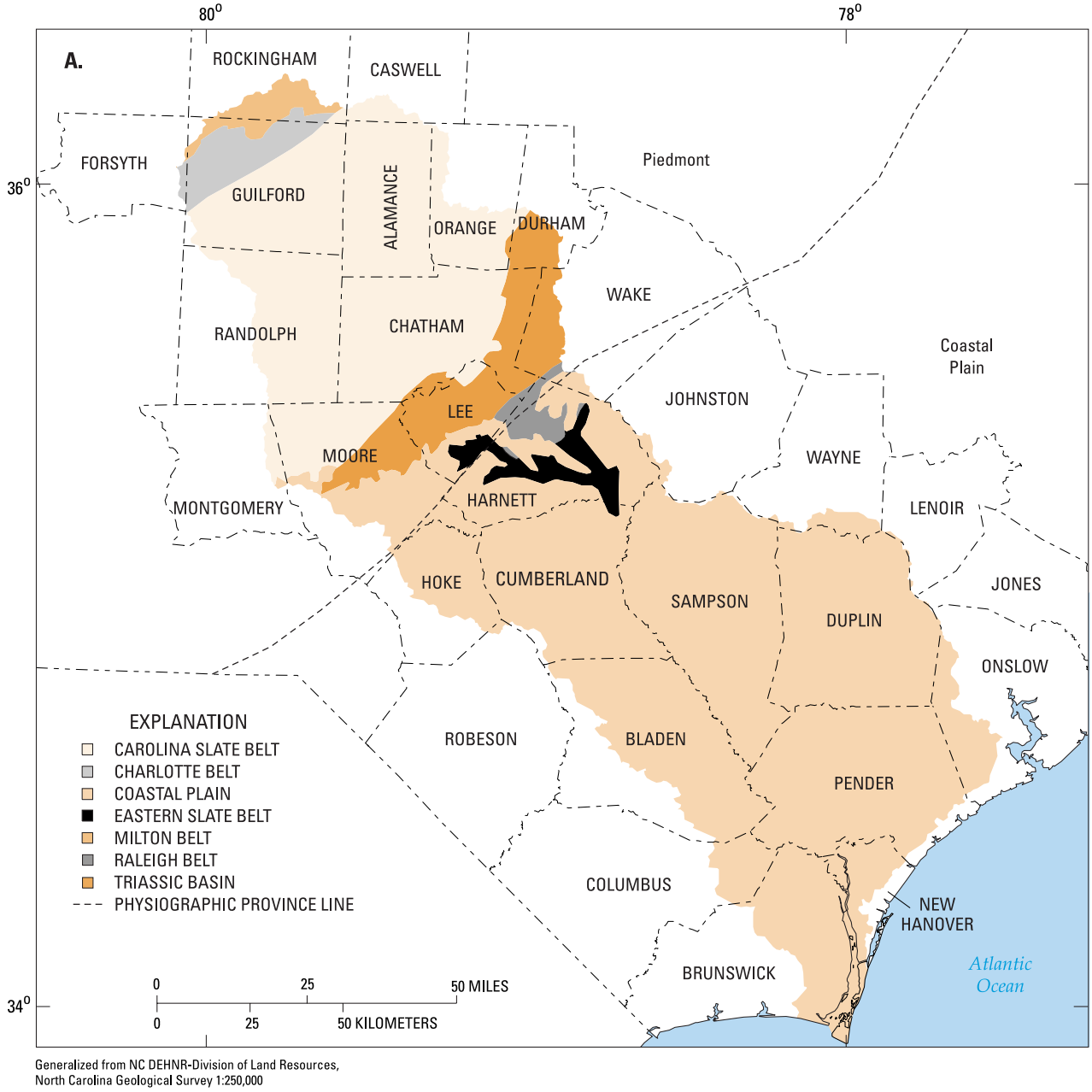
Average annual precipitation (1961–90) in the study area ranges from nearly 43 in. in the headwaters of the basin to 55 in. or more near the mouth of the Cape Fear River near Fort Caswell (National Oceanic and Atmospheric Administration, 1996). The higher temperatures and more abundant moisture in the Coastal Plain reflect the moderating effects exerted by the Atlantic Ocean on the climate in that region (Kopec and Clay, 1975). On a monthly basis, the highest amounts of rainfall occur during July and August. The lowest monthly rainfall generally occurs during April in the upstream half of the Cape Fear River Basin, and during October–November in the downstream half of the basin. Most rainfall occurring during the warmer months comes from isolated, convective-type storms that arise in the late afternoons and evenings as a result of daytime heating. Rainfall occurring during cooler months is commonly from more organized frontal storms that cover broad areas of the region.

Between 1900 and 1990, seven major droughts occurred in North Carolina (Zembrzuski and others, 1991). The drought of longest duration affecting streams in the Cape Fear River Basin occurred during 1950–57. At the Black River near Tomahawk (site 586, pl. 1) in Sampson County, the lowest daily mean discharge (8.9 ft^3/s on September 13) and instantaneous discharge (8.5 ft^3/s on October 13) for the period of record (October 1951 to September 1998) occurred during the fall of 1954 (U.S. Geological Survey, 1999). Near-record low flows at other long-term gaging stations on the Haw River (site 81, pl. 1), Deep River (site 417, pl. 1), and Northeast Cape Fear River (site 639, pl. 1) also occurred in the fall of 1954 during the 1950–57 drought. In addition, notable droughts affecting streams in the study area occurred during 1966–71 and 1985–88 (Zembrzuski and others, 1991). In the mid to late 1990's, drought conditions affected streamflows in the study area, which prompted local officials in some municipal areas to implement major water-conservation measures to reduce the consumption of water.

Geology and Soils

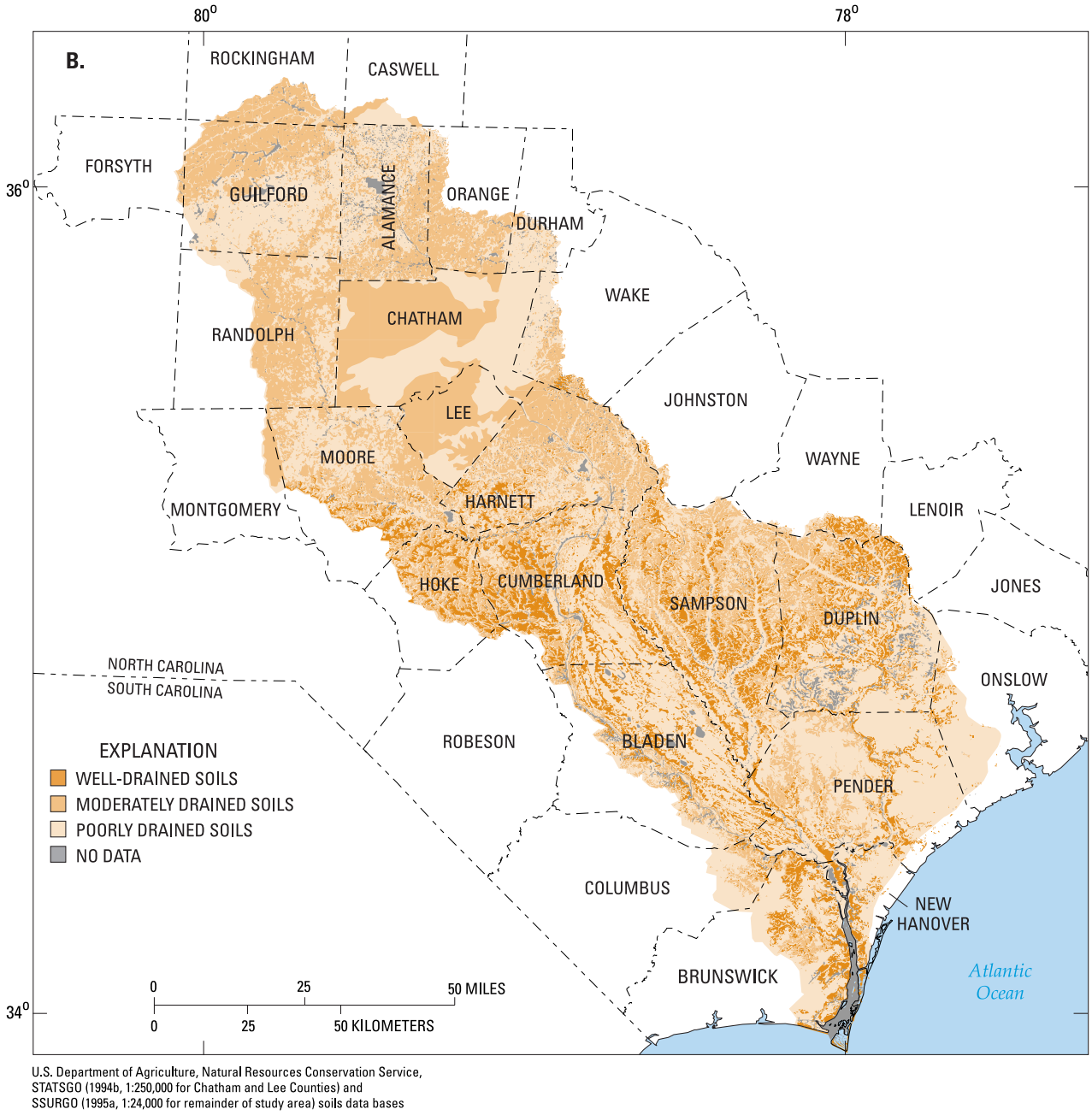
Diverse geology and soils in the Cape Fear River Basin have varying degrees of effects on the potential for sustained base flows. The geology indirectly affects the potential for sustained base flow through the soils, the material into which the underlying geologic rock units are transformed through the processes of physical and chemical weathering. The extent of fractures in underlying rocks is an important factor in the potential to sustain base flow. Because the fractures are conduits for water, a rock unit having an abundance of fractures has a higher capacity to discharge ground water to streams than does a unit having fewer fractures. In a similar manner, soils that exhibit higher degrees of permeability allow for greater movement of water between surficial aquifers and stream channels than do soils with low permeabilities, which limit water movement.

Geology in the Cape Fear River Basin can be divided into two general regions that roughly correspond to the Piedmont and Coastal Plain Provinces. Each region is underlain by multiple geologic rock units that affect base flows in the study area. Most of the study area within the Piedmont is underlain by belts of metamorphic and metavolcanic rocks of the Carolina Slate Belt, ranging in age from late Proterozoic to early Paleozoic (North Carolina Geological Survey, 1985; fig. 5A). These underlying rocks include granite, granitic gneiss, and slate. The soils weathered from these rocks do not exhibit the



Generalized from NC DEHNR-Division of Land Resources, North Carolina Geological Survey 1:250,000

Figure 5A. Generalized geology in the Cape Fear River Basin, North Carolina.



U.S. Department of Agriculture, Natural Resources Conservation Service, STATSGO (1994b, 1:250,000 for Chatham and Lee Counties) and SSURGO (1995a, 1:24,000 for remainder of study area) soils data bases

Figure 5B. Soil hydrologic groups in the Cape Fear River Basin, North Carolina.

thicknesses in some areas that allow water to be stored in shallow aquifers for later release during periods of base flow. Thus, the potential for base flow may be very little in some streams. As discussed in later sections of this report, a number of sites in the study area underlain by the Carolina Slate Belt were determined to have zero or minimal flow 7Q10 discharges.

Another notable unit within the Piedmont is the Triassic (early Mesozoic) basin across parts of Durham, Wake, Chatham, Lee, and Moore Counties (fig. 5A). This area is underlain by basalt and fine-grained sedimentary rocks, which include mudstones, siltstones, and shale. These rocks have been characterized as having very little porosity and permeability (Brown, 1988) and, thus, support a lower potential for sustained base flows as compared to those of the older igneous and metamorphic bedrock. A number of sites within the Triassic basin were determined to have 7Q10 discharges equal to zero flow.

In the study area, the transition from the Piedmont to the Coastal Plain occurs in Moore, Lee, and Harnett Counties (fig. 5A). The transition is signified by a gradual change from well-drained and gently rolling surface features to flat surfaces. In the Coastal Plain, most of the basin is underlain by unconsolidated sediments composed of alternating layers of sand, silt, and clay (fig. 5A). The Black Creek and Peedee Formations are two dominant geologic units in this area; other units present to a lesser extent include the Castle Hayne, Cape Fear, and Middendorf Formations (North Carolina Geological Survey, 1985). The Cape Fear and Middendorf underlie much of the Sand Hills area where streams have been identified as having some of the highest potentials for sustained base flows in North Carolina.

More than 35 soils associations, or groups of soils having similar characteristics, are found in the Cape Fear River Basin (U.S. Department of Agriculture, 1994b, 1995a). Soils may have multiple characteristics that interact to affect the low-flow characteristics of streams in a given area; one such characteristic is the soil hydrologic group. Soil hydrologic groups represent the internal drainage (or infiltration) characteristics of soils. Ten categories of soil hydrologic groups have been defined for soils, and among the 10 categories, 3 general classifications of internal drainage have been defined: well-drained, moderately drained, or poorly drained soils (Musgrave and Holtan, 1964) (fig. 5B; table 4). The soil hydrologic groups and associated minimum infiltration rates provide an indicator of the water storage within the soils (table 4; Musgrave and Holtan, 1964). Because base flow is defined as sustained flow from ground water or springs and has no surface-runoff component, the streams in the study area that are covered by moderately or well-drained soils will have a high potential for sustained flow during dry conditions. Streams in areas underlain by poorly drained soils can be expected to have low potential for sustained flows during dry periods. Much of the upstream half of the study area is covered by soils that are moderately and well-drained (table 4; fig. 5B) with the exception of areas in Wake, Durham, and Chatham Counties where soils from the Triassic basin are poorly drained. Another area containing poorly drained soils extends from south-western Guilford County through northeastern Alamance County. In the downstream half of the study area, many of the soils are characterized as well-drained or poorly drained (fig. 5B). Well-drained soils in the study area (16 percent) occur in the central part of the

Table 4. Soil hydrologic groups in the Cape Fear River Basin, North Carolina (U.S. Department of Agriculture, 1994b, 1995a)

[mi^2, square mile; n/a, not available. Soil characteristics and minimum infiltration rates for soil hydrologic groups are described in table footnotes. Some soil hydrologic groups, as indicated by "n/a" for the area, were not found in the GIS map coverages of soils in the study area. Sections of the study area not included (approx. 270 mi^2) are those covered by some of the water bodies and those with unknown soil hydrologic groups. Differences in total drainage area from those listed in other tables reflect differences in scale of map and accuracy of methods used by source to compute areas]

Well-drained		Moderately drained		Poorly drained	
Soil group	Area (mi^2)	Soil group	Area (mi^2)	Soil group	Area (mi^2)
A[a]	1,224	A/C	n/a	A/D	170
A/B	n/a	B[b]	3,003	B/D	1,011
		B/C	n/a	C[c]	2,196
				C/D	30
				D[d]	1,256

[a] Soil Group A—Deep sands, deep loesses, and aggregated soils having minimum infiltration rates of approximately 0.30 to 0.45 inch per hour.

[b] Soil Group B—Shallow loess and sandy loam soils having minimum infiltration rates of approximately 0.15 to 0.30 inch per hour.

[c] Soil Group C—Clay loams, shallow sandy loams, soils low in organic matter, and soils high in clay content having minimum infiltration rates of approximately 0.05 to 0.15 inch per hour.

[d] Soil Group D—Swelling soils, heavy plastic clays, and certain saline soils having minimum infiltration rates of approximately 0 to 0.05 inch per hour.

basin and are interspersed with moderately and poorly drained soils. One area with a large concentration of well-drained soils in the basin occurs in southern Moore, southern Harnett, Hoke, and western Cumberland Counties (fig. 5B). This area is part of the Sand Hills region in North Carolina. In terms of unit flows, low-flow characteristics for sites in this region were found to be among the highest in the basin. Overall, moderately and poorly drained soils occupy nearly 33 and 51 percent, respectively, of the study area.

Land Use

Land-use information for the study area was obtained from the Multi-Resolution Land Characteristics data set, a product of the Ecological Monitoring and Assessment Program of the U.S. Environmental Protection Agency (USEPA) and other agencies, including the U.S. Forest Service, National Oceanic and Atmospheric Administration, and the USGS (Eimers and others, 1999). Collected by the Landsat Thematic Mapper sensor using remote-sensing techniques (Vogelmann and others, 1998), the USEPA land-cover information was compiled from aerial photographs taken primarily during the spring seasons of 1991, 1992, and 1993. Information was processed into 15 land-use classes established for the development of a consistent and generalized land-cover data base for all of the United States (Vogelmann and others, 1998). In the Cape Fear River Basin, 6 general categories were identified from the 15 land-use classes in the study area (table 5).

Land use in the Cape Fear River Basin is mostly rural; more than 77 percent of the study area is classified as agricultural or forested (table 5). About 5 percent of the study area is developed land and includes the urban areas of Greensboro and parts of High Point in Guilford County, Burlington in Alamance County, parts of Durham in Durham County, Fayetteville in Cumberland County, and Wilmington in New Hanover County. Much of the percentage shown for water (1.7 percent, table 5) consists of the Cape Fear River estuary, which begins at Wilmington. Other water bodies, such as Jordan Lake, Lake Brandt, Lake Townsend, and other impoundments in the Cape Fear River Basin, account for less than 1 percent of the study area. Wetlands occupy more than 14 percent of the study area and occur primarily adjacent to streams in the lower Coastal Plain. Between 1982 and 1992, urban and built-up areas increased by 43 percent (North Carolina Department of Environment and Natural Resources, 1996). Agricultural land-use categories (cultivated crop, uncultivated crop, pasture) had a net increase of 7 percent during the same period, whereas forest areas decreased by 5 percent.

Table 5. Areas and percentages of land-use categories in the Cape Fear River Basin, North Carolina

[mi^2, square mile. Differences in total drainage area from those listed in other tables reflect differences in scale of map and accuracy of methods used by sources to compute areas]

Land-use category	Extent and percentage of study area covered by land-use category[a]	
	(mi^2)	(percent)
Developed (includes urban areas)	422	4.6
Agricultural	2,098	23.0
Forested	4,999	54.8
Water	152	1.7
Wetlands	1,320	14.4
Barren (includes quarries, gravel pits, and transitional areas such as clear-cut areas)	136	1.5
Totals	9,127	100.0

[a] From U.S. Environmental Protection Agency Land-Cover Data Set (Vogelmann and others, 1998).

Changes in land use and effects on low flows in North Carolina generally has not been the subject of in-depth investigations. As previously discussed, Evett (1994) investigated the effects of urbanization and land-use changes on low flows. While the conclusions from that investigation tended to support the hypothesis of decreasing low flows with increasing urbanization, Evett (1994) described the results as being statistically inconclusive. Nevertheless, speculation among hydrologists has been that increasing urbanization results in decreased low flows due to less infiltration of water to shallow aquifers. Rather, the runoff from impervious areas is directed toward stream channels for immediate removal; consequently, no storage of water occurs in the soils for later release during periods of base flow. As developed areas in North Carolina's larger municipalities continue to expand, additional investigations may aid in the understanding of land-use effects on low-flow hydrology.

LOW-FLOW CHARACTERISTICS IN THE CAPE FEAR RIVER BASIN

Low-flow characteristics were determined for selected gaging stations in the Cape Fear River Basin. Historical records of gage height and streamflow at 681 sites (pl. 1) were compiled; streamflow records were examined (table 6, p. 81–129) for selection of sites where low-flow characteristics could be determined. Records of discharge collected through the 1998 water year were used. Of the 681 sites, 47 were continuous-record gaging stations, 611 were partial-record measuring sites, and 23 were sites having a combination of continuous- and partial-record discharges. The period of record varies from site to site. The low-flow characteristics for selected sites in the Cape Fear River Basin are presented in this section.

Continuous-Record Gaging Stations

Low-flow characteristics based on continuous records of discharge were developed for 67 sites—45 of the 47 continuous-record gaging stations and 22 of the 23 sites that have both continuous- and partial-record discharges. Most of these sites were analyzed by using frequency curves, which depict the relation between recurrence interval and the lowest average annual discharge for a specified number of days at a gaging station (Riggs, 1972). A number of sites required other graphical correlation techniques as explained below. The magnitude and frequency of low flows for the continuous-record gaging stations are shown in table 7 (p. 130–133). Not all sites having continuous records could be used to determine low-flow characteristics. Of the 47 sites having only continuous-record discharges, low-flow characteristics were not developed for two sites: site 254, because only records of gage height were available, and site 364, because reliable low-flow characteristics could not be determined. Among the sites having both continuous- and partial-record discharges, low-flow characteristics for site 594 were determined from records of partial-record discharges because reliable low-flow characteristics based on analyses of continuous records could not be determined.

Frequency curves were developed for annual (climatic year) 7-day and 30-day lowest average discharges as well as for the winter (November–March) 7-day lowest average discharge and then fitted with the log-Pearson Type III frequency distribution. The computed log-Pearson distribution generally corresponds closely to the distribution of annual low flows for sites having long-term periods of record (fig. 6). The method of analysis for these sites is denoted as “LP” in table 7. For sites 136, 229, 236, 399, and 520, which have 8 to 10 years of records, analyses using the log-Pearson Type III frequency distribution

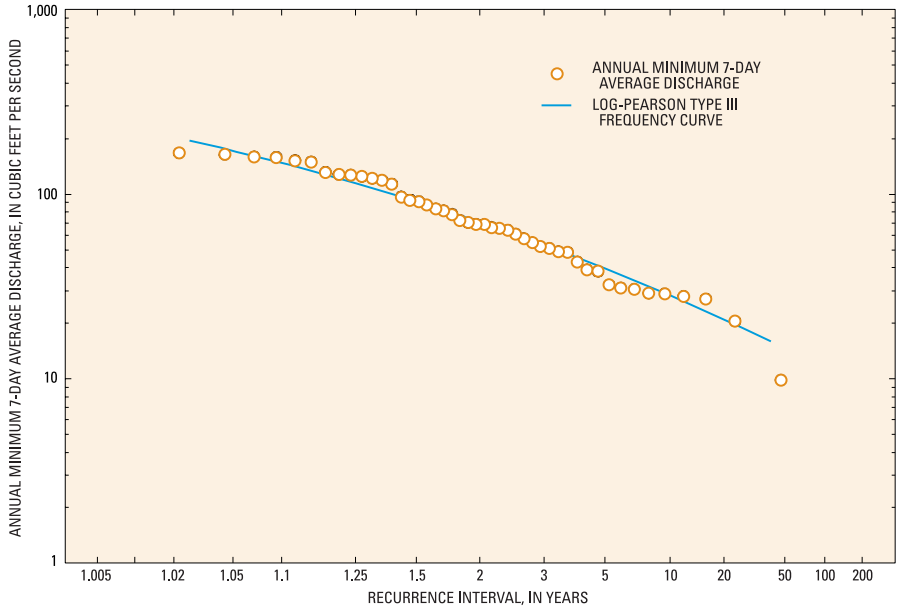


Figure 6. Low-flow frequency curve of annual, minimum 7-day average discharges using log-Pearson Type III frequency distribution at Black River near Tomahawk (site 586).

yielded best-fit curves (Weibull plots) that were closely examined and, where necessary, graphically adjusted to better fit the distribution of the annual low flows. The method of analysis for these sites is denoted as "G" in table 7. The remaining gaging stations have less than 10 years of record and usually less than 5 years, and were treated as partial-record measuring sites by using the methods of correlation described in the following discussion. The method of analysis for these sites is denoted as "C" in table 7.

Since 1982, streamflows at four gaging stations on the Cape Fear River (sites 255, 438, 549, and 559; pl. 1) have been affected by flow releases from Jordan Lake. Low-flow characteristics are presented for pre- and post-regulation flow conditions associated with the presence of the lake. A common base period, the 1982–97 climatic years (April 1, 1982–March 31, 1998), was used to analyze post-regulation discharges at three of the four stations (438, 549, and 559). At site 255, discharge records are available through September 1992, and low-flow characteristics for this site reflect the flows during this period only. For analyses of pre-regulation discharges, available period of record up through the 1971 climatic year (ending March 31, 1972, prior to the start of construction) was used at these same sites and at two additional sites (156, 516; pl. 1), which were discontinued before the construction of Jordan Lake.

At the four Cape Fear River gaging stations (sites 255, 438, 549, and 559), only the values for post-regulation flow conditions are used in the discharge profiles presented in this report. Pre-regulation values are listed for comparison purposes only and are intended to provide a means of quantifying the effects of Jordan Lake on downstream flows. At site 255, immediately downstream from the dam, the increases in low-flow discharges range from 35 to nearly 270 percent above pre-regulation values (table 7). The effects are even more pronounced at site 438 at Lillington, where a target flow of 600 ft^3/s must be maintained by flow releases from the dam. Post-regulation low-flow discharges range from about 180 to greater than 600 percent above pre-regulation values (table 7). The higher percentage increases at Lillington are a reflection of the efforts to meet the target flow at the gage. Under pre-regulation flow conditions, the daily discharges at Lillington (site 438) were at or above 195 ft^3/s for 95 percent of the time. In comparison, daily discharges have been 525 ft^3/s or higher for 95 percent of the time since Jordan Lake was constructed. Downstream from Lillington, as the ratio of drainage area at a given site to the drainage area at the dam increases, the effects of regulation become less apparent when compared to pre-regulation conditions. At site 549 near Tarheel and site 559 near Kelly, the drainage-area ratios are nearly 2.9 and 3.1, respectively, and increases between pre- and post-regulation low flows range from 5 to about 160 percent.

The common base period (1982–97) used for a number of the sites on the Cape Fear River downstream from Jordan Lake was not applied to the analyses of low flows at other gaging stations. While this period reflects flow conditions in the Cape Fear River since the construction of Jordan Lake, the availability of longer-term records of discharge at other gaging stations allows for longer periods of analysis, which improve the statistical reliability of low-flow discharges determined in the analyses. A number of sites have records of discharge during the severe droughts of the 1950's and 1960's, periods when many record low flows were set. Thus, except for sites in table 7 where the indicated period of analysis is the 1982–97 climatic years, low-flow characteristics reflect the available periods of record.

Twenty-three continuous-record gaging stations having less than 10 years of record were treated as partial-record measuring sites for the analysis of low-flow characteristics; the method of analysis is denoted by "C" and the period of analysis is denoted as "PR" in table 7. Daily mean discharges at these sites were correlated with concurrent flows at nearby long-term, continuous-record gaging stations where low-flow characteristics are known. At these sites, available periods of record were used in the correlations.

The presence of upstream regulation and(or) diversions in flows is denoted as "R" in table 7; where flows at a gaging station are largely regarded as being unaffected by human-induced flow modifications during the period of record, the flow is denoted as "U". By definition, the term "regulation" refers to the artificial manipulation of flow in a stream (Langbein and Iseri, 1960), an effect only achieved by the presence of a dam having a flow-release system that can be operated to adjust the magnitudes of flow in a stream. In this report, the low-flow characteristics at gaging stations where the flow has been denoted as "R" also may reflect the effects of diversions and(or) diurnal fluctuations caused by industries and(or) small impoundments upstream from the station. Gaging stations denoted as "R" in table 7 are footnoted to

clarify the type of effects on the low-flow characteristics. Low-flow characteristics for regulated sites can be considered valid as long as the observed patterns of regulation and(or) diversions continue to exist.

The last year of data collection for many discontinued sites occurred more than 25 years ago (table 7). Low-flow characteristics for these sites cannot necessarily be interpreted as reflecting low-flow characteristics that would be calculated if the gages were still in operation. Changes in basin characteristics—such as development, artificial drainage, and(or) flow modifications—could result in changes in low-flow characteristics. Thus, when examining the low-flow characteristics for discontinued sites, the period of record should be considered, particularly in basins that have experienced major changes. No means of determining current low-flow characteristics is possible in the absence of more recent data. Two discontinued sites with known low-flow characteristics that have likely been affected by recent changes in flow diversions and regulation are Morgan Creek near Chapel Hill (site 236) and Cape Fear River at Fayetteville (site 516).

Records of daily mean discharges at sites located downstream from flow diversions were not adjusted to account for the diversions. Records of daily-flow diversions necessary for making proper adjustments to streamflow records usually are unavailable. In most instances, only annual average flow diversions can be obtained. In addition, overall average withdrawals and point-source discharges have increased during the past few decades as a result of development and population increases. However, records at three sites—North Buffalo Creek in Guilford County, and New Hope Creek and Northeast Creek in Durham County (sites 58, 197, and 223, respectively; table 7)—were adjusted to obtain some understanding of just how much the 7Q10 discharge based on current conditions differs from an estimate of the "natural-flow" 7Q10 discharge. These sites are each located downstream from major NPDES point-source discharges of treated effluent from municipal wastewater-treatment plants. During 1988–90, the point-source discharges upstream from the site on North Buffalo Creek (site 58) averaged about 52 percent of the daily flow at the gage. Similarly, at the sites on New Hope Creek (site 197) for 1991–97 and Northeast Creek (site 223) for 1993–97, point-source discharges averaged 50 percent of the daily discharges at both sites.

Available (for the periods stated in the above comparisons) daily records of point-source discharges from the wastewater-treatment plants upstream from these three sites were used to adjust daily mean discharges at the gages. At site 58 on North Buffalo Creek, the adjusted estimate of 7Q10 discharge is 2.5 ft^3/s compared to the 7Q10 discharge of 11.5 ft^3/s (table 7) based on current conditions, a nearly five-fold difference between the values. At site 197 on New Hope Creek, the adjusted estimate of 7Q10 discharge is 0.2 ft^3/s compared to the 7Q10 discharge of 6.1 ft^3/s (table 7) based on current conditions. At site 223 on Northeast Creek, the adjusted estimate of 7Q10 discharge is 0 ft^3/s compared to the 7Q10 discharge of 1.8 ft^3/s (table 7) based on current conditions. While the low-flow characteristics have been adjusted for the major NPDES discharges upstream from these sites, the effects of other diversions still may be included in the records of discharges used in the low-flow analyses. For example, in addition to the municipal discharges from the wastewater-treatment plant on North Buffalo Creek, point-source discharges from a textile mill occur upstream from site 58. No adjustments, however, were made to the discharge records at site 58 for the mill's NPDES discharges. Of note, New Hope Creek and Northeast Creek are located in the Triassic basin, an area noted as having streams with little potential for sustained base flows. The adjusted 7Q10 discharges at sites 197 and 223 are thus consistent with the observations of zero or minimal 7Q10 discharges at other sites in the Triassic basin.

Partial-Record Measuring Sites

Using the techniques discussed by Riggs (1972), low-flow characteristics were determined for 120 of the 611 sites in the Cape Fear River Basin study area identified as having partial-record data and for one (594) of the 23 sites that have a combination of continuous- and partial-record discharges (table 8, p. 134–140). In general, sites having 10 or more discharge measurements were included in the analyses of low-flow characteristics. However, some sites having less than 10 measurements were included in the compilation of low-flow characteristics where (1) low-flow characteristics previously have been published (Giese and Mason, 1993), (2) knowledge of low-flow discharges were necessary in the development of discharge profiles, and (3) 7Q10 discharges of zero flow could be determined either by

multiple occurrences of zero-flow discharge measurements or site location upstream from another site having zero-flow 7Q10 discharge. Some sites listed in table 6 having more than 10 measurements were not included because (1) most or all measurements were crest-gage (flood) discharges that could not be used in low-flow analyses (for example, sites 4, 108, 157), or (2) low-flow characteristics were not included due to unreliable low-flow analyses (for example, sites 16, 62).

Discharge measurements at the partial-record measuring sites were plotted with concurrent flows at nearby index sites, typically continuous-record gaging stations where low-flow characteristics had been determined (fig. 7). Plots were then examined to determine if a relation exists between the concurrent flows. Index sites for possible use in the correlation analysis were selected primarily on the basis of (1) proximity of the partial-record and index sites; (2) availability and range of concurrent flows; and (3) to the extent possible, similarity in basin characteristics such as drainage area, topography, geology, and(or) soils.

In this investigation, both statistical and graphical methods (Riggs, 1972) were used to establish the relation between the concurrent flows. When applying the statistical method, the Maintenance of Variance Extension (MOVE.1) technique was used instead of the ordinary least-squares regression techniques, which have been shown to provide biased estimates of low-flow characteristics (Stedinger and Thomas, 1985). The relation depicted in the correlation shown in figure 7 is based on the MOVE.1 technique. As a general rule, computed MOVE.1 relations having correlation coefficients greater than 0.8 were used to derive the estimates of low flows. For cases in which the correlation coefficient was less than 0.8 or the relation was nonlinear, visually fit correlations (graphical techniques) were applied to more adequately describe the relations between concurrent flows.

At most partial-record measuring sites, correlations of the discharge measurements with

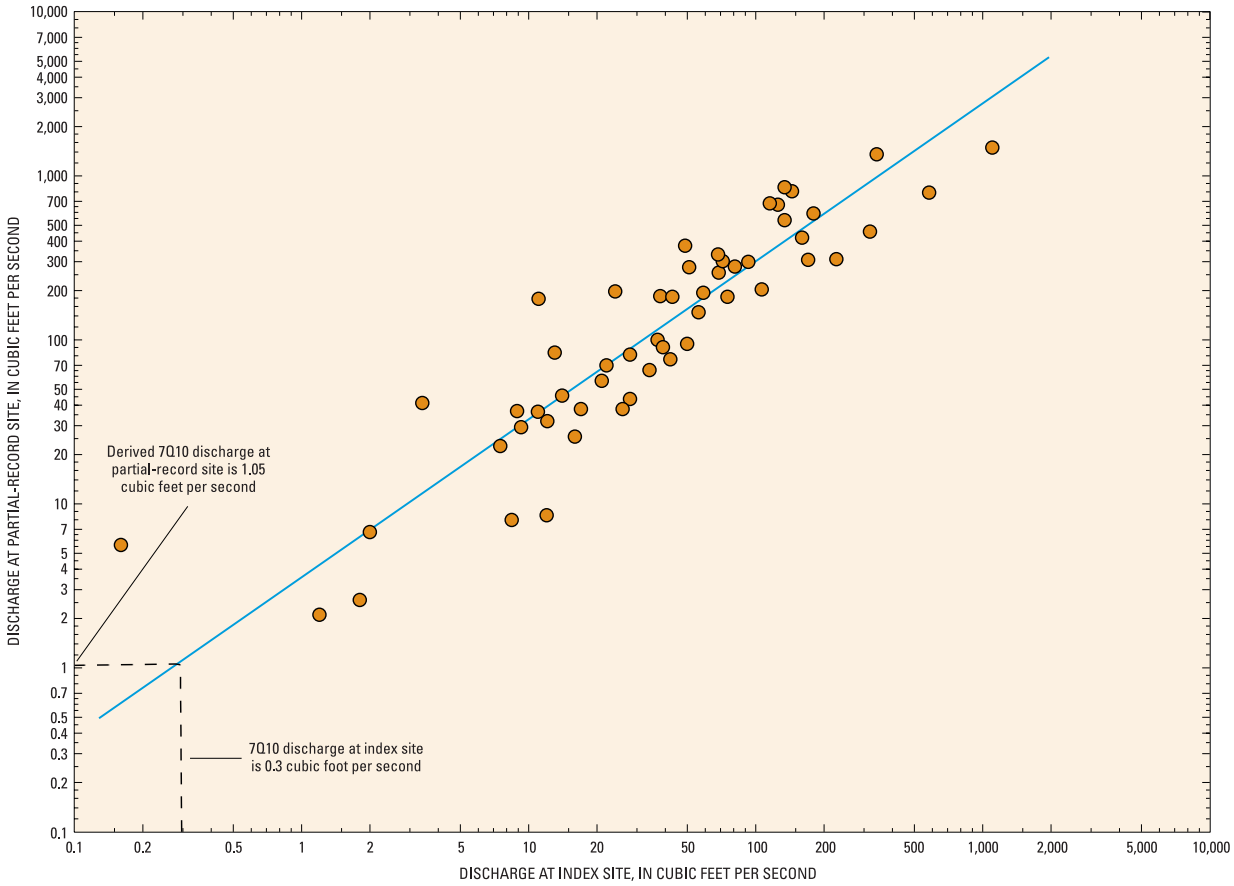


Figure 7. Correlation of concurrent discharge at partial-record measuring site at Upper Little River near Erwin (site 463, drainage area 217 square miles) and at the index site at Middle Creek near Clayton (station 02088000 in the Neuse River Basin, drainage area 83.5 square miles).

concurrent flows at multiple index sites yielded several relations from which estimates of low-flow discharges could be determined. In general, two to four index sites were used in the analyses at each partial-record measuring site. From each relation, estimates of low-flow discharges were derived from the individual correlation plot. Then, overall estimates of low-flow discharges (7Q10, 30Q2, W7Q10, and 7Q2) for the partial-record site were determined as the average of estimates from each correlation. Where correlations revealed extensive scatter in the plots, individually derived estimates could not be determined. In such instances, where visually fitted lines could not be established or otherwise were deemed suspect, the individual estimates were not included in the average for overall estimates.

Low-flow characteristics for the partial-record measuring sites generally reflect unregulated conditions in the study area. However, discharge measurements at some sites reflect some effects of flow modifications, particularly at streams such as Reedy Fork, North Buffalo Creek, South Buffalo Creek, Big Alamance Creek, Haw River, and New Hope Creek (pl. 1). Additionally, effects from tidal influences downstream from site 609 (Moores Creek) also affect flows at that location as well as at other sites in lower parts of the Northeast Cape Fear River Basin and the Cape Fear River estuary (Giese and others, 1985). The presence of minor regulation and(or) flow diversions was not quantified and adjusted for in the records of discharge measurements at the partial-record measuring sites (table 8).

A comparison was made of low-flow characteristics based on regional equations presented by Giese and Mason (1993) at 11 sites in HA3 and HA9 in the Cape Fear River Basin (table 9) with those based on analysis of streamflow data as previously outlined (tables 7 and 8). The 11 sites presented in table 9 were part of those used by Giese and Mason (1993) to develop the regional equations for estimating low-flow characteristics at ungaged sites. Percentage differences between the regional equation estimates and data estimates vary among the sites. Seven of the 11 sites (36, 491, 511, 512, 520, 530, and 546; table 9) have regional estimates that are lower than the data estimates. Of the remaining four sites, the largest percentage differences, ranging from nearly 50 to 125 percent, were at site 498 on the Little River. Excluding site 498, the average percentage differences at all sites ranged from 10 to 30 percent. For most sites, differences between the low-flow characteristics can be attributed to the general nature of residual errors associated with use of a statistical regression to compute estimates. Giese and Mason (1993) identified site 498 on the Little River as being located within an area of mixed sandy and clay soils adjacent to the Sand Hills (HA3), although much of the basin is located within HA3. Therefore, use of the HA3 regional equations does not account for part of the basin's presence in adjacent hydrologic areas that include some clay soils, a factor that is not reflected in the regional estimates but is reflected in the lower data estimates. Still, the regional equations provided by Giese and Mason (1993) are useful for computing estimates at locations where no other data are available to assess low-flow characteristics. Further, their conclusions regarding relatively higher unit low flows in the part of HA3 that lies within the Cape Fear River Basin are confirmed by the higher unit low flows in the Sand Hills region compared to low flow in other parts of the basin.

Occurrence of Zero or Minimal 7Q10 Discharges

Estimated 7Q10 discharges at 54 of the 188 sites in the study area were determined to be zero (tables 7, 8). Fourteen sites have 7Q10 discharges estimated to be less than 0.05 ft^3/s. In previously published reports on the low-flow characteristics in the Roanoke River Basin and the Deep River Basin (tributary to the Cape Fear River), Weaver (1996, 1997) defined minimal 7Q10 discharges as those reported to be less than 0.1 ft^3/s, a threshold used by Giese and Mason (1993) in reporting low-flow characteristics for streams across North Carolina. In the report on low-flow characteristics in the Neuse River Basin, Weaver (1998) redefined minimal 7Q10 discharges to a lower threshold of 0.05 ft^3/s, the minimum flow allowed by the DWQ in its evaluation of NPDES permits. In this report, minimal 7Q10 discharges continue to be defined as those reported to be less than 0.05 ft^3/s.

When the sites in the Cape Fear River Basin were arranged in ascending order by drainage area, there was no clear indication of a maximum drainage area below which 7Q10 discharges generally are zero. Sites having zero or minimal 7Q10 discharges were then plotted on a map to determine what other factors, if any, may account for the low potential to sustain base flow. Three general areas of the basin where zero or

Table 9. Low-flow characteristics for continuous- and partial-record sites and regional equations in hydrologic areas 3 (HA3) and 9 (HA9) in the Cape Fear River Basin, North Carolina

[mi^2, square mile; water year, the annual period from October 1 to September 30 and identified by the year in which the period ends; ft^3/s, cubic foot per second; 7Q10, 7-day, 10-year low flow; 30Q2, 30-day, 2-year low flow; W7Q10, winter 7-day, 10-year low flow; 7Q2, 7-day, 2-year low flow; SR, secondary road. First line of low-flow characteristics (denoted Data under Method column) are those based on analysis of discharge records available for site and listed in table 7 (site type 1) or 8 (site type 2) depending on site type. The second line of low-flow characteristics are based on the regional equations (computed to two significant figures, denoted by hydrologic area under Method column) presented for HA3 and HA9 in Giese and Mason (1993)]

Site index no. (pl. 1)	USGS downstream order number	Station name	Drainage area (mi^2)	Period of record (water years)	Low-flow characteristics (ft^3/s)				Site type	Method
					7Q10	30Q2	W7Q10	7Q2		
2	02093250	Haw River at SR 2109 near Oak Ridge	14.1	1951–60, 1962, 1966, 1971, 1973–84, 1986–98	0.5 .80	2.7 2.8	1.9 2.2	1.7 2.0	2	Data HA9
36	02094000	Horsepen Creek at Battle Ground	16.4	1926–31, 1934–59	1.4 .86	3.3 3.2	3.0 2.5	2.5 2.2	1	Data HA9
491	02102908	Flat Creek near Inverness	7.63	1968–98	3.6 2.6	6.4 5.3	6.2 4.9	5.3 4.2	1	Data HA3
498	02103000	Little River at Manchester	347	1939–50	35.0 78.6	114 170	70.0 153	75.0 134	1	Data HA3
511	02103770	Cross Creek at Langdon Street at Fayetteville	14.5	1955, 1966–68, 1970–71, 1974	6.2 4.7	9.6 9.5	9.6 8.8	8.6 7.5	2	Data HA3
512	02103960	Blounts Creek at Fayetteville	4.22	1960–68, 1970	1.9 1.6	3.9 3.1	3.8 2.9	3.2 2.4	2	Data HA3
520	02104220	Rockfish Creek at Raeford	92.7	1988–98	41.8 24.3	58.4 51.2	67.8 46.5	49.7 40.4	1	Data HA3
522	02104255	Beaver Creek near Arabia	11.9	1965–68, 1971	3.1 3.9	5.8 7.9	5.7 7.3	4.7 6.2	2	Data HA3
530	02104320	Little Rockfish Creek near Cumberland	44.9	1960–68, 1970	14.1 12.7	30.5 26.5	30.0 24.2	24.0 20.9	2	Data HA3
540	02104380	Beaver Creek at Cumberland	32.6	1955–56, 1960–65, 1968, 1973–75, 1979–93	9.3 9.6	18.3 19.8	18.3 18.2	14.7 15.6	2	Data HA3
546	02104500	Rockfish Creek near Hope Mills	292	1929–31, 1939–54	97.6 67.4	186 145	163 131	144 115	1	Data HA3

minimal 7Q10 discharges could be expected for small- to mid-size basins are identified on plate 1. While there are common factors that can be identified to explain the occurrence of zero or minimal flows, all the factors that combine to result in zero or minimal flows at one site may not be the same factors that cause zero or minimal flows at other sites. Thus, it is difficult to establish absolute thresholds of drainage areas at or below which 7Q10 discharges are assured of being zero or minimal flows. The determination of such drainage-area thresholds are subjective, requiring some interpretation and judgment. Areas (headwaters of the basin, parts of the Coastal Plain) on plate 1 where no drainage-area thresholds were identified do not mean that zero or minimal 7Q10 discharges do not occur on some streams. Rather, the data used in this analysis revealed very few occurrences of zero or minimal 7Q10 discharges in this area, thus no drainage-area thresholds could be specified.

The first area where numerous occurrences of zero or minimal 7Q10 discharges were noted is underlain by the geologic rock units of the Carolina Slate Belt (fig. 5A), an area in the upper part of the Cape Fear River Basin marked by the presence of

igneous, metaigneous, and metavolcanic rocks. Within this area, drainage areas for sites having zero or minimal 7Q10 discharges ranged from 0.42 (site 203) to 45.2 mi^2 (site 75). All sites in this area with drainage areas less than 5 mi^2 where low-flow characteristics were determined had zero or minimal 7Q10 discharges, suggesting that 7Q10 discharges at ungaged sites within the Carolina Slate Belt with drainage areas less than 5 mi^2 will likely have zero or minimal discharges (see table below). However, there are sites within the Carolina Slate Belt with larger drainage areas where zero or minimal 7Q10 discharges were noted, such as Stony Creek and its tributaries north of Burlington (up to 45 mi^2), Cane Creek in Orange County (up to 8 mi^2), and Tick Creek and Bear Creek in Chatham County (up to 42 mi^2). Well yields estimated by Daniel (1989) for this part of the study area were below the overall average determined for hydrogeologic units in the Piedmont and Blue Ridge Provinces, particularly for metavolcanic rocks. Daniel also identified soils in this area as typically being thin and thus having very little storage of water to sustain streams during base-flow periods (Charles Daniel, U.S. Geological Survey, oral commun., September 2000). Examination of the soils map indicates that many sites having zero or minimal 7Q10 discharges are underlain by poorly drained soils, which results in very little to practically no infiltration of water into the shallow aquifers.

Drainage-area thresholds, in square miles, below which 7Q10 discharge is likely zero or minimal flow in selected areas of the Cape Fear River Basin, North Carolina

[Minimal 7Q10 discharge defined as less than 0.05 cubic foot per second]

Piedmont:	
Carolina Slate Belt	5
Triassic basin	35
Coastal Plain:	
Eastern Harnett and northeastern Cumberland Counties	3
Northeast Cape Fear River Basin	8

The second area where numerous occurrences of zero or minimal 7Q10 discharges have been noted is underlain by the geologic rock unit known as the Triassic basin (fig. 5A), an area that has long been recognized as having very little potential for sustained base flows. Drainage areas for sites in the Triassic basin having zero or minimal 7Q10 discharges ranged from 0.1 (site 213) to 97.3 mi^2 (site 375), but most of these were less than 35 mi^2 at sites occurring on New Hope Creek and its tributaries in Durham and Chatham Counties. Other observations of zero flow 7Q10 have been noted for two sites (369, 375) on McLendons Creek (lower Deep River subbasin) in Moore County, as well as a number of sites in western Wake County. The average 7Q10 unit flow was 0.01 $(ft^3/s)/mi^2$ among the sites with 7Q10 discharges above zero flow. During the investigation of low flows in the adjacent Neuse River Basin, Weaver (1998) reported that nearby Triassic basin sites with drainage areas less that about 10 mi^2 could be expected to have zero or minimal 7Q10 discharges. Giese and Mason (1993) reported the drainage-area threshold for zero flow 7Q10 discharges at 45 mi^2, a value based on the assessment of nine sites used for HA6 (Triassic basin) in their investigation. Given repeated observations of sites with zero 7Q10 discharges in the Triassic basin, an appropriate drainage-area threshold is 35 mi^2 while recognizing that zero-flow 7Q10 discharges have been noted for sites with larger drainage areas in the lower Deep River subbasin. Well yields estimated for the Triassic basin by Daniel (1989) were the lowest of all the hydrogeologic units mapped for the Piedmont and Blue Ridge Provinces. Giese and Mason (1993) reported that low-flow characteristics of streams in the Triassic basin are among the lowest in North Carolina, an observation verified in the compilation of low-flow characteristics for sites in the study area (tables 7, 8). Soils in the Triassic basin are for the most part poorly drained and do not allow for the storage of water in shallow aquifers for later release during extended periods of base flow.

The third area with numerous occurrences of zero or minimal 7Q10 discharges is the Coastal Plain Province; drainage areas for these sites ranged from 0.7 (site 664) to 108 mi^2 (site 607). Although the occurrences are more widely scattered, most of these sites were found in two general areas: (1) streams in eastern Harnett County and portions of northeastern Cumberland County, and (2) streams that drain to the Northeast Cape Fear River in the lower Coastal Plain Province.

In eastern Harnett County and northeastern Cumberland County, the drainage areas at sites having zero or minimal 7Q10 discharges ranged from 4.68 (site 590) to 50.4 mi^2 (site 598). The average 7Q10 unit flow among sites having 7Q10 discharges above zero flow is about 0.02 $(ft^3/s)/mi^2$. Visual comparison of hydrologic areas mapped by Giese and Mason (1993) for the Coastal Plain show areas of mixed sandy and clay soils in eastern Harnett County and northeastern Cumberland County that appear to coincide with the

occurrence of sites having zero or minimal 7Q10 discharges in this area. Giese and Mason (1993) also reported that drainage-area thresholds for 7Q10 discharges at sites in HA1 (clay soils) and HA2 (sandy soils) are 35 and 2 mi^2, respectively. The area is underlain by mixed soils, but its proximity to the Sand Hills region suggests the possibility that sandy soils may be more dominant in the mixed soils. Thus, a drainage-area threshold of 3 mi^2 appears to be an appropriate threshold for zero or minimal 7Q10 discharge.

The second group of sites in the Coastal Plain having numerous occurrences of zero or minimal 7Q10 discharges is in the Northeast Cape Fear River Basin, particularly the tributaries located on the western side of the river. The drainage areas at sites having zero or minimal 7Q10 discharges range from 0.7 (site 664) to 50.9 mi^2 (site 619). The average 7Q10 unit flow among sites having 7Q10 discharges above zero flow is about 0.03 $(ft^3/s)/mi^2$. An area of predominantly clay soils (HA1) corresponds to this group of sites; the drainage-area threshold reported for HA1 is 35 mi^2 (Giese and Mason, 1993). Examining the range of drainage areas reported for sites in this area having zero or minimal 7Q10 discharges, it would be appropriate to use a threshold of 8 mi^2 for zero or minimal 7Q10 discharges at nearby ungaged sites.

Other sites (563, 607, and 609) in the Coastal Plain that have zero 7Q10 discharges are in the headwaters of Great Coharie Creek, and on Colly Creek and Moores Creek in the lower part of the Black River Basin. The existence of little topographic relief, as well as the swampy nature of these streams and others in the Coastal Plain, also may result in the low potentials for sustained base flows. Giese and Mason (1993) emphasized the role that low topographic relief and hydraulic gradients have in low-flow characteristics in the Coastal Plain by comparing unit flows that have been determined for streams in HA1 (clay soils) and HA2 (sandy soils) with those in HA3 (Sand Hills). Many of the factors (for example, aquifer material and climate patterns) are nearly the same, yet the unit low flows in the Sand Hills are much higher than those in other parts of the Coastal Plain, an observation that was verified in the compilation of the low-flow characteristics presented in this report (tables 7, 8).

DISCHARGE PROFILES FOR SELECTED STREAMS IN THE CAPE FEAR RIVER BASIN

Discharge profiles of low flows were developed for the Haw and Cape Fear Rivers as well as for selected tributaries. The tributaries, which vary in basin size and characteristics, include North Buffalo Creek, Buffalo Creek (including South Buffalo Creek), and Reedy Fork in Guilford County; Big Alamance Creek in Guilford and Alamance Counties; Rocky River (tributary to the Deep River) in Chatham County; Upper Little River in Lee and Harnett Counties; Little River in Moore, Hoke, Harnett, and Cumberland Counties; Rockfish Creek in Hoke and Cumberland Counties; Six Runs Creek in Sampson County; Black River (including Great Coharie Creek) in Sampson and Bladen Counties; Rockfish Creek in Duplin County; and Northeast Cape Fear River in Duplin, Pender, and New Hanover Counties. Drainage-area profiles also were developed for each of these streams to document the relation between basin size and low-flow characteristics.

River miles shown on the profiles were determined by using the USEPA's River Reach Files (Bondelid and others, 1990), which are 1:100,000-scale GIS coverages of rivers and streams digitized from USGS topographic maps. River miles computed for each stream begin at zero at the mouth and increase upstream toward the headwaters. On the drainage-area profiles, the locations listed in table 6 where drainage areas are known are identified (shown as orange points).

Profiles are presented for the 7Q10, 30Q2, W7Q10, and 7Q2 low-flow discharges. Synoptically measured discharges also are presented for the Haw and Cape Fear Rivers as well as for two tributaries, Reedy Fork and the Northeast Cape Fear River. Locations where low-flow characteristics were developed, using either continuous- or partial-discharge records (tables 7, 8), are identified on the low-flow discharge profiles (shown as orange points). These locations are referred to as anchor points on the profiles. Low-flow characteristics at these anchor points were used as the basis for estimating low-flow discharges at ungaged points on the streams. In general, linear interpolation of unit low-flow discharge (that is,

discharge divided by the drainage area, or unit low flow) between the nearest upstream and downstream anchor points was used to determine low-flow discharges at ungaged locations on the profile. For profiled reaches upstream and downstream from the first and last anchor points, the low-flow characteristics are based on extrapolation of the unit low-flow discharges at the first or last anchor point.

For most streams, the low-flow discharge profiles have multiple anchor points. Low-flow discharge profiles developed for Six Runs Creek, however, have only one anchor point (fig. 16B, p. 63). The unit low flows at the anchor point were applied to the locations upstream from Clinton (pl. 1). Downstream from Clinton, the profile was based on the anchor point and low-flow characteristics computed for site 584, which is on Stewarts Creek and is tributary to Six Runs Creek.

The development of low-flow discharge profiles for a given stream typically begins with the identification of low-flow characteristics for anchor points and for sites on tributaries where such estimates have been developed. Once the points have been identified, an examination of the unit low flows at each location is made to determine the general trends in the unit values. Where major differences in unit low flows are noted between anchor points and(or) tributary contributions, (1) the low-flow characteristics for anchor points are reassessed for revision where appropriate and(or) (2) other means of explanation for the change in unit flows are sought. An important source of information used in the development of the low-flow discharge profiles was the soil hydrologic groups that define the internal drainage, or infiltration, characteristics of soils. Much of the explanation for differences in unit low-flow trends is tied to information concerning the presence of—and changes between—poorly, moderately, and well-drained soils.

Estimates of low-flow discharges were developed for tributaries to profiled streams if the drainage area of the tributary was 5 percent or greater of the drainage area immediately upstream from the tributary. Estimates of tributary contributions to low-flow discharges were based on (1) unit low flows from a site on a tributary for which low-flow discharge estimates were developed (tables 7, 8), (2) interpolated unit low flows between the anchor points on the profiled stream, or (3) a combination of the above two techniques.

Profiles for Reedy Fork, the Northeast Cape Fear River, and the Haw and Cape Fear Rivers include actual measurements of discharge obtained synoptically at multiple points along streams (shown on low-flow discharge profiles as blue points). Streamflows at selected locations on these streams were measured in October 2000 during a period of extended dry conditions. The measurements provide an assessment of the conditions when flows in many streams were at or near 30Q2 or 7Q2 discharge conditions. As shown in the profiles for these streams, the measured discharges do not always increase in the downstream direction and serve as a reminder of the complex flow patterns that can exist for a stream. In most instances, explanations for flow losses that occur at measured locations can only be speculated. However, the measured discharges aid in the confirmation of overall trends depicted in the low-flow discharges shown on the profiles for these streams.

In the early stages of this investigation, plans called for the development of low-flow discharge profiles for New Hope Creek in Orange and Durham Counties. Low-flow characteristics for one continuous-record gaging station (site 197) and two partial-record measuring sites (175, 183) on New Hope Creek, and two partial-record measuring sites (185, 196) on tributaries to the creek were available. New Hope Creek drains part of the Triassic basin where a number of sites were found to have zero 7Q10 discharges (tables 7, 8). Major differences in unit low flows between sites 183, 197, and two of the tributaries (Sandy Creek, Third Fork Creek) could not be resolved or otherwise explained in such a manner that reliable profiles could be developed. The presence of a major NPDES discharge upstream from site 197 further complicated estimation of low-flow characteristics. Consequently, no profiles were developed for this stream. Additional and continuing streamflow measurements in the New Hope Creek Basin may allow low-flow discharge profiles to be developed for this stream in the future.

North Buffalo Creek

North Buffalo Creek has a drainage area of 43.7 mi^2 at its mouth (fig. 8A, p. 46) in central Guilford County where it joins South Buffalo Creek to become Buffalo Creek (pl. 1). Tributaries to North Buffalo Creek include Muddy Creek and Jordan Branch. North Buffalo Creek is nearly 17 mi in length and drains an area where the land use is primarily urban.

One continuous-record gaging station (site 58) and one partial-record measuring site (53) having records of discharge on North Buffalo Creek were used to develop the low-flow discharge profiles for the stream between river mile 15.4 and the mouth (fig. 8B, p. 47). The daily discharge records at site 58 include the effluents associated with a major point-source discharge upstream from the site. Hence, the profiles for this stream show flow increases at the location of this point-source discharge to account for the change in flows. Prior to the development of these profiles, daily discharge records at site 58 were adjusted to estimate low-flow statistics representative of flow conditions without the major point-source discharge (no adjustments were made for other NPDES point-source discharges in the basin). Then the unit low flows for the adjusted low-flow statistics at site 58 were used in combination with the unit low flows at site 53 to estimate increases in low flows (due to tributary contributions) upstream and downstream from the point-source discharge. Not including the point-source discharge, the increases in low-flow discharges shown on the profiles represent somewhat natural-flow conditions. At its mouth, the 7Q10 discharge for North Buffalo Creek is about 12 ft^3/s (fig. 8B), based on low-flow estimates at site 58 that include the effects of the upstream major point-source discharge.

The North Buffalo Creek Basin is underlain by the Carolina Slate Belt (fig. 5A) in close proximity to the boundary between the Carolina Slate Belt and the Charlotte Belt. Giese and Mason (1993) described low-flow characteristics in the nearby Charlotte Belt (part of HA9) as relatively higher than low-flow characteristics in the Carolina Slate Belt (HA7). Unit low flows in North Buffalo Creek appear to be in a transition from relatively high unit flows observed at sites in the adjacent Charlotte Belt to relatively low unit flows for sites on South Buffalo Creek. This transition in unit low flows also appears to reflect effects of moderately drained soils that occur on the northern side of the basin; poorly drained soils are predominant on the southern side of the basin.

As of 1998, there were seven point-source discharges in the North Buffalo Creek Basin. In 1998, the City of Greensboro discharged from a wastewater-treatment facility an average of 20.5 ft^3/s (13.3 Mgal/d, table 3) to the stream, an amount that represents a significant percentage of the streamflows in this 44-mi^2 basin. Discharge from a textile facility into North Buffalo Creek averaged 1.7 ft^3/s (1.1 Mgal/d, table 3) in 1998.

South Buffalo Creek and Buffalo Creek

Buffalo Creek drains about 100 mi^2 in central Guilford County and is a tributary of Reedy Fork (pl. 1). About 30 mi in length (fig. 9A, p. 48), the stream begins as South Buffalo Creek in western Greensboro and flows in a general east-northeast direction. Tributaries to Buffalo Creek include Ryan Creek, Mile Run Creek, and North Buffalo Creek, which is the largest tributary (43.7 mi^2 or about 44 percent of the Buffalo Creek Basin). Where North and South Buffalo Creeks merge, the stream name becomes Buffalo Creek. Land use in the basin is mostly urban.

Low-flow characteristics depicted in the profiles for Buffalo Creek highlight the complexity associated with understanding low flows in an urban area. Partial-record discharges at three sites (42, 45, and 48) and continuous-record discharges at three sites (47, 49, and 60) on South Buffalo Creek and Buffalo Creek were analyzed to determine low-flow characteristics for use in developing discharge profiles (fig. 9B, p. 49). The City of Greensboro has operated a wastewater-treatment plant on South Buffalo Creek since 1928. The plant was located upstream from site 47 until 1984 when it was relocated just downstream from site 48. The last year of streamflow record at site 47 was 1958, and the percentage of streamflow that is attributed to wastewater discharges during the period of record is unknown.

As was done for North Buffalo Creek, analyses were conducted to estimate low-flow statistics for this stream that could be used to determine increases in low flows (due to tributary contributions) representative of somewhat natural-flow conditions. Then profiles were developed for the reaches upstream and downstream

from the point-source discharge (at its current location) on South Buffalo Creek.

Low-flow analyses at partial-record measuring site 48 were based on seven discharge measurements obtained in the 1986 water year to reflect the relocation of the plant (that is, discharge measurements do not include the point-source discharges). Unit low flows at site 48 were found to be comparable to the unit low flows at site 47; the unit low flows for 7Q10 discharges at these two sites are about 0.03 $(ft^3/s)/mi^2$. While the analyses for site 48 are based on a short period of record, the similarity in unit low flows at site 48 with those at site 47 suggests that the effects of effluent discharges made during the 1920–50's may not have been too high a percentage of flows to render the low-flow characteristics at site 47 as unreliable for use in low-flow discharge profiles.

Upstream from the plant's original location, unit low flows at sites 42 and 45 were found to be comparable; the unit low flows for 7Q10 discharges at these two sites are about 0.05 $(ft^3/s)/mi^2$. However, unit low flows at these sites are higher than at sites 47 and 48, thereby suggesting an increase in low-flow discharges between sites 45 and 47 (fig. 9B). The Buffalo Creek Basin is underlain by the Carolina Slate Belt, and information concerning soils indicates that most of the area is underlain by poorly drained soils. Thus, without any apparent changes in geologic or soils characteristics, it is difficult to explain the increases in unit low flows between sites 45 and 47 (as noted in the slope change between these two sites, fig. 9B). It is possible that changes in low-flow characteristics may be partly attributed to differences in time for the periods of records at these sites, the discharges from the wastewater-treatment plant at its initial location upstream from site 47, and(or) the overall impact of other basin changes on streamflow characteristics.

Downstream from the plant's current location, the low-flow discharges at sites 49 and 60 were used to develop the profiles. Unit low flows at these sites ranged from 0.38 to 0.40 $(ft^3/s)/mi^2$ for 7Q10 discharges and clearly reflect the effects of the point-source discharges on North Buffalo Creek and South Buffalo Creek. The 7Q10 discharge estimated from the profile for the mouth of Buffalo Creek is about 38 ft^3/s (fig. 9B).

As of 1998, there were four point-source discharges in the Buffalo Creek Basin. The largest is from the municipal wastewater-treatment plant on South Buffalo Creek, which discharged an average of about 30 ft^3/s (19.2 Mgal/d, table 3) in 1998. Combined with the point-source discharges from the wastewater-treatment plant on North Buffalo Creek, the 1998 average flow was about 50 ft^3/s. Historical streamflow records at nearby sites indicate the average unit flow in the Greensboro area is 0.9 $(ft^3/s)/mi^2$. With a drainage area of about 100 mi^2, the average natural flow for Buffalo Creek at the mouth is estimated to be 90 ft^3/s. The average unit flows determined from observed streamflow records at sites 47 and 58 are in the range of 1 to 1.5 $(ft^3/s)/mi^2$.

Differences in unit low flows in the upper parts of the North Buffalo Creek and Buffalo Creek Basins are consistent with the changes in annual mean groundwater recharge rates reported by Daniel and Harned (1998). The estimated annual mean recharge in the North Buffalo Creek Basin is about 9.7 inches per year; the annual mean recharge in the South Buffalo Creek Basin is about 5.5 inches per year (Daniel and Harned, 1998). In comparison, the unit 7Q10 low flows for North Buffalo Creek upstream from the major point-source discharge into this stream ranged from 0.07 to 0.08 $(ft^3/s)/mi^2$, and the unit 7Q10 low flows in South Buffalo Creek upstream from partial-record site 45 ranged from 0.02 to 0.03 $(ft^3/s)/mi^2$. The transition from the Charlotte Belt in northwest Guilford County to the Carolina Slate Belt in the southeastern part of the county is reflected in the changes in unit low flows across these two basins.

Reedy Fork

Reedy Fork drains nearly 257 mi^2 and flows directly into the Haw River in northwestern Alamance County (pl. 1). Most of the basin is in Guilford County, within or near the City of Greensboro; thus, land use is mostly urban and suburban. The drainage-area profile was developed for the 43-mi reach of Reedy Fork between Kernersville and the mouth (fig. 10A, p. 50). Tributaries to Reedy Fork include Horsepen Creek (by way of Lake Brandt); Richland Creek (by way of Lake Townsend); and Buffalo Creek, which is the largest tributary (100 mi^2 or 39 percent of the total drainage area). A number of lakes are located within the Reedy Fork Basin, the largest being Lake Brandt and Lake Townsend, constructed in 1923 and 1968, respectively. The City of Greensboro uses both of these lakes as water-supply sources.

The low-flow discharge profiles were developed for the 39-mi reach of Reedy Fork between a partial-

record measuring site (24) near Oak Ridge and the mouth of the stream (fig. 10B, p. 51). The low-flow characteristics of the reach upstream from Lake Brandt differ from those downstream from Lake Townsend. The upstream reach above the lakes has steadily increasing low-flow discharges. At the confluence of Horsepen Creek and Reedy Fork, the 7Q10 discharge is 9.1 ft^3/s (fig. 10B). The upper end of Reedy Fork is underlain by the Charlotte Belt, an area having relatively high low flows compared to downstream sites located in the Carolina Slate Belt (fig. 5A; Giese and Mason, 1993). Much of the upper Reedy Fork Basin is underlain by moderately drained soils.

Low-flow characteristics are lower downstream from Lake Townsend than upstream from Lake Brandt because of (1) the large water-supply withdrawals from the two lakes and (2) the absence of any required minimum-flow releases downstream from Lake Townsend (fig. 10B). Additionally, soils in the areas downstream from these lakes change from moderately drained to poorly drained in the lower Reedy Fork Basin. Much of the Buffalo Creek Basin, the largest tributary to Reedy Fork, is underlain by poorly drained soils. No low-flow characteristics were determined for the reach of Reedy Fork inundated by Lake Townsend. Low-flow characteristics estimated at the dam are extrapolated from the partial-record measuring site (38) near Monticello where the 7Q10 discharge is 1.8 ft^3/s (fig. 10B). Water-supply withdrawals from Lakes Brandt and Townsend have increased over the years in response to increasing demands, and in 1998, withdrawals averaged nearly 60 ft^3/s (38.6 Mgal/d, table 3). The largest tributary contribution (7Q10 discharge of about 38 ft^3/s) is from Buffalo Creek and includes the effects of major point-source discharges on North Buffalo Creek and South Buffalo Creek. Low-flow characteristics at site 61 near Osceola are much higher than upstream at site 40 at Gibsonville, a result of the high tributary contributions from Buffalo Creek. From the profile, the 7Q10 discharge for Reedy Fork at the mouth is estimated at about 45 ft^3/s (fig. 10B).

Overall trends depicted in the low-flow discharge profiles for Reedy Fork are supported by a series of discharge measurements between partial-record measuring sites near Oak Ridge (24) and at Ossipee (62; fig. 10B). The measurements were made October 23–24, 2000, a period of base-flow conditions throughout much of the Cape Fear River Basin. Flows along the stream were above 30Q2-discharge conditions (fig. 10B). The flow upstream from Lake Brandt at site 27 (drainage area = 20.6 mi^2) was greater than the flow at a site downstream from Lake Townsend where the drainage area is 127 mi^2 (fig. 10B). During the 2-day measuring period, the City of Greensboro withdrew an average of about 60 ft^3/s from the lakes for water supply. The decrease in measured flows below the lakes agrees with the reduction in low-flow discharges shown on the profiles.

As previously discussed, the tributary contribution from Buffalo Creek includes the effects of two major NPDES point-source discharges in the basin drained by this tributary. The measured discharge at the partial-record measuring site (61) near Osceola includes the contribution from Buffalo Creek, which in turn includes these point-source discharges. During the 2-day measuring period, the City of Greensboro discharged an average of nearly 46 ft^3/s from the municipal wastewater-treatment plants on North Buffalo Creek and South Buffalo Creek. This amount is approximately 55 percent of the discharge measured (83.3 ft^3/s) at the partial-record measuring site (61) on Reedy Fork.

The discharge measurements indicate a loss in flow of about 7 ft^3/s between sites 61 and 62 near Osceola and at Ossipee. Although the distance between these two sites is about 4.5 mi, site 62 is located immediately downstream from a dam on Reedy Fork at Ossipee. The flow loss between the two sites may be a result of the changes in storage caused by the dam during the 2-day measuring period.

There are five point-source discharges in the Reedy Fork Basin, in addition to the four point-source discharges in the Buffalo Creek Basin. The largest point-source discharge to Reedy Fork is located downstream from Lake Townsend and has a permitted flow of about 2.3 ft^3/s (1.5 Mgal/d, table 3). No minimum-flow releases are required from Lake Brandt and Lake Townsend; however, some undetermined amount of leakage from the Lake Townsend Dam occurs, which helps to maintain minimum flows in Reedy Fork downstream from the dam (James Mead, North Carolina Division of Water Resources, oral commun., September 26, 2000).

Big Alamance Creek

Big Alamance Creek drains southeastern Guilford and Alamance Counties (pl. 1). At its mouth near Swepsonville (southeast of Burlington), where

Big Alamance Creek drains into the Haw River, the drainage area is 262 mi^2 (fig. 11A, p. 52). The largest tributaries to Big Alamance Creek are Little Alamance Creek, which contributes about 62 mi^2 (24 percent), and Stinking Quarter Creek, which contributes 83 mi^2 (32 percent). Other tributaries to Big Alamance Creek include Beaver Creek, Back Creek, and Gum Creek. Of note on Big Alamance Creek are three distinct tributaries identified on USGS topographic maps that are named Little Alamance Creek. In table 8, which lists the low-flow characteristics for partial-record measuring sites, the low-flow discharges listed for sites 97, 106, and 125 are for three distinct and separate Little Alamance Creeks. One lake on Big Alamance Creek is Lake Mackintosh, in operation since 1993 and one of the water-supply sources for the City of Burlington (table 3). The intake is located at partial-record measuring site 113 (pl. 1).

Low-flow discharge profiles for Big Alamance Creek were developed by using the low-flow characteristics determined at one continuous-record gaging station (site 109) and three partial-record measuring sites (95, 114, and 124; fig. 11B, p. 53). The potential for sustained base flows increases between the headwaters and mouth with most of the increase in unit low flows occurring between sites 95 and 109. The headwaters of Big Alamance Creek are underlain by poorly drained soils that change to a mixture of moderately and poorly drained soils in the downstream direction. From the "second" Little Alamance Creek (just upstream from site 109) to the mouth, the profiles depict a substantial increase in the low-flow discharges. In this reach, unit low flows at sites 109, 114, and 124 are comparable and depict a reach of steadily increasing low-flow discharges downstream from site 109. The 7Q10 discharge at the mouth is estimated at 3.1 ft^3/s from the profile (fig. 11B).

There are three point-source discharges to Big Alamance Creek and its tributaries. The largest has a permitted flow of 18.5 ft^3/s (12 Mgal/d, table 3) and is located 0.5 mi upstream from the mouth of Big Alamance Creek; the low-flow discharge profiles do not account for the changes in flows caused by this NPDES discharge. The total of the permitted flows among the remaining discharges is about 0.15 ft^3/s.

A water-supply withdrawal also occurs on Big Alamance Creek at approximately river mile 10.4 (Lake Mackintosh). The average daily withdrawal from this lake reported for 1998 is 16.5 ft^3/s (10.7 Mgal/d, table 3). However, the profiles do not depict any effects of withdrawals from Lake Mackintosh on low-flow characteristics at Big Alamance Creek (fig. 11B) because low-flow characteristics at downstream sites (tables 7, 8) are based on data collected prior to 1993 when construction of the dam was completed. A variable minimum-flow release occurs at the dam and is a function of the available storage contents in the lake (Steve Shoaf, City of Burlington, oral commun., October 2, 2000). The minimum-flow release is 2 ft^3/s during drought conditions when water-supply availability is reduced and ranges up to 8 ft^3/s during normal capacity. At the continuous-record gaging station (site 109, now discontinued and inundated by the lake), the 7Q10 discharge is 1.3 ft^3/s (table 7). At the partial-record site (114) located downstream from the dam, the 7Q10 discharge is 1.8 ft^3/s (table 8). At the dam, the 7Q10 discharge estimated from the profile is 1.5 ft^3/s (fig. 11B).

Rocky River

The Rocky River, which is about 40 mi long, drains slightly more than 242 mi^2 at its mouth where it flows into the Deep River in Chatham County (pl. 1). The largest tributary to the Rocky River is Bear Creek, which contributes about 52 mi^2 (21 percent) of the total drainage area (fig. 12A, p. 54). Other tributaries to the Rocky River include Loves Creek, Tick Creek, Landrum Creek, and Holland Creek. One reservoir exists on the Rocky River at mile 31.5 where the drainage area is about 37 mi^2. The reservoir is operated under minimum-release requirements that vary according to a tiered schedule defined by season as well as the volume of available water. Currently (2001), a second reservoir is being planned for a downstream location where the drainage area is about 55 mi^2.

Low-flow discharge profiles for the Rocky River were developed by using the low-flow characteristics determined at one continuous-record gaging station (site 399) and three partial-record measuring sites (398, 407, and 416) (fig. 12B, p. 55). Additionally, tributary contributions determined from low-flow characteristics at one continuous-record gaging station (site 409) and two partial-record measuring sites (411, 415) located on Tick Creek and Bear Creek were used in the profile development.

Low-flow discharge profiles for the Rocky River depict steadily increasing low-flow discharges

throughout the entire reach (fig. 12B). The highest unit low flows occur in the upper reach of the Rocky River and decrease toward the mouth. This trend in unit low flows is supported by a transition from moderately drained soils in the basin upstream from site 407 to poorly drained soils between site 407 and the mouth of the Rocky River. The presence of zero-flow 7Q10 discharges at three sites (409, 411, and 415; tables 7, 8) underscores the occurrence of decreased unit flows in the lower reaches of the Rocky River as opposed to the upper reaches. Most of the area drained by Tick Creek and Bear Creek is underlain by poorly drained soils.

There are five point-source discharges on Loves Creek and Bear Creek, tributaries to the Rocky River. The largest point-source discharge is operated by Siler City and is located on Loves Creek, with a 1998 average discharge of 4.5 ft^3/s (2.9 Mgal/d, table 3). In 1998, the average water-supply withdrawal from the reservoir located on Rocky River at mile 31.5 was 4.6 ft^3/s (3 Mgal/d, table 3) and the average point-source discharge was 4.5 ft^3/s (2.9 Mgal/d, table 3), resulting in an average net loss of flow from Rocky River of 0.1 ft^3/s. The effects of these diversions are not depicted on the low-flow discharge profiles. However, the effects of these diversions on low flows in the 7.5 mi between the withdrawal and the confluence of Loves Creek with Rocky River are significant, given that the 1998 average withdrawal is similar in magnitudes to the "natural" 30Q2 discharges depicted in the profiles for this reach (fig. 12B). The total of the permitted flows for the point-source discharges on Bear Creek is 0.05 ft^3/s.

The minimum-flow releases from the water-supply reservoir located at river mile 31.5 vary by season and reservoir contents (James Mead, North Carolina Division of Water Resources, written commun., October 4, 2000). During June through November, the minimum-flow releases are 2.0 ft^3/s (when the reservoir is 70–100 percent full), 1.0 ft^3/s (40–69 percent), or 0.3 ft^3/s (less than 40 percent). During December through May, the minimum-flow releases are 3.5 ft^3/s (40–100 percent), or 0.3 ft^3/s (less than 40 percent). During the winter period and under full reservoir contents, however, the release pipe is often augmented by spillage over the crest of the weir at the water-supply intake, such that downstream flows are at or above 6 ft^3/s (James Mead, North Carolina Division of Water Resources, written commun., October 4, 2000). The low-flow discharge profiles do not reflect the direct effects of the minimum-flow releases but fall within the range of the releases specified for each seasonal period. By way of comparison, the 7Q10 discharge shown on the profiles at river mile 31.5 is estimated at 0.6 ft^3/s, and the W7Q10 discharge is 1.5 ft^3/s (fig. 12B).

Upper Little River

The Upper Little River and its tributaries drain about 220 mi^2 of southern Lee County and central Harnett County (fig. 13A, p. 56). The river is approximately 51 mi long and enters the Cape Fear River near Erwin. The largest tributary is Barbecue Creek, which contributes about 49 mi^2 (22 percent) of the total drainage area; other tributaries include Gasters and Juniper Creeks in the headwaters area and Walkers Creek near Norrington Crossroads in Harnett County.

The low-flow discharge profiles depict the low-flow characteristics from site 445 to the mouth (fig. 13B, p. 57). The profiles were developed by using low-flow characteristics at four partial-record measuring sites (445, 452, 461, and 463) on the Upper Little River and two sites (448, 455) on Gasters Creek and Barbecue Creek. Low-flow discharges at the confluence of the Upper Little River and Barbecue Creek are approximately two-thirds of those estimated from the profile for the Upper Little River at the mouth. At the confluence of Barbecue Creek with the river, the 7Q10 and 30Q2 discharges for the Upper Little River are 1.2 and 13.3 ft^3/s, respectively (fig. 13B). At the mouth, the 7Q10 and 30Q2 discharges are 1.8 and 19.9 ft^3/s, respectively. This reflects comparable unit low flows throughout the entire Upper Little River. Soils in the basin are moderately drained in the headwaters area and change to a mix of moderately and poorly drained soils in the central reach, and then to mostly poorly drained soils in the downstream reach.

Only one NPDES point-source discharge is identified on the Upper Little River. Occurring in the headwaters area in Lee County, the permitted flow is 0.5 ft^3/s, which is about 40 percent of the 7Q10 discharge at the confluence of Barbecue Creek and Upper Little River. No withdrawals from the Upper Little River are known to occur.

Little River

The Little River drains portions of Moore, Hoke, Harnett, and Cumberland Counties and is about 70 mi

in length. At the mouth where Little River enters the Cape Fear River, the drainage area is 482 mi^2 (fig. 14A, p. 58). In local areas surrounding the river and on some USGS site and streamflow records, the river also is known as Lower Little River. The largest tributary to the Little River is Crane Creek, which drains 100 mi^2 (21 percent) of the basin; other tributaries include Nicks Creek, James Creek, Jumping Run Creek, and Anderson Creek. A number of small lakes, including Thagards Lake and Spring Valley Lake, are present in the headwaters area near Whispering Pines in Moore County.

Low-flow characteristics for two continuous-record gaging stations (sites 498 and 502) and one partial-record measuring site (466) on Little River were used in the development of the low-flow profiles (fig. 14B, p. 59). Additionally, one continuous-record gaging station (site 491) and two partial-record measuring sites (496, 503) on tributaries to the Little River were used. The profiles depict the low-flow discharges in the reach from site 466 to the mouth. The Little River Basin is located in an area where the Sand Hills influence low-flow characteristics. Unit low flows for streams in the Sand Hills region are highest in the Cape Fear River Basin, and thus, relatively large increases in low-flow discharges can occur for relatively small increases in drainage-area sizes. The unit low flows increase between sites 466 and 498, then remain somewhat constant toward the mouth. At site 466, the 7Q10 discharge is 0.07 ft^3/s and increases to 35 ft^3/s at site 498 (fig. 14B). At the mouth, the 7Q10 discharge is about 49 ft^3/s.

Upstream from site 498, the basin is underlain primarily by well-drained and moderately drained soils, particularly on the south side of the Little River. Downstream from site 498, the soils change to a mixture of mostly poorly drained soils with some well-drained and moderately drained soils. Additionally, much of the remaining accumulation of drainage area is from the north side of Little River where poorly drained soils are predominant. The part of the basin in eastern Harnett County and northeastern Cumberland County is underlain by a mixture of sandy and clay soils (Giese and Mason, 1993). This area was identified as one in which zero or minimal 7Q10 discharges may be possible for sites having drainage areas less than 3 mi^2 (see preceding section on low-flow characteristics).

There are 11 permitted point-source discharges in the Little River Basin. The largest point-source discharge has a permitted flow of about 12.5 ft^3/s (8 Mgal/d, table 3) from municipal water and wastewater-treatment plants located on the Fort Bragg military reservation in northwestern Cumberland County. A second NPDES point-source discharge from a wastewater-treatment plant in Spring Lake is permitted to discharge up to 2.3 ft^3/s (1.5 Mgal/d, table 3). The only water-supply withdrawal from Little River identified was by the U.S. Army on the Fort Bragg military reservation, and the average withdrawal in 1998 was 12.1 ft^3/s (7.8 Mgal/d, table 3).

Rockfish Creek (Hoke and Cumberland Counties)

Rockfish Creek drains about 310 mi^2 in parts of Hoke and Cumberland Counties and merges with the Cape Fear River just southeast of Fayetteville (pl. 1). Rockfish Creek is about 48 mi in total length. The largest tributary to Rockfish Creek is Little Rockfish Creek, which contributes about 98 mi^2 (32 percent) to the Rockfish Creek Basin (fig. 15A, p. 60). Other tributaries include Juniper Creek, Nicholson Creek, Puppy Creek (merges with Beaver Creek at mouth), and Stewarts Creek. A number of lakes are present in the Rockfish Creek Basin. The largest is Upchurches Pond (also known as Upchurch Pond), which is located west of Hope Mills in Cumberland County.

Although the basin drained by Rockfish Creek is not the largest tributary basin for which low-flow characteristics have been developed, the low-flow profiles for this stream depict some of the highest low-flow discharges in the Cape Fear River Basin (fig. 15B, p. 61). Low-flow characteristics for two continuous-record gaging stations (sites 520 and 546) and one partial-record measuring site (524) on Rockfish Creek were used in the development of the low-flow profiles (fig. 15B). Additionally, three partial-record measuring sites (522, 530, and 540) on tributaries to Rockfish Creek were used. Throughout the entire reach of Rockfish Creek, the influence of the Sand Hills region on low-flow characteristics is evident. Unit low flows for 7Q10 discharges generally are in the range of 0.4 to 0.5 $(ft^3/s)/mi^2$ and decrease to values that still exceed 0.3 $(ft^3/s)/mi^2$ in the reach downstream from Little Rockfish Creek near Hope Mills. At the continuous-record gaging station (site 520, drainage area 92.7 mi^2) at Raeford, the 7Q10 discharge is nearly 42 ft^3/s (fig. 15B), equivalent to 0.45 $(ft^3/s)/mi^2$. At the mouth of Rockfish Creek, the

7Q10 discharge is nearly 104 ft^3/s (fig. 15B), equivalent to 0.33 $(ft^3/s)/mi^2$. Across North Carolina, comparable unit low flows in the range of 0.4 to 0.5 $(ft^3/s)/mi^2$ have only been noted for sites in southwestern North Carolina in the Blue Ridge Province where some of the highest annual rainfall rates in the State help to sustain base flows. The profiles in figure 15B confirm conclusions made by Giese and Mason (1993) who reported streams in the Sand Hills area as having some of the highest low-flow characteristics in the State. Well-drained soils, as well as higher topographic relief in the Sand Hills relative to other areas in the Coastal Plain, contribute to the high potentials for sustained base flows.

There is one permitted point-source discharge into Rockfish Creek. The permitted discharge flow is about 4.6 ft^3/s (3 Mgal/d, table 3) from a municipal wastewater-treatment plant near Raeford. The lake (Upchurches Pond) on Rockfish Creek west of Hope Mills serves as a recreational lake as well as a source for hydropower generation (James Mead, North Carolina Division of Water Resources, oral commun., September 28, 2000). No minimum-flow releases have been required downstream from the lake, but the lake is required to be operated in run-of-river mode in which outflows below the dam must be approximately equal to inflows to the lake.

Six Runs Creek

At the mouth, the Six Runs Creek Basin is about 271 mi^2 and drains most of eastern Sampson County (pl. 1). The stream is nearly 35 mi in length and merges with Great Coharie Creek near Ingold to form the Black River (fig. 16A, p. 62). The largest tributary is Stewarts Creek which contributes 54 mi^2 (20 percent) to the basin drained by Six Runs Creek. Other tributaries to Six Runs Creek include Gilmore Swamp, Turkey Creek, and Crane Creek.

Low-flow profiles for Six Runs Creek were developed by using one partial-record measuring site (578) located on the stream and a second site (584) located on a tributary (fig. 16B, p. 63). Low-flow discharge profiles depict low potential for sustained base flows upstream from site 578 near Clinton relative to locations downstream from Clinton. In the reach upstream from Clinton, soils are moderately to poorly drained. At the partial-record measuring site (578, drainage area 108 mi^2) located on Six Runs Creek near Clinton, the 7Q10 discharge is 0.2 ft^3/s (fig. 16B), equivalent to about 0.002 $(ft^3/s)/mi^2$. Downstream from Clinton, the soils change to a mixture of well-drained soils in the interstream areas with poorly drained soils adjacent to streams. Consequently, unit low flows increase dramatically, about 20 times the magnitude of unit low flows in the upper reaches of Six Runs Creek. At the mouth, the 7Q10 discharge is 11.5 ft^3/s (fig. 16B), equivalent to about 0.04 $(ft^3/s)/mi^2$. The profiles reflect the increases in unit low flows between the partial-record measuring site (578) near Clinton and the confluence of Six Runs Creek and Stewarts Creek. There is probably a more gradual transition in the unit flows that cannot be adequately depicted given the data available for developing the profiles. Low-flow characteristics at other sites on Six Runs Creek (table 6) could not be determined as a result of either insufficient data or poor correlations.

One NPDES point-source discharge is in the Six Runs Creek Basin near the mouth of the stream. At less than 0.01 ft^3/s permitted flow, its effects on low-flow discharges are negligible.

Great Coharie Creek and Black River

The Black River and its tributaries compose hydrologic unit 03030006 (fig. 4). At the mouth, the Black River Basin is about 1,530 mi^2 and drains Sampson County as well as parts of Harnett, Cumberland, Bladen, and Pender Counties (pl. 1). The river drains to the Cape Fear River northwest of Wilmington (New Hanover County) and is about 113 mi in length. The Black River begins as the Great Coharie Creek near Newton Grove and receives its name at the confluence of Great Coharie Creek and Six Runs Creek. The largest tributary to the Black River is South River, which drains the western fringes of the basin and contributes 494 mi^2 (32 percent) of the total drainage (fig. 17A, p. 64). Other major tributaries include Little Coharie Creek and Six Runs Creek, which drain to Great Coharie Creek, as well as Colly Creek and Moores Creek, which drain to the Black River just above its mouth.

Low-flow discharge profiles were developed for the reach between the partial-record measuring site (563) near Timothy and the location of the partial-record measuring site (604) near Atkinson (fig. 17B, p. 65). Low-flow characteristics at two partial-record measuring sites (563, 567) on Great Coharie Creek, and one continuous-record gaging station (site 586) and

one partial-record measuring site (587) on the Black River were used in the development of the profiles. Additionally, the low-flow discharge contributions developed in the profile for Six Runs Creek along with five sites (572, 602, 603, 607, and 609) on Little Coharie Creek, South River, Colly Creek, and Moores Creek also were used in the development of the profiles. Profiles were not developed for the reach of Black River downstream from site 604 near Atkinson because of information that indicates tidal influences in flows below this location (Giese and others, 1985).

In the reach of Great Coharie Creek upstream from Clinton, unit low flows are minimal; the 7Q10 discharge does not exceed 0.05 ft^3/s (minimal 7Q10 discharge threshold established by the DWQ) until the drainage area is greater than 30 mi^2. The 7Q10 discharge at the partial-record measuring site (563) in the headwaters near Timothy is zero flow (fig. 17B; table 8). Downstream from Clinton, unit low flows increase until the confluence of the Black River and South River. At the partial-record measuring site (567, drainage area 201 mi^2) on Great Coharie Creek near Parkersburg, the 7Q10 discharge is 6.4 ft^3/s (fig. 17B; table 8), equivalent to about 0.03 $(ft^3/s)/mi^2$. Further increases in unit low flows are noted in the low-flow characteristics for sites (586, 587) near Tomahawk and at Ivanhoe. Unit 7Q10 low flows at these locations are slightly above 0.04 $(ft^3/s)/mi^2$. Downstream from its confluence with the South River, unit low flows in the Black River decrease somewhat. At the location of the partial-record measuring site (604) near Atkinson, the 7Q10 discharge estimated from the profile is about 36 ft^3/s (fig. 17B), equivalent to about 0.03 $(ft^3/s)/mi^2$. Poorly and moderately drained soils are found in the headwaters of Great Coharie Creek. Downstream toward Clinton, well-drained soils are found in the basin and become predominant between Clinton and the confluence of the Black River and South River. Downstream from the confluence, poorly drained soils underlie increasingly larger areas of the remaining basin. These observations are consistent with the higher unit low flows between Clinton and the mouth of the South River.

Results of an investigation to map the hydrogeologic framework in the Coastal Plain show direct contact between the Great Coharie Creek and the Black Creek aquifer in the area between Clinton and Parkersburg (Winner and Coble, 1996, pl. 9). The contact of the Great Coharie Creek channel with the Black Creek aquifer suggests the possibility that increases in unit low flows in Great Coharie Creek may be attributed to ground-water discharge from the Black Creek aquifer directly into the stream. Winner and Coble (1996) report that the Black Creek aquifer contains, on average, nearly 60 percent sand.

There are 10 permitted point-source discharges within the Black River Basin with a total permitted discharge of about 7.7 ft^3/s (5.0 Mgal/d). The largest permitted flow is 4.6 ft^3/s (3 Mgal/d, table 3) from a municipal wastewater-treatment plant in Clinton into Williams Old Mill Branch, a tributary of Great Coharie Creek. In 1998, almost 4.2 ft^3/s (2.7 Mgal/d, table 3) was discharged from the town's wastewater-treatment plant. Given that the Town of Clinton obtains its water supply from ground water, point-source discharges serve to augment the streamflow amounts in Great Coharie Creek and are likely a high percentage of the flows in the reaches between Clinton and Parkersburg.

Rockfish Creek (Duplin County)

Rockfish Creek drains 177 mi^2 in southwestern Duplin County and northwestern Pender County, and enters the Northeast Cape Fear River just east of Wallace (pl. 1). Rockfish Creek is about 23 mi in total length (fig. 18A, p. 66). The largest tributary to Rockfish Creek is Doctors Creek, which contributes 54 mi^2 (30 percent) to the basin; other tributaries include Duffs Creek, Sills Creek, and Little Rockfish Creek.

Low-flow characteristics at one continuous-record gaging station (652) and two partial-record measuring sites (648, 655) on Rockfish Creek, and one continuous-record gaging station (site 658) and one partial-record measuring site (654) on tributaries to Rockfish Creek were used in the development of the low-flow discharge profiles (fig. 18B, p. 67). Along the entire length of Rockfish Creek, low-flow discharges steadily increase on the basis of unit low flows—between 0.02 and 0.03 $(ft^3/s)/mi^2$ for 7Q10 discharges—that are fairly consistent for this stream, even though unit low flow for sites on Doctors Creek and Little Rockfish Creek (654, 658) are about one-sixth of the unit low flows on Rockfish Creek. At the mouth of Rockfish Creek, the 7Q10 discharge is 3.6 ft^3/s (fig. 18B). Soils within the Rockfish Creek Basin are primarily a mixture of moderately and poorly drained soils; however, well-drained soils also are present in the headwaters of the basin, as well as along the reach of Rockfish Creek downstream from its confluence with Doctors Creek.

There are two permitted point-source discharges into Rockfish Creek. The largest is a permitted discharge of 2.3 ft^3/s (1.5 Mgal/d, table 3) from a food-processing facility on Rockfish Creek. The second NPDES point-source discharge is permitted up to 1.5 ft^3/s (1 Mgal/d, table 3) from a wastewater-treatment plant in Wallace. A third NPDES discharge, which is no longer present, was permitted for about 7 ft^3/s into Little Rockfish Creek from a recently closed textile facility in Wallace. The use of ground water for water supply in this basin combined with the presence of relatively lower unit low flows from two large tributaries to Rockfish Creek make it likely that point-source discharges serve to augment the flows in Rockfish Creek.

Northeast Cape Fear River

The Northeast Cape Fear is the largest tributary to the Cape Fear River Basin and, along with its tributaries, composes hydrologic unit 03030007 (fig. 4). At the mouth, the Northeast Cape Fear River Basin is about 1,670 mi^2 and drains most of Duplin and Pender Counties as well as parts of Onslow and New Hanover Counties (fig. 19A, p. 68; pl. 1). The river drains to the Cape Fear River estuary in Wilmington and is about 131 mi in length. The largest tributary to the Northeast Cape Fear River is Holly Shelter Creek, which drains the central eastern area of the basin and contributes 245 mi^2 (15 percent) of the total drainage. Other major tributaries include Goshen Swamp, Limestone Creek, Rockfish Creek, and Long Creek.

Low-flow profiles shown for the Northeast Cape Fear River are limited to the reach of the river between Mount Olive (site 611) and the partial-record measuring site (660) near Watha (fig. 19B, p. 69). Low-flow characteristics at one partial-record measuring site (611) and two continuous-record gaging stations (sites 613, 639) on the Northeast Cape Fear Rive were used in the development of the profiles. Additionally, the low-flow discharge contributions developed in the profile for Rockfish Creek along with three sites (619, 629, and 638) on Goshen Swamp, Grove Creek, and Muddy Creek were used in the development of the profiles. In an hydrologic investigation of major estuaries and sounds in North Carolina, Giese and others (1985) reported that tides affect flows in the Northeast Cape Fear River as far inland as its confluence with Holly Shelter Creek. Installation in August 1999 of a stage-only site on the Northeast Cape Fear River near Burgaw (USGS station 02108566) upstream from the confluence with Holly Shelter Creek has provided additional data that indicate that tides affect flows at this site. The lack of sufficient streamflow data at locations downstream from site 660 as well as the lack of standard techniques for determining low-flow discharge affected by tides prevent the development of low-flow discharge profiles for the reach downstream of Watha.

Overall, the low-flow characteristics depicted in the profiles reflect unit low flows that are relatively high in the upstream parts of the basin and decrease in the downstream direction. Between the two continuous-record gaging stations on the Northeast Cape Fear River near Seven Springs (Wayne County) and Chinquapin (sites 613, 639), unit low flows decrease by 58 to 80 percent. At site 613 near Seven Springs, the 7Q10 discharge is 5.0 ft^3/s (fig. 19B), equivalent to about 0.10 $(ft^3/s)/mi^2$. In comparison, the 7Q10 discharge at site 639 near Chinquapin is 12.1 ft^3/s, equivalent to about 0.02 $(ft^3/s)/mi^2$. Well-drained soils are present in the upstream parts of the basin in extreme southeastern Wayne and northeastern Duplin Counties. Downstream from the confluence with Goshen Swamp, soils change to a mixture of well-drained and poorly drained soils, and then to mostly poorly drained soils in the downstream half of the basin. At the location of the partial-record measuring site 660 near Watha (drainage area about 890 mi^2), the 7Q10 discharge estimated from the profile is 18 ft^3/s (fig. 19B), about 0.02 $(ft^3/s)/mi^2$.

In the preceding section on low-flow characteristics, the Northeast Cape Fear River Basin was identified as an area where zero or minimal 7Q10 discharges likely occur for drainage areas less than 8 mi^2, particularly in tributaries on the western side of the river. Giese and Mason (1993) identified this area of the basin as being underlain by clay soils (HA1). In particular, five sites on Goshen Swamp and its tributaries (with drainage areas ranging from 1.1 to 50.9 mi^2) were found to have zero or minimal 7Q10 discharges. Goshen Swamp and its tributaries are located near the reach of Northeast Cape Fear River, which is noted for having relatively high unit low flows. The lower potentials for sustained base flows at the Goshen Swamp sites serve to lower the overall unit low flows in the Northeast Cape Fear River downstream from its confluence with Goshen Swamp. This wide variation in unit low flows highlights the complex patterns of low-flow characteristics that can

exist for streams located in close proximity to each other.

The wide variation in unit low flows is supported by a series of discharge measurements shown (in blue, fig. 19B) for selected locations on the Northeast Cape Fear River upstream from a recently installed USGS stage-only gaging station near Burgaw in Pender County (fig. 19B; pl. 1). The measurements were obtained during the week of October 23–27, 2000, a period of base-flow conditions throughout much of the Cape Fear River Basin. The measurements indicate that flow conditions along the river were above 30Q2-discharge conditions (fig. 19B). The unit flows for the measured discharges decrease in the downstream direction from Mount Olive to Chinquapin, and provide a general confirmation of decreased unit low flows observed in the low-flow discharges shown on the profiles (fig. 19B). Further, the unit flows associated with the measured discharge on Goshen Swamp (site 628), 180 mi^2 at the mouth, lend added support to observed decreases in unit low flows in the upstream part of the Northeast Cape Fear River Basin. The decrease in flow rate between measurements at Chinquapin and Burgaw may be the result of backwater from tidal effects.

More than 30 NPDES point-source discharges are permitted in the Northeast Cape Fear River Basin. Five are listed as discharges into the Northeast Cape Fear River itself, many of which are in the reach of the river near Wilmington. The largest permitted flow is about 2.9 ft^3/s (1.875 Mgal/d, table 3) from an industrial facility in Wilmington. Among the point-source discharges in the basin, a total of 18 are present in the part of the basin upstream from the confluence of the Northeast Cape Fear River and Holly Shelter Creek. The total of the permitted flows among these 18 discharges is about 19 ft^3/s (12.4 Mgal/d), which is more than the estimated 7Q10 discharge (18 ft^3/s, fig. 19B) estimated from the profile for the location at Watha.

Haw River and Cape Fear River

From the headwaters of the Haw River in Forsyth County to the mouth at Fort Caswell in Brunswick County, the Cape Fear River is nearly 290 mi long (fig. 20A, p. 70; fig. 21A, p. 72). The river can be subdivided into two reaches. The first reach is about 95 mi long and consists of the Haw River between Forsyth County and the dam at Jordan Lake in Chatham County. In this reach, the largest tributaries are Reedy Fork and Big Alamance Creek. At the dam at Jordan Lake, the drainage area is about 1,690 mi^2; the length of the Haw River inundated by Jordan Lake is 4 mi. The second reach, about 195 mi in length, is the Cape Fear River between the dam and the mouth of the river at Fort Caswell. Immediately downstream from the dam, the river is still identified as the Haw River. Where the Haw and Deep Rivers merge, the river becomes known as the Cape Fear River. The largest tributary downstream from Jordan Lake Dam is the Northeast Cape Fear River, which drains 1,670 mi^2 or 17 percent of the basin. Other large tributaries include the Deep River (1,440 mi^2), Little River (482 mi^2), and Black River (1,530 mi^2).

Low-flow profiles were developed for the Haw River between the headwaters and the continuous-record gaging station (site 152, drainage area 1,275 mi^2; fig. 20B, p. 71) near Bynum in Chatham County, and for the Cape Fear River between the continuous-record gaging stations at Lillington (site 438, drainage area 3,464 mi^2) and Lock 1 near Kelly (site 559, drainage area 5,255 mi^2; fig. 21B, p. 73). Low-flow profiles for the Haw River were developed by using low-flow characteristics determined at three continuous-record gaging stations (sites 20, 81, and 152) and two partial-record measuring sites (2, 141). Additionally, tributary contributions based on profiles developed for Reedy Fork and Big Alamance Creek were used as well as extrapolations of low-flow characteristics at sites directly tributary to the Haw River.

The profiles for the Cape Fear River between Lillington and Kelly were developed by using the low-flow characteristics at three continuous-record gaging stations (sites 438, 549, and 559) along with tributary contributions based on profiles developed for Upper Little River, Little River, and Rockfish Creek (fig. 21B). Low-flow discharges used in the profiles at the long-term continuous-record gaging stations (table 7; sites 438, 549, and 559) on the Cape Fear are based on post-regulation flows since the construction of Jordan Lake was completed in 1982. Low-flow characteristics at a discontinued site (516) at Fayetteville were not used in the profiles because the period of record reflects flows before the construction of Jordan Lake. Downstream from Lock 1 near Kelly, flows in the river are subject to tidal effects, a factor not readily quantified in low-flow characteristics using available streamflow data and standard techniques of analysis.

The low-flow discharge profiles indicate moderate and steady increases in discharge between the headwaters and continuous-record gaging station near Bynum (site 152, fig. 20B). Unit low flows between the sites at Oak Ridge (2) and Benaja (20) are, in general, fairly consistent and indicate little variation in the potentials for sustained flows. Unit low flows for 7Q10 discharges between the headwaters and Benaja ranged from 0.03 to 0.05 $(ft^3/s)/mi^2$. At site 81 at Haw River, the 7Q10 discharge is about 69 ft^3/s (fig. 20A), equivalent to about 0.11 $(ft^3/s)/mi^2$. The increase in unit low flows is attributed to the tributary contributions from Reedy Fork. As previously discussed, low-flow characteristics in Reedy Fork downstream from its confluence with Buffalo Creek reflect the effects of major water-supply withdrawals from Lakes Brandt and Townsend as well as major point-source discharges on North Buffalo Creek and South Buffalo Creek. Correspondingly, the effects of these diversions are still evident in the low-flow characteristics at site 81 at Haw River. Downstream from site 81, the unit low flows decrease in response to an increased presence of poorly drained soils in the northeastern parts of Chatham County. At site 152 near Bynum, the 7Q10 discharge is about 76 ft^3/s, equivalent to nearly 0.06 $(ft^3/s)/mi^2$ (fig. 20B). No low-flow characteristics are depicted for the reach of the Haw River inundated by Jordan Lake. Thus, the low-flow characteristics for two sites near Pittsboro (sites 156, 247; table 7), which are now inundated by Jordan Lake, do not reflect current conditions and were not used in the development of the profiles.

In the reach between the dam at Jordan Lake and the continuous-record gaging station (site 438) at Lillington, streamflow data reveal occurrences of flow loss during low-flow conditions. A target flow of 600 ft^3/s must be maintained at Lillington, and difficulties have been encountered in recent years in setting the flow releases at Jordan Lake so that, when combined with flows from the Deep River, the target flow is met. For example, on many days during the low-flow period from late May through September 1998, the summation of daily outflows from Jordan Lake plus the daily discharges at Deep River at Moncure (site 47) exceed the daily discharges observed on the Cape Fear River at Lillington (site 438; fig. 22), suggesting a loss of water in the reach. Flow losses apparently occurred in this reach both before and after the construction of Jordan Lake Dam, with little difference between the percentage of days for the two periods on which flow losses occurred. During the pre-regulation period of October 1965–September 1978, the summation of flows at sites 255 and 417 exceeded flow at site 438 about 21 percent of the days. During

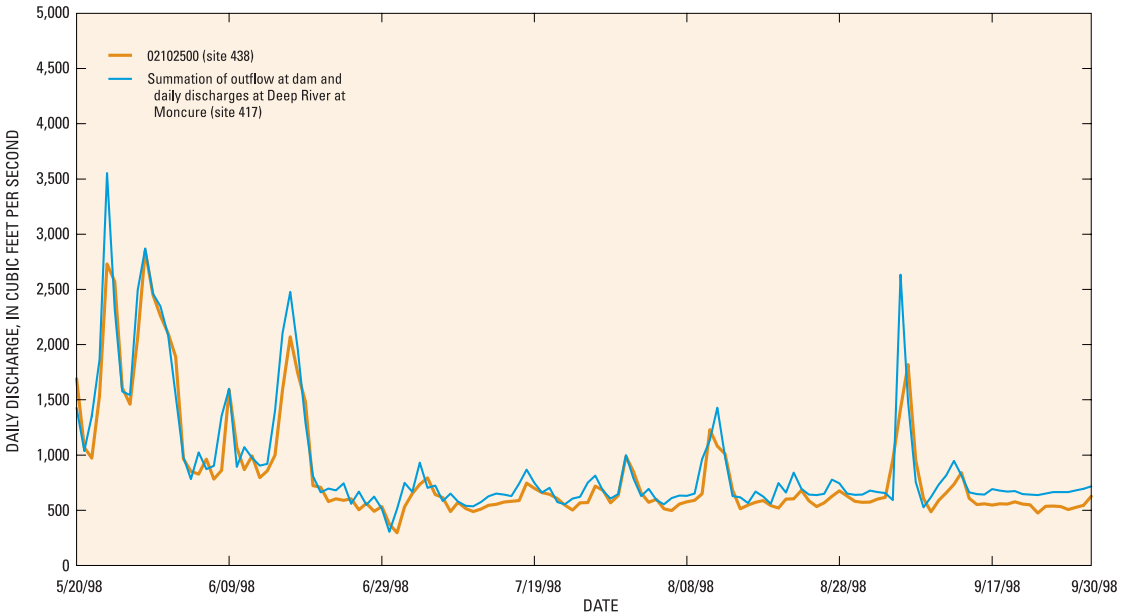


Figure 22. Comparison of daily discharges at the Cape Fear River at Lillington with summation of outflow at B. Everett Jordan Dam and daily discharges at Deep River at Moncure for May 20 through September 30, 1998.

the post-regulation period of October 1982–September 1998, flow losses apparently occurred on about 25 percent of the days. However, the average annual unit flow at each of the three sites is 1.0 $(ft^3/s)/mi^2$ (table 7).

In contrast to the daily flow record, estimated 7Q10 discharges suggest the presence of a gaining reach between Jordan Lake and Lillington during low-flow conditions. At the dam (drainage area 1,690 mi^2), the 7Q10 discharge is about 180 ft^3/s (or 0.11 $(ft^3/s)/mi^2$). At Lillington (site 438, drainage area 3,464 mi^2), the 7Q10 discharge is 530 ft^3/s (or 0.15 $(ft^3/s)/mi^2$). The intervening drainage area between the two locations is 1,775 mi^2, of which 1,440 mi^2 is contributed by the Deep River, which enters the Haw River about 4.4 mi downstream from the dam. The 7Q10 discharge at site 417 on the Deep River just upstream from the mouth is 24 ft^3/s (or 0.02 $(ft^3/s)/mi^2$), which is a much lower unit 7Q10 flow than calculated for the sites below Jordan Lake and at Lillington. However, the pre-regulation 7Q10 discharge on the Haw River at site 255 just downstream from the dam is 50 ft^3/s (or 0.03 $(ft^3/s)/mi^2$), which is almost identical to the pre-regulation unit 7Q10 flow on the Deep River at site 417. The pre-regulation estimate of 7Q10 discharge on the Cape Fear River at Lillington (site 438) is about 75 ft^3/s (or 0.02 $(ft^3/s)/mi^2$), again similar to the unit 7Q10 low flows at sites 255 and 417. Hence, Jordan Lake has resulted in a three- to seven-fold increase in 7Q10 discharges in the river between the dam and Lillington.

An assessment of streamflow records on the Haw River (site 156), New Hope River (site 247), Deep River (site 417), and Cape Fear River (site 438) during the 1950–71 climatic years (prior to the construction of Jordan Lake) indicated that all the annual, minimum 7-day average discharges occurred during the summer months (May–October). Since completion of the lake, however, the occurrence of the lowest flows immediately downstream from the dam has been altered in time. During the 1982–97 climatic-year period (since Jordan Lake was completed), the annual, minimum 7-day average discharges at the dam occurred during the winter months (November–April) for 11 of the 16 years (table 10). In contrast, the annual, minimum 7-day average discharges at the gaging stations at Moncure (site 417) and Lillington (site 438) occurred during the summer months for 16 and 14 years, respectively, for the same period (table 10). The occurrence of annual, minimum 7-day average discharges at the dam during the winter months is because streamflow from the Deep River Basin and intervening drainage area between Jordan Lake and Lillington is apparently sufficient to meet the target flow (600 ft^3/s) at Lillington without substantial additional releases from the dam. Conversely, when the lower flows from the Deep River and intervening drainage area occur during the summer months, flow releases from the dam must be increased to supplement Deep River flows in order to meet the target. The variations in seasonal flows are reflected in the values for 7Q10 and W7Q10 discharges at sites 255 and 438. Where 7Q10 discharges are typically lower in magnitude than W7Q10 discharges (tables 7, 8), the values for W7Q10 discharges at sites 255 and 438 are lower than the respective 7Q10 discharges at these two locations.

Other factors may affect the occurrence of the flow losses in this reach of the Haw and Cape Fear Rivers. Below the dam at Jordan Lake, a smaller dam near Brickhaven known as the Buckhorn Dam previously was operated for power production but later was abandoned. Located on the Cape Fear below the Deep River, the dam results in the storage of water behind it, which may result in increased evapo-transpiration and channel loss (James Mead, North Carolina Division of Water Resources, oral commun., June 29, 2000). The Carbonton and Lockville Dams on the Deep River are required to operate in run-of-river mode, but may result in some fluctuations in flows resulting from the temporary storage of water used for power production. The effects on flows in this reach may also be a function of daily variations in flow diversions or evaporation losses from Shearon Harris Lake. In 1998, nearly 58 and 6.0 ft^3/s (37.4 and 3.9 Mgal/d, table 3) were withdrawn from and returned to the lake, respectively, by a regional power utility for cooling-water purposes at a nuclear power-production facility located adjacent to the lake. However, because a full assessment of these issues is beyond the scope of this report, and pending further investigations and analyses of the flows in this reach, no low-flow discharge profiles are depicted for the reach of the Haw River and Cape Fear River between the dam and Lillington (fig. 20B).

Downstream from Lillington, low flows increase between sites 438 and 549 (near Tarheel in Bladen County), which reflect the effects of well-drained soils, particularly in basins drained by the Little River and Rockfish Creek. Downstream from the site near

Table 10. Annual, minimum 7-day average discharges at B. Everett Jordan Lake Dam, Deep River at Moncure (site 417), and Cape Fear River at Lillington (site 438) during the 1982–97 climatic years in the Cape Fear River Basin, North Carolina

[Climatic year, the annual period from April 1 to March 31 and identified by the year in which the period begins; ft^3/s, cubic foot per second]

Climatic year	B. Everett Jordan Lake Dam[a]		Deep River at Moncure (site 417)		Cape Fear River at Lillington (site 438)	
	Annual, minimum 7-day average (ft^3/s)	7-day period beginning on:	Annual, minimum 7-day average (ft^3/s)	7-day period beginning on:	Annual, minimum 7-day average (ft^3/s)	7-day period beginning on:
1982	235.9	10/25/82	90.6	09/13/82	619.7	10/02/82
1983	129.0	11/23/83	71.4	08/18/83	559.1	11/01/83
1984	290.4	12/04/84	81.4	09/24/84	616.0	09/18/84
1985	197.4	11/05/85	120.7	10/14/85	636.4	09/14/85
1986	185.0	11/27/86	28.7	10/06/86	597.3	07/15/86
1987	182.3	03/24/88	49.3	10/14/87	628.6	07/17/87
1988	132.4	11/02/88	47.0	08/14/88	587.4	08/09/88
1989	285.7	05/30/89	217.1	09/06/89	616.3	09/06/89
1990	203.1	10/12/90	44.6	09/04/90	552.3	07/27/90
1991	214.6	12/30/91	67.0	09/13/91	607.7	06/11/91
1992	254.1	11/04/92	35.7	10/21/92	617.7	09/12/92
1993	187.9	12/16/93	35.3	10/01/93	501.1	11/18/93
1994	197.0	07/22/94	39.9	10/03/94	532.0	05/27/94
1995	362.1	07/18/95	65.1	08/13/95	596.7	08/13/95
1996	197.9	02/01/97	65.0	07/03/96	571.6	07/02/96
1997	197.7	04/02/97	102.7	10/09/97	524.0	09/15/97

[a] Based on outflow data provided by U.S. Army Corps of Engineers.

Tarheel, further increases in low-flow discharges are tempered by an increase in poorly drained soils. At sites 549 and 559, the 7Q10 discharges are 797 and 825 ft^3/s, respectively (both equivalent to 0.16 $(ft^3/s)/mi^2$; fig. 21B; table 7).

A series of discharge measurements at selected locations on the Haw and Cape Fear Rivers were obtained during the week of October 23–27, 2000, a period of base-flow conditions throughout much of the Cape Fear River Basin (fig. 20B). The measurements indicate that flow conditions along the main stem generally were above 30Q2-discharge conditions upstream from the confluence of the Cape Fear River and Rockfish Creek. Downstream from Rockfish Creek, flows generally were between the 7Q2- and 30Q2-discharges (fig. 21B). On the Haw River downstream from Big Alamance Creek, the discharge measurements indicate a slight decrease in flows between several points. A number of dams in this reach of the Haw River may be a factor on fluctuations in discharges along this reach. Overall, however, the discharge measurements support the general trends depicted in the low-flow discharge profiles.

In 1998, there were 15 permitted point-source discharges on the Haw River and 40 on the Cape Fear River, including discharges downstream from site 559 at Lock 1. There are 17 point-source discharges between Jordan Lake and Lock 1 (of which 14 are included in table 3); 8 withdrawals also occur on this reach from the Cape Fear River between Jordan Lake and Lock 1 (table 3). Within this reach, the largest withdrawal and, correspondingly, the largest NPDES discharge on the Cape Fear River is by a regional power utility for cooling-water purposes at a facility in Chatham County. In 1998, nearly 320 and 316 ft^3/s (207 and 204 Mgal/d, table 3) were withdrawn and returned to the river, respectively. The return discharge occurs just above the mouth of an unnamed tributary to the Cape Fear River at river mile 186.3. The largest return discharge to the Haw River (river mile 234.4) was made by the City of Burlington from a wastewater-treatment plant, with a 1998 average flow of nearly

11.0 ft^3/s (7.1 Mgal/d, table 3). No major withdrawals are made from the Haw River (table 3), although several are made from tributary streams, such as Reedy Fork in Guilford County, Big Alamance Creek in Alamance County, Cane Creek in Orange County, and the New Hope River arm of Jordan Lake.

The North Carolina Division of Water Resources and a number of municipalities sponsored the development of a water-balance model for assisting with the Jordan Lake water-supply allocation process and for guidance in decisions concerning interbasin transfers and other flow-management issues (Moffatt & Nichol Engineers and Danish Hydraulic Institute, Inc., 2000). The model, referred to as the Cape Fear River Basin model, provides simulation of a number of flow statistics, including estimates for the 7Q10 discharges along with 30-day, 20-year low-flow discharges and 30-day, 50-year low-flow discharges (not presented in this report) for specified water-management scenarios. Comparisons of flow durations as well as monthly mean and minimum flows based on USGS streamflow records and simulated flows from the model at selected gaging stations indicated comparable statistics, particularly at low and average streamflow levels (Sydney Miller, North Carolina Division of Water Resources, written commun., January 11, 2001). Currently (2001), no comparisons have been made of estimates of 7Q10 discharges for gaging stations listed in this report (tables 7, 8) and those resulting from model simulations of current conditions. Simulated streamflows, however, are adjusted based on a comprehensive database that describes flow diversions, whereas low-flow statistics presented in this report have not been adjusted for diversions.

SUMMARY

This report describes low-flow characteristics of the Cape Fear River Basin in North Carolina through the 1998 water year and 1997 climatic year. Low-flow characteristics are summarized for a number of gaging stations in the study area, and drainage area and low-flow discharge profiles were developed for selected rivers and streams.

The Cape Fear River is located in central and southeastern North Carolina and drains about 9,100 square miles. The river flows nearly 290 miles from the headwaters of the Haw River in the eastern part of Forsyth County to the mouth of the Cape Fear River at Fort Caswell in Brunswick County. The Northeast Cape Fear River is the largest tributary to the Cape Fear River. The Cape Fear River Basin is the largest of the three river basins (Tar-Pamlico, Neuse, and Cape Fear) that are located completely within North Carolina. One-third of the upstream part of the basin is in the Piedmont Province and is characterized by rolling and hilly topography. The remaining two-thirds of the basin is in the Coastal Plain Province and is characterized by a gradual transition from gentle, rolling hills with little relief to nearly level land surfaces.

There are nearly 1,100 impoundments with structural heights exceeding 15 feet in the basin. The largest impoundment in the basin is B. Everett Jordan Lake in Chatham, Orange, Durham, and Wake Counties and has a surface area of nearly 14,300 acres. Eight other major impoundments and five natural lakes with surface areas exceeding 200 acres are in the basin. Although the effects of impoundments on downstream low flows vary, the primary effect is dependent on minimum-flow releases, if any, at the dam. Not all of the major impoundments have assigned minimum-flow releases. In general, dams constructed since the mid-1980's have been assigned minimum-flow releases.

A total of 63 water withdrawals in the Cape Fear River Basin are registered with the State of North Carolina; most withdrawals are made by municipalities and major industries for water supply and manufacturing purposes. The State also has permitted about 350 point-source discharges at more than 260 facilities under the NPDES permitting system; 54 are deemed by the State as major discharges (generally defined as facilities discharging more than 1 Mgal/d or facilities having discharges that include high levels of toxicants or metals). A number of major withdrawals and point-source discharges are paired and, thus, result in negligible effects on low flows. The largest municipal withdrawal and, correspondingly, the largest point-source discharge in the basin was made by the City of Greensboro with withdrawal and discharge averages of 38.6 and 32.5 million gallons per day, respectively, in 1998. Other flow diversions exceeding 5 million gallons per day were made by the Cities of Durham, High Point, Fayetteville, and Wilmington. The largest industrial withdrawal and return discharge in the study area was nearly 1,400 million gallons per day from the Cape Fear River in Brunswick County by a regional power company that uses the water for cooling

purposes at a nuclear powerplant and returns all of it to the Atlantic Ocean near the mouth of the Cape Fear River. In the Coastal Plain, some municipalities and facilities that discharge to streams do not make surface-water withdrawals, but rather obtain water supplies from ground water or by transfer from other facilities. Other flow modifications having potentially significant effects on low flows are unregistered withdrawals in small to mid-size basins. Often made for irrigation or de-watering (mining) purposes, the cumulative effects of multiple withdrawals, particularly in small to mid-size basins that have low potential to sustain base flows, could be to further reduce the availability of flow in nearby streams.

The drought of longest duration affecting streams in the Cape Fear River Basin occurred during 1950–57. Near-record low flows at long-term gaging stations on the Black River, Haw River, Deep River, and Northeast Cape Fear River occurred in the fall of 1954. Notable droughts affecting streams in the study area also occurred during 1966–71 and 1985–88. As recently as the mid- to late-1990's, drought conditions in the study area have affected streamflows, prompting local officials in some municipal areas to implement water-conservation measures to reduce water use.

Some soils in the upstream parts of the Cape Fear River Basin, particularly those derived from Carolina Slate Belt and Triassic basin rocks, are thin in terms of thicknesses or have low infiltration rates. These soils have low potential to sustain base flows for some streams in that area. Numerous sites in the upstream parts of the basin have zero or minimal (defined as less than 0.05 cubic foot per second) 7Q10 discharges. Many soils in the study area in the lower Coastal Plain also are classified as having low infiltration rates. Similarly, the potential for sustaining base flows at many of the gaging stations in this area is low. Well-drained and moderately drained soils are present in the central part of the basin, with one of the largest concentrations of well-drained soils found in the Sand Hills region, an area where low-flow characteristics were the highest in the basin. Variability of soil hydrologic groups in the Cape Fear River Basin is partly reflected in the potential to sustain low flows in the study area.

Surface-water data were identified and compiled for 681 sites in the study area. Low-flow characteristics (7Q10, 30Q2, W7Q10, and 7Q2) were determined for 188 sites (67 continuous-record and 121 partial-record). At three gaging stations that have long-term continuous records of daily mean discharge on the Cape Fear River downstream from Jordan Lake, a common base period (1982–97 climatic years) was used to determine low-flow characteristics. This period reflects the regulation of flows by Jordan Lake since its construction.

Three general areas of zero or minimal (less than 0.05 cubic foot per second) 7Q10 discharges occur in the Cape Fear River Basin. A number of sites in the upstream parts of the basin underlain by the Carolina Slate Belt and Triassic basin, as well many sites in downstream areas of the Coastal Plain (particularly the Northeast Cape Fear River Basin), have zero or minimal 7Q10 discharges. In the two upstream areas, the poorly sustained base flows are reflective of either (1) thin soils that cause the streams to drain fairly rapidly (Carolina Slate Belt), or (2) soils that have very little to no infiltration rates (Triassic basin). As a result, little water is stored in the surficial aquifers in these areas, which results in little water being available for release to streams during extended dry periods. Within the part of the study area underlain by the Carolina Slate Belt, streams draining basins of 5 square miles or less may have zero or minimal 7Q10 discharges. The part of the study area underlain by the Triassic basin has a higher drainage-area threshold at 35 square miles, below which 7Q10 discharges may be zero or minimal flow. Occurrences of zero or minimal 7Q10 discharges in the Coastal Plain were noted, though on a more widespread basis. In the Coastal Plain, low flows are more likely affected by the presence of poorly drained soils in combination with very low topographic relief in the terrain.

Two areas in the Coastal Plain with occurrences of zero or minimal 7Q10 discharges were highlighted in this report. In eastern Harnett County and northeastern Cumberland County, basins with less than 3 square miles may be prone to have zero or minimal 7Q10 discharges. Soils in this area have been described as a mixture of sandy and clay soils. In the Northeast Cape Fear River Basin, particularly on the western side of the river, streams draining less than 8 square miles may have zero or minimal 7Q10 discharges. The clay soils, which are poorly drained, along with very little to no topographic relief result in the low potential for sustained base flows in this part of the study area.

Drainage area and low-flow discharge profiles were developed for 13 streams and rivers in the study area. Streams profiled in this report include the Haw River (between headwaters and Bynum), the Cape Fear

River (between Lillington and Kelly), and selected tributaries to the Cape Fear River. The selected tributaries include North Buffalo Creek, Buffalo Creek (including South Buffalo Creek), and Reedy Fork in Guilford County; Big Alamance Creek in Guilford and Alamance Counties; Rocky River (tributary to the Deep River) in Chatham County; Upper Little River in Lee and Harnett Counties; Little River between Moore and Cumberland Counties; Rockfish Creek in Hoke and Cumberland Counties; Six Runs Creeks in Sampson County; Black River (including Great Coharie Creek) in Sampson and Bladen Counties; Rockfish Creek in Duplin County; and Northeast Cape Fear River in Duplin, Pender, and New Hanover Counties.

Low-flow discharge profiles for Reedy Fork indicate two distinct stream reaches that have very different low-flow characteristics. The drainage area of Reedy Fork at its mouth is 257 square miles. The upper reach is located upstream from Lake Brandt and is underlain by the Charlotte Belt, a geologic unit that contributes to relatively higher potentials for sustained base flows for Piedmont streams. Downstream from Lakes Brandt and Townsend, low-flow characteristics are affected by major water-supply withdrawals and for the City of Greensboro and the absence of minimum-flow releases at the dams. Additionally, tributary contributions from Buffalo Creek include major point-source discharges.

North Buffalo Creek, Buffalo Creek (including South Buffalo Creek), Big Alamance Creek, and Rocky River (tributary to the Deep River) drainage basins are underlain by the Carolina Slate Belt, and these basins range in size from 43.7 to 262 square miles. Among these streams, North Buffalo Creek has higher unit low flows because of the basin's proximity to the Charlotte Belt, the area noted for relatively higher potentials for sustained base flows in Piedmont streams. The profiles for Buffalo Creek and Big Alamance Creek indicated relatively lower unit low flows throughout their reaches as a result of poorly drained soils throughout much of the basins. Flows in North Buffalo Creek and Buffalo Creek also are affected by the presence of major point-source discharges. Low-flow characteristics in the Rocky River Basin display relatively higher unit low flows in the upper reach of the stream that decrease in the downstream direction as a result of a transition from moderately to poorly drained soils in the basin.

The basins drained by the Upper Little River, Little River, and Rockfish Creek (Hoke and Cumberland Counties) range in size from 220 to 482 square miles. Low-flow characteristics in these Coastal Plain basins reflect the widespread presence of well-drained soils, which have one of the highest concentrations in the central part of the study area, particularly in Moore, Harnett, Hoke and Cumberland Counties. In Rockfish Creek in the Sand Hills region, the low-flow characteristics have the highest unit low flows among streams in the study area as well as in much of North Carolina.

In the downstream part of the Coastal Plain, profiles for Six Runs Creek, the Black River (including Great Coharie Creek), Rockfish Creek (Duplin County), and the Northeast Cape Fear River, a wider range in unit low flows was noted in the discharges developed in the low-flow discharge profiles. These streams drain basins ranging in size from 271 to 1,670 square miles. Much of the soils in these basins are poorly drained, but moderately and well-drained soils are present in various areas within the basins. The terrains in these basins also have very little topographic relief. Consequently, unit low flows varied in response to the changing patterns in soil hydrologic groups. Low-flow profiles for the Black River were not developed for the reach downstream from a partial-record measuring site near Atkinson because of information that indicate tidal influences in the flows below this location. In a similar manner, the low-flow profiles for the Northeast Cape Fear River were not developed for the reach downstream from a partial-record measuring site near Watha due to insufficient data and tidal effects.

The low-flow profiles for the Cape Fear River Basin were developed for two reaches: (1) the Haw River between its headwaters and the continuous-record gaging station at Bynum in Chatham County, and (2) the Cape Fear River between the continuous-record gaging stations at Lillington in Harnett County and near Kelly in Bladen County. Overall, the profiles for each reach show moderate and steady increases in low-flow discharges. No profiles were developed for the reach of the Cape Fear between the site near Kelly and the mouth because of tidal effects. In addition to the tidally affected reach, no profiles were developed for the reach of the Haw River inundated by Jordan Lake and the reach of the river between Jordan Lake and Lillington. Flow patterns observed in the reach between Jordan Lake and Lillington indicate losses in

flow, particularly during some low-flow periods. Possible factors that could be related to occurrence of flow losses between Jordan Lake Dam and the gaging station at Lillington include effects of several other dams on the Deep and Cape Fear Rivers, the effects of daily variations in flow diversions on streamflow, or evaporation losses from Shearon Harris Lake. Records of NPDES point-source discharges indicate the presence of 15 and 40 permitted discharges on the Haw and Cape Fear Rivers, respectively. Seventeen of the point-source discharges on the Cape Fear River occur in the reach between Jordan Lake and Lock 1. Eight withdrawals also occur on the reach between Jordan Lake and Lock 1.

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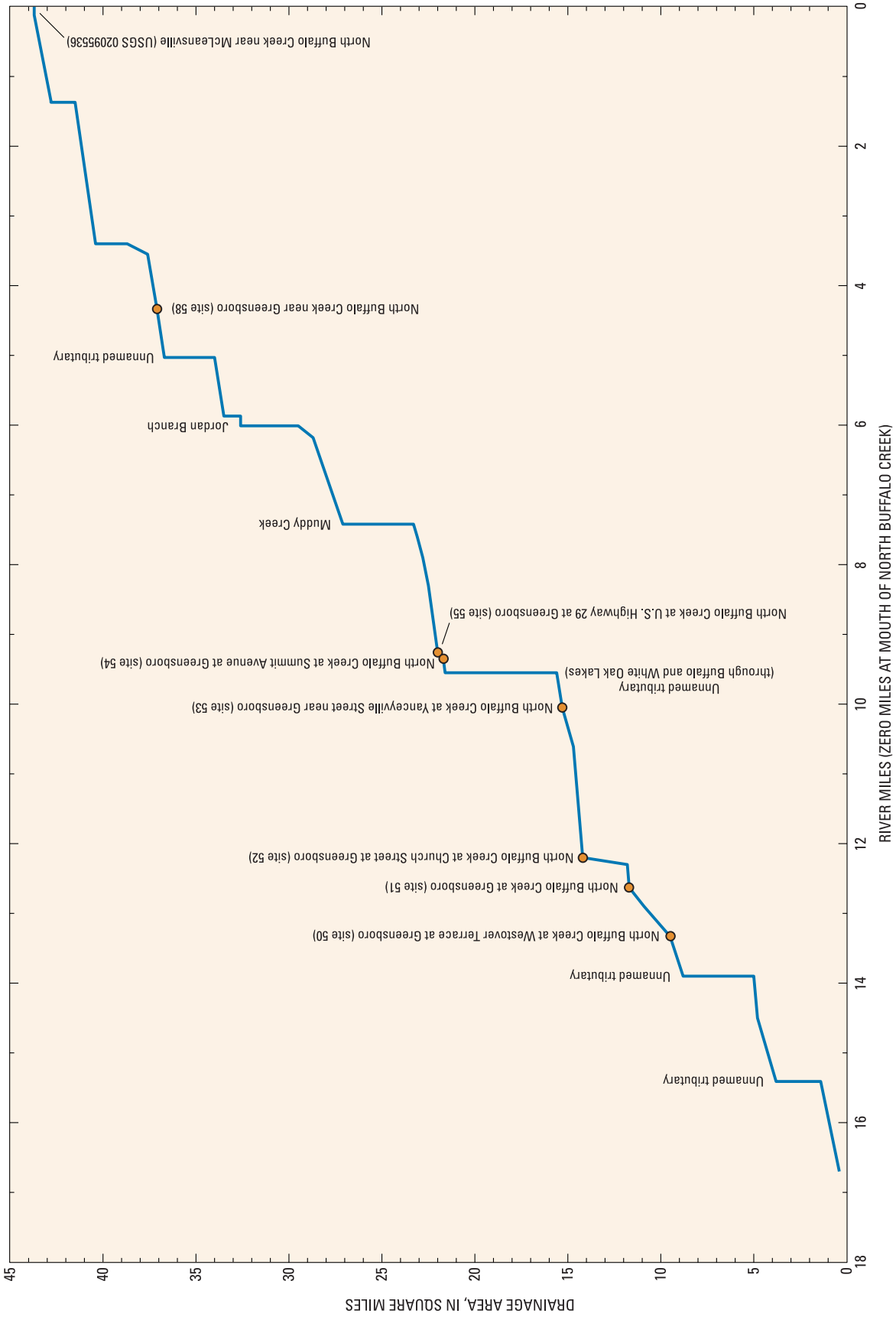

Figure 8A. Relation of river miles to drainage area for North Buffalo Creek (see p. 27).

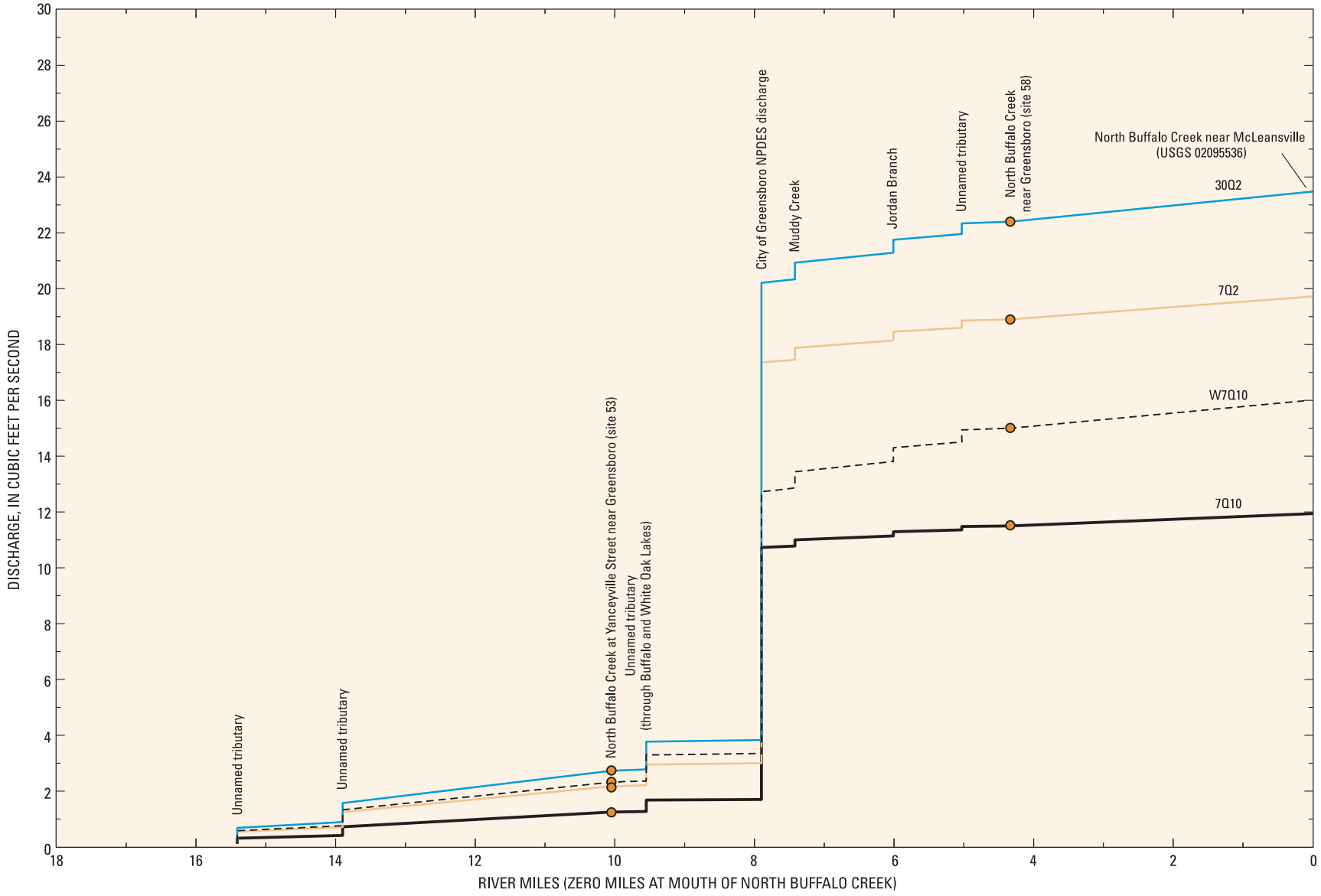

Figure 8B. Relation of river miles to low-flow discharges for North Buffalo Creek (see p. 27).

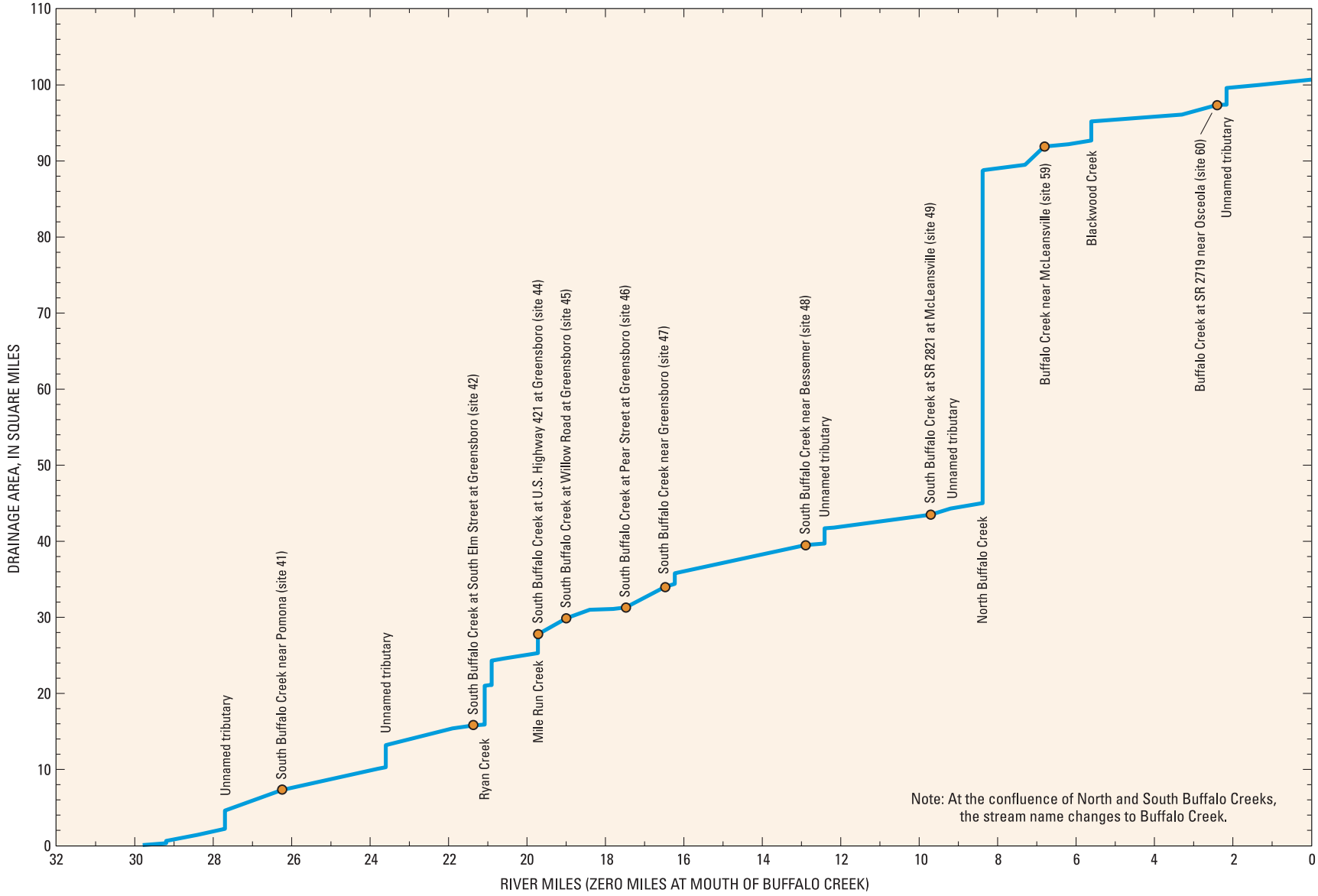

Figure 9A. Relation of river miles to drainage area for Buffalo Creek (see p. 27).

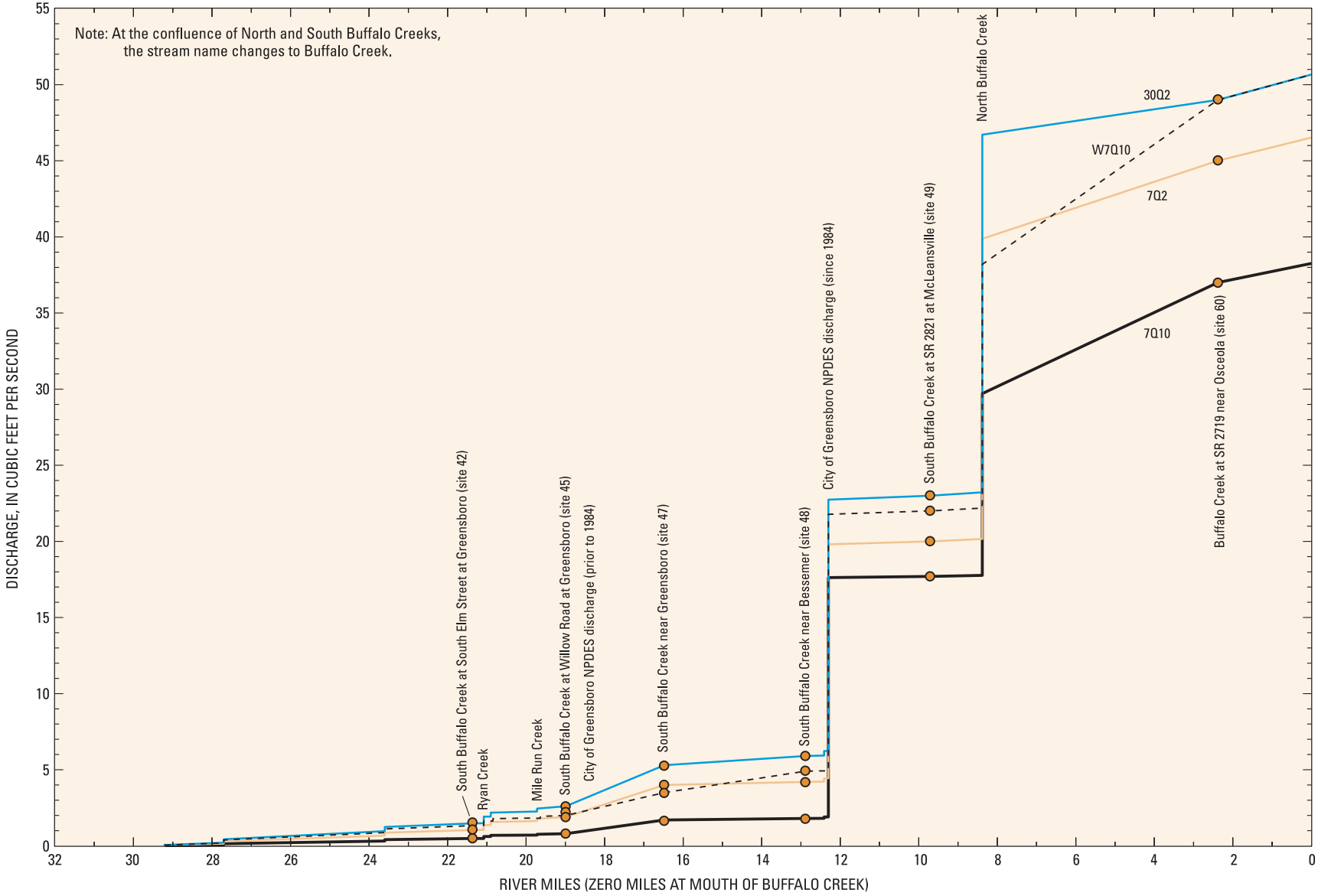

Figure 9B. Relation of river miles to low-flow discharges for Buffalo Creek (see p. 27).

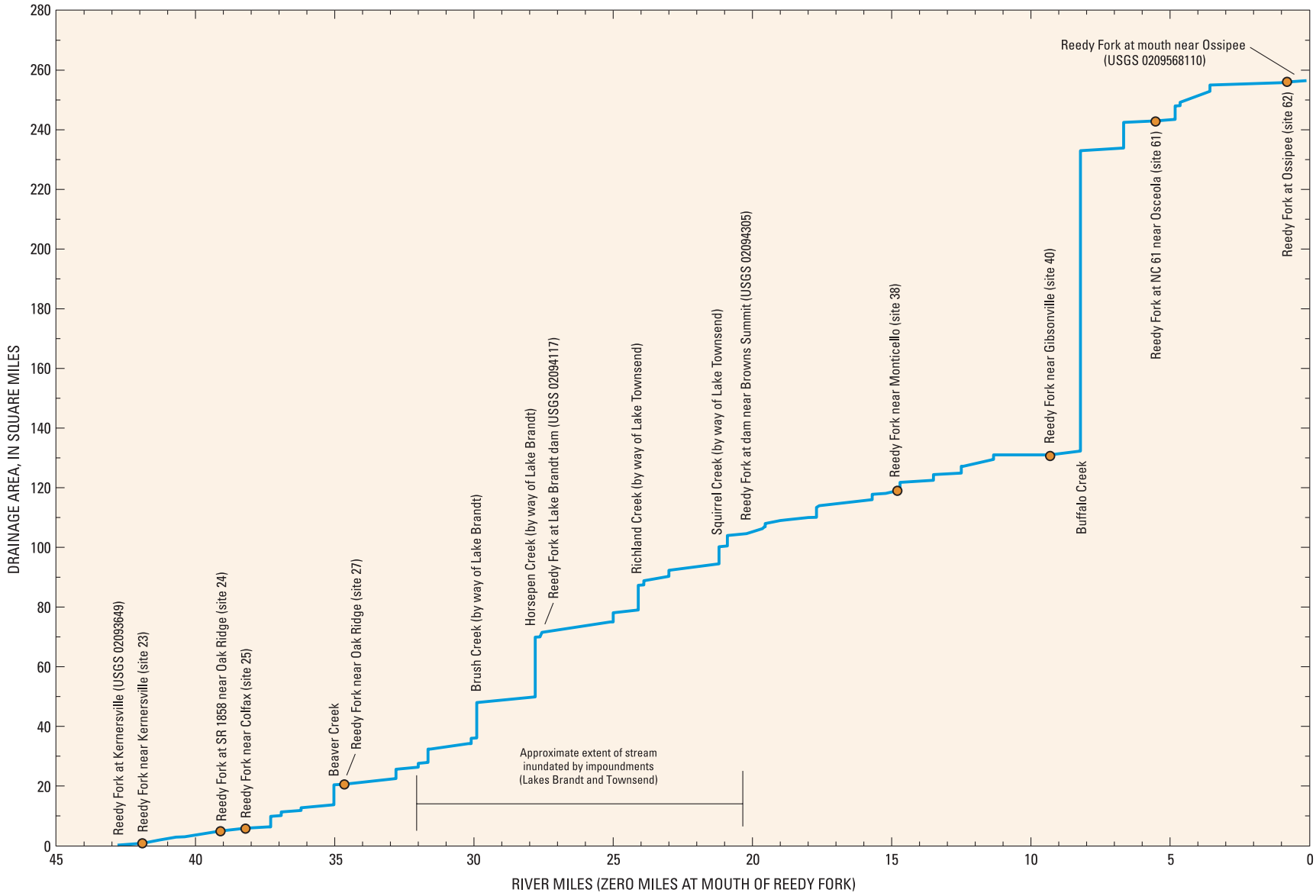

Figure 10A. Relation of river miles to drainage area for Reedy Fork (see p. 28).

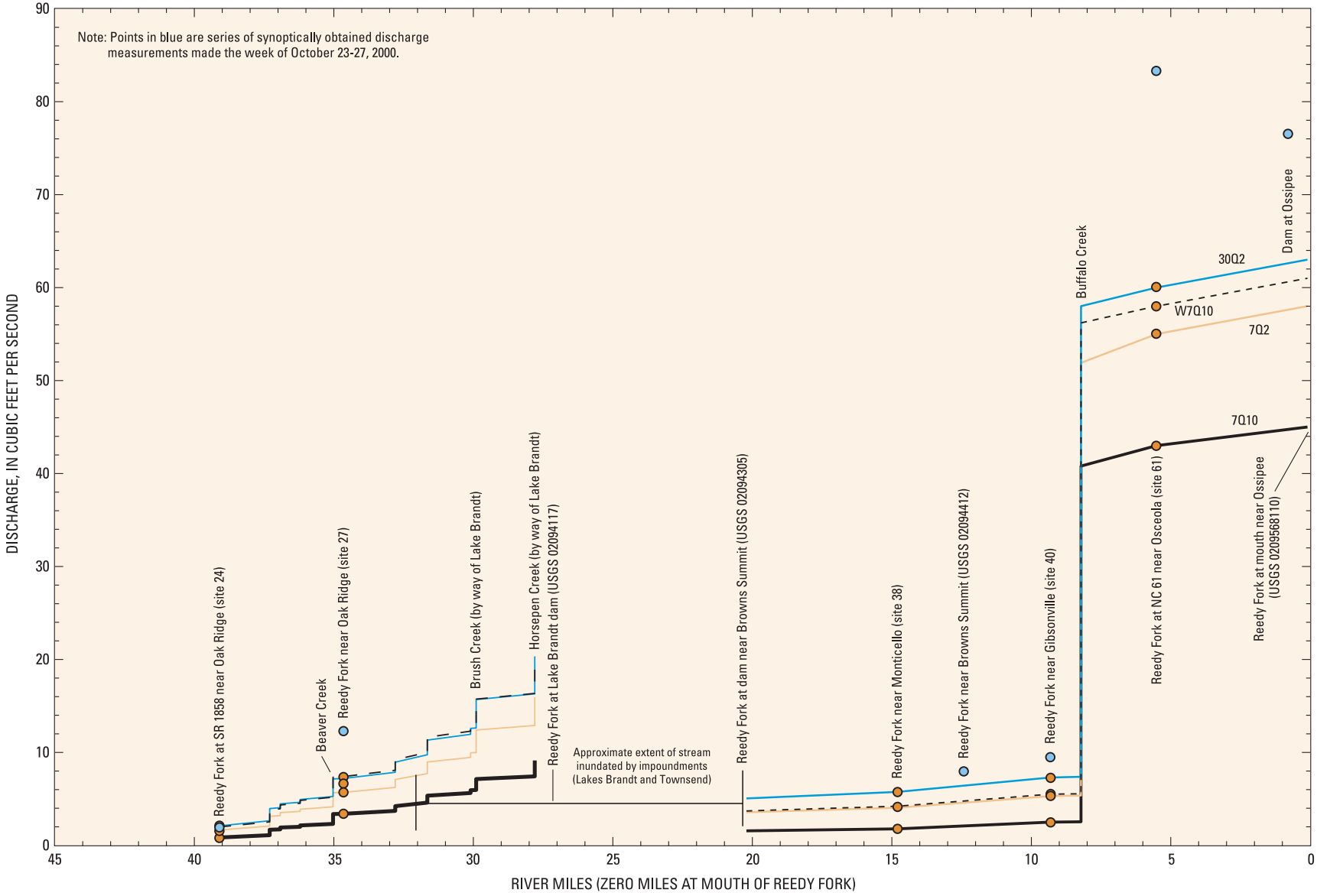

Figure 10B. Relation of river miles to low-flow discharges for Reedy Fork (see p. 28).

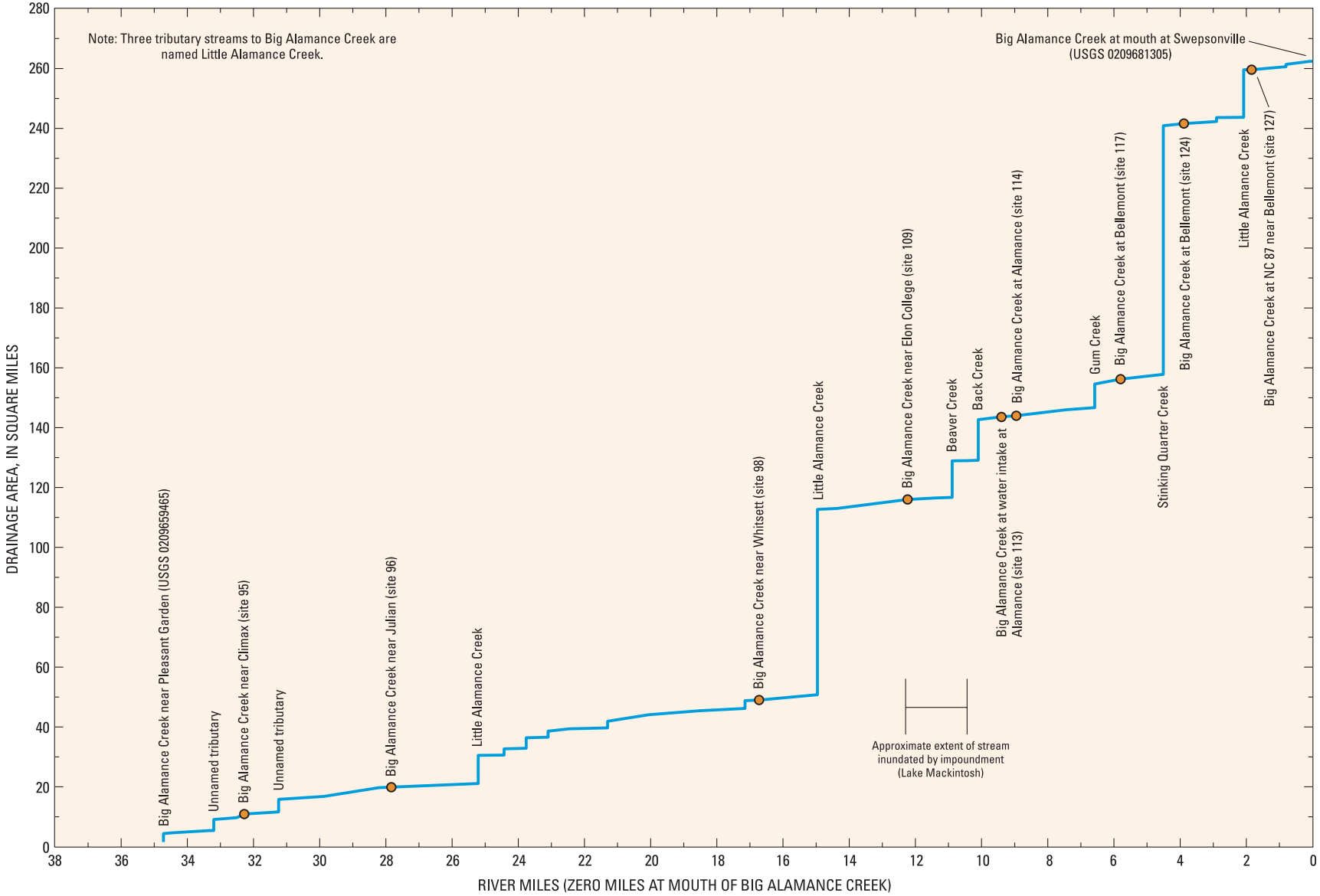

Figure 11A. Relation of river miles to drainage area for Big Alamance Creek (see p. 29).

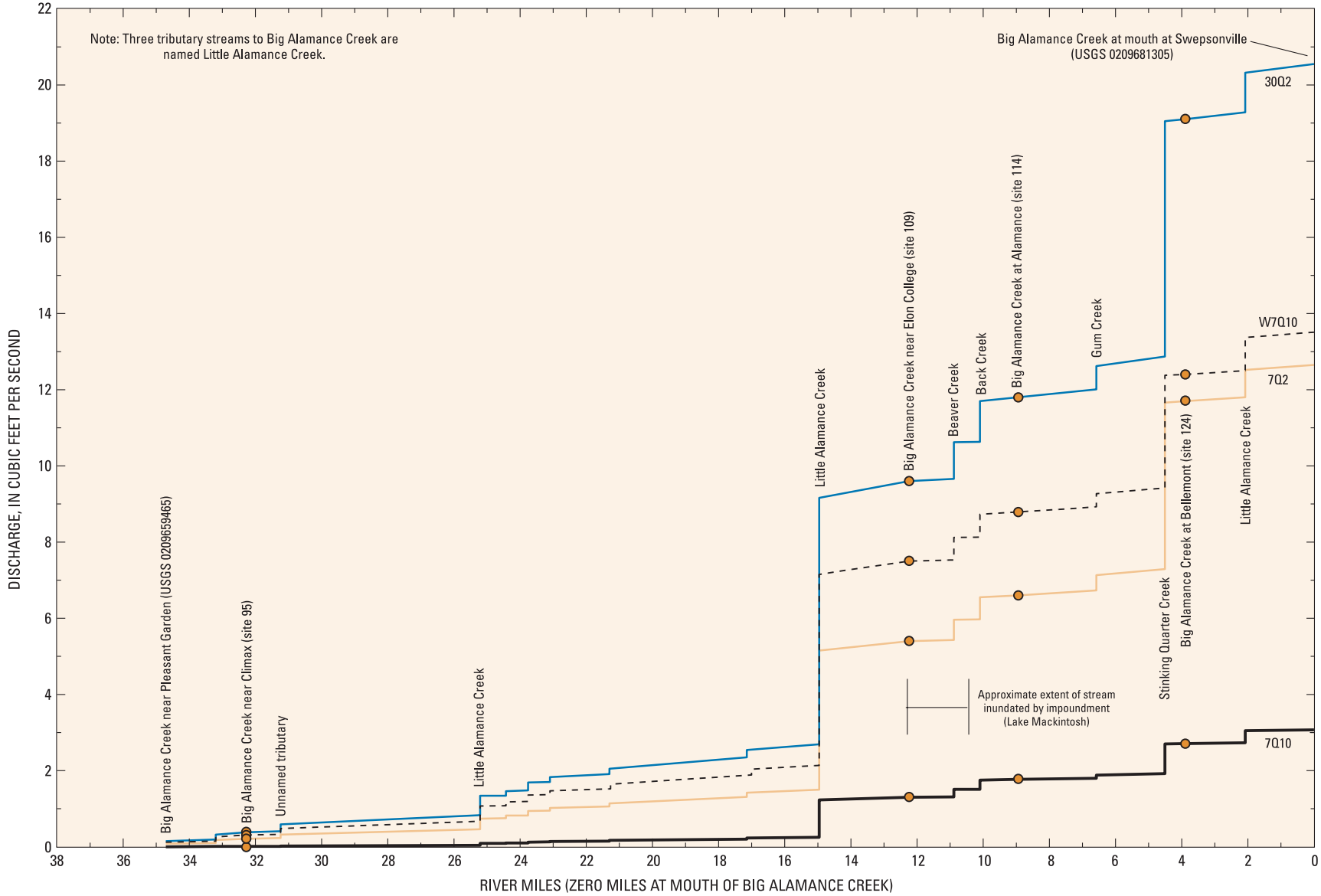

Figure 11B. Relation of river miles to low-flow discharges for Big Alamance Creek (see p. 29).

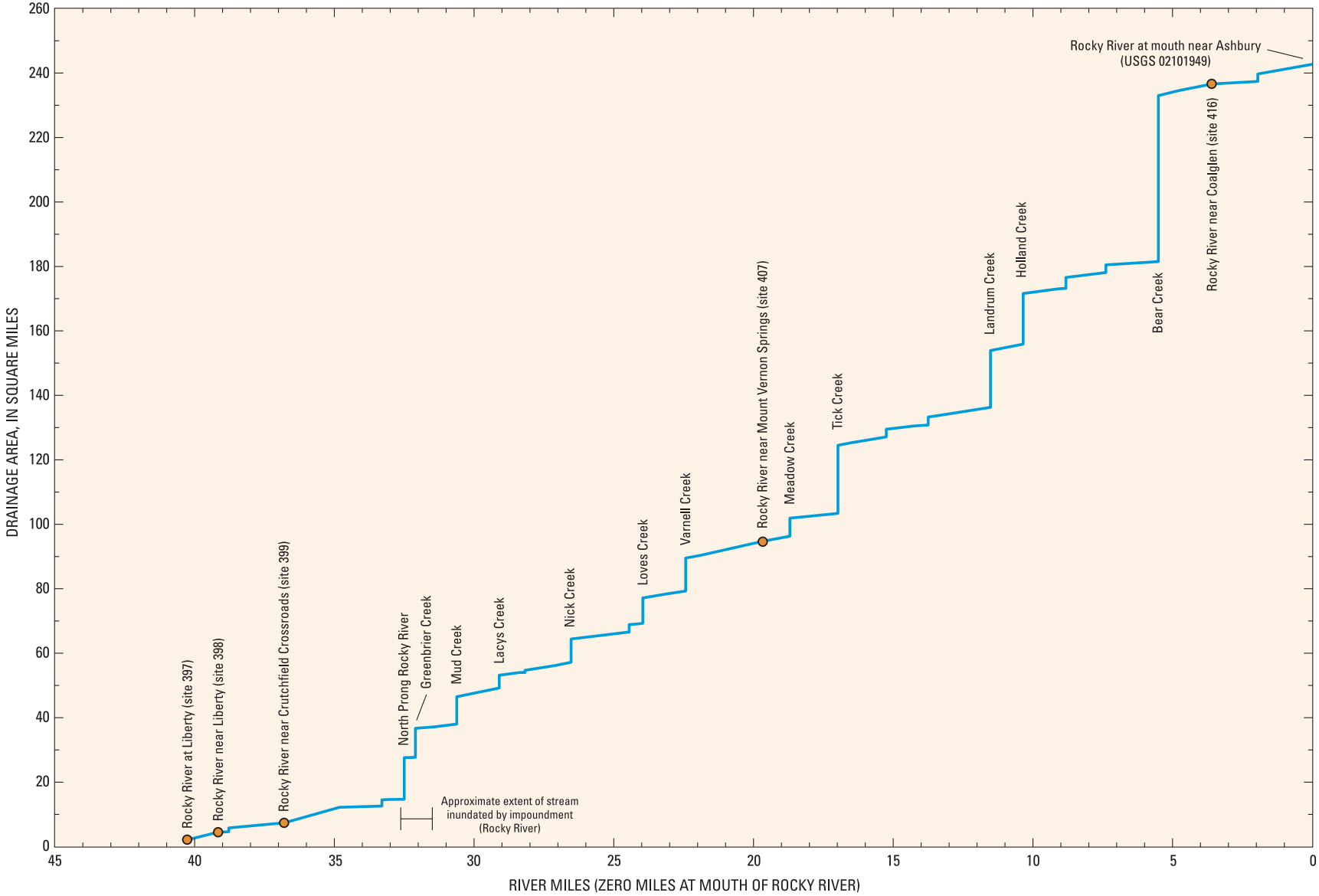

Figure 12A. Relation of river miles to drainage area for Rocky River (tributary to the Deep River; see p. 30).

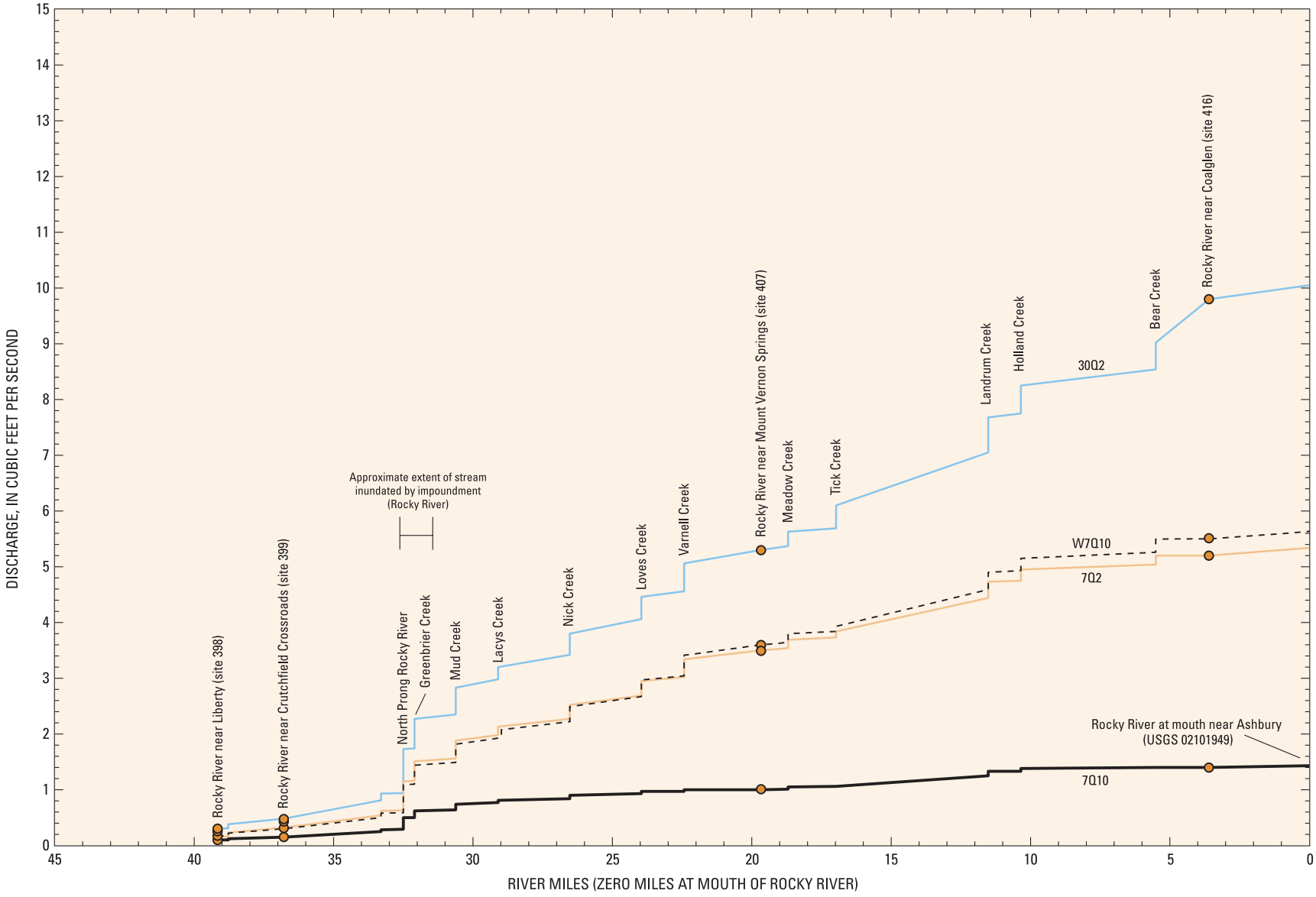

Figure 12B. Relation of river miles to low-flow discharges for Rocky River (tributary to the Deep River; see p. 30).

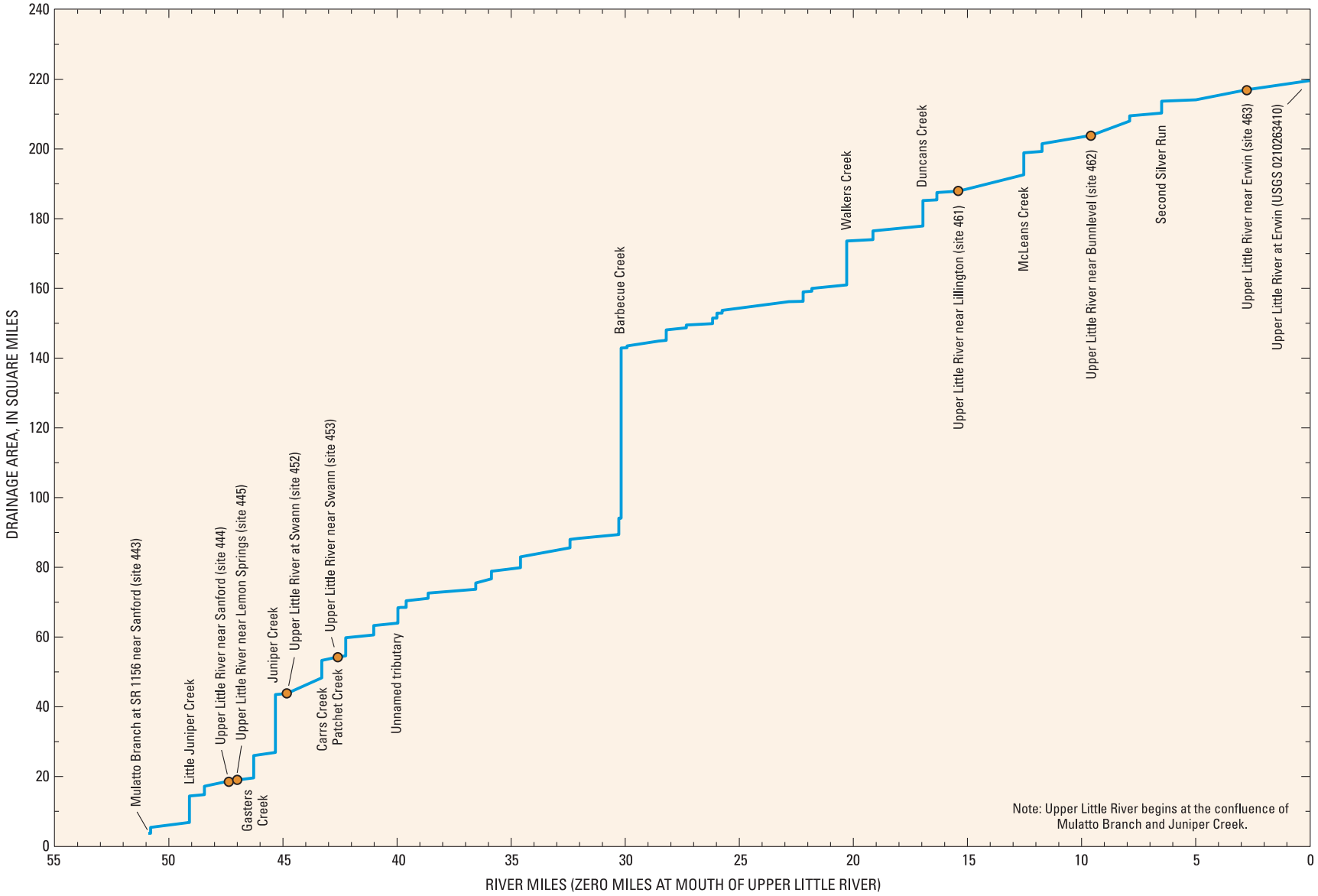

Figure 13A. Relation of river miles to drainage area for Upper Little River (see p. 31).

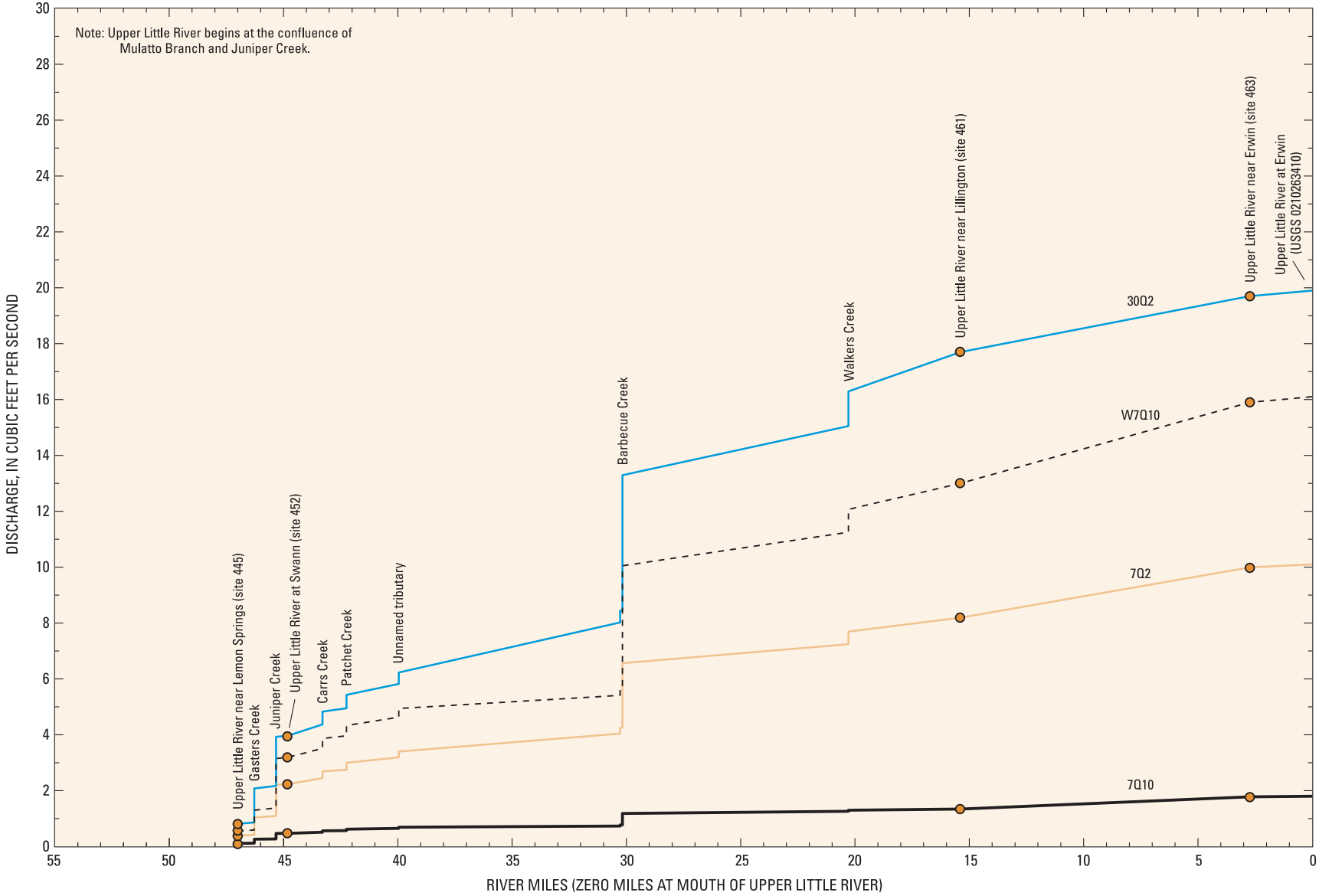

Figure 13B. Relation of river miles to low-flow discharges for Upper Little River (see p. 31).

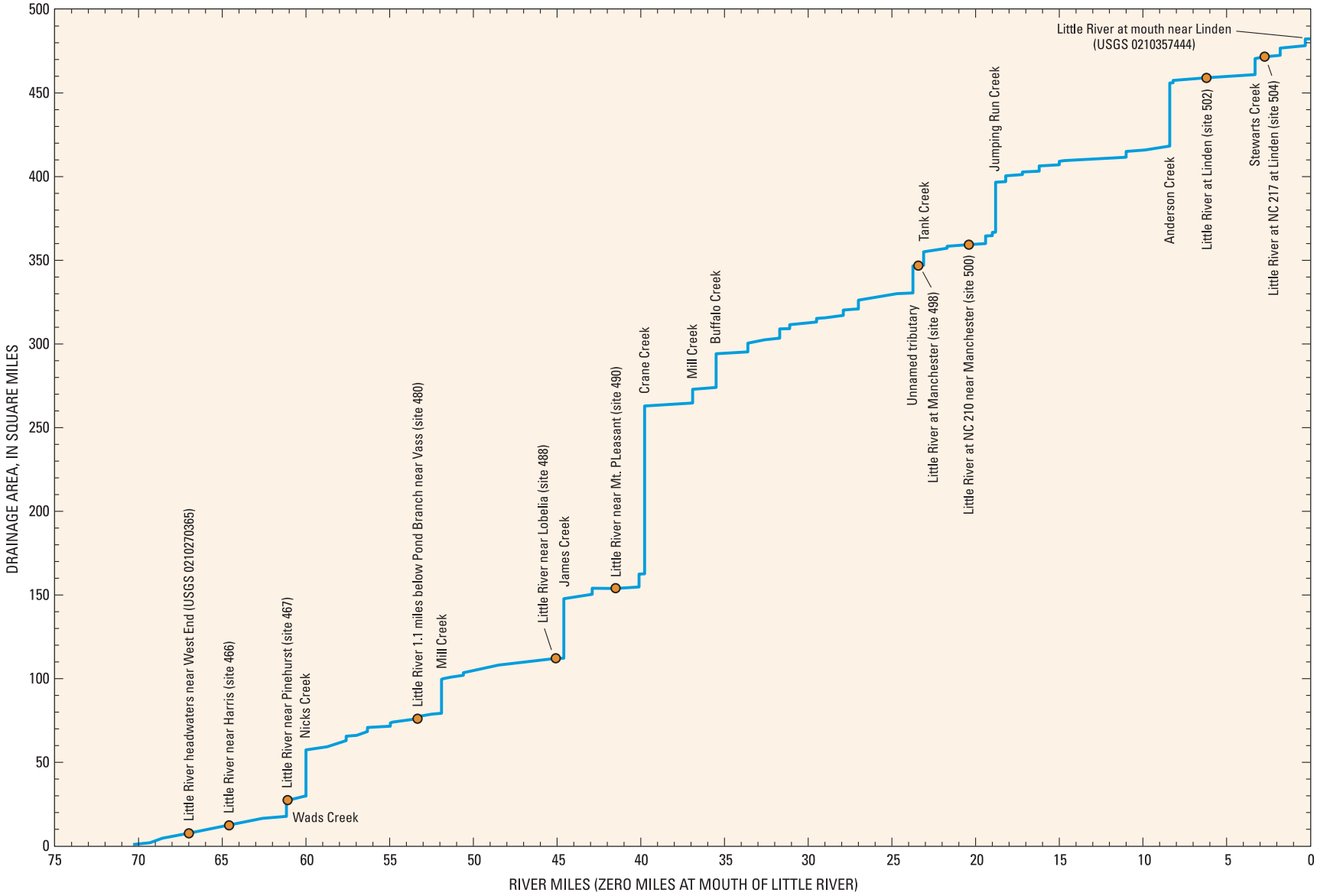

Figure 14A. Relation of river miles to drainage area for Little River (see p. 31).

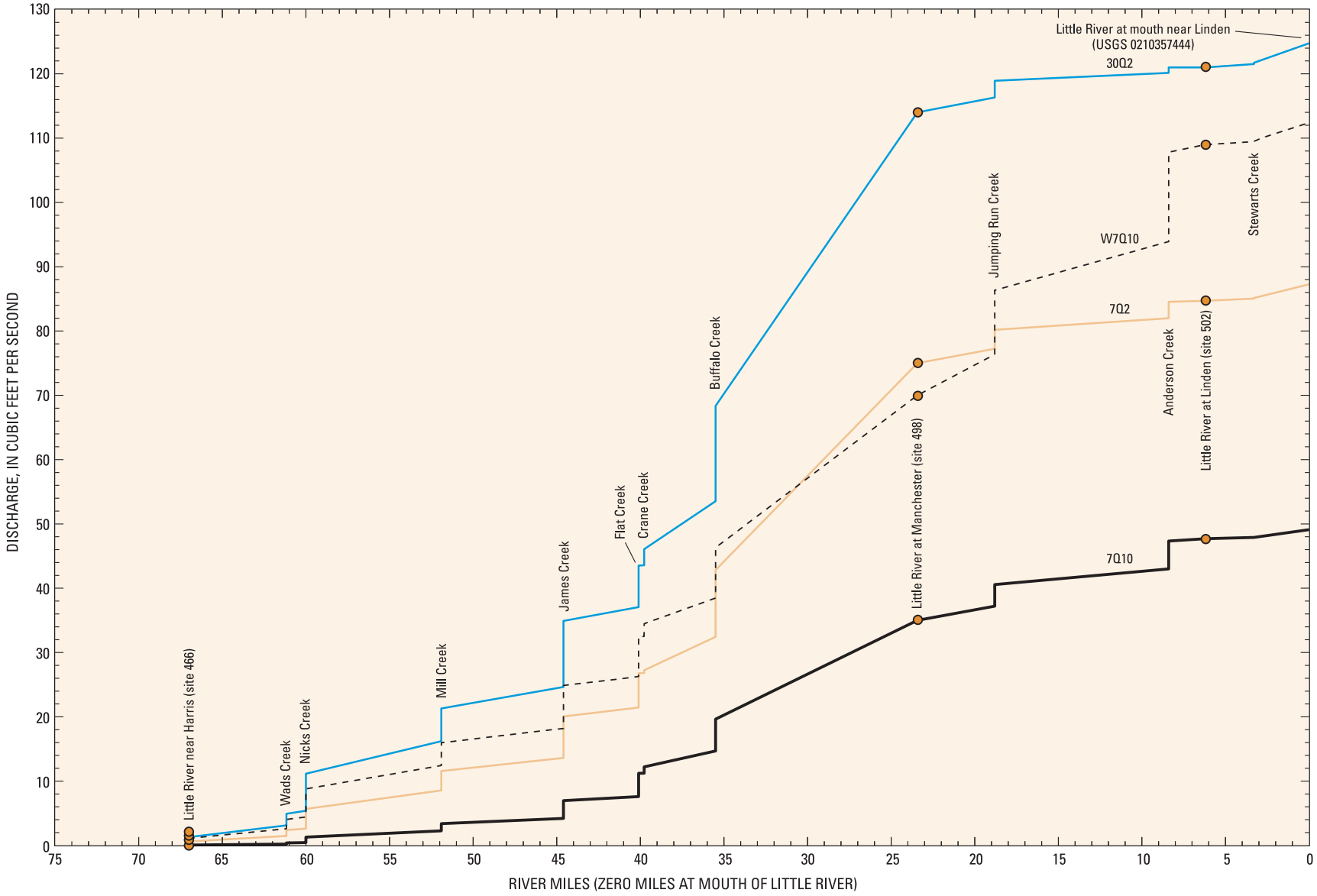

Figure 14B. Relation of river miles to low-flow discharges for Little River (see p. 31).

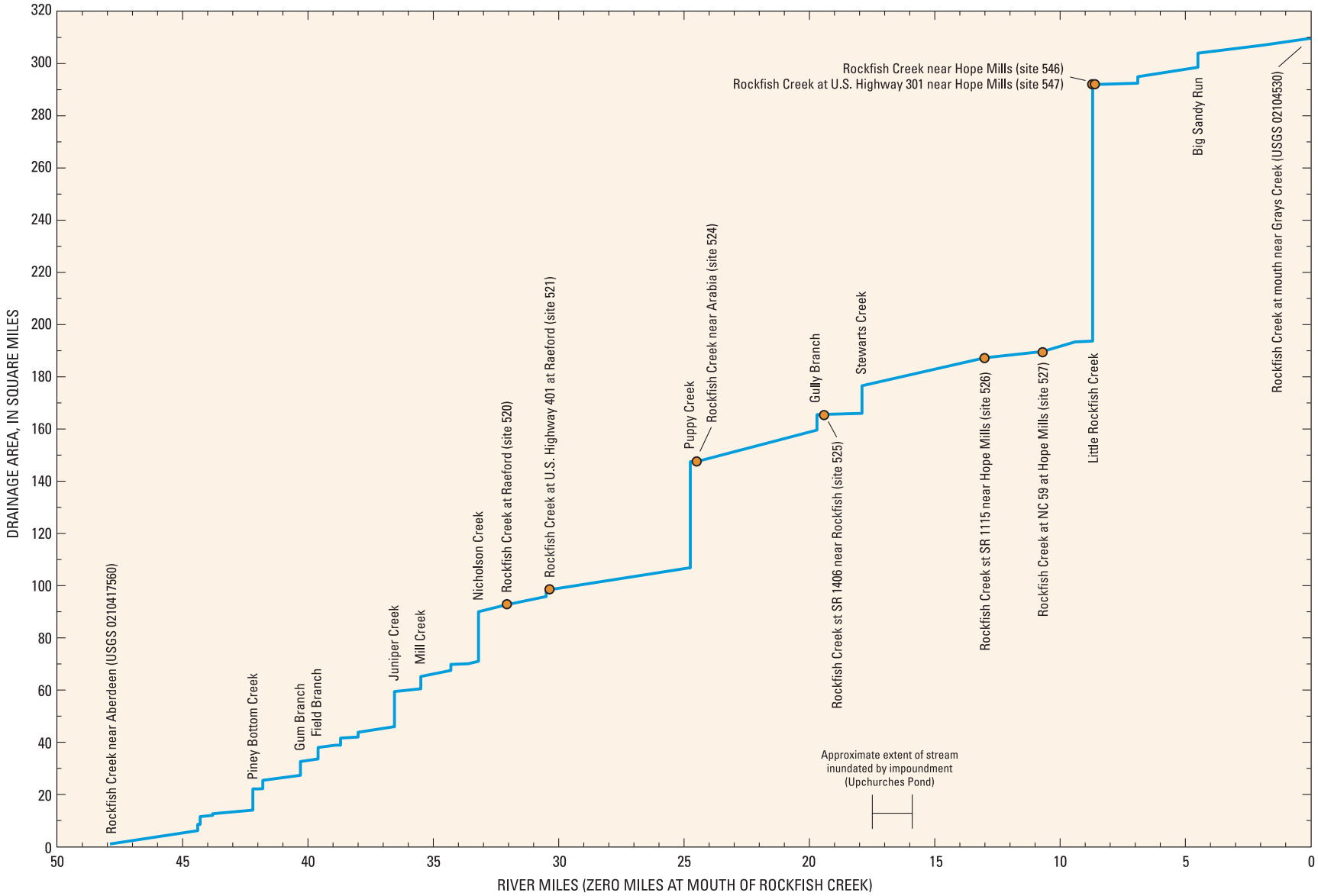

Figure 15A. Relation of river miles to drainage area for Rockfish Creek (Hoke and Cumberland Counties; see p. 32).

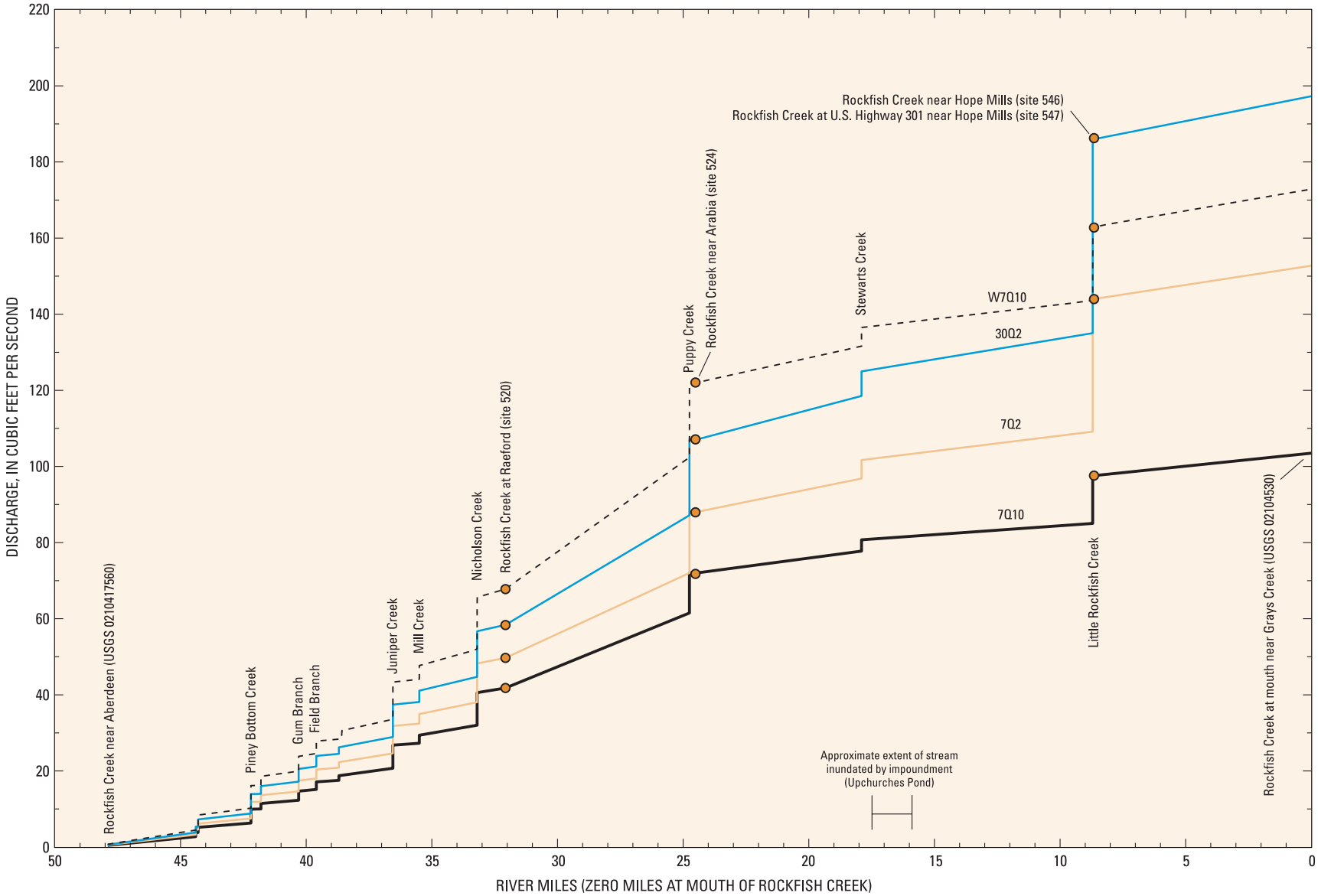

Figure 15B. Relation of river miles to low-flow discharges for Rockfish Creek (Hoke and Cumberland Counties; see p. 32).

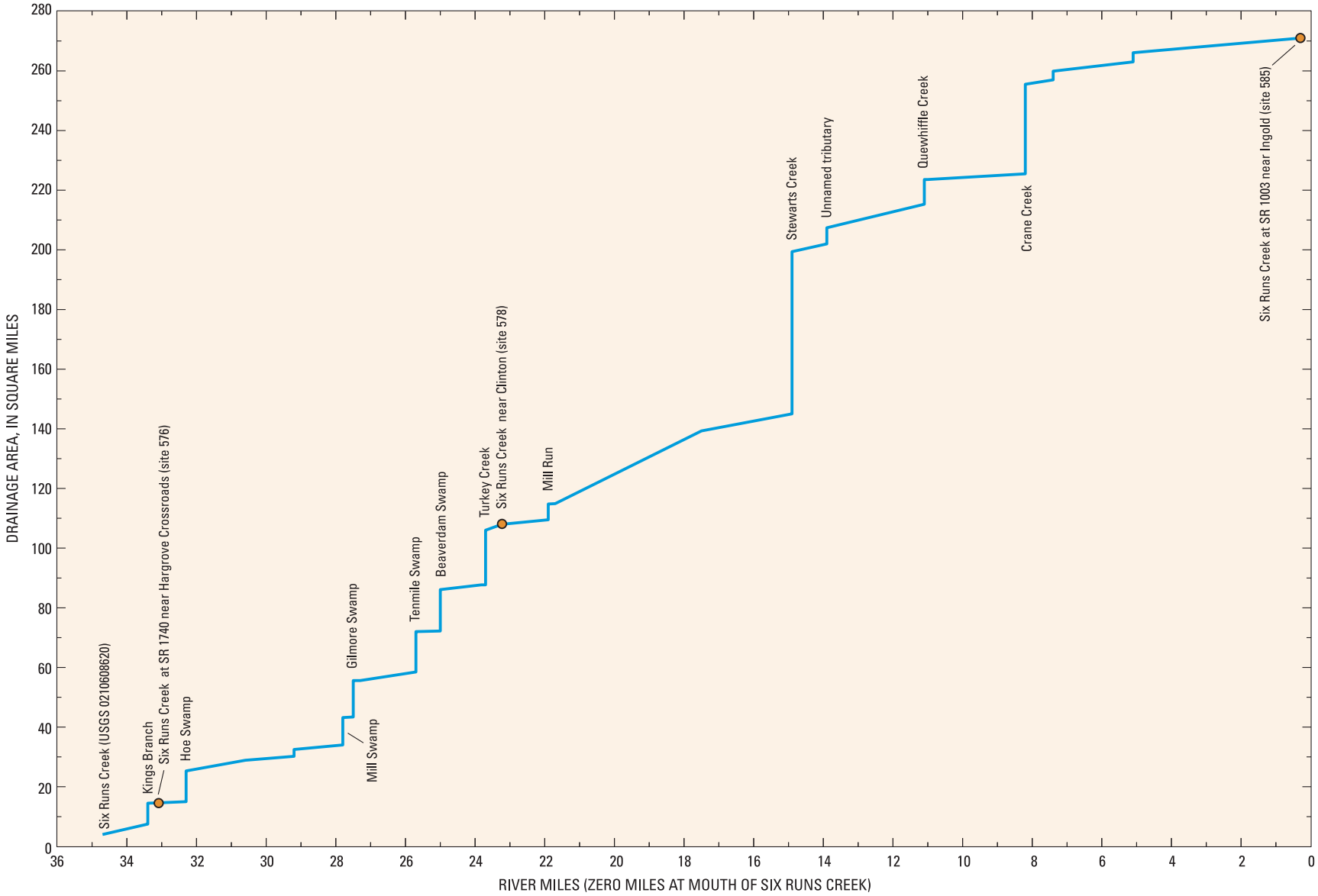

Figure 16A. Relation of river miles to drainage area for Six Runs Creek (see p. 33).

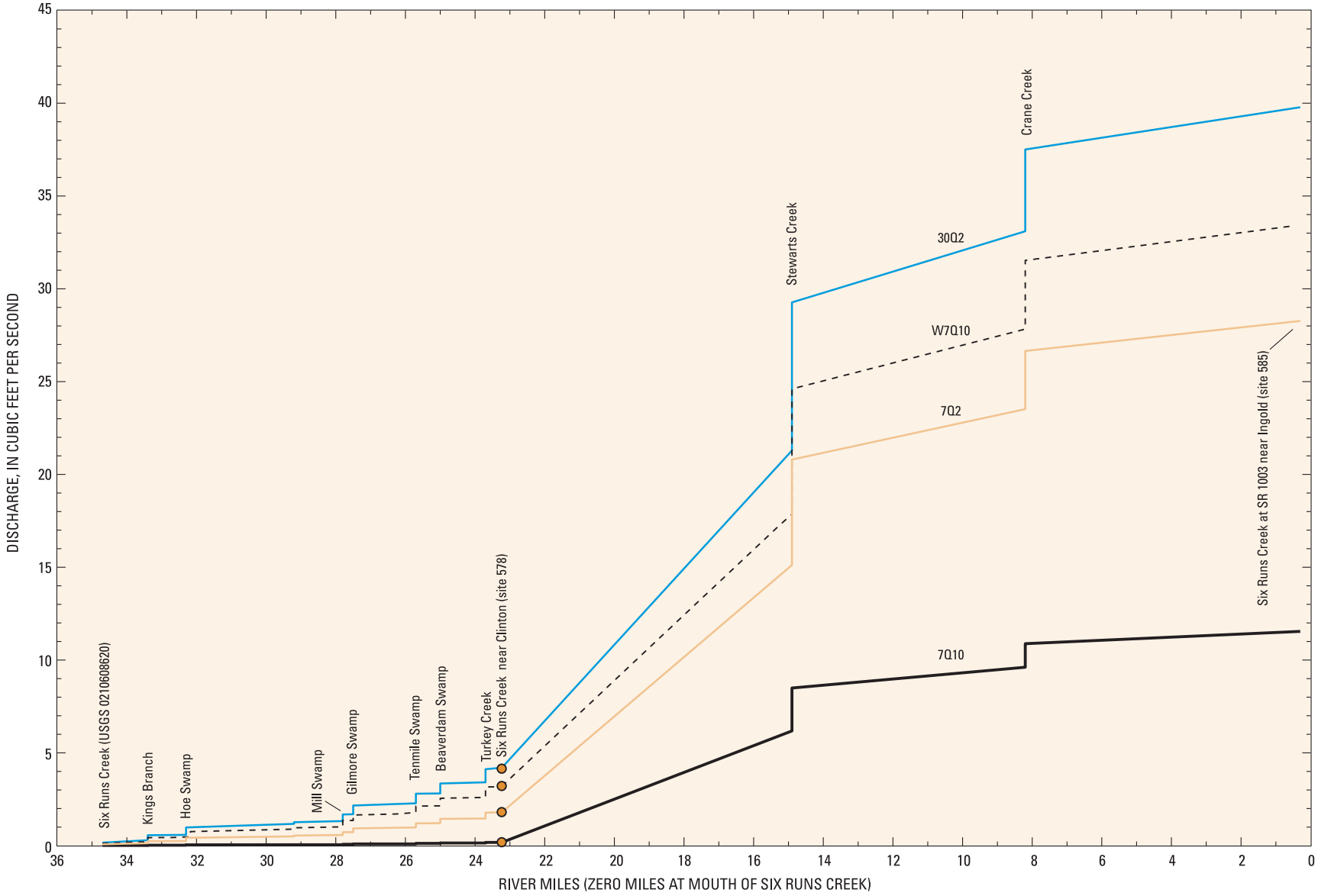

Figure 16B. Relation of river miles to low-flow discharges for Six Runs Creek (see p. 33).

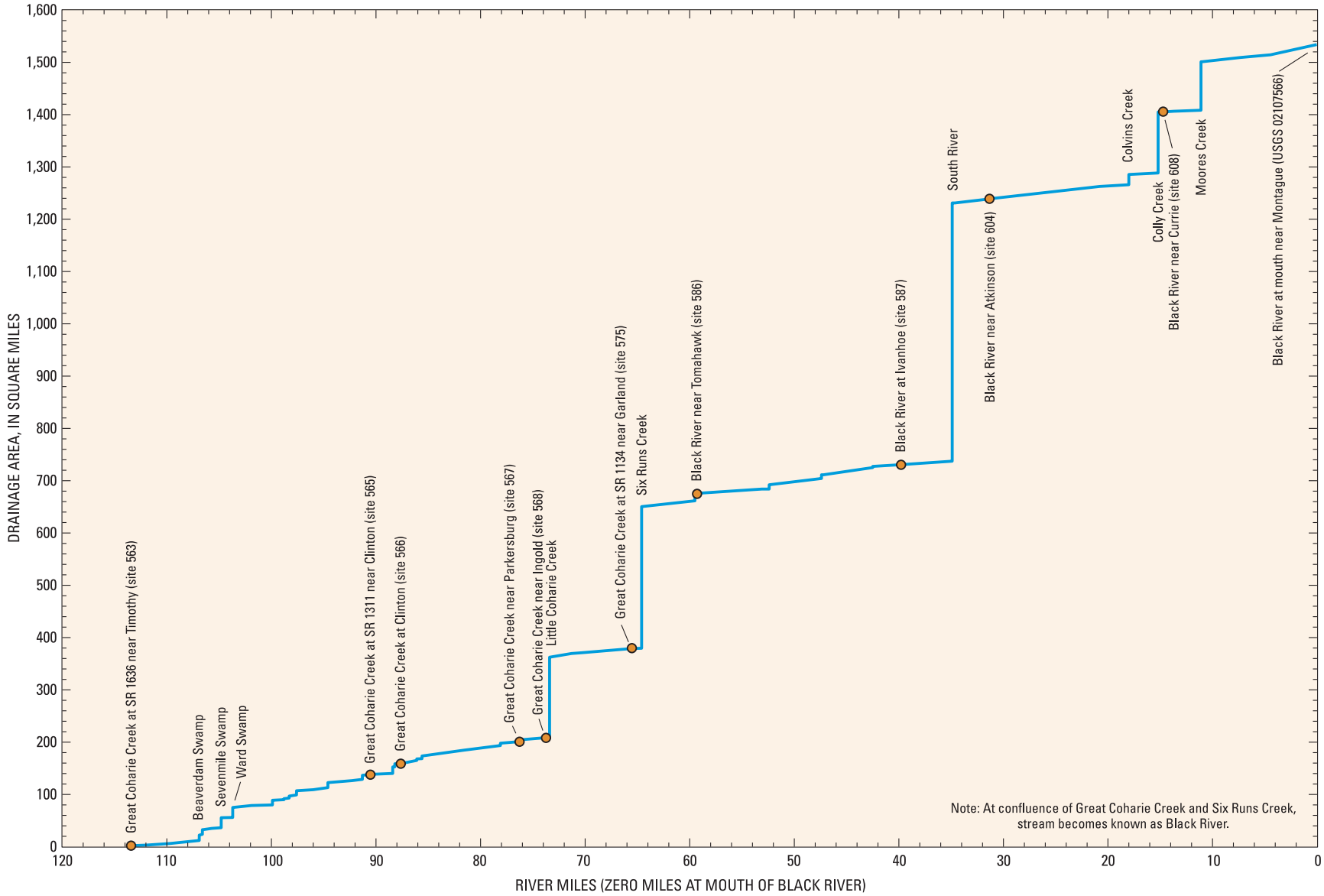

Figure 17A. Relation of river miles to drainage area for Black River (see p. 33).

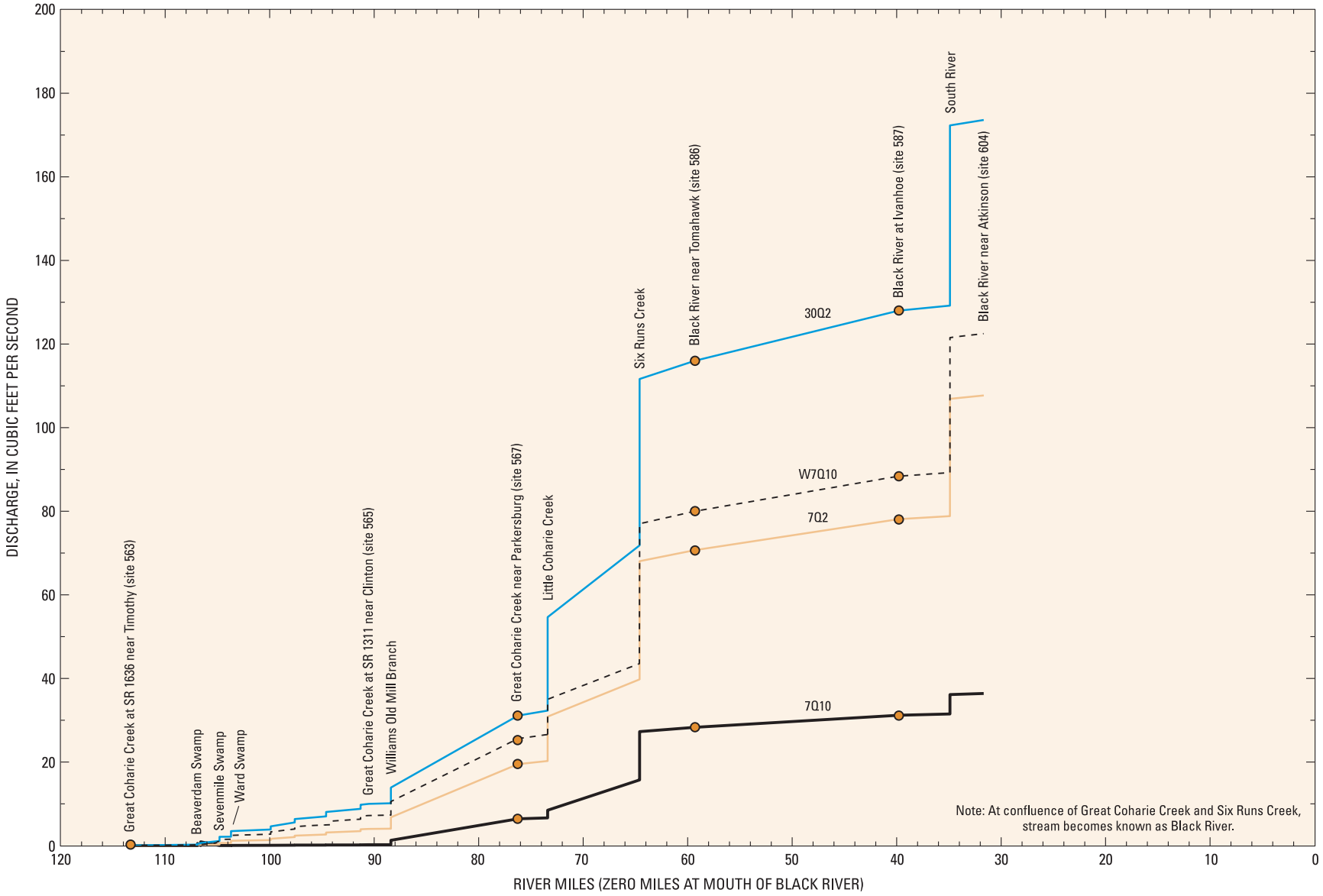

Figure 17B. Relation of river miles to low-flow discharges for Black River (see p. 33).

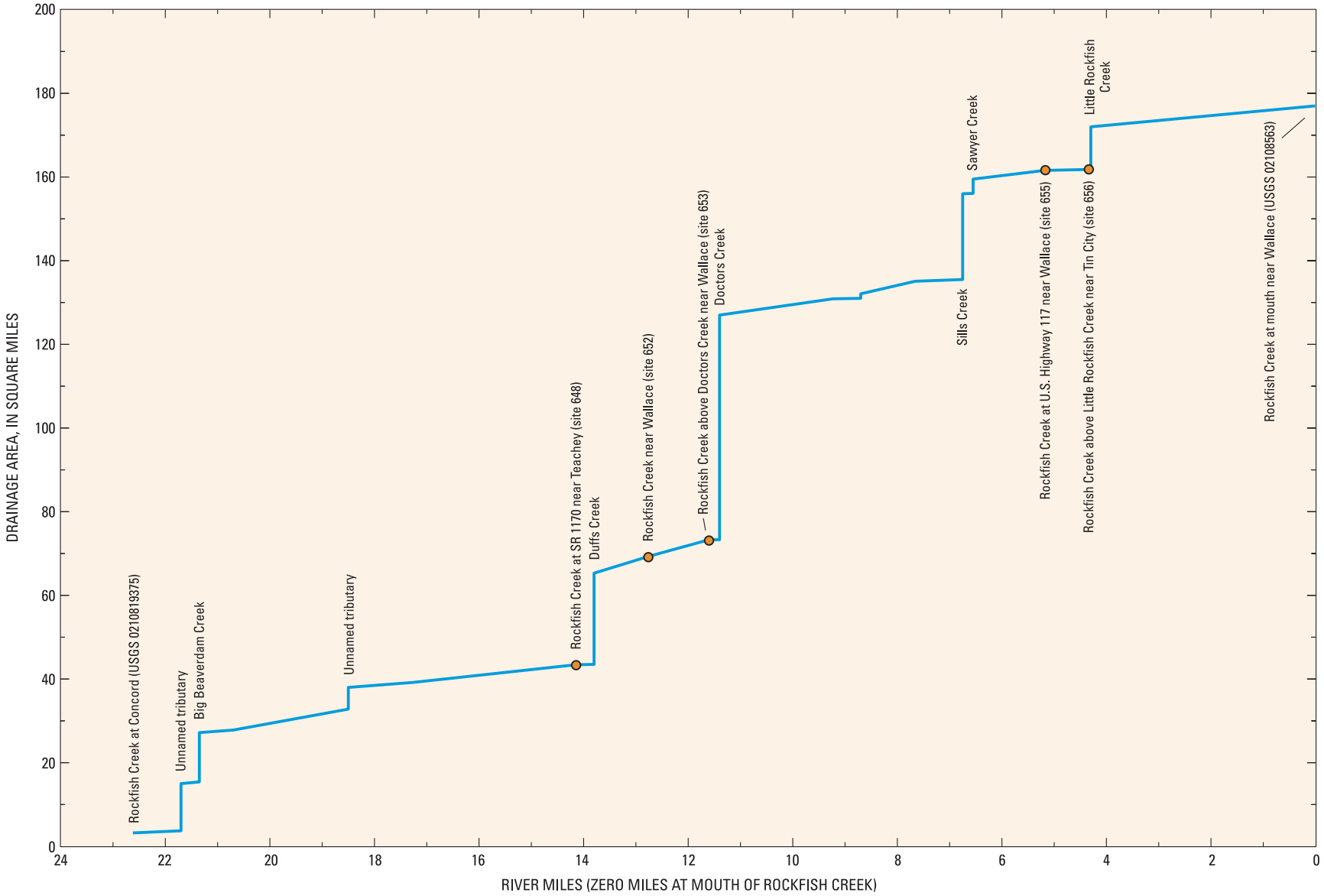

Figure 18A. Relation of river miles to drainage area for Rockfish Creek (Duplin County; see p. 34).

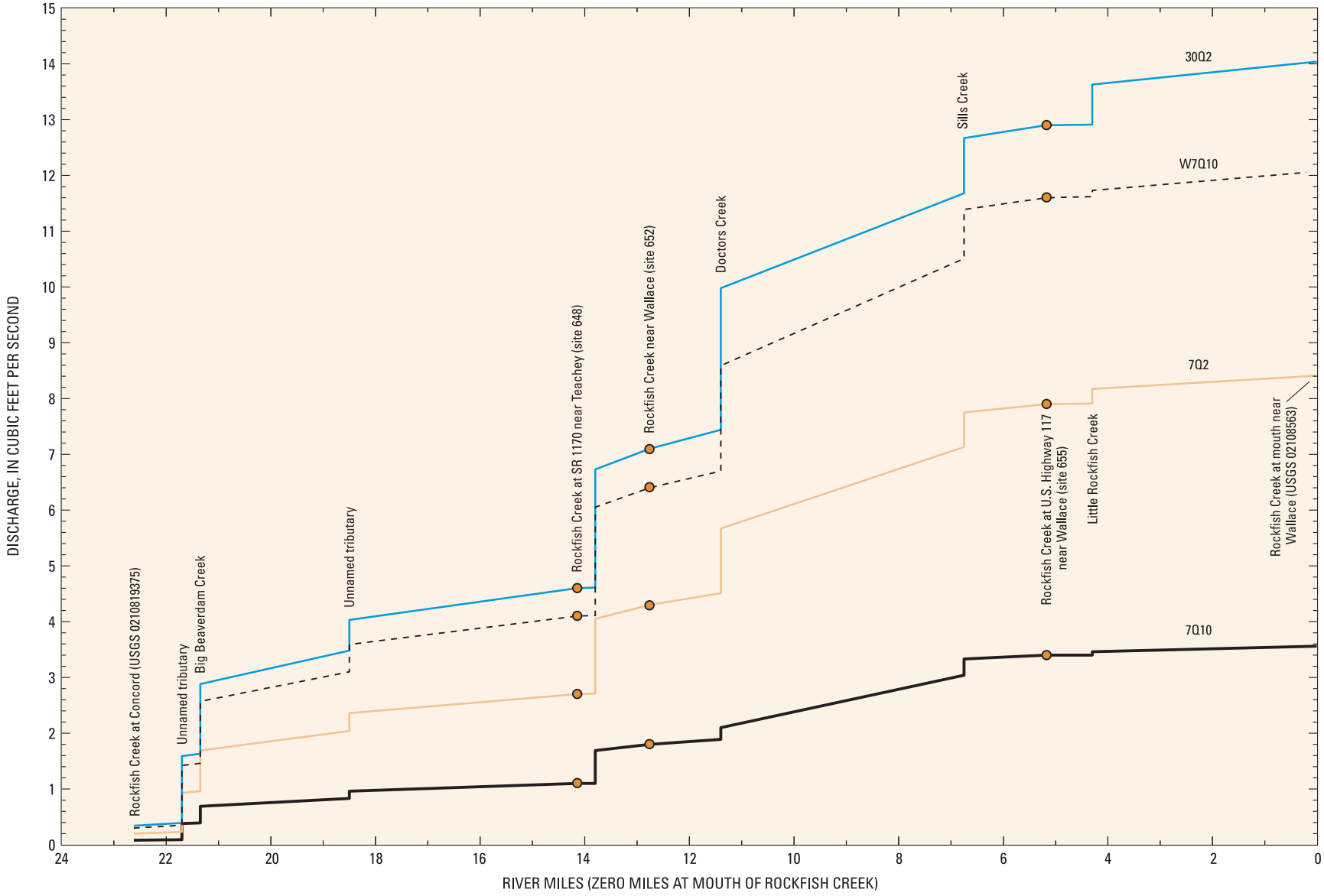

Figure 18B. Relation of river miles to low-flow discharges for Rockfish Creek (Duplin County; see p. 34).

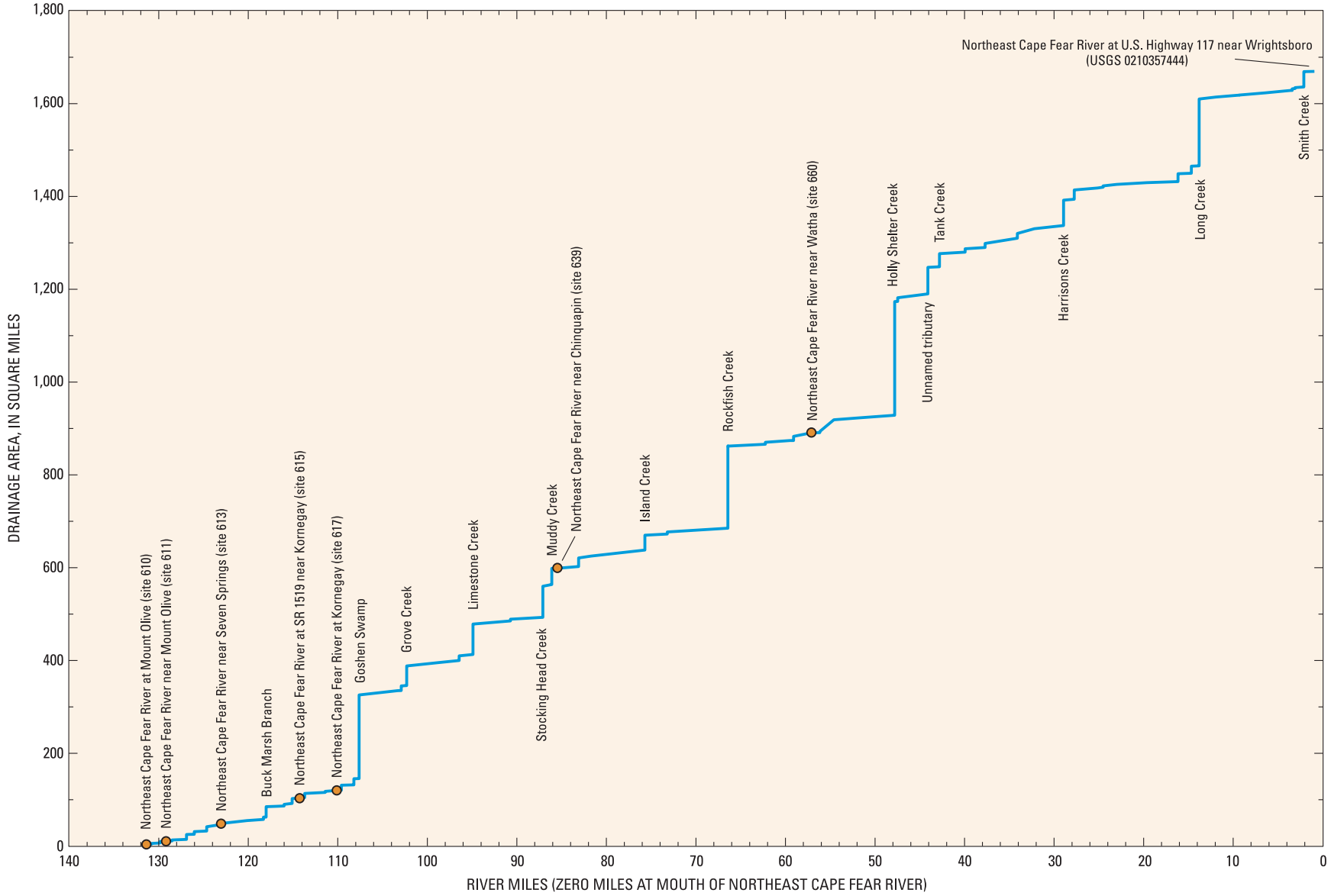

Figure 19A. Relation of river miles to drainage area for Northeast Cape Fear River (see p. 35).

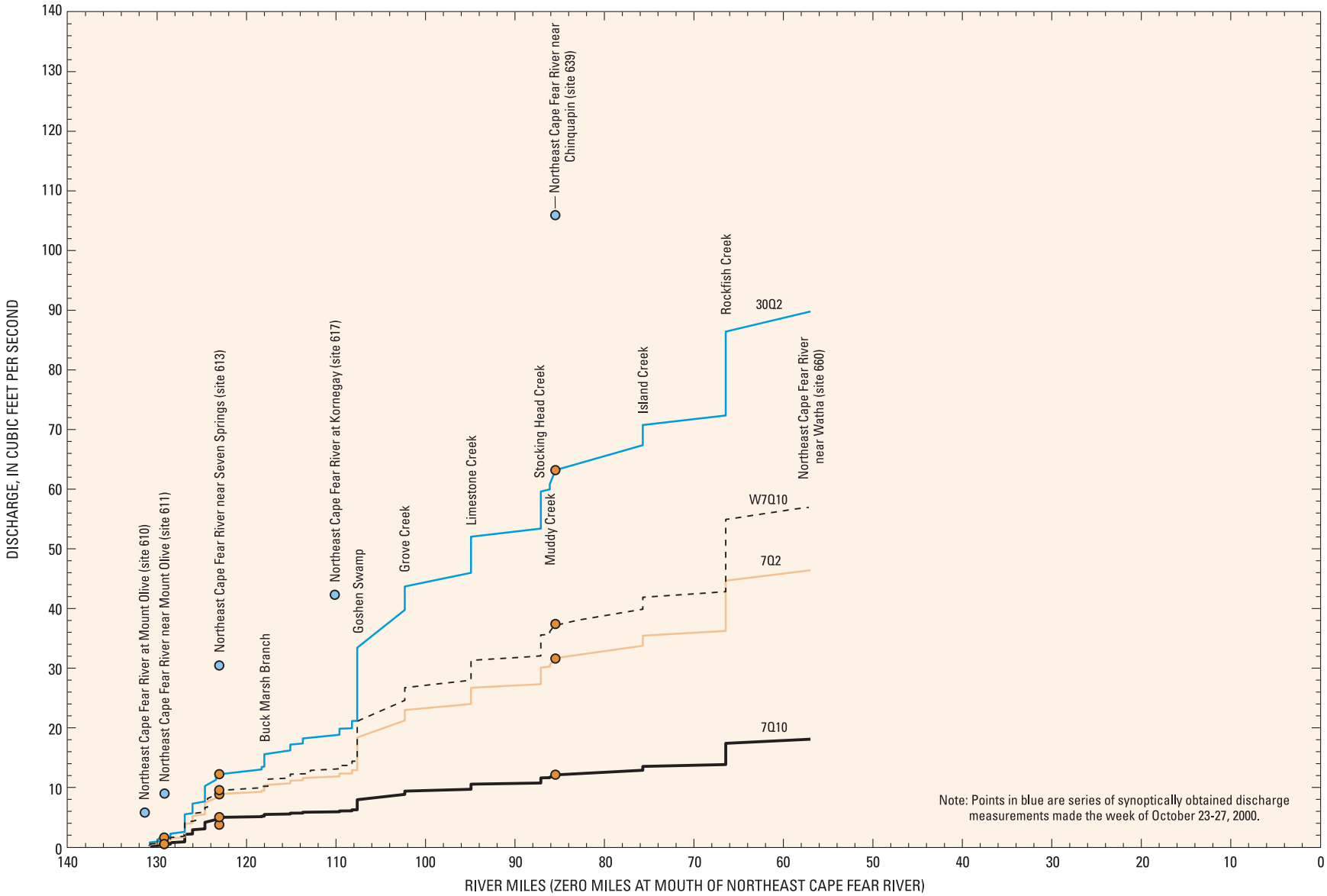

Figure 19B. Relation of river miles to low-flow discharges for Northeast Cape Fear River (see p. 35).

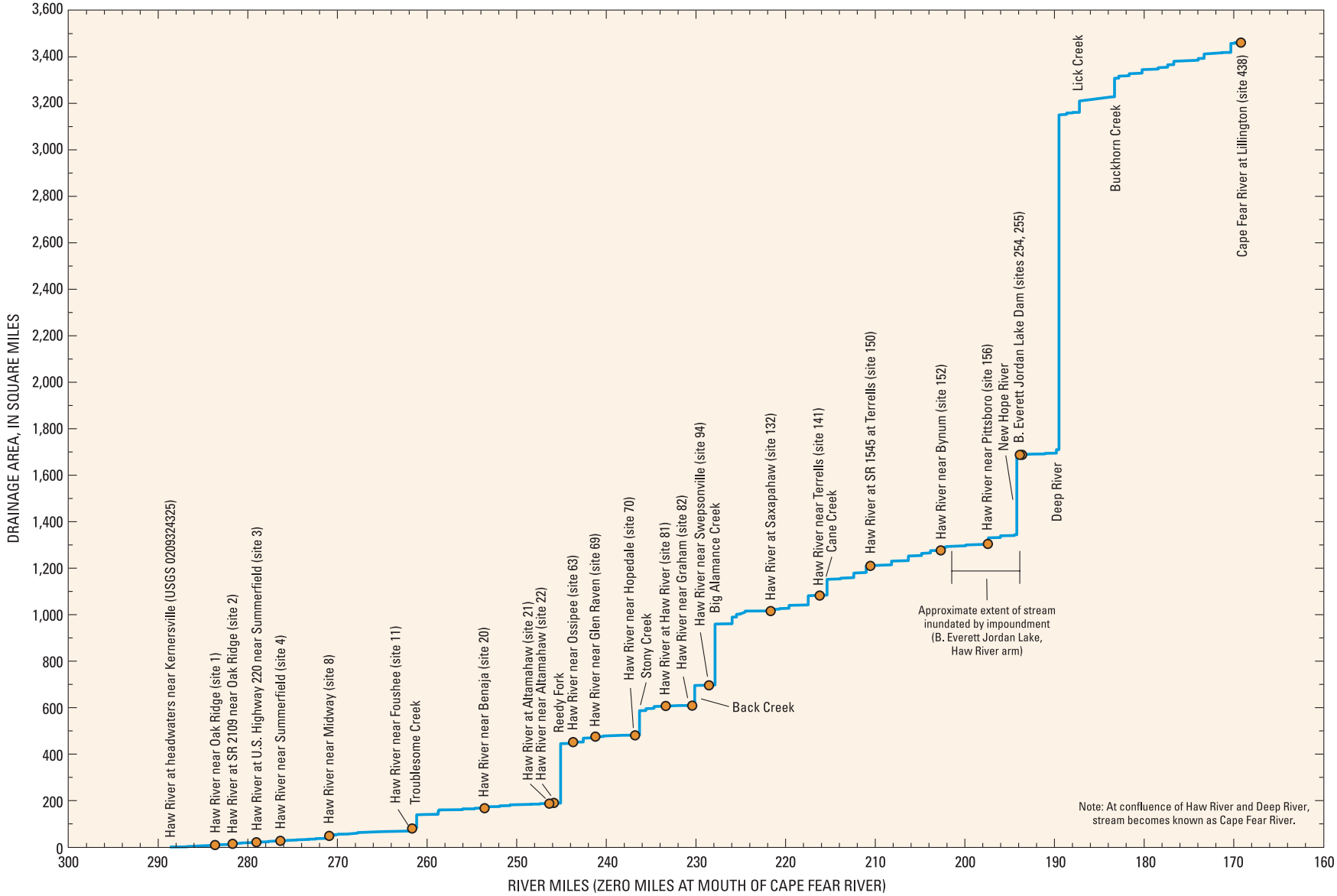

Figure 20A. Relation of river miles to drainage area for Haw River and Cape Fear River (upstream from Lillington, site 438; see p. 36).

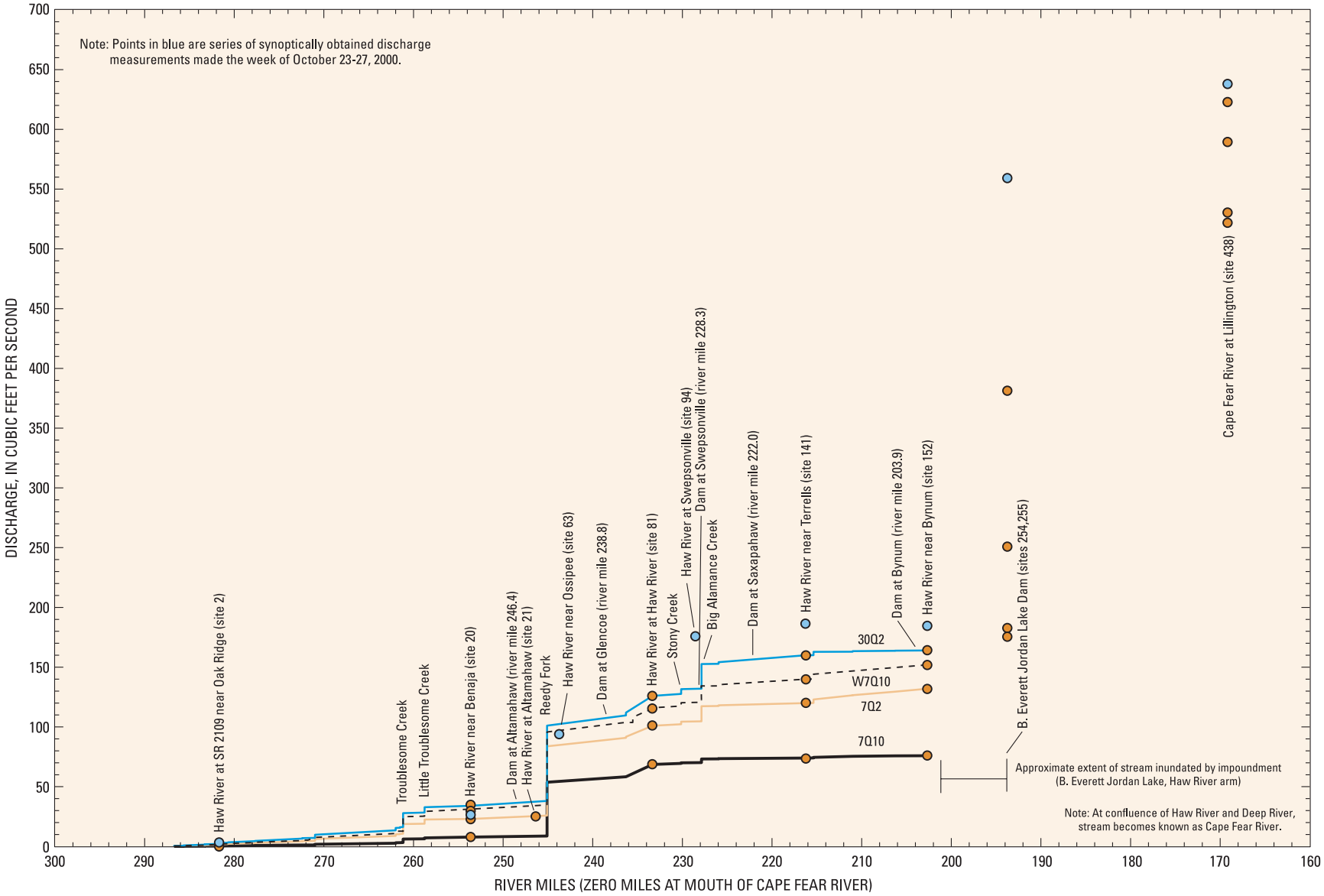

Figure 20B. Relation of river miles to low-flow discharges for Haw River and Cape Fear River (upstream from Lillington, site 438; see p. 36).

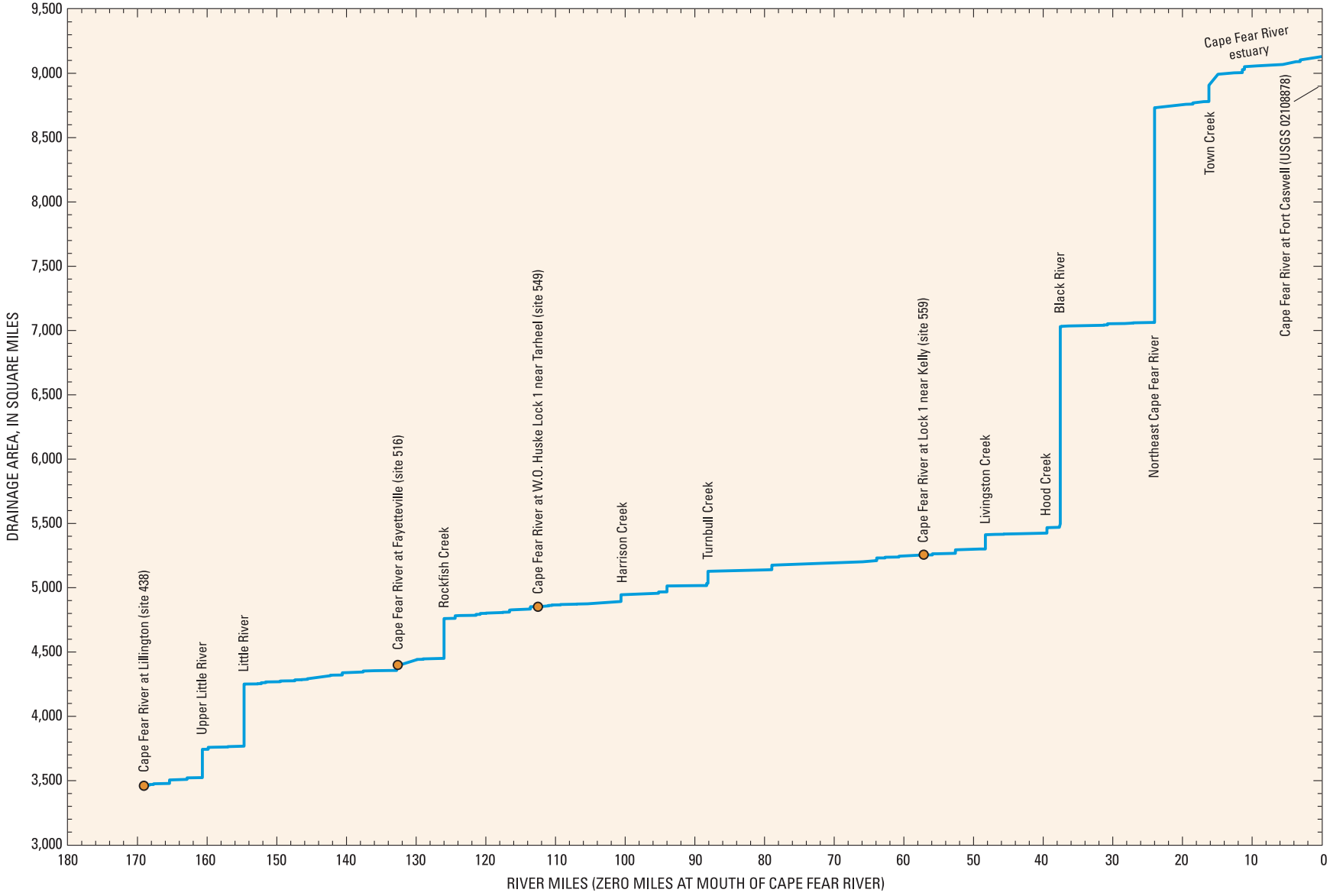

Figure 21A. Relation of river miles to drainage area for Cape Fear River (downstream from Lillington, site 438; see p. 36).

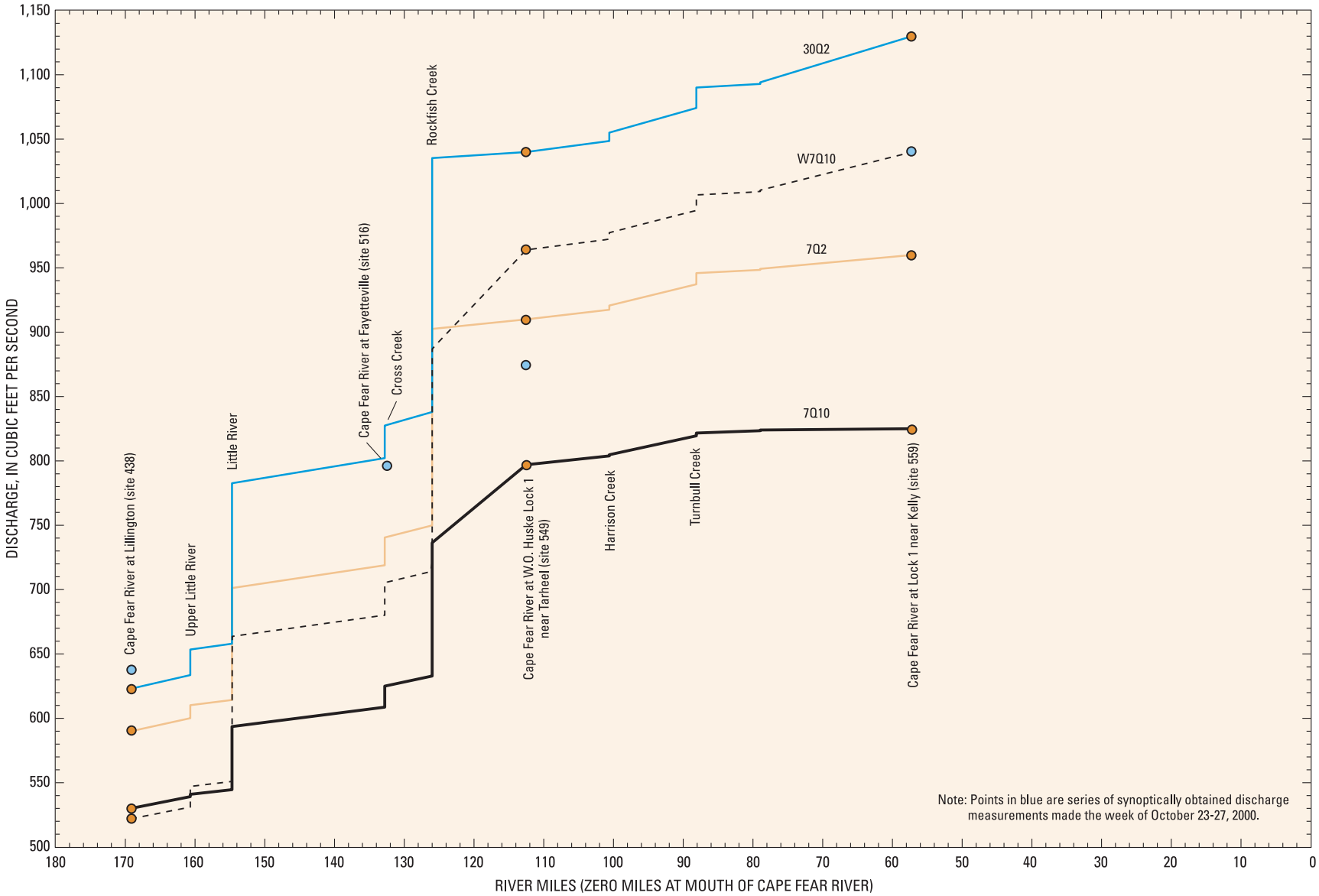

Figure 21B. Relation of river miles to low-flow discharges for Cape Fear River (downstream from Lillington, site 438; see p. 36).

Table 3. Summary of selected surface-water withdrawals and point-source discharges to streams in the Cape Fear River Basin, North Carolina, 1998

[Mgal/d, million gallons per day (1 Mgal/d is equivalent to approximately 1.5 cubic feet per second); NPDES, National Pollutant Discharge Elimination System; UT, unnamed tributary; WTP, water-treatment plant; WWTP, wastewater-treatment plant; N/A, not applicable. Facilities are listed in general downstream order in the Cape Fear River Basin. For streams profiled in this report, river miles to the nearest tenth are listed in parentheses beside stream names. Locations of numbered sites are shown on plate 1. For municipalities having multiple withdrawals and(or) point-source discharges, the sum of withdrawals should be compared against sum of point-source discharges for more meaningful comparisons. Where point-source discharge(s) is greater than withdrawal amount(s) for some municipalities, these facilities treat wastewater for nearby smaller municipalities]

County	Facility name	Purpose	Source of withdrawal	Average withdrawal (Mgal/d)	Destination of point-source discharge	Average point-source discharge (Mgal/d)	NPDES permit number	Permitted NPDES discharge (Mgal/d)
Rockingham	Town of Reidsville	Public water supply	Troublesome Creek	3.6	Little Troublesome Creek	3.3	NC0024881	5
Alamance	Glen Raven Mills – Altamahaw Division	Manufacturing	Haw River (mile 246.1)	0.20	Haw River (mile 246.1)	0.12[a,b]	NC0003913	0.15
Guilford	Cone Mills – Greensboro	Manufacturing	Buffalo Lake[c] Lake Jeanette (formerly Richland Lake)	1.4	North Buffalo Creek (mile 9.6), UT North Buffalo Creek	1.1[a]	NC0000876	1.25
Guilford	City of Greensboro	Public water supply	Reedy Fork (15.4 Mgal/d by way of Lake Brandt; 23.2 Mgal/d by way of Lake Townsend)	38.6	Reedy Fork Creek (Lake Townsend WTP, mile 20.2)	1.7[d]	NC0081671	1.5
					North Buffalo Creek WWTP (mile 8.1)	13.3	NC0024325	16
					South Buffalo Creek (T.Z. Osborne plant, mile 12.4)	19.2	NC0047384	22
Alamance	Town of Mebane	Public water supply	Back Creek (Graham-Mebane Lake)	3.7[e]	Moadams Creek	1.0	NC0021474	2.5
Alamance	City of Graham	Public water supply	Back Creek (Graham-Mebane Lake)	N/A[e]	Haw River (mile 230.1)	2.0	NC0021211	3.5
Alamance	City of Burlington	Public water supply	Big Alamance Creek (Lake Mackintosh, mile 9.4, site 113)	10.7	Haw River (Eastside WWTP, mile 234.3)	7.1[f]	NC0023868	12
			Stony Creek (Stony Creek Reservoir/Lake Cammack)	2.5[g]	Big Alamance Creek (Southside WWTP, mile 0.5)	8.3	NC0023876	12
Chatham	Town of Pittsboro	Public water supply	Haw River (mile 202.9)	0.71[h]	Roberson Creek	0.36	NC0020354	0.75
Durham	City of Durham	Public water supply	Lake Michie and Little River Reservoir (Neuse River Basin)	N/A[i]	New Hope Creek	10.4	NC0047597	20
Durham	Durham County	Public water supply	Supplied by City of Durham	N/A	Northeast Creek	4.4	NC0026051	6

Table 3. Summary of selected surface-water withdrawals and point-source discharges to streams in the Cape Fear River Basin, North Carolina, 1998—Continued

[Mgal/d, million gallons per day (1 Mgal/d is equivalent to approximately 1.5 cubic feet per second); NPDES, National Pollutant Discharge Elimination System; UT, unnamed tributary; WTP, water-treatment plant; WWTP, wastewater-treatment plant; N/A, not applicable. Facilities are listed in general downstream order in the Cape Fear River Basin. For streams profiled in this report, river miles to the nearest tenth are listed in parentheses beside stream names. Locations of numbered sites are shown on plate 1. For municipalities having multiple withdrawals and(or) point-source discharges, the sum of withdrawals should be compared against sum of point-source discharges for more meaningful comparisons. Where point-source discharge(s) is greater than withdrawal amount(s) for some municipalities, these facilities treat wastewater for nearby smaller municipalities]

County	Facility name	Purpose	Source of withdrawal	Average withdrawal (Mgal/d)	Destination of point-source discharge	Average point-source discharge (Mgal/d)	NPDES permit number	Permitted NPDES discharge (Mgal/d)
Orange	Orange Water and Sewer Authority (OWASA)	Public water supply	Cane Creek (3.8 Mgal/d by way of Cane Creek Reservoir)	9.1	Morgan Creek	8.0	NC0025241	8
			Morgan Creek (5.3 Mgal/d by way of University Lake)					
Wake	Town of Cary	Public water supply	Jordan Lake	11.6[j]	Crabtree Creek (North Cary WWTP in Neuse River Basin)	6.0	NC0048879	12
					Middle Creek (South Cary WWTP in Neuse River Basin)	3.6	NC0065102	16
Wake	Town of Apex	Public water supply	Jordan Lake	N/A[j]	UT Middle Creek (Neuse River Basin)	1.5	NC0064050	1.8
Wake	Town of Holly Springs	Public water supply	Supplied by City of Raleigh and Harnett County (by way of Fuquay-Varina)	N/A	Utley Creek	0.48	NC0063096	0.5
Chatham	Honeywell International Inc.	Manufacturing	Haw River (mile 191.1)	0.25[b]	Haw River (mile 191.1), UT Shaddox Creek	0.20[a]	NC0001899	0.244
Guilford	City of High Point[k]	Public water supply	Deep River (High Point Muncipal Lake)	13.9	UT Richland Creek (WTP)	0.71	NC0081256	10
					Richland Creek (East Side WWTP)	12.7	NC0024210	16
					Rich Fork Creek (West Side WWTP in Yadkin-Pee Dee River Basin)	3.4	NC0024228[l]	10
Randolph	Town of Randleman	Public water supply	Polecat Creek (by way of reservoir located on stream)	1.1	Deep River	1.2[m]	NC0025445	1.745

Table 3. Summary of selected surface-water withdrawals and point-source discharges to streams in the Cape Fear River Basin, North Carolina, 1998—Continued

[Mgal/d, million gallons per day (1 Mgal/d is equivalent to approximately 1.5 cubic feet per second); NPDES, National Pollutant Discharge Elimination System; UT, unnamed tributary; WTP, water-treatment plant; WWTP, wastewater-treatment plant; N/A, not applicable. Facilities are listed in general downstream order in the Cape Fear River Basin. For streams profiled in this report, river miles to the nearest tenth are listed in parentheses beside stream names. Locations of numbered sites are shown on plate 1. For municipalities having multiple withdrawals and(or) point-source discharges, the sum of withdrawals should be compared against sum of point-source discharges for more meaningful comparisons. Where point-source discharge(s) is greater than withdrawal amount(s) for some municipalities, these facilities treat wastewater for nearby smaller municipalities]

County	Facility name	Purpose	Source of withdrawal	Average withdrawal (Mgal/d)	Destination of point-source discharge	Average point-source discharge (Mgal/d)	NPDES permit number	Permitted NPDES discharge (Mgal/d)
Randolph	City of Asheboro	Public water supply	Back Creek (by way of Lucas Lake) and Uwharrie River (by way of Reese Lake) in the Yadkin River Basin	N/A	Hasketts Creek	4.7	NC0026123	9
Randolph	Town of Ramseur	Public water supply	Sandy Creek	0.57	Deep River	0.27	NC0026565	0.48
Montgomery	Town of Star	Public water supply	Supplied by Montgomery County (most of county in Yadkin River basin)	N/A	Cotton Creek	0.33	NC0058548	0.6
Moore	Town of Robbins	Public water supply	Bear Creek, Cabin Creek, Brooks Reservoir	0.9[n]	Deep River	0.78	NC0062855	1
Lee	Golden Poultry, Inc.	Food processing	Supplied by Lee County Water and Sewer District	N/A	Deep River	0.77	NC0072575	1
Lee	City of Sanford	Public water supply	Cape Fear River (mile 185.8)	7.5	Deep River	4.0	NC0024147	6.8[o]
Chatham	Town of Siler City	Public water supply	Rocky River (mile 31.7)	3.0	Loves Creek	2.9	NC0026441	4
Chatham	Carolina Power and Light (Cape Fear plant)	Cooling water	Cape Fear River (mile 183.6)	206.9	UT Cape Fear River (just above mouth, mile 183.6)	204.0[a]	NC0003433	10
Wake	Carolina Power and Light (Shearon Harris nuclear plant)	Cooling water	Shearon Harris Lake (Buckhorn Creek)	37.4[b]	Shearon Harris Lake	3.9[a]	NC0039586	0.05
Wake	Town of Fuquay-Varina[p]	Public water supply	Supplied by City of Raleigh (by way of Town of Garner) and Harnett County	N/A	Kenneth Creek	0.91	NC0028118	1.2
					Terrible Creek (Neuse River Basin)	0.0[p]	NC0066516	6.0
Harnett	Harnett County[q]	Public water supply	Cape Fear River (mile 169.3)	6.5	Cape Fear River (Buies Creek WWTP, mile 165.0)	0.41	NC0030091	0.5
Harnett	Town of Lillington	Public water supply	Supplied by Harnett County	N/A	Cape Fear River (mile 168.4)	0.37	NC0021636	0.6
Harnett	Town of Angier	Public water supply	Supplied by Harnett County	N/A	Cape Fear River (mile 166.8)	0.33	NC0082597	0.5
Harnett	Town of Broadway	Public water supply	Supplied by City of Sanford, ground-water wells	N/A	Daniels Creek	0.08	NC0059242	0.145

Table 3. Summary of selected surface-water withdrawals and point-source discharges to streams in the Cape Fear River Basin, North Carolina, 1998—Continued

[Mgal/d, million gallons per day (1 Mgal/d is equivalent to approximately 1.5 cubic feet per second); NPDES, National Pollutant Discharge Elimination System; UT, unnamed tributary; WTP, water-treatment plant; WWTP, wastewater-treatment plant; N/A, not applicable. Facilities are listed in general downstream order in the Cape Fear River Basin. For streams profiled in this report, river miles to the nearest tenth are listed in parentheses beside stream names. Locations of numbered sites are shown on plate 1. For municipalities having multiple withdrawals and(or) point-source discharges, the sum of withdrawals should be compared against sum of point-source discharges for more meaningful comparisons. Where point-source discharge(s) is greater than withdrawal amount(s) for some municipalities, these facilities treat wastewater for nearby smaller municipalities]

County	Facility name	Purpose	Source of withdrawal	Average withdrawal (Mgal/d)	Destination of point-source discharge	Average point-source discharge (Mgal/d)	NPDES permit number	Permitted NPDES discharge (Mgal/d)
Harnett	Swift Textiles – Erwin	Manufacturing	Cape Fear River (mile 160.0)	3.4[r]	Cape Fear River (mile 159.7)	2.2[a]	NC0001406	2.5
Harnett	Town of Erwin	Public water supply	Supplied by Swift Textiles[r]	N/A	Cape Fear River (mile 159.7)	1.0	NC0064521	1.2
Harnett	City of Dunn	Public water supply	Cape Fear River (mile 160.0)	3.0	Juniper Creek (WTP)	0.23	NC0078955	2
					Cape Fear River (WWTP, mile 159.7)	2.6	NC0043176	3
Cumberland	U.S. Army – Fort Bragg	Public water supply	Little River (mile 27.0)	7.8	Little River (WTP and WWTP, mile 24.6)	5.4[s]	NC0003964	8
Cumberland	Town of Spring Lake	Public water supply	Supplied by City of Fayetteville, ground-water wells	N/A	Little River (mile 21.4)	0.92	NC0030970	1.5
Cumberland	City of Fayetteville	Public water supply	Cape Fear River (Hoffer WTP, mile 135.1)	17.5	Cape Fear River (Cross Creek WWTP, mile 133.6)	14.7	NC0023957	22
			Little Cross Creek[t] (Glenville Lake WTP)	9.6	Cape Fear River (Rockfish Creek WWTP, mile 126.3)	9.8	NC0050105	14
Cumberland	Monsanto – Fayetteville	Industrial	Supplied by City of Fayetteville (PWC)	N/A	Cape Fear River (mile 123.7)	1.0[a]	NC0003719	0.889
Hoke	City of Raeford	Public water supply	Ground-water wells	N/A	Rockfish Creek (mile 29.8)	1.5	NC0026514	3
Bladen	Dupont – Fayetteville	Industrial	Cape Fear River (mile 112.2)	14.4	Cape Fear River (mile 112.2)	14.4[u]	NC0003573	2
Bladen	Smithfield Foods, Inc. – Tarheel	Food processing	Ground-water wells	N/A	Cape Fear River (mile 106.3)	2.3	NC0078344	3
Bladen	Alamac Knit Fabrics	Manufacturing	Ground-water wells	N/A	Cape Fear River (mile 93.5)	1.7	NC0003522	2.5
Bladen	Veeder–Root Company	Industrial	Supplied by Town of Elizabethtown	N/A	Cape Fear River (mile 92.6)	0.31[a]	NC0001121	5
Bladen	Town of Elizabethtown	Public water supply	Ground-water wells	N/A	Cape Fear River (mile 90.4)	0.67	NC0026671	0.7
Bladen	Town of White Lake	Public water supply	Ground-water wells	N/A	UT Colly Creek	0.32	NC0023353	0.8
Columbus	International Paper – Riegelwood	Manufacturing	Cape Fear River (mile 48.8)	39.2	Cape Fear River (mile 48.8)	36.4	NC0003298	50

Table 3. Summary of selected surface-water withdrawals and point-source discharges to streams in the Cape Fear River Basin, North Carolina, 1998—Continued

[Mgal/d, million gallons per day (1 Mgal/d is equivalent to approximately 1.5 cubic feet per second); NPDES, National Pollutant Discharge Elimination System; UT, unnamed tributary; WTP, water-treatment plant; WWTP, wastewater-treatment plant; N/A, not applicable. Facilities are listed in general downstream order in the Cape Fear River Basin. For streams profiled in this report, river miles to the nearest tenth are listed in parentheses beside stream names. Locations of numbered sites are shown on plate 1. For municipalities having multiple withdrawals and(or) point-source discharges, the sum of withdrawals should be compared against sum of point-source discharges for more meaningful comparisons. Where point-source discharge(s) is greater than withdrawal amount(s) for some municipalities, these facilities treat wastewater for nearby smaller municipalities]

County	Facility name	Purpose	Source of withdrawal	Average withdrawal (Mgal/d)	Destination of point-source discharge	Average point-source discharge (Mgal/d)	NPDES permit number	Permitted NPDES discharge (Mgal/d)
Sampson	Town of Newton Grove	Public water supply	Ground-water wells	N/A	Beaverdam Swamp	0.05	NC0072877	0.2
Sampson	Town of Clinton	Public water supply	Ground-water wells	N/A	Williams Old Mill Branch	2.7	NC0020117	3
Duplin	Town of Warsaw	Public water supply	Ground-water wells	N/A	Stewarts Creek	0.59	NC0021903	0.61
Sampson	Town of Roseboro	Public water supply	Ground-water wells	N/A	Little Coharie Creek	0.49	NC0026816	0.7
Sampson	Town of Garland	Public water supply	Ground-water wells	N/A	Great Coharie Creek (mile 69.0	0.07	NC0025569	0.126
Brunswick	Town of Belville	Public water supply	Supplied by Brunswick County	N/A	Brunswick River	0.04	NC0075540	0.4
Brunswick	Brunswick County	Public water supply	Cape Fear River (mile 57.2, site 559)	8.0	N/A[v]	N/A	N/A	N/A
			Ground-water wells	N/A				
Brunswick	Dupont – Wilmington, Brunswick	Industrial	Cape Fear River (mile 35.7)	7.7	Cape Fear River (mile 35.7), UT Cape Fear River, UT Bay Branch	4.8[a]	NC0000663	3.5
New Hanover	Arteva Specialties (KoSa) – Wilmington	Industrial	Supplied by Lower Cape Fear Water and Sewer Authority, ground-water wells	N/A	Cape Fear River (mile 33.2), Northeast Cape Fear River (mile 7.5)	1.7[a]	NC0001112	1.25
Brunswick	Carolina Power and Light (Sutton plant)	Cooling water	Cape Fear River (mile 27.5)	21.1	Cape Fear River (mile 27.5)	20.4	NC0001422	No limit
Wayne	Mt. Olive Pickle Company	Food processing	Supplied by Town of Mount Olive	N/A	Barlow Branch	0.36[a]	NC0001074	0.4
Wayne	Town of Mount Olive	Public water supply	Ground-water wells	N/A	Northeast Cape Fear River (mile 130.8)	1.0	NC0020575	1
Duplin	Dean Pickle & Specialty Prod.	Food processing	Supplied by City of Faison	N/A	UT Panther Branch	0.38	NC0001970	0.5
Duplin	Town of Kenansville	Public water supply	Ground-water wells	N/A	Grove Creek	0.17	NC0036668	0.3
Duplin	Guilford Mills, Inc. (Guilford East Plant)	Manufacturing	Ground-water wells	N/A	Northeast Cape Fear River (mile 106.9)	0.63[w]	NC0002305	1.5
Duplin	Town of Beulaville	Public water supply	Ground-water wells	N/A	Persimmon Branch	0.17	NC0026018	0.26
Duplin	Town of Rose Hill	Public water supply	Ground-water wells	N/A	Reedy Branch	0.23	NC0056863	0.45

Table 3. Summary of selected surface-water withdrawals and point-source discharges to streams in the Cape Fear River Basin, North Carolina, 1998—Continued

[Mgal/d, million gallons per day (1 Mgal/d is equivalent to approximately 1.5 cubic feet per second); NPDES, National Pollutant Discharge Elimination System; UT, unnamed tributary; WTP, water-treatment plant; WWTP, wastewater-treatment plant; N/A, not applicable. Facilities are listed in general downstream order in the Cape Fear River Basin. For streams profiled in this report, river miles to the nearest tenth are listed in parentheses beside stream names. Locations of numbered sites are shown on plate 1. For municipalities having multiple withdrawals and(or) point-source discharges, the sum of withdrawals should be compared against sum of point-source discharges for more meaningful comparisons. Where point-source discharge(s) is greater than withdrawal amount(s) for some municipalities, these facilities treat wastewater for nearby smaller municipalities]

County	Facility name	Purpose	Source of withdrawal	Average withdrawal (Mgal/d)	Destination of point-source discharge	Average point-source discharge (Mgal/d)	NPDES permit number	Permitted NPDES discharge (Mgal/d)
Duplin	Swift-Eckrich – Butterball	Food processing	Ground-water wells	N/A	Rockfish Creek (mile 14.0)	0.74[x]	NC0003344	1.5
Duplin	Town of Wallace	Public water supply	Ground-water wells	N/A	Rockfish Creek (mile 4.3)	0.62[y]	NC0020702	1
Pender	Town of Burgaw	Public water supply	Ground-water wells	N/A	Osgood Canal	0.42	NC0021113	0.75
New Hanover	Occidental Chemical Corp.	Industrial	Northeast Cape Fear River (mile 25.2)	0.54[z]	Northeast Cape Fear River (mile 25.2)	0.68[a]	NC0003875	1.07
New Hanover	Global Nuclear Fuel (General Electric)	Industrial	Ground-water wells	N/A	Northeast Cape Fear River (mile 6.5)	0.56[a]	NC0001228	1.875
New Hanover	City of Wilmington	Public water supply	Cape Fear River (mile 57.2, site 559)	11.3	Northeast Cape Fear River (Sweeney WTP, mile 1.6)	0.91	NC0002879	1.5
			Ground-water wells[aa]	N/A				
					Cape Fear River (Northside WWTP, mile 24.2)	5.2[aa]	NC0023965	8
					Cape Fear River (Southside WWTP, mile 18.6)	9.2[aa]	NC0023973	12
New Hanover	Town of Carolina Beach	Public water supply	Ground-water wells	N/A	Cape Fear River (mile 8.7)	1.7	NC0023256	3
New Hanover	Town of Kure Beach	Public water supply	Ground-water wells	N/A	Cape Fear River (mile 6.8)	0.09	NC0025763	0.285
Brunswick	Archer Daniels Midland Company	Industrial	Supplied by Brunswick County	N/A	Cape Fear River (mile 1.2)	2.0	NC0027065	3.51
Brunswick	City of Southport	Public water supply	Ground-water wells	N/A	Cottage Creek	0.53	NC0021334	0.8
Brunswick	Carolina Power and Light (Brunswick nuclear plant)	Cooling water	Cape Fear River (mile 3.7)	1,391[ab]	Atlantic Ocean[ac]	1,391[a]	NC0007064	0.055

[a] Average return discharge listed is the sum of two or more separate discharges reported for this facility. The permitted flow listed for the facility is amount of treated effluent allowed in the return discharge. In most instances where facilities have multiple return discharges, the treated effluent is not the total discharge to a stream, and facilities are not limited in their discharge of water that does not require treatment before being returned to a stream (Mr. Charles Weaver, North Carolina Division of Water Quality, oral commun., July 21, 2000).

[b] Withdrawal and(or) return discharge listed are average amounts observed during past several years; no data for 1998 were available.

[c] Facility obtains potable water from the City of Greensboro; the water is treated by the facility and returned to North Buffalo Creek by permitted NPDES discharge (Mr. Arthur Toompas, Cone Mills, oral commun., August 2, 2000).

[d] Construction and dredging operations at the facility resulted in higher average return discharge than permitted flow during 1998 (Mr. Bob Wardlow, City of Greensboro, oral commun., August 3, 2000).

[e] Town of Mebane and City of Graham make a joint withdrawal from Graham–Mebane Lake located on Back Creek, yet have separate return discharges.

Table 3. Summary of selected surface-water withdrawals and point-source discharges to streams in the Cape Fear River Basin, North Carolina, 1998—Continued

[f] The City of Burlington treats wastewater for nearby smaller municipalities, including Gibsonville, Elon College, and Haw River, which supply part of their own water from ground-water wells and(or) connections to other systems (Mr. Steve Shoaf, City of Burlington, oral commun., August 18, 2000).

[g] No withdrawals were made from Stony Creek Reservoir during 3 months (September–November) in 1998.

[h] Average daily withdrawal reported for 1997; no data for 1998 were available.

[i] The City of Durham is located on the drainage-basin divide between the Neuse and Cape Fear River Basins. Water-supply withdrawals are drawn from the Flat and Little Rivers in the Neuse River Basin; part of the wastewater is treated and released into the Cape Fear River Basin.

[j] The Towns of Cary and Apex jointly operate a water-supply facility that withdraws water from Jordan Lake. Part of the withdrawal (less than 10 percent) is diverted to Chatham County for its water-supply needs. The Town of Cary currently has contracts to purchase 5 and 4 Mgal/d of water supply from the Cities of Raleigh and Durham, respectively. Part of the water received through these transfers is provided to Apex, Research Triangle Park, and Morrisville. When expansions of water-treatment facilities are completed in the future, it is anticipated that transfers from Raleigh and Durham will only be done in emergency situations (Mr. Kelvin Creech, Town of Cary, oral commun., August 2000).

[k] The City of High Point also supplies and treats water for the Archdale and Jamestown municipalities.

[l] NPDES permit number was published erroneously as NC0081256 in the report on low-flow characteristics in the Deep River subbasin (Weaver, 1997).

[m] The Town of Randleman receives and treats some wastewater from the City of Asheboro.

[n] Average withdrawal reported for the Town of Robbins represents total amount of water withdrawn from the three identified sources.

[o] Permitted flow was published erroneously as 5 Mgal/d in the report on low-flow characteristics in the Deep River subbasin (Weaver, 1997).

[p] Currently (2001), a water-supply line is being constructed to bring up to 2 Mgal/d of water from Johnston County. Town is also participating in an effort to develop a regional wastewater-treatment facility with nearby small municipalities and Harnett County, which eventually will discharge treated effluent into the Cape Fear River. When the regional facility is opened, the wastewater-treatment plant that discharges to Kenneth Creek will be closed. The wastewater-treatment plant on Terrible Creek (Neuse River Basin) discharged little treated effluent in 1998 and continues to be expanded (Mr. Larry Bennett, Town of Fuquay-Varina, oral commun., August 17, 2000).

[q] Harnett County treats and supplies water to nearby smaller municipalities, including Angier, Coats, Fuquay-Varina, Lillington, and Linden. The County recently took over a wastewater-treatment facility in southwestern Harnett County that has a permitted flow of 0.4 Mgal/d and discharges into Jumping Run Creek (tributary to Little River) (Mr. Gary Averitte, Harnett County, oral commun., August 21, 2000).

[r] Withdrawals from the Cape Fear River by Swift Textiles are stored in a holding pond behind the facility, which the Town of Erwin also accesses for public water supply. Beginning in 1999, changes in operations at Swift Textiles reduced the withdrawal amounts by approximately 25 percent (Mr. Carlton Williams, Swift Textiles, oral commun., July 27, 2000). In 2000, announcements concerning the planned closure of Swift Textiles were made public. Consequently, the Town of Erwin has asked that the holding pond and pumping station be turned over to the town.

[s] Average return discharge listed is the sum of discharges from the water-treatment and wastewater-treatment plants for Fort Bragg.

[t] In addition to the withdrawal made from the Cape Fear River at the Hoffer water-treatment plant, part of the intake water treated at the Glenville Lake water-treatment plant is withdrawn from the Cape Fear River.

[u] Treated effluent is about 1 Mgal/d of the total return discharge amount listed for this facility. Most all water withdrawn by the facility is returned to the Cape Fear River (Mr. Michael Johnson, DuPont Fayetteville, oral commun., July 21, 2000).

[v] Brunswick County has several minor NPDES discharges with permitted flows generally less than 0.1 Mgal/d. Most of the nearby municipalities supplied by the county treat and discharge their own effluents.

[w] Average return discharge has increased to about 1 Mgal/d due to recent increases in production since 1998 (Mr. Jimmy Summers, Guilford Mills, oral commun., August 1, 2000).

[x] Recent changes in food sanitation regulations have resulted in increased return discharges in the range of 1.0 to 1.1 Mgal/d. These regulations have been applied to all poultry and other meat-processing operations (Mr. Buddy Harris, Swift-Eckrich (Butterball), oral commun., August 18, 2000).

[y] The Town of Wallace recently acquired another wastewater-treatment facility that was operated by a textile mill that discharged treated effluent to Little Rockfish Creek (NPDES permit NC0003450, permitted flow 5 Mgal/d). The town plans to renovate the facility and make it available as part of its wastewater-treatment infrastructure.

[z] Facility also obtains potable and processed water from three ground-water wells. In 1999, the average daily withdrawal from the wells was 0.36 Mgal/d (Mr. John O'Janpa, Occidental Chemical, oral commun., July 27, 2000).

[aa] City of Wilmington recently purchased Cape Fear Utilities, which has ground-water wells that supply the eastern parts of New Hanover County. The city treats wastewater for Wrightsville Beach and most of New Hanover County (Mr. Mike Richardson and Mr. W.T. Anderson, Jr., City of Wilmington, oral commun., August 17–18, 2000).

[ab] Based on 1999 withdrawal amounts reported to N.C. Division of Water Resources. Consultation with facility personnel indicated that 1998 withdrawals were approximately the same as those reported for 1999.

[ac] Return discharge is located 2,000 feet offshore from Caswell Beach in Brunswick County.

Table 6. Summary of continuous-record gaging stations and partial-record measuring sites in the Cape Fear River Basin in North Carolina where records of gage height and streamflow were collected

[mi^2, square mile; SR, secondary road; N/A, not applicable; SEO, sewage effluent outfall; Ind, drainage area is undetermined and(or) may be indeterminate. Gray shading indicates sites for which low-flow characteristics have been developed. Period of record for continuous-record sites (site type 1) is shown in months and years; period of record for partial-record sites (site type 2) is shown in water years in which discharge measurements were made]

Site index no. (pl. 1)	USGS downstream order number	Station name	Latitude	Longitude	County	USGS topographic quadrangle	Drainage area (mi^2)	Tributary to	Hydrologic unit code	Site type	Period of record	Number of measurements for partial-record sites	
												Flow	Zero flow
1	02093248	Haw River near Oak Ridge	36°11'52"	79°59'08"	Guilford	Summerfield	7.93	Cape Fear River	03030002	2	1962, 1966, 1971, 1973-84	45	1
2	02093250	Haw River at SR 2109 near Oak Ridge	36°12'47"	79°57'24"	Guilford	Summerfield	14.1	Cape Fear River	03030002	2	1971, 1973, 1984, 1986-98	48	0
3	02093260	Haw River at U.S. Hwy 220 near Summerfield	36°13'42"	79°54'52"	Guilford	Summerfield	20.6	Cape Fear River	03030002	2	1951-60, 1962, 1966	21	0
4	02093290	Haw River near Summerfield	36°14'32"	79°52'20"	Guilford	Lake Brandt	26.9	Cape Fear River	03030002	2	1954, 1956-71	17	0
5	02093297	Mears Fork near Summerfield	36°12'56"	79°50'42"	Guilford	Lake Brandt	5.11	Haw River	03030002	2	1962, 1966	3	0
6	02093298	Mears Fork tributary near Hillsdale	36°12'55"	79°50'40"	Guilford	Lake Brandt	0.53	Mears Fork	03030002	2	1962	1	0
7	02093301	Mears Fork at mouth near Hillsdale	36°14'52"	79°47'05"	Guilford	Lake Brandt	12.7	Haw River	03030002	2	1962, 1966	3	0
8	02093304	Haw River near Midway	36°14'57"	79°46'57"	Guilford	Lake Brandt	50.3	Cape Fear River	03030002	2	1962, 1966	3	0
9	0209330990	Brooks Lake tributary near Browns Summit	36°13'40"	79°43'20"	Guilford	Browns Summit	0.06	Brooks Lake (tributary to Benaja Creek)	03030002	1	Nov 1984 - Feb 1990	N/A	N/A
10	02093311	Benaja Creek at Benaja	36°14'56"	79°40'36"	Rockingham	Browns Summit	8.21	Haw River	03030002	2	1966	1	0
11	02093313	Haw River near Foushee	36°16'00"	79°39'00"	Rockingham	Reidsville	79.7	Cape Fear River	03030002	2	1954, 1962	3	0
12	0209331325	Candy Creek at SR 2700 near Monticello	36°14'02"	79°39'43"	Guilford	Browns Summit	1.10	Haw River	03030002	1	Oct 1985 - Sept 1990	N/A	N/A
13	02093328	Troublesome Creek near Midway	36°18'01"	79°46'40"	Rockingham	Bethany	25.6	Haw River	03030002	2	1962	2	0
14	02093336	Troublesome Creek near Monroeton	36°18'14"	79°43'13"	Rockingham	Reidsville	44[a]	Haw River	03030002	2	1954-55, 1962, 1966, 1970	6	0

Table 6. Summary of continuous-record gaging stations and partial-record measuring sites in the Cape Fear River Basin in North Carolina where records of gage height and streamflow were collected—Continued

[mi^2, square mile; SR, secondary road; N/A, not applicable; SEO, sewage effluent outfall; Ind, drainage area is undetermined and(or) may be indeterminate. Gray shading indicates sites for which low-flow characteristics have been developed. Period of record for continuous-record sites (site type 1) is shown in months and years; period of record for partial-record sites (site type 2) is shown in water years in which discharge measurements were made]

Site index no. (pl. 1)	USGS downstream order number	Station name	Latitude	Longitude	County	USGS topographic quadrangle	Drainage area (mi^2)	Tributary to	Hydrologic unit code	Site type	Period of record	Number of measurements for partial-record sites	
												Flow	Zero flow
15	02093345	Troublesome Creek near Reidsville	36°17'29"	79°41'34"	Rockingham	Reidsville	51.5	Haw River	03030002	2	1974	2	0
16	02093360	Troublesome Creek near Reidsville[b]	36°16'00"	79°39'00"	Rockingham	Reidsville	54.8	Haw River	03030002	2	1930, 1949-55	25	1
17	02093383	Little Troublesome Creek at Reidsville	36°19'51"	79°39'56"	Rockingham	Reidsville	3.78	Haw River	03030002	2	1970-73	5	0
18	0209340340	Little Troublesome Creek at U.S. Hwy 29 Bypass near Williamsburg	36°17'53"	79°38'29"	Rockingham	Reidsville	9.2[a]	Haw River	03030002	2	1974-75	3	0
19	02093423	Little Troublesome Creek near Williamsburg	36°16'53"	79°36'37"	Rockingham	Williamsburg	12.1	Haw River	03030002	2	1970-73, 1976-77, 1995-98	23	0
20	02093500	Haw River near Benaja	36°15'06"	79°33'55"	Rockingham	Williamsburg	168	Cape Fear River	03030002	1	Oct 1928 - Sept 1971	N/A	N/A
21	02093549	Haw River at Altamahaw	36°10'57"	79°30'37"	Alamance	Ossipee	188	Cape Fear River	03030002	2	1967-74	13	0
22	02093599	Haw River near Altamahaw	36°10'43"	79°30'17"	Alamance	Ossipee	189	Cape Fear River	03030002	2	1969-71, 1973, 1976-77	12	0
23	02093699	Reedy Fork near Kernersville	36°07'25"	80°03'00"	Forsyth	Kernersville	0.8[a]	Haw River	03030002	2	1955	1	0
24	0209374350	Reedy Fork at SR 1858 near Oak Ridge	36°08'00"	80°00'52"	Guilford	Belews Creek	4.91	Haw River	03030002	2	1973-74, 1976-77	10	0
25	02093749	Reedy Fork near Colfax	36°08'16"	79°59'33"	Guilford	Summerfield	5.85	Haw River	03030002	2	1955, 1962	3	0
26	02093792	Beaver Creek near Oak Ridge	36°09'37"	79°58'45"	Guilford	Summerfield	4.56	Reedy Fork	03030002	2	1962, 1966	2	0
27	02093800	Reedy Fork near Oak Ridge	36°10'22"	79°57'12"	Guilford	Summerfield	20.6	Haw River	03030002	1	Oct 1955 - Sept 1998	N/A	N/A
28	02093822	Moores Creek at SR 2132 near Oak Ridge	36°08'38"	79°56'52"	Guilford	Summerfield	0.9[a]	Reedy Fork	03030002	2	1971, 1973-74	7	0
29	02093876	Brush Creek at SR 2137 near Friendship	36°07'15"	79°59'40"	Guilford	Guilford	4.59	Reedy Fork	03030002	2	1974-75	5	0
30	02093878	Brush Creek at Brass Eagle Loop near Oak Ridge[c]	36°08'27"	79°54'46"	Guilford	Summerfield	7.46	Reedy Fork	03030002	2	1974-75, 1986	12	0
31	02093879	Brush Creek near Summerfield	36°09'00"	79°54'00"	Guilford	Summerfield	10[a]	Reedy Fork	03030002	2	1955	1	0

Table 6. Summary of continuous-record gaging stations and partial-record measuring sites in the Cape Fear River Basin in North Carolina where records of gage height and streamflow were collected—Continued

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Site index no. (pl. 1)	USGS downstream order number	Station name	Latitude	Longitude	County	USGS topographic quadrangle	Drainage area (mi^2)	Tributary to	Hydrologic unit code	Site type	Period of record	Number of measure-ments for partial-record sites	
												Flow	Zero flow
32	0209391880	Horsepen Creek at SR 2136 near Guilford College	36°07'02"	79°53'31"	Guilford	Summerfield	7.52	Reedy Fork	03030002	2	1974-75, 1986	13	0
33	02093919	Horsepen Creek near Guilford College	36°07'20"	79°53'02"	Guilford	Guilford	9.1[a]	Reedy Fork	03030002	2	1954-55, 1966, 1970	6	0
34	02093959	Horsepen Creek tributary near Guilford College	36°07'08"	79°52'10"	Guilford	Greensboro	3.04	Horsepen Creek	03030002	2	1954-55, 1986	16	0
35	02093992	Horsepen Creek at U.S. Hwy 220 near Greensboro	36°08'12"	79°51'40"	Guilford	Lake Brandt	15.9	Reedy Fork	03030002	2	1960, 1962, 1974-75, 1986	14	0
36	02094000	Horsepen Creek at Battle Ground	36°08'34"	79°51'40"	Guilford	Lake Brandt	16.4	Reedy Fork	03030002	1	Oct 1925 - Sept 1931, Apr 1934 - Sept 1959	N/A	N/A
37	02094232	Squirrel Creek near Greensboro	36°11'42"	79°45'16"	Guilford	Lake Brandt	5.42	Reedy Fork	03030002	2	1962	1	0
38	02094377	Reedy Fork near Monticello	36°10'55"	79°40'27"	Guilford	Browns Summit	119	Haw River	03030002	2	1969-71, 1973	8	0
39	02094379	Smith Branch near Monticello	36°11'20"	79°40'33"	Guilford	Browns Summit	2.51	Reedy Fork	03030002	2	1962, 1966	3	0
40	02094500	Reedy Fork near Gibsonville	36°10'31"	79°37'01"	Guilford	Ossipee	131	Haw River	03030002	1	Sept 1928 - Sept 1998	N/A	N/A
41	02094659	South Buffalo Creek near Pomona	36°02'59"	79°51'22"	Guilford	Greensboro	7.30	Buffalo Creek	03030002	2	1954	3	0
42	02094772	South Buffalo Creek at South Elm Street at Greensboro	36°02'02"	79°47'30"	Guilford	Greensboro	15.8	Buffalo Creek	03030002	2	1969-70, 1973	6	0
43	0209478755	South Buffalo Creek tributary at SR 3303 at Greensboro	36°00'58"	79°47'22"	Guilford	Greensboro	2.5[a]	South Buffalo Creek	03030002	2	1974-75	5	0
44	02094819	South Buffalo Creek at U.S. Hwy 421 at Greensboro	36°02'37"	79°46'27"	Guilford	Greensboro	27.8	Buffalo Creek	03030002	2	1969-71, 1973-74	10	0
45	02094980	South Buffalo Creek at Willow Road at Greensboro	36°02'43"	79°45'43"	Guilford	Greensboro	29.9	Buffalo Creek	03030002	2	1954, 1956, 1958-64, 1966	27	0

Table 6. Summary of continuous-record gaging stations and partial-record measuring sites in the Cape Fear River Basin in North Carolina where records of gage height and streamflow were collected—Continued

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Site index no. (pl. 1)	USGS downstream order number	Station name	Latitude	Longitude	County	USGS topographic quadrangle	Drainage area (mi^2)	Tributary to	Hydrologic unit code	Site type	Period of record	Number of measure-ments for partial-record sites	
												Flow	Zero flow
46	02094996	South Buffalo Creek at Pear Street at Greensboro	36°03'09"	79°44'19"	Guilford	McLeansville	31.3	Buffalo Creek	03030002	2	1969-70, 1973-74	7	0
47	02095000	South Buffalo Creek near Greensboro	36°03'36"	79°43'33"	Guilford	McLeansville	34.0	Buffalo Creek	03030002	1	Aug 1928 - Sept 1958	N/A	N/A
										2	1969, 1973-74	6	0
48	02095046	South Buffalo Creek near Bessemer	36°05'22"	79°41'19"	Guilford	McLeansville	39.5	Buffalo Creek	03030002	2	1969-70, 1973-74, 1986	14	0
49	02095091	South Buffalo Creek at SR 2821 at McLeansville	36°06'45"	79°40'19"	Guilford	McLeansville	43.5	Buffalo Creek	03030002	1	Mar 1986 - Sept 1987	N/A	N/A
										2	1969-70, 1973, 1976-81, 1983-89, 1991-98	62	0
50	02095181	North Buffalo Creek at Westover Terrace at Greensboro	36°04'45"	79°48'48"	Guilford	Greensboro	9.55	Haw River	03030002	2	1962	2	0
51	02095228	North Buffalo Creek at Greensboro	36°04'53"	79°48'09"	Guilford	Greensboro	11.7	Buffalo Creek	03030002	2	1969-71, 1973	6	0
52	02095271	North Buffalo Creek at Church Street at Greensboro	36°05'52"	79°46'58"	Guilford	Greensboro	14.2	Buffalo Creek	03030002	2	1986	4	0
53	02095273	North Buffalo Creek at Yanceyville Street near Greensboro	36°06'05"	79°46'24"	Guilford	Greensboro	15.3	Buffalo Creek	03030002	2	1974-75, 1989	10	0
54	02095316	North Buffalo Creek at Summit Avenue at Greensboro	36°06'18"	79°45'53"	Guilford	Greensboro	21.7	Buffalo Creek	03030002	2	1986	4	0
55	02095317	North Buffalo Creek at U.S. Hwy 29 at Greensboro	36°06'17"	79°45'43"	Guilford	Greensboro	22.0	Buffalo Creek	03030002	2	1969-71, 1973	7	0
56	02095406	Muddy Creek at Greensboro	36°06'35"	79°44'30"	Guilford	McLeansville	3.85	North Buffalo Creek	03030002	2	1954, 1962	2	0
57	02095475	North Buffalo Creek tributary at SR 2835 at Greensboro	36°08'01"	79°43'29"	Guilford	Browns Summit	1.19	North Buffalo Creek	03030002	2	1974-75	5	0

Table 6. Summary of continuous-record gaging stations and partial-record measuring sites in the Cape Fear River Basin in North Carolina where records of gage height and streamflow were collected—Continued

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Site index no. (pl. 1)	USGS downstream order number	Station name	Latitude	Longitude	County	USGS topographic quadrangle	Drainage area (mi^2)	Tributary to	Hydrologic unit code	Site type	Period of record	Number of measure-ments for partial-record sites	
												Flow	Zero flow
58	02095500	North Buffalo Creek near Greensboro	36°07'13"	79°42'30"	Guilford	McLeansville	37.1	Buffalo Creek	03030002	1	Aug 1928 - Sept 1990	N/A	N/A
										2	1996-97	6	0
59	02095554	Buffalo Creek near McLeansville	36°08'34"	79°38'54"	Guilford	Browns Summit	91.9	Reedy Fork	03030002	2	1969-71, 1973, 1976-84	39	0
60	0209555450	Buffalo Creek at SR 2719 near Osceola	36°09'11"	79°36'51"	Guilford	Ossipee	97.4	Haw River	03030002	1	May 1986 - Mar 1987	N/A	N/A
61	02095608	Reedy Fork at NC 61 near Osceola	36°10'44"	79°34'36"	Guilford	Ossipee	243	Haw River	03030002	1	April 1986 - Dec 1987	N/A	N/A
										2	1969-71, 1973, 1988	10	0
62	02095681	Reedy Fork at Ossipee	36°10'23"	79°30'38"	Alamance	Ossipee	256	Haw River	03030002	2	1969-70, 1973, 1976-87, 1989-98	59	0
63	02095716	Haw River near Ossipee	36°09'10"	79°29'23"	Alamance	Lake Burlington	452	Cape Fear River	03030002	2	1969-71, 1973	8	0
64	02095752	Travis Creek tributary at Gibsonville	36°07'13"	79°32'27"	Guilford	Gibsonville	1.4[a]	Travis Creek	03030002	2	1970, 1973-75	10	0
65	0209581050	Travis Creek at SR 1500 near Gibsonville	36°07'45"	79°31'41"	Alamance	Ossipee	4.20	Haw River	03030002	2	1973-75	9	0
66	02095824	Travis Creek near Elon College	36°07'39"	79°30'45"	Alamance	Ossipee	4.70	Haw River	03030002	2	1970, 1973-74	5	0
67	02095862	Travis Creek near Ossipee	36°08'21"	79°29'36"	Alamance	Lake Burlington	14.5	Haw River	03030002	2	1969-71, 1973-74	8	0
68	02095907	Dry Creek at Glen Raven	36°07'49"	79°28'38"	Alamance	Lake Burlington	3.42	Haw River	03030002	2	1962, 1966	3	1
69	0209591001	Haw River near Glen Raven	36°07'56"	79°27'53"	Alamance	Lake Burlington	475	Cape Fear River	03030002	2	1969	2	0
70	02095968	Haw River at Hopedale	36°07'23"	79°24'27"	Alamance	Burlington	482	Cape Fear River	03030002	2	1969-70, 1973	6	0
71	02095977	Grays Branch near Stony Creek	36°15'26"	79°26'50"	Caswell	Cherry Grove	12.4	Stony Creek	03030002	2	1966, 1968	2	2

Table 6. Summary of continuous-record gaging stations and partial-record measuring sites in the Cape Fear River Basin in North Carolina where records of gage height and streamflow were collected—Continued

[mi^2, square mile; SR, secondary road; N/A, not applicable; SEO, sewage effluent outfall; Ind, drainage area is undetermined and(or) may be indeterminate. Gray shading indicates sites for which low-flow characteristics have been developed. Period of record for continuous-record sites (site type 1) is shown in months and years; period of record for partial-record sites (site type 2) is shown in water years in which discharge measurements were made]

Site index no. (pl. 1)	USGS downstream order number	Station name	Latitude	Longitude	County	USGS topographic quadrangle	Drainage area (mi^2)	Tributary to	Hydrologic unit code	Site type	Period of record	Number of measurements for partial-record sites	
												Flow	Zero flow
72	02095978	Stony Creek near Stony Creek	36°15'19"	79°26'36"	Caswell	Cherry Grove	23.8	Haw River	03030002	2	1960-62, 1966, 1968, 1970	8	2
73	02095991	Toms Creek near Union Ridge	36°14'06"	79°23'18"	Alamance	Lake Burlington	7.00	Stony Creek	03030002	2	1961-62, 1966	4	3
74	02095993	Toms Creek at Union Ridge[d]	36°12'00"	79°25'00"	Guilford	Lake Burlington	14[a]	Stony Creek	03030002	2	1960	1	0
75	02096000	Stony Creek near Burlington[d]	36°11'00"	79°24'50"	Alamance	Burlington NE	45.2	Haw River	03030002	1	July 1952 - Sept 1959	N/A	N/A
76	02096116	Buttermilk Creek below SEO near Stony Creek	36°15'33"	79°30'35"	Caswell	Williamsburg	0.1[a]	Stony Creek	03030002	2	1970, 1973-74	5	1
77	02096120	Buttermilk Creek near Burlington	36°11'30"	79°25'47"	Alamance	Lake Burlington	14.3	Stony Creek	03030002	2	1952-57, 1959-62, 1966	35	5
78	02096230	Jordan Creek near Union Ridge	36°11'20"	79°23'43"	Alamance	Lake Burlington	24.1	Stony Creek	03030002	2	1949-57, 1959-62, 1966, 1997-98	55	14
79	02096473	Service Creek near Hopedale	36°05'34"	79°24'08"	Alamance	Burlington	7.46	Haw River	03030002	2	1962, 1966	3	0
80	02096483	Boyds Creek near Haw River	36°06'07"	79°22'38"	Alamance	Burlington	6.58	Haw River	03030002	2	1962, 1966	3	1
81	02096500	Haw River at Haw River	36°05'13"	79°22'02"	Alamance	Mebane	606	Cape Fear River	03030002	1	Oct 1928 - Sept 1998	N/A	N/A
82	02096518	Haw River near Graham	36°02'56"	79°21'46"	Alamance	Mebane	609	Cape Fear River	03030002	2	1969-70, 1973, 1976-77	11	0
83	02096519	Town Branch near Graham	36°02'47"	79°21'59"	Alamance	Mebane	4.1[a]	Haw River	03030002	2	1969-70, 1973, 1975	11	0
84	0209651925	County Home Branch at SR 2100 near Graham	36°02'52"	79°22'33"	Alamance	Burlington	1.6[a]	Town Branch	03030002	2	1971, 1973-74	5	1
85	02096521	Back Creek near Pleasant Grove	36°08'26"	79°16'38"	Alamance	Burlington NE	14.5	Haw River	03030002	2	1962, 1966	3	0
86	02096522	Stagg Creek near Pleasant Grove	36°09'29"	79°16'44"	Alamance	Burlington NE	15.3	Back Creek	03030002	2	1962, 1966	3	1
87	02096523	Mill Creek near Mebane	36°07'00"	79°15'00"	Orange	Efland	3.9[a]	Back Creek	03030002	2	1962	2	0

Table 6. Summary of continuous-record gaging stations and partial-record measuring sites in the Cape Fear River Basin in North Carolina where records of gage height and streamflow were collected—Continued

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Site index no. (pl. 1)	USGS downstream order number	Station name	Latitude	Longitude	County	USGS topographic quadrangle	Drainage area (mi^2)	Tributary to	Hydrologic unit code	Site type	Period of record	Number of measure-ments for partial-record sites	
												Flow	Zero flow
88	02096527	Back Creek near Mebane	36°06'58"	79°18'30"	Alamance	Mebane	46.9	Haw River	03030002	2	1955, 1962, 1966	4	0
89	02096536	Quaker Creek near Mebane[e]	36°06'00"	79°19'00"	Alamance	Mebane	14.8	Back Creek	03030002	2	1962	2	0
90	02096553	Moadams Creek above SEO near Mebane	36°05'20"	79°17'01"	Alamance	Mebane	0.90	Back Creek	03030002	2	1954-55, 1966, 1970, 1973-75	10	1
91	02096571	Moadams Creek near Mebane	36°05'21"	79°18'28"	Alamance	Mebane	3.11	Back Creek	03030002	2	1970, 1973-74	4	0
92	0209657775	Back Creek near Mebane	36°05'24"	79°20'16"	Alamance	Mebane	73.0	Haw River	03030002	2	1969-70, 1973	6	0
93	02096582	Back Creek at NC 54 near Graham	36°02'43"	79°21'33"	Alamance	Mebane	81.2	Haw River	03030002	2	1969	1	0
94	02096587	Haw River at Swepsonville	36°01'33"	79°22'05"	Alamance	Mebane	697	Cape Fear River	03030002	2	1969, 1971, 1975	5	0
95	02096597	Big Alamance Creek near Climax	35°57'34"	79°41'32"	Guilford	Climax	10.9	Haw River	03030002	2	1962, 1966	3	1
96	0209659801	Big Alamance Creek near Julian	35°59'00"	79°39'00"	Guilford	Climax	19.9	Haw River	03030002	2	1962, 1966	3	1
97	0209659814	Little Alamance Creek near Julian	35°55'52"	79°40'34"	Guilford	Climax	2.0[a]	Big Alamance Creek	03030002	2	1974, 1976-77, 1979-81	13	1
98	02096601	Big Alamance Creek near Whitsett	36°02'15"	79°34'39"	Guilford	Gibsonville	49.0	Haw River	03030002	2	1962	2	0
99	02096602	Little Alamance Creek near Vandalia	36°00'12"	79°45'13"	Guilford	Greensboro	3.0[a]	Big Alamance Creek	03030002	2	1970, 1973-74	6	0
100	0209660225	Little Alamance Creek at SR 3317 near Pleasant Garden	36°00'20"	79°45'02"	Guilford	Greensboro	4.03	Big Alamance Creek	03030002	2	1974-75	5	0
101	02096603	Little Alamance Creek below SEO near Vandalia	36°00'46"	79°44'50"	Guilford	McLeansville	7.3[a]	Haw River	03030002	2	1970, 1973-74	5	0
102	02096604	Little Alamance Creek near Greensboro	36°01'52"	79°43'49"	Guilford	McLeansville	9.45	Big Alamance Creek	03030002	2	1962, 1966-67	4	0

Table 6. Summary of continuous-record gaging stations and partial-record measuring sites in the Cape Fear River Basin in North Carolina where records of gage height and streamflow were collected—Continued

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Site index no. (pl. 1)	USGS downstream order number	Station name	Latitude	Longitude	County	USGS topographic quadrangle	Drainage area (mi^2)	Tributary to	Hydrologic unit code	Site type	Period of record	Number of measurements for partial-record sites	
												Flow	Zero flow
103	02096605	Little Alamance Creek at SR 3077 near Sedalia	36°02'26"	79°40'59"	Guilford	McLeansville	18.7	Big Alamance Creek	03030002	2	1971, 1973-74	5	0
104	02096607	Beaver Creek near Sedalia	36°02'26"	79°39'58"	Guilford	McLeansville	7.26	Little Alamance Creek	03030002	2	1962	2	0
105	02096609	Little Alamance Creek tributary near Sedalia	36°03'56"	79°38'43"	Guilford	McLeansville	6.34	Little Alamance Creek	03030002	2	1962, 1966	3	0
106	02096610	Little Alamance Creek near Whitsett	36°03'15"	79°38'14"	Guilford	McLeansville	39.1	Big Alamance Creek	03030002	2	1950-59, 1962, 1966, 1974-75	24	0
107	02096650	Little Alamance Creek at SR 3056 near Sedalia	36°03'19"	79°36'08"	Guilford	Gibsonville	42.5	Big Alamance Creek	03030002	2	1974-75	5	0
108	02096660	Rock Creek near Whitsett	36°03'55"	79°35'57"	Guilford	Gibsonville	14.6	Little Alamance Creek	03030002	2	1954, 1956-71	23	0
109	02096700	Big Alamance Creek near Elon College[f]	36°02'21"	79°31'29"	Alamance	Gibsonville	116	Haw River	03030002	1	Aug 1957 - Sept 1980	N/A	N/A
110	02096704	Beaver Creek near Alamance	36°02'00"	79°31'00"	Alamance	Gibsonville	11.3	Big Alamance Creek	03030002	2	1962	2	0
111	02096705	Back Creek above SEO near Gibsonville	36°05'12"	79°33'24"	Guilford	Gibsonville	2.4[a]	Big Alamance Creek	03030002	2	1970, 1973-74	5	0
112	02096707	Back Creek near Gibsonville	36°04'44"	79°32'56"	Guilford	Gibsonville	3.19	Big Alamance Creek	03030002	2	1949, 1954-55, 1970, 1973-74	11	1
113	02096719	Big Alamance Creek at water intake at Alamance	36°02'10"	79°29'19"	Alamance	Burlington	140[a]	Haw River	03030002	2	1975	3	0

Table 6. Summary of continuous-record gaging stations and partial-record measuring sites in the Cape Fear River Basin in North Carolina where records of gage height and streamflow were collected—Continued

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Site index no. (pl. 1)	USGS downstream order number	Station name	Latitude	Longitude	County	USGS topographic quadrangle	Drainage area (mi^2)	Tributary to	Hydrologic unit code	Site type	Period of record	Number of measurements for partial-record sites	
												Flow	Zero flow
114	02096720	Big Alamance Creek at Alamance	36°02'25"	79°29'15"	Alamance	Burlington	144	Haw River	03030002	2	1949-54, 1956-57, 1961-63, 1970, 1973	25	0
115	02096735	Gum Branch below SEO near Elon College	36°04'21"	79°29'47"	Alamance	Burlington	1.1[a]	Big Alamance Creek	03030002	2	1970, 1973-74	5	0
116	02096740	Gum Creek near Alamance	36°03'07"	79°28'16"	Alamance	Burlington	4.06	Big Alamance Creek	03030002	2	1961-73	13	0
117	02096758	Big Alamance Creek at Bellemont	36°01'41"	79°26'27"	Alamance	Burlington	156	Haw River	03030002	2	1970-71, 1973	4	0
118	02096766	North Prong Stinking Quarter Creek near Kimesville	35°57'44"	79°34'25"	Guilford	Kimesville	12.6	Haw River	03030002	2	1960, 1962	3	0
119	02096773	South Prong Stinking Quarter Creek near Kimesville	35°58'01"	79°31'50"	Alamance	Kimesville	17.8	Stinking Quarter Creek	03030002	2	1962	2	0
120	02096780	South Prong Stinking Quarter Creek near Bellemont	35°59'22"	79°29'49"	Alamance	Snow Camp	33.6	Stinking Quarter Creek	03030002	2	1956-68, 1970	30	1
121	02096782	Stinking Quarter Creek near Bellemont	36°00'10"	79°28'07"	Alamance	Burlington	62.5	Big Alamance Creek	03030002	2	1962	1	0
122	02096784	Rock Creek near Kimesville	35°58'30"	79°27'03"	Alamance	Snow Camp	10.6	Stinking Quarter Creek	03030002	2	1962, 1966	2	0
123	02096786	Rock Creek near Bellemont	35°59'00"	79°27'00"	Alamance	Snow Camp	13.6	Stinking Quarter Creek	03030002	2	1962	1	0
124	02096788	Big Alamance Creek near Bellemont	36°01'01"	79°24'50"	Alamance	Burlington	242	Haw River	03030002	2	1974-84, 1986-89, 1994	41	0
125	02096798	Little Alamance Creek near Graham	36°02'49"	79°24'57"	Alamance	Burlington	13.5	Big Alamance Creek	03030002	2	1954, 1962, 1964-68, 1970	20	0

Table 6. Summary of continuous-record gaging stations and partial-record measuring sites in the Cape Fear River Basin in North Carolina where records of gage height and streamflow were collected—Continued

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Site index no. (pl. 1)	USGS downstream order number	Station name	Latitude	Longitude	County	USGS topographic quadrangle	Drainage area (mi^2)	Tributary to	Hydrologic unit code	Site type	Period of record	Number of measurements for partial-record sites	
												Flow	Zero flow
126	02096804	Little Alamance Creek near Bellemont	36°01'36"	79°24'20"	Alamance	Burlington	14.7	Big Alamance Creek	03030002	2	1970, 1975	2	0
127	02096811	Big Alamance Creek at NC 87 near Bellemont	36°01'25"	79°23'33"	Alamance	Burlington	260	Haw River	03030002	2	1969, 1973	5	0
128	02096817	Haw Creek near Mebane	36°02'09"	79°17'00"	Alamance	Mebane	8.92	Haw River	03030002	2	1960, 1962, 1966	4	0
129	02096818	Rock Creek near Mebane	36°01'44"	79°16'44"	Alamance	Mebane	4.94	Haw Creek	03030002	2	1960, 1962, 1966	4	2
130	02096820	Haw Creek near Swepsonville	36°00'02"	79°20'36"	Alamance	Mebane	27.8	Haw River	03030002	2	1955, 1960, 1962, 1964-68, 1970	16	0
131	02096824	Varnals Creek near Swepsonville	35°59'14"	79°21'33"	Alamance	Saxapahaw	11.6	Haw River	03030002	2	1962, 1966	3	0
132	02096829	Haw River at Saxapahaw	35°56'29"	79°18'58"	Alamance	Saxapahaw	1,016	Cape Fear River	03030002	2	1974	1	0
133	02096833	Motes Creek at Saxapahaw	35°56'53"	79°18'54"	Alamance	Saxapahaw	5.53	Haw River	03030002	2	1960, 1962, 1966	4	0
134	02096841	Marys Creek near Saxapahaw	35°54'57"	79°18'26"	Alamance	Saxapahaw	12.0	Haw River	03030002	2	1960, 1962, 1966	4	0
135	02096842	Cane Creek 0.1 mile above SR 1126 near Buckhorn	36°01'33"	79°10'30"	Orange	Efland	0.64	Haw River	03030002	1	Oct 1979 - Sept 1981	N/A	N/A
136	02096846	Cane Creek near Orange Grove	35°59'13"	79°12'23"	Orange	White Cross	7.54	Haw River	03030002	1	Nov 1988 - Sept 1998	N/A	N/A
										2	1960, 1962, 1966	4	0
137	02096847	Bear Creek near Orange Grove	35°58'19"	79°11'39"	Orange	White Cross	2.07	Cane Creek	03030002	2	1966	1	0
138	02096849	Toms Creek near Teer	35°58'30"	79°14'27"	Orange	White Cross	6.54	Cane Creek	03030002	2	1966	1	0
139	02096850	Cane Creek near Teer	35°56'34"	79°14'46"	Orange	White Cross	33.4	Haw River	03030002	1	Oct 1959 - Sept 1973	N/A	N/A
										2	1974-75	3	0
140	02096860	Cane Creek near Carrboro	35°55'42"	79°15'33"	Orange	Saxapahaw	36.6	Haw River	03030002	2	1954-56, 1958-62, 1968, 1970	22	0

Table 6. Summary of continuous-record gaging stations and partial-record measuring sites in the Cape Fear River Basin in North Carolina where records of gage height and streamflow were collected—Continued

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												Flow	Zero flow
141	02096879	Haw River near Terrells	35°53'43"	79°15'31"	Alamance	Saxapahaw	1,083	Cape Fear River	03030002	2	1969, 1974-76, 1979-87, 1990-91, 1993, 1995-98	43	0
142	02096886	Cane Creek near Snow Camp	35°53'23"	79°25'48"	Alamance	Snow Camp	15.7	Haw River	03030002	2	1962	1	0
143	02096894	Reedy Branch near Snow Camp	35°53'23"	79°24'07"	Alamance	Snow Camp	2.94	Cane Creek	03030002	2	1960, 1962, 1966	4	0
144	02096899	South Fork Cane Creek near Saxapahaw	35°52'25"	79°20'42"	Alamance	Silk Hope	18.5	Cane Creek	03030002	2	1962, 1966	3	0
145	02096902	Cane Creek near Mandale	35°53'04"	79°17'47"	Alamance	Saxapahaw	64.6	Haw River	03030002	2	1974-75	4	0
146	02096917	Collins Creek near White Cross	35°53'46"	79°14'32"	Orange	White Cross	14.4	Haw River	03030002	2	1966	1	0
147	02096919	Collins Creek near Terrells	35°51'00"	79°14'00"	Chatham	Bynum	18.5	Haw River	03030002	2	1955, 1960, 1962	4	1
148	02096930	Terrells Creek near Pittsboro	35°49'18"	79°15'20"	Chatham	Silk Hope	20.9	Haw River	03030002	2	1960, 1962, 1966-68, 1970	10	1
149	0209693225	Terrells Creek at SR 1520 at Terrells	35°49'40"	79°14'15"	Chatham	Bynum	28.6	Haw River	03030002	2	1974	3	0
150	0209693250	Haw River at SR 1545 at Terrells	35°49'45"	79°13'09"	Chatham	Bynum	1,211	Cape Fear River	03030002	2	1973	3	0
151	02096940	Dry Creek near Terrells	35°48'12"	79°12'42"	Chatham	Bynum	17.7	Haw River	03030002	2	1955, 1960, 1962, 1967-68, 1970	9	3
152	02096960	Haw River near Bynum	35°45'48"	79°08'02"	Chatham	Bynum	1,275	Cape Fear River	03030002	1	Oct 1973 - Sept 1998	N/A	N/A
153	02096968	Pokeberry Creek near Farrington	35°48'41"	79°06'18"	Chatham	Farrington	4.11	Haw River	03030002	2	1974	4	0
154	02096975	Ward Branch near Bynum	35°46'55"	79°06'24"	Chatham	Farrington	0.90	Pokeberry Creek	03030002	2	1976, 1979	2	0
155	02096979	Pokeberry Creek near Pittsboro	35°46'27"	79°07'13"	Chatham	Farrington	11.6	Haw River	03030002	2	1955, 1962	3	0
156	02097000	Haw River near Pittsboro[g]	35°42'19"	79°05'00"	Chatham	Merry Oaks	1,303	Cape Fear River	03030002	1	Oct 1928 - Sept 1973	N/A	N/A
										2	1974	1	0

Table 6. Summary of continuous-record gaging stations and partial-record measuring sites in the Cape Fear River Basin in North Carolina where records of gage height and streamflow were collected—Continued

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Site index no. (pl. 1)	USGS downstream order number	Station name	Latitude	Longitude	County	USGS topographic quadrangle	Drainage area (mi^2)	Tributary to	Hydrologic unit code	Site type	Period of record	Number of measurements for partial-record sites	
												Flow	Zero flow
157	02097010	Robeson Creek near Pittsboro	35°43'29"	79°12'33"	Chatham	Pittsboro	1.71	Haw River	03030002	2	1961-76	25	1
158	02097014	Robeson Creek tributary near Pittsboro	35°43'30"	79°13'10"	Chatham	Pittsboro	1.21	Robeson Creek	03030002	2	1962, 1966	2	1
159	02097018	Robeson Creek tributary No.2 near Pittsboro	35°43'15"	79°11'31"	Chatham	Pittsboro	1.32	Robeson Creek	03030002	2	1962, 1966	2	1
160	02097028	Robeson Creek above Pittsboro	35°43'01"	79°11'23"	Chatham	Pittsboro	7.81	Haw River	03030002	2	1962, 1966	3	2
161	0209703155	Robeson Creek 1.3 miles above Turkey Creek at Pittsboro	35°42'50"	79°11'50"	Chatham	Pittsboro	7.2[a]	Haw River	03030002	2	1974	3	0
162	02097039	Robeson Creek at Pittsboro	35°43'01"	79°10'40"	Chatham	Pittsboro	10.0	Haw River	03030002	2	1970, 1973-74	6	0
163	0209709850	Turkey Creek at NC 87 near Pittsboro	35°42'05"	79°10'29"	Chatham	Pittsboro	3.0[a]	Robeson Creek	03030002	2	1973-74	6	1
164	02097099	Turkey Creek at Pittsboro	35°42'09"	79°10'34"	Chatham	Pittsboro	4.13	Robeson Creek	03030002	2	1954, 1970, 1973-74	7	2
165	02097145	Robeson Creek tributary at SR 1012 near Pittsboro	35°41'48"	79°09'37"	Chatham	Pittsboro	2.64	Robeson Creek	03030002	2	1974	3	0
166	02097159	Robeson Creek at Goulds Farm near Pittsboro	35°42'23"	79°09'13"	Chatham	Pittsboro	19.7	Haw River	03030002	2	1970-71, 1973-74	9	0
167	02097189	Robeson Creek near Seaforth[g]	35°42'10"	79°05'41"	Chatham	Merry Oaks	27.2	Haw River	03030002	2	1954, 1966, 1970-71, 1973-74, 1976, 1978, 1980-82	21	0
168	02097196	Stinking Creek near Pittsboro[g]	35°41'00"	79°06'00"	Chatham	Merry Oaks	5.9[a]	Haw River	03030002	2	1962, 1966	3	1
169	02097198	New Hope Creek near Dobsons Crossroads	35°59'56"	79°07'18"	Orange	Chapel Hill	4.46	New Hope River	03030002	2	1973-74	4	0
170	0209719840	New Hope Creek below SEO near Blackwood	35°59'59"	79°06'55"	Orange	Chapel Hill	7.4[a]	New Hope River	03030002	2	1971, 1973-74	6	2
171	0209719850	New Hope Creek at SR 1723 near Chapel Hill	36°00'13"	79°05'37"	Orange	Hillsborough	11.3	New Hope River	03030002	2	1971, 1973	5	0

Table 6. Summary of continuous-record gaging stations and partial-record measuring sites in the Cape Fear River Basin in North Carolina where records of gage height and streamflow were collected—Continued

[mi^2, square mile; SR, secondary road; N/A, not applicable; SEO, sewage effluent outfall; Ind, drainage area is undetermined and(or) may be indeterminate. Gray shading indicates sites for which low-flow characteristics have been developed. Period of record for continuous-record sites (site type 1) is shown in months and years; period of record for partial-record sites (site type 2) is shown in water years in which discharge measurements were made]

Site index no. (pl. 1)	USGS downstream order number	Station name	Latitude	Longitude	County	USGS topographic quadrangle	Drainage area (mi^2)	Tributary to	Hydrologic unit code	Site type	Period of record	Number of measurements for partial-record sites	
												Flow	Zero flow
172	0209719950	New Hope Creek at Blackwood	35°59′42"	79°04′23"	Orange	Chapel Hill	15.3	New Hope River	03030002	2	1971, 1973, 1975	8	0
173	02097201	New Hope Creek near Chapel Hill	35°59′45"	79°03′16"	Orange	Chapel Hill	17[a]	New Hope River	03030002	2	1968, 1971, 1973	9	0
174	0209720109	Old Field Creek at NC 86 at Eubanks	35°58′48"	79°03′59"	Orange	Chapel Hill	2.11	New Hope Creek	03030002	2	1974-75	6	0
175	02097203	New Hope Creek near Blackwood	35°59′31"	79°02′45"	Orange	Chapel Hill	22.4	New Hope River	03030002	2	1962, 1966, 1968, 1971, 1973, 1976, 1978-84	36	1
176	02097204	New Hope Creek near University	35°59′08"	79°01′21"	Orange	Chapel Hill	25.4	New Hope River	03030002	2	1968	3	0
177	02097206	Piney Mountain Creek near Blackwood	35°59′32"	79°00′10"	Orange	Chapel Hill	4.27	New Hope Creek	03030002	2	1968, 1971, 1973	8	0
178	02097207	Little Creek tributary near Blackwood Station	35°59′20"	78°59′46"	Orange	Durham South (15-min)	Ind	Little Creek	03030002	2	1971, 1973-75	9	2
179	02097208	New Hope Creek tributary near Keene	35°58′47"	78°59′49"	Durham	Southwest Durham	0.36	New Hope Creek	03030002	2	1968, 1971, 1973	9	0
180	02097209	New Hope Creek near Eubanks	35°58′30"	79°00′00"	Orange	Durham South (15-min)	32[a]	New Hope River	03030002	2	1968, 1971, 1973-75	7	0
181	02097223	Mud Creek at Durham	35°58′31"	78°59′04"	Durham	Southwest Durham	5.37	New Hope Creek	03030002	2	1962, 1968	2	1
182	0209722350	Mud Creek near Durham	35°57′38"	78°58′57"	Durham	Southwest Durham	5.85	New Hope Creek	03030002	2	1962, 1968, 1970, 1973-74	11	2
183	02097224	New Hope Creek at U.S. Hwy 15-501 near Durham	35°57′34"	78°58′54"	Durham	Southwest Durham	42.3	New Hope River	03030002	2	1932, 1954-68, 1970-71, 1973-74	50	4
184	02097230	Sandy Creek at Picket Road at Durham	35°58′32"	78°57′56"	Durham	Southwest Durham	5.95	New Hope Creek	03030002	2	1967, 1969-70	4	0
185	02097231	Sandy Creek near Durham	35°58′05"	78°58′08"	Durham	Southwest Durham	6.26	New Hope Creek	03030002	2	1954-55, 1966, 1968, 1970	7	3

Table 6. Summary of continuous-record gaging stations and partial-record measuring sites in the Cape Fear River Basin in North Carolina where records of gage height and streamflow were collected—Continued

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Site index no. (pl. 1)	USGS downstream order number	Station name	Latitude	Longitude	County	USGS topographic quadrangle	Drainage area (mi^2)	Tributary to	Hydrologic unit code	Site type	Period of record	Number of measurements for partial-record sites	
												Flow	Zero flow
186	02097233	New Hope Creek tributary near Durham	35°57'16"	78°58'23"	Durham	Southwest Durham	1.66	New Hope Creek	03030002	2	1970-71, 1974-75	7	1
187	02097234	New Hope Creek near Lowes Grove[g]	35°56'33"	78°58'32"	Durham	Southwest Durham	52.2	New Hope River	03030002	2	1968, 1970-71, 1973	11	0
188	02097235	New Hope Creek tributary No.2 at SR 1110 near Durham	35°56'41"	78°59'01"	Durham	Southwest Durham	0.5[a]	New Hope Creek	03030002	2	1970, 1973-75	9	4
189	02097237	New Hope Creek near Durham	35°55'00"	78°58'13"	Durham	Southwest Durham	57.1	Haw River	03030002	2	1949-55, 1958	23	0
190	02097240	Third Fork Creek tributary at University Drive at Durham	35°58'46"	78°54'54"	Durham	Southwest Durham	0.52	Third Fork Creek	03030002	2	1967-71	5	0
191	02097243	Third Fork Creek at Durham	35°58'43"	78°54'48"	Durham	Southwest Durham	1.67	New Hope Creek	03030002	1	Nov 1968 - May 1973	N/A	N/A
										2	1969-71	12	0
192	02097250	Rocky Creek tributary at NC 55 at Durham	35°58'08"	78°53'43"	Durham	Southwest Durham	0.50	Rocky Creek	03030002	2	1967	1	0
193	02097255	Rocky Creek at Fayetteville Street at Durham	35°57'43"	78°54'31"	Durham	Southwest Durham	3.55	Third Fork Creek	03030002	2	1967-70	4	0
194	02097259	Third Fork Creek at Cornwallis Road at Durham	35°57'40"	78°54'55"	Durham	Southwest Durham	7.13	New Hope Creek	03030002	2	1970-71, 1973	6	0
195	02097262	Third Fork Creek between SEO near Keene	35°56'47"	78°55'49"	Durham	Southwest Durham	10[a]	New Hope Creek	03030002	2	1970-71, 1974-75	6	0
196	02097299	Third Fork Creek near Blands[g]	35°54'38"	78°57'39"	Durham	Southwest Durham	16.5	New Hope River	03030002	2	1970-71, 1973-74, 1976, 1978, 1980-87	48	0
197	02097314	New Hope Creek near Blands[g]	35°53'05"	78°57'58"	Durham	Southwest Durham	75.9	Haw River	03030002	1	Oct 1982 - Sept 1998	N/A	N/A
										2	1981-82	10	0
198	02097329	Gum Branch near Blands	35°53'42"	78°57'12"	Durham	Southwest Durham	0.92	New Hope Creek	03030002	2	1960	1	1

Table 6. Summary of continuous-record gaging stations and partial-record measuring sites in the Cape Fear River Basin in North Carolina where records of gage height and streamflow were collected—Continued

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Site index no. (pl. 1)	USGS downstream order number	Station name	Latitude	Longitude	County	USGS topographic quadrangle	Drainage area (mi^2)	Tributary to	Hydrologic unit code	Site type	Period of record	Number of measurements for partial-record sites	
												Flow	Zero flow
199	02097334	Bolin Creek at SR 1009 near Carrboro	35°56'56"	79°06'34"	Orange	Chapel Hill	1.00	Little Creek	03030002	2	1966	1	0
200	0209734450	Bolin Creek near Chapel Hill	35°55'15"	79°03'52"	Orange	Chapel Hill	7.96	Little Creek	03030002	2	1974-75	6	0
201	02097345	Bolin Creek at NC 86 at Chapel Hill	35°55'31"	79°03'13"	Orange	Chapel Hill	8.95	Little Creek	03030002	2	1974-75	3	0
202	02097360	Bolin Creek at Chapel Hill	35°55'40"	79°02'08"	Orange	Chapel Hill	10.7	Little Creek	03030002	2	1954, 1960, 1962, 1964-68, 1970, 1980-92	62	0
203	0209736050	Battle Branch near Chapel Hill	35°55'02"	79°01'57"	Orange	Chapel Hill	0.42	Bolin Creek	03030002	1	Oct 1996 - Sept 1998[h]	N/A	N/A
204	02097374	Bolin Creek near Chapel Hill	35°55'29"	79°01'34"	Orange	Chapel Hill	11.8	Little Creek	03030002	2	1932, 1974-76, 1978	8	0
205	02097386	Booker Creek at SR 1751 near Chapel Hill	35°56'31"	79°02'58"	Orange	Chapel Hill	2.1[a]	Little Creek	03030002	2	1970, 1973-74	5	0
206	02097410	Crooked Creek near Lowes Grove	35°54'21"	78°56'02"	Durham	Southwest Durham	1.82	New Hope Creek	03030002	2	1967-71	8	0
207	02097411	Crooked Creek near Blands	35°52'12"	78°56'45"	Durham	Green Level	3.50	New Hope Creek	03030002	2	1962, 1968	3	3
208	02097413	Northeast Creek tributary above SEO near Lowes Grove	35°55'01"	78°52'35"	Durham	Southwest Durham	0.22	Northeast Creek	03030002	2	1970, 1973-74	5	0
209	0209741305	Northeast Creek tributary below SR 2020 at Research Triangle Park	35°55'00"	78°52'40"	Durham	Southwest Durham	0.2[a]	Northeast Creek	03030002	2	1973, 1975	5	0
210	0209741350	Northeast Creek below SEO near Lowes Grove	35°54'36"	78°53'21"	Durham	Southwest Durham	7.02	New Hope Creek	03030002	2	1970, 1973-75	13	2
211	02097414	Northeast Creek at Lowes Grove	35°54'09"	78°54'04"	Durham	Southwest Durham	11.9	New Hope Creek	03030002	2	1960, 1970, 1973	7	3
212	02097416	Northeast Creek near Lowes Grove	35°53'12"	78°54'00"	Durham	Southwest Durham	13.0	New Hope Creek	03030002	2	1962, 1968, 1970, 1973	8	2
213	0209741630	Harveys Branch above SEO near Nelson	35°54'12"	78°51'18"	Durham	Southeast Durham	0.1[a]	Burdens Creek	03030002	2	1970, 1973-74	9	1
214	0209741660	Harveys Branch below SEO near Nelson	35°53'54"	78°51'37"	Durham	Southeast Durham	0.2[a]	Burdens Creek	03030002	2	1970, 1973-74	7	0

Table 6. Summary of continuous-record gaging stations and partial-record measuring sites in the Cape Fear River Basin in North Carolina where records of gage height and streamflow were collected—Continued

[mi^2, square mile; SR, secondary road; N/A, not applicable; SEO, sewage effluent outfall; Ind, drainage area is undetermined and(or) may be indeterminate. Gray shading indicates sites for which low-flow characteristics have been developed. Period of record for continuous-record sites (site type 1) is shown in months and years; period of record for partial-record sites (site type 2) is shown in water years in which discharge measurements were made]

Site index no. (pl. 1)	USGS downstream order number	Station name	Latitude	Longitude	County	USGS topographic quadrangle	Drainage area (mi^2)	Tributary to	Hydrologic unit code	Site type	Period of record	Number of measurements for partial-record sites	
												Flow	Zero flow
215	0209741663	Effluent ditch to Lake Branch near Nelson	35°54'25"	78°51'38"	Durham	Southeast Durham	Ind	Lake Branch	03030002	2	1970, 1974-75	5	2
216	0209741665	Burdens Creek tributary below SEO near Nelson	35°54'18"	78°51'38"	Durham	Southeast Durham	0.4[a]	Burdens Creek	03030002	2	1970, 1973-75	8	1
217	0209741670	Burdens Creek at NC 54 near Nelson	35°53'37"	78°52'05"	Durham	Southeast Durham	0.3[a]	Northeast Creek	03030002	2	1970, 1973-74	6	1
218	0209741677	Lake Branch at NC 54 near Nelson	35°53'37"	78°52'05"	Durham	Southeast Durham	1.0[a]	Burdens Creek	03030002	2	1970, 1973-75	8	0
219	0209741681	Two Bottle Branch below SEO near Nelson	35°54'39"	78°51'58"	Durham	Southeast Durham	2.9[a]	Burdens Creek	03030002	2	1970, 1973-74	4	0
220	0209741692	Burdens Creek at SR 2028 near Lowes Grove	35°53'24"	78°52'52"	Durham	Southwest Durham	4.2[a]	Northeast Creek	03030002	2	1970, 1973-75	7	2
221	02097417	Burdens Creek near Lowes Grove	35°53'03"	78°53'39"	Durham	Southwest Durham	5.11	Northeast Creek	03030002	2	1970, 1973-74	6	3
222	02097419	Northeast Creek near Nelson[g]	35°52'30"	78°54'25"	Durham	Green Level	19.6	New Hope River	03030002	2	1962	2	2
223	0209741955	Northeast Creek at Secondary Road 1100 near Genlee[g]	35°52'20"	78°54'49"	Durham	Green Level	21.1	New Hope Creek	03030002	1	Oct 1982 - Jan 1994, Aug 1995 - Sept 1998	N/A	N/A
										2	1970-71, 1973-74	12	0
224	02097421	Northeast Creek tributary near Lowes Grove	35°53'00"	78°54'50"	Durham	Southwest Durham	0.74	Northeast Creek	03030002	2	1970, 1973-75	8	3
225	02097426	Kit Creek near Genlee	35°51'08"	78°54'00"	Wake	Green Level	8.29	Northeast Creek	03030002	2	1960, 1962, 1968	4	3
226	02097440	Northeast Creek at O'Kellys Church[g]	35°51'19"	78°56'26"	Chatham	Green Level	35.0	New Hope Creek	03030002	2	1963-67, 1970, 1976, 1978, 1980-82	28	1
227	02097449	Northeast Creek near Farrington[g]	35°49'42"	78°57'53"	Chatham	Green Level	46.9	New Hope Creek	03030002	2	1955, 1962	3	2

Table 6. Summary of continuous-record gaging stations and partial-record measuring sites in the Cape Fear River Basin in North Carolina where records of gage height and streamflow were collected—Continued

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Site index no. (pl. 1)	USGS downstream order number	Station name	Latitude	Longitude	County	USGS topographic quadrangle	Drainage area (mi^2)	Tributary to	Hydrologic unit code	Site type	Period of record	Number of measure-ments for partial-record sites	
												Flow	Zero flow
228	0209746350	Morgan Creek at SR 1112 near Dobsons Crossroads	35°57'44"	79°08'06"	Orange	White Cross	2.12	New Hope River	03030002	2	1974-76, 1978-80	8	0
229	02097464	Morgan Creek near White Cross	35°55'25"	79°06'56"	Orange	Chapel Hill	8.35	New Hope River	03030002	1	Nov 1988 - Sept 1998	N/A	N/A
										2	1960, 1962, 1966	4	0
230	02097474	Morgan Creek near Carrboro	35°53'55"	79°05'45"	Orange	Chapel Hill	10[a]	New Hope River	03030002	2	1930	1	0
231	02097476	Phils Creek at SR 1104 near Calvander	35°55'47"	79°09'01"	Orange	White Cross	1.11	Neville Creek	03030002	2	1975	4	0
232	0209747698	Phils Creek at SR 1945 near Calvander	35°54'43"	79°08'02"	Orange	White Cross	4.95	Neville Creek	03030002	2	1974-75	6	0
233	02097477	Phils Creek near White Cross	35°54'19"	79°06'59"	Orange	Chapel Hill	6.68	Neville Creek	03030002	2	1960, 1962, 1966	4	0
234	02097489	Neville Creek near Carrboro	35°53'55"	79°05'45"	Orange	Chapel Hill	12[a]	Morgan Creek	03030002	2	1930	1	0
235	02097494	Price Creek near Carrboro	35°53'45"	79°05'40"	Orange	Chapel Hill	7.33	Morgan Creek	03030002	2	1930-31	2	0
236	02097500	Morgan Creek near Chapel Hill	35°53'51"	79°05'28"	Orange	Chapel Hill	30.0	New Hope River	03030002	1	Jan 1923 - June 1932	N/A	N/A
										2	1970, 1973	4	1
237	02097506	Morgan Creek at Carrboro	35°53'54"	79°04'25"	Orange	Chapel Hill	32.7	New Hope River	03030002	2	1970, 1974-75	3	0
238	02097509	Morgan Creek at U.S. Hwy 15-501 near Chapel Hill	35°53'30"	79°03'33"	Orange	Chapel Hill	36[a]	New Hope River	03030002	2	1970, 1973	4	0
239	02097514	Morgan Creek below SEO at Chapel Hill	35°53'38"	79°01'46"	Orange	Chapel Hill	38[a]	New Hope River	03030002	2	1970-71, 1973-74	6	0
240	02097517	Morgan Creek (below University Lake Dam) near Chapel Hill	35°53'36"	79°01'10"	Orange	Chapel Hill	41.0	New Hope River	03030002	1	Nov 1982 - Sept 1998	N/A	N/A

Table 6. Summary of continuous-record gaging stations and partial-record measuring sites in the Cape Fear River Basin in North Carolina where records of gage height and streamflow were collected—Continued

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Site index no. (pl. 1)	USGS downstream order number	Station name	Latitude	Longitude	County	USGS topographic quadrangle	Drainage area (mi^2)	Tributary to	Hydrologic unit code	Site type	Period of record	Number of measurements for partial-record sites	
												Flow	Zero flow
241	02097521	Morgan Creek near Farrington[g]	35°51'48"	79°00'35"	Chatham	Farrington	45.6	New Hope River	03030002	2	1970, 1973, 1976, 1978, 1980-98	77	0
242	02097526	Cub Creek at U.S. Hwy 15-501 near Farrington	35°50'15"	79°05'25"	Chatham	Farrington	0.3[a]	New Hope River	03030002	2	1974	4	0
243	02097683	New Hope River at Farrington[g]	35°47'44"	79°00'32"	Chatham	Farrington	230	Haw River	03030002	2	1970, 1973	3	0
244	02097711	Bush Creek at Farrington[g]	35°47'59"	79°01'16"	Chatham	Farrington	11.9	New Hope River	03030002	2	1966	1	1
245	0209782150	New Hope River tributary at SR 1716 near Farrington[g]	35°45'50"	79°03'08"	Chatham	Farrington	2.05	New Hope River	03030002	1	Mar 1986 - Sept 1988	N/A	N/A
246	02097910	White Oak Creek near Wilsonville[g]	35°44'47"	79°00'44"	Chatham	Merry Oaks	24[a]	New Hope River	03030002	2	1953, 1955, 1960-71	32	11
247	02098000	New Hope River near Pittsboro[g]	35°44'20"	79°01'23"	Chatham	Merry Oaks	288	Haw River	03030002	1	Jan 1949 - Sept 1973	N/A	N/A
248	02098062	Beaver Creek tributary at Apex	35°44'00"	78°52'00"	Wake	Apex	0.5[a]	Beaver Creek	03030002	2	1954-55, 1962, 1968	8	6
249	02098093	Beaver Creek at Apex	35°43'48"	78°53'44"	Wake	New Hill	5.65	New Hope River	03030002	2	1954, 1962, 1968	6	6
250	02098124	Beaver Creek near New Hill[g]	35°43'00"	78°57'00"	Wake	New Hill	18[a]	New Hope River	03030002	2	1960, 1962, 1968	4	4
251	02098134	Little Beaver Creek near Seaforth[g]	35°41'00"	79°00'00"	Chatham	New Hill	7.9[a]	Beaver Creek	03030002	2	1962	2	2
252	02098139	Beaver Creek near Seaforth[g]	35°41'48"	79°01'17"	Chatham	Merry Oaks	37[a]	New Hope River	03030002	2	1962, 1966, 1971	7	3
253	02098156	New Hope River near New Hill[g]	35°41'40"	79°02'31"	Chatham	Merry Oaks	340	Haw River	03030002	2	1974-76, 1978	7	0
254	02098197	B. Everett Jordan Lake at Dam near Moncure	35°39'16"	79°04'06"	Chatham	Merry Oaks	1,689	Cape Fear River	03030002	1	May 1987 - Sept 1998 (gage height only)	N/A	N/A

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Site index no. (pl. 1)	USGS downstream order number	Station name	Latitude	Longitude	County	USGS topographic quadrangle	Drainage area (mi^2)	Tributary to	Hydrologic unit code	Site type	Period of record	Number of measure-ments for partial-record sites	
												Flow	Zero flow
255	02098198 (revised from 02098200[i])	Haw River below B. Everett Jordan Dam near Moncure	35°39'11"	79°04'03"	Chatham	Merry Oaks	1,689	Cape Fear River	03030002	1	Oct 1965 - Sept 1992 (discharge), Oct 1992 - Sept 1998 (gage height only)	N/A	N/A
256	02098218	Shaddox Creek at Moncure	35°36'55"	79°02'24"	Chatham	Moncure	7.29	Haw River	03030002	2	1954, 1966, 1974	5	1
257	02098249	Shaddox Creek near Moncure	35°35'46"	79°02'39"	Chatham	Moncure	14.3	Haw River	03030002	2	1954, 1966	2	2
258	02098312	West Fork Deep River tributary near Colfax	36°05'15"	80°01'25"	Guilford	Kernersville	2.18	Deep River	03030003	2	1955	1	0
259	0209831460	West Fork Deep River at SR 2602 near Kernersville	36°05'01"	80°02'33"	Forsyth	Kernersville	1.43	Deep River	03030003	2	1974-75	4	0
260	02098343	West Fork Deep River near Friendship	36°03'24"	80°01'19"	Guilford	Kernersville	11.5	Deep River	03030003	2	1955, 1962, 1966	4	0
261	02098374	West Fork Deep River tributary near Friendship[j]	36°02'30"	80°00'05"	Guilford	Kernersville	1.95	West Fork Deep River	03030003	2	1955, 1966	2	0
262	02098437	Hiatt Branch near Deep River[j]	36°00'50"	80°00'05"	Guilford	Kernersville	4.09	West Fork Deep River	03030003	2	1955, 1966	3	0
263	02098468	West Fork Deep River tributary No.3 near High Point[j]	36°00'00"	80°00'05"	Guilford	Kernersville	2.48	West Fork Deep River	03030003	2	1955, 1966	2	0
264	02098500	West Fork Deep River near High Point	36°00'15"	79°58'42"	Guilford	Guilford	32.5	Deep River	03030003	1	June 1923 - Sept 1958	N/A	N/A
										2	1960-69	27	0
265	02098833	East Fork Deep River near Friendship	36°04'50"	79°57'28"	Guilford	Guilford	3.91	Deep River	03030003	2	1955, 1962, 1966	4	0
266	02099000	East Fork Deep River near High Point	36°02'15"	79°56'46"	Guilford	Guildford	125	Cape Fear River	03030003	1	July 1928 - Mar 1994, Oct 1997 - Sept 1998	N/A	N/A

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Site index no. (pl. 1)	USGS downstream order number	Station name	Latitude	Longitude	County	USGS topographic quadrangle	Drainage area (mi^2)	Tributary to	Hydrologic unit code	Site type	Period of record	Number of measure-ments for partial-record sites	
												Flow	Zero flow
267	02099007	Long Branch near Deep River	36°02'28"	79°56'16"	Guilford	Guilford	2.21	East Fork Deep River	03030003	2	1962, 1966, 1974-75	8	1
268	02099193	Deep River at SR 1352 near Jamestown	35°58'46"	79°55'41"	Guilford	High Point East	66.6	Cape Fear River	03030003	2	1971, 1973-74	5	0
269	02099240	Bull Run at Oakdale	35°58'48"	79°55'37"	Guilford	High Point East	7.75	Deep River	03030003	2	1954, 1960-67, 1969	25	1
270	02099245	Deep River near Jamestown	35°58'44"	79°55'35"	Guilford	High Point East	74.4	Cape Fear River	03030003	2	1983	1	0
271	02099324	Deep River below Sewage Outfall near Jamestown	35°58'22"	79°55'05"	Guilford	High Point East	75[a]	Cape Fear River	03030003	2	1971, 1974-75	3	0
272	02099399	Deep River at Kivett Drive extension near Jamestown	35°57'32"	79°54'25"	Guilford	High Point East	77.7	Cape Fear River	03030003	2	1974-75	6	0
273	02099480	Richland Creek near Archdale	35°56'28"	79°55'56"	Guilford	High Point East	12.5	Deep River	03030003	2	1954-56, 1958-60, 1962, 1966, 1971, 1973	21	0
274	02099484	Richland Creek near Groomtown	35°56'26"	79°54'08"	Guilford	High Point East	16.2	Deep River	03030003	2	1971, 1973-76, 1978-98	64	0
275	0209948955	Deep River at SR 1129 near Jamestown	35°56'16"	79°53'26"	Guilford	High Point East	96.3	Cape Fear River	03030003	2	1971, 1973-75	6	0
276	0209948980	Hickory Creek tributary at SR 1129 at Groometown	35°59'30"	79°52'02"	Guilford	Pleasant Garden	Ind	Hickory Creek	03030003	2	1974-75	3	3
277	0209948990	Hickory Creek tributary at Secondary Road 1132 near Groometown	35°57'50"	79°50'49"	Guilford	Pleasant Garden	1.3[a]	Hickory Creek	03030003	2	1971, 1973-74	6	2
278	02099490	Hickory Creek near High Point	35°57'03"	79°52'08"	Guilford	Pleasant Garden	9.60	Deep River	03030003	2	1955, 1962, 1964-67, 1969-70, 1974-75	18	1
279	0209949155	Reddicks Creek at SR 1372 at Sedgefield	36°00'39"	79°53'02"	Guilford	Guilford	2.6[a]	Deep River	03030003	2	1971, 1973-75	8	0
280	02099492	Reddicks Creek near Jamestown	35°59'10"	79°53'36"	Guilford	High Point East	4.90	Deep River	03030003	2	1971, 1973-75	10	0

Table 6. Summary of continuous-record gaging stations and partial-record measuring sites in the Cape Fear River Basin in North Carolina where records of gage height and streamflow were collected—Continued

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Site index no. (pl. 1)	USGS downstream order number	Station name	Latitude	Longitude	County	USGS topographic quadrangle	Drainage area (mi^2)	Tributary to	Hydrologic unit code	Site type	Period of record	Number of measurements for partial-record sites	
												Flow	Zero flow
281	02099493	Reddicks Creek near Groometown	35°57'11"	79°53'09"	Guilford	High Point East	8.68	Hickory Creek	03030003	2	1966	1	0
282	02099494	Reddicks Creek near Oakdale	35°56'00"	79°52'00"	Guilford	Pleasant Garden	9.34	Hickory Creek	03030003	2	1966	1	0
283	02099495	Hickory Creek near Groometown	35°56'02"	79°52'12"	Guilford	Pleasant Garden	20.1	Deep River	03030003	2	1955, 1962, 1976	6	1
284	02099496	Deep River tributary near Randleman	35°55'17"	79°51'21"	Guilford	Pleasant Garden	2.77	Deep River	03030003	2	1966	1	0
285	02099500	Deep River near Randleman	35°54'12"	79°51'10"	Randolph	Pleasant Grove	125	Cape Fear River	03030003	1	Oct 1928 - Sept 1998	N/A	N/A
286	02099815	Muddy Creek at SR 1916 at Archdale	35°53'55"	79°55'38"	Randolph	High Point East	8.53	Deep River	03030003	2	1974	3	0
287	02100000	Muddy Creek near Archdale	35°52'35"	79°52'43"	Randolph	High Point East	16.5	Deep River	03030003	1	May 1934 - Jan 1942	N/A	N/A
										2	1962-63	4	0
288	02100028	Bob Branch near Randleman	35°51'15"	79°51'20"	Randolph	Randleman	2.85	Muddy Creek	03030003	2	1955, 1962	4	1
289	02100056	Muddy Creek near Randleman	35°50'55"	79°50'00"	Randolph	Randleman	26.4	Deep River	03030003	2	1955, 1962	3	1
290	02100082	Deep River tributary 7 near Randleman	35°50'05"	79°49'10"	Randolph	Randleman	0.81	Deep River	03030003	2	1971, 1975	3	1
291	02100096	Deep River at U.S. Highway 220 at Randleman	35°49'24"	79°48'12"	Randolph	Randleman	177	Cape Fear River	03030003	2	1971, 1973-74	5	0
292	0210017155	Polecat Creek at SR 3428 near Pleasant Garden	35°57'12"	79°48'43"	Guilford	Pleasant Garden	7.34	Deep River	03030003	2	1974-75	5	0
293	0210017165	Polecat Creek tributary at SR 3433 at Pleasant Garden	35°58'17"	79°46'54"	Guilford	Pleasant Garden	Ind	Polecat Creek	03030003	2	1974-75	4	2
294	02100172	Polecat Creek near Pleasant Garden	35°55'10"	79°47'47"	Guilford	Pleasant Garden	15.6	Deep River	03030003	2	1962, 1966	3	0

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Site index no. (pl. 1)	USGS downstream order number	Station name	Latitude	Longitude	County	USGS topographic quadrangle	Drainage area (mi^2)	Tributary to	Hydrologic unit code	Site type	Period of record	Number of measurements for partial-record sites	
												Flow	Zero flow
295	02100180	Polecat Creek near Climax	35°53'15"	79°46'13"	Randolph	Pleasant Garden	29.1	Deep River	03030003	2	1954-59, 1962-63, 1966, 1970	18	1
296	02100181	Polecat Creek near Level Cross	35°51'37"	79°46'09"	Randolph	Randleman	31.9	Deep River	03030003	2	1966	1	0
297	02100193	Little Polecat Creek near Randleman	35°52'18"	79°45'17"	Randolph	Randleman	11.6	Polecat Creek	03030003	2	1955, 1962, 1966	4	1
298	02100194	Polecat Creek tributary No.3 near Salem	35°51'14"	79°46'46"	Randolph	Randleman	8.21	Polecat Creek	03030003	2	1962, 1966	2	1
299	02100197	Polecat Creek tributary No.2 near Salem	35°50'15"	79°45'50"	Randolph	Randleman	3.52	Polecat Creek	03030003	2	1962, 1966	2	1
300	02100209	Polecat Creek tributary near Randleman	35°48'40"	79°46'20"	Randolph	Randleman	2.46	Polecat Creek	03030003	2	1960, 1962	3	0
301	02100219	Deep River at Worthville	35°48'09"	79°46'37"	Randolph	Randleman	236	Cape Fear River	03030003	2	1971, 1973-74, 1976	7	0
302	02100244	Haskett Creek above Penwood Branch near Asheboro	35°45'25"	79°47'45"	Randolph	Asheboro (15-min)	5.62	Deep River	03030003	2	1954	3	0
303	02100262	Penwood Branch near Asheboro	35°44'12"	79°47'09"	Randolph	Asheboro	2.92	Haskett Creek	03030003	2	1966	1	0
304	02100294	Haskett Creek below Penwood Branch near Asheboro	35°45'33"	79°47'35"	Randolph	Randleman	9.86	Deep River	03030003	2	1971, 1973-75	7	0
305	02100307	Haskett Creek at Central Falls	35°46'05"	79°46'45"	Randolph	Randleman	10.6	Deep River	03030003	2	1966, 1971, 1973-74	5	0
306	02100319	Deep River at Central Falls	35°45'45"	79°46'20"	Randolph	Randleman	254	Cape Fear River	03030003	2	1974	1	0
307	02100338	Gabriels Creek tributary near Asheboro	35°43'22"	79°46'40"	Randolph	Asheboro	0.91	Gabriels Creek	03030003	2	1966	1	0
308	02100344	Deep River at Cedar Falls	35°45'04"	79°43'56"	Randolph	Grays Chapel	266	Cape Fear River	03030003	2	1971, 1974-75	5	0
309	02100357	Bush Creek near Cedar Falls	35°45'10"	79°43'19"	Randolph	Grays Chapel	13.2	Deep River	03030003	2	1955, 1962	3	0

Table 6. Summary of continuous-record gaging stations and partial-record measuring sites in the Cape Fear River Basin in North Carolina where records of gage height and streamflow were collected—Continued

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Site index no. (pl. 1)	USGS downstream order number	Station name	Latitude	Longitude	County	USGS topographic quadrangle	Drainage area (mi^2)	Tributary to	Hydrologic unit code	Site type	Period of record	Number of measure-ments for partial-record sites	
												Flow	Zero flow
310	02100369	Deep River at Franklinville	35°44'33"	79°42'07"	Randolph	Ramseur	277	Cape Fear River	03030003	2	1973-74	3	0
311	02100407	Sandy Creek tributary near Liberty	35°52'27"	79°37'47"	Randolph	Grays Chapel	3.11	Sandy Creek	03030003	2	1953	3	0
312	02100419	Sandy Creek tributary No.3 at Liberty	35°52'27"	79°35'33"	Randolph	Liberty	0.94	Sandy Creek	03030003	2	1953-54, 1970	9	0
313	02100432	Sandy Creek tributary No.2 near Melanchton	35°51'53"	79°36'59"	Randolph	Liberty	5.43	Sandy Creek	03030003	2	1953, 1966, 1970	7	0
314	02100463	Sandy Creek near Whites Chapel	35°47'07"	79°39'57"	Randolph	Grays Chapel	45.1	Deep River	03030003	2	1962, 1966	2	0
315	02100464	Mount Pleasant Creek at Whites Chapel	35°47'16"	79°39'00"	Randolph	Grays Chapel	8.07	Sandy Creek	03030003	2	1962, 1966	2	0
316	02100469	Sandy Creek near Ramseur	35°46'30"	79°39'52"	Randolph	Grays Chapel	55.2	Deep River	03030003	2	1954, 1960, 1962, 1966	4	0
317	02100500	Deep River at Ramseur	35°43'34"	79°39'20"	Randolph	Ramseur	349	Cape Fear River	03030003	1	Nov 1922 - Sept 1998	N/A	N/A
318	02100536	Reed Creek near Ramseur	35°43'21"	79°38'24"	Randolph	Ramseur	9.65	Deep River	03030003	2	1955, 1962	3	1
319	02100554	Mill Creek near Ramseur	35°41'00"	79°38'00"	Randolph	Ramseur	16.5	Deep River	03030003	2	1955, 1962	3	0
320	02100572	Millstone Creek near Ramseur	35°41'00"	79°38'00"	Randolph	Ramseur	10.1	Deep River	03030003	2	1955, 1962	3	1
321	02100599	Deep River near Parks Crossroads	35°40'20"	79°37'39"	Randolph	Ramseur	392	Cape Fear River	03030003	2	1971, 1973-76	9	0
322	0210063677	Richland Creek near Ulah	35°39'00"	79°45'00"	Randolph	Ramseur	23.2	Deep River	03030003	2	1962, 1966	2	0
323	02100638	Panther Creek near Michfield	35°37'48"	79°44'03"	Randolph	Ramseur	3.35	Richland Creek	03030003	2	1962, 1966	2	1
324	02100639	Squirrel Creek near Michfield	35°39'00"	79°44'00"	Randolph	Ramseur	7.14	Richland Creek	03030003	2	1962, 1966	2	0
325	02100640	Richland Creek near Asheboro	35°38'22"	79°42'50"	Randolph	Ramseur	36.8	Deep River	03030003	2	1949-55, 1957, 1960, 1962, 1966	21	0

Table 6. Summary of continuous-record gaging stations and partial-record measuring sites in the Cape Fear River Basin in North Carolina where records of gage height and streamflow were collected—Continued

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Site index no. (pl. 1)	USGS downstream order number	Station name	Latitude	Longitude	County	USGS topographic quadrangle	Drainage area (mi^2)	Tributary to	Hydrologic unit code	Site type	Period of record	Number of measurements for partial-record sites	
												Flow	Zero flow
326	02100664	Bachelor Creek near Coleridge	35°35'39"	79°40'27"	Randolph	Erect	10.5	Richland Creek	03030003	2	1962, 1966	3	0
327	02100674	Richland Creek near Coleridge	35°36'30"	79°37'10"	Randolph	Bennett	65.2	Deep River	03030003	2	1954, 1960, 1962	4	0
328	02100694	Brush Creek near Siler City	35°42'32"	79°32'27"	Chatham	Coleridge	19.1	Deep River	03030003	2	1960, 1962, 1966	4	0
329	0210070125	Blood Run Creek at U.S. 421 near Siler City	35°45'05"	79°28'50"	Chatham	Crutchfield Crossroads	0.13	Brush Creek	03030003	2	1974-75	5	0
330	0210070165	Blood Run Creek at SR 1108 near Siler City	35°44'30"	79°29'10"	Chatham	Siler City	1.14	Brush Creek	03030003	2	1974-75	4	0
331	02100702	Bloodrun Creek near Siler City	35°42'15"	79°32'14"	Chatham	Coleridge	7.59	Brush Creek	03030003	2	1962, 1966	3	1
332	02100703	Brush Creek at Coleridge	35°38'29"	79°34'36"	Randolph	Coleridge	39.8	Deep River	03030003	2	1962	1	0
333	02100704	Little Brush Creek near Coleridge	35°37'50"	79°33'26"	Randolph	Coleridge	17.1	Brush Creek	03030003	2	1960, 1962, 1966	4	0
334	02100706	Little Brush Creek tributary near Coleridge	35°38'04"	79°33'34"	Randolph	Coleridge	1.20	Little Brush Creek	03030003	2	1962	1	1
335	02100710	Brush Creek near Coleridge	35°36'05"	79°35'00"	Randolph	Bennett	67.4	Deep River	03030003	2	1954-60, 1962-63, 1966	22	0
336	02100714	Richardson Creek near Erect	35°33'43"	79°41'18"	Randolph	Erect	7.02	Fork Creek	03030003	2	1960, 1962	3	0
337	02100719	Reedy Creek near Coleridge	35°31'37"	79°38'39"	Randolph	Erect	7.29	Deep River	03030003	2	1954, 1966	2	1
338	02100730	Fork Creek near Coleridge	35°31'38"	79°38'31"	Randolph	Erect	38.5	Deep River	03030003	2	1954-63, 1966	30	0
339	02100747	Deep River at Howards Mill near Robbins	35°30'02"	79°34'53"	Moore	Bennett	621	Cape Fear River	03030003	2	1970, 1974-77	9	0
340	02100769	Bear Creek above SEO at Seagrove	35°31'57"	79°46'09"	Randolph	Asheboro (15-min)	0.54	Deep River	03030003	2	1971, 1973-75	7	4
341	02100771	Bear Creek at State Highway 705 at Seagrove	35°31'55"	79°45'54"	Randolph	Asheboro (15-min)	0.63	Deep River	03030003	2	1971, 1973-74	5	0
342	02100772	Bear Creek at SR 2859 near Seagrove	35°31'45"	79°45'48"	Randolph	Asheboro (15-min)	0.7[a]	Deep River	03030003	2	1971, 1973	4	0

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												Flow	Zero flow
343	02100787	Bear Creek tributary near Whynot	35°31'33"	79°45'44"	Randolph	Seagrove	0.53	Deep River	03030003	2	1954, 1966	3	1
344	02100806	Bear Creek near Dover	35°27'12"	79°40'24"	Moore	Spies	28.7	Deep River	03030003	2	1962, 1966	3	0
345	02100818	Wolf Creek near Spies	35°26'37"	79°40'49"	Moore	Spies	11.3	Bear Creek	03030003	2	1962	2	2
346	02100824	Bear Creek near Spies	35°26'58"	79°38'47"	Moore	Spies	44.6	Deep River	03030003	2	1954-55, 1971, 1973	11	0
347	02100842	Cabin Creek below SEO at Candor	35°18'37"	79°44'21"	Montgomery	Candor	1.33	Bear Creek	03030003	2	1971, 1974-75	7	0
348	02100843	Cabin Creek near Candor	35°18'42"	79°44'23"	Montgomery	Candor	1.56	Bear Creek	03030003	2	1971-72, 1974	5	0
349	02100859	Cotton Creek at SR 1369 near Star	35°23'15"	79°45'55"	Montgomery	Troy (15-min)	0.92	Cabin Creek	03030003	2	1971, 1974-75	6	1
350	02100862	Mill Creek at Biscoe	35°21'38"	79°45'48"	Montgomery	Biscoe	1.38	Lick Creek	03030003	2	1971-72, 1974-75	8	3
351	02100872	Cabin Creek near Dover	35°23'47"	79°42'11"	Moore	Spies	24.2	Bear Creek	03030003	2	1962	2	0
352	02100911	Mill Creek near Spies	35°23'17"	79°40'39"	Moore	Spies	15.7	Cabin Creek	03030003	2	1962, 1966, 1968	4	0
353	02100921	Wet Creek near Robbins	35°23'25"	79°39'28"	Moore	Spies	15.9	Cabin Creek	03030003	2	1962, 1966, 1968	4	0
354	02100929	Dry Creek near West Philadelphia	35°23'50"	79°37'34"	Moore	Spies	9.65	Cabin Creek	03030003	2	1962, 1966, 1968	4	2
355	02100939	Cabin Creek above mine near Robbins	35°25'00"	79°37'00"	Moore	Robbins	78.0	Bear Creek	03030003	2	1954, 1962	3	0
356	02101000	Bear Creek at Robbins	35°26'03"	79°35'39"	Moore	Robbins	137	Deep River	03030003	1	Oct 1939 - Sept 1971	N/A	N/A
357	02101001	Bear Creek at NC 705 at Robbins	35°26'26"	79°35'20"	Moore	Robbins	139	Deep River	03030003	2	1973-74, 1985-98	49	0
358	02101005	Bear Creek below sewage outfall near Robbins	35°27'08"	79°34'53"	Moore	Robbins	141	Deep River	03030003	2	1971, 1974-75	4	0
359	02101016	Deep River tributary No.3 near High Falls	35°30'16"	79°32'21"	Moore	Bennett	6.26	Deep River	03030003	2	1966	1	1
360	02101030	Falls Creek near Bennett	35°33'20"	79°29'56"	Chatham	Bennett	3.43	Deep River	03030003	2	1953, 1961-73	15	2
361	02101042	Falls Creek near High Falls	35°29'51"	79°31'01"	Moore	Robbins	12.6	Deep River	03030003	2	1955, 1962	3	3

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												Flow	Zero flow
362	02101045	Buffalo Creek at McConnell	35°28'14"	79°31'00"	Moore	Robbins	21.4	Deep River	03030003	2	1962, 1965-68, 1970-71	12	4
363	02101061	Tysons Creek at SR 1600 near Glendon	35°29'54"	79°27'05"	Moore	Putnam	12.7	Deep River	03030003	2	1962	2	2
364	02101066	Deep River at Glendon	35°29'20"	79°25'15"	Moore	Putnam	859	Cape Fear River	03030003	1	July 1993 - Sept 1996	N/A	N/A
365	02101078	Deep River tributary No.5 at Glendon	35°29'43"	79°25'17"	Moore	Putnam	2.23	Deep River	03030003	2	1966	1	1
366	02101084	McLendons Creek near Harris	35°18'28"	79°32'35"	Moore	Zion Grove	14.5	Deep River	03030003	2	1962, 1966, 1968	4	1
367	0210108450	Suck Creek tributary near Zion Grove	35°20'17"	79°33'57"	Moore	Zion Grove	0.67	Suck Creek	03030003	1	Apr 1986 - Sept 1988	N/A	N/A
368	02101087	Big Juniper Creek near Harris	35°19'17"	79°30'29"	Moore	Zion Grove	9.01	McLendons Creek	03030003	2	1962, 1968	3	1
369	02101090	McLendons Creek near Carthage	35°22'23"	79°27'30"	Moore	Carthage	44.0	Deep River	03030003	2	1949-54, 1959, 1962, 1966, 1968	22	3
370	02101179	Killetts Creek at SR 1240 near Carthage	35°20'03"	79°26'13"	Moore	Carthage	2.15	McLendons Creek	03030003	2	1971, 1973-74	7	3
371	02101183	Killetts Creek near Carthage	35°21'16"	79°27'18"	Moore	Carthage	8.94	McLendons Creek	03030003	2	1971, 1973	3	0
372	02101277	Richland Creek at NC 27 near Carthage	35°22'59"	79°29'08"	Moore	Putnam	11.0	McLendons Creek	03030003	2	1952, 1962	3	3
373	02101283	Richland Creek near Putnam	35°25'58"	79°25'58"	Moore	Putnam	24.9	McLendons Creek	03030003	2	1962-63, 1966, 1971	6	5
374	0210128859	McClendons Creek near Hallison	35°24'00"	79°26'00"	Moore	Putnam	62.8	Deep River	03030003	2	1954	3	1
375	02101290	McLendons Creek near Putnam	35°27'01"	79°25'22"	Moore	Putnam	97.3	Deep River	03030003	2	1963-68, 1970-71	14	0
376	02101308	McClendons Creek near Glendon	35°27'37"	79°24'07"	Moore	Putnam	99.7	Deep River	03030003	2	1954-55	4	1
377	02101358	McIntosh Creek near Carthage	35°24'33"	79°21'27"	Moore	White Hill	2.69	Big Governors Creek	03030003	2	1962	2	2

Table 6. Summary of continuous-record gaging stations and partial-record measuring sites in the Cape Fear River Basin in North Carolina where records of gage height and streamflow were collected—Continued

[mi^2, square mile; SR, secondary road; N/A, not applicable; SEO, sewage effluent outfall; Ind, drainage area is undetermined and(or) may be indeterminate. Gray shading indicates sites for which low-flow characteristics have been developed. Period of record for continuous-record sites (site type 1) is shown in months and years; period of record for partial-record sites (site type 2) is shown in water years in which discharge measurements were made]

Site index no. (pl. 1)	USGS downstream order number	Station name	Latitude	Longitude	County	USGS topographic quadrangle	Drainage area (mi^2)	Tributary to	Hydrologic unit code	Site type	Period of record	Number of measurements for partial-record sites	
												Flow	Zero flow
378	02101371	Big Governors Creek near Glendon	35°27'28"	79°22'12"	Moore	White Hill	31.4	Deep River	03030003	2	1954, 1963, 1966	4	3
379	02101387	Little Governors Creek near Carbonton	35°27'53"	79°21'16"	Lee	White Hill	8.21	Deep River	03030003	2	1962	2	2
380	02101388	Big Governors Creek near Hawbranch	35°28'24"	79°21'25"	Moore	White Hill	40.8	Deep River	03030003	2	1962	1	0
381	02101433	Indian Creek near Carbonton	35°32'18"	79°20'09"	Chatham	Goldston	25.4	Deep River	03030003	2	1955, 1960, 1962	4	2
382	0210146350	Deep River at Gulf	35°34'18"	79°17'14"	Chatham	Goldston	1,063	Cape Fear River	03030003	2	1970, 1973, 1976, 1979-80	7	0
383	02101480	Sugar Creek near Tramway	35°25'28"	79°14'50"	Lee	Sanford	0.9[a]	Pocket Creek	03030003	2	1953, 1955, 1961-73	15	1
384	02101484	Pocket Creek near Cumnock	35°29'25"	79°16'24"	Lee	White Hill	23.2	Deep River	03030003	2	1960, 1962	3	0
385	02101488	Little Pocket Creek near Cumnock	35°30'17"	79°17'32"	Lee	Goldston	9.52	Pocket Creek	03030003	2	1960, 1962	3	1
386	02101502	Cedar Creek tributary at U.S. 421 near Gulf	35°34'37"	79°18'35"	Chatham	Goldston	0.02	Cedar Creek	03030003	2	1974-75	7	3
387	02101504	Cedar Creek at SR 2142 at Gulf	35°34'00"	79°17'05"	Chatham	Goldston	4.42	Deep River	03030003	2	1974-75	5	1
388	02101506	Cedar Creek at SR 2145 near Gulf	35°34'05"	79°14'45"	Chatham	Colon	13.0	Deep River	03030003	2	1974-75	5	1
389	02101513	Big Buffalo Creek near Sanford	35°28'55"	79°12'03"	Lee	Sanford	9.73	Deep River	03030003	2	1954, 1962, 1971	6	2
390	02101524	Big Buffalo Creek at SR 1100 near Sanford	35°29'19"	79°12'08"	Lee	Sanford	8.64	Deep River	03030003	2	1970, 1972-73	4	0
391	02101539	Big Buffalo Creek near Colon	35°30'40"	79°12'12"	Lee	Colon	12.5	Deep River	03030003	2	1970, 1972-75	8	0
392	02101540	Big Buffalo Creek tributary at U.S. 1-15-501 near Sanford	35°30'44"	79°11'16"	Lee	Colon	0.31	Big Buffalo Creek	03030003	2	1974-75	6	2
393	02101542	Purgatory Branch at U.S. 421 near Cumnock	35°31'44"	79°14'03"	Lee	Colon	1.27	Big Buffalo Creek	03030003	2	1970, 1973-74	4	0
394	02101552	Big Buffalo Creek near Cumnock	35°32'30"	79°13'47"	Lee	Colon	19.7	Deep River	03030003	2	1962, 1970, 1972-73	7	0

Table 6. Summary of continuous-record gaging stations and partial-record measuring sites in the Cape Fear River Basin in North Carolina where records of gage height and streamflow were collected—Continued

[mi^2, square mile; SR, secondary road; N/A, not applicable; SEO, sewage effluent outfall; Ind, drainage area is undetermined and(or) may be indeterminate. Gray shading indicates sites for which low-flow characteristics have been developed. Period of record for continuous-record sites (site type 1) is shown in months and years; period of record for partial-record sites (site type 2) is shown in water years in which discharge measurements were made]

Site index no. (pl. 1)	USGS downstream order number	Station name	Latitude	Longitude	County	USGS topographic quadrangle	Drainage area (mi^2)	Tributary to	Hydrologic unit code	Site type	Period of record	Number of measurements for partial-record sites	
												Flow	Zero flow
395	02101571	Georges Creek at SR 2145 at Farmville	35°34'23"	79°12'55"	Chatham	Colon	11.8	Deep River	03030003	2	1962, 1966	3	3
396	02101612	Little Buffalo Creek near Colon	35°31'54"	79°10'27"	Lee	Colon	4.79	Deep River	03030003	2	1960-62, 1964-65	7	0
397	02101631	Rocky River at Liberty	35°49'30"	79°34'24"	Randolph	Liberty	2.18	Deep River	03030003	2	1954	3	1
398	02101660	Rocky River near Liberty	35°49'09"	79°33'24"	Randolph	Liberty	4.52	Deep River	03030003	2	1953-55, 1960-63, 1966	18	1
399	0210166029	Rocky River near Crutchfield Crossroads	35°48'25"	79°31'41"	Chatham	Liberty	7.42	Deep River	03030003	1	May 1988 - Sept 1998	N/A	N/A
400	02101686	North Prong Rocky River near Liberty	35°51'51"	79°32'34"	Randolph	Liberty	2.70	Rocky River	03030003	2	1971, 1973-74, 1976-81	16	0
401	02101719	Mud Creek near Siler City	35°47'43"	79°27'47"	Chatham	Crutchfield Crossroads	7.99	Rocky River	03030003	2	1960, 1962	3	1
402	02101723	Nick Creek near Siler City	35°45'58"	79°26'13"	Chatham	Crutchfield Crossroads	5.01	Rocky River	03030003	2	1966	1	1
403	02101739	Loves Creek above SEO near Siler City	35°43'43"	79°26'19"	Chatham	Siler City	7.51	Rocky River	03030003	2	1954-55, 1974	6	0
404	02101752	Loves Creek below SEO near Siler City	35°43'49"	79°25'37"	Chatham	Siler City	8.[a]	Rocky River	03030003	2	1973	3	0
405	0210175555	Loves Creek at mouth near Siler City	35°43'57"	79°25'23"	Chatham	Siler City	7.99	Rocky River	03030003	2	1973-75	5	0
406	02101779	Varnell Creek at U.S. 64 near Siler City	35°44'04"	79°24'08"	Chatham	Siler City	9.74	Rocky River	03030003	2	1955, 1960, 1962	4	4
407	02101792	Rocky River near Mount Vernon Springs	35°41'54"	79°22'35"	Chatham	Siler City	94.7	Deep River	03030003	2	1970, 1973-74	5	0
408	02101793	Meadow Creek near Bonlee	35°41'27"	79°22'20"	Chatham	Siler City NE	5.33	Rocky River	03030003	2	1966	1	1
409	02101800	Tick Creek near Mount Vernon Springs	35°39'37"	79°24'08"	Chatham	Siler City	15.5	Rocky River	03030003	1	June 1958 - Sept 1981, Jan 1994 - Sept 1998	N/A	N/A
										2	1984-89	13	3

Table 6. Summary of continuous-record gaging stations and partial-record measuring sites in the Cape Fear River Basin in North Carolina where records of gage height and streamflow were collected—Continued

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Site index no. (pl. 1)	USGS downstream order number	Station name	Latitude	Longitude	County	USGS topographic quadrangle	Drainage area (mi^2)	Tributary to	Hydrologic unit code	Site type	Period of record	Number of measure-ments for partial-record sites	
												Flow	Zero flow
410	02101808	Tick Creek near Bear Creek	35°39'57"	79°23'08"	Chatham	Siler City	17.0	Rocky River	03030003	2	1961	1	0
411	02101820	Tick Creek near Bonlee	35°40'24"	79°21'59"	Chatham	Siler City NE	20.0	Rocky River	03030003	2	1954, 1956-58, 1960-63, 1970	16	1
412	02101848	Landrum Creek near Pittsboro	35°41'16"	79°16'32"	Chatham	Siler City NE	14.5	Rocky River	03030003	2	1955, 1962, 1966	4	0
413	02101862	Holland Creek near Pittsboro	35°41'30"	79°14'40"	Chatham	Pittsboro	12.7	Rocky River	03030003	2	1955, 1962	3	1
414	02101884	Bear Creek near Bonlee	35°35'57"	79°23'59"	Chatham	Bear Creek	21.7	Rocky River	03030003	2	1960, 1962	3	2
415	02101890	Bear Creek near Goldston	35°37'33"	79°17'54"	Chatham	Siler City NE	42.4	Rocky River	03030003	2	1949-71	50	2
416	02101946	Rocky River near Coalglen	35°37'20"	79°11'17"	Chatham	Colon	237	Deep River	03030003	2	1974, 1976, 1979	6	0
417	02102000	Deep River at Moncure	35°37'38"	79°06'58"	Chatham	New Hope Dam	1,434	Cape Fear River	03030003	1	July 1930 - Sept 1998	N/A	N/A
418	0210214010	Lick Creek near Sanford	35°29'06"	79°07'38"	Lee	Sanford	1.9[a]	Cape Fear River	03030004	2	1974	3	0
419	02102144	Hughes Creek at Rosser	35°33'48"	79°05'37"	Lee	Moncure	10.8	Cape Fear River	03030004	2	1964	1	1
420	02102179	White Oak Creek near Friendship	35°39'19"	78°53'31"	Wake	New Hill	13.2	Buckhorn Creek	03030004	2	1972-74	5	1
421	02102180	White Oak Creek near Holly Springs	35°37'24"	78°55'00"	Wake	Cokesbury	22.5	Buckhorn Creek	03030004	2	1963-68, 1970, 1972-74	18	4
422	02102182	Little White Oak Creek near Bonsal	35°37'40"	78°56'13"	Wake	New Hill	7.72	White Oak Creek	03030004	2	1972-74	5	1
423	02102184	White Oak Creek near Corinth	35°34'45"	78°58'12"	Chatham	Cokesbury	46.3	Buckhorn Creek	03030004	2	1972-74	5	1

Table 6. Summary of continuous-record gaging stations and partial-record measuring sites in the Cape Fear River Basin in North Carolina where records of gage height and streamflow were collected—Continued

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Site index no. (pl. 1)	USGS downstream order number	Station name	Latitude	Longitude	County	USGS topographic quadrangle	Drainage area (mi^2)	Tributary to	Hydrologic unit code	Site type	Period of record	Number of measurements for partial-record sites	
												Flow	Zero flow
424	02102186	Buckhorn Creek near Burt	35°35'18"	78°54'24"	Wake	Cokesbury	10[a]	Cape Fear River	03030004	2	1972-74	5	0
425	0210218650	Buckhorn Creek at SR 1116 near Duncan	35°35'28"	78°54'53"	Wake	Cokesbury	11.6	Cape Fear River	03030004	2	1974	3	0
426	02102187	Buckhorn Creek at Burt	35°35'23"	78°54'32"	Wake	Cokesbury	14[a]	Cape Fear River	03030004	2	1972-74	5	0
427	0210218750	Cary Branch at Holleman's Crossroads	35°36'46"	78°54'20"	Wake	Cokesbury	3.87	Buckhorn Creek	03030004	2	1972-74	5	0
428	02102188	Buckhorn Creek near Corinth[k]	35°34'30"	78°57'49"	Chatham	Cokesbury	22[a]	Cape Fear River	03030004	2	1972-74	5	0
429	0210218920	Buckhorn Creek tributary No.1 near Corinth	35°38'58"	78°57'21"	Chatham	Cokesbury	3.95	Buckhorn Creek	03030004	2	1973-74	4	0
430	0210219050	Buckhorn Creek tributary No.2 near Corinth	35°33'38"	78°58'12"	Chatham	Cokesbury	1.01	Buckhorn Creek	03030004	2	1973-74	4	1
431	02102192	Buckhorn Creek near Corinth	35°33'34"	78°58'25"	Chatham	Cokesbury	76.3	Cape Fear River	03030004	1	June 1972 - Sept 1998	N/A	N/A
432	02102280	Hector Creek near Chalybeate	35°28'00"	78°51'30"	Harnett	Lillington	17.4	Cape Fear River	03030004	2	1965-68, 1970-71	9	0
433	02102337	Kenneth Creek near Fuquay Springs	35°33'46"	78°48'22"	Wake	Fuquay-Varina	4.35	Neills Creek	03030004	2	1955-56	4	0
434	02102384	Kenneth Branch at SR 2770 near Fuquay Springs	35°34'14"	78°47'04"	Wake	Fuquay-Varina	0.98	Kenneth Creek	03030004	2	1970, 1972, 1974	5	0
435	02102386	Kenneth Branch above SEO near Fuquay Springs	35°33'47"	78°48'36"	Wake	Fuquay-Varina	4.0[a]	Kenneth Creek	03030004	2	1955	3	0
436	02102457	Kenneth Creek near Chalybeate	35°32'01"	78°47'41"	Harnett	Fuquay-Varina	14[a]	Neills Creek	03030004	2	1955, 1970, 1972-74	11	0
437	02102480	Neills Creek near Lillington	35°25'42"	78°49'28"	Harnett	Lillington	37.6	Cape Fear River	03030004	2	1954-59, 1964	13	1

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												Flow	Zero flow
438	02102500	Cape Fear River at Lillington	35°24'22"	78°48'48"	Harnett	Lillington	3,464	Atlantic Ocean	03030004	1	Dec 1923 - Sept 1998	N/A	N/A
439	02102512	Buies Creek at Buies Creek	35°24'26"	78°44'51"	Harnett	Coats	7.24	Cape Fear River	03030004	2	1955	4	0
440	02102517	Buies Creek above East Buies Creek near Buies Creek	35°23'52"	78°44'59"	Harnett	Coats	7.64	Cape Fear River	03030004	2	1974-75	4	0
441	02102520	East Buies Creek at Buies Creek	35°24'01"	78°44'03"	Harnett	Coats	7.56	Buies Creek	03030004	2	1965-68, 1970-71	10	1
442	0210252355	Buies Creek at SR 1519 at Buies Creek	35°23'40"	78°45'10"	Harnett	Coats	25.9	Cape Fear River	03030004	2	1974-75	3	0
443	02102542	Mulatto Branch at SR 1156 near Sanford	35°24'16"	79°11'40"	Lee	Sanford	3.73	Little Juniper Creek	03030004	2	1974-75	6	0
444	02102548	Upper Little River near Sanford	35°24'01"	79°08'37"	Lee	Sanford	18.7	Cape Fear River	03030004	2	1955, 1968	4	0
445	02102550	Upper Little River near Lemon Springs	35°24'08"	79°07'47"	Lee	Sanford	19[a]	Cape Fear River	03030004	2	1974, 1976, 1978, 1980	7	0
446	02102557	Gasters Creek at Carnes, Inc., near Sanford	35°27'15"	79°08'30"	Lee	Sanford	0.1[a]	Upper Little River	03030004	2	1974-75	6	1
447	02102559	Gasters Creek tributary at SR 1306 near Sanford	35°27'25"	79°08'45"	Lee	Sanford	Ind	Gasters Creek	03030004	2	1974-75	6	1
448	0210256025	Gasters Creek at SR 1132 near Sanford	35°27'00"	79°08'46"	Lee	Sanford	0.5[a]	Upper Little River	03030004	2	1973-75	9	0
449	02102573	Gasters Creek near Sanford	35°25'19"	79°08'24"	Lee	Sanford	4.4[a]	Upper Little River	03030004	2	1973-74	5	0
450	02102576	Juniper Creek near Swann	35°23'00"	79°08'00"	Lee	Sanford	13.0	Upper Little River	03030004	2	1968	1	0
451	02102578	Juniper Creek at mouth near Swann	35°23'52"	79°07'16"	Lee	Broadway	16.6	Upper Little River	03030004	2	1974-75	5	0

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Site index no. (pl. 1)	USGS downstream order number	Station name	Latitude	Longitude	County	USGS topographic quadrangle	Drainage area (mi^2)	Tributary to	Hydrologic unit code	Site type	Period of record	Number of measurements for partial-record sites	
												Flow	Zero flow
452	02102580	Upper Little River at Swann	35°23'59"	79°06'46"	Lee	Broadway	43.8	Cape Fear River	03030004	2	1932, 1952, 1954-55, 1964-68, 1970	19	0
453	02102582	Upper Little River near Swann	35°24'57"	79°05'11"	Lee	Broadway	54.3	Cape Fear River	03030004	2	1966, 1968, 1974	5	0
454	0210258306	Upper Little River tributary at SR 1280 near Seminole	35°24'08"	79°01'19"	Harnett	Broadway	0.75	Cape Fear River	03030004	2	1986	1	1
455	02102590	Barbecue Creek at Barbecue	35°20'17"	79°02'45"	Harnett	Olivia	31.4	Upper Little River	03030004	2	1960-69	23	0
456	02102591	Barbecue Creek near Arlington	35°21'14"	79°00'22"	Harnett	Olivia	45.7	Upper Little River	03030004	2	1968	1	0
457	0210259845	Bear Branch at NC 27 at Norrington Crossroads	35°21'13"	78°54'42"	Harnett	Anderson Creek	1.46	Walkers Creek	03030004	2	1986	1	1
458	0210259990	Walkers Creek at SR 1250 near Mamers	35°22'41"	78°55'05"	Harnett	Mamers	6.46	Upper Little River	03030004	2	1986	1	1
459	0210260085	Walkers Creek at NC 27 at Norrington Crossroads	35°21'36"	78°53'59"	Harnett	Anderson Creek	9.50	Upper Little River	03030004	2	1986	1	1
460	0210260360	Duncans Creek at NC 27 near Lillington	35°22'15"	78°51'51"	Harnett	Bunnlevel	5.42	Upper Little River	03030004	2	1986	1	1
461	02102610	Upper Little River near Lillington	35°21'35"	78°50'37"	Harnett	Bunnlevel	188	Cape Fear River	03030004	2	1949-55, 1968	17	0
462	02102622	Upper Little River near Bunnlevel	35°20'05"	78°47'03"	Harnett	Bunnlevel	204	Cape Fear River	03030004	2	1930, 1955-56, 1968, 1971	6	1
463	02102634	Upper Little River near Erwin	35°19'33"	78°43'26"	Harnett	Erwin	217	Cape Fear River	03030004	2	1968, 1974-76, 1979, 1985-98	54	0
464	02102658	Stewart Creek at U.S. Hwy 421 near Erwin	35°20'44"	78°41'07"	Harnett	Erwin	7.81	Juniper Creek	03030004	2	1955	2	0
465	02102671	Juniper Creek near Erwin	35°20'13"	78°41'33"	Harnett	Erwin	13.3	Cape Fear River	03030004	2	1955	1	0

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Site index no. (pl. 1)	USGS downstream order number	Station name	Latitude	Longitude	County	USGS topographic quadrangle	Drainage area (mi^2)	Tributary to	Hydrologic unit code	Site type	Period of record	Number of measure-ments for partial-record sites	
												Flow	Zero flow
466	02102704	Little River near Harris	35°16'18"	79°30'31"	Moore	Zion Grove	7.57	Cape Fear River	03030004	2	1965, 1974, 1976-77	11	0
467	02102705	Little River near Pinehurst	35°16'00"	79°28'00"	Moore	Carthage	12.5	Cape Fear River	03030004	2	1965	1	0
468	02102708	Wads Creek near Eastwood	35°16'55"	79°25'53"	Moore	Carthage	6.29	Little River	03030004	2	1965	1	0
469	02102709	Little River near Eastwood	35°16'11"	79°25'01"	Moore	Carthage	27.3	Cape Fear River	03030004	2	1965, 1968	2	0
470	02102719	Joes Fork near Pinehurst	35°13'09"	79°28'45"	Moore	Southern Pines	3.52	Nicks Creek	03030004	2	1955, 1968	3	0
471	02102727	McLeans Branch at Pinehurst	35°12'15"	79°28'24"	Moore	Southern Pines	0.37	Joes Fork	03030004	2	1968	1	0
472	02102731	McLeans Branch near Pinehurst	35°13'11"	79°28'40"	Moore	Southern Pines	0.93	Joes Fork	03030004	2	1955	2	0
473	02102754	Rattlesnake Creek near Pinehurst	35°13'08"	79°27'50"	Moore	Southern Pines	0.49	Joes Fork	03030004	2	1968	1	0
474	02102755	Rattlesnake Creek below water intake near Pinehurst	35°13'09"	79°27'50"	Moore	Southern Pines	0.49	Joes Fork	03030004	2	1968	1	0
475	02102757	Spring at Pinehurst Water Supply near Pinehurst	35°13'05"	79°27'50"	Moore	Southern Pines	Ind	Rattlesnake Creek tributary	03030004	2	1968	1	0
476	02102766	Joes Fork near Eastwood	35°13'37"	79°27'26"	Moore	Southern Pines	5.84	Nicks Creek	03030004	2	1955, 1973-74	6	0
477	02102778	Nicks Creek near Eastwood	35°14'15"	79°26'52"	Moore	Southern Pines	20.6	Little River	03030004	2	1955, 1962, 1965	4	0
478	02102791	Nicks Creek near Southern Pines	35°15'12"	79°24'46"	Moore	Carthage	26.8	Little River	03030004	2	1965-66	2	0
479	02102792	Nicks Creek near Pinehurst	35°15'52"	79°24'07"	Moore	Carthage	27.6	Little River	03030004	2	1974	3	0
480	02102796	Little River 1.1 miles below Pond Branch near Vass	35°15'15"	79°18'47"	Moore	Vass	76[a]	Cape Fear River	03030004	2	1974	3	0
481	02102801	Mill Creek near Eastwood	35°12'56"	79°24'06"	Moore	Southern Pines	1.78	Little River	03030004	2	1974	1	1
482	02102813	McDeeds Creek above SEO at Southern Pines	35°11'31"	79°23'10"	Moore	Southern Pines	2.30	Mill Creek	03030004	2	1955, 1965, 1972-74	8	0

Table 6. Summary of continuous-record gaging stations and partial-record measuring sites in the Cape Fear River Basin in North Carolina where records of gage height and streamflow were collected—Continued

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Site index no. (pl. 1)	USGS downstream order number	Station name	Latitude	Longitude	County	USGS topographic quadrangle	Drainage area (mi^2)	Tributary to	Hydrologic unit code	Site type	Period of record	Number of measurements for partial-record sites	
												Flow	Zero flow
483	02102838	McDeeds Creek below SEO at Southern Pines	35°12'05"	79°22'45"	Moore	Southern Pines	4.20	Mill Creek	03030004	2	1972, 1975	5	0
484	02102849	McDeeds Creek near Niagara	35°13'00"	79°21'31"	Moore	Niagara	7.07	Mill Creek	03030004	2	1973-74	4	0
485	0210284950	McDeeds Creek at SR 1853 near Niagara	35°13'44"	79°20'46"	Moore	Niagara	8.27	Mill Creek	03030004	2	1972-75	8	0
486	02102859	Mill Creek near Skyline	35°14'06"	79°20'09"	Moore	Niagara	15.9	Little River	03030004	2	1972-74	5	0
487	0210287225	Mill Creek above Crystal Lake Dam near Vass	35°14'25"	79°18'25"	Moore	Niagara	20[a]	Little River	03030004	2	1972	1	0
488	02102897	Little River near Lobelia	35°12'13"	79°12'59"	Moore	Lobelia	110	Cape Fear River	03030004	2	1997-98	6	0
489	02102906	Horse Creek near Inverness	35°11'07"	79°12'03"	Hoke	Lobelia	3.25	Little River	03030004	2	1968	1	0
490	02102907	Little River near Mt. Pleasant	35°11'31"	79°11'04"	Moore	Lobelia	154	Cape Fear River	03030004	2	1968	1	0
491	02102908	Flat Creek near Inverness	35°10'54"	79°10'40"	Hoke	Lobelia	7.63	Little River	03030004	1	June 1968 - Sept 1998	N/A	N/A
492	02102910	Dunhams Creek near Carthage	35°18'45"	79°23'01"	Moore	Carthage	2.2[a]	Crane Creek	03030004	2	1953, 1961-71	13	2
493	02102912	Dunhams Creek near Whispering Pines	35°18'38"	79°20'35"	Moore	Vass	8.87	Crane Creek	03030004	2	1965	1	0
494	02102914	Crane Creek near Carthage	35°20'09"	79°20'43"	Moore	Vass	3.77	Little River	03030004	2	1965	1	0
495	02102922	Herds Creek near Cameron	35°19'09"	79°18'07"	Moore	Vass	8.90	Crane Creek	03030004	2	1965, 1968	2	0
496	02102930	Crane Creek near Vass	35°17'04"	79°16'19"	Moore	Vass	32.7	Little River	03030004	2	1949-56, 1961-71	31	3
497	02102938	Crane Creek near Lobelia	35°14'36"	79°12'41"	Moore	Lobelia	80.0	Little River	03030004	2	1968	1	1
498	02103000	Little River at Manchester	35°11'38"	78°59'14"	Cumberland	Manchester	347	Cape Fear River	03030004	1	Nov 1938 - Sept 1950	N/A	N/A
										2	1968, 1973-74, 1978, 1980-98	67	0
499	02103081	Tank Creek at Manchester	35°11'22"	78°59'04"	Cumberland	Manchester	8.11	Little River	03030004	2	1955, 1968	4	0

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												Flow	Zero flow
500	02103348	Little River at NC 210 near Manchester	35°12′07"	78°57′12"	Cumberland	Manchester	359	Cape Fear River	03030004	2	1955, 1968, 1973-74	6	0
501	02103390	South Prong Anderson Creek near Lillington	35°15′31"	78°55′27"	Harnett	Anderson Creek	7.57	Anderson Creek	03030004	2	1954, 1961-71	13	2
502	02103500	Little River at Linden	35°15′46"	78°46′35"	Harnett	Bunnlevel	459	Cape Fear River	03030004	1	Nov 1928 - Sept 1971	N/A	N/A
503	02103520	Stewarts Creek at Linden	35°16′09"	78°45′21"	Harnett	Bunnlevel	9.44	Little River	03030004	2	1955, 1957-68, 1970	32	0
504	02103550	Little River at NC 217 at Linden	35°15′49"	78°44′26"	Harnett	Erwin	472	Cape Fear River	03030004	2	1974, 1976, 1979	7	0
505	02103620	Cape Fear River tributary near Slocumb	35°11′13"	78°47′00"	Cumberland	Slocomb	16.4	Cape Fear River	03030004	2	1960-68, 1971	19	1
506	0210364910	Carvers Creek at SR 1658 near Slocomb	35°10′24"	78°52′06"	Cumberland	Slocomb	5.85	Cape Fear River	03030004	2	1972-74	6	0
507	02103650	Carvers Creek near Fayetteville	35°09′14"	78°51′18"	Cumberland	Slocomb	9.79	Cape Fear River	03030004	2	1966-68, 1970-71	8	0
508	0210365050	Carvers Creek tributary No.1 at U.S. Hwy 401 near Slocomb	35°09′30"	78°52′08"	Cumberland	Slocomb	2.22	Carvers Creek	03030004	2	1972, 1974	4	0
509	0210365075	Carvers Creek tributary No.2 at U.S. Hwy 401 near Slocomb	35°09′03"	78°52′15"	Cumberland	Slocomb	3.8[a]	Carvers Creek	03030004	2	1972-74	6	0
510	0210365090	Carvers Creek below Carvers Creek Falls near Slocomb	35°08′58"	78°51′23"	Cumberland	Slocomb	17.2	Cape Fear River	03030004	2	1972-74	5	0
511	02103770	Cross Creek at Langdon Street at Fayetteville	35°04′48"	78°53′19"	Cumberland	Fayetteville	14.5	Cape Fear River	03030004	2	1955, 1966-68, 1970-71, 1974	17	0
512	02103960	Blounts Creek at Fayetteville	35°02′25"	78°53′51"	Cumberland	Fayetteville	4.22	Cross Creek	03030004	2	1960-68, 1970	23	0
513	02103967	Hybarts Branch near Fayettville	35°04′35"	78°56′26"	Cumberland	Fayetteville	0.22	Branson Creek	03030004	2	1973-75	7	2
514	02103973	Hybarts Branch at Morganton Road at Fayetteville	35°03′50"	78°55′48"	Cumberland	Fayettville	1.15	Branson Creek	03030004	2	1973-74	6	1

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												Flow	Zero flow
515	02103997	Cross Creek at U.S. Hwy 301 at Fayetteville	35°03'18"	78°51'48"	Cumberland	Vander	38[a]	Cape Fear River	03030004	2	1980	1	0
516	02104000	Cape Fear River at Fayetteville	35°02'49"	78°51'36"	Cumberland	Vander	4,395	Atlantic Ocean	03030004	1	Jan 1889 - Sept 1917, Oct 1928 - Sept 1940 (discharge), Oct 1986 - Sept 1998 (gage height only)	N/A	N/A
517	02104080	Reese Creek near Fayetteville	35°04'49"	78°47'45"	Cumberland	Vander	9.96	Locks Creek	03030004	2	1955, 1957, 1961-71	14	0
518	02104088	Buzzard Branch at East Fayetteville	35°02'39"	78°50'58"	Cumberland	Vander	0.40	Locks Creek	03030004	2	1955, 1973-74	4	0
519	02104090	Locks Creek at East Fayetteville	35°02'48"	78°51'19"	Cumberland	Vander	38[a]	Cape Fear River	03030004	2	1955-56, 1966-68, 1970-71	12	0
520	02104220	Rockfish Creek at Raeford	34°59'55"	79°12'55"	Hoke	Raeford	92.7	Cape Fear River	03030004	1	July 1988 - Sept 1998	N/A	N/A
										2	1950-55, 1959, 1962, 1964, 1968	21	0
521	02104244	Rockfish Creek at U.S. Hwy 401 at Raeford	34°58'46"	79°11'46"	Hoke	Raeford	98.5	Cape Fear River	03030004	2	1973-75	8	0
522	02104255	Beaver Creek near Arabia	34°58'29"	79°07'10"	Hoke	Parkton	11.9	Rockfish Creek	03030004	2	1965-68, 1971	9	0
523	02104262	Puppy Creek near Rockfish	35°02'58"	79°07'47"	Hoke	Nicholson Creek	19.7	Rockfish Creek	03030004	2	1968	1	0
524	02104279	Rockfish Creek near Arabia	34°58'10"	79°06'40"	Hoke	Parkton	150[a]	Cape Fear River	03030004	2	1973-74, 1978, 1980-93, 1997-98	58	0
525	02104288	Rockfish Creek at SR 1406 near Rockfish	35°57'08"	79°03'13"	Hoke	Parkton	166	Cape Fear River	03030004	2	1973-74	3	0
526	0210429150	Rockfish Creek at SR 1115 near Hope Mills	34°57'38"	78°58'21"	Cumberland	Saint Pauls (15-min)	187	Cape Fear River	03030004	2	1973-74	3	0

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Site index no. (pl. 1)	USGS downstream order number	Station name	Latitude	Longitude	County	USGS topographic quadrangle	Drainage area (mi^2)	Tributary to	Hydrologic unit code	Site type	Period of record	Number of measure-ments for partial-record sites	
												Flow	Zero flow
527	02104298	Rockfish Creek at NC 59 at Hope Mills	34°57′38"	78°56′39"	Cumberland	Saint Pauls (15-min)	190	Cape Fear River	03030004	2	1973-74	3	0
528	02104310	Little Rockfish Creek above U.S. Hwy 401 near Clifdale	35°03′16"	79°05′28"	Cumberland	Clifdale	11.2	Rockfish Creek	03030004	2	1968	1	0
529	02104316	Bones Creek near Cumberland	35°03′48"	79°02′20"	Cumberland	Clifdale	12.2	Little Rockfish Creek	03030004	2	1968	1	0
530	02104320	Little Rockfish Creek near Cumberland	35°00′38"	79°00′59"	Cumberland	Clifdale	44.9	Rockfish Creek	03030004	2	1960-68, 1970	17	0
531	02104341	Jacks Ford Branch at Bonnie Doone	35°05′45"	78°57′55"	Cumberland	Fayettville	0.42	Beaver Creek	03030004	2	1974-75	4	0
532	02104346	Beaver Creek at Bonnie Doone	35°05′00"	78°58′09"	Cumberland	Fayettville	10.6	Little Rockfish Creek	03030004	2	1973-74	3	0
533	02104356	Stewarts Creek near Clifdale	35°04′25"	79°00′43"	Cumberland	Clifdale	5.04	Beaver Creek	03030004	2	1973-74	4	0
534	0210435650	Stewart Creek 1.0 mile above mouth near Clifdale	35°04′01"	78°59′47"	Cumberland	Clifdale	6.1[a]	Beaver Creek	03030004	2	1973-74	5	0
535	02104357	Beaver Creek near Cumberland	35°03′33"	78°58′53"	Cumberland	Fayettville	22.9	Little Rockfish Creek	03030004	2	1973-74	4	0
536	02104362	Beaver Creek near Skibo	35°02′39"	78°58′41"	Cumberland	Fayettville	25.3	Little Rockfish Creek	03030004	2	1974-75, 1979-80	5	0
537	0210436450	Beaver Creek tributary at U.S. Hwy 401 near Skibo	35°02′38"	78°58′34"	Cumberland	Fayettville	1.1[a]	Beaver Creek	03030004	2	1973-74	3	0
538	0210436650	Beaver Creek tributary No.1 near Clifdale	35°03′40"	79°01′25"	Cumberland	Clifdale	0.1[a]	Beaver Creek	03030004	2	1974-75	4	1
539	02104367	Beaver Creek tributary No.1 at SR 1410 near Clifdale	35°03′08"	79°00′25"	Cumberland	Clifdale	0.27	Beaver Creek	03030004	2	1975	3	0

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												Flow	Zero flow
540	02104380	Beaver Creek at Cumberland	35°00'09"	78°58'45"	Cumberland	Fayettville	32.6	Little Rockfish Creek	03030004	2	1955-56, 1960-65, 1968, 1973-75, 1979-93	81	0
541	02104386	Little Rockfish Creek below Cumberland	34°59'12"	78°57'38"	Cumberland	Saint Pauls (15-min)	83.7	Rockfish Creek	03030004	2	1973-74	4	0
542	0210438690	Buckhead Creek at Owens	35°02'37"	78°56'59"	Cumberland	Fayetteville	1.56	Little Rockfish Creek	03030004	2	1973-75	6	0
543	02104387	Buckhead Creek near Owens	35°01'37"	78°57'08"	Cumberland	Fayetteville	2.62	Little Rockfish Creek	03030004	1	Nov 1976 - Feb 1980	N/A	N/A
										2	1973-74	5	0
544	0210439050	Little Rockfish Creek at SR 1132 at Hope Mills	34°58'03"	78°56'27"	Cumberland	Saint Pauls (15-min)	95[a]	Rockfish Creek	03030004	2	1973-74	3	0
545	0210439333	Little Rockfish Creek at SR 1131 near Hope Mills	34°58'00"	78°55'04"	Cumberland	Saint Pauls (15-min)	97[a]	Rockfish Creek	03030004	2	1973-74	4	0
546	02104500	Rockfish Creek near Hope Mills	34°57'57"	78°55'04"	Cumberland	Saint Pauls (15-min)	292	Cape Fear River	03030004	1	Oct 1902 - May 1903 (gage height only), Nov 1928 - Dec 1931, Feb 1939 - Dec 1954	N/A	N/A
										2	1983-92, 1994-97	36	0
547	0210450005	Rockfish Creek at U.S. Hwy 301 near Hope Mills	34°57'57"	78°55'00"	Cumberland	Saint Pauls (15-min)	292	Cape Fear River	03030004	2	1974-76, 1979-82	16	0
548	02104648	Grays Creek near Lena	34°54'17"	78°49'42"	Cumberland	Saint Pauls (15-min)	14.8	Cape Fear River	03030005	2	1968	1	0
549	02105500	Cape Fear River at William O. Huske Lock near Tarheel	34°50'05"	84°49'27"	Bladen	Saint Pauls (15-min)	4,852	Atlantic Ocean	03030005	1	Oct 1937 - Sept 1998	N/A	N/A
550	02105510	Mines Creek near Duart	34°48'51"	78°49'59"	Bladen	Saint Pauls (15-min)	3.49	Cape Fear River	03030005	2	1966-67	2	0

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												Flow	Zero flow
551	02105520	Harrisons Creek at White Oak	34°43'55"	78°42'59"	Bladen	Elizabethtown (15-min)	50.1	Cape Fear River	03030005	2	1955, 1960-68, 1985-93	44	0
552	02105524	Ellis Creek tributary at SR 1325 near White Oak	34°46'02"	78°41'24"	Bladen	Roseboro (15-min)	1.81	Ellis Creek	03030005	1	Nov 1979 - Sept 1981	N/A	N/A
553	02105570	Browns Creek near Elizabethtown	34°36'33"	78°36'59"	Bladen	Elizabethtown (15-min)	11.3	Cape Fear River	03030005	2	1961-73	17	0
554	02105630	Turnbull Creek near Elizabethtown	34°41'32"	78°35'02"	Bladen	Elizabethtown (15-min)	60.1	Cape Fear River	03030005	2	1949-59, 1961-71	49	0
555	0210563128	Turnbull Creek at NC 41 near Elizabethtown	34°33'49"	78°33'26"	Bladen	Elizabethtown (15-min)	81.4	Cape Fear River	03030005	2	1985-93	23	0
556	02105690	Hammond Creek near Lisbon	34°34'07"	78°33'09"	Bladen	Elizabethtown (15-min)	17[a]	Cape Fear River	03030005	2	1955, 1957-68	27	0
557	02105706	Whites Creek near Lisbon	34°32'44"	78°30'24"	Bladen	Elizabethtown (15-min)	10.3	Hammond Creek	03030005	2	1955	1	0
558	02105738	Carvers Creek near Carvers	34°27'06"	78°25'36"	Bladen	Bolton (15-min)	9.80	Cape Fear River	03030005	2	1955	1	0
559	02105769	Cape Fear River at Lock 1 near Kelly	34°24'15"	78°17'38"	Bladen	Bolton (15-min)	5,255	Atlantic Ocean	03030005	1	July 1969 - Sept 1998	N/A	N/A
										2	1966	1	0
560	02105790	Livingston Creek near Acme	34°18'57"	78°14'18"	Columbus	Acme (15-min)	92.5	Cape Fear River	03030005	2	1950-54, 1956-59, 1974-75	21	1
561	0210580160	Livingston Creek at NC 87 at Acme	34°19'42"	78°12'40"	Columbus	Acme (15-min)	102	Cape Fear River	03030005	2	1974-75	4	0
562	02105900	Hood Creek near Leland	34°16'43"	78°07'34"	Brunswick	Acme (15-min)	19.7	Cape Fear River	03030005	1	Oct 1956 - Sept 1973, Oct 1993 - Sept 1998	N/A	N/A
										2	1950-54, 1956	14	0
563	0210591620	Great Coharie Creek at SR 1636 near Timothy	35°14'38"	78°27'00"	Sampson	Coharie (15-min)	1.93	Black River	03030006	2	1974-76, 1979-80	9	2

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564	02105921	Ward Swamp near Hobbton	35°10'30"	78°20'50"	Sampson	Coharie (15-min)	17.2	Great Coharie Creek	03030006	2	1964	1	1
565	02105924	Great Coharie Creek at SR 1311 near Clinton	35°01'28"	78°17'16"	Sampson	Clinton North	139	Black River	03030006	2	1973-74	4	0
566	02105952	Great Coharie Creek at Clinton	34°59'38"	78°22'44"	Sampson	Garland (15-min)	159	Black River	03030006	2	1973-74	3	0
567	02105960	Great Coharie Creek near Parkersburg	34°51'41"	78°21'22"	Sampson	Garland (15-min)	201	Black River	03030006	2	1965-68	6	0
568	02105966	Great Coharie Creek near Ingold	34°50'06"	78°21'56"	Sampson	Garland (15-min)	209	Black River	03030006	2	1955-56, 1976, 1979	4	0
569	0210596760	Little Coharie Creek at SR 1477 near Spivey's Corner	35°10'16"	78°27'23"	Sampson	Coharie (15-min)	9.2[a]	Great Coharie Creek	03030006	2	1974-76	5	1
570	02105982	Little Coharie Creek near Salemburg	34°59'30"	78°31'22"	Sampson	Roseboro (15-min)	74.2	Great Coharie Creek	03030006	2	1973-74	3	0
571	02105991	Little Coharie Creek at NC 242 near Roseboro	34°58'39"	78°30'32"	Sampson	Roseboro (15-min)	85.7	Great Coharie Creek	03030006	2	1973-74	4	0
572	02106000	Little Coharie Creek near Roseboro	34°57'13"	78°29'17"	Sampson	Garland (15-min)	92.8	Great Coharie Creek	03030006	1	Jan 1950 - Mar 1992	N/A	N/A
573	02106044	Little Coharie Creek near Ingold	34°50'10"	78°22'20"	Sampson	Garland (15-min)	154	Great Coharie Creek	03030006	2	1955-56, 1976, 1979	4	0
574	0210604420	Great Coharie Creek tributary near Garland	34°47'46"	78°21'48"	Sampson	Garland (15-min)	2.72	Great Coharie Creek	03030006	2	1973-74, 1979-80	8	2
575	0210604480	Great Coharie Creek at SR 1134 near Garland	34°47'15"	78°19'23"	Sampson	Garland (15-min)	379	Black River	03030006	2	1974, 1976, 1979	7	0

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												Flow	Zero flow
576	0210608640	Six Runs Creek at SR 1740 near Hargrove Crossroads	35°07'13"	78°15'05"	Sampson	Garland (15-min)	14.6	Black River	03030006	2	1974-76, 1979	7	2
577	02106240	Turkey Creek near Turkey	35°00'11"	78°11'06"	Sampson	Faison	14.8	Six Runs Creek	03030006	2	1954, 1961-73	14	1
578	02106360	Six Runs Creek near Clinton	34°59'16"	78°14'04"	Sampson	Rose Hill (15-min)	108	Black River	03030006	2	1950-54, 1956-58, 1964	17	1
579	02106407	Stewarts Creek at Warsaw	34°59'54"	78°04'50"	Duplin	Rose Hill (15-min)	1.34	Six Runs Creek	03030006	2	1973-74	5	0
580	02106409	Stewarts Creek at Warsaw	34°57'49"	78°04'51"	Duplin	Rose Hill (15-min)	4.47	Six Runs Creek	03030006	2	1973-74	4	0
581	02106410	Stewarts Creek tributary near Warsaw	34°57'25"	78°04'42"	Duplin	Rose Hill (15-min)	0.46	Stewarts Creek	03030006	2	1961-71	11	0
582	0210641655	Miller Creek at SR 1107 near Magnolia	34°54'31"	78°06'03"	Duplin	Rose Hill (15-min)	8.4[a]	Stewarts Creek	03030006	2	1973-74	6	3
583	02106417	Millers Creek near Magnolia	34°54'32"	78°07'52"	Duplin	Rose Hill (15-min)	12.6	Stewarts Creek	03030006	2	1956	2	0
584	02106420	Stewarts Creek near Magnolia	34°54'08"	78°08'50"	Duplin	Rose Hill (15-min)	47.0	Six Runs Creek	03030006	2	1955-56, 1960-68	21	0
585	02106467	Six Runs Creek at SR 1003 near Ingold	34°47'36"	78°18'42"	Sampson	Garland (15-min)	271	Black River	03030006	2	1974, 1976, 1979	5	0
586	02106500	Black River near Tomahawk	34°45'17"	78°17'21"	Sampson	Garland (15-min)	676	Cape Fear River	03030006	1	Oct 1951 - Sept 1998	N/A	N/A
587	02106531	Black River at Ivanhoe	34°36'52"	78°15'12"	Sampson	White Lake (15-min)	731	Cape Fear River	03030006	2	1955-56, 1974-76	6	0
588	02106561	Black River at Angier	35°30'00"	78°44'00"	Harnett	Angier	1.2[a]	South River	03030006	2	1955	1	0
589	02106591	Black River near Angier	35°29'18"	78°43'33"	Harnett	Coats	3.06	South River	03030006	2	1955	1	0
590	02106621	Black River near Barclaysville	35°29'15"	78°42'34"	Harnett	Coats	4.68	South River	03030006	2	1973-74, 1976, 1978-80	12	1

Table 6. Summary of continuous-record gaging stations and partial-record measuring sites in the Cape Fear River Basin in North Carolina where records of gage height and streamflow were collected—Continued

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Site index no. (pl. 1)	USGS downstream order number	Station name	Latitude	Longitude	County	USGS topographic quadrangle	Drainage area (mi^2)	Tributary to	Hydrologic unit code	Site type	Period of record	Number of measurements for partial-record sites	
												Flow	Zero flow
591	02106648	Black River at SR 1722 near Dunn	35°20'52"	78°37'28"	Harnett	Dunn	37.3	South River	03030006	2	1977-81	20	4
592	0210665090	Black River at Dunn	35°18'49"	78°38'35"	Harnett	Erwin	43[a]	South River	03030006	2	1973	5	1
593	02106651	Black River near Erwin	35°18'42"	78°38'15"	Harnett	Erwin	42.6	South River	03030006	2	1955	3	1
594	02106681	Black River near Dunn	35°16'58"	78°38'16"	Harnett	Erwin	48.3	South River	03030006	1	Oct 1976 - Sept 1977	N/A	N/A
										2	1974-75, 1977-85	58	4
595	02106711	Mingo Swamp at NC 55 near Dunn	35°17'52"	78°34'23"	Harnett	Dunn	29.5	South River	03030006	2	1955, 1973-74	6	1
596	0210674020	Stony Run tributary near Dunn	35°19'12"	78°36'21"	Harnett	Dunn	0.2[a]	Stony Run	03030006	2	1973, 1975	4	2
597	0210674050	Stony Run near Dunn	35°18'47"	78°35'47"	Harnett	Dunn	6.87	Mingo Swamp	03030006	2	1973	5	1
598	02106760	Mingo Swamp near Dunn	35°16'19"	78°35'11"	Harnett	Dunn	50.4	South River	03030006	2	1955, 1957-63, 1973, 1976, 1979-85	49	2
599	02106811	South River at Falcon	35°11'35"	78°38'27"	Sampson	Wade	139	South River	03030006	2	1955-56	2	0
600	02106910	Big Swamp near Roseboro	34°58'38"	78°34'07"	Sampson	Roseboro (15-min)	31.9	South River	03030006	2	1954, 1960-73	15	1
601	02106960	Beaver Dam Creek near Stedman	34°53'16"	78°34'51"	Cumberland	Roseboro (15-min)	16.3	South River	03030006	2	1966-68, 1970	5	1
602	02107000	South River near Parkersburg	34°48'45"	78°27'26"	Bladen	Garland (15-min)	379	Black River	03030006	1	Jan 1950 - Sept 1986	N/A	N/A
603	02107171	South River near Kerr	34°38'23"	78°18'43"	Sampson	White Lake (15-min)	458	Black River	03030006	2	1955-56, 1974, 1976, 1979	9	0
604	02107214	Black River near Atkinson	34°33'12"	78°15'12"	Sampson	White Lake (15-min)	1,239	Cape Fear River	03030006	2	1974-76	5	0
605	0210733955	Colly Creek near White Lake	34°39'19"	78°28'00"	Bladen	White Lake (15-min)	44.7	Black River	03030006	2	1973-75	5	0

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												Flow	Zero flow
606	02107341	Colly Creek at Bevans Bridge near White Lake	34°34'50"	78°23'13"	Bladen	White Lake (15-min)	66[a]	Black River	03030006	2	1973-75	4	0
607	02107500	Colly Creek near Kelly	34°27'48"	78°15'26"	Bladen	Kelly	108[l]	Black River	03030006	1	Jan 1950 - Sept 1971	N/A	N/A
608	02107544	Black River near Currie	34°25'57"	78°08'33"	Pender	Acme (15-min)	1,405	Cape Fear River	03030006	2	1974	1	0
609	02107560	Moores Creek near Atkinson	34°33'24"	78°07'25"	Pender	Atkinson (15-min)	52.7	Black River	03030006	2	1949-52, 1956-66	19	6
610	02107581	Northeast Cape Fear River at Mount Olive	35°11'10"	78°03'00"	Duplin	Mount Olive	3.91	Cape Fear River	03030007	2	1956, 1973	3	2
611	02107586	Northeast Cape Fear River near Mount Olive	35°11'28"	78°01'05"	Wayne	Mount Olive	10.5	Cape Fear River	03030007	2	1973, 1975-76, 1978-79	6	0
612	02107590	Northeast Cape Fear River tributary near Mount Olive	35°11'06"	77°57'34"	Wayne	Seven Springs (15-min)	0.63	Northeast Cape Fear River	03030007	2	1954-58, 1961-71	17	1
613	02107600	Northeast Cape Fear River near Seven Springs (Wayne County)	35°10'20"	77°55'56"	Wayne	Seven Springs (15-min)	48.5	Cape Fear River	03030007	1	July 1958 - Sept 1975	N/A	N/A
614	02107610	Buck Marsh Branch at Outlaws Bridge	35°08'36"	77°51'47"	Duplin	Seven Springs (15-min)	21.9	Northeast Cape Fear River	03030007	2	1965-68, 1970	6	0
615	0210761250	Northeast Cape Fear River at SR 1519 near Kornegay	35°06'02"	77°49'59"	Duplin	Seven Springs (15-min)	104	Cape Fear River	03030007	2	1973	2	0
616	02107620	Mathews Creek near Pink Hill	35°05'49"	77°49'10"	Duplin	Seven Springs (15-min)	8.13	Northeast Cape Fear River	03030007	2	1961-76	16	0
617	02107672	Northeast Cape Fear River at Kornegay	35°03'10"	77°50'17"	Duplin	Seven Springs (15-min)	120	Cape Fear River	03030007	2	1956, 1971, 1974, 1976, 1978, 1980	8	0
618	0210772380	Panther Branch at NC 50 at Faison	35°07'23"	78°09'09"	Duplin	Faison	3.72	Goshen Swamp	03030007	2	1973-74	5	2

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												Flow	Zero flow
619	02107724	Goshen Swamp at Faison	35°08'57"	78°07'22"	Duplin	Mount Olive	50.9	Northeast Cape Fear River	03030007	2	1956, 1973-75	8	3
620	0210777598	Reedy Branch at NC 403 at Faison	35°06'59"	78°07'37"	Duplin	Faison	2.65	Goshen Swamp	03030007	2	1973-74	7	0
621	02107776	Reedy Branch at Faison	35°06'00"	78°07'00"	Duplin	Warsaw North	3.3[a]	Goshen Swamp	03030007	2	1956	2	0
622	02107786	Goshen Swamp near Faison	35°07'22"	78°05'37"	Duplin	Warsaw North	58.6	Northeast Cape Fear River	03030007	2	1973-74	5	2
623	0210782005	Nahunga Creek at SR 1301 near Warsaw	35°01'36"	78°00'41"	Duplin	Warsaw	8.28	Goshen Swamp	03030007	1	Oct 1982 - Sept 1990	N/A	N/A
624	0210783230	Herrings Marsh Run near Summerlins Crossroads	35°05'37"	77°56'35"	Duplin	Summerlins Crossroads	2.25	Goshen Swamp	03030007	1	April 1991 - Sept 1998	N/A	N/A
625	0210783240	Herrings Marsh Run tributary near Summerlins Crossroads	35°05'49"	77°56'01"	Duplin	Summerlins Crossroads	1.49	Herrings Marsh Run	03030007	1	May 1991 - Sept 1998	N/A	N/A
626	0210783273	Herrings Marsh Run tributary at Red Hill	35°04'32"	77°54'49"	Duplin	Summerlins Crossroads	1.14	Herrings Marsh Run	03030007	1	Aug 1991 - Sept 1997	N/A	N/A
627	0210783276	Herrings Marsh Run below Secondary Road 1306 at Red Hill	35°04'25"	77°54'50"	Duplin	Summerlins Crossroads	9.11	Goshen Swamp	03030007	1	May 1991 - Sept 1998	N/A	N/A
628	02107838	Goshen Swamp near Kornegay	35°01'40"	77°51'05"	Duplin	Seven Springs (15-min)	179	Northeast Cape Fear River	03030007	2	1956	2	0
629	02107891	Grove Creek at Kenansville	34°58'13"	77°57'32"	Duplin	Kenansville	22.6	Northeast Cape Fear River	03030007	1	Oct 1982 - Sept 1990	N/A	N/A
630	0210797940	Limestone Creek at NC 24 near Hadley	34°54'55"	77°41'34"	Duplin	Potters Hill	1.61	Northeast Cape Fear River	03030007	1	Apr 1986 - Sept 1988	N/A	N/A

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												Flow	Zero flow
631	02107980	Limestone Creek near Beulaville	34°55'38"	77°48'10"	Duplin	Kenansville (15-min)	57.0	Northeast Cape Fear River	03030007	2	1954, 1956-71	17	1
632	0210798170	Beaverdam Branch at culvert on U.S. Hwy 117 near Rose Hill	34°51'43"	78°02'09"	Duplin	Rose Hill (15-min)	3.0[a]	Maxwell Creek	03030007	2	1973-74	5	2
633	0210798230	Beaverdam Branch near Rose Hill	34°51'57"	78°00'35"	Duplin	Rose Hill (15-min)	12[a]	Maxwell Creek	03030007	2	1973-74	5	2
634	0210798475	Maxwell Creek at SR 1141 near Sutton	34°51'55"	77°56'21"	Duplin	Kenansville (15-min)	45.9	Stocking Head Creek	03030007	2	1973-74	5	1
635	02107985	Stocking Head Creek near Hallsville	34°52'02"	77°51'57"	Duplin	Kenansville (15-min)	66.0	Northeast Cape Fear River	03030007	2	1965-68, 1973	9	0
636	0210798750	Muddy Creek tributary at SR 1801 near Beulaville	34°54'24"	77°45'00"	Duplin	Kenansville (15-min)	3.42	Muddy Creek	03030007	2	1973-74	4	1
637	02107989	Muddy Creek at Beulaville	34°53'10"	77°45'40"	Duplin	Kenansville (15-min)	8.30	Cape Fear River	03030007	2	1973-74	5	2
638	02107990	Muddy Creek near Chinquapin	34°50'20"	77°49'57"	Duplin	Kenansville (15-min)	34.5	Northeast Cape Fear River	03030007	2	1941, 1960-68, 1973	19	0
639	02108000	Northeast Cape Fear River near Chinquapin	34°49'40"	77°50'00"	Duplin	Kenansville (15-min)	599	Cape Fear River	03030007	1	July 1940 - Sept 1998	N/A	N/A
640	02108061	Cypress Creek near Chinquapin	34°48'20"	77°49'10"	Duplin	Kenansville (15-min)	17.4	Northeast Cape Fear River	03030007	2	1941	1	0
641	02108120	Island Creek tributary at Rose Hill	34°49'20"	78°01'15"	Duplin	Rose Hill (15-min)	Ind	Island Creek	03030007	2	1974	3	0
642	02108125	Island Creek tributary near Rose Hill	34°49'00"	78°00'35"	Duplin	Rose Hill (15-min)	0.6[a]	Island Creek	03030007	2	1974-75	3	0

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												Flow	Zero flow
643	02108131	Island Creek tributary near Charity	34°48'50"	77°57'41"	Duplin	Kenansville (15-min)	2.94	Island Creek	03030007	2	1956	2	0
644	0210813120	Reedy Branch at SR 1932 near Rose Hill	34°49'52"	77°59'09"	Duplin	Kenansville (15-min)	2.5[a]	Island Creek	03030007	2	1973-74	4	1
645	0210813130	Reedy Branch at SR 1102 near Rose Hill	34°49'21"	77°58'38"	Duplin	Kenansville (15-min)	5.08	Island Creek	03030007	2	1973-75	6	1
646	02108191	Island Creek tributary near Rose Hill	34°47'50"	77°55'20"	Duplin	Kenansville (15-min)	20.6	Northeast Cape Fear River	03030007	2	1956	2	0
647	0210819150	Island Creek at NC 41 near Murphey	34°47'03"	77°54'20"	Duplin	Kenansville (15-min)	31.4	Northeast Cape Fear River	03030007	2	1976	1	0
648	0210821250	Rockfish Creek at SR 1170 near Teachey	34°45'04"	78°03'23"	Duplin	Rose Hill (15-min)	43[a]	Northeast Cape Fear River	03030007	2	1973-74	4	0
649	02108243	Taylors Creek near Teachey	34°46'32"	78°03'22"	Duplin	Rose Hill (15-min)	13.2	Duff Creek	03030007	2	1964	1	1
650	02108251	Duffs Creek near Teachey	34°46'04"	78°03'14"	Duplin	Rose Hill (15-min)	20.6	Rockfish Creek	03030007	2	1954, 1964	2	1
651	02108261	Duffs Creek at mouth near Teachey	34°45'18"	78°03'20"	Duplin	Rose Hill (15-min)	21.5	Rockfish Creek	03030007	2	1954, 1964	2	1
652	02108500	Rockfish Creek near Wallace	34°44'32"	78°02'22"	Duplin	Atkinson (15-min)	69.3	Northeast Cape Fear River	03030007	1	July 1955 - Sept 1981	N/A	N/A
										2	1982-94	41	0
653	02108502	Rockfish Creek above Doctors Creek near Wallace	34°43'44"	78°02'43"	Duplin	Atkinson (15-min)	73.3	Northeast Cape Fear River	03030007	2	1973-74	3	0
654	02108510	Doctors Creek near Wallace	34°43'30"	78°03'18"	Duplin	Atkinson (15-min)	53.6	Rockfish Creek	03030007	2	1954-56, 1964-68	14	2

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655	02108534	Rockfish Creek at U.S. Hwy 117 near Wallace	34°43'03"	77°58'48"	Duplin	Burgaw (15-min)	150[a]	Northeast Cape Fear River	03030007	2	1973, 1976, 1978-80	6	0
656	02108536	Rockfish Creek above Little Rockfish Creek near Tin City	34°43'10"	77°58'30"	Duplin	Burgaw (15-min)	162	Northeast Cape Fear River	03030007	2	1956	3	0
657	02108543	Little Rockfish Creek at Tin City	34°44'25"	77°58'55"	Duplin	Burgaw (15-min)	7.04	Rockfish Creek	03030007	2	1974-75	4	1
658	02108548	Little Rockfish Creek at Wallace	34°43'56"	77°58'03"	Duplin	Burgaw (15-min)	7.8	Rockfish Creek	03030007	1	Sept 1976 - Sept 1992	N/A	N/A
659	02108552	Little Rockfish Creek near Tin City	34°43'20"	77°59'00"	Duplin	Burgaw (15-min)	11[a]	Rockfish Creek	03030007	2	1973-74	5	0
660	02108564	Northeast Cape Fear River near Watha	34°38'50"	77°52'20"	Pender	Burgaw (15-min)	886	Cape Fear River	03030007	2	1974-75	3	0
661	02108580	Holly Shelter Creek near Maple Hill	34°38'20"	77°44'02"	Pender	Maple Hill (15-min)	33.6	Northeast Cape Fear River	03030007	2	1960-68	12	0
662	02108585	Angola Creek near Maple Hill	34°39'15"	77°44'02"	Pender	Maple Hill (15-min)	55.8	Holly Shelter Creek	03030007	2	1963-68	8	0
663	02108598	Osgood Branch at Burgaw	34°33'10"	77°55'20"	Pender	Burgaw (15-min)	3.16	Burgaw Creek	03030007	2	1956	2	0
664	0210860020	Burgaw Creek Creek at SR 1345 at Burgaw	34°33'48"	77°56'05"	Pender	Burgaw (15-min)	0.7[a]	Northeast Cape Fear River	03030007	2	1973-75	6	3
665	02108601	Burgaw Creek at U.S. Hwy 117 near Burgaw	34°33'50"	77°55'30"	Pender	Burgaw (15-min)	8.56	Northeast Cape Fear River	03030007	2	1973-74	4	0
666	0210860550	Burgaw Creek at SR 1411 at Walkers	34°32'27"	77°51'13"	Pender	Burgaw (15-min)	24.8	Northeast Cape Fear River	03030007	2	1973	2	0

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												Flow	Zero flow
667	02108610	Pike Creek near Burgaw	34°30'00"	77°53'58"	Pender	Rocky Point	1.1[a]	Northeast Cape Fear River	03030007	2	1953-54, 1957-59, 1961-71	19	1
668	02108620	Prince George Creek near Castle Hayne	34°20'19"	77°52'22"	New Hanover	Scotts Hill	4.20	Northeast Cape Fear River	03030007	2	1966-68, 1974	9	0
669	02108630	Turkey Creek near Castle Hayne	34°23'47"	77°54'48"	Pender	Rocky Point	10.5	Northeast Cape Fear River	03030007	2	1954, 1961-71	12	1
670	02108640	Smith Creek near Murraysville	34°16'38"	77°52'07"	New Hanover	Scotts Hill	8.9[a]	Northeast Cape Fear River	03030007	2	1965-68	19	0
671	02108641	Smith Creek tributary No.2 near Baymeade	34°16'10"	77°52'10"	New Hanover	Scotts Hill	3.66	Smith Creek	03030007	2	1965	1	0
672	02108644	Spring Branch tributary near Baymeade	34°15'00"	77°52'20"	New Hanover	Scotts Hill	0.1[a]	Spring Branch	03030007	2	1965	1	0
673	02108645	Spring Branch near Murraysville	34°15'20"	77°52'20"	New Hanover	Scotts Hill	1.1[a]	Smith Creek	03030007	2	1965, 1974-75	4	0
674	02108730	Greenfield Lake Outlet at Wilmington	34°12'40"	77°56'40"	New Hanover	Wilmington	4.1[a]	Cape Fear River	03030005	2	1966, 1968	5	1
675	02108760	Town Creek near Bolivia	34°10'31"	78°08'40"	Brunswick	Lewis Swamp	19.4	Cape Fear River	03030005	2	1939, 1956, 1965-68	8	0
676	02108762	Lewis Swamp near Bolivia	34°09'57"	78°11'04"	Brunswick	Lewis Swamp	10.1	Town Creek	03030005	2	1956	1	0
677	02108771	Russells Creek near Bolivia	34°08'48"	78°06'54"	Brunswick	Winnabow	2.69	Town Creek	03030005	2	1956	1	0
678	02108788	Mill Creek near Bolivia	34°06'06"	78°04'41"	Brunswick	Funston	13.1	Rices Creek	03030005	2	1956	1	1
679	02108795	Mott Creek near Myrtle Grove	34°08'32"	77°53'33"	New Hanover	Wilmington	1.35	Cape Fear River	03030005	2	1966-68	8	0
680	02108830	Allen Creek near Southport	34°02'46"	78°02'13"	Brunswick	Funston	9.90	Lilliput Creek	03030005	2	1956-60	9	0

Table 6. Summary of continuous-record gaging stations and partial-record measuring sites in the Cape Fear River Basin in North Carolina where records of gage height and streamflow were collected—Continued

[mi^2, square mile; SR, secondary road; N/A, not applicable; SEO, sewage effluent outfall; Ind, drainage area is undetermined and(or) may be indeterminate. Gray shading indicates sites for which low-flow characteristics have been developed. Period of record for continuous-record sites (site type 1) is shown in months and years; period of record for partial-record sites (site type 2) is shown in water years in which discharge measurements were made]

Site index no. (pl. 1)	USGS downstream order number	Station name	Latitude	Longitude	County	USGS topographic quadrangle	Drainage area (mi^2)	Tributary to	Hydrologic unit code	Site type	Period of record	Number of measure-ments for partial-record sites	
												Flow	Zero flow
681	02108831	Bouncing Log Spring near Southport	34°02’45"	78°02’10"	Brunswick	Funston	Ind	Allen Creek	03030005	2	1956-60, 1963-64	12	0

[a] Approximate drainage area.

[b] Of note for this particular site (16), discharge measurements were judged unsuitable for analysis in 1965 due to occurence of diversion and ponds in basin. Office files indicates that site was discontinued as partial-record measuring site in 1965. In this investigation, no attempts were made to conduct further analysis of discharge records.

[c] Site now inundated by Lake Higgins.

[d] Site now inundated by Lake Burlington.

[e] Site now inundated by Quaker Creek Reservoir.

[f] Site now inundated by Lake Mackintosh.

[g] Site now inundated by, or subject to, backwater from B. Everett Jordan Lake.

[h] Discharge records at this site are available for period February 1987 through September 1996, but are considered unreliable and should not be used.

[i] Discharges obtained October 1965 to September 1978 published as station 02098200, Haw River near Haywood. Low-flow characteristics in table 6 are listed under station 02098198 (site 255).

[j] Site now inundated by Oak Hollow Reservoir.

[k] Site now inundated by Shearon Harris Reservoir.

[l] Indeterminate drainage area during high-flow events as a result of runoff diverted by canals from nearby French’s Creek and Lyon Swamp.

Table 7. Magnitude and frequency of annual low-flow characteristics at selected continuous-record gaging stations in the Cape Fear River Basin, North Carolina

[mi^2, square mile; climatic years, the annual period from April 1 to March 31 and identified by the year in which the period begins; $(ft^3/s)/mi^2$, cubic foot per second per square mile; ft^3/s, cubic foot per second; 7Q10, 7-day, 10-year low flow; 30Q2, 30-day, 2-year low flow; W7Q10, winter 7-day, 10-year low flow; 7Q2, 7-day, 2-year low flow; Flow regulation: U, unregulated flow; R, regulated flow; Method of analysis: C, estimates based on correlation techniques; LP, estimates based on log-Pearson frequency distribution; G, estimates based on best-fit curves developed graphically from the log-Pearson analyses; PR, gaging station having less than 10 years record of daily mean discharge, treated as a partial-record site where low-flow characteristics were developed by using correlation techniques; <, less than; SR, secondary road; N/A, not available; NPDES, National Pollutant Discharge Elimination System. For each continuous-record site using the period of analysis (usually the available period of record), the number of daily discharges equal to zero or less than or equal to the indicated 7Q10 discharge are provided for informational purposes]

Site index no. (pl. 1)	USGS downstream order number	Station name	Drainage area (mi^2)	Period of analysis (climatic years)	Number of observed days of flow		Average annual unit flow $[(ft^3/s)/mi^2]$	Low-flow characteristics (ft^3/s)				Flow regulation	Method of analysis
					Equal to zero flow	Less than or equal to 7Q10		7Q10	30Q2	W7Q10	7Q2		
9	0209330990	Brooks Lake tributary near Browns Summit	0.06	PR	0[a]	0	0.9	0	< 0.05	< 0.05	0	U	C
12	0209331325	Candy Creek at SR 2700 near Monticello	1.10	PR	0	23	0.9	< 0.05	0.2	0.2	0.1	U	C
20	02093500	Haw River near Benaja	168	1929–70	0	68	0.9	7.8	34.0	31.0	23.0	U	LP
27	02093800	Reedy Fork near Oak Ridge	20.6	1956–97	0	94	1.2	3.4	7.2	7.4	5.7	R[b]	LP
36	02094000	Horsepen Creek at Battle Ground[c]	16.4	1926–30, 1934–58	0	72	0.9	1.4	3.3	3.0	2.5	U	LP
40	02094500	Reedy Fork near Gibsonville	131	1970–97	0	76	0.8	2.5	7.3	5.5	5.3	R[d]	LP
47	02095000	South Buffalo Creek near Greensboro[c]	34.0	1929–57	0	97	1.1	1.7	5.3	3.5	4.0	R[e]	LP
49	02095091	South Buffalo Creek at SR 2821 at McLeansville	43.5	PR	0	34	1.5	17.7	23	22	20	R[e]	C
58	02095500	North Buffalo Creek near Greensboro	37.1	1938–89[f]	0	299	1.6	11.5	22.4	15.0	18.9	R[e]	LP
60	0209555450	Buffalo Creek at SR 2719 near Osceola	97.4	PR	0	23	1.5	37	49	49	45	R[e]	C
61	02095608	Reedy Fork at NC 61 near Osceola	243	PR	0	30	1.5	43	60	58	55	R[e]	C
75	02096000	Stony Creek near Burlington[c]	45.2	PR	29	29	0.9	0	1.0	0.6	0.4	U	C
81	02096500	Haw River at Haw River	606	1973–97	0	60	1.1	68.6	126	116	101	R[b]	LP
109	02096700	Big Alamance Creek near Elon College[c]	116	1958–80	0	28	1.0	1.3	9.6	7.5	5.4	U	LP
135	02096842	Cane Creek 0.1 mile above SR 1126 near Buckhorn	0.64	PR	74	74	1.0	0	0	0	0	U	C
136	02096846	Cane Creek near Orange Grove	7.54	1989–97	53	53	1.0	0	0.09	.07	< 0.05	U	G
139	02096850	Cane Creek near Teer[c]	33.4	1960–72	0	5	0.9	0.1	1.9	1.6	1.1	U	LP
152	02096960	Haw River near Bynum	1,275	1974–97	0	94	1.0	75.9	164	152	132	R[b]	LP
156	02097000	Haw River near Pittsboro[g]	1,303	1929–72	0	270	0.9	40.0	160	103	102	R[b]	LP
191	02097243	Third Fork Creek at Durham	1.67	PR	0[a]	0	1.0	0	0.2	0.1	0.1	U	C
197	02097314	New Hope Creek near Blands	75.9	1983–97	0	25	1.4	6.1	12.7	6.9	9.1	R[e]	LP

Table 7. Magnitude and frequency of annual low-flow characteristics at selected continuous-record gaging stations in the Cape Fear River Basin, North Carolina—Continued

[mi^2, square mile; climatic years, the annual period from April 1 to March 31 and identified by the year in which the period begins; $(ft^3/s)/mi^2$, cubic foot per second per square mile; ft^3/s, cubic foot per second; 7Q10, 7-day, 10-year low flow; 30Q2, 30-day, 2-year low flow; W7Q10, winter 7-day, 10-year low flow; 7Q2, 7-day, 2-year low flow; Flow regulation: U, unregulated flow; R, regulated flow; Method of analysis: C, estimates based on correlation techniques; LP, estimates based on log-Pearson frequency distribution; G, estimates based on best-fit curves developed graphically from the log-Pearson analyses; PR, gaging station having less than 10 years record of daily mean discharge, treated as a partial-record site where low-flow characteristics were developed by using correlation techniques; <, less than; SR, secondary road; N/A, not available; NPDES, National Pollutant Discharge Elimination System. For each continuous-record site using the period of analysis (usually the available period of record), the number of daily discharges equal to zero or less than or equal to the indicated 7Q10 discharge are provided for informational purposes]

Site index no. (pl. 1)	USGS downstream order number	Station name	Drainage area (mi^2)	Period of analysis (climatic years)	Number of observed days of flow		Average annual unit flow [$(ft^3/s)/mi^2$]	Low-flow characteristics (ft^3/s)				Flow regulation	Method of analysis
					Equal to zero flow	Less than or equal to 7Q10		7Q10	30Q2	W7Q10	7Q2		
203	0209736050	Battle Branch near Chapel Hill	0.42	PR[h]	531	531	1.0	0	0.05	< 0.05	< 0.05	U	C
223	0209741955	Northeast Creek at SR 1100 near Genlee	21.1	1983-92, 1996–97	0	32	1.5	1.8	4.6	2.4	3.0	R[e]	LP
229	02097464	Morgan Creek near White Cross	8.35	1989–97	0	12	1.0	< 0.05	0.4	0.5	0.2	U	G
236	02097500	Morgan Creek near Chapel Hill[i]	30.0	1923–31	0	10	1.1	0.6	4.2	2.2	2.7	R[j]	G
240	02097517	Morgan Creek (below University Lake Dam) near Chapel Hill	41.0	1983–97	0	38	1.1	6.4	12.2	6.5	10.5	R[j]	LP
245	0209782150	New Hope River tributary at SR 1716 near Farrington	2.05	PR	516	516	1.1	0	0	0	0	U	C
247	02098000	New Hope River near Pittsboro[g]	288	1949–72	0	67	1.0	4.5	16.4	10.7	10.8	R[b]	LP
255	02098198	Haw River below B. Everett Jordan Dam near Moncure	1,689	PR	0	18	1.0	50.0	203	130	128	R[b]	C
				1982–91	0	36	1.0	183	382	176	251	R[k]	LP
264	02098500	West Fork Deep River near High Point[c,l]	32.5	1929–57	0	57	1.0	2.1	5.7	5.3	4.0	R[b]	LP
266	02099000	East Fork Deep River near High Point[c,l]	14.8	1929–93	0	210	1.1	2.0	3.8	3.3	3.1	R[b]	LP
285	02099500	Deep River near Randleman[l]	125	1929–94	0	403	1.0	7.7	18.1	12.5	13.6	R[b]	LP
287	02100000	Muddy Creek near Archdale[l]	16.5	PR	45	48	1.0	< 0.05	0.6	0.3	0.2	U	C
317	02100500	Deep River at Ramseur[l]	349	1923–94	0	384	1.0	12.0	45.6	25.1	29.5	R[b]	LP
356	02101000	Bear Creek at Robbins[l]	137	1940–70	36	82	1.1	0.4	11.9	7.4	6.2	U	LP
367	0210108450	Suck Creek tributary near Zion Grove[l]	0.67	PR	49	49	1.0	0	< 0.05	< 0.05	0	U	C
399	0210166029	Rocky River near Crutchfield Crossroads[l]	7.42	1989–97	4	101	1.1	0.2	0.5	0.3	0.3	U	G
409	02101800	Tick Creek near Mount Vernon Springs[c,l]	15.5	1959–80, 1994	304	304	0.9	0	0.3	0.08	0.06	U	LP
417	02102000	Deep River at Moncure[l]	1,434	1931–94	0	178	1.0	24.0	113	45.7	71.3	R[b]	LP
431	02102192	Buckhorn Creek near Corinth	76.3	1981–97	0	54	0.7	0.2	0.9	0.4	0.4	R[m]	LP
438	02102500	Cape Fear River at Lillington	3,464	1924–71	0	190	1.0	75.1	342	177	212	R[b]	LP
				1982–97	0	108	1.0	530	623	522	590	R[k]	LP

Table 7. Magnitude and frequency of annual low-flow characteristics at selected continuous-record gaging stations in the Cape Fear River Basin, North Carolina—Continued

[mi^2, square mile; climatic years, the annual period from April 1 to March 31 and identified by the year in which the period begins; $(ft^3/s)/mi^2$, cubic foot per second per square mile; ft^3/s, cubic foot per second; 7Q10, 7-day, 10-year low flow; 30Q2, 30-day, 2-year low flow; W7Q10, winter 7-day, 10-year low flow; 7Q2, 7-day, 2-year low flow; Flow regulation: U, unregulated flow; R, regulated flow; Method of analysis: C, estimates based on correlation techniques; LP, estimates based on log-Pearson frequency distribution; G, estimates based on best-fit curves developed graphically from the log-Pearson analyses; PR, gaging station having less than 10 years record of daily mean discharge, treated as a partial-record site where low-flow characteristics were developed by using correlation techniques; <, less than; SR, secondary road; N/A, not available; NPDES, National Pollutant Discharge Elimination System. For each continuous-record site using the period of analysis (usually the available period of record), the number of daily discharges equal to zero or less than or equal to the indicated 7Q10 discharge are provided for informational purposes]

Site index no. (pl. 1)	USGS downstream order number	Station name	Drainage area (mi^2)	Period of analysis (climatic years)	Number of observed days of flow		Average annual unit flow [$(ft^3/s)/mi^2$]	Low-flow characteristics (ft^3/s)				Flow regulation	Method of analysis
					Equal to zero flow	Less than or equal to 7Q10		7Q10	30Q2	W7Q10	7Q2		
491	02102908	Flat Creek near Inverness[c]	7.63	1969–97	0	51	1.7	3.6	6.4	6.2	5.3	R[b]	LP
498	02103000	Little River at Manchester[c]	347	1939–49	0	51	1.3	35.0	114	70.0	75.0	U	LP
502	02103500	Little River at Linden	459	1929–70	0	147	1.2	47.7	121	109	84.7	R[b]	LP
516	02104000	Cape Fear River at Fayetteville	4,395	1898–1916, 1929–39	0	151	1.1	310	897	548	625	R[b]	LP
520	02104220	Rockfish Creek at Raeford[c]	92.7	1989–97	0	12	1.3	41.8	58.4	67.8	49.7	U	G
543	02104387	Buckhead Creek near Owens	2.62	PR	0	0	1.3	0.5	1.2	1.1	0.9	U	C
546	02104500	Rockfish Creek near Hope Mills[c]	292	1929–30, 1939–53	0	575	1.3	97.6	186	163	144	R[b]	LP
549	02105500	Cape Fear River at William O. Huske Lock near Tarheel	4,852	1938–71	0	140	1.0	380	923	655	671	R[b]	LP
				1982–97	0	48	1.1	797	1,040	964	910	R[k]	LP
552	02105524	Ellis Creek tributary at SR 1325 near White Oak	1.81	PR	231	231	1.2	0	0	0	0	U	C
559	02105769	Cape Fear River at Lock 1 near Ke1ly	5,255	PR	0	0	1.1	451	1,084	772	791	R[b]	C
				1982–97	0	57	1.1	825	1,130	1,040	960	R[k]	LP
562	02105900	Hood Creek near Leland	19.7	1957–72, 1994–97	1	40	1.9	0.05	1.1	2.5	0.2	U[n]	LP
572	02106000	Little Coharie Creek near Roseboro[c]	92.8	1950–90	0	80	1.2	1.1	13.5	12.7	6.4	U	LP
586	02106500	Black River near Tomahawk	676	1952–97	0	128	1.2	28.3	116	80.0	70.7	U	LP
602	02107000	South River near Parkersburg	379	1952–85	0	72	1.1	2.0	24.6	17.2	15.2	U	LP
607	02107500	Colly Creek near Kelly	108	1950–70	188	188	1.1	0	3.5	1.5	1.0	U	LP
613	02107600	Northeast Cape Fear River near Seven Springs (Wayne Co)[c]	48.5	1959–74	0	39	1.3	5.0	12.2	9.5	8.9	U	LP
623	0210782005	Nahunga Creek at SR 1301 near Warsaw	8.28	PR	312	312	1.1	0	0.2	0.09	< 0.05	U	C
624	0210783230	Herrings Marsh Run near Summerlins Crossroads	2.25	PR	6	14	0.9	< 0.05	0.1	0.07	0.06	U	C
625	0210783240	Herrings Marsh Run tributary near Summerlins Crossroads	1.49	PR	0	83	1.2	0.06	0.3	0.1	0.1	U	C

Table 7. Magnitude and frequency of annual low-flow characteristics at selected continuous-record gaging stations in the Cape Fear River Basin, North Carolina—Continued

[mi^2, square mile; climatic years, the annual period from April 1 to March 31 and identified by the year in which the period begins; $(ft^3/s)/mi^2$, cubic foot per second per square mile; ft^3/s, cubic foot per second; 7Q10, 7-day, 10-year low flow; 30Q2, 30-day, 2-year low flow; W7Q10, winter 7-day, 10-year low flow; 7Q2, 7-day, 2-year low flow; Flow regulation: U, unregulated flow; R, regulated flow; Method of analysis: C, estimates based on correlation techniques; LP, estimates based on log-Pearson frequency distribution; G, estimates based on best-fit curves developed graphically from the log-Pearson analyses; PR, gaging station having less than 10 years record of daily mean discharge, treated as a partial-record site where low-flow characteristics were developed by using correlation techniques; <, less than; SR, secondary road; N/A, not available; NPDES, National Pollutant Discharge Elimination System. For each continuous-record site using the period of analysis (usually the available period of record), the number of daily discharges equal to zero or less than or equal to the indicated 7Q10 discharge are provided for informational purposes]

Site index no. (pl. 1)	USGS downstream order number	Station name	Drainage area (mi^2)	Period of analysis (climatic years)	Number of observed days of flow		Average annual unit flow [$(ft^3/s)/mi^2$]	Low-flow characteristics (ft^3/s)				Flow regulation	Method of analysis
					Equal to zero flow	Less than or equal to 7Q10		7Q10	30Q2	W7Q10	7Q2		
626	0210783273	Herrings Marsh Run tributary at Red Hill	1.14	PR	0	0	1.2	< 0.05	0.2	0.1	0.09	U	C
627	0210783276	Herrings Marsh Run below Secondary Road 1306 at Red Hill	9.11	PR	0	7	1.0	0.3	1.2	0.7	0.6	U	C
629	02107891	Grove Creek at Kenansville	22.6	PR	0	16	1.2	0.9	3.0	2.4	1.8	U	C
630	0210797940	Limestone Creek at NC 24 near Hadley	1.61	PR	242	242	1.3	0	< 0.05	0	0	U	C
639	02108000	Northeast Cape Fear River near Chinquapin	599	1941–97	0	133	1.2	12.1	63.2	37.4	31.7	U	LP
652	02108500	Rockfish Creek near Wallace	69.3	1956–80	0	61	1.4	1.8	7.1	6.4	4.3	U	LP
658	02108548	Little Rockfish Creek at Wallace	7.8	1977–91	41	87	1.2	< 0.05	0.4	0.06	0.1	U	LP

[a] No daily mean discharges equal to zero were observed during the period of record available for low-flow analyses at this site. However, low-flow analyses at this site indicate that the 7Q10 discharge is zero.

[b] Low-flow characteristics reflect effects of some minor regulation and(or) diurnal fluctuation during periods of low flow caused by industries and(or) small impoundments upstream from the station. At some sites, low-flow characteristics may reflect the effects of diversions upstream from the station.

[c] Low-flow characteristics previously published in Giese and Mason (1993); where different, estimates in this report supersede previous estimates.

[d] Low-flow characteristics reflect effects of regulation of flows from Lake Townsend and other upstream reservoirs.

[e] Low-flow characteristics include effects of major point-source discharges upstream from site. For sites 58, 197, and 223 on North Buffalo Creek, New Hope Creek, and Northeast Creek, see discussion in this section concerning estimates of natural-flow 7Q10 discharges for comparisons.

[f] Period of analysis reflects record of discharges since opening of wastewater-treatment plant on North Buffalo Creek upstream from site.

[g] This site is now inundated by Lake Jordan. Low-flow characteristics are reported for historical reference and were not used to develop the low-flow discharge profiles presented in this report for the Haw River.

[h] Low-flow characteristics were based on streamflow data October 1996 through September 1998. Discharge records at this site are available for period February 1987 through September 1996, but are considered unreliable and should not be used.

[i] This site was operated during periods during early part of 1900's. Low-flow characteristics shown for these sites reflect flow conditions during periods of record likely have been affected by changes in flow diversions and regulation. In particular, low-flow characteristics shown for site 516 were not used to develop the low-flow discharge profiles presented in this report for the Cape Fear River.

[j] Site downstream from dam at University Lake as well as major NPDES point-source discharge; low-flow characteristics reflect flow releases from the dam and the point-source discharges.

[k] Low-flow characteristics reflect effects of flow regulation by B. Everett Jordan Lake. At sites 255 and 438, the 7Q10 discharges are greater than W7Q10 discharges for regulated-flow conditions since completion of Jordan Lake. Typically, in low-flow analyses, the 7Q10 discharge is less than the W7Q10 discharge. However, the reversal in discharge magnitudes for these two statistics at sites 255 and 438 is apparently a reflection of the seasonal flow conditions that vary in response to efforts to meet a target discharge of 600 ft^3/s at site 438 at Lillington.

[l] Low-flow estimates for this site were determined in a previous investigation of low-flow characteristics for sites in the Deep River subbasin (Weaver, 1997). Records of discharges available through the 1995 water year were used in the analyses. However, low-flow characteristics at sites 287, 367, and 399 in the Deep River subbasin were not published due to oversight or additional record that accumulated since the investigation was completed.

[m] Site is downstream from the dam at Shearon Harris Lake; low-flow characteristics reflect flow releases from the dam.

[n] No upstream regulation and(or) diversions have been noted in flows at this site. However, low-flow characteristics possibly reflect effects of tides.

Table 8. Magnitude and frequency of annual low-flow characteristics at selected partial-record measuring sites in the Cape Fear River Basin, North Carolina

[mi^2, square mile; water year, the annual period from October 1 to September 30 and identified by the year in which the period ends; $(ft^3/s)/mi^2$, cubic foot per second per square mile; ft^3/s, cubic foot per second; 7Q10, 7-day, 10-year low flow; 30Q2, 30-day, 2-year low flow; W7Q10, winter 7-day, 10-year low flow; 7Q2, 7-day, 2-year low flow; SR, secondary road; <, less than; N/A, not available; SEO, sewage effluent outfall. Unless otherwise noted, low-flow characteristics typically reflect unregulated flow conditions]

Site index no. (pl. 1)	USGS downstream order number	Station name	Drainage area (mi^2)	Period of analysis (water years)	Number of measurements		Average annual unit flow [$(ft^3/s)/mi^2$]	Low-flow characteristics (ft^3/s)			
					Flow	Zero flow		7Q10	30Q2	W7Q10	7Q2
2	02093250	Haw River at SR 2109 near Oak Ridge	14.1	1951-60, 1962, 1966, 1971, 1973-84, 1986-98	112[a]	1	1.1	0.5	2.7	1.9	1.7
19	02093423	Little Troublesome Creek near Williamsburg	12.1	1970-73, 1976-77, 1995-98	23	0	0.9	1.7	4.2	3.7	3.3
24	0209374350	Reedy Fork at SR 1858 near Oak Ridge	4.91	1973-74, 1976-77	10	0	1.1	0.9	2.1	2.0	1.7
30	02093878	Brush Creek at Brass Eagle Loop near Oak Ridge	7.46	1974-75, 1986	12	0	1.1	0.7	1.9	1.7	1.5
32	0209391880	Horsepen Creek at SR 2136 near Guilford College	7.52	1974-75, 1986	13	0	0.9	0.8	1.8	1.7	1.5
34	02093959	Horsepen Creek tributary near Guilford College	3.04	1954-55, 1986	16	0	0.9	0.1	0.5	0.5	0.3
38	02094377	Reedy Fork near Monticello	119	1969-71, 1973	8	0	0.9	1.8	5.8	4.2	4.1
42	02094772	South Buffalo Creek at South Elm Street at Greensboro	15.8	1969-70, 1973	6	0	0.9	0.5	1.5	1.3	1.0
45	02094980	South Buffalo Creek at Willow Road at Greensboro[b]	29.9	1954, 1956, 1958–64, 1966, 1969–71, 1973–74	37[c]	0	0.9	0.8	2.6	2.0	1.9
48	02095046	South Buffalo Creek near Bessemer	39.5	1986	7[d]	0	0.9	1.8	5.9	4.9	4.2
53	02095273	North Buffalo Creek at Yanceyville Street near Greensboro	15.3	1974-75, 1989	10	0	0.9	1.3	2.7	2.3	2.2
64	02095752	Travis Creek tributary at Gibsonville	1.4	1970, 1973-75	10	0	0.9	< 0.05	0.1	0.1	0.07
72	02095978	Stony Creek near Stony Creek[b]	23.8	1960-62, 1966, 1968, 1970	8	2	0.9	0	0.8	0.5	0.3
73	02095991	Toms Creek near Union Ridge	7.00	1961–62, 1966	4	3	0.9	0[e]	N/A[e]	N/A[e]	N/A[e]
77	02096120	Buttermilk Creek near Burlington[b]	14.3	1952-57, 1959-62, 1966	35	5	0.9	0	0.2	0.1	< 0.05
78	02096230	Jordan Creek near Union Ridge[b]	24.1	1949-57, 1959-62, 1966, 1997-98	55	14	0.9	0	0.4	0.3	0.1
90	02096553	Moadams Creek above SEO near Mebane	0.90	1954-55, 1966, 1970, 1973-75	10	1	0.9	0	0.05	< 0.05	< 0.05
95	02096597	Big Alamance Creek near Climax	10.9	1962, 1966	3	1	0.9	< 0.05	0.4	0.3	0.2
97	0209659814	Little Alamance Creek near Julian[f]	2.0	1974, 1976-77, 1979-81	13	1	0.9	0	0.08	0.05	< 0.05
106	02096610	Little Alamance Creek near Whitsett[b, f]	39.1	1950-59, 1962, 1966, 1974-75	24	0	0.9	0.7	3.8	3.3	2.4
112	02096707	Back Creek near Gibsonville[b]	3.19	1949, 1954-55, 1970, 1973-74	11	1	0.9	0	0.08	0.05	< 0.05

Table 8. Magnitude and frequency of annual low-flow characteristics at selected partial-record measuring sites in the Cape Fear River Basin, North Carolina—Continued

[mi^2, square mile; water year, the annual period from October 1 to September 30 and identified by the year in which the period ends; $(ft^3/s)/mi^2$, cubic foot per second per square mile; ft^3/s, cubic foot per second; 7Q10, 7-day, 10-year low flow; 30Q2, 30-day, 2-year low flow; W7Q10, winter 7-day, 10-year low flow; 7Q2, 7-day, 2-year low flow; SR, secondary road; <, less than; N/A, not available; SEO, sewage effluent outfall. Unless otherwise noted, low-flow characteristics typically reflect unregulated flow conditions]

Site index no. (pl. 1)	USGS downstream order number	Station name	Drainage area (mi^2)	Period of analysis (water years)	Number of measurements		Average annual unit flow [$(ft^3/s)/mi^2$]	Low-flow characteristics (ft^3/s)			
					Flow	Zero flow		7Q10	30Q2	W7Q10	7Q2
114	02096720	Big Alamance Creek at Alamance[b]	144	1949-54, 1956-57, 1961-63, 1970, 1973	25	0	0.9	1.8	11.8	8.8	6.7
120	02096780	South Prong Stinking Quarter Creek near Bellemont[b]	33.6	1956-68, 1970	30	1	0.9	0.3	2.8	1.9	1.5
124	02096788	Big Alamance Creek near Bellemont	242	1974-84, 1986-89, 1994	41	0	0.9	2.7	19.1	12.4	11.7
125	02096798	Little Alamance Creek near Graham[f]	13.5	1954, 1962, 1964-68, 1970	20	0	0.9	0.3	0.9	0.7	0.6
130	02096820	Haw Creek near Swepsonville[b]	27.8	1955, 1960, 1962, 1964-68, 1970	16	0	0.9	0.1	1.9	1.5	1.0
140	02096860	Cane Creek near Carrboro[b]	36.6	1954-56, 1958-62, 1968, 1970	22	0	1.0	0.2	3.0	2.3	1.8
141	02096879	Haw River near Terrells	1,083	1969, 1974-76, 1979-87, 1990-91, 1993, 1995-98	43	0	1.0	63	140	130	112
148	02096930	Terrells Creek near Pittsboro[b]	20.9	1960, 1962, 1966-68, 1970	10	1	1.0	0	0.3	0.09	0.06
151	02096940	Dry Creek near Terrells	17.7	1955, 1960, 1962, 1967-68, 1970	9	3	1.0	0	0.07	< 0.05	< 0.05
167	02097189	Robeson Creek near Seaforth	27.2	1954, 1966, 1970-71, 1973-74, 1976, 1978, 1980-82	21	0	1.0	< 0.05	1.1	0.5	0.5
175	02097203	New Hope Creek near Blackwood	22.4	1962, 1966, 1968, 1971, 1973, 1976, 1978-84	36	1	1.0	0.05	0.7	0.4	0.4
183	02097224	New Hope Creek at U.S. Hwy 15-501 near Durham	42.3	1932, 1954-68, 1970-71, 1973-74	50	4	1.0	0.07	1.5	0.8	0.7
185	02097231	Sandy Creek near Durham	6.26	1954-55, 1966, 1968, 1970	7	3	1.0	0[e]	N/A[e]	N/A[e]	N/A[e]
196	02097299	Third Fork Creek near Blands	16.5	1970-71, 1973-74, 1976, 1978, 1980-87	48	0	1.0	0.2	1.6	0.9	1.1
202	02097360	Bolin Creek at Chapel Hill[b]	10.7	1954, 1960, 1962, 1964-68, 1970, 1980-92	62	0	1.0	0.5	1.0	0.8	0.7
210	0209741350	Northeast Creek below SEO near Lowes Grove	7.02	1970, 1973-75	13	2	1.0	0[e]	N/A[e]	N/A[e]	N/A[e]

Table 8. Magnitude and frequency of annual low-flow characteristics at selected partial-record measuring sites in the Cape Fear River Basin, North Carolina—Continued

[mi^2, square mile; water year, the annual period from October 1 to September 30 and identified by the year in which the period ends; $(ft^3/s)/mi^2$, cubic foot per second per square mile; ft^3/s, cubic foot per second; 7Q10, 7-day, 10-year low flow; 30Q2, 30-day, 2-year low flow; W7Q10, winter 7-day, 10-year low flow; 7Q2, 7-day, 2-year low flow; SR, secondary road; <, less than; N/A, not available; SEO, sewage effluent outfall. Unless otherwise noted, low-flow characteristics typically reflect unregulated flow conditions]

Site index no. (pl. 1)	USGS downstream order number	Station name	Drainage area (mi^2)	Period of analysis (water years)	Number of measurements		Average annual unit flow [$(ft^3/s)/mi^2$]	Low-flow characteristics (ft^3/s)			
					Flow	Zero flow		7Q10	30Q2	W7Q10	7Q2
213	0209741630	Harveys Branch above SEO near Nelson	0.1	1970, 1973-75	9	1	1.1	0[e]	N/A[e]	N/A[e]	N/A[e]
224	02097421	Northeast Creek tributary near Lowes Grove	0.74	1970, 1973-75	8	3	1.0	0[e]	N/A[e]	N/A[e]	N/A[e]
225	02097426	Kit Creek near Genlee	8.29	1960, 1962, 1968	4	3	1.0	0[e]	N/A[e]	N/A[e]	N/A[e]
226	02097440	Northeast Creek at O'Kellys Church[b]	35.0	1963-67, 1970, 1976, 1978, 1980-82	28	1	1.0	0	0.2	0.05	0.08
233	02097477	Phils Creek near White Cross	6.68	1960, 1962, 1966	10[g]	0	1.0	0.1	0.6	0.4	0.4
246	02097910	White Oak Creek near Wilsonville[b]	24	1953, 1955, 1960-71	32	11	1.0	0	0.1	< 0.05	< 0.05
248	02098062	Beaver Creek tributary at Apex	0.5	1954-55, 1962, 1968	8	6	1.0	0[e]	N/A[e]	N/A[e]	N/A[e]
249	02098093	Beaver Creek at Apex	5.65	1954, 1962, 1968	6	6	1.0	0[e]	N/A[e]	N/A[e]	N/A[e]
250	02098124	Beaver Creek near New Hill	18	1960, 1962, 1968	4	4	1.0	0[e]	N/A[e]	N/A[e]	N/A[e]
260	02098343	West Fork Deep River near Friendship[b,h]	11.5	1955, 1962, 1966	4	0	1.0	1.7	3.3	3.0	2.8
268	02099193	Deep River at SR 1352 near Jamestown[h]	66.6	1971, 1973-74	5	0	1.0	0.8	4.0	2.4	2.3
269	02099240	Bull Run at Oakdale[b,h]	7.75	1954, 1960-67, 1969	25	1	1.0	0	0.6	0.2	0.2
272	02099399	Deep River at Kivett Drive extension near Jamestown[h]	77.7	1974-75	6	0	1.0	2.1	6.4	4.4	4.3
273	02099480	Richland Creek near Archdale[b,h]	12.5	1954-56, 1958-60, 1962, 1966, 1971, 1973	21	0	0.9	0.9	2.2	2.0	1.7
278	02099490	Hickory Creek near High Point[h]	9.60	1955, 1962, 1964-67, 1969-70, 1974-75	18	1	0.9	0.05	0.6	0.4	0.3
280	02099492	Reddicks Creek near Jamestown[h]	4.90	1971, 1973-75	10	0	0.9	0[i]	0.4	0.2	0.2
291	02100096	Deep River at U.S. Highway 220 at Randleman[h]	177.1	1971, 1973-74	5	0	1.0	7.8	22	14.3	15
295	02100180	Polecat Creek near Climax[h]	29.1	1954-59, 1962-63, 1966, 1970	18	1	1.0	< 0.05	1.6	0.9	0.7
301	02100219	Deep River at Worthville[h]	236	1971, 1973-74, 1976	7	0	1.0	8.0	26	14.5	17
308	02100344	Deep River at Cedar Falls[h]	266	1971, 1974-75	5	0	1.0	8.5	32	18	27
321	02100599	Deep River near Parks Crossroads[h]	392	1971, 1973-76	9	0	1.0	13.5	57	31	40

Table 8. Magnitude and frequency of annual low-flow characteristics at selected partial-record measuring sites in the Cape Fear River Basin, North Carolina—Continued

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Site index no. (pl. 1)	USGS downstream order number	Station name	Drainage area (mi^2)	Period of analysis (water years)	Number of measurements		Average annual unit flow [$(ft^3/s)/mi^2$]	Low-flow characteristics (ft^3/s)			
					Flow	Zero flow		7Q10	30Q2	W7Q10	7Q2
325	02100640	Richland Creek near Asheboro[b,h]	36.8	1949-55, 1957, 1960, 1962, 1966	21	0	1.0	0.1	3.0	1.9	1.5
335	02100710	Brush Creek near Coleridge[b,h]	67.4	1954-60, 1962-63, 1966	22	0	1.0	0.4	3.3	2.1	1.8
338	02100730	Fork Creek near Coleridge[b,h]	38.5	1954-63, 1966	30	0	1.0	0.1	2.6	1.6	1.3
339	02100747	Deep River at Howards Mill near Robbins[h]	621	1970, 1974-77	9	0	1.0	18	75	40	48
346	02100824	Bear Creek near Spies[h]	44.6	1954-55, 1971, 1973	11	0	1.1	0.05	1.8	1.0	0.8
362	02101045	Buffalo Creek at McConnell[b,h]	21.4	1962, 1965-68, 1970-71	12	4	1.0	0	0.08	0.05	< 0.05
369	02101090	McLendons Creek near Carthage[h]	44.0	1949-54, 1959, 1962, 1966, 1968	22	3	1.2	0[e]	N/A[e]	N/A[e]	N/A[e]
375	02101290	McLendons Creek near Putnam[h]	97.3	1963-68, 1970-71	14	0	1.0	0[i]	1.4	0.5	0.3
398	02101660	Rocky River near Liberty[b,h]	4.52	1953-55, 1960-63, 1966	18	1	0.9	< 0.05	0.3	0.2	0.2
407	02101792	Rocky River near Mount Vernon Springs[j]	94.7	1970, 1973-74	5	0	0.9	1.0	5.3	3.6	3.5
411	02101820	Tick Creek near Bonlee[h]	20.0	1954, 1956-58, 1960-63, 1970	16	1	1.2	0[e]	N/A[e]	N/A[e]	N/A[e]
415	02101890	Bear Creek near Goldston[h]	42.4	1949-71	50	2	1.0	0	0.4	0.2	0.1
416	02101946	Rocky River near Coalglen[j]	237	1974, 1976, 1979	6	0	1.0	1.4	9.8	5.5	5.2
420	02102179	White Oak Creek near Friendship[b]	13.2	1972-74	5	1	1.1	0[e]	N/A[e]	N/A[e]	N/A[e]
421	02102180	White Oak Creek near Holly Springs[b]	22.5	1963-68, 1970, 1972-74	18	4	1.1	0	0.07	< 0.05	0
432	02102280	Hector Creek near Chalybeate	17.4	1965-68, 1970-71	9	0	1.1	0.2	2.5	1.7	1.3
436	02102457	Kenneth Creek near Chalybeate	14	1955, 1970, 1972-74	11	0	1.1	0.08	1.5	1.1	0.8
437	02102480	Neills Creek near Lillington	37.6	1954-59, 1964	13	1	1.2	< 0.05	2.7	1.4	0.9
441	02102520	East Buies Creek at Buies Creek	7.56	1965-68, 1970-71	10	1	1.2	0	0.2	0.1	< 0.05
445	02102550	Upper Little River near Lemon Springs	19	1974, 1976, 1978, 1980	11[k]	0	1.2	0.1	0.8	0.6	0.4
448	0210256025	Gasters Creek at SR 1132 near Sanford	0.5	1973-75	9	0	1.1	< 0.05	0.1	0.1	0.1
452	02102580	Upper Little River at Swann	43.8	1932, 1952, 1954-55, 1964-68, 1970	19	0	1.2	0.5	4.0	3.2	2.2

Table 8. Magnitude and frequency of annual low-flow characteristics at selected partial-record measuring sites in the Cape Fear River Basin, North Carolina—Continued

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					Flow	Zero flow		7Q10	30Q2	W7Q10	7Q2
455	02102590	Barbecue Creek at Barbecue	31.4	1960-69	23	0	1.2	0.3	3.1	2.8	1.5
461	02102610	Upper Little River near Lillington	188	1949-55, 1968	17	0	1.2	1.3	17.7	13.0	8.2
463	02102634	Upper Little River near Erwin	217	1968, 1974-76, 1979, 1985-98	54	0	1.2	1.8	19.7	15.9	10.0
466	02102704	Little River near Harris	7.57	1965, 1974, 1976-77	11	0	1.3	0.07	1.3	1.1	0.6
496	02102930	Crane Creek near Vass	32.7	1949-56, 1961-71	31	3	1.3	0	0.8	0.6	0.1
503	02103520	Stewarts Creek at Linden	9.44	1955, 1957-68, 1970	32	0	1.2	0[i]	0.2	0.2	0.07
505	02103620	Cape Fear River tributary near Slocumb	16.4	1960-68, 1971	19	1	1.2	0	0.1	0.09	< 0.05
511	02103770	Cross Creek at Langdon Street at Fayetteville[b]	14.5	1955, 1966-68, 1970-71, 1974	17	0	1.3	6.2	9.6	9.6	8.6
512	02103960	Blounts Creek at Fayetteville[b]	4.22	1960-68, 1970	23	0	1.3	1.9	3.9	3.8	3.2
519	02104090	Locks Creek at East Fayetteville	38	1955-56, 1966-68, 1970-71	12	0	1.3	1.7	5.7	5.6	3.7
522	02104255	Beaver Creek near Arabia[b]	11.9	1965-68, 1971	9	0	1.3	3.1	5.8	5.7	4.7
524	02104279	Rockfish Creek near Arabia	150	1973-74, 1978, 1980-93, 1997-98	58	0	1.3	72	107	122	88
530	02104320	Little Rockfish Creek near Cumberland[b]	44.9	1960-68, 1970	17	0	1.3	14.1	30.5	30.0	24.0
540	02104380	Beaver Creek at Cumberland[b]	32.6	1955-56, 1960-65, 1968, 1973-75, 1979-93	81	0	1.3	9.3	18.3	18.3	14.7
551	02105520	Harrisons Creek at White Oak[b]	50.1	1955, 1960-68, 1985-93	44	0	1.2	0.7	5.1	4.0	2.6
554	02105630	Turnbull Creek near Elizabethtown[b]	60.1	1949-59, 1961-71	49	0	1.1	0.2	5.1	4.0	2.5
555	0210563128	Turnbull Creek at NC 41 near Elizabethtown	81.4	1985-93	23	0	1.1	1.7[l]	12.3	9.3	6.7
556	02105690	Hammond Creek near Lisbon	17	1955, 1957-68	27	0	1.1	0.2	0.6	0.6	0.4
563	0210591620	Great Coharie Creek at SR 1636 near Timothy	1.93	1974-76, 1979-80	9	2	1.2	0	< 0.05	< 0.05	0
567	02105960	Great Coharie Creek near Parkersburg[b]	201	1955–56, 1965-68, 1976, 1979	10[m]	0	1.1	6.4	31.1	25.6	19.5
578	02106360	Six Runs Creek near Clinton[b]	108	1950-54, 1956-58, 1964	17	1	1.1	0.2	4.2	3.2	1.8

Table 8. Magnitude and frequency of annual low-flow characteristics at selected partial-record measuring sites in the Cape Fear River Basin, North Carolina—Continued

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					Flow	Zero flow		7Q10	30Q2	W7Q10	7Q2
584	02106420	Stewarts Creek near Magnolia	47.0	1955-56, 1960-68	21	0	1.3	2.0	6.9	5.8	4.9
587	02106531	Black River at Ivanhoe	731	1955-56, 1974-76	6	0	1.2	31.2	128	88.4	78.1
590	02106621	Black River near Barclaysville	4.68	1973-74, 1976, 1978-80	12	1	1.2	0	0.1	0.1	0.05
591	02106648	Black River at SR 1722 near Dunn	37.3	1977-81	20	4	1.2	0	2.2	0.7	0.6
594	02106681	Black River near Dunn[n]	48.3	1974-75, 1977-85	58	4	1.2	0.08	2.7	1.8	1.0
598	02106760	Mingo Swamp near Dunn[b]	50.4	1955, 1957-63, 1973, 1976, 1979-85	49	2	1.2	0	1.8	0.9	0.6
603	02107171	South River near Kerr	458	1955-56, 1974, 1976, 1979	9	0	1.1	4.3	40	30	26
609	02107560	Moores Creek near Atkinson	52.7	1949-52, 1956-66	19	6	1.5	0	0	0	0
611	02107586	Northeast Cape Fear River near Mount Olive	10.5	1973, 1975-76, 1978-79	6	0	1.3	0.4	1.5	1.0	0.9
618	0210772380	Panther Branch at NC 50 at Faison	3.72	1973-74	5	2	1.2	0[e]	N/A[e]	N/A[e]	N/A[e]
619	02107724	Goshen Swamp at Faison	50.9	1956, 1973-75	8	3	1.2	0[e]	N/A[e]	N/A[e]	N/A[e]
638	02107990	Muddy Creek near Chinquapin[b]	34.5	1941, 1960-68, 1973	19	0	1.4	0.07	0.9	0.5	0.3
648	0210821250	Rockfish Creek at SR 1170 near Teachey	43	1973-74	4	0	1.4	1.1	4.6	4.1	2.7
654	02108510	Doctors Creek near Wallace	53.6	1954-56, 1964-68	14	2	1.4	0.2	2.5	1.9	1.2
655	02108534	Rockfish Creek at U.S. Hwy 117 near Wallace	150	1973, 1976, 1978-80	6	0	1.4	3.4	12.9	11.6	7.9
661	02108580	Holly Shelter Creek near Maple Hill[b]	33.6	1960-68	12	0	1.5	0.5	5.3	2.9	2.2
664	0210860020	Burgaw Creek Creek at SR 1345 at Burgaw	0.7	1973-75	6	3	1.5	0[e]	N/A[e]	N/A[e]	N/A[e]
668	02108620	Prince George Creek near Castle Hayne[b]	4.20	1966-68, 1974	9	0	1.5	0[i]	0.1	0.1	< 0.05
670	02108640	Smith Creek near Murraysville	8.9	1965-68	19	0	1.5	0.6	1.5	1.8	0.9
679	02108795	Mott Creek near Myrtle Grove[b]	1.35	1966-68	8	0	1.5	< 0.05	0.09	0.07	0.06

[a] Low-flow characteristics are based on combined discharge records at partial-record measuring sites 02093248 (site 1), 02093250 (site 2), and 02093260 (site 3). Initially, 114 measurements were available in the combined record of discharges; however, two measurements were made on concurrent dates resulting in 112 measurements used in the analysis. Discharges at sites 2 and 4 were adjusted by drainage area prior to analysis. Low-flow characteristics at station 02093290 (site 4) were published previously in Giese and Mason (1993).

[b] Low-flow characteristics were published previously in Giese and Mason (1993). Where different, estimates in this report supersede the previous estimates.

Table 8. Magnitude and frequency of annual low-flow characteristics at selected partial-record measuring sites in the Cape Fear River Basin, North Carolina—Continued

[c] Low-flow characteristics are based on combined discharge records at partial-record measuring sites 02094819 (site 44) and 02094980 (site 45). Thirty-seven measurements were available in the combined record of discharges; discharges at site 45 were adjusted by drainage area prior to analysis.

[d] Record of discharges indicates 14 measurements were made at this site during 1969–70, 1973–74, and 1986 water years. However, only seven measurements made during 1986 were used in determining the low-flow characteristics for this site to reflect the relocation of the City of Greensboro's wastewater-treatment plant to a location downstream from the site on South Buffalo Creek in 1984.

[e] Estimates for all low-flow characteristics cannot be determined based on available data; however, multiple observations of zero flow at site and(or) zero flow 7Q10 discharge at downstream site allow estimate of zero flow 7Q10 at indicated site.

[f] There are three tributaries to Big Alamance Creek named Little Alamance Creek. The low-flow characteristics listed for sites 97, 106, and 125 are for three distinct and separate Little Alamance Creeks.

[g] Low-flow characteristics are based on combined discharge records at partial-record measuring sites 0209747698 (site 232) and 02097477 (site 233). Ten measurements are available in the combined record of discharges; discharges at site 232 were adjusted by drainage area prior to analysis.

[h] Low-flow estimates for this site were determined in previous investigation of low-flow characteristics for sites in the Deep River subbasin (Weaver, 1997). Records of discharges available through the 1995 water year were used in the analyses. Estimates for these sites are listed in this report as published in the earlier investigation with the exception of site 398 where low-flow characteristics were reevaluated as part of developing the low-flow discharge profile for the Rocky River.

[i] No discharges equal to zero were observed during the period of record available for low-flow analyses at this site. However, low-flow analyses at this site indicate that the 7Q10 discharge is zero.

[j] Low-flow characteristics were determined as part of development of low-flow discharge profile for the indicated stream.

[k] Low-flow characteristics are based on combined discharge records at partial-record measuring sites 02102548 (site 444) and 02102550 (site 445). Eleven measurements are available in the combined record of discharges; discharges at site 444 (drainage area 18.7 mi^2) were added to record of measurements at site 445 prior to analysis.

[l] The significant increase in low-flow discharges from the previous site on Turnbull Creek (site 554) may be a reflection of increased ground-water discharge from the Peedee aquifer, which apparently cuts through the land surface into the Cape Fear River and lower reaches of Turnbull Creek near Elizabethtown (Winner and Coble, 1996).

[m] Low-flow characteristics are based on combined discharge records at partial-record measuring sites 02105960 (site 567) and 02105966 (site 568). Ten measurements are available in the combined record of discharges; discharges at site 568 were adjusted by drainage area prior to analysis.

[n] Site has continuous records of discharge for period October 1976 through September 1977. Low-flow characteristics shown for this site based on partial records of discharge collected at this site during the 1974–85 water years.

GLOSSARY

Base flow. The contribution of flow to a stream from ground water or spring discharge.

Climatic year. A continuous 12-month period during which a complete annual cycle occurs. The climatic year typically is from April 1 through March 31, designated by the calendar year in which the climatic year begins. For example, the 1997 climatic year is the period from April 1, 1997, to March 31, 1998. The year begins and ends during the period of increased flows so that all flows during a single dry season are included in annual values for that year.

Continuous-record gaging station. A site on a stream where continuous records of gage height are collected and for which discharge records are computed.

Drainage area. The drainage area of a stream at a specified location is that area, measured in a horizontal plane, which is enclosed by a drainage divide.

Gage height. The water-surface elevation referenced to an arbitrary gage datum, often used interchangeably with the term "stage."

Low flow. Base flow or sustained fair-weather flow.

Partial-record measuring site. A site on a stream where periodic discharge measurements are collected, usually for a period of years. The data collected at partial-record sites are often correlated with data at nearby continuous-record gaging stations to estimate low-flow characteristics at the partial-record sites.

Recurrence interval. The average interval of time within which the magnitude of an extreme event can be expected to be equaled or exceeded once. The primary recurrence intervals used in this report are 2 years and 10 years. For example, if the 7-day, 10-year low-flow discharge is 5 cubic feet per second (ft^3/s), then the annual minimum average discharge for a 7-consecutive-day period would be 5 ft^3/s or lower, on average, 1 time in 10 years, 5 times in 50 years, or 10 times in 100 years. Expressed in terms of probability, there is a 10 percent probability (inverse of recurrence interval) that the flow will be less than or equal to the 7-day, 10-year low-flow discharge in any one year. In a similar manner, there is a 50 percent probability that the flow will be less than or equal to the 7-day, 2-year low-flow discharge in any one year. While recurrence intervals indicate the average frequency of occurrence for a particular hydrologic event, it should be noted that the event could occur more than once in a given year, in consecutive years, or not at all during the period specified by the recurrence interval.

River mile. A measure of the distance upstream from the mouth of a stream.

Unit flow. Value of flow expressed in units of volume per time per square-mile drainage area. In this report, unit flow (sometimes used interchangeably with the term "yield") is expressed as cubic feet per second per square mile [$(ft^3/s)/mi^2$].

Water year. The 12-month period October 1 through September 30, designated by the calendar year in which the period ends. For example, the 1998 water year is the period from October 1, 1997, to September 30, 1998. Average discharge and flow-duration data are computed using the water-year time frame.

Zero-flow day. Day in which no flow occurred at a continuous-record gaging station as evidenced by a daily mean discharge of zero.