Cape Fear River Basinwide Water Quality Plan

October 2005

NC Department of Environment & Natural Resources
Division of Water Quality
Planning Section
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Raleigh, NC 27699-1617

This Document was approved by the NC Environmental Management Commission on October 13, 2005 to be used as a guide by the NC Division of Water Quality for carrying out its Water Quality Program duties and responsibilities in the Cape Fear River basin. This plan is the third five-year update to the Cape Fear River Basinwide Water Quality Plan approved by the NC Environmental Management Commission in October 1996.

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Executive Summary

This document is the third five-year update of the Cape Fear River Basinwide Water Quality Plan. Basinwide water quality planning is a watershed-based approach to restoring and protecting the quality of North Carolina's surface waters. Basinwide water quality plans are prepared by the NC Division of Water Quality (DWQ) for each of the 17 major river basins in the state. Each basinwide plan is revised at five-year intervals. While these plans are prepared by the DWQ, their implementation and the protection of water quality entail the coordinated efforts of many agencies, local governments and stakeholders in the state.

The first basinwide plan for the Cape Fear River basin was completed in 1995 and the second in 2000. The format of this third plan was revised in response to comments received during the first and second planning cycles. A greater emphasis is placed on watershed level information in order to facilitate protection and restoration efforts.

DWQ considered comments from five public workshops held in the basin in spring 2004 and subsequent discussions with local resource agency staff and citizens during draft plan development. This input will help guide continuing water quality management activities in the basin over the next five years.

The goals of basinwide planning are to:

- Identify water quality problems and restore full use to Impaired waters.
- Identify and protect high value resource waters.
- Protect unimpaired waters yet allow for reasonable economic growth.

DWQ accomplishes these goals through the following objectives:

- Collaborate with other agencies to develop appropriate management strategies.
- Assure equitable distribution of waste assimilative capacity.
- Better evaluate cumulative effects of pollution.
- Improve public awareness and involvement.

Noteable Themes in the Cape Fear River Basinwide Water Quality Plan

- New impairments on the mainstems of the Cape Fear River (Chapter 7 and 15) and Deep River (Chapter 10)
- Development of TMDLs to address fecal coliform bacteria and turbidity (Chapter 35)
- Jordan Reservoir impairment, TMDL and proposed management strategies (Chapter 36)
- Development of lower Cape Fear River TMDL (Chapter 37)
- Population growth and land cover changes (Chapter 26)
- Stormwater runoff control programs (Chapter 31)

Basin Overview

The Cape Fear River basin drains the middle portion of North Carolina and includes portions of 26 counties and 115 municipalities (Figure 1). It is also one of four river basins completely within North Carolina (Figure 2). DWQ subdivides all river basins into subbasins. The Cape Fear River basin contains 24 subbasins (Figure 1). Maps of each subbasin are included in each subbasin chapter. The basin is composed of five major drainages: Haw River, Deep River, Northeast Cape Fear River, Black River and the Cape Fear River.

Population Growth and Land Cover Changes

Chapter 26 provides an overview of population growth in the Cape Fear River basin and associated land cover changes. The overall population (2000) of the basin based on the percent of the counties that are partially or entirely in the basin is 1,834,545, with approximately 197 persons/square mile. Refer to Appendices I and III for more information on population and land cover changes.

Cape Fear River Basin Statistics

Total Area: 9,149 sq. miles
Freshwater Stream Miles: 6,386 mi
Freshwater Lakes Acres: 31,135 ac
Estuarine Acres: 31,753 ac
Coastline Miles: 61 mi
No. of Counties: 26
No. of Municipalities: 115
No. of Subbasins: 24
Population (1990): 1,465,451
Population (2000): 1,834,545*
Pop. Density (2000): 197 persons/sq. mi.*

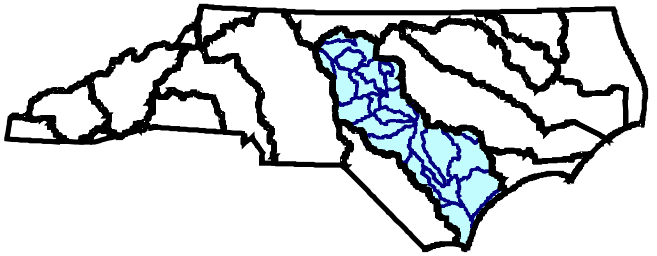
* Estimated based on % of county land area that is partially or entirely within the basin.

The most populated areas are located in and around the Triad, Triangle, Fayetteville and Wilmington. Counties in the upper basin and along the coast are experiencing high population growth that will add increased drinking water demands and wastewater discharges. There will also be a loss of natural areas and an increase in impervious surfaces associated with construction of new homes and businesses. At the current growth rate as much as one million acres of land will be in development by 2020. Many of the water quality problems summarized below are associated with urban and urbanizing areas. Most of the impaired streams in the basin are in heavily urbanized areas. Chapter 31 reviews the various stormwater programs in place to help prevent degradation to streams as urban areas increase in the Cape Fear River basin.

Water Quality Standards and Classifications

Chapter 25 discusses water quality classifications and standards, including maps showing water supply watersheds (WS), Outstanding Resource Waters (ORW), High Quality Waters (HQW) and shellfish harvesting waters (SA). Definitions of each classification and summaries of the miles and acres of the different classifications are provided. The classifications and standards are the basis for use support assessment.

Figure 1 General Map of the Cape Fear River Basin



ROCKINGHAM
CASWELL
Reidsville
03-06-01
03-06-02
FORSYTH
GUILFORD
Greensboro
Burlington
ORANGE
DURHAM
ALAMANCE
03-06-03
High Point
03-06-08
Durham
03-06-06
Archdale
Liberty
Chapel Hill
WAKE
03-06-04
03-06-05
Cary
Asheboro
Siler City
CHATHAM
RANDOLPH
03-06-09
03-06-12
Holly Springs
Goldston
03-06-07
Seagrove
03-06-11
Sanford
Angier
JOHNSTON
03-06-10
LEE
Lillington
MOORE
03-06-13
CAPE FEAR
WAYNE
Star
Carthage
HARNETT
Dunn
MONTGOMERY
Candor
03-06-14
LENOIR
Newton Grove
Spring Lake
Pinehurst
Calypso
03-06-21
03-06-15
CUMBERLAND
03-06-18
SAMPSON
JONES
Fayetteville
Clinton
DUPLIN
Hope Mills
Beulaville
HOKE
03-06-19
03-06-22
03-06-16
Rose Hill
ONSLOW
Tar Heel
Harrells
FEAR
ROBESON
BLADEN
Watha
Elizabethtown
03-06-23
03-06-20
Saint Helena
PENDER
Surf City
NEW HANOVER
03-06-24
COLUMBUS
Northwest
Wilmington
03-06-17
BRUNSWICK
CAPE FEAR RIVER
Boiling Spring Lakes

Legend

- Subbasin Boundary
- County Boundary
- Hydrgraphy
- Municipality

20 0 20 40 Miles

NC Division of Water Quality
Basinwide Planning Program
February 1, 2005

Use Support Summary

Appendix X provides DWQ methods for using current data and information to determine if a waterbody is supporting classified uses. Table 1 presents a summary of Impaired waters (in all categories) in the Cape Fear River basin that were monitored by DWQ within the five-year assessment period. Current status and recommendations for restoration of water quality for each Impaired water are discussed in each subbasin chapter (Chapters 1-24). Maps showing current use support ratings for waters in the Cape Fear River basin are presented in each subbasin chapter as well.

Table 1 Summary of Impaired Waters in the Cape Fear River Basin

Use Support Category	Units	Stream Length or Waterbody Area	Percent of All Waters for Each Category
Aquatic Life	Freshwater acres (impoundments)	10,833.9	35.2
Aquatic Life	Freshwater miles (streams)	425.4	6.9
Aquatic Life	Estuarine acres	6,527.4	20.6
Recreation	Freshwater miles	39.2	0.6
Recreation	Estuarine acres	96.6	0.3
Recreation	Coastline miles (Atlantic Ocean)	4.7	7.7
Shellfish Harvesting	Estuarine acres	6,500.7	41.4

Water Quality Stressors Identified in the Cape Fear River Basin

Within this plan, attempts were made to identify stressors for Impaired waters as well as for waters with noteable impacts. Stressors identified during this assessment are discussed below and in more detail in Chapter 27. Certain stressors are associated with specific use support categories. For example, in the recreation category, violations of the fecal coliform bacteria standard are the reason for impairment; therefore, fecal coliform bacteria is the stressor for Impaired waters in this category. In the shellfish harvesting category, a growing area classification that is not approved by Division of Environmental Health Shellfish Sanitation Section results in impairment. The growing area classification is based on fecal coliform bacteria monitoring by DEH; therefore, fecal coliform bacteria is the stressor for Impaired waters in this category as well. In the aquatic life category, Impaired waters result from violations of one or more numerical water quality standards or because a biological community sample (fish or benthic-bottom dwelling aquatic animals) did not meet use support criteria. Stressors to aquatic life can be numerical water quality standards that are violated, or a host of aquatic habitat quality indicators such as excessive sediment or lack of organic habitat. The following discussion summarizes stressors identified during this assessment period and possible sources of the stressors.

DWQ identifies the source of a stressor as specifically as possible depending on the amount of information available in a watershed. Most often the source is based on the predominant land use in a watershed. Stressor sources identified in the Cape Fear River basin during this

assessment period include urban or impervious surface areas, construction sites, road building, land clearing, agriculture and forestry. Because land disturbance is one of the main stressor sources there has been increased funding to the Division of Land Resources to help address these sources. Point source discharges are also water quality stressor sources.

Habitat Degradation

In the Cape Fear River basin, over 140 stream miles are Impaired where at least one form of habitat degradation is the stressor. Quantifying the amount of habitat degradation is very difficult in most cases. The most common stressors associated with physical habitat degradation are sediment, lack of organic material and stream channelization.

Sediment fills in pools and embeds or covers riffle habitat areas. Sediment may come from disturbed land in the watershed via runoff through storm sewers, ditches and roads or may be from stream banks that are eroded during high flow events. In many disturbed and developed watersheds, increased surface runoff becomes more common as impervious surfaces prevent infiltration of rain into the ground. In addition to the loss of instream habitat as noted above, sediment also can alter fish feeding and damage gills. During high flow events, suspended sediment can scour habitats as well as fish and insects.

Organic materials (wood and leaf) in streams are important as habitat and as a food source. A lack of organic habitat can reduce the diversity of benthic and fish species. A lack of organic habitat may also result from reduced riparian area quality associated with unstable stream banks and a lack of stream shading. Organic material in streams can form temporary dams that slow waters during high flows, reducing stream bank erosion and providing increased habitat.

Channelized streams are characterized by having little habitat diversity. Straightened stream channels allow for increased velocity of water during rain events and prevents the formation of pools and riffles seen in naturally sinuous streams. Streams can become channelized due to watershed development, where streams are moved and straightened to allow for roads and structures to be built. This type of channelization is most common in highly urbanized areas where the streams are usually a stormwater conveyance. Streams are also channelized by ditching to drain land for forestry, agriculture and development. These streams are often maintained as ditches and are not allowed to recover to a more natural state. Channelization can also occur by the force of large amounts of water running off the land. These high flows overrun natural bends and the sediment from eroded stream banks is deposited in the stream, resulting in low diversity aquatic habitats. These streams are most closely associated with urbanized and urbanizing areas.

To assess instream habitat degradation requires extensive technical and monetary resources. Although DWQ and other agencies are starting to address this issue, local efforts are needed to prevent further instream habitat degradation and to restore streams that have been impacted by activities that caused habitat degradation. As discharges become less of a source of water quality impairment, nonpoint sources that pollute water and cause habitat degradation need to be addressed to further improve water quality in North Carolina's streams and rivers.

DWQ recommends the use of careful planning to maintain riparian buffers and the use of good land use management practices during all land disturbing activities to prevent habitat degradation. In addition, watersheds that are being developed need to maintain management

practices for long periods to prevent excessive runoff that is the ultimate source of the habitat degradation noted above.

Arsenic
In the Cape Fear River basin during this assessment period, 7 miles of the Deep River are Not Rated due to arsenic standards violations (Chapter 8).

Chlorophyll a
In the Cape Fear River basin during this assessment period, there were over 10,000 freshwater acres and over 10 stream miles Impaired because of chlorophyll *a* standards violations. There were also over 2,160 freshwater acres and over 50 stream miles where chlorophyll *a* levels were elevated enough to be of concern. These violations were detected behind dams on the Deep River (Chapter 10) and Cape Fear River (Chapter 15), as well as in three reservoirs (Chapter 2 and 5) including Jordan Reservoir (Chapter 5 and 36).

Low Dissolved Oxygen
In the Cape Fear River basin during this assessment period, there were over 6,527 estuarine acres and over 40 stream miles Impaired because of dissolved oxygen (DO) standards violations. This includes a large portion of the Cape Fear Estuary (Chapter 17 and 37) and small streams draining mostly urban areas in the upper subbasins. There were also over 400 stream miles where dissolved oxygen levels were low enough to be of concern, although many of these streams are in swampy areas where low DO levels are likely a natural condition.

pH
In the Cape Fear River basin during this assessment period, there were over 6,360 estuarine acres, 1,392 freshwater acres, and over 97 stream miles Impaired because of pH standards violations (Chapters 5, 13, 14 and 15). The low pH was associated with the Cape Fear estuary and Sandhills streams. The elevated pH was associated with the 1,392-acre Haw River Arm of Jordan Reservoir (Chapter 5). There were also over 4,131 freshwater acres and 108 stream miles where pH levels were low enough to be of concern, although many of these streams are in swampy areas where low pH levels are likely a natural condition.

Turbidity
In the Cape Fear River basin during this assessment period, there were over 57 stream miles Impaired because of turbidity standards violations. The turbidity violations were mostly associated with areas downstream of urban and urbanizing areas in the upper subbasins (Chapter 2 and 9). There were also over 200 stream miles where turbidity levels were high enough to be of concern.

Fecal Coliform Bacteria and Enterroccus
During this assessment period, there were 41 stream miles where the fecal coliform bacteria standard was violated and these waters are Impaired for recreation. Most of these violations were associated with urban and urbanizing areas in the upper subbasins. There were also 97 estuarine acres (Chapter 17) and 5 miles of Atlantic coastline (Chapter 24) Impaired for recreation because of permanent postings of swimming advisories by the DEH Recreational Water Quality Monitoring Program. This program uses *enterroccus* as an indicator of potential pathogen contamination. A total of 19,339 acres, 1,120 stream miles and 49 coastline miles were monitored for recreation.

Fecal coliform bacteria are also the stressor for Impaired shellfish harvesting in Class SA waters. In the Cape Fear River basin, there are 2,654 acres of prohibited waters, 94 acres of conditionally approved-closed waters, and 3,822 acres of conditionally approved-open waters. All of these waters (6,571 acres or 41 percent) are Impaired for shellfish harvesting. The Impaired waters are associated with local coastal draining watersheds and not from basinwide sources (Chapter 17 and 24).

Mercury in Fish Tissue

DWQ has sampled fish tissue from 13 locations in the Cape Fear River basin. There are 1,392 freshwater acres and 281freshwater miles Impaired on a monitored basis in the Cape Fear River basin. Because of statewide fish consumption advice for several species of fish, all waters in the basin are Impaired on an evaluated basis in the fish consumption category. The source of mercury is most likely airborne and will have to be addressed on a regional and global scale.

Agriculture and Water Quality

Chapter 28 provides information related to the impacts of agriculture on water quality. Cultivated cropland was 16 percent (947,100 acres) of the land use in the Cape Fear River basin in 1997. While still a large portion of the basin land use, this is 20 percent (1,177,000 acres) less cultivated cropland than reported in 1982 (USDA-NRCS, 2001). In the Cape Fear River basin, there are nearly 265 Impaired stream miles that may be impacted by agricultural activities. Impacts to water quality from agricultural sources may decrease over the next basin cycle due to substantial increases in urban/built-up areas throughout the river basin.

DWQ will identify streams where agricultural activities may be impacting water quality and aquatic habitat. This information will be related to local Division of Soil and Water Conservation and Natural Resources Conservation Service staff to investigate impacts in these watersheds and to reduce these impacts. The DSWC Ag Cost Share Program has spent nearly $5 million on various management practices in the Cape Fear River basin. DWQ recommends that funding and technical support for agricultural BMPs be continued and increased. Refer to Appendix VIII for agricultural nonpoint source agency contact information.

Forestry and Water Quality

Chapter 29 provides information related to the impacts of forestry on water quality. Forestland was 60 (3,531,100 acres) percent of the land use in the Cape Fear River basin in 1997. While still the largest portion of the basin land use, this is six percent less forestland than reported in 1982 (USDA-NRCS, 2001). In the Cape Fear River basin, there are no stream miles Impaired by forest harvesting activities. Most land clearing activities around urban areas are for development and usually not associated with forest harvesting.

DWQ will identify streams where forest harvesting may be impacting water quality and aquatic habitat. This information will be related to Division of Forest Resources staff to investigate the impacts in these watersheds and to recommend BMPs to reduce impacts. DWQ recommends that funding and technical support for forestry BMPs be continued and increased. Refer to Appendix VIII for forestry nonpoint source agency contact information.

Wastewater Treatment and Disposal
Currently, there are 244 permitted wastewater discharges in the Cape Fear River basin with a permitted flow of approximately 425 MGD. Chapter 30 provides summary information (by type and subbasin) about the discharges. This chapter also provides guidance for permitting in various watersheds that may be water quality limited and also contains general information related to wastewater treatment disposal associated with registered animal operations. Maps of permitted facilities are provided in each subbasin chapter. For a complete listing of permitted facilities in the basin, refer to Appendix VI. The majority of NPDES permitted wastewater discharges into the waters of the Cape Fear River basin are from major municipal wastewater treatment plants. Nonmunicipal discharges also contribute substantial wastewater into the Cape Fear River basin.

There were 52 significant NPDES permit violations in the last two years of the assessment period. There are 156 Impaired stream miles where point sources may have negatively impacted the water quality. Facilities, large or small, where recent data show problems with a discharge are discussed in each subbasin chapter. DWQ will determine if the violations are ongoing and address them using the NPDES permitting process. Many other waters are adversely impacted by the cumulative effects of discharges and nonpoint source runoff.

Stormwater Programs
As described above, there have been large increases in population in the Cape Fear River basin. Water quality impacts associated with increased population are numerous. Streams with the worst water quality in the basin are closely associated with existing urban areas. In the Cape Fear River basin, there are over 300 miles of Impaired streams that drain urban or urbanizing watersheds. Chapter 31 describes the various stormwater programs and rules designed to prevent further impacts associated with population growth and development, as well as recommendations for local governments to further address impacts associated with the increased growth.

There are many different stormwater programs administered by DWQ. One or more of these programs affect many communities in the Cape Fear River basin. The goal of the DWQ stormwater discharge permitting regulations and programs is to prevent pollution from entering the waters of the state via stormwater runoff. These programs try to accomplish this goal by controlling the source(s) of pollutants. These programs include NPDES Phase I and II, coastal county stormwater requirements, HQW/ORW stormwater requirements, and requirements associated with the Water Supply Watershed Program. Local governments that are or may be affected by these programs are presented in this chapter.

Water Resources, Minimum Streamflows and Interbasin Transfers
Chapter 32 contains an overview of minimum streamflow requirements for many hydroelectric and water supply dams in the Cape Fear River basin. There is also a table that associates the federal and state watersheds by hydrologic units. There is extensive discussion of interbasin transfers and summary of transfers, and discussion of drought conditions during the assessment period for this plan.

Significant Ecological Resources and Endangered Species

The Cape Fear River basin is high in natural diversity with rare mussels and fish in the basin that are found nowhere else. There are four rare mollusks, eight rare insects, two rare crustaceans, and 19 rare fish in the basin. The Natural Heritage Program identifies sites (terrestrial or aquatic) that have particular biodiversity significance. A site's significance may be due to the presence of rare species, rare or high quality natural communities, or other important ecological features. Over 450 individual natural areas have been identified in the Cape Fear River basin. Several of these areas are discussed in Chapter 33. A table of rare animals associated with aquatic habitats in the Cape Fear River basin is also provided.

Water Quality Initiatives

As the Basinwide Planning Program completes its third cycle of plan development, there are many efforts being undertaken at the local level to improve water quality. Information about local efforts particular to a watershed or subbasin is included in Chapters 1-24. DWQ encourages local agencies and organizations to learn about and become active in their watersheds. An important benefit of local initiatives is that people make decisions that affect change in their own communities. There are a variety of state agency limitations that local initiatives can overcome, including: state government budgets, staff resources, lack of regulations for nonpoint sources, the state rule-making process, and many others.

Local organizations and agencies are able to combine professional expertise in a watershed. This allows groups to holistically understand the challenges and opportunities of different water quality efforts. Involving a wide array of people in water quality projects also brings together a range of knowledge and interests, and encourages others to become involved and invested in these projects. By working in coordination across jurisdictions and agency lines, more funding opportunities are available, and it is easier to generate necessary matching or leveraging funds. This will potentially allow local entities to do more work and be involved in more activities because their funding sources are diversified. The most important aspect of these local endeavors is that the more localized the project, the better the chances for success.

The collaboration of these local efforts are key to water quality improvements. There are good examples of local agencies and groups using these cooperative strategies throughout the state. Chapter 34 highlights local organizations and agencies in order to share their efforts towards water quality improvement. Specific projects are described in the subbasin chapters (Chapters 1 – 24).

Chapter 34 also summarizes monies spent by federal and state programs to help implement water quality improvement projects. Just over $2 million was granted by the Clean Water Act Section 319 program for 12 projects in the basin and over $54 million was made available through the Clean Water Management Trust Fund. This chapter also contains information about the Ecosystem Enhancement Program.

Total Maximum Daily Loads (TMDLs)

A TMDL is a calculation of the maximum amount of a pollutant that a waterbody can receive and still meet water quality standards, and an allocation of that amount to the pollutant sources. A TMDL is the sum of the allowable loads of a single pollutant from all contributing point and nonpoint sources. The calculation must include a margin of safety to ensure that the waterbody

can be used for the purposes the state had designated. The calculation must also account for seasonal variation and critical conditions in water quality.

For each waterbody limited segment Impaired by a pollutant and identified in the 303(d) list, a TMDL must be developed. A TMDL includes a water quality assessment that provides the scientific foundation for an implementation plan. Seven TMDLs are completed and approved by EPA (Chapter 35); five are for fecal coliform bacteria, one for chlorophyll *a* and one for turbidity. There are seven TMDLs in progress including one for Jordan Reservoir (Chapter 36) and the Cape Fear River Estuary (Chapter 37).

Jordan Reservoir and Haw River Watershed NSW Strategy
Chapter 36 describes the Jordan Reservior stakeholder process, the Clean Water Responsibility Act and the modeling performed to support the nutrient management strategy. Most of the reservoir is Impaired because of chlorophyll *a* violations associated with excess nutrient loading to the reservoir. The nutrient TMDL recommends reductions from both point and nonpoint sources. Chapter 36 provides the framework for making these reductions through a rule-making process.

Cape Fear River Estuary TMDL
The Cape Fear river Estuary from Bryants Creek to Snows Cut is Impaired for aquatic life because of dissolved oxygen standard violations. This portion of the estuary has been considered Impaired since the *1996 Cape Fear River Basinwide Water Quality Plan* and was included on the 1998 303(d) list of Impaired waters. Data used in the water quality assessment of the estuary were collected by DWQ and the Lower Cape Fear River Program. Chapter 37 discusses the water quality assessment in detail.

Sources of the low dissolved oxygen levels include the many discharges of oxygen-consuming waste into this segment of the estuary and to tributary streams. There is also a considerable volume of naturally occurring blackwater that may contribute natural sources of oxygen-consuming materials. This portion of the estuary is influenced by tides and high flows from the entire basin, and therefore goes through many extreme changes in water column chemistry over the course of a year.

The Cape Fear River Estuary continues to violate the dissolved oxygen water quality standard as of this assessment cycle. Therefore, a TMDL is required for the estuary. The DWQ obtained an EPA grant of $253,000 in order to mount an extensive field monitoring project. This field monitoring includes the installation of continuous monitoring devices by the US Geological Survey, sediment oxygen demand measurements, dye studies, and intensive chemical monitoring. A major portion of the monitoring was completed in 2004; however, hurricanes prevented the completion of the study. The study is scheduled to be completed in 2005.

Monitored Impaired Waters in Cape Fear River Basin

Subbasin	Stream Name	AU Number	Length/Area
03-06-01	HAW RIVER	16-(1)d1	1.3 FW Miles
03-06-01	Little Troublesome Creek	16-7b	5.1 FW Miles
03-06-01	Troublesome Creek	16-6-(3)	1.8 FW Miles
03-06-02	Brush Creek	16-11-4-(1)a3	1.6 FW Miles
03-06-02	HAW RIVER	16-(1)d3	2.1 FW Miles
03-06-02	Horsepen Creek	16-11-5-(0.5)b	3.2 FW Miles
03-06-02	Horsepen Creek	16-11-5-(2)	1.8 FW Miles
03-06-02	North Buffalo Creek	16-11-14-1b	8.1 FW Miles
03-06-02	North Buffalo Creek	16-11-14-1a1	7.5 FW Miles
03-06-02	North Buffalo Creek	16-11-14-1a2	1.6 FW Miles
03-06-02	Reedy Creek	16-11-(1)b	4.2 FW Miles
03-06-02	Reedy Fork (Hardys Mill Pond)	16-11-(9)a2	2.2 FW Miles
03-06-02	Reedy Fork (Hardys Mill Pond)	16-11-(9)b	8.6 FW Miles
03-06-02	Ryan Creek	16-11-14-2-3	4.2 FW Miles
03-06-02	South Buffalo Creek	16-11-14-2c	4.8 FW Miles
03-06-02	South Buffalo Creek	16-11-14-2b	4.7 FW Miles
03-06-02	South Buffalo Creek	16-11-14-2a	15.4 FW Miles
03-06-02	Town Branch	16-17	4.2 FW Miles
03-06-02	Unnamed Tributary at Guilford College	16-11-5-1-(2)	1.3 FW Miles
03-06-02	Varnals Creek	16-21a	4.6 FW Miles
03-06-03	Big Alamance Creek (Alamance Cr)(Lk Macintoch)	16-19-(4.5)a	5.6 FW Miles
03-06-03	Little Alamance Creek (Gant Lake, Mays Lake)(Alamance County	16-19-11	12.6 FW Miles
03-06-04	Collins Creek	16-30-(1.5)	3.7 FW Miles
03-06-04	Dry Creek	16-34-(0.7)	10.1 FW Miles
03-06-04	HAW RIVER	16-(37.3)	53.2 FW Acres
03-06-04	Haw River (B. Everett Jordan Lake below normal pool elevatio	16-(37.5)	1,392.3 FW Acres
03-06-04	Robeson Creek	16-38-(3)c	2.4 FW Miles
03-06-05	New Hope Creek	16-41-1-(11.5)c	4.0 FW Miles
03-06-05	New Hope Creek	16-41-1-(11.5)b	3.5 FW Miles
03-06-05	New Hope Creek (including New Hope Creek Arm of New Hope River Arm of B. Everett Jordan Lake)	16-41-1-(14)	1,415.7 FW Acres
03-06-05	New Hope River Arm of B. Everett Jordan Lake (below normal pool elevation)	16-41-(3.5)a	5,673.3 FW Acres
03-06-05	New Hope River Arm of B. Everett Jordan Lake (below normal pool elevation)	16-41-(0.5)	1,199.8 FW Acres
03-06-05	Northeast Creek	16-41-1-17-(0.7	3.3 FW Miles
03-06-05	Northeast Creek	16-41-1-17-(0.7	3.3 FW Miles
03-06-05	Northeast Creek	16-41-1-17-(0.7	3.2 FW Miles
03-06-05	Third Fork Creek	16-41-1-12-(2)	3.9 FW Miles
03-06-06	Bolin Creek (Hogan Lake)	16-41-1-15-1-(0	3.1 FW Miles
03-06-06	Morgan Creek	16-41-2-(5.5)b	4.1 FW Miles
03-06-06	Morgan Creek (including the Morgan Creek Arm of New Hope River Arm of B. Everett Jordan Lake)	16-41-2-(9.5)	836.2 FW Acres
03-06-07	CAPE FEAR RIVER	18-(1)	3.2 FW Miles

Subbasin	Stream Name	AU Number	Length/Area
03-06-07	CAPE FEAR RIVER	18-(4.5)a	0.5 FW Miles
03-06-07	East Buies Creek	18-18-1-(2)	6.2 FW Miles
03-06-07	Kenneth Creek	18-16-1-(2)	3.9 FW Miles
03-06-07	Lick Creek	18-4-(2)	10.3 FW Miles
03-06-07	Neills Creek (Neals Creek)	18-16-(0.7)c1	6.7 FW Miles
03-06-07	Neills Creek (Neals Creek)	18-16-(0.7)a	2.0 FW Miles
03-06-07	Neills Creek (Neals Creek)	18-16-(0.3)	2.6 FW Miles
03-06-07	Neills Creek (Neals Creek)	18-16-(0.7)b	1.3 FW Miles
03-06-08	DEEP RIVER(including High Point Lake at normal pool elevation)	17-(1)	263.3 FW Acres
03-06-08	East Fork Deep River	17-2-(0.7)	0.8 FW Miles
03-06-08	East Fork Deep River	17-2-(0.3)b	4.8 FW Miles
03-06-08	Hickory Creek	17-8.5-(1)a	3.0 FW Miles
03-06-08	Jenny Branch	17-8-2	3.2 FW Miles
03-06-08	Long Branch	17-2-1-(2)	0.5 FW Miles
03-06-08	Long Branch	17-2-1-(1)	3.5 FW Miles
03-06-08	Muddy Creek	17-9-(1)	6.9 FW Miles
03-06-08	Reddicks Creek	17-8-(0.5)a	5.1 FW Miles
03-06-08	Richland Creek	17-7-(0.5)	6.4 FW Miles
03-06-08	Richland Creek	17-7-(4)	1.7 FW Miles
03-06-08	West Fork Deep River(Oak Hollow Reservoir)	17-3-(0.7)a	0.5 FW Miles
03-06-09	DEEP RIVER	17-(10.5)e1	6.7 FW Miles
03-06-09	Haskett Creek	17-12a	6.3 FW Miles
03-06-09	Haskett Creek	17-12b	1.3 FW Miles
03-06-09	Penwood Branch	17-12-1	6.1 FW Miles
03-06-10	Cotton Creek	17-26-5-3c	3.7 FW Miles
03-06-10	Cotton Creek	17-26-5-3b	2.5 FW Miles
03-06-10	Cotton Creek	17-26-5-3a	0.3 FW Miles
03-06-10	DEEP RIVER	17-(32.5)a	4.0 FW Miles
03-06-10	DEEP RIVER	17-(10.5)e2	2.8 FW Miles
03-06-10	Indian Creek	17-35	7.4 FW Miles
03-06-11	Big Buffalo Creek	17-40	8.0 FW Miles
03-06-11	DEEP RIVER	17-(43.5)	6.0 FW Miles
03-06-12	Loves Creek	17-43-10b	2.5 FW Miles
03-06-12	Loves Creek	17-43-10c	0.4 FW Miles
03-06-12	Tick Creek	17-43-13a	8.2 FW Miles
03-06-14	Little River (Lower Little River)	18-23-(10.7)	12.6 FW Miles
03-06-14	Little River (Lower Little River)	18-23-(24)	25.6 FW Miles
03-06-15	CAPE FEAR RIVER	18-(26)c	4.0 FW Miles
03-06-15	Little Cross Creek (Bonnie Doone Lake, Kornbow Lake, Mintz p	18-27-4-(1)e	1.1 FW Miles
03-06-15	Little Cross Creek (Glenville Lake)	18-27-4-(2)	2.1 FW Miles
03-06-15	Rockfish Creek	18-31-(23)	18.8 FW Miles
03-06-15	Rockfish Creek	18-31-(12)	3.8 FW Miles
03-06-15	Rockfish Creek	18-31-(15)	5.9 FW Miles

Subbasin	Stream Name	AU Number	Length/Area
03-06-15	Rockfish Creek [(Upchurches Pond, Old Brower Mill Pond (Number Two Lake)]	18-31-(18)	25.0 FW Miles
03-06-16	Browns Creek (Cross Pond)	18-45	10.5 FW Miles
03-06-16	CAPE FEAR RIVER	18-(26)d	21.3 FW Miles
03-06-17	Atlantic Ocean	99-(3)b	4.7 Coast Miles
03-06-17	Bald Head Creek	18-88-8-4	79.9 S acres
03-06-17	Beaverdam Creek	18-88-9-1-(1.5)	11.3 S acres
03-06-17	Brunswick River	18-77	743.7 S acres
03-06-17	CAPE FEAR RIVER	18-(87.5)a	769.2 S acres
03-06-17	CAPE FEAR RIVER	18-(63)a	3.8 FW Miles
03-06-17	CAPE FEAR RIVER	18-(87.5)d	17.7 S acres
03-06-17	CAPE FEAR RIVER	18-(71)a	5,616.7 S acres
03-06-17	CAPE FEAR RIVER	18-(87.5)c	322.6 S acres
03-06-17	Coward Creek	18-88-9-2-5-1	5.9 S acres
03-06-17	Denis Creek	18-88-9-2-3	34.2 S acres
03-06-17	Dutchman Creek	18-88-9-3-(2.5)	75.8 S acres
03-06-17	Dutchman Creek Outlet Channel	18-88-9-3-3	78.3 S acres
03-06-17	Dutchman Creek Shellfish Area	18-88-9-3-(4)	37.9 S acres
03-06-17	Elizabeth River	18-88-9-2-(1)	83.5 S acres
03-06-17	Elizabeth River Shellfishing Area	18-88-9-2-(2)	205.6 S acres
03-06-17	Fishing Creek	18-88-8-4-1	7.9 S acres
03-06-17	Intracoastal Waterway	18-88-9b	96.6 S acres
03-06-17	Intracoastal Waterway	18-88-9a	222.6 S acres
03-06-17	Molasses Creek	18-88-9-2-5	1.0 S acres
03-06-17	Piney point Creek	18-88-9-2-4	11.5 S acres
03-06-17	Town Creek (Rattlesnake Branch)	18-81	32.1 FW Miles
03-06-18	South River	18-68-12-(8.5)	45.4 FW Miles
03-06-19	Black River	18-68a	31.9 FW Miles
03-06-19	Great Coharie Creek (Blackmans Pond)	18-68-1	42.6 FW Miles
03-06-20	Black River	18-68b	40.5 FW Miles
03-06-20	Moores Creek	18-68-18b	9.9 FW Miles
03-06-22	Goshen Swamp	18-74-19a	16.6 FW Miles
03-06-22	Muddy Creek	18-74-25	14.0 FW Miles
03-06-22	Northeast Cape Fear River	18-74-(25.5)	19.5 FW Miles
03-06-23	Burnt Mill Creek	18-74-63-2	4.6 FW Miles
03-06-23	Long Creek	18-74-55a	7.7 FW Miles
03-06-23	Long Creek	18-74-55b	21.5 FW Miles
03-06-23	Northeast Cape Fear River	18-74-(47.5)	15.6 FW Miles
03-06-23	Smith Creek	18-74-63	11.1 FW Miles
03-06-24	Banks Channel	18-87-10-1b	4.2 S acres
03-06-24	Banks Channel	18-87-24-3	111.1 S acres
03-06-24	Batts Mill Creek (Barlow Creek)	18-87-6	40.8 S acres
03-06-24	Beckys Creek (Bishops Creek)	18-87-8b	66.4 S acres
03-06-24	Beckys Creek (Bishops Creek)	18-87-8a	42.5 S acres
03-06-24	County Line Branch	18-87-6-1	1.0 S acres

Subbasin	Stream Name	AU Number	Length/Area
03-06-24	Cypress Branch	18-87-6-2	1.0 S acres
03-06-24	Everett Bay	18-87-2	240.6 S acres
03-06-24	Everett Creek	18-87-29	0.7 S acres
03-06-24	Futch Creek	18-87-19b	14.3 S acres
03-06-24	Futch Creek	18-87-19a	13.7 S acres
03-06-24	Hewletts Creek	18-87-26b	19.9 S acres
03-06-24	Hewletts Creek	18-87-26a	78.3 S acres
03-06-24	Howe Creek	18-87-23	28.6 S acres
03-06-24	Intracaostal Waterway	18-87-(5.5)	159.6 S acres
03-06-24	Intracoastal Waterway	18-87-(11.5)	112.9 S acres
03-06-24	Intracoastal Waterway	18-87-(23.5)c	70.4 S acres
03-06-24	Intracoastal Waterway	18-87-(23.5)b	63.1 S acres
03-06-24	Intracoastal Waterway	18-87	76.2 S acres
03-06-24	Masonboro Sound ORW Area	18-87-25.7d	64.3 S acres
03-06-24	Masonboro Sound ORW Area	18-87-25.7c	215.9 S acres
03-06-24	Masonboro Sound ORW Area	18-87-25.7b	99.5 S acres
03-06-24	Mill Creek (Betts Creek)	18-87-14	18.2 S acres
03-06-24	Mullett Run	18-87-9-1	7.5 S acres
03-06-24	Nixons Creek	18-87-11	5.8 S acres
03-06-24	Old Mill Creek	18-87-7	0.1 S acres
03-06-24	Old Topsail Creek	18-87-12a	16.5 S acres
03-06-24	Old Topsail Creek	18-87-12b	12.4 S acres
03-06-24	Pages Creek	18-87-22a	48.4 S acres
03-06-24	Pages Creek	18-87-22b	28.5 S acres
03-06-24	Stump Sound	18-87-3	87.3 S acres
03-06-24	Stump Sound ORW Area	18-87-0.5	939.9 S acres
03-06-24	Topsail Sound	18-87-10d	12.7 S acres
03-06-24	Topsail Sound	18-87-10b	56.2 S acres
03-06-24	Topsail Sound	18-87-10c	1,144.5 S acres
03-06-24	Topsail Sound and Middle Sound ORW Area	18-87-11.7c	272.5 S acres
03-06-24	Topsail Sound and Middle Sound ORW Area	18-87-11.7d	2.7 S acres
03-06-24	Topsail Sound and Middle Sound ORW Area	18-87-11.7e	2.7 S acres
03-06-24	Topsail Sound and Middle Sound ORW Area	18-87-11.7f	6.8 S acres
03-06-24	Topsail Sound and Middle Sound ORW Area	18-87-11.7b	2.1 S acres
03-06-24	Turkey Creek	18-87-1a	79.5 S acres
03-06-24	Turkey Creek	18-87-1b	59.6 S acres
03-06-24	Virginia Creek	18-87-9b	73.6 S acres
03-06-24	Virginia Creek	18-87-9a	23.5 S acres
03-06-24	Whiskey Creek (Purviance Creek)	18-87-28	13.0 S acres

What is Basinwide Water Quality Planning?

Basinwide water quality planning is a watershed-based approach to restoring and protecting the quality of North Carolina's surface waters. Basinwide water quality plans are prepared by the NC Division of Water Quality (DWQ) for each of the 17 major river basins in the state (Figure 2 and Table 2). Preparation of a basinwide water quality plan is a five-year process, which is broken down into three phases (Table 3). While these plans are prepared by the DWQ, their implementation and the protection of water quality entail the coordinated efforts of many agencies, local governments and stakeholder groups in the state. The first cycle of plans was completed in 1998, but each plan is updated at five-year intervals.

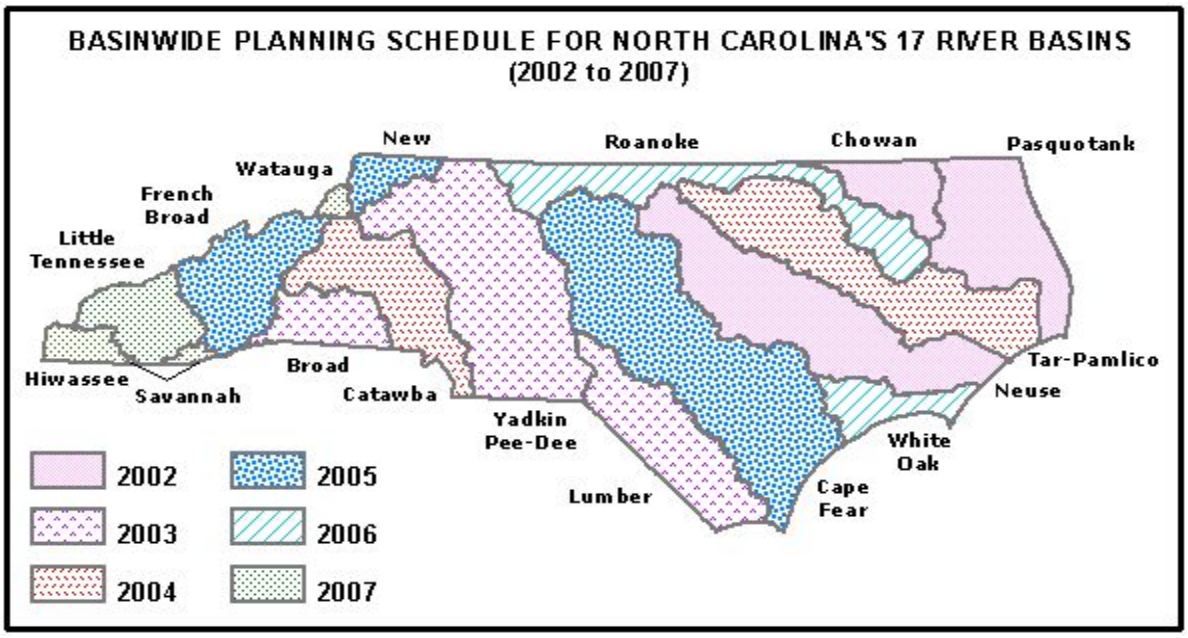


Figure 2 Basinwide Planning Schedule (2002 to 2007)

Goals of Basinwide Water Quality Planning

The goals of basinwide planning are to:

- Identify water quality problems and restore full use to Impaired waters.
- Identify and protect high value resource waters.
- Protect unimpaired waters yet allow for reasonable economic growth.

DWQ accomplishes these goals through the following objectives:

- Collaborate with other agencies to develop appropriate management strategies.
- Assure equitable distribution of waste assimilative capacity.
- Better evaluate cumulative effects of pollution.
- Improve public awareness and involvement.

Table 2 Basinwide Planning Schedule (2000 to 2007)

Basin	DWQ Biological Data Collection	Draft for Public Review	Plan Receives EMC Approval	Begin NPDES Permit Issuance
Chowan	Summer 2000	5/2002	7/2002	11/2002
Pasquotank	Summer 2000	5/2002	7/2002	12/2002
Neuse	Summer 2000	5/2002	7/2002	1/2003
Broad	Summer 2000	11/2002	2/2003	7/2003
Yadkin-Pee Dee	Summer 2001	1/2003	3/2003	9/2003
Lumber	Summer 2001	9/2003	12/2003	7/2004
Tar-Pamlico	Summer 2002	12/2003	3/2004	9/2004
Catawba	Summer 2002	7/2004	9/2004	12/2004
French Broad	Summer 2002	2/2005	4/2005	9/2005
New	Summer 2003	7/2005	9/2005	3/2006
Cape Fear	**Summer 2003**	**4/2005**	**8/2005**	**4/2006**
Roanoke	Summer 2004	6/2006	10/2006	1/2007
White Oak	Summer 2004	9/2006	12/2006	6/2007
Savannah	Summer 2004	11/2006	2/2007	8/2007
Watauga	Summer 2004	12/2006	3/2007	9/2007
Hiwassee	Summer 2004	11/2006	2/2007	8/2007
Little Tennessee	Summer 2004	1/2007	4/2007	10/2007

Note: A basinwide plan was completed for all 17 basins during the first cycle (1993 to 1998). This schedule represents the second and/or third cycle for each.

Table 3 Five-Year Process for Development of an Individual Basinwide Plan

Years 1 – 2 **Water Quality Data Collection and Identification of Goals and Issues**	• Identify sampling needs • Conduct biological monitoring activities • Conduct special studies and other water quality sampling activities • Coordinate with local stakeholders and other agencies to continue to implement goals within current basinwide plan
Years 2 – 3 **Data Analysis and Public Input**	• Gather and analyze data from sampling activities • Develop use support ratings • Conduct special studies and other water quality sampling activities • Coordinate with local stakeholders and agencies to establish goals and objectives and identify and prioritize issues for the next basin cycle • Develop preliminary pollution control strategies
Years 3 – 5 **Preparation of Draft Basinwide Plan, Public Review, Approval of Plan, Issue NPDES Permits and Begin Implementation of Plan**	• Develop draft basinwide plan based on water quality data, use support ratings, and recommended pollution control strategies • Circulate draft basinwide plan for review and revise plan after public review period • Submit plan to Environmental Management Commission for approval • Issue NPDES permits • Coordinate with other agencies and local interest groups to prioritize implementation actions • Conduct special studies and other water quality sampling activities

Benefits of Basinwide Water Quality Planning

Basinwide planning and management benefits water quality by:

- *Focusing resources* on one river basin at a time.
- *Using sound ecological planning and fostering comprehensive NPDES* permitting by working on a watershed scale.
- *Ensuring better consistency and equitability by* clearly defining the program's long-term goals and approaches regarding permits and water quality improvement strategies.
- *Fostering public participation* to increase involvement and awareness about water quality.
- *Integrating and coordinating programs and agencies* to improve implementation of point and nonpoint source pollution reduction strategies.

Division of Water Quality Functions and Locations

For more information on the above documents, DWQ activities or contacts, please visit http://h2o.enr.state.nc.us/basinwide/ or call (919) 733-5083 and ask for the basin planner responsible for your basin of interest. Feel free to contact the appropriate Regional Office for additional information (Figure 3). For general questions about the Department of Environment and Natural Resources, contact the Customer Service Center at 1-877-623-6748.

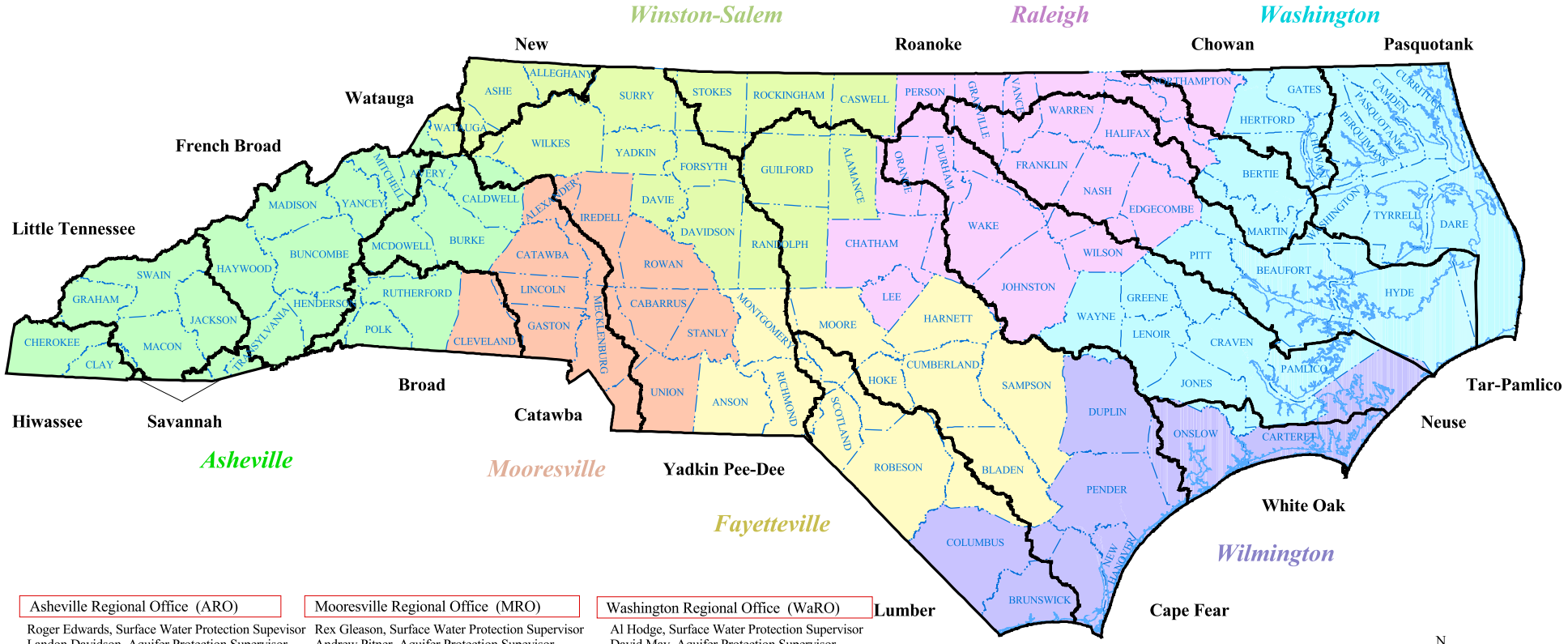
How You Can Get Involved

To assure that basinwide plans are accurately written and effectively implemented, it is important for citizens and local stakeholders to participate in all phases of the planning process. You may contact the basinwide planner responsible for your basin anytime during the plan's development. Upon request, the basin planner can also present water quality information and basin concerns to local stakeholder groups.

To make the plan more inclusive, DWQ is coordinating with the local Soil and Water Conservation Districts (SWCD), council of governments, NC Cooperative Extension Service, the county Natural Resources Conservation Service (NRCS), and stakeholder groups to develop language and identify water quality concerns throughout the basin. Citizens and local communities can also be involved during the planning process by contacting their county extension service or local SWCD.

During the public comment period, the draft plan is available online and by request for a period of at least 30 days. DWQ welcomes written comments and questions during this phase of the planning process and will incorporate comments and suggestions when appropriate.

Figure 3 North Carolina Department of Environment and Natural Resources
Division of Water Quality Regional Offices



Asheville Regional Office (ARO)

Roger Edwards, Surface Water Protection Supevisor
Landon Davidson, Aquifer Protection Supervisor
2090 US Highway 70
Swannanoa, NC 28778
COURIER 12-59-01
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Avery	Haywood	Polk
Buncombe	Henderson	Rutherford
Burke	Jackson	Swain
Caldwell	Macon	Transylvania
Cherokee	Madison	Yancey
Clay	McDowell	
Graham	Mitchell	

Mooresville Regional Office (MRO)

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Fax: (704) 663-6040

Alexander	Lincoln	
Cabarrus	Mecklenburg	
Catawba	Rowan	
Cleveland	Stanly	
Gaston	Union	
Iredell		

Washington Regional Office (WaRO)

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David May, Aquifer Protection Supervisor
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Washington, NC 27889
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Beaufort	Gates	Pamlico
Bertie	Greene	Pasquotank
Camden	Hertford	Perquimans
Chowan	Hyde	Pitt
Craven	Jones	Tyrrell
Currituck	Lenoir	Washington
Dare	Martin	Wayne

Winston-Salem Regional Office (WSRO)

Steve Tedder, Surface Water Protection Supervisor
Sherri Knight, Aquifer Protection Supervisor
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Fax: (336) 771-4630

Alamance	Forsyth	Watauga
Alleghany	Guilford	Wilkes
Ashe	Randolph	Yadkin
Caswell	Rockingham	
Davidson	Stokes	
Davie	Surry	

Central Office

DENR
DIVISION OF WATER QUALITY
WATER QUALITY SECTION
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RALEIGH NC 27699-1617
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Anson	Moore	
Bladen	Richmond	
Cumberland	Robeson	
Harnett	Sampson	
Hoke	Scotland	
Montgomery		

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Jay Zimmerman, Aquifer Protection Supervisor
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Raleigh, NC 27609
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Chatham	Johnston	Vance
Durham	Lee	Wake
Edgecombe	Nash	Warren
Franklin	Northampton	Wilson
Granville	Orange	
Halifax	Person	

Wilmington Regional Office (WiRO)

Ed Beck, Surface Water Protection Supervisor
Charlie Stehman, Aquifer Protection Supervisor
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Wilmington, NC 28405-2845
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Phone: (910) 796-7215
Fax: (910) 350-2004

Brunswick	New Hanover
Carteret	Onslow
Columbus	Pender
Duplin	

NCDENR

NC Division of Water Quality
Basinwide Planning Program
June 1, 2005

Other Reference Materials

There are several reference documents and websites that provide additional information about basinwide planning and the basin's water quality:

- *A Citizen's Guide to Water Quality Management in North Carolina*. August 2000. This document includes general information about water quality issues and programs to address these issues. It is intended to be an informational document on water quality. Visit the website at http://h2o.enr.state.nc.us/basinwide/ to download document.
- *Cape Fear River Basinwide Assessment Report*. June 2004. This technical report presents physical, chemical and biological data collected in the Cape Fear River basin.
- *Cape Fear River Basinwide Water Quality Management Plan*. October 1996 and July 2000. These first basinwide plans for the Cape Fear River basin present water quality data, information and recommended management strategies for the first two five-year cycles.
- NC Division of Water Quality Environmental Sciences Branch website at http://www.esb.enr.state.nc.us/.
- *North Carolina's Basinwide Approach to Water Quality Management: Program Description*. Creager, C.S. and J.P. Baker. 1991. DWQ Water Quality Section. Raleigh, NC.
- *Watershed Restoration Plan for the Cape Fear River Basin*. July 2001. DWQ NC Wetlands Restoration Program.

How to Read the Basinwide Plan

Chapters 1 - 24: Subbasin and Watershed Information

- **Summarizes information and data by subbasin, including: recommendations from previous basin plan, achievements, current priority issues and concerns, Impaired waters, and goals and recommendations for the next five years by subbasin.**

Chapter 25 - 37

- **Presents information on various topics of interest to the protection and restoration of water quality in the basin, including: stream classifications, population and land cover changes, stressors to water quality, agricultural, forestry and permitting activities in the basin, water and natural resources, and water quality initiatives.**

Appendices

- **Population and land use changes over time, local governments in the basin.**
- **Describes water quality data collected by DWQ, use support methodology and 303(d) listing methodology.**
- **Lists NPDES dischargers and individual stormwater permits.**
- **Points of contact and a glossary of terms and acronyms.**

Chapter 1
Cape Fear River Subbasin 03-06-01
Including: Haw River, Troublesome Creek and Little Troublesome Creek

1.1 Subbasin Overview

Subbasin 03-06-01 at a Glance

Land and Water Area

Total area:	189 mi²
Land area:	187 mi²
Water area:	2 mi²

Population

2000 Est. Pop.: 66,449 people
Pop. Density: 352 persons/mi²

Land Cover (percent)

Forest/Wetland:	58.6 %
Water:	2.0 %
Urban:	1.7 %
Cultivated Crop:	7.1 %
Pasture/Managed Herbaceous:	30.6 %

Counties

Alamance, Caswell, Forsyth, Guilford and Rockingham

Municipalities

Reidsville and Stokesdale

This subbasin is a piedmont watershed characterized by highly erodible soils. Most of the watershed is forested with extensive agriculture. Development is occurring north of Greensboro and around Reidsville. Population is expected to grow by 140,000 people in counties with portions or all of their areas in this subbasin by 2020.

There are 11 individual NPDES wastewater discharge permits in this subbasin with a total permitted flow of 7.8 MGD (Figure 4). The largest is Reidsville WWTP (7.5 MGD). Refer to Appendix VI and Chapter 30 for more information on NPDES permit holders. Issues related to compliance with NPDES permit conditions are discussed below in Section 1.3 for Impaired waters.

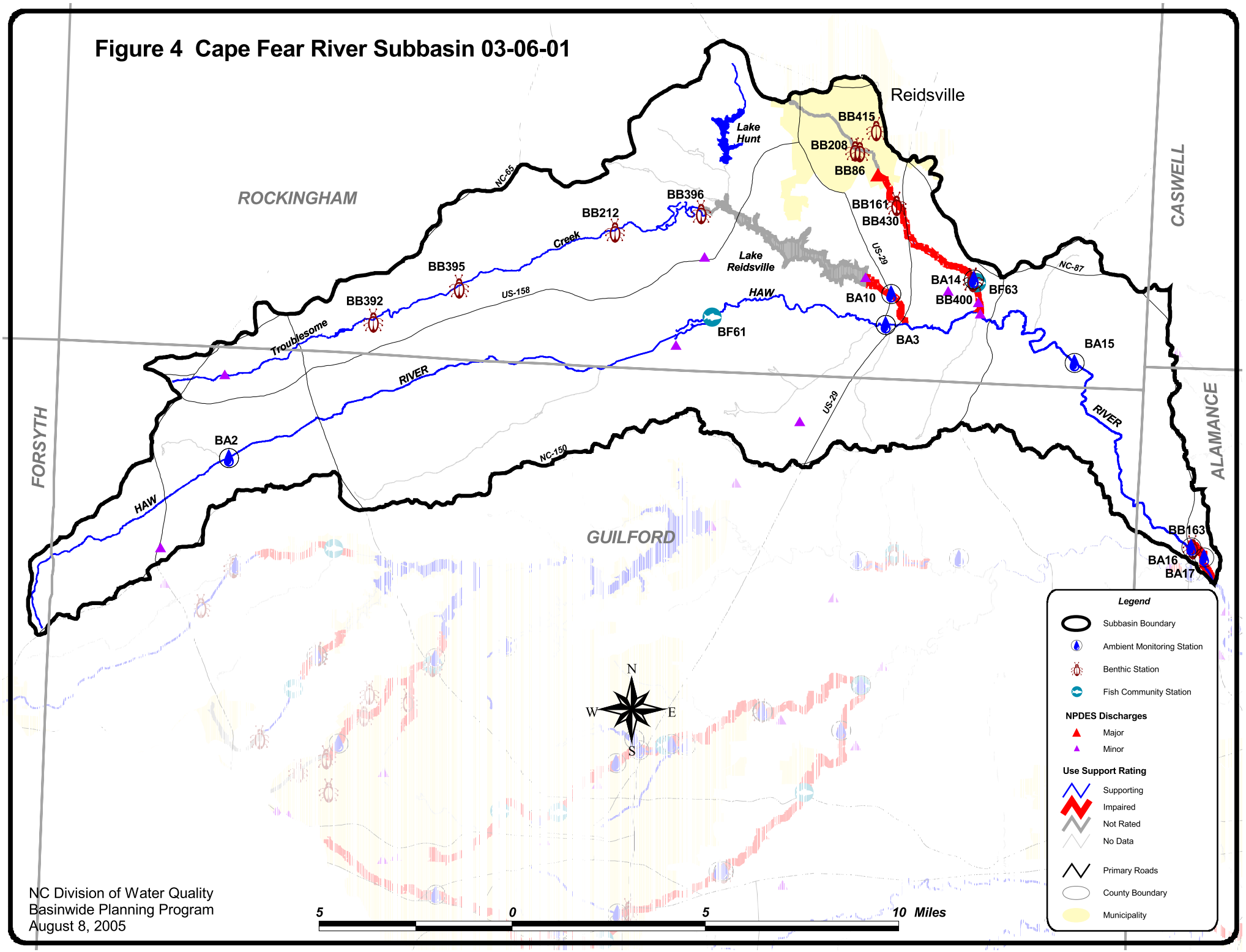
There are no municipal areas in this subbasin required to develop a stormwater program (Chapter 31).

There is one registered cattle, two registered swine, and four registered dairy operations, as well as one registered horse farm in this subbasin. Issues related to agricultural activities are discussed below in Section 1.3 for Impaired waters.

There were 11 benthic macroinvertebrate community samples and two fish community samples (Figure 4 and Table 4) collected during this assessment period. Some sites were not sampled because of high flows in 2003, and low flows in 2001 and 2002 may have had impacts on the biological communities as well. Data were collected from eight ambient monitoring stations including four DWQ stations, two UCFRBA (Appendix V) stations, and two shared stations. Two reservoirs were also monitored. Refer to the *2003 Cape Fear River Basinwide Assessment Report* at http://www.esb.enr.state.nc.us/bar.html and Appendix IV for more information on monitoring.

Waters in the following sections are identified by an assessment unit number (AU#). This number is used to track defined segments in the water quality assessment database, 303(d) Impaired waters list, and the various tables in this basin plan. The assessment unit number is a subset of the DWQ index number (classification identification number). A letter attached to the end of the AU# indicates that the assessment unit is smaller than the DWQ index segment. No letter indicates that the assessment unit and the DWQ index segment are the same.

Figure 4 Cape Fear River Subbasin 03-06-01



NC Division of Water Quality
Basinwide Planning Program
August 8, 2005

Table 4 CAPE FEAR Subbasin 03-06-01

AU Number	Classification	Length/Area	Description	Aquatic Life Assessment					Recreation Assessment			Stressors	Sources
				AL Rating	Station	Result	Year/ Parameter	% Exc	REC Rating	Station	Result		
HAW RIVER													
16-(1)a	C NSW	7.8 FW Miles	From source to SR 2109	**S**	BA2	NCE			**NR***	BA2	NCE	Habitat Degradation	Impervious Surfac
												Habitat Degradation	Agriculture
												Fecal Coliform Bacteria	WWTP NPDES
												Fecal Coliform Bacteria	Impervious Surfac
16-(1)b	C NSW	12.5 FW Miles	From SR 2109 to SR 2426	**S**	BA3	NCE			**S**	BA3	NCE	Low Dissolved Oxygen	Unknown
					BF61	G	'1998						
16-(1)c	C NSW	21.2 FW Miles	From SR 2426 to NC 87	**S**	BA15	NCE	Turbidity	7.3	**S**	BA15	NCE	Habitat Degradation	Unknown
					BA16	NCE						Turbidity	Land Clearing
					BB163	GF	'2003					Turbidity	Agriculture
					BF61	G	'1998						
16-(1)d1	C NSW	1.3 FW Miles	From NC 87 to Subbasin 01/02 boundary	**S**	BA17	NCE			**I**	BA17	CE	Fecal Coliform Bacteria	MS4 NPDES
Little Troublesome Creek													
16-7a	C NSW	3.5 FW Miles	From source to Reidsville WWTP	**NR**					ND			Habitat Degradation	Impervious Surfac
					BB208	NR	'2001						
					BB415	NR	'2001						
					BB86	NR	'2000						
16-7b	C NSW	5.1 FW Miles	From Reidsville WWTP to Haw River	**I**	BA14	NCE	Turbidity	9.3	**S**	BA14	NCE	Fecal Coliform Bacteria	MS4 NPDES
					BB161	F	'2001					Turbidity	Impervious Surfac
					BB161	F	'2000					Habitat Degradation	Agriculture
					BB400	F	'2003					Habitat Degradation	Road Construction
					BB400	F	'2001					Habitat Degradation	Impervious Surfac
					BB400	F	'2001						
					BB400	F	'2000						
					BF63	P	'1998						
					BF63	GF	'2003						

Table 4 CAPE FEAR Subbasin 03-06-01

AU Number / Description	Classification	Length/Area		Aquatic Life Assessment						Recreation Assessment					
				AL Rating	Station	Result	Year/ Parameter	% Exc		REC Rating	Station	Result		Stressors	Sources
Troublesome Creek															
16-6-(0.3)	WS-III NS	16.4	FW Miles	**S**						ND				Low Dissolved Oxygen	WWTP NPDES
From source to Rockingham County SR 2423					BB212	GF	2002								
					BB392	GF	2002								
					BB395	GF	2002								
					BB396	GF	2002								
16-6-(3)	C NSW	1.8	FW Miles	**I**	BA10	CE	Low DO	12.8		**S**	BA10	NCE		Turbidity	Unknown
					BA10	NCE	Turbidity	7.3						Low Dissolved Oxygen	Impoundment
From dam at Lake Reidsville to Haw River															
Troublesome Creek (Lake Reidsville)															
16-6-(0.7)	WS-III NS	667.5	FW Acres	**NR**	BL17	NCE	Chlor a	66		ND				Turbidity	Agriculture
From Rockingham County SR 2423 to dam at Lake Reidsville (City of Reidsville water supply intake)														Chlorophyll a	Agriculture
														Low Dissolved Oxygen	Agriculture
Unnamed Tributary to Troublesome Creek (Lake Hunt)															
16-6-2-(1)	WS-III&B	176.4	FW Acres	**S**	BL18	NCE				ND					
From source to dam at Lake Hunt															

Table 4 CAPE FEAR Subbasin 03-06-01

AU Number	Classification	Length/Area	Description	Aquatic Life Assessment					Recreation Assessment				
				AL Rating	Station	Result	Year/ Parameter	% Exc	REC Rating	Station	Result	Stressors	Sources

AL - Aquatic Life	BF - Fish Community Survey	E - Excellent	S - Supporting, I - Impaired
REC - Recreation	BB - Benthic Community Survey	G - Good	NR - Not Rated
	BA - Ambient Monitoring Site	GF - Good-Fair	NR*- Not Rated for Recreation (screening criteria exceeded)
	BL- Lake Monitoring	F - Fair	ND-No Data Collected to make assessment
	S- DEH RECMON	P - Poor	**Results**
		NI - Not Impaired	CE-Criteria Exceeded > 10% and more than 10 samples
	Miles/Acres	S- Severe Stress	NCE-No Criteria Exceeded
	FW- Fresh Water	M-Moderate Stress	
	S- Salt Water	N- Natural	

Aquatic Life Rating Summary

S	m	59.2	FW Miles
NR	m	3.5	FW Miles
I	m	6.8	FW Miles
S	m	176.4	FW Acres
NR	m	667.5	FW Acres
ND		34.9	FW Miles
ND		24.8	FW Acres

Recreation Rating Summary

S	m	40.5	FW Miles
NR*	m	7.8	FW Miles
I	m	1.3	FW Miles
ND		54.8	FW Miles
ND		868.7	FW Acres

Fish Consumption Rating Summary

I	e	104.5	FW Miles
I	e	868.7	FW Acres

1.2 Use Support Assessment Summary

Use support ratings were assigned for waters in subbasin 03-06-01 in the aquatic life, recreation, fish consumption and water supply categories. All waters are Impaired on an evaluated basis in the fish consumption category because of fish consumption advice (Chapter 27) that applies to the entire basin. In the water supply category, all WS classified waters (843.9 acres and 24.3 miles) are Supporting on an evaluated basis based on reports from DEH regional water treatment plant consultants. Refer to Appendix X for a complete list of monitored waters and more information on Supporting monitored waters.

There were 69.6 stream miles (66.6 percent) and 843.9 freshwater acres (97 percent) monitored during this assessment period in the aquatic life category. There were 6.8 miles (6.5 percent) of Impaired waters in this category. There were also 1.3 stream miles (1.2 percent) Impaired for recreation in this subbasin.

1.3 Status and Recommendations of Previously and Newly Impaired Waters

The following waters were either identified as Impaired in the previous basin plan (2000) or are newly Impaired based on recent data. If previously identified as Impaired, the water will either remain on the state's 303(d) list or will be delisted based on recent data showing water quality improvements. If the water is newly Impaired, it will likely be placed on the 2006 303(d) list. The current status and recommendations for addressing these waters are presented below, and each is identified by an assessment unit number (AU#). Refer to the overview for more information on AUs. Information regarding 303(d) listing and reporting methodology is presented in Appendix VII.

1.3.1 Haw River [AU# 16-(1)a and b and d1]

2000 Recommendations
The 2000 basin plan recommended that no new discharges be permitted in these segments of the Haw River, and that further monitoring be done to determine the extent of agricultural impacts and to identify stressors to the biological community.

Current Status
The Haw River [16-(1)a] from the source to SR 2109 (7.8 miles) is Supporting aquatic life because no criteria were exceeded at site BA2 although dissolved oxygen was below 5 mg/l in 17 percent of samples collected during the assessment period. Previous benthic community ratings were Fair at this site, although a benthic community sample was not collected during the most recent assessment period due to high flows. This segment is Not Rated for recreation because fecal coliform bacteria screening criteria were exceeded at site BA2. The Oak Ridge Military Academy (NC0046043) had significant violations of the fecal coliform bacteria permit limits in the last two years of the assessment period as well. The discharge is into an unnamed tributary of the Haw River off NC 68. Oak Ridge Military Academy has had violations of other parameters in 2004 that were handled with notice of violations (NOV) and enforcement actions by DWQ.

The Haw River [16-(1)b] from SR 2109 to SR 2426 (12.5 miles) is Supporting aquatic life because of a Good fish community rating at site BF61. The site has regular high flows that have made sampling difficult at site BF61. In 2003, flow was too high and the water was too turbid to collect fish community samples. Dissolved oxygen was below 5 mg/l in 14 percent of samples at site BA3 about six miles downstream of BF61.

No new dischargers have been permitted into these two segments. The western portion of the watershed is currently experiencing rapid development from Greensboro and Kernersville. The Ag Sediment Initiative (Chapter 28) identified runoff from impervious surfaces and streambank erosion as stressors to the biological community in both segments.

The Haw River [16-(1)c] from SR 2426 to NC 87 (21.2 miles) is Supporting aquatic life because of a Good-Fair benthic community rating at site BB163 and a Good fish community rating at site BF61. Turbidity was above the standard in 7 percent of samples at site BA15.

The Haw River [16-(1)d1] from NC 87 to the subbasin boundary (1.3 miles) is Supporting aquatic life because no criteria were exceeded at site BA17. This segment is Impaired for recreation because the fecal coliform bacteria standard was violated at site BA17.

2005 Recommendations

DWQ will continue to monitor these segments of the Haw River and work with DSWC staff to further implement BMPs to reduce the impacts of development and agriculture in this watershed. Further recommendations to protect streams in urbanizing areas and to restore streams in existing urban areas are discussed in Chapter 31. The NPDES compliance process will continue to be used to address the significant permit violations noted above and any ongoing violations.

Segment 16-(1)a will remain on the 303(d) list due to an Impaired biological community from 1998 sampling. Segment 16-(1)b will be removed from the 303(d) list because of the improved biological community rating. Segment 16-(1)d1 will be added to the 303(d) list because it is Impaired for recreation. TMDLs (Chapter 35) will be developed for identified stressors within 8-13 years of listing.

Water Quality Initiatives

The Ag Sediment Initiative (Chapter 28) estimates that over $1.2 million is needed in this watershed to preserve 1,000 acres of farmland, repair 20,000 feet of streambank, and install BMPs on 525 acres of cropland. An urban conservationist is also recommended to help address impacts in this watershed associated with conversion of cropland to development.

In 1998, the Haw River Assembly received a $24,500 CWMTF grant to preserve four acres around the headwater springs of the Haw River. In 2002, the Piedmont Land Conservancy received a minigrant of $25,000 for pre-acquisition of 500 acres along the Haw River and Troublesome Creek. In 2001, the Haw River Assembly received a minigrant of $14,500 for pre-acquisition of six tracts in the headwaters of the Haw River. The NCEEP has also preserved 3,628 linear feet of stream in this watershed (See Chapter 34 for information on all projects).

1.3.2 Little Troublesome Creek [AU# 16-7a and b]

2000 Recommendations
The 2000 basin plan recommended that DWQ work on a detailed study of Little Troublesome Creek as part of the WARP project to assess the effects of nonpoint source runoff on the creek.

Current Status
Little Troublesome Creek [AU# 16-7a] from the source to the Reidsville WWTP (3.5 miles) is Not Rated for aquatic life because benthic community ratings could not be assigned at sites BB208, BB415 and BB86 because of the small size of the stream.

Little Troublesome Creek [AU# 16-7b] from Reidsville WWTP to the Haw River (5.1 miles) is Impaired for aquatic life because of Fair benthic community ratings at sites BB161 and BB400. The fish community at site BF63 improved from Poor to Good-Fair after the Reidsville WWTP discharge was moved to the Haw River in 1998. Turbidity also exceeded the water quality standard in 9 percent of samples at site BA14.

A WARP study completed in November 2002 identified toxicity, organic enrichment, and widespread habitat degradation from storm sewers and runoff as being stressors to the biological communities in both segments. An assessment made as part of the Little Troublesome Creek Local Watershed Plan (Chapter 34) indicated that 43 to 59 percent of the buffer had been disturbed in the upper watershed and greater than 10 percent was disturbed in the lower watershed. The assessment also concluded that sediment from agricultural land was not a problem in the watershed. The Ag Sediment Initiative (Chapter 28) identified runoff from impervious surfaces, urban development, unpaved roads, road construction, cropland erosion and streambank erosion as stressors to the biological community in both segments.

DWQ developed a fecal coliform bacteria TMDL (Chapter 35), approved by EPA in September 2002, that recommended a 40 percent reduction in fecal coliform bacteria loading to Little Troublesome Creek.

2005 Recommendations
DWQ will continue to work with all agencies and local governments involved in the Local Watershed Planning (Chapter 34) process to identify funding for and implementation of restoration, BMPs and preservation projects in the watershed. The City of Reidsville should develop measures to help protect Little Troublesome Creek from stormwater impacts and to reduce fecal coliform loading to the TMDL target of 40 percent.

Both segments of Little Troublesome Creek will remain on the 303(d) list. TMDLs (Chapter 35) will be developed for identified stressors within 8-13 years of listing.

Water Quality Initiatives
The Ag Sediment Initiative (Chapter 28) estimates that over $160,000 is needed in this watershed to install field borders on 74 acres of cropland, 34 acres of cropland conversion, and other BMPs to help improve water quality from agriculture areas in the watershed.

In 2001, the NCEEP initiated a Local Watershed Planning effort for Troublesome and Little Troublesome Creeks. The two watersheds present sharp contrasts: Troublesome Creek is

relatively large, predominantly rural, and includes the Reidsville Lake water supply reservoir; Little Troublesome Creek's watershed is much smaller, heavily urbanized in its headwater reaches, and includes a significant reach of mainstem that is characterized by impaired water quality and degraded aquatic habitat. The two major watershed management issues, therefore, relate to (1) protection/preservation of streams, riparian buffers and wetlands within the Troublesome Creek system – especially as encroaching development is rapidly spreading northward from Guilford County and Greensboro; and (2) opportunities for stream restoration and urban storm water BMP projects/retrofits in the greater Reidsville area within the Little Troublesome Creek watershed. Numerous watershed project opportunities have been identified within both these watersheds, and NCEEP staff are working with local resource professionals and landowners in an effort to begin design and construction on the priority sites. The Local Watershed Plan may be downloaded at:
http://www.nceep.net/services/lwps/Troublesome_Creek/troublesome.htm

1.3.3 Troublesome Creek [AU# 16-6-(0.3) and 16-6-(3)]

2000 Recommendations
The 2000 basin plan recommended that no new discharges be permitted in these two segments of Troublesome Creek and that further monitoring be done to determine the extent of agricultural impacts and to identify stressors to the biological community.

Current Status
Troublesome Creek [16-6-(0.3)] from the source to SR 2423 (16.4 miles) is Supporting aquatic life because of Good-Fair benthic community ratings at sites BB212, BB392, BB395 and BB396. A special study conducted in April 2002 found the benthic communities was slightly more degraded than the reference stream, but there were no indications of toxicity or nutrient impacts. There were indicators of low dissolved oxygen instream, although no ambient water quality data were collected in this segment. The sandy stream bottom is thought to be a natural condition in upper piedmont streams. Monroeton Elementary School (NC0036994) had significant violations of the biological oxygen demand permit limit in the last two years of the assessment period. The discharge was into an unnamed tributary of Troublesome Creek off SR 2422 just upstream of site BB396. This facility is no longer discharging and the permit has been rescinded.

Lake Reidsville [16-6-(0.7)], a 667.5-acre impoundment of Troublesome Creek, is Not Rated for aquatic life. Although dissolved oxygen, chlorophyll *a* and turbidity exceeded water quality standards during lakes monitoring, not enough samples were collected to assign a use support rating. Dissolved oxygen saturation was elevated, and nutrient levels were higher than in previous years as well.

Reidsville uses the reservoir as a water supply and has implemented a 100-foot buffer on the impoundment and 50-foot buffers on all tributaries. Reidsville should continue to protect the water supply by implementing BMPs where possible to reduce nutrient loading and turbidity in the watershed. DWQ will determine if increased monitoring efforts in this lake are warranted to better assess water quality.

Troublesome Creek [16-6-(3)] from dam at Reidsville Lake to the Haw River (1.8 miles) is Impaired for aquatic life because dissolved oxygen levels violated the standard in 13 percent of samples at site BA10 during the assessment period.

2005 Recommendations
DWQ will continue to monitor Troublesome Creek and work with DSWC staff to further implement BMPs to reduce the impacts of agriculture in this watershed. DWQ will investigate releases from the Reidsville Lake Dam to determine if the source of the low DO is from dam releases.

Segment 16-6-(0.3) will be removed from the 303(d) list because of the improved biological community rating. Segment 16-6-(3) will be added to the 303(d) list because of the dissolved oxygen standard violation. TMDLs (Chapter 35) will be developed for identified stressors within 8-13 years of listing.

Water Quality Initiatives
In 2002, the Piedmont Land Conservancy (Chapter 34) received a minigrant of $25,000 to pay for pre-acquisition of 500 acres along the Haw River and Troublesome Creek. NCEEP has initiated a local watershed planning effort that includes this watershed. The plan is discussed above with Little Troublesome Creek. NCEEP has purchased a 52-acre parcel of riparian wetlands in the Troublesome Creek watershed to aid in the preservation of water quality. The Local Watershed Plan may be downloaded at:
http://www.nceep.net/services/lwps/Troublesome_Creek/troublesome.htm

1.4 Status and Recommendations for Waters with Noted Impacts

The surface waters discussed in this section are not Impaired. However, notable water quality problems and concerns have been documented for these waters during this assessment. Attention and resources should be focused on these waters to prevent additional degradation and facilitate water quality improvements. DWQ will notify local agencies of these water quality concerns and work with them to conduct further assessments and to locate sources of water quality protection funding. Additionally, education on local water quality issues and voluntary actions are useful tools to prevent water quality problems and to promote restoration efforts. Nonpoint source program agency contacts are listed in Appendix X. Waters in the following section are identified by assessment unit number (AU#). See overview for more information on AU#s.

1.4.1 Mears Fork [AU# 16-3]

Current Status and 2005 Recommendations
Mears Fork from source to Haw River, was not assessed for use support determination. This stream is near high growth areas north of Greensboro. This stream as well tributaries may be adversely impacted by poor development practices. Further recommendations to protect streams in urbanizing areas and to restore streams in existing urban areas are discussed in Chapter 31.

Water Quality Initiatives
Mears Fork Conservation Plan. In 1999, the Haw River Assembly (Chapter 34) received a $200,000 CWMTF (Chapter 34) grant to acquire 46 acres of land and for landowner permanent conservation easements on another 60 acres in this watershed.

1.5 Additional Water Quality Issues within Subbasin 03-06-01

The following section discusses issues that may threaten water quality in the subbasin that are not specific to particular streams, lakes or reservoirs. The issues discussed may be related to waters near certain land use activities or within proximity to different pollution sources.

1.5.1 Jordan Haw River Watershed Nutrient Sensitive Waters Strategy

All land uses and discharges of wastewater and stormwater in subbasin 03-06-01 potentially contribute nutrients to Jordan Reservoir in subbasins 03-06-04 and 03-06-05. The reservoir is Impaired for aquatic life because chlorophyll *a* violated the standard in all segments of the reservoir. Refer to Chapter 36 for more information on this strategy.

Chapter 2
Cape Fear River Subbasin 03-06-02
Including: Haw River, Buffalo Creek, Reedy Fork Creek and Greensboro Reservoirs

2.1 Subbasin Overview

Subbasin 03-06-02 at a Glance

Land and Water Area

Total area:	562 mi²
Land area:	555 mi²
Water area:	7 mi²

Population Statistics

2000 Est. Pop.: 247,449 people
Pop. Density: 441 persons/mi²

Land Cover (percent)

Forest/Wetland:	58.9%
Surface Water:	2.5%
Urban:	8.5%
Cultivated Crop:	2.3%
Pasture/ Managed Herbaceous:	27.9%

Counties

Alamance, Caswell, Forsyth, Guilford and Orange

Municipalities

Burlington, Graham, Green Level, Greensboro, Haw River and Mebane

Subbasin 03-06-02 is an outer piedmont watershed characterized by highly erodible soils. Most of the watershed is forested or in agriculture, with increasing urban development that can have negative water quality impacts. Development is occurring along the I-85/40 corridor in Greensboro and Burlington. Population is expected to grow by 165,000 people in counties with portions or all of their areas in this subbasin by 2020.

There are 30 individual NPDES wastewater discharge permits in this subbasin with a permitted flow of 76.6 MGD (Figure 5). The largest are Burlington Eastside WWTP (12.0 MGD), Graham WWTP (3.5 MGD), Mebane WWTP (2.5 MGD), North Buffalo WWTP (16 MGD) and T.Z. Osborne WWTP (40 MGD). Refer to Appendix VI and Chapter 30 for more information on NPDES permit holders. Issues related to compliance with NPDES permit conditions are discussed below in Section 2.3 for Impaired waters.

In this subbasin, Burlington, Graham, Greensboro, Haw River and Mebane are required to develop stormwater programs (Chapter 31).

There is one registered swine operation, one registered cattle operation and five registered dairy operations in this subbasin. Issues related to agricultural activities are discussed below in Section 2.3 for Impaired waters.

There were 22 benthic macroinvertebrate community samples and 13 fish community samples (Figure 5 and Table 5) collected during this assessment period. Data were also collected from 34 ambient monitoring stations including four DWQ stations, nine UCFRBA (Appendix V) stations, four shared ambient stations, and 16 City of Greensboro (Appendix V) stations. Three DWQ bacterial special study stations were also sampled as well as six reservoirs. Refer to the *2003 Cape Fear River Basinwide Assessment Report* at http://www.esb.enr.state.nc.us/bar.html and Appendix IV for more information on monitoring.

Figure 5 Cape Fear River Subbasin 03-06-02

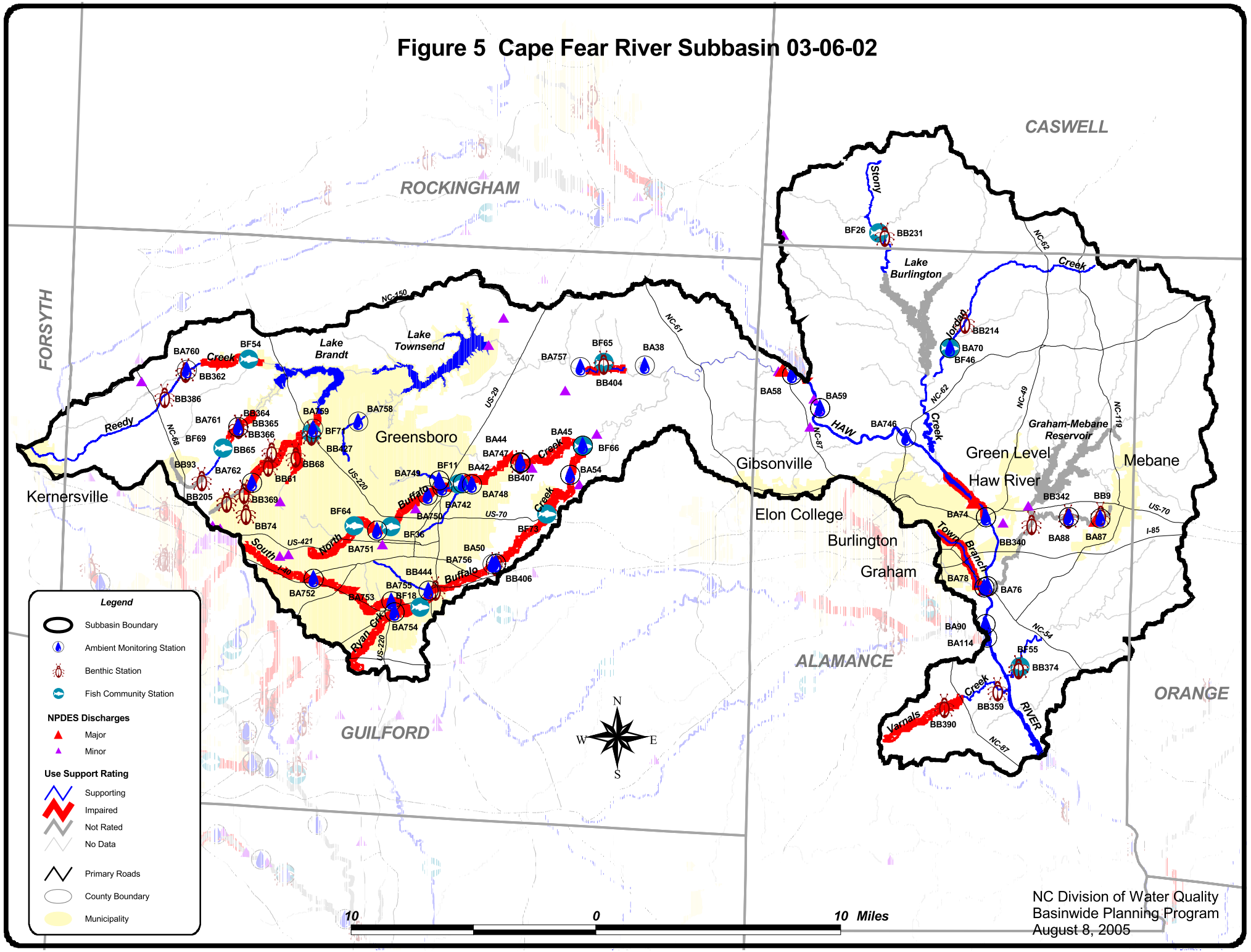


Table 5 CAPE FEAR Subbasin 03-06-02

AU Number	Classification	Length/Area	Description	Aquatic Life Assessment					Recreation Assessment			Stressors	Sources
				AL Rating	Station	Result	Year/ Parameter	% Exc	REC Rating	Station	Result		
Back Creek													
16-18-(6)	C NSW	6.2 FW Miles		**NR**					ND				
			From dam at Graham-Mebane Reservoir to Haw River		BB340	NR	'1999						
Back Creek (Graham-Mebane Reservoir)													
16-18-(1.5)	WS-II HQ	693.3 FW Acres		**NR**	BL7	NCE	Chlor a	33	ND			Chlorophyll a	Unknown
			From .3 mile upstream of NC Hwy 119 to dam at Graham-Mebane Res										
Blackwood Creek													
16-11-14-2-4	C NSW	5.6 FW Miles		**S**	BA755	NCE			**NR***	BA755	NCE	Fecal Coliform Bacteria	MS4 NPDES
			From source to Buffalo Creek										
Brush Creek													
16-11-4-(1)a1	WS-III NS	2.4 FW Miles		**NR**					ND				
			From source to UT at SR 2085		BB93	NR	'2003						
16-11-4-(1)a2	WS-III NS	1.8 FW Miles		**S**					ND				
			From UT at SR 2085 to UT 0.3 miles downstream fo SR 3820		BF69	G	'1999						
16-11-4-(1)a3	WS-III NS	1.6 FW Miles		**I**	BA761	NCE	Turbidity	10	**NR***	BA761	NCE	Fecal Coliform Bacteria	MS4 NPDES
			From UT 0.3 miles downstream of SR 3820 to a point 0.5 mile downstream of Guilford County SR 2190		BB364	F	'2003					Habitat Degradation	MS4 NPDES
												Turbidity	MS4 NPDES
Brush Creek(Lake Higgins)													
16-11-4-(2)	WS-III NS	79.2 FW Acres		**S**	BL4	NCE			ND				
			From a point 0.5 mile downstream of Guilford SR 2190 to Lake Brandt, Reedy Fork										
Haw Creek													
16-20-(4)	C NSW	3.8 FW Miles		**S**					ND				
			From N.C. Hwy. 54 to Haw River		BB374	GF	'2003						
					BB374	NR	'1999						
					BF55	G	'2003						

Table 5 CAPE FEAR Subbasin 03-06-02

AU Number / Description	Classification	Length/Area	Aquatic Life Assessment						Recreation Assessment			Stressors	Sources
			AL Rating	Station	Result	Year/ Parameter	% Exc		REC Rating	Station	Result		
HAW RIVER													
16-(1)d2	C NSW	10.1 FW Miles	**S**	BA59	NCE	Turbidity	9.8		**S**	BA59	NCE	Turbidity	Impervious Surfac
				BA59	NCE							Turbidity	MS4 NPDES
				BA746	NCE							Turbidity	Agriculture
From Subbasin 01/02 boundary to Service Creek													
16-(1)d3	C NSW	2.1 FW Miles	**S**	BA74	NCE	Turbidity	9.6		**I**	BA74	CE	Fecal Coliform Bacteria	Unknown
										BA74	NCE	Turbidity	Unknown
From Service Creek to a NC 49													
16-(1)e	C NSW	18.5 FW Miles	**S**	BA117	NCE				**NR***	BA118	NCE	Fecal Coliform Bacteria	Unknown
				BA118	NCE					BA76	NCE	Turbidity	Unknown
				BA76	NCE	Turbidity	9.8			BA90	NCE		
				BA90	NCE	Turbidity	7.3						
From NC 49 to a point 0.4 mile downstream of Cane Creek (South side of Haw River)				BB220	GF	2002							
				BB220	GF	1998							
Horsepen Creek													
16-11-5-(0.5)a	WS-III NS	1.8 FW Miles	**NR**						ND			Habitat Degradation	MS4 NPDES
From source to Ballinger Road				BB205	NR	2001							
				BB205	NR	2000							
				BB369	NR	2001							
				BB369	NR	2000							
16-11-5-(0.5)b	WS-III NS	3.2 FW Miles	**I**						**NR***	BA762	NCE	Fecal Coliform Bacteria	Unknown
From Ballinger Road to U.S. Hwy 220				BB61	P	2000						Habitat Degradation	MS4 NPDES
16-11-5-(2)	WS-III NS	1.8 FW Miles	**I**						**NR***	BA759	NCE	Fecal Coliform Bacteria	Unknown
From U.S. Hwy 220 to Lake Brandt, Reedy Fork				BB427	P	2003						Habitat Degradation	MS4 NPDES
				BB427	NR	2001							
				BB427	F	2000							
				BF71	GF	1999							

Table 5 CAPE FEAR Subbasin 03-06-02

AU Number / Description	Classification	Length/Area		Aquatic Life Assessment					Recreation Assessment			Stressors	Sources
				AL Rating	Station	Result	Parameter	Year/ % Exc	REC Rating	Station	Result		
Jordan Creek													
16-14-6-(0.5)	Ws-II HQW	10.6	FW Miles	**S**	BA70	NCE			**S**	BA70	NCE		
From source to a point 0.7 mile upstream of mouth					BB214	GF		'2003					
					BF46	GF		'2003					
Moadams Creek (Latham Lake)													
16-18-7	C NSW	4.6	FW Miles	**NR**	BA87	NCE			**NR***	BA87	NCE		
					BA88	NCE				BA88	NCE		
From source to Back Creek					BB342	NR		'1999					
					BB9	NR		'1999					
Muddy Creek													
16-11-14-1-3	C NSW	3.7	FW Miles	**S**	BA748	NCE			**NR***	BA748	NCE	Fecal Coliform Bacteria	Unknown
From source to North Buffalo Creek													
North Buffalo Creek													
16-11-14-1a1	C NSW	7.5	FW Miles	**I**					**NR***	BA750	NCE	Habitat Degradation	Unknown
										BA751	NCE		
From source to Philadelphia Lake					BF36	P		'1999					
					BF64	P		'1999					
16-11-14-1a2	C NSW	1.6	FW Miles	**S**					**I**	BA42	NCE	Fecal Coliform Bacteria	MS4 NPDES
										BA742	CE		
From Philadelphia Lake to North Buffalo Creek WWTP					BF11	P		'1999					
					BF11	GF		'2003					
16-11-14-1b	C NSW	8.1	FW Miles	**I**	BA44	NCE	Turbidity	7.4	**NR***	BA44	NCE	Habitat Degradation	MS4 NPDES
					BA45	NCE				BA45	NCE	Fecal Coliform Bacteria	MS4 NPDES
										BA747	NCE	Turbidity	MS4 NPDES
From North Buffalo Creek WWTP to Buffalo Creek					BB407	P		'2003					
Philadelphia Lake (Buffalo lake, and White Oak Lake)													
16-11-14-1-2b	C NSW	18.0	FW Acres	**S**	BA749	NCE	Turbidity	10	**NR***	BA749	NCE	Fecal Coliform Bacteria	MS4 NPDES
White Oak Lake												Turbidity	MS4 NPDES

Table 5 CAPE FEAR Subbasin 03-06-02

AU Number / Description	Classification	Length/Area		Aquatic Life Assessment					Recreation Assessment			Stressors	Sources
				AL Rating	Station	Result	Year/ Parameter	% Exc	REC Rating	Station	Result		
Reedy Creek													
16-11-(1)a	WS-III NS	8.1	FW Miles	S	BA760	NCE			S	BA760	NCE	Habitat Degradation	Impervious Surfac
From source to UT 0.7 miles downstream of SR 2128					BB362	GF	2003						
					BB362	G	2001						
					BB386	GF	2003						
16-11-(1)b	WS-III NS	4.2	FW Miles	I					ND			Habitat Degradation	Impervious Surfac
From SR 2128 to a point 0.4 mile downstream of Moores Creek					BF54	F	1999						
Reedy Fork (Hardys Mill Pond)													
16-11-(9)a1	C NSW	6.7	FW Miles	S	BA757	NCE			S	BA757	NCE		
From Lake Townsend Dam to UT at SR 2782													
16-11-(9)a2	C NSW	2.2	FW Miles	I					ND				
From UT at SR 2782 to UT at SR 2778					BB404	F	2003						
					BF65	G	2003						
16-11-(9)a3	C NSW	3.0	FW Miles	S	BA38	NCE			S	BA38	NCE		
From Ut at SR 2778 to Buffalo Creek													
16-11-(9)b	C NSW	8.6	FW Miles	S	BA58	NCE			I	BA58	CE	Fecal Coliform Bacteria	Unknown
										BA58	NCE		
From Buffalo Creek to Haw River													
Reedy Fork(including Lake Brandt and Lake Townsend below nor													
16-11-(3.5)a	WS-III NS	760.0	FW Acres	S	BL2	NCE			ND				
Lake Brandt													
16-11-(3.5)b	WS-III NS	1,404.7	FW Acres	S	BL3	NCE			ND				
Lake Townsend													
Richland Creek (Richland Lake)													
16-11-7-(1)a	WS-III NS	3.1	FW Miles	S	BA758	NCE			NR*	BA758	NCE	Fecal Coliform Bacteria	Unknown
From source to backwaters of Richland Lake													
Ryan Creek													
16-11-14-2-3	C NSW	4.2	FW Miles	I	BA754	CE	Turbidity	14	NR*	BA754	NCE	Fecal Coliform Bacteria	MS4 NPDES
From source to South Buffalo Creek												Turbidity	MS4 NPDES

Table 5 CAPE FEAR Subbasin 03-06-02

AU Number	Classification	Length/Area	Aquatic Life Assessment						Recreation Assessment				
Description			AL Rating	Station	Result	Year/ Parameter	% Exc		REC Rating	Station	Result	Stressors	Sources
South Buffalo Creek													
16-11-14-2a	C NSW	15.4 FW Miles	I	BA50	NCE	Turbidity	7.3		NR*	BA50	NCE	Habitat Degradation	MS4 NPDES
				BA752	CE	Turbidity	14			BA752	NCE	Fecal Coliform Bacteria	MS4 NPDES
				BA756	NCE					BA753	NCE	Turbidity	MS4 NPDES
From source to McConnell Rd				BB406	P	2003							
16-11-14-2b	C NSW	4.7 FW Miles	I						ND			Habitat Degradation	MS4 NPDES
From McConnell Rd to US 70				BF73	P	2003							
16-11-14-2c	C NSW	4.8 FW Miles	I	BA54	CE	Turbidity	10.5		ND	BA54	NCE	Turbidity	MS4 NPDES
From US 70 to Buffalo Creek													
Stony Creek (Lake Burlington)													
16-14-(1)a	Ws-II HQW	4.3 FW Miles	S						ND			Habitat Degradation	
From source to Benton Branch				BF26	GF	2003							
16-14-(1)b	Ws-II HQW	2.7 FW Miles	S						ND			Habitat Degradation	
From Benton Branch to backwaters of Lake Burlington				BB231	GF	2003							
16-14-(1)c	Ws-II HQW	738.0 FW Acres	NR	BL5	NCE	Chlor a	33		ND			Chlorophyll a	Agriculture
Lake Burlington													
Stony Creek (Stony Creek Reservoir)													
16-14-(5.5)	WS-II HQ	118.0 FW Acres	S	BL6	NCE				ND				
From Buttermilk Creek to dam at Stony Creek Reservoir													
Town Branch													
16-17	C NSW	4.2 FW Miles	S	BA78	NCE				I	BA78	NCE	Fecal Coliform Bacteria	MS4 NPDES
										BA78	CE		
From source to Haw River													
Unnamed Tributary at Guilford College													
16-11-5-1-(2)	WS-III NS	1.3 FW Miles	I						ND				
From dam at Guilford College bathing lake to Horsepen Creek				BB68	P	2001							

Table 5 CAPE FEAR Subbasin 03-06-02

AU Number	Classification	Length/Area	Description	Aquatic Life Assessment					Recreation Assessment				
				AL Rating	Station	Result	Year/ Parameter	% Exc	REC Rating	Station	Result	Stressors	Sources
Varnals Creek													
16-21a	C NSW	4.6 FW Miles		I					ND				
	From source to Rock Creek				BB390	F	2000						
16-21b	C NSW	2.8 FW Miles		S					ND				
	From Rock Creek to Haw River				BB359	G	2000						

AL - Aquatic Life	BF - Fish Community Survey	E - Excellent	S - Supporting, I - Impaired
REC - Recreation	BB - Benthic Community Survey	G - Good	NR - Not Rated
	BA - Ambient Monitoring Site	GF - Good-Fair	NR*- Not Rated for Recreation (screening criteria exceeded)
	BL- Lake Monitoring	F - Fair	ND-No Data Collected to make assessment
	S- DEH RECMON	P - Poor	**Results**
		NI - Not Impaired	CE-Criteria Exceeded > 10% and more than 10 samples
	Miles/Acres	S- Severe Stress	NCE-No Criteria Exceeded
	FW- Fresh Water	M-Moderate Stress	
	S- Salt Water	N- Natural	

Aquatic Life Rating Summary

S	m	101.3	FW Miles
NR	m	15.0	FW Miles
I	m	63.5	FW Miles
S	m	2,379.9	FW Acres
NR	m	1,431.3	FW Acres
ND		213.4	FW Miles
ND		498.0	FW Acres

Recreation Rating Summary

S	m	38.5	FW Miles
NR*	m	77.2	FW Miles
I	m	16.5	FW Miles
NR*	m	18.0	FW Acres
ND		261.0	FW Miles
ND		4,291.2	FW Acres

Fish Consumption Rating Summary

I	e	393.2	FW Miles
I	e	4,309.2	FW Acres

Waters in the following sections are identified by assessment unit number (AU#). This number is used to track defined segments in the water quality assessment database, 303(d) Impaired waters list and the various tables in this basin plan. The assessment unit number is a subset of the DWQ index number (classification identification number). A letter attached to the end of the AU# indicates that the assessment is smaller than the DWQ index segment. No letter indicates that the assessment unit and the DWQ index segment are the same.

2.2 Use Support Assessment Summary

Use support ratings were assigned for waters in subbasin 03-06-02 in the aquatic life, recreation, fish consumption and water supply categories. All waters are Impaired on an evaluated basis in the fish consumption category because of fish consumption advice that applies to the entire basin. In the water supply category, all WS classified waters (4,201.1 acres and 182.3 miles) are Supporting on an evaluated basis based on reports from DEH regional water treatment plant consultants. Refer to Appendix X for a complete list of monitored waters and more information on Supporting monitored waters.

There were 179.8 stream miles (45.7 percent) and 3,811.2 freshwater acres (88.4 percent) monitored during this assessment period in the aquatic life category. There were 63.5 miles (16.2 percent) of Impaired waters in this category. There were also 16.5 stream miles (4.2 percent) Impaired for recreation in this subbasin.

2.3 Status and Recommendations of Previously and Newly Impaired Waters

The following waters were either identified as Impaired in the previous basin plan (2000) or are newly Impaired based on recent data. If previously identified as Impaired, the water will either remain on the state's 303(d) list or will be delisted based on recent data showing water quality improvements. If the water is newly Impaired, it will likely be placed on the 2006 303(d) list. The current status and recommendations for addressing these waters are presented below, and each is identified by an assessment unit number (AU#). Refer to the overview for more information on AUs. Information regarding 303(d) listing and reporting methodology is presented in Appendix VII.

2.3.1 Brush Creek [AU# 16-11-4-(1)a1, a2 and a3]

2000 Recommendations
The 2000 basin plan recommended that Brush Creek be resampled and that DWQ work with the City of Greensboro to improve water quality where possible.

Current Status
Brush Creek [16-11-4-(1)a1] from source to SR 2085 (2.4 miles) is Not Rated for aquatic life because a benthic community rating could not be assigned at site BB93 because of the small size of the stream.

Brush Creek [16-11-4-(1)a2] from SR 2085 to 0.3 miles downstream of SR 3820 (1.8 miles) is Supporting aquatic life because of a Good fish community rating at site BF69.

Brush Creek [16-11-4-(1)a3] from SR 3820 to 0.5 miles downstream of SR 2190 (1.6 miles) is Impaired for aquatic life because of a Fair benthic community rating at site BB364. Turbidity also exceeded the water quality standard in 10 percent of samples at site BA761. This segment is Not Rated for recreation because fecal coliform bacteria screening criteria were exceeded at site BA761.

The Brush Creek watershed drains large impervious areas from the Piedmont Triad International Airport as well as residential areas west of the airport. Road construction along the I-85 corridor has also impacted water quality in Brush Creek. DWQ staff noted several storm sewers draining directly into the creek and evidence of very high storm flows. There is no riparian area on Brush Creek as it flows through a golf course. A stressor survey conducted in 2003 found habitat degradation caused by modified watershed hydrology resulting in streambank erosion and sedimentation continues to stress the benthic community in Brush Creek.

2005 Recommendations
DWQ will continue to monitor water quality in the Brush Creek watershed. DWQ recommends that the City of Greensboro (Appendix V) continue to monitor water quality at site BA761 and submit these data to DWQ. Construction of the FEDEX project should use and maintain BMPs to minimize further disturbance to the Brush Creek watershed. DWQ will determine if intensive sampling is needed to assess the fecal coliform bacteria standard in this creek (Appendix X). Further recommendations to protect streams in urbanizing areas and to restore streams in existing urban areas are discussed in Chapter 31.

Segments 16-11-4-(1)a1 and a3 will remain on the 303(d) list of Impaired waters. Segment 16-11-4-(1)a2 will be removed from the 303(d) list because of the Good fish community rating. TMDLs (Chapter 35) will be developed for identified stressors within 8-13 years of listing.

2.3.2 Haw River [AU# 16-(1)d2, d3 and e]

2000 Recommendations
The 2000 basin plan recommended that a TMDL be developed for turbidity and fecal coliform bacteria in this segment of the Haw River. The plan also noted that improvements to the Buffalo/Reedy Fork watersheds were also needed.

Current Status
The Haw River [16-(1)d2] from the subbasin boundary to Service Creek (10.1 miles) is Supporting aquatic life because no criteria were exceeded at sites BA59 and BA746, although turbidity exceeded the standard in 9.8 percent of samples collected at site BA59. The fecal coliform bacteria screening criteria were exceeded during the assessment period, but bacteria levels were below the standard during resamples the following summer at sites BA59 and BA746. This segment is Supporting recreation.

The Haw River [16-(1)d3] from Service Creek to NC 49 (2.1 miles) is Impaired for recreation because the fecal coliform bacteria standard was violated at site BA74. Although this segment is Supporting aquatic life, the turbidity standard was exceeded in 10 percent of samples collected at site BA74. Turbidity violated the standard in two storm events monitored by DWQ.

A TMDL, completed in 2004 and approved in January 2005, recommended a 61 percent reduction in Total Suspended Solids and a 77 percent reduction in fecal coliform bacteria from both point and nonpoint sources to meet the turbidity and fecal coliform bacteria standards in these two segments of the Haw River (Chapter 35).

The Haw River [16-(1)e] from NC 49 to Cane Creek (18.5 miles) is Supporting aquatic life because of a Good-Fair benthic community rating at site BB220; however, the turbidity standard was exceeded in 7 and 10 percent of samples collected at site BA76 and BA90. This segment is Not Rated for recreation because the fecal coliform bacteria screening criteria were exceeded at sites BA76, BA90 and BA118.

2005 Recommendations

DWQ will work with nonpoint source agencies and local governments to identify funding sources and BMP opportunities to implement reductions in TSS and fecal coliform bacteria as recommended in the TMDL. DWQ will continue to monitor the Haw River.

Segment 16-(1)d2 will be removed from the 303(d) list of Impaired waters because the fecal coliform bacteria and turbidity standards were not violated. Segment 16-(1)d3 will remain on the 303(d) until water quality standards for fecal coliform bacteria are met, although turbidity will be removed as a cause of impairment based on data from site BA74. TMDLs (Chapter 35) will be developed for identified stressors within 8-13 years of listing.

Water Quality Initiatives

The Ag Sediment initiative estimates that $650,000 is needed to install field agriculture BMPs and livestock exclusion to reduce agriculture loading of turbidity and fecal coliform bacteria to this segment of the Haw River. The survey also noted urban development, impervious surfaces, and streambank erosion in addition to agriculture as sources of sediment.

In 1999, Graham received a $20,000 CWMTF (Chapter 34) grant to study the feasibility of a greenway between I-85 and NC 54 along the Haw River [16-(1)e]. In 2001, Graham received a $140,000 CWMTF grant to purchase 22 acres along the Haw River as part of the greenway system. In 2001, Piedmont Triad COG (Chapter 34) received a $65,000 CWMTF grant to develop a riparian corridor plan targeting 214 parcels along the Haw River.

2.3.3 Horsepen Creek [AU# 16-11-5-(0.5)a and b and 16-11-5-(2)] and Unnamed Tributary at Guilford College [AU#16-11-5-1-(2)]

2000 Recommendations

The 2000 basinwide plan recommended that Horsepen Creek be resampled and that DWQ work with the City of Greensboro to improve water quality where possible. DWQ, with the CWMTF, conducted a detailed study of the watershed as part of WARP project to identify stressors and recommend solutions to water quality problems.

Current Status

Horsepen Creek [16-11-5-(0.5)a] from source to Ballinger Road (1.8 miles) is Not Rated for aquatic life because benthic community ratings could not be assigned at sites BB369 and BB205. Amoco Greensboro Terminal (NC0003671) had significant violations of phenolics permit limits

during the last two years of the assessment period. The problem has been remedied and there were no violations in 2004.

The unnamed tributary [16-11-5-1-(2)] from dam at Guilford College Bathing Lake to Horsepen Creek (1.3 miles) is Impaired for aquatic life because of a Poor benthic community rating at site BB68.

Horsepen Creek [16-11-5-(0.5)b] from Ballinger Road to US 220 (3.2 miles) is currently Impaired for aquatic life because of a Poor benthic community rating at site BB61. This segment is Not Rated for recreation because fecal coliform bacteria screening criteria were exceeded at site BA762.

Horsepen Creek [16-11-5-(2)] from US 220 to Lake Brandt (1.8 miles) is currently Impaired for aquatic life because of Poor and Fair benthic community ratings at site BB427. This segment is Not Rated for recreation because fecal coliform bacteria screening criteria were exceeded at site BA759.

A WARP study was completed in December 2002 in the Horsepen Creek watershed. The study identified potential toxicity, organic enrichment and habitat degradation from scour, channel modification, culverting and impervious surface runoff as stressors to the benthic community. To view the entire report and recommendations to restore water quality in the Horsepen Creek watershed visit http://h2o.enr.state.nc.us/swpu/.

2005 Recommendations

DWQ will work with nonpoint source agencies and the City of Greensboro Stormwater Program to identify funding sources for restoration projects and BMP implementation recommended in the WARP study. DWQ recommends that the City of Greensboro (Appendix V) continue to monitor water quality at sites BA762 and BA759 on Horsepen Creek and submit these data to DWQ. DWQ will determine if intensive sampling is needed to assess the fecal coliform bacteria standard in this creek (Appendix X). Further recommendations to protect streams in urbanizing areas and to restore streams in existing urban areas are discussed in Chapter 31.

All three segments of Horsepen Creek will remain on the 303(d) list of Impaired waters and the Unnamed Tributary at Guilford College Bathing Lake will be added to the 303(d) list. TMDLs (Chapter 35) will be developed for identified stressors within 8-13 years of listing.

Water Quality Initiatives

In 2000, Greensboro received a $6,000 Section 319 grant (Chapter 34) to convert two retention ponds to bioretention BMPs as part of an urban BMP demonstration project. The bioretention BMPs are located on Downwind Road and Terrault Drive. The NCEEP completed 1.77 acres of riverine restoration in this watershed (Chapter 34).

2.3.4 North Buffalo Creek [AU# 16-11-14-1a1, a2 and 1b]

2000 Recommendations
The 2000 basin plan recommended that North Buffalo Creek be resampled and that TMDLs be developed for identified stressors. DWQ also recommended that no new discharges be permitted to North Buffalo Creek and that Cone Mills connect to the Greensboro Metro WWTP as soon as possible.

Current Status
North Buffalo Creek [16-11-14-1a1] from source to Philadelphia Lake (7.5 miles) is Impaired for aquatic life because of Poor fish community ratings at sites BF36 and BF64. This segment is Not Rated for recreation because fecal coliform bacteria screening criteria were exceeded at sites BA751 and BA750.

North Buffalo Creek [16-11-14-1a2] from Philadelphia Lake to North Buffalo WWTP (1.6 miles) is Supporting for aquatic life because of a Good-Fair fish community rating at site BF11. The fish community rating improved after the Cone Mills discharge was removed and connected to the Metro WWTP on South Buffalo Creek in January 2001. This segment is Impaired for recreation because the fecal coliform bacteria standard was violated at site BA742. Fecal coliform bacteria screening criteria were also exceeded at site BA42.

North Buffalo Creek [16-11-14-1b] from North Buffalo WWTP to Buffalo Creek (8.1 miles) is Impaired for aquatic life because of a Poor fish community rating at sites BF66 and a Poor benthic community rating at site BB407. Prolific algal growths were noted at site BB407. Turbidity also exceeded the water quality standard in 7 percent of samples collected at site BA44. The North Buffalo Creek WWTP (NC0024325) had significant violations of the cyanide permit limits and three whole effluent toxicity test failures during the last two years of the assessment period. The facility is conducting a cyanide study to determine the source of the violations. The smell of treated effluent has been noted at site BF66, 8.5 miles downstream of the WWTP. There have been odor problems reported and sanitary sewer overflows in the watershed as well. This segment is Not Rated for recreation because fecal coliform screening criteria were exceeded at sites BA747, BA44 and BA45.

A fecal coliform bacteria TMDL was completed for North Buffalo Creek in 2004. The Piedmont-Triad COG and partners completed a fecal coliform bacteria source-tracking project to assist in TMDL development. The TMDL recommended reductions of 60 to 100 percent depending on the source and climatic conditions. Exfiltrating sewers, sanitary sewer overflows, pets and illicit discharges were identified as sources of fecal coliform bacteria.

2005 Recommendations
DWQ recommends that the reductions called for in the TMDL be implemented by the various sources to reduce fecal coliform bacteria loading to North Buffalo Creek. The NPDES compliance process will be used to address the significant permit violations noted above. DWQ recommends that the City of Greensboro (Appendix V) continue to monitor water quality at sites on North Buffalo Creek and submit these data to DWQ. These data will be helpful in measuring the success of TMDL implementation. DWQ will continue to monitor North Buffalo Creek to identify stressors to the biological community. Further recommendations to protect streams in urbanizing areas and to restore streams in existing urban areas are discussed in Chapter 31.

Segments 16-11-14-1a1 and 1b will remain on the 303(d) list of Impaired waters. Segment 16-11-14-1a2 may be removed from the list, although any restoration efforts or TMDLs for stressors to the biological community will target the entire watershed. This segment will remain on the 303(d) list for the recreation impairment. TMDLs (Chapter 35) will be developed for identified stressors within 8-13 years of listing.

Water Quality Initiatives
The City of Greensboro is pursuing funding to rehabilitate the wastewater collection system to reduce exfiltration and sanitary sewer overflows.

2.3.5 Reedy Creek [AU# 16-11-(1)a and b]

Current Status
Reedy Creek was Fully Supporting in the 2000 basin plan and no recommendations were made. Reedy Creek [16-11-(1)b] from SR 2128 to 0.4 miles downstream of Moores Creek (4.2 miles) is Impaired for aquatic life because of a Fair fish community rating at site BF54. Habitat degradation was noted by eroding streambanks and few pools and riffles.

2005 Recommendations
DWQ will continue to monitor this segment of Reedy Creek to identify stressors to the fish community. This portion of the watershed could experience growth in the next few years. Every effort should be made to minimize impacts to Reedy Creek. Further recommendations to protect streams in urbanizing areas and to restore streams in existing urban areas are discussed in Chapter 31.

This segment of Reedy Creek will be added to the 303(d) list of Impaired waters. TMDLs (Chapter 35) will be developed for identified stressors within 8-13 years of listing.

2.3.6 Reedy Fork (Hardys Mill Pond) [AU# 16-11-(9)a1, a2, a3 and b]

2000 Recommendations
The 2000 basin plan recommended that DWQ work with Greensboro to reduce impacts to Reedy Fork. Reedy Fork [16-11-(9)b] was Partially Supporting in the 2000 plan.

Current Status
Reedy Fork [16-11-(9)a1] from Lake Townsend Dam to UT at SR 2782 (6.7 miles) is Supporting recreation because no criteria were exceeded at site BA757. Although Autumn Forest Manufactured Homes (NC0022691) had significant violations of fecal coliform bacteria permit limits during the last two years of the assessment period, the facility had no violations of bacteria limits in 2004. This segment is Supporting aquatic life because no criteria were exceeded at site BA757, although Lake Townsend WTP (NC0081617) had significant violations of solids permit limits.

Reedy Fork [16-11-(9)a2] from the UT at SR 2782 to SR 2778 (2.2 miles) is Impaired for aquatic life because of a Fair benthic community rating at site BB404. The benthic community may have been adversely impacted by low dissolved oxygen releases from Lake Townsend dam during drought conditions. Northeast Middle and Senior High School (NC0038156) discharges into an unnamed tributary in this segment and had significant violations of ammonia permit

limits during the last two years of the assessment period as well. The schools are under a special order of consent (SOC# S91039) that expires in June 2005. The schools are expected to be connected to the City of Greensboro collection system and cease discharging by March 2005. Segment 16-11-(9)a3 is Supporting aquatic life because no criteria were exceeded at site BA38.

Reedy Fork [16-11-(9)b] from Buffalo Creek to the Haw River (8.6 miles) is Impaired for recreation because the fecal coliform bacteria standard was violated at site BA58. This segment is Supporting aquatic life because no criteria were exceeded at site BA58.

2005 Recommendations
DWQ will continue to monitor this segment of Reedy Fork to identify stressors to the fish community. This portion of the watershed could experience growth in the next few years. Every effort should be made to minimize impacts to Reedy Fork. Flow conditions should be maintained below Lake Townsend to minimize adverse impacts to the downstream benthic community (Chapter 32). DWQ recommends that the City of Greensboro (Appendix V) continue to monitor water quality at sites on Reedy Fork. The NPDES compliance process will be used to address the significant permit violations noted above. Further recommendations to protect streams in urbanizing areas and to restore streams in existing urban areas are discussed in Chapter 31.

Segments 16-11-(9)a2 will be added to the 303(d) list of Impaired waters and 16-11-(9)b will remain on the list because of the recreation impairment and because of past biological impairment. TMDLs (Chapter 35) will be developed for identified stressors within 8-13 years of listing.

2.3.7 Ryan Creek [AU # 16-11-14-2-3]

Current Status
Ryan Creek was Not Rated in the 2000 basin plan; however, Ryan Creek [16-11-14-2-3] from source to South Buffalo Creek (4.2 miles) is currently Impaired for aquatic life because the turbidity standard was violated at site BA754 in 14 percent of samples. Ryan Creek is Not Rated for recreation because fecal coliform bacteria screening criteria were exceeded at site BA754.

2005 Recommendations
DWQ recommends that the City of Greensboro (Appendix V) continue to monitor water quality in Ryan Creek and submit these data to DWQ. DWQ will determine if intensive sampling is needed to assess the fecal coliform bacteria standard in this creek (Appendix X). Further recommendations to protect streams in urbanizing areas and to restore streams in existing urban areas are discussed in Chapter 31.

Ryan Creek will be added to the 303(d) list of Impaired waters because of the turbidity violations. TMDLs (Chapter 35) will be developed for identified stressors within 8-13 years of listing.

2.3.8 South Buffalo Creek [AU# 16-11-14-2a, b and c]

2000 Recommendations
The 2000 basin plan recommended that South Buffalo Creek be resampled and that TMDLs be developed for identified stressors, and that the City of Greensboro stormwater program work to improve water quality in this creek.

Current Status
South Buffalo Creek [all segments] from source to Buffalo Creek (24.9 miles) is Impaired for aquatic life because the turbidity standard was violated in 14 and 11 percent of samples at sites BA752 and BA54, Fair and Poor benthic community ratings at sites BB444 and BB406, and Fair and Poor fish community ratings at sites BF18 and BF73. The stream is filled with debris and has undercut banks. Periphyton covered rocks at the site below the Metro WWTP. The Metro WWTP (NC0047384) also had significant violations of cyanide permit limits, which could have adversely impacted aquatic life in the creek. The facility is conducting a cyanide study to determine the source of the violations. South Buffalo Creek is Not Rated for recreation because fecal coliform bacteria screening criteria were exceeded at sites BA50, BA752 and BA753.

2005 Recommendations
DWQ recommends that the City of Greensboro (Appendix V) continue to monitor water quality on South Buffalo Creek and submit these data to DWQ. DWQ will continue to work with the City of Greensboro to identify measures that can be used to reduce stormwater impacts to the creek. The NPDES compliance process will be used to address the significant permit violations noted above. DWQ will determine if intensive sampling is needed to assess the fecal coliform bacteria standard in this creek (Appendix X). Further recommendations to protect streams in urbanizing areas and to restore streams in existing urban areas are discussed in Chapter 31.

All three segments will remain on the 303(d) list of Impaired waters. TMDLs (Chapter 35) will be developed for identified stressors within 8-13 years of listing.

Water Quality Initiatives
In 1997, Greensboro received a $800,000 CWMTF (Chapter 34) grant to acquire 40 acres to construct a stormwater wetland along South Buffalo Creek. In 2002, Greensboro received a $570,000 CWMTF grant to construct a 20-acre stormwater wetland along South Buffalo Creek treating runoff from 13 square miles of urban land.

NCEEP has completed 1,752 linear feet of stream restoration in Benbow Park, 2,748 linear feet in Brown Park, 5,963 linear feet in Hillsdale Park and 1,776 linear feet in Price Park. Also completed were 5,963 linear feet of stream restoration and 1,200 linear feet of stream enhancement at Gillespie Golf Course (Chapter 34).

2.3.9 Town Branch [AU# 16-17]

2000 Recommendations
Town Branch was Impaired in the 1996 basin plan, but limited sampling resulted in a Not Rated status in the 2000 basin plan. The 2000 plan recommended that Town Branch be resampled.

Current Status
Town Branch from source to the Haw River (4.2 miles) is Impaired for recreation because the fecal coliform bacteria standard was violated at site BA78. The stream is Supporting aquatic life because no criteria were exceeded at site BA78.

A TMDL for fecal coliform bacteria was approved for Town Branch in September 2002. The TMDL called for 70 percent reduction in bacteria loading from urban areas in Burlington and Graham. The TMDL also indicated leaking sewer systems, sanitary sewer overflows and failing septic systems in the lower portion of the watershed as a source of bacteria.

2005 Recommendations
DWQ will continue to monitor Town Branch. DWQ recommends that Burlington and Graham reduce fecal coliform bacteria loading as called for in the TMDL. It is also recommended that Graham annex homes in the lower portion of the watershed and connect them to municipal sewer system. The towns should also pursue funding to upgrade the wastewater collection system to reduce leaking lines and sanitary sewer overflows. DWQ will determine if intensive sampling is needed to assess the fecal coliform bacteria standard in this creek (Appendix X). Further recommendations to protect streams in urbanizing areas and to restore streams in existing urban areas are discussed in Chapter 31.

This segment will remain on the 303(d) list of Impaired waters. TMDLs (Chapter 35) will be developed for identified stressors other than fecal coliform bacteria within 8-13 years of listing.

2.3.10 Varnals Creek [AU#16-21a and b]

Current Status
Varnals Creek was Fully Supporting in the 2000 basin plan; however, Varnals Creek [16-21a] from source to Rock Creek (4.6 miles) is currently Impaired for aquatic life because of a Fair benthic community rating at site BB390. Varnals Creek was studied in 2000 to determine if it would qualify for a supplemental HQW classification. Because of the Impaired benthic community, the creek did not qualify for the HQW classification.

Varnals Creek [16-21b] from Rock Creek to the Haw River (2.8 miles) is Supporting based on a Good benthic community rating at site BB359.

2005 Recommendations
DWQ will continue to monitor Varnals Creek to identify stressors to the biological community in the upper watershed. This watershed is predominately agriculture and DWQ will work with DSWC staff to further implement BMPs to reduce the impacts of agriculture in this watershed.

This segment will be added to the 303(d) list of Impaired waters. TMDLs (Chapter 35) will be developed for identified stressors within 8-13 years of listing.

2.4 Status and Recommendations for Waters with Noted Impacts

The surface waters discussed in this section are not Impaired. However, notable water quality problems and concerns have been documented for some waters based on this assessment. While

these waters are not Impaired, attention and resources should be focused on these waters to prevent additional degradation or facilitate water quality improvement. Waters in the following section are identified by assessment unit number (AU#). See overview for more information on AU#s.

2.4.1 Back Creek (Graham-Mebane Reservoir) [AU# 16-18-(1.5)]

Current Status and 2005 Recommendations
Graham Mebane Reservoir (693.3 acres) is Not Rated for aquatic life because 33 percent of chlorophyll *a* samples exceeded the water quality criterion; however, not enough samples were collected to assign a use support rating. Nutrient levels in the reservoir were higher than in previous years and nuisance algal blooms were present in summer months. DWQ will determine if increased monitoring efforts in this lake are warranted to better assess water quality.

2.4.2 Blackwood Creek [AU# 16-11-14-2-4]

Current Status and 2005 Recommendations
Blackwood Creek from source to Buffalo Creek (5.6 miles) is Not Rated for recreation because the fecal coliform bacteria screening criteria were exceeded at site BA755. DWQ recommends that the City of Greensboro (Appendix V) continue to monitor water quality at sites in Blackwood Creek. DWQ will determine if intensive sampling is needed to assess the fecal coliform bacteria standard in this creek (Appendix X).

2.4.3 MoAdams Creek (Latham Lake) [AU# 16-18-7]

Current Status and 2005 Recommendations
MoAdams Creek from source to Back Creek (4.6 miles) is Not Rated for recreation because the fecal coliform bacteria screening criteria were exceeded at sites BA87 and BA88. DWQ will determine if intensive sampling is needed to assess the fecal coliform bacteria standard in this creek (Appendix X).

2.4.4 Muddy Creek [AU# 16-11-14-1-3]

Current Status and 2005 Recommendations
Muddy Creek from source to North Buffalo Creek (3.7 miles) is Not Rated for recreation because the fecal coliform bacteria screening criteria were exceeded at sites BA748. DWQ recommends that the City of Greensboro (Appendix V) continue to monitor water quality at sites in Muddy Creek. DWQ will determine if intensive sampling is needed to assess the fecal coliform bacteria standard in this creek (Appendix methods).

2.4.5 Philadelphia Lake (Buffalo Lake and White Oak Lake) [AU# 16-11-14-1-2b]

Current Status and 2005 Recommendations
Philadelphia Lake (18 acres) is Not Rated for recreation because the fecal coliform bacteria screening criteria were exceeded at site BA749. Turbidity also exceeded the standard in 10 percent of samples at site BA749. DWQ recommends that the City of Greensboro (Appendix V) continue to monitor water quality at sites in Philadelphia Lake. DWQ will determine if intensive sampling is needed to assess the fecal coliform bacteria standard in this lake (Appendix X).

2.4.6 Richland Creek [AU# 16-11-7-(1)a]

Current Status and 2005 Recommendations
Richland Creek from source to Richland Lake (3.1 miles) is Not Rated for recreation because the fecal coliform bacteria screening criteria were exceeded at sites BA758. DWQ recommends that the City of Greensboro (Appendix V) continue to monitor water quality at sites in Philadelphia Lake. DWQ will determine if intensive sampling is needed to assess the fecal coliform bacteria standard in this lake (Appendix X).

2.4.7 Stony Creek (Lake Burlington) [AU# 16-14-(1)a, b and c]

Current Status and 2005 Recommendations
Stony Creek [16-14-(1)a] from source to Benton Branch (4.3 miles) is Supporting aquatic life because of a Good-Fair fish community rating at site BF26; however, this is a lower rating than the Excellent rating from 1994. There was evidence of past streambank erosion at the site.

Stony Creek [16-14-(1)b] from Benton Branch to backwaters of Lake Burlington (2.7 miles) is Not Rated because a benthic community rating could not be assigned at site BB231 due to small size stream. There were indications of increased sedimentation, and only one small riffle area was found. Drought conditions in 2001 and 2002 likely have had impacts on these communities. DWQ will continue to monitor water quality in this watershed and contact DSWC staff to determine if noted habitat impacts are from agricultural activities or from development in the area.

Lake Burlington [16-14-(1)c] (738 acres) is Not Rated for aquatic life because 33 percent of chlorophyll *a* samples exceeded the water quality standard; however, not enough samples were collected to assign a use support rating. Nutrient levels in the reservoir were higher than in previous years and nuisance algal blooms that can cause taste and odor problems in treated drinking water were present. DWQ will determine if increased monitoring efforts in this lake are warranted to better assess water quality.

2.5 Additional Water Quality Issues within Subbasin 03-06-02

The following section discusses issues that may threaten water quality in the subbasin that are not specific to particular streams, lakes or reservoirs. The issues discussed may be related to waters near certain land use activities or within proximity to different pollution sources.

2.5.1 Jordan Haw River Watershed Nutrient Sensitive Waters Strategy

All land uses and discharges of wastewater and stormwater in subbasin 03-06-02 potentially contribute nutrients to Jordan Reservoir in subbasins 03-06-04 and 03-06-05. The reservoir is Impaired for aquatic life because chlorophyll *a* violated the standard in all segments of the reservoir. Refer to Chapter 36 for more information on this strategy.

2.5.2 Greensboro Collection System SOC

The City of Greensboro collection system (WQCS00006) is currently under a special order of consent (SOC) because the North Buffalo WWTP is hydraulically overloaded, causing sanitary sewer overflows (SSOs) in the WWTP service area that includes the North Buffalo Creek watershed and portions of the Reedy Fork watershed. The SOC (WQS04012) was issued because Greensboro was unable to comply with collection system permit conditions which prohibit SSOs. The SOC contains dates by which specific actions must be accomplished. The SSOs are occurring most often from Hill Street to the WWTP. Greensboro will be building new pump stations to divert wastewater out of the North Buffalo Creek watershed and enlarging the primary outfall. Greensboro must build one of the new pump stations in the Reedy Fork watershed by March 2005. The SOC also provides for payment of penalties for any SSOs between Hill Street and the WWTP during anything less than a 10-year 24-hour storm event. DWQ will continue to work with Greensboro or ensure timely compliance with the conditions in the SOC.

Chapter 3
Cape Fear River Subbasin 03-06-03
Including: Little Alamance Creek, Big Alamance Creek and Stinking Quarter Creek

3.1 Subbasin Overview

Subbasin 03-06-03 at a Glance

Land and Water Area

Total area:	263 mi²
Land area:	262 mi²
Water area:	1 mi²

Population Statistics

2000 Est. Pop.: 132,837 people
Pop. Density: 508 persons/mi²

Land Cover (percent)

Forest/Wetland:	59.4%
Surface Water:	0.2%
Urban:	5.8%
Cultivated Crop:	2.2%
Pasture/ Managed Herbaceous:	32.4%

Counties

Alamance, Guilford and Randolph

Municipalities

Alamance, Burlington, Elon and Graham

Subbasin 03-06-03 is a piedmont watershed characterized by highly erodible soils. Most of the watershed is forested with extensive agriculture present. Development is occurring along the I-85/40 corridor in and around Burlington. Population is expected to grow by 120,000 people in counties with portions or all of their areas in this subbasin by 2020.

There are six individual NPDES wastewater discharge permits in this subbasin with a permitted flow of 12.1 MGD (Figure 6). The largest is South Burlington WWTP (12 MGD). Refer to Appendix VI and Chapter 30 for more information on NPDES permit holders. Issues related to compliance with NPDES permit conditions are discussed below in Section 3.3 for Impaired waters and in Section 3.4 for other waters.

Burlington and Graham are the only municipal areas in this subbasin required to develop stormwater programs (Chapter 31).

There are three registered swine operations and two registered dairy operations in this subbasin. Issues related to agricultural activities are discussed below in Section 3.3 for Impaired waters.

There were six benthic macroinvertebrate community samples and five fish community samples (Figure 6 and Table 6) collected during this assessment period. Data were also collected from three ambient monitoring stations including one DWQ station, one UCFRBA (Appendix V) station, and one shared ambient station. One reservoir was also monitored. Refer to the *2003 Cape Fear River Basinwide Assessment Report* at http://www.esb.enr.state.nc.us/bar.html and Appendix IV for more information on monitoring.

Waters in the following sections are identified by assessment unit number (AU#). This number is used to track defined segments in the water quality assessment database, 303(d) Impaired waters list and the various tables in this basin plan. The assessment unit number is a subset of the DWQ index number (classification identification number). A letter attached to the end of the AU# indicates that the assessment is smaller than the DWQ index segment. No letter indicates that the assessment unit and the DWQ index segment are the same.

Figure 6 Cape Fear River Subbasin 03-06-03

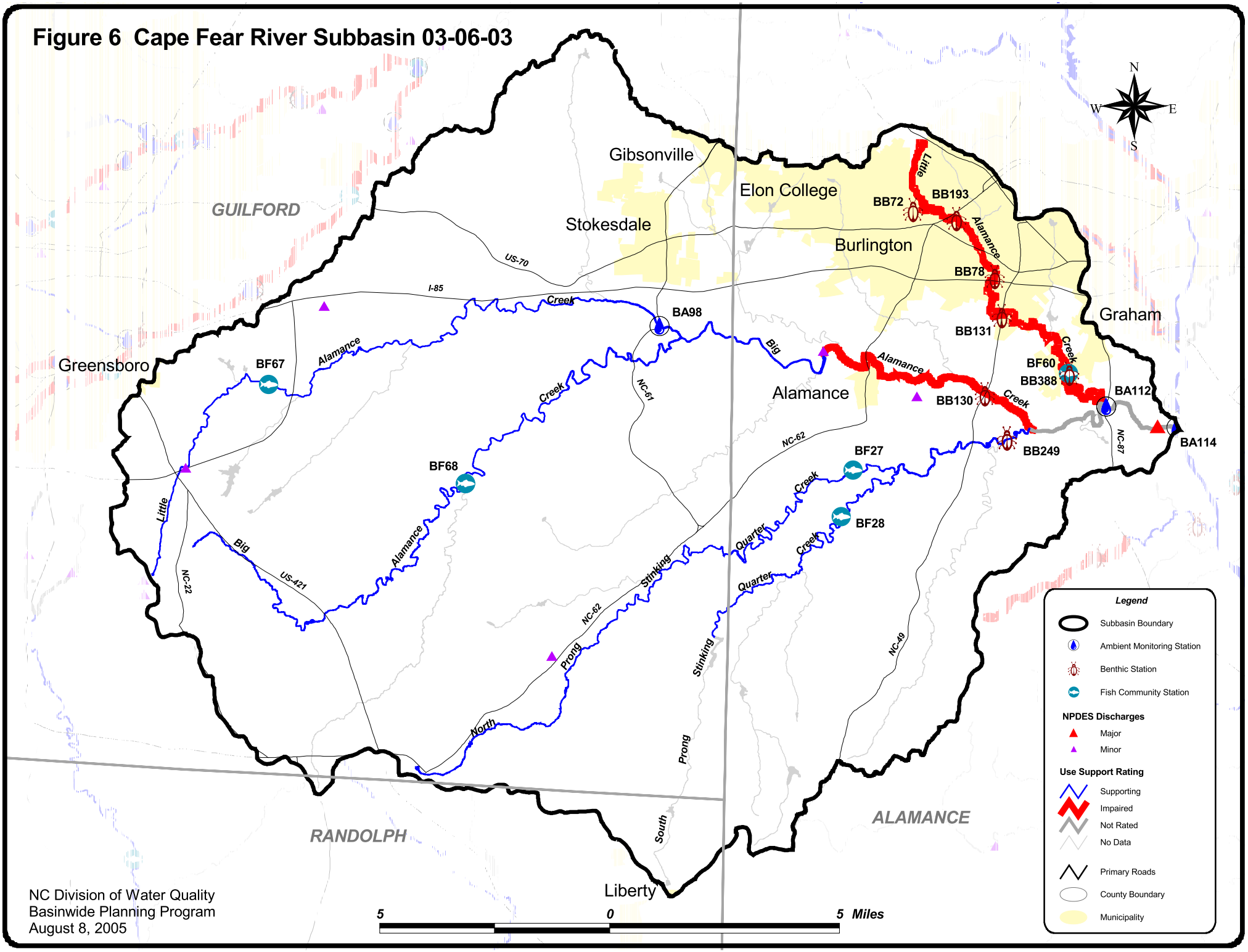


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Table 6 CAPE FEAR Subbasin 03-06-03

AU Number	Classification	Length/Area	Description	Aquatic Life Assessment					Recreation Assessment			Stressors	Sources
				AL Rating	Station	Result	Year/ Parameter	% Exc	REC Rating	Station	Result		
Big Alamance Creek (Alamance Cr)(Lk Macintoch)													
16-19-(2.5)	WS-IV NS	67.7 FW Acres	From a point 2.4 miles downstream of Guilford County SR 3045 to dam at Lake Macintosh	**S**	BL8 BL9	NCE NCE			ND				
16-19-(4.5)a	C NSW	5.6 FW Miles	From Dam at Lake Macintosh to confluence with Stinking Quarter Creek	**I**	BB130	F	2003		ND			Habitat Degradation Habitat Degradation	Agriculture MS4 NPDES
16-19-(4.5)b	C NSW	4.6 FW Miles	From confluence with Stinking Quarter Creek to Haw River	**NR**	BA112 BA114	NCE NCE	Turbidity	7.3	**NR***	BA112	NCE		
Big Alamance Creek (Alamance Creek)													
16-19-(1)	WS-IV NS	18.0 FW Miles	From source to a point 2.4 miles downstream of Guilford County SR 3045	**S**	BF68 BF68 BF68	G F GF	1999 1999 2003		ND				
Little Alamance Creek (Gant Lake, Mays Lake)(Alamance County													
16-19-11	C NSW	12.6 FW Miles	From source to Big Alamance Creek	**I**	BB131 BB193 BB388 BB78 BF60	P P F P G	2003 2003 2003 2003 2003		ND			Habitat Degradation	MS4 NPDES
Little Alamance Creek (Guilford County)													
16-19-3-(0.5)	WS-IV NS	15.0 FW Miles	From source to a point 0.3 mile downstream of Guilford County SR 3073	**S**	BF67	GF	2003		ND				
Little Alamance Creek(Guilford County)													
16-19-3-(4.5)	WS-IV NS	3.6 FW Miles	From a point 0.3 mile downstream of Guilford County SR 3073 to Lake Macintosh, Big Alamance Creek	**S**	BA98	NCE			**S**	BA98	NCE		

Table 6 CAPE FEAR Subbasin 03-06-03

AU Number / Description	Classification	Length/Area	Aquatic Life Assessment: AL Rating	Station	Result	Year/ Parameter	% Exc	Recreation Assessment: REC Rating	Station	Result	Stressors	Sources
North Prong Stinking Quarter Creek												
16-19-8-1	C NSW	18.3 FW Miles	**S**					ND				
From source to Stinking Quarter Creek				BF27	G	2003						
South Prong Stinking Quarter Creek												
16-19-8-2-(2)	C NSW	8.3 FW Miles	**S**					ND				
From dam at Kimesville Lake to Stinking Quarter Creek				BF28	E	2003						
Stinking Quarter Creek												
16-19-8	C NSW	4.6 FW Miles	**S**					ND			Habitat Degradation	
from source to Big Alamance Creek				BB249	GF	2003						
				BB249	F	2003						

AL - Aquatic Life	BF - Fish Community Survey	E - Excellent	S - Supporting, I - Impaired
REC - Recreation	BB - Benthic Community Survey	G - Good	NR - Not Rated
	BA - Ambient Monitoring Site	GF - Good-Fair	NR*- Not Rated for Recreation (screening criteria exceeded)
	BL- Lake Monitoring	F - Fair	ND-No Data Collected to make assessment
	S- DEH RECMON	P - Poor	**Results**
		NI - Not Impaired	CE-Criteria Exceeded > 10% and more than 10 samples
	Miles/Acres	S- Severe Stress	NCE-No Criteria Exceeded
	FW- Fresh Water	M-Moderate Stress	
	S- Salt Water	N- Natural	

Aquatic Life Rating Summary

S	m	67.8	FW Miles
NR	m	4.6	FW Miles
I	m	18.2	FW Miles
S	m	67.7	FW Acres
ND		110.4	FW Miles
ND		3.0	FW Acres

Recreation Rating Summary

S	m	3.6	FW Miles
NR*	m	4.6	FW Miles
ND		192.9	FW Miles
ND		70.7	FW Acres

Fish Consumption Rating Summary

I	e	201.1	FW Miles
I	e	70.7	FW Acres

3.2 Use Support Assessment Summary

Use support ratings were assigned for waters in subbasin 03-06-03 in the aquatic life, recreation, fish consumption and water supply categories. All waters are Impaired on an evaluated basis in the fish consumption category because of fish consumption advice that applies to the entire basin. In the water supply category, all WS classified waters (70.7 acres and 77 miles) are Supporting on an evaluated basis based on reports from DEH regional water treatment plant consultants. Refer to Appendix X for a complete list of monitored waters and more information on Supporting monitored waters.

There were 90.6 stream miles (45.1 percent) and 67.6 freshwater acres (95.7 percent) monitored during this assessment period in the aquatic life category. There were 18.2 miles (9.1 percent) of Impaired waters in this category.

3.3 Status and Recommendations of Previously and Newly Impaired Waters

The following waters were either identified as Impaired in the previous basin plan (2000) or are newly Impaired based on recent data. If previously identified as Impaired, the water will either remain on the state's 303(d) list or will be delisted based on recent data showing water quality improvements. If the water is newly Impaired, it will likely be placed on the 2006 303(d) list. The current status and recommendations for addressing these waters are presented below, and each is identified by an assessment unit number (AU#). Refer to the overview for more information on AUs. Information regarding 303(d) listing and reporting methodology is presented in Appendix VII.

3.3.1 Little Alamance Creek [AU# 16-19-11]

2000 Recommendations
The 2000 basinwide plan recommended that Little Alamance Creek be resampled and the City of Burlington address stormwater issues in the creek as part of the Phase II stormwater program.

Current Status
Little Alamance Creek from source to Big Alamance Creek (12.6 miles) is Impaired because of Fair and Poor benthic community ratings at sites BB388, BB193, BB131 and BB78. A DWQ TMDL stressor study found that urban runoff from large impervious surface areas in the watershed have caused stream channelization with associated habitat degradation. Pollutants associated with urban runoff as well as riparian area removals are also noted stressors to the benthic community. Streambank erosion was noted and many storm sewers discharge into the stream. In the lower watershed, land clearing was noted associated with many residential developments.

2005 Recommendations
DWQ will continue to monitor water quality in the Little Alamance Creek watershed and work with the Burlington and Graham stormwater programs to reduce further impacts due to new development and to implement BMPs and restore instream habitat in Little Alamance Creek.

Further recommendations to protect streams in urbanizing areas and to restore streams in existing urban areas are discussed in Chapter 31.

Little Alamance Creek will remain on the 303(d) list of Impaired waters. TMDLs (Chapter 35) will be developed for identified stressors within 8-13 years of listing.

3.3.2 Big Alamance Creek [AU# 16-19-(4.5)a and b]

Current Status
Big Alamance Creek was Fully Supporting in the 2000 basin plan; however, Big Alamance Creek [16-19-(4.5)a] from dam at Lake Macintosh to Stinking Quarter Creek (5.6 miles) is currently Impaired because of a Fair benthic community rating at site BB130. Runoff from agriculture and urbanizing areas in the watershed are impacting water quality in Big Alamance Creek. The channel is entrenched and severe streambank erosion was noted. Effects of drought and high flows late in the assessment period may have impacted the benthic community as well.

Big Alamance Creek [16-19-(4.5)b] from Stinking Quarter Creek to the Haw River (4.6 miles) is Not Rated for recreation because fecal coliform bacteria screening criteria were exceeded at site BA112. This segment is Supporting aquatic life, although turbidity exceeded the standard in 7 percent of samples collected at site BA112. Burlington Southside WWTP (NC0023876) had significant violations of biological oxygen demand permit limits during the last two years of the assessment period. The violation occurred during a period of extremely wet weather and likely did not impact water quality at that time. There has been only one violation since the installation of new equipment.

2005 Recommendations
DWQ will continue to monitor water quality in the Big Alamance Creek watershed and work with the Burlington stormwater programs to reduce further impacts due to new development and to implement BMPs and restore instream habitat in Big Alamance Creek. The NPDES compliance process will be used to address the significant permit violations noted above. DWQ will determine if intensive sampling is needed to assess the fecal coliform bacteria standard in this creek (Appendix X). DWQ will continue to work with DSWC staff to assure that agricultural impacts are minimized in this watershed.

Big Alamance Creek will be added to the 303(d) list of Impaired waters. TMDLs (Chapter 35) will be developed for identified stressors within 8-13 years of listing.

3.4 Status and Recommendations for Waters with Noted Impacts

The surface waters discussed in this section are not Impaired. However, notable water quality problems and concerns have been documented for some waters based on this assessment. While these waters are not Impaired, attention and resources should be focused on these waters to prevent additional degradation or facilitate water quality improvement. Waters in the following section are identified by assessment unit number (AU#). See overview for more information on AU#s.

3.4.1 North Prong Stinking Quarter Creek [AU# 16-19-8-1]

Current Status and 2005 Recommendations
North Prong Stinking Quarter Creek from source to Stinking Quarter Creek (18.3 miles) is Supporting aquatic life because of a Good fish community rating at site BF27. Nathaniel Greene Elementary School (NC0038164) had significant violations of pH limits during the last two years of the assessment period that may have adversely impacted water quality in this creek. The NPDES compliance process will be used to address the permit violations. The school is planning to move the discharge point further downstream. DWQ will work with the school to evaluate the effectiveness of the treatment plant and make any changes needed to maintain compliance with permit limits. DWQ will continue to monitor water quality in this watershed.

3.5 Additional Water Quality Issues within Subbasin 03-06-03

The following section discusses issues that may threaten water quality in the subbasin that are not specific to particular streams, lakes or reservoirs. The issues discussed may be related to waters near certain land use activities or within proximity to different pollution sources. This section also identifies those surface waters given an Excellent bioclassification, and therefore, may be eligible for reclassification to a High Quality Water (HQW) or an Outstanding Resource Water (ORW). For more information regarding water quality standards and classifications, please refer to Chapter 25.

3.5.1 Jordan Haw River Watershed Nutrient Sensitive Waters Strategy

All land uses and discharges of wastewater and stormwater in subbasin 03-06-03 potentially contribute nutrients to Jordan Reservoir in subbasins 03-06-04 and 03-06-05. The reservoir is Impaired for aquatic life because chlorophyll *a* violated the standard in all segments of the reservoir. Refer to Chapter 36 for more information on this strategy.

3.5.2 Surface Waters Identified for Potential Reclassification

South Prong Stinking Quarter Creek [AU# 16-19-8-2-(2)]
South Prong Stinking Quarter Creek from dam at Kimesville Lake to Stinking Quarter Creek (8.3 miles) is Supporting because of an Excellent fish community rating at site BF28. DWQ will consider pursuing reclassification of this creek to include a supplemental classification of ORW (Chapter 25).

Chapter 4
Cape Fear River Subbasin 03-06-04
Including: Haw River, Robeson Creek and Jordan Reservoir Haw River Arm

4.1 Subbasin Overview

Subbasin 03-06-04 at a Glance

Land and Water Area

Total area:	331 mi²
Land area:	327 mi²
Water area:	4 mi²

Population Statistics

2000 Est. Pop.: 59,718 people
Pop. Density: 181 persons/mi²

Land Cover (percent)

Forest/Wetland:	73.0%
Surface Water:	1.7%
Urban:	0.3%
Cultivated Cropland:	3.0%
Pasture/ Managed Herbaceous:	22.0%

Counties

Alamance, Chatham and Orange

Municipalities

Pittsboro

Subbasin 03-06-04 is in the Carolina slate belt characterized by low flowing streams during summer months. Most of the watershed is forested with extensive agriculture present. Development is occurring around Pittsboro and north along the US 15/501 corridor. Population is expected to grow by 60,000 people in counties with portions or all of their areas in this subbasin by 2020.

There are six individual NPDES wastewater discharge permits in this subbasin with a permitted flow of 0.83 MGD (Figure 7). The largest is Pittsboro WWTP (0.75 MGD). Refer to Appendix VI and Chapter 30 for more information on NPDES permit holders. Issues related to compliance with NPDES permit conditions are discussed below in Section 4.3 for Impaired waters.

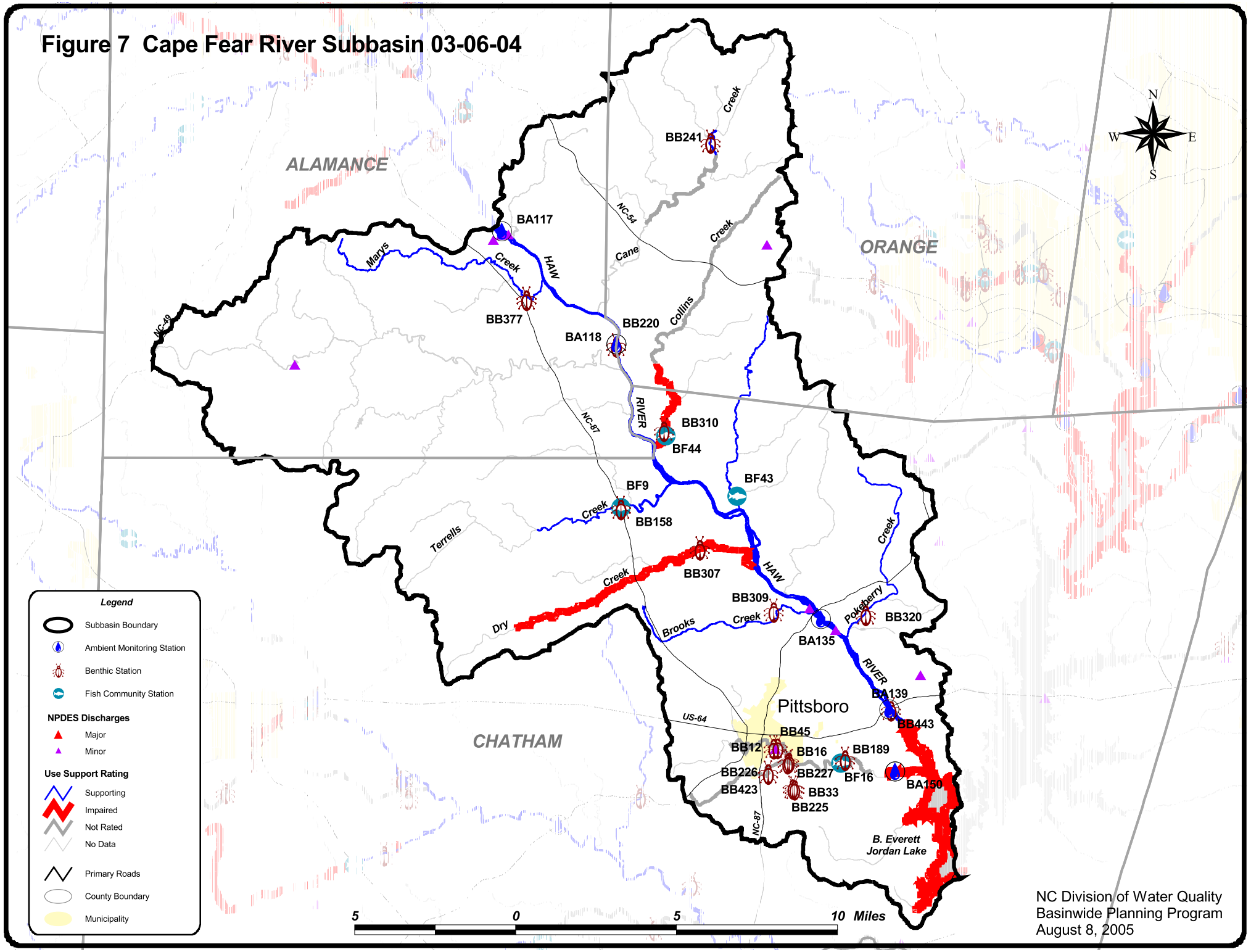
There are no municipal areas in this subbasin required to develop stormwater programs (Chapter 31).

There are two registered swine operations and 18 registered cattle operations in this subbasin. Issues related to agricultural activities are discussed below in Section 4.3 for Impaired waters.

There were 15 benthic macroinvertebrate community samples and four fish community samples (Figure 7 and Table 7) collected during this assessment period. Data were also collected from three ambient monitoring stations including one DWQ station, one UCFRBA (Appendix V) station, and one shared ambient station. Three reservoirs were also monitored. Refer to the *2003 Cape Fear River Basinwide Assessment Report* at http://www.esb.enr.state.nc.us/bar.html and Appendix IV for more information on monitoring.

Waters in the following sections are identified by assessment unit number (AU#). This number is used to track defined segments in the water quality assessment database, 303(d) Impaired waters list and the various tables in this basin plan. The assessment unit number is a subset of the DWQ index number (classification identification number). A letter attached to the end of the AU# indicates that the assessment is smaller than the DWQ index segment. No letter indicates that the assessment unit and the DWQ index segment are the same.

Figure 7 Cape Fear River Subbasin 03-06-04



NC Division of Water Quality
Basinwide Planning Program
August 8, 2005

Table 7 CAPE FEAR Subbasin 03-06-04

AU Number	Classification	Length/Area	Description	Aquatic Life Assessment					Recreation Assessment				
				AL Rating	Station	Result	Year/ Parameter	% Exc	REC Rating	Station	Result	Stressors	Sources
Brooks Creek (Branch)													
16-36	WS-IV&B	7.3 FW Miles	From source to Haw River	**S**	BB309	NI	2001		ND				
Cane Creek (Cane Creek Reservoir)													
16-27-(2.5)a	WS-II HQ	1.2 FW Miles	From a point 0.4 miles upstream of Turkey Creek to UT 0.5 miles downstream of SR 1114	**S**	BB241	GF	2003		ND				
					BB241	GF	2003						
					BB241	GF	2003						
16-27-(2.5)b	WS-II HQ	25.1 FW Acres	From UT 0.5 miles downstream of SR1114 to dam at Cane Creek Reservoir	**NR**	BL10	NCE	Chlor a	66	ND			Chlorophyll a	Agriculture
Collins Creek													
16-30-(1.5)	WS-IV NS	3.7 FW Miles	From a point 0.8 miles downstream of Orange County SR 1005 to Haw River	**I**	BB310	GF	2003		ND			Habitat Degradation	Agriculture
					BF44	P	2003						
Dry Creek													
16-34-(0.7)	WS-IV NS	10.1 FW Miles	From a point 0.3 miles downstream of Chatham County SR 1506 to Haw River	**I**	BB307	F	2003		ND			Turbidity	Land Clearing
					BB307	F	2003					Habitat Degradation	Unknown

Table 7 CAPE FEAR Subbasin 03-06-04

AU Number	Classification	Length/Area	Description	Aquatic Life Assessment						Recreation Assessment				
				AL Rating	Station	Result	Year/ Parameter	% Exc		REC Rating	Station	Result	Stressors	Sources
HAW RIVER														
16-(28.5)	WS-IV NS	11.4 FW Miles	From a point 0.4 miles downstream of Cane Creek (South side of Haw River) to a point 0.4 miles downstream of Brooks Branch	S	BA135	NCE				S	BA135	NCE		
16-(36.3)	WS-IV NS	0.5 FW Miles	From a point 0.4 miles downstream of Brooks Branch to Pittsboro water supply intake (located 0.3 miles upstream of Pokeberry Creek)	S	BA139	NCE				S	BA139	NCE		
16-(36.7)	WS-IV NS	3.8 FW Miles	From Pittsboro water supply intake to a point 0.5 mile downstream of U.S. Hw. 64	S	BB443	G	2002			S				
16-(37.3)	WS-IV NS	53.2 FW Acres	From a point 0.5 mile downstream of US Hwy 64 to approximately 1.0 mile below US Hwy 64	I	BL1	CE	Chlor a	33		ND			High pH	Agriculture
					BL1	CE	High pH	23.5					High pH	Impervious Surfac
													High pH	MS4 NPDES
													High pH	WWTP NPDES
													Chlorophyll a	Agriculture
													Chlorophyll a	Impervious Surfac
													Chlorophyll a	MS4 NPDES
													Chlorophyll a	WWTP NPDES
Haw River (B. Everett Jordan Lake below normal pool elevatio														
16-(37.5)	WS-IV&B	1,392.3 FW Acres	From approximately 1.0 mile below U.S. Hwy. 64 to dam at B. Everett Jordan Lake)	I	BA150	CE	Chlor a	24		ND			High pH	Agriculture
					BL1	CE	Chlor a	33					High pH	Impervious Surfac
					BL1	CE	High pH	23.5					High pH	MS4 NPDES
													High pH	WWTP NPDES
													Chlorophyll a	Agriculture
													Chlorophyll a	Impervious Surfac
													Chlorophyll a	MS4 NPDES
													Chlorophyll a	WWTP NPDES

Table 7 CAPE FEAR Subbasin 03-06-04

AU Number	Classification	Length/Area	Description	Aquatic Life Assessment						Recreation Assessment			Stressors	Sources
				AL Rating	Station	Result	Year/ Parameter	% Exc		REC Rating	Station	Result		
Marys Creek														
16-26	C NSW	10.1 FW Miles		**S**						ND			Habitat Degradation	
	From source to Haw River				BB377	GF	2003							
					BB377	NR	2003							
					BB377	GF	2000							
Pokeberry Creek														
16-37	WS-IV NS	8.0 FW Miles		**S**						ND			Habitat Degradation	Land Clearing
	From source to Haw River				BB320	GF	2003							
					BB320	GF	2003							
Robeson Creek														
16-38-(3)b	WS-IV NS	16.7 FW Acres		**NR**	BL11	NCE	Chlor a	100		ND			Chlorophyll a	Impervious Surfac
	Pittsboro Lake												Chlorophyll a	WWTP NPDES
16-38-(3)c	WS-IV NS	2.4 FW Miles		**I**						ND			Habitat Degradation	ND land app site
	From Pittsboro Lake to UT across from SR 1951				BB12	F	2001						Habitat Degradation	Impervious Surfac
					BB16	F	2001						Habitat Degradation	WWTP NPDES
					BB45	F	2001							
16-38-(3)d	WS-IV NS	3.1 FW Miles		**S**						ND			Habitat Degradation	
	From UT across from SR 1951 to Jordan Reservoir				BB189	GF	2001							
					BB189	F	2001							
					BF16	G	2003							
Terrells Creek (Ferrells Creek) (North Side Haw River)														
16-32	WS-IV NS	7.6 FW Miles		**S**						ND				
	From source to Haw River				BF43	G	2003							
Terrells Creek (South Side Haw River)														
16-31-(2.5)	WS-IV NS	6.7 FW Miles		**S**						ND			Low Dissolved Oxygen	
	From Cattail Creek to Haw River				BB158	GF	2003							
					BB158	F	2003							
					BF9	E	2003							

Table 7 CAPE FEAR Subbasin 03-06-04

AU Number / Description	Classification	Length/Area	Aquatic Life Assessment: AL Rating	Station	Result	Year/ Parameter	% Exc	Recreation Assessment: REC Rating	Station	Result	Stressors	Sources
Turkey Creek												
16-38-4	WS-IV NS	4.1 FW Miles	**NR**					ND				
From source to Robeson Creek				BB226	NR	2001						
				BB227	NR	2001						
				BB423	NR	2001						

AL - Aquatic Life	BF - Fish Community Survey	E - Excellent	S - Supporting, I - Impaired
REC - Recreation	BB - Benthic Community Survey	G - Good	NR - Not Rated
	BA - Ambient Monitoring Site	GF - Good-Fair	NR*- Not Rated for Recreation (screening criteria exceeded)
	BL- Lake Monitoring	F - Fair	ND-No Data Collected to make assessment
	S- DEH RECMON	P - Poor	**Results**
		NI - Not Impaired	CE-Criteria Exceeded > 10% and more than 10 samples
	Miles/Acres	S- Severe Stress	NCE-No Criteria Exceeded
	FW- Fresh Water	M-Moderate Stress	
	S- Salt Water	N- Natural	

Aquatic Life Rating Summary

S	m	59.8	FW Miles
NR	m	4.1	FW Miles
I	m	16.1	FW Miles
NR	m	41.8	FW Acres
I	m	1,445.5	FW Acres
NR	e	9.4	FW Miles
ND		167.8	FW Miles

Recreation Rating Summary

S	m	15.7	FW Miles
ND		241.4	FW Miles
ND		1,487.3	FW Acres

Fish Consumption Rating Summary

I	m	1,392.3	FW Acres
I	e	257.1	FW Miles
I	e	95.0	FW Acres

4.2 Use Support Assessment Summary

Use support ratings were assigned for waters in subbasin 03-06-04 in the aquatic life, recreation, fish consumption and water supply categories. All waters are Impaired on an evaluated basis in the fish consumption category because of fish consumption advice that applies to the entire basin. In the water supply category, all WS classified waters (1,434.6 acres and 132.5 miles) are Supporting on an evaluated basis based on reports from DEH regional water treatment plant consultants. Refer to Appendix X for a complete list of monitored waters and more information on Supporting monitored waters.

There were 80 stream miles (31.1 percent) and 1,487.3 freshwater acres (100 percent) monitored during this assessment period in the aquatic life category. There were 16.1 miles (6.3 percent) and 1,445.5 acres (97.2 percent) of Impaired waters in this category.

4.3 Status and Recommendations of Previously and Newly Impaired Waters

The following waters were either identified as Impaired in the previous basin plan (2000) or are newly Impaired based on recent data. If previously identified as Impaired, the water will either remain on the state's 303(d) list or will be delisted based on recent data showing water quality improvements. If the water is newly Impaired, it will likely be placed on the 2006 303(d) list. The current status and recommendations for addressing these waters are presented below, and each is identified by an assessment unit number (AU#). Refer to the overview for more information on AUs. Information regarding 303(d) listing and reporting methodology is presented in Appendix VII.

4.3.1 Collins Creek [AU # 16-30-(0.5) and (1.5)]

Current Status
Collins Creek was Fully Supporting in the 2000 basin plan; however, Collins Creek [16-30-(1.5)] from 0.8 miles downstream of SR 1005 to the Haw River (3.7 miles) is currently Impaired for aquatic life because of a Poor fish community rating at site BF44. There are indications of nutrient enrichment in Collins Creek, and the fish community has been adversely affected by drought conditions during the assessment period. Habitat and riparian area were stable at site BF44. The watershed is experiencing rapid growth but is currently in rural residential development.

Collins Creek [16-30-(0.5)] from source to downstream of SR 1005 (8.5 miles) is currently Not Rated on an evaluated basis for aquatic life because Trails WWTP (NC0042285) had significant violations of biological oxygen demand permit limits during the last two years of the assessment period that could have adversely impacted aquatic life. The facility is currently upgrading and expanding.

2005 Recommendations
DWQ will continue to monitor the Collins Creek watershed to document the effects of development and the implementation of best management practices (BMPs). The NPDES compliance process will be used to address the significant permit violations noted above. In

addition to implementing BMPs on agricultural lands, BMPs need to be installed during and post-development activities. Further recommendations to protect streams in urbanizing areas and to restore streams in existing urban areas are discussed in Chapter 31.

Segment 16-30-(1.5) will be added to the 303(d) list of Impaired waters. TMDLs (Chapter 35) will be developed for identified stressors within 8-13 years of listing.

4.3.2 Dry Creek [AU # 16-34-(0.7)]

Current Status
Dry Creek was Fully Supporting in the 2000 basinwide plan; however, Dry Creek from 0.3 miles downstream of SR 1506 to the Haw River (10.1 miles) is currently Impaired for aquatic life because of a Poor benthic community rating at site BB307. There are indications of low dissolved oxygen in Dry Creek, although no ambient monitoring data were collected. The benthic community may have been adversely affected by drought conditions during the assessment period, although the creek has had low community ratings in past collections. Habitat and riparian area were stable at site BB307. Pools were filled with sediment and habitat variety was lacking. A new development in a tributary to Dry Creek is a potential source of sediment. The DLR has inspected the site and indicated that BMPs were in place. Haw River Watch monitoring indicates frequent high levels of turbidity downstream of the development. There are concerns that the BMPs are not adequate to protect water quality in Dry Creek.

2005 Recommendations
DWQ will continue to monitor the Dry Creek watershed to document the effects of development and the implementation and effectiveness of best management practices (BMPs). In addition to implementing BMPs on agricultural lands, BMPs need to be installed and maintained during and post-development activities. Further recommendations to protect streams in urbanizing areas and to restore streams in existing urban areas are discussed in Chapter 31.

Dry Creek will be added to the 303(d) list of Impaired waters. TMDLs (Chapter 35) will be developed for identified stressors within 8-13 years of listing.

4.3.3 Haw River [AU # 16-(28.5), (36.3), (36.7), (37.3) and (37.5)]

Current Status
Haw River [16-(28.5)] from downstream of Cane Creek to downstream of Brooks Branch to Pittsboro water supply intake (11.4 miles) was Fully Supporting in the 2000 basinwide plan and is currently Supporting aquatic life because no criteria were exceeded at site BA135. Total nitrogen (TN) and total phosphorus (TP) trend analyses were completed for the 19-year period from 1985 to 2003 at site BA135. The analyses indicated a significant 57 percent decrease in TP over the time period. There was no trend observed for TN. Possible explanations for the decrease in TP include the phosphate detergent ban (1988) and improved TP removal from wastewater discharges upstream of site BA135.

Haw River [16-(36.3) and 16-(36.7)] from downstream of Brooks Branch to downstream of US64 (4.3 miles) was Fully Supporting in the 2000 basinwide plan and is currently Supporting aquatic life because of a Good benthic community rating at site BB443. Bynum WWTP

(NC0035866) had significant violations of pH permit limits during the last two years of the assessment period.

The Haw River [16-(37.3) and (37.5) from 0.5 miles downstream of US 64 to 1 mile downstream of US 64 (53.2 acres) and from 1 mile downstream of US 64 to B. Everett Jordan Reservoir Dam (1,392.3 acres) are considered part of Jordan Reservoir and are discussed with the remainder of the reservoir in Chapter 5. The Haw River Arm [16-(37.5)] is also Impaired on a monitored basis in the fish consumption category.

2005 Recommendations
DWQ will continue to monitor the Haw River. Although there has been a decrease in TP in the Haw River; DWQ recommends NPDES discharges continue to improve TP and TN removal capabilities, and all land-disturbing activities utilize appropriate BMPs to reduce TP and TN delivery to the Haw River watershed. The NPDES compliance process will be used to address the significant permit violations noted above. Segment 16-(37.5) will be placed on the 303(d) list for aquatic life and fish consumption.

Water Quality Initiatives
The NCEEP has also preserved 32,000 linear feet of stream in this watershed (Chapter 34).

4.3.4 Marys Creek [AU # 16-30-(1.5)]

2000 Recommendations
The 2000 basin plan recommended that Marys Creek be resampled to determine stressors to the biological community and the effects of agricultural BMPs installation.

Current Status
Marys Creek from source to the Haw River (10.1 miles) is Supporting aquatic life because of a Good-Fair benthic community rating at site BB377. The benthic community has been impacted by drought conditions, but was able to recover by time of sampling in 2003.

2005 Recommendations
DWQ will continue to monitor the Marys Creek watershed. Marys Creek was removed from the 2002 303(d) list of Impaired waters because of the improved biological community rating.

Water Quality Initiatives
The NCEEP completed 2,500 linear feet of stream restoration in this watershed (Chapter 34).

4.3.5 Pittsboro Lake and Robeson Creek [AU # 16-38-(3)a, b, c and d]

2000 Recommendations
The 2000 basin plan recommended that Robeson Creek and Pittsboro Lake be resampled and that local governments work to protect water quality in the watershed. The 2000 basin plan improperly identified the lower portion of Robeson Creek. A portion Impaired for chlorophyll *a* is actually an embayment of Jordan Reservoir and is discussed in Chapter 5.

Current Status

Robeson Creek [16-38-(3)a] from source to Pittsboro Lake (0.9 miles) is Not Rated on an evaluated basis for aquatic life because Haw River Assembly information indicate habitat degradation and a pollution tolerant benthic community. Agriculture, as well as impervious surfaces associated with Pittsboro, are potential sources of degradation.

Pittsboro Lake [16-38-(3)b] a 16.7-acre impoundment of Robeson Creek is Not Rated for aquatic life because all chlorophyll *a* samples exceeded the water quality criterion; however, only three samples were collected. A minimum of 10 samples are needed to assign a use support rating (Appendix X). The chlorophyll *a* levels were the highest recorded for the lake by DWQ.

Robeson Creek [16-38-(3)c] from Pittsboro Lake to a UT across from SR 1951 (2.4 miles) is Impaired for aquatic life because of Fair benthic community ratings at sites BB45, BB16 and BB12. There are indications of nutrient enrichment in Robeson Creek. Habitat and riparian area were stable downstream in segment 16-38-(3)d at site BF16 and BB189. This lower segment (3.1 miles) is Supporting. The watershed drains Pittsboro and is experiencing rapid growth. The benthic communities were stressed by habitat degradation associated with runoff from urban areas and nutrients from Townsend Foods spray fields. Townsend Foods reduced capacity so that the waste generated could be managed on the spray field.

A TMDL for phosphorus was developed that called for 71 percent reduction from urban runoff and the Pittsboro WWTP. The TMDL for phosphorus was targeted at the lower portion of Robeson Creek. This segment has since been identified as part of the Haw River arm of Jordan Reservoir. The TMDL will be applied to Jordan Reservoir (Chapter 5).

2005 Recommendations

DWQ will continue to monitor the Robeson Creek and Pittsboro Lake watershed to document the effects of continued development and the removal of the Pittsboro WWTP discharge as recommended in the TMDL. Further recommendations to protect streams in urbanizing areas and to restore streams in existing urban areas are discussed in Chapter 31.

Pittsboro Lake [16-38-(3)b] and Robeson Creek [16-38-(3)a and c] will remain on the 303(d) list of Impaired waters. A TMDL is being developed for aquatic weeds in Pittsboro Lake. Segment [16-38-(3)d] will be removed because of the improved biological community ratings. Segment [16-38-(5)] will be added to the list because it is a part of Jordan Reservoir and is Impaired because of chlorophyll *a*. TMDLs (Chapter 35) will be developed for identified stressors within 8-13 years of listing.

Water Quality Initiatives

In 1999, NCSU received a $210,000 Section 319 grant (Chapter 34) to conduct watershed assessment and support monitoring stations to assist in development of the TMDL for the Robeson Creek watershed. The Haw River Assembly (Chapter 34) Stream Stewards Campaign has also received 319 grants to conduct citizen stream assessments in the Robeson Creek watershed and to encourage business participation in decreasing runoff into Robeson Creek. The NCSU Water Quality Group has worked with Pittsboro to form the Robeson Creek Watershed Council. The council meets regularly and includes members from state and federal resource agencies, local governments, businesses, residents and the Haw River Assembly.

4.4 Status and Recommendations for Waters with Noted Impacts

The surface waters discussed in this section are not Impaired. However, notable water quality problems and concerns have been documented for some waters based on this assessment. While these waters are not Impaired, attention and resources should be focused on these waters to prevent additional degradation or facilitate water quality improvement. Waters in the following section are identified by assessment unit number (AU#). See overview for more information on AU#s.

4.4.1 Cane Creek (Cane Creek Reservior) [AU# 16-27-(2.5)b]

Current Status and 2005 Recommendations
Cane Creek Reservoir (25.1 acres) is Not Rated for aquatic life because 66 percent of chlorophyll *a* samples exceeded the water quality standard; however, not enough samples were collected to assign a use support rating. Nutrient levels in the reservoir were higher than in previous years and blue-green algal blooms occurred throughout the summer months. These blooms can cause taste and odor problems in treated drinking water. Cattle have also been observed in tributary streams to Cane Creek. DWQ will determine if increased monitoring efforts in this lake are warranted to better assess water quality. DWQ will also contact DSWC staff to evaluate if BMPs can be implemented in this watershed to exclude cattle.

Water Quality Initiatives
In 1997, Orange Water and Sewer Authority (Chapter 34) received a $1,042,500 CWMTF grant to acquire 1,265 acres in the Cane Creek watershed to help protect the water supply. In 2001, Orange Water and Sewer Authority received a $687,000 CWMTF grant to acquire an additional 150 acres in the Cane Creek watershed to help protect the water supply. In 2003, the Haw River Assembly (Chapter 34) received a minigrant of $25,000 for transactional costs to purchase six tracts along Cane Creek and the Haw River. Also in 2003, Orange Water and Sewer Authority received a minigrant of $25,000 for transactional costs to purchase 144 acres and conservation easements on 467 acres in the Cane Creek watershed. The NCEEP also completed 9,700 linear feet of stream restoration in this watershed (Chapter 34).

4.5 Additional Water Quality Issues within Subbasin 03-06-04

The following section discusses issues that may threaten water quality in the subbasin that are not specific to particular streams, lakes or reservoirs. The issues discussed may be related to waters near certain land use activities or within proximity to different pollution sources.

4.5.1 Jordan Haw River Watershed Nutrient Sensitive Waters Strategy

All land uses and discharges of wastewater and stormwater in subbasin 03-06-04 potentially contribute nutrients to Jordan Reservoir in subbasins 03-06-04 and 03-06-05. The reservoir is Impaired for aquatic life because chlorophyll *a* violated the standard in all segments of the reservoir. Refer to Chapter 36 for more information on this strategy.

Chapter 5
Cape Fear River Subbasin 03-06-05
Including: New Hope Creek, Northeast Creek and Jordan Reservoir

5.1 Subbasin Overview

Subbasin 03-06-05 at a Glance

Land and Water Area

Total area:	269 mi²
Land area:	251 mi²
Water area:	18 mi²

Population Statistics

2000 Est. Pop.: 112,558 people
Pop. Density: 419 persons/mi²

Land Cover (percent)

Forest/Wetland:	78.2%
Surface Water:	8.2%
Urban:	6.4%
Cultivated Crop:	0.6%
Pasture/ Managed Herbaceous:	6.6%

Counties

Chatham, Durham, Orange and Wake

Municipalities

Apex, Cary, Durham and Morrisville

Subbasin 03-06-05 overlies the geology of the Triassic basin, with all but the largest streams having regular very low flow periods. Most of the watershed is forested, with large urban areas in the eastern upland areas. Jordan Reservoir is a substantial percentage of the subbasin area. Development is occurring in the Wake County portion of the subbasin. Population is expected to grow by 250,000 people in counties with portions or all of their areas in this subbasin by 2020. Most of the growth is expected in Wake County, with only a small portion in this subbasin.

There are 11 individual NPDES wastewater discharge permits in this subbasin with a permitted flow of 32.4 MGD (Figure 8). The largest are Triangle WWTP (12 MGD) and South Durham WRF (20 MGD). Refer to Appendix VI and Chapter 30 for more information on NPDES permit holders. Issues related to compliance with NPDES permit conditions are discussed below in Section 5.3 for Impaired waters and in Section 5.4 for other waters.

Apex, Cary, Durham and Morrisville are required to develop Phase II stormwater programs (Chapter 31).

There were four benthic macroinvertebrate community samples and one fish community sample (Figure 8 and Table 8) collected during this assessment period. Data were also collected from six ambient monitoring stations including one DWQ station, four UCFRBA (Appendix V) stations and one shared ambient station. Three reservoirs were also monitored. Refer to the *2003 Cape Fear River Basinwide Assessment Report* at http://www.esb.enr.state.nc.us/bar.html and Appendix IV for more information on monitoring.

Waters in the following sections are identified by assessment unit number (AU#). This number is used to track defined segments in the water quality assessment database, 303(d) Impaired waters list and the various tables in this basin plan. The assessment unit number is a subset of the DWQ index number (classification identification number). A letter attached to the end of the AU# indicates that the assessment is smaller than the DWQ index segment. No letter indicates that the assessment unit and the DWQ index segment are the same.

Figure 8 Cape Fear River Subbasin 03-06-05

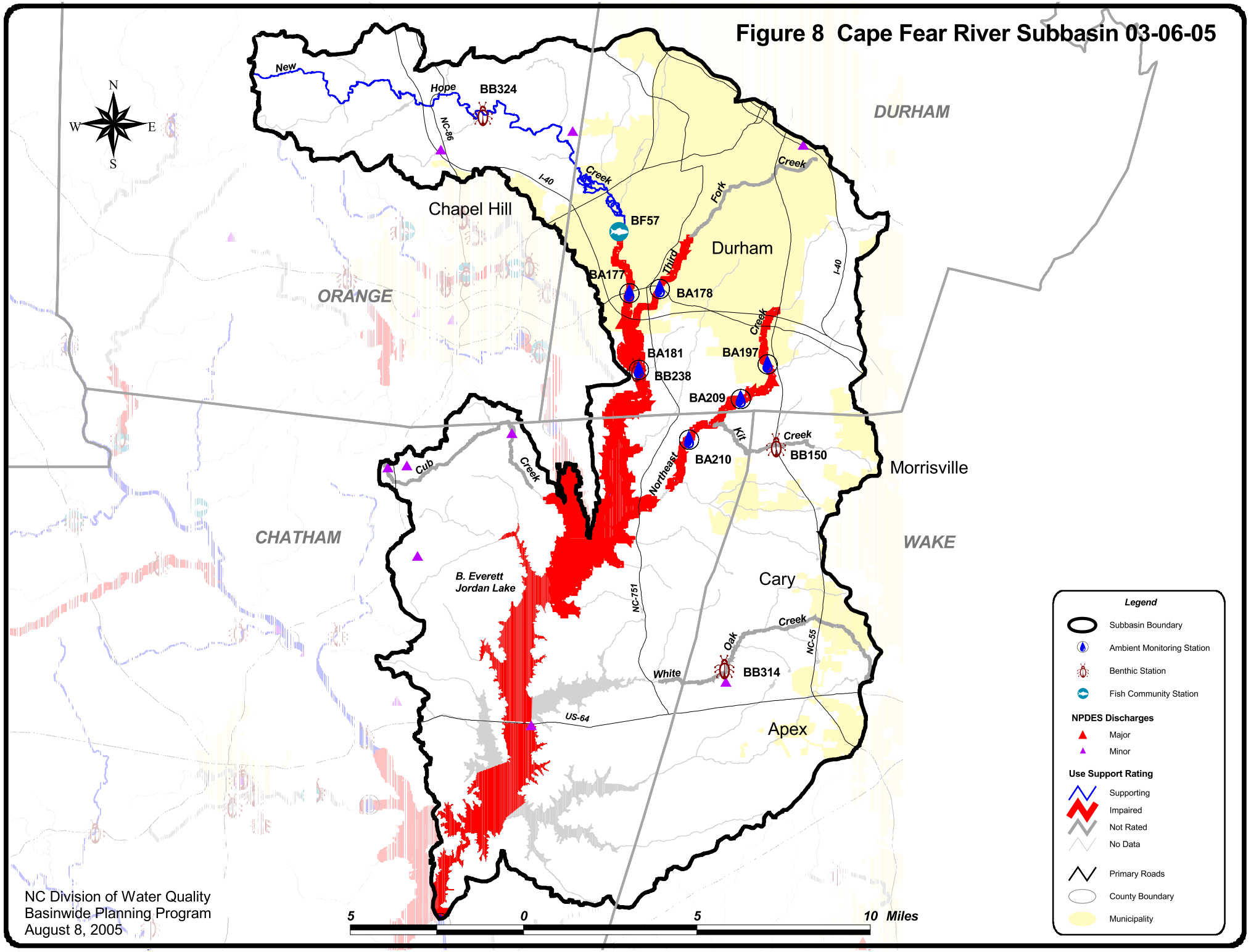


Table 8 CAPE FEAR Subbasin 03-06-05

AU Number / Description	Classification	Length/Area	Aquatic Life Assessment					Recreation Assessment			Stressors	Sources
			AL Rating	Station	Result	Year/ Parameter	% Exc	REC Rating	Station	Result		
Kit Creek												
16-41-1-17-2-(0.7)	WS-IV NS	4.2 FW Miles	**NR**					ND				
From a point 1.3 miles upstream of NC Hwy 55 to Northeast Creek				BB150	NR	2003						
New Hope Creek												
16-41-1-(0.5)a	C NSW	17.5 FW Miles	**S**					ND				
From source to Sandy Creek				BB324	GF	2003						
16-41-1-(0.5)b	C NSW	0.7 FW Miles	**S**					ND			Habitat Degradation	MS4 NPDES
From Sandy Creek to a point 0.3 mile upstream of Durham County SR 2220				BF57	GF	2003						
16-41-1-(11.5)a	WS-IV NS	0.4 FW Miles	**S**					ND			Habitat Degradation	MS4 NPDES
From a point 0.3 mile upstream of Durham County SR 2220 to SR 2220				BF57	GF	2003						
16-41-1-(11.5)b	WS-IV NS	3.5 FW Miles	**I**	BA177	CE	Low DO	12.9	**NR***	BA177	NCE	Fecal Coliform Bacteria	MS4 NPDES
				BA177	CE	Turbidity	12.2				Turbidity	MS4 NPDES
From SR 2220 to I 40											Low Dissolved Oxygen	MS4 NPDES
16-41-1-(11.5)c	WS-IV NS	4.0 FW Miles	**I**	BA181	CE	Turbidity	12.2	**S**	BA181	NCE	Habitat Degradation	MS4 NPDES
				BA181	NCE	Low DO	9.1				Low Dissolved Oxygen	WWTP NPDES
From I-40 to a point 0.8 mile downstream of Durham County SR 1107				BB238	F	2003					Low Dissolved Oxygen	MS4 NPDES
											Turbidity	MS4 NPDES
New Hope Creek (including New Hope Creek Arm of New Hope River Arm of B. Everett Jordan Lake)												
16-41-1-(14)	WS-IV NS	1,415.7 FW Acres	**I**	BL14	CE	Chlor a	73	ND			Chlorophyll a	MS4 NPDES
From a point 0.8 mile downstream of Durham County SR 1107 to confluence with Morgan Creek Arm of New Hope River Arm of B. Everett Jordan Lake											Chlorophyll a	WWTP NPDES

Table 8 CAPE FEAR Subbasin 03-06-05

AU Number / Description	Classification	Length/Area	Aquatic Life Assessment: AL Rating	Station	Result	Year/ Parameter	% Exc	Recreation Assessment: REC Rating	Station	Result	Stressors	Sources
New Hope River Arm of B. Everett Jordan Lake (below normal pool elevation)												
16-41-(0.5)	WS-IV&B	1,199.8 FW Acres	I	BL12	CE	Chlor a	40	ND			Chlorophyll a	MS4 NPDES
											Chlorophyll a	WWTP NPDES
From source at confluence of Morgan Creek and New Hope Creek Arm of B. Everett Jordan Lake (a east-west line across the southern tip of the formed penisula) to Chatham Co												
16-41-(3.5)a	WS-IV&B	5,673.3 FW Acres	I	BL13	CE	Chlor a	14.3	ND			Chlorophyll a	WWTP NPDES
				BL13	CE	Chlor a	20				Chlorophyll a	MS4 NPDES
				BL13	CE	Chlor a	27					
From Chatham County SR 1008 to Haw River Arm of B. Everett Jordan Lake, Haw River												
Northeast Creek												
16-41-1-17-(0.7)a	WS-IV NS	3.3 FW Miles	I	BA197	CE	Low DO	11.3	S	BA197	NCE	Turbidity	MS4 NPDES
				BA197	CE	Turbidity	14.6		BA197	NCE	Low Dissolved Oxygen	MS4 NPDES
From US Hwy 55 to Durham Triangle WWTP												
16-41-1-17-(0.7)b1	WS-IV NS	3.3 FW Miles	I	BA209	CE	Turbidity	10.3	I	BA209	CE	Turbidity	MS4 NPDES
									BA209	NCE		
From Durham Triangle WWTP to Kit Creek												
16-41-1-17-(0.7)b2	WS-IV NS	3.2 FW Miles	I	BA210	CE	Turbidity	14.6	S	BA210	NCE	Turbidity	MS4 NPDES
									BA210	NCE		
From Kit Creek to a point 0.5 mile downstream of Panther Creek												
Third Fork Creek												
16-41-1-12-(2)	WS-IV NS	3.9 FW Miles	I	BA178	NCE			NR*	BA178	NCE	Turbidity	MS4 NPDES
				BA178	CE	Turbidity	12.2				Low Dissolved Oxygen	MS4 NPDES
											Fecal Coliform Bacteria	MS4 NPDES
From a point 2.0 miles upstream of NC HWY. 54 to New Hope Creek												
White Oak Creek												
16-41-6-(0.3)	C NSW	3.7 FW Miles	NR					ND			Habitat Degradation	
From source to a point 0.6 mile upstream of Jack Branch				BB314	NR	2003						
				BB314	NR	2003						
16-41-6-(0.7)	WS-IV NS	5.9 FW Miles	NR					ND			Habitat Degradation	MS4 NPDES
From a point 0.6 mile upstream of Jacks Branch to a point 0.3 mile upstream of NC Hwy 751				BB314	NR	2003						
				BB314	NR	2003						

Table 8 CAPE FEAR Subbasin 03-06-05

AU Number / Description	Classification	Length/Area	Aquatic Life Assessment					Recreation Assessment				
			AL Rating	Station	Result	Year/ Parameter	% Exc	REC Rating	Station	Result	Stressors	Sources

AL - Aquatic Life	BF - Fish Community Survey	E - Excellent	S - Supporting, I - Impaired
REC - Recreation	BB - Benthic Community Survey	G - Good	NR - Not Rated
	BA - Ambient Monitoring Site	GF - Good-Fair	NR*- Not Rated for Recreation (screening criteria exceeded)
	BL- Lake Monitoring	F - Fair	ND-No Data Collected to make assessment
	S- DEH RECMON	P - Poor	**Results**
		NI - Not Impaired	CE-Criteria Exceeded > 10% and more than 10 samples
	Miles/Acres	S- Severe Stress	NCE-No Criteria Exceeded
	FW- Fresh Water	M-Moderate Stress	
	S- Salt Water	N- Natural	

Aquatic Life Rating Summary

S	m	18.6	FW Miles
NR	m	13.9	FW Miles
I	m	21.1	FW Miles
I	m	8,288.8	FW Acres
NR	e	13.2	FW Miles
ND		121.2	FW Miles
ND		2,613.6	FW Acres

Recreation Rating Summary

S	m	10.5	FW Miles
NR*	m	7.4	FW Miles
I	m	3.3	FW Miles
ND		166.8	FW Miles
ND		10,902.4	FW Acres

Fish Consumption Rating Summary

I	e	187.9	FW Miles
I	e	10,902.4	FW Acres

5.2 Use Support Assessment Summary

Use support ratings were assigned for waters in subbasin 03-06-05 in the aquatic life, recreation, fish consumption and water supply categories. All waters are Impaired on an evaluated basis in the fish consumption category because of fish consumption advice that applies to the entire basin. In the water supply category, all WS classified waters (10,902.4 acres and 124.9 miles) are Supporting on an evaluated basis based on reports from DEH regional water treatment plant consultants. Refer to Appendix X for a complete list of monitored waters and more information on Supporting monitored waters.

There were 53.6 stream miles (28.5 percent) and 8,288.8 freshwater acres (76 percent) monitored during this assessment period in the aquatic life category. There were 21.1 miles (11.2 percent) and 8,288.8 acres (76 percent) of Impaired waters in this category. There were also 3.3 miles (1.7 percent) Impaired for recreation in this subbasin.

5.3 Status and Recommendations of Previously and Newly Impaired Waters

The following waters were either identified as Impaired in the previous basin plan (2000) or are newly Impaired based on recent data. If previously identified as Impaired, the water will either remain on the state's 303(d) list or will be delisted based on recent data showing water quality improvements. If the water is newly Impaired, it will likely be placed on the 2006 303(d) list. The current status and recommendations for addressing these waters are presented below, and each is identified by an assessment unit number (AU#). Refer to the overview for more information on AUs. Information regarding 303(d) listing and reporting methodology is presented in Appendix VII.

5.3.1 B. Everett Jordan Reservoir

New Hope Creek Arm [AU # 16-41-1-(14)]
New Hope River Arm [AU # 16-41-(0.5) and (3.5)a]
Morgan Creek Arm [AU # 16-41-2-(9.5)] (Subbasin 03-06-06)
Haw River Arm [AU # 16-(37.3) and (37.5)] (Subbasin 03-06-04)

2000 Recommendations

The 2000 basin plan recommended that DWQ continue to monitor Jordan Reservoir to assess impacts from increasing wastewater discharges and development in the watershed and to update the NSW strategy for the reservoir and its watershed.

Current Status

Jordan Reservoir (9,766.5 acres) is Impaired because the chlorophyll *a* standard was violated at stations in all mainstem segments of the reservoir and because modeling indicated violations of the chlorophyll *a* standard in the New Hope Creek, Morgan Creek and Haw River Arms of the reservoir. The highest chlorophyll *a* levels were collected from August to November. Chlorophyll *a* levels exceeded the standard in 73 percent of samples in the New Hope River Arm and in 13 percent of samples in mid reservoir. Blooms of blue-green algae associated with taste and odor problems in drinking water were observed in July 2003. The reservoir has been eutrophic since 1982. The Beaver Creek, Parkers Creek and White Oak Creek Arms (2,613.5

acres) are Not Rated for aquatic life. Data to assess recreation use support were not collected in the reservoir.

2005 Recommendations
Refer to Chapter 36 for complete discussions of the Jordan NSW strategy, TMDLs, modeling, monitoring, HB515 and SB1366. DWQ, with the Jordan stakeholders, will continue to monitor the reservoir to assess water quality changes associated with implementation of the NSW strategies.

Segments 16-41-1-(14), 16-41-1-(0.5) and 16-41-2-(9.5) will remain on the 303(d) list. The Haw River and New Hope River Arms will be added to the 303(d) list. TMDLs are currently being developed to address the Impairment in Jordan Reservoir (Chapter 36).

5.3.2 New Hope Creek [AU# 16-41-1-(0.5)a, b, and (11.5)a, b and c]

2000 Recommendations
The 2000 basin plan recommended that DWQ work with the stormwater programs to help improve water quality in New Hope Creek. DWQ also encouraged smaller facilities to connect to the regional WWTP where possible.

Current Status
New Hope Creek [16-41-1-(0.5)a] from source to Sandy Creek (17.4 miles) is Supporting aquatic life because of a Good-Fair benthic community rating at site BB324.

New Hope Creek [16-41-1-(0.5)b and (11.5)a] from Sandy Creek to SR 2220 (1.1 miles) is Supporting aquatic life because of a Good-Fair fish community rating at site BF57. The creek had no intolerant species indicating degraded water quality.

New Hope Creek [16-41-1-(11.5)b] from SR 2220 to I-40 (3.5 miles) is Impaired for aquatic life because the dissolved oxygen standard was violated in 13 percent of samples and the turbidity standard was violated in 12 percent of samples collected during the assessment period at site BA177. This segment is Not Rated for recreation because fecal coliform bacteria screening criteria were exceeded at site BA177.

DWQ performed a statistical trend analysis at site BA177 using total nitrogen, total phosphorus and total suspended solids data collected from 1990 to 2004. There was a significant decrease in total nitrogen of 0.17 mg/l per year in New Hope Creek. Downward trends were noted for total phosphorus and total suspended solids, although these trends were not significant.

New Hope Creek [16-41-1-(11.5)c] from I-40 to SR 1107 (4 miles) is Impaired for aquatic life because of a Fair benthic community rating at site BB238. The riparian zone was intact at site BB238, but the banks were steep and eroding and there was little pool and riffle habitat. The stream also contains trash from the surrounding urban watershed. DWQ completed a fecal coliform study in New Hope Creek in 2000 and determined that fecal coliform bacteria did not exceed the standard in this segment. This segment is Supporting recreation because of this sampling. There are many single family NPDES permitted discharges in this watershed that may contribute oxygen-consuming wastes as well as bacteria and nutrients.

2005 Recommendations
DWQ will continue to monitor the New Hope Creek to identify stressors to the benthic community. DWQ will continue to work with Durham stormwater program to pursue funding for BMPs in the New Hope Creek watershed to further decrease nutrient loading into Jordan Reservoir. Further recommendations to protect streams in urbanizing areas and to restore streams in existing urban areas are discussed in Chapter 31.

Segment 16-41-1-(11.5)b and c remain on the 303(d) list. Segments 16-41-(0.5)a and b and 16-41-(11.5)a will be removed from the 303(d) list. TMDLs (Chapter 35) will be developed for identified stressors within 8-13 years of listing.

Water Quality Initiatives
In 1997, Durham County received a $750,000 CWMTF (Chapter 34) grant to purchase 340 acres of conservation easements along New Hope Creek [16-41-1-(0.5)a] and Mud Creek [16-41-1-10] in this watershed. The Triangle Land Conservancy (Chapter 34) also received a $2,750,000 CWMTF grant to acquire 392 acres along the New Hope Creek Greenway. In 1998, Chapel Hill received a $502,000 CWMTF grant to acquire 105 acres of permanent easements along Dry Creek. In 1999, NCEEP (Chapter 34) received a $582,500 CWMTF grant to stabilize and restore 450 linear feet of Sandy Creek [16-41-1-11] in Duke Forest and to construct a bioretention areas to treat runoff from 25 acres of urban area. This grant also included restoration of 8.2 acres of bottomland hardwood wetlands in the New Hope Creek watershed. The NCEEP completed 3,000 linear feet of stream enhancement in the Sandy Creek watershed.

5.3.3 Northeast Creek [AU # 16-41-1-17-(0.7)a, b1 and b2]

2000 Recommendations
The 2000 basin plan recommended that DWQ work with the stormwater programs to help improve water quality in Northeast Creek.

Current Status
Northeast Creek [16-41-1-17-(0.7)a] from US 55 to Durham Triangle WWTP (3.3 miles) is Impaired for aquatic life because the turbidity standard was violated in 15 percent of samples and the dissolved oxygen standard was violated in 11 percent of samples at sites BA197. This segment is Supporting recreation because the fecal coliform bacteria standard was not violated during intensive sampling to assess the standard at site BA197.

Northeast Creek [16-41-1-17-(0.7)b1] from Durham Triangle WWTP to Kit Creek (3.3 miles) is Impaired for aquatic life because the turbidity standard was violated in 10.3 percent of samples at site BA209. This segment is Impaired for recreation because the fecal coliform bacteria standard was violated during intensive sampling to assess the standard at site BA209.

Northeast Creek [16-41-1-17-(0.7)b2] from Kit Creek to downstream of Panther Creek (3.2 miles) is Impaired for aquatic life because the turbidity standard was violated in 15 percent of samples at site BA209. This segment is Supporting for recreation because the fecal coliform bacteria standard was not violated during intensive sampling at site BA209. DWQ developed a fecal coliform bacteria TMDL that was approved by EPA in September 2003. The TMDL recommended a 90 percent reduction in bacteria loading from urban stormwater in Durham (Chapter 35).

2005 Recommendations
DWQ will continue to monitor Northeast Creek. DWQ will work with Durham stormwater services where possible to help reduce the impacts of stormwater and to reduce bacteria loading by 90 percent. Further recommendations to protect streams in urbanizing areas and to restore streams in existing urban areas are discussed in Chapter 31.

All three segments will remain on the 303(d) list. TMDLs (Chapter 35) will be developed for identified stressors within 8-13 years of listing.

5.3.4 Third Fork Creek [AU # 16-41-1-12-(1) and (2)]

2000 Recommendations
The 2000 basin plan recommended that DWQ continue to monitor Third Fork Creek to determine the impacts of development in the watershed.

Current Status
Third Fork Creek [16-41-1-12-(1)] from source to 2 miles upstream of NC 54 (5.2 miles) is Not Rated on an evaluated basis because Brenntag Southeast Incorporated (NC0086827) failed whole effluent toxicity (WET) tests five times during the last two years of the assessment period. The facility is in the headwaters of Third Fork Creek and instream impacts of these failures could not be assessed. Chemical leaching at Brenntag may be a potential source of toxicity.

Third Fork Creek [16-41-1-12-(2)] from 2 miles upstream of NC 54 to New Hope Creek (3.9 miles) is Impaired for aquatic life because the turbidity standard was violated in 12 percent of samples collected at site BA178 during the assessment period. This segment is Not Rated for recreation because the fecal coliform bacteria screening criteria were exceeded at site BA178.

A TMDL (Chapter 35) was approved in January 2005 for total suspended solids that recommended a 56 percent reduction in TSS mostly from the Durham stormwater system.

2005 Recommendations
DWQ will continue to monitor Third Fork Creek. DWQ will work with Durham stormwater services where possible to help reduce the impacts of stormwater. DWQ will determine if intensive sampling is needed to assess the fecal coliform bacteria standard in this creek (Appendix X). The NPDES compliance process will be used to address the significant permit violations noted above.

Segment 16-41-1-12-(2) will be added to the 303(d) list. TMDLs (Chapter 35) will be developed for identified stressors within 8-13 years of listing.

Water Quality Initiatives
The NCEEP completed 3,200 linear feet of stream restoration in this watershed (Chapter 34).

5.4 Status and Recommendations for Waters with Noted Impacts

The surface waters discussed in this section are not Impaired. However, notable water quality problems and concerns have been documented for some waters based on this assessment. While these waters are not Impaired, attention and resources should be focused on these waters to prevent additional degradation or facilitate water quality improvement. Waters in the following section are identified by assessment unit number (AU#). See overview for more information on AU#s.

5.4.1 Beaver Creek [AU# 16-41-10-(0.5)]

Current Status and 2005 Recommendations
Beaver Creek from NC 55 to SR 1141 (6 miles) was not assigned a use support rating during this assessment period. Beaver Creek drains urbanized areas in and around Apex and is likely impacted by runoff. Further recommendations to protect streams in urbanizing areas and to restore streams in existing urban areas are discussed in Chapter 31.

Water Quality Initiatives
The Town of Apex (Chapter 34) received a $387,000 CWMTF grant to acquire 43.2 acres of riparian floodplain to add to 81.6 acres already owned by the town as part of a greenway system.

5.4.2 Cub Creek [AU # 16-41-2-10-(0.5)]

Current Status and 2005 Recommendations
Cub Creek from the source to downstream of SR 1008 (8 miles) is currently Not Rated for aquatic life on an evaluated basis because Cole Park Plaza (NC0051314) had significant violations of surfactant permit limits, which could have adversely impacted aquatic life in the creek. The NPDES compliance process will continue to be used to address significant permit violations.

5.4.3 White Oak Creek [AU# 16-41-6-(0.3) and (0.7)]

Current Status and 2005 Recommendations
White Oak Creek from source to NC 751 (9.6 miles) is Not Rated for aquatic life, and a benthic community rating could not be assigned at site BB314 because the stream dries in summer months. The benthic community was impacted by 2002 drought conditions. The upper portions of White Oak Creek drain urbanized Cary. Further recommendations to protect streams in urbanizing areas and to restore streams in existing urban areas are discussed in Chapter 31.

Water Quality Initiatives
The Town of Cary (Chapter 34) requires 100-foot buffers on all USGS mapped perennial and intermittent streams. The buffer requirements will help minimize water quality impacts in the White Oak Creek watershed as development proceeds. In 2000, Cary (Chapter 34) received an $86,000 CWMTF grant to produce a greenway feasibility study in the White Oak Creek watershed. In 2001, Cary received a $1,084,000 CWMTF grant to purchase conservation easements along 197 acres of White Oak Creek to be part of a greenway system.

5.5 Additional Water Quality Issues within Subbasin 03-06-05

The following section discusses issues that may threaten water quality in the subbasin that are not specific to particular streams, lakes or reservoirs. The issues discussed may be related to waters near certain land use activities or within proximity to different pollution sources.

5.5.1 Jordan Haw River Watershed Nutrient Sensitive Waters Strategy

All land uses and discharges of wastewater and stormwater in subbasin 03-06-05 potentially contribute nutrients to Jordan Reservoir in subbasins 03-06-04 and 03-06-05. The reservoir is Impaired for aquatic life because chlorophyll *a* violated the standard in all segments of the reservoir. Refer to Chapter 36 for more information on this strategy.

Chapter 6
Cape Fear River Subbasin 03-06-06

Including: Morgan Creek, Bolin Creek, Booker Creek, Little Creek and University Lake

6.1 Subbasin Overview

Subbasin 03-06-06 at a Glance

Land and Water Area

Total area:	75 mi²
Land area:	74 mi²
Water area:	1 mi²

Population Statistics

2000 Est. Pop.: 23,470 people
Pop. Density: 315 persons/mi²

Land Cover (percent)

Forest/Wetland:	84%
Surface Water:	1.4%
Urban:	5.3%
Cultivated Crop:	0.6%
Pasture/ Managed Herbaceous:	8.6%

Counties

Chatham, Durham and Orange

Municipalities

Carrboro and Chapel Hill

Subbasin 03-06-06 is in the Carolina slate belt characterized by low flowing streams during summer months. Most of the watershed is forested with urban areas and development around Chapel Hill and Carrboro. Population is expected to grow by 55,000 people in counties with portions or all of their areas in this subbasin by 2020.

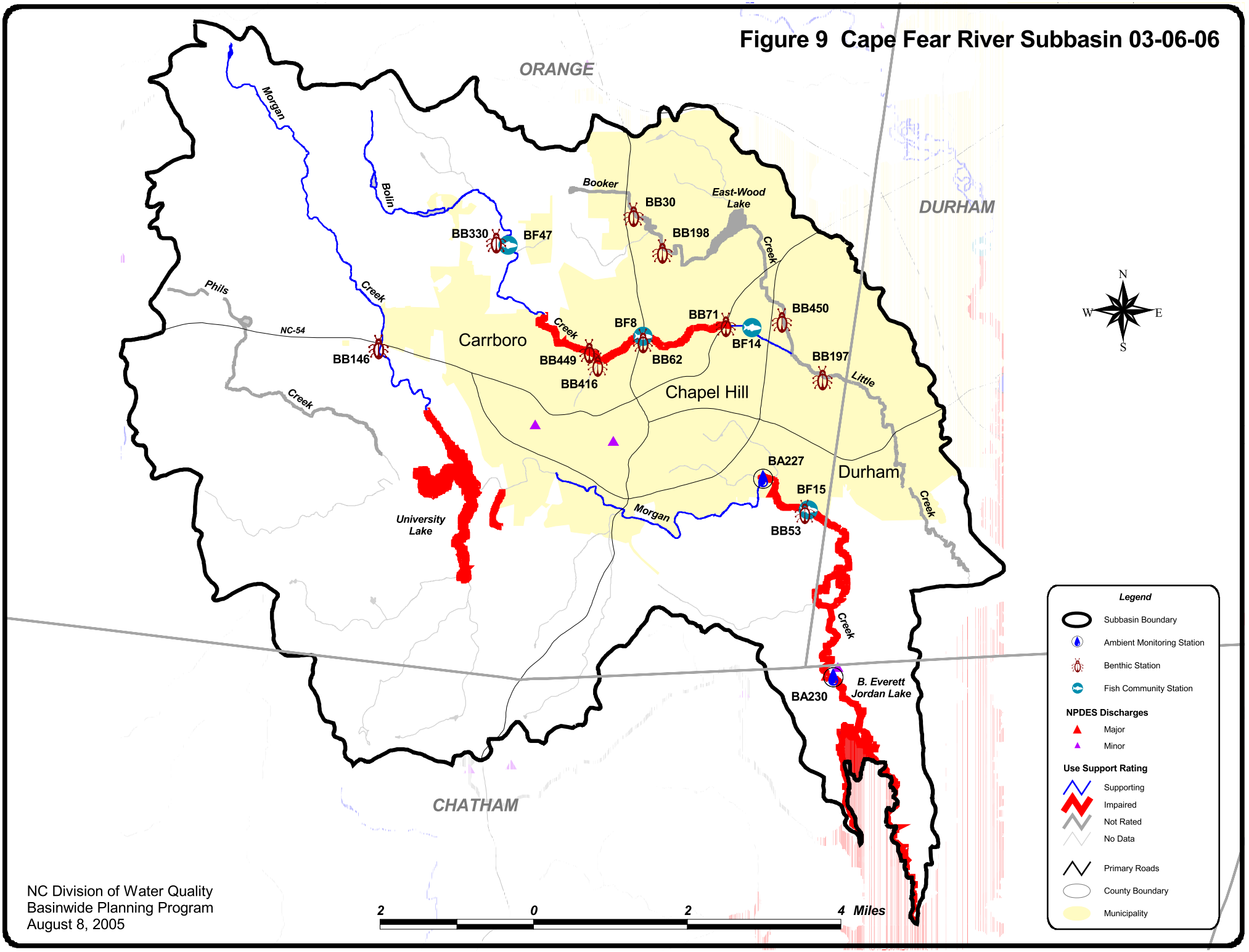
There are four individual NPDES wastewater discharge permits in this subbasin with a permitted flow of 14.8 MGD (Figure 9). The largest is Mason Farm WWTP (14.5 MGD). Refer to Appendix VI and Chapter 30 for more information on NPDES permit holders. Issues related to compliance with NPDES permit conditions are discussed below in Section 6.3 for Impaired waters and in Section 6.4 for other waters.

Carrboro and Chapel Hill are required to develop Phase II stormwater programs (Chapter 31).

There were 11 benthic community samples and four fish community samples (Figure 9 and Table 9) collected during this assessment period. Data were also collected from two ambient monitoring stations including one UCFRBA (Appendix V) station and one shared ambient station. Two reservoirs were also monitored. Refer to the *2003 Cape Fear River Basinwide Assessment Report* at http://www.esb.enr.state.nc.us/bar.html and Appendix IV for more information on monitoring.

Waters in the following sections are identified by assessment unit number (AU#). This number is used to track defined segments in the water quality assessment database, 303(d) Impaired waters list and the various tables in this basin plan. The assessment unit number is a subset of the DWQ index number (classification identification number). A letter attached to the end of the AU# indicates that the assessment is smaller than the DWQ index segment. No letter indicates that the assessment unit and the DWQ index segment are the same.

Figure 9 Cape Fear River Subbasin 03-06-06



NC Division of Water Quality
Basinwide Planning Program
August 8, 2005

Table 9 CAPE FEAR Subbasin 03-06-06

AU Number / Description	Classification	Length/Area		Aquatic Life Assessment					Recreation Assessment			Stressors	Sources
				AL Rating	Station	Result	Year/ Parameter	% Exc	REC Rating	Station	Result		
Bolin Creek													
16-41-1-15-1-(4)	WS-IV NS	0.9	FW Miles	**S**					ND			Habitat Degradation	MS4 NPDES
From US Hwy 501 Business to Little Creek					BF14	GF	2001						
Bolin Creek (Hogan Lake)													
16-41-1-15-1-(0.5)a	C NSW	5.3	FW Miles	**S**					ND				
From source to Pathway Drive					BB330	GF	2001						
					BB330	NR	2001						
					BB330	G	2000						
					BF47	G	2001						
16-41-1-15-1-(0.5)b	C NSW	3.1	FW Miles	**I**					ND				
From Pathway Drive to US Hwy 501 Business					BB449	F	2002						
					BB449	F	2001						
					BB449	P	2001						
					BB62	P	2002						
					BB62	P	2001						
					BB71	P	2001						
					BB71	P	2001						
					BF8	G	2001						
Booker Creek													
16-41-1-15-2-(4)	C NSW	1.2	FW Miles	**NR**					ND				
From dam at eastwood Lake to US Hwy 15					BB450	NR	2001						
					BB450	NR	2001						
16-41-1-15-2-(5)	WS-IV NS	0.9	FW Miles	**NR**					ND				
From US Hwy 15 to Little Creek					BB450	NR	2001						
					BB450	NR	2001						
Booker Creek (East-wood Lake)													
16-41-1-15-2-(1)	B NSW	3.5	FW Miles	**NR**					ND				
From source to dam at Eastwood Lake					BB198	NR	2001						
					BB198	NR	2001						
					BB30	NR	2001						
					BB30	NR	2001						

Table 9 CAPE FEAR Subbasin 03-06-06

AU Number	Classification	Length/Area	Description	Aquatic Life Assessment					Recreation Assessment			Stressors	Sources
				AL Rating	Station	Result	Year/ Parameter	% Exc	REC Rating	Station	Result		
Little Creek													
16-41-1-15-(0.5)	WS-IV NS	4.9 FW Miles	From source to a point 0.7 mile downstream of Durham County SR 1110	**NR**	BB197	NR	2001		ND				
					BB197	P	2001						
Morgan Creek													
16-41-2-(1)	Ws-II HQW	7.1 FW Miles	From source to a point 1.4 miles downstream of NC Hwy 54	**S**	BB146	G	2003		ND			Habitat Degradation	MS4 NPDES
					BB146	GF	2003					Habitat Degradation	WWTP NPDES
					BB146	GF	2003						
					BB146	NR	2003						
					BB146	NR	2002						
					BB146	E	2000						
					BB146	NR	2003						
16-41-2-(5.5)a	WS-IV NS	4.0 FW Miles	From Orange County SR 1919 to Meeting of the Waters	**S**	BA227	NCE			**NR***	BA227	NCE		
16-41-2-(5.5)b	WS-IV NS	4.1 FW Miles	From Meeting of the Waters to Chatham County SR 1726 (Durham County SR 1109)	**I**	BB53	F	2003		ND			Habitat Degradation	MS4 NPDES
					BF15	F	1999						
Morgan Creek (including the Morgan Creek Arm of New Hope River Arm of B. Everett Jordan Lake)													
16-41-2-(9.5)	WS-IV NS	836.2 FW Acres	From Chatham County SR 1726 (Durham County SR	**I**	BA230	NCE			**S**	BA230	NCE	Chlorophyll a	MS4 NPDES
					BL16	CE	Chlor a	66.7				Chlorophyll a	WWTP NPDES
Morgan Creek (University Lake)													
16-41-2-(1.5)	WS-II HQ	163.2 FW Acres	From a point 1.4 miles downstream of NC Hwy 54 to dam at University Lake	**NR**	BL15	NCE	Chlor a	100	ND			Chlorophyll a	Agriculture
Tanbark Branch													
16-41-1-15-1-3	C NSW	1.2 FW Miles	From source to Bolin Creek	**NR**	BB416	NR	2002		ND				

Table 9 CAPE FEAR Subbasin 03-06-06

AU Number	Classification	Length/Area	Description	Aquatic Life Assessment					Recreation Assessment				
				AL Rating	Station	Result	Year/ Parameter	% Exc	REC Rating	Station	Result	Stressors	Sources

AL - Aquatic Life	BF - Fish Community Survey	E - Excellent	S - Supporting, I - Impaired
REC - Recreation	BB - Benthic Community Survey	G - Good	NR - Not Rated
	BA - Ambient Monitoring Site	GF - Good-Fair	NR*- Not Rated for Recreation (screening criteria exceeded)
	BL- Lake Monitoring	F - Fair	ND-No Data Collected to make assessment
	S- DEH RECMON	P - Poor	**Results**
		NI - Not Impaired	CE-Criteria Exceeded > 10% and more than 10 samples
	Miles/Acres	S- Severe Stress	NCE-No Criteria Exceeded
	FW- Fresh Water	M-Moderate Stress	
	S- Salt Water	N- Natural	

Aquatic Life Rating Summary

S	m	17.4	FW Miles
NR	m	11.8	FW Miles
I	m	7.2	FW Miles
NR	m	163.2	FW Acres
I	m	836.2	FW Acres
NR	e	5.0	FW Miles
ND		36.1	FW Miles

Recreation Rating Summary

NR*	m	4.0	FW Miles
S	m	836.2	FW Acres
ND		73.4	FW Miles
ND		163.2	FW Acres

Fish Consumption Rating Summary

I	e	77.4	FW Miles
I	e	999.4	FW Acres

6.2 Use Support Assessment Summary

Use support ratings were assigned for waters in subbasin 03-06-06 in the aquatic life, recreation, fish consumption and water supply categories. All waters are Impaired on an evaluated basis in the fish consumption category because of fish consumption advice that applies to the entire basin. In the water supply category, all WS classified waters (999.4 acres and 57.2 miles) are Supporting on an evaluated basis based on reports from DEH regional water treatment plant consultants. Refer to Appendix X for a complete list of monitored waters and more information on Supporting monitored waters.

There were 36.3 stream miles (46.9 percent) and 999.4 freshwater acres (100 percent) monitored during this assessment period in the aquatic life category. There were 7.2 miles (9.3 percent) and 836.2 acres (83.7 percent) of Impaired waters in this category.

6.3 Status and Recommendations of Previously and Newly Impaired Waters

The following waters were either identified as Impaired in the previous basin plan (2000) or are newly Impaired based on recent data. If previously identified as Impaired, the water will either remain on the state's 303(d) list or will be delisted based on recent data showing water quality improvements. If the water is newly Impaired, it will likely be placed on the 2006 303(d) list. The current status and recommendations for addressing these waters are presented below, and each is identified by an assessment unit number (AU#). Refer to the overview for more information on AUs. Information regarding 303(d) listing and reporting methodology is presented in Appendix VII.

6.3.1 Bolin Creek [AU#16-41-1-15-1-(0.5) a and b and 16-41-1-15-1-(4)]

2000 Recommendations
The 2000 basin plan recommended that DWQ work with Chapel Hill as they develop a stormwater program to help improve water quality in Bolin Creek.

Current Status
Bolin Creek [16-41-1-15-1-(0.5)a] from source to Pathway Drive (5.3 miles) is Supporting aquatic life because of a Good-Fair benthic community rating at site BB330 and a Good fish community rating at site BF47, although intolerant fish species were absent from this site.

Bolin Creek [16-41-1-15-1-(0.5)b] from Pathway Drive to US 501 (3.1 miles) is Impaired for aquatic life because of a Fair benthic community rating at site BB449 and Poor benthic community ratings at sites BB71 and BB62. The fish community rating was Good at site BF8, although intolerant fish species were absent from this site. DWQ regional office staff indicates that grease clogging has caused sanitary sewer overflows that may have negative impacts on water quality in this segment.

A WARP study completed in June 2003 identified toxicity, low dissolved oxygen, organic enrichment, scour and widespread habitat degradation from sedimentation from storm sewers and runoff from impervious surfaces as stressors to the biological communities of Bolin Creek.

For more information on Bolin Creek, visit the Little Creek Watershed Assessment Report at http://h2o.enr.state.nc.us/swpu/.

Bolin Creek [16-41-1-15-1-(4)] from US 501 to Little Creek (0.9 mile) is Supporting aquatic life because of a Good-Fair benthic community rating at site BF14, although intolerant fish species were absent from this site and a high percentage of fish exhibited disease symptoms.

2005 Recommendations
DWQ will continue to monitor Bolin Creek. The WARP project also recommends retrofitting existing stormwater discharges and preventing increased sedimentation to the watershed during future development. DWQ will work with the Chapel Hill stormwater program to help identify stormwater retrofit opportunities. Further recommendations to protect streams in urbanizing areas and to restore streams in existing urban areas are discussed in Chapter 31.

Segment 16-41-1-15-1-(4) will be removed from the 303(d) list, and segment 16-41-1-15-1-(0.5)b will be added to the list based on data collected as part of the WARP study. TMDLs (Chapter 35) will be developed for identified stressors within 8-13 years of listing.

Water Quality Initiatives
In 2002, Carrboro received a $202,000 CWMTF (Chapter 34) grant to help purchase 28 acres along Bolin Creek. This watershed is also included in the NCEEP Local Watershed Plan for Morgan and Little Creeks, discussed under Little Creek in this chapter. The Final Local Watershed Plan for Morgan and Little Creeks, completed in 2004, may be viewed at: http://www.nceep.net/services/lwps/Morgan_Creek/morgan.htm

6.3.2 Booker Creek [AU# 16-41-1-15-2-(1), (4) and (5)]

2000 Recommendations
The 2000 basin plan recommended that DWQ work with Chapel Hill as they develop a stormwater program to help improve water quality in Booker Creek.

Current Status
Booker Creek [all segments] from source to Little Creek (5.6 miles) is Not Rated for aquatic life because benthic community ratings could not be assigned at sites BB198, BB30 and BB450.

A WARP study completed in June 2003 identified toxicity, low dissolved oxygen, organic enrichment, scour and widespread habitat degradation from sedimentation from storm sewers and runoff from impervious surfaces as being stressors to the biological communities Booker Creek. The study also indicates that the impoundments on Booker Creek are also a stressor to the biological community. For more information on Booker Creek, visit the Little Creek Watershed Assessment Report at http://h2o.enr.state.nc.us/swpu/.

2005 Recommendations
DWQ will continue to monitor Booker Creek. The WARP project recommends retrofitting existing stormwater discharges and preventing increased sedimentation to the watershed during future development. DWQ will work with the Chapel Hill stormwater program to help identify stormwater retrofit opportunities. Further recommendations to protect streams in urbanizing areas and to restore streams in existing urban areas are discussed in Chapter 31.

All three segments will remain on the 303(d) list of Impaired waters. TMDLs (Chapter 35) will be developed for identified stressors within 8-13 years of listing.

Water Quality Initiatives
This watershed is also included in the NCEEP Local Watershed Plan for Morgan and Little Creeks, discussed under Little Creek in this chapter. The Final Local Watershed Plan for Morgan and Little Creeks, completed in 2004, may be viewed at: http://www.nceep.net/services/lwps/Morgan_Creek/morgan.htm

6.3.3 Little Creek [AU#16-41-1-15-(0.5) and (3)]

2000 Recommendations
The 2000 basin plan recommended that DWQ work with Chapel Hill as they develop a stormwater program to help improve water quality in Little Creek.

Current Status
Little Creek [16-41-1-15-(0.5)] from source to downstream of SR 1110 (4.9 miles) is Not Rated for aquatic life because a benthic community rating could not be assigned at site BB197. This site previously received a Poor benthic community rating. Segment [16-41-1-15-(3)] (0.8 miles) has never been monitored and is in a swampy area associated with Army Corps of Engineers flow easements south of NC 54.

A WARP study completed in June 2003 identified toxicity, low dissolved oxygen, organic enrichment, scour and widespread habitat degradation from sedimentation from storm sewers and runoff from impervious surfaces as being stressors to the biological communities Little Creek. For more information, visit the Little Creek Watershed Assessment Report at http://h2o.enr.state.nc.us/swpu/. These creeks exhibit or are threatened with habitat degradation, sediment, fecal coliform bacteria, toxicity and low dissolved oxygen. Urban runoff and effluent from wastewater treatment are possible sources of degradation. In upper Morgan Creek, agriculture is also a possible source of degradation.

2005 Recommendations
DWQ will continue to monitor the Little Creek. The WARP project recommends retrofitting existing stormwater discharges and preventing increased sedimentation to the watershed during future development. DWQ will work with the Chapel Hill stormwater program to help identify stormwater retrofit opportunities. Further recommendations to protect streams in urbanizing areas and to restore streams in existing urban areas are discussed in Chapter 31.

Both segments will remain on the 303(d) list. TMDLs (Chapter 35) will be developed for identified stressors within 8-13 years of listing.

Water Quality Initiatives
The focus of the NCEEP local watershed planning activity is on upper Morgan Creek (30 square miles), lower Morgan Creek (19.9 square miles), and Little Creek (Booker and Bolin Creeks, with 24.6 square miles). The Local Watershed Plan recommends restoration and preservation projects through the implementation of:

- 25 Best Management Practices to treat water quality in 600 acres of priority subwatersheds
- 11 stream restoration projects to gain 28,000 linear feet of restored stream
- 137 priority preservation parcels to protect over 600 acres of priority habitat

In addition, proposed changes to local rules are advocated to support Low Impact Development and prevent future degradation from occurring in the watershed. The Local Watershed Plan for Morgan and Little Creeks, completed in 2004, may be viewed at: http://www.nceep.net/services/lwps/Morgan_Creek/morgan.htm

6.3.4 Meeting of the Waters [AU#16-41-2-7]

2000 Recommendations
The 2000 basin plan recommended that DWQ work with Chapel Hill as they develop a stormwater program to help improve water quality in Meetings of the Waters.

Current Status
This stream was not resampled during this assessment period, and previous benthic community ratings have been changed to Not Rated because the stream was too small to assign a rating. The stream is in a highly urbanized area of Chapel Hill. Meeting of the Waters will remain on the 303(d) list of Impaired waters.

Water Quality Initiatives
This watershed is also included in the NCEEP Local Watershed Plan for Morgan and Little Creeks, discussed under Little Creek in this chapter. The Final Local Watershed Plan for Morgan and Little Creeks, completed in 2004, may be viewed at: http://www.nceep.net/services/lwps/Morgan_Creek/morgan.htm

6.3.5 Morgan Creek [AU#16-41-2-(5.5)a and b]

2000 Recommendations
The 2000 basin plan recommended that DWQ work with Chapel Hill as they develop a stormwater program to help improve water quality in Morgan Creek.

Current Status
Morgan Creek [16-41-2-(5.5)a] from SR 1919 to SR 1726 at Meeting of the Waters (4 miles) is Supporting aquatic life because no criteria were exceeded at site BA227. This segment is Not Rated for recreation because the fecal coliform bacteria screening criteria were exceeded at site BA227.

Morgan Creek [16-41-2-(5.5)b] from Meeting of the Waters to SR 1109 (4.1 miles) is Impaired for aquatic life because of Fair benthic and fish community ratings at sites BB53 and BF15. The water was turbid at the sample site and smelled of sewage. Suitable aquatic habitat was limited to stream margins and woody debris as the stream bottom was entirely sand. This segment is Not Rated for recreation because the fecal coliform bacteria screening criteria were exceeded at site BA227, and because Mason Farm WWTP (NC0025241) and Carolina Meadows WWTP (NC0056413) had significant violations of fecal coliform bacteria permit limits during the last

two years of the assessment period. The violations at Mason Farm occurred during plant upgrades and are not ongoing.

2005 Recommendations
DWQ will continue to monitor Morgan Creek. The WARP project recommends retrofitting existing stormwater discharges and preventing increased sedimentation to the watershed during future development. The NPDES compliance process will be used to address the significant permit violations noted above. DWQ will determine if intensive sampling is needed to assess the fecal coliform bacteria standard in this creek (Appendix X). DWQ will work with the Chapel Hill stormwater program to help identify stormwater retrofit opportunities. Further recommendations to protect streams in urbanizing areas and to restore streams in existing urban areas are discussed in Chapter 31.

Segment 16-41-2-(5.5)b will remain on the 303(d)list. TMDLs (Chapter 35) will be developed for identified stressors within 8-13 years of listing.

Water Quality Initiatives
This watershed is also included in the NCEEP Local Watershed Plan for Morgan and Little Creeks, discussed under Little Creek in this chapter. The Final Local Watershed Plan for Morgan and Little Creeks, completed in 2004, may be viewed at:
http://www.nceep.net/services/lwps/Morgan_Creek/morgan.htm

The NCEEP has also completed 10 acres of riverine restoration in the Morgan Creek floodplain (Chapter 34).

6.3.6 Morgan Creek University Lake [AU#16-41-2-(1.5)]

Current Status
University Lake was Fully Supporting in the 2000 basin plan. University Lake (163.2 acres) is currently Not Rated for aquatic life because 100 percent of the three chlorophyll *a* samples exceeded the water quality criterion; however, not enough samples were collected to assign a use support rating. Nutrient levels in the reservoir were high and the lake has been hypereutrophic as noted in previous years. Dissolved oxygen saturation was elevated. Mild to severe algal blooms occurred throughout the summer months of 2003. Some of the blue-green algal blooms can cause taste and odor problems in treated drinking water.

2005 Recommendations
DWQ will continue to monitor University Lake. It is recommended that OWASA continue efforts to protect the water supply from nutrient loading that causes algal blooms.

Water Quality Initiatives
OWASA has continued to pursue funding to protect this watershed from further increases in nutrient loading. This watershed is also included in the NCEEP Local Watershed Plan for Morgan and Little Creeks, discussed under Little Creek in this chapter. The Local Watershed Plan for Morgan and Little Creeks, completed in 2004, may be viewed at:
http://www.nceep.net/services/lwps/Morgan_Creek/morgan.htm

6.4 Additional Water Quality Issues within Subbasin 03-06-06

The following section discusses issues that may threaten water quality in the subbasin that are not specific to particular streams, lakes or reservoirs. The issues discussed may be related to waters near certain land use activities or within proximity to different pollution sources.

6.4.1 Jordan Haw River Watershed Nutrient Sensitive Waters Strategy

All land uses and discharges of wastewater and stormwater in subbasin 03-06-06 potentially contribute nutrients to Jordan Reservoir in subbasins 03-06-04 and 03-06-05. The reservoir is Impaired for aquatic life because chlorophyll *a* violated the standard in all segments of the reservoir. Refer to Chapter 36 for more information on this strategy.

Chapter 7
Cape Fear River River Subbasin 03-06-07
Including: Cape Fear River, Neills Creek and Parkers Creek

7.1 Subbasin Overview

Subbasin 03-06-07 at a Glance

Land and Water Area

Total area:	415 mi²
Land area:	403 mi²
Water area:	12 mi²

Population Statistics

2000 Est. Pop.: 106,866people
Pop. Density: 257 persons/mi²

Land Cover (percent)

Forest/Wetland:	69.6%
Surface Water:	2.9%
Urban:	1.6%
Cultivated Crop:	21.4%
Pasture/ Managed Herbaceous:	4.6%

Counties

Chatham, Harnett, Lee and Wake

Municipalities

Angier, Broadway, Coats, Erwin, Fuquay-Varina, Holly Springs, Lillington and Sanford

Subbasin 03-06-07 contains streams that drain Triassic basin soils, the coastal plain and the Piedmont. The Cape Fear River starts in this subbasin at the confluence of the Haw and Deep Rivers. Most of the watershed is forested, with extensive agriculture present. Development is occurring in the northern portion near Fuquay-Varina. Population is expected to grow by 435,000 people in counties with portions or all of their areas in this subbasin by 2020. Most growth is expected in Wake County.

There are 16 individual NPDES wastewater discharge permits in this subbasin with a permitted flow of 17.6 MGD (Figure 10). The largest are Progress Energy (10 MGD), Holly Springs WWTP (2.4 MGD), Erwin Mills (2.5 MGD), Shearon Harris (1.6 MGD) and Kenneth Creek WWTP (1.2 MGD). Refer to Appendix VI and Chapter 30 for more information on NPDES permit holders. Issues related to compliance with NPDES permit conditions are discussed below in Section 7.3 for Impaired waters and in Section 7.4 for other waters.

There are two registered swine operations in this subbasin.

There were 16 benthic community samples and four fish community samples (Figure 10 and Table 10) collected during this assessment period. Data were also collected from 15 ambient monitoring stations including eight MCFRBA (Appendix V) stations, one UCFRBA (Appendix V) station, one DWQ station, and two shared ambient stations. Refer to the *2003 Cape Fear River Basinwide Assessment Report* at http://www.esb.enr.state.nc.us/bar.html and Appendix IV for more information on monitoring.

Waters in the following sections are identified by assessment unit number (AU#). This number is used to track defined segments in the water quality assessment database, 303(d) Impaired waters list and the various tables in this basin plan. The assessment unit number is a subset of the DWQ index number (classification identification number). A letter attached to the end of the AU# indicates that the assessment is smaller than the DWQ index segment. No letter indicates that the assessment unit and the DWQ index segment are the same.

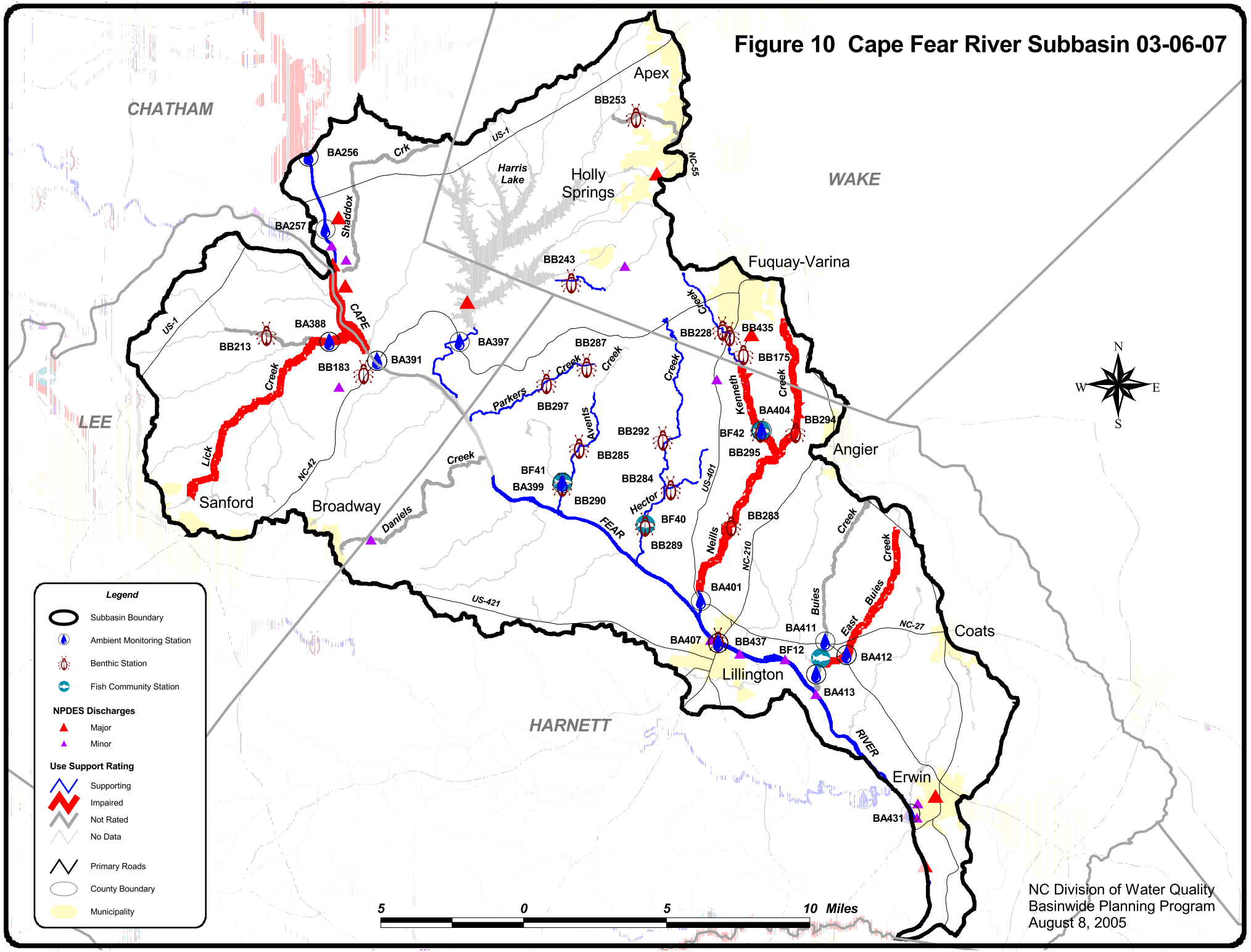


Figure 10 Cape Fear River Subbasin 03-06-07
CHATHAM
WAKE
LEE
HARNETT
Apex
Holly Springs
Fuquay-Varina
Angier
Sanford
Broadway
Lillington
Coats
Erwin
Harris Lake
US-1
NC-55
US-421
NC-42
NC-27
NC-210
US-401
BA256
BA257
BA388
BA391
BA397
BA399
BA401
BA404
BA407
BA411
BA412
BA413
BA431
BB213
BB183
BB253
BB243
BB228
BB435
BB175
BB287
BB297
BB292
BB285
BB284
BB290
BB289
BB283
BB437
BB294
BB295
BF41
BF40
BF42
BF12
Shaddox Crk
CAPE FEAR
Lick Creek
Parkers Creek
Avents Creek
Hector Creek
Kenneth Creek
Neills Creek
Buies Creek
East Buies Creek
Daniels Creek
FEAR RIVER
Legend
Subbasin Boundary
Ambient Monitoring Station
Benthic Station
Fish Community Station
NPDES Discharges
Major
Minor
Use Support Rating
Supporting
Impaired
Not Rated
No Data
Primary Roads
County Boundary
Municipality
5 0 5 10 Miles
N
S
E
W
NC Division of Water Quality
Basinwide Planning Program
August 8, 2005

Table 10 CAPE FEAR Subbasin 03-06-07

AU Number / Description	Classification	Length/Area	Aquatic Life Assessment						Recreation Assessment				
			AL Rating	Station	Result	Year/ Parameter	% Exc		REC Rating	Station	Result	Stressors	Sources
Avents Creek													
18-13-(2)	WS-IV HQ	5.5 FW Miles	**S**	BA399	NCE				**NR***	BA399	NCE	Fecal Coliform Bacteria	Unknown
From a point 1.3 miles upstream of Harnett County SR 1418 to Cape Fear River				BB285	G	2000							
				BB290	E	2003							
				BF41	GF	2003							
Buckhorn Creek													
18-7-(2)	B	2.2 FW Miles	**S**						ND				
From Norfolk Southern Railroad to backwaters of Harris Lake				BB243	G	2003							
Buckhorn Creek (Harris Lake)													
18-7-(11)	C	4.3 FW Miles	**S**	BA397	NCE				ND				
From dam at Harris Lake to Cape Fear River													
Buies Creek													
18-18	WS-IV	8.2 FW Miles	**NR**	BA411	NCE	Low pH	9.1		**NR***	BA411	NCE	Low pH	Unknown
										BA413	NCE	Fecal Coliform Bacteria	Unknown
From source to Cape Fear River				BF12	NR	2003							

Table 10 CAPE FEAR Subbasin 03-06-07

AU Number / Description	Classification	Length/Area	Aquatic Life Assessment						Recreation Assessment					
			AL Rating	Station	Result	Parameter	Year/ % Exc		REC Rating	Station	Result	Stressors	Sources	
CAPE FEAR RIVER														
18-(1)	WS-IV	3.2 FW Miles	I	BA391	NCE	High pH	9.59		S	BA391	NCE	High pH		
				BA391	CE	Chlor a	23.5					Chlorophyll a		
From junction of Haw River and Deep River to a point														
18-(10.5)	WS-IV	9.5 FW Miles	S						ND					
From a point 0.6 mile downstream of mouth of Daniels Creek to a point 0.2 mile dwonstream of Neils Creek				BB437	GF	2003								
				BB437	NR	2002								
				BB437	GF	2003								
18-(16.3)	WS-IV CA	0.5 FW Miles	S						ND					
From a point 0.2 mile downstream of Neills Creek to Lillington water supply				BB437	GF	2003								
				BB437	NR	2002								
				BB437	GF	2003								
18-(16.7)	WS-IV	9.0 FW Miles	S	BA407	NCE	Turbidity	10		S	BA407	NCE	Turbidity	Unknown	
From Lillington water supply intake to Upper Little River				BB437	GF	2003								
				BB437	NR	2002								
				BB437	GF	2003								
18-(20.7)a	WS-V	5.4 FW Miles	S	BA431	NCE				S	BA431	NCE			
From Dunn water supply intake to Lower Little River														
18-(4.5)a	WS-IV CA	0.5 FW Miles	I	BA391	NCE	High pH	9.59		S	BA391	NCE	Chlorophyll a	Unknown	
				BA391	CE	Chlor a	23.5					High pH	Unknown	
From a point 0.5 mile upstream of NC Hwy 42 to NC														
Coopers Branch														
18-15-1	WS-IV HQ	2.9 FW Miles	S						ND					
From source to Hector Creek				BB284	G	2003								
East Buies Creek														
18-18-1-(2)	WS-IV	6.2 FW Miles	I	BA412	CE	Low DO	21.7		NR*	BA412	NCE	Fecal Coliform Bacteria	Unknown	
				BA412	NCE	Low pH	8.7					Low Dissolved Oxygen	Unknown	
From a point 0.2 mile downstream of NC Hwy 55 to Buies Creek												Low pH	Unknown	

Table 10 CAPE FEAR Subbasin 03-06-07

AU Number / Description	Classification	Length/Area	Aquatic Life Assessment					Recreation Assessment				
			AL Rating	Station	Result	Year/ Parameter	% Exc	REC Rating	Station	Result	Stressors	Sources
HAW RIVER												
16-(42)	WS-IV	4.3 FW Miles	**S**	BA256	NCE		25	**S**	BA256	NCE		
				BA257	NCE		13.6		BA257	NCE		
From dam at B. Everett Jordan Lake to Cape Fear River (junction with Deep River)												
Hector Creek												
18-15-(0.7)	WS-IV HQ	8.9 FW Miles	**S**					ND				
From a point 1.1 miles upstream of Harnett County SR 1415 to Cape Fear River				BB289	E	2003						
				BB292	G	2003						
				BF40	E	2003						
Hughes Creek												
18-4-7	WS-IV	3.9 FW Miles	**NR**					ND				
From source to Lick Creek				BB213	NR	2003						
Kenneth Creek												
18-16-1-(1)	C	4.9 FW Miles	**S**					ND				
From source to Wake-Harnett County Line				BB228	G	2003						
				BB435	NR	1998						
18-16-1-(2)	WS-IV	3.9 FW Miles	**I**	BA404	NCE			**S**	BA404	NCE	Habitat Degradation	WWTP NPDES
From Wake-Harnett County Line to Neils Creek				BB295	P	2003					Habitat Degradation	Impervious Surfac
				BF42	G	2003						
Lick Creek												
18-4-(2)	WS-IV	10.3 FW Miles	**I**	BA388	CE	Low DO	15.6	**NR***	BA388	NCE	Fecal Coliform Bacteria	MS4 NPDES
				BA388	NCE	Turbidity	7.8				Turbidity	MS4 NPDES
From dam at Olhams Lake to Cape Fear River											Low Dissolved Oxygen	MS4 NPDES
Little Branch												
18-7-6-1-1	C	3.4 FW Miles	**NR**					ND				
From source to Big Branch				BB253	NR	2003						

Table 10 CAPE FEAR Subbasin 03-06-07

AU Number / Description	Classification	Length/Area	Aquatic Life Assessment					Recreation Assessment			Stressors	Sources
			AL Rating	Station	Result	Year/ Parameter	% Exc	REC Rating	Station	Result		
Neills Creek (Neals Creek)												
18-16-(0.3)	C	2.6 FW Miles	I					ND			Habitat Degradation	Impervious Surfac
From source to a point 0.3 mile upstream of Wake-Harnett County Line				BB294	P	2003					Habitat Degradation	Pasture
											Habitat Degradation	Agriculture
											Habitat Degradation	MS4 NPDES
18-16-(0.7)a	WS-IV	2.0 FW Miles	I					ND			Habitat Degradation	Impervious Surfac
From a point 0.3 mile upstream of Wake-Harnett County Line to SR 1441				BB294	P	2003					Habitat Degradation	Pasture
											Habitat Degradation	Agriculture
											Habitat Degradation	MS4 NPDES
18-16-(0.7)b	WS-IV	1.3 FW Miles	I					ND			Habitat Degradation	Impervious Surfac
From SR 1441 to Kenneth Creek				BB294	P	2003					Habitat Degradation	Pasture
											Habitat Degradation	Agriculture
											Habitat Degradation	MS4 NPDES
18-16-(0.7)c1	WS-IV	6.7 FW Miles	I					ND				
From Kenneth Creek to 0.4 miles upstream of US 401				BB283	F	2003						
18-16-(0.7)c2	WS-IV	1.6 FW Miles	S	BA401	NCE			S	BA401	NCE		
From US 401 to the Cape Fear River												
Parkers Creek												
18-9	C HQW	6.0 FW Miles	S					ND			Turbidity	Unknown
From source to Cape Fear River				BB287	NI	2003						
				BB297	G	2003						

Table 10 CAPE FEAR Subbasin 03-06-07

AU Number / Description	Classification	Length/Area	Aquatic Life Assessment					Recreation Assessment				
			AL Rating	Station	Result	Year/ Parameter	% Exc	REC Rating	Station	Result	Stressors	Sources

AL - Aquatic Life	BF - Fish Community Survey	E - Excellent	S - Supporting, I - Impaired
REC - Recreation	BB - Benthic Community Survey	G - Good	NR - Not Rated
	BA - Ambient Monitoring Site	GF - Good-Fair	NR*- Not Rated for Recreation (screening criteria exceeded)
	BL- Lake Monitoring	F - Fair	ND-No Data Collected to make assessment
	S- DEH RECMON	P - Poor	**Results**
		NI - Not Impaired	CE-Criteria Exceeded > 10% and more than 10 samples
	Miles/Acres	S- Severe Stress	NCE-No Criteria Exceeded
	FW- Fresh Water	M-Moderate Stress	
	S- Salt Water	N- Natural	

Aquatic Life Rating Summary

S	m	65.1	FW Miles
NR	m	15.5	FW Miles
I	m	36.7	FW Miles
S	e	2.9	FW Miles
NR	e	16.6	FW Miles
ND		174.2	FW Miles
ND		4,154.2	FW Acres

Recreation Rating Summary

S	m	27.9	FW Miles
NR*	m	30.2	FW Miles
ND		252.9	FW Miles
ND		4,154.2	FW Acres

Fish Consumption Rating Summary

I	e	311.0	FW Miles
I	e	4,154.2	FW Acres

7.2 Use Support Assessment Summary

Use support ratings were assigned for waters in subbasin 03-06-07 in the aquatic life, recreation, fish consumption and water supply categories. All waters are Impaired on an evaluated basis in the fish consumption category because of fish consumption advice that applies to the entire basin. In the water supply category, all WS classified waters (4,4145.7 acres and 199.8 miles) are Supporting on an evaluated basis based on reports from DEH regional water treatment plant consultants. Refer to Appendix X for a complete list of monitored waters and more information on Supporting monitored waters.

There were 117.4 stream miles (37.7 percent) monitored during this assessment period in the aquatic life category. There are 36.7 stream miles (11.8 percent) Impaired in this same category.

7.3 Status and Recommendations of Previously and Newly Impaired Waters

The following waters were either identified as Impaired in the previous basin plan (2000) or are newly Impaired based on recent data. If previously identified as Impaired, the water will either remain on the state's 303(d) list or will be delisted based on recent data showing water quality improvements. If the water is newly Impaired, it will likely be placed on the 2006 303(d) list. The current status and recommendations for addressing these waters are presented below, and each is identified by an assessment unit number (AU#). Refer to the overview for more information on AUs. Information regarding 303(d) listing and reporting methodology is presented in Appendix VII.

7.3.1 Cape Fear River [AU# 18-(1), (4.5a), (10.5), (16.3), (16.7) and (20.7)]

Current Status

The Cape Fear River was Fully Supporting in the 2000 basinwide plan; however, the Cape Fear River [18-(1) and (4.5a)] from confluence of the Haw and Deep Rivers to NC 42 (3.7 miles) is Impaired for aquatic life because chlorophyll *a* exceeded the standard in 24 percent of samples at site BA391. Algal blooms have been common in this segment of the river upstream of Buckhorn Dam and pH levels were commonly elevated at site BA391 as well. Discharges in the Haw and Deep Rivers, as well as nutrient laden runoff from upstream urban and agricultural land uses, are contributing nutrients into this slow-moving segment. Algal activity was especially high during the summer of 2002 when flow was extremely low due to drought conditions.

The Cape Fear River [18-(10.5), (16.3) and (16.7)] from downstream of Daniels Creek to the Upper Little River (19 miles) is Supporting aquatic life because of a Good-Fair benthic community rating at site BB437; however, turbidity was above the water quality standard in 10 percent of samples collected at site BA407. Runoff from upstream land uses in the Haw and Deep River watersheds are the likely source of the increased turbidity.

The Cape Fear River [18-(20.7)a)] from Dunn water supply intake to Lower Little River (5.4 miles) is Supporting aquatic life because no criteria were exceeded at site BA431. This segment of the Cape Fear River is Not Rated on an evaluated basis for recreation because the Erwin WWTP (NC0064521) had significant violations of fecal coliform bacteria permit limits.

2005 Recommendations
DWQ and MCFRBA (Appendix V) will continue to monitor water quality in this segment of the Cape Fear River. The NPDES compliance process will be used to address the significant permit violations noted above.

Segments 18-(1) and (4.5) will be added to the 303(d) list of Impaired waters. TMDLs (Chapter 35) will be developed for identified stressors within 8-13 years of listing.

Water Quality Initiatives
In 2000, Erwin received a $300,000 CWMTF (Chapter 34) grant to upgrade the WWTP including a new inflow channel, clarifier baffles, aeration equipment and sludge digestion storage equipment.

7.3.2 East Buies Creek [AU#18-18-1-(2)]

Current Status
East Buies Creek was Not Rated in the 2000 basinwide plan; however, East Buies Creek from NC 55 to Buies Creek (6.2 miles) is currently Impaired for aquatic life because dissolved oxygen was below the standard in 21.7 percent of samples at site BA412. Samples collected at site BA412 were also below the pH standard in 8.7 percent of samples. This segment is Not Rated for recreation because the fecal coliform bacteria screening criteria were exceeded at site BA412.

2005 Recommendations
It is recommended that MCFRBA (Appendix V) continue to monitor water quality in East Buies Creek and work with DWQ to determine if the low dissolved oxygen levels are natural in this watershed. Station BA412 has been moved because the previous location ceased flowing during summer months. DWQ will reassess data at the new station during the next assessment period to determine if dissolved levels exceed criteria.

East Buies Creek will be added to the 303(d) list of Impaired waters. TMDLs (Chapter 35) will be developed for identified stressors within 8-13 years of listing.

7.3.3 Gulf Creek [AU#18-18-1-(2)]

2000 Recommendations
The 2000 basin plan recommended that DWQ would resample Gulf Creek. Gulf Creek was Partially Supporting and Not Supporting in the 2000 plan. The benthic community ratings on Gulf Creek have been changed to Not Rated because criteria have not been developed to assign ratings to Triassic basin streams. This stream will remain on the 303(d) list of Impaired waters.

7.3.4 Kenneth Creek [AU#18-16-1-(1) and (2)]

2000 Recommendations
The 2000 basin plan recommended that local programs work to protect Kenneth Creek and that DWQ would resample the creek. It was also recommended that any new or expanding discharges to Kenneth Creek meet permit limits of 5 mg/l BOD5 and 2 mg/l NH3-N.

Current Status

Kenneth Creek [18-16-1-(1)] from source to Wake-Harnett county line (4.9 miles) is Supporting aquatic life because of a Good benthic community rating at site BB228. However, Kenneth Creek WWTP (NC0028118) had significant violations of biological oxygen demand permit limits, which could have adversely impacted aquatic life in this segment and in the downstream segments.

Kenneth Creek [18-16-1-(2)] from Wake-Harnett county line to Neills Creek (3.9 miles) is Impaired for aquatic life because of a Poor benthic community rating at site BB295. No criteria were exceeded at site BA404, and there was a Good fish community rating at site BF42. This segment is Supporting recreation because fecal coliform bacteria screening criteria were not exceeded at site BA295; however, Senters Rest Home (NC0048101) had significant violations of fecal coliform bacteria permit limits during the last two years of the assessment period. Senters is under a special order consent (SOC# S94026) that expires in March 2006.

2005 Recommendations

It is recommended that MCFRBA (Appendix V) continue to monitor water quality in Kenneth Creek. The NPDES compliance process will be used to address the significant permit violations noted above.

Segment 18-16-1-(1) will be removed from the 303(d) list of Impaired waters because of the improved biological community. Segment 18-16-1-(2) will remain on the 303(d) list. TMDLs (Chapter 35) will be developed for identified stressors within 8-13 years of listing.

Water Quality Initiatives

The NCEEP Local Watershed Plan for Harris Lake and Tributaries, completed in 2004, includes Kenneth Creek. This plan area encompasses three local watersheds that are parallel drainages to the Cape Fear River and are located within portions of Chatham, Wake, and Harnett Counties in the North Carolina Piedmont. The total land area is approximately 180 square miles. The watersheds include parts of the towns of Apex, Holly Springs, and Fuquay-Varina and the portion of Raven Rock State Park north and east of the Cape Fear River.

This watershed is approximately 46 square miles in size, extending south from the Town of Fuquay-Varina to Lillington, and east from US 401 to the Town of Angier. It is the most urbanized of the three watersheds in the study area. Kenneth Creek is a tributary to Neills Creek, which flows to the Cape Fear River near Lillington. A portion of Kenneth Creek was rated as impaired on the 2000 303(d) list.

The water resources in the study area exhibit signs of stress with future development likely to cause additional impacts. Given the vulnerable condition of these natural resources, it is vital to expedite implementation of the recommended efforts. The Local Watershed Plan for Middle Cape Fear and Kenneth/Harris Creeks may be viewed at:
http://www.nceep.net/services/lwps/Harris-Kenneth/Harris-Kenneth.htm

7.3.5 Lick Creek [AU#18-4-(2)]

Current Status
Lick Creek was Fully Supporting in the 2000 basinwide plan; however, Lick Creek from Olhams Lake Dam to the Cape Fear River (10.3 miles) is currently Impaired for aquatic life because dissolved oxygen was below the standard in 16 percent of samples at site BA388. Turbidity was also above the standard in 8 percent of samples. Lick Creek is Not Rated for recreation because the fecal coliform bacteria screening criteria were exceeded at site BA388.

2005 Recommendations
It is recommended that MCFRBA (Appendix V) continue to monitor water quality in Lick Creek and work with DWQ to determine if the low dissolved oxygen levels are natural in this watershed.

Lick Creek will be added to the 303(d) list of Impaired waters. TMDLs (Chapter 35) will be developed for identified stressors within 8-13 years of listing.

7.3.6 Neills Creek [AU#18-16-(0.3), (0.7)a, b and c1]

Current Status
Neills Creek was Fully Supporting and Not Rated in the 2000 basin plan; however, Neills Creek [18-16-(0.3), (0.7)a, b and c1] from source to US 401 (12.6 miles) is Impaired for aquatic life because of Poor and Fair benthic community ratings at sites BB294 and BB283. Site BB294 declined from Good-Fair to Poor in 2003. This decline was initially thought to be due to the drought in 2002, but other area streams did not show this decline. The stream may have been impacted by a toxic spill or other disturbance that prevented recovery of the benthic community. Neills Creek [18-16-(0.7)c2] from US 401 to the Cape Fear River (1.6 miles) is Supporting aquatic life and recreation because no criteria were exceeded at site BA401.

2005 Recommendations
DWQ will continue to monitor Neills Creek to evaluate recovery and investigate other disturbances that may have caused the decline in benthic community rating. It is recommended that MCFRBA (Appendix V) continue to monitor water quality in Neills Creek.

Segments 18-16-(0.3), (0.7)a, b and c1 will be added to the 303(d) list of Impaired waters. TMDLs (Chapter 35) will be developed for identified stressors within 8-13 years of listing.

Water Quality Initiatives
The NCEEP Local Watershed Plan for Harris Lake and Tributaries, completed in 2004, includes Neills Creek. The plan findings are discussed under Kenneth Creek. The Final Local Watershed Plan for Middle Cape Fear and Kenneth/Harris Creeks may be viewed at:
http://www.nceep.net/services/lwps/Harris-Kenneth/Harris-Kenneth.htm

7.4 Status and Recommendations for Waters with Noted Impacts

The surface waters discussed in this section are not Impaired. However, notable water quality problems and concerns have been documented for some waters based on this assessment. While these waters are not Impaired, attention and resources should be focused on these waters to prevent additional degradation or facilitate water quality improvement. Waters in the following section are identified by assessment unit number (AU#). See overview for more information on AU#s.

7.4.1 Avents Creek [AU# 18-13-(2)]

Current Status and 2005 Recommendations
Avents Creek from upstream of SR 1418 to the Cape Fear River (5.5 miles) is Not Rated for recreation because the fecal coliform bacteria screening criteria were exceeded at site BA399. DWQ will determine if intensive sampling is needed to assess the fecal coliform bacteria standard in this creek (Appendix X).

Water Quality Initiatives
The NCEEP Local Watershed Plan for Harris Lake and Tributaries includes Avents Creek, Parkers Creek and Hector Creek. This watershed is approximately 54 square miles in size, and is located almost entirely within Harnett County. Raven Rock State Park is located along the Cape Fear River on the southern boundary of the watershed. There are no municipalities within the watershed. Most of the land area is part of the water supply watershed for the Town of Lillington, located farther downstream along the Cape Fear River. The three mainstem streams in this watershed, Parkers Creek, Avents Creek and Hector Creek, all have High Quality Waters designations. The Final Local Watershed Plan for Middle Cape Fear and Kenneth/Harris Creeks may be viewed at: http://www.nceep.net/services/lwps/Harris-Kenneth/Harris-Kenneth.htm

7.4.2 Daniels Creek [AU# 18-10-(2)]

Current Status and 2005 Recommendations
Daniels Creek from the source to the Cape Fear River (8.5 miles) is Not Rated for aquatic life on an evaluated basis because Broadway WWTP (NC0059242) had significant violations of dissolved oxygen permit limits, which could have adversely impacted aquatic life in the creek. The NPDES compliance process will be used to address the significant permit violations noted above.

7.4.3 Haw River [AU# 16-(42)]

Current Status and 2005 Recommendations
The Haw River from the Jordan Dam to the Cape Fear River (4.3 miles) is Supporting aquatic life because no criteria were exceeded at sites BA256 or BA257. However, Moncure Plywood (NC0023442) had significant violations of dissolved oxygen permit limits, which could have adversely impacted aquatic life in this segment. The NPDES compliance process will be used to address the significant permit violations noted above.

7.4.4 Shaddox Creek [AU# 16-43]

Current Status and 2005 Recommendations

Shaddox Creek from source to Haw River (8.1 miles) is Not Rated for aquatic life on an evaluated basis because Sierrapine Limited (NC0040701) had significant violations of total suspended solids permit limits, which could have adversely impacted aquatic life in this stream. The facility installed screens that have solved the TSS violations. The NPDES compliance process will be used to address the significant permit violations noted above.

7.4.5 Utley Creek [AU# 18-7-5.5]

Current Status and 2005 Recommendations

Utley Creek from source to Harris Lake (4.6 miles) was Not Rated in the 2000 plan, and no data were collected to assign a use support rating during this assessment period. Earlier studies indicated the Holly Springs WWTP was a significant contributor of nutrients to the creek that could cause algal blooms and subsequent fish kills downstream. Because of the water quality problems noted above, the 2000 basin plan recommended that Holly Springs pursue other alternatives to a discharge into Utley Creek. It was also recommended that land use planning be used to prevent further increases in nutrient loading from the developing watershed. DWQ continues to recommend that Holly Springs find another wastewater disposal alternative. Further recommendations to protect streams in urbanizing areas and to restore streams in existing urban areas are discussed in Chapter 31.

Water Quality Initiatives

The NCEEP Local Watershed Plan for Harris Lake and Tributaries includes Utley Creek. This watershed is approximately 80 square miles in size, extending south from the Town of Apex to the Cape Fear River and east from the Chatham/Wake County line to the Town of Holly Springs. Both Apex and Holly Springs span the ridgeline that separates the Neuse and Cape Fear River basins. The watershed contains Harris Lake, an impoundment of Buckhorn Creek, which is used by Progress Energy's Shearon Harris Nuclear Plant for cooling. The Local Watershed Plan for Middle Cape Fear and Kenneth/Harris Creeks may be viewed at:
http://www.nceep.net/services/lwps/Harris-Kenneth/Harris-Kenneth.htm

Chapter 8
Cape Fear River Subbasin 03-06-08

Including: East Fork Deep River, West Fork Deep River, Deep River, Randleman Reservoir, Richland Creek, Hickory Creek, Muddy Creek and Oak Hollow Lake

8.1 Subbasin Overview

Subbasin 03-06-08 at a Glance

Land and Water Area

Total area:	179 mi²
Land area:	177 mi²
Water area:	2 mi²

Population Statistics

2000 Est. Pop.: 91,181people
Pop. Density: 510 persons/mi²

Land Cover (percent)

Forest/Wetland:	58.4%
Surface Water:	1.7%
Urban:	13.0%
Cultivated Crop:	1.5%
Pasture/ Managed Herbaceous:	25.4%

Counties

Forsyth, Guilford and Randolph

Municipalities

Archdale, Greensboro, Highpoint, Kernersville and Randleman

Subbasin 03-06-08 is a piedmont watershed containing the headwaters of the Deep River. The watershed is forested in the south, but has large developed areas in the northern portion. Development is occurring between Greensboro and High Point. Population is expected to grow by 265,000 people in counties with portions or all of their areas in this subbasin by 2020.

There are 23 individual NPDES wastewater discharge permits in this subbasin with a permitted flow of 29.4 MGD (Figure 11). The largest are Eastside WWTP (16 MGD), Ward WTP (10 MGD) and Randleman WWTP (1.7 MGD). Refer to Appendix VI and Chapter 30 for more information on NPDES permit holders. Issues related to compliance with NPDES permit conditions are discussed below in Section 8.3 for Impaired waters and in Section 8.4 for other waters.

There are five registered dairy operations in this subbasin.

There were 16 benthic community samples and five fish community samples (Figure 11 and Table 11) collected during this assessment period. Data were also collected from 14 ambient monitoring stations including four UCFRBA (Appendix V) stations, four DWQ stations, three DWQ special study stations, two Greensboro stations, and two shared ambient stations. One reservoir was also monitored. Refer to the *2003 Cape Fear River Basinwide Assessment Report* at http://www.esb.enr.state.nc.us/bar.html and Appendix IV for more information on monitoring.

Waters in the following sections are identified by assessment unit number (AU#). This number is used to track defined segments in the water quality assessment database, 303(d) Impaired waters list and the various tables in this basin plan. The assessment unit number is a subset of the DWQ index number (classification identification number). A letter attached to the end of the AU# indicates that the assessment is smaller than the DWQ index segment. No letter indicates that the assessment unit and the DWQ index segment are the same.

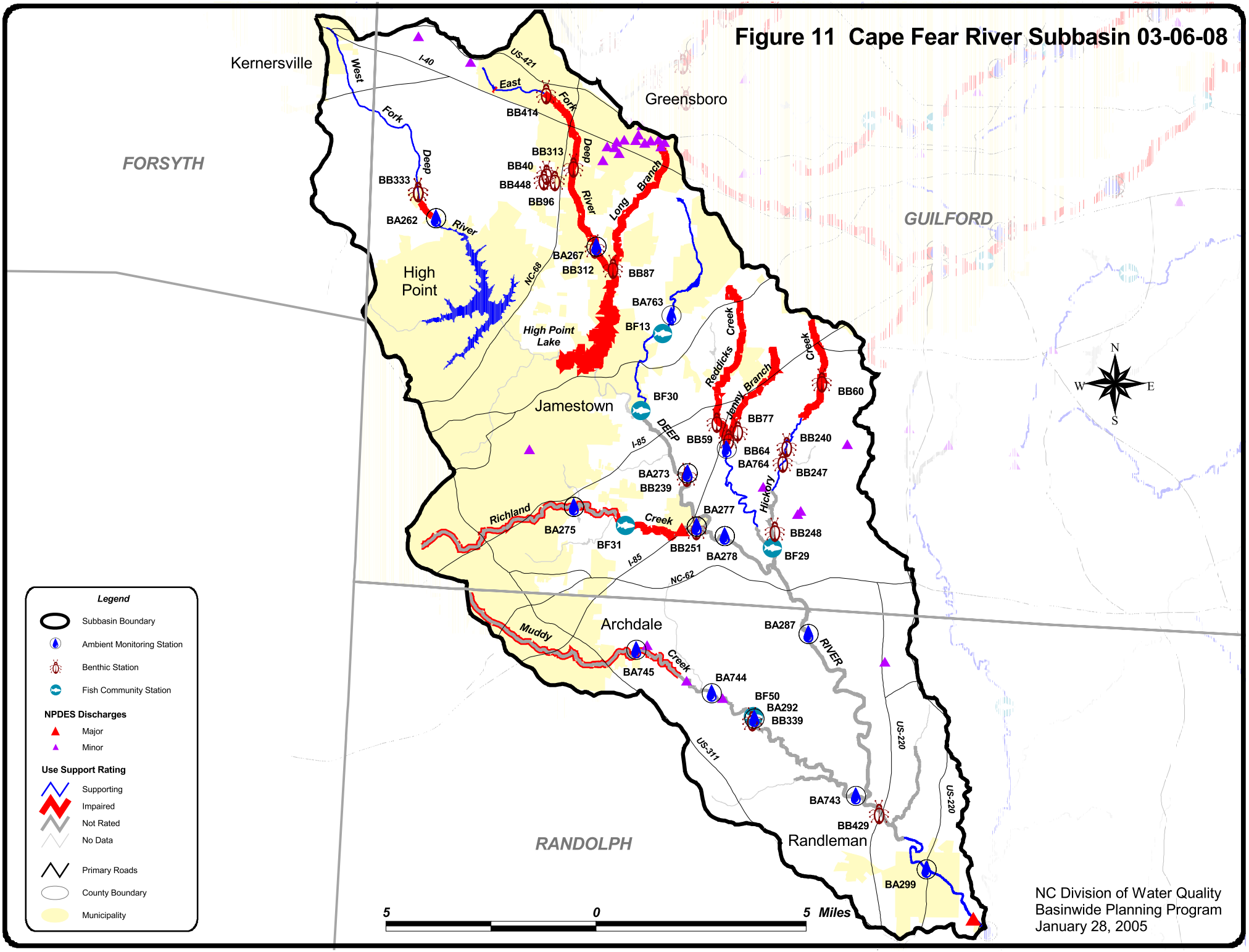


Figure 11 Cape Fear River Subbasin 03-06-08
Kernersville
Greensboro
High Point
Jamestown
Archdale
Randleman
FORSYTH
GUILFORD
RANDOLPH
West Fork Deep River
East Fork Deep River
Long Branch
Reddicks Creek
Jenny Branch
Hickory Creek
Richland Creek
Muddy Creek
High Point Lake
I-40
US-421
NC-68
I-85
NC-62
US-311
US-220
BB414
BB313
BB40
BB448
BB96
BB333
BA262
BA267
BB312
BB87
BA763
BF13
BF30
BB60
BB77
BB59
BB64
BA764
BB240
BB247
BA273
BB239
BA277
BB248
BF29
BA275
BF31
BB251
BA278
BA745
BA744
BF50
BA292
BB339
BA287
BA743
BB429
BA299
N
S
E
W
5 0 5 Miles
Legend
Subbasin Boundary
Ambient Monitoring Station
Benthic Station
Fish Community Station
NPDES Discharges
Major
Minor
Use Support Rating
Supporting
Impaired
Not Rated
No Data
Primary Roads
County Boundary
Municipality
NC Division of Water Quality
Basinwide Planning Program
January 28, 2005

Table 11 CAPE FEAR Subbasin 03-06-08

AU Number	Classification	Length/Area	Description	Aquatic Life Assessment						Recreation Assessment					
				AL Rating	Station	Result	Year/ Parameter	% Exc		REC Rating	Station	Result		Stressors	Sources
Bull Run															
17-5-(1)	WS-IV *	7.2 FW Miles	From a source to a point 0.5 mile upstream of mouth	S	BA763	NCE				S	BA763	NCE			
					BF13	GF	1999								
17-5-(2)	WS-IV CA	0.6 FW Miles	From a point 0.5 mile upstream of mouth to Randleman Reservoir, Deep River	S						ND					
					BF30	GF	2003								
DEEP RIVER															
17-(10.5)a	C	1.6 FW Miles	From dam at Randleman Reservoir to US 220 Business	S	BA299	NCE	Turbidity	7.3		NR*	BA299	NCE		Fecal Coliform Bacteria	Unknown
														Turbidity	Unknown
17-(10.5)b	C	2.2 FW Miles	From US 220 business to Subbasin 03-06-08 and 03-06-09 boundary	S	BA301	NCE	Turbidity	8.3		NR*	BA301	NCE		Fecal Coliform Bacteria	Unknown
														Turbidity	Unknown
17-(4)a	WS-IV CA	2.0 FW Miles	From dam at Oakdale Cotton Mills, Inc. to SR 1113	NR	BA273	NCE				NR*	BA273	NCE		Fecal Coliform Bacteria	Unknown
					BB239	F	1998							Low Dissolved Oxygen	Unknown
17-(4)b	WS-IV CA	6.6 FW Miles	From Kivett Drive to Coltrane Mill Road	NR	BA277	CE	Arsenic	17.6		NR*	BA277	CE		Low Dissolved Oxygen	Unknown
					BA278	CE	Low DO	10.1			BA277	NCE		Fecal Coliform Bacteria	Unknown
					BB248	GF	2003							Arsenic	Unknown
					BB251	F	2003								
17-(4)c	WS-IV CA	7.4 FW Miles	From Coltrane Mill Road to dam at Randleman Reservoir (located 1.6 mile upstream of US Hwy 220 Business)	NR	BA287	NCE				NR*	BA287	NCE		Fecal Coliform Bacteria	Unknown
											BA292	NCE			
											BA743	CE			
											BA744	CE			
					BB429	GF	2003								
DEEP RIVER(including High Point Lake at normal pool elevation)															
17-(1)	WS-IV CA	263.3 FW Acres	From source in backwaters of High Point Lake to dam at High Point Lake(City of High Point water supply intake)	I	BL19	CE	Chlor a	20		ND				Chlorophyll a	Pasture
														Chlorophyll a	Agriculture
														Chlorophyll a	MS4 NPDES

Table 11 CAPE FEAR Subbasin 03-06-08

AU Number / Description	Classification	Length/Area	Aquatic Life Assessment					Recreation Assessment			Stressors	Sources
			AL Rating	Station	Result	Year/ Parameter	% Exc	REC Rating	Station	Result		
East Fork Deep River												
17-2-(0.3)a	WS-IV *	1.9 FW Miles	S					ND			Habitat Degradation	MS4 NPDES
From source to Thatcher Road				BB414	GF	2003						
17-2-(0.3)b	WS-IV *	4.8 FW Miles	I	BA267	CE	Turbidity	10.9	I	BA267	CE	Fecal Coliform Bacteria	MS4 NPDES
From Thatcher Road to a point 0.4 mile downstream of Guilford County SR 1541				BB312	F	2003					Turbidity	MS4 NPDES
				BB313	F	2003						
17-2-(0.7)	WS-IV CA	0.8 FW Miles	I	BA267	CE	Turbidity	10.9	ND	BA267	CE		
From a point 0.4 mile downstream of Guilford County SR 1541 to High Point Lake, Deep River												
Hickory Creek												
17-8.5-(1)a	WS-IV *	3.0 FW Miles	I					ND				
From source to Rolling Brook Drive				BB60	F	2003						
17-8.5-(1)b	WS-IV *	1.3 FW Miles	S					ND				
From Rolling Brook Drive to a point 0.6 mile upstream of mouth				BB240	GF	2003						
17-8.5-(3)	WS-IV CA	0.9 FW Miles	S					ND			Habitat Degradation	
From a point 0.6 mile upstream of mouth to Randleman Reservoir, Deep River				BB247	GF	2003						
Jenny Branch												
17-8-2	WS-IV *	3.2 FW Miles	I					ND				
From source to Reddicks Creek				BB64	F	2003						
Long Branch												
17-2-1-(1)	WS-IV *	3.5 FW Miles	I					ND				
From source to a point 0.5 mile downstream of Guilford County SR 1541				BB87	F	2003						
17-2-1-(2)	WS-IV CA	0.5 FW Miles	I					ND				
From a point 0.5 mile downstream of Guilford County SR 1541 to East Fork Deep River				BB87	F	2003						

Table 11 CAPE FEAR Subbasin 03-06-08

AU Number / Description	Classification	Length/Area	Aquatic Life Assessment					Recreation Assessment			Stressors	Sources
			AL Rating	Station	Result	Year/ Parameter	% Exc	REC Rating	Station	Result		
Muddy Creek												
17-9-(1)	WS-IV *	6.9 FW Miles	**NR**					**I**	BA745	CE	Habitat Degradation	MS4 NPDES
From source to a point 0.5 mile upstream of mouth											Fecal Coliform Bacteria	MS4 NPDES
17-9-(2)	WS-IV CA	0.8 FW Miles	**NR**					**NR***				
From a point 0.5 mile upstream of mouth to Randleman Reservoir				BB339	F	2003						
				BF50	G	2003						
Reddicks Creek												
17-8-(0.5)a	WS-IV *	5.1 FW Miles	**I**					ND			Habitat Degradation	MS4 NPDES
From source to Groomtown Road				BB59	F	2003						
17-8-(0.5)b	WS-IV *	1.8 FW Miles	**S**	BA764	NCE			**S**	BA764	NCE		
From Groomtown Road to a point 0.9 mile upstream of mouth				BB77	GF	2003						
17-8-(3)	WS-IV CA	1.6 FW Miles	**S**	BA764	NCE			**S**	BA764	NCE		
From a point 0.9 mile upstream of mouth to Randleman Reservoir, Deep River												
Richland Creek												
17-7-(0.5)	WS-IV *	6.4 FW Miles	**NR**	BA275	NCE	Turbidity	7.3	**I**	BA275	CE	Fecal Coliform Bacteria	MS4 NPDES
									BA275	NCE	Turbidity	MS4 NPDES
From source to a point 0.4 mile upstream of Guilfors												
17-7-(4)	WS-IV CA	1.7 FW Miles	**I**					ND			Habitat Degradation	WWTP NPDES
From a point 0.4 mile upstream of Guilford County SR 1154 to Randleman Reservoir, Deep River				BF31	F	2003					Habitat Degradation	MS4 NPDES
West Fork Deep River												
17-3-(0.3)	WS-IV *	5.4 FW Miles	**S**					ND			Habitat Degradation	MS4 NPDES
From source to a point 0.3 mile downstream of Guilford County SR 1850				BB333	GF	2003						
				BB333	GF	2003						
				BB333	GF	1998						

Table 11 CAPE FEAR Subbasin 03-06-08

AU Number	Classification	Length/Area	Description	Aquatic Life Assessment					Recreation Assessment			Stressors	Sources
				AL Rating	Station	Result	Year/ Parameter	% Exc	REC Rating	Station	Result		
West Fork Deep River(Oak Hollow Reservoir)													
17-3-(0.7)a	WS-IV CA	0.5 FW Miles	From a point 0.3 mile downstream of Guilford County SR 1850 to SR 1818	I	BA262	CE	Turbidity	22.9	NR*	BA262	NCE	Fecal Coliform Bacteria	MS4 NPDES
17-3-(0.7)b	WS-IV CA	705.4 FW Acres	From SR 1818 to dam at Oak Hollow Reservoir	S	BL22	NCE			ND				

AL - Aquatic Life
REC - Recreation

BF - Fish Community Survey
BB - Benthic Community Survey
BA - Ambient Monitoring Site
BL- Lake Monitoring
S- DEH RECMON

Miles/Acres
FW- Fresh Water
S- Salt Water

E - Excellent
G - Good
GF - Good-Fair
F - Fair
P - Poor
NI - Not Impaired
S- Severe Stress
M-Moderate Stress
N- Natural

S - Supporting, I - Impaired
NR - Not Rated
NR*- Not Rated for Recreation (screening criteria exceeded)
ND-No Data Collected to make assessment

Results
CE-Criteria Exceeded > 10% and more than 10 samples
NCE-No Criteria Exceeded

Aquatic Life Rating Summary

S	m	24.3	FW Miles
NR	m	30.1	FW Miles
I	m	23.1	FW Miles
S	m	705.4	FW Acres
I	m	263.3	FW Acres
ND		28.3	FW Miles

Recreation Rating Summary

S	m	10.5	FW Miles
NR*	m	21.1	FW Miles
I	m	18.1	FW Miles
ND		56.1	FW Miles
ND		968.7	FW Acres

Fish Consumption Rating Summary

I	e	105.8	FW Miles
I	e	968.7	FW Acres

8.2 Use Support Assessment Summary

Use support ratings were assigned for waters in subbasin 03-06-08 in the aquatic life, recreation, fish consumption and water supply categories. All waters are Impaired on an evaluated basis in the fish consumption category because of fish consumption advice that applies to the entire basin. In the water supply category, all WS classified waters (968.7 acres and 107.2 miles) are Supporting on an evaluated basis based on reports from DEH regional water treatment plant consultants. Refer to Appendix X for a complete list of monitored waters and more information on Supporting monitored waters.

There were 77.5 stream miles (73.3 percent) and 968.7 freshwater acres (100 percent) monitored during this assessment period in the aquatic life category. There are 23.1 stream miles (21.8 percent) and 263.3 acres (27.2 percent) identified as Impaired in this same category. There were also 18.1 miles (17.1percent) Impaired for recreation in this subbasin.

8.3 Status and Recommendations of Previously and Newly Impaired Waters

The following waters were either identified as Impaired in the previous basin plan (2000) or are newly Impaired based on recent data. If previously identified as Impaired, the water will either remain on the state's 303(d) list or will be delisted based on recent data showing water quality improvements. If the water is newly Impaired, it will likely be placed on the 2006 303(d) list. The current status and recommendations for addressing these waters are presented below, and each is identified by an assessment unit number (AU#). Refer to the overview for more information on AUs. Information regarding 303(d) listing and reporting methodology is presented in Appendix VII.

8.3.1 Deep River [AU# 17-(3.3), (3.7), (4)a, b, c, (10.5)a and b]

2000 Recommendations
The 2000 basin plan recommended that the Deep River be resampled and that a TMDL for fecal coliform bacteria be developed.

Current Status
The Deep River [17-(4)a] from dam at Oakdale Cotton Mill to SR 1113 (2 miles) is Not Rated for aquatic life because this segment will be inundated by Randleman Reservoir. The fish community rating at site BB239 was Fair, and dissolved oxygen was low 24 percent of samples collected at site BA273. Data from these sites suggest water quality problems that would result in an Impaired rating for a flowing stream in the piedmont.

The Deep River [17-(4)b] from SR 1113 (Kivett Drive) to SR 1921 (Coltrane Mill Road) (6.6 miles) is Not Rated for aquatic life because this segment will be inundated by Randleman Reservoir. Dissolved oxygen violated the standard in 10 percent of samples collected at site BA278. Data from this site suggest water quality problems that would result in an Impaired rating for a flowing stream in the piedmont. This segment is Not Rated for recreation, although the fecal coliform bacteria standard was violated.

Dissolved oxygen also violated water quality standards in 10 percent of samples, and arsenic violated water quality standards in 17.6 percent of samples at site BA277. The benthic community rating at site BB251 was also Fair. High Point Eastside WWTP (NC0024210) had significant violations of the biological oxygen demand permit limit during the assessment period, which may have contributed to the low dissolved oxygen levels noted above. High Point Eastside has nearly completed an expansion and upgrade of the facility to 26 MGD and experienced much better operations in 2004. This discharge will be relocated to the main body of the reservoir and sites BB251 and BA277 will be inundated by Randleman Reservoir; therefore, these sites were not used to assign use support ratings to Richland Creek or the Deep River.

The Deep River [17-(4)c] from SR 1921 to Randleman dam (7.4 miles) is Not Rated for aquatic life because this segment will be inundated by Randleman Reservoir. The benthic community rating at site BB429 has been Good-Fair since 1983. The smell of sewage has been noted at this site and the water is turbid after heavy rains. There were also indicators of low dissolved oxygen at this site. Hidden Forest Estates WWTP (NC0065358) had significant violations of fecal coliform bacteria permit limits during the last two years of the assessment period. This segment is Not Rated for recreation, although the fecal coliform bacteria standard was violated. The WWTP has had only one violation since 2003.

A TMDL developed for these three segments called for a 75 percent reduction in fecal coliform bacteria in order the meet the standard. Sources of fecal coliform bacteria include the Greensboro and High Point MS4s.

The Deep River [17-(10.5)a] from dam at Randleman Reservoir to US 220 Business (1.6 miles) is Not Rated for recreation because fecal coliform bacteria screening criteria were exceeded at site BA299.

These segments of the Deep River were Fully Supporting in the 2000 plan. The Deep River [17-(10.5)b] from US 220 to subbasin boundary (2.2 miles) is Supporting aquatic life because no criteria were exceeded at site BA301. The Randleman WWTP (NC0025445) had significant violations of fecal coliform bacteria permit limits during the last two years of the assessment period.

2005 Recommendations

DWQ will monitor Randleman Reservoir as part of the lakes monitoring program, collecting appropriate data to assign use support ratings in reservoirs. It is recommended that High Point and Greensboro address water quality problems identified above through their respective stormwater programs, including the reductions in fecal coliform bacteria specified in the TMDL. The NPDES compliance process will be used to address the significant permit violations noted above.

Segments 17-(3.3), (3.7), (4)a, b and c will be inundated by the Randleman Reservoir project. These segments will be considered for removal from the 303(d) list of Impaired waters because the sites used to initially assign use support ratings will not be resampled due to inundation.

8.3.2 Deep River (High Point Lake) [AU#17-(1)]

Current Status
High Point Lake was Fully Supporting in the 2000 basin; however, High Point Lake (263.3 acres) is currently Impaired for aquatic life because 20 percent of chlorophyll *a* samples violated the water quality standard. Nutrient levels in the reservoir were high, and the lake has been hypereutrophic as noted in previous years. Dissolved oxygen has been low in the lake, and High Point has installed a forced air destratification system to address the problem. Algal blooms have been noted and numerous complaints have been received of taste, odor and aesthetic problems in treated drinking water. Filamentous algae have formed in thick mats that have clogged water intakes and fouled boat motors. Pesticides have also been a noted problem in the lake.

2005 Recommendations
DWQ will continue to monitor High Point Lake. It is recommended that High Point and Greensboro address water quality problems identified above through their respective stormwater programs, including reductions in nutrient loading that are driving algal blooms in High Point Lake.

High Point Lake will be added to the 303(d) list, which will require TMDL development within 8-13 years of listing. Once a TMDL is developed and approved, Greensboro and High Point will be required to address the pollutant(s) through their stormwater and collection systems permits.

8.3.3 East Fork Deep River [AU# 17-2-(0.3)a and b and (0.7)]

2000 Recommendations
The 2000 basin plan recommended that the East Fork Deep River be resampled and TMDLs be developed for fecal coliform bacteria and turbidity and to work with the City of Greensboro stormwater program to improve water quality.

Current Status
The East Fork Deep River [17-2-(0.3)a] from source to Thatcher Road (1.9 miles) is Supporting aquatic life because of a Good-Fair benthic community rating at site BB414. This segment is Impaired for recreation because the fecal coliform bacteria standard was violated at sites monitored by PTCOG (discussed below).

The East Fork Deep River [17-(0.3)b and (0.7)] from Thatcher Road to High Point Lake (5.6 miles) is Impaired for aquatic life because of Fair benthic community ratings at sites BB313 and BB312. Also the turbidity standard was violated in 10.9 percent samples at site BA267. A TMDL stressor study completed in 2003 found that sedimentation, habitat degradation and scour from storm flows were stressors to the benthic community.

This lower segment is also Impaired for recreation because the fecal coliform bacteria standard was violated at site BA267 and at sites in the watershed sampled as part of a bacteria source tracking study by PTCOG (Appendix V). The approved TMDL called for between a 63 and 75 percent reduction in fecal coliform bacteria and a 62 percent reduction in total suspended solids in order to meet the turbidity standard. Sources of fecal coliform include the Greensboro and High Point sewer systems and other urban watershed inputs.

A stressor survey conducted in 2003 found habitat degradation caused by modified watershed hydrology resulting in streambank erosion and sedimentation continues to stress the benthic community in East Fork Deep River. The survey also noted storm sewer discharges into the stream. The watershed drains heavily urbanized areas of Greensboro including the Piedmont Triad International Airport as well many petroleum storage sites.

DWQ performed a statistical trend analysis at site BA267 using total nitrogen, total phosphorus and total suspended solids data collected from 1990 to 2004. There was a significant decrease in total phosphorus of 0.0033 mg/l per year in East Fork of Deep River. There were no trends noted in the other parameters.

Two unnamed tributaries to East Fork Deep River were sampled in 2000 to evaluate impacts from the Millwood School Road construction. The sites were Not Rated, but comparisons of upstream and downstream sites indicated a significant decline in water quality downstream of the construction.

2005 Recommendations
DWQ and the UCFRBA will continue to monitor these segments of the East Fork Deep River. It is recommended that High Point and Greensboro address water quality problems identified above through their respective stormwater programs, including the reductions in fecal coliform bacteria and turbidity specified in the TMDL. Greensboro and High Point will be required to submit information on outfalls and other potential sources of TSS and fecal coliform bacteria, as well as a monitoring plan to DWQ as required in their stormwater permits.

Segment 17-2-(0.3)a will be removed from the 303(d) list. Segments 17-2-(0.3)b and 17-2-(0.7) will remain on the 303(d) list. TMDLs (Chapter 35) will be developed for identified stressors within 8-13 years of listing.

8.3.4 Hickory Creek [AU# 17-8.5-(1)a, b and (3)]

Current Status
Hickory Creek was Not Rated in the 2000 plan; however, Hickory Creek [17-8.5-(1)a] from source to Rolling Brook Drive (3 miles) is currently Impaired for aquatic life because of a Fair benthic community rating at site BB60.

Hickory Creek [17-8.5-(1)b and (3)] from Rolling Brook Drive to the Deep River (2.2 miles) is Supporting aquatic life because of a Good-Fair benthic community rating at sites BB240, BB247 and BB248, and a Good fish community rating at site BF29. Southern Elementary School (NC0038091) and Crown Mobile WWTP (NC0055255) had significant violations of dissolved oxygen permit limits, and Southern Guilford High School (NC0038229) had significant violations of pH permit limits during the last two years of the assessment period. These facilities discharge into unnamed tributaries of Hickory Creek upstream of BB248. Southern Guilford High School is under a special order of consent (SOC# S91039) that expires in June 2005. The schools are expected to be connected to the City of Greensboro collection system and cease discharging by March 2005. Crown Mobile WWTP has had operational problems and has made recent upgrades to help improve treatment. While these facilities are small in size, they could have negative impacts on water quality especially during low flow years.

A stressor survey conducted in 2003 found that high flows after rain events were impacting aquatic habitat in Hickory Creek. The survey also noted large amounts of periphyton on rocks in the upper watershed and high dissolved oxygen levels indicated algal activity. Conductivity was also high in the creek.

2005 Recommendations
DWQ will continue to monitor Hickory Creek. The NPDES compliance process will be used to address the significant permit violations noted above. It is recommended that Crown Mobile continue to improve treatment to avoid permit violations. The lower segment of Hickory Creek (sites BB248 and BF29) will be inundated by Randleman Reservoir and will be sampled by the lake monitoring program in the future.

Segment 17-8.5-(1)b will be removed from the 303(d) list of Impaired waters because of the improved benthic community rating and 17-8.5-(3) will be removed because of the Good fish community rating. Segement 17-8.5-(1)a will be added to the 303(d) list. TMDLs (Chapter 35) will be developed for identified stressors within 8-13 years of listing.

8.3.5 Jenny Branch [AU# 17-8-2]

Current Status
Jenny Branch was Not Rated in the 2000 plan; however, Jenny Branch from source to Reddicks Creek (3.2 miles) is currently Impaired for aquatic life because of a Fair benthic community rating at site BB64. A TMDL stressor study completed in 2003 found that sedimentation, habitat degradation and urban runoff were stressors to the benthic.

2005 Recommendations
DWQ will continue to monitor Jenny Branch and it will be added to the 303(d) list. TMDLs (Chapter 35) will be developed for identified stressors within 8-13 years of listing.

8.3.6 Long Branch [AU# 17-2-1-(1) and (2)]

Current Status
Long Branch was Not Rated in the 2000 plan; however, Long Branch from source to East Fork Deep River (4 miles) is currently Impaired for aquatic life because of a Fair benthic community rating at site BB87. Greensboro Colonial Pipeline Terminal (NC0031046) and Williams Terminals (NC0074578) had significant violations of the total phenolics permit limit during the assessment period, which could have adversely affected water quality in Long Branch. Colonial Pipeline may have been experiencing reporting problems. Williams Terminals did not experience any violations in 2004.

2005 Recommendations
DWQ will continue to monitor Long Branch. The NPDES compliance process will be used to address the significant permit violations noted above. DWQ will work with Colonial Pipeline to evaluate reporting and data entry procedures to assure that phenolics permit limits are being properly assessed. Long Branch will be added the 303(d) list of Impaired waters. TMDLs (Chapter 35) will be developed for identified stressors within 8-13 years of listing.

8.3.7 Muddy Creek [AU# 17-9-(1) and (2)]

Current Status
Muddy Creek was Fully Supporting in the 2000 plan; however, Muddy Creek from source to Randleman Reservoir (7.7 miles) is currently Not Rated for aquatic life because of a Fair benthic community rating at site BB339. Instream habitat was sparse; banks eroded, and the water was turbid at BB339. Some improvements were noted in the fish community, rated Good at site BF50. Sites BB339, BF50, BA743, BA744 and BA292 will be inundated by Randleman Reservoir.

Muddy Creek is Impaired for recreation because the fecal coliform bacteria standard was violated at site BA745 during a special study of Muddy Creek.

2005 Recommendations
DWQ will continue to monitor Muddy Creek and it will be added to the 303(d) list of Impaired waters because of the recreation impairment. A TMDL (Chapter 35) was approved in May 2004 that recommended an 80 percent reduction in fecal coliform bacteria loading into Muddy Creek.

8.3.8 Reddicks Creek [AU# 17-8-(0.5) a]

Current Status
Reddicks Creek was Not Rated in the 2000 plan; however, Reddicks Creek from source to Groomtown Road (5.1 miles) is currently Impaired for aquatic life because of a Fair benthic community rating at site BB59. A TMDL stressor study completed in 2003 found that sedimentation, habitat degradation and urban runoff were stressors to the benthic community.

2005 Recommendations
DWQ will continue to monitor Reddicks Creek and it will be added to the 303(d) list of Impaired waters. TMDLs (Chapter 35) will be developed for identified stressors within 8-13 years of listing.

8.3.9 Richland Creek [AU# 17-7-(0.5) and (4)]

2000 Recommendations
DWQ recommended resampling of Richland Creek to determine stressors to the biological community. It was also recommended that a TMDL be developed for fecal coliform bacteria.

Current Status
Richland Creek from source to Randleman Reservoir (8.1 miles) is Impaired for aquatic life because of a Fair fish community rating at site BF31. Streambanks were steep and habitat was sparse. These segments are also Impaired for recreation because the fecal coliform bacteria standard was violated at site BA275.

A TMDL (Chapter 35) was approved in May 2004 that recommended an 82 percent reduction in fecal coliform bacteria loading into Richland Creek.

2005 Recommendations

DWQ will continue to monitor Richland Creek and it will remain on the 303(d) list. DWQ will further investigate the sources of arsenic in the watershed. The NPDES compliance process will be used to address the significant permit violations noted above. DWQ recommends that High Point Eastside continue to improve operations and treatment at this facility.

8.3.10 West Fork Deep River [AU# 17-3-(0.7)a]

Current Status

The West Fork Deep River was Fully Supporting in the 2000 basin plan; however, West Fork Deep River [17-3-(0.7)a] from SR 1850 to SR 1818 (0.5 miles) is Impaired for aquatic life because the turbidity standard was violated in 23 percent of samples at site BA262.

2005 Recommendations

DWQ will continue to monitor West Fork Deep River and it will be added to the 303(d) list.

Chapter 9
Cape Fear River Subbasin 03-06-09
Including: Hasketts Creek, Deep River, Polecat Creek and Sandy Creek

9.1 Subbasin Overview

Subbasin 03-06-09 at a Glance

Land and Water Area

Total area:	446 mi²
Land area:	445 mi²
Water area:	1 mi²

Population Statistics

2000 Est. Pop.: 80,068 people
Pop. Density: 180 persons/mi²

Land Cover (percent)

Forest/Wetland:	68.7%
Surface Water:	0.6%
Urban:	1.1%
Cultivated Crop:	2.8%
Pasture/ Managed Herbaceous:	26.9%

Counties

Chatham, Guilford, Moore and Randolph

Municipalities

Asheboro, Franklinville, Liberty, Ramseur and Seagrove

Subbasin 03-06-09 is mostly in the Carolina slate belt with a small portion in the piedmont. Most of the watershed is forest and pasture land. Development is occurring around Asheboro. Population is expected to grow by 220,000 people in counties with portions or all of their areas in this subbasin by 2020.

There are 13 individual NPDES wastewater discharge permits in this subbasin with a permitted flow of 9.8 MGD (Figure 12). The largest is Asheboro WWTP (9 MGD). Refer to Appendix VI and Chapter 30 for more information on NPDES permit holders. Issues related to compliance with NPDES permit conditions are discussed below in Section 9.3 for Impaired waters and in Section 9.4 for other waters.

There are six registered dairy operations, one registered cattle operation, one registered poultry operation and seven swine operations in this subbasin.

There were 11 benthic community samples and three fish community samples (Figure 12 and Table 12) collected during this assessment period. Data were also collected from seven ambient monitoring stations including three UCFRBA (Appendix V) stations, two DWQ stations and two shared ambient stations. Two reservoirs were also monitored. Refer to the *2003 Cape Fear River Basinwide Assessment Report* at http://www.esb.enr.state.nc.us/bar.html and Appendix IV for more information on monitoring.

Waters in the following sections are identified by assessment unit number (AU#). This number is used to track defined segments in the water quality assessment database, 303(d) Impaired waters list and the various tables in this basin plan. The assessment unit number is a subset of the DWQ index number (classification identification number). A letter attached to the end of the AU# indicates that the assessment is smaller than the DWQ index segment. No letter indicates that the assessment unit and the DWQ index segment are the same.

Figure 12 Cape Fear River Subbasin 03-06-09

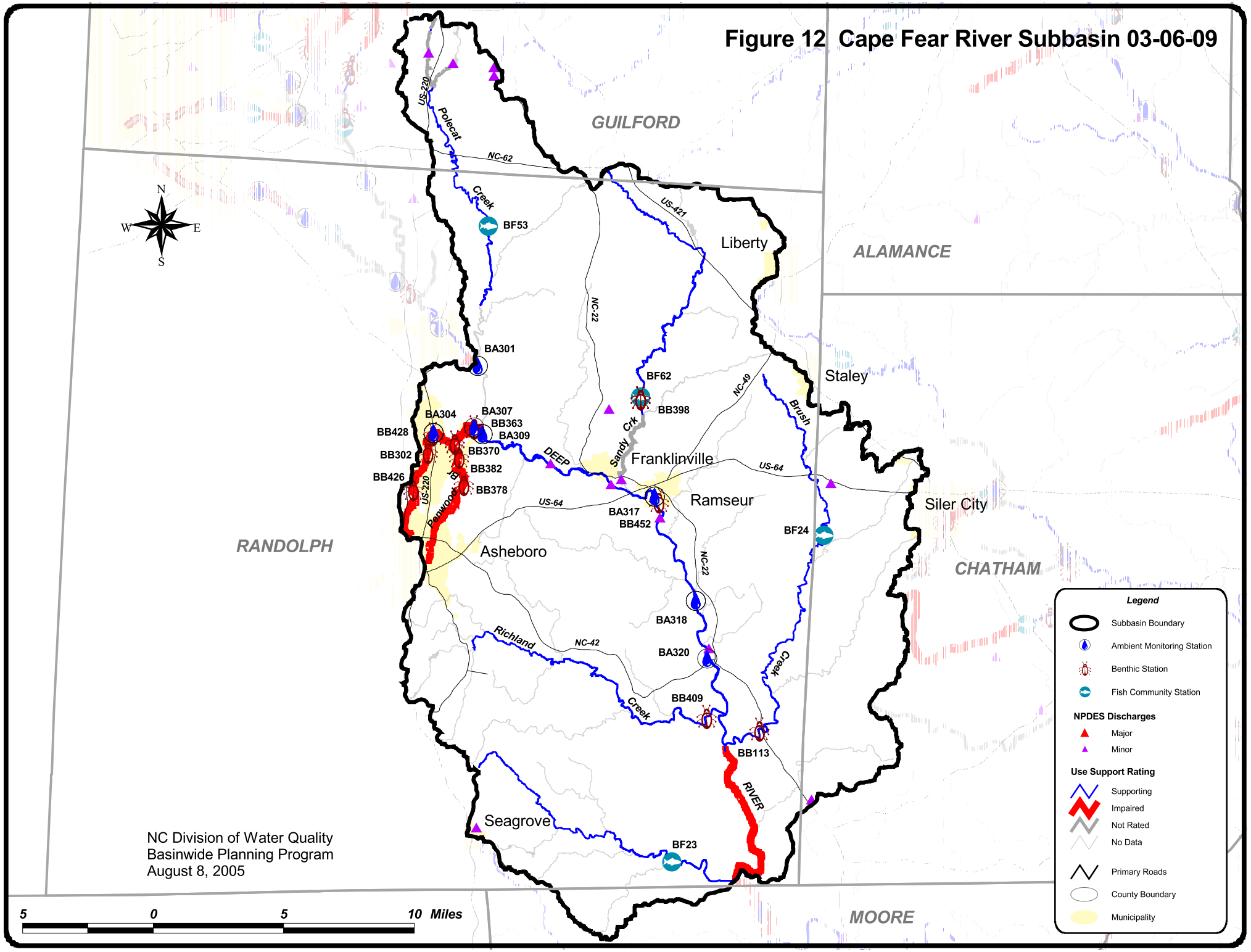


Table 12 CAPE FEAR Subbasin 03-06-09

AU Number / Description	Classification	Length/Area		Aquatic Life Assessment						Recreation Assessment					
				AL Rating	Station	Result	Year/ Parameter	% Exc		REC Rating	Station	Result		Stressors	Sources
Brush Creek															
17-23a	C	19.0	FW Miles	**S**						ND					
From source to Little Brush Creek					BF24	G	2003								
17-23b	C	5.0	FW Miles	**S**						ND					
From Little Brush Creek to Deep River					BB113	GF	2003								
DEEP RIVER															
17-(10.5)d	C	20.9	FW Miles	**S**	BA309	NCE	Chlor a	7.4		**NR***	BA309	NCE		Chlorophyll a	Unknown
					BA317	NCE	Turbidity	8.4			BA318	NCE		Turbidity	Unknown
					BA318	NCE	Turbidity	9.8						Habitat Degradation	Unknown
					BA320	NCE								Fecal Coliform Bacteria	Unknown
From Haskett Creek to Brush Creek					BB452	G	2003								
17-(10.5)e1	C	6.7	FW Miles	**I**	BA322	CE	Turbidity	10.9		**S**	BA322	NCE		Turbidity	Unknown
From Brush Creek to Subbasin 03-06-09 and 03-06-10 boundary															
Fork Creek															
17-25	C	15.1	FW Miles	**S**						ND					
From source to Deep River					BF23	G	2003								
Haskett Creek															
17-12a	C	6.3	FW Miles	**I**	BA304	NCE	Turbidity	7.5		**NR***	BA304	NCE		Habitat Degradation	MS4 NPDES
From source to SR 2149					BB302	P	2003								
					BB370	P	1998								
					BB370	F	2003								
					BB426	P	2003								
					BB428	P	2003								
17-12b	C	1.3	FW Miles	**I**	BA307	NCE				**NR***	BA307	NCE		Fecal Coliform Bacteria	MS4 NPDES
From SR 2149 to Deep River					BB363	P	2003							Habitat Degradation	WWTP NPDES
					BB363	P	1998							Habitat Degradation	MS4 NPDES

Table 12 CAPE FEAR Subbasin 03-06-09

AU Number / Description	Classification	Length/Area	Aquatic Life Assessment						Recreation Assessment				
			AL Rating	Station	Result	Year/ Parameter	% Exc		REC Rating	Station	Result	Stressors	Sources
Penwood Branch													
17-12-1	C	6.1 FW Miles	I						ND				
From source to Haskett Creek				BB378	F	2003							
				BB382	F	2003							
Polecat Creek													
17-11-(1)b	WS-III	16.4 FW Miles	S						ND				
From Ut at Cone Mills Club to a point 0.4 mile downstream of Randolph County SR 2116				BF53	G	2003							
Richland Creek													
17-22	C	14.6 FW Miles	S						ND				
From source to Deep River				BB409	G	2003							
Sandy Creek													
17-16-(1)a	WS-III	16.1 FW Miles	S						ND				
From source to SR 2495				BB398	G	2003							
				BB398	G	2002							
				BB398	E	2001							
				BB398	G	2003							
				BF62	E	1999							
				BF62	G	2003							
17-16-(1)b	WS-III	19.3 FW Acres	NR	BL20	NCE	Chlor a	66		ND			Chlorophyll a	Agriculture
From SR 2495 to a point 0.6 mile upstream of NC Hwy 22												Chlorophyll a	Impervious Surfac
17-16-(3.5)	WS-III CA	4.6 FW Acres	NR	BL21	NCE	Chlor a	66		ND			Chlorophyll a	Agriculture
From a point 0.6 mile upstream of NC Hwy 22 to Ramseur water supply												Chlorophyll a	Impervious Surfac

Table 12 CAPE FEAR Subbasin 03-06-09

AU Number	Classification	Length/Area	Description	Aquatic Life Assessment					Recreation Assessment				
				AL Rating	Station	Result	Year/ Parameter	% Exc	REC Rating	Station	Result	Stressors	Sources

AL - Aquatic Life	BF - Fish Community Survey	E - Excellent	S - Supporting, I - Impaired
REC - Recreation	BB - Benthic Community Survey	G - Good	NR - Not Rated
	BA - Ambient Monitoring Site	GF - Good-Fair	NR*- Not Rated for Recreation (screening criteria exceeded)
	BL- Lake Monitoring	F - Fair	ND-No Data Collected to make assessment
	S- DEH RECMON	P - Poor	**Results**
		NI - Not Impaired	CE-Criteria Exceeded > 10% and more than 10 samples
	Miles/Acres	S- Severe Stress	NCE-No Criteria Exceeded
	FW- Fresh Water	M-Moderate Stress	
	S- Salt Water	N- Natural	

Aquatic Life Rating Summary

S	m	107.1	FW Miles
I	m	20.4	FW Miles
NR	m	23.9	FW Acres
NR	e	4.2	FW Miles
ND		182.4	FW Miles

Recreation Rating Summary

S	m	6.7	FW Miles
NR*	m	28.5	FW Miles
ND		279.0	FW Miles
ND		23.9	FW Acres

Fish Consumption Rating Summary

I	e	314.2	FW Miles
I	e	23.9	FW Acres

9.2 Use Support Assessment Summary

Use support ratings were assigned for waters in subbasin 03-06-09 in the aquatic life, recreation, fish consumption and water supply categories. All waters are Impaired on an evaluated basis in the fish consumption category because of fish consumption advice that applies to the entire basin. In the water supply category, all WS classified waters (23.9 acres and 68.9 miles) are Supporting on an evaluated basis based on reports from DEH regional water treatment plant consultants. Refer to Appendix X for a complete list of monitored waters and more information on Supporting monitored waters.

There were 127.5 stream miles (40.6 percent) and 23.9 freshwater acres (100 percent) monitored during this assessment period in the aquatic life category. There are 20.4 stream miles (6.5 percent) identified as Impaired in this same category.

9.3 Status and Recommendations of Previously and Newly Impaired Waters

The following waters were either identified as Impaired in the previous basin plan (2000) or are newly Impaired based on recent data. If previously identified as Impaired, the water will either remain on the state's 303(d) list or will be delisted based on recent data showing water quality improvements. If the water is newly Impaired, it will likely be placed on the 2006 303(d) list. The current status and recommendations for addressing these waters are presented below, and each is identified by an assessment unit number (AU#). Refer to the overview for more information on AUs. Information regarding 303(d) listing and reporting methodology is presented in Appendix VII.

9.3.1 Deep River [AU# 17-(10.5)d and e1]

Current Status
The Deep River [17-(10.5)d] from Haskett Creek to Brush Creek (20.9 miles) is Supporting aquatic life because of a Good benthic community rating at site BB452. There was a lack of pool and riffles, but streambank and riparian areas were intact. Turbidity was above the water quality standard in 9.8 of samples collected at site BA318. Chlorophyll *a* was above the standard in 7.4 percent of samples at site BA309, which is in a backwater of a dam just downstream of Hasketts Creek. The Ramseur WWTP (NC0026565) had significant violations of biological oxygen demand permit limits that could have negatively impacted aquatic life. The WWTP has had no violations since 2003. This segment is Not Rated for recreation because the fecal coliform bacteria screening criteria were exceeded at sites BA309 and BA318.

The Deep River [17-(10.5)e1] from Brush Creek to the subbasin boundary (6.7 miles) is Impaired for aquatic life because the turbidity standard was violated at site BA322 in 11 percent of samples collected during the assessment period. Site BA322 is subbasin 03-06-10.

2005 Recommendations
DWQ and the UCFRBA will continue to monitor these segments of the Deep River. The NPDES compliance process will be used to address the significant permit violations noted above.

Segment 17-(10.5e1) will be added to the 303(d) list of Impaired waters. TMDLs (Chapter 35) will be developed for identified stressors within 8-13 years of listing.

Water Quality Initiatives
In 1998, Ramseur received a $344,000 CWMTF (Chapter 34) grant to rehabilitate 7,500 linear feet of the wastewater collection system in order to reduce inflow and infiltration that was causing operational problems at the plant. In 1999, Franklinville received a $1,052,000 CWMTF grant to replace the WWTP and install UV disinfection and backup emergency power. In 2003, Ramseur received a $278,000 CWMTF grant to rehabilitate another 3,000 linear feet of the wastewater collection system and to purchase a backup generator.

9.3.2 Haskett Creek [AU#17-12a and b]

2000 Recommendations
The 2000 basin plan recommended that these segments of Hasketts Creek be resampled using the 303(d) approach to determine problem parameters.

Current Status
Haskett Creek [17-12a] from source to SR 2149 (6.3 miles) is Impaired for aquatic life because of Poor and Fair benthic community ratings at sites BB426, BB428, BB302 and BB370. Turbidity was also above the water quality standard in 7.5 percent of samples collected at site BA304. This segment is Not Rated for recreation because the fecal coliform bacteria screening criteria were exceeded at site BA304.

Haskett Creek [17-12b] from SR 2149 to the Deep River (1.3 miles) is Impaired for aquatic life because of a Poor benthic community rating at site BB363. The Asheboro WWTP (NC0026123) had significant violations of chlorine permit limits in the last two years of the assessment period. Instream toxicity testing downstream of the WWTP in August 2003 indicated no toxicity, and the facility has had only one violation since 2003.

A stressor study completed in the Hasketts Creek watershed indicated that habitat degradation from urban runoff were stressors to the benthic community. Streambank erosion, inadequate riparian areas and channelization were also noted stressors. Hasketts Creek is subjected to rapid increases in flow after rainfall events due to urban runoff.

2005 Recommendations
DWQ will continue to monitor the Hasketts Creek watershed. The NPDES compliance process will be used to address the significant permit violations noted above. Refer to Chapter 31 for more information and recommendations for urban streams. Both segments will remain on the 303(d) list of Impaired waters.

9.3.3 Penwood Branch [AU#17-12-1]

Current Status
Penwood Branch was Not Rated in the 2000 plan; however, Penwood Branch [17-12-1] from source to Hasketts Creek (6.1 miles) is Impaired for aquatic life because of Poor benthic community ratings at sites BB378 and BB382. A stressor study completed in the Hasketts Creek watershed (including Penwood Branch) indicated that habitat degradation from urban runoff

were stressors to the benthic community. Streambank erosion, inadequate riparian areas and channelization were also noted stressors. Hasketts Creek is subjected to rapid increases in flow after rainfall events due to urban runoff.

2005 Recommendations
DWQ will continue to monitor the Penwood Branch watershed. Refer to Chapter 31 for more information and recommendations for urban streams.

Penwood Branch will be added to the 303(d) list of Impaired waters. TMDLs (Chapter 35) will be developed for identified stressors within 8-13 years of listing.

9.4 Status and Recommendations for Waters with Noted Impacts

The surface waters discussed in this section are not Impaired. However, notable water quality problems and concerns have been documented for some waters based on this assessment. While these waters are not Impaired, attention and resources should be focused on these waters to prevent additional degradation or facilitate water quality improvement. Waters in the following section are identified by assessment unit number (AU#). See overview for more information on AU#s.

9.4.1 Polecat Creek [AU#17-11-1a]

Current Status and 2005 Recommendations
Polecat Creek from source to UT at Cone Mills Club (2.8 miles) is Not Rated on an evaluated basis for aquatic life because Monroe Mobile Home Park (NC0055913) had significant violations of biological oxygen demand permit limits in the last two years of the assessment period that could have negatively impacted aquatic life. The facility continued to have occasional violations of BOD in 2004. The lower 16.4 miles are Supporting aquatic life because of a Good fish community rating at site BF53. DWQ will continue to monitor the Polecat Creek. The NPDES compliance process will be used to address the significant permit violations noted above.

9.4.2 Sandy Creek (Sandy Creek Reservior) [AU# 17-19-(1)b and (3.5)]

Current Status and 2005 Recommendations
Sandy Creek Reservoir (23.9 acres) is Not Rated for aquatic life because 33 percent of chlorophyll *a* samples exceeded the water quality standard. However, not enough samples were collected to assign a use support rating. Nutrient levels in the reservoir were higher than in previous years and blue-green algal blooms occurred throughout the summer months. These blooms can cause taste and odor problems in treated drinking water. DWQ will determine if increased monitoring efforts in this lake are warranted to better assess water quality.

Water Quality Initiatives
In 1997, the Piedmont Land Conservancy received a $134,000 CWMTF grant to acquire 144 acres of permanent easements in this watershed (Chapter 34).

9.4.3 UT at Cone Mills Club [AU#17-11-2-(2)]

Current Status and 2005 Recommendations

UT at Cone Mills Club from Cone Mills Lake Club Dam to Polecat Creek (1.4 miles) is Not Rated on an evaluated basis because the Woodlake Mobile Home Park (NC0023299) had significant violations of biological oxygen demand permit limits in the last two years of the assessment period that could have negatively impacted aquatic life. The facility has new owners that hired a new operator and plan to upgrade the facility. The NPDES compliance process will be used to address the permit violations.

Chapter 10
Cape Fear River River Subbasin 03-06-10
Including: Deep River, McLendons Creek, Bear Creek, Cabin Creek and Mill Creek

10.1 Subbasin Overview

Subbasin 03-06-10 at a Glance

Land and Water Area

Total area:	448 mi²
Land area:	446 mi²
Water area:	2 mi²

Population Statistics

2000 Est. Pop.: 45,209 people
Pop. Density: 101 persons/mi²

Land Cover (percent)

Forest/Wetland:	80.0%
Surface Water:	0.9%
Urban:	0.4%
Cultivated Crop:	0.9%
Pasture/ Managed Herbaceous:	17.9%

Counties

Chatham, Montgomery, Moore and Randolph

Municipalities

Biscoe, Carthage, Robbins and Star

Subbasin 03-06-10 is primarily in the Carolina slate belt, with some streams draining Triassic basin soils and the Sandhills. Almost the entire watershed is forested with very few urban areas. Population is expected to grow by 105,000 people in counties with portions or all of their areas in this subbasin by 2020; however, most of the growth will be in portions of the counties outside of this subbasin.

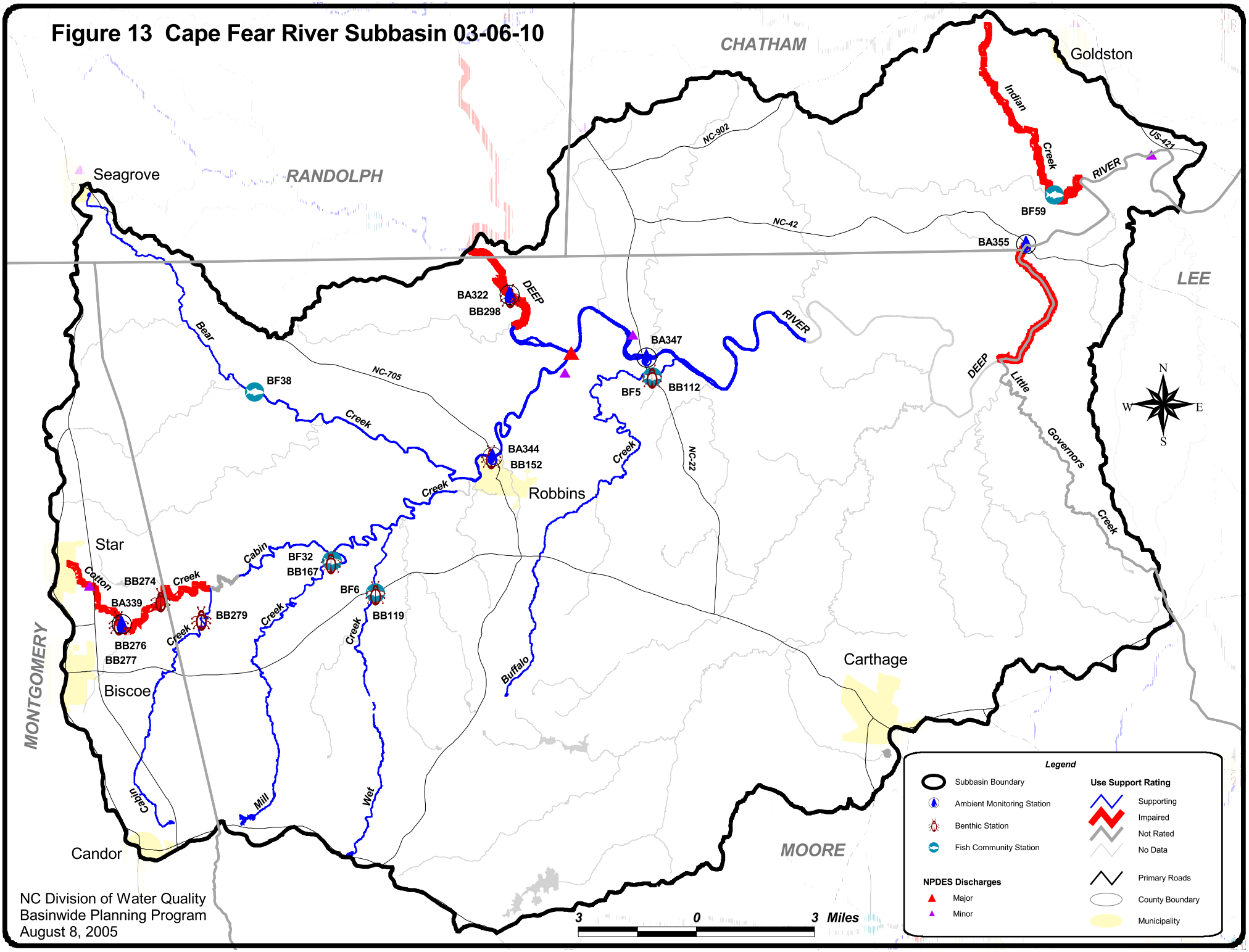
There are three individual NPDES wastewater discharge permits in this subbasin with a permitted flow of 1.9 MGD (Figure 13). The largest is Robbins WWTP (1.3 MGD). Refer to Appendix VI and Chapter 30 for more information on NPDES permit holders. Issues related to compliance with NPDES permit conditions are discussed below in Section 10.3 for Impaired waters.

There is one registered dairy, one registered cattle operation and three registered swine operations in this subbasin.

There were 10 benthic community samples and six fish community samples (Figure 13 and Table 13) collected during this assessment period. Data were also collected from five ambient monitoring stations including one UCFRBA (Appendix V) station, two DWQ stations and two shared ambient station. One reservoir was also monitored. Refer to the *2003 Cape Fear River Basinwide Assessment Report* at http://www.esb.enr.state.nc.us/bar.html and Appendix IV for more information on monitoring.

Waters in the following sections are identified by assessment unit number (AU#). This number is used to track defined segments in the water quality assessment database, 303(d) Impaired waters list and the various tables in this basin plan. The assessment unit number is a subset of the DWQ index number (classification identification number). A letter attached to the end of the AU# indicates that the assessment is smaller than the DWQ index segment. No letter indicates that the assessment unit and the DWQ index segment are the same.

Figure 13 Cape Fear River Subbasin 03-06-10



NC Division of Water Quality
Basinwide Planning Program
August 8, 2005

Table 13 CAPE FEAR Subbasin 03-06-10

AU Number / Description	Classification	Length/Area	Aquatic Life Assessment					Recreation Assessment				
			AL Rating	Station	Result	Year/ Parameter	% Exc	REC Rating	Station	Result	Stressors	Sources
Bear Creek												
17-26-(1)	WS-III	14.9 FW Miles	S					ND				
From a source to a point 0.5 mile upstream of Cabin Creek				BF38	G	'2003						
17-26-(4.5)	WS-III CA	0.2 FW Miles	S	BA344	NCE			S	BA344	NCE		
From a point 0.5 mile upstream of Cabin Creek to Robbins water supply intake				BB152	G	'2003						
17-26-(6)	C	6.3 FW Miles	S	BA344	NCE			S	BA344	NCE	Habitat Degradation	Unknown
From Robbins water supply intake to Deep River				BB152	G	'2003						
Buffalo Creek												
17-28	C	16.5 FW Miles	S					ND				
From source to Deep River				BB112	GF	'2003						
				BF5	G	'2003						
Cabin Creek												
17-26-5-(1)a	WS-III	8.7 FW Miles	S					ND				
From source to Cotton Creek				BB279	G	'2003						
				BB279	NR	'2002						
				BB279	GF	'2003						
17-26-5-(1)c	WS-III	10.5 FW Miles	S					ND				
From SR 1281 to Moore County SR 1434				BF32	E	'1999						
				BF32	E	'1999						
				BF32	G	'1999						
				BF32	GF	'2003						

Table 13 CAPE FEAR Subbasin 03-06-10

AU Number / Description	Classification	Length/Area	Aquatic Life Assessment					Recreation Assessment			Stressors	Sources
			AL Rating	Station	Result	Year/ Parameter	% Exc	REC Rating	Station	Result		
Cotton Creek												
17-26-5-3a	WS-III	0.3 FW Miles	I	BA339	NCE			NR*	BA339	NCE	Fecal Coliform Bacteria	Unknown
From source to Center Street				BB276	P	2001					Toxic Impacts	WWTP NPDES
17-26-5-3b	WS-III	2.5 FW Miles	I	BA339	NCE			NR*	BA339	NCE	Fecal Coliform Bacteria	Unknown
From Center Street to SR 1371				BB276	P	2001					Toxic Impacts	WWTP NPDES
				BB277	P	1998						
17-26-5-3c	WS-III	3.7 FW Miles	I					ND			Toxic Impacts	WWTP NPDES
From SR 1371 to Cabin Creek				BB274	F	2001						
				BB275	F	1998						
DEEP RIVER												
17-(10.5)e2	C	2.8 FW Miles	I	BA322	CE	Turbidity	10.9	S	BA322	NCE	Turbidity	Unknown
From Subbasin 03-06-09 and 03-06-10 boundary to Grassy Creek				BB298	G	2002						
				BB298	E	2003						
17-(25.7)	C HQW	12.4 FW Miles	S	BA347	NCE	Turbidity	7.94	S	BA347	NCE	Turbidity	Unknown
From Grassy Creek to a point 1.0 mile upstream of Tysons Creek												
17-(32.5)a	WS-IV	4.0 FW Miles	I	BA355	NCE	Low DO	6.8	ND	BA355	NCE	Chlorophyll a	Unknown
				BA355	CE	Chlor a	13.2					
From mouth of Big Governors Creek to Carbonton Dam												
Indian Creek												
17-35	WS-IV	7.4 FW Miles	I					ND			Habitat Degradation	Land Clearing
From source to Deep River				BF59	F	2003						
Killets Creek												
17-30-3-(1)	WS-III CA	8.0 FW Acres	NR	BL23	NCE	Low pH	100	ND			Low pH	
From source to dam at Carthages water supply reservoir												
Mill Creek												
17-26-5-4	WS-III	11.7 FW Miles	S					ND				
From source to Cabin Creek				BB167	G	2003						

Table 13 CAPE FEAR Subbasin 03-06-10

AU Number / Description	Classification	Length/Area	Aquatic Life Assessment					Recreation Assessment				
			AL Rating	Station	Result	Year/ Parameter	% Exc	REC Rating	Station	Result	Stressors	Sources
Wet Creek												
17-26-5-5	WS-III	10.6 FW Miles	**S**					ND				
From source to Cabin Creek				BB119	G	2003						
				BF6	NR	2003						

AL - Aquatic Life	BF - Fish Community Survey	E - Excellent	S - Supporting, I - Impaired
REC - Recreation	BB - Benthic Community Survey	G - Good	NR - Not Rated
	BA - Ambient Monitoring Site	GF - Good-Fair	NR*- Not Rated for Recreation (screening criteria exceeded)
	BL- Lake Monitoring	F - Fair	ND-No Data Collected to make assessment
	S- DEH RECMON	P - Poor	**Results**
		NI - Not Impaired	CE-Criteria Exceeded > 10% and more than 10 samples
	Miles/Acres	S- Severe Stress	NCE-No Criteria Exceeded
	FW- Fresh Water	M-Moderate Stress	
	S- Salt Water	N- Natural	

Aquatic Life Rating Summary

S	m	91.9	FW Miles
I	m	20.7	FW Miles
NR	m	8.0	FW Acres
NR	e	1.2	FW Miles
ND		283.3	FW Miles

Recreation Rating Summary

S	m	21.7	FW Miles
NR*	m	2.8	FW Miles
ND		372.5	FW Miles
ND		8.0	FW Acres

Fish Consumption Rating Summary

I	e	397.1	FW Miles
I	e	8.0	FW Acres

10.2 Use Support Assessment Summary

Use support ratings were assigned for waters in subbasin 03-06-10 in the aquatic life, recreation, fish consumption and water supply categories. All waters are Impaired on an evaluated basis in the fish consumption category because of fish consumption advice that applies to the entire basin. In the water supply category, all WS classified waters (8 acres and 165.4 miles) are Supporting on an evaluated basis based on reports from DEH regional water treatment plant consultants. Refer to Appendix X for a complete list of monitored waters and more information on Supporting monitored waters.

There were 112.6 stream miles (28.4 percent) and 8 freshwater acres (100 percent) monitored during this assessment period in the aquatic life category. There are 20.7 stream miles (5.2 percent) identified as Impaired in this same category.

10.3 Status and Recommendations of Previously and Newly Impaired Waters

The following waters were either identified as Impaired in the previous basin plan (2000) or are newly Impaired based on recent data. If previously identified as Impaired, the water will either remain on the state's 303(d) list or will be delisted based on recent data showing water quality improvements. If the water is newly Impaired, it will likely be placed on the 2006 303(d) list. The current status and recommendations for addressing these waters are presented below, and each is identified by an assessment unit number (AU#). Refer to the overview for more information on AUs. Information regarding 303(d) listing and reporting methodology is presented in Appendix VII.

10.3.1 Cabin Creek [AU#17-26-5-(1)b and c]

Current Status
Cabin Creek [17-26-5-(1)b] from Cotton Creek to SR 1281 (1.2 miles) is Not Rated on an evaluated basis for aquatic life because it is impacted by the Star WWTP discharging to Cotton Creek (see below). The conductivity has been up to ten times higher than in nearby streams.

Cabin Creek [17-26-5-(1)c] from SR 1281 to SR 1434 (10.5 miles) is Supporting aquatic life because of Good-Fair fish community rating at site BF32. The fish community has been rated Excellent in the past and is expected to recover after the drought and high flows in 2003.

2005 Recommendations
DWQ will continue to monitor Cabin Creek to evaluate recovery of the fish community and the reduced impacts of the Star WWTP. Segment 17-26-5-(1)b will remain on the 303(d) list.

10.3.2 Cotton Creek [AU#17-26-5-3a,b and c]

2000 Recommendations
The 2000 basinwide plan recommended that Star WWTP maintain the highest quality effluent possible to protect aquatic life in Cotton Creek, and a 303(d) sampling approach would be conducted by DWQ.

Current Status
Cotton Creek from source to Cabin Creek (6.5 miles) is Impaired for aquatic life because of Poor and Fair benthic community ratings at sites BB276 and BB274. The Star WWTP (NC0058548) had significant violations of cyanide permit limits and many whole effluent toxicity test failures during the last two years of the assessment period. The Star WWTP has decreased flow and improved effluent quality after a significant industrial user ceased discharging to the plant in 2003. Due to changes in the influent to the Star WWTP, the facility was in compliance in 2004. The downstream benthic community site was severely stressed by the WWTP toxicity. Segment [17-26-5-3b] is Not Rated for recreation because the fecal coliform bacteria screening criteria were exceeded at site BA339.

2005 Recommendations
DWQ will continue to monitor Cotton Creek. Fayetteville Regional Office staff will continue to monitor improvements at the Town of Star WWTP. DWQ recommends that Star pursue other wastewater disposal options to Cotton Creek. Cotton Creek will remain on the 303(d) list and closely evaluated during the next assessment period.

10.3.3 Deep River [AU#17-(10.5)e2, (25.7) and (32.5)a]

Current Status
These segments of the Deep River were Fully Supporting in the 2000 basin; however, NPDES permit limits were recommended in this segment (Chapter 30). The Deep River [17-(10.5)e2] from the subbasin boundary to Grassy Creek (2.8 miles) is Impaired for aquatic life because the turbidity standard was violated in 10.9 percent samples at site BA322. The benthic community was rated Excellent at site BB298.

The Deep River [17-(25.7)] from Grassy Creek to upstream of Tysons Creek (12.4 miles) is Supporting aquatic life because no criteria were exceeded at site BA347; however, turbidity was above the standard in 7.9 percent samples at site BA347. The Robbins WWTP (NC0062855) also had significant violations of mercury permit limits during the last two years of the assessment period. Robbins conducted mercury investigations during 2002 and isolated several sources. A review of data for 2003 and 2004 indicated no violations of mercury permit limits.

The Deep River [17-(32.5)a] from Big Governors Creek to Carbonton Dam (4 miles) is Impaired for aquatic life because the chlorophyll *a* standard was violated in 13 percent of samples at site BA355. Site BA355 is in the backwaters of Carbonton Dam. Nutrient loading from upstream land uses has caused increased algal growth behind other dams in the Deep River as well.

2005 Recommendations
DWQ and UCFRBA (Appendix V) will continue to monitor the Deep River.
Segments 17-(10.5)e2 and 17-(32.5)a will be added to the 303(d) list of Impaired waters.
TMDLs (Chapter 35) will be developed for identified stressors within 8-13 years of listing.

Water Quality Initiatives
In 1998, Triangle Land Conservancy received a $1,189,000 CWMTF grant to acquire 563 acres along the Deep River (Chapter 34).

10.3.4 Indian Creek [AU#17-35]

Current Status
Indian Creek was Not Rated in the 2000 basin plan; however, Indian Creek from source to Deep River (7.4 miles) is currently Impaired for aquatic life because of a Fair fish community rating at site BF59. Indian Creek was a regional reference site because of habitat characteristics and was rated Excellent in 1998. The habitat has been extremely degraded since 1998 due to extensive land clearing in the immediate watershed that has left only a narrow buffer of mature trees. High flows and drought conditions during the assessment period have also impacted the fish community in Indian Creek. The land clearing was to establish pastureland and was not related to forest harvesting.

2005 Recommendations
DWQ will continue to monitor Indian Creek and work with DSWC staff to identify BMPs to minimize further degradation to the creek. Land clearing activities should use forestry BMPs (Chapter 29) to minimize impacts to local streams. Adequate buffers should be maintained for all land clearing activities.

10.4 Status and Recommendations for Waters with Noted Impacts

The surface waters discussed in this section are not Impaired. However, notable water quality problems and concerns have been documented for some waters based on this assessment. While these waters are not Impaired, attention and resources should be focused on these waters to prevent additional degradation or facilitate water quality improvement. Waters in the following section are identified by assessment unit number (AU#). See overview for more information on AU#s.

10.4.1 Killets Creek (Carthage City Lake)[AU#17-30-3-(1)]

Current Status and 2005 Recommendations
Carthage City Lake (8 acres) is Not Rated for aquatic life because 100 percent of pH samples were below the water quality standard. However, not enough samples were collected to assign a use support rating. Increased nutrient and turbidity levels were noted in the lake compared to previous monitoring. DWQ will determine if increased monitoring efforts in this lake are warranted to better assess water quality.

10.4.2 McLendons Creek [AU#17-30]

Current Status and Water Quality Initiatives
McLendons Creek (28 acres) from source to the Deep River was not assessed during this assessment period. Previous biological assessments indicated that the low summer flow of this Triassic basin stream did not meet criteria to assign use support ratings. McLendons Creek has been impacted by nutrients and sediment from agriculture land uses. In 1996, NCSU received a $198,000 Section 319 grant (Chapter 34) to implement BMPs on dry litter poultry farms, exclude cattle from streambanks, and to start a volunteer monitoring program.

Chapter 11
Cape Fear River Subbasin 03-06-11

Including: Deep River, Big Buffalo Creek, Cedar Creek, Georges Creek and Pocket Creek

11.1 Subbasin Overview

Subbasin 03-06-11 at a Glance

Land and Water Area

Total area:	133 mi²
Land area:	132 mi²
Water area:	1 mi²

Population Statistics

2000 Est. Pop.:	19,646people
Pop. Density:	98 persons/mi²

Land Cover (percent)

Forest/Wetland:	83.8%
Surface Water:	1.2%
Urban:	3.2%
Cultivated Crop:	2.2%
Pasture/ Managed Herbaceous:	9.5%

Counties

Chatham and Lee

Municipalities

Goldston and Sanford

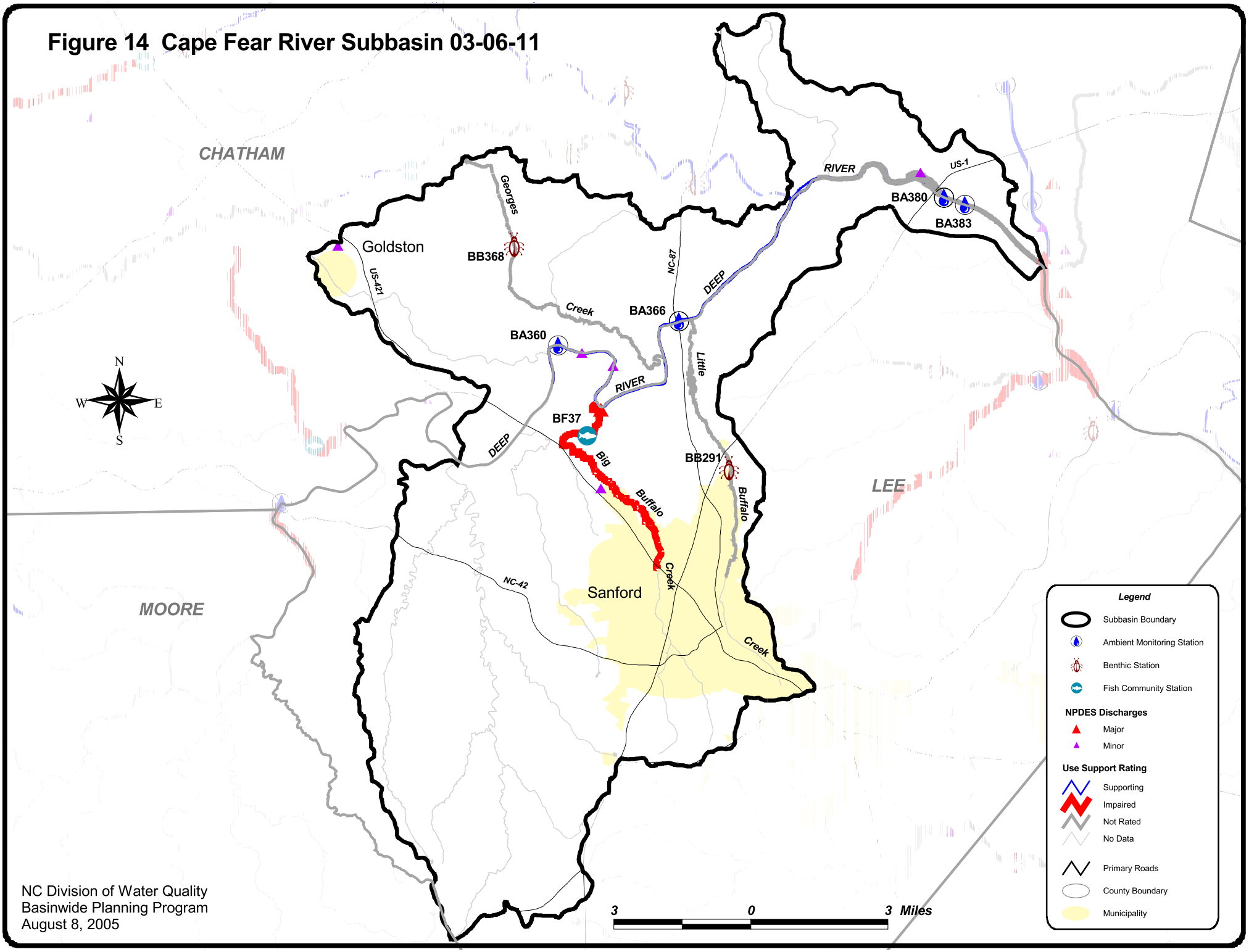
Subbasin 03-06-11 drains Triassic basin soils, and many of the streams have very low or zero flow at certain times of year. Most of the watershed is forested. Development is occurring near Sanford. Population is expected to grow by 35,000 people in counties with portions or all of their areas in this subbasin by 2020.

There are seven individual NPDES wastewater discharge permits in this subbasin with a permitted flow of 7.8 MGD (Figure 14). The largest are Sanford WWTP (6.8 MGD) and Gold Kist Inc. (1 MGD). Refer to Appendix VI and Chapter 30 for more information on NPDES permit holders. Issues related to compliance with NPDES permit conditions are discussed below in Section 11.3 for Impaired waters and in Section 11.4 for other waters.

There were two benthic community samples and one fish community sample (Figure 14 and Table 14) collected during this assessment period. Data were also collected from four ambient monitoring stations including one UCFRBA (Appendix V) station and four shared ambient stations. Refer to the *2003 Cape Fear River Basinwide Assessment Report* at http://www.esb.enr.state.nc.us/bar.html and Appendix IV for more information on monitoring.

Waters in the following sections are identified by assessment unit number (AU#). This number is used to track defined segments in the water quality assessment database, 303(d) Impaired waters list and the various tables in this basin plan. The assessment unit number is a subset of the DWQ index number (classification identification number). A letter attached to the end of the AU# indicates that the assessment is smaller than the DWQ index segment. No letter indicates that the assessment unit and the DWQ index segment are the same.

Figure 14 Cape Fear River Subbasin 03-06-11



NC Division of Water Quality
Basinwide Planning Program
August 8, 2005

Table 14 CAPE FEAR Subbasin 03-06-11

AU Number / Description	Classification	Length/Area	Aquatic Life Assessment					Recreation Assessment			Stressors	Sources
			AL Rating	Station	Result	Year/ Parameter	% Exc	REC Rating	Station	Result		
Big Buffalo Creek												
17-40	C	8.0 FW Miles	I					ND			Habitat Degradation	MS4 NPDES
From source to Deep River				BF37	F	2003						
DEEP RIVER												
17-(38.7)	C	12.0 FW Miles	S	BA360	NCE			ND	BA360	NCE		
				BA366	NCE				BA366			
From Lee County water supply intake to a point 0.4 mile upstream of Rocky Branck												
17-(43.5)	WS-IV	6.0 FW Miles	NR	BA380	NCE	Turbidity	8.33	S	BA380		Turbidity	
				BA383	NCE				BA383	NCE		
From a point 0.4 mile upstream of Rocky Branch to Cape Fear River (junction with Haw River)												
Georges Creek												
17-41	C	8.6 FW Miles	NR					ND			Habitat Degradation	Unknown
From source to Deep River				BB368	NR	2003						
Little Buffalo Creek												
17-42	C	9.9 FW Miles	NR					ND			Habitat Degradation	MS4 NPDES
From source to Deep River				BB291	NR	2003						

Table 14 CAPE FEAR Subbasin 03-06-11

AU Number / Classification / Length/Area / Description	Aquatic Life Assessment					Recreation Assessment				
	AL Rating	Station	Result	Year/ Parameter	% Exc	REC Rating	Station	Result	Stressors	Sources

AL - Aquatic Life	BF - Fish Community Survey	E - Excellent	S - Supporting, I - Impaired
REC - Recreation	BB - Benthic Community Survey	G - Good	NR - Not Rated
	BA - Ambient Monitoring Site	GF - Good-Fair	NR*- Not Rated for Recreation (screening criteria exceeded)
	BL- Lake Monitoring	F - Fair	ND-No Data Collected to make assessment
	S- DEH RECMON	P - Poor	**Results**
		NI - Not Impaired	CE-Criteria Exceeded > 10% and more than 10 samples
	Miles/Acres	S- Severe Stress	NCE-No Criteria Exceeded
	FW- Fresh Water	M-Moderate Stress	
	S- Salt Water	N- Natural	

Aquatic Life Rating Summary

S	m	12.0	FW Miles
NR	m	24.5	FW Miles
I	m	8.0	FW Miles
ND		68.0	FW Miles

Recreation Rating Summary

S	m	6.0	FW Miles
ND		106.5	FW Miles

Fish Consumption Rating Summary

I	m	6.0	FW Miles
I	e	106.5	FW Miles

11.2 Use Support Assessment Summary

Use support ratings were assigned for waters in subbasin 03-06-11 in the aquatic life, recreation, fish consumption and water supply categories. All waters are Impaired on an evaluated basis in the fish consumption category because of fish consumption advice that applies to the entire basin. In the water supply category, all WS classified waters (18.7 miles) are Supporting on an evaluated basis based on reports from DEH regional water treatment plant consultants. Refer to Appendix X for a complete list of monitored waters and more information on Supporting monitored waters.

There were 44.5 stream miles (39.5 percent) monitored during this assessment period in the aquatic life category. There are 8 stream miles (7.1 percent) identified as Impaired in this same category.

11.3 Status and Recommendations of Previously and Newly Impaired Waters

The following waters were either identified as Impaired in the previous basin plan (2000) or are newly Impaired based on recent data. If previously identified as Impaired, the water will either remain on the state's 303(d) list or will be delisted based on recent data showing water quality improvements. If the water is newly Impaired, it will likely be placed on the 2006 303(d) list. The current status and recommendations for addressing these waters are presented below, and each is identified by an assessment unit number (AU#). Refer to the overview for more information on AUs. Information regarding 303(d) listing and reporting methodology is presented in Appendix VII.

11.3.1 Big Buffalo Creek [AU#17-40]

2000 Recommendations
The 2000 basinwide plan recommended that Sanford address stormwater issues as part of the Phase II NPDES permit process. Big Buffalo Creek was Not Rated in the 2000 basin plan.

Current Status
Big Buffalo Creek from source to Deep River (8 miles) is Impaired for aquatic life because of a Fair fish community rating at site BF37. The watershed drains the urban areas associated with Sanford.

2005 Recommendations
DWQ will continue to monitor Big Buffalo Creek. Refer to Chapter 31 for more information and recommendations for urban streams.

Big Buffalo Creek will be added to the 303(d) list of Impaired waters. TMDLs (Chapter 35) will be developed for identified stressors within 8-13 years of listing.

11.4 Status and Recommendations for Waters with Noted Impacts

The surface waters discussed in this section are not Impaired. However, notable water quality problems and concerns have been documented for some waters based on this assessment. While these waters are not Impaired, attention and resources should be focused on these waters to prevent additional degradation or facilitate water quality improvement. Waters in the following section are identified by assessment unit number (AU#). See overview for more information on AU#s.

11.4.1 Little Buffalo Creek [AU#17-42]

Current Status and 2005 Recommendations
Little Buffalo Creek from source to the Deep River (9.9 miles) is Not Rated for aquatic life because a benthic community rating could not be assigned at site BB291. The creek drains urban areas in Sanford and had steep undercut banks and sandbars. A problematic pump station in this watershed is scheduled to be eliminated.

Water Quality Initiatives
In 1998, Sanford received a $765,000 CWMTF (Chapter 34) grant to purchase or acquire permanent easements on 250 acres along Little Buffalo Creek.

11.4.2 Purgatory Branch [AU#17-40-3]

Current Status and 2005 Recommendations
Purgatory Branch from source to Big Buffalo Creek (2.2 miles) is Not Rated for aquatic life on an evaluated basis because the Bost Distributing Corporation (NC0081493) had significant violations of biological oxygen demand permit limits during the assessment period that could have negatively impacted water quality. Turbidity also exceeded the standard in 8.3 percent of samples collected at site BA380. The NPDES compliance process will be used to address the significant permit violations noted above.

11.4.3 Deep River [AU#17-(38.7) and (43.5)]

Current Status and 2005 Recommendations
Deep River [17-(38.7)] from Lee County water supply intake to upstream of Rocky Branch (12 miles) is Supporting aquatic life because no criteria were exceeded at site BA366, although dissolved oxygen was below 5 mg/l in 14 percent of samples collected during the assessment period.

Deep River [17-(43.5)] from upstream of Rocky Branch to the Cape Fear River (6 miles) is Not Rated for aquatic life because Moncure Community Health (NC0030384) had significant violations of total suspended solids permit limits during the last two years of the assessment period. Although no criteria were exceeded at site BA383, turbidity was above the standard in 8.3 percent of samples collected at site BA380. This segment is Impaired on a monitored basis in the fish consumption category and will be added to the 303(d) list of Impaired waters.

Because of the historically low dissolved oxygen levels in these segments and because of the downstream Impairment in the Cape Fear River, a permitting strategy will apply to new and expanding discharges (Chapter 30). The NPDES compliance process will be used to address the significant permit violations noted above.

Water Quality Initiatives

In 1998, Triangle Land Conservancy received a $1,189,000 CWMTF grant to acquire 563 acres along the Deep River. In 2001, the Triangle Land Conservancy received a minigrant of $25,000 for pre-acquisition of 874 acres along the Deep River. In 2002, Triangle Land Conservancy received a $1,825,000 CWMTF grant to acquire 62 percent of 762 acres along the Deep River (See Chapter 34 for more information on all projects).

Chapter 12
Cape Fear River Subbasin 03-06-12
Including: Rocky River, Loves Creek, Tick Creek and Bear Creek

12.1 Subbasin Overview

Subbasin 03-06-12 at a Glance

Land and Water Area

Total area:	244 mi²
Land area:	243 mi²
Water area:	1 mi²

Population Statistics

2000 Est. Pop.:	20,039people
Pop. Density:	82 persons/mi²

Land Cover (percent)

Forest/Wetland:	68.9%
Surface Water:	0.6%
Urban:	1.3%
Cultivated Crop:	2.5%
Pasture/ Managed Herbaceous:	26.8%

Counties

Alamance, Chatham and Randolph

Municipalities

Siler City

Subbasin 03-06-12 is in the Carolina Slate belt and is characterized by seasonally low flowing streams. Most of the watershed is forested, with extensive pastureland as well. Development is occurring along the US 64 corridor between Siler City and Pittsboro. Population is expected to grow by 110,000 people in counties with portions or all of their areas in this subbasin by 2020.

There are four individual NPDES wastewater discharge permits in this subbasin with a permitted flow of 4.02 MGD (Figure 15). The largest is Siler City WWTP (4 MGD). Refer to Appendix VI and Chapter 30 for more information on NPDES permit holders. Issues related to compliance with NPDES permit conditions are discussed below in Section 12.3 for Impaired waters and in Section 12.4 for other waters.

There is one registered dairy, three registered cattle operations and one registered swine operation in this subbasin. Issues related to agricultural activities are discussed below in Section 12.3 for Impaired waters.

There were 12 benthic community samples and four fish community samples (Figure 15 and Table 15) collected during this assessment period. Data were also collected from three ambient monitoring stations including two UCFRBA (Appendix V) stations and one DWQ ambient station. One reservoir was also monitored. Refer to the *2003 Cape Fear River Basinwide Assessment Report* at http://www.esb.enr.state.nc.us/bar.html and Appendix IV for more information on monitoring.

Waters in the following sections are identified by assessment unit number (AU#). This number is used to track defined segments in the water quality assessment database, 303(d) Impaired waters list and the various tables in this basin plan. The assessment unit number is a subset of the DWQ index number (classification identification number). A letter attached to the end of the AU# indicates that the assessment is smaller than the DWQ index segment. No letter indicates that the assessment unit and the DWQ index segment are the same.

Figure 15 Cape Fear River Subbasin 03-06-12

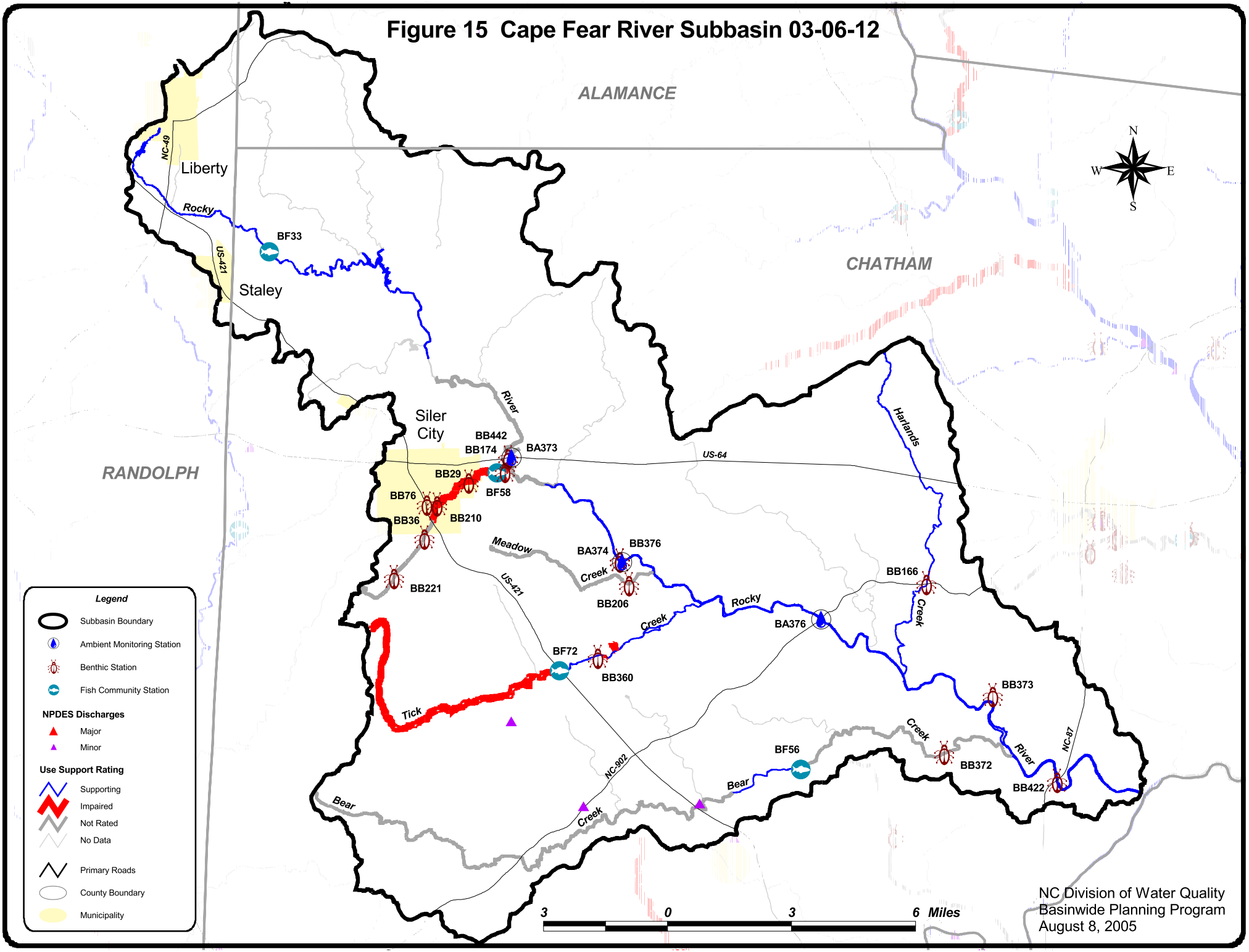


Table 15 CAPE FEAR Subbasin 03-06-12

AU Number	Classification	Length/Area	Description	Aquatic Life Assessment					Recreation Assessment			Stressors	Sources
				AL Rating	Station	Result	Year/ Parameter	% Exc	REC Rating	Station	Result		
Bear Creek													
17-43-16b	C	2.0 FW Miles		**S**					ND				
	From SR 2189 to SR 2187				BF56	GF	'1999						
					BF56	F	'1999						
					BF56	GF	'2003						
17-43-16c	C	7.3 FW Miles		**NR**					ND			Habitat Degradation	
	From SR 2187 to Rocky River				BB372	NR	'2003						
Harlands Creek(Hollands Creek)													
17-43-15	C	10.2 FW Miles		**S**					ND			Habitat Degradation	
	From source to Rocky River				BB166	GF	'2003						
Loves Creek													
17-43-10a	C	3.3 FW Miles		**NR**					ND			Habitat Degradation	MS4 NPDES
	From source to Chatham Avenue				BB221	NR	'2003						
					BB36	NR	'2003						
17-43-10b	C	2.5 FW Miles		**I**					ND			Habitat Degradation	MS4 NPDES
	From Chatham Avenue to Siler City WWTP				BB210	F	'2003						
					BB29	F	'2003						
					BF58	GF	'2003						
17-43-10c	C	0.4 FW Miles		**I**					ND			Habitat Degradation	WWTP NPDES
	From Siler City WWTP to Rocky River				BB174	F	'2003					Habitat Degradation	MS4 NPDES
Meadow Creek													
17-43-12	C	5.0 FW Miles		**NR**					ND				
	From source to Rocky River				BB206	NR	'2003						

Table 15 CAPE FEAR Subbasin 03-06-12

AU Number / Description	Classification	Length/Area	Aquatic Life Assessment: AL Rating	Station	Result	Year/ Parameter	% Exc	Recreation Assessment: REC Rating	Station	Result	Stressors	Sources
Rocky River												
17-43-(1)a	WS-III	10.6 FW Miles	**S**					ND				
From source to upper Rocky River Reservoir				BF33	GF	2003						
17-43-(1)b	WS-III	3.9 FW Miles	**S**	BL24	NCE			ND			Chlorophyll a	Agriculture
From upper Rocky River Reservoir to a point 0.3 mile downstream of Lacy Creek											Chlorophyll a	Pasture
17-43-(8)a	C	6.7 FW Miles	**NR**	BA373	NCE			**S**	BA373	NCE	Turbidity	Unknown
From dam at lower supply reservoir for Siler City to Varnal Creek				BB442	NR	2003					Habitat Degradation	Impervious Surfac
17-43-(8)b	C	21.6 FW Miles	**S**	BA374	NCE			**S**	BA374	NCE	Habitat Degradation	Pasture
				BA376	NCE				BA376	NCE	Habitat Degradation	Agriculture
From Varnal Creek to Deep River				BB376	GF	2003					Habitat Degradation	MS4 NPDES
				BB376	NR	2002						
Tick Creek												
17-43-13a	C	8.2 FW Miles	**I**					ND				
From source to US 421				BF72	F	2003						
17-43-13b	C	4.9 FW Miles	**S**					ND			Habitat Degradation	Agriculture
From US 421 to Rocky River				BB360	GF	2003					Habitat Degradation	Impervious Surfac
											Habitat Degradation	Pasture

Table 15 CAPE FEAR Subbasin 03-06-12

AU Number	Classification	Length/Area	Description	Aquatic Life Assessment					Recreation Assessment				
				AL Rating	Station	Result	Year/ Parameter	% Exc	REC Rating	Station	Result	Stressors	Sources

AL - Aquatic Life	BF - Fish Community Survey	E - Excellent	S - Supporting, I - Impaired
REC - Recreation	BB - Benthic Community Survey	G - Good	NR - Not Rated
	BA - Ambient Monitoring Site	GF - Good-Fair	NR*- Not Rated for Recreation (screening criteria exceeded)
	BL- Lake Monitoring	F - Fair	ND-No Data Collected to make assessment
	S- DEH RECMON	P - Poor	**Results**
		NI - Not Impaired	CE-Criteria Exceeded > 10% and more than 10 samples
	Miles/Acres	S- Severe Stress	NCE-No Criteria Exceeded
	FW- Fresh Water	M-Moderate Stress	
	S- Salt Water	N- Natural	

Aquatic Life Rating Summary

S	m	53.2	FW Miles
NR	m	22.4	FW Miles
I	m	11.1	FW Miles
NR	e	14.9	FW Miles
ND		59.6	FW Miles
ND			FW Acres

Recreation Rating Summary

S	m	28.3	FW Miles
ND		132.9	FW Miles
ND			FW Acres

Fish Consumption Rating Summary

I	e	161.2	FW Miles
			FW Acres

12.2 Use Support Assessment Summary

Use support ratings were assigned for waters in subbasin 03-06-12 in the aquatic life, recreation, fish consumption and water supply categories. All waters are Impaired on an evaluated basis in the fish consumption category because of fish consumption advice that applies to the entire basin. In the water supply category, all WS classified waters (42 miles) are Supporting on an evaluated basis based on reports from DEH regional water treatment plant consultants. Refer to Appendix X for a complete list of monitored waters and more information on Supporting monitored waters.

There were 86.7 stream miles (51.7 percent) monitored during this assessment period in the aquatic life category. There are 11.1 stream miles (6.6 percent) identified as Impaired in this same category.

12.3 Status and Recommendations of Previously and Newly Impaired Waters

The following waters were either identified as Impaired in the previous basin plan (2000) or are newly Impaired based on recent data. If previously identified as Impaired, the water will either remain on the state's 303(d) list or will be delisted based on recent data showing water quality improvements. If the water is newly Impaired, it will likely be placed on the 2006 303(d) list. The current status and recommendations for addressing these waters are presented below, and each is identified by an assessment unit number (AU#). Refer to the overview for more information on AUs. Information regarding 303(d) listing and reporting methodology is presented in Appendix VII.

12.3.1 Loves Creek [AU#17-43-10a, b and c]

2000 Recommendations
These segments of Loves Creek were recommended for resampling using the 303(d) approach. Siler City was encouraged to develop a stormwater program and other watershed initiatives to improve water quality in this creek.

Current Status
Loves Creek [17-43-10b and c] from Chatham Avenue to the Rocky River (2.9 miles) is Impaired for aquatic life because of Fair benthic community ratings at sites BB29, BB174 and BB210. The upper 3.3 miles are Not Rated because benthic community ratings could not be assigned at sites BB221 and BB36.

A stressor study completed in the Loves Creek watershed indicated toxic chemicals in runoff from Siler City are the main stressors to the benthic community. Streambank erosion, sedimentation and excessive algal growth are also stressors. The WWTP was not the main stressor, and agricultural land uses are also a source. The survey noted runoff from animal operations in the upper watershed may be contributing nutrients and bacteria to the creek.

2005 Recommendations
DWQ will continue to monitor the Loves Creek watershed. DWQ will work with DSWC to evaluate if BMPs can be implemented to reduce nutrients from animal operations in the watershed. Refer to Chapter 31 for more information and recommendations for urban streams.

All segments will remain on the 303(d) list of Impaired waters. TMDLs (Chapter 35) will be developed for identified stressors within 8-13 years of listing.

Water Quality Initiatives
The NCEEP initiated a Local Watershed Planning that included Loves Creek. The preliminary findings are discussed under the Rocky River in this chapter.

12.3.2 Rocky River [AU#17-43-(1)a and b and 17-43-(8)a]

2000 Recommendations
The 2000 basin plan recommended that the Rocky River be resampled and that agricultural BMPs, including fencing cattle out of streams be implemented.

Current Status
Rocky River [17-43-(1)a] from source to upper Rocky River Reservoir (10.6 miles) is Supporting aquatic life because of a Good-Fair fish community rating at site BF33.

Upper Rocky River Reservoir [17-43-(1)b] from upper Rocky River Reservoir to downstream of Lacy Creek (3.9 miles) is Supporting aquatic life because no criteria were exceeded during lakes monitoring in 2003. The reservoir is hypereutrophic. In August 2003, chlorophyll *a* levels were elevated and there indications that animal operations (both cattle and horse) may be contributing nutrients to the reservoir and downstream.

Rocky River [17-43-(8)a] from dam at Siler City water supply to Varnal Creek (6.7 miles) is Not Rated for aquatic life because of numerous reports of nuisance periphyton growth in the river. During summer months algal mats have been observed to cover areas down to the confluence with the Deep River. No criteria were exceeded at site BA373; however, nutrient levels were elevated. The Siler WWTP, as well as agriculture and residential activities, are potential sources of nutrients.

The watershed is predominately forested, but development is increasing. Agriculture, as well as the Loves Creek WWTP in Siler City, are likely the main sources of nutrients.

2005 Recommendations
DWQ will continue to monitor the Rocky River watershed. DWQ will work with DSWC staff to further implement BMPs to reduce the impacts of development and agriculture in this watershed. DWQ will work with Siler City to evaluate nutrient reduction strategies from urban areas as well as from the WWTP.

Segment 17-43-(1)a will be removed from the 303(d) list of Impaired waters because of the improved fish community rating.

Water Quality Initiatives
In 2002, Liberty received a $203,000 CWMTF (Chapter 34) grant to rehabilitate 7,556 linear feet of the wastewater collection system and rehabilitate or replace 43 manholes.

The NCEEP initiated a Local Watershed Planning project focusing on three local watersheds comprising the upper and middle Rocky River drainage system. The study area is located primarily in northwestern Chatham County, including Siler City and portions of Randolph and Alamance counties. The planning area addresses the Rocky River mainstem and tributary watersheds, including N. Prong Rocky River, Greenbriar Creek, Varnal Creek, Loves Creek, Tick Creek, Bear Creek and others.

A technical advisory team consisting of local resource professionals and municipal staff from the counties and towns in the planning area was formed to help guide the watershed assessment and plan development work. This team will also help identify optimal watershed project sites with cooperative landowners for the establishment of long-term conservation easements. Watershed projects to be identified include traditional stream and stream buffer restoration/enhancement sites, wetlands and buffer preservation sites, and sites for the implementation of urban stormwater or agricultural best management practices (BMPs).

The Preliminary Findings Report was completed in February 2005. The Phase II assessment & modeling of watershed conditions, and subsequent development of watershed restoration and protection strategies, are slated for completion by summer of 2005. To date, over 60 potential stream restoration sites and dozens of high-quality preservation tracts have been identified.

12.3.3 Tick Creek [AU#17-43-13a]

Current Status
This segment of Tick Creek was Fully Supporting in the 2000 plan; however, Tick Creek from source to US 421 (8.2 miles) is currently Impaired for aquatic life because of a Fair fish community rating at site BF72. Cattle have unrestricted access to the stream and under story vegetation has been heavily damaged by hoof traffic. Bare dirt and severely eroded banks were also noted at the sample site. Bonlee Elementary School (NC0039331) had significant violations of ammonia permit limits during the last two years of the assessment period.

2005 Recommendations
DWQ will continue to monitor the Tick Creek watershed. DWQ will also contact DSWC staff to prioritize BMP implementation in this watershed to limit cattle access to the stream. The NPDES compliance process will be used to address the significant permit violations noted above.

This segment will be added to the 303(d) list of Impaired waters. TMDLs (Chapter 35) will be developed for identified stressors within 8-13 years of listing.

Water Quality Initiatives
The NCEEP initiated a Local Watershed Planning that included Tick Creek. The preliminary findings are discussed under the Rocky River in this chapter.

12.4 Status and Recommendations for Waters with Noted Impacts

The surface waters discussed in this section are not Impaired. However, notable water quality problems and concerns have been documented for some waters based on this assessment. While these waters are not Impaired, attention and resources should be focused on these waters to prevent additional degradation or facilitate water quality improvement. Waters in the following section are identified by assessment unit number (AU#). See overview for more information on AU#s.

12.4.1 Bear Creek [AU#17-43-16a]

Current Status and 2005 Recommendations
Bear Creek [17-43-16a] from source to SR 2189 (14.9 miles) is Not Rated on an evaluated basis for aquatic life because Hill Forest Rest Home (NC0038849) had significant violations of ammonia permit limits in the last two years of the assessment period that could have negatively impacted aquatic life. The NPDES compliance process will be used to address the significant permit violations noted above.

Water Quality Initiatives
The NCEEP initiated a Local Watershed Planning that included Bear Creek. The preliminary findings are discussed under the Rocky River in this chapter.

Chapter 13
Cape Fear River Subbasin 03-06-13
Including: Upper Little River and Barbeque Creek

13.1 Subbasin Overview

Subbasin 03-06-13 at a Glance

Land and Water Area

Total area:	221 mi²
Land area:	219 mi²
Water area:	2 mi²

Population Statistics

2000 Est. Pop.: 35,654 people
Pop. Density: 162 persons/mi²

Land Cover (percent)

Forest/Wetland:	65.2%
Surface Water:	2.0%
Urban:	1.3%
Cultivated Crop:	23.4%
Pasture/ Managed Herbaceous:	8.1%

Counties
Harnett and Lee

Municipalities
Broadway and Sanford

Subbasin 03-06-13 includes the entire Upper Little River watershed draining Triassic basin, piedmont and the coastal plain. Most of the watershed is forested or with extensive agriculture. Development is occurring around Sanford in the western region of the subbasin. Population is expected to grow by 65,000 people in counties with portions or all of their areas in this subbasin by 2020.

There are six individual NPDES wastewater discharge permits in this subbasin with a permitted flow of 9 MGD (Figure 16). The largest are Erwin Mills (2.5 MGD), Dunn WWTP (3 MGD) and Erwin WWTP (1.2 MGD). Refer to Appendix VI and Chapter 30 for more information on NPDES permit holders.

There are eight registered swine operations in this subbasin.

There was one benthic community sample (Figure 16 and Table 16) collected during this assessment period. Data were also collected from one ambient monitoring station shared by UCFRBA (Appendix V) and DWQ. Refer to the *2003 Cape Fear River Basinwide Assessment Report* at http://www.esb.enr.state.nc.us/bar.html and Appendix IV for more information on monitoring.

Waters in the following sections are identified by assessment unit number (AU#). This number is used to track defined segments in the water quality assessment database, 303(d) Impaired waters list and the various tables in this basin plan. The assessment unit number is a subset of the DWQ index number (classification identification number). A letter attached to the end of the AU# indicates that the assessment is smaller than the DWQ index segment. No letter indicates that the assessment unit and the DWQ index segment are the same.

13.2 Use Support Assessment Summary

Use support ratings were assigned for waters in subbasin 03-06-13 in the aquatic life, recreation, fish consumption and water supply categories. All waters are Impaired on an evaluated basis in the fish consumption category because of fish consumption advice that applies to the entire

Figure 16 Cape Fear River Subbasin 03-06-13

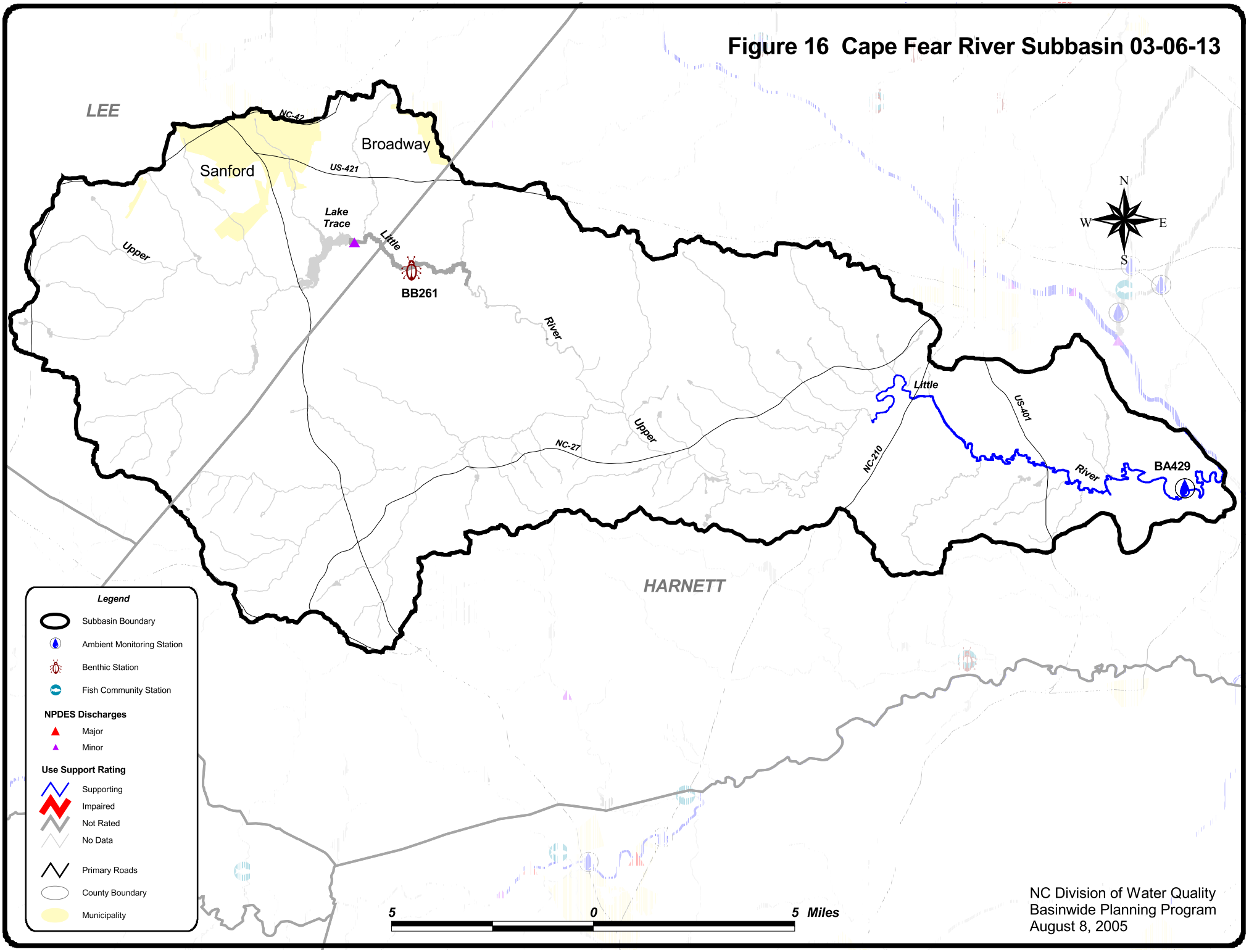


Table 16 CAPE FEAR Subbasin 03-06-13

AU Number / Description	Classification	Length/Area	Aquatic Life Assessment					Recreation Assessment			Stressors	Sources
			AL Rating	Station	Result	Year/ Parameter	% Exc	REC Rating	Station	Result		
Upper Little River												
18-20-(24.5)	WS-IV	15.6 FW Miles	**S**	BA429	NCE	Low pH	9.1	**S**	BA429	NCE	Low pH	Unknown
From a point 0.6 mile downstream of Juniper Branch to Cape Fear River												
18-20-(8)a	C	4.3 FW Miles	**S**					**NR**			Habitat Degradation	
From dam at Lake Trace to Corndack Creek				BB261	GF	2003					Fecal Coliform Bacteria	WWTP NPDES

AL - Aquatic Life
REC - Recreation

BF - Fish Community Survey
BB - Benthic Community Survey
BA - Ambient Monitoring Site
BL- Lake Monitoring
S- DEH RECMON

Miles/Acres
FW- Fresh Water
S- Salt Water

E - Excellent
G - Good
GF - Good-Fair
F - Fair
P - Poor
NI - Not Impaired
S- Severe Stress
M-Moderate Stress
N- Natural

S - Supporting, I - Impaired
NR - Not Rated
NR*- Not Rated for Recreation (screening criteria exceeded)
ND-No Data Collected to make assessment
Results
CE-Criteria Exceeded > 10% and more than 10 samples
NCE-No Criteria Exceeded

Aquatic Life Rating Summary

S	m	19.9	FW Miles
ND		209.3	FW Miles

Recreation Rating Summary

S	m	15.6	FW Miles
NR	e	4.3	FW Miles
ND		209.3	FW Miles

Fish Consumption Rating Summary

I	e	229.2	FW Miles

basin. In the water supply category, all WS classified waters (37.5 miles) are Supporting on an evaluated basis based on reports from DEH regional water treatment plant consultants. Refer to Appendix X for a complete list of monitored waters and more information on Supporting monitored waters.

There were 19.9 stream miles (8.7 percent) monitored during this assessment period in the aquatic life category. There are no stream miles identified as Impaired in this category.

13.3 Status and Recommendations of Previously and Newly Impaired Waters

The following waters were either identified as Impaired in the previous basin plan (2000) or are newly Impaired based on recent data. If previously identified as Impaired, the water will either remain on the state's 303(d) list or will be delisted based on recent data showing water quality improvements. If the water is newly Impaired, it will likely be placed on the 2006 303(d) list. The current status and recommendations for addressing these waters are presented below, and each is identified by an assessment unit number (AU#). Refer to the overview for more information on AUs. Information regarding 303(d) listing and reporting methodology is presented in Appendix VII.

13.3.1 Upper Little River [AU#18-20-(24.5) and (8)a]

Current Status
Upper Little River was Fully Supporting in the 2000 plan; however, Upper Little River [18-20-(24.5)] from downstream of Juniper Branch to the Cape Fear River (15.6 miles) is currently Supporting aquatic life because no criteria were exceeded at site BA429 although pH was below the standard in 9 percent of samples.

Upper Little River [18-20-(8)a] from Lake Trace to Corndack Creek (4.3 miles) is Supporting aquatic life because of a Good-Fair benthic community rating at site BB261, although moderate streambank erosion was noted at this site. Upper Little River was tannin stained, and the low pH levels may represent natural conditions. Carolina Trace (NC0038831) had significant violations of fecal coliform bacteria permit limits during the last two years of the assessment period and the segment is Not Rated for recreation.

2005 Recommendations
DWQ will continue to monitor the Upper Little River watershed and reestablish benthic community sites that could not be monitored in 2003 because of high flows. Reestablishing these sites will allow DWQ to determine if the low pH values are due to natural swamp conditions. The NPDES compliance process will be used to address the significant permit violations noted above.

Segment 18-20-(24.5) will be added to the 303(d) list of Impaired waters. TMDLs (Chapter 35) will be developed for identified stressors within 8-13 years of listing.

Chapter 14
Cape Fear River Subbasin 03-06-14

Including: Lower Little River, Nicks Creek, Juniper Creek, Anderson Creek and Crane Creek

14.1 Subbasin Overview

Subbasin 03-06-14 at a Glance

Land and Water Area

Total area:	484 mi²
Land area:	478 mi²
Water area:	6 mi²

Population Statistics

2000 Est. Pop.: 80,611people
Pop. Density: 166 persons/mi²

Land Cover (percent)

Forest/Wetland:	78.8%
Surface Water:	2.2%
Urban:	2.4%
Cultivated Crop:	8.2%
Pasture/ Managed Herbaceous:	8.4%

Counties

Cumberland, Harnett, Hoke, Lee and Moore

Municipalities

Carthage, Linden, Pinhurst, Spring Lake, Southern Pines and Taylortown

Subbasin 03-06-14 drains the Sandhills region. Most of the watershed is forested. Development is occurring in the western portion of the subbasin. Population is expected to grow by 150,000 people in counties with portions or all of their areas in this subbasin by 2020.

There are nine individual NPDES wastewater discharge permits in this subbasin with a permitted flow of 10.5 MGD (Figure 17). The largest are Fort Bragg WWTP and WTP (8 MGD) and Spring Lake WWTP (1.5 MGD). Refer to Appendix VI and Chapter 30 for more information on NPDES permit holders. Issues related to compliance with NPDES permit conditions are discussed below in Section 14.3 for Impaired waters.

There is one registered dairy and five registered swine operations in this subbasin.

There were 13 benthic community samples and 14 fish community samples (Figure 17 and Table 17) collected during this assessment period. Data were also collected from three ambient monitoring stations including one MCFRBA (Appendix V) station, one DWQ ambient station and one shared station. One reservoir was also monitored. Refer to the *2003 Cape Fear River Basinwide Assessment Report* at http://www.esb.enr.state.nc.us/bar.html and Appendix IV for more information on monitoring.

Waters in the following sections are identified by assessment unit number (AU#). This number is used to track defined segments in the water quality assessment database, 303(d) Impaired waters list and the various tables in this basin plan. The assessment unit number is a subset of the DWQ index number (classification identification number). A letter attached to the end of the AU# indicates that the assessment is smaller than the DWQ index segment. No letter indicates that the assessment unit and the DWQ index segment are the same.

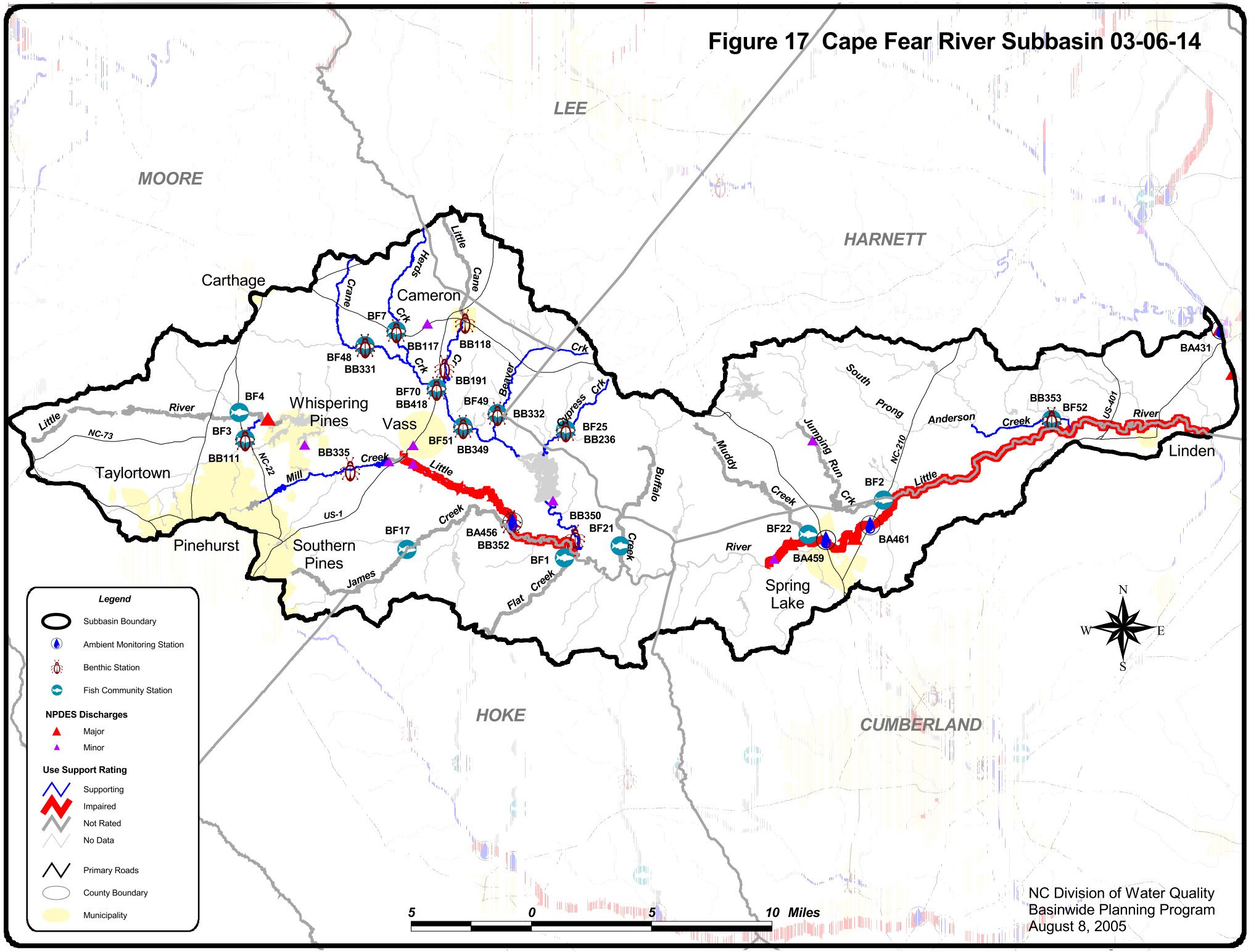


Figure 17 Cape Fear River Subbasin 03-06-14
LEE
MOORE
HARNETT
HOKE
CUMBERLAND
Carthage
Cameron
Whispering Pines
Vass
Taylortown
Pinehurst
Southern Pines
Spring Lake
Linden
Little River
Crane Crk
Herds Crk
Cane Crk
Beaver Crk
Cypress Crk
Mill Creek
Buffalo Creek
Muddy Creek
Jumping Run Crk
South Prong Creek
Anderson Creek
James Creek
Flat Creek
NC-73
NC-22
US-1
NC-210
US-401
BF4
BF3
BB111
BB335
BF7
BB117
BB118
BF48
BB331
BB191
BF70
BB418
BF49
BB332
BF51
BB349
BF25
BB236
BB350
BF21
BF17
BA456
BB352
BF1
BF2
BA461
BF22
BA459
BB353
BF52
BA431
Legend
Subbasin Boundary
Ambient Monitoring Station
Benthic Station
Fish Community Station
NPDES Discharges
Major
Minor
Use Support Rating
Supporting
Impaired
Not Rated
No Data
Primary Roads
County Boundary
Municipality
5 0 5 10 Miles
N
W
E
S
NC Division of Water Quality
Basinwide Planning Program
August 8, 2005

Table 17 CAPE FEAR Subbasin 03-06-14

AU Number / Description	Classification	Length/Area	Aquatic Life Assessment					Recreation Assessment			Stressors	Sources
			AL Rating	Station	Result	Year/ Parameter	% Exc	REC Rating	Station	Result		
Anderson Creek												
18-23-32	C	5.4 FW Miles	**S**					ND			Habitat Degradation	Impervious Surfac
From source to Little River				BB353	G	2000						
				BB353	G	2003						
				BF52	NR	2003						
Beaver Creek												
18-23-16-8	WS-III	7.2 FW Miles	**S**					ND				
From source to Cane Creek				BB332	GF	2002						
				BF49	NR	2002						
Buffalo Creek												
18-23-18	WS-III	7.6 FW Miles	**NR**					ND				
From source to Little River				BF21	NR	2003						
Crane Creek (Craine Creek)												
18-23-16a	WS-III	16.3 FW Miles	**S**					ND				
From source to Lake Surf				BB331	GF	2003						
				BB331	G	2002						
				BB349	GF	2002						
				BB418	G	2002						
				BF48	NR	2002						
				BF51	NR	2002						
				BF70	NR	2002						
18-23-16b2	WS-III	6.3 FW Miles	**S**					ND				
From Lake Surf to Little River				BB350	G	2002						
Cypress Creek												
18-23-16-10	WS-III	5.4 FW Miles	**S**					ND				
From source to Lake Surf, Cane Creek				BB236	NI	2002						
				BF25	NR	2002						
Flat Creek												
18-23-15	WS-III	6.2 FW Miles	**NR**					ND				
From source to Little River				BF1	NR	2003						

Table 17 CAPE FEAR Subbasin 03-06-14

AU Number / Description	Classification	Length/Area		Aquatic Life Assessment						Recreation Assessment					
				AL Rating	Station	Result	Year/ Parameter	% Exc		REC Rating	Station	Result		Stressors	Sources
Herds Creek															
18-23-16-3	WS-III	8.1	FW Miles	**S**						ND					
From source to Cane Creek					BB117	NI	2002								
					BF7	NR	2002								
James Creek															
18-23-13	WS-III	14.4	FW Miles	**NR**						ND					
From source to Little River					BF17	NR	2003								
Jumping Run Creek															
18-23-29	C	10.0	FW Miles	**NR**						ND					
From source to Little River					BF2	NR	2003								
Little Cane Creek (White Oak Creek)															
18-23-16-4a	WS-III	5.0	FW Miles	**NR**						ND					
From source to SR 24 and 27					BB118	NR	2003								
18-23-16-4b	WS-III	4.4	FW Miles	**S**						ND					
From SR 24 and 27 to Cane Creek					BB191	GF	2003								
Little River (Lower Little River)															
18-23-(1)	WS-III HQ	14.9	FW Miles	**NR**						ND					
From source to backwaters of Thagards Lake					BF4	NR	2003								
18-23-(10.7)	WS-III HQ	12.6	FW Miles	**I**	BA456	CE	Low pH	67.9		**S**	BA456	NCE		Low pH	Unknown
From Vass water supply intake to Crane Creek					BB352	GF	2002								
					BB352	GF	2003								
18-23-(24)	C	25.6	FW Miles	**I**	BA459	CE	Low pH	31.6		**S**	BA459	NCE		Low pH	Unknown
					BA461	CE	Low pH	26.6			BA461	NCE			
From Fort Bragg lower water supply intake to Cape Fear River															
Mill Creek															
18-23-11-(1)	WS-III HQ	58.1	FW Acres	**NR**	BL25	NCE	Low pH	66		ND				Low pH	Unknown
From source to dam at old Southern Pines Water Supply															
Mill Creek (Warrior Lake, Crystal Lake)															
18-23-11-(2)	WS-III&B	8.6	FW Miles	**S**						ND					
From dam at old Southern Pines water supply to dam at Crystal Lake					BB335	E	2000								

Table 17 CAPE FEAR Subbasin 03-06-14

AU Number / Description	Classification	Length/Area	Aquatic Life Assessment: AL Rating	Station	Result	Year/ Parameter	% Exc	Recreation Assessment: REC Rating	Station	Result	Stressors	Sources
Muddy Creek (Overhills Lake)												
18-23-26	C	9.4 FW Miles	**NR**					ND				
From source to Little River				BF22	NR	2003						
Nicks Creek												
18-23-3-(3)	WS-III	2.0 FW Miles	**S**					ND			Habitat Degradation	Impoundment
From Carthage water supply intake to Little River				BB111	GF	2003						
				BF3	NR	2003						

AL - Aquatic Life	BF - Fish Community Survey	E - Excellent	S - Supporting, I - Impaired
REC - Recreation	BB - Benthic Community Survey	G - Good	NR - Not Rated
	BA - Ambient Monitoring Site	GF - Good-Fair	NR*- Not Rated for Recreation (screening criteria exceeded)
	BL- Lake Monitoring	F - Fair	ND-No Data Collected to make assessment
	S- DEH RECMON	P - Poor	**Results**
		NI - Not Impaired	CE-Criteria Exceeded > 10% and more than 10 samples
	Miles/Acres	S- Severe Stress	NCE-No Criteria Exceeded
	FW- Fresh Water	M-Moderate Stress	
	S- Salt Water	N- Natural	

Aquatic Life Rating Summary

S	m	63.6	FW Miles
NR	m	67.5	FW Miles
I	m	38.2	FW Miles
NR	m	58.1	FW Acres
ND		256.1	FW Miles
ND		1,274.3	FW Acres

Recreation Rating Summary

S	m	38.2	FW Miles
ND		387.2	FW Miles
ND		1,332.4	FW Acres

Fish Consumption Rating Summary

I	e	425.4	FW Miles
I	e	1,332.4	FW Acres

14.2 Use Support Assessment Summary

Use support ratings were assigned for waters in subbasin 03-06-14 in the aquatic life, recreation, fish consumption and water supply categories. All waters are Impaired on an evaluated basis in the fish consumption category because of fish consumption advice that applies to the entire basin. In the water supply category, all WS classified waters (1,332.4 acres and 279.3 miles) are Supporting on an evaluated basis based on reports from DEH regional water treatment plant consultants. Refer to Appendix X for a complete list of monitored waters and more information on Supporting monitored waters.

There were 169.3 stream miles (39.7 percent) and 58.1 freshwater acres (4.4 percent) monitored during this assessment period in the aquatic life category. There are 38.2 stream miles (9 percent) identified as Impaired in this same category.

14.3 Status and Recommendations of Previously and Newly Impaired Waters

The following waters were either identified as Impaired in the previous basin plan (2000) or are newly Impaired based on recent data. If previously identified as Impaired, the water will either remain on the state's 303(d) list or will be delisted based on recent data showing water quality improvements. If the water is newly Impaired, it will likely be placed on the 2006 303(d) list. The current status and recommendations for addressing these waters are presented below, and each is identified by an assessment unit number (AU#). Refer to the overview for more information on AUs. Information regarding 303(d) listing and reporting methodology is presented in Appendix VII.

14.3.1 Crane Creek [AU#18-23-16a and 16b2]

2000 Recommendations
The 2000 basinwide plan recommended that Crane Creek be resampled using the 303(d) approach, and that local initiatives were needed to address agricultural impacts.

Current Status
Crane Creek [18-23-16a] from source to Lake Surf (16.3 miles) is Supporting aquatic life because of Good-Fair benthic community ratings at sites BB331 and BB349 and Good at site BB418. Crane Creek was intensively studied in 2002 at the request of NCEEP (Chapter 34) to support development of a Local Watershed Plan. No Impaired drainages were identified during the study. The Plan identified 28 stream restoration sites representing 27,000 linear feet of stream and 111 acres of wetland sites. See the website for more information http://www.nceep.net/services/lwps/Cranes_Creek/cranes_creek_lwp.pdf.

Crane Creek [18-23-16b2] from Lake Surf to the Lower Little River (6.3 miles) is Supporting aquatic life because of a Good benthic community rating at site BB350.

2005 Recommendations
DWQ will continue to monitor the Crane Creek watershed. DWQ will also work with NCEEP and other agencies to implement projects identified in the Local Watershed Plan. Crane Creek will be recommended for removal from the 303(d) list.

14.3.2 Lower Little River [AU#18-23-(10.7) and (24)]

Current Status
Lower Little River was Fully Supporting in the 2000 plan; however, Lower Little River [18-23-(10.7)] from Vass water supply intake to Crane Creek (12.6 miles) is currently Impaired for aquatic life because pH was below standard in 68 percent of samples collected at site BA456. The low pH levels may be from natural sources. The benthic community at site BB352 was Good-Fair. Riparian areas were intact and streambanks and instream habitat were stable and plentiful. This site has been rated Excellent in past sampling and the lower rating is likely related to drought impacts.

Lower Little River [18-23-(24)] from Fort Bragg water supply to the Cape Fear River (25.6 miles) is Impaired for aquatic life because pH was below the standard in 32 and 27 percent of samples collected at sites BA459 and BA461. The low pH levels may be from natural sources. Fort Bragg WTP and WWTP (NC0003964) had significant violations of ammonia permit limits during the last two years of the assessment period that may have negatively impacted aquatic life. Fort Bragg has made repairs and modifications to the WWTP to address this issue. Spring Lake WWTP (NC0030970) also had significant violations of total suspended solids permit limits and is under a special order of consent (SOC# S03006) that expires in December 2005. The SOC includes requirements to submit plans for collection system repairs. Spring Lake is actively constructing additional treatment units to address noncompliance. The town is also addressing infiltration and inflow problems that will help NPDES compliance.

2005 Recommendations
DWQ will continue to monitor the Lower Little River watershed to determine if low pH levels are natural or related to drought conditions.

Both segments will be added to the 303(d) list of Impaired waters. TMDLs (Chapter 35) will be developed for identified stressors within 8-13 years of listing.

Water Quality Initiatives
The NCEEP completed 1,100 linear feet of stream restoration in this watershed (Chapter 34).

14.4 Status and Recommendations for Waters with Noted Impacts

The surface waters discussed in this section are not Impaired. However, notable water quality problems and concerns have been documented for some waters based on this assessment. While these waters are not Impaired, attention and resources should be focused on these waters to prevent additional degradation or facilitate water quality improvement. Waters in the following section are identified by assessment unit number (AU#). See overview for more information on AU#s.

14.4.1 Buffalo Creek [18-23-18]

Current Status and 2005 Recommendations
Buffalo Creek from source to the Little River (7.6 miles) is Not Rated for aquatic life because a fish community rating could not be assigned at site BF21. The site had the lowest diversity of any sand hills site, and only 14 fish were collected in 2003, compared to 28 in 1998. DWQ will continue to monitor Buffalo Creek and work to develop fish community criteria for sand hills streams so that community ratings can be assigned and use support determinations can be made.

14.4.2 Mill Creek [18-23-18]

Current Status and 2005 Recommendations
Old Town Reservoir (58.1-acre impoundment of Mill Creek) is Not Rated for aquatic life because pH was below the water quality standards in 66 percent of samples collected during lake monitoring in 2003. However, not enough samples were collected to assign a use support rating. Water quality is considered good in the reservoir and the low pH may be related to natural conditions. Activities on adjacent lands should use BMPs during land-disturbing activities in order to maintain good water quality in Old Town Reservoir. DWQ will determine if increased monitoring efforts in this lake are warranted to better assess water quality.

14.4.3 Nicks Creek [18-23-3-(3)]

Current Status and 2005 Recommendations
Nicks Creek from Carthage water supply intake to the Little River (2 miles) is Supporting aquatic life because of a Good-Fair benthic community rating at site BB111. Above site BB111, there is a newly constructed dam and rip-rap channel. It appears that the benthic and fish community sites may have been negatively impacted by construction and maintenance of the dam. The stream appears to be channelized around the dam structure. Site BB111 has been rated Good in the past. Refer to Chapter 32 for more information on dam operation.

Chapter 15
Cape Fear River Subbasin 03-06-15
Including: Cape Fear River, Cross Creek, Little Cross Creek and Rockfish Creek

15.1 Subbasin Overview

Subbasin 03-06-15 at a Glance

Land and Water Area

Total area:	600 mi²
Land area:	595 mi²
Water area:	5 mi²

Population Statistics

2000 Est. Pop.: 206,406people
Pop. Density: 344 persons/mi²

Land Cover (percent)

Forest/Wetland:	64.2%
Surface Water:	1.6%
Urban:	9.9%
Cultivated Crop:	14.2%
Pasture/Managed Herbaceous:	10.0%

Counties

Bladen, Cumberland, Harnett, Hoke, Moore and Robeson

Municipalities

Fayetteville, Hope Mills, Raeford and Southern Pines

Subbasin 03-06-15 drains mostly the Sandhills region. Most of the watershed is forested with extensive agriculture present. Development is occurring mostly around Fayetteville and along the southern boundary of Fort Bragg. Population is expected to grow by 170,000 people in counties with portions or all of their areas in this subbasin by 2020.

There are six individual NPDES wastewater discharge permits in this subbasin with a permitted flow of 53.3 MGD (Figure 18). The largest are Cross Creek WWTP (25 MGD) and Rockfish Creek WWTP (24 MGD). Refer to Appendix VI and Chapter 30 for more information on NPDES permit holders. Issues related to compliance with NPDES permit conditions are discussed below in Section 15.3 for Impaired waters.

There are 11 registered swine operations in this subbasin.

There were 14 benthic community samples and seven fish community samples (Figure 18 and Table 18) collected during this assessment period. Data were also collected from 16 ambient monitoring stations including 9 MCFRBA (Appendix V) stations, three DWQ ambient stations and one shared station. Four reservoirs were also monitored. Refer to the *2003 Cape Fear River Basinwide Assessment Report* at http://www.esb.enr.state.nc.us/bar.html and Appendix IV for more information on monitoring.

Waters in the following sections are identified by assessment unit number (AU#). This number is used to track defined segments in the water quality assessment database, 303(d) Impaired waters list and the various tables in this basin plan. The assessment unit number is a subset of the DWQ index number (classification identification number). A letter attached to the end of the AU# indicates that the assessment is smaller than the DWQ index segment. No letter indicates that the assessment unit and the DWQ index segment are the same.

Figure 18 Cape Fear River Subbasin 03-06-15

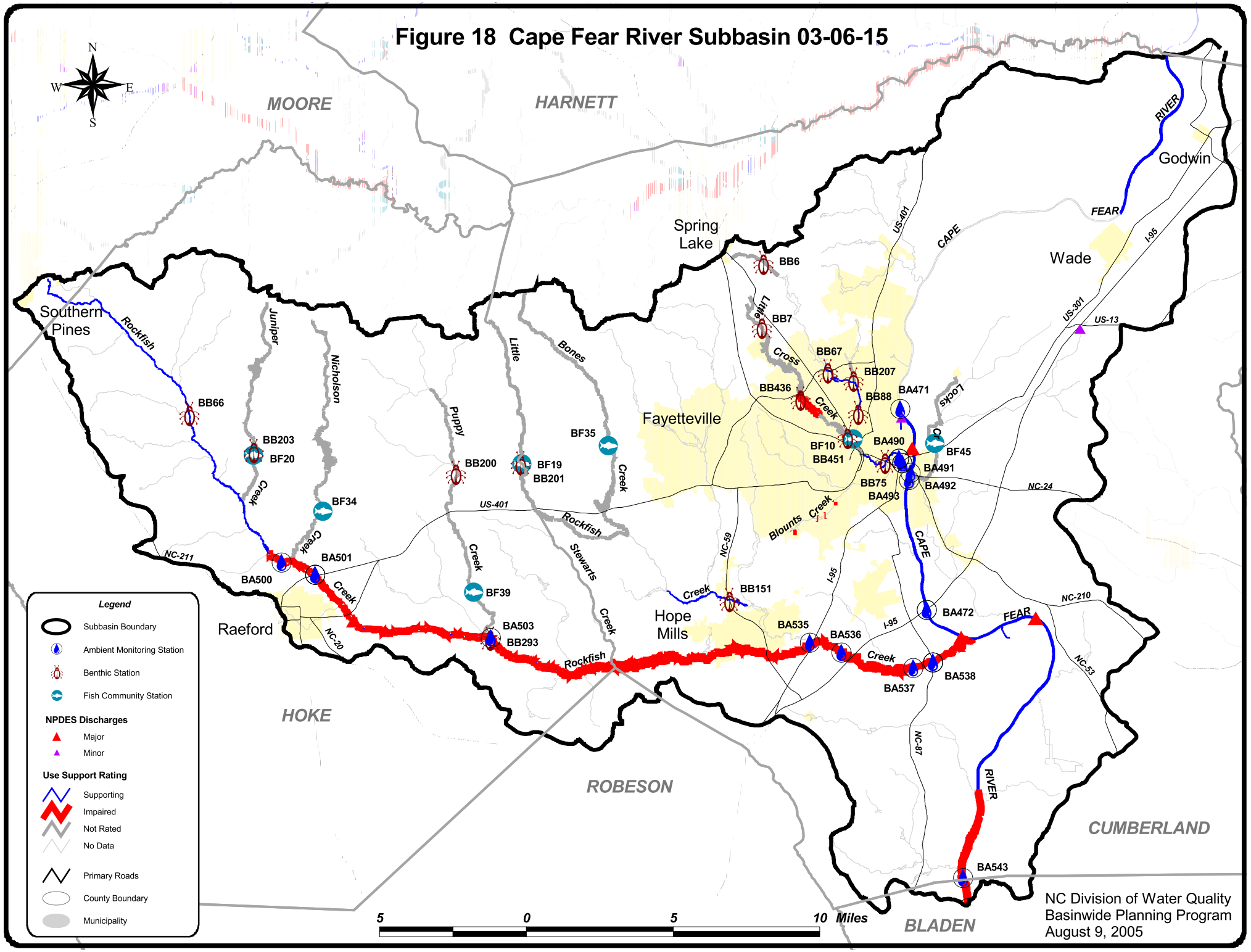


Table 18 CAPE FEAR Subbasin 03-06-15

AU Number	Classification	Length/Area	Description	Aquatic Life Assessment					Recreation Assessment			Stressors	Sources
				AL Rating	Station	Result	Year/ Parameter	% Exc	REC Rating	Station	Result		
Bones Creek													
18-31-24-2	C	12.0 FW Miles	From source to Little Rockfish Creek	**NR**	BF35	NR	2003		ND				
CAPE FEAR RIVER													
18-(20.7)b	WS-V	6.0 FW Miles	From Lower Little River to a point 8.2 mile upstream of Carvers Creek	**S**	BA471	NCE			**S**	BA471	NCE		
18-(26)a	C	6.4 FW Miles	From City of Fayettville water supply intake to Peares Mill Creek	**S**	BA492 BA493	NCE NCE			**S**	BA492 BA493	NCE NCE		
18-(26)b	C	13.1 FW Miles	From Peares Mill Creek to Grays Creek	**S**	BA472	NCE	Turbidity	7.9	**NR***	BA472	NCE	Turbidity Fecal Coliform Bacteria	Unknown Unknown
18-(26)c	C	4.0 FW Miles	From Grays Creek to Lock and Dam 3	**I**	BA543	CE	Chlor a	26.7	**S**	BA543	NCE	Chlorophyll a	Unknown
Cross Creek (Big Cross Creek)													
18-27-(3)a	C	0.7 FW Miles	From water supply intake at Murchison Road in Fayetteville to Hillsboro Street	**NR**	BF10	NR	2003		ND				
18-27-(3)b	C	1.4 FW Miles	From Hillsboro Street to Blounts Creek	**S**	BB75	GF	2003		ND			Habitat Degradation	MS4 NPDES
18-27-(3)c	C	1.4 FW Miles	From Blount Street to Cape Fear River	**S**	BA490 BA491	NCE NCE			**NR***	BA490 BA491	NCE NCE	Fecal Coliform Bacteria	MS4 NPDES
Cross Creek (Big Cross Creek) (Texas Pond, Smith Lake, Rose													
18-27-(1)a	WS-IV	2.0 FW Miles	From source to Honeycutt Road	**NR**	BB6	NR	1998		ND				
18-27-(1)c	WS-IV	2.7 FW Miles	From Country Club Road to a point 0.5 mile upstream of water supply intake at Murchison Road in Fayetteville	**S**	BB67 BB88	GF GF	2003 2003		ND			Habitat Degradation	MS4 NPDES

Table 18 CAPE FEAR Subbasin 03-06-15

AU Number	Classification	Length/Area	Description	Aquatic Life Assessment					Recreation Assessment			Stressors	Sources
				AL Rating	Station	Result	Year/ Parameter	% Exc	REC Rating	Station	Result		
Juniper Creek (MCKietham Pond)													
18-31-10	C	9.0 FW Miles		**NR**					ND				
	From source to Rockfish Creek				BB203	NR	2003						
					BF20	NR	2003						
Little Cross Creek (Bonnie Doone Lake, Kornbow Lake, Mintz p													
18-27-4-(1)a	WS-IV	1.6 FW Miles		**NR**					ND			Habitat Degradation	MS4 NPDES
	From source to Bonnie Doone Lake				BB7	NR	1998						
18-27-4-(1)b	WS-IV	22.4 FW Acres		**NR**	BL26	NCE	Low pH	100	ND			Low pH	
	Bonnie Doone Lake												
18-27-4-(1)c	WS-IV	47.1 FW Acres		**NR**	BL27	NCE	Low pH	100	ND			Low pH	
	Kornbow Lake												
18-27-4-(1)d	WS-IV	14.9 FW Acres		**NR**	BL28	NCE	Low pH	100	ND			Low pH	
	Mintz Pond												
18-27-4-(1)e	WS-IV	1.1 FW Miles		**I**					ND			Habitat Degradation	MS4 NPDES
	From Kornbow Lake to a point 0.5 mile upstream of backwaters of Glenville Lake				BB436	F	2003						
Little Cross Creek (Glenville Lake)													
18-27-4-(1.5)	WS-IV CA	25.7 FW Acres		**NR**	BL29	NCE	Low pH	50	ND			Low pH	
	From a point 0.5 mile upstream of backwaters of Glenville Lake to dam at Glenville Lake												
18-27-4-(2)	WS-IV CA	2.1 FW Miles		**I**					ND				
	From dam at Glenville Lake to Cross Creek				BB451	F	2003						
Little Rockfish Creek													
18-31-24-(4)	C	4.0 FW Miles		**S**					ND			Habitat Degradation	MS4 NPDES
	From Unnamed Tributary at Lakewood Lake to backwaters of Hope Mill Lake				BB151	G	2003						
Little Rockfish Creek (Lake William)													
18-31-24-(1)	C	12.4 FW Miles		**NR**					ND				
	From source to mouth of Bones Creek				BB201	NR	2003						
					BF19	NR	2003						

Table 18 CAPE FEAR Subbasin 03-06-15

AU Number / Description	Classification	Length/Area	Aquatic Life Assessment						Recreation Assessment				
			AL Rating	Station	Result	Year/ Parameter	% Exc		REC Rating	Station	Result	Stressors	Sources
Locks Creek													
18-28	C	5.7 FW Miles	**NR**						ND				
From source to Cape Fear River				BF45	NR	2003							
Nicholson Creek (Mott Lake)													
18-31-14	C	10.9 FW Miles	**NR**						ND				
From source to Rockfish Creek				BF34	NR	2003							
Puppy Creek													
18-31-19	C	10.5 FW Miles	**NR**						ND				
From source to Rockfish Creek				BB200	NR	2003							
				BF39	NR	2003							
Rockfish Creek													
18-31-(1)	C	14.4 FW Miles	**S**						ND				
From source to mouth of Dry Branch				BB66	G	2001							
18-31-(12)	B	3.8 FW Miles	**I**	BA500	CE	Low pH	88.5		**NR***	BA500	NCE	Low pH	Unknown
				BA501	NCE	Low DO	50			BA501	NCE		
				BA501	NCE	Low pH	100						
From mouth of Dry Branch to mouth of Pedler Branch													
18-31-(15)	C	5.9 FW Miles	**I**	BA535	CE	Low pH	40		**S**	BA535	NCE	Low pH	Unknown
From mouth of Pedler Branch to mouth of Puppy Creek													
18-31-(23)	C	18.8 FW Miles	**I**	BA535	CE	Low pH	40		**NR***	BA535	NCE	Fecal Coliform Bacteria	Unknown
				BA536	CE	Low pH	69.8			BA538	NCE	Turbidity	Unknown
				BA537	CE	Low pH	21.6					Low pH	Unknown
				BA538	CE	Low pH	50						
				BA538	NCE	Turbidity	7.1						
From dam at Old Brower Mill Pond to Cape Fear River													
Rockfish Creek [(Upchurches Pond, Old Brower Mill Pond (Number Two Lake)]													
18-31-(18)	B	25.0 FW Miles	**I**	BA503	CE	Low pH	52.1		**S**	BA503	NCE	Fecal Coliform Bacteria	Unknown
From mouth of Puppy Creek to dam at Old Brower Mill Pond Dam				BB293	G	2003						Low pH	Unknown
				BB293	G	2003							

Table 18 CAPE FEAR Subbasin 03-06-15

AU Number / Description	Classification	Length/Area	Aquatic Life Assessment					Recreation Assessment				
			AL Rating	Station	Result	Year/ Parameter	% Exc	REC Rating	Station	Result	Stressors	Sources
Ut near Rosehill Road												
18-27-2-(2)	WS-IV	0.8 FW Miles	**NR**					ND				
From dam at Country Club Lake to Cross Creek				BB207	NR	2003						

AL - Aquatic Life	BF - Fish Community Survey	E - Excellent	S - Supporting, I - Impaired
REC - Recreation	BB - Benthic Community Survey	G - Good	NR - Not Rated
	BA - Ambient Monitoring Site	GF - Good-Fair	NR*- Not Rated for Recreation (screening criteria exceeded)
	BL- Lake Monitoring	F - Fair	ND-No Data Collected to make assessment
	S- DEH RECMON	P - Poor	**Results**
		NI - Not Impaired	CE-Criteria Exceeded > 10% and more than 10 samples
	Miles/Acres	S- Severe Stress	NCE-No Criteria Exceeded
	FW- Fresh Water	M-Moderate Stress	
	S- Salt Water	N- Natural	

Aquatic Life Rating Summary

S	m	49.4	FW Miles
NR	m	65.5	FW Miles
I	m	60.7	FW Miles
NR	m	110.1	FW Acres
ND		276.0	FW Miles
ND		160.5	FW Acres

Recreation Rating Summary

S	m	47.3	FW Miles
NR*	m	37.1	FW Miles
ND		367.2	FW Miles
ND		270.7	FW Acres

Fish Consumption Rating Summary

I	e	451.6	FW Miles
I	e	270.7	FW Acres

15.2 Use Support Assessment Summary

Use support ratings were assigned for waters in subbasin 03-06-15 in the aquatic life, recreation, fish consumption and water supply categories. All waters are Impaired on an evaluated basis in the fish consumption category because of fish consumption advice that applies to the entire basin. In the water supply category, all WS classified waters (145.1 acres and 57.4 miles) are Supporting on an evaluated basis based on reports from DEH regional water treatment plant consultants. Refer to Appendix X for a complete list of monitored waters and more information on Supporting monitored waters.

There were 175.6 stream miles (38.9 percent) and 110.1 freshwater acres (40.7 percent) monitored during this assessment period in the aquatic life category. There are 60.7 stream miles (13.4 percent) identified as Impaired in this same category.

15.3 Status and Recommendations of Previously and Newly Impaired Waters

The following waters were either identified as Impaired in the previous basin plan (2000) or are newly Impaired based on recent data. If previously identified as Impaired, the water will either remain on the state's 303(d) list or will be delisted based on recent data showing water quality improvements. If the water is newly Impaired, it will likely be placed on the 2006 303(d) list. The current status and recommendations for addressing these waters are presented below, and each is identified by an assessment unit number (AU#). Refer to the overview for more information on AUs. Information regarding 303(d) listing and reporting methodology is presented in Appendix VII.

15.3.1 Cape Fear River [AU#18-(26)b and c]

Current Status
The Cape Fear River was Fully Supporting in the 2000 plan; however, NPDES permit limits were recommended. Refer to Chapter 30 for information on NPDES permitting. The Cape Fear River [18-(26)c] from Grays Creek to Lock and Dam 3 (4 miles) is Impaired for aquatic life because the chlorophyll *a* standard was violated in 27 percent of samples collected at site BA543. A DWQ study in 2003 noted nutrient levels behind Lock and Dam 3 were high enough to support nuisance algal blooms and nitrogen was a limiting factor. Studies by UNC and MCFRBA indicate that nutrients are not limiting due to light limitations and hydraulic mixing upstream of the lock and dam structure. Continuous monitoring at BA543 indicated that dissolved oxygen levels were below the standard during the 2001 and 2002 drought. The water behind the lock and dam structure became more reservoir like with the greatly reduced flow during the drought. Data from 2003 at this station indicated far fewer exceedances because of the return of regular to high flows during that summer.

The Cape Fear River [18-(26)b] from Peares Mill Creek to Grays Creek (13.1 miles) is Not Rated for recreation because the fecal coliform bacteria screening criteria were exceeded at site BA472.

2005 Recommendations
DWQ and MCFRBA (Appendix V) will continue to monitor the Cape Fear River. DWQ will determine if further assessment of the fecal coliform standard is warranted in segment 18-(26)b. Refer to Chapter 30 for recommendations for discharges into the Cape Fear River.

Segment 18-(26)c will be added to the 303(d) list of Impaired waters. TMDLs (Chapter 35) will be developed for identified stressors within 8-13 years of listing.

Water Quality Initiatives
In 2003, Sandhills Area Land Trust received a CWMTF minigrant of $25,000 to pay for transactional costs for purchase of 83 acres of permanent conservation easemsents at Methodist College along the Cape Fear River (Chapter 34).

15.3.2 Cross Creek [AU#18-27-(1)a, c, 18-27-(3)a, b and c]

2000 Recommendations
The 2000 basin plan recommended that Cross Creek be resampled using the 303(d) approach, and that DWQ would work with the City of Fayetteville stormwater program to improve water quality.

Current Status
Cross Creek [18-27-(1)a] from source to Honeycutt Road (2 miles) is Not Rated for aquatic life because a benthic community rating could not be assigned at site BB6. Segment 18-27-(1)b consists of Texas Lake, Smith Lake and Rose Lake, which were not monitored during the assessment period. Cross Creek [18-27-(1)c] from Country Club Road to Murchinson Road (2.7 miles) is Supporting aquatic life because of Good-Fair benthic community ratings at sites BB67 and BB88.

Cross Creek [18-27-(3)a] from Murchinson Road to Hillsboro Street (0.7 miles) is Not Rated for aquatic life because a fish community rating could not be assigned at site BF10. Habitat conditions were poor at this mostly urbanized site, and there were indications of nutrient enrichment.

Cross Creek [18-27-(3)b] from Hillsboro Road to Blounts Street (1.4 miles) is Supporting aquatic life because of a Good-Fair benthic community rating at site BB75. The site has been Fair in the past, and 2003 monitoring indicated no real change in water quality. Habitat conditions in the creek are poor.

Cross Creek [18-27-(3)c] from Blounts Creek to the Cape Fear River (1.4 miles) is Supporting aquatic life because no criteria were exceeded at sites BA490 and BA491. This segment is not rated for recreation because the fecal coliform bacteria screening criteria were exceeded at sites BA490 and BA491.

A stressor study, completed in 2003, indicated that altered hydrology and sedimentation are the likely stressors to the benthic community in Cross Creek.

2005 Recommendations
DWQ will continue to monitor the Cross Creek watershed. DWQ will determine if further assessment of the fecal coliform standard is warranted in segment 18-27-(3)c. DWQ will work with the City of Fayetteville stormwater program to look for opportunities to improve water quality in Cross Creek.

Water Quality Initiatives
In 1998, Cape Fear Botanical Garden received a $77,000 CWMTF (Chapter 34) grant to stabilize and restore a streambank on Cross Creek just above the confluence with the Cape Fear River. Fayetteville Pubic Works Commission (PWC) identified one illicit discharge using photography of the Cross Creek watershed. In 2005, PWC completed an extensive fecal coliform bacteria study in the watershed and has identified a tributary with regular excursions of the fecal coliform bacteria standard. PWC is continuing to find and eliminate potential sources of fecal coliform bacteria in the Cross Creek watershed. The NCEEP completed 2,400 linear feet of stream restoration in this watershed (Chapter 34).

15.3.3 Little Cross Creek [AU#18-27-4-(1)a through e (1.5) and (2)]

2000 Recommendations
The 2000 basin plan recommended that Cross Creek be resampled using the 303(d) approach, and that DWQ would work with the City of Fayetteville stormwater program to improve water quality. This rating did not intend to include ratings for the impoundments on Little Cross (see 15.4 below).

Current Status
Little Cross Creek [18-27-4-(1)a] from source to Bonnie Doone Lake (1.6 miles) is Not Rated for aquatic life because a benthic community rating could not be assigned at site BB7 because of the small size of the stream.

Bonnie Doone Lake [18-27-4-(1)b] (22.4 acres), Kornbow Lake [18-27-4-(1)c] (47.1 acres), Mintz Pond [18-27-4-(1)d] (14.9 acres), and Glenville Lake [18-27-4-(1.5)] (25.7 acres) are Not Rated for aquatic life (See 15.4 below for more information).

Little Cross Creek [18-27-4-(1)e] from Kornbow Lake to backwaters of Glenville Lake (1.1 miles) is Impaired for aquatic life because of a Fair benthic community rating at site BB436.

Little Cross Creek [18-27-4-(2)] from Glenville Lake to Cross Creek (2.1 miles) is Impaired for aquatic life because of a Fair benthic community rating at site BB451. The benthic community is dominated by tolerant species and the stream bottom was hardpan clay. A few riffles were formed by urban debris, and the stream is channelized and has little riparian buffer.

A stressor study completed in 2003 indicated that altered hydrology causing bank erosion and sedimentation are likely stressors to the benthic community in Little Cross Creek. A stressor survey in 2003 also noted tannin stained waters, trash and urban debris, and elevated ammonia levels and periphyton growths.

2005 Recommendations
DWQ will continue to monitor the Little Cross Creek watershed. Because the impoundments on Little Cross Creek are treated separately, it is recommended that 18-27-4-(1)b, c, d and (1.5) be removed from the 303(d) list. Segments 18-27-4-(1)a, e and (2) will remain on the 303(d) list. Further recommendations to protect streams in urbanizing areas and to restore streams in existing urban areas are discussed in Chapter 31.

Water Quality Initiatives
In 1998, Fayetteville received a $63,000 CWMTF grant to conduct a nutrient, sediment and bacteria susceptibility study in this watershed. Fayetteville and PWC have undertaken efforts to restore water quality in the Little Cross Creek watershed. The study has identified 98 projects to reduce sediment loading and have prioritized 35 of the projects. In 2002, Fayetteville received a $766,000 CWMTF grant to design five stormwater structures and to acquire 21 acres for one of the ponds (Chapter 34).

15.3.4 Rockfish Creek [AU#18-31-(12), (15), (18) and (23)]

Current Status
Little Rockfish Creek was Fully Supporting in the 2000 plan; however, Rockfish Creek [18-31-(12)] from Dry Branch to Pedlar Branch (3.8 miles) is currently Impaired for aquatic life because pH was below standard in 89 percent of samples collected at site BA500 and 100 percent of samples at BA501, although a Good benthic community rating was found at site BB66 upstream of this segment.

Rockfish Creek [18-31-(15)] from Pedlar Branch to Puppy Creek (5.9 miles) is Impaired for aquatic life because pH was below the standard in 40 percent of samples collected at site BA535. Raeford WWTP (NC0026514) had significant violations of biological oxygen demand permit limits and had three whole effluent toxicity test failures during the last two years of the assessment period.

Rockfish Creek [18-31-(18) and (23)] from Puppy Creek to the Cape Fear River (43.8 miles) is Impaired for aquatic life because pH was below the standard in 40, 70, 22, 50 and 52 percent of samples collected at sites BA535, BA536, BA537, BA538 and BA503. However, a Good benthic community rating was found at site BB293 in segment 18-31-(18). Turbidity also exceeded the standard in 7 percent of samples at site BA538 in segment 18-31-(23). This segment is Not Rated for recreation because the fecal coliform bacteria screening criteria were exceeded at site BA538.

DWQ performed a statistical trend analysis at site BA503 using total nitrogen, total phosphorus and total suspended solids data collected from 1990 to 2004. There were no significant trends in any of the parameters analyzed in Rockfish Creek.

2005 Recommendations
DWQ will continue to monitor the Rockfish Creek watershed to determine if low pH levels are related to drought conditions or from other sources. DWQ will determine if further assessment of the fecal coliform standard is warranted in segment 18-31-(23). The NPDES compliance process will be used to address the significant permit violations noted above.

All four segments will be added to the 303(d) list of Impaired waters. TMDLs (Chapter 35) will be developed for identified stressors within 8-13 years of listing.

15.4 Status and Recommendations for Waters with Noted Impacts

The surface waters discussed in this section are not Impaired. However, notable water quality problems and concerns have been documented for some waters based on this assessment. While these waters are not Impaired, attention and resources should be focused on these waters to prevent additional degradation or facilitate water quality improvement. Waters in the following section are identified by assessment unit number (AU#). See overview for more information on AU#s.

15.4.1 Bonnie Doone Lake [AU#18-27-4-(1)b], Glenville Lake [AU#18-27-4-(2)], Kornbow Lake [AU#18-27-4-(1)c] and Mintz Pond [AU#18-27-4-(1)d]

Current Status and 2005 Recommendations
Bonnie Doone Lake (22.4 acres), Glenville Lake (25.7 acres), Kornbow Lake (47.1 acres) and Mintz Pond (14.9 acres) are Not Rated for aquatic life because pH was below the standard in 100 percent of lake monitoring samples collected in 2003. However, not enough samples were collected to assign a use support rating. The pH levels may be due to natural conditions. The impoundments are in the heavily urbanized and Impaired Little Cross Creek watershed. Glenville Lake is filling in with sediment, and riparian buffers have been removed at the head of the impoundment. Fayetteville PWC has an intensive monitoring program for these lakes. Fayetteville should continue efforts to protect the lakes from further degradation associated with urban runoff. Further recommendations to protect streams in urbanizing areas and to restore streams in existing urban areas are discussed in Chapter 31. DWQ will determine if increased monitoring efforts in these lakes are warranted to better assess water quality.

Water Quality Initiatives
In 1997, Fayetteville received a $502,000 CWMTF (Chapter 34) grant to acquire 122 acres in this watershed. In 1998, Fayetteville also received a $63,000 CWMTF grant to conduct a nutrient, sediment and bacteria susceptibility study in this watershed.

15.4.2 Pedler Branch [AU# 18-31-16]

Current Status and 2005 Recommendations
Pedler Branch from source to Rockfish Creek (2.8 miles) was not assessed for aquatic life during this assessment period. Pedler Branch drains the Town of Raeford and is impacted by urban stormwater runoff.

Water Quality Initiatives
In 2000, Raeford received a $194,000 CWMTF (Chapter 34) grant to acquire 40 acres along Pedler Branch. The grant included design of a stormwater wetland and pond to treat 55 percent of runoff from Raeford. In 2002, Raeford received a $296,000 CWMTF grant to construct a stormwater wetland to treat 50 percent of Raeford's runoff (964 acres).

15.4.3 Puppy Creek [AU# 18-31-19]

Current Status and 2005 Recommendations
Puppy Creek from source to Rockfish Creek (10.5 miles) is Not Rated for aquatic life. Benthic and fish community ratings could not be assigned at sites BB200 or BF39, although there are indications of water quality problems. This stream is mostly within Fort Bragg and DWQ recommends that Fort Bragg implement measures to reduce impacts to Puppy Creek.

15.5 Additional Water Quality Issues within Subbasin 03-06-06

The following section discusses issues that may threaten water quality in the subbasin that are not specific to particular streams, lakes or reservoirs. The issues discussed may be related to waters near certain land use activities or within proximity to different pollution sources.

15.5.1 Fort Bragg BMP Implementation

Fort Bragg has worked with Hoke and Cumberland SWCDs and NRCS in planning and implementing BMPs on the base to take care of erosion problems that may have been negatively impacting water quality in the Cross Creek, Rockfish Creek and Lower Little River watersheds.

Chapter 16
Cape Fear River Subbasin 03-06-16

Including: Cape Fear River, Harrison Creek, Turnbull Creek, Brown Creek and White Lake

16.1 Subbasin Overview

Subbasin 03-06-16 at a Glance

Land and Water Area

Total area:	438 mi²
Land area:	430 mi²
Water area:	8 mi²

Population Statistics

2000 Est. Pop.: 37,095 people
Pop. Density: 85 persons/mi²

Land Cover (percent)

Forest/Wetland:	78.7%
Surface Water:	2.5%
Urban:	0.6%
Cultivated Crop:	12.7%
Pasture/Managed Herbaceous:	5.6%

Counties

Bladen, Columbus, Cumberland and Pender

Municipalities

Dublin, East Acadia, Elizabethtown, Tar Heel and White Lake

Subbasin 03-06-16 includes the Cape Fear River and many streams that drain coastal plain wetlands and bay lakes. Most of the watershed is forested with some agriculture present. Development is occurring in the Cumberland County portion of the subbasin. Population is expected to grow by 100,000 people in counties with portions or all of their areas in this subbasin by 2020; however, most of the growth is expected in portions of the county outside of this subbasin.

There are seven individual NPDES wastewater discharge permits in this subbasin with a permitted flow of 13.7 MGD (Figure 19). The largest are Smithfield Tarheel Plant (3 MGD), Alamac Knits (2.5 MGD) and Dupont (2 MGD). Refer to Appendix VI and Chapter 30 for more information on NPDES permit holders. There are also 50 registered swine operations in this subbasin.

There were five benthic community samples (Figure 19 and Table 19) collected during this assessment period. Data were also collected from 21 ambient monitoring stations including 12 MCFRBA (Appendix V) stations, three LCFRP (Appendix V) stations, four DWQ ambient stations and two shared stations. Three reservoirs were also monitored. Refer to the *2003 Cape Fear River Basinwide Assessment Report* at http://www.esb.enr.state.nc.us/bar.html and Appendix IV for more information on monitoring.

Waters in the following sections are identified by assessment unit number (AU#). This number is used to track defined segments in the water quality assessment database, 303(d) Impaired waters list and the various tables in this basin plan. The assessment unit number is a subset of the DWQ index number (classification identification number). A letter attached to the end of the AU# indicates that the assessment is smaller than the DWQ index segment. No letter indicates that the assessment unit and the DWQ index segment are the same.

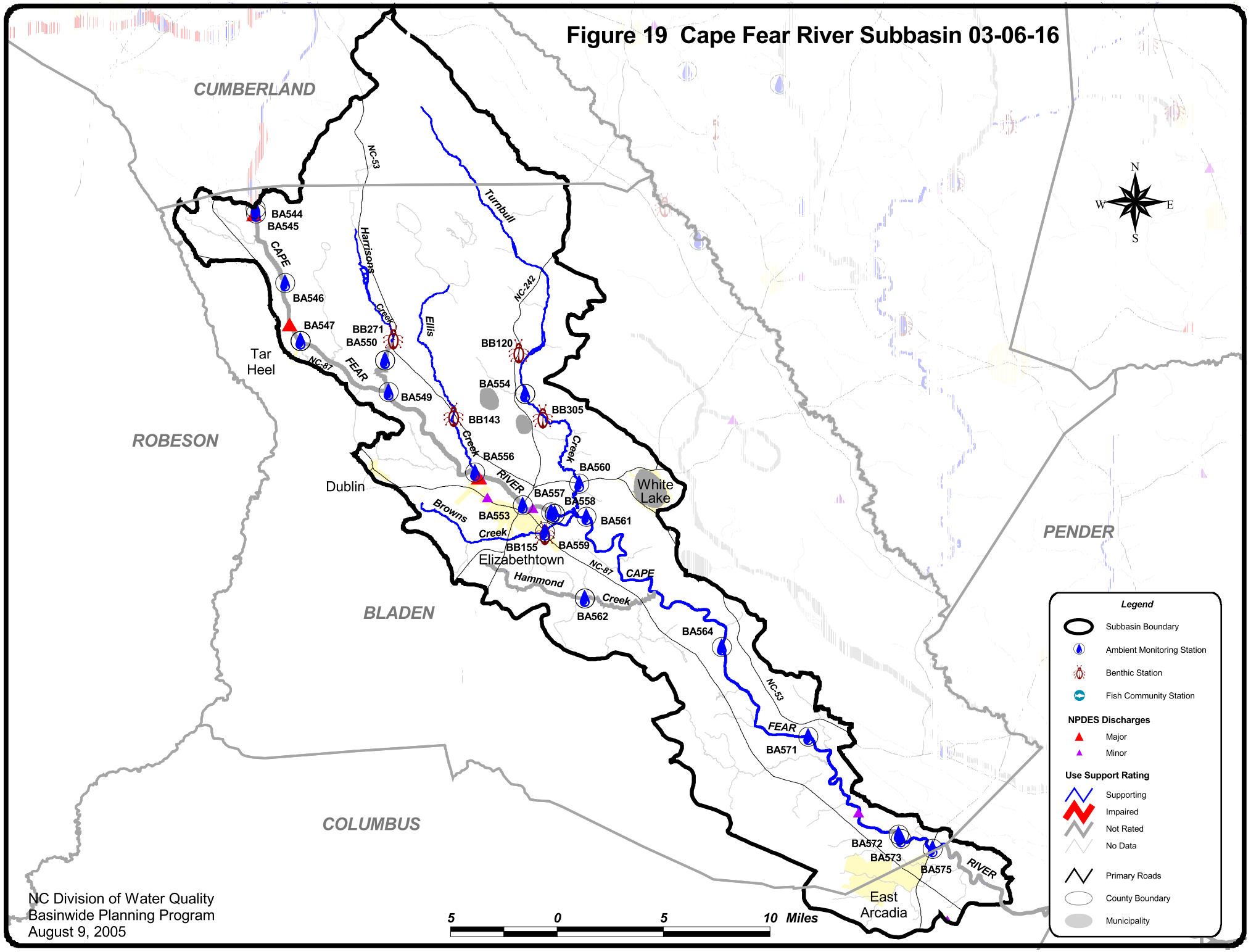


Figure 19 Cape Fear River Subbasin 03-06-16
CUMBERLAND
ROBESON
BLADEN
COLUMBUS
PENDER
Tar Heel
Dublin
Elizabethtown
White Lake
East Arcadia
BA544
BA545
BA546
BA547
BA549
BA550
BA553
BA554
BA556
BA557
BA558
BA559
BA560
BA561
BA562
BA564
BA571
BA572
BA573
BA575
BB120
BB143
BB155
BB271
BB305
CAPE FEAR RIVER
Harrisons Creek
Turnbull Creek
Ellis Creek
Browns Creek
Hammond Creek
NC-53
NC-87
NC-242
N
S
E
W
5 0 5 10 Miles
Legend
Subbasin Boundary
Ambient Monitoring Station
Benthic Station
Fish Community Station
NPDES Discharges
Major
Minor
Use Support Rating
Supporting
Impaired
Not Rated
No Data
Primary Roads
County Boundary
Municipality
NC Division of Water Quality
Basinwide Planning Program
August 9, 2005

Table 19 CAPE FEAR Subbasin 03-06-16

AU Number	Classification	Length/Area	Description	Aquatic Life Assessment						Recreation Assessment				Stressors	Sources
				AL Rating	Station	Result	Parameter	Year/ % Exc		REC Rating	Station	Result			
Browns Creek (Cross Pond)															
18-45	C	10.5 FW Miles	From source to Cape Fear River	S	BA559 BB155	NCE M	Low pH 2003	12.5		S	BA559	NCE			
CAPE FEAR RIVER															
18-(26)d	C	21.3 FW Miles	From Lock and Dam 3 to NC 41	NR	BA544 BA545 BA546 BA547 BA549 BA553 BA556	NCE NCE NCE NCE NCE NCE NCE	Chlor a Low DO 	57.1 7.14 		S	BA544 BA545 BA546 BA547 BA549 BA553 BA556	NCE NCE NCE NCE NCE NCE NCE	Chlorophyll a	Unknown
18-(26)e	C	1.8 FW Miles	From NC 41 to Browns Creek	NR	BA557 BA558	NCE NCE	Chlor a Chlor a	10 42.9		S	BA557 BA558	NCE NCE	Chlorophyll a	Unknown
18-(26)f	C	10.0 FW Miles	From Browns Creek to mouth of Hammond Creek	S	BA561	NCE				S	BA561	NCE			
18-(49)	WS-V	8.1 FW Miles	From mouth of Hammond Creek to mouth of Drunken Run (near mile 53)	S	BA564	NCE				S	BA564	NCE			
18-(53.5)	WS-IV	12.0 FW Miles	From mouth of Drunken Run (near mile 53) to a point 0.6 mile upstream of Lock #1 near Acme	S	BA571	NCE				S	BA571	NCE			
18-(58.5)	WS-IV CA	0.8 FW Miles	From a point 0.6 mile upstream of Lock #1 near Acme to Lock #1 (City of Wilmington water supply intake)	NR	BA572	NCE	Low pH	10.6		S	BA572	NCE	Low pH	Unknown
18-(59)	WS-IV Sw	7.7 FW Miles	From US Corps of Engineers Lock #1 near Acme to a point 0.5 mile upstream of raw WSI at Fed. Paper Board Corp. (Riegelwood)	S	BA573 BA575	NCE NCE				S	BA573 BA575	NCE NCE			
Ellis Creek															
18-44	C	11.8 FW Miles	From source to Cape Fear River	S	BB143	GF	2003			ND					

Table 19 CAPE FEAR Subbasin 03-06-16

AU Number / Description	Classification	Length/Area		Aquatic Life Assessment						Recreation Assessment				Stressors	Sources
				AL Rating	Station	Result	Parameter	Year/ % Exc		REC Rating	Station	Result			
Hammond Creek															
18-50	C	11.4	FW Miles	**NR**	BA562	NCE	Low DO	8.9		**S**	BA562	NCE		Low pH	Unknown
					BA562	NCE	Low pH	14.3						Low Dissolved Oxygen	Unknown
From source to Cape Fear River															
Harrisons Creek (Little Alligator Swamp)															
18-42a	C	9.9	FW Miles	**S**						ND					
From source to 0.3 miles downstream of SR 1318					BB271	GF	2003								
18-42b	C	4.8	FW Miles	**NR**	BA550	NCE	Low pH	89.8		**NR***	BA550	NCE		Fecal Coliform Bacteria	Unknown
From 0.3 miles downstream of SR 1318 to Cape Fear River														Low pH	Unknown
Jones Lake															
18-46-7-1	B	214.1	FW Acres	**NR**	BL31	NCE	Low pH	100		ND				Low pH	Unknown
From source to Lake Drain															
Salters Lake															
18-44-4	C	315.4	FW Acres	**NR**	BL30	NCE	Low pH	100		ND				Low pH	Unknown
Entire lake and connecting stream to Ellis Creek															
Turnbull Creek															
18-46	C	31.6	FW Miles	**S**	BA554	NCE	Low DO	13.8		**S**	BA554	NCE		Low pH	Unknown
					BA554	NCE	Low pH	100			BA560	NCE		Low Dissolved Oxygen	Unknown
					BA560	NCE	Low pH	100							
From source to Cape Fear River					BB120	NR	1999								
					BB305	GF	2003								
White Lake															
18-46-8-1	B	1,063.8	FW Acres	**NR**	BL32	NCE	Low pH	100		ND				Low pH	Unknown
From source to Lake Drain															

Table 19 CAPE FEAR Subbasin 03-06-16

AU Number	Classification	Length/Area	Description	Aquatic Life Assessment					Recreation Assessment				
				AL Rating	Station	Result	Year/ Parameter	% Exc	REC Rating	Station	Result	Stressors	Sources

AL - Aquatic Life	BF - Fish Community Survey	E - Excellent	S - Supporting, I - Impaired
REC - Recreation	BB - Benthic Community Survey	G - Good	NR - Not Rated
	BA - Ambient Monitoring Site	GF - Good-Fair	NR*- Not Rated for Recreation (screening criteria exceeded)
	BL- Lake Monitoring	F - Fair	ND-No Data Collected to make assessment
	S- DEH RECMON	P - Poor	**Results**
		NI - Not Impaired	CE-Criteria Exceeded > 10% and more than 10 samples
	Miles/Acres	S- Severe Stress	NCE-No Criteria Exceeded
	FW- Fresh Water	M-Moderate Stress	
	S- Salt Water	N- Natural	

Aquatic Life Rating Summary

S	m	101.5	FW Miles
NR	m	40.1	FW Miles
NR	m	1,593.2	FW Acres
ND		131.4	FW Miles
ND		917.6	FW Acres

Recreation Rating Summary

S	m	115.1	FW Miles
NR*	m	4.8	FW Miles
ND		153.1	FW Miles
ND		2,510.8	FW Acres

Fish Consumption Rating Summary

I	m	31.8	FW Miles
I	e	241.2	FW Miles
I	e	2,510.8	FW Acres

16.2 Use Support Assessment Summary

Use support ratings were assigned for waters in subbasin 03-06-16 in the aquatic life, recreation, fish consumption and water supply categories. All waters are Impaired on an evaluated basis in the fish consumption category because of fish consumption advice that applies to the entire basin. In the water supply category, all WS classified waters (82.7 miles) are Supporting on an evaluated basis based on reports from DEH regional water treatment plant consultants. Refer to Appendix X for a complete list of monitored waters and more information on Supporting monitored waters.

There were 141.6 stream miles (51.9 percent) and 1,593.2 freshwater acres (63.5 percent) monitored during this assessment period in the aquatic life category. There were no stream miles identified as Impaired in this category.

16.3 Status and Recommendations of Previously and Newly Impaired Waters

The following waters were either identified as Impaired in the previous basin plan (2000) or are newly Impaired based on recent data. If previously identified as Impaired, the water will either remain on the state's 303(d) list or will be delisted based on recent data showing water quality improvements. If the water is newly Impaired, it will likely be placed on the 2006 303(d) list. The current status and recommendations for addressing these waters are presented below, and each is identified by an assessment unit number (AU#). Refer to the overview for more information on AUs. Information regarding 303(d) listing and reporting methodology is presented in Appendix VII.

16.3.1 Browns Creek [AU#18-45]

2000 Recommendations
The 2000 basinwide plan recommended that Browns Creek be resampled using the 303(d) approach and that local initiatives were needed to address water quality.

Current Status
Browns Creek from source to the Cape Fear River (10.5 miles) is Supporting aquatic life because of a Moderate benthic community rating at site BB155. No intolerant species were found at site BB155. The low pH (12.5 percent below standard) at site BA559 is likely from natural swamp drainage. Browns Creek is Impaired on a monitored basis in the fish consumption category.

2005 Recommendations
DWQ will continue to monitor the Browns Creek watershed. This creek will be evaluated to determine if a supplemental Sw classification is warranted. Browns Creek will remain on the 303(d) list because of the fish consumption impairment.

16.4 Status and Recommendations for Waters with Noted Impacts

The surface waters discussed in this section are not Impaired. However, notable water quality problems and concerns have been documented for some waters based on this assessment. While

these waters are not Impaired, attention and resources should be focused on these waters to prevent additional degradation or facilitate water quality improvement. Waters in the following section are identified by assessment unit number (AU#). See overview for more information on AU#s.

16.4.1 Cape Fear River [AU#18-(26)d and (58.5)]

Current Status and 2005 Recommendations
The Cape Fear River [18-(26)d] from Lock and Dam 3 to NC 41 (21.3 miles) is Not Rated for aquatic life because Alamac Knits (NC0003522) had significant violations of pH permit limits during the last two years of the assessment period. This facility ceased discharging in 2003. Dissolved oxygen was also below 4 mg/l in 7 percent of samples at site BA547. The NPDES compliance process will be used to address the significant permit violations noted above. Chlorophyll *a* exceeded the standard in 57 percent of samples collected at BA544; however, not enough samples were collected to assign a use support rating. This segment is Impaired on a monitored basis in the fish consumption category and will be added to the 303(d) list of Impaired waters. The segment just upstream of Lock and Dam 3 is Impaired and is discussed in Chapter 15.

The Cape Fear River [18-(58.5)] just above Lock and Dam 1 (0.8 miles) is Not Rated for aquatic life because pH was below the standard in 11 percent of samples collected at site BA572. The low pH is likely from swamp streams that drain into the Cape Fear River in this subbasin. DWQ will determine if a supplemental classification of Sw is warranted for this segment. The Cape Fear River below Lock and Dam 1 is Class C Sw.

16.4.2 Beaverdam Creek [AU# 18-61-4]

Current Status and 2005 Recommendations
Beaverdam Creek from source to Cape Fear River (6.7 miles) was not assessed during this assessment period, but is in a watershed that has experienced growth along the NC 87 corridor.

Water Quality Initiatives
In 2003, Sandyfield received a $161,000 CWMTF (Chapter 34) grant to purchase 43 wetland acres along Beaverdam Creek.

16.4.3 Hammond Creek [AU#18-50]

Current Status and 2005 Recommendations
Hammond Creek from source to the Cape Fear River (11.4 miles) is Not Rated for aquatic life because pH was below the standard in 14 percent of samples collected at site BA562. The low pH is likely from swamp stream drainage. DWQ will determine if a supplemental classification of Sw is warranted for this segment.

16.4.4 Harrisons Creek (Little Alligator Swamp) [AU#18-42b]

Current Status and 2005 Recommendations
Harrisons Creek from downstream of SR 1318 to the Cape Fear River (4.8 miles) is Not Rated for aquatic life because pH was below the standard in 90 percent of samples collected at site

BA550. The low pH is likely from swamp stream drainage. DWQ will determine if a supplemental classification of Sw is warranted for this segment. The upstream segment is Supporting aquatic life because of a Good-Fair benthic community rating at site BB271. Intolerant species were found at this site suggesting good water quality in Harrisons Creek.

16.4.5 Jones Lake [AU#18-46-7-1]

Current Status and 2005 Recommendations
Jones Lake (214.1 acres) is Not Rated for aquatic life because pH was below the standard during summer 2003 lake monitoring. However, not enough samples were collected to assign a use support rating. The low pH is likely from swamp stream drainage. DWQ will determine if a supplemental classification of Sw is warranted for this lake. DWQ will also determine if increased monitoring efforts in this lake are warranted to better assess water quality.

16.4.6 Little Singletary Lake [AU#18-44-2-1]

Current Status and Water Quality Initiatives
Little Singletary Lake (626 acres) was not assessed for use support determination. In 1999, the NC Wildlife Resources Commission received a $1,810,406 CWMTF (Chapter 34) grant to acquire 9,740 acres around this lake.

16.4.7 Mulford Creek [AU#18-47]

Current Status and Water Quality Initiatives
Mulford Creek from source to the Cape Fear River (2 miles) was not assessed for use support determination. In 2001, the NC Division of Forest Resources received a $345,000 CWMTF (Chapter 34) grant to acquire 273 acres of riparian wetland along Mulford Creek. The overall project included 777 acres.

16.4.8 Salters Lake [AU#18-44-4]

Current Status and 2005 Recommendations
Salters Lake (315.4 acres) is Not Rated for aquatic life because pH was below the standard during summer 2003 lake monitoring. However, not enough samples were collected to assign a use support rating. The low pH is likely from swamp stream drainage. DWQ will determine if a supplemental classification of Sw is warranted for this lake. DWQ will also determine if increased monitoring efforts in this lake are warranted to better assess water quality.

16.4.9 Suggs Mill Pond [AU#18-44-1]

Current Status and Water Quality Initiatives
Suggs Mill Pond (200.3 acres) was not assessed for use support determination. In 1997, the NC Wildlife Resources Commission received a $2,250,500 CWMTF (Chapter 34) grant to acquire 9,740 acres around the Suggs Mill Pond Complex.

16.4.10 Turnbull Creek [AU#18-46]

Current Status and 2005 Recommendations
Turnbull Creek from source to the Cape Fear River (31.6 miles) is Supporting aquatic life because of a Good-Fair benthic community rating at site BB305. Intolerant species were found, suggesting good water quality in Turnbull Creek. Dissolved oxygen exceeded the standard in 14 percent of samples at site BA554, and pH was below the standard in 100 percent of samples collected at sites BA554 and BA560. The low pH and low dissolved oxygen are likely from swamp stream drainage. DWQ will determine if a supplemental classification of Sw is warranted for this segment.

Water Quality Initiatives
In 1999, the Cape Fear RC&D received an $18,550 CWMTF grant to purchase a no-till drill to make available to farmers in this watershed (Chapter 34).

16.4.11 White Lake [AU#18-46-8-1]

Current Status and 2005 Recommendations
White Lake (1,063.8 acres) is Not Rated for aquatic life because pH was below the standard during summer 2003 lake monitoring. However, not enough samples were collected to assign a use support rating. The low pH is likely from swamp stream drainage. DWQ will determine if a supplemental classification of Sw is warranted for this lake. DWQ will also determine if increased monitoring efforts in this lake are warranted to better assess water quality.

Chapter 17
Cape Fear River Subbasin 03-06-17

Including: Cape Fear River, Cape Fear River Estuary, Livingston Creek and Town Creek

17.1 Subbasin Overview

Subbasin 03-06-17 at a Glance

Land and Water Area

Total area:	547 mi²
Land area:	498 mi²
Water area:	49 mi²

Population Statistics

2000 Est. Pop.: 78,348 people
Pop. Density: 143 persons/mi²

Land Cover (percent)

Forest/Wetland:	74.7%
Surface Water:	9.3%
Urban:	4.1%
Cultivated Crop:	7.6%
Pasture/Managed Herbaceous:	4.3%

Counties

Brunswick, Columbus, New Hanover and Pender

Municipalities

Bellville, Boiling Springs, Bolton, Carolina Beach, Caswell Beach, Kure Beach, Leland, Long Beach, Navassa, Northwest, Wilmington and Yaupon Beach

Subbasin 03-06-17 is in the coastal plain with slow-moving tannin stained tributary streams and the large Cape Fear River estuary and tidal creeks. Most of the watershed is forested with urban areas growing on the west side of the Cape Fear River in Brunswick County. Population is expected to grow by 140,000 people in counties with portions or all of their areas in this subbasin by 2020.

There are 41 individual NPDES wastewater discharge permits in this subbasin with a permitted flow of 99.9 MGD (Figure 20). The largest are International Paper (50 MGD), Progress Energy (3.5 MGD), New Hanover County WWTP (4 MGD), Northside WWTP (16 MGD) and Southside WWTP (12 MGD). Refer to Appendix VI and Chapter 30 for more information on NPDES permit holders. Issues related to compliance with NPDES permit conditions are discussed below in Section 17.3 for Impaired waters and in Section 17.4 for other waters.

There are seven registered swine operations in this subbasin.

There were eight benthic community samples (Figure 20 and Table 20) collected during this assessment period. Data were also collected from 17 ambient monitoring stations including nine LCFRP (Appendix V) stations, two DWQ ambient stations and four shared stations. Two reservoirs were also monitored. Refer to the *2003 Cape Fear River Basinwide Assessment Report* at http://www.esb.enr.state.nc.us/bar.html.

Waters in the following sections are identified by assessment unit number (AU#). This number is used to track defined segments in the water quality assessment database, 303(d) Impaired waters list and the various tables in this basin plan. The assessment unit number is a subset of the DWQ index number (classification identification number). A letter attached to the end of the AU# indicates that the assessment is smaller than the DWQ index segment. No letter indicates that the assessment unit and the DWQ index segment are the same.

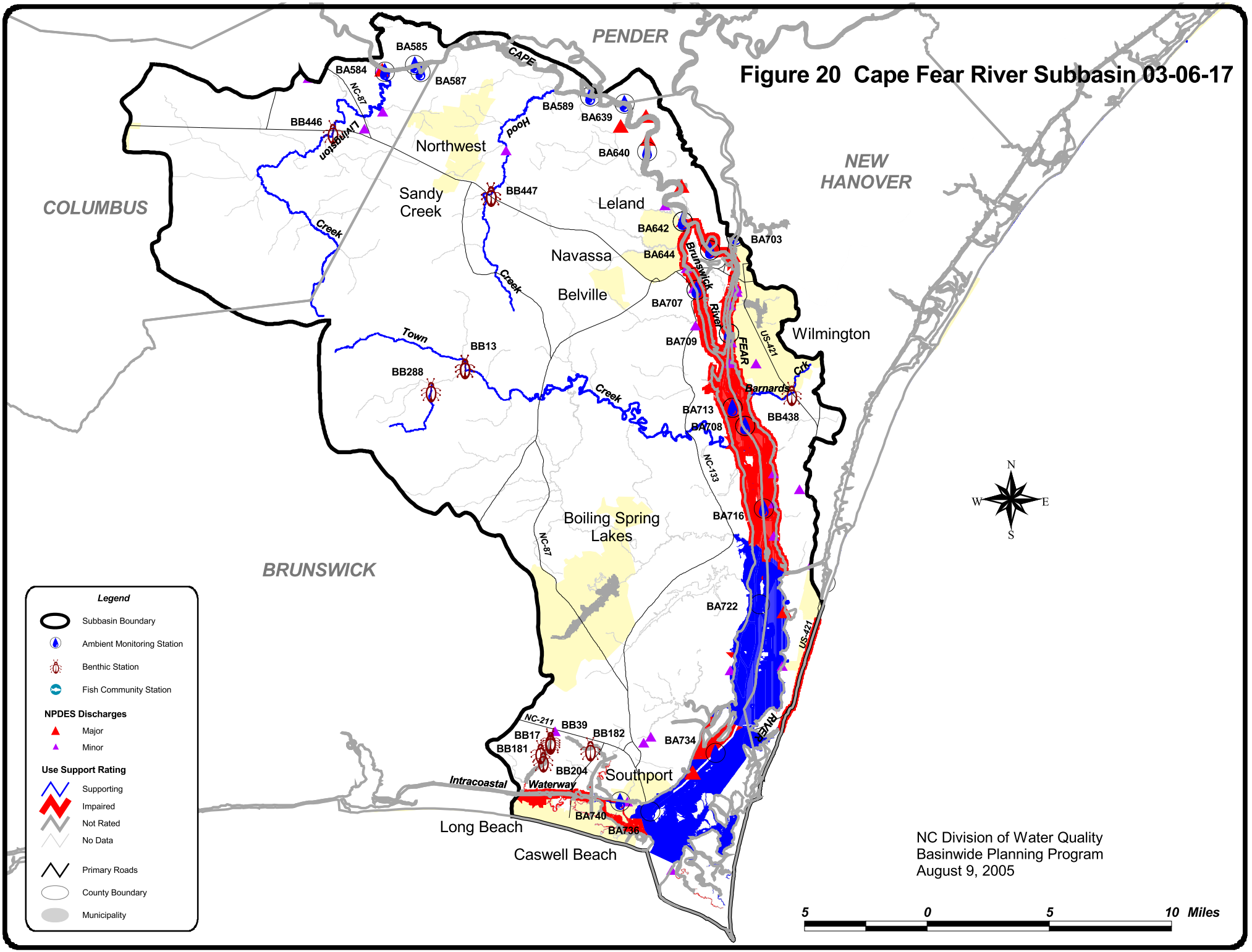


Figure 20 Cape Fear River Subbasin 03-06-17
PENDER
COLUMBUS
NEW HANOVER
BRUNSWICK
Northwest
Sandy Creek
Navassa
Belville
Leland
Wilmington
Boiling Spring Lakes
Southport
Long Beach
Caswell Beach
BA585
BA584
BA587
BA589
BA639
BA640
BA642
BA644
BA703
BA707
BA709
BA713
BA708
BA716
BA722
BA734
BA740
BA736
BB446
BB447
BB13
BB288
BB438
BB39
BB17
BB181
BB182
BB204
Cape Fear River
Hood Creek
Livingston Creek
Town Creek
Brunswick River
Barnards Crk
NC-87
NC-133
NC-211
US-421
Intracoastal Waterway
Legend
Subbasin Boundary
Ambient Monitoring Station
Benthic Station
Fish Community Station
NPDES Discharges
Major
Minor
Use Support Rating
Supporting
Impaired
Not Rated
No Data
Primary Roads
County Boundary
Municipality
N
W
E
S
5 0 5 10 Miles
NC Division of Water Quality
Basinwide Planning Program
August 9, 2005

Table 20 CAPE FEAR Subbasin 03-06-17

AU Number	Classification	Length/Area	Description	Aquatic Life Assessment					Recreation Assessment			Shellfish Harvesting			
				AL Rating	Station	Result	Year/ Parameter	% Exc	REC Rating	Station	Result	SH Rating	GA Status	Stressors	Sources
Allen Creek (Boil															
18-85-1-(1)	B Sw	331.6 FW Acres	From source to Boiling Springs Lake Dam	**NR**	BL37	NCE	Low pH	100	ND						
Atlantic Ocean															
99-(2)	SB	5.6 Coast Miles	The waters of the Atlantic Ocean contiguous with that portion of the Cape Fear River Basin that extends from the eastern edge of the Lumber River Basin to the eastern end of Bald Head Island	ND					**NR***	S-14 S-15	NCE NCE			Enterrococcus	Stormwater Outfal
99-(3)b	SB	4.7 Coast Miles	The waters of the Atlantic Ocean contiguous to that portion of the Cape Fear River Basin from S. Fort Fisher Blvd. Along Kure Beach to the subbasin 17/24 boundary.	ND					**I**	S-18 S-19 S-19a S-19b S-20	NCE NCE NCE CE NCE			Enterrococcus	Stormwater Outfal
Bald Head Creek															
18-88-8-4	SA HQW	79.9 S acres	From source to Cape Fear River	ND					ND			I	PRO	Fecal Coliform Bacteria	Unknown
Barnards Creek															
18-80	C Sw	3.9 FW Miles	From source to Cape Fear River	**S**	BB438	M	2003		ND						
Bay Creek															
18-88-8-3-1	SA HQW	80.6 S acres	From source to Cape Creek	ND					ND			S	APP		

Table 20 CAPE FEAR Subbasin 03-06-17

AU Number	Classification	Length/Area		Aquatic Life Assessment					Recreation Assessment			Shellfish Harvesting			
Description				AL Rating	Station	Result	Year/ Parameter	% Exc	REC Rating	Station	Result	SH Rating	GA Status	Stressors	Sources
Beaverdam Cree															
18-88-9-1-(0.5)	SC Sw HQ	1.0	S acres	**NR**					ND						
From source to mouth of Polly Gully Creek					BB17	NR	1999								
					BB204	NR	1999								
					BB39	NR	1999								
18-88-9-1-(1.5)	SA HQW	11.3	S acres	ND					ND			I	PRO	Fecal Coliform Bacteria	Unknown
From mouth of Polly Gully Creek to Intracoastal Waterway															
Bowensville Cree															
18-88-6	SA HQW	5.2	S acres	ND					ND			S	APP		
From Muddy Slough to Cape Fear River															
Brunswick River															
18-77	SC	743.7	S acres	**I**	BA707	CE	Low DO	14.3	**S**	BA707	NCE			Low pH	Unknown
					BA707	CE	Low pH	19.6						Low Dissolved Oxygen	Unknown
From source to Cape Fear River															
Burris Creek															
18-88-8-2-3	SA HQW	12.7	S acres	ND					ND			S	APP		
From Muddy Slough to Buzzard Bay															
Buzzard Bay															
18-88-8-2	SA HQW	578.1	S acres	ND					ND			S	APP		
Entire Basin															
Cape Creek															
18-88-8-3	SA HQW	198.4	S acres	ND					ND			S	APP		
From source to Cape Fear River															

Table 20 CAPE FEAR Subbasin 03-06-17

AU Number / Description	Classification	Length/Area		Aquatic Life Assessment: AL Rating	Station	Result	Year/ Parameter	% Exc	Recreation Assessment: REC Rating	Station	Result	Shellfish Harvesting: SH Rating	GA Status	Stressors	Sources
CAPE FEAR RI															
18-(63)a	C Sw	3.8	FW Miles	**NR**	BA585	NCE			**S**	BA585	NCE			Chlorophyll a	Unknown
					BA587	NCE	Chlor a	33.3		BA587	NCE				
From raw water supply intake at Federal Paper Board corporation (Riegelwood) to Bryant Mill Creek															
18-(63)b	C Sw	18.5	FW Miles	**NR**	BA589	NCE	Low DO	8.8	**S**	BA589	NCE			Low Dissolved Oxygen	Unknown
					BA639	NCE	Low DO	13.8		BA639	NCE				
					BA640	NCE	Low DO	11		BA640	NCE				
From Bryant Mill Creek to upstream mouth of Toomers Creek															
18-(71)a	SC	5,616.7	S acres	**I**	BA642	CE	Low DO	42.9	**S**	BA642	NCE			Turbidity	Unknown
					BA642	CE	Low pH	38.5		BA644	NCE			Low pH	Unknown
					BA642	NCE	Turbidity	8.8		BA708	NCE			Low Dissolved Oxygen	Unknown
					BA644	CE	Low DO	37.1		BA709	NCE				
					BA644	CE	Low pH	37.1		BA713	NCE				
					BA708	CE	Low DO	16.4		BA716	NCE				
					BA708	CE	Low pH	10.4							
					BA709	CE	Low DO	29.5							
					BA709	CE	Low pH	20.5							
					BA713	CE	Low DO	23.2							
					BA713	CE	Low pH	19.6							
					BA716	CE	Low DO	10.4							
From upstream mouth of Toomers Cr. to a line across the river Between Lilliput Creek and Snows Cut															
18-(71)b	SC	7,856.7	S acres	**S**	BA722	NCE			**S**	BA722	NCE				
										S-44	NCE				
From a line across the river between Lilliput Creek and Snows Cut to a line across the river from Snows Point to Federal Marsh															

Table 20 CAPE FEAR Subbasin 03-06-17

AU Number	Classification	Length/Area		Aquatic Life Assessment					Recreation Assessment				Shellfish Harvesting			
Description				AL Rating	Station	Result	Year/ Parameter	% Exc	REC Rating	Station	Result	SH Rating	GA Status	Stressors	Sources
18-(87.5)a	SA HQW	769.2	S acres	S	BA734	NCE			S	S-43 BA734	NCE NCE	I	PRO	Fecal Coliform Bacteria	Unknown
Prohibited area north of Southport Restricted Area and west of ICWW in Cape Fear River															
18-(87.5)b	SA HQW	4,784.2	S acres	S	BA734	NCE			S	BA734	NCE	S	APP		
Approved area east of ICWW in Cape Fear River															
18-(87.5)c	SA HQW	322.6	S acres	ND					ND			I	PRO	Fecal Coliform Bacteria	Unknown
Prohibited area south of Southport Restricted Area															
18-(87.5)d	SA HQW	17.7	S acres	ND					ND			I	PRO	Fecal Coliform Bacteria	Impervious Surfac
Prohibited area east of ICWW in Cape Fear River															
Cedar Creek															
18-88-8-2-4	SA HQW	105.1	S acres	ND					ND			S	APP		
From Cape Fear River to Buzzard Bay															
Coward Creek															
18-88-9-2-5-1	SA HQW	5.9	S acres	ND					ND			I	PRO	Fecal Coliform Bacteria	Unknown
From source to Molasses Creek															
Deep Creek															
18-88-8-3-1-1	SA HQW	31.0	S acres	ND					ND			S	APP		
From source to Bay Creek															
Denis Creek															
18-88-9-2-3	SA HQW	34.2	S acres	ND					ND			I	PRO	Fecal Coliform Bacteria	Unknown
From source to Intracoastal Waterway															

Table 20 CAPE FEAR Subbasin 03-06-17

AU Number	Classification	Length/Area		Aquatic Life Assessment					Recreation Assessment			Shellfish Harvesting			
Description				AL Rating	Station	Result	Year/ Parameter	% Exc	REC Rating	Station	Result	SH Rating	GA Status	Stressors	Sources
Dutchman Creek															
18-88-9-3-(2.5)	SA HQW	75.8	S acres	ND					ND			I	PRO	Fecal Coliform Bacteria	Unknown
From CP&L Discharge Canal to Intracoastal Waterway															
Dutchman Creek															
18-88-9-3-3	SA HQW	78.3	S acres	ND					ND			I	PRO	Fecal Coliform Bacteria	Unknown
From Intracoastal waterway to Dutchman Creek															
Dutchman Creek															
18-88-9-3-(4)	SA HQW	37.9	S acres	ND					ND			I	PRO	Fecal Coliform Bacteria	Unknown
That section of Dutchman Creek within a line beginning at a point of marsh at the junction of Dutchman Creek and Elizabeth River and running due north to a point of marsh															
Elizabeth River															
18-88-9-2-(1)	SA HQW	83.5	S acres	ND					ND			I	PRO	Fecal Coliform Bacteria	Unknown
That section of Elizabeth River exclusive of the Elizabeth River Shellfishing Area															
Elizabeth River S															
18-88-9-2-(2)	SA HQW	205.6	S acres	ND					ND			I	PRO	Fecal Coliform Bacteria	Unknown
That section of Elizabeth River within a line beginning at the mouth of Molasses Creek and running northeast to a point of marsh at the junction of Elizabeth River and Du															
Fishing Creek															
18-88-8-4-1	SA HQW	7.9	S acres	ND					ND			I	PRO	Fecal Coliform Bacteria	Unknown
From source to Bald Head Creek															

Table 20 CAPE FEAR Subbasin 03-06-17

AU Number / Description	Classification	Length/Area		Aquatic Life Assessment: AL Rating	Station	Result	Year/ Parameter	% Exc	Recreation Assessment: REC Rating	Station	Result	Shellfish Harvesting: SH Rating	GA Status	Stressors	Sources
Greenfield Lake															
18-76-1	C Sw	75.3	FW Acres	**NR**	BL36	NCE			ND					Chlorophyll a	MS4 NPDES
Entire Lake														Fecal Coliform Bacteria	MS4 NPDES
Hood Creek															
18-66	C Sw	13.8	FW Miles	**S**					ND						
From source to Cape Fear River					BB447	M	'2003								
					BB447	GF	'1999								
					BB447	GF	'1998								
Intracoastal Wat															
18-88-9a	SA HQW	222.6	S acres	ND					**S**	S-41	NCE	I	PRO	Fecal Coliform Bacteria	Unknown
From Channel Marker F1, R. "22" to Dutchmans Creek outlet channel															
18-88-9b	SA HQW	96.6	S acres	**I**	BA740	CE	Low DO	11.1	**I**	S-42	CE	I	PRO	Fecal Coliform Bacteria	Unknown
From Dutchmans Creek outlet channel to mouth of Cottage Creek														Enterrococcus	Unknown
														Low Dissolved Oxygen	Unknown
Jump and Run C															
18-88-9-3-2	SC Sw	1.0	S acres	**NR**					ND						
From source to Dutchman Creek					BB182	NR	'1999								
Lewis Branch															
18-81-2-2	C Sw	3.8	FW Miles	**S**					ND						
From source to Lewis Swamp					BB288	N	'2003								

Table 20 CAPE FEAR Subbasin 03-06-17

AU Number / Description	Classification	Length/Area		Aquatic Life Assessment: AL Rating	Station	Result	Parameter	Year/ % Exc	Recreation Assessment: REC Rating	Station	Result	Shellfish Harvesting: SH Rating	GA Status	Stressors	Sources
Livingston Creek															
18-64	C Sw	21.8	FW Miles	**S**	BA584	NCE	Low DO		**S**	BA584	NCE			Low Dissolved Oxygen	Unknown
From source to Cape Fear River					BB446	GF		2003							
Middle Creek															
18-88-5	SA HQW	10.8	S acres	ND					ND			S	APP		
From Muddy Slough to Cape Fear River															
Molasses Creek															
18-88-9-2-5	SA HQW	1.0	S acres	ND					ND			I	PRO	Fecal Coliform Bacteria	Unknown
From source to Elizabeth River															
Muddy Slough															
18-88-7	SA HQW	1.0	S acres	ND					ND			S	APP		
Entire Slough															
Piney point Cree															
18-88-9-2-4	SA HQW	11.5	S acres	ND					ND			I	PRO	Fecal Coliform Bacteria	Unknown
From source to Denis Creek															
Shellbed Creek															
18-88-4	SA HQW	1.0	S acres	ND					ND			S	APP		
From Muddy Slough to Cape Fear River															
Southport Restri															
18-88-3.5	SC	715.3	S acres	**S**	BA736	NCE			**S**	BA736	NCE				
Beginning at a point on the west bank of the Cape Fear River 1000 yards upstream of Price Creek, thence in an easterly direction to the eastern border of the Lower Cape F															

Table 20 CAPE FEAR Subbasin 03-06-17

AU Number / Description	Classification	Length/Area		Aquatic Life Assessment					Recreation Assessment			Shellfish Harvesting			
				AL Rating	Station	Result	Year/ Parameter	% Exc	REC Rating	Station	Result	SH Rating	GA Status	Stressors	Sources
Still Creek															
18-88-8-2-2	SA HQW	32.5	S acres	ND					ND			S	APP		
From Muddy Slough to Buzzard Bay															
The Basin															
18-88-8-1	SA HQW	384.0	S acres	ND					**S**	S-18a	NCE	S	APP		
Entire Basin															
Town Creek (Rat															
18-81	C Sw	32.1	FW Miles	**S**					ND						
From source to Cape Fear River					BB13	NR	1999								
					BB13	N	1999								
					BB13	NR	1998								

Table 20 CAPE FEAR Subbasin 03-06-17

AU Number	Classification	Length/Area	Aquatic Life Assessment					Recreation Assessment			Shellfish Harvesting			
Description			AL Rating	Station	Result	Year/ Parameter	% Exc	REC Rating	Station	Result	SH Rating	GA Status	Stressors	Sources

AL - Aquatic Life	BF - Fish Community Survey	E - Excellent	S - Supporting, I - Impaired
REC - Recreation	BB - Benthic Community Survey	G - Good	NR - Not Rated
	BA - Ambient Monitoring Site	GF - Good-Fair	NR*- Not Rated for Recreation (screening criteria exceeded)
	BL- Lake Monitoring	F - Fair	ND-No Data Collected to make assessment
	S- DEH RECMON	P - Poor	**Results**
		NI - Not Impaired	CE-Criteria Exceeded > 10% and more than 10 samples
	Miles/Acres	S- Severe Stress	NCE-No Criteria Exceeded
	FW- Fresh Water	M-Moderate Stress	
	S- Salt Water	N- Natural	GA Status- DEH SS Growing Area Status

Aquatic Life Rating Summary

S	m	14,125.4	S acres
NR	m	2.0	S acres
I	m	6,457.0	S acres
S	m	75.4	FW Miles
NR	m	22.3	FW Miles
NR	m	406.9	FW Acres
ND		2,859.2	S acres
ND		215.4	FW Miles
ND		844.5	FW Acres
ND		22.8	Coast Mile

Recreation Rating Summary

S	m	21,092.3	S acres
I	m	96.6	S acres
S	m	44.1	FW Miles
NR*	m	5.6	Coast Mile
I	m	4.7	Coast Mile
ND		2,254.6	S acres
ND		269.1	FW Miles
ND		1,251.5	FW Acres
ND		12.5	Coast Mile

Fish Consumption Rating Summary

I	m	35.9	FW Miles
I	e	23,443.5	S acres
I	e	277.3	FW Miles
I	e	1,251.5	FW Acres
I	e	22.8	Coast Mile

17.2 Use Support Assessment Summary

Use support ratings were assigned for waters in subbasin 03-06-17 in the aquatic life, recreation, fish consumption and water supply categories. All waters are Impaired on an evaluated basis in the fish consumption category because of fish consumption advice that applies to the entire basin. In the water supply category, all WS classified waters (1.6 miles) are Supporting on an evaluated basis based on reports from DEH regional water treatment plant consultants. Refer to Appendix X for a complete list of monitored waters and more information on Supporting monitored waters.

In the aquatic life category, 97.8 stream miles (31.2 percent), 407 freshwater acres (32.5 percent), and 20,592 estuarine acres (87.8 percent) were monitored during this assessment period. There were 6,457 estuarine acres (27.5 percent) identified as Impaired in this category.

In the recreation category, 21,188.9 estuarine acres (90.4 percent), 44.1 freshwater miles (14.1 percent), and 10.3 coastline miles (45.2 percent) were monitored during the assessment period. There were 96.6 estuarine acres (<1 percent) and 4.7 coastline miles (20.6 percent) identified as Impaired in this category.

In the shellfish harvesting category, 8,286.1 estuarine acres (100 percent) were monitored during the assessment period. There were 2,061.6 estuarine acres (24.8 percent) identified as Impaired in this category.

17.3 Status and Recommendations of Previously and Newly Impaired Waters

The following waters were either identified as Impaired in the previous basin plan (2000) or are newly Impaired based on recent data. If previously identified as Impaired, the water will either remain on the state's 303(d) list or will be delisted based on recent data showing water quality improvements. If the water is newly Impaired, it will likely be placed on the 2006 303(d) list. The current status and recommendations for addressing these waters are presented below, and each is identified by an assessment unit number (AU#). Refer to the overview for more information on AUs. Information regarding 303(d) listing and reporting methodology is presented in Appendix VII.

For Impaired Class SA waters presented below, refer to Chapter 27 for more information and recommendations on shellfish harvesting use support. All waters identified as Impaired in the shellfish harvesting category will be added to the 303(d) list of Impaired waters. TMDLs (Chapter 35) will be developed for identified stressors within 8-13 years of listing.

17.3.1 Atlantic Ocean [99-(2) and (3)b]

Current Status
These segments of the Atlantic Ocean were not individually identified in the 2000 basin plan, and no specific recommendations were made in the 2000 basin plan.

The Atlantic Ocean [99-(3)b] from the subbasin boundary to South Fort Fisher Boulevard (4.7 coastline miles) is Impaired for recreation because of permanent postings of swimming advisories and the 18 known storm drains that periodically discharge onto the beach in this segment. Segment 99-(2) is Not Rated for recreation because of the presence of storm drains that periodically discharge into these waters, although no criteria were exceeded at sites S-14 and S-15.

17.3.2 Bald Head Creek [AU# 18-88-8-4]

Current Status
Bald Head Creek from source to the Cape Fear River (79.9 acres) is Impaired for shellfish harvesting because this segment is classified by DEH SS (Chapter 27) as prohibited in growing area B-2. Bald Head Creek will be added to the 303(d) list of Impaired waters.

17.3.3 Beaverdam Creek [AU# 18-88-9-1-(0.5) and (1.5)]

Current Status
Beaverdam Creek [18-88-9-1-(0.5)] from source to Polly Gully Creek (1 mile) is Not Rated for aquatic life because benthic community ratings could not be assigned at sites BB17, BB39 and BB204 in 1999. The watershed was studied in 1999 to evaluate the effects of ditching associated with the St. James Plantation development. Large amounts of silt in the creek promoted a shift toward silt tolerant species. The Brunswick WTP discharge provided permanent flow and increased the pH of the stream above what would be natural for streams in this area. A surprisingly pollution intolerant benthic community was present in some areas of the watershed.

Beaverdam Creek [18-88-9-1-(1.5)] from Polly Gully Creek to ICWW (11.3 acres) is Impaired for shellfish harvesting because this segment is classified by DEH SS (Chapter 27) as prohibited in growing area B-1.

2005 Recommendations
DWQ will continue to monitor Beaverdam Creek. It is recommended that further development in this area avoid ditching and use BMPs to prevent further siltiation of streams in this watershed. Segment 18-88-9-1-(1.5) will be added to the 303(d) list of Impaired waters.

17.3.4 Cape Fear River Estuary
Brunswick River [AU#18-77]
Cape Fear River [AU#18-(63)a and b, (71)a and (71)b]
Cape Fear River [AU#18-(87.5)a, c and d]

2000 Recommendations
The 2000 basinwide plan recommended that a TMDL be developed for dissolved oxygen and that the TMDL be used to guide wasteload allocations for new and expanding discharges. Refer to Chapter 30 for information on NPDES permitting.

Current Status
The Brunswick River [18-77] from source to the Cape Fear River (743.7 acres) is Impaired for aquatic life because the dissolved oxygen standard was violated in 14.3 percent of samples at site BA707. The dissolved oxygen standard for SC classified waters is 5 mg/l. The pH standard was

also below the standard in 19.6 percent of samples. The low pH may be associated with swamp drainage from the Black and Northeast Cape Fear Rivers. Clairmont Shopping Center (NC0058599) had significant violations of ammonia permit limits during the last two years of the assessment period as well.

The Cape Fear River [18-(63)a] from International Paper intake to Bryant Mill Creek (3.8 miles) is Impaired on a monitored basis in the fish consumption category.

The Cape Fear River [18-(63)b] from Bryant Mill Creek to Toomers Creek (18.5 miles) is Not Rated because dissolved oxygen was below 4 mg/l in 11 and 13.8 of samples collect at sites BA640 and BA639. This segment is classified as C Sw, which acknowledges natural characteristics of swamps such as low pH. Also, BASF (NC0059234) had significant violations of biological oxygen demand permit limits, and Leland Industrial Park WWTP (NC0065676) had significant violations of total suspended solids permit limits during the last two years of the assessment period. BASF is under a special order of consent (SOC# S0314) that expires in August 2005.

The Cape Fear River [18-(71)a] from Toomers Creek to Snows Cut (5,616.7 acres) is Impaired for aquatic life because the dissolved oxygen standard was violated in 42.9, 37.1, 16.4, 29.5, 23.2 and 10.4 percent of samples collected at sites BA642, BA644, BA708, BA709, BA713 and BA716. The dissolved oxygen standard for SC waters is 5 mg/l. The pH standard was also below the standard in 38.5, 37.1, 10.4, 20.5 and 19.6 percent of samples at the same sites. The low pH may be associated with swamp drainage from the Black and Northeast Cape Fear Rivers. The segment of the Cape Fear River upstream of this area has a supplemental classification of Sw that acknowledges that swamp streams may have lower dissolved oxygen and pH.

The Cape Fear River [18-(71)b] from Snows Cut to Federal Marsh (7,856.7 acres) is Supporting aquatic life because no criteria were exceeded at site BA722, although Kure Beach WWTP (NC0025763) had significant violations of total suspended solids permit limits during the last two years of the assessment period.

The Cape Fear River [18-(87.5)a, c and d] from Polly Gully Creek to ICWW (11.3 acres) is Impaired for shellfish harvesting because these segments are classified by DEH SS (Chapter 27) as prohibited in growing areas B-1 and B-4. Segment 18-(87.5)a is Supporting aquatic life and recreation because no criteria were exceeded at sites BA722 and S-43. Segment 18-(87.5)b is Supporting shellfish harvesting and aquatic life because this area is approved and no criteria were exceeded at site BA734.

2005 Recommendations

DWQ is developing a TMDL to address the low dissolved oxygen in these segments. TMDL targets and allocations will be addressed as part of the process. Modeling efforts will include a watershed model of the Northeast Cape Fear River and hydrodynamic and water quality modeling of the estuary. The TMDL is scheduled to be submitted to EPA in late 2005. Until the TMDL is approved by EPA, new and expanding discharges will be carefully considered on a case-by-case basis. The NPDES compliance process will be used to address the significant permit violations noted above. Refer to Chapter 30 for information on NPDES permitting and Chapter 37 for information on the modeling and monitoring efforts.

Segments 18-(71)a and 18-77 will remain on the 303(d) list of Impaired waters replacing the Cape Fear (DEH Area) B10 listing. Segments 18-(63)a and 18-(87.5)a, c and d will be added to the list.

Water Quality Initiatives
In 2005, a NOAA grant was used to implement BMPs at the Carolina Beach State Park Marina. The BMPs included two rain gardens to treat runoff from parking lots and two inlet slip filters to filter sediment, oils and grease from runoff.

17.3.5 Coward Creek [AU# 18-88-9-2-5-1]

Current Status
Coward Creek from source to the Cape Fear River (5.9 acres) is Impaired for shellfish harvesting because this segment is classified by DEH SS (Chapter 27) as prohibited in growing area B-1. Coward Creek will be added to the 303(d) list of Impaired waters.

17.3.6 Dennis Creek [AU# 18-88-9-2-3] and Piney Point Creek [AU# 18-88-9-2-4]

Current Status
Dennis Creek and Piney Point Creek south of the ICWW (45.7 acres) are Impaired for shellfish harvesting because these segments are classified by DEH SS (Chapter 27) as prohibited in growing area B-1. These creeks will be added to the 303(d) list of Impaired waters.

17.3.7 Dutchman Creek [AU# 18-88-9-3-(2.5)], Dutchman Creek Outlet Channel [AU# 18-88-9-3-3], and Dutchman Creek Shellfish Area [AU# 18-88-9-3-(4)]

Current Status
Dutchman Creek, the Outlet Channel and Shellfish Area north of the ICWW (192 acres) are Impaired for shellfish harvesting because these segments are classified by DEH SS (Chapter 27) as prohibited in growing area B-1. These creeks will be added to the 303(d) list of Impaired waters.

17.3.8 Elizabeth River [AU# 18-88-9-2-(1)], Elizabeth River Shellfishing Area [AU# 18-88-9-2-(2)] and Molasses Creek Shellfish Area [AU# 18-88-9-2-5]

Current Status
Elizabeth River, Shellfish Area and Molasses Creek south of the ICWW (290.1 acres) are Impaired for shellfish harvesting because these segments are classified by DEH SS (Chapter 27) as prohibited in growing area B-1. These creeks will be added to the 303(d) list of Impaired waters.

17.3.9 Fishing Creek [AU# 18-88-8-4-1]

Current Status
Fishing Creek from source to Bald Head Creek (7.9 acres) is Impaired for shellfish harvesting because this segment is classified by DEH SS (Chapter 27) as prohibited in growing area B-1. Fishing Creek will be added to the 303(d) list of Impaired waters.

17.3.10 Intracoastal Waterway (ICWW) [AU#18-88-9a and b]

2000 Recommendations
This segment of the ICWW was not individually identified in the 2000 basin plan, but was considered Not Supporting because it was closed to shellfish harvesting. No specific recommendations were made in the 2000 basin plan.

Current Status
The Intracoastal Waterway [18-88-9a] from channel marker F1 to Dutchmans Creek Outlet Channel (226.6 acres) is Impaired for shellfish harvesting because this segment is classified by DEH SS (Chapter 27) as prohibited in growing area B-1. This segment is Supporting recreation because no criteria were exceeded at site S-41.

The Intracoastal Waterway [18-88-9b] from Dutchmans Creek Outlet Channel to Cottage Creek (96.6 acres) is Impaired for aquatic life because the dissolved oxygen standard was violated in 11 percent of samples at site BA740. The dissolved oxygen standard for SC classified waters is 5 mg/l. This segment is also Impaired for shellfish harvesting and recreation because this segment is classified by DEH SS (Chapter 27) as prohibited in growing area B-1 and because of permanent swimming advisories at site S-42.

2005 Recommendations
DWQ and DEH will continue to monitor the ICWW and work with local governments to identify sources of bacteria and oxygen-consuming materials. This segment of the ICWW will be added to the 303(d) list of Impaired waters. TMDLs (Chapter 35) will be developed for identified stressors within 8-13 years of listing.

17.3.11 Town Creek [AU# 18-81]

Current Status and 2005 Recommendations
Town Creek from source to the Cape Fear River (32.1 miles) is Supporting aquatic life because of a natural benthic community rating at site BB13. A sample in November 1999, after three hurricanes, indicated the benthic community was not severely impacted by the storms. Town Creek is Impaired on a monitored basis in the fish consumption category and will be added to the 303(d) list of Impaired waters.

Water Quality Initiatives
In 2000, the NC Coastal Land Trust received a $305,000 CWMTF grant to acquire 260 acres conservation easements along Town Creek, with an additional 320 acres of donated conservation easements included in the project. In 2001, the NC Coastal Land Trust received a $277,000 CWMTF grant to acquire 115 acres conservation easements along Town and Russell Creeks, with an additional 135 acres of donated conservation easements included in the project. In 2002, the NC Coastal Land Trust received a $2,095,000 CWMTF grant to acquire 638 acres along Town Creek (See Chapter 34 for more information on all projects).

17.4 Status and Recommendations for Waters with Noted Impacts

The surface waters discussed in this section are not Impaired. However, notable water quality problems and concerns have been documented for some waters based on this assessment. While these waters are not Impaired, attention and resources should be focused on these waters to prevent additional degradation or facilitate water quality improvement. Waters in the following section are identified by assessment unit number (AU#). See overview for more information on AU#s.

17.4.1 Greenfield Lake [AU# 18-76-1]

Current Status and 2005 Recommendations
Greenfield Lake (75.3 acres) is Not Rated for aquatic life because data from UNCW indicates elevated fecal coliform bacteria levels and chlorophyll *a* levels. There are also indications that dissolved oxygen levels are below the water quality standard and the lake has problems with aquatic weeds. In 2003, almost 75 percent of the surface was covered with aquatic weeds, though no water quality standards were violated during DWQ lake monitoring.

17.4.2 Southport Restricted Area [AU# 18-88-3.5]

Current Status and 2005 Recommendations
The Southport Restricted Area, on the west bank of the Cape Fear River from Price Creek to Southport (715.3 acres), is Not Rated for aquatic life on an evaluated basis because the ADM Southport Plant (NC0027065) had significant violations of total settable solids permit limits during the last two years of the assessment period that could have negatively impacted aquatic life. The NPDES compliance process will be used to address the significant permit violations noted above.

Chapter 18
Cape Fear River Subbasin 03-06-18
Including: South River, Little Black River and Big Creek

18.1 Subbasin Overview

Subbasin 03-06-18 at a Glance

Land and Water Area

Total area:	495 mi²
Land area:	493 mi²
Water area:	2 mi²

Population Statistics

2000 Est. Pop.: 85,550people
Pop. Density: 173 persons/mi²

Land Cover (percent)

Forest/Wetland:	56.1%
Surface Water:	1.3%
Urban:	1.7%
Cultivated Crop:	34.4%
Pasture/Managed Herbaceous:	6.6%

Counties

Bladen, Cumberland, Harnett, Johnston, Sampson and Wake

Municipalities

Angier, Autryville, Benson, Coats, Dunn, Erwin, Falcon, Garland, Roseboro and Stedman

Subbasin 03-06-18 is in the coastal plain with many slow-moving tannin stained streams draining wetland areas. Most of the watershed is forested with extensive agriculture present. Development is occurring north of Fayetteville in the western portion of the subbasin. Population is expected to grow by 230,000 people in counties with portions or all of their areas in this subbasin by 2020; however, most of the growth is occurring in the county areas outside of the subbasin. Sampson County is expected to grow by 26,000, which is more representative for this subbasin.

There are two individual NPDES wastewater discharge permits in this subbasin with a permitted flow of 0.08 MGD (Figure 21). Refer to Appendix VI and Chapter 30 for more information on NPDES permit holders.

There are 105 registered swine operations in this subbasin. Issues related to agricultural activities are discussed below in Section 18.4.

There was one benthic community sample (Figure 21 and Table 21) collected during this assessment period. Data were also collected from two ambient monitoring stations including one LCFRBA (Appendix V) station and one DWQ ambient station. One lake was also monitored. Refer to the *2003 Cape Fear River Basinwide Assessment Report* at http://www.esb.enr.state.nc.us/bar.html and Appendix IV for more information on monitoring.

Waters in the following sections are identified by assessment unit number (AU#). This number is used to track defined segments in the water quality assessment database, 303(d) Impaired waters list and the various tables in this basin plan. The assessment unit number is a subset of the DWQ index number (classification identification number). A letter attached to the end of the AU# indicates that the assessment is smaller than the DWQ index segment. No letter indicates that the assessment unit and the DWQ index segment are the same.

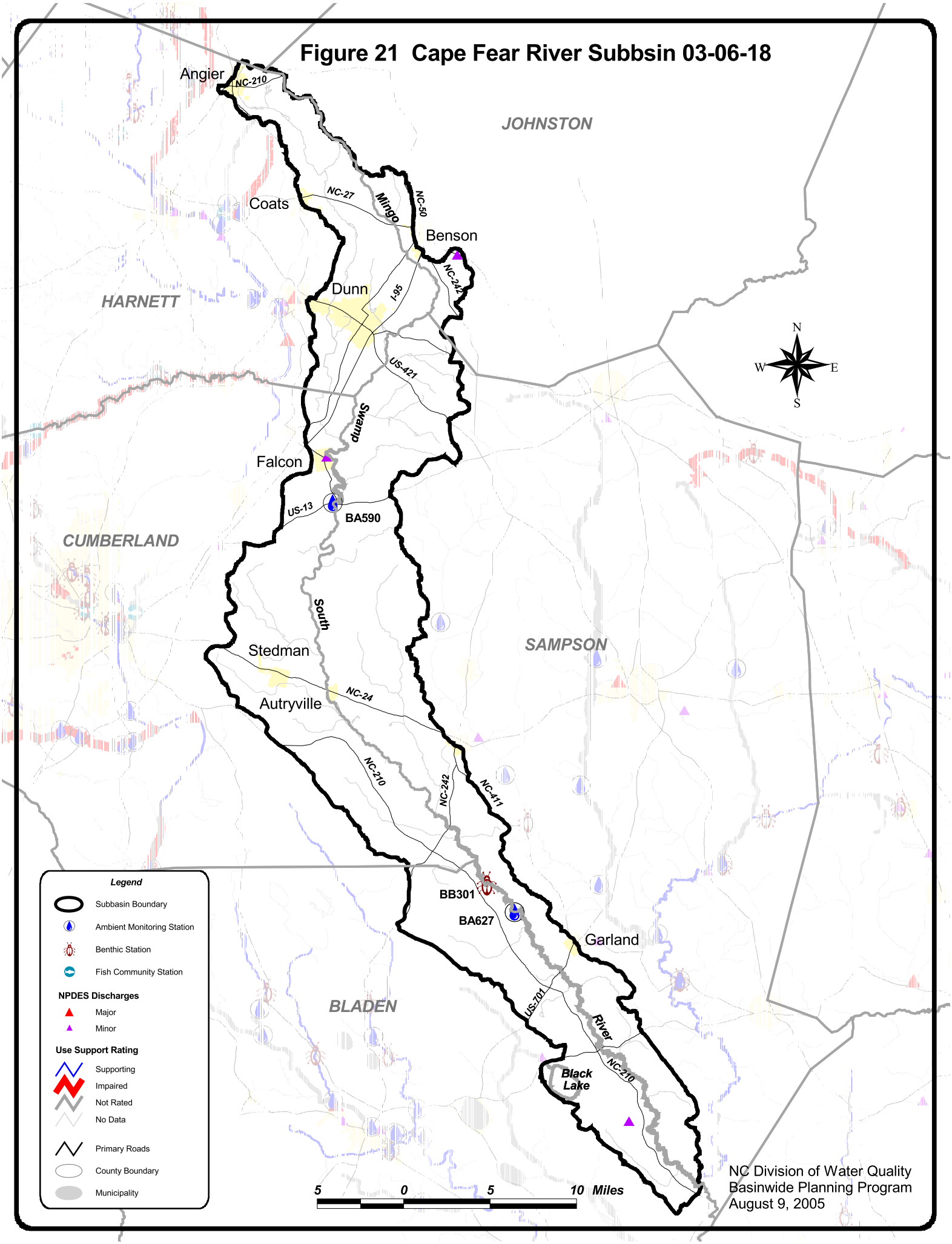


Figure 21 Cape Fear River Subbsin 03-06-18
Angier
NC-210
JOHNSTON
Coats
NC-27
Mingo
NC-50
Benson
NC-242
Dunn
I-95
HARNETT
US-421
Swamp
Falcon
US-13
BA590
CUMBERLAND
South
Stedman
SAMPSON
NC-24
Autryville
NC-210
NC-242
NC-411
BB301
BA627
Garland
BLADEN
US-701
River
NC-210
Black Lake
N
W
E
S
Legend
Subbasin Boundary
Ambient Monitoring Station
Benthic Station
Fish Community Station
NPDES Discharges
Major
Minor
Use Support Rating
Supporting
Impaired
Not Rated
No Data
Primary Roads
County Boundary
Municipality
5 0 5 10 Miles
NC Division of Water Quality
Basinwide Planning Program
August 9, 2005

Table 21 CAPE FEAR Subbasin 03-06-18

AU Number / Description	Classification	Length/Area		Aquatic Life Assessment: AL Rating	Station	Result	Year/ Parameter	% Exc	Recreation Assessment: REC Rating	Station	Result	Stressors	Sources
Black Lake (Bay Tree Lake)													
18-68-17-1-1	C Sw	1,454.2	FW Acres	**NR**	BL33	NCE	Low pH	100	ND			Low pH	Unknown
From source to Lake Drain													
South River													
18-68-12-(0.5)a	C Sw	6.7	FW Miles	**NR**	BA590	NCE	Low DO	48.2	**S**	BA590	NCE	Low Dissolved Oxygen	Unknown
From source to US 13													
18-68-12-(8.5)	C Sw ORW	45.4	FW Miles	**NR**	BA627	NCE	Low DO	12.3	**S**	BA627	NCE	Low Dissolved Oxygen	Unknown
From Big Swamp to Black River					BB301	NR	2002						

AL - Aquatic Life
REC - Recreation

BF - Fish Community Survey
BB - Benthic Community Survey
BA - Ambient Monitoring Site
BL- Lake Monitoring
S- DEH RECMON

Miles/Acres
FW- Fresh Water
S- Salt Water

E - Excellent
G - Good
GF - Good-Fair
F - Fair
P - Poor
NI - Not Impaired
S- Severe Stress
M-Moderate Stress
N- Natural

S - Supporting, I - Impaired
NR - Not Rated
NR*- Not Rated for Recreation (screening criteria exceeded)
ND-No Data Collected to make assessment
Results
CE-Criteria Exceeded > 10% and more than 10 samples
NCE-No Criteria Exceeded

Aquatic Life Rating Summary

NR	m	52.1	FW Miles
NR	m	1,454.2	FW Acres
ND		242.5	FW Miles

Recreation Rating Summary

S	m	52.1	FW Miles
ND		242.5	FW Miles
ND		1,454.2	FW Acres

Fish Consumption Rating Summary

I	m	45.4	FW Miles
I	e	249.2	FW Miles
I	e	1,454.2	FW Acres

18.2 Use Support Assessment Summary

Use support ratings were assigned for waters in subbasin 03-06-18 in the aquatic life, recreation, fish consumption and water supply categories. All waters are Impaired on an evaluated basis in the fish consumption category because of fish consumption advice that applies to the entire basin. In the water supply category, all waters are Supporting on an evaluated basis based on reports from DEH regional water treatment plant consultants. Refer to Appendix X for a complete list of monitored waters and more information on Supporting monitored waters.

There were 52.1 stream miles (17.7 percent) and 1,454.2 freshwater acres (100 percent) monitored during this assessment period in the aquatic life category. There were no Impaired stream miles identified as Impaired in this category.

18.3 Status and Recommendations of Previously and Newly Impaired Waters

The following waters were either identified as Impaired in the previous basin plan (2000) or are newly Impaired based on recent data. If previously identified as Impaired, the water will either remain on the state's 303(d) list or will be delisted based on recent data showing water quality improvements. If the water is newly Impaired, it will likely be placed on the 2006 303(d) list. The current status and recommendations for addressing these waters are presented below, and each is identified by an assessment unit number (AU#). Refer to the overview for more information on AUs. Information regarding 303(d) listing and reporting methodology is presented in Appendix VII.

18.3.1 Black River (Little Black) [AU#18-68-12-(0.5)a]

2000 Recommendations
The 2000 basinwide plan recommended that the Black River be resampled. Black River was Not Rated in the 2000 plan because it could not be sampled due to low flow conditions.

Current Status and 2005 Recommendations
The Black River from source to the South River (28.3 miles) was not monitored during this assessment period, and no data were available to make an assessment in any use support category. DWQ will reestablish a monitoring site on the Black River during this assessment period. The Black River will remain on the 303(d) list until monitoring data are obtained and a use support assessment can be determined.

18.3.2 South River [AU#18-68-12-(0.5)a and 8.5]

2000 Recommendations
The 2000 basinwide plan recommended that the South River be resampled using the 303(d) approach. South River was Not Rated in the 2000 plan because it could not be sampled. The lower segment was Fully Supporting in the 2000 plan and no recommendations were made.

Current Status

The South River [18-68-12-(0.5)a] from source to US 13 (6.7 miles) is Not Rated for aquatic life because dissolved oxygen was below the 4 mg/l in 48 percent of samples at site BA590.

The South River [18-68-12-(8.5)] from Big Swamp to the Black River (45.4 miles) is Not Rated for aquatic life because a benthic community rating could not be assigned at site BB301. Dissolved oxygen was below the 4 mg/l in 12 percent of samples at site BA627. This segment is Impaired on a monitored basis in the fish consumption category.

These segments of the South River have a supplemental classification of Sw, which acknowledges natural characteristics of swamps such as low dissolved oxygen and low pH.

2005 Recommendations

DWQ will continue to monitor the South River watershed. The South River will remain on the 303(d) list until further evaluations can be made on the swamp characteristics.

Water Quality Initiatives

In 1999, the Cape Fear RC&D received an $18,550 CWMTF (Chapter 34) grant to purchase a no-till drill to make available to farmers in this watershed (Chapter 34).

Chapter 19
Cape Fear River Subbasin 03-06-19
Including: Black River, Six Runs Creek, Great Coharie Creek and Little Coharie Creek

19.1 Subbasin Overview

Subbasin 03-06-19 at a Glance

Land and Water Area

Total area:	739 mi²
Land area:	737 mi²
Water area:	2 mi²

Population Statistics

2000 Est. Pop.:	46,801people
Pop. Density:	63 persons/mi²

Land Cover (percent)

Forest/Wetland:	87%
Surface Water:	<1%
Urban:	<1%
Cultivated Crop:	<1%
Pasture/Managed Herbaceous:	12%

Counties

Bladen, Duplin, Johnston, Pender and Sampson

Municipalities

Clinton, Garland, Harrels, Magnolia, Newton Grove, Roseboro, Salemburg, Turkey and Warsaw

Subbasin 03-06-19 is in the coastal plain and drains many wetlands with tannin stained slow-moving streams. Most of the watershed is forested with some agriculture present and very few urban areas. Development is occurring near Clinton. Population is expected to grow by 70,000 people in counties with portions or all of their areas in this subbasin by 2020.

There are eight individual NPDES wastewater discharge permits in this subbasin with a permitted flow of 6.8 MGD (Figure 22). The largest is Clinton WWTP (5 MGD). Refer to Appendix VI and Chapter 30 for more information on NPDES permit holders. Issues related to compliance with NPDES permit conditions are discussed below in Section 19.3 for Impaired waters.

There are 374 registered swine operations in this subbasin. Issues related to agricultural activities are discussed below in Section 19.5.

There were five benthic community samples (Figure 22 and Table 22) collected during this assessment period. Data were also collected from nine ambient monitoring stations including three LCFRP (Appendix V) stations and six DWQ ambient stations. Refer to the *2003 Cape Fear River Basinwide Assessment Report* at http://www.esb.enr.state.nc.us/bar.html and Appendix IV for more information on monitoring.

Waters in the following sections are identified by assessment unit number (AU#). This number is used to track defined segments in the water quality assessment database, 303(d) Impaired waters list and the various tables in this basin plan. The assessment unit number is a subset of the DWQ index number (classification identification number). A letter attached to the end of the AU# indicates that the assessment is smaller than the DWQ index segment. No letter indicates that the assessment unit and the DWQ index segment are the same.

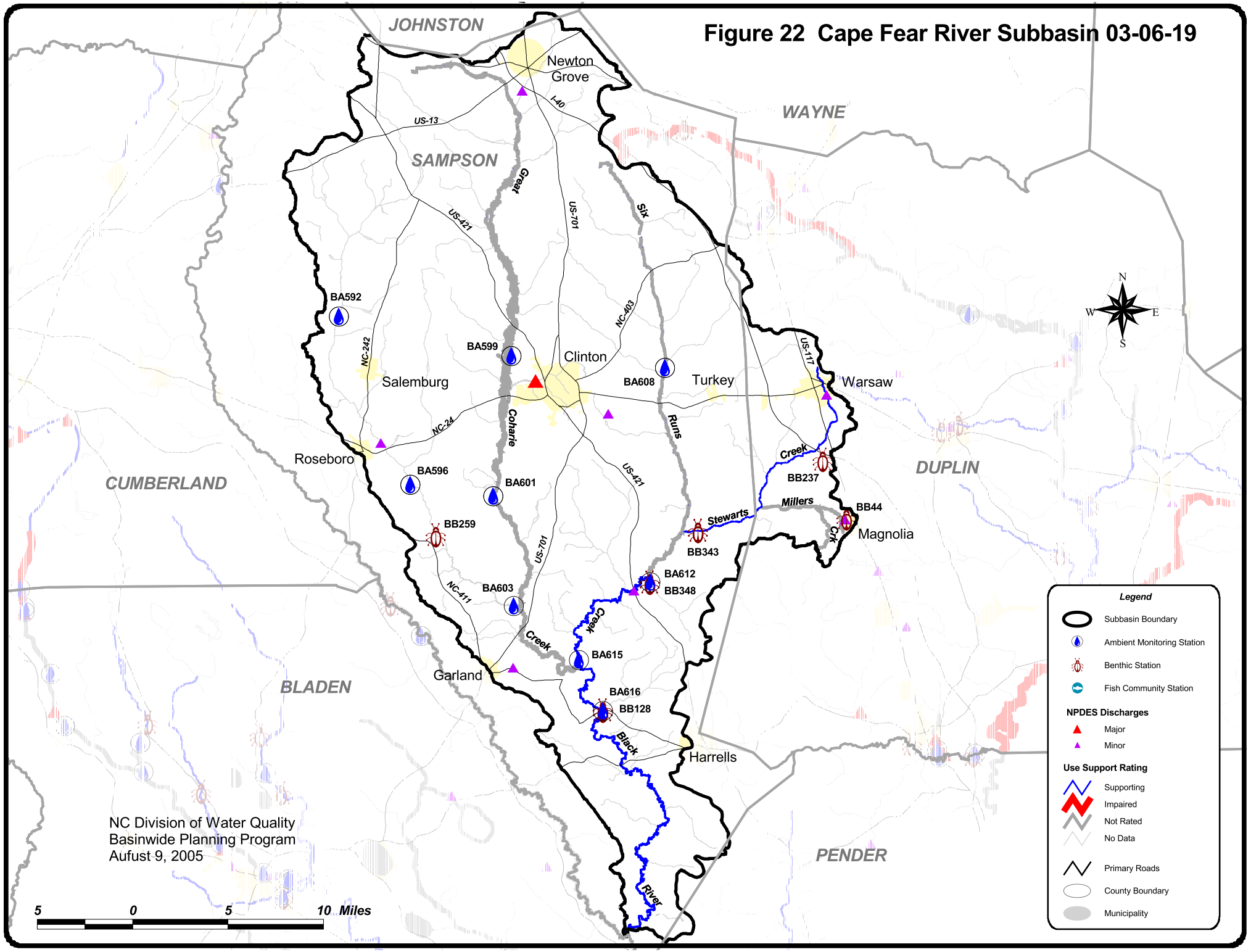


Figure 22 Cape Fear River Subbasin 03-06-19
JOHNSTON
WAYNE
SAMPSON
CUMBERLAND
DUPLIN
BLADEN
PENDER
Newton Grove
Clinton
Salemburg
Roseboro
Turkey
Warsaw
Magnolia
Garland
Harrells
BA592
BA599
BA608
BA596
BA601
BB259
BB237
BB44
BB343
BA612
BB348
BA603
BA615
BA616
BB128
US-13
I-40
US-421
US-701
NC-242
NC-24
NC-403
US-117
NC-411
Great Coharie Creek
Six Runs Creek
Stewarts Creek
Millers Creek
Black River
NC Division of Water Quality
Basinwide Planning Program
Aufust 9, 2005
5 0 5 10 Miles
N
W
E
S
Legend
Subbasin Boundary
Ambient Monitoring Station
Benthic Station
Fish Community Station
NPDES Discharges
Major
Minor
Use Support Rating
Supporting
Impaired
Not Rated
No Data
Primary Roads
County Boundary
Municipality

Table 22 CAPE FEAR Subbasin 03-06-19

AU Number / Description	Classification	Length/Area		Aquatic Life Assessment						Recreation Assessment				
				AL Rating	Station	Result	Year/ Parameter	% Exc		REC Rating	Station	Result	Stressors	Sources
Black River														
18-68a	C Sw ORW	31.9	FW Miles	S	BA616	NCE				S	BA616	NCE		
From source to Subasin 19/20 boundary					BB128	E	2002							
					BB128	G	1998							
Great Coharie Creek (Blackmans Pond)														
18-68-1	C Sw	42.6	FW Miles	NR	BA599	NCE	Low DO	44.8		S	BA599	NCE	Low Dissolved Oxygen	Unknown
					BA601	NCE	Low DO	16.9			BA601	NCE		
From source to Black River														
Little Coharie Creek (Sinclair Lake)														
18-68-1-17a	C Sw	28.6	FW Miles	NR	BA592	NCE	Low DO	44.8		S	BA592	NCE		
					BA596	NCE	Low DO	14.3			BA596	NCE		
From source to SR 1240														
18-68-1-17b	C Sw	12.2	FW Miles	S	BA603	NCE				S				
From SR 1240 to Great Coharie Creek					BB259	G	2003							
Six Runs Creek														
18-68-2-(0.3)	C Sw	26.0	FW Miles	NR	BA608	NCE	Low DO	55.2		S	BA608	NCE		
From source to Quewiffle Swamp														
18-68-2-(11.5)	C Sw ORW	11.7	FW Miles	S	BA612	NCE				S	BA612	NCE		
					BA615	NCE					BA615	NCE		
From Quewiffle Swamp to Black River					BB348	G	2003							
					BB348	GF	1998							
Stewarts Creek														
18-68-2-10	C Sw	15.5	FW Miles	S						ND				
From source to Six Runs Creek					BB343	G	2003							
					BB343	NR	2003							
Unnamed Tributary at Magnolia														
18-68-2-10-3-1	C Sw	2.5	FW Miles	NR						NR				
From source to Millers Creek					BB44	NR	2000							

Table 22 CAPE FEAR Subbasin 03-06-19

AU Number / Description	Classification	Length/Area	Aquatic Life Assessment					Recreation Assessment				
			AL Rating	Station	Result	Year/ Parameter	% Exc	REC Rating	Station	Result	Stressors	Sources

AL - Aquatic Life	BF - Fish Community Survey	E - Excellent	S - Supporting, I - Impaired
REC - Recreation	BB - Benthic Community Survey	G - Good	NR - Not Rated
	BA - Ambient Monitoring Site	GF - Good-Fair	NR*- Not Rated for Recreation (screening criteria exceeded)
	BL- Lake Monitoring	F - Fair	ND-No Data Collected to make assessment
	S- DEH RECMON	P - Poor	**Results**
		NI - Not Impaired	CE-Criteria Exceeded > 10% and more than 10 samples
	Miles/Acres	S- Severe Stress	NCE-No Criteria Exceeded
	FW- Fresh Water	M-Moderate Stress	
	S- Salt Water	N- Natural	

Aquatic Life Rating Summary

S	m	71.3	FW Miles
NR	m	99.7	FW Miles
ND		338.4	FW Miles

Recreation Rating Summary

S	m	153.0	FW Miles
NR	e	8.8	FW Miles
ND		347.6	FW Miles

Fish Consumption Rating Summary

I	m	74.5	FW Miles
I	e	434.9	FW Miles

19.2 Use Support Assessment Summary

Use support ratings were assigned for waters in subbasin 03-06-19 in the aquatic life, recreation, fish consumption and water supply categories. All waters are Impaired on an evaluated basis in the fish consumption category because of fish consumption advice that applies to the entire basin. In the water supply category, all waters are Supporting on an evaluated basis based on reports from DEH regional water treatment plant consultants. Refer to Appendix X for a complete list of monitored waters and more information on Supporting monitored waters.

There were 171 stream miles (33.6 percent) monitored during this assessment period in the aquatic life category. There were no Impaired stream miles identified as Impaired in this category.

19.3 Status and Recommendations of Previously and Newly Impaired Waters

The following waters were either identified as Impaired in the previous basin plan (2000) or are newly Impaired based on recent data. If previously identified as Impaired, the water will either remain on the state's 303(d) list or will be delisted based on recent data showing water quality improvements. If the water is newly Impaired, it will likely be placed on the 2006 303(d) list. The current status and recommendations for addressing these waters are presented below, and each is identified by an assessment unit number (AU#). Refer to the overview for more information on AUs. Information regarding 303(d) listing and reporting methodology is presented in Appendix VII.

19.3.1 Black River [AU# 18-68a]

Current Status and 2005 Recommendations
The Black River from source to the subbasin boundary (31.9 miles) is Supporting aquatic life because of an Excellent benthic community rating at site BB128. This site has been Excellent, except after hurricanes. The river has a very diverse benthic community. This portion of the Black River is supplementally classified as Outstanding Resource Waters (ORW). This segment is Impaired on a monitored basis in the fish consumption category and will be added to the 303(d) list of Impaired waters.

19.3.2 Stewarts Creek River [AU#18-68-2-10] and UT at Magnolia [18-68-2-10-3-1]

2000 Recommendations
The 2000 basinwide plan recommended that Stewarts Creek be resampled. It was also recommended that the Magnolia WWTP be monitored as repairs are made to the collection system. Magnolia WWTP discharges into an UT in the headwaters of Stewarts Creek.

Current Status
Stewarts Creek from source to Six Runs Creek (15.5 miles) is Supporting aquatic life because of a Good benthic community rating at site BB343. The UT from source to Millers Creek (2.5 miles) is Not Rated for aquatic life because a benthic community rating could not be assigned at site BB44. A stressor study in 2003 found swampy conditions in Stewarts Creek and many

blockages due to debris and aquatic weeds. Nitrogen levels were slightly elevated. A long-term study found that the benthic community had recovered after impacts from hurricanes in 1996.

Magnolia WWTP has made repairs that have greatly reduced sanitary overflows into Stewarts Creek. The town received $3 million from CG&L in 2001 to replace the WWTP and for a reuse project.

2005 Recommendations
DWQ will continue to monitor the Stewarts Creek watershed. Stewarts Creek will be recommended for removal from the 303(d) list.

19.4 Status and Recommendations for Waters with Noted Impacts

The surface waters discussed in this section are not Impaired. However, notable water quality problems and concerns have been documented for some waters based on this assessment. While these waters are not Impaired, attention and resources should be focused on these waters to prevent additional degradation or facilitate water quality improvement. Waters in the following section are identified by assessment unit number (AU#). See overview for more information on AU#s.

19.4.1 Great Coharie Creek [AU# 18-68-1]

Current Status and 2005 Recommendations
Great Coharie Creek from source to Black River (42.6 miles) is Not Rated for aquatic life because dissolved oxygen was below 4 mg/l in 45 and 17 percent of samples at sites BA599 and BA601. Great Coharie Creek is classified as C Sw, which acknowledges natural characteristics of swamps such as low dissolved oxygen. DWQ will continue to monitor the Great Coharie watershed. Great Coharie Creek is Impaired on a monitored basis in the fish consumption category and will be added to the 303(d) list of Impaired waters.

Water Quality Initiatives
The Town of Garland received a $45,000 CWMTF (Chapter 34) grant to install generators to prevent overflows during power outages at pump stations and the WWTP. The NCEEP has also preserved 154,000 linear feet of stream in this watershed (Chapter 34).

19.4.2 Little Coharie Creek [AU# 18-68-1-17a and b]

Current Status and 2005 Recommendations
Little Coharie Creek [18-68-1-17a] from source to SR 1240 (28.6 miles) is Not Rated for aquatic life because dissolved oxygen was below 4 mg/l in 45 and 14 percent of samples at sites BA592 and BA596. Little Coharie Creek is classified as C Sw, which acknowledges natural characteristics of swamps such as low dissolved oxygen.

Little Coharie Creek [18-68-1-17b] from SR 1240 to Great Coharie Creek (12.2 miles) is Supporting because of a Good benthic community rating at site BA259 and because no criteria were exceeded at site BA603. DWQ will continue to monitor the Little Coharie watershed.

19.4.3 Millers Creek [AU# 18-68-2-10-3]

Current Status and 2005 Recommendations
Millers Creek from source to Stewarts Creek (6.3 miles) is Not Rated for recreation on an evaluated basis because the Magnolia WWTP (NC0020346) had significant violations of fecal coliform bacteria permit limits during the last two years of the assessment period. The NPDES compliance process will be used to address the significant permit violations noted above.

19.4.4 Six Runs Creek [AU# 18-68-2-(0.3) and (11.5)]

Current Status and 2005 Recommendations
Six Runs Creek [18-68-2-(0.3)] from source to Quewhiffle Swamp (26 miles) is Not Rated for aquatic life because dissolved oxygen was below 4 mg/l in 55 percent of samples at site BA608. Six Runs Creek is classified as C Sw, which acknowledges natural characteristics of swamps such as low dissolved oxygen.

Six Runs Creek [18-68-2-(11.5)] from Quewhiffle Swamp to Black River (11.7 miles) is Supporting because of a Good benthic community rating at site BA348 and because no criteria were exceeded at sites BA612 and BA615. DWQ will continue to monitor the Six Runs Creek watershed.

Chapter 20
Cape Fear River Subbasin 03-06-20
Including: Black River, Colly Creek, Moores Creek and Singletary Lake

20.1 Subbasin Overview

Subbasin 03-06-20 at a Glance

Land and Water Area

Total area:	343 mi²
Land area:	338 mi²
Water area:	5 mi²

Population Statistics

2000 Est. Pop.:	14,421people
Pop. Density:	42 persons/mi²

Land Cover (percent)

Forest/Wetland:	77.9%
Surface Water:	0.8%
Urban:	0.2%
Cultivated Crop:	18.0%
Pasture/Managed Herbaceous:	3.1%

Counties
Bladen, Pender and Sampson

Municipalities
Atkinson and White Lake

Subbasin 03-06-20 is in the coastal plain and drains wetland areas with tannin stained streams. There are also acidic streams draining natural bay lakes. Most of the watershed is forested with some agriculture present. Population is expected to grow by 55,000 people in counties with portions or all of their areas in this subbasin by 2020.

There are two individual NPDES wastewater discharge permits in this subbasin with a permitted flow of 0.82 MGD (Figure 23). The largest is White Lake WWTP (0.8 MGD). Refer to Appendix VI and Chapter 30 for more information on NPDES permit holders. Issues related to compliance with NPDES permit conditions are discussed below in Section 20.4 for other waters.

There are 18 registered swine operation in this subbasin.

There was one benthic community sample (Figure 23 and Table 23) collected during this assessment period. Data were also collected from three ambient monitoring stations including two LCFRP (Appendix V) stations and one DWQ ambient station. One lake was also monitored. Refer to the *2003 Cape Fear River Basinwide Assessment Report* at http://www.esb.enr.state.nc.us/bar.html and Appendix IV for more information on monitoring.

Waters in the following sections are identified by assessment unit number (AU#). This number is used to track defined segments in the water quality assessment database, 303(d) Impaired waters list and the various tables in this basin plan. The assessment unit number is a subset of the DWQ index number (classification identification number). A letter attached to the end of the AU# indicates that the assessment is smaller than the DWQ index segment. No letter indicates that the assessment unit and the DWQ index segment are the same.

Figure 23 Cape Fear River Subbasin 03-06-20

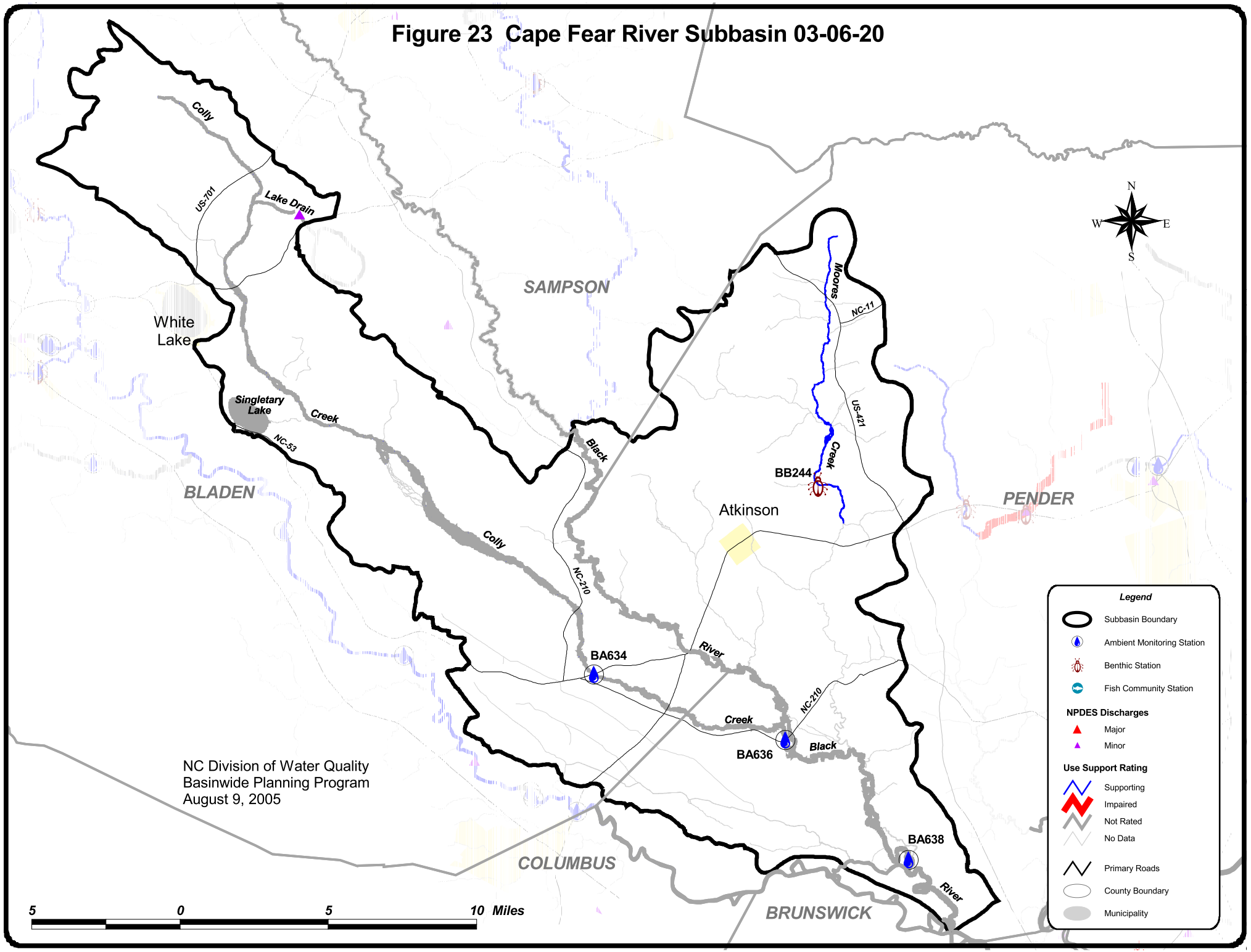


Table 23 CAPE FEAR Subbasin 03-06-20

AU Number / Description	Classification	Length/Area		Aquatic Life Assessment						Recreation Assessment			Stressors	Sources
				AL Rating	Station	Result	Year/ Parameter	% Exc		REC Rating	Station	Result		
Black River														
18-68b	C Sw ORW	40.5	FW Miles	**NR**	BA636	NCE	Low DO	10.2		ND	BA636	NCE		
					BA638	NCE	Low DO	28.1			BA638	NCE		
From Subbasin 19/20 boundary to Cape Fear River														
Colly Creek														
18-68-17	C Sw	34.9	FW Miles	**NR**	BA634	NCE	Low pH	87.5		**S**	BA634	NCE	Low pH	Unknown
From source to Black River														
Moores Creek														
18-68-18a	C Sw	13.0	FW Miles	**S**						ND				
From source to Buxton Branch					BB244	M	2003							
18-68-18b	C Sw	9.9	FW Miles	ND						ND				
From Buxton Branch to Black River														
Singletary Lake														
18-68-17-5-1	B Sw	576.0	FW Acres	**NR**	BL34	NCE	Low pH	100		ND			Low pH	Unknown
From source to Lake Drain														

AL - Aquatic Life
REC - Recreation

BF - Fish Community Survey
BB - Benthic Community Survey
BA - Ambient Monitoring Site
BL- Lake Monitoring
S- DEH RECMON

Miles/Acres
FW- Fresh Water
S- Salt Water

E - Excellent
G - Good
GF - Good-Fair
F - Fair
P - Poor
NI - Not Impaired
S- Severe Stress
M-Moderate Stress
N- Natural

S - Supporting, I - Impaired
NR - Not Rated
NR*- Not Rated for Recreation (screening criteria exceeded)
ND-No Data Collected to make assessment
Results
CE-Criteria Exceeded > 10% and more than 10 samples
NCE-No Criteria Exceeded

Aquatic Life Rating Summary

S	m	13.0	FW Miles
NR	m	75.4	FW Miles
NR	m	576.0	FW Acres
NR	e	2.5	FW Miles
ND		143.8	FW Miles

Recreation Rating Summary

S	m	34.9	FW Miles
ND		199.8	FW Miles
ND		576.0	FW Acres

Fish Consumption Rating Summary

I	m	50.4	FW Miles
I	e	184.3	FW Miles
I	e	576.0	FW Acres

20.2 Use Support Assessment Summary

Use support ratings were assigned for waters in subbasin 03-06-20 in the aquatic life, recreation, fish consumption and water supply categories. All waters are Impaired on an evaluated basis in the fish consumption category because of fish consumption advice that applies to the entire basin. In the water supply category, all WS classified waters (1.1 miles) are Supporting on an evaluated basis based on reports from DEH regional water treatment plant consultants. Refer to Appendix X for a complete list of monitored waters and more information on Supporting monitored waters.

There were 88.4 stream miles (37.7 percent) and 576 freshwater acres (100 percent) monitored during this assessment period in the aquatic life category. There were no Impaired stream miles identified as Impaired in this category.

20.3 Status and Recommendations of Previously and Newly Impaired Waters

The following waters were either identified as Impaired in the previous basin plan (2000) or are newly Impaired based on recent data. If previously identified as Impaired, the water will either remain on the state's 303(d) list or will be delisted based on recent data showing water quality improvements. If the water is newly Impaired, it will likely be placed on the 2006 303(d) list. The current status and recommendations for addressing these waters are presented below, and each is identified by an assessment unit number (AU#). Refer to the overview for more information on AUs. Information regarding 303(d) listing and reporting methodology is presented in Appendix VII.

20.3.1 Moores Creek [AU# 18-68-18a and b]

Current Status
Moores Creek [18-68-18a] from source to Buxton Branch (13 miles) is Supporting aquatic life because of a Moderate benthic community rating at site BB244. This stream has generally good habitat for a swamp stream.

Moores Creek [18-68-18b] from Buxton Branch to the Black River (9.9 miles) is Impaired on a monitored basis in the fish consumption category.

2005 Recommendations
DWQ will continue to monitor Moores Creek. Segment 18-68-18b will be added to the 303(d) list of Impaired waters.

20.4 Status and Recommendations for Waters with Noted Impacts

The surface waters discussed in this section are not Impaired. However, notable water quality problems and concerns have been documented for some waters based on this assessment. While these waters are not Impaired, attention and resources should be focused on these waters to prevent additional degradation or facilitate water quality improvement. Waters in the following

section are identified by assessment unit number (AU#). See overview for more information on AU#s.

20.4.1 Black River [AU# 18-68b]

Current Status and 2005 Recommendations
The Black River from the subbasin boundary to Cape Fear River (40.5 miles) is Not Rated for aquatic life because dissolved oxygen was below 4 mg/l in 10 and 28 percent of samples at sites BA636 and BA638. The Black River is classified as C Sw ORW+, which acknowledges natural characteristics of swamps such as low dissolved oxygen as well as outstanding resources. DWQ will continue to monitor the Black River watershed. This segment is Impaired on a monitored basis in the fish consumption category and will be added to the 303(d) list of Impaired waters.

Water Quality Initiatives
In 1998, The Nature Conservancy received a $2,000,000 CWMTF grant to acquire 9,000 acres in this watershed along the Black and South River (Chapter 34).

20.4.2 Colly Creek [AU# 18-68-17]

Current Status and 2005 Recommendations
Colly Creek from source to the Black River (34.9 miles) is Not Rated for aquatic life because pH was below 6 in 88 percent of samples at site BA634. Colly Creek is classified as C Sw, which acknowledges natural characteristics of swamps such as low pH. Colly Creek is Supporting recreation because no criteria were exceeded at site BA634; however, the White Lake WWTP (NC0023353) had significant violations of fecal coliform bacteria permit limits during the assessment period. DWQ will continue to monitor the Colly Creek watershed. The NPDES compliance process will be used to address the significant permit violations noted above.

20.4.3 Lake Drain [AU# 18-68-17-1]

Current Status and 2005 Recommendations
Lake Drain from Black Lake to Colly Creek (2.5 miles) is Not Rated for aquatic life on an evaluated basis because the Bay Tree Lakes WWTP (NC0036404) had significant violations of biological oxygen demand permit limits during the assessment period that could have negatively impacted aquatic life. The NPDES compliance process will be used to address the significant permit violations noted above.

20.4.4 Singletary Lake [AU# 18-68-17-5-1]

Current Status and 2005 Recommendations
Singletary Lake (576 acres) is Not Rated for aquatic life because pH was below the standard during lake monitoring in 2003. Singletary Lake is classified as B Sw, which acknowledges natural characteristics of swamps such as low pH. Chlorophyll *a* was noted to be higher than in previous years as well. DWQ will continue to monitor the lake.

Chapter 21
Cape Fear River Subbasin 03-06-21
Including: Northeast Cape Fear River and Matthews Creek

21.1 Subbasin Overview

Subbasin 03-06-21 at a Glance

Land and Water Area

Total area:	119 mi²
Land area:	119 mi²
Water area:	0 mi²

Population Statistics

2000 Est. Pop.: 13,472people
Pop. Density: 113 persons/mi²

Land Cover (percent)

Forest/Wetland:	46.5%
Surface Water:	0.2%
Urban:	0.8%
Cultivated Crop:	45.2%
Pasture/Managed Herbaceous:	7.3%

Counties

Duplin, Lenoir and Wayne

Municipalities

Mount Olive

Subbasin 03-06-21 is in the coastal plain and contains the headwaters of the Northeast Cape Fear River. Most of the watershed is forested and in agriculture. Population is expected to grow by 32,000 people in counties with portions or all of their areas in this subbasin by 2020.

There are six individual NPDES wastewater discharge permits in this subbasin with a permitted flow of 1.4 MGD (Figure 24). The largest is Mount Olive WWTP (1 MGD). Refer to Appendix VI and Chapter 30 for more information on NPDES permit holders. Issues related to compliance with NPDES permit conditions are discussed below in Section 21.3 for Impaired waters.

There are 75 registered swine operation in this subbasin.

Data were collected from four ambient monitoring stations including two DWQ ambient stations, one LCFRP (Appendix V) station and one shared station (Figure 24 and Table 24). Refer to the *2003 Cape Fear River Basinwide Assessment Report* at http://www.esb.enr.state.nc.us/bar.html and Appendix IV for more information on monitoring.

Waters in the following sections are identified by assessment unit number (AU#). This number is used to track defined segments in the water quality assessment database, 303(d) Impaired waters list and the various tables in this basin plan. The assessment unit number is a subset of the DWQ index number (classification identification number). A letter attached to the end of the AU# indicates that the assessment is smaller than the DWQ index segment. No letter indicates that the assessment unit and the DWQ index segment are the same.

21.2 Use Support Assessment Summary

Use support ratings were assigned for waters in subbasin 03-06-21 in the aquatic life, recreation, fish consumption and water supply categories. All waters are Impaired on an evaluated basis in the fish consumption category because of fish consumption advice that applies to the entire basin. In the water supply category, all waters are Supporting on an evaluated basis based on

Figure 24 Cape Fear River Subbasin 03-06-21

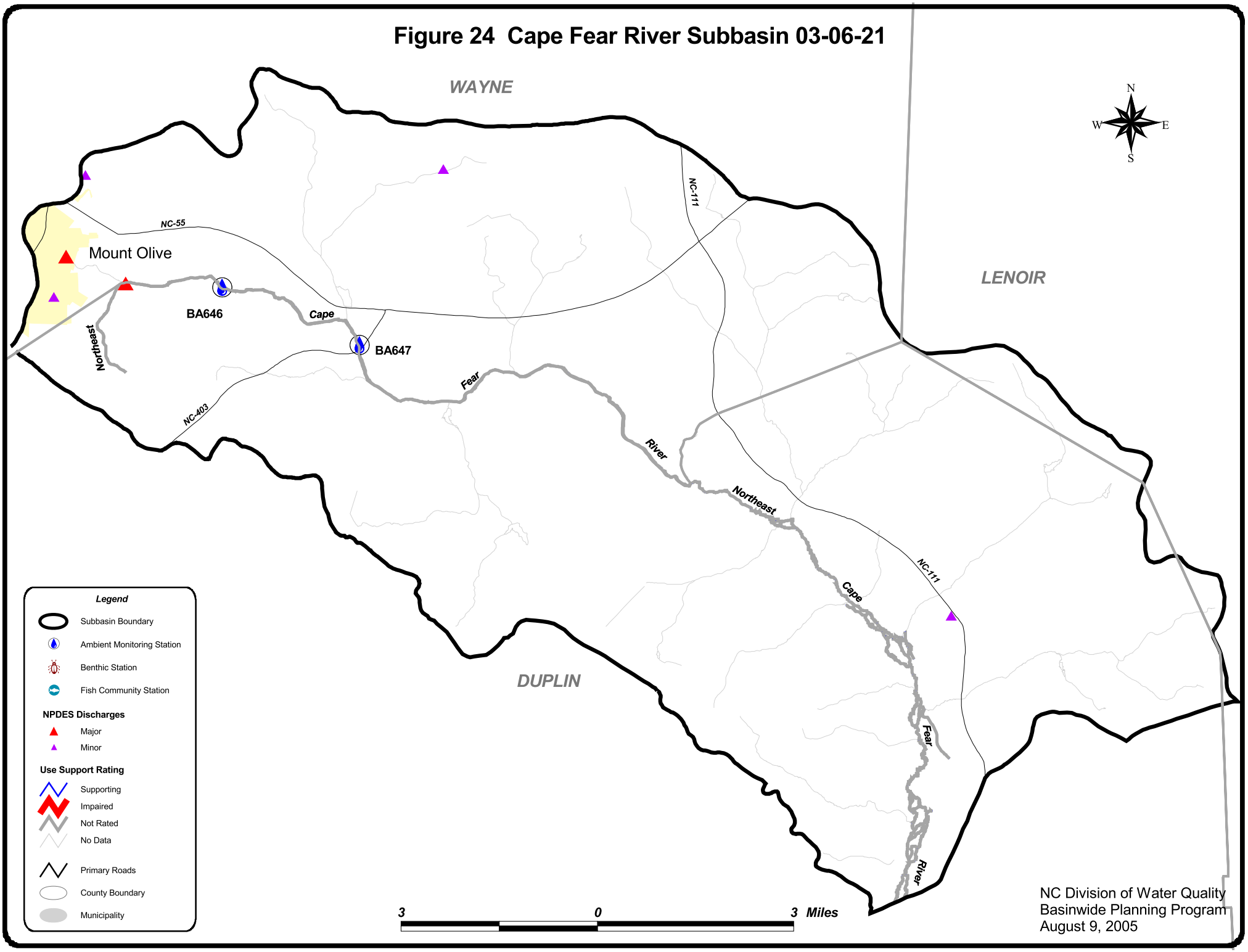


Table 24 CAPE FEAR Subbasin 03-06-21

AU Number	Classification	Length/Area	Aquatic Life Assessment					Recreation Assessment			Stressors	Sources
Description			AL Rating	Station	Result	Year/ Parameter	% Exc	REC Rating	Station	Result		
Northeast Cape Fear River												
18-74-(1)a	C Sw	3.4 FW Miles	**NR**	BA646	NCE	Chloride	51.4	ND			Chloride	WWTP NPDES
				BA646	NCE	Low DO	44.9				Low Dissolved Oxygen	Unknown
From source to SR 1558												
18-74-(1)b	C Sw	2.7 FW Miles	**NR**	BA646	NCE	Chloride	51.4	**S**			Chloride	WWTP NPDES
				BA646	NCE	Low DO	44.9				Low Dissolved Oxygen	Unknown
				BA647	NCE	Low DO	57.3					
From SR 1558 to NC 403												
18-74-(1)c1	C Sw	32.9 FW Miles	**NR**	BA658	NCE	Low DO	12.5	**S**	BA658	NCE	Low Dissolved Oxygen	Unknown
From NC 403 to Subbasin 03-06-21and 03-06-22 boundary												
18-74-(1)c3	C Sw	21.7 FW Miles	**S**	BA661	NCE			**S**				
From Persimmon Branch to Muddy Creek												

AL - Aquatic Life
REC - Recreation

BF - Fish Community Survey
BB - Benthic Community Survey
BA - Ambient Monitoring Site
BL- Lake Monitoring
S- DEH RECMON

Miles/Acres
FW- Fresh Water
S- Salt Water

E - Excellent
G - Good
GF - Good-Fair
F - Fair
P - Poor
NI - Not Impaired
S- Severe Stress
M-Moderate Stress
N- Natural

S - Supporting, I - Impaired
NR - Not Rated
NR*- Not Rated for Recreation (screening criteria exceeded)
ND-No Data Collected to make assessment
Results
CE-Criteria Exceeded > 10% and more than 10 samples
NCE-No Criteria Exceeded

Aquatic Life Rating Summary

S	m	21.7	FW Miles
NR	m	38.9	FW Miles
ND		84.7	FW Miles

Recreation Rating Summary

S	m	57.3	FW Miles
ND		88.1	FW Miles

Fish Consumption Rating Summary

I	e	145.4	FW Miles

reports from DEH regional water treatment plant consultants. Refer to Appendix X for a complete list of monitored waters and more information on Supporting monitored waters.

There were 60.6 stream miles (41.7 percent) monitored during this assessment period in the aquatic life category. There were no Impaired stream miles identified as Impaired in this category.

21.3 Status and Recommendations of Previously and Newly Impaired Waters

The following waters were either identified as Impaired in the previous basin plan (2000) or are newly Impaired based on recent data. If previously identified as Impaired, the water will either remain on the state's 303(d) list or will be delisted based on recent data showing water quality improvements. If the water is newly Impaired, it will likely be placed on the 2006 303(d) list. The current status and recommendations for addressing these waters are presented below, and each is identified by an assessment unit number (AU#). Refer to the overview for more information on AUs. Information regarding 303(d) listing and reporting methodology is presented in Appendix VII.

21.3.1 Northeast Cape Fear River [AU# 18-74-(1)a, b and c1]

2000 Recommendations
The 2000 basinwide plan recommended that the Northeast Cape Fear River ambient monitoring station be relocated at SR 1937 to better evaluate impacts of the Mount Olive Pickle Company discharge into Barlow Branch as efforts to reduce chloride levels continue.

Current Status
Northeast Cape Fear River [18-74-(1)a and b] from source to NC 403 (6.1 miles) is Not Rated for aquatic life because dissolved oxygen was below 4 mg/l in 45 and 57 percent of samples collected at sites BA646 and BA647. Northeast Cape Fear River is classified as C Sw, which acknowledges natural characteristics of swamps such as low dissolved oxygen. Chlorides also exceeded the action level in 51 percent of samples at site BA646 (at SR 1937). This site was established to better monitor the Mount Olive Pickle Company discharge. This is similar to chloride exceedances measured from 1993 to 1996. Mount Olive Pickle Company has had a variance to discharge chlorides above permitted levels since 1996. No data were collected in Barlow Branch that could be assessed to assign a use support rating.

The Town of Mount Olive received $3 million to rehabilitate the collection system and WWTP, which discharges into an unnamed tributary to Northeast Cape Fear River.

2005 Recommendations
DWQ will continue to monitor the Northeast Cape Fear River watershed. Mount Olive Pickle will be required to continue efforts to reduce the discharge of chlorides and to monitor instream chloride levels.

Chapter 22
Cape Fear River Subbasin 03-06-22
Including: Northeast Cape River, Rockfish Creek, Muddy Creek and Limestone Creek

22.1 Subbasin Overview

Subbasin 03-06-22 at a Glance

Land and Water Area

Total area:	829 mi²
Land area:	828 mi²
Water area:	1 mi²

Population Statistics

2000 Est. Pop.:	54,835people
Pop. Density:	66 persons/mi²

Land Cover (percent)

Forest/Wetland:	58.6%
Surface Water:	0.3%
Urban:	1.3%
Cultivated Crop:	30.3%
Pasture/Managed Herbaceous:	9.6%

Counties

Duplin, Jones, Lenoir, Onslow, Pender, Sampson and Wayne

Municipalities

Beulaville, Calypso, Faison, Greenevers, Harrells, Kenansville, Pink Hill, Rose Hill, Teachey and Wallace

Subbasin 03-06-22 is in the coastal plain with many streams draining wetland areas. Most of the watershed is forested with extensive agriculture present. Population is expected to grow by 100,000 people in counties with portions or all of their areas in this subbasin by 2020.

There are 13 individual NPDES wastewater discharge permits in this subbasin with a permitted flow of 9.9 MGD (Figure 25). The largest is Wallace WWTP#1 (1 MGD), Wallace WWTP#2 (4.4 MGD) and Guilford East Mill WWTP (1.5 MGD). Refer to Appendix VI and Chapter 30 for more information on NPDES permit holders. Issues related to compliance with NPDES permit conditions are discussed below in Section 22.3 for Impaired waters.

There are 449 registered swine operation in this subbasin.

There were ten benthic community samples (Figure 25 and Table 25) collected during this assessment period. Data were also collected from seven ambient monitoring stations including four LCFRP (Appendix V) stations, two DWQ ambient stations and one shared station. One lake was also monitored. Refer to the *2003 Cape Fear River Basinwide Assessment Report* at http://www.esb.enr.state.nc.us/bar.html and Appendix IV for more information on monitoring.

Waters in the following sections are identified by assessment unit number (AU#). This number is used to track defined segments in the water quality assessment database, 303(d) Impaired waters list and the various tables in this basin plan. The assessment unit number is a subset of the DWQ index number (classification identification number). A letter attached to the end of the AU# indicates that the assessment is smaller than the DWQ index segment. No letter indicates that the assessment unit and the DWQ index segment are the same.

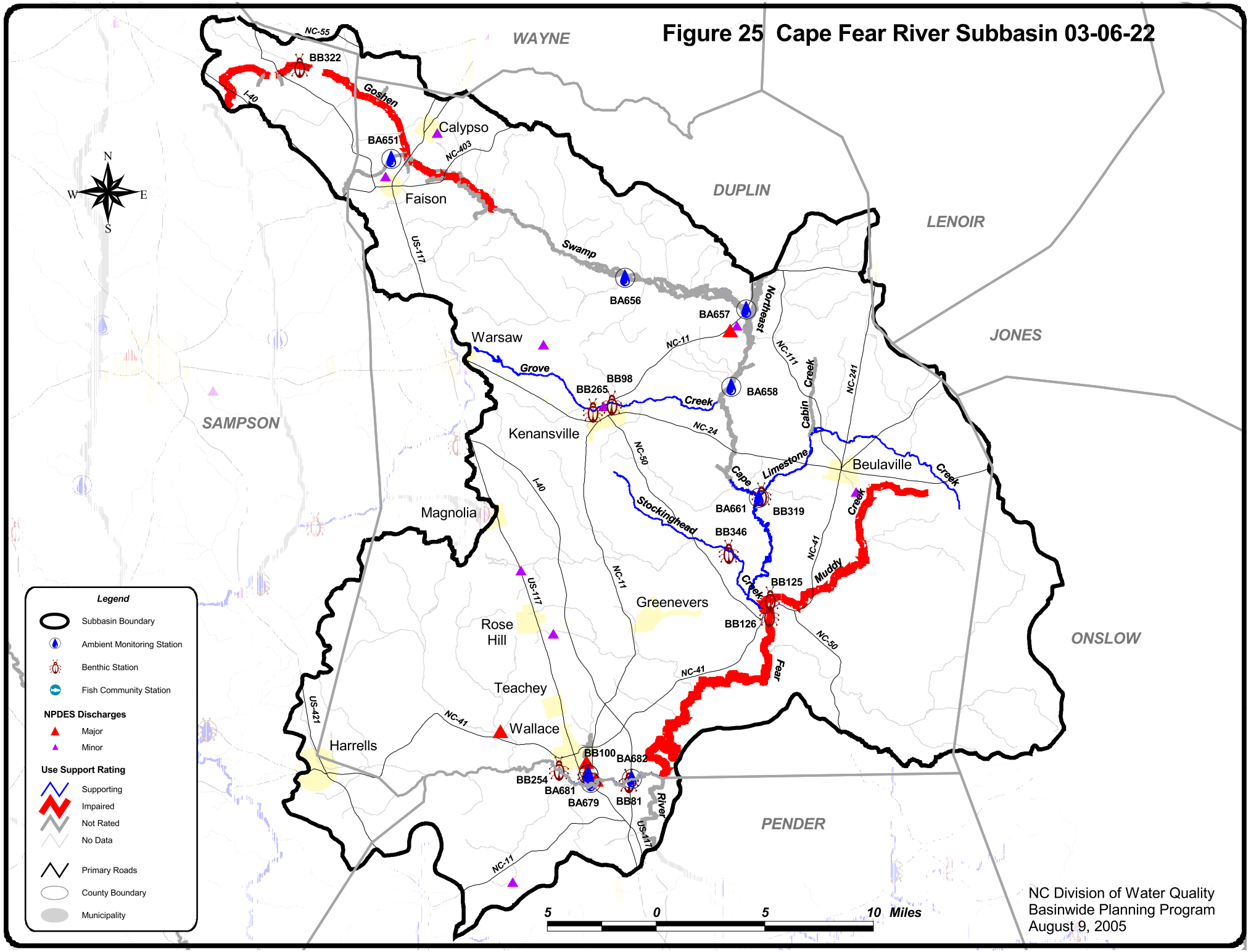


Figure 25 Cape Fear River Subbasin 03-06-22
WAYNE
DUPLIN
LENOIR
JONES
ONSLOW
PENDER
SAMPSON
N
W
E
S
NC-55
I-40
Goshen
BB322
Calypso
BA651
NC-403
Faison
US-117
Swamp
BA656
BA657
Northeast
NC-11
Warsaw
Grove
BB98
BB265
Creek
BA658
NC-111
Cabin
Creek
NC-241
NC-24
Kenansville
NC-50
Cape
Limestone
Creek
Beulaville
Stockinghead
BA661
BB319
BB346
Creek
Magnolia
I-40
NC-41
Muddy
Creek
BB125
US-117
NC-11
Greenevers
Rose
Hill
BB126
NC-50
Teachey
NC-41
Wallace
Harrells
US-421
BB100
BA682
BB254
BA681
BA679
BB81
River
US-117
NC-11
Legend
Subbasin Boundary
Ambient Monitoring Station
Benthic Station
Fish Community Station
NPDES Discharges
Major
Minor
Use Support Rating
Supporting
Impaired
Not Rated
No Data
Primary Roads
County Boundary
Municipality
5 0 5 10 Miles
NC Division of Water Quality
Basinwide Planning Program
August 9, 2005

Table 25 CAPE FEAR Subbasin 03-06-22

AU Number	Classification	Length/Area	Description	Aquatic Life Assessment						Recreation Assessment				Stressors	Sources
				AL Rating	Station	Result	Year/ Parameter	% Exc		REC Rating	Station	Result			
Cabin Creek															
18-74-23-2	B Sw	4.0 FW Miles	From source to Limestone Creek	**NR**	BL35	NCE	Chlor a	33		ND				Chlorophyll a	Unknown
Goshen Swamp															
18-74-19a	C Sw	16.6 FW Miles	From source to Bear Swamp	**I**	BB322	S	'2003			ND					
18-74-19b	C Sw	13.4 FW Miles	From Bear Swamp to Northeast Cape Fear River	**NR**	BA656	NCE	Low DO	50		**S**	BA656	NCE		Low Dissolved Oxygen	Unknown
					BA657	NCE	Low DO	28.6			BA657	NCE			
Grove Creek															
18-74-21	C Sw	15.4 FW Miles	From source to Northeast Cape Fear River	**S**	BB265	M	'2001			ND					
					BB98	N	'2001								
Limestone Creek															
18-74-23	C Sw	16.4 FW Miles	From source to Northeast Cape Fear River	**S**	BB319	GF	'2003			ND				Habitat Degradation	Land Clearing
Little Rock Fish Creek (Boney Mill Pond)															
18-74-29-6	C Sw	3.0 FW Miles	From source to Rock Fish Creek	**NR**	BA681	NCE				**NR***	BA681	NCE		Fecal Coliform Bacteria	Unknown
					BB100	NR	'2003								
Muddy Creek															
18-74-25	C Sw	14.0 FW Miles	From source to Mortheast Cape Fear River	**I**	BB125	F	'2003			ND					
Northeast Cape Fear River															
18-74-(1)c2	C Sw	11.9 FW Miles	From Subbasin 03-06-21 03-06-22 boundary to Persimmon Branch	**NR**	BA658	NCE	Low DO	12.5		**S**	BA658	NCE		Low Dissolved Oxygen	Unknown
18-74-(25.5)	C Sw HQW	19.5 FW Miles	From Muddy Creek to Rock Fish Creek	**I**	BB126	P	'1998			ND					
18-74-(29.5)	C Sw	35.7 FW Miles	From Rock Fish Creek to NC Hwy 210	**NR**	BA683	NCE	Low DO	10.9		**S**				Low Dissolved Oxygen	Unknown

Table 25 CAPE FEAR Subbasin 03-06-22

AU Number / Description	Classification	Length/Area	Aquatic Life Assessment					Recreation Assessment			Stressors	Sources
			AL Rating	Station	Result	Year/ Parameter	% Exc	REC Rating	Station	Result		
Panther Creek												
18-74-19-3a	C Sw	2.4 FW Miles	**NR**	BA651	NCE	Low DO	23.2	**S**	BA651	NCE	Low Dissolved Oxygen	Unknown
From source to NC 50												
18-74-19-3b	C Sw	1.8 FW Miles	**NR**	BA651	NCE	Low DO	23.2	**S**	BA651	NCE	Low Dissolved Oxygen	Unknown
From NC 50 to Goshen Swamp												
Rock Fish Creek (New Kirk Pond)												
18-74-29c	C Sw	3.4 FW Miles	**S**	BA679	NCE			**S**	BA679	NCE		
From SR 1165 to Little Rockfish Creek				BB254	GF	'2003						
18-74-29d	C Sw	4.7 FW Miles	**S**	BA682	NCE			**S**	BA682	NCE		
From Little Rockfish Creek to Northeast Cape Fear River				BB81	GF	'2003						
				BB81	F	'1998						
Stockinghead Creek												
18-74-24	C Sw	11.2 FW Miles	**S**					ND				
From source to Northeast Cape Fear River				BB346	GF	'2003						

AL - Aquatic Life	BF - Fish Community Survey	E - Excellent	S - Supporting, I - Impaired
REC - Recreation	BB - Benthic Community Survey	G - Good	NR - Not Rated
	BA - Ambient Monitoring Site	GF - Good-Fair	NR*- Not Rated for Recreation (screening criteria exceeded)
	BL- Lake Monitoring	F - Fair	ND-No Data Collected to make assessment
	S- DEH RECMON	P - Poor	**Results**
		NI - Not Impaired	CE-Criteria Exceeded > 10% and more than 10 samples
	Miles/Acres	S- Severe Stress	NCE-No Criteria Exceeded
	FW- Fresh Water	M-Moderate Stress	
	S- Salt Water	N- Natural	

Aquatic Life Rating Summary

S	m	51.1	FW Miles
NR	m	72.1	FW Miles
I	m	50.1	FW Miles
ND		408.8	FW Miles

Recreation Rating Summary

S	m	73.2	FW Miles
NR*	m	3.0	FW Miles
ND		505.9	FW Miles

Fish Consumption Rating Summary

I	e	582.1	FW Miles

22.2 Use Support Assessment Summary

Use support ratings were assigned for waters in subbasin 03-06-22 in the aquatic life, recreation, fish consumption and water supply categories. All waters are Impaired on an evaluated basis in the fish consumption category because of fish consumption advice that applies to the entire basin. In the water supply category, all waters are Supporting on an evaluated basis based on reports from DEH regional water treatment plant consultants. Refer to Appendix X for a complete list of monitored waters and more information on Supporting monitored waters.

There were 173.3 stream miles (29.8 percent) monitored during this assessment period in the aquatic life category. There are 50.1 stream miles (8.6 percent) identified as Impaired in this same category.

22.3 Status and Recommendations of Previously and Newly Impaired Waters

The following waters were either identified as Impaired in the previous basin plan (2000) or are newly Impaired based on recent data. If previously identified as Impaired, the water will either remain on the state's 303(d) list or will be delisted based on recent data showing water quality improvements. If the water is newly Impaired, it will likely be placed on the 2006 303(d) list. The current status and recommendations for addressing these waters are presented below, and each is identified by an assessment unit number (AU#). Refer to the overview for more information on AUs. Information regarding 303(d) listing and reporting methodology is presented in Appendix VII.

22.3.1 Goshen Swamp [AU#18-74-19a and b]

2000 Recommendations
The 2000 basinwide plan recommended that Goshen Swamp be resampled to further assess the Dean Pickle and Specialty Products discharge into Panther Creek (see below) as efforts continue to reduce chloride levels. Goshen Swamp was Not Rated in the 2000 plan.

Current Status
Goshen Swamp [18-74-19a] from source to Bear Swamp (16.6 miles) is Impaired for aquatic life because of a Severe benthic community rating at site BB322. Site BB322 is upstream of the Dean Pickle and Specialty Products discharge. Aquatic habitat was good at the site, suggesting that the water quality is degraded. There are three registered swine operations in the watershed above BB322.

Goshen Swamp [18-74-19b] from Bear Swamp to Northeast Cape Fear River (13.4 miles) is Not Rated for aquatic life because dissolved oxygen was below 4 mg/l in 50 and 29 percent of samples collected at sites BA656 and BA657. Goshen Swamp is classified as C Sw, which acknowledges natural characteristics of swamps such as low dissolved oxygen. A study of a clear cut in Goshen Swamp just upstream of the Northeast Cape Fear River suggested that a 30-foot buffer was insufficient to protect Goshen Swamp from adverse water quality impacts during forest harvesting. Higher suspended solids, nutrients and bacteria levels, and lower dissolved oxygen levels were found downstream of the site (Ensign and Mallin, 2001).

2005 Recommendations
DWQ will continue to monitor the Goshen Swamp watershed. Dean Pickle and Specialty Products will be required to continue efforts to reduce the discharge of chlorides and monitor chloride levels.

22.3.2 Muddy Creek [AU#18-74-25]

2000 Recommendations
The 2000 basinwide plan recommended that Muddy Creek be resampled using the 303(d) approach.

Current Status
Muddy Creek from source to Northeast Cape Fear River (14 miles) is Impaired for aquatic life because of a Fair benthic community rating at site BB125. Aquatic habitat was good at the site, suggesting that the water quality is degraded. There are 41 animal operations and one NPDES wastewater discharger in the watershed that may be the sources of the degraded water quality.

2005 Recommendations
DWQ will continue to monitor the Muddy Creek watershed to determine stressors to water quality. For more information on animal operations and NPDES permits, refer to Chapter 30.

22.3.3 Northeast Cape Fear River [AU#18-74-(1)c2, (25.5) and (29.5)]

Current Status
The Northeast Cape Fear River [18-74-(1)c2] from the subbasin boundary to Persimmon Branch (11.9 miles) is Not Rated for aquatic life because Guilford East Mill WWTP (NC0002305) had significant violations of biological oxygen demand permit limits and eight whole effluent toxicity test failures during the last two years of the assessment period.

The Northeast Cape Fear River was Fully Supporting in the 2000 plan; however, the Northeast Cape Fear River [18-74-(25.5)] from Muddy Creek to Rock Fish Creek (19.5 miles) is currently Impaired for aquatic life because of a Poor benthic community rating at site BB126. This segment of the Northeast Cape Fear River is classified as C Sw HQW.

Northeast Cape Fear River [18-74-(29.5)] from Rock Fish Creek to NC 210 (35.7 miles) is Not Rated for aquatic life because dissolved oxygen was below 4 mg/l in 11 percent of samples collected at site BA683. Northeast Cape Fear River is classified as C Sw, which acknowledges natural characteristics of swamps such as low dissolved oxygen.

2005 Recommendations
DWQ will continue to monitor the Northeast Cape Fear River watershed. The NPDES compliance process will be used to address the significant permit violations noted above.

Water Quality Initiatives
In 2003, Wallace received a $1,037,000 CWMTF (Chapter 34) grant to reroute the WWTP to an upgraded industrial facility. Approximately 1,000 failing septic systems or straight pipes will be connected to the system along the HQW segment of the Northeast Cape Fear River.

22.3.4 Panther Creek [AU#18-74-19-3a and b]

2000 Recommendations
The 2000 basinwide plan recommended that Panther Creek be resampled to continue monitoring the Dean Pickle and Specialty Products discharge as efforts continue to reduce chloride levels. Panther Creek was Not Rated in the 2000 plan.

Current Status
Panther Creek from source to Goshen Swamp (4.2 miles) is Not Rated for aquatic life because dissolved oxygen was below 4 mg/l in 23 percent of samples collected at site BA651. Panther Creek is classified as C Sw, which acknowledges natural characteristics of swamps such as low dissolved oxygen. Conductivity was very high at site BA651, suggesting the Dean Pickle and Specialty Products discharge is impacting water quality.

2005 Recommendations
DWQ will continue to monitor the Panther Creek watershed. Dean Pickle and Specialty Products will be required to continue efforts to reduce the discharge of chlorides and monitor chloride levels.

22.4 Status and Recommendations for Waters with Noted Impacts

The surface waters discussed in this section are not Impaired. However, notable water quality problems and concerns have been documented for some waters based on this assessment. While these waters are not Impaired, attention and resources should be focused on these waters to prevent additional degradation or facilitate water quality improvement. Waters in the following section are identified by assessment unit number (AU#). See overview for more information on AU#s.

22.4.1 Cabin Creek [AU#18-74-23-2]

Current Status and 2005 Recommendations
Cabin Creek from source to Limestone Creek (4 miles) is Not Rated for aquatic life because 33 percent of chlorophyll *a* samples exceeded the water quality standard. However, not enough samples were collected to assign a use support rating. Nutrient levels in the reservoir were extremely elevated. DWQ will determine if increased monitoring efforts in this lake are warranted to better assess water quality.

22.4.2 Little Rockfish Creek [AU#18-74-29-6]

Current Status and 2005 Recommendations
Little Rockfish Creek from source to Rockfish Creek (3 miles) is Not Rated for aquatic life because a benthic community rating could not be assigned at site BB100. There were signs of degradation in Little Rockfish Creek. The creek is Not Rated for recreation because fecal coliform bacteria screening criteria were exceeded at site BA681. DWQ will resample Little Rockfish Creek using Coastal A criteria so that a benthic community rating can be assigned. DWQ will also determine if more intensive sampling of the creek is warranted to assess the bacteria standard.

22.4.3 Limestone Creek [AU#18-74-23]

Current Status and 2005 Recommendations

Limestone Creek from source to Northeast Cape Fear River (16.4 miles) is Supporting aquatic life because of a Good-Fair benthic community rating at site BB319. The creek had been recently de-snagged. The streambanks were eroding and the bottom was unstable sand. There were no pools and little riparian vegetation. The stream had an Excellent benthic community rating in 1993 that fell to Poor after a chicken waste spill in 1995. Limestone Creek has not fully recovered because of the habitat problems.

Chapter 23
Cape Fear River Subbasin 03-06-23

Including: Northeast Cape Fear River, Burnt Mill Creek, Smith Creek and Burgaw Creek

23.1 Subbasin Overview

Subbasin 03-06-23 at a Glance

Land and Water Area

Total area:	795 mi²
Land area:	789 mi²
Water area:	6 mi²

Population Statistics

2000 Est. Pop.: 117,200 people
Pop. Density: 148 persons/mi²

Land Cover (percent)

Forest/Wetland:	82.5%
Surface Water:	0.9%
Urban:	2.1%
Cultivated Crop:	11.2%
Pasture/ Managed Herbaceous:	3.2%

Counties

Duplin, New Hanover, Onslow and Pender

Municipalities

Burgaw, Holly Ridge, Saint Helena, Watha and Wilmington

Subbasin 03-06-23 is in the coastal plain where many streams stop flowing during summer months. Most of the watershed is forested with some agriculture present and increasing development. Development is occurring north around Wilmington. Population is expected to grow by 140,000 people in counties with portions or all of their areas in this subbasin by 2020.

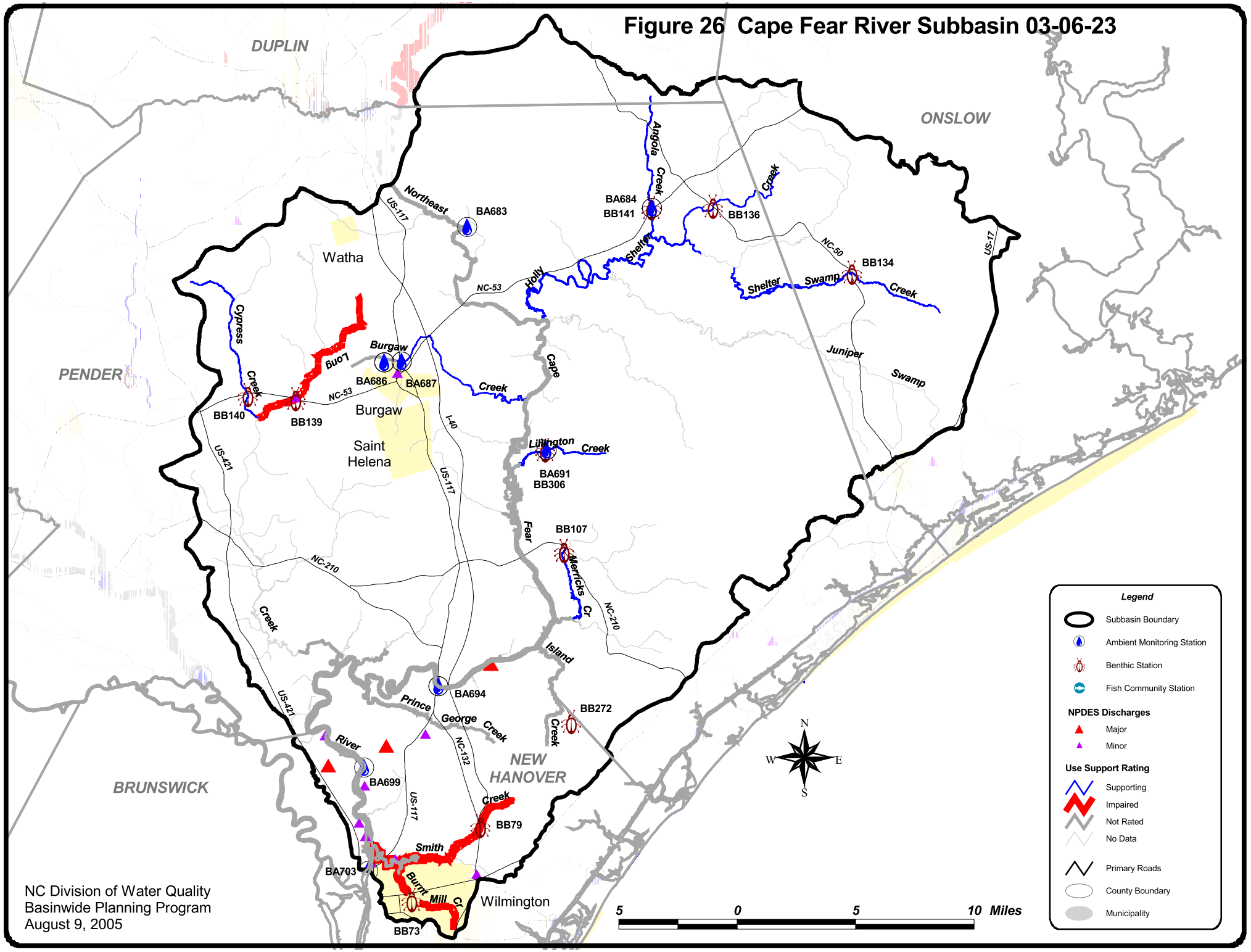
There are seven individual NPDES wastewater discharge permits in this subbasin with a permitted flow of 3.8 MGD (Figure 26). The largest are Global Nuclear Fuels (1.9 MGD) and Elementis Chromium (1 MGD). Refer to Appendix VI and Chapter 30 for more information on NPDES permit holders. Issues related to compliance with NPDES permit conditions are discussed below in Section 23.3 for Impaired waters.

There is one registered horse and 52 registered swine operations in this subbasin.

There were ten benthic community samples (Figure 26 and Table 26) collected during this assessment period. Data were also collected from eight ambient monitoring stations including two LCFRP (Appendix V) stations and two DWQ ambient station and four shared stations. Two reservoirs were also monitored. Refer to the *2003 Cape Fear River Basinwide Assessment Report* at http://www.esb.enr.state.nc.us/bar.html and Appendix IV for more information on monitoring.

Waters in the following sections are identified by assessment unit number (AU#). This number is used to track defined segments in the water quality assessment database, 303(d) Impaired waters list and the various tables in this basin plan. The assessment unit number is a subset of the DWQ index number (classification identification number). A letter attached to the end of the AU# indicates that the assessment is smaller than the DWQ index segment. No letter indicates that the assessment unit and the DWQ index segment are the same.

Figure 26 Cape Fear River Subbasin 03-06-23



NC Division of Water Quality
Basinwide Planning Program
August 9, 2005

Table 26 CAPE FEAR Subbasin 03-06-23

AU Number / Description	Classification	Length/Area	Aquatic Life Assessment						Recreation Assessment			Stressors	Sources
			AL Rating	Station	Result	Year/ Parameter	% Exc		REC Rating	Station	Result		
Angola Creek													
18-74-33-3	C Sw	6.5 FW Miles	**S**	BA684	NCE	Low DO	44.1		**S**	BA684	NCE	Low Dissolved Oxygen	Unknown
From source to Holly Shelter Creek				BB141	G	2003							
Burgaw Creek													
18-74-39a	C Sw	2.1 FW Miles	**NR**	BA686	NCE	Chlor a	15.2		**NR***	BA686	NCE	Fecal Coliform Bacteria	Impervious Surfac
				BA686	NCE	Low DO	31.7					Chlorophyll a	Agriculture
From source to Osgood Branch												Chlorophyll a	Impervious Surfac
												Chlorophyll a	WWTP NPDES
18-74-39b	C Sw	9.5 FW Miles	**S**	BA687	NCE				**NR***	BA687	NCE	Fecal Coliform Bacteria	Unknown
From Osgood Branch to Northeast Cape Fear River													
Burnt Mill Creek													
18-74-63-2	C Sw	4.6 FW Miles	**I**						ND			Toxic Impacts	MS4 NPDES
From source to Smith Creek				BB73	P	2001						Habitat Degradation	MS4 NPDES
Cypress Creek													
18-74-55-2	C Sw	8.3 FW Miles	**S**						ND				
From source to Long Creek				BB140	M	2003							
Holly Shelter Creek													
18-74-33	C Sw	25.9 FW Miles	**S**						ND				
From source to Northeast Cape Fear River				BB136	M	2003							
Island Creek													
18-74-50	C Sw	6.7 FW Miles	**NR**						ND				
From source to Northeast Cape Fear River				BB272	NR	2003							
Lillington Creek													
18-74-42	C Sw	5.0 FW Miles	**S**	BA691	NCE	Low DO	16.7		**S**	BA691	NCE		
				BA691	NCE	Low pH	61.5						
From source to Northeast Cape Fear River				BB306	N	2003							

Table 26 CAPE FEAR Subbasin 03-06-23

AU Number / Description	Classification	Length/Area	Aquatic Life Assessment: AL Rating	Station	Result	Year/ Parameter	% Exc	Recreation Assessment: REC Rating	Station	Result	Stressors	Sources
Long Creek												
18-74-55a	C Sw	7.7 FW Miles	I					ND			Habitat Degradation	Unknown
From source to Cypress Creek				BB139	S	2003						
18-74-55b	C Sw	21.5 FW Miles	ND					ND				
From Cypress Creek to Northeast Cape Fear River												
Merricks Creek												
18-74-49-2	C Sw	5.3 FW Miles	S					ND				
From source to Harrisons Creek				BB107	N	2003						
				BB107	N	1999						
Northeast Cape Fear River												
18-74-(47.5)	B Sw	15.6 FW Miles	NR	BA694	NCE	Low DO	23.3	S	BA694	NCE	Low Dissolved Oxygen	Unknown
From NC Hwy 210 to Princes George Creek												
18-74-(52.5)	C Sw	12.4 FW Miles	NR	BA699	NCE	Low DO	10.4	S	BA699	NCE	Total Suspended Solids	WWTP NPDES
From Prince George Creek to mouth of Ness Creek											Low Dissolved Oxygen	WWTP NPDES
18-74-(61)	SC Sw	1.0 S acres	NR	BA703	NCE	Low DO	39.3	S	BA703	NCE	Low Dissolved Oxygen	Unknown
From mouth of Ness Creek to Cape Fear River												
Shelter Swamp Creek												
18-74-33-2-2	C Sw	13.3 FW Miles	S					ND				
From source to Sandy Run Swamp				BB134	N	1999						
Smith Creek												
18-74-63	C Sw	11.1 FW Miles	I					ND			Low Dissolved Oxygen	WWTP NPDES
From source to Northeast Cape Fear River				BB79	S	2003						

Table 26 CAPE FEAR Subbasin 03-06-23

AU Number	Classification	Length/Area	Description	Aquatic Life Assessment					Recreation Assessment				
				AL Rating	Station	Result	Year/ Parameter	% Exc	REC Rating	Station	Result	Stressors	Sources

AL - Aquatic Life	BF - Fish Community Survey	E - Excellent	S - Supporting, I - Impaired
REC - Recreation	BB - Benthic Community Survey	G - Good	NR - Not Rated
	BA - Ambient Monitoring Site	GF - Good-Fair	NR*- Not Rated for Recreation (screening criteria exceeded)
	BL- Lake Monitoring	F - Fair	ND-No Data Collected to make assessment
	S- DEH RECMON	P - Poor	**Results**
		NI - Not Impaired	CE-Criteria Exceeded > 10% and more than 10 samples
	Miles/Acres	S- Severe Stress	NCE-No Criteria Exceeded
	FW- Fresh Water	M-Moderate Stress	
	S- Salt Water	N- Natural	

Aquatic Life Rating Summary

NR	m	1.0	S acres
S	m	73.8	FW Miles
NR	m	36.8	FW Miles
I	m	23.4	FW Miles
NR	e	8.3	FW Miles
ND		233.2	FW Miles

Recreation Rating Summary

S	m	1.0	S acres
S	m	39.5	FW Miles
NR*	m	11.6	FW Miles
ND		324.5	FW Miles

Fish Consumption Rating Summary

I	m	37.1	FW Miles
I	e	1.0	S acres
I	e	338.4	FW Miles

23.2 Use Support Assessment Summary

Use support ratings were assigned for waters in subbasin 03-06-23 in the aquatic life, recreation, fish consumption and water supply categories. All waters are Impaired on an evaluated basis in the fish consumption category because of fish consumption advice that applies to the entire basin. In the water supply category, all waters are Supporting on an evaluated basis based on reports from DEH regional water treatment plant consultants. Refer to Appendix X for a complete list of monitored waters and more information on Supporting monitored waters.

There were 134 stream miles (35.7 percent) monitored during this assessment period in the aquatic life category. There are 23.4 stream miles (6.2 percent) identified as Impaired in this same category.

23.3 Status and Recommendations of Previously and Newly Impaired Waters

The following waters were either identified as Impaired in the previous basin plan (2000) or are newly Impaired based on recent data. If previously identified as Impaired, the water will either remain on the state's 303(d) list or will be delisted based on recent data showing water quality improvements. If the water is newly Impaired, it will likely be placed on the 2006 303(d) list. The current status and recommendations for addressing these waters are presented below, and each is identified by an assessment unit number (AU#). Refer to the overview for more information on AUs. Information regarding 303(d) listing and reporting methodology is presented in Appendix VII.

23.3.1 Burgaw Creek [AU#18-74-39a]

Current Status
The 2000 basin plan recommended that Burgaw Creek be resampled. Burgaw Creek from source to Osgood Branch (2.1 miles) is Not Rated for aquatic life because chlorophyll *a* exceeded the standard in 15 percent of samples collected at site BA686. The chlorophyll *a* data were not collected and processed using a certified laboratory, and therefore, cannot be used by DWQ to make use support determinations. Site BA686 is monitored by the Lower Cape Fear River Program (Appendix V).

2005 Recommendations
DWQ and LCFRP will continue to monitor the Burgaw Creek watershed. DWQ recommends that the Burgaw WWTP optimize plant processes to reduce nutrients that may be causing algal blooms in Burgaw Creek. The LCFRP is in the process of becoming state certified for chlorophyll *a* analysis.

Water Quality Initiatives
In 2002, The Nature Conservancy received a $606,000 CWMTF grant to purchase 521 floodplain acres. The overall project included 795 acres along Burgaw Creek near the Northeast Cape Fear River (Chapter 34).

23.3.2 Burnt Mill Creek [AU#18-74-63-2]

2000 Recommendations
The 2000 basin plan recommended that Burnt Mill Creek be resampled using the 303(d) approach.

Current Status
Burnt Mill Creek from source to Smith Creek (4.6 miles) is Impaired for aquatic life because of a Poor benthic community rating at site BB73. A Collaborative Assessment of Watersheds and Streams (CAWS) in 2003 indicated that the benthic community in Burnt Mill Creek was primarily impacted by toxicity and sedimentation, with lack of instream habitat and nutrient enrichment as chronic stressors to the benthic community. The watershed drains a highly urbanized portion of Wilmington. A Local Watershed Plan (Chapter 34) was developed by NCEEP in 2002 that identified similar habitat problems in the watershed. The plan also outlines restoration strategies and locations for BMPs.

2005 Recommendations
DWQ will continue to monitor the Burnt Mill Creek watershed. DWQ will work with NCEEP and the watershed stakeholders, including the City of Wilmington, to assist where possible in implementation of the restoration strategy. Burnt Mill Creek will remain on the 303(d) list of Impaired waters. TMDLs (Chapter 35) will be developed for identified stressors within 8-13 years of listing.

Water Quality Initiatives
In 2002, Wilmington received a $120,000 Section 319 grant (Chapter 34) to install urban BMP demonstration projects in the Burnt Mill Creek watershed. The grant projects will be completed in 2005. UNCW has also increased monitoring efforts in Burnt Mill Creek with funding from the 319 program.

The NCEEP completed the New Hanover County Local Watershed Plan in 2003. The EEP currently has two stream restoration projects in design for a total of 3,000 feet of stream restoration, and has a stormwater wetland that was constructed in 2000 and is in the fourth year of post-construction monitoring. Additionally, a team headed by Watershed Education for Communities and Officials at NCSU and including the City of Wilmington, Cape Fear River Watch, NCSU Dept. of Biological and Agricultural Engineering, UNC-Wilmington, and the New Hanover Local Watershed Group obtained an EPA 319 Grant of $608,000. The project purpose is to construct 6 stormwater BMP retrofits, monitor and analyze the impacts of retrofit activities on the watershed, involve the community in residential BMP retrofits, and conduct an educational campaign. The project implements recommendations from the Local Watershed Plan that was sponsored by EEP, and builds on educational activities conducted by the City of Wilmington with their previous EPA 319 grant.

Additionally, Watershed Education for Communities and Officials (WECO) received a 319 grant to fund the construction of two stormwater ponds in the Burnt Mill Creek watershed. NCEEP has also completed 0.6 acres of riverine restoration and 3,000 linear feet of stream restoration in the Burnt Mill Creek watershed (Chapter 34). The final report is available for download at: http://www.nceep.net/services/lwps/new%20hanover/newhanover.htm

23.3.3 Northeast Cape Fear River [AU#18-74-(47.5)]

Current Status and 2005 Recommendations
The Northeast Cape Fear River from Hwy 210 to Prince George Creek (15.6 miles) is Impaired on a monitored basis in the fish consumption category and will be added to the 303(d) list of Impaired waters.

23.3.4 Long Creek [AU#18-74-55a and b]

Current Status
Long Creek was Fully Supporting in the 2000 basin plan; however, Long Creek [18-74-55a] from source to Cypress Creek (7.7 miles) is currently Impaired for aquatic life because of a Severe benthic community rating at site BB139. Long Creek is channelized and has poor habitat conditions. The stream is affected by beaver dams. Conductivity was high at the sample site and the benthic community was dominated by tolerant species.

Long Creek [18-74-55b] from Cypress Creek to (21.5 miles) is Impaired on a monitored basis in the fish consumption category. No other data were collected in this segment.

2005 Recommendations
DWQ will continue to monitor the Long Creek watershed and evaluate impacts of NPDES discharges into Long Creek. DWQ will contact DSWC to evaluate if agricultural BMPs can be implemented to improve water quality.

Both segments will be added to the 303(d) list of Impaired waters. TMDLs (Chapter 35) will be developed for identified stressors within 8-13 years of listing.

23.3.5 Smith Creek [AU#18-74-63]

Current Status
Smith Creek was Not Rated in the 2000 basin plan; however, Smith Creek from source to Northeast Cape River (11.1 miles) is currently Impaired for aquatic life because of a Severe benthic community rating at site BB79. The Smith Creek WWTP (NC0000817) had significant violations of dissolved oxygen permit limits during the assessment period that could have negatively impacted aquatic life. This facility is no longer discharging.

2005 Recommendations
DWQ will continue to monitor the Smith Creek watershed. The NPDES compliance process will be used to address the significant permit violations noted above.

Smith Creek will be added to the 303(d) list of Impaired waters. TMDLs (Chapter 35) will be developed for identified stressors within 8-13 years of listing.

Water Quality Initiatives
The NCEEP completed the New Hanover County Local Watershed Plan in 2003 that includes Smith Creek. The plan is discussed under Burnt Mill Creek in this chapter. The plan is available for download at: http://www.nceep.net/services/lwps/new%20hanover/newhanover.htm

23.4 Status and Recommendations for Waters with Noted Impacts

The surface waters discussed in this section are not Impaired. However, notable water quality problems and concerns have been documented for some waters based on this assessment. While these waters are not Impaired, attention and resources should be focused on these waters to prevent additional degradation or facilitate water quality improvement. Waters in the following section are identified by assessment unit number (AU#). See overview for more information on AU#s.

23.4.1 Angola Creek [AU# 18-74-33-3]

Current Status and Water Quality Initiatives
Angola Creek from source to Holly Shelter Creek (6.5 miles) is Supporting aquatic life because a Good benthic community rating at site BB141. The benthic community suggested inputs of organic particulate material, and dissolved oxygen was very low at time of sampling (<4 mg/l in 44 percent of samples collected) at site BA684. Angola Creek is classified as C Sw, which acknowledges natural characteristics of swamps such as low dissolved oxygen. In 2001, The Nature Conservancy received a $442,000 CWMTF (Chapter 34) grant to purchase conservation easements on 82 acres along Angola Creek.

23.4.2 Dero Creek [AU# 18-74-32]

Current Status and Water Quality Initiatives
Dero Creek from source to Northeast Cape Fear River (2.8 miles) was not assessed during this assessment period. In 2003, the North Carolina Coastal Land Trust received a $992,000 CWMTF grant to purchase conservation easements on 94 riparian acres. The overall project also included 775 acres of donated easements in upland areas (Chapter 34).

23.4.3 Holly Shelter Creek [AU# 18-74-33]

Current Status and 2005 Recommendations
Holly Shelter Creek from source to Northeast Cape Fear River (25.9 miles) is Supporting aquatic life because of a Moderate benthic community rating at site BB136. The creek had a diverse benthic community and one rare species was found.

Water Quality Initiatives
In 2001, The Nature Conservancy received a $7,900,000 CWMTF (Chapter 34) grant to acquire 14,391 acres along Holly Shelter Creek and several tributaries.

23.4.4 Prince George Creek [AU# 18-74-53]

Current Status and 2005 Recommendations
Prince George Creek from source to Northeast Cape Fear River (8.3 miles) is Not Rated on an evaluated basis. Hermitage House Rest Home (NC 0051969) had significant violations of chlorine permit limits that may have adversely impacted aquatic life during the last two years of the assessment period.

Water Quality Initiatives
In 2002, The Nature Conservancy received a $148,000 CWMTF grant to purchase 160 floodplain acres. The overall project included 421 acres along Shelter Swamp Creek and Sandy Run Swamp. In 2003, The Nature Conservancy received a $671,000 CWMTF grant to purchase 970 acres along Prince George Creek and the Northeast Cape Fear River (Chapter 34).

23.4.5 Shaken Creek [AU# 18-74-33-4]

Current Status and Water Quality Initiatives
Shelter Swamp Creek from source to Holly Shelter Creek (19.5 miles) was not assessed during this assessment period, but is in a watershed that has extensive agriculture. In 2003, the North Carolina Coastal Land Trust received a $366,000 CWMTF grant to purchase conservation easements on 303 riparian acres. The project also included 862 acres of donated easements in upland areas. The acquisition completes protection of the entire creek (Chapter 34).

23.4.6 Shelter Swamp Creek [AU# 18-74-33-2-2]

Current Status and 2005 Recommendations
Shelter Swamp Creek from source to Sandy Run Swamp (13.3 miles) is Supporting aquatic life because of a Natural benthic community rating at site BB134. The creek had a diverse benthic community and one rare species was found.

Water Quality Initiatives
In 2002, The Nature Conservancy received a $148,000 CWMTF grant to purchase 160 floodplain acres. The overall project included 421 acres along Shelter Swamp Creek and Sandy Run Swamp (Chapter 34).

23.4.7 Northeast Cape Fear River [AU# 18-74-(47.5) and (52.5)]

Current Status and 2005 Recommendations
The Northeast Cape Fear River from NC 210 to Ness Creek (28 miles) is Not Rated for aquatic life because dissolved oxygen was below 4 mg/l in 23 and 10 percent of samples collected at sites BA694 and BA699. Northeast Cape Fear River is classified as C Sw, which acknowledges natural characteristics of swamps such as low dissolved oxygen. Walnut Hills WWTP (NC0039527) had significant violations of total suspended solids permit limits, and New Hanover County Landfill WWTP (NC0049743) had significant violations of biological oxygen demand permit limits during the last two years of the assessment period. The NPDES compliance process will be used to address the significant permit violations noted above.

Water Quality Initiatives
In 1998, the NC Wildlife Resource Commission received a $1,070,000 CWMTF (Chapter 34) grant to acquire 1,076 acres in this watershed near the confluence with Turkey Creek.

Chapter 24
Cape Fear River Subbasin 03-06-24
Including: Masonboro Sound, Topsail Sound and ICWW

24.1 Subbasin Overview

Subbasin 03-06-24 at a Glance

Land and Water Area

Total area:	162 mi²
Land area:	142 mi²
Water area:	20 mi²

Population Statistics

2000 Est. Pop.: 58658people
Pop. Density: 361 persons/mi²

Land Cover (percent)

Forest/Wetland:	63.0%
Surface Water:	17.5%
Urban:	8.3%
Cultivated Crop:	6.7%
Pasture/ Managed Herbaceous:	4.5%

Counties

New Hanover, Onlsow and Pender

Municipalities

Carolina Beach, Holly Ridge, North Topsail Beach, Surf City, Topsail, Wilmington and Wrightsville Beach

Subbasin 03-06-24 drains entirely to the ICWW and the Atlantic Ocean. There are large urban areas around Wilmington and many beach communities. Population is expected to grow by 110,000 people in counties with portions or all of their areas in this subbasin by 2020.

There are three individual NPDES wastewater discharge permits in this subbasin with a permitted flow of 0.1 MGD (Figure 27). Refer to Appendix VI and Chapter 30 for more information on NPDES permit holders. Issues related to compliance with NPDES permit conditions are discussed below in Section 24.3 for Impaired waters and in Section 24.4 for other waters.

There is one registered swine operation in this subbasin.

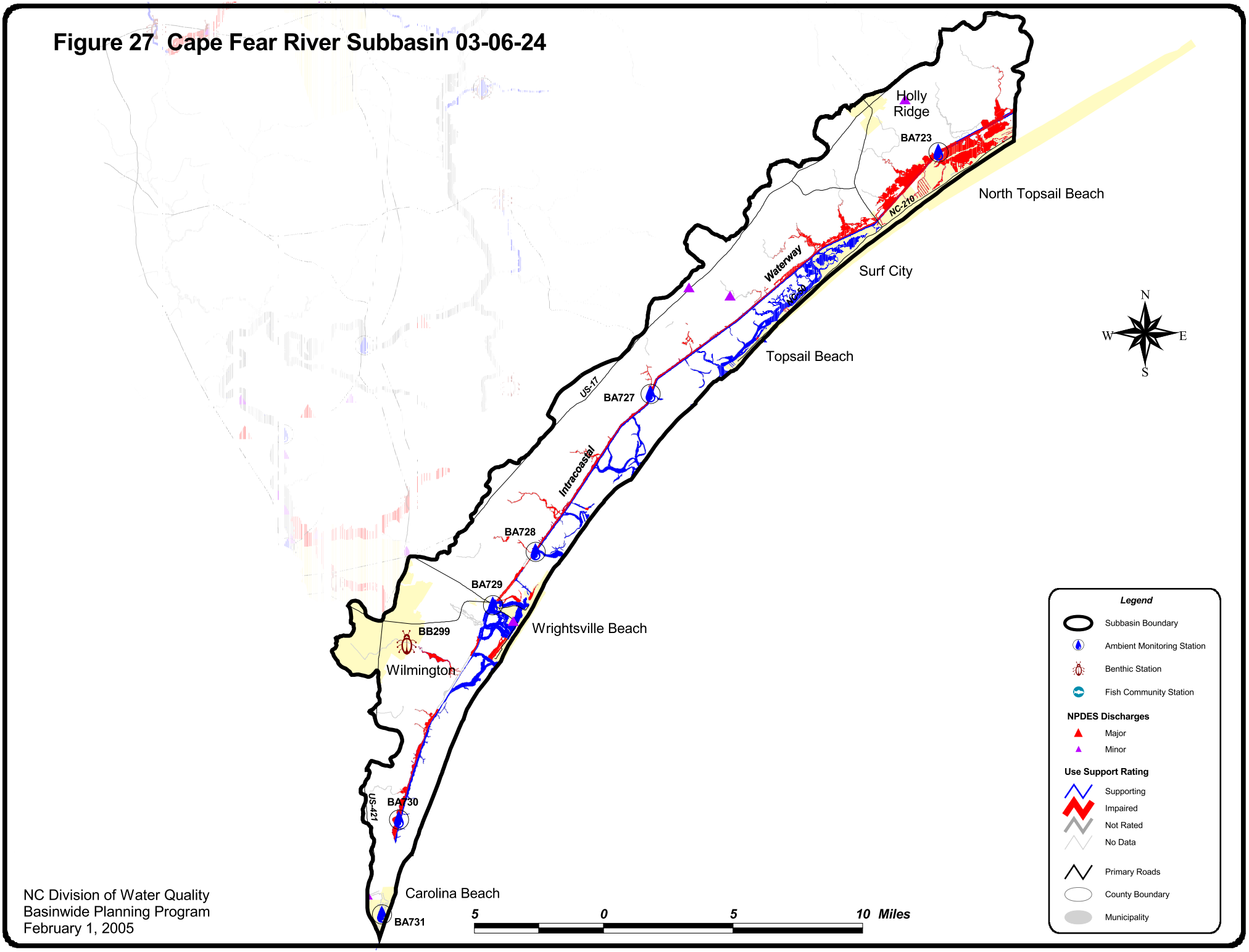
There was one benthic community sample (Figure 27 and Table 27) collected during this assessment period. Data were also collected from six DWQ ambient stations. Refer to the *2003 Cape Fear River Basinwide Assessment Report* at http://www.esb.enr.state.nc.us/bar.html and Appendix IV for more information on monitoring.

Waters in the following sections are identified by assessment unit number (AU#). This number is used to track defined segments in the water quality assessment database, 303(d) Impaired waters list and the various tables in this basin plan. The assessment unit number is a subset of the DWQ index number (classification identification number). A letter attached to the end of the AU# indicates that the assessment is smaller than the DWQ index segment. No letter indicates that the assessment unit and the DWQ index segment are the same.

24.2 Use Support Assessment Summary

Use support ratings were assigned for waters in subbasin 03-06-24 in the aquatic life, recreation, fish consumption and water supply categories. All waters are Impaired on an evaluated basis in the fish consumption category because of fish consumption advice that applies to the entire basin. In the water supply category, all waters are Supporting on an evaluated basis based on reports from DEH regional water treatment plant consultants.

Figure 27 Cape Fear River Subbasin 03-06-24



NC Division of Water Quality
Basinwide Planning Program
February 1, 2005

Table 27 CAPE FEAR Subbasin 03-06-24

AU Number / Description	Classification	Length/Area		Aquatic Life Assessment: AL Rating	Station	Result	Year/ Parameter	% Exc	Recreation Assessment: REC Rating	Station	Result	Shellfish Harvesting: SH Rating	GA Status	Stressors	Sources
Atlantic Ocean															
99-(3)c	SB	38.3	Coast Miles	ND					**S**	S-22a	NCE				
										S-23	NCE				
										S-25	NCE				
										S-28	NCE				
										S-29	NCE				
The waters of the Atlantic Ocean contiguous to that portion of the Cape Fear River Basin that extends from the edge of White Oak River Basin to the subbasin 17/24 boundary															
Banks Channel															
18-87-10-1a	SA HQW	313.5	S acres	ND					ND			S	APP		
From New Topsail Inlet to Topsail Sound excluding prohibited area at Annamarina															
18-87-10-1b	SA HQW	4.2	S acres	ND					ND			I	PRO	Fecal Coliform Bacteria	Marina
Prohibited area at Annamarina															
18-87-24-3	SA HQW	111.1	S acres	ND					ND			I	CAO	Fecal Coliform Bacteria	MS4 NPDES
Entire Channel south of the Wrightsville Recreational Area															
Batts Mill Creek															
18-87-6	SA HQW	40.8	S acres	ND					ND			I	CAO	Fecal Coliform Bacteria	Unknown
From source to Intracoastal Waterway															
Beckys Creek (Bi															
18-87-8a	SA HQW	42.5	S acres	ND					ND			I	PRO	Fecal Coliform Bacteria	Impervious Surfac
From source 0.5 miles inland Intracoastal Waterway															
18-87-8b	SA HQW	66.4	S acres	ND					ND			I	CAO	Fecal Coliform Bacteria	Impervious Surfac
From 0.5 miles inland of ICWW to Intracoastal Waterway															

Table 27 CAPE FEAR Subbasin 03-06-24

AU Number / Description	Classification	Length/Area		Aquatic Life Assessment: AL Rating	Station	Result	Year/ Parameter	% Exc	Recreation Assessment: REC Rating	Station	Result	Shellfish Harvesting: SH Rating	GA Status	Stressors	Sources
Bradley Creek															
18-87-24-4-(1)	SC HQW #	28.8	S acres	ND					ND						
From source to US Hwys 17, 74 & 76 bridge															
18-87-24-4-(2)	SC #	55.9	S acres	ND					ND						
From US Hwy 17, 74 & 76 bridge to Intracoastal Waterway															
Butler Creek															
18-87-18	SA ORW	30.9	S acres	ND					ND			S	APP		
From Nixon Channel to Intracoastal Waterway															
Carolina Beach															
18-87-31.2	SB	102.8	S acres	ND	BA731		NCE		ND						
All waters beginning at a point on the northern side of Snows Cut and running directly east across the Intracoastal Waterway to a point on the eastern side, thence follow															
Cedar Snag Cree															
18-87-17	SA ORW	3.2	S acres	ND					ND			S	APP		
From Green Channel to Intracoastal Waterway															
County Line Bra															
18-87-6-1	SA HQW	1.0	S acres	ND					ND			I	CAC	Fecal Coliform Bacteria	Unknown
From source to Batts Mill Creek															
Cypress Branch															
18-87-6-2	SA HQW	1.0	S acres	ND					ND			I	CAC	Fecal Coliform Bacteria	Unknown
From source to Batts Mill Creek															

Table 27 CAPE FEAR Subbasin 03-06-24

AU Number	Classification	Length/Area		Aquatic Life Assessment					Recreation Assessment			Shellfish Harvesting			
Description				AL Rating	Station	Result	Year/ Parameter	% Exc	REC Rating	Station	Result	SH Rating	GA Status	Stressors	Sources
Everett Bay															
18-87-2	SA ORW	240.6	S acres	ND					ND			I	CAO	Fecal Coliform Bacteria	
Entire Bay excluding that portion in King Creek Restricted Area															
Everett Creek															
18-87-29	SA HQW	0.7	S acres	ND					ND			I	PRO	Fecal Coliform Bacteria	MS4 NPDES
From source to Intracoastal Waterway															
Futch Creek															
18-87-19a	SA HQW	13.7	S acres	ND					ND			I	PRO	Fecal Coliform Bacteria	Impervious Surfac
From source to 0.35 miles inland of Intracoastal Waterway															
18-87-19b	SA HQW	14.3	S acres	ND					ND			I	CAO	Fecal Coliform Bacteria	Impervious Surfac
From 0.35 miles inland of Intracoastal Waterway to ICWW															
Green Channel															
18-87-16	SA ORW	111.5	S acres	ND					ND			S	APP		
From Rich Inlet to Intracoastal Waterway															
Hewletts Creek															
18-87-26a	SA HQW	78.3	S acres	**S**					ND			I	PRO	Fecal Coliform Bacteria	MS4 NPDES
From source to 0.5 miles inland of Intracoastal Waterway					BB299	M	2003								
18-87-26b	SA HQW	19.9	S acres	ND					ND			I	CAO	Fecal Coliform Bacteria	MS4 NPDES
From 0.5 miles inland of ICWW to Intracoastal Waterway															
Howard Channel															
18-87-13	SA ORW	38.3	S acres	ND					ND			S	APP		
From Old Topsail Inlet to Intracoastal Waterway															

Table 27 CAPE FEAR Subbasin 03-06-24

AU Number / Description	Classification	Length/Area		Aquatic Life Assessment: AL Rating	Station	Result	Year/ Parameter	% Exc	Recreation Assessment: REC Rating	Station	Result	Shellfish Harvesting: SH Rating	GA Status	Stressors	Sources
Howe Creek															
18-87-23	SA ORW	28.6	S acres	ND					ND			I	PRO	Fecal Coliform Bacteria	
From source to Intracoastal Waterway															
Intracaostal Wat															
18-87-(5.5)	SA HQW	159.6	S acres	ND					**S**	S-52	NCE	I	CAO	Fecal Coliform Bacteria	Impervious Surfac
										S-53	NCE				
										S-54	NCE				
From Morris Landing to the eastern mouth of Old Topsail Creek															

Table 27 CAPE FEAR Subbasin 03-06-24

AU Number	Classification	Length/Area		Aquatic Life Assessment					Recreation Assessment				Shellfish Harvesting			
Description				AL Rating	Station	Result	Year/ Parameter	% Exc	REC Rating	Station	Result	SH Rating	GA Status	Stressors	Sources
Intracoastal Wat															
18-87	SA ORW	76.2	S acres	S	BA723	NCE			S	BA723	NCE	I	CAO	Fecal Coliform Bacteria	Unknown
										S-55	NCE				
From southern edge of White Oak River Basin to Morris Landing															
18-87-(11.5)	SA ORW	112.9	S acres	ND					S	S-50	NCE	I	CAO	Fecal Coliform Bacteria	Unknown
										S-51	NCE				
From the eastern mouth of Old Topsail Creek to the western mouth of Howe Creek															
18-87-(23.5)a	SA HQW	52.8	S acres	ND					S	S-48	NCE	S	APP		
Approved area south of Wrightsville Recreation area and east of ICWW															
18-87-(23.5)b	SA HQW	63.1	S acres	ND					ND			I	PRO	Fecal Coliform Bacteria	Unknown
Prohibited area north of Wrightsville Reacreation area															
18-87-(23.5)c	SA HQW	70.4	S acres	I	BA728	CE	Low DO	11.4	S	BA728	NCE	I	CAO	Low Dissolved Oxygen	MS4 NPDES
Conditional area south of Wrightsville Recreation area and west of ICWW.														Fecal Coliform Bacteria	Unknown
	SA HQW	70.4	S acres	I	BA728	CE	Low DO	11.4	S	BA728	NCE	I	CAO	Low Dissolved Oxygen	MS4 NPDES
Conditional area south of Wrightsville Recreation area and west of ICWW.														Fecal Coliform Bacteria	Unknown
John Creek															
18-87-30	SA ORW	5.0	S acres	ND					ND			S	APP		
From source to Intracoastal Waterway															

Table 27 CAPE FEAR Subbasin 03-06-24

AU Number / Description	Classification	Length/Area		Aquatic Life Assessment: AL Rating	Station	Result	Year/ Parameter	% Exc	Recreation Assessment: REC Rating	Station	Result	Shellfish Harvesting: SH Rating	GA Status	Stressors	Sources
King Creek Restr															
18-87-4	SC Sw HQ	165.7	S acres	ND					ND						
Inside a line beginning at a point on the mainland and running due south 100 yards to reflector buoy #43 in the Intracoastal Waterway, thence along the south side of the															
Long Point Chan															
18-87-15	SA ORW	16.0	S acres	ND					ND			S	APP		
From Old Topsail Inlet to Intracoastal Waterway															
Masonboro Chan															
18-87-27	SA ORW	216.4	S acres	ND					ND			S	APP		
From Masonboro Inlet to Intracoastal Waterway															
Masonboro Soun															
18-87-25.7a	SA ORW	285.3	S acres	ND					**S**	S-47	NCE	S	APP		
East of ICWW															
18-87-25.7b	SA ORW	99.5	S acres	ND					ND			I	PRO	Fecal Coliform Bacteria	Impervious Surfac
Three prohibited areas inland of ICWW														Fecal Coliform Bacteria	Marina
18-87-25.7c	SA ORW	215.9	S acres	**S**	BA730	NCE			**S**	BA730	NCE	I	CAO	Fecal Coliform Bacteria	Impervious Surfac
West of ICWW														Fecal Coliform Bacteria	Marina
18-87-25.7d	SA ORW	64.3	S acres	ND					ND			I	PRO	Fecal Coliform Bacteria	MS4 NPDES
Prohibited area at mouth of Whiskey Creek															

Table 27 CAPE FEAR Subbasin 03-06-24

AU Number / Description	Classification	Length/Area		Aquatic Life Assessment					Recreation Assessment			Shellfish Harvesting			
				AL Rating	Station	Result	Parameter	Year/ % Exc	REC Rating	Station	Result	SH Rating	GA Status	Stressors	Sources
Mill Creek (Betts															
18-87-14	SA HQW	18.2	S acres	ND					ND			I	PRO	Fecal Coliform Bacteria	Impervious Surfac
From source to Intracoastal Waterway															
Mullett Run															
18-87-9-1	SA HQW	7.5	S acres	ND					ND			I	PRO	Fecal Coliform Bacteria	Impervious Surfac
From source to Virginia Creek															
Nixon Channel															
18-87-20	SA ORW	181.8	S acres	ND					ND			S	APP		
From Rich Inlet to Intracoastal Waterway															
Nixons Creek															
18-87-11	SA HQW	5.8	S acres	ND					ND			I	CAO	Fecal Coliform Bacteria	Marina
From source to Intracoastal Waterway															
Old Mill Creek															
18-87-7	SA HQW	0.1	S acres	ND					ND			I	CAO	Fecal Coliform Bacteria	Unknown
From source to Intracoastal Waterway															
Old Topsail Cree															
18-87-12a	SA HQW	16.5	S acres	ND					ND			I	PRO	Fecal Coliform Bacteria	Impervious Surfac
From source to 0.5 miles inland of ICWW to Intracoastal Waterway															
18-87-12b	SA HQW	12.4	S acres	ND					ND			I	CAO	Fecal Coliform Bacteria	Impervious Surfac
From 0.5 miles inland of Intracoastal Waterway to ICWW															

Table 27 CAPE FEAR Subbasin 03-06-24

AU Number / Description	Classification	Length/Area		Aquatic Life Assessment: AL Rating	Station	Result	Year/ Parameter	% Exc	Recreation Assessment: REC Rating	Station	Result	Shellfish Harvesting: SH Rating	GA Status	Stressors	Sources
Pages Creek															
18-87-22a	SA HQW	48.4	S acres	ND					ND			I	PRO	Fecal Coliform Bacteria	
From source to 0.5 miles inland of Intracoastal Waterway															
18-87-22b	SA HQW	28.5	S acres	ND					ND			I	CAO	Fecal Coliform Bacteria	
From 0.5 miles inland of ICWW to Intracoastal Waterway															
Shinn Creek															
18-87-25	SA HQW	87.0	S acres	ND					ND			S	APP		
From Masonboro Inlet to Intracoastal Waterway															
Snows Cut															
18-87-31.5	SC	60.5	S acres	ND					ND						
From Carolina Beach Yacht Basin to Cape Fear River															
Stump Sound															
18-87-3	SA ORW	87.3	S acres	ND					ND			I	CAO	Fecal Coliform Bacteria	Unknown
Entire Sound excluding that portion in King Creek Restricted Area															
Stump Sound O															
18-87-0.5	SA ORW	939.9	S acres	ND					ND			I	CAO	Fecal Coliform Bacteria	Unknown
All waters between the s edge of the White Oak RB to the western end of Permuda Is. exclusive of the restricted area															

Table 27 CAPE FEAR Subbasin 03-06-24

AU Number / Description	Classification	Length/Area		Aquatic Life Assessment					Recreation Assessment			Shellfish Harvesting			
				AL Rating	Station	Result	Year/ Parameter	% Exc	REC Rating	Station	Result	SH Rating	GA Status	Stressors	Sources
Topsail Sound															
18-87-10a Entire Sound south of ICWW	SA HQW	1,190.7	S acres	ND					ND			S	APP		
18-87-10b Prohibited areas at Queens Grant and Hwy 210 Bridge	SA HQW	56.2	S acres	ND					ND			I	PRO	Fecal Coliform Bacteria	Impervious Surfac
18-87-10c Entire Sound north of ICWW	SA HQW	1,144.5	S acres	ND					ND			I	CAO	Fecal Coliform Bacteria	Impervious Surfac
18-87-10d Conditional areas at mouth of Batts Mill Creek and at Hwy 210 Bridge	SA HQW	12.7	S acres	ND					ND			I	CAC	Fecal Coliform Bacteria	Marina

Table 27 CAPE FEAR Subbasin 03-06-24

AU Number / Description	Classification	Length/Area		Aquatic Life Assessment					Recreation Assessment				Shellfish Harvesting			
				AL Rating	Station	Result	Parameter	Year/ % Exc	REC Rating	Station	Result		SH Rating	GA Status	Stressors	Sources
Topsail Sound an																
18-87-11.7a South of ICWW	SA ORW	444.8	S acres	ND					ND				S	APP		
18-87-11.7b Prohibited area north of ICWW	SA ORW	2.1	S acres	ND					ND				I	PRO	Fecal Coliform Bacteria	
18-87-11.7c North of ICWW	SA ORW	272.5	S acres	**S**	BA727	NCE			ND	BA727	NCE		I	CAO	Fecal Coliform Bacteria	Marina
18-87-11.7d Prohibited area on northside of ICWW	SA ORW	2.7	S acres	ND					ND				I	PRO	Fecal Coliform Bacteria	Marina
18-87-11.7e Prohibited area at mouth of Mill Creek	SA ORW	2.7	S acres	ND					ND				I	PRO	Fecal Coliform Bacteria	
18-87-11.7f Prohibited area at Figure Eight Island Marina	SA ORW	6.8	S acres	ND					ND				I	PRO	Fecal Coliform Bacteria	
Turkey Creek																
18-87-1a From source to 0.25 miles inland of Intracoastal Waterway to ICWW	SA ORW	79.5	S acres	ND					ND				I	CAC	Fecal Coliform Bacteria	Unknown
18-87-1b From 0.25 miles inland of ICWW to Intracoastal Waterway	SA ORW	59.6	S acres	ND					ND				I	CAO	Fecal Coliform Bacteria	Unknown

Table 27 CAPE FEAR Subbasin 03-06-24

AU Number	Classification	Length/Area		Aquatic Life Assessment					Recreation Assessment			Shellfish Harvesting			
Description				AL Rating	Station	Result	Year/ Parameter	% Exc	REC Rating	Station	Result	SH Rating	GA Status	Stressors	Sources
Virginia Creek															
18-87-9a	SA HQW	23.5	S acres	ND					ND			I	PRO	Fecal Coliform Bacteria	Impervious Surfac
From source to 0.75 miles inland of Intracoastal Waterway															
18-87-9b	SA HQW	73.6	S acres	ND					ND			I	CAO	Fecal Coliform Bacteria	Impervious Surfac
From 0.75 miles inland of ICWW to Intracoastal Waterway															
Whiskey Creek (															
18-87-28	SA HQW	13.0	S acres	ND					ND			I	PRO	Fecal Coliform Bacteria	MS4 NPDES
From source to Intracoastal Waterway															
Wrightsville Recr															
18-87-24	SB #	478.7	S acres	**S**	BA729	NCE			ND	BA729	NCE				
In any waters within a line beginning at a point on the mainland along the Intracoastal Waterway 1400 feet north of the U.S. Hwy. 74-76 bridge extending directly across t															

Table 27 CAPE FEAR Subbasin 03-06-24

AU Number	Classification	Length/Area	Description	Aquatic Life Assessment					Recreation Assessment			Shellfish Harvesting			
				AL Rating	Station	Result	Year/ Parameter	% Exc	REC Rating	Station	Result	SH Rating	GA Status	Stressors	Sources

AL - Aquatic Life	BF - Fish Community Survey	E - Excellent	S - Supporting, I - Impaired
REC - Recreation	BB - Benthic Community Survey	G - Good	NR - Not Rated
	BA - Ambient Monitoring Site	GF - Good-Fair	NR*- Not Rated for Recreation (screening criteria exceeded)
	BL- Lake Monitoring	F - Fair	ND-No Data Collected to make assessment
	S- DEH RECMON	P - Poor	**Results**
		NI - Not Impaired	CE-Criteria Exceeded > 10% and more than 10 samples
	Miles/Acres	S- Severe Stress	NCE-No Criteria Exceeded
	FW- Fresh Water	M-Moderate Stress	
	S- Salt Water	N- Natural	GA Status- DEH SS Growing Area Status

Aquatic Life Rating Summary

S	m	1,121.6	S acres
I	m	70.4	S acres
ND		7,116.8	S acres
ND		38.3	Coast Mile

Recreation Rating Summary

S	m	973.1	S acres
S	m	38.3	Coast Mile
ND		7,335.7	S acres

Fish Consumption Rating Summary

I	e	8,308.8	S acres
I	e	38.3	Coast Mile

There were 1,192 estuarine acres (14.3 percent) monitored during this assessment period in the aquatic life category with 70.4 acres (<1 percent) Impaired. There were 973.1 estuarine acres (11.7 percent) monitored during this assessment period in the recreation category with no Impaired acreage. There were 7,416.3 estuarine acres (100 percent) monitored during this assessment period in the shellfish harvesting category with 4,439.1 acres (59.8 percent) Impaired.

24.3 Status and Recommendations of Previously and Newly Impaired Waters

The following waters were either identified as Impaired in the previous basin plan (2000) or are newly Impaired based on recent data. If previously identified as Impaired, the water will either remain on the state's 303(d) list or will be delisted based on recent data showing water quality improvements. If the water is newly Impaired, it will likely be placed on the 2006 303(d) list. The current status and recommendations for addressing these waters are presented below, and each is identified by an assessment unit number (AU#). Refer to the overview for more information on AUs. Information regarding 303(d) listing and reporting methodology is presented in Appendix VII.

For Impaired Class SA waters presented below, refer to Chapter 27 for more information and recommendations on shellfish harvesting use support and DEH SS growing area classifications. All waters identified as Impaired in the shellfish harvesting category will be added to the 303(d) list of Impaired waters. TMDLs (Chapter 35) will be developed for identified stressors within 8-13 years of listing.

24.3.1 Banks Channel [AU# 18-87-10-1b and 18-87-24-3]

Current Status
Banks Channel [18-87-10-1b] Prohibited area at Annamarina (4.2 acres) is Impaired for shellfish harvesting because this segment is classified by DEH SS as prohibited in growing area B-7.

Banks Channel [18-87-24.3] south of Wrightsville Beach Recreational area (111.1 acres) is Impaired for shellfish harvesting because this segment is classified by DEH SS as conditionally approved-open in growing area B-8. These segments of Banks Channel will be added to the 303(d) list of Impaired waters.

24.3.2 Batts Mill Creek [AU# 18-87-6], County Line Branch [AU# 18-87-6-1] and Cypress Branch [AU# 18-87-6-2]

Current Status
Batts Mill Creek from source to the ICWW (40.8 acres) is Impaired for shellfish harvesting because this segment is classified by DEH SS as conditionally approved-open in growing area B-9. County Line Branch from source to Batts Mill Creek (1 acres) and Cypress Branch from source to Batts Mill Creek (1 acre) are Impaired for shellfish harvesting because these segments are classified by DEH SS as conditionally approved-closed in growing area B-9. These segments of Batts Mill Creek will be added to the 303(d) list of Impaired waters.

24.3.3 Beckys Creek [AU# 18-87-8a and b]

Current Status
Beckys Creek [18-87-8a and b] from source to the ICWW (108.9 acres) is Impaired for shellfish harvesting because these segments are classified by DEH SS as prohibited and conditionally approved-open in growing area B-8. Beckys Creek will be added to the 303(d) list of Impaired waters.

24.3.4 Everett Bay [AU# 18-87-2]

Current Status
Everett Bay (240.6 acres) is Impaired for shellfish harvesting because this segment is classified by DEH SS as conditionally approved-open in growing area B-9. Everett Bay will be added to the 303(d) list of Impaired waters.

24.3.5 Everett Creek [AU# 18-87-29]

Current Status
Everett Creek from source to ICWW (0.7 acres) is Impaired for shellfish harvesting because this segment is classified by DEH SS as prohibited in growing area B-5. Everett Creek will be added to the 303(d) list of Impaired waters.

24.3.6 Futch Creek [AU# 18-87-19a and b]

Current Status
Futch Creek [18-87-19a and b] from source to the ICWW (28 acres) is Impaired for shellfish harvesting because these segments are classified by DEH SS as prohibited and conditionally approved-open in growing area B-8. These segments of Futch Creek will be added to the 303(d) list of Impaired waters.

24.3.7 Hewletts Creek [AU# 18-87-26a and b]

Current Status
Hewletts Creek [18-87-26a and b] from source to the ICWW (98.2 acres) is Impaired for shellfish harvesting because these segments are classified by DEH SS as prohibited and conditionally approved-open in growing area B-6. Segment 18-87-26a (78.3 acres) is Supporting aquatic life because of a Moderate benthic community rating at site BB299. This upper portion of Hewletts Creek had good snag and root mat habitats, and some intolerant species were noted at the site. These segments of Hewletts Creek will be added to the 303(d) list of Impaired waters.

24.3.8 Howe Creek [AU# 18-87-23]

Current Status
Howe Creek from source to ICWW (28.6 acres) is Impaired for shellfish harvesting because this segment is classified by DEH SS as prohibited in growing area B-7. Howe Creek will be added to the 303(d) list of Impaired waters.

24.3.9 Intracoastal Waterway (ICWW) [AU# 18-87, 18-87-(5.5), (11.5), (23.5)a, b and c]

Current Status
The ICWW [18-87] in DEH growing area B-9 (76.2 acres) is Impaired for shellfish harvesting because this segment is classified by DEH SS as conditionally approved-open in growing area B-9. This segment is supporting aquatic life and recreation because no criteria were exceeded at sites BA 723 and S-55. This segment will be added to the 303(d) list of Impaired waters.

The ICWW [18-87-(5.5)] in DEH growing area B-8 (159.6 acres) is Impaired for shellfish harvesting because this segment is classified by DEH SS as conditionally approved-open in growing area B-8. This segment is supporting recreation because no criteria were exceeded at sites S-52, S-53 and S-54. This segment will be added to the 303(d) list of Impaired waters.

The ICWW [18-87-(11.5) and (23.5)b] in DEH growing area B-7 (176 acres) is Impaired for shellfish harvesting because these segments are classified by DEH SS as prohibited and conditionally approved-open in growing area B-7. Segment 18-87-(11.5) is supporting recreation because no criteria were exceeded at sites S-50 and S-51. These segments will be added to the 303(d) list of Impaired waters.

The ICWW [18-87-(23.5)a] in DEH growing area B-7 (52.8 acres) is Supporting recreation and shellfish harvesting because this segment is classified by DEH SS as approved and because no criteria were exceeded at site S-48.

The ICWW [18-87-(23.5)c] in DEH growing area B-7 (70.4 acres) is Impaired for aquatic life and shellfish harvesting because dissolved oxygen violated water quality standards in 11 percent of samples at site BA728, and this segment is classified by DEH SS as conditionally approved-open. Site BA728 is at the mouth of Howe Creek in the ICWW. There is extensive development occurring in the headwaters of Howe Creek in and around Wilmington. This segment will be added to the 303(d) list of Impaired waters. DWQ will work with Wilmington and New Hanover County to identify potential sources of bacteria and oxygen-consuming materials.

24.3.10 Masonboro Sound ORW Area (ICWW) [AU# 18-87-25.7a, b, c and d]

Current Status
Masonboro Sound [18-87-25.7a] in DEH growing area B-5 and B-6 (285.3 acres) is Supporting recreation and shellfish harvesting because this segment is classified by DEH SS as approved and because no criteria were exceeded at site S-47.

Masonboro Sound [18-87-25.7b, c and d] in DEH growing area B-5 and B-6 (379.7 acres) is Impaired for shellfish harvesting because these segments are classified by DEH SS as prohibited and conditionally approved-open. Segment 18-87-25.7c is Supporting aquatic life because no criteria were exceeded at sites BA730. These segments will be added to the 303(d) list of Impaired waters.

24.3.11 Mill Creek [AU# 18-87-14]

Current Status
Mill Creek from source to ICWW (18.2 acres) is Impaired for shellfish harvesting because this segment is classified by DEH SS as prohibited in growing area B-8. Mill Creek will be added to the 303(d) list of Impaired waters.

24.3.12 Virginia Creek [18-87-9a and b] and Mullett Run [AU# 18-87-9-1]

Current Status
Virginia Creek and Mullett Run from source to ICWW (104.6 acres) are Impaired for shellfish harvesting because these segments are classified by DEH SS as prohibited and conditionally approved-open in growing area B-8. Both creeks will be added to the 303(d) list of Impaired waters.

24.3.13 Nixons Creek [AU# 18-87-11]

Current Status
Nixons Creek from source to ICWW (5.8 acres) is Impaired for shellfish harvesting because this segment is classified by DEH SS as conditionally approved-open in growing area B-8. Nixons Creek will be added to the 303(d) list of Impaired waters.

24.3.14 Old Mill Creek [AU# 18-87-7]

Current Status
Old Mill Creek from source to ICWW (0.1 acres) is Impaired for shellfish harvesting because this segment is classified by DEH SS as conditionally approved-open in growing area B-9. Old Mill Creek will be added to the 303(d) list of Impaired waters.

24.3.15 Old Topsail Creek [AU# 18-87-12a and b]

Current Status
Old Topsail Creek from source to the ICWW (28.9 acres) is Impaired for shellfish harvesting because these segments are classified by DEH SS as prohibited and conditionally approved-open in growing area B-8. These segments of Old Topsail Creek will be added to the 303(d) list of Impaired waters.

24.3.16 Pages Creek [AU# 18-87-22a and b]

Current Status
Pages Creek from source to the ICWW (76.9 acres) is Impaired for shellfish harvesting because these segments are classified by DEH SS as prohibited and conditionally approved-open in growing area B-7. These segments of Pages Creek will be added to the 303(d) list of Impaired waters.

24.3.17 Stump Sound [18-87-3] and Stump Sound ORW Area [AU# 18-87-0.5]

Current Status
Stump Sound and Stump Sound ORW Area from the White Oak River Basin to Permuda Island (1,027.2 acres) are Impaired for shellfish harvesting because these segments are classified by DEH SS as conditionally approved-open in growing area B-8. Both segments will be added to the 303(d) list of Impaired waters.

24.3.18 Topsail Sound [AU# 18-87-10a, b, c and d]

Current Status
Topsail Sound [18-87-10b, c, and d] areas north of the ICWW and around Queens Grant and the Hwy 210 bridge (1,213.4 acres) are Impaired for shellfish harvesting because these segments are classified by DEH SS as prohibited, conditionally approved-open and conditionally approved-closed in growing areas B-8 and B-9. These segments will be added to the 303(d) list of Impaired waters. Segment 18-87-10a (1,190.7 acres) south of the ICWW is Supporting shellfish harvesting because this area is classified by DEH SS as approved.

24.3.19 Topsail Sound and Middle Sound ORW Area [AU# 18-87-11.7a, b, c, d, e and f]

Current Status
Topsail Sound [18-87-11.7b, d, e and f] areas north of the ICWW and around the Figure Eight Island Marina (14.3 acres) are Impaired for shellfish harvesting because these segments are classified by DEH SS as prohibited and conditionally approved-open in growing areas B-7 and B-8.

Segment 18-87-11.7c (272.5 acres) is Impaired for shellfish harvesting because this segment is classified by DEH SS as conditionally approved-open. This segment will be added to the 303(d) list of Impaired waters. This segment is Supporting aquatic life because no criteria were exceeded at site BA727.

Segment 18-87-11.7a (444.8 acres) south of the ICWW is Supporting shellfish harvesting because this area is classified by DEH SS as approved.

24.3.20 Turkey Creek [AU# 18-87-1a and b]

Current Status
Turkey Creek from source to the ICWW (139.1 acres) is Impaired for shellfish harvesting because these segments are classified by DEH SS as conditionally approved-open and conditionally approved-closed in growing area B-9. These segments of Turkey Creek will be added to the 303(d) list of Impaired waters.

24.3.21 Whiskey Creek [AU# 18-87-28]

Current Status
Whiskey Creek from source to ICWW (13 acres) is Impaired for shellfish harvesting because this segment is classified by DEH SS as prohibited in growing area B-6. Whiskey Creek will be added to the 303(d) list of Impaired waters.

24.4 Status and Recommendations for Waters with Noted Impacts

The surface waters discussed in this section are not Impaired. However, notable water quality problems and concerns have been documented for some waters based on this assessment. While these waters are not Impaired, attention and resources should be focused on these waters to prevent additional degradation or facilitate water quality improvement. Waters in the following section are identified by assessment unit number (AU#). Refer to the overview for more information on AUs.

24.4.1 Kings Creek Restricted Area [AU# 18-87-4]

Current Status and 2005 Recommendations

Kings Creek Restricted Area from source to ICWW (165.7 acres) is Not Rated on an evaluated basis for recreation because Holly Ridge WWTP (NC0025859) had significant violations of fecal coliform bacteria permit limits. This creek is Not Rated for aquatic life because the WWTP also had five whole effluent toxicity test failures that may have adversely impacted aquatic life during the last two years of the assessment period. The NPDES compliance process will be used to address the significant permit violations noted above.

Chapter 25
North Carolina Water Quality Standards and Classifications

25.1 Description of Surface Water Classifications and Standards

North Carolina's Water Quality Standards Program adopted classifications and water quality standards for all the state's river basins by 1963. The program remains consistent with the Federal Clean Water Act and its amendments. Water quality classifications and standards have also been modified to promote protection of surface water supply watersheds, high quality waters, and the protection of unique and special pristine waters with outstanding resource values.

25.2 Classifications Summary

All surface waters in the state are assigned a *primary* classification that is appropriate to the best uses of that water. In addition to primary classifications, surface waters may be assigned a *supplemental* classification. Most supplemental classifications have been developed to provide special protection to sensitive or highly valued resource waters. Table 28 briefly describes the best uses of each classification. A full description is available in the document titled: *Classifications and Water Quality Standards Applicable to Surface Waters of North Carolina*. Information on this subject is also available at DWQ's website at http://h2o.enr.state.nc.us/wqs/.

Table 28 Primary and Supplemental Surface Water Classifications

PRIMARY FRESHWATER AND SALTWATER CLASSIFICATIONS*	
Class	**Best Uses**
C and SC	Aquatic life propagation/protection and secondary recreation.
B and SB	Primary recreation and Class C uses.
SA	Waters classified for commercial shellfish harvesting.
WS	*Water Supply watershed*. There are five WS classes ranging from WS-I through WS-V. WS classifications are assigned to watersheds based on land use characteristics of the area. Each water supply classification has a set of management strategies to protect the surface water supply. WS-I provides the highest level of protection and WS-IV provides the least protection. A Critical Area (CA) designation is also listed for watershed areas within a half-mile and draining to the water supply intake or reservoir where an intake is located.
SUPPLEMENTAL CLASSIFICATIONS	
Class	**Best Uses**
Sw	*Swamp Waters*: Recognizes waters that will naturally be more acidic (have lower pH values) and have lower levels of dissolved oxygen.
Tr	*Trout Waters*: Provides protection to freshwaters for natural trout propagation and survival of stocked trout.
HQW	*High Quality Waters*: Waters possessing special qualities including excellent water quality, Native or Special Native Trout Waters, Critical Habitat areas, or WS-I and WS-II water supplies.
ORW	*Outstanding Resource Waters*: Unique and special surface waters which are unimpacted by pollution and have some outstanding resource values.
NSW	*Nutrient Sensitive Waters*: Areas with water quality problems associated with excessive plant growth resulting from nutrient enrichment.

* Primary classifications beginning with a "S" are assigned to saltwaters.

25.3 Water Quality Standards and Rules

Each primary and supplemental classification is assigned a set of water quality *standards* that establish the level of water quality that must be maintained in the waterbody to support the uses associated with each classification. Some of the standards, particularly for HQW and ORW waters, outline protective management strategies aimed at controlling point and nonpoint source pollution. These strategies are discussed briefly below. The standards for C and SC waters establish the basic protection level for all state surface waters. The other primary and supplemental classifications have more stringent standards than for C and SC, and therefore, require higher levels of protection.

Some of North Carolina's surface waters are relatively unaffected by pollution sources and have water quality higher than the standards that are applied to the majority of the waters of the state. In addition, some waters provide habitat for sensitive biota such as trout, juvenile fish, or rare and endangered aquatic species.

25.4 High Quality Waters (HQW)

Criteria for HQW Classification

- Waters rated as Excellent based on DWQ's chemical and biological sampling.
- Streams designated as native or special native trout waters by the Wildlife Resources Commission.
- Waters designated as primary nursery areas or other functional nursery areas by the Division of Marine Fisheries.
- Waters classified by DWQ as WS-I, WS-II or SA.

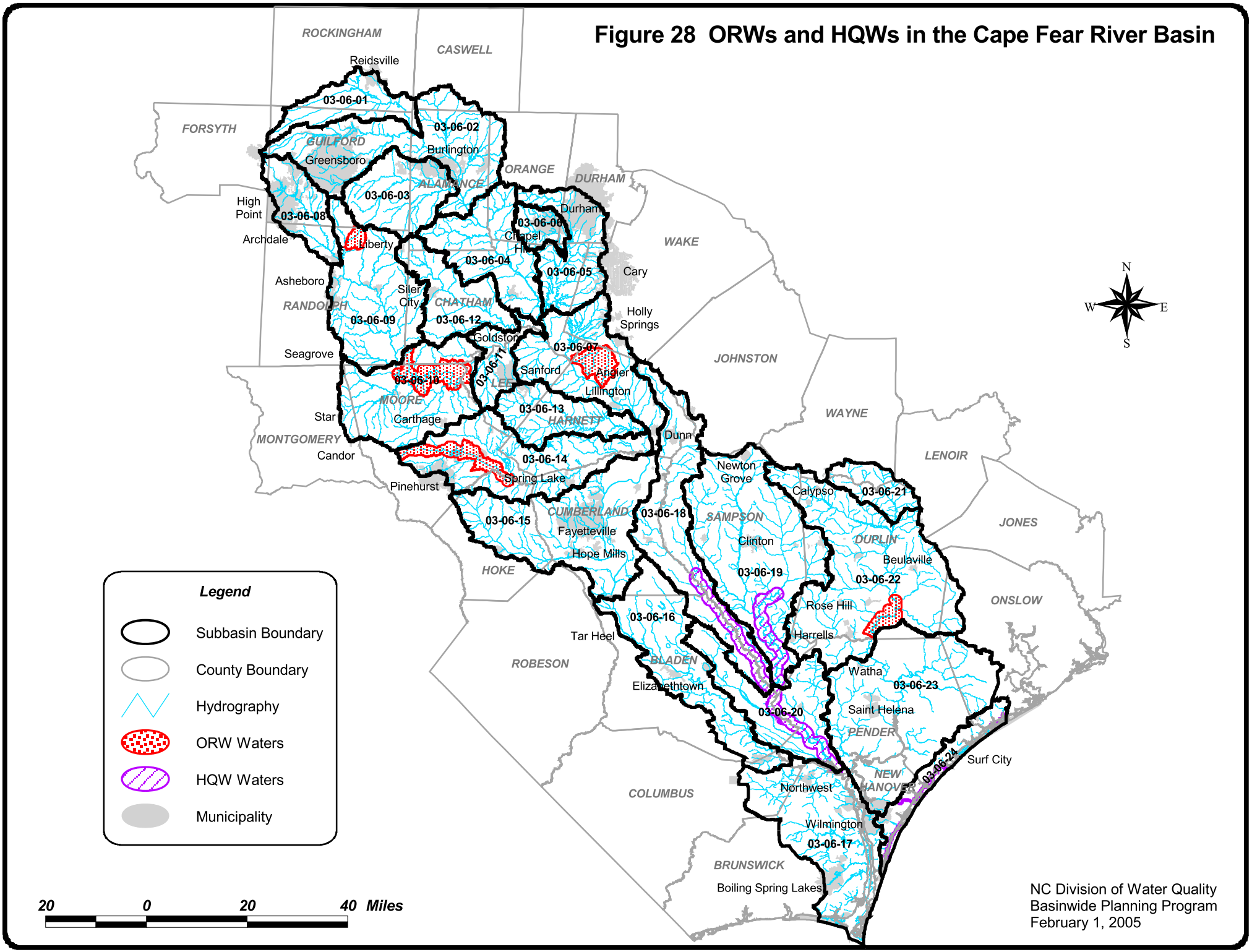
There are 163 stream miles and 262 freshwater acres of HQW waters in the Cape Fear River basin (Figure 28). There are also 165 stream miles, 1,737 freshwater acres of WS-II classified waters, and over 11,000 acres of SA waters that also meet HQW waters criteria. Special HQW protection management strategies are intended to prevent degradation of water quality below present levels from both point and nonpoint sources. HQW requirements for new wastewater discharge facilities and facilities which expand beyond their currently permitted loadings address oxygen-consuming wastes, total suspended solids, disinfection, emergency requirements, volume, nutrients (in nutrient sensitive waters) and toxic substances.

For nonpoint source pollution, development activities which require a Sedimentation and Erosion Control Plan in accordance with rules established by the NC Sedimentation Control Commission or an approved local erosion and sedimentation control program, and which drain to and are within 1 mile of HQWs, are required to control runoff from the development using either a low density or high density option. The low density option requires a 30-foot vegetated buffer between development activities and the stream; whereas, the high density option requires structural stormwater controls. In addition, the Division of Land Resources requires more stringent erosion controls for land-disturbing projects within 1 mile of and draining to HQWs.

25.4 Outstanding Resources Waters (ORW)

There are 129 stream miles and 3,623 acres of ORW waters in the Cape Fear River basin (Figure 28). These waters have excellent water quality (based on biological and chemical sampling as with HQWs) and an associated outstanding resource.

Figure 28 ORWs and HQWs in the Cape Fear River Basin



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The ORW rule defines outstanding resource values as including one or more of the following:

- an outstanding fisheries resource;
- a high level of water-based recreation;
- a special designation such as National Wild and Scenic River or a National Wildlife Refuge;
- within a state or national park or forest; or
- a special ecological or scientific significance.

The requirements for ORW waters are more stringent than those for HQWs. Special protection measures that apply to North Carolina ORWs are set forth in 15A NCAC 2B .0225. At a minimum, no new discharges or expansions are permitted, and a 30-foot vegetated buffer or stormwater controls for new developments are required. In some circumstances, the unique characteristics of the waters and resources that are to be protected require that a specialized (or customized) ORW management strategy be developed.

25.5 Primary Recreation (B, SB and SA)

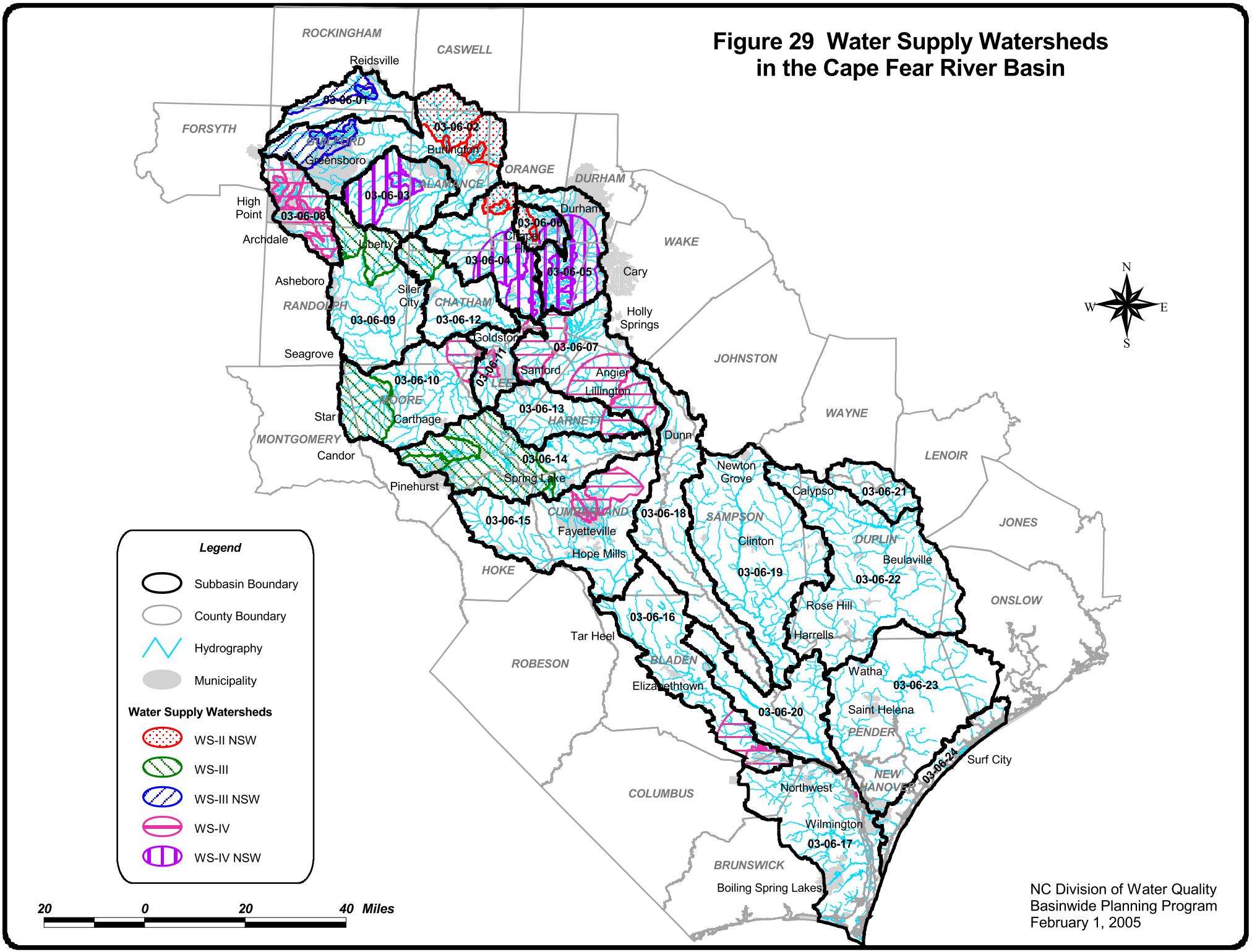
There are 13,779.1 freshwater acres, 584 estuarine acres and 199 stream miles classified for primary recreation in the Cape Fear River basin. There are 14,434 acres SA classified waters that are also protected for primary recreation. Waters classified as Class B or SB are protected for primary recreation, include frequent and/or organized swimming, and must meet water quality standards for fecal coliform bacteria. Sewage and all discharged wastes into Class B or SB waters must be treated to avoid potential impacts to the existing water quality.

25.6 Water Supply (WS-II to WS-V)

There are 1,781 freshwater stream miles and 25,075 freshwater acres currently classified for water supply in the Cape Fear River basin (Figure 29). The purpose of the Water Supply Watershed Protection Program is to provide a proactive drinking water supply protection program for communities. Local governments administer the program based on state minimum requirements. There are restrictions on wastewater discharges, development, landfills and residual application sites to control the impacts of point and nonpoint sources of pollution to water supplies. These programs are applied to 2,169.3 square miles of watershed in the Cape Fear River basin.

There are five water supply classifications (WS-I to WS-V) that are defined according to the land use characteristics of the watershed. The WS-I classification carries the greatest protection for water supplies. No development is allowed in these watersheds. Generally, WS-I lands are publicly owned. WS-V watersheds have the least amount of protection and do not require development restrictions. These are either former water supply sources or sources used by industry. WS-I and WS-II classifications are also HQW by definition because requirements for these levels of water supply protection are at least as stringent as those for HQWs. Those watersheds classified as WS-II through WS-IV require local governments having jurisdiction within the watersheds to adopt and implement land use ordinances for development that are at least as stringent as the state's minimum requirements. A 30-foot vegetated setback is required on perennial streams in these watersheds. The Cape Fear River basin currently contains WS-II, WS-III, WS-IV and WS-V water supply watersheds.

Figure 29 Water Supply Watersheds in the Cape Fear River Basin



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25.7 Nutrient Sensitive Waters (NSW)

There are 1,274 freshwater stream miles and 18,584 freshwater acres with a supplemental classification of NSW (Figure 29). All waters in the Haw River/Jordan Reservoir watershed (subbasins 03-06-01 to 03-06-06) are supplementally classified as NSW. Strategies related to these waters are discussed in Chapter 36.

25.8 Pending and Recent Reclassifications

The Rocky River is in the process of having some segments reclassified to WS to accommodate a new dam and water supply intake. Additional water quality information about the Rocky River is presented in Chapter 12.

Waters upstream of the Randleman Dam on the Deep River were reclassified to WS-IV and WS-IV CA in 1999, as this watershed will be used as a water supply for High Point and Greensboro. See Chapter 8 for water quality information on these waters.

Waters in the Mill Creek watershed upstream of Crystal Lake were reclassified to include the supplemental classification of HQW in 2002. See Chapter 14 for water quality information on these waters.

Chapter 26
Population Growth, Land Cover Changes and Water Quality

26.1 Introduction

Human activities can negatively impact surface water quality, even when the activity is far removed from the waterbody. Pollutants that enter waters fall into two general categories: *point sources* and *nonpoint sources*. With increased population comes increased demand for wastewater discharge and conversion of land from lower impact uses to more intensive urban and suburban land uses. In the Cape Fear River basin, there are over 300 miles of Impaired streams that drain urban or urbanizing areas. With proper management of wastes and land use activities, these impacts can be minimized. Every person living in or visiting a watershed impacts water quality. Therefore, each individual should be aware of these contributions and take actions to reduce them. This chapter provides an overview of population growth impacts associated with increased wastewater discharges and conversion of land from agriculture and forestry to urban land uses.

The Cape Fear River basin is one of the fastest developing basins in the state; the effects of development are impacting water quality. Population in the Cape Fear River basin has grown from just under 1.5 million to over 1.8 million people from 1990 to 2000. The overall population of the basin based on 2000 Census data is 1,834,545, with approximately 197 persons/square mile. This growth is expected to continue especially around existing urban areas. The 26 counties with some land area in the Cape Fear River basin are expected to increase population from just under 3 million to over 5 million people (28.9 percent) over the next 20 years (Appendix I). Associated with this growth will be increasing strain on water resources for drinking water, wastewater assimilation and runoff impacts. There will also be loss of natural areas and increases in impervious surfaces associated with construction of new homes and businesses.

26.2 Impacts of Increased Wastewater Discharges

Point sources are typically piped discharges and are controlled through regulatory programs administered by the state. All regulated point source discharges in North Carolina must apply for and obtain a National Pollutant Discharge Elimination System (NPDES) permit from the state. There has been an increase in wastewater flow discharged to waters in the Cape Fear River basin to meet the demands of the rapidly growing population. Generally, treatment technology has improved to the extent that point sources are no longer the primary source of water quality problems.

Point Sources

Piped discharges from:
- Municipal wastewater treatment plants
- Industrial facilities
- Small package treatment plants
- Large urban and industrial stormwater systems

In the Cape Fear River basin, there are just over 150 Impaired stream miles where point sources are a possible contributor to water quality problems. There are just over 340 miles of streams that may have been adversely impacted by discharges. Most of these streams are located in urban areas where water quality is already degraded. Because of limited assimilative capacity in the basin local governments, industry and the state must carefully plan for wastewater increases on a basinwide scale. Chapter 30 discusses NPDES compliance issues and permitting strategies to be used to accommodate new and expanding discharges in this basin.

26.3 Impacts of Growth and Development

Nonpoint sources are from a broad range of land use activities. Nonpoint source pollutants are typically carried to surface waters by rainfall, runoff or snowmelt. Sediment and nutrients are most often associated with nonpoint source pollution. Other pollutants associated with nonpoint source pollution include fecal coliform bacteria, heavy metals, oil and grease, and any other substance that may be washed off the ground or deposited from the atmosphere into surface waters.

Nonpoint Sources

- Construction activities
- Roads, parking lots and rooftops
- Agriculture
- Failing septic systems and straight pipes
- Timber harvesting
- Hydrologic modifications

Unlike point source pollution, nonpoint pollution sources are diffuse in nature and occur intermittently, depending on rainfall events and land disturbance. Given these characteristics, it is difficult and resource intensive to quantify nonpoint contributions to water quality degradation in a given watershed. While nonpoint source pollution control often relies on voluntary actions, the state has many programs designed to reduce nonpoint source pollution.

Water quality issues and programs associated with agricultural are discussed in Chapter 28. Water quality issues and programs associated with forestry are discussed in Chapter 29. The remainder of this chapter will discuss water quality issues associated with conversion of land to urban and suburban areas.

Cumulative Effects

While any one activity may not have a dramatic effect on water quality, the cumulative effect of land use activities in a watershed can have a severe and long-lasting impact.

Urban land uses have increased from 370,000 acres in 1982 to 627,000 acres in 1997 (70 percent) in the Cape Fear River basin (Appendix III). At this rate of development, well over 1 million acres will be in urban land cover by 2020. Water quality declines dramatically in streams in and around urban centers and along interstate corridors. Most of the Impaired streams in this basin are concentrated in and around existing urban areas. In the Cape Fear River basin, over 300 Impaired stream miles are associated with urban and urbanizing areas. Programs in place to help prevent further degradation to water quality during development are discussed in Chapter 31.

More than any other human activity, urban growth is the greatest threat to aquatic resources. The impacts on rivers, lakes and streams, as development surrounding metropolitan areas consumes neighboring forests and fields, can be significant and permanent if stormwater runoff is not

controlled. Greater numbers of homes, stores and businesses require greater quantities of water. Growing populations not only require more water, but they also lead to the discharge and runoff of greater quantities of waste and pollutants into the state's streams and groundwater. Thus, just as demand and use increases, some of the potential water supply is lost (Orr and Stuart, 2000).

In addition, as watershed vegetation is replaced with impervious surfaces in the form of paved roads, buildings, parking lots, and residential homes and driveways, the ability of the environment to absorb and diffuse the effects of natural rainfall is diminished. Urbanization results in increased surface runoff and correspondingly earlier and higher peak streamflows after rainfall. Flooding frequency is also increased. These effects are compounded when small streams are channelized (straightened) or piped and storm sewer systems are installed to increase transport of drainage waters downstream. Bank scour from these frequent high flow events tends to enlarge urban streams and increase suspended sediment. Scouring also destroys the variety of habitat in streams, leading to degradation of benthic macroinvertebrate populations and loss of fisheries (EPA, 1999).

Most of the impacts result in habitat degradation (Chapter 27), but urban runoff also carries a potentially toxic cocktail including oil and grease from roads and parking lots, street litter and pollutants from the atmosphere. Cumulative impacts from developing and urban areas can cause severe impairment to urban streams.

Water supply needs have normally been sufficient to meet agriculture, water supply, industrial and power generation needs. The severe drought conditions in 2001 and 2002 stressed water resources to near the limit for these uses. It is during these periods of drought that point to the impending threats to the availability of good quality water. Clean water can likely be provided in sufficient quantity to supply the future needs of the basin, but only with inspired foresight, planning and management. Refer to Chapter 32 for more information on water resources management.

Chapter 27
Water Quality Stressors

27.1 Stressor Identification

27.1.1 Introduction and Overview

Water quality stressors are identified when impacts have been noted to biological (fish and benthic) communities or water quality standards have been violated. Stressors apply to one or more use support categories and may be identified for Impaired as well as Supporting waters with noted impacts. Identifying stressors is difficult in many cases because direct measurements of the stressor may be difficult or prohibitively expensive. DWQ staff use field observations from sample sites, special studies and data from ambient monitoring stations as well as information from other agencies and the public to identify potential water quality stressors. It is important to identify stressors and potential sources of stressors so that water quality programs can target limited resources to address water quality problems.

Stressors to recreation uses include the following pathogen indicators - fecal coliform bacteria, escheria coli, and enterrococci. Stressors to shellfish harvesting are fecal coliform bacteria, and stressors to fish consumption are mercury and any other substance that causes issuance of a fish consumption advisory.

Most stressors to the biological community are complex groupings of many different stressors that individually may not degrade water quality or aquatic habitat but together can severely degrade aquatic life. Sources of stressors are most often associated with land use in a watershed as well as the quality and quantity of any treated wastewater that may be entering a stream. During naturally severe conditions such as droughts or floods, any individual stressor or group of stressors may have more severe impacts to aquatic life than during normal climatic conditions. The most common source of stressors is from altered watershed hydrology.

As discussed above, sources of stressors most often come from a watershed where the hydrology is altered enough to allow the stressor to be easily delivered to a stream during a rain event along with unnaturally large amounts of water. DWQ identifies the source of a stressor as specifically as possible depending on the amount of information available in a watershed. Most often the source is based on the predominant land use in a watershed. Stressor sources identified in the Cape Fear River basin during this assessment period include urban or impervious surface areas, construction sites, road building, land clearing, agriculture and forestry.

27.1.2 Altered Hydrology as the Ultimate Stressor Source

Aquatic communities (benthic macroinvertebrates and fish) in natural or undisturbed watersheds are impacted only by the most extreme events such as hurricanes or extreme droughts. Even after these events streams in these watersheds are able to recover. As a watershed is altered, more stressors (such as chemicals and bacteria) are found in the watershed and because of the nature of watershed alteration, there are more ways for water to get to streams very rapidly

carrying these new stressors. Once a watershed is severely altered, such as in most urban areas, there are multitudes of stressors in the watershed and many ways for the stressors to affect aquatic life. Also in these watersheds the important habitats are depleted because the natural ground cover is removed and trees are rare. The very high flows in heavily altered watersheds can cause a multitude of instream habitat problems as well. The following stressor discussions are aimed at identification of specific stressors to the various land uses, but the ultimate cause and source of these stressors is the altered watershed hydrology.

27.1.3 Overview of Stressors Identified in the Cape Fear River Basin

The stressors noted below are summarized from all waters and for all use support categories. Figures 30 to 32 identify stressors noted for Impaired waters in the Cape Fear River basin during the most recent assessment period. The stressors noted in these figures may not be the sole reason for an Impaired use support rating. Stressors that are listed because of standards violations may require TMDL development for waters where these stressors are identified. Refer to subbasin chapters for a complete listing of stressors by waterbody. For specific discussions of stressors to Impaired waters refer to the subbasin chapters 1 through 24. There are also 4.7 miles of Atlantic Coastline miles Impaired for recreation where the identified stressor is enterrococcus (not graphed). All waters in the basin are Impaired in the fish consumption category where mercury is the stressor of concern. Stressor definitions and impacts are discussed in the remainder of this chapter.

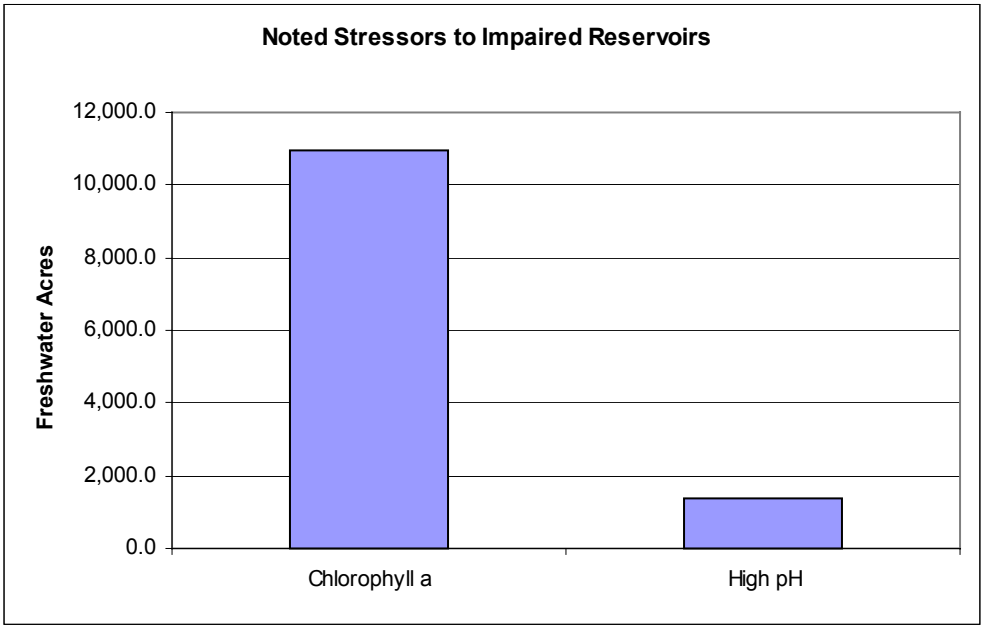


Figure 30 Noted Stressors to Impaired Reservoirs in the Cape Fear River Basin.

Figure 31 Noted Stressors to Impaired Streams in the Cape Fear River Basin.

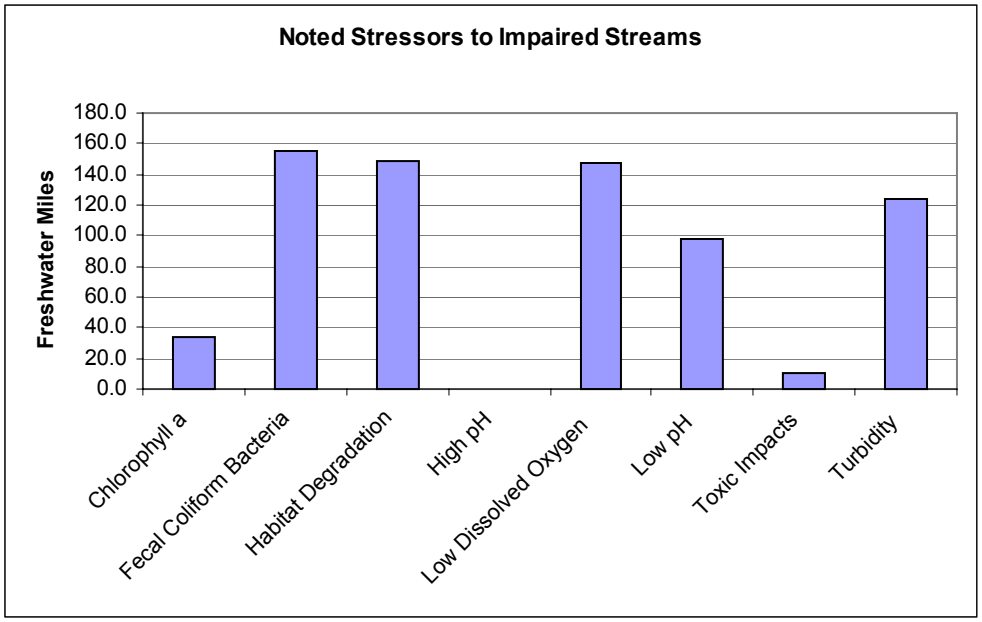
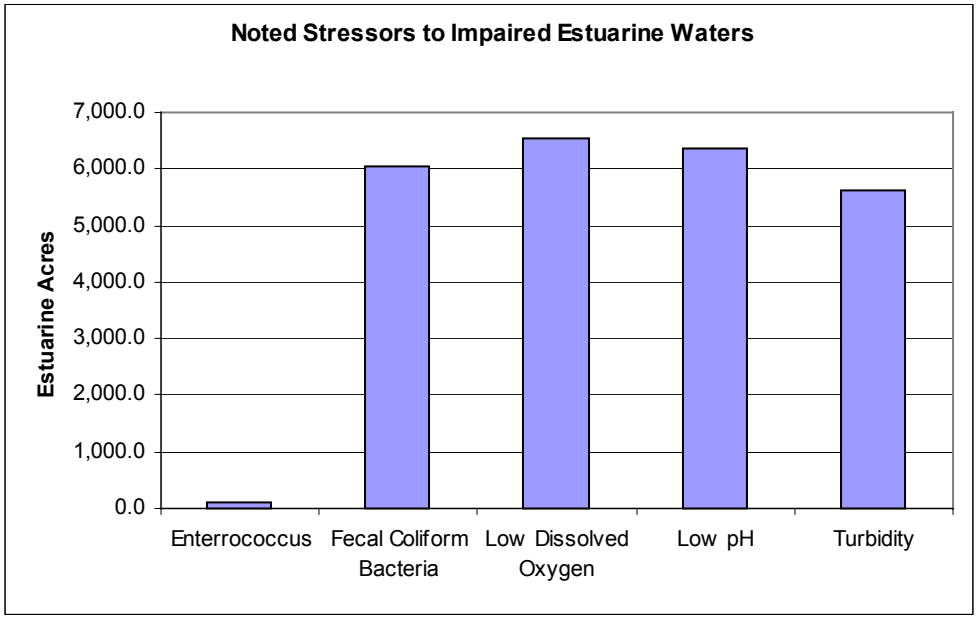


Figure 32 Noted Stressors to Impaired Estuarine Waters in the Cape Fear River Basin.



Figures 33 to 35 identify stressors noted for Impacted waters in the Cape Fear River basin during the most recent assessment period. The stressors noted in these figures did not result in an Impaired use support rating. Refer to subbasin chapters for a complete listing of stressors by waterbody. For specific discussions of stressors to Impacted waters refer to the subbasin chapters 1 through 24. Stressor definitions and impacts are discussed in the remainder of this chapter.

Figure 33 Noted Stressors to Impacted Reservoirs in the Cape Fear River Basin.

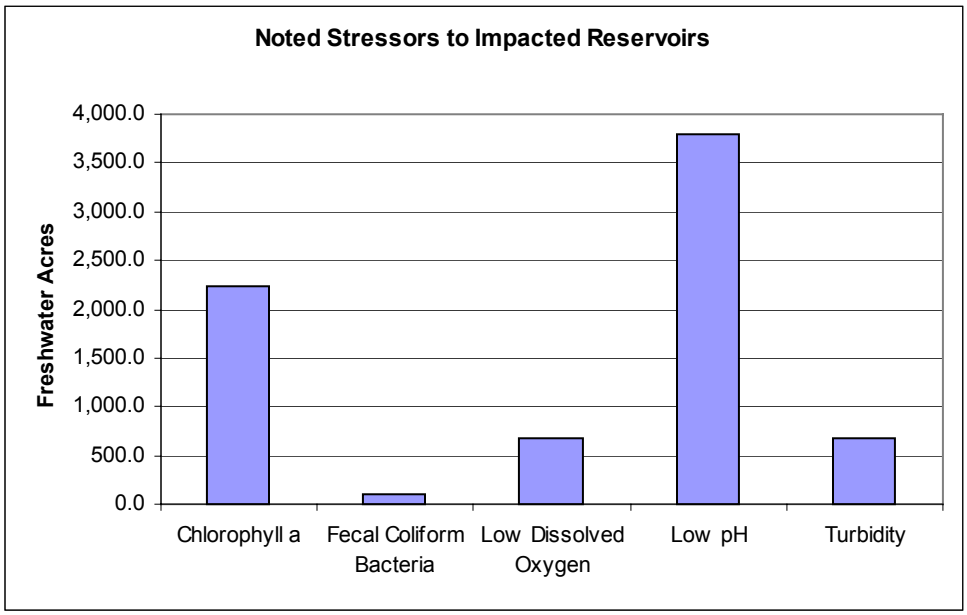


Figure 34 Noted Stressors to Impacted Streams in the Cape Fear River Basin.

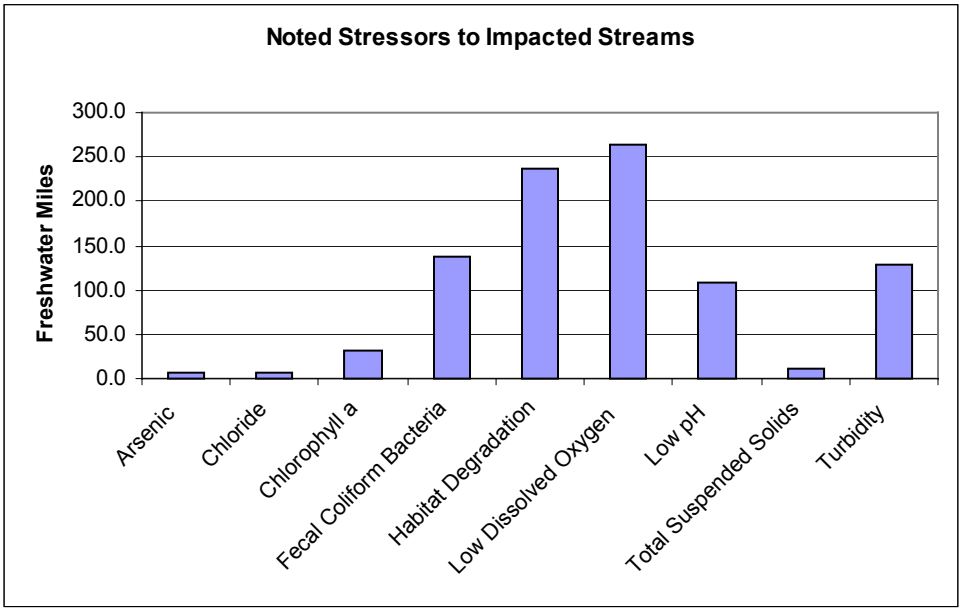
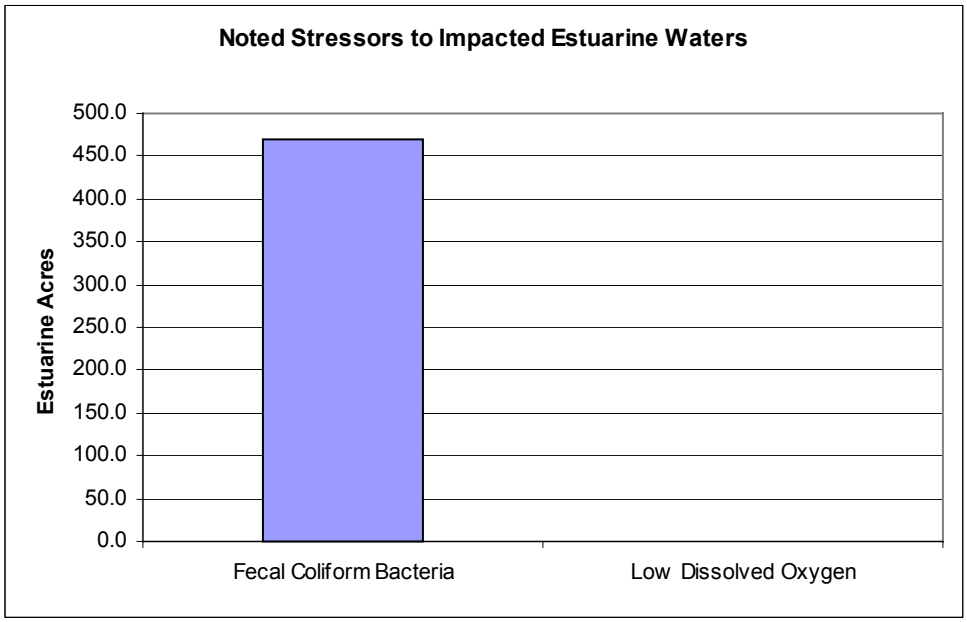


Figure 35 Noted Stressors to Impacted Estuarine Waters in the Cape Fear River Basin.



27.1.4 Overview of Stressor Sources Identified in the Cape Fear River Basin

The sources noted below are summarized from all waters and for all use support categories. Figures 36 to 38 identify sources of stressors noted for waters in the Cape Fear River basin during the most recent assessment period. Refer to subbasin chapters for a complete listing of sources by waterbody. For specific discussions of stressor sources refer to the subbasin chapters 1 through 24. There are also 10.3 miles of Atlantic Coastline where the identified sources of stressors are stormwater outfalls to the beach (not graphed).

WWTP NPDES (wastewater treatment plants) were noted as a potential source to many of the freshwater acres in the Cape Fear River basin. WWTPs contribute nutrients (with other sources) that may increase the potential for algal blooms and cause exceedances of the chlorophyll *a* standard. This can include all discharges upstream of the area of Impairment or noted impacts. WWTPs were noted as a potential source of water quality problems in 105.8 stream miles. Most of these impacts were localized and based on permit violations. Better treatment technology and permit compliance has greatly decreased the number of stream miles locally impacted by WWTPs.

MS4 NPDES (municipal separate storm sewer systems) were noted as sources to many of the freshwater acres for the same reasons as the WWTPs discussed above. MS4 was noted as a potential source when the stream segment was associated with a NPDES permitted municipality. Unlike the WWTPs, MS4s were noted as a potential source of stressors to 375.8 stream miles because of the local impacts of runoff from these urban areas. Impervious surface was noted as a source when field observations indicated that roads and other development not associated with permitted urban areas was the source of stressors to the stream segment. Impervious surface was noted as a source of stressors in 77.2 stream miles. Developed land is the most common source of stressors to water quality in the Cape Fear River basin.

Agriculture was noted as a potential source of water quality stressors when field observations and watershed studies noted agriculture as the predominant land cover. Agriculture was noted as a source of stressors in 91.8 stream miles. Pasture was also noted as a source when field observations indicated that cattle had access to streams or streams ran through pasture areas. Pasture was noted as a potential source of water quality stressors in 36.3 stream miles. Agriculture and pasture impacts and programs are discussed in more detail in Chapter 28.

Land clearing and road construction were noted as potential sources of water quality stressors to less than 70 stream miles. Much of the land clearing and road construction is associated with increased development. Streams where land clearing is a noted source are likely to be more heavily impacted in the future by increased development.

Figure 36 Sources of Stressors to Reservoirs in the Cape Fear River Basin.

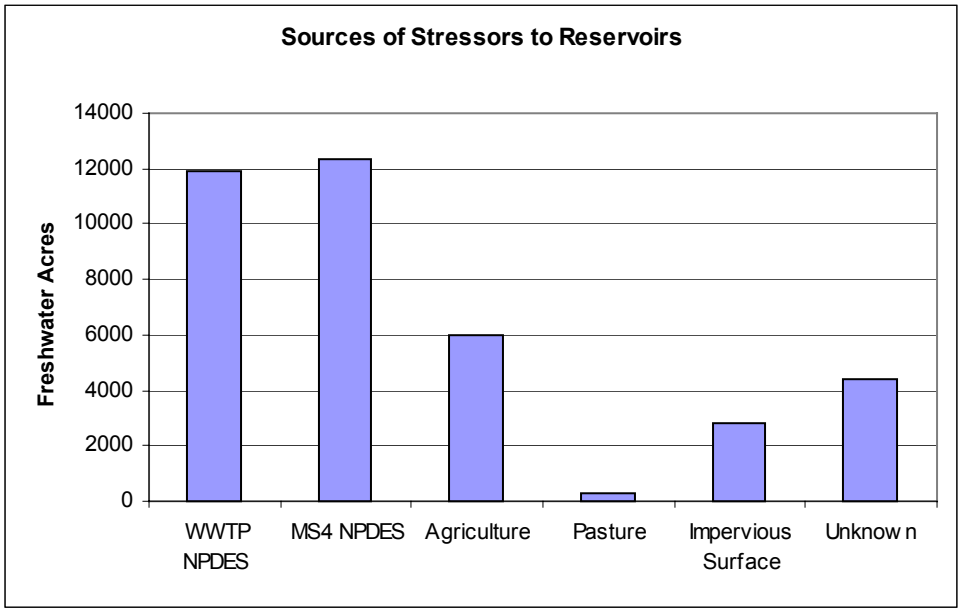


Figure 37 Sources of Stressors to Streams in the Cape Fear River Basin.

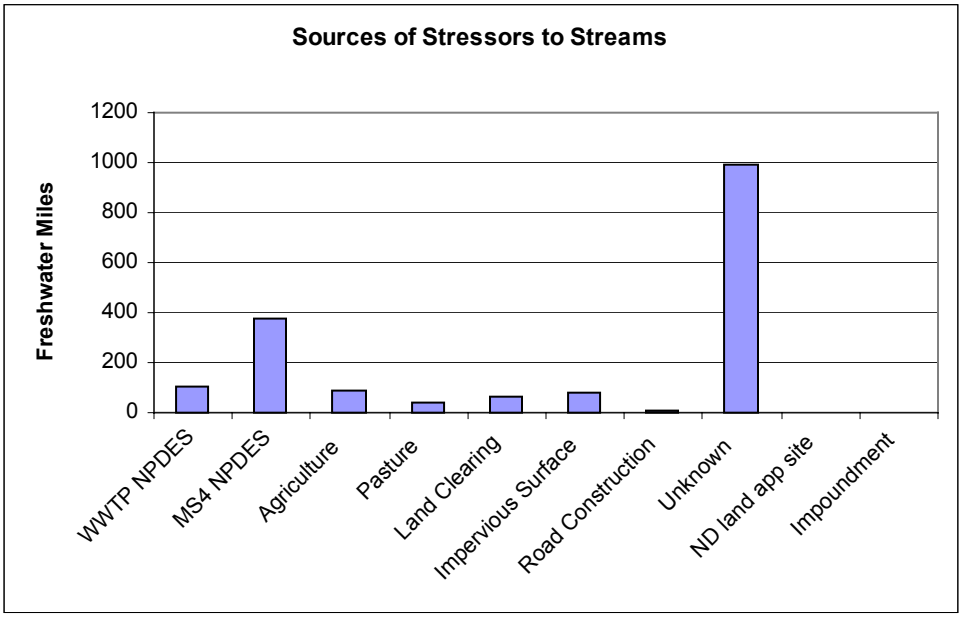
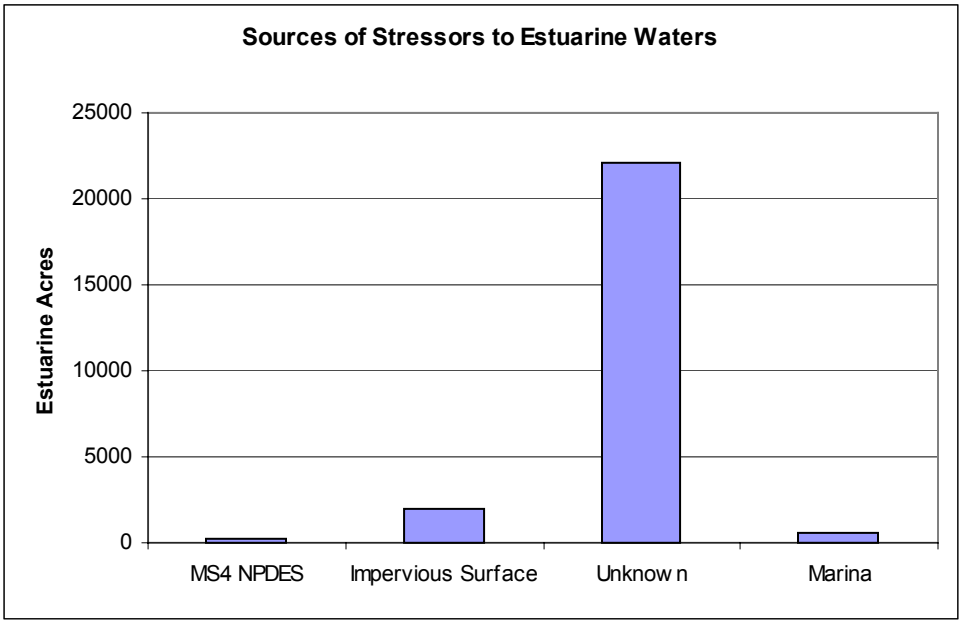


Figure 38 Sources of Stressors to Estuarine Waters in the Cape Fear River Basin.



27.2 Aquatic Life Stressors-Habitat Degradation

27.2.1 Introduction and Overview

Instream habitat degradation is identified as a notable reduction in habitat diversity or a negative change in habitat. This term may include sedimentation, lack of organic (woody and leaf) habitats and channelization. These stressors to aquatic insect and fish communities can be caused by many different land use activities and less often by discharges of treated wastewater into small streams. In the Cape Fear River basin, over 149.2 stream miles are Impaired where at least one form of habitat degradation is the stressor. There are an additional 236.0 stream miles where habitat degradation is impacting water quality. Many of the stressors discussed below are either directly caused by or are a symptom of altered watershed hydrology. The altered hydrology increases both sources of stressors and delivery of stressors to receiving waters. Refer to the subbasin chapters for more information on the types of habitat degradation noted at sample locations and in watershed studies.

Some Best Management Practices

Agriculture

- No till or conservation tillage practices
- Strip cropping and contour farming
- Leaving natural buffer areas around small streams and rivers

Construction

- Using phased grading/seeding plans
- Limiting time of exposure
- Planting temporary ground cover
- Using sediment basins and traps

Forestry

- Controlling runoff from logging roads
- Replanting vegetation on disturbed areas
- Leaving natural buffer areas around small streams and rivers

Good instream habitat is necessary for aquatic life to survive and reproduce. Streams that typically show signs of habitat degradation are in watersheds that have a large amount of land-disturbing activities (construction, mining, timber harvest and agricultural activities) or a large percentage of impervious surface area. A watershed in which most of the riparian vegetation has been removed from streams or channelization has occurred also exhibits instream habitat degradation. Streams that receive a discharge quantity that is much greater than the natural flow in the stream often have degraded habitat as well. All of these activities result in altered watershed hydrology.

Quantifying amounts of habitat degradation is very difficult in most cases. To assess instream habitat degradation in most streams would require extensive technical and monetary resources and even more resources to restore the stream. Although DWQ and other agencies are starting to address this issue, local efforts are needed to prevent further instream habitat degradation and to restore streams that have been Impaired by activities that cause habitat degradation. As point sources become less of a source of water quality impairment, nonpoint sources that pollute water and cause habitat degradation need to be addressed to further improve water quality in North Carolina's streams and rivers.

27.2.2 Sedimentation

Sedimentation is a natural process that is important to the maintenance of diverse aquatic habitats. Overloading of sediment in the form of sand, silt and clay particles fills pools and

covers or embeds riffles that are vital aquatic insect and fish habitats. A diversity of these habitats is important for maintenance of biological integrity. Suspended sediment can decrease primary productivity (photosynthesis) by shading sunlight from aquatic plants, affecting the overall productivity of a stream system. Suspended sediment also has several effects on various fish species including avoidance and redistribution, reduced feeding efficiency, and therefore, reduced growth by some species, respiratory problems, reduced tolerance to diseases and toxicants, and increased physiological stress (Roell, 1999). Sediment filling rivers, streams and reservoirs also decreases their storage volume and increases the frequency of floods (NCDENR-DLR, 1998). Suspended sediment also increases the cost of treating municipal drinking water. Sediment overloading to many streams has reduced biological diversity to the point of the stream being Impaired for aquatic life.

Sediment comes from land-disturbing activities in a watershed. The cause of this form of sedimentation is erosion of land in the watershed. Land-disturbing activities such as the construction of roads and buildings, crop production, livestock grazing and timber harvesting can accelerate erosion rates by causing more soil than usual to be detached and moved by water.

Streambank erosion, caused by very high stormwater flows after rain events, is another source of sediment overloading. Watersheds with large amounts of impervious surfaces transport water to streams very rapidly and at higher volumes than occurs in watersheds with little impervious surfaces. In many urban areas, stormwater is delivered directly by storm sewers. This high volume and velocity of water after rain events undercuts streambanks causing bank failure and large amounts of sediment to be deposited directly into the stream. Many urban streams are adversely impacted by sediment overloading from the watershed as well as from the streambanks.

Sedimentation can be controlled during most land-disturbing activities by using appropriate BMPs. Substantial amounts of erosion can be prevented by planning to minimize the amount and time that land is exposed during land-disturbing activities and by minimizing impervious surface area and direct stormwater outlets to streams. Refer to Chapter 31 for more information on programs designed to reduce sedimentation.

27.2.3 Lack of Organic Aquatic Habitats

During 2002 basinwide sampling, DWQ biologists reported degradation of aquatic communities at numerous sites throughout the Cape Fear River basin in association with narrow or nonexistent zones of native riparian vegetation. Riparian vegetation loss was common in rural and residential areas as well as in urban areas. The loss of riparian vegetation and subsequent reduction of organic aquatic habitats is caused by loss of riparian areas, most commonly by land clearing for development, field agriculture, pastureland, forestry and by grazing animals. Instream organic habitat removal has also been caused by de-snagging activities.

Removing trees, shrubs and other vegetation to plant grass or place rock (also known as riprap) along the bank of a river or stream degrades water quality. Removing riparian vegetation eliminates habitat for aquatic macroinvertebrates that are food for trout and other fish. Rocks or concrete lining on a bank absorb the sun's heat and warm the water. Some fish require cooler water temperatures as well as the higher dissolved oxygen levels cooler water provides. Trees, shrubs and other native vegetation cool the water by shading it. Straightening a stream, clearing

streambank vegetation, and lining the banks with grass or rock severely impact the habitat that aquatic insects and fish need to survive.

Establishing, conserving and managing streamside vegetation (riparian buffer) is one of the most economical and efficient BMPs. Forested buffers in particular provide a variety of benefits including filtering runoff and taking up nutrients, moderating water temperature, preventing erosion and loss of land, providing flood control and helping to moderate streamflow, and providing food and habitat for both aquatic and terrestrial wildlife. To obtain a free copy of DWQ's *Buffers for Clean Water* brochure, call (919) 733-5083, ext. 558.

Organic microhabitat (leafpacks, sticks and large wood) and edge habitat (root banks and undercut banks) play very important roles in a stream ecosystem. Organic matter in the form of leaves, sticks and other materials serve as the base of the food web for small streams. Additionally, these microhabitats serve as special niches for different species of benthic macroinvertebrates, providing food and/or habitat. For example, many stoneflies are found almost exclusively in leafpacks and on small sticks. Some beetle species prefer edge habitat, such as undercut banks. If these microhabitat types are not present, there is no place for these specialized macroinvertebrates to live and feed. The absence of these microhabitats in some streams in the Cape Fear River basin is directly related to the absence of riparian vegetation. Organic microhabitats are critical to headwater streams, the health of which is linked to the health of the entire downstream watershed.

27.2.4 Channelization

Channelization refers to the physical alteration of naturally occurring stream and riverbeds. Channelization is caused by mechanical straightening of channels or by hydraulic overloading during rain events. Often streams in urban areas become channelized as part of the development process in essence using the stream channels as stormwater conveyances. Although increased flooding, bank erosion and channel instability often occur in downstream areas after channelization has occurred, flood control, reduced erosion, increased usable land area, greater navigability and more efficient drainage are frequently cited as the objectives of channelization projects (McGarvey, 1996).

Channelization reduces the sinuosity of streams greatly increasing the velocity of water running these streams. Direct or immediate biological effects of channelization include injury and mortality of benthic macroinvertebrates, fish, shellfish/mussels and other wildlife populations, as well as habitat loss. Indirect biological effects include changes in benthic macroinvertebrate, fish and wildlife community structures, favoring species that are more tolerant of or better adapted to the altered habitat (McGarvey, 1996).

Restoration or recovery of channelized streams may occur through processes, both naturally and artificially induced. In general, streams that have not been excessively stressed by the channelization process can be expected to return to their original forms. However, streams that have been extensively altered may establish a new, artificial equilibrium (especially when the channelized streambed has been hardened). In such cases, the stream may enter a vicious cycle of erosion and continuous entrenchment. Once the benefits of a channelization project become outweighed by the costs, both in money and environmental integrity, channel restoration efforts are likely to be taken (McGarvey, 1996).

Channelization of streams is extensive and promises to become even more so as urban development continues. Overall estimates of lost or altered riparian habitats within US streams are as high as 70 percent. Unfortunately, the dynamic nature of stream ecosystems makes it difficult (if not impossible) to quantitatively predict the effects of channelization (McGarvey, 1996). Channelization has occurred historically in parts of the Cape Fear River basin and continues to occur in some watersheds, especially in small headwater streams.

27.3 Aquatic Life Stressors - Water Quality Standards Violations

27.3.1 Introduction and Overview

In addition to the habitat stressors discussed in the previous section, the stressors discussed below are identified by water quality standards violations. These are usually direct measures of water quality parameters from ambient water quality monitoring stations. The water quality standards are designed to protect aquatic life. As discussed above, altered watershed hydrology greatly increases the sources of these stressors as well as delivery of the stressors to the receiving waters. The following stressors were identified for waters where greater than 10 percent of the observations were above the water quality standard. Refer to the subbasin chapters for more information on the affected waters and the data used to make these assessments.

27.3.2 Arsenic

Arsenic is a metal that is toxic to aquatic life. Waters are Impaired for aquatic life when greater than 10 percent of samples collected exceed the state arsenic standard and at least 10 samples were collected. The arsenic water quality standard for Class C waters is 50 µg/l. In the Cape Fear River basin during this assessment period, there were 6.6 stream miles where arsenic was the identified stressor (see Chapter 8).

27.3.3 Chlorophyll *a* Algal Blooms

Algae are aquatic, microscopic plants, which respond to nutrients, temperature and light, and are an important food source for fish and other aquatic animals. Algae also contain pigments, including chlorophyll, which enable them to photosynthesize and produce oxygen. During summer, algae respond to warm temperatures, high light and nutrients washed into waterways after rain events and from treated wastewater. When temperatures and nutrient concentrations are elevated, algae reproduce to high concentrations ("bloom"). When this occurs at a particular site, chlorophyll *a*, dissolved oxygen (DO) and pH increase. When a site experiences dissolved oxygen concentrations >9 mg/l, DO percent saturation >110%, pH >8, or chlorophyll *a* concentrations exceed the state standard of 40 µg/l, the site is likely experiencing an algal bloom. When these algae die off or respire at night, dissolved oxygen can become very low. Many times low dissolved oxygen caused by algal die off can cause fish kills. Algal blooms have been a problem in lakes, reservoirs and estuaries that are overloaded with nutrients.

Waters are Impaired for aquatic life when greater than 10 percent of samples collected exceed the state chlorophyll *a* standard of 40 µg/l and at least 10 samples were collected. In the Cape Fear River basin during this assessment period, there were 10,833.9 freshwater acres and 11.7

stream miles that are Impaired where chlorophyll *a* is a stressor. There were also 2,239.8 freshwater acres and 32.6 stream miles that are impacted where chlorophyll *a* is a stressor.

27.3.4 Low Dissolved Oxygen

Maintaining an adequate amount of dissolved oxygen (DO) is critical to the survival of aquatic life and to the general health of surface waters. A number of factors influence DO concentrations including water temperature, depth and turbulence. Additionally, in the Cape Fear River basin, a large floodplain drainage system and flow management from upstream impoundments also influences DO. Oxygen-consuming wastes such as decomposing organic matter and some chemicals can reduce DO levels in surface water through biological activity and chemical reactions. NPDES permits for wastewater discharges set limits on certain parameters in order to control the effects that oxygen depletion can have in receiving waters.

Waters are Impaired for aquatic life when greater than 10 percent of samples collected exceed the state DO standard and at least 10 samples were collected. The DO water quality standard for Class C waters is not less than a daily average of 5 mg/l with a minimum instantaneous value of not less than 4 mg/l. For Class SC waters the standard is 5 mg/l. Swamp waters (supplemental Class Sw) may have lower values if caused by natural conditions. In the Cape Fear River basin during this assessment period, there were 6,527.4 estuarine acres and 43.9 stream miles that are Impaired where low DO is a stressor. There were also over 667.5 freshwater acres, 264.9 stream miles and 1.0 estuarine acres where low DO is a stressor, although many of these streams are in swampy areas where low DO levels are likely from natural sources.

27.3.5 pH

Waters are Impaired for aquatic life when greater than 10 percent of samples collected exceed the state pH standard and at least 10 samples were collected. The pH water quality standard for Class C waters is between 6.0 and 9.0. For Class SC waters the standard is between 6.8 and 8.5. Swamp waters (supplemental Class Sw) may have lower values if caused by natural conditions. In the Cape Fear River basin during this assessment period, there were 97.9 stream miles and 6,360.4 estuarine acres that are Impaired where low pH is a stressor. There were 1,445.5 freshwater acres that are Impaired where high pH is a stressor. There were also 3,799.6 freshwater acres and 107.2 stream miles that are impacted where low pH is a stressor, although many of these streams are in swampy areas where low pH levels are likely from natural sources.

27.3.6 Total Suspended Solids

Total suspended solids (TSS) are noted as a stressor when identified from NPDES compliance reports. Waters are not Impaired due to TSS permit violations. In the Cape Fear River basin during this assessment period, there were 12.4 stream miles impacted where TSS is a stressor.

27.3.7 Toxic Impacts

Toxic impacts are noted as a stressor when identified during biological community monitoring. Waters are not Impaired due to toxic impacts. In the Cape Fear River basin during this assessment period, there were 10.8 stream miles Impaired where toxic impacts are a stressor.

27.3.8 Turbidity

Waters are Impaired for aquatic life when greater than 10 percent of samples collected exceed the state turbidity standard and at least 10 samples were collected. The turbidity water quality standard for Class C waters is not to exceed 50 Nephelometric Turbidity Units (NTU). In the Cape Fear River basin during this assessment period, there were 115.4 stream miles and 5,616.7 estuarine acres that are Impaired where turbidity is a stressor. There were also 685.5 freshwater acres and 127.7 stream miles that are impacted where turbidity is a stressor.

27.4 Recreation Stressors - Pathogens

27.4.1 Fecal Coliform Bacteria

Water quality standards for fecal coliform bacteria are intended to ensure safe use of waters for recreation (refer to Administrative Code Section 15A NCAC 2B .0200). The North Carolina fecal coliform standard for freshwater is 200 colonies/100ml based on the geometric mean of at least five consecutive samples taken during a 30-day period and not to exceed 400 colonies/100ml in more than 20 percent of the samples during the same period. In the Cape Fear River basin, there are 40.9 stream miles where this standard was exceeded. These waters are Impaired for recreation. In 154.6 stream miles fecal coliform bacteria is a noted stressor because annual screening criteria were exceeded. These waters were not intensively sampled to assess the standard as described above, but had either a geometric above 200 colonies/100ml and/or 20 percent of samples exceeded 400 colonies/100ml over the five-year assessment period. These waters are discussed in the subbasin chapters. A total of 19,339 acres, 1,119.9 stream miles and 48.6 coastline miles were monitored for recreation.

A number of factors beyond the control of any state regulatory agency contribute to elevated levels of disease-causing bacteria. Therefore, the state does not encourage swimming in surface waters. To assure that waters are safe for swimming indicates a need to test waters for pathogenic bacteria. Although fecal coliform standards have been used to indicate the microbiological quality of surface waters for swimming for more than 50 years, the value of this indicator is often questioned. Evidence collected during the past several decades suggests that the coliform group may not adequately indicate the presence of pathogenic viruses or parasites in water.

Fecal coliform bacteria live in the digestive tract of warm-blooded animals (humans as well as other mammals) and are excreted in their waste. Fecal coliform bacteria do not actually pose a danger to people or animals. However, where fecal coliform are present, disease-causing bacteria may also be present and water that is polluted by human or animal waste can harbor other pathogens that may threaten human health.

The presence of disease-causing bacteria tends to affect humans more than aquatic creatures. High levels of fecal coliform bacteria can indicate high levels of sewage or animal wastes that could make water unsafe for human contact (swimming). Fecal coliform bacteria and other potential pathogens associated with waste from warm-blooded animals are not harmful to fish and aquatic insects. However, high levels of fecal coliform bacteria may indicate contamination that increases the risk of contact with harmful pathogens in surface waters. Pathogens associated

with fecal coliform bacteria can cause diarrhea, dysentery, cholera and typhoid fever in humans. Some pathogens can also cause infection in open wounds.

Under favorable conditions, fecal coliform bacteria can survive in bottom sediments for an extended period (Howell et *al*., 1996; Sherer et *al*., 1992; Schillinger and Gannon, 1985). Therefore, concentrations of bacteria measured in the water column can reflect both recent inputs as well as the resuspension of older inputs.

Sources of Fecal Coliform in Surface Waters

- Urban stormwater
- Wild animals and domestic pets
- Improperly designed or managed animal waste facilities
- Livestock with direct access to streams
- Improperly treated discharges of domestic wastewater, including leaking or failing septic systems and straight pipes

Reducing fecal coliform bacteria in wastewater requires a disinfection process, which typically involves the use of chlorine and other disinfectants. Although these materials may kill the fecal coliform bacteria and other pathogenic disease-causing bacteria, they also kill bacteria essential to the proper balance of the aquatic environment, and thereby, endanger the survival of species dependent on those bacteria.

The detection and identification of specific pathogenic bacteria, viruses and parasites such as *Giardia*, *Cryptosporidium* and *Shigella* are expensive, and results are generally difficult to reproduce quantitatively. Also, to ensure the water is safe for swimming would require a whole suite of tests for many organisms, as the presence/absence of one organism would not document the presence/absence of another. This type of testing program is not possible due to resource constraints.

27.4.2 Enterrococcus-Recreational Beach Monitoring

Enterrococcus is the pathogen indicator used by DEH Recreational Water Quality Monitoring Program to assess recreation in coastal waters. DWQ does not directly use enterococcus data to assign use support ratings. Waters are Impaired when swimming advisories are posted for more than 61 days during the five year assessment period. In the Cape Fear River basin 96.6 estuarine acres and 4.7 Atlantic coastline miles are Impaired for recreation because of swimming advisories posted during the assessment period. Enterrococcus is the stressor in these waters.

27.5 Fish Consumption Stressors - Mercury

The presence and accumulation of mercury in North Carolina's aquatic environment are similar to contamination observed throughout the country. Mercury has a complex life in the environment, moving from the atmosphere to soil, to surface water and into biological organisms. Mercury circulates in the environment as a result of natural and human (anthropogenic) activities. A dominant pathway of mercury in the environment is through the atmosphere. Mercury that has been emitted from industrial and municipal stacks into the ambient air can circulate across the globe. At any point, mercury may then be deposited onto land and water. Once in the water, mercury can accumulate in fish tissue and humans. Mercury is also commonly found in wastewater.

The NC Department of Health and Human Services issues fish consumption advisories and advice for those fish species which have median and/or average methyl mercury levels at 0.4 mg/kg or greater. These fish include shark, swordfish, king mackerel, tilefish, as well as largemouth bass, bowfin (or blackfish) and chain pickerel (or jack) in North Carolina waters south and east of Interstate 85. See *Fish Consumption Advice* below. Refer to Appendix X for more information regarding use support ratings and assessment methodology. DWQ has sampled fish tissue from 13 locations in the Cape Fear River basin. Refer to subbasin chapters for more information on these waters.

For more detailed information, visit EPA's internet site at http://www.epa.gov/waterscience/fish/ or visit http://www.cfsan.fda.gov/seafood1.html or call the FDA's food information line toll-free at 1-888-SAFEFOOD.

For more information and detailed listing of site-specific advisories, visit the NC Department of Health and Human Services website at http://www.schs.state.nc.us/epi/fish/current.html or call (919) 733-3816.

27.6 Shellfish Harvesting Stressors - Fecal Coliform Bacteria

DWQ does not directly use DEH Shellfish Sanitation Section (DEH SS) fecal coliform bacteria data to make use support determinations in Class SA waters. DWQ relies on the growing area status of waters in the Cape Fear River basin that are monitored by DEH SS. Class SA waters that are in a DEH SS Approved classification are Supporting in the shellfish harvesting use support category by DWQ. All other DEH SS growing area classifications are considered to be Impaired in the shellfish harvesting category by DWQ. In the Cape Fear River basin, there are 2,654.2 acres of prohibited waters, 94.2 acres of conditionally approved-closed waters, and 3,822.8 acres of conditionally approved-open waters. All of these waters (6,571.2 acres) are Impaired for shellfish harvesting and the stressor is fecal coliform bacteria.

Chapter 28
Agriculture and Water Quality

28.1 Impacted Streams in Agricultural Areas

Cultivated cropland was 16 (947,100 acres) percent of the land use in the Cape Fear River basin in 1997. While still a large portion of the basin land use, this is 20 percent (1,177,000 acres) less cultivated cropland than in 1982 (USDA-NRCS, 2001). In the Cape Fear River basin, there are nearly 265 stream miles that may be impacted by agricultural activities. There are over 25 Impaired stream miles where agriculture is identified as a potential source of water quality stressors. Impacts to water quality from agricultural sources may decrease over the next basin cycle due to substantial increases in urban/built-up areas throughout the river basin.

2005 Recommendations

DWQ will identify streams where agricultural land use may be impacting water quality and aquatic habitat. This information will be related to local Division of Soil and Water Conservation and NRCS staff to investigate the agricultural impacts in these watersheds and to recommend BMPs to reduce impacts. DWQ recommends that funding and technical support for agricultural BMPs be continued and increased. Refer to Appendix VIII for agricultural nonpoint source agency contact information.

28.2 Agricultural Best Management Practices Funding Opportunities

28.2.1 USDA – NRCS Environmental Quality Incentives Program (EQIP)

The Environmental Quality Incentives Program provides technical, educational and financial assistance to eligible farmers to address soil, water and related natural resource concerns on their lands in an environmentally beneficial and cost-effective manner. The program provides assistance to farmers in complying with federal and state environmental laws and encourages environmental enhancement. The purposes of the program are achieved through the implementation of a conservation plan that includes structural, vegetative and land management practices on eligible land. Five to 20-year contracts are made with eligible producers. Cost share payments may be made to implement one or more eligible structural or vegetative practice, such as animal waste management facilities, terraces, filter strips, tree planting and permanent wildlife habitat. Incentive payments can be made to implement one or more land management practices, such as nutrient management, pest management and grazing land management.

Fifty percent of the funding available for this program will be targeted at natural resource concerns relating to livestock production. The program is carried out primarily in priority areas that may be watersheds, regions or multi-state areas and for significant statewide natural resource concerns that are outside of geographic priority areas. EQIP's authorized budget of $1.3 billion is prorated at $200 million per year through the year 2002.

NRCS district contacts for the Cape Fear River basin are provided in Appendix VIII or visit the website at http://www.nrcs.usda.gov/programs/eqip/ for more information.

28.2.2 NC Agriculture Cost Share Program

The North Carolina Agriculture Cost Share Program (ACSP) was established in 1984 to help reduce the sources of agricultural nonpoint source pollution to the state's waters. The program helps owners and renters of established agricultural operations improve their on-farm management by using Best Management Practices (BMPs). These BMPs include vegetative, structural or management systems that can improve the efficiency of farming operations while reducing the potential for surface and groundwater pollution. The Agriculture Cost Share Program is a voluntary program that reimburses farmers up to 75 percent of the cost of installing an approved BMP. The program is implemented by the Division of Soil and Water Conservation (DSWC). The cost share funds are paid to the farmer once the planned control measures and technical specifications are completed. The annual statewide budget for BMP cost sharing is approximately 6.9 million.

From 1998 to 2003, DSWC ACSP implemented nearly $5 million in practices to 1580 projects. The practices have affected 65,586 acres, saved 251,451 tons of soil, 1.5 million pounds of nitrogen and 425,130 pounds of phosphorus in the Cape Fear River basin. SWCD contacts for the Cape Fear River basin are included in Appendix VIII or for more information, visit the website at http://www.enr.state.nc.us/DSWC/pages/agcostshareprogram.html.

28.2.3 Agricultural Sediment Initiative

In 2000, the NC Association of Soil and Water Conservation Districts and the NC Soil and Water Conservation Commission initiated an effort to assess stream channels and watersheds of streams on the state's 2000 303(d) list due to sediment where agriculture was included as a potential source. The primary objective of the Agricultural Sediment Initiative was to evaluate 303(d) listed waters in order to assess the severity of sedimentation associated with agricultural activities within the watershed and to develop local strategies for addressing sedimentation. The initiative involved 47 Impaired stream segments in 34 counties and 11 river basins.

In 2001, the Soil and Water Conservation Commission allocated additional Agriculture Cost Share Funds to districts to address agricultural sediment. Table 29 summarizes the results of the completed Agricultural Sediment Surveys for five watersheds in three counties in the Cape Fear River basin. District staff requested approximately $2,840,000 for restoration and protection work in two of the watersheds.

Table 29 Summary of Agricultural Sediment Initiative Surveys

Stream	County	Problems Identified	Funds Requested by District
Haw River	Guilford/ Alamance	Cropland erosion, urban development, impervious surface, road construction, streambank erosion, deforestation	$1,200,000
Little Troublesome Creek	Rockingham	Streambank erosion, urban development, unpaved roads, cropland erosion	$160,000

Chapter 29
Forestry in the Cape Fear River Basin

29.1 Impacted Streams in Forestland

Forestland was 60 (3,531,100 acres) percent of the land use in the Cape Fear River basin in 1997. While still the largest portion of the basin land use, this is six percent less forestland than in 1982 (USDA-NRCS, 2001). In the Cape Fear River basin, there are no Impaired stream miles that have been directly impacted by forest harvesting activities. Impacts to water quality from forestry sources may decrease over the next basin cycle due to substantial increases in urban/built-up areas throughout the river basin. Most land clearing activities around urban areas are for development and usually not associated with forest harvesting.

DWQ will identify streams where forest harvesting may be impacting water quality and aquatic habitat. This information will be related to Division of Forest Resources staff to investigate the impacts in these watersheds and to recommend BMPs to reduce impacts. DWQ recommends that funding and technical support for forestry BMPs be continued and increased. Refer to Appendix VIII for forestry nonpoint source agency contact information.

29.2 Forestland Ownership

Nearly 3.2 million acres are classified as timberland in the Cape Fear River basin, as estimated from data in the most recent publication by the USDA-Forest Service (Brown, 2004) Nearly 84 percent of this land is owned by nonindustrial private landowners. Forest industry accounts for 7 percent of the timberland, while federal and state governments each comprise approximately 4 percent ownership (Figure 39). Local governments own the remaining 1 percent of timberland.

While there are no National Forests in the basin, publicly-owned forestland includes over 33,000 acres at Bladen Lakes State Forest located in Bladen County (subbasin 03-06-16). This demonstration forest, certified under the international Forest Stewardship Council (FSC), is managed for the sustainable production of forest resources and contributes to the protection of the unique pocosin and Carolina Bay ecosystems.

Two Educational State Forests are also operated by the Division of Forest Resources' to provide educational programs while managing the forests for multiple resources. Turnbull Creek ESF, at 890 acres, protects portions of Turnbull Creek and is located north of Elizabethtown (subbasin 03-06-16). Approximately 900 acres of the federally protected lands around Jordan Lake are managed as the Jordan Lake ESF (subbasin 03-06-05). More information about the ESFs is available on the DFR's website www.dfr.state.nc.us.

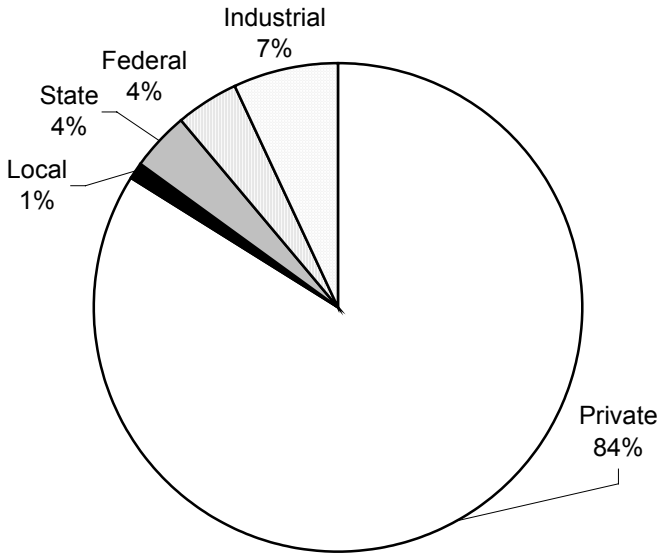


Figure 39 Ownership of Forestland in the Cape Fear River Basin

29.3 Forestry Water Quality Regulations in North Carolina

29.3.1 Forest Practices Guidelines for Water Quality (FPGs) and Randleman Buffer Rules

Forestry operations in North Carolina are subject to regulation under the Sedimentation Pollution Control Act of 1973 (G.S. Ch.113A Art.4 referred to as "SPCA"). However, forestry operations may be exempted from the permit and plan requirements of the SPCA, if the operations meet the compliance standards outlined in the *Forest Practices Guidelines Related to Water Quality* (15A NCAC 1I .0101 - .0209, referred to as "FPGs") and General Statutes regarding stream obstruction (G.S.77-13 and G.S.77-14). Additional regulations affect forestry operations that occur within the Randleman Lake watershed, including mandatory vegetative riparian buffers and specific limitations on tree harvesting in the buffer.

The North Carolina Division of Forest Resources (DFR) is delegated the authority to monitor and evaluate forestry operations for compliance with these aforementioned laws and/or rules. In addition, the DFR works to resolve identified FPG compliance questions brought to its attention through citizen complaints. Violations of the FPG performance standards that cannot be resolved by the DFR are referred to the appropriate state agency for enforcement action.

During the period January 1, 1999 through December 31, 2003, the Division of Forest Resources conducted 4,111 FPG inspections for water quality issues on forestry-related activities in the Cape Fear River basin; 96 percent of the sites inspected were in compliance.

29.3.2 Other Forestry Related Water Quality Regulations

In addition to the state regulations noted above, DFR monitors the implementation of the following federal rules relating to water quality and forestry operations:

- The Section 404 Dredge and Fill exemption under the Clean Water Act.
- The US Army Corps of Engineers 15 mandatory Best Management Practices (BMPs) related to road construction in wetlands.
- The US Army Corps of Engineers BMPs for mechanical site preparation activities for the establishment of pine plantations in the southeast.

29.3.3 Water Quality Foresters

Two Water Quality Foresters based out of the DFR's Hillsborough and Whiteville District Offices handle water quality issues on forestry operations located in the upper and lower subbasins of the Cape Fear River basin. Two additional Water Quality Foresters handle those small portions of the Cape Fear River basin located in Wayne and Onslow counties. The DFR currently has a Water Quality Forester located in seven of the DFR's 13 districts across the state. Assistant District Foresters or Service Foresters handle water quality issues in the remaining districts, along with other forest management and fire control responsibilities. Water Quality Foresters conduct FPG inspections, survey BMP implementation, develop pre-harvest plans, and provide training opportunities for landowners, loggers and the public regarding water quality issues related to forestry.

29.3.4 Forestry Best Management Practices

Implementing Forestry Best Management Practices is strongly encouraged by the Division of Forest Resources in order to efficiently and effectively protect the water resources of North Carolina. The *Forestry Best Management Practices Manual* describes recommended techniques that should be used to help comply with the state's forestry laws and help protect water quality. This manual is currently undergoing its first revision since adoption in 1989. This revision, led by the DENR-appointed Technical Advisory Committee (TAC), has undertaken over two years' of effort on this project.

From March 2000 through March 2003, the DFR conducted a statewide BMP Implementation Survey to evaluate Forestry BMPs on active harvest operations related to forest management. This survey evaluated 65 sites in the Cape Fear River basin, with a resulting BMP implementation rate of 82 percent, on par with the statewide implementation rate. The problems most often cited in this survey, across the state, relate to stream crossings, skid trails and site rehabilitation. This survey, and additional surveys to be conducted, will serve as a basis for focused efforts in the forestry community to address water quality concerns through better and more effective BMP implementation and training.

To help address some of these issues, the DFR has been providing bridgemats on loan out to loggers for establishing temporary stream crossings during harvest activities. Temporary bridges are usually the best solution for stream crossings, instead of culverts or hard-surfaced 'ford' crossings. Bridgemats have been available for use in the entire Cape Fear River basin for only a

short period of time. They are available upon request from DFR District Offices. More information about using bridgemats, and the above noted BMP survey, is available on the 'Water Quality' section of the DFR's website at www.dfr.state.nc.us. These bridgemats were acquired through Section 319 grants from the USEPA.

29.4 Forest Resources

29.4.1 Forest Products Industry

Forestry is a vital economic driver throughout the Cape Fear River basin, with significant forest industry operations located in the upper, middle and lower sectors of the basin. Statewide, forest industry contributes nearly $18 billion annually to North Carolina's economy. In the Cape Fear River basin, 32 different businesses are considered "Primary Processors" of forest products raw material, which represents 13 percent of the total number of primary processors in the state. This basin includes one of the five major pulp and paper mills located in North Carolina. Other examples of a primary processor are a sawmill, veneer mill, chip mill, pallet mill or plywood mill. These primary processors pay an assessment to the state, which is then combined with annual legislative appropriations, to fund the "Forest Development Program - FDP", which provides cost shared reforestation assistance for forest landowners.

29.4.2 Forest Management

At least 106,000 acres of privately-owned land were established or regenerated with forest trees across the Cape Fear River basin from January 1, 1999 through December 31, 2003 with nearly one-half of these acres reforested with partial funding through the FDP. During this same time period, the DFR provided approximately 5,800 individual forest management plans for landowners, encompassing over 326,000 acres in the Cape Fear River basin.

Nearly 18,000 acres across 61 tracts are certified under the DFR's Forest Stewardship Program. This voluntary, cooperative program helps individual forest owners manage their total forest resource. Landowners receive technical assistance in developing a stewardship management plan based on their ownership objectives. Activities are scheduled to enhance the forest for wildlife, soil and water quality, timber production, recreational opportunities, and natural beauty. Recertification is required periodically to benchmark the progress of the owner's stewardship plan.

29.4.3 Urban Forestry

Twelve towns and cities are "Tree City USA" communities, ranging from recent awards in Wilmington (2002) to the longest term in Graham (1980). Since 2001, the Urban and Community Forestry Grant Program has awarded over $98,000 for 13 community-based urban forestry projects in the basin. These projects may include urban forestry education, municipal tree inventories, tree planting and teacher education. Urban forestry and an associated field known as 'Agroforestry' are becoming increasingly vital components in reducing NPS runoff by integrating "working green space" into urban development projects.

29.5 Forestry Accomplishments

Since the previous basinwide plan was produced, the DFR accomplished the following tasks in an ongoing effort to improve compliance with forest regulations and, in turn, minimize nonpoint source (NPS) pollution from forestry activities:

1. Expanded the availability of bridgemats to all of DFR's operating districts within the Cape Fear River basin.
2. Established a Forestry NPS Unit that develops and oversees projects throughout the state that involves protection, restoration and education on forestry NPS issues.
3. Produced 1,500 copies of an information leaflet explaining the Randleman Lake Watershed Buffer Protection Rule for use by loggers, landowners and forestry professionals.
4. Revised and produced 10,000 copies of a pocket field guide outlining the requirements of the FPGs and suggested BMPs to implement.
5. Created and published 15,000 copies of a new brochure "Call Before You Cut" for landowners promoting pre-harvest planning to insure water quality issues are addressed prior to undertaking timber harvesting.
6. Continued to assist with workshops in cooperation with the NC Forestry Association's "ProLogger" logger training program. As of 2004, this program requires at least six credit hours of continuing education every three years focused exclusively on water quality topics.
7. Achieved third-party sustainable forestry certification at Bladen Lakes State Forest through the internationally recognized Forest Stewardship Council (FSC).

DFR continues its efforts to protect water quality through various protection, restoration and education projects. This includes research project, on-site demonstrations, and integration of NPS topics through the DFR's network of Educational State Forests and State Forests. Progress reports and summaries are posted in the 'Water Quality' section of the DFR's website at www.dfr.state.nc.us as they are completed.

Chapter 30
Wastewater Treatment and Disposal

30.1 NPDES Wastewater Discharge Permit Summary

The primary pollutants associated with point source discharges are:

* oxygen-consuming wastes,
* nutrients,
* color, and
* toxic substances including chlorine, ammonia and metals.

Discharges that enter surface waters through a pipe, ditch or other well-defined point of discharge are broadly referred to as 'point sources'. Wastewater point source discharges include municipal (city and county) and industrial wastewater treatment plants and small domestic wastewater treatment systems serving schools, commercial offices, residential subdivisions and individual homes. Point source dischargers in North Carolina must apply for and obtain a National Pollutant Discharge Elimination System (NPDES) permit. Discharge permits are issued under the NPDES program, which is delegated to DWQ by the Environmental Protection Agency.

Types of Wastewater Discharges

Major Facilities: Wastewater Treatment Plants with flows ≥1 MGD (million gallons per day); and some industrial facilities (depending on flow and potential impacts to public health and water quality).

Minor Facilities: Facilities not defined as Major.

100% Domestic Waste: Facilities that only treat domestic-type waste (from toilets, sinks, washers).

Municipal Facilities: Public facilities that serve a municipality. Can treat waste from homes and industries.

Nonmunicipal Facilities: Non-public facilities that provide treatment for domestic, industrial or commercial wastewater. This category includes wastewater from industrial processes such as textiles, mining, seafood processing, glass-making and power generation, and other facilities such as schools, subdivisions, nursing homes, groundwater remediation projects, water treatment plants and non-process industrial wastewater.

Currently, there are 244 permitted wastewater discharges in the Cape Fear River basin with a permitted flow of approximately 425 MGD. Table 30 provides summary information (by type and subbasin) about the discharges. Various types of dischargers listed in the table are described in the inset box. Facilities are mapped in each subbasin chapter. For a complete listing of permitted facilities in the basin, refer to Appendix VI.

The majority of NPDES permitted wastewater discharges into the waters of the Cape Fear River basin are from major municipal wastewater treatment plants. Nonmunicipal discharges also contribute substantial wastewater into the Cape Fear River basin.

Table 30 Summary of NPDES Dischargers and Permitted Flows for the Cape Fear River Basin (as of 10/27/04)

	Catawba River Subbasin																							
Facility Categories	**01**	**02**	**03**	**04**	**05**	**06**	**07**	**08**	**09**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**TOTAL**
Total Facilities	11	30	6	6	11	4	16	23	13	3	7	4	6	9	6	7	41	2	8	2	6	13	7	3	244
Total Permitted Flow (MGD)	7.80	76.61	12.06	0.83	32.4	14.77	17.56	29.41	9.85	1.93	7.82	4.02	9.03	10.49	53.28	13.73	99.93	0.08	6.83	0.82	1.4	9.94	3.80	0.1	424.49
Major Discharges	2	6	1	0	2	1	6	2	1	1	1	1	3	2	4	3	13	0	1	0	1	3	2	0	56
Total Permitted Flow (MGD)	7.65	74.05	12.0	0.0	32.0	14.5	15.56	17.75	9.0	1.3	6.8	4.0	6.7	9.5	53.25	7.5	96.16	0.0	5.0	0.0	1.0	6.92	2.95	0.0	383.59
Minor Discharges	9	24	5	6	9	3	10	21	12	2	6	3	3	7	2	4	28	2	7	2	5	10	5	3	188
Total Permitted Flow (MGD)	0.15	2.56	0.06	0.83	0.4	0.27	2.0	11.67	0.85	0.63	1.02	0.02	2.33	0.99	0.03	6.23	3.77	0.08	1.83	0.82	0.4	3.02	0.86	0.1	40.92
100% Domestic Waste	8	11	3	2	6	1	3	8	6	0	2	3	1	4	1	1	8	1	1	1	0	1	2	0	74
Total Permitted Flow (MGD)	0.15	0.45	0.06	0.04	0.4	0.18	0.1	0.17	0.13	0.0	0.01	0.02	0.33	0.93	0.03	0.01	1.08	0.05	0.01	0.02	0.0	0.01	0.04	0.0	4.22
Municipal Facilities	1	5	1	2	2	1	6	2	3	2	1	1	2	2	3	1	9	0	6	1	1	5	1	1	59
Total Permitted Flow (MGD)	7.5	74.0	12.0	0.78	32.0	14.5	5.5	17.75	9.58	1.9	6.8	4.0	4.2	1.56	52.0	1.23	38.66	0.0	6.82	0.8	1.0	6.43	0.75	0.1	299.86
Nonmunicipal Facilities	10	25	5	4	9	3	10	21	10	1	6	3	4	7	3	6	32	2	2	1	5	8	6	2	185
Total Permitted Flow (MGD)	0.3	2.61	0.06	0.06	0.4	0.27	12.07	11.67	0.27	0.03	1.02	0.02	4.83	8.93	1.28	12.51	61.27	0.08	0.01	0.02	0.4	3.51	3.05	0.0	124.67

30.2 NPDES Wastewater Compliance Summary

There were 52 significant NPDES permit violations in the last two years of the assessment period. There are 156 Impaired stream miles where point sources may have negatively impacted the water quality. Facilities, large or small, where recent data show problems with a discharge are discussed in each subbasin chapter. DWQ will determine if the violations are ongoing and address them using the NPDES permitting process. Many other waters are adversely impacted by the cumulative affects of discharges and nonpoint source runoff.

30.3 NPDES Permitting Strategies

The following permitting strategies are to address specific water quality issues in receiving waters. Dischargers into tributaries of the following streams may also be required to adhere to recommendations presented below. Permitted facilities and new permit applications that are not discussed below will be treated on a case-by-case basis dependant upon local water quality conditions and use support ratings.

30.3.1 Haw River Jordan Reservoir

Jordan Reservoir is Impaired, and a TMDL and NSW strategy is being developed that will include changes to NPDES permit limits. This strategy is discussed in Chapter 36.

30.3.2 Randleman Watershed Permitting Strategy

The 2000 basin plan recommended that no new discharges be permitted and that only High Point Eastside WWTP be allowed to expand. Refer to Chapter 8 for more information on water quality issues in this watershed.

30.3.3 Deep River from Randleman Reservoir to Carbonton Dam

The 2000 basin plan recommended the following permit limits for oxygen-consuming waste in this segment of the Deep River:

New and expanding discharges ≥1 MGD: BOD5 = 5 mg/l, NH_3-N = 1 mg/l, TP = 1 mg/l
New and expanding discharges <1 MGD: BOD5 = 15 mg/l, NH_3-N = 4 mg/l
New and expanding discharges <1 MGD and >0.5 MGD: TP = 2 mg/l

DWQ continues to recommend the permit limits from the 2000 basin plan. The Deep River behind Carbonton Dam is Impaired because of chlorophyll *a* standards violations (Chapter 10) that are an indicator of excessive algal growth (Chapter 27). Because of this impairment, further reductions in nutrients from permitted facilities upstream of the dam as well as from nonpoint sources may be required. No additional TP or TN mass loading will be permitted for any discharges upstream of Carbonton Dam and below Randleman Dam.

30.3.4 Deep River from Carbonton Dam to the Haw River

No new discharges of oxygen-consuming wastes should be permitted into this segment since wastewater assimilative capacity no longer exists in this segment of the Deep River.

30.3.5 Cape Fear River from Jordan Dam to Buckhorn Dam

The Cape Fear River upstream of Buckhorn Dam is Impaired because of chlorophyll *a* standards violations (Chapter 7) that are an indicator of excessive algal growth (Chapter 27). A TMDL will be developed to address the chlorophyll *a* impairment that may require further reductions in nutrients from permitted facilities upstream of the dam as well as from nonpoint sources. No additional TP or TN mass loading will be permitted for any discharges upstream of Buckhorn Dam and below Carbonton Dam on the Deep River and Jordon Dam on the Haw River.

30.3.6 Cape Fear River from Buckhorn Dam to L&D 3

The Cape Fear River from Grays Creek to Lock and Dam 3 is Impaired because of chlorophyll *a* standards violations (Chapter 15) that are an indicator of excessive algal growth (Chapter 27). Because of this impairment, the following interim permitting policy will be used for discharges from Buckhorn Dam to L&D #3.

New discharges:

- Seasonal summer (April-October) mass nutrient loads based on permitted flow and concentrations of TN = 6 mg/l and TP = 2 mg/l.

Expanding discharges:

- Seasonal summer (April-October) mass nutrient loads based on the greater of either: a) freezing current nutrient mass loading using actual flows and actual nutrient concentrations; or b) mass nutrient loadings based on permitted expansion flow and concentrations of TN = 6 mg/l and TP = 2 mg/l.

Because of this impairment, a TMDL will be developed which may require further reductions in nutrients from permitted facilities upstream of the dam as well as from nonpoint sources may be required.

The following permit limits from the 2000 basin plan continue to be recommended for other oxygen-consuming wastes.

New and expanding municipal discharges ≥1 MGD: BOD5 = 5 mg/l, NH_3-N = 1 mg/l
New and expanding municipal discharges <1 MGD: BOD5 = 12 mg/l, NH_3-N = 2 mg/l
New industrial discharges ≥1 MGD: BOD5 = 5 mg/l, NH_3-N = 1 mg/l
New industrial discharges <1 MGD: BOD5 = 5 mg/l, NH_3-N = 2 mg/l
Expanding industrial discharges: site specific best available technology or
BOD5 = 5 mg/l, NH_3-N = 2 mg/l

30.3.7 Cape Fear River from L&D 3 to L&D1

The following permit limits from the 2000 basin plan continue to be recommended for oxygen-consuming wastes.

New and expanding municipal discharges ≥1 MGD: BOD5 = 5mg/l, NH_3-N = 1mg/l
New and expanding municipal discharges <1 MGD: BOD5 = 12mg/l, NH_3-N = 2mg/l
New industrial discharges ≥1 MGD: BOD5 = 5mg/l, NH_3-N = 1mg/l
New industrial discharges <1 MGD: BOD5 = 5mg/l, NH_3-N = 2mg/l
Expanding industrial discharges: site specific best available technology or
BOD5 = 5mg/l, NH_3-N = 2mg/l

30.3.8 Cape Fear River from Lock and Dam #1 to the Lower Cape Fear River Estuary

The following permit limits from the 2000 basin plan continue to be recommended for oxygen-consuming wastes.

New and expanding municipal discharges ≥1 MGD: BOD5 = 5mg/l, NH_3-N = 1mg/l
New and expanding municipal discharges <1 MGD: BOD5 = 5mg/l, NH_3-N = 2mg/l
New industrial discharges: BOD5 = 5mg/l, NH_3-N = 2 mg/l
Expanding industrial discharges: site specific best available technology or
BOD5 = 5mg/l, NH_3-N = 2mg/l

A TMDL is being developed to address low dissolved oxygen levels in the Cape Fear River estuary. This may require further reductions in permit limits for discharges of oxygen-consuming wastes into this segment of the Cape Fear River. Expanding discharges will be carefully considered on a case-by-case basis.

30.4 Animal Operations Wastewater Treatment and Disposal

In 1992, the Environmental Management Commission (EMC) adopted a rule modification (15A NCAC 2H.0217) establishing procedures for managing and reusing animal wastes from intensive livestock operations. The rule applies to new, expanding or existing feedlots with animal waste management systems designed to serve animal populations of at least the following size: 100 head of cattle, 75 horses, 250 swine, 1,000 sheep or 30,000 birds (chickens and turkeys) with a liquid waste system.

These systems are design to treat liquid waste and spray the waste at agronomic rates onto fields where the nutrients are assimilated by crops. Failures in the waste treatment systems that impact surface waters are discussed in the subbasin chapters.

Key Animal Operation Legislation (1995-2003)

1995 Senate Bill 974 requires owners of swine facilities with 250 or more animals to hire a certified operator. Operators are required to attend a six-hour training course and pass an examination for certification. Senate Bill 1080 established buffer requirements for swine houses, lagoons and land application areas for farms sited after October 1, 1995.

1996 Senate Bill 1217 required all facilities (above threshold populations) to obtain coverage under a general permit, beginning in January 1997, for all new and expanding facilities. DWQ was directed to conduct annual inspections of all animal waste management facilities. Poultry facilities with 30,000+ birds and a liquid waste management system were required to hire a certified operator by January 1997 and facilities with dry litter animal waste management systems were required to develop an animal waste management plan by January 1998. The plan must address three specific items: 1) periodic testing of soils where waste is applied; 2) development of waste utilization plans; and 3) completion and maintenance of records on-site for three years. Additionally, anyone wishing to construct a new, or expand an existing, swine farm must notify all adjoining property owners.

1997 House Bill 515 placed a moratorium on new or existing swine farm operations and allows counties to adopt zoning ordinances for swine farms with a design capacity of 600,000 pounds (SSLW) or more. In addition, owners of potential new and expanding operations are required to notify the county (manager or chair of commission) and local health department, as well as adjoining landowners. NCDENR was required to develop and adopt economically feasible odor control standards by March 1, 1999.

1998 House Bill 1480 extended the moratorium on construction or expansion of swine farms. The bill also requires owners of swine operations to register with DWQ any contractual relationship with an integrator.

1999 House Bill 1160 extended (again) the moratorium on new construction or expansion of swine farms, required NCDENR to develop an inventory of inactive lagoons. The Bill requires owners/operators of an animal waste treatment system to notify the public in the event of a discharge to surface waters of the state of 1,000 gallons or more of untreated wastewater.

2000 Attorney General Easley reached a landmark agreement with Smithfield Foods, Inc. to phase out hog lagoons and implement new technologies that will substantially reduce pollutants from hog farms. The agreement commits Smith field to phase out all anaerobic lagoon systems on 276 company-owned farms. Legislation will be required to phase out the remaining systems statewide within a 5-year period (State of Environment Report, 2000).

2001 House Bill 1216 extended (again) the moratorium on new construction or expansion of swine farms.

Table 31 and Figure 40 summarize, by subbasin, the number of registered livestock operations, total number of animals, number of facilities, and total steady state live weight as of October 2004. These numbers reflect only operations required by law to be registered, and therefore, do not represent the total number of animals in each subbasin.

Overall the majority of registered animal operations are found in Sampson and Duplin counties in subbasins 03-06-18 and 03-06-22. Registered animal operations where recent data show problems are discussed in the appropriate subbasin chapter in Section B.

Table 31 Registered Animal Operations in the Cape Fear River Basin (October 2004)

Subbasin	Cattle			Poultry			Swine		
	No. of Facilities	No. of Animals	Total Steady State Live Weight	No. of Facilities	No. of Animals	Total Steady State Live Weight	No. of Facilities	No. of Animals	Total Steady State Live Weight
03-06-01	5	2,794	2,891,600	0	0	0	1	1,140	493,620
03-06-02	5	1,000	1,400,000	0	0	0	1	250	130,500
03-06-03	2	425	595,000	0	0	0	3	10,570	901,950
03-06-04	17	2,777	3,887,800	0	0	0	3	23,544	2,432,520
03-06-05	0	0	0	0	0	0	0	0	0
03-06-06	1	125	175,000	0	0	0	0	0	0
03-06-07	0	0	0	0	0	0	2	2,747	976,787
03-06-08	4	2,479	3,470,600	0	0	0	0	0	0
03-06-09	2	475	665,000	0	0	0	10	33,734	5,690,858
03-06-10	1	200	280,000	0	0	0	2	12,253	924,090
03-06-11	0	0	0	0	0	0	0	0	0
03-06-12	1	150	210,000	0	0	0	1	100	52,200
03-06-13	0	0	0	0	0	0	6	28,616	3,197,880
03-06-14	1	650	910,000	0	0	0	5	21,952	4,157,160
03-06-15	0	0	0	0	0	0	13	44,824	6,740,600
03-06-16	0	0	0	0	0	0	40	199,783	31,771,545
03-06-17	0	0	0	0	0	0	7	40,866	6,381,110
03-06-18	0	0	0	0	0	0	82	304,214	57,107,552
03-06-19	0	0	0	0	0	0	300	1,373,714	181,748,547
03-06-20	0	0	0	0	0	0	12	65,172	10,984,120
03-06-21	0	0	0	0	0	0	67	228,483	26,796,659
03-06-22	0	0	0	0	0	0	391	1,618,256	219,202,863
03-06-23	0	0	0	0	0	0	44	174,282	25,343,570
03-06-24	0	0	0	0	0	0	1	1,800	243,000
Totals	39	11,075	14,485,000	0	0	0	991	4,186,300	585,277,131

* Steady State Live Weight (SSLW) is in pounds, after a conversion factor has been applied to the number of swine, cattle or poultry on a farm. Conversion factors come from the US Department of Agriculture, Natural Resource Conservation Service guidelines. Since the amount of waste produced varies by hog size, this is the best way to compare the sizes of the farms.

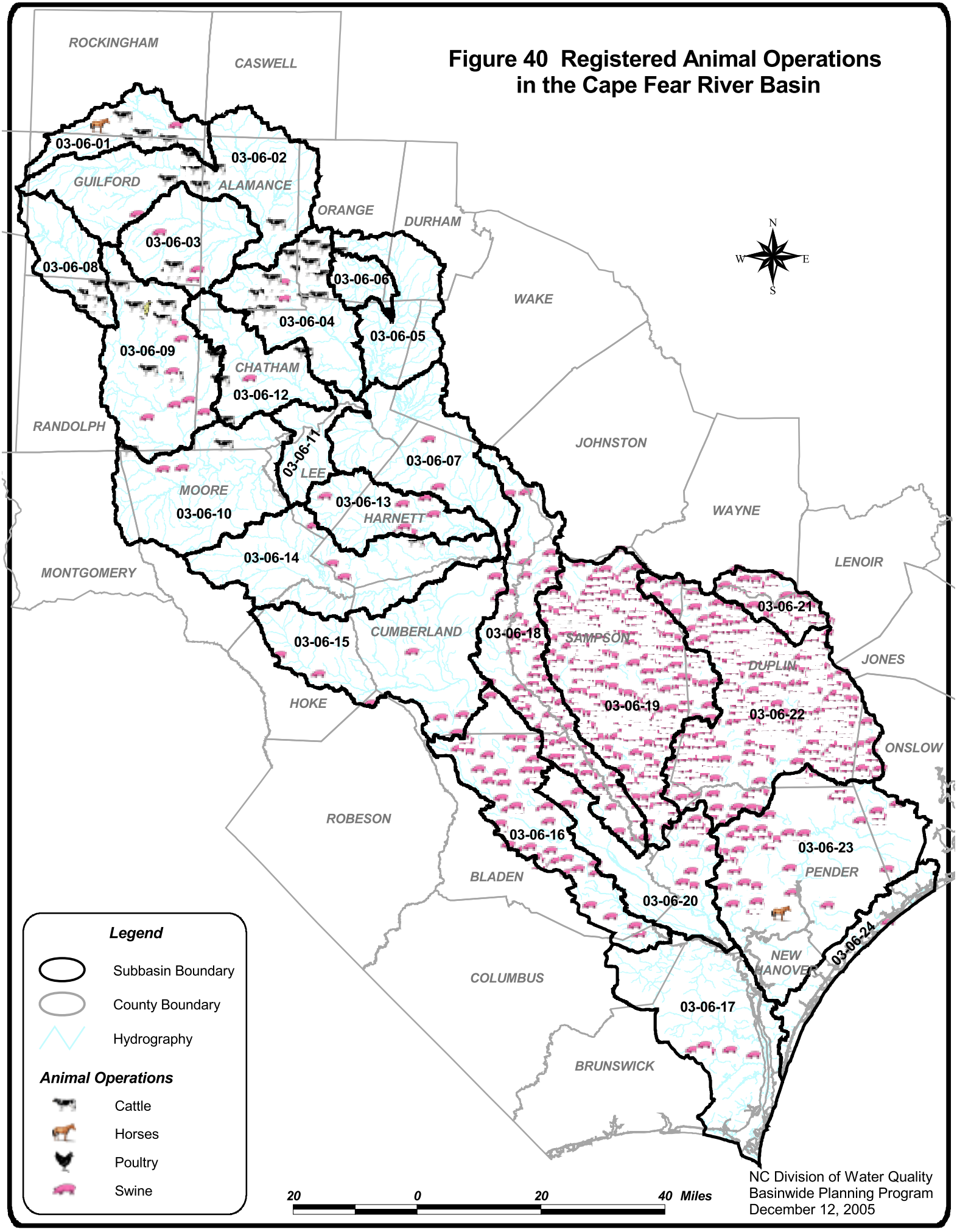


Figure 40 Registered Animal Operations in the Cape Fear River Basin
ROCKINGHAM
CASWELL
GUILFORD
ALAMANCE
ORANGE
DURHAM
WAKE
CHATHAM
RANDOLPH
JOHNSTON
LEE
MOORE
HARNETT
WAYNE
LENOIR
MONTGOMERY
CUMBERLAND
SAMPSON
DUPLIN
JONES
HOKE
ONSLOW
ROBESON
BLADEN
PENDER
COLUMBUS
NEW HANOVER
BRUNSWICK
03-06-01
03-06-02
03-06-03
03-06-04
03-06-05
03-06-06
03-06-07
03-06-08
03-06-09
03-06-10
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03-06-22
03-06-23
03-06-24
N
W
E
S
Legend
Subbasin Boundary
County Boundary
Hydrography
Animal Operations
Cattle
Horses
Poultry
Swine
20 0 20 40 Miles
NC Division of Water Quality
Basinwide Planning Program
December 12, 2005

30.5 Septic Systems and Straight Piping

In the Cape Fear River basin, wastewater from many households is not treated at wastewater treatment plants associated with NPDES discharge permits, but is treated on the property through the use of permitted septic systems. Wastewater from some homes illegally discharges directly to streams through what is known as a "straight pipe". In other cases, wastewater from failing septic systems makes its way to streams or contaminates groundwater. Straight piping and failing septic systems are illegal discharges of wastewater into waters of the state.

With on-site septic systems, the septic tank unit treats some wastes, and the drainfield associated with the septic tank provides further treatment and filtration of the pollutants and pathogens found in wastewater. A septic system that is operating properly does not discharge untreated wastewater to streams and lakes or to the ground's surface where it can run into nearby surface waters. Septic systems are a safe and effective long-term method for treating wastewater if they are sited, sized and maintained properly. If the tank or drainfield are improperly located or constructed, or the systems are not maintained, nearby wells and surface waters may become contaminated, causing potential risks to human health. Septic tank systems must be properly sited, designed, installed and maintained to insure they function properly over the life of the system. Information about the proper installation and maintenance of septic tanks can be obtained by calling the environmental health sections of the local county health departments (Appendix VIII contains contact information).

Septic system permitting and site visits are tracked by county and not by watershed or basin. Currently, it is difficult to determine if septic system failures are directly causing water quality problems in any specific watershed. Information and data on septic system failures that can be related to surface waters are discussed in the subbasin chapters. For program information by county, visit the website at http://www.deh.enr.state.nc.us/oww/Program_improvement_team/2003forweb.xls.

2005 Recommendations

Efforts to create a permanent statewide septic maintenance and repair program similar to the straight pipe and failing septic system initiative currently active in western NC should be pursued. Additional monitoring of fecal coliform throughout tributary watersheds where straight pipes and failing septic systems are a potential problem should be conducted in order to narrow the focus of the surveys. For more information on the septic tank systems, contact the DENR On-Site Wastewater Section, NC Division of Environmental Health, toll free at 1-866-223-5718 or visit their website at http://www.deh.enr.state.nc.us/oww/.

Additionally, precautions should be taken by local septic system permitting authorities to ensure that new systems are sited and constructed properly and that an adequate repair area is available. Educational information should also be provided to new septic system owners regarding the maintenance of these systems over time. DWQ has developed a booklet that discusses actions individuals can take to reduce stormwater runoff and improve stormwater quality entitled *Improving Water Quality In Your Own Backyard*. The publication includes a discussion about septic system maintenance and offers other sources of information. To obtain a free copy, call (919) 733-5083, ext. 558. The following website also offers good information in three easy to follow steps: http://www.wsg.washington.edu/outreach/mas/water_quality/septicsense/septicmain.html.

Chapter 31
Stormwater Programs

31.1 Introduction

As described in Chapter 26, there have been large increases in population in the Cape Fear River basin. Water quality impacts associated with increased population are numerous. Streams with the worst water quality in the basin are closely associated with existing urban areas. In the Cape Fear River basin, there are over 300 miles of Impaired streams that drain urban or urbanizing watersheds. The following sections describe the various stormwater programs and rules designed to prevent impacts associated with population growth and development as well as recommendations for local governments to further address impacts associated with the increased growth.

31.2 DWQ Stormwater Programs

There are many different stormwater programs administered by DWQ. One or more of these programs affect many communities in the Cape Fear River basin. The goal of the DWQ stormwater discharge permitting regulations and programs is to prevent pollution from entering the waters of the state via stormwater runoff. These programs try to accomplish this goal by controlling the source(s) of pollutants. These programs include NPDES Phase I and II, coastal county stormwater requirements, HQW/ORW stormwater requirements, and requirements associated with the Water Supply Watershed Program. Local governments that are or may be affected by these programs are presented in Table 32.

31.2.1 NPDES Phase I

Phase I of the EPA stormwater program started with Amendments to the Clean Water Act (CWA) in 1990. Phase I required NPDES permit coverage to address stormwater runoff from medium and large stormwater sewer systems serving populations of 100,000 or more people. There are three NPDES Phase I stormwater permits issued to communities in the basin.

Phase I also has requirements for 11 categories of industrial sources to be covered under stormwater permits. Industrial activities which require permitting are defined in categories ranging from sawmills and landfills to manufacturing plants and hazardous waste treatment, storage or disposal facilities. Construction sites disturbing greater than five acres are also required to obtain an NPDES stormwater permit under Phase I of the EPA stormwater program. Excluding construction stormwater general permits, there are 673 general stormwater permits and 47 individual stormwater permits in the Cape Fear River basin. Refer to the subbasin chapters for more information on stormwater programs and permits and a complete listing of individual permits in Appendix VI.

31.2.2 NPDES Phase II

The Phase II stormwater program is an extension of the Phase I program that includes permit coverage for smaller municipalities and covers construction activities down to one acre. The local governments permitted under Phase II will be required to develop and implement a comprehensive stormwater management program that includes six minimum measures.

1) Public education and outreach on stormwater impacts.
2) Public involvement/participation.
3) Illicit discharge detection and elimination.
4) Construction site stormwater runoff control.
5) Post-construction stormwater management for new development and redevelopment.
6) Pollution prevention/good housekeeping for municipal operations.

Construction sites greater than one acre will also be required to obtain an NPDES stormwater permit under Phase II of the EPA stormwater program in addition to erosion and sedimentation control approvals.

Current Status
There are 28 municipalities and 9 counties (Table 32) in the basin that are automatically required (based on 1990 US Census Designated Urban Areas and results of the 2000 US Census) to obtain a Phase II NPDES stormwater permit. These local governments were required to submit applications for NPDES stormwater permits by March 2003. DWQ is currently developing criteria that will be used to determine whether other municipalities should be required to obtain a NPDES permit and how the program will be implemented. DWQ is also working to finalize state rules to implement the Phase II stormwater rules as required by the EPA.

2004 Recommendations
DWQ recommends that the local governments that will be permitted under Phase II proceed with permit applications and develop programs that can go beyond the six minimum measures. Implementation of Phase II, as well as the other stormwater programs, should help to reduce future impacts to streams in the basin. Local governments, to the extent possible, should identify sites for preservation or restoration. DWQ and other NCDENR agencies will continue to provide information on funding sources and technical assistance to support local government stormwater programs.

31.2.3 State Stormwater Program

The State Stormwater Management Program was established in the late 1980s under the authority of the North Carolina Environmental Management Commission (EMC) and North Carolina General Statute 143-214.7. This program codified in 15A NCAC 2H .1000 affects development activities that require either an Erosion and Sediment Control Plan (for disturbances of one or more acres) or a CAMA major permit within one of the 20 coastal counties and/or development draining to Outstanding Resource Waters (ORW) or High Quality Waters (HQW).

The State Stormwater Management Program requires developments to protect these sensitive waters by maintaining a low density of impervious surfaces, maintaining vegetative buffers, and transporting runoff through vegetative conveyances. Low density development thresholds vary

from 12-30 percent built-upon area (impervious surface) depending on the classification of the receiving stream. If low density design criteria cannot be met, then high density development requires the installation of structural best management practices (BMPs) to collect and treat stormwater runoff from the project. High density BMPs must control the runoff from the 1 or 1.5-inch storm event (depending on the receiving stream classification) and remove 85 percent of the total suspended solids.

Current Status

Table 32 shows the 17 counties in the Cape Fear River basin where permits may be required under the state stormwater management program. All development requiring an Erosion and Sediment Control Plan (for disturbances of one or more acres) must obtain a stormwater permit.

2005 Recommendations

DWQ will continue implementing the state stormwater program with the other NCDENR agencies and local governments. Local governments should develop local land use plans that minimize impervious surfaces in sensitive areas. Communities should integrate state stormwater program requirements, to the extent possible, with other stormwater programs in order to be more efficient and gain the most water quality benefits for protection of public health and aquatic life.

Table 32 Communities in the Cape Fear River Subject to Stormwater Requirements

	NPDES Phase I and Phase II	**State Stormwater Program**	**Water Supply Watershed Stormwater Requirements**
Municipalities			
Alamance			**X**
Angier			**X**
Apex	Phase II 1990		**X**
Archdale	Phase II 1990		**X**
Asheboro			**X**
Biscoe			**X**
Broadway			**X**
Burgaw			
Burlington	Phase II 1990		**X**
Calypso			
Cameron			**X**
Candor		**X**	**X**
Carolina Beach	Phase II 2000		
Carrboro	Phase II 1990		**X**
Carthage			**X**
Cary	Phase II 1990		**X**
Chapel Hill	Phase II 1990		

Coats			**X**
Durham	Phase I		**X**
East Arcadia			**X**
Elon	Phase II 1990		
Erwin			**X**
Fayetteville	Phase I		**X**
Franklinville			**X**
Fuquay-Varina	Phase II 2000		**X**
Garland		**X**	
Gibsonville	Phase II 2000		**X**
Goldston			**X**
Graham	Phase II 1990		
Green Level	Phase II 2000		**X**
Greensboro	Phase I		**X**
Haw River	Phase II 1990		**X**
High Point	Phase II 1990		**X**
Holly Springs	Phase II 2000		
Hope Mills	Phase II 1990		
Jamestown	Phase II 1990		**X**
Kernersville	Phase II 2000		**X**
Kure Beach	Phase II 2000		
Leland	Phase II 1990		
Liberty			**X**
Lillington			**X**
Mebane	Phase II 1990		**X**
Morrisville	Phase II 2000		**X**
Navassa	Phase II 2000		
North Topsail Beach		**X**	
Pinehurst			**X**
Pittsboro			**X**
Randleman			**X**
Reidsville			**X**
Robbins			**X**
Sandyfield			**X**
Sanford			**X**
Seagrove			**X**
Siler City			**X**
Southern Pines			**X**
Spring Lake	Phase II 1990		**X**
Staley			**X**

Star			**X**
Stokesdale			**X**
Summerfield			**X**
Swepsonville	Phase II 2000		
Taylortown			**X**
Vass		**X**	**X**
Wade			**X**
Whispering Pines		**X**	**X**
Whitsett			**X**
Wilmington	Phase II 1990	**X**	
Wrightsville Beach	Phase II 1990		
Counties			
Alamance	Phase II 1990		**X**
Bladen		**X**	**X**
Brunswick	Phase II 1990	**X**	
Caswell			**X**
Chatham	Phase II 2000	**X**	**X**
Columbus		**X**	**X**
Cumberland		**X**	**X**
Duplin		**X**	
Durham			**X**
Forsyth	Phase II 1990		**X**
Guilford	Phase II 1990	**X**	**X**
Harnett		**X**	**X**
Hoke		**X**	**X**
Johnston			
Lee		**X**	**X**
Montgomery		**X**	**X**
Moore		**X**	**X**
New Hanover	Phase II 1990	**X**	**X**
Onslow	Phase II 1990	**X**	
Orange	Phase II 1990		**X**
Pender		**X**	**X**
Randolph		**X**	**X**
Rockingham			**X**
Sampson		**X**	
Wake	Phase II 1990		**X**

31.2.4 Water Supply Watershed Stormwater Rules

The purpose of the Water Supply Watershed Protection Program is to provide an effective drinking water supply protection program for communities. Local governments administer the program based on state minimum requirements. There are restrictions on wastewater discharges, development, landfills and residual application sites to control the impacts of point and nonpoint sources of pollution. The program attempts to minimize the impacts of stormwater runoff by utilizing low density development or stormwater treatment in high density areas.

Current Status
All communities in the Cape Fear River basin in water supply watersheds have EMC approved water supply watershed protection ordinances.

2005 Recommendations
DWQ recommends continued implementation of local water supply protection ordinances to ensure safe and economical treatment of drinking water. Communities should also integrate water supply protection ordinances with other stormwater programs, to the extent possible, in order to be more efficient and gain the most water quality benefits for both drinking water and aquatic life.

31.3 Local Government Role in Addressing Runoff Impacts

31.3.1 The Role of Local Governments

A summary of recommended management actions by local authorities is provided here, followed by discussions on large, watershed management issues. These recommended actions are necessary to address current sources of impairment and to prevent continuing degradation in all streams. The intent of these recommendations is to describe the types of actions necessary to improve stream conditions, not to specify particular administrative or institutional mechanisms for implementing remedial practices. Those types of decisions must be made at the local level.

Because of uncertainties regarding how individual remedial actions cumulatively impact stream conditions and in how aquatic organisms will respond to improvements, the intensity of management effort necessary to bring about a particular degree of biological improvement cannot be established in advance. The types of actions needed to improve biological conditions can be identified, but the mix of activities that will be necessary – and the extent of improvement that will be attainable – will only become apparent over time as an adaptive management approach is implemented. Management actions are suggested below to address individual problems, but many of these actions are interrelated.

Actions one through five are important to restoring and sustaining aquatic communities in the watershed, with the first three recommendations being the most important.

1. **Feasible and cost-effective stormwater retrofit projects should be implemented throughout the watershed to mitigate the hydrologic effects of development** (increased stormwater volumes and increased frequency and duration of erosive and scouring flows). This should be viewed as a long-term process. Although there are many uncertainties, costs in the range of $1 million per square mile can probably be anticipated.

a. Over the short-term, currently feasible retrofit projects should be identified and implemented.
b. In the longer term, additional retrofit opportunities should be implemented in conjunction with infrastructure improvements and redevelopment of existing developed areas.
c. Grant funds for these retrofit projects may be available from EPA initiatives, such as Section 319 funds, or the North Carolina Clean Water Management Trust Fund.

2. **A watershed scale strategy to address toxic inputs should be developed and implemented, including a variety of source reduction and stormwater treatment methods.** As an initial framework for planning toxicity reduction efforts, the following general approach is proposed:
    a. Implementation of available BMP opportunities for control of stormwater volume and velocities. As recommended above to improve aquatic habitat potential, these BMPs will also remove toxics from stormwater.
    b. Development of a stormwater and dry weather sampling strategy in order to facilitate the targeting of pollutant removal and source reduction practices.
    c. Implementation of stormwater treatment BMPs, aimed primarily at pollutant removal, at appropriate locations.
    d. Development and implementation of a broad set of source reduction activities focused on: reducing nonstorm inputs of toxics; reducing pollutants available for runoff during storms; and managing water to reduce storm runoff.
3. **Stream channel restoration activities should be implemented in target areas, in conjunction with stormwater retrofit BMPs, in order to improve aquatic habitat.** Before beginning stream channel restoration, a geomorphologic survey should be conducted to determine the best areas for stream channel restoration. Additionally, it would probably be advantageous to implement retrofit BMPs before embarking on stream channel restoration, as restoration is probably best designed for flows driven by reduced stormwater runoff. Costs of approximately $200 per foot of channel should be anticipated (Haupt et *al*., 2002 and Weinkam et *al*., 2001). Grant funds for these retrofit projects may be available from federal sources, such as EPA's Section 319 funds, or state sources including North Carolina Clean Water Management Trust Fund.
4. Actions recommended above (e.g., stormwater quantity and quality retrofit BMPs) are likely to reduce nutrient/organic loading and its impacts to some extent. Activities recommended to address this loading include the identification and elimination of illicit discharges; education of homeowners, commercial applicators, and others regarding proper fertilizer use; street sweeping; catch basin clean-out practices; and the installation of additional BMPs targeting BOD and nutrient removal at appropriate sites.
5. Prevention of further channel erosion and habitat degradation will require effective post-construction stormwater management for all new development in the study area.
6. Effective enforcement of sediment and erosion control regulations will be essential to the prevention of additional sediment inputs from construction activities. Development of improved erosion and sediment control practices may be beneficial.
7. Watershed education programs should be implemented and continued by local governments with the goal of reducing current stream damage and preventing future degradation. At a minimum, the program should include elements to address the following issues:
    a. redirecting downspouts to pervious areas rather than routing these flows to driveways or gutters;

b. protecting existing woody riparian areas on all streams;
c. replanting native riparian vegetation on stream channels where such vegetation is absent; and
d. reducing and properly managing pesticide and fertilizer use.

31.3.2 Maintain and Reestablish Riparian Buffers

The presence of intact riparian buffers and/or wetlands in urban areas can reduce the impacts of urban development. Establishment and protection of buffers should be considered where feasible, and the amount of impervious cover should be limited as much as possible. Wide streets, large cul-de-sacs, and long driveways and sidewalks lining both sides of the street are all features of urban development that create excess impervious cover and consume natural areas. Preserving the natural streamside vegetation (riparian buffer) is one of the most economical and efficient BMPs. Forested buffers in particular provide a variety of benefits including filtering runoff and taking up nutrients, moderating water temperature, preventing erosion and loss of land, providing flood control and helping to moderate streamflow, and providing food and habitat for both aquatic and terrestrial wildlife. To obtain a free copy of DWQ's *Buffers for Clean Water* brochure, call (919) 733-5083, ext. 558.

31.3.3 Protecting Headwaters

Many streams in a given river basin are only small trickles of water that emerge from the ground. A larger stream is formed at the confluence of these trickles. This constant merging eventually forms a large stream or river (Figure 41). Most monitoring of fresh surface waters evaluates these larger streams. The many miles of small trickles, collectively known as headwaters, are not directly monitored and in many instances are not even indicated on maps. These streams account for approximately 80 percent of the stream network and provide many valuable services for quality and quantity of water delivered downstream (Meyer et *al*., 2003). However, degradation of headwater streams can (and does) impact the larger stream or river.

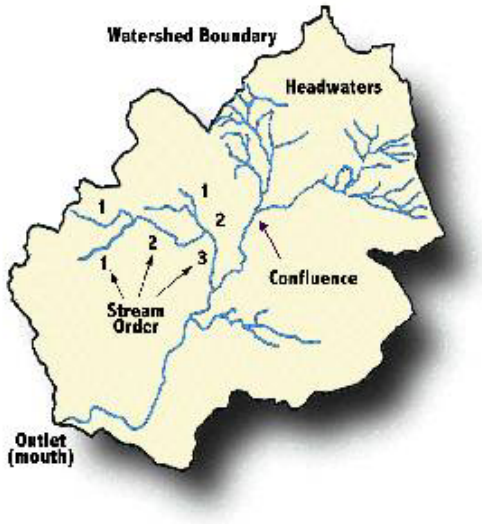


Figure 41 Diagram of Headwater Streams within a Watershed Boundary

There are three types of headwater streams: perennial (flow year-round), intermittent (flow during wet seasons), and ephemeral (flow only after precipitation events). All types of headwater streams provide benefits to larger streams and rivers. Headwater streams control flooding, recharge groundwater, maintain water quality, reduce downstream sedimentation, recycle nutrients, and create habitat for plants and animals (Meyer et *al*., 2003).

In smaller headwater streams, fish communities are not well developed and benthic macroinvertebrates dominate aquatic life. Benthic macroinvertebrates are often thought of as "fish food" and, in mid-sized streams and rivers, they are critical to a healthy fish community. However, these insects, both in larval and adult stages, are also food for small mammals, such as river otter and raccoons, birds and amphibians (Erman, 1996). Benthic macroinvertebrates in headwater streams also perform the important function of breaking down coarse organic matter, such as leaves and twigs, and releasing fine organic matter. In larger rivers, where coarse organic matter is not as abundant, this fine organic matter is a primary food source for benthic macroinvertebrates and other organisms in the system (CALFED, 1999). When the benthic macroinvertebrate community is changed or extinguished in an area, even temporarily, as occurs during land use changes, it can have repercussions in many parts of both the terrestrial and aquatic food web.

Headwater streams also provide a source of insects for repopulating downstream waters where benthic macroinvertebrate communities have been eliminated due to human alterations and pollution. Adult insects have short life spans and generally live in the riparian areas surrounding the streams from which they emerge (Erman, 1996). Because there is little upstream or stream-to-stream migration of benthic macroinvertebrates, once headwater populations are eliminated, there is little hope for restoring a functioning aquatic community. In addition to macroinvertebrates, these streams support diverse populations of plants and animals that face similar problems if streams are disturbed. Headwater streams are able to provide these important ecosystem services due to their unique locations, distinctive flow patterns, and small drainage areas.

Because of the small size of headwater streams, they are often overlooked during land use activities that impact water quality. All landowners can participate in the protection of headwaters by keeping small tributaries in mind when making land use management decisions on the areas they control. This includes activities such as retaining vegetated stream buffers, minimizing stream channel alterations, and excluding cattle from streams. Local rural and urban planning initiatives should also consider impacts to headwater streams when land is being developed. For a more detailed description of watershed hydrology and watershed management, refer to EPA's Watershed Academy website at http://www.epa.gov/OWOW/watershed/wacademy/acad2000/watershedmgt/principle1.html.

31.3.4 Reduce Impacts of Future Development

Proactive planning efforts at the local level are needed to assure that development is done in a manner that maintains water quality. These planning efforts will need to find a balance between water quality protection, natural resource management and economic growth. Growth management requires planning for the needs of future population increases, as well as developing and enforcing environmental protection measures. These actions are critical to water quality management and the quality of life for the residents of the basin.

Areas adjacent to the high growth areas of the basin are at risk of having Impaired biological communities. These biological communities are important to maintaining the ecological integrity in the Cape Fear River basin. These streams will be important as sources of benthic macroinvertebrates and fishes for reestablishment of biological communities in nearby streams that are recovering from past impacts or are being restored.

To prevent further impairment to aquatic life in streams in urbanizing watersheds local governments should:

1. Identify waters that are threatened by development.
2. Protect existing riparian habitat along streams.
3. Implement stormwater BMPs during and after development.
4. Develop land use plans that minimize disturbance in sensitive areas of watersheds.
5. Minimize impervious surfaces including roads and parking lots.
6. Develop public outreach programs to educate citizens about stormwater runoff.

Action should be taken at the local level to plan for new development in urban and rural areas.

For more detailed information regarding recommendations for new development found in the text box (above), refer to EPA's website at www.epa.gov/owow/watershed/wacademy/acad2000/protection, the Center for Watershed Protection website at www.cwp.org, and the Low Impact Development Center website at www.lowimpactdevelopment.org. Additional public education is also needed in the Cape Fear River basin in order for citizens to understand the value of urban planning and stormwater management. DWQ recently developed a booklet that discusses actions individuals can take to reduce stormwater runoff and improve stormwater quality entitled *Improving Water Quality In Your Own Backyard*. To obtain a free copy, call (919) 733-5083, ext. 558. For an example of local community planning, visit the website at http://www.charmeck.org/Home.htm.

Planning Recommendations for New Development

- Minimize number and width of residential streets.
- Minimize size of parking areas (angled parking & narrower slots).
- Place sidewalks on only one side of residential streets.
- Minimize culvert pipe and hardened stormwater conveyances.
- Vegetate road right-of-ways, parking lot islands and highway dividers to increase infiltration.
- Plant and protect natural buffer zones along streams and tributaries.

Chapter 32
Water Resources, Minimum Streamflows and Interbasin Transfers

32.1 River Basin Hydrologic Units

Under the federal system, the Cape Fear River basin is made up of hydrologic areas referred to as cataloging units (USGS 8-digit hydrologic units). The Cape Fear River basin is made up of seven whole cataloging units. Cataloging units are further divided into smaller watershed units (14-digit hydrologic units or local watersheds) that are used for smaller scale planning. There are 2,819 local watershed units in the basin. Table 33 compares the three systems. A map identifying the hydrologic units and subbasins can be found in Appendix I.

Table 33 Hydrologic Subdivisions in the Cape Fear River Basin

Watershed Name and Major Tributaries	DWQ Subbasin 6-Digit Codes	USGS 8-Digit Hydrologic Units
Onslow Bay	03-06-24	03030001
Masonboro and Middle Sounds		
Topsail and Stump Sounds		
Haw River and Jordan Reservoir	03-06-01, 02, 03, 04, 05, 06	03030002
Upper Haw River	01	
Reedy Fork, Stony Creek and Haw River (middle)	02	
Big and Little Alamance Creeks	03	
Haw River (lower)	04	
New Hope Creek and Jordan Reservoir	05	
Morgan Creek and University Lake	06	
Deep River	03-06-08, 09, 10, 11, 12	03030003
Deep River (upper) and Muddy Creek	08	
Deep River (middle) and Richland Creek	09	
Deep River (middle), Cabin Creek and McLendons Creek	10	
Deep River (lower)	11	
Rocky River	12	
Upper Cape Fear River	03-06-07, 13, 13, 15	03030004
Cape Fear River (upper)	07	
Upper Little River	13	
Little River	14	
Rockfish Creek and Cape Fear River	15	
Lower Cape Fear River	03-06-15, 16, 17	03030005
Cape Fear River	16	
Town Creek, Brunswick River and Cape Fear River (extreme lower)	17	
Black River	03-06-18, 19, 20	03030006
South River	18	
Great Coharie Creek, Six Runs Creek and Upper Black River	19	
Black River	20	
Northeast Cape Fear River	03-06-21, 22, 23	03030007
Upper Northeast Cape Fear River	21	
Middle Northeast Cape Fear River, Goshen Swamp and Rockfish Creek	22	
Lower Northeast Cape Fear River	23	

32.2 Minimum Streamflow

One of the purposes of the Dam Safety Law is to ensure maintenance of minimum streamflows below dams. Conditions may be placed on dam operations specifying mandatory minimum releases in order to maintain adequate quantity and quality of water in the length of a stream affected by an impoundment. The Division of Water Resources, in conjunction with the Wildlife Resources Commission, recommends conditions relating to release of flows to satisfy minimum instream flow requirements. The Division of Land Resources issues the permits.

The Federal Energy Regulatory Commission (FERC) licenses all dams associated with hydropower that meet the conditions of the Federal Poser Act. FERC-related dams are exempt from DLR authority, and flow requirements are included in the federal license. Flow requirements were also requested by agencies in the Certification of Convenience and Necessity (CPCN) that is required for public utilities and issued by the NC Utility Commission.

32.2.1 Deep River Hydroelectric Projects

Coltrane Dam is unlicensed and will be inundated by the Randleman Reservoir project.

Worthville Dam has no minimum release requirement according to their FERC license. This dam operates in a run-of-river (non-peaking) mode and has no bypass reach. The dam is located near Ramseur.

Cox Lake Dam is required by FERC to provide a minimum flow of 42 cfs. The dam is located near Asheboro and has a 506-foot bypass reach.

Cedar Falls Dam is required by FERC to provide a minimum flow of 32 cfs. The dam is located near Asheboro and has a 2,112-foot bypass reach. The license has been transferred to Piedmont Triad Regional Water Authority. The possible removal of the dam is being studied.

Franklinville/Randolph Mills Dam was deemed non-jurisdictional by FERC and is unlicensed. This dam operates in a run-of-river (non-peaking) mode and has no bypass reach. There is a 46cfs minimum flow requirement in its CPCN. The by-pass reach is 480 feet. The dam is located near Franklinville.

Ramseur Dam is required by FERC to provide a minimum flow of 45 cfs. The dam is located near Ramseur and has a 1,430-foot bypass reach.

Coleridge Dam is required by FERC to provide a minimum flow of 35 cfs. The dam is located near Coleridge and has a 500-foot bypass reach.

High Falls Dam is required by FERC to provide a minimum flow of 108 cfs. The dam is located near Robbins and has a 2,844-foot bypass reach.

Carbonton Dam has no minimum release requirement according to their FERC license. This dam operates in a run-of-river (non-peaking) mode and has no bypass reach. The dam is located upstream of Sanford.

Lockville Dam is required by FERC to provide a minimum flow of 70 cfs. The dam is located near Sanford and has a 2,300-foot bypass reach. The upper 700 feet is subject to project operations and lower 1,600 feet is the backwater of the Buckhorn Dam

32.2.2 Haw River Hydroelectric Projects

Altamahaw Dam is unlicensed and has no minimum release requirements. The dam is located near Altamahaw and has an 800-foot bypass reach.

Glencoe Mills Dam is required by FERC to provide a minimum flow of 57 cfs. The dam is located near Glencoe and has a 1,815-foot bypass reach.

Swepsonville Dam is unlicensed and not operational. The dam is being considered for removal.

Saxapahaw Dam is required by FERC to operate in run-of-river non-peaking mode. The CPCN states that 10 cfs or one-quarter of the reservoir inflow, whichever is less, is required in the west channel below the dam. The dam is located near Saxapahaw and has a 5,200-foot bypass reach.

Bynum Dam is required by FERC to provide a minimum flow of 80 cfs. The dam is located near Bynum and has a 3,000-foot bypass reach.

32.2.3 Rockfish Creek Hydroelectric Projects

Raeford Dam has no minimum release requirement according to their FERC license. This dam operates in a run-of-river (non-peaking) mode and has no bypass reach. The dam is located near Raeford.

32.2.4 Rocky River Hydroelectric Projects

Rocky River Dam has no minimum release requirement according to their FERC license. This dam operates in a run-of-river (non-peaking) mode and has no bypass reach. The dam is located upstream of Sanford.

32.2.5 Lake Mackintosh (Big Alamance Creek) Burlington Water Supply

The Town of Burlington's water supply, Lake Mackintosh, has a tiered release with a maximum flow release of 9 cfs at full pool. The recommendation was based on a wetted perimeter study done by Division of Water Resources (DWR).

32.2.6 Back Creek (Graham-Mebane Reservoir) Graham-Mebane Water Supply

DWR requested, following the review of the environmental assessment for the expansion of the Graham-Mebane water treatment plant from 6 to 12 MGD, a tiered release with a maximum low flow release of 5 cfs at full pool from Graham-Mebane Lake. The flow recommendation was based on a wetted perimeter study by DWR.

32.2.7 Bones Creek (Lake Rimm)

Lake Rim is used by the NC Wildlife Resources Commission as a fish hatchery storage pond. DWR requested a minimum flow as a stipulation for dam repair. The Division assisted the Commission in determining a tiered release of 18 cfs from the impoundment in all months except July, when the release is 10.5 cfs. The releases are based on a hydrologic desktop investigation. A calibrated gage is required to monitor releases.

32.2.8 Bransom Creek (Forest Lake Dam)

A stipulation for repairs to Forest Lake Dam in Fayetteville was a minimum flow requirement of 3.4 cfs. The recommendation is based on a NC Wildlife Resources Commission habitat evaluation and a hydrologic desktop investigation.

32.2.9 Little Cross Creek (below Glenville Lake)

DWR participated in an aquatic habitat assessment of Little Cross Creek below Glenville Lake (Fayetteville's reserve water source) with the NC Wildlife Resources Commission and DWQ. A minimum flow of 3.6 cfs, based on a hydrologic desktop investigation, was established.

32.2.10 Deep River (Randleman Dam)

The proposed Randleman Reservoir will serve the cities of Greensboro and High Point. The reservoir will have a tiered minimum release ranging from a high of 30 cfs at full pool, 20 cfs when below 60 percent full pool, and 10 cfs when below 30 percent full pool. The minimum flow recommendations are based on a wetted perimeter study. The project will divert up to 30.5 MGD (47.1 cfs) that will reduce the average annual flow. The natural low flows in the lower Deep River will be increased by the minimum release. There will be some interbasin transfer. Randleman Reservoir will impact hydropower generation in the Deep River. The Coltrane Mill project will be inundated by the impoundment. DWR estimates that hydropower generation will be reduced by 5 to 15 percent depending on the amount of withdrawal from the reservoir, proximity of the generation facility to Randleman, and the minimum flow requirement at each project.

32.2.11 Mill Creek (Reservoir Park Dam Southern Pines)

Reservoir Park Dam in Southern Pines has a minimum flow requirement of 0.5 cfs based upon consultation with the NC Wildlife Resources Commission and a hydrologic desktop investigation.

32.2.12 Nick's Creek (Town of Carthage Water Supply)

Based on an instream flow study, the Town of Carthage was granted permission for an increase of its run-of-river withdrawal from 0.5 MGD to 1 MGD with no flow requirement. Carthage received temporary permits to reconstitute the breached dam upstream of the water supply intake. A flow requirement is under consideration.

32.2.13 Reedy Fork Creek (Lake Townsend)

Lake Townsend in Greensboro has a minimum flow requirement of 7.1 cfs at full pool as a stipulation for expansion of the water treatment plant from 20 to 30 MGD. The recommended flow is based upon a wetted perimeter study done by DWR.

32.2.14 Rocky River (Rocky River Reservoir)

The Town of Siler City has a tiered release at their water withdrawal structure based on an instream flow study performed by DWR. The minimum release from December through May is 3.5 cfs when the town's reservoir is at 40 percent capacity or greater. The town has installed gages to monitor the release. The Siler City is proposing to build a new dam 105 downstream of the existing lower dam that would increase storage from 24.1 to 162.5 acres. Instream flow requirements are being developed based on requirements in the 401 permit.

32.2.15 Haw River (Greensboro Emergency Intake)

Greensboro has an emergency intake on the Haw River that can only be used during drought conditions. Based on previous studies a minimum instream flow of 22 cfs is recommended below the intake at all times during pumping.

32.2.16 Little Rockfish Creek (Hope Mills Dam)

The Hope Mills dam was destroyed during high flow events in 2003. Based on existing studies DWR recommends a minimum instream flow of 38 cfs after dam reconstruction.

32.2.17 Juniper Branch (Forest Creek Golf Club)

The Forest Creek Golf Club irrigation impoundment provides a 0.15 cfs minimum instream flow.

32.3 Interbasin Transfers

In addition to water withdrawals (discussed above), water users in North Carolina are also required to register surface water transfers with the Division of Water Resources if the amount is 100,000 gallons per day or more. In addition, persons wishing to transfer two million gallons per day (MGD) or more, or increase an existing transfer by 25 percent or more, must first obtain a certificate from the Environmental Management Commission (G.S. 143-215.22I). The river basin boundaries that apply to these requirements are designated on a map entitled *Major River Basins and Sub-Basins in North Carolina*, on file in the Office of the Secretary of State. These boundaries differ from the 17 major river basins delineated by DWQ. Table 60 summarizes interbasin transfers within the Cape Fear River basin.

In determining whether a certificate should be issued, the state must determine that the overall benefits of a transfer outweigh the potential impacts. Factors used to determine whether a certificate should be issued include:

- The necessity, reasonableness and beneficial effects of the transfer.
- The detrimental effects on the source and receiving basins, including effects on water supply needs, wastewater assimilation, water quality, fish and wildlife habitat, hydroelectric power generation, navigation and recreation.
- The cumulative effect of existing transfers or water uses in the source basin.
- Reasonable alternatives to the proposed transfer.
- Any other facts and circumstances necessary to evaluate the transfer request.

A provision of the interbasin transfer law requires that an environmental assessment or environmental impact statement be prepared in accordance with the State Environmental Policy Act as supporting documentation for a transfer petition. For more information, visit the website at http://www.ncwater.org/ or call DWR at (919) 733-4064. Water users in North Carolina are required to register their water withdrawals and transfers with the Division of Water Resources if the amount is 100,000 gallons per day or more, according to NCGS §143-215.22H. In addition, transfers of two million gallons per day or more require certification from the Environmental Management Commission, according to NCGS §143-215.22I.

The river basin boundaries that apply to these requirements are designated on a map entitled *Major River Basins and Sub-Basins in North Carolina* that was filed in the Office of the Secretary of State on April 16, 1991. Within the Cape Fear River basin, six subbasins are delineated: the Haw River, the Deep River, the Cape Fear River, the South River, Northeast Cape Fear River and the New River. (Note: The New River is not considered part of the Cape Fear River basin under the basinwide management approach which utilizes basin definitions adopted by the Department of Water and Air Resources in 1974. The New River will be addressed as part of the *White Oak River Basinwide Water Quality Plan* in 2001.)

Table 34 lists all potential transfers within the basin. Unless otherwise noted, the transfer amounts are 1992 average daily amounts in million gallons per day (MGD) based on Local Water Supply Plans and registered withdrawal/transfer information. Many of the transfers can not be quantified due to undocumented consumptive losses (examples: septic, lawn irrigation). Note: Under a provision of Senate Bill 1299 (ratified by the General Assembly on September 23, 1988), all local water systems are now required to report existing and anticipated interbasin transfers as part of the Local Water Supply Planning process. This information will be available for future updates of this management plan and will allow an assessment of cumulative impacts.

There are two permitted transfers in the Cape Fear River basin. The first permit is for Cary/Apex's 16 MGD transfer from the Haw River subbasin to the Neuse River basin. The EMC granted an increased transfer to 24 MGD effective July 2001. The certificate requires that any water used in the Neuse basin in excess of 16 MGD shall be returned to the Haw River subbasin or into the Cape Fear River by 2010. Water used for consumptive purposes in the Neuse basin is not subject to this condition. The second permit, for Piedmont Triad Water Authority's 30.5 MGD transfer from the Deep River subbasin to the Haw and Yadkin River subbasins, covers anticipated transfers for the operation of the proposed Randleman Dam.

Beginning in 1999, North Carolina General Statute 143-215.22H requires all persons who withdraw or transfer 100,000 gallons per day or more of surface or groundwater on any day to register with the Division of Water Resources (DWR). Table 34 lists the registered withdrawals in the Cape Fear River basin as of January 1, 1999.

Table 34 Interbasin Transfers in the Cape Fear River Basin

Source System	Receiving System	Source Subbasin	Receiving Subbasin	Estimated Transfer (MGD)[1,2,3]
Permitted Transfers				
Cary/Apex	Cary/Apex	Haw	Neuse	16.0[4]
Piedmont Triad WA	Piedmont Triad WA	Deep	Haw, Yadkin	30.5[5]
Other Transfers				
Graham	Orange-Alamance	Haw	Neuse	Emergency
Greensboro	Jamestown	Haw	Deep	0.09
Greensboro	Greensboro	Haw	Deep	Unknown
OWASA	Hillsborough	Haw	Neuse	Emergency
Reidsville	Reidsville	Haw	Roanoke	Unknown
High Point	Greensboro	Deep	Haw	Unknown
High Point	Thomasville	Deep	Yadkin	Emergency
High Point	High Point	Deep	Yadkin	3.5
Lower Cape Fear WSA	Brunswick County	Cape Fear	Shallotte	Unknown
Carthage	Carthage	Cape Fear	Deep	Unknown
Dunn	Benson	Cape Fear	Neuse	1.0
Dunn	Dunn	Cape Fear	South	Unknown
Dunn	Benson	Cape Fear	South	Unknown
Harnett	Fuquay-Varina	Cape Fear	Neuse	Unknown
Harnett	Angier	Cape Fear	South	Unknown
Harnett	Coats	Cape Fear	South	Unknown
Harnett	Dunn	Cape Fear	South	Emergency
Sanford	Chatham County East	Cape Fear	Deep	Unknown
Sanford	Sanford	Cape Fear	Deep	Unknown
Sanford	Lee County - Tramway	Cape Fear	Deep	Emergency
Wilmington	Wilmington	Cape Fear	New	Unknown
General Electric	General Electric	NE Cape Fear	Cape Fear	0.75
Southern Pines	Southern Pines	Lumber	Cape Fear	Unknown
Archer Daniel Midland	Archer Daniel Midland	Shallotte	Cape Fear	1.89
Durham	OWASA	Neuse	Haw	Emergency
Durham	Durham	Neuse	Haw	18.0[6]
Goldsboro	Wayne WD	Neuse	NE Cape Fear	Emergency
Hillsborough	Orange-Alamance WS	Neuse	Haw	Emergency
Orange-Alamance WS	Mebane	Neuse	Haw	Emergency
Orange-Alamance WS	Orange-Alamance WS	Neuse	Haw	Unknown
Raleigh	Holly Springs	Neuse	Cape Fear	0.8
Davidson	Archdale	Yadkin	Deep	Unknown
Davidson	Davidson	Yadkin	Deep	Unknown
Montgomery County	Montgomery County	Yadkin	Deep	1.0
North Wilkesboro	Broadway	Yadkin	Cape Fear	Unknown
Winston Salem	Kernersville	Yadkin	Haw	Unknown
Winston Salem	Winston Salem	Yadkin	Deep	Unknown
Winston Salem	Winston Salem	Yadkin	Haw	Unknown
Asheboro	Randleman	Uwharrie	Deep	Emergency
Asheboro	Asheboro	Uwharrie	Deep	4.7

[1] Transfer amounts are based on average daily water use reported in 1992 Local Water Supply Plans, and the 1993 Water Withdrawal and Transfer Registration Database.

[2] "Unknown" refers to undocumented consumptive use.

[3] "Emergency" refers to emergency connections.

[4] Transfer amount for Cary/Apex are based on its permitted transfer.

[5] Transfer amount for Piedmont Triad Regional Water Authority is based on its permitted transfer, but will not become effective until completion of Randleman Dam.
[6] The estimated transfer amount for Durham is based on information in their Jordan Lake allocation application.

32.4 Water Quality Issues Related to Drought

Water quality problems associated with rainfall events usually involve degradation of aquatic habitats because the high flows may carry increased loadings of substances like metals, oils, herbicides, pesticides, sand, clay, organic material, bacteria and nutrients. These substances can be toxic to aquatic life (fish and insects) or may result in oxygen depletion or sedimentation. During drought conditions, these pollutants become more concentrated in streams due to reduced flow. Summer months are generally the most critical months for water quality. Dissolved oxygen is naturally lower due to higher temperatures, algae grow more due to longer periods of sunlight, and streamflows are reduced. In a long-term drought, these problems can be greatly exacerbated and the potential for water quality problems to become catastrophic is increased. This section discusses water quality problems that can be expected during low flow conditions.

The frequency of acute impacts due to nonpoint source pollution (runoff) is actually minimized during drought conditions. However, when rain events do occur, pollutants that have been collecting on the land surface are quickly delivered to streams. When streamflows are well below normal, this polluted runoff becomes a larger percentage of the water flowing in the stream. Point sources may also have water quality impacts during drought conditions even though permit limits are being met. Facilities that discharge wastewater have permit limits that are based on the historic low flow conditions. During droughts these wastewater discharges make up a larger percentage of the water flowing in streams than normal and might contribute to lowered dissolved oxygen concentrations and increased levels of other pollutants.

As streamflows decrease, there is less habitat available for aquatic insects and fish, particularly around lake shorelines. There is also less water available for irrigation and for water supplies. The dry conditions and increased removal of water for these uses further increases strain on the resource. With less habitat, naturally lower dissolved oxygen levels and higher water temperatures, the potential for large kills of fish and aquatic insects is very high. These conditions may stress the fish to the point where they become more susceptible to disease and where stresses that normally would not harm them result in mortality.

These are also areas where longer retention times due to decreased flows allow algae to take full advantage of the nutrients present resulting in algal blooms. During the daylight hours, algae greatly increase the amount dissolved oxygen in the water, but at night algal respiration and die off can cause dissolved oxygen levels to drop low enough to cause fish kills. Besides increasing the frequency of fish kills, algae blooms can also cause difficulty in water treatment resulting in taste and odor problems in finished drinking water.

Chapter 33
Significant Ecological Resources and Endangered Species

33.1 Ecological Significance of the Cape Fear River Basin

The Cape Fear River basin is the largest of North Carolina's river basins, and because of its size it contains a wide variety of aquatic systems. The Cape Fear River itself has the character of three or more rivers including: the clearwater Piedmont stream that rises at the confluence of the Deep River and the Haw River; a meandering coastal "brownwater" river draining farmlands at its mid-section; and a 30-mile long brackish estuary at its lower end. Also in the basin are "blackwater" tributaries such as the Black, South and Northeast Cape Fear Rivers. Not only is the Cape Fear River basin high in natural diversity, it also has a high rate of endemism. Among the many rare mussels and fish known from the basin are species found nowhere else.

33.2 Rare Aquatic and Wetland-Dwelling Animal Species

For information on any of the species listed in Table 35, visit the NC Natural Heritage Program website at www.ncsparks.net/nhp.

Table 35 List of Rare Species associated with Aquatic Habitats in the Cape Fear River Basin

Group	Scientific Name	Common Name	State Status	Federal Status
Crustacean	*Cambarus catagius*	Greensboro burrowing crayfish	SC	
Crustacean	*Cambarus davidi*	Carolina ladle crayfish	SR	
Fish	*Evorthodus lyricus*	Lyre goby	SR	
Fish	*Acipenser brevirostrum*	Shortnose sturgeon	E	E
Fish	*Fundulus luciae*	Spotfin killifish	SR	
Fish	*Etheostoma collis pop 2*	Carolina darter - eastern piedmont population	SC	FSC
Fish	*Carpiodes velifer*	Highfin carpsucker	SC	
Fish	*Lucania goodei*	Bluefin killifish	SC	
Fish	*Heterandria formosa*	Least killifish	SC	
Fish	*Notropis mekistocholas*	Cape Fear shiner	E	E
Fish	*Hypsoblennius ionthas*	Freckled blenny	SR	
Fish	*Microphis brachyurus*	Opossum pipefish	SR	
Fish	*Poecilia latipinna*	Sailfin molly	SR	
Fish	*Noturus sp. 1*	Broadtail madtom	SC	
Fish	*Eleotris pisonis*	Spinycheek sleeper	SR	

Fish	*Elassoma boehlkei*	Carolina pygmy sunfish	T	FSC
Fish	*Cyprinella zanema pop 2*	Santee chub - Coastal Plain population	SC	
Fish	*Semotilus lumbee*	Sandhills chub	SC	
Fish	*Gobionellus stigmaticus*	Marked goby	SR	
Fish	*Moxostoma sp. 2*	Carolina redhorse	SR	FSC
Fish	*Ambloplites cavifrons*	Roanoke bass	SR	
Insect	*Ephemerella argo*	Argo ephemerellan mayfly	SR	FSC
Insect	*Tricorythodes robacki*	A mayfly	SR	
Insect	*Gomphus septima*	Septima's clubtail	SR	FSC
Insect	*Triaenodes marginata*	A triaenode caddisfly	SR	
Insect	*Dolania americana*	American sand burrowing mayfly	SR	FSC
Insect	*Progomphus bellei*	Belle's sanddragon	SR	FSC
Insect	*Choroterpes basalis*	A mayfly	SR	
Insect	*Ceraclea cancellata*	A caddisfly	SR	
Mollusk	*Villosa vaughaniana*	Carolina creekshell	E	FSC
Mollusk	*Fusconaia masoni*	Atlantic pigtoe	E	FSC
Mollusk	*Planorbella magnifica*	Magnificent rams-horn	E	FSC
Mollusk	*Anodonta couperiana*	Barrel floater	E	
Reptile	*Alligator mississippiensis*	American alligator	T	T(S/A)
Reptile	*Caretta caretta*	Loggerhead seaturtle	T	T
Reptile	*Malaclemys terrapin centrata*	Carolina diamond-backed terrapin	SC	

Rare Species Listing Criteria

E =	Endangered (those species in danger of becoming extinct)
T =	Threatened (considered likely to become endangered within the foreseeable future)
SR =	Significantly Rare (those whose numbers are small and whose populations need monitoring)
SC =	Species of Special Concern
FSC =	Federal Species of Concern (those under consideration for listing under the Federal Endangered Species Act)
T(S/A) =	Threatened due to similarity of appearance
EX =	Extirpated

33.3 Significant Natural Heritage Areas in the Cape Fear River Basin

Figure 42 is a map of the Significant Natural Heritage Areas of the Cape Fear River basin. The Natural Heritage Program identifies sites (terrestrial or aquatic) that have particular biodiversity significance. A site's significance may be due to the presence of rare species, rare or high quality natural communities, or other important ecological features. The accompanying map shows the Significant Natural Heritage Areas identified in the Cape Fear River basin. Over 450 individual natural areas have been identified in the Cape Fear River basin, too large a number to discuss in detail here, so only the most important of these areas are discussed below.

33.3.1 Cape Fear Shiner Aquatic Habitats

Sections of three Piedmont rivers form the primary population centers for the very rare and endangered Cape Fear shiner (*Notropis mekistocholas*), a fish endemic to a small part of the Cape Fear River basin. Because of this, stretches of these rivers have been designated by the US Fish and Wildlife Service as critical habitat. These rivers, the Deep, Rocky and Haw, also support a number of other rare aquatic animals, including fish such as the Carolina redhorse (*Moxostoma sp*.) and the Roanoke bass (*Ambloplites cavifrons*); freshwater mussels such as the brook floater (*Alasmidonta varicosa*), triangle floater (*Alasmidonta undulata*), Atlantic pigtoe (*Fusconaia masoni)*, yellow lampmussel (*Lampsilis cariosa*), squawfoot (*Strophitus undulatus*), notched rainbow (*Villosa constricta*), and eastern creekshell (*Villosa delumbis*); and dragonflies such as Septima's clubtail (*Gomphus septima)*. Also found here is one of just two North Carolina populations of the endangered plant harperella (*Ptilimnium nodosum*), found on an island in the Deep River in Chatham County.

33.3.2 Sandhills Megasite

The diverse natural communities of the sandhills region, such as hillside seeps, upland longleaf pine forests, streamhead pocosins, and mixed hardwood-Atlantic white cedar swamps, provide habitat for many rare and endemic species including perhaps the largest remaining concentration of the endangered red-cockaded woodpecker (*Picoides borealis*) in the state. Endangered plants include Michaux's sumac (*Rhus michauxii*), chaffseed (*Schwalbea americana*), and rough-leaf loosestrife (*Lysimachia asperulifolia*). The publicly-owned Sandhills Game Land, Camp MacKall and Fort Bragg contain some of the largest remnants of the sandhills in natural condition in North Carolina.

33.3.3 Bladen Lakes Megasite

Occurring on ancient terraces of the Cape Fear River, the Bladen Lakes area contains the greatest concentration of relatively unaltered Carolina bays in North Carolina. The bays contain lakes and a diversity of peatland communities. The surrounding landscape is an irregular mosaic of shallow peatlands and sand longleaf pine communities. Many of the significant natural areas are in public ownership, either as game lands, state forest or state parks.

33.3.4 Black and South Rivers

The Black and South Rivers contain significant aquatic communities with two rare fish species – the broadtail madtom (*Noturus sp*.) and the Santee chub (*Cyprinella zanema*); and several rare mussels – pod lance (*Elliptio folliculata*), Cape Fear spike (*E. marsupiobesa*), Atlantic pigtoe (*Fusconaia masoni*), and yellow lampmussel (*Lampsilis cariosa*). The Black River is also one of the best remaining examples of a blackwater river system in the southeast coastal plain. Particularly notable is an ancient cypress-gum swamp, which contains the oldest stand of trees east of the Rocky Mountains; some cypress trees in this swamp have been core-dated to 364 AD. The swamp forest of the Black River supports several colonies of the rare Rafinesque's big-eared bat (*Corynorhinus rafinesquii*), a bat that is dependent on large hollow trees found in old-growth forests.

33.3.5 Lower Cape Fear River

The lower reach of the Cape Fear River is brackish and supports numerous rare marine fishes, including the endangered shortnose sturgeon (*Acipenser brevirostrum*), as well as freckled blennies (*Hypsoblennius ionthas*), marked gobies (*Gobionellus stigmaticus*), spinycheek sleepers (*Eleotris pisonis*), and opossum pipefish (*Microphis brachyurus*). The endangered manatee (*Trichechus manatus*) is an occasional visitor, especially in summer.

33.3.6 Northeast Cape Fear River Floodplain

The Northeast Cape Fear River floodplain is a drowned blackwater river corridor characterized by Tidal Freshwater Marshes at the lower end and extensive Tidal Cypress--Gum Swamp communities upstream. Encompassing more than 22,000 acres, the Northeast Cape Fear River floodplain contains some very high quality natural communities, including rare types such as Peatland Atlantic White Cedar Forest and longleaf pine forests. At least one portion of the site contains old-growth longleaf pine communities and mature examples of nonriverine wetland communities. Though not thoroughly explored, a number of rare plant and animal species have been found here. The southeastern myotis (*Myotis austroriparius*) – a bat that roosts in hollow trees near water – is widespread along the upper portion, and alligators are present throughout. The rare estuarine fishes lyre goby (*Evorthodus lyricus)* and spinycheek sleeper (*Eleotris pisonis*) have been found in the marshes at the lower end. The site is a major forested connector between other large sites.

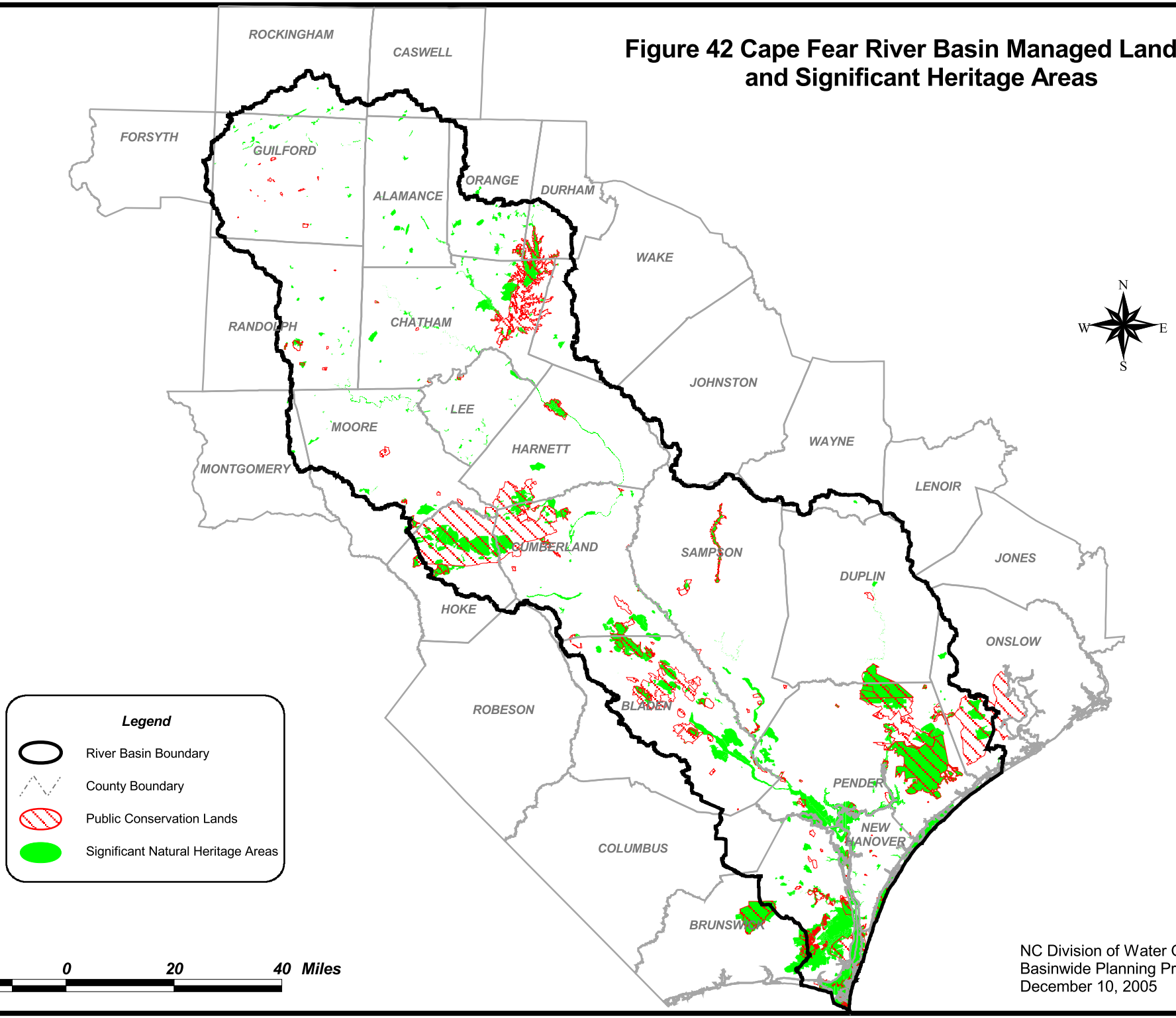
33.3.7 Pine Savannas

The Cape Fear River basin contains a high concentration of savanna habitats. These wet, generally flat areas have an open to sparse tree canopy, with few shrubs and a dense herb layer. The pine savannas of southeastern North Carolina have among the highest species diversity of any natural community in temperate North America, and more rare species are associated with the pine savanna than any other natural community type in the state. Only a few examples of this natural community are protected through public ownership or conservation easement.

33.3.8 Holly Shelter/Angola Bay Megasite

The Holly Shelter/Angola Bay region is one of the largest, nearly contiguous natural areas in the state. The Holly Shelter Game Land has a large domed peatland in its center that supports one of the largest pocosin community complexes in the state. On the southeast side of the Game Land is an extensive relict beach ridge system with associated longleaf pine communities and great concentrations of rare species, including one of the largest populations of Venus flytrap (*Dionaea muscipula*) in the state and several dozen red-cockaded woodpecker colonies. To the north is Angola Bay, one of states most inaccessible interior wetlands. The bay has a diameter of more than ten miles with no roads or trails. Most of the area is low pocosin with scattered pond pine in an otherwise near-treeless expanse of evergreen shrubbery.

Figure 42 Cape Fear River Basin Managed Lands and Significant Heritage Areas



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Basinwide Planning Program
December 10, 2005

33.3.9 Boiling Spring Lakes Wetland Complex

The Boiling Spring Lakes Wetland Complex is another large, hydrologically intact complex of relict beach ridges and swales interspersed with Carolina bays. The extensive pine flatwoods, pine savannas, pond pine woodlands, and pocosin communities of this area support a number of rare plant species. This ecologically significant natural area was until recently the largest unprotected natural longleaf pine/pocosin landscape complex in the state. However, the NC Department of Agriculture and The Nature Conservancy are currently focusing protection efforts in this area.

33.4 Significant Aquatic Habitats in Cape Fear River Basin

The Natural Heritage Program collaborates with a number of freshwater ecologists in other agencies and organizations to identify Significant Aquatic Habitats in North Carolina. Significant Aquatic Habitats are stream segments or other bodies of water that contain significant natural resources, such as a high diversity of rare aquatic animal species. The impact from lands adjacent and upstream of these stream reaches will determine their water quality and the viability of their aquatic species. The Significant Aquatic Habitats of the Cape Fear River basin include:

Bear Creek Aquatic Habitat - A regionally-significant creek that adjoins the Rocky River-Lower Deep River Aquatic Habitat at its downstream end. This medium-sized stream supports a diverse mussel fauna, including the brook floater (*Alasmidonta varicosa*) and Atlantic elktoe (*Fusconaia masoni*).

Black River Aquatic Habitat - A state-significant aquatic habitat containing four rare mussels: Cape Fear Spike (*Elliptio marsupiobesa*), Atlantic pigtoe (*Fusconaia masoni*), yellow lampmussel (*Lampsilis cariosa*), and pod lance (*Elliptio folliculata*). Other rare aquatic animals known from the Black River include river frog (*Rana hecksheri*), American alligator, and the American sand burrowing mayfly (*Dolania americana*). The American sand burrowing mayfly is a predaceous mayfly that is able to dig rapidly into sandy substrates. It is known from only a few places in the southeast, and in North Carolina has only been found in one location – the Black River.

Deep River (Moore/Randolph) Aquatic Habitat - Considered to be nationally significant, it is home to a population of the Cape Fear Shiner (*Notropis mekistocholas*), as well as the Carolina redhorse (*Moxostoma sp. 2*), Roanoke bass (*Ambloplites cavifrons*), and a number of mussels, including triangle floater (*Alasmidonta undulata)*, brook floater (*Alasmidonta varicosa*), Atlantic pigtoe (*Fusconia masoni)*, yellow lampmussel (*Lampsilis cariosa*), squawfoot (*Strophitus undulatus*), and notched rainbow (*Villosa constricta*).

Haw River Aquatic Habitat - The nationally significant stretch of the Haw River contains one of just a few known sites for the endemic and Federally Endangered Cape Fear shiner (*Notropis mekistocholas*). The globally rare Septima's clubtail (*Gomphus septima*) is also found here.

Lower Cape Fear River Aquatic Habitat - The state significant lower Cape Fear River is brackish and contains numerous rare animals. Records of the shortnose sturgeon indicate that it occurs here rarely, while manatees are found more occasionally, especially in summer. Alligators are

present mainly in tributary streams. Freckled blenny and spinycheek sleeper are rare marine fishes of this section of the river.

Rocky River/Lower Deep River Aquatic Habitat - This nationally-significant habitat is separated from the Upper Rocky River Aquatic Habitat (see below) by an impoundment. The federally endangered Cape Fear (*Notropis mekistocholas*) shiner has its primary population center in this area. The aquatic plant harperella (*Ptilimnium nodosum*) only has two known populations in North Carolina, one of which occurs on an island in the Deep River.

South River Aquatic Habitat - A state-significant site discussed above in association with the Black River. This high quality blackwater river contains two undescribed and rare fish species, *Noturus sp*. and *Hybopsis sp*., and diversity of other aquatic biota.

Town Creek Aquatic Habitat - This nationally-significant site is a short creek that flows eastward in eastern Brunswick County and empties into the Cape Fear River. Despite its short length, it contains the only known population of the Greenfield ramshorn snail (*Helisoma eucosmium*), a globally rare and imperiled mollusk, as well as several other rare animals and plants.

University Lake Aquatic Habitat - This state-significant site contains the largest population in the state, by far, of the rare mussel Savannah lilliput (*Toxolasma pullus*).

Upper Cape Fear River Aquatic Habitat - This state-significant site passes through Harnett, Chatham and Lee counties. This site contains seven rare mussels and two rare fishes: the Carolina redhorse (*Moxostoma sp. 2*) and occasional reports of the federally endangered Cape Fear shiner (*Notropis mekistocholas*).

Upper Rocky River Aquatic Habitat - This state-significant site is separated from the Rocky River/Lower Deep River Aquatic Habitat (see above) by the Reeves Lake impoundment. The site has a population of the federally endangered Cape Fear shiner (*Notropis mekistocholas*), along with two rare mollusks and one rare stream insect.

Upper Black River Aquatic Habitat - This site contains lower portions of Six Runs and Great Coharie and Little Coharie Creeks, where biologists have found three rare mussels: eastern creekshell (*Villosa delumbis*), eastern lampmussel (*Lampsilis radiata radiata*), and pod lance *(Elliptio folliculata*), as well as two rare fishes: Santee chub (*Cyprinella zanema*) and broadtail madtom (*Noturus sp. 1*).

There are a number of Significant Natural Heritage Areas not listed here that contribute to Cape Fear River water quality. Please contact the NC Natural Heritage Program to obtain information about these natural areas. Significant Natural Heritage Areas are identified by the Natural Heritage Program, but the identification of a natural area conveys no protection. Protection comes from the landowner. For details about any of the Significant Natural Heritage Areas, please contact the North Carolina Natural Heritage Program.

33.5 Public Lands

The accompanying map shows the land protected by public ownership in the Cape Fear River basin. Many significant natural areas, including some already mentioned, are located on public land. Also on the map are some preserves or conservation easements held by private conservation organizations.

Some notable public lands within the Cape Fear River basin include the military lands – Fort Bragg, Pope Air Force Base, Military Ocean Terminal Sunny Point, and part of Camp Lejeune – substantial areas which balance conservation with military training missions. Another large piece of land in the Cape Fear River basin is Jordan Lake (about 40,000 acres). The Army Corps of Engineers own the lands under and around Jordan Lake, but state agencies manage most of the upland areas. Notable state-owned lands within Cape Fear River basin include: a number of State Parks (Raven Rock, Bay Tree Lake, Bushy Lake State Natural Area, Bald Head Island State Natural Area, Weymouth Woods, Singletary Lake, Carolina Beach); Wildlife Resources Commission Game Lands (Holly Shelter Angola Bay, Cape Fear River Wetlands, Suggs Mill Pond); the Department of Agriculture's Boiling Springs Lakes Preserve (a joint project with The Nature Conservancy); the North Carolina Zoo; and the Division of Forest Resources' Bladen Lakes State Forest. Also, the Department of Transportation has acquired several properties in the basin to mitigate for wetlands impacted during highway construction. This property is permanently protected, and hopefully will be restored to provide a number of ecological benefits.

Local efforts to protect land within the Cape Fear River basin have yielded a great deal of benefit to water quality. For instance, the City of Fayetteville has protected land along Cross Creek – land that is an important natural area, a tributary of the Cape Fear, and part of the water supply for Fayetteville. Also, the North Carolina Botanical Garden Foundation has dedicated as State Nature Preserves some of the land they own near Chapel Hill, protecting natural diversity and the water quality of Morgan Creek.

While federal, state and local agencies are important players in land protection efforts within the Cape Fear River basin, key partners in these efforts are private conservation organizations such as the North Carolina Coastal Land Trust, Triangle Land Conservancy, Sandhills Area Land Trust, and the North Carolina Chapter of The Nature Conservancy. Although only partially shown on the map, these organizations have achieved significant protection in the Cape Fear River basin. Using innovative tools such as conservation easements, these organizations work with landowners in a number of ways to protect important natural areas and water quality, as well as the "open space" of agricultural lands. The work that they do is helping to improve the quality of life for residents of the Cape Fear River basin.

Chapter 34
Water Quality Initiatives

34.1 The Importance of Local Initiatives

As the Basinwide Planning Program completes its third cycle of plan development, there are many efforts being undertaken at the local level to improve water quality. Information about local efforts particular to a watershed or subbasin is included in Chapters 1-24. DWQ encourages local agencies and organizations to learn about and become active in their watersheds.

In an effort to provide water quality information and gain public input, DWQ held public workshops in Greensboro, Pittsboro, Fayetteville, Clinton and Wilmington during May 2004. The purpose of the workshops was to inform people of the 2005 update plan and to seek input prior to finalizing the plan. Participants provided comments on specific waters in the Cape Fear River basin and generalized issues related to urbanization and land use changes, water supply quantity and protection, enforcement, permitting, monitoring and funding sources. Refer to Appendix IX for specific comments received during the public workshops.

An important benefit of local initiatives is that local people make decisions that affect change in their own communities. There are a variety of limitations local initiatives can overcome including: state government budgets, staff resources, lack of regulations for nonpoint sources, the rule-making process, and many others.

These local organizations and agencies are able to combine professional expertise in a watershed. This allows groups to holistically understand the challenges and opportunities of different water quality efforts. Involving a wide array of people in water quality projects also brings together a range of knowledge and interests, and encourages others to become involved and invested in these projects. By working in coordination across jurisdictions and agency lines, more funding opportunities are available, and it is easier to generate necessary matching or leveraging funds. This will potentially allow local entities to do more work and be involved in more activities because their funding sources are diversified. The most important aspect of these local endeavors is that the more localized the project, the better the chances for success.

The collaboration of these local efforts are key to water quality improvements. There are good examples of local agencies and groups using these cooperative strategies throughout the state. The following local organizations and agencies (Table 60) are highlighted to share their efforts towards water quality improvement. Specific projects are described in the subbasin chapters (Chapters 1 – 24).

DWQ applauds the foresight and proactive response to potential water quality problems in the watersheds listed above. Federal and state government agencies are interested in assisting local governments and citizen groups in developing their water quality management programs. The distribution of several grantors is discussed below.

34.1.1 Cape Fear Assembly

Office location: Fayetteville, North Carolina
Executive Director: Don Freeman
Website: http://www.cfra-nc.org/
Contact: cfra@faynet.com Phone: (910) 223-4601

The Mission of the CFRA is to provide for the highest quality of life possible for the residents of the Cape Fear River basin, through the proper management of the Cape Fear River, its tributaries, and adjacent land uses. This mission will be accomplished through our support of efforts to investigate, educate and effectuate. Scientific study coupled with economic analyses will provide the information needed to make the best possible decisions regarding this river system and its uses. Education will provide for a better informed public, and thereby, improved stewardship of the river system as a resource. Then finally, development of policy will bring into effect the benefits of the information and education. The assembly also works with the three monitoring coalitions in the Cape Fear River basin (Appendix V).

The Cape Fear River Assembly received $933,675 through EPA's Targeted Watershed Program to address impaired water quality areas. They proposed to develop, demonstrate, and evaluate an innovative water quality nutrient trading program for the Jordan Lake watershed within the Cape Fear River Basin. The project will provide a much needed example of integrating urban stormwater management into a credit trading and watershed permitting program. The project will involve developing a water quality protection platform that combines traditional BMPs with nonstructural BMPs. Economic incentives will be created for developers to implement more environmentally sustainable land use patterns that promote more permeable surfaces. This project will result in a program that will protect the watershed's valuable water resources while allowing for continued economic growth.

34.1.2 Haw River Assembly/Haw River Watch/Stream Steward Campaign

Office location: Bynum, North Carolina
Executive Director: Elaine Chiosso chiosso@hawriver.org
Website: www.hawriver.org
Contact: info@hawriver.org and riverwatch@hawriver.org Phone: (919) 542-5790

The Haw River Assembly is a nonprofit citizen organization working to restore the Haw River and protect Jordan Lake using education, citizen water quality monitoring and research as tools. The Assembly shares water quality monitoring information collected by the Haw River Watch volunteers with state biologists and are working with state and federal agencies in the areas of land conservation, nonpoint source pollution education and dam removal. The Haw River Assembly has been instrumental in drawing attention to the Impaired streams in our river basin.

The Haw River Assembly's Stream Steward campaign has been funded through the 319 program since 2000 to conduct educational outreach on nonpoint source pollution to communities with impaired streams. The campaign has targeted Robeson Creek (Chapter 4) and the upper Haw River (Chapter 1). In 2004 the campaign received a new 319 grant to expand the campaign to the entire Haw River watershed, focusing particularly on communities with streams on the impaired waters list.

34.1.3 Piedmont Triad Council of Governments

Office location: Greensboro, North Carolina
Environmental Projects Coordinator: Carol Patrick cpatrick@ptcog.org
Website: http://www.ptcog.org/
Contact: (336) 294-4950

The Piedmont Triad Council of Governments (PTCOG) is a voluntary association of municipal and county governments, enabled by state law to promote regional issues and cooperation among members. The PTCOG serves 41 member governments in the following seven counties: Alamance, Caswell, Davidson, Guilford, Montgomery, Randolph and Rockingham. The COG is involved in the Jordan stakeholders' process (Chapter 36), Upper Cape Fear Basin Association (Appendix V), as well as various TMDLs being developed in the region.

34.1.4 Triangle J Council of Governments

Office location: Research Triangle Park, North Carolina
Water Resources Program Manager: Sydney Miller smiller@tjcog.org
Website: http://www.tjcog.dst.nc.us/index.shtml
Contact: tjcog@tjcog.org Phone: (919) 549-0551

The Triangle J Council of Governments promotes the wise and responsible stewardship of our region's water resources. TJCOG facilitates regional approaches to water resources management and provides technical assistance to local governments, and state and federal agencies. The Triangle J Council of Governments is recognized as a leader in water supply protection efforts. TJCOG assisted local governments in the development of their watershed management regulations and has strongly encouraged the development of the state's minimum standards for the protection of public water supplies. The Triangle J Council of Governments has worked closely with local, state and federal agencies to develop several ongoing projects, such as the Triangle Area Water Supply Monitoring Project.

34.1.5 UNC Wilmington Center for Marine Science Research Programs

Office location: Wilmington, North Carolina
Website: http://www.uncwil.edu/cmsr/
Contact: Nancy Stevens stevensn@uncw.edu Phone: (910) 962-2301

The Center for Marine Science Research administers the Lower Cape Fear Program (Appendix V) as well as a host of other environmental monitoring and research in the Cape Fear River basin. Researchers at UNC-CMS have been involved in post-hurricane monitoring of water quality and studies of impacts of land use changes and intensive farming in the Northeast Cape Fear and Black River watersheds.

34.2 Federal Initiatives

34.2.1 Clean Water Act – Section 319 Program

Section 319 of the Clean Water Act provides grant money for nonpoint source demonstration and restoration projects. Approximately $1 million is available annually through base funding for demonstration and education projects across the state. An additional $2 million is available annually through incremental funding for restoration projects. All projects must provide nonfederal matching funds of at least 40 percent of the project's total costs. Project proposals are reviewed and selected by the North Carolina Nonpoint Source Workgroup, made up of state and federal agencies involved in regulation or research associated with nonpoint source pollution. Information on the North Carolina Section 319 Grant Program application process is available online at http://h2o.enr.state.nc.us/nps/application_process.htm.

There are 12 projects in the Cape Fear River basin that have been funded through the Section 319 Program between 1996 and 2003, many of which have basinwide applications (Table 36). Many are demonstration projects and educational programs that allow for the dissemination of information to the public through established programs at NC State University and the NC Cooperative Extension Service. Other projects fund stream restoration activities that improve water quality.

Descriptions of projects and general Section 319 Program information are available at http://h2o.enr.state.nc.us/nps/Section_319_Grant_Program.htm.

34.3 State Initiatives

34.3.1 North Carolina Ecosystem Enhancement Program

The North Carolina Ecosystem Enhancement Program (NCEEP) is responsible for implementing wetland and stream restoration projects as part of a statewide effort to provide more ecologically effective compensatory mitigation. The focus of the program is to restore, enhance and protect key watershed functions in the 17 river basins across the state through the implementation of wetlands, streams and riparian buffer projects within selected local watersheds *in advance of permitted impacts*. These vital watershed functions include water quality protection, floodwater conveyance & storage, fisheries & wildlife habitat, and recreational opportunities. The NCEEP is not a grant program. Instead, the program funds local mitigation projects directly through its various in-lieu fee receipts.

Through the development of ***River Basin Restoration Priorities*** (formerly called Watershed Restoration Plans), the NCEEP identifies local watersheds (14-digit Hydrologic Units) with the greatest need and opportunity for watershed mitigation projects. The *RBRP*s are developed, in part, using information compiled by DWQ's programmatic activities. Additional local resource data and locations of existing or planned watershed projects are considered in the selection of "Targeted Local Watersheds", which are identified and mapped within the *RBRP*s. ***Targeted Local Watersheds*** represent those areas within a given river basin where NCEEP resources can be most efficiently focused for maximum benefit to local watershed functions. The NCEEP *RBRPs* are periodically updated and presented on the NCEEP website: http://www.nceep.net.

Table 36 Projects Funded Through Clean Water Act Section 319

Fiscal Year	Name	Description	Agency	Amount
1996	McLendens Creek	BMP Implementation	NCSU	$198,000.00
2000	Stream Steward Education Campaign	Educational	Haw River Assembly	$6,000.00
2000	Retention Pond to Biorention Conversion Project	BMP Demonstration	Greensboro, City of Storm Water Management Division	$150,000.00
1999	Robeson Creek Watershed Assessment	TMDL Development	NCSU	$210,000.00
2002	Stream Steward Campaign	Education and BMP installation	Haw River Assembly	$26,989.00
2002	Burnt Mill Creek Watershed Outreach and Demonstration Project	Education and BMP installation	Wilmington, City of Storm Water Services	$120,000.00
1998	Jordan Lake Stakeholder Project	Stakeholder Development	Triangle J Council of Governments	$39,730.00
2003	Stream Steward Campaign	Educational	Haw River Assembly	$32,300.00
2003	Little Troublesome Creek Fecal Coliform Bacteria TMDL Implementation Plan	TMDL Implementation	Piedmont Triad COG	$366,248.00
2003	Town Branch Fecal Coliform Bacteria TMDL Implementation Plan	TMDL Implementation	Piedmont Triad COG	$163,308.00
2003	Robeson creek NPS Restoration Watershed Project	TMDL Implementation	NCSU	$300,000.00
2004	Quantification of Water Quality Improvement in Sandy Creek, after Stream and Riparian Restoration and Wetland Treatment Cell Creation (proposed)	Wetlands Restoration/ Enhancement	Duke University	$338,337.00
			Total	$1,950,912

The NCEEP can perform restoration projects cooperatively with other state or federal programs or environmental groups (such as the Section 319 Program). Integrating wetlands or riparian area restoration components with Section 319-funded or proposed projects will often improve the overall water quality, hydrologic and habitat benefits of both projects.

The NCEEP is also developing comprehensive **Local Watershed Plans**, often within Targeted Local Watersheds identified in the *RBRPs*. Through the Local Watershed Planning process, EEP conducts comprehensive watershed assessments to identify stressors in local watersheds, and

then coordinates with local resource professionals and local governments to identify and implement watershed projects and management strategies to address these problems. The Plans identify and prioritize wetland areas, stream reaches, riparian buffer areas and best management practices that will provide water quality improvement, habitat protection and other environmental benefits to the local watershed. There are currently six local watershed planning efforts that are either completed or underway in the Cape Fear River basin, as described below. These planning efforts are also discussed in the subbasin chapters.

Troublesome Creek and Little Troublesome Creek Local Watershed Plan (Chapter 1). The Plan is available at: http://www.nceep.net/services/lwps/Troublesome_Creek/troublesome.htm

Morgan Creek and Little Creek Local Watershed Plan (Chapter 6). The Plan is available at: http://www.nceep.net/services/lwps/Morgan_Creek/morgan.htm

Middle Cape Fear and Kenneth/Harris Local Watershed Plan (Chapter 7). The Plan is available at: http://www.nceep.net/services/lwps/Harris-Kenneth/Harris-Kenneth.htm

Rocky River Local Watershed Plan is not yet complete (Chapter 12). The Plan is due to be completed in 2005.

New Hanover County Local Watershed Plan (Chapter 23). The Plan is available at: http://www.nceep.net/services/lwps/new%20hanover/newhanover.htm

34.3.2 Clean Water Management Trust Fund

The Clean Water Management Trust Fund offers approximately $40 million annually in grants for projects within the broadly focused areas of restoring and protecting state surface waters and establishing a network of riparian buffers and greenways. In the Cape Fear River basin, 71 projects have been funded for a total of $54,330,400 (Table 37). For more information on the CWMTF or these grants, call (252) 830-3222 or visit the website at www.cwmtf.net.

Table 37 Projects in the Cape Fear River Basin Funded by the Clean Water Management Trust Fund (July 2004)

Project Number	Application Name	Amount Funded	Subbasin
1997A-085	Orange Water and Sewer Authority – Acquisition / Cane River Resv	$1,042,500	03-06-04
1997A-087	NC Wildlife Resources Commission – Acquisition / Suggs Mill Pond	$2,250,000	03-06-16
1997A-097	Triangle J COG – Acq and Restoration Plan / Upper Cape Fear River	$70,000	03-06-03
1997A-104	Durham County – Acquisition / New Hope Creek	$750,000	03-06-05
1997A-119	Fayetteville – Acquisition / Little Cross Ck	$502,500	03-06-15
1997B-008	Piedmont Land Conservancy – Acq / Sandy Creek Reservoir/Ramseur	$134,000	03-06-09
1997B-009	Triangle Land Conservancy – Acq and Greenway / New Hope Creek	$2,750,000	03-06-05
1997B-904	Greensboro – Acq and Stormwater Wetland / South Buffalo Creek	$800,000	03-06-02

1998A-004	Triangle Land Conservancy – Deep River Acquisition	$1,189,000	03-06-10
1998A-005	NC Wildlife Resources Commission – Bellhammon Tract Acq / NE Cape Fear	$1,070,000	03-06-23
1998A-101	New Hanover Co – Airlie Gardens and Tidal Creeks Acquisition / Stormwater	$6,000,000	03-06-24
1998A-103	Chapel Hill – Dry Creek Acquisition and Greenway	$200,000	03-06-05
1998A-301	Brunswick County – Wastewater Reuse System	$1,500,000	03-06-17
1998A-302	Cape Fear Botanical Garden – Streambank Stabilization / Cross Creek	$77,000	03-06-15
1998A-505	Ramseur – Sewer Rehabilitation / Deep River	$344,000	03-06-09
1998A-807	Fayetteville – Little Cross Creek Pollutant Susceptibility Study	$63,200	03-06-15
1998B-001	Haw River Assembly – Haw River Headwaters Acquisition	$24,500	03-06-01
1998B-012	Nature Conservancy – Acquisition / Black and South Rivers	$2,000,000	03-06-20
1998B-015	Sanford – Acquisition / Little Buffalo Creek	$765,000	03-06-11
1998B-409	Piedmont Triad Reg. Water Authority – Acquisition / Deep River	$615,000	03-06-08
1998B-505	New Hanover Co / Dept. Env Mgmt – Landfill Leachate Treatment	$785,000	03-06-23
1999A-007	NC Wildlife Resources Commission – Little Lake Singletary Acq	$1,810,406	03-06-16
1999A-701	NC WRP – Restoration and Stormwater / Sandy Creek	$582,500	03-06-05
1999A-901	Cape Fear RC&D – Bladen Co / No-Till Drill	$18,550	03-06-16 03-06-18 03-06-19 03-06-20
1999B-007	Haw River Assembly – Conrad Tract Acquisition / Mears Fork Creek	$200,000	03-06-01
1999B-010	NC Coastal Land Trust – Town Creek Conservation Easements	$1,441,000	03-06-17
1999B-103	Graham – Haw River Trail Feasibility Study	$20,000	03-06-02
1999B-506	Franklinville – WWTP Improvements	$1,052,000	03-06-09
1999B-512	Garland – Backup generation	$45,000	03-06-18
2000A-002	Cary – Acquisition and Greenway Feasibility / White Oak Creek	$86,000	03-06-05
2000A-009	NC Coastal Land Trust – Acquisition / Town Creek	$305,000	03-06-17
2000A-504	Erwin – WWTP Improvements	$300,000	03-06-07
2000A-701	Raeford – Acq and Stormwater Wetland Design / Peddlers Branch	$194,000	03-06-15
2000A-803	Moore County Soil and Water Conservation District – Sediment Monitoring / Cane Creek	$9,724	03-06-14
2000B-008	NC Coastal Land Trust – Foy Creek Acquisition	$1,251,000	03-06-24
2000B-505	Chatham County – Wastewater Reuse	$1,000,000	03-06-04
2000B-509	Liberty – Sewer Rehabilitation	$212,020	03-06-12
2001A-015	NC Coastal Land Trust – Henry Prop / Town and Russell Creeks Acq	$277,000	03-06-17

2001A-016	NC Coastal Land Trust – Henline Tract / NE Cape Fear Acquisition	$181,000	03-06-23
2001A-018	NC Div Forest Resources – Mulford Creek / Bladen Lakes State Forest Acquisition	$315,000	03-06-16
2001A-025	Orange Water and Sewer Authority – Phase II Cane Creek Reservoir Acquisition	$687,000	03-06-04
2001B-001	Apex – Acquisition / Beaver Creek	$387,000	03-06-05
2001B-004	Cary – Acquisition / White Oak Creek	$1,084,000	03-06-05
2001B-008	Graham – Acquisition / Haw River	$140,000	03-06-02
2001B-017	Nature Conservancy – Acquisition / Bear Garden and Angola Bay Tracts / NE Cape Fear River and tributaries	$7,900,000	03-06-23
2001B-025	NC Coastal Land Trust – Acquisition / Burney Tract / Shelter Creek and Corbington Branch	$783,000	03-06-23
2001B-026	NC Coastal Land Trust – Acquisition / Holland Tract / Shelter Creek and Angola Creek	$442,000	03-06-23
2001B-807	Piedmont Triad COG – Riparian Corridor Plan / Haw River	$65,000	03-06-02
2001M-008	Triangle Land Conservancy – Acquisition Minigrant	$25,000	03-06-11
2001M-010	Haw River Assembly – Acquisition Minigrant	$14,500	03-06-02
2002A-003	Carrboro, Town of – Acquisition / Bolin Creek	$202,000	03-06-06
2002A-018	Nature Conservancy – Acquisition / Burgaw Creek	$606,000	03-06-23
2002A-019	Nature Conservancy – Acquisition / Shelter Swamp	$148,000	03-06-23
2002A-030	Triangle Land Conservancy – Acquisition / Deep River Justice Tract	$1,825,000	03-06-11
2002A-404	Pilot View RC&D – Stream Restoration and Stormwater / Koerner Place Creek	$175,000	03-06-08
2002A-504	Liberty, Town of – Rocky River Sewer System Rehabilitation	$203,000	03-06-09
2002A-705	Greensboro, City of – Stormwater Wetland / South Buffalo Construction	$570,000	03-06-02
2002A-708	Raeford, City of – Stormwater Wetland / Peddler's Branch Construction	$296,000	03-06-15
2002B-012	NC Coastal Land trust – Acquisition / IP Realty, Town Creek	$2,095,000	03-06-17
2002B-702	Fayetteville, City of – Stormwater /Little Cross Creek	$766,000	03-06-15
2002M-001	Piedmont Land Conservancy Minigrant / Troublesome Creek	$25,000	03-06-01
2002M-006	New Hanover Soil and Water Conservation District Minigrant /Eagle Island	$25,000	03-06-17
2003A-010	Conservation Fund – Acquisition / Goshen Swamp and Grove Creek	$55,000	03-06-22
2003A-019	Nature Conservancy, The – Acquisition / Corbett Tract, NE Cape Fear	$671,000	03-06-23
2003A-023	NC Coastal Land Trust – Acq / Humphrey Tract, Shaken Creek	$366,000	03-06-23
2003A-024	NC Coastal Land Trust – Acq / McKeithan Tract, NE Cape Fear	$992,000	03-06-23
2003A-038	Sandyfield, Town of – Acquisition / Beaverdam Creek Wetlands	$161,000	03-06-16

2003A-512	Ramseur, Town of – Wastewater / Deep River Collection Rehabilitation	$278,000	03-06-09
2003A-515	Wallace, Town of – Wastewater / Rock Fish Creek Regionalization	$1,037,000	03-06-22
2003M-002	Sandhills Area Land Trust Minigrant – Methodist College River Tract	$25,000	03-06-15
2003M-004	Haw River Assembly – Minigrant – Alston Quarter, Saxapahaw	$25,000	03-06-04
2003M-008	Orange Water and Sewer Authority – Minigrant / Cane Creek Dairy	$25,000	03-06-04
		$54,330,400	

Notes:

(1) The total funded amount excludes funded projects that were subsequently withdrawn by the applicant.

(2) Several regional and statewide projects were funded in areas that include the Cape Fear River basin. The projects include various riparian corridor planning projects, a straight pipe and septic system discharge elimination program, and a Watershed Assessment and Restoration Program.

34.3.2 NCSU Water Quality Group

The water quality group is a multidisciplinary team that implements, analyzes and evaluates nonpoint source pollution control technologies and water quality programs in North Carolina and nationwide. The Water quality group is a component of the NC Cooperative Extension Service, Biological and Agricultural Engineering Department, and the NCSU Soil and Water Environmental Technology Center.

The mission of the Water Quality Group is to enhance NCSU's water quality programs by conducting research, dessiminating information and providing technical assistance on nonpoint source pollution control for agriculture, forestry, urban land uses, construction an on-site wastewater systems. This role improves the effectiveness and increases the benefits derived from research and extension efforts and NCSU by facilitating interdepartmental and inter-institutional cooperative efforts to understand and address environmental problems.

Chapter 35
TMDLs in the Cape Fear River Basin

35.1 Introduction to TMDLs

A TMDL or Total Maximum Daily Load is a calculation of the maximum amount of a pollutant that a waterbody can receive and still meet water quality standards, and an allocation of that amount to the pollutant sources. A TMDL is the sum of the allowable loads of a single pollutant from all contributing point and nonpoint sources. The calculation must include a margin of safety to ensure that the waterbody can be used for the purposes the state had designated. The calculation must also account for seasonal variation and critical conditions in water quality.

For each water quality limited segment Impaired by a pollutant and identified in the 303(d) list, a TMDL must be developed. TMDLs are not required for waters Impaired by dam operations. A TMDL includes a water quality assessment that provides the scientific foundation for an implementation plan. An implementation plan outlines the steps necessary to reduce pollutant loads in a certain body of water to restore and maintain human uses or aquatic life. For more information on TMDLs and the 303(d) listing process, refer to Appendix VII or visit the TMDL website at http://h2o.enr.state.nc.us/tmdl/.

35.2 Approved TMDLs in the Cape Fear River Basin

The following TMDLs have been completed and approved by EPA (Table 38). Refer to the subbasin chapters for specific reductions called for in the TMDLs and to determine what local governments may be affected by TMDLs.

Table 38 EPA approved TMDLs in the Cape Fear River Basin

Waterbody (Subbasin)	Pollutant	Approval Date	Chapter
Little Troublesome Creek (03-06-01)	Fecal coliform bacteria	May 17, 2002	1
North Buffalo Creek (03-06-02)	Fecal coliform bacteria	April 28, 2004	2
Town Branch (03-06-02)	Fecal coliform bacteria	September 16, 2002	2
Roberson (Robeson) Creek (03-06-04)	Chlorophyll *a* (Total phosphorus)	January 13, 2004	4
Northeast Creek (03-06-05)	Fecal coliform bacteria	September 12, 2003	6
East Fork Deep River (03-06-08)	Turbidity, Fecal coliform bacteria	March 4, 2004	8
Richland and Muddy Creeks (03-06-08)	Fecal coliform bacteria	May 17, 2004	8

Several TMDLs are currently in progress at the DWQ. These include a fecal coliform bacteria and turbidity TMDL for the Haw River (Chapter 1), a fecal coliform TMDL for the Deep River (Chapter 8), a turbidity TMDL for Third Fork Creek (Chapter 5), a chlorophyll *a* TMDL for

Jordan Reservoir (Chapter 36), and a dissolved oxygen TMDL for the Cape Fear Estuary (Chapter 37).

Two large TMDL efforts underway in the Cape Fear River Basin include the Jordan Reservoir Chlorophyll *a* TMDL and the Cape Fear Estuary Dissolved Oxygen TMDL. Information regarding water quality data and assessment for Jordan Reservoir is discussed in Chapter 5, while TMDL information is discussed in Chapter 36. Information regarding water quality data and assessment for the Cape Fear Estuary is discussed in Chapter 17, while TMDL information is discussed in Chapter 37.

35.3 Scheduled TMDLs in the Cape River Basin

EPA guidance provides a timeline for TMDL development of 8 to 13 years. Thus, the elapsed time between 303(d) listing and TMDL development should not exceed 8 to 13 years. If the pace of TMDL development does not comply with this schedule, EPA may elect to develop TMDLs in order to meet this timeline. Waterbodies that were listed in 1998 should have TMDLs developed by 2006 to 2011.

35.4 TMDL Implementation Efforts

Point source (i.e., wastewater) implementation plans are included in TMDLs per EPA guidance. Thus, any point source discharging to an Impaired water will receive an explicit allocation within the TMDL. In some cases, the allocation may be equal to existing permit limits; thus, no action is needed by the wastewater permittee. In other cases, the allocation may be associated with a reduction in loading. Where applicable, the point source allocation may include provisions for bubble permits and point-to-point trading.

Nonpoint source implementation plans are not included in TMDLs, nor are they required by federal law. Nonpoint source implementation plans can be developed by DWQ, other agencies within DENR, COGs or local government offices. For example, the Piedmont Triad Council of Governments (PTCOG) obtained Section 319 grants to develop implementation plans for Little Troublesome Creek and Town Branch. Each of these TMDLs has only nonpoint source loadings contributing to impairment.

EPA has provided guidance regarding TMDLs and NPDES stormwater permits. As a result, selected NPDES stormwater permits may contain additional language when subject to a TMDL. Per EPA, MS4s identified in TMDLs as contributors to impairment may be required to develop a management plan that includes additional monitoring and BMP installation associated with pollutants of concern.

35.5 Impaired Waters Update

Waters identified as Impaired during this assessment period will be updated in the 2006 Integrated Report. These waters will be considered Impaired upon EMC approval of this basin plan. TMDLs will be scheduled as appropriate depending upon the classification of the waterbody and the identified problem parameters.

Chapter 36
Jordan Reservoir and Haw River Watershed NSW Strategy

36.1 Introduction and Overview

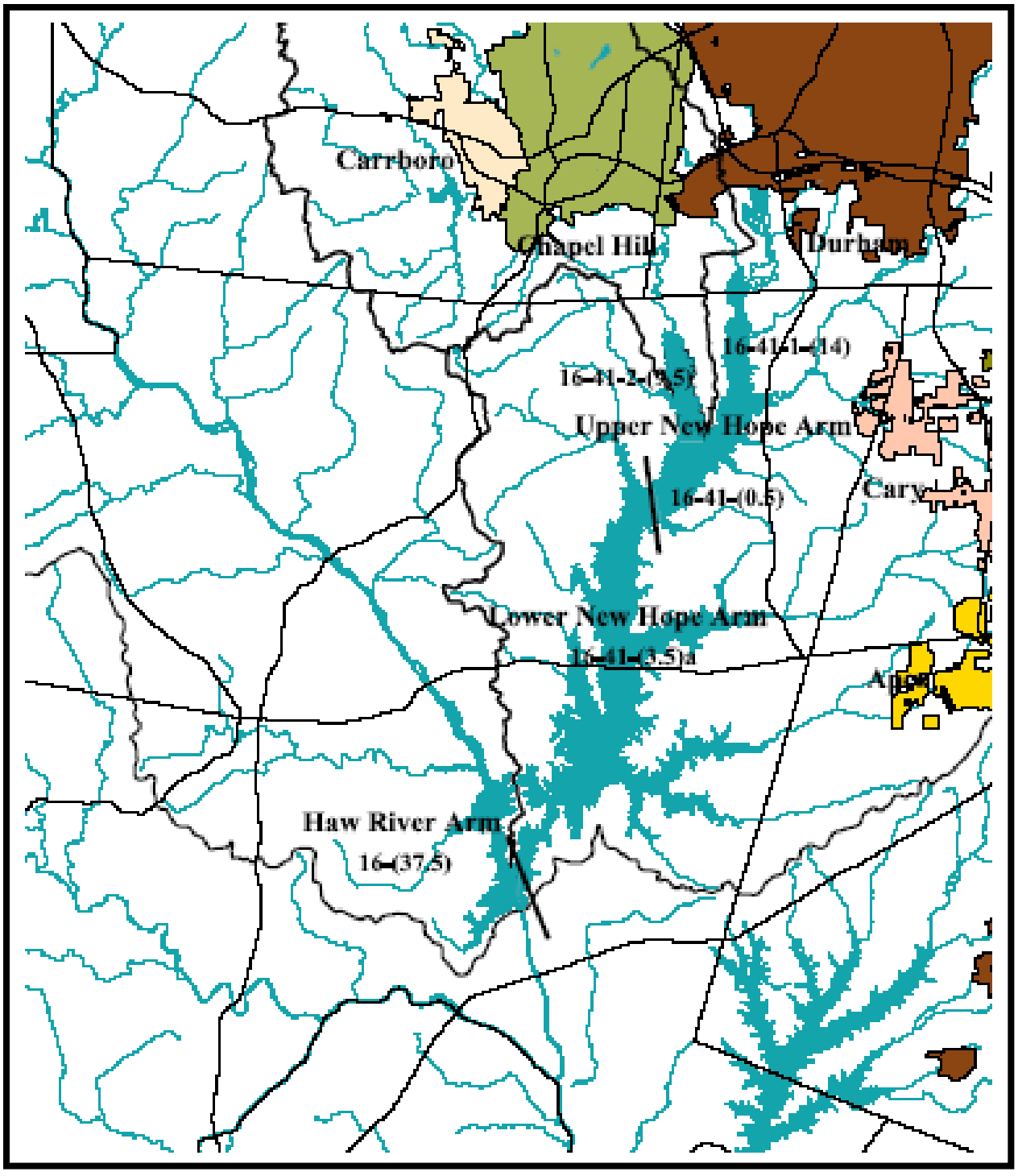
In 1983, all waters in the Haw River watershed (subbasins 03-06-01 to 03-06-06) including Jordan Reservoir received a supplemental classification of nutrient sensitive water (NSW) to acknowledge that Jordan Reservoir could have water quality problems associated with excessive nutrient inputs from both wastewater discharges and runoff from the various land uses in the watershed. The supplemental classification required that a NSW strategy be put in place to protect the reservoir from water quality problems associated with nutrient enrichment.

Total phosphorus (TP) limits of 2 mg/l were required for NPDES permitted facilities with flow greater than 0.005 MGD. In 2000, all subject dischargers were meeting this limit. In addition, discharges located upstream of the Upper New Hope Arm of Jordan Reservoir received TP limits of 0.5 mg/l during the months from April to October. However, nuisance algal blooms and chlorophyll *a* levels exceeding water quality standards continue to be observed.

The Upper New Hope Arm of B. Everett Jordan Reservoir was placed on the 2002 303(d) list of Impaired waters based on results of the nutrient response model developed as described in Section 36.2 below. The listing of the Upper New Hope Arm is consistent with EPA rules that require water quality models to be utilized as a basis for 303(d) listing. The 303(d) listing of the Upper New Hope Arm of the reservoir results in the need for a TMDL for this portion of the lake. Thus, the Jordan Reservoir nutrient management strategy was developed in order to meet requirements of both the Clean Water Responsibility Act and the federal rules and guidance regarding TMDLs. The Lower New Hope Arm and Haw River Arm are currently Impaired as well (Chapter 5). Refer to Figure 43 for identification of the arms discussed here.

The following sections describe 1) the Jordan stakeholder process, 2) Clean Water Responsibility Act, 3) the modeling performed to support the nutrient management strategy, 4) the development of loading targets and 5) the nutrient management strategy that have occurred throughout the development of the models and the nutrient management strategy. For more information on use support assessments used to identify impairment of the reservoir, refer to Chapter 5 and Appendix X.

Figure 43 Jordan Reservoir Segments



36.1 Jordan Reservoir Stakeholder Processes

Two stakeholder processes occurred during the development of this strategy. The first process was through the efforts of the Project Partners. During the initial development of the data review technical memorandum and the nutrient response model, the Project Partners held regular meetings with DWQ staff. At major completion steps, the Project Partners convened greater stakeholder meetings to share and discuss results of the data review and the modeling.

DWQ staff, the Triangle J Council of Governments, and the Piedmont Triad Council of Governments initialized a more formal stakeholder process to carry a greater group of stakeholders forward through the development of management targets and the management strategy. A USEPA 104(b)(3) grant, in the amount of $29,730, and administered by the Division of Water Quality, was used to support this stakeholder process. A total of 21 stakeholder meetings were held between May 2003 and December 2004 to discuss TMDL development, modeling issues, target setting, and management strategy development. The councils of governments prepared a stakeholder report that includes descriptions of the meetings, stakeholder comments and concerns, and recommendations. The Triangle J Council of Governments also continues to maintain a project website, with links to presentations and handouts posted regularly. Materials can be downloaded from this website at http://h2o.enr.state.nc.us/tmdl/SpecialStudies.htm#Jordan.

36.2 The Clean Water Responsibility Act of 1997 (House Bill 515, Senate Bill 1366)

The Clean Water Responsibility Act of 1997 (often referred to as HB515) included legislation to further address water quality problems in NSW waters. The act set total nitrogen (TN) and total phosphorus (TP) NPDES permit limits for facilities discharging greater than 0.5 MGD into the Jordan Reservoir/Haw River watershed. A five-year compliance period for limits of 5.5 mg/l of TN and 2 mg/l of TP was established for qualifying facilities. Amendments to the act approved in 1998 (referred to as Senate Bill 1366) provided a compliance extension to the nutrient limits, with conditions. Those wastewater facilities granted a compliance extension by the Environmental Management Commission were required to develop a calibrated nutrient response model, evaluate and optimize the operation of all facilities to reduce nutrient loading, and evaluate methods to reduce nutrient mass loading to NSW waters. The municipalities of Greensboro, Mebane, Reidsville, Graham, Pittsboro and Burlington; and the Orange Water and Sewer Authority (OWASA) were granted the compliance extension by the Environmental Management Commission in April 1999. This collective group of facilities will be referred to as the Project Partners in subsequent sections of this chapter. Facilities that did not seek compliance extensions are the City of Durham/Durham South WWTP and Durham County/Triangle WWTP.

The CWRA provided a timeline for progress towards a site-specific nutrient management strategy should facilities and/or municipalities choose to seek the compliance extension. This established timeline is as follows:

- Two years for the collection of data needed to prepare a calibrated nutrient response model.
- A maximum of one year to prepare the calibrated nutrient response model.
- The amount of time, if any, that is required for the Commission to develop a nutrient management strategy and to adopt rules or to modify discharge permits to establish maximum mass loads or concentration limits based on the calibrated nutrient response model.
- A maximum of three years to plan, design, finance and construct a facility that will comply with those maximum mass loads and concentration limits.

If the Commission finds that additional time is needed to complete the construction of a facility, the Commission may further extend the compliance date by a maximum of two additional years.

Each municipality developed optimization plans and submitted them to the Water Quality Committee. Plans for nutrient response model development began in 1999 when the project partners, through the local councils of governments, released a request for proposals for both a data review document and nutrient response model development. Screening level and detailed nutrient response models were developed by Tetra Tech, Inc., the consultant to the project partners. The total cost to the project partners for the development of the data review document and the models was $370,000. The combined hydrodynamic and water quality model was approved by the Water Quality Committee in July 2002. DWQ began work to develop a nutrient management strategy following this approval.

36.3 Nutrient Response and Watershed Loading Modeling

Both the Projects Partners, with the addition of the municipalities of Apex and Cary, and the DWQ funded the development of numerous modeling tools to use for the development of the nutrient management strategy. Four modeling tools were developed by the Project Partners as part of meeting the requirements of the Clean Water Responsibility Act. These tools included a screening level nutrient response model using the BATHTUB modeling framework, a combined hydrodynamic and water quality model, and a nutrient fate and transport model for all major wastewater dischargers in the watershed. Hydrodynamic models simulate water circulation and movement, and nutrient response models simulate the nitrogen and phosphorus cycles, and algal response. The consultants, Tetra Tech, Inc., utilized the Environmental Fluid Dynamics Code (EFDC) framework to construct the reservoir hydrodynamic model, and the Water Quality Analysis Simulation Program (WASP) to link to the hydrodynamic model and simulate reservoir nutrient response (i.e., the water quality model). The models were run for the time period from 1997 through 2001. The Jordan Reservoir Nutrient Response Model results were summarized to provide information regarding the average chlorophyll *a* levels in the reservoir and the likelihood of chlorophyll *a* standard violations in various portions of the reservoir. An example of model output is provided below in Figure 44. Detailed model output is provided in the modeling reports available on the Modeling and TMDL Unit website at h2o.enr.state.nc.us/tmdl.

The Project Partners also funded the development of a nutrient fate and transport model to predict the fraction of wastewater that reaches Jordan Reservoir. The model demonstrates that a smaller fraction of wastewater discharged from facilities located farther upstream in watershed actually reaches Jordan Reservoir. This is contrary to facilities located nearer to the reservoir

that have substantially greater delivery to the reservoir. The fraction of nutrients delivered to the lake from each of the major dischargers varies depending upon the location of the effluent discharge. For example, 43 percent of the nitrogen load and 42 percent of the phosphorus load from the City of Greensboro North Buffalo WWTP reach Jordan Reservoir. In contrast, 96 percent of the nitrogen load and 97 percent of the phosphorus load from the Durham County Triangle WWTP reach Jordan Reservoir. Specific delivery rates for each facility are provided in the nutrient management strategy and TMDL document.

After approval from the Water Quality Committee, DWQ funded an update of the hydrodynamic and nutrient response model developed by the Project Partners. An additional model year, 2001, was added to the calibration and model summaries. This year had the largest amount of measured data of the five years ultimately modeled. DWQ also funded the development of a screening level watershed loading model in order to capture loading from nonpoint sources in the watershed. The watershed loading model was constructed using the Generalized Watershed Loading Function (GWLF) model. The watershed loading model was combined with the previously developed fate and transport model to provide a better analysis of the point and nonpoint source nutrient load contributions to Jordan Reservoir.

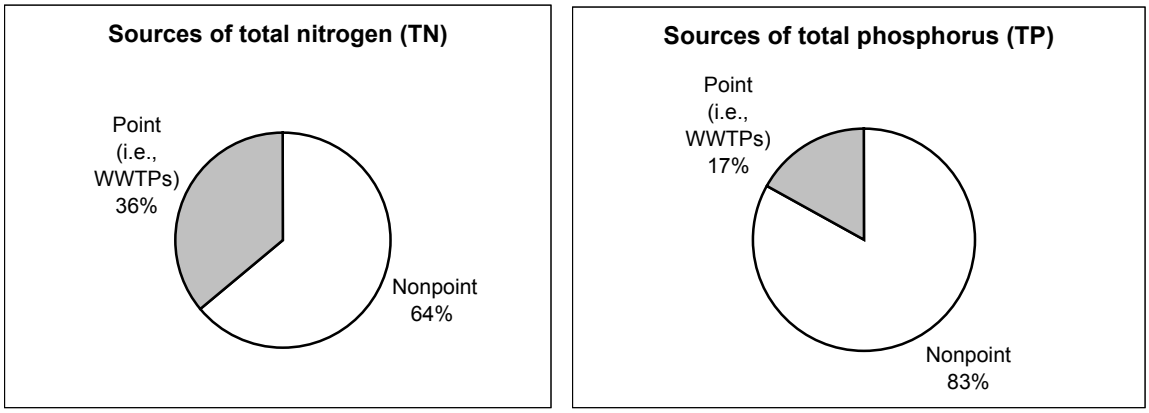


Figure 44 Sources of Nutrient Loads to Jordan Reservoir (1997-2000)

Modeling reports are available electronically from the Triangle J Council of Governments http://h2o.enr.state.nc.us/tmdl/SpecialStudies.htm#Jordan and the DWQ Modeling and TMDL Unit (http://h2o.enr.state.nc.us/tmdl).

36.4 TMDL and Management Targets

Management targets are those nutrient loads associated with chlorophyll *a* standard compliance. The nutrient response model is used to determine nutrient loads likely to produce compliance in all parts of the lake. For Jordan Reservoir, the loads would primarily derive from the Morgan, New Hope and Northeast Creeks, and the Haw River. Nutrient loading targets were determined for three different parts of the reservoir, the Upper New Hope Arm, the Lower New Hope Arm, and the Haw River Arm. Together, these three parts of the reservoir include all of the main body of Jordan Reservoir, with the exception of coves. These three parts were selected based on hydrology, frequency of standard violations, and the locations of reservoir tributaries.

The federal rules for Impaired waters and TMDLs require targets to consider seasonal variation and critical conditions. Thus, targets are based on the summer and early fall seasons to consider those times when predicted algal growth is most likely to result in standard violations. Consistent with use support methodology, the nutrient loading targets were then determined based on a standard violation frequency of less than 10 percent during the summer and early fall. The federal rules for Impaired waters also require targets to have a margin of safety. Per EPA guidance (1999), the margin of safety is a required component of a TMDL and accounts for the uncertainty about the relationship between pollutant loads and the quality of the receiving waterbody. For this TMDL, DWQ has elected to use an explicit margin of safety determined by adjusting the TMDL target from a 10 percent standard violation frequency to an 8 percent standard violation frequency.

Reduction targets were evaluated in terms of nitrogen and phoshorus loads. Multiple combinations of nitrogen and phosphorus loading scenarios that resulted in an 8 percent standard violation frequency were considered. Ultimately, three different targets were selected for Jordan Reservoir, corresponding to three different hydrologic areas of the lake. These targets are summarized in Table 39 by percentage reduction:

Table 39 Nutrient Load Reduction Targets from 1997-2001 Baseline

Area	Total Nitrogen (TN) Percent Reduction	Total Phosphorus (TP) Percent Reduction
Upper New Hope Arm (above SR 1008)	35%	5%
Middle and Lower New Hope Arm (from SR 1008 to the narrows)	0% (a)	0% (a)
Haw River Arm	8%	5%
(a) Provides a loading cap equal to 1997-2001 baseline nutrient loads.		

36.5 Point Source Management Strategies

There are numerous factors considered in the point source allocation strategy. These include the distance from the reservoir and the amount and type of waste discharged. Further weighting of the amount of wasteload allocations for each facility was evaluated using the actual annual average flow during the 1997-2001 period, the permitted flow during the 1997-2001 period, and the permitted flow in 2004. The final allocations are based on the permitted flow in 2004. The result of the allocation strategy is presented below for the Upper New Hope and Haw River arms of the reservoir. Detailed discussions can be found in the TMDL document.

36.5.1 Upper New Hope Arm of Jordan Reservoir

Converting the wasteload allocation from the lake to the load at the effluent pipe yields a total allowable end of pipe nitrogen load of 444,088 lbs/year and phosphorus load of 34,270 lbs/year for all facilities. All of the available loading was allocated to the existing facilities. Therefore, there will be no new nitrogen or phosphorus bearing loads permitted in this watershed. There are five facilities discharging greater than 100,000 gallons per day in the Upper New Hope Arm, as shown in Table 40. These facilities account for 99.8 percent of the total permitted flow from

point sources. The discharge allocations for these five facilities provide equivalent concentrations for each facility. For nitrogen, this equivalent concentration is 3.05 mg/l, and for phosphorus this equivalent is 0.23 mg/l. Therefore, the five large facilities will receive annual mass load limits as shown in Table 40.

Table 40 Wasteload Allocations for Facilities Great Than 100,000 Gallons Per Day

Permittee	Facility	Permitted Flow (MGD)	Percent of Total Flow	Wasteload Allocation (lbs/yr)	
				TN	TP
City of Durham	South Durham WRF	20.0	42.1	185,648	14,154
Orange Water & Sewer Authority	Mason Farm WWTP	14.5	30.5	134,595	10,262
Durham County	Triangle WWTP	12.0	25.3	111,389	8,492
Fearrington Utilities	Fearrington Utilities WWTP	0.5	1.1	4,461	354
Whippoorwill LLC	Carolina Meadows WWTP	0.35	0.7	3,249	248
	Total for large facilities	*47.4*	*99.7%*	*439,342*	*33,510*

36.5.2 Haw River Arm of Jordan Reservoir

Converting the wasteload allocation from the lake to the load at the effluent pipe yields a total allowable end of pipe nitrogen load of 1,570,890 lbs/year and phosphorus load of 195,510 lbs/year. All of the available loading was allocated to the existing facilities. Therefore, there will be no new nitrogen or phosphorus bearing loads permitted in this watershed. There are ten facilities discharging greater than 100,000 gallons per day in the Haw River Arm, as shown in Table 41. These facilities account for 99.3 percent of the total permitted flow from point sources. The discharge allocations for these ten facilities provide equivalent treatment levels for each facility. For nitrogen, this equivalent treatment level is 5.3 mg/l, and for phosphorus this equivalent is 0.67 mg/l. Therefore, the ten large facilities will receive annual mass load limits as shown in Table 41.

Special Permitting Options. There are two permitting options available to provide existing facilities flexibility with target compliance. One option is a bubble permit, which allows multiple facilities owned by the same permittee to pool the mass loading limits. This will only be an option for the cities of Greensboro and Burlington. Another option is a group compliance option, which allows multiple facilities owned by various permittees to pool the mass loading limits for compliance purposes. The group compliance option provides the interested permittees the ability to meet to the total mass limit even if an individual facility does not meet the individual mass limit. This option also provides the ability for a new discharge with nitrogen or phosphorus bearing loads to purchase loading from the existing compliance group members, if they choose to sell. Both options are provided in the TMDL document.

Table 41 Wasteload Allocations for Facilities Greater Than 100,000 Gallons Per Day

Permittee	Facility	Permitted Flow (MGD)	Percent of Total Flow	Wasteload allocation (lbs/yr)	
				TN	TP
City of Greensboro	T.Z. Osborne WWTP	40.0	41.5	645,834	81,222
City of Greensboro	North Buffalo Creek WWTP	16.0	16.6	258,333	32,489
City of Burlington	Eastside WWTP	12.0	12.4	193,750	24,367
City of Burlington	Southside WWTP	12.0	12.4	193,750	24,367
City of Reidsville	Reidsville WWTP	7.5	7.8	121,094	15,229
City of Graham	Graham WWTP	3.5	3.6	56,510	7,107
City of Mebane	Mebane WWTP	2.5	2.6	40,365	5,076
Town of Pittsboro	Pittsboro WWTP	2.0	2.1	32,292	4,061
Quarterstone Farm Homeowners Association	Quarterstone Farm WWTP	0.2	0.2	3,229	406
Glen Raven Inc.	Altamahaw Division plant	0.15	0.2	2,422	305
	Total for large facilities	*95.85*	*99.4%*	*1,547,580*	*194,630*

36.6 Nonpoint Source Management Strategies

36.6.1 Introduction and Overview

The comprehensive stakeholder process yielded five potential nonpoint source management scenarios covering the spectrum of possibilities between completely voluntary and regulation of all significant nutrient sources. Recognizing that point sources would be regulated, equity concerns led the stakeholders to favor some form of mandatory measures for all significant source types.

The NPS management strategy proposed by DWQ staff builds from concepts implemented in the Neuse and Tar-Pamlico River basins. All of the following elements would apply in the subwatersheds of both the Upper New Hope and Haw River arms, while only the riparian buffer protection and new development controls – would apply in the Lower New Hope subwatershed. The proposed strategy contains the following provisions. It should be noted that these provisions will be subject to change during the rule-making process that is expected to run from September 2005 to July of 2007.

- All **agricultural** operations would collectively meet N and P export performance goals as implemented by local committees.
- **Stormwater:**
  - All local governments would achieve stormwater N and P export performance goals from all new and existing development. This would entail establishing loading caps for all new development that would be tailored to each arm of the lake. For existing development, rules would be developed to ensure achievement N and P reduction targets through phased retrofitting.

- Local governments required to meet NPDES Phase II stormwater requirements of S1210 would have the option of adopting the

- DWQ would protect existing **riparian buffers on the lake and all perennial and intermittent streams in the watershed.**.
- Persons who apply fertilizers to lands in the lake's watershed would complete **nutrient management** training and a written plan for those lands. Stakeholders suggested pursuing a tax on fertilizer would fund the implementation of this rule, however, this would require approval of the general assembly, and is beyond the scope of the EMC's authority
- DWQ would work with DEH to develop programs to reduce N and P loading from **on-site wastewater** (the EMC has no control over this management area).
- DWQ would refine existing **wastewater land application** permitting programs as needed.
- DWQ would consult with DFR and forest industry to ensure that **forestry** does its part in meeting forest practice guidelines and minimizing nutrient loading to the lake (EMC has no control over this management area).
- DWQ would craft rules to allow for a **trading** program among point sources, between point and nonpoint sources, and among nonpoint sources.
- Local governments and agricultural committees would provide annual reports to the EMC. The EMC would reexamine the management strategy every five years.

Table 42 presents the loading goals that have been calculated based on the percentage reductions established for each subwatershed. The following sections describe the agriculture, urban stormwater, buffer protection, nutrient management, and land application proposals in more detail. Proposed requirements in the agriculture and development sections refer back to these numeric loading goals.

Table 42 Loading Goals by Subwatershed

Subwatershed	Nitrogen Reduction Goal / Load Goal		Phosphorus Reduction Goal / Load Goal	
Upper New Hope	35%	4.1 lb/ac-yr	5%	1.1 lb/ac-yr
Haw	8%	5.6 lb/ac-yr	5%	1.5 lb/ac-yr
Lower New Hope	0%	4.8 lb/ac-yr	0%	0.8 lb/ac-yr

36.6.2 Agriculture Strategy

Applicable Subwatersheds: Upper New Hope River and Haw River.
What: Achieve and maintain net annual N and P loads from agricultural lands, in lb/ac-yr, equal to or less than the targets allocated to an arm's subwatershed.

Who Administers: Local committees and a watershed oversight committee.

Who is Affected: All agricultural operations lying wholly or partly within the lake watershed, including animal operations, crop-farming, pasture and horticulture.

How: Local committees would be responsible for registering all producers, drafting strategies to achieve load targets, and submitting annual progress reports. A watershed oversight committee would develop a site evaluation tool to account for loading, review and approve local strategies, and provide reports to the EMC. Individual producers could comply automatically by implementing standard BMPs or they could contribute as needed to their collective local strategy and rely on it to comply.

When: Relative to rule effective date, producers register within one year, accounting tool completed in two years, strategies developed in three years, targets reached in five years. If a local committee did not meet its goal in five years, then producers in that area would be subject to additional implementation needs as determined by the EMC.

36.6.3 Urban Stormwater Strategy

Applicable Subwatersheds: Upper New Hope River and Haw River subject to all elements. Lower New Hope River - subject to new development and redevelopment elements; existing development element would not apply, and NPDES Phase II would apply only to local governments dictated by S1210.

What: A stormwater rule to address N and P loading from new development, redevelopment and existing development. The rule would require new development and redevelopment activities to achieve and maintain net annual N and P loads, in lb/ac-yr, equal to or less than the targets allocated to an arm's watershed. Redevelopment would have the option of meeting the subwatershed's percentage reduction targets relative to the previous development. Off-site trading options would be provided. The rule would also require retrofitting of existing development. Phase II communities would have the option of incorporating this nutrient stormwater rule into their programs to avoid having to administer two rules.

Who Administers: All local governments wholly or partly within an arm's subwatershed except as stated above.

Who is Affected: All new development and redevelopment projects, and existing development.

How: Local governments would adopt stormwater programs. A watershed oversight committee would be established, responsible for developing a site evaluation tool for load accounting by all local governments and for presenting the tool to the EMC. For existing development, local governments would analyze their jurisdictions within a subwatershed to determine stormwater BMPs needed for existing development to meet the loading targets allocated to that subwatershed. They would prioritize BMP installations, develop implementation schedules, then implement retrofits.

When: New development and redevelopment permitting would begin upon adoption of local ordinances within stormwater rule timeframes. Local governments would set retrofit implementation schedules for existing development within five years, then provide annual implementation reports to the EMC. The EMC would reexamine the retrofit approach every five years. Based on input from public review of the draft strategy, the stormwater rule may contain provisions for feasibility studies during the first years immediately following the effective date of the rules.

36.6.4 Buffer Protection Strategy

Applicable Subwatersheds: All.

What: Existing vegetated riparian buffers would be protected and maintained on both sides of perennial and intermittent streams, lakes and ponds.

Who Administers: DWQ. DWQ may delegate programs to interested, qualified local governments.

Who is Affected: Potentially all owners of property with riparian buffers.

How: 50 feet of riparian area would be protected on each side of waterbodies. The first 30 feet adjacent to the water, or Zone 1, would remain undisturbed with the exception of certain activities. The outer 20 feet, or Zone 2, may be graded but would need to be revegetated, with certain additional uses allowed. Specific activities would be identified in the rule as "exempt", "allowable", or "allowable with mitigation". Examples of "exempt" activities would include driveway and utility crossings of certain sizes through zone 1, and grading and revegetating in Zone 2. "Allowable" and "allowable with mitigation" activities would require review by DWQ staff and would include activities such as new ponds in drainage ways and road crossings. Mitigation options would be defined. Footprints of existing uses within the buffer such as cropland, buildings, commercial facilities, lawns, utility lines, and on-site wastewater systems would be exempt. A newly vegetated buffer would not be required unless the existing use of the riparian area changes.

When: Upon rule effective date.

36.6.5 Nutrient Application Management Strategy

Applicable Subwatersheds: All.

What: Completion of training and continuing education in nutrient management, completion and implementation of a written nutrient management plan addressing both N and P for all lands where nutrients are applied.

Who Administers: Not yet determined.

Who is Affected: All persons who apply fertilizer or biosolids to, or manage, ten or more acres of cropland; golf courses; recreational lands; rights-of-way; residential, commercial or industrial lawns and gardens; and other turfgrass areas. Cropland with a certified animal waste management plan would be exempt.

How: Revenue from a tax on fertilizer would fund implementation of the rule.

When: Upon rule effective date, persons affected would be required to complete initial training and plans within five years. Persons who become subject after the effective date would be given a shorter time period to comply. Biosolids applicators would be given until 2010 to begin

implementation of plans addressing both N and P. All persons would be required to comply with continuing education requirements on a periodic basis.

36.6.6 Wastewater Land Application Strategy

DWQ would refine its existing permitting program as needed for the entire Jordan Lake watershed. Changes may include requiring all non-discharge systems within a certain distance of the lake or mainstems of the Haw River or New Hope River tributaries to meet reclaimed water effluent standards, with the exception of individual single family homes. New and existing industrial non-discharger facilities may be required to establish vegetated buffers compliant with the riparian buffer rule.

36.6.7 Proposed Rule-making Schedule for the Nutrient Management Strategy.

Below is a tentative rule-making schedule beginning with submitting draft rules to the Water Quality Committee (WQC) in October 2005, and ending with review by the General Assembly.

October 2005	Draft rules submitted by DWQ to WQC for review and approval to bring to the EMC in November.
November 2005	Draft rules submitted to EMC for approval to go to public hearings.
April 2006	Publish fiscal note and announcement of public hearings for proposed rules.
April – May 2006	Hold hearing and receive public comments.
June – July 2006	Hearing officer deliberations on public comments.
September 2006	EMC adoption of rules.
October – December 2006	Seek approval of rules from RRC. (Note: If the RRC approves the rules, and has not received more than 10 written objections, then the rules become effective the following month.)
December 2006	Send rules to the General Assembly for review and approval.
April – September 2007	Effective date of rule will vary depending on action taken by the General Assembly.

Chapter 37
Cape Fear River Estuary Modeling and TMDL

37.1 Introduction

The Cape Fear Estuary from Bryants Creek to Snows Cut is Impaired for aquatic life because of dissolved oxygen standard violations. This portion of the estuary has been considered Impaired since the *1996 Cape Fear River Basinwide Water Quality Plan* and was included on the 1998 303(d) list of Impaired waters. Data used in the water quality assessment of the estuary were collected by DWQ and the LCFRP (Appendix V). Refer to Chapter 17 for current water quality assessment information.

Sources of the low dissolved oxygen levels include the many discharges of oxygen-consuming waste into this segment and to tributary streams. There is also a considerable volume of blackwater that may contribute natural sources of oxygen-consuming materials. This portion of the estuary is influenced by tides and high flows from the entire basin, and therefore, goes through many extreme changes in water column chemistry over the course of a year.

A point source management strategy was put in place in the *1996 Cape Fear River Basin Plan* in order to control oxygen-consuming wastes from wastewater discharges. The Cape Fear Estuary continues to violate the dissolved oxygen water quality standard as of this assessment cycle. Therefore, a TMDL is required for the estuary.

The DWQ obtained an EPA grant of $253,000 in order to mount an extensive field monitoring project. This field monitoring includes the installation of continuous monitoring devices by the US Geological Survey, sediment oxygen demand measurements, dye studies, and intensive chemical monitoring. A major portion of the monitoring was completed in 2004; however, hurricanes prevented the completion of the study. The remainder of the study is scheduled to be completed in 2005.

37.2 Dissolved Oxygen and Watershed Loading Modeling

The City of Wilmington funded the development of a combined hydrodynamic and water quality model of the estuary in order to justify alternate wastewater permit limits. A combined hydrodynamic and water quality model was constructed using the EFDC modeling framework. Some additional data were collected to support the model development. The City of Wilmington has provided this model to DWQ for use in developing the TMDL. DWQ is funding the enhancement of the Cape Fear Estuary DO model to include the additional data collected specifically for that purpose. Work on this enhancement is expected to begin in 2005.

In order to further understand the input of oxygen-consuming material from the watershed, a watershed fate, transport and loading model will also be developed. The Black and Northeast Cape Fear Rivers are both tributary to the Cape Fear River below Lock and Dam #1. At this time, DWQ expects to model the Northeast Cape Fear River watershed to evaluate watershed-

based sources of oxygen-consuming materials and nutrients. DWQ expects to begin developing this model in 2005.

37.3 TMDL Development

TMDL development has not begun for the Cape Fear Estuary. Following the completion of the Cape Fear Estuary Dissolved Oxygen model, the process of determining TMDL targets will begin. Subsequent processes include the point and nonpoint allocations, and the development of an implementation strategy.

37.4 Lower Stakeholder Process

Representatives from the Lower Cape Fear River Program (LCFRP) formed an advisory group to participate in TMDL development. The advisory group is referred to as the Lower Cape Fear River Program Cape Fear Estuary TMDL Advisory Subcommittee (LCFRP CFRE TMDL AS). DWQ staff meets with this group on a quarterly basis to provide updates on project activities and to discuss project issues. The advisory group communicates the progress and implications of TMDL development to the LCFRP membership.

37.5 City of Wilmington Modeling Efforts

The City of Wilmington and new Hanover undertook a dye study and water quality modeling from 1999 to 2001. The study determined that the Wilmington discharges were influencing dissolved oxygen concentrations by less than 0.1 mg/l and that all discharges into the estuary were influencing dissolved oxygen concentrations by less than 0.5 mg/l. The study noted that sediment oxygen demand and swamp effects accounted for between 64 and 84 percent of the oxygen demand in the estuary.

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Appendix I

Population and Growth Trends in the Cape Fear River Basin

Population and Growth Trends

Below are three different ways of presenting population data for the Cape Fear River basin. Population data presented by county allow for analysis of projected growth trends in the basin based on Office of State Planning information (April and May 2001). Data presented by municipality summarizes information on past growth of large urban areas in the basin. The data presented by subbasin allow for 2000 population data to be presented by subbasin. While the three different sets of information cannot be directly compared, general conclusions are apparent by looking at the information. Counties with the highest expected growth are associated with the largest municipal areas and the most densely populated subbasins in the basin.

County Population and Growth Trends

The following table and map show the projected population for 2020 and the change in growth between 1990 and 2020 for counties that are wholly or partly contained within the basin. Since river basin boundaries do not coincide with county boundaries, these numbers are not directly applicable to the Cape Fear River basin. This information is intended to present an estimate of expected population growth in counties that have some land area in the Cape Fear River basin. For more information on past, current and projected population estimates, contact the Office of State Planning at (919) 733-4131 or visit their website at http://demog.state.nc.us/.

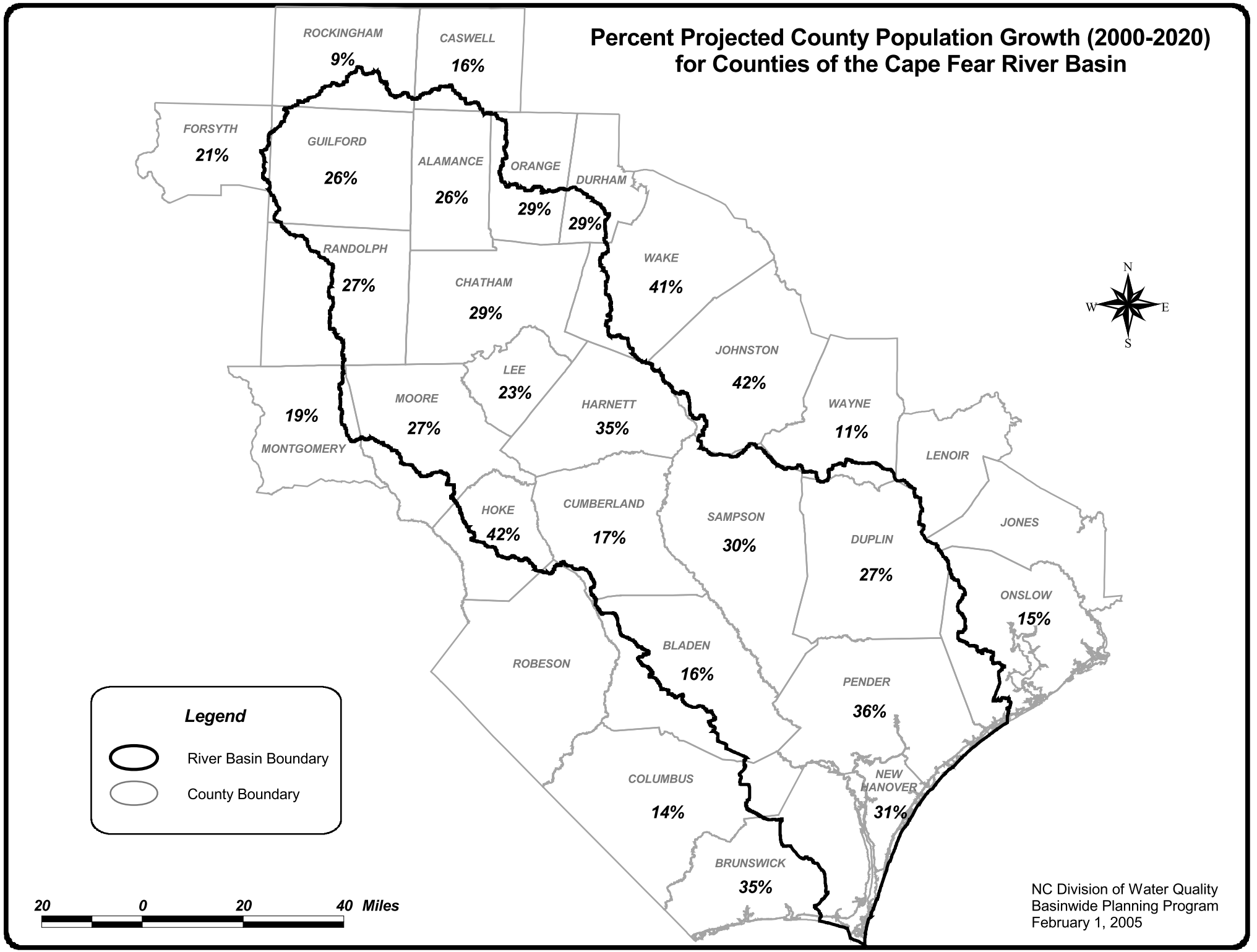
County	Percent of County in Basin ♦	1990	2000	Estimated % Growth 1990-2000	Estimated Population 2020	Estimated % Growth 2000-2020
Alamance	100	108,213	130,800	17.3	175,620	25.5
Bladen	69	28,663	32,278	11.2	38,274	15.7
Brunswick	45	50,985	73,143	30.3	112,885	35.2
Caswell	10	20,662	23,501	12.1	27,918	15.8
Chatham	100	38,979	49,329	21.0	69,137	28.7
Columbus	11	49,587	54,749	9.4	63,283	13.5
Cumberland	98	274,713	302,963	9.3	365,182	17.0
Duplin	100	39,995	49,063	18.5	67,447	27.3
Durham	27	181,844	223,314	18.6	312,144	28.5
Forsyth	2	265,855	306,067	13.1	385,079	20.5
Guilford	97	347,431	421,048	17.5	568,580	25.9
Harnett	100	67,833	91,025	25.5	140,902	35.4
Hoke	57	22,856	33,646	32.1	57,891	41.9
Johnston	2	81,306	121,965	33.3	210,178	42.0
Lee	100	41,370	49,040	15.6	64,038	23.4
Montgomery	6	23,359	26,822	12.9	33,247	19.3
Moore	79	59,000	74,769	21.1	102,828	27.3
New Hanover	100	120,284	160,307	25.0	233,681	31.4
Onslow	22	149,838	150,355	0.3	175,762	14.5

Orange	49	93,662	118,227	20.8	166,971	29.2
Pender	100	28,855	41,082	29.8	64,106	35.9
Randolph	56	106,546	130,454	18.3	178,852	27.1
Rockingham	19	86,064	91,928	6.4	100,414	8.5
Sampson	99	47,297	60,161	21.4	86,472	30.4
Wake	15	426,311	627,846	32.1	1,071,768	41.4
Wayne	9	104,666	113,329	7.6	127,945	11.4
Subtotals		2,866,174	3,557,211	19.4	5,000,604	28.9

♦ Source: North Carolina Center for Geographic Information and Analysis (CGIA), 1997.

Note: The numbers reported reflect county population; however, these counties are not entirely within the basin. The intent is to demonstrate growth for counties located wholly or partially within the basin.

Percent Projected County Population Growth (2000-2020) for Counties of the Cape Fear River Basin



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Basinwide Planning Program
February 1, 2005

Municipal Population and Growth Trends

The table below presents population data from Office of State Planning for municipalities with populations greater than 2,000 persons, located wholly or partly within the basin. These data represent 53 of the 115 municipalities in the basin.

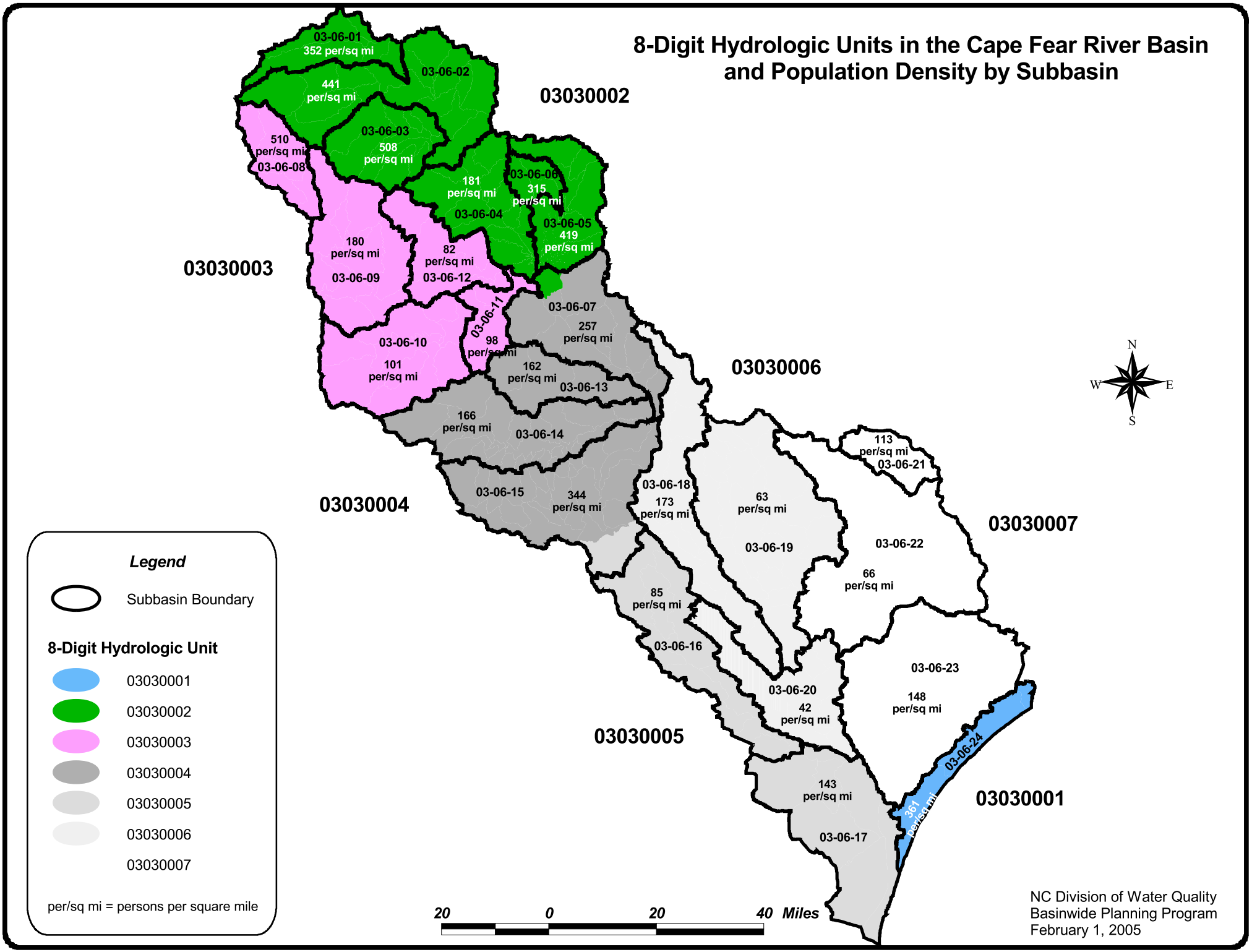
Municipality	County	Apr-80	Apr-90	Apr-2000	Percent Change (1980-90)	Percent Change (1990-2000)
Angier	Harnett	1,709	2,235	3,419	30.8	53.0
Apex •	Wake	2,847	4,789	20,212	68.2	322.1
Archdale •	Guilford, Randolph	5,326	6,975	9,014	31.0	29.2
Asheboro •	Randolph	15,252	16,362	21,672	7.3	32.5
Benson •	Johnston	2,792	3,044	2,923	9.0	-4.0
Boiling Spring Lakes •	Brunswick	998	1,650	2,972	65.3	80.1
Burgaw	Pender	1,738	2,099	3,337	20.8	59.0
Burlington	Alamance	37,266	39,498	44,917	6.0	13.7
Carolina Beach	New Hanover	2,000	3,630	4,701	81.5	29.5
Carrboro	Orange	7,336	12,134	16,782	65.4	38.3
Cary •	Chatham, Wake	21,763	44,397	94,536	104.0	112.9
Chapel Hill	Durham, Orange	32,421	38,711	48,715	19.4	25.8
Clinton	Sampson	7,552	8,385	8,600	11.0	2.6
Dunn	Harnett	8,962	8,556	9,196	-4.5	7.5
Durham •	Durham, Orange	101,149	136,612	187,035	35.1	36.9
Elizabethtown	Bladen	3,551	3,704	3,698	4.3	-0.2
Elon	Alamance	2,873	4,448	6,738	54.8	51.5
Erwin	Harnett	2,828	4,109	4,537	45.3	10.4
Fayetteville	Cumberland	59,507	75,850	121,015	27.5	59.5
Fuquay-Varina •	Wake	3,110	4,447	7,898	43.0	77.6
Gibsonville	Alamance, Guilford	2,865	3,445	4,372	20.2	26.9
Graham	Alamance	8,674	10,368	12,833	19.5	23.8
Green Level	Alamance	1,154	1,548	2,042	34.1	31.9
Greensboro	Guilford	155,642	183,894	223,891	18.2	21.8
High Point •	Davidson, Forsyth, Guilford, Randolph	63,479	69,428	85,839	9.4	23.6
Holly Springs •	Wake	688	1,024	9,192	48.8	797.7
Hope Mills	Cumberland	5,412	8,272	11,237	52.8	35.8
Jamestown	Guilford	2,148	2,662	3,088	23.9	16.0
Kernersville •	Forsyth, Guilford	5,875	10,899	17,126	85.5	57.1
Liberty	Randolph	1,997	2,047	2,661	2.5	30.0

Lillington	Harnett	1,948	2,048	2,915	5.1	42.3
Mebane	Alamance, Orange	2,782	4,754	7,284	70.9	53.2
Morrisville •	Durham, Wake	251	1,489	5,208	493.2	249.8
Mount Olive •	Duplin, Wayne	4,876	4,582	4,567	-6.0	-0.3
Oak Ridge	Guilford	-----	2,322	3,988	-----	71.7
Pinehurst •	Moore	1,746	5,091	9,706	191.6	90.7
Pittsboro	Chatham	1,332	1,621	2,226	21.7	37.3
Pleasant Garden	Guilford	-----	3,921	4,714	-----	20.2
Raeford •	Hoke	3,630	3,469	3,386	-4.4	-2.4
Randleman •	Randolph	2,156	2,612	3,557	21.2	36.2
Reidsville •	Rockingham	12,492	12,183	14,485	-2.5	18.9
Sanford	Lee	14,773	14,755	23,220	-0.1	57.4
Siler City	Chatham	4,446	4,808	6,966	8.1	44.9
Southern Pines •	Moore	8,620	9,213	10,918	6.9	18.5
Southport	Brunswick	2,824	2,369	2,351	-16.1	-0.8
Spring Lake	Cumberland	6,273	7,524	8,098	19.9	7.6
Stokesdale •	Guilford	1,973	2,134	3,267	8.2	53.1
Summerfield	Guilford	-----	1,687	7,018	-----	316.0
Wallace	Duplin, Pender	2,903	2,939	3,344	1.2	13.8
Warsaw	Duplin	2,910	2,859	3,051	-1.8	6.7
Whispering Pines	Moore	1,160	1,346	2,090	16.0	55.3
Wilmington	New Hanover	44,000	55,530	75,838	26.2	36.6
Wrightsville Beach	New Hanover	2,910	2,937	2,593	0.9	-11.7

• - The numbers reported reflect municipality population; however, these municipalities are not entirely within the basin. The intent is to demonstrate growth for municipalities located wholly or partially within the basin.

Basin Population and Population Density

Information on population density at a watershed scale is useful in determining what streams are likely to have the most impacts as a result of population growth. This information is also useful in identifying stream segments that have good opportunities for preservation or restoration. This information is presented to estimate population and population density by each subbasin and for the entire basin. It is assumed that county populations are distributed evenly throughout each county; therefore, subbasins that are within counties with large urban areas may overestimate the actual population in that portion of the basin. The overall population of the basin based on 2000 Census data is 1,834,545, with approximately 197 persons/square mile. Population density estimated by subbasin is presented in the following map.


8-Digit Hydrologic Units in the Cape Fear River Basin
and Population Density by Subbasin
03-06-01
352 per/sq mi
03-06-02
441
per/sq mi
03030002
03-06-03
508
per/sq mi
510
per/sq mi
03-06-08
181
per/sq mi
03-06-04
03-06-06
315
per/sq mi
03-06-05
419
per/sq mi
03030003
180
per/sq mi
03-06-09
82
per/sq mi
03-06-12
03-06-11
98
per/sq mi
03-06-07
257
per/sq mi
03-06-10
101
per/sq mi
162
per/sq mi
03-06-13
03030006
166
per/sq mi
03-06-14
03-06-15
344
per/sq mi
03030004
03-06-18
173
per/sq mi
63
per/sq mi
03-06-19
113
per/sq mi
03-06-21
03-06-22
66
per/sq mi
03030007
85
per/sq mi
03-06-16
03-06-20
42
per/sq mi
03-06-23
148
per/sq mi
03030005
03-06-24
361
per/sq mi
143
per/sq mi
03-06-17
03030001
N
W
E
S
Legend
Subbasin Boundary
8-Digit Hydrologic Unit
03030001
03030002
03030003
03030004
03030005
03030006
03030007
per/sq mi = persons per square mile
20
0
20
40
Miles
NC Division of Water Quality
Basinwide Planning Program
February 1, 2005

Appendix II

Local Governments and Planning Jurisdictions in the Cape Fear River Basin

Local Governments and Planning Jurisdictions in the Basin

The Cape Fear River basin encompasses all or portions of 26 counties and 115 municipalities. The following table provides a listing of these local governments, along with the regional planning jurisdiction (Council of Governments). Twenty-seven municipalities are located in more than one major river basin, and 15 municipalities are located in more than one county.

County	Region	Municipalities
Alamance	G	Alamance, Burlington, Elon, Gibsonville *, Graham, Green Level, Haw River, Mebane *♦, Swepsonville
Bladen	N	Dublin ♦, East Arcadia, Elizabethtown, Tar Heel ♦, White Lake
Brunswick	O	Bald Head Island, Belville, Boiling Spring Lakes ♦, Caswell Beach, Leland, Navassa, Northwest, Saint James, Sandy Creek, Southport
Caswell	G	None
Chatham	J	Cary *♦, Goldston, Pittsboro, Siler City
Columbus	O	Bolton ♦, Sandyfield
Cumberland	M	Falcon *, Fayetteville, Godwin, Hope Mills, Linden, Spring Lake, Stedman, Wade
Duplin	P	Beulaville, Calypso, Faison, Greenevers, Harrells *, Kenansville, Magnolia, Mount Olive *♦, Rose Hill, Teachey, Wallace *, Warsaw
Durham	J	Chapel Hill *, Durham *♦, Morrisville *♦
Forsyth	I	High Point *♦, Kernersville *♦
Guilford	G	Archdale *♦, Gibsonville *, Greensboro, High Point *♦, Jamestown, Kernersville *♦, Oak Ridge, Pleasant Garden, Sedalia, Stokesdale ♦, Summerfield, Whitsett
Harnett	M	Angier, Broadway *, Coats, Dunn, Erwin, Lillington
Hoke	N	Raeford ♦
Johnston	J	Benson ♦
Lee	J	Broadway *, Sanford
Montgomery	---	Biscoe ♦, Candor ♦, Star ♦
Moore	---	Cameron, Carthage, Pinehurst ♦, Robbins, Southern Pines ♦,Taylortown, Vass, Whispering Pines
New Hanover	O	Carolina Beach, Kure Beach, Wilmington, Wrightsville Beach
Onslow	P	Holly Ridge, North Topsail Beach ♦, Surf City *
Orange	J	Carrboro, Chapel Hill *, Durham *♦, Mebane *♦
Pender	O	Atkinson, Burgaw, Saint Helena, Surf City *, Topsail Beach, Wallace *, Watha
Randolph	G	Archdale *♦, Asheboro, Franklinville, High Point *♦, Liberty, Ramseur, Randleman ♦, Seagrove ♦, Staley
Rockingham	G	Reidsville ♦
Sampson	M	Autryville, Clinton, Falcon *, Garland, Harrells *, Newton Grove, Roseboro, Salemburg, Turkey

Wake	J	Apex ♦, Cary *♦, Fuquay-Varina ♦, Holly Springs ♦, Morrisville *♦
Wayne	P	Mount Olive *♦

* Located in more than one county.

♦ Located in more than one major river basin.

Note: Counties adjacent to and sharing a border with a river basin are not included as part of that basin if only a trace amount of the county (<2 percent) is located in that basin, unless a municipality is located in that county.

Region	Name	Location
G	Piedmont Triad Council of Governments	Greensboro
I	Northwest Piedmont Council of Governments	Winston-Salem
J	Triangle J Council of Governments	Research Triangle Park
M	Mid Carolina Council of Governments	Fayetteville
N	Lumber River Council of Governments	Lumberton
O	Cape Fear Council of Governments	Wilmington
P	Eastern Carolina Council	New Bern

Appendix III

Land Cover
in the
Cape Fear River Basin

Land Cover

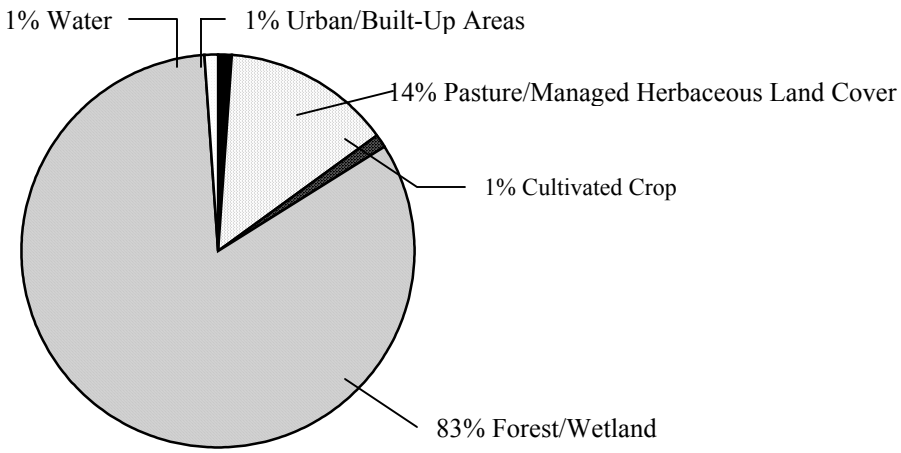
Land cover can be an important way to evaluate the effects of land use changes on water quality. Unfortunately, the tools and database to do this on a watershed scale are not yet available. The information below describes two different ways of presenting land cover in the Cape Fear River basin.

The CGIA land cover information is useful in providing a snapshot of land cover in the basin from 1993 to 1995. This information is also available in a GIS format so it can be manipulated to present amounts of the different land covers by subbasin or at the watershed scale. The NRI land cover information is presented only at a larger scale (8-digit hydrologic unit), but the collection methods allow for between year comparisons. The two datasets cannot be compared to evaluate land cover data. This information is presented to provide a picture of the different land covers and some idea of change in land cover over time. In the future, it is hoped that land cover information like the GIS formatted dataset will be developed to make more meaningful assessments of the effects of land use changes on water quality. This dataset would also be useful in providing reliable and small-scale information on land cover changes that can be used in water quality monitoring, modeling and restoration efforts.

CGIA Land Cover

The North Carolina Corporate Geographic Database contains land cover information for the Cape Fear River basin based on satellite imagery from 1993-1995. The state's Center for Geographic Information and Analysis (CGIA) developed 24 categories of statewide land cover information. For the purposes of this report, those categories have been condensed into five broader categories as described in table below. The following chart provides an illustration of the relative amount of land area that falls into each major cover type for the Cape Fear River basin.

Land Cover Type	Land Cover Description
Urban	Greater than 50 percent coverage by synthetic land cover (built-upon area) and municipal areas.
Cultivated Cropland	Areas that are covered by crops that are cultivated in a distinguishable pattern.
Pasture/Managed Herbaceous	Areas used for the production of grass and other forage crops and other managed areas such as golf courses and cemeteries. Also includes upland herbaceous areas not characteristic of riverine and estuarine environments.
Forest/Wetland	Includes salt and freshwater marshes, hardwood swamps, shrublands and all kinds of forested areas (such as needleleaf evergreens, deciduous hardwoods).
Water	Areas of open surface water, areas of exposed rock, and areas of sand or silt adjacent to tidal waters and lakes.



NRI Land Cover Trends

Land cover information in this section is from the most current National Resources Inventory (NRI), as developed by the Natural Resources Conservation Service (USDA, updated June 2001). The National Resources Inventory (NRI) is a statistically based longitudinal survey that has been designed and implemented to assess conditions and trends of soil, water and related resources on the Nation's nonfederal rural lands. The NRI provides results that are nationally and temporally consistent for four points in time -- 1982, 1987, 1992 and 1997.

In general, NRI protocols and definitions remain fixed for each inventory year. However, part of the inventory process is that the previously recorded data are carefully reviewed as determinations are made for the new inventory year. For those cases where a protocol or definition needs to be modified, all historical data must be edited and reviewed on a point-by-point basis to make sure that data for all years are consistent and properly calibrated. The following excerpt from the *Summary Report: 1997 National Resources Inventory* provides guidance for use and interpretation of current NRI data:

> *The 1997 NRI database has been designed for use in detecting significant changes in resource conditions relative to the years 1982, 1987, 1992 and 1997. All comparisons for two points in time should be made using the new 1997 NRI database. Comparisons made using data previously published for the 1982, 1987 or 1992 NRI may provide erroneous results because of changes in statistical estimation protocols, and because all data collected prior to 1997 were simultaneously reviewed (edited) as 1997 NRI data were collected.*

The following table summarizes acreage and percentage of land cover from the 1997 NRI for the major watersheds within the basin, as defined by the USGS 8-digit hydrologic units, and compares the coverages to 1982 land cover. Definitions of the different land cover types are also presented.

LAND COVER	MAJOR WATERSHED AREAS												1997 TOTAL		1982 TOTAL		% change since 1982
	Haw River		Deep River		Upper Cape Fear River		Lower Cape Fear River		Black River		Northeast Cape Fear River						
	Acres (1000s)	%	Acres (1000s)	%	Acres (1000s)	%	Acres (1000s)	%	Acres (1000s)	%	Acres (1000s)	%	Acres (1000s)	% of TOTAL	Acres (1000s)	% of TOTAL	
Cult. Crop	126.6	11.8	36.2	3.9	156.1	14.9	67.6	9.5	348.3	34.6	212.3	18.9	947.1	16.1	1177.0	20.0	-20
Uncult. Crop	25.5	2.4	37.7	4.1	17.2	1.6	10.4	1.5	30.7	3.0	21.9	1.9	143.4	2.4	44.6	0.8	+222
Pasture	119.5	11.1	113.5	12.4	33.5	3.2	4.3	0.6	10.0	1.0	20.3	1.8	301.1	5.1	297.0	5.0	1
Forest	471.3	43.9	579.4	63.1	498.7	47.5	497.9	70.1	535.6	53.2	729.3	64.8	3312.2	56.3	3531.7	59.9	-6
Urban & Built-up	233.0	21.7	100.3	10.9	141.4	13.5	57.1	8.0	41.2	4.1	54.6	4.8	627.6	10.7	370.0	6.3	+70
Federal	17.9	1.7	0.0	0.0	143.8	13.7	9.1	1.3	0.0	0.0	21.9	1.9	192.7	3.3	159.2	2.7	+21
Other	79.0	7.4	51.4	5.6	60.0	5.7	63.9	9.0	41.6	4.1	65.8	5.8	361.7	6.1	319.7	5.4	+13
Totals	1072.8	100.0	918.5	100.0	1050.7	100.0	710.3	100.0	1007.4	100.0	1126.1	100.0	5885.8		5899.2		
% of Total Basin		18.2		15.6		17.9		12.1		17.1		19.1		100.0			
SUBBASINS	01 to 06 and 07*		08 to 12		07*, 13 to 15*		15*, 16 and 17		18, 19 and 20		21, 22 and 23						
8- Digit Hydraulic Units	03030002		03030003		03030004		03030005		03030006		03030007						

* These subbasins are found within more than one 8-Digit Hydraulic Unit.

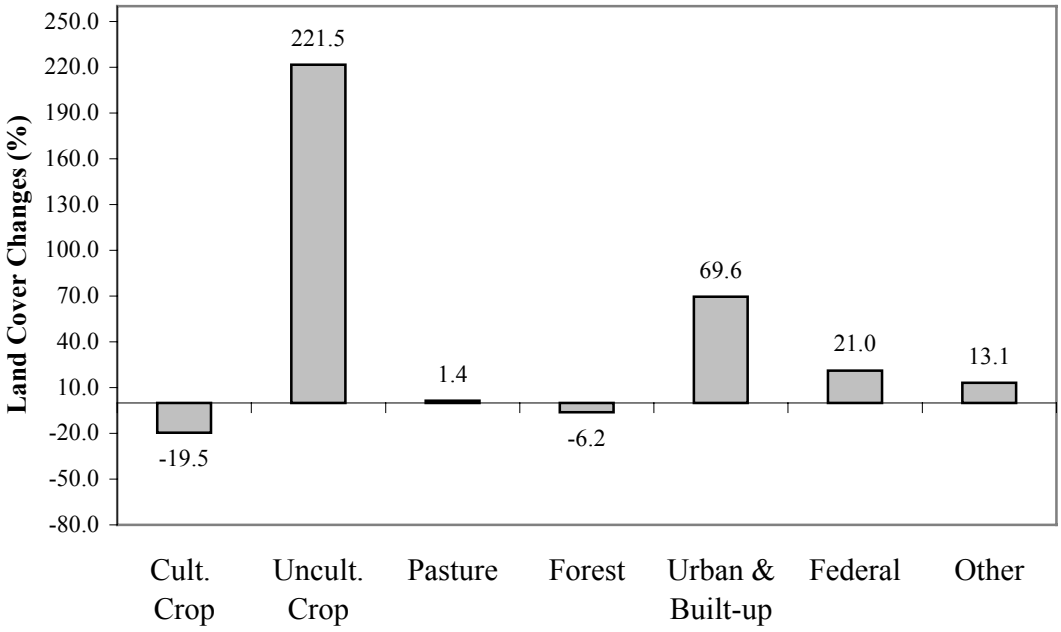
** Watershed areas as defined by the 8-Digit Hydraulic Units do not necessarily coincide with subbasin titles used by DWQ.

Source: USDA, Soil Conservation Service - 1982 and 1997 NRI

Type	Description
Cultivated Cropland	Harvestable crops including row crops, small-grain and hay crops, nursery and orchard crops, and other specialty crops.
Uncultivated Cropland	Summer fallow or other cropland not planted.
Pastureland	Includes land that has a vegetative cover of grasses, legumes and/or forbs, regardless of whether or not it is being grazed by livestock.
Forestland	At least 10 percent stocked (a canopy cover of leaves and branches of 25 percent or greater) by single-stemmed trees of any size which will be at least 4 meters at maturity, and land bearing evidence of natural regeneration of tree cover. The minimum area for classification of forestland is 1 acre, and the area must be at least 1,000 feet wide.
Urban and Built-up Areas	Includes airports, playgrounds with permanent structures, cemeteries, public administration sites, commercial sites, railroad yards, construction sites, residences, golf courses, sanitary landfills, industrial sites, sewage treatment plants, institutional sites, water control structure spillways and parking lots. Includes highways, railroads and other transportation facilities if surrounded by other urban and built-up areas. Tracts of less than 10 acres that are completely surrounded by urban and built-up lands.
Other	*Rural Transportation*: Consists of all highways, roads, railroads and associated rights-of-way outside urban and built-up areas; private roads to farmsteads; logging roads; and other private roads (but not field lanes). *Small Water Areas*: Waterbodies less than 40 acres; streams less than 0.5 miles wide. *Census Water*: Large waterbodies consisting of lakes and estuaries greater than 40 acres and rivers greater than 0.5 miles in width. *Minor Land*: Lands that do not fall into one of the other categories.

Source: USDA, Soil Conservation Service - 1982 and 1997 NRI

Data from 1982 are also provided for a comparison of change over 15 years. During this period, urban and built-up land cover increased by 258,000 acres. Uncultivated cropland and pastureland increased by 103,000 and acres. Forest and cultivated cropland cover significantly decreased by 219,500 and 230,000 acres, respectively. Most land cover change is accounted for in the Northeast Cape Fear River hydrologic unit that includes rapidly growing areas in Duplin and Pender counties. Below is a graph that presents changes in land cover between 1982 and 1997.



Source: USDA-NRCS, NRI, updated June 2001

Appendix IV

DWQ Water Quality Monitoring Programs in the Cape Fear River Basin

DWQ Water Quality Monitoring Programs in the Cape Fear River Basin

Staff in the Environmental Sciences Branch (ESB) and Regional Offices of DWQ collect a variety of biological, chemical and physical data. The following discussion contains a brief introduction to each program, followed by a summary of water quality data in the Cape Fear River basin for that program. For more detailed information on sampling and assessment of streams in this basin, refer to the *Basinwide Assessment Report* for the Cape Fear River basin, available from the Environmental Sciences Branch website at http://www.esb.enr.state.nc.us/bar.html or by calling (919) 733-9960.

DWQ monitoring programs for the French Broad River Basin include:

- Benthic Macroinvertebrates
- Fish Assessments
- Aquatic Toxicity Monitoring
- Lake Assessment
- Ambient Monitoring System

Benthic Macroinvertebrate Monitoring

Benthic macroinvertebrates, or benthos, are organisms that live in and on the bottom substrates of rivers and streams. These organisms are primarily aquatic insect larvae. The use of benthos data has proven to be a reliable monitoring tool, as benthic macroinvertebrates are sensitive to subtle changes in water quality. Since macroinvertebrates have life cycles of six months to over one year, the effects of short-term pollution (such as a spill) will generally not be overcome until the following generation appears. The benthic community also integrates the effects of a wide array of potential pollutant mixtures.

Criteria have been developed to assign a bioclassification to each benthic sample based on the number of different species present in the pollution intolerant groups of Ephemeroptera (Mayflies), Plecoptera (Stoneflies) and Trichoptera (Caddisflies), commonly referred to as EPTs. A Biotic Index (BI) value gives an indication of overall community pollution tolerance. Different benthic macroinvertebrate criteria have been developed for different ecoregions (mountains, piedmont, coastal plain and swamp) within North Carolina, and bioclassifications fall into five categories: Excellent, Good, Good-Fair, Fair and Poor.

Overview of Benthic Macroinvertebrate Data

There were 273 benthic samples collected during this assessment period. The following table lists the total bioclassifications (by subbasin) for all benthos sites in the Cape Fear River basin. Benthos sampling may slightly overestimate the proportion of Fair, Poor and Severe stress sites, as DWQ special studies often have the greatest sampling intensity (number of sites/stream) in areas where it is believed that water quality problems exist. Many streams also ceased flowing during the summer drought of 2002. For detailed information regarding the samples collected during this assessment period, refer to the tables at the end of this appendix. Refer to *2003 Cape Fear River Basinwide Assessment Report* at http://www.esb.enr.state.nc.us/bar.html for more information on monitoring sites and for past benthic community ratings.

Summary of Bioclassifications for All Freshwater Benthic Macroinvertebrate Sites (using the most recent rating for each site) in the Cape Fear River Basin

Subbasin	Excellent	Natural	Good	Moderate	Good-Fair	Not Impaired	Fair	Poor	Severe	Not Rated	Total
03-06-01					5		6			3	14
03-06-02			2		6		5	5		11	29
03-06-03					1		3	3			7
03-06-04			2		10	1	7			4	24
03-06-05					1		1			3	5
03-06-06	1		2		3		3	6		12	27
03-06-07	2		6		3	1	1	3		4	20
03-06-08					9		10				19
03-06-09	1		5		1		3	6			16
03-06-10	1		6		2		2	2		1	14
03-06-11										2	2
03-06-12			1		3		3			6	13
03-06-13					1						1
03-06-14	1		5		7	2				1	16
03-06-15			4		3		2			6	15
03-06-16				1	3					1	5
03-06-17		2		2	3					6	13
03-06-18										1	1
03-06-19	1		4		1					2	8
03-06-20				1							1
03-06-22		1		1	4		2	1	1	1	11
03-06-23		4	1	2				1	2	1	11
03-06-24				1							1
Total	7	7	38	8	66	4	48	27	3	65	273

Assessing Benthic Macroinvertebrate Communities in Small Streams

The benthic macroinvertebrate community of small streams is naturally less diverse than the streams used to develop the current criteria for flowing freshwater streams. The benthic macroinvertebrate database is being evaluated, and a study to systematically look at small reference streams in different ecoregions is being developed with the goal of finding a way to evaluate water quality conditions in such small streams.

Presently, a designation of Not Impaired may be used for flowing waters that are too small to be assigned a bioclassification (less than 4 meters in width), but meet the criteria for a Good-Fair or higher bioclassification using the standard qualitative and EPT criteria. This designation will translate into a use support rating of Supporting. However, DWQ will use the monitoring

information from small streams to identify potential impacts to small streams even in cases when a use support rating cannot be assigned.

DWQ will use this monitoring information to identify potential impacts to these waters even though a use support rating is not assigned. DWQ will continue to develop criteria to assess water quality in small streams.

Fish Assessments

Historical studies of fish communities in the Cape Fear River basin were conducted primarily by the North Carolina Wildlife Resources Commission (NCWRC) in the 1960s and late 1970s. Several streams were sampled by DWQ during the past basinwide planning cycle (1994), and two samples were collected in 1999. Scores are assigned to these samples using the North Carolina Index of Biotic Integrity (NCIBI). The NCIBI uses a cumulative assessment of 12 parameters or metrics. Each metric is designed to contribute unique information to the overall assessment. The scores for all metrics are then summed to obtain the overall NCIBI score.

During the late 1990s, application of the NCIBI has been restricted to wadeable streams that can be sampled by a crew of 2-4 persons using backpack electrofishers and following the DWQ Standard Operating Procedures (NCDEHNR, 1997). Work began in 1998 to develop a fish community boat sampling method that could be used in nonwadeable coastal plain streams. Plans are to sample 10-15 reference sites with the boat method once it is finalized. As with other biological monitoring programs, many years of reference site data will be needed before solid criteria can be developed to evaluate biological integrity of large streams and rivers using the fish community assessment.

Overview of Fish Community Data

Fish community samples have been collected at 85 sites in the Cape Fear River basin during this assessment period. The following table lists the most recent ratings since 1990, by subbasin, for all fish community sites. Refer to *2003 Cape Fear River Basinwide Assessment Report* at http://www.esb.enr.state.nc.us/bar.html for more information on monitoring sites and for past fish community ratings.

Summary of NCIBI Categories for All Freshwater Fish Community Sites (using the most recent rating for each site) in the Cape Fear River Basin

Subbasin	Excellent	Good	Good-Fair	Fair	Poor	Not Rated	Total
03-06-01		2	1		1		4
03-06-02		3	4	2	5		14
03-06-03	1	3	2	1			7
03-06-04	1	2			1		4
03-06-05			2				2
03-06-06		2	1	1			4
03-06-07	1	1	1			1	4
03-06-08		2	2	1			5
03-06-09	1	4					5
03-06-10	2	3	1	1		1	8
03-06-11				1			1
03-06-12			4	2			6
03-06-14						14	14
03-06-15						7	7
Total	6	22	18	9	7	23	85

Cape Fear River Basin Fish Kills

The NC DWQ has systematically monitored and reported on fish kill events across the state since 1996 (http://www.esb.enr.state.nc.us/). Investigators reported 43 incidents which killed more than one million fish in the basin from 1999 to 2003. All kills, except one, were reported from freshwaters and were generally evenly dispersed throughout the basin. Kills were attributed to low dissolved oxygen, algal blooms, temperature stress, and spills of toxic substances. The largest kill occurred as a result of bycatch from a fishing operation in the Atlantic Ocean off Yaupon Beach (Brunswick County) and involved an estimated one million menhaden. About one-half of the events investigated in the basin could not be attributed to an obvious cause.

Yearly kills reported decreased during the monitoring period from 14 events in 1999 to just three reports in 2003. The decrease has not been associated with any improvements in water quality throughout the basin.

Overview of Fish Tissue Sampling

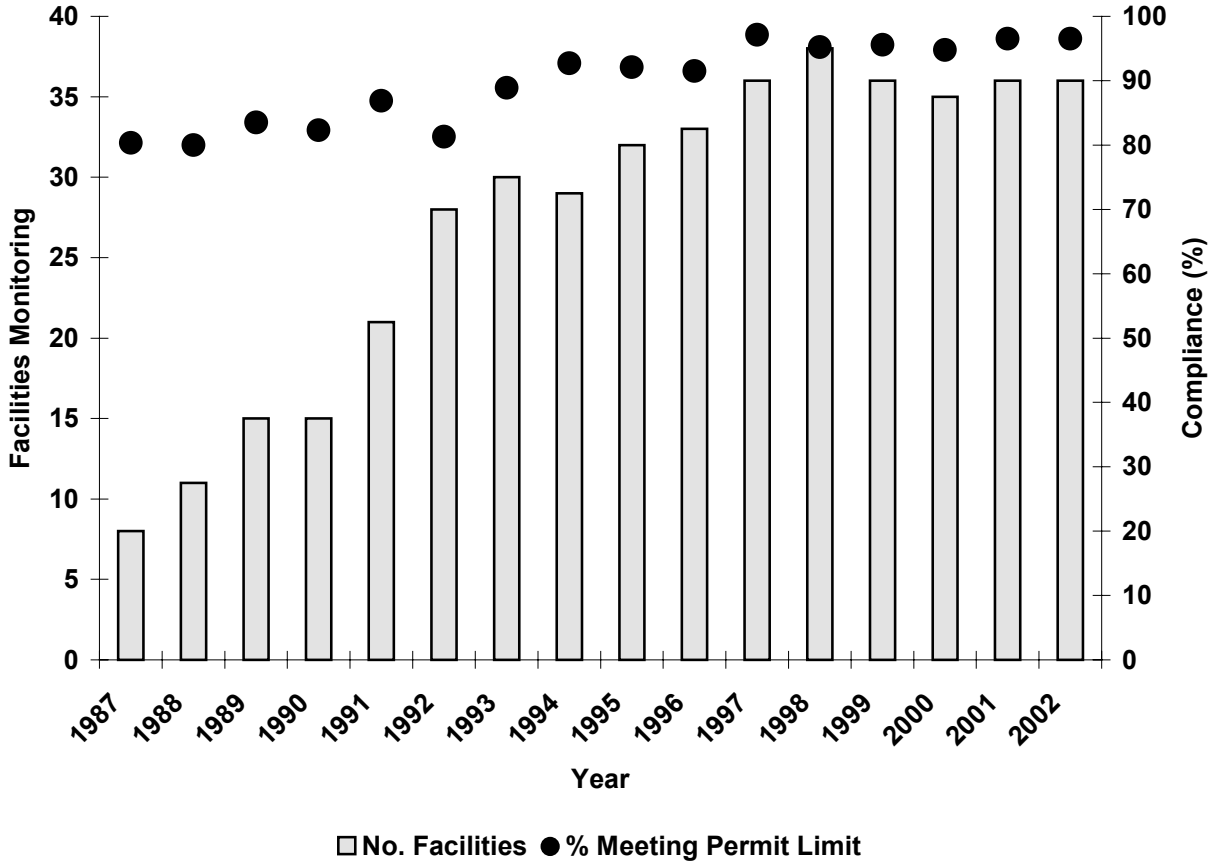
Fish tissue was sampled for metals contaminants at 12 stations within the basin from 1999 to 2003. All fish collected from the Coastal Plain in subbasins 03-06-16 to 03-06-23 were part of DWQ's eastern North Carolina mercury surveys. Three hundred-eight individual samples were analyzed. Total mercury concentrations exceeded the North Carolina criteria and USEPA's screening value (0.4 ppm) in 62 percent of the samples. Concentrations also exceeded the US Food and Drug Administration criteria limit of 1.0 ppm in 16 percent of the samples.

Aquatic Toxicity Monitoring

Acute and/or chronic toxicity tests are used to determine toxicity of discharges to sensitive aquatic species (usually fathead minnows or the water flea, *Ceriodaphnia dubia*). Results of these tests have been shown by several researchers to be predictive of discharge effects on receiving stream populations. Many facilities are required to monitor whole effluent toxicity (WET) by their NPDES permit or by administrative letter. Other facilities may also be tested by DWQ's Aquatic Toxicology Unit (ATU). Per Section 106 of the Clean Water Act, the ATU is required to test at least 10 percent of the major discharging facilities over the course of the federal fiscal year (FFY). However, it is ATU's target to test 20 percent of the major dischargers in the FFY. This means that each major facility would get evaluated over the course of their five-year permit. There are no requirements or targets for minor dischargers.

In addition, the ATU maintains a compliance summary for all facilities required to perform tests and provides monthly updates of this information to regional offices and DWQ administration. Ambient toxicity tests can be used to evaluate stream water quality relative to other stream sites and/or a point source discharge.

One hundred-nineteen facility permits in the basin currently require whole effluent toxicity (WET) monitoring. Ninety-four facility permits have a WET limit; the other 25 facility permits specify monitoring with no limit. Since 1999, the compliance rate for those facilities with a limit has stabilized at approximately 90 to 95 percent. Eleven facilities have had difficulty meeting their toxicity limits or targets and are discussed in the subbasin chapters.



Lakes Assessment Program

In 2003, 33 lakes in the basin were monitored as part of the Lakes Assessment Program. Each lake was sampled three times during the summer. Lakes with noted water quality impacts are discussed in the appropriate subbasin chapter.

Ambient Monitoring System

The Ambient Monitoring System (AMS) is a network of stream, lake and estuarine stations strategically located for the collections of physical and chemical water quality data. North Carolina has more than 378 water chemistry monitoring stations statewide. Between 23 and 32 parameters are collected monthly at each station. The locations of these stations are listed in the following table and shown on individual subbasin maps. Chemical and physical measurements were obtained from 173 stations located throughout the basin by DWQ and three NPDES discharger monitoring coalitions. All data were collected between September 1, 1998 and August 31, 2003. Notable ambient water quality parameters are discussed in the subbasin chapters. Refer to *2003 Cape Fear River Basinwide Assessment Report* at http://www.esb.enr.state.nc.us/bar.html for more detailed analysis of ambient water quality monitoring data.

Subbasin	Station Number	Waterbody/Location Description	DWQ Index Number	Stream Classification
03-06-01				
	B0040000	Haw R. at SR 2109 near Oak Ridge	16-(1)	C NSW
	B0050000	Haw R. at US 29A near Benaja	16-(1)	C NSW
	B0160000	Little Troublesome Crk at SR 2600 near Reidsville	16-7	C NSW
	B0190000	Haw R. at NC 87 near Altamahaw	16-(1)	C NSW
	B0210000	Haw R. at SR 1561 near Altamahaw	16-(1)	C NSW
03-06-02				
	B0540000	N Buffalo Crk at SR 2832 near Greensboro	16-11-14-1	C NSW
	B0750000	S Buffalo Crk at SR 2821 at McLeansville	16-11-14-2	C NSW
	B0840000	Reedy Fork at NC 87 at Ossipee	16-11-(9)	C NSW
	B1095000	Jordan Crk at SR 1754 near Union Ridge	16-14-6-(0.5)	WS-II HQW
	B1140000	Haw R. at NC 49N at Haw River	16-(1)	C NSW
	B1260000	Town Branch at SR 2109 near Graham	16-17	C NSW
	B1960000	Alamance Crk at SR 2116 at Swepsonsville	16-19-(4.5)	C NSW
03-06-03				
	B1670000	Lake MacIntosh at NC 61 near Whitsett 19	16-19-3-(4.5)	WS-IV NSW
03-06-04				
	B1980000	Haw R. at SR 2171 at Saxapahaw	16-(1)	C NSW
	B2000000	Haw R. at SR 1005 near Saxapahaw	16-(1)	C NSW
	B2100000	Haw R. at SR 1713 near Bynum	16-(28.5)	WS-IV NSW
	B2450000	Robeson Crk at SR 1943 near Hanks Chapel	16-38-(3)	WS-IV NSW
	B4050000	Haw R. below Jordan Dam near Moncure	16-(42)	WS-IV
03-06-05				
	B3025000	Third Fork Crk at NC 54 near Durham	16-41-1-12-(2)	WS-IV NSW
	B3040000	New Hope Crk at SR 1107 near Blands	16-41-1-(11.5)	WS-IV NSW
	B3660000	Northeast Crk at SR 1100 near Nelson	16-41-1-17-(0.7)	WS-IV NSW
03-06-06				
	B3900000	Morgan Crk at SR 1726 near Farrington	16-41-2-(5.5)	WS-IV NSW
03-06-07				
	B6160000	Cape Fear R. at NC 42 near Corinth	18-(4.5)	WS-IV CA
	B6370000	Cape Fear R. at US 401 at Lillington	18-(16.7)	WS-IV
03-06-08				
	B4210000	W Fork Deep R. at SR 1818 near High Point	17-3-(0.7)	WS-IV CA
	B4240000	E Fork Deep R. at SR 1541 near High Point	17-2-(0.3)	WS-IV
	B4410000	Richland Crk at SR 1145 near High Point	17-7-(4)	WS-IV CA
	B4440000	Deep R. at SR 1129 near High Point	17-(4)	WS-IV CA
	B4615000	Deep R. at SR 1921 near Randleman	17-(4)	WS-IV CA
03-06-09				
	B4800000	Deep R. at SR 2122 at Worthville	17-(10.5)	C
	B4890000	Haskett Crk at SR 2128 near Central Falls	17-12	C
	B5070000	Deep R. at SR 2615 at Ramseur	17-(10.5)	C
	B5131000	Deep R. at NC 42 near Coleridge	17-(10.5)	C
	B5190000	Deep R. at SR 1456 near High Falls	17-(10.5)	C
03-06-10				
	B5480000	Bear Crk at NC 705 at Robbins	17-26-(6)	C
	B5520000	Deep R. at NC 22 at High Falls	17-(25.7)	C HQW
	B5575000	Deep R. at NC 42 at Carbonton	17-(32.5)	WS-IV
03-06-11				
	B5820000	Deep R. at US 15 and 501 near Sanford	17-(38.7)	C
	B6040300	Deep R. at SR 1011 old US 1 near Moncure	17-(43.5)	WS-IV
	B6050000	Deep R. at CSX RR Bridge near Moncure	17-(43.5)	WS-IV
03-06-12				
	B6000000	Rocky R. at NC 902 near Pittsboro	17-43-(8)	C
03-06-13				
	B6830000	Upper Little R. at SR 2021 near Lillington	18-20-(24.5)	WS-IV
	B6840000	Cape Fear R. at NC 217 at Erwin	18-(20.7)	WS-V
03-06-14				
	B7245000	Lower Little R. at SR 2023 near Lobelia	18-23-(10.7)	WS-III HQW
	B7280000	Lower Little R. at SR 1451 at Manchester	18-23-(24)	C

Subbasin	Station Number	Waterbody/Location Description	DWQ Index Number	Stream Classification
03-06-15				
	B7600000	Cape Fear R. at NC 24 at Fayetteville	18-(26)	C
	B7610000	Cape Fear R. at Riverside Landing	18-(26)	C
	B7700000	Rockfish Crk at SR 1432 near Raeford	18-31-(18)	B
	B8220000	Rockfish Crk near US 301 Hope Mills	18-31-(23)	C
	B8224000	Rockfish Crk at SR 2350 near Cedar Creek	18-31-(23)	C
03-06-16				
	B8300000	Cape Fear R. at Wo Huske Lock near Tar Heel	18-(26)	C
	B8305000	Cape Fear R. at SR 1316 at Tarheel	18-(26)	C
	B8321000	Turnbull Crk at SR 1509 near Johnsontown	18-46	C
	B8340000	Cape Fear R. at Lock 2 near Elizabethtown	18-(26)	C
	B8340050	Browns Crk at NC 87 mouth	18-45	C
	B8350000	Cape Fear R. at Lock 1 near Kelly	18-(59)	WS-IV Sw
	B8360000	Cape Fear R. at NC 11 near Kings Bluff	18-(59)	WS-IV Sw
03-06-17				
	B8445000	Livingston Crk at mouth near Riegelwood	18-64	C Sw
	B8450000	Cape Fear R. at Neils Eddy Landing near Acme	18-(63)	C Sw
	B9020000	Cape Fear R. DNS Hale Pt Landing near Phoenix	18-(63)	C Sw
	B9050000	Cape Fear R. at Navassa	18-(71)	SC
	B9740000	Northeast Cape Fear R. at US 421 at Wilmington	18-74-(61)	SC Sw
	B9800000	Cape Fear R. at CM 61 at Wilmington	18-(71)	SC
	B9820000	Cape Fear R. at CM 56 near Wilmington	18-(71)	SC
03-06-18				
	B8919000	South R. at SR 1503 near Parkersburg	18-68-12-(8.5)	C Sw ORW +
03-06-19				
	B8490000	Little Coharie Crk at SR 1414 Minnie Hall Rd near Salemburg	18-68-1-17	C Sw
	B8545000	Little Coharie Crk at SR 1240 near Roseboro	18-68-1-17	C Sw
	B8580000	Great Coharie Crk at SR 1311 near Clinton	18-68-1	C Sw
	B8679500	Six Runs Crk at SR 1919 near Moltonville	18-68-2-(0.3)	C Sw
	B8725000	Six Runs Crk at SR 1960 near Taylors Bridge	18-68-2-(11.5)	C Sw ORW +
	B8750000	Black R. at NC 411 near Tomahawk	18-68	C Sw ORW +
03-06-20				
	B9013000	Black R. at Raccoon Island near Huggins	18-68	C Sw ORW +
03-06-21				
	B9080000	Northeast Cape Fear R. at SR 1937 near Mt Olive	18-74-(1)	C Sw
	B9090000	Northeast Cape Fear R. at NC 403 near Williams	18-74-(1)	C Sw
03-06-22				
	B9190500	Goshen Swamp at SR 1004 near Westbrook Crossroad	18-74-19	C Sw
	B9196000	Northeast Cape Fear R. at SR 1961 at Hallsville	18-74-(1)	C Sw
	B9470000	Rockfish Crk at I-40 at Wallace	18-74-29	C Sw
03-06-23				
	B9480000	Northeast Cape Fear R. at SR 1318 near Watha	18-74-(29.5)	C Sw
	B9490000	Angola Crk at NC 53	18-74-33-3	C Sw
	B9520000	Burgaw Canal at US 117	18-74-39	C Sw
	B9550000	Lillington Crk at SR 1520 near Stag Park	18-74-42	C Sw
	B9580000	Northeast Cape Fear R. at US 117 at Castle Hayne	18-74-(47.5)	B Sw
03-16-24				
	B9865000	ICW at Morris Landing	18-87	SA ORW
	B9872000	ICW at CM 102 near Long Point	18-87-11.7	SA ORW
	B9872500	ICW at CM 123 near Howe Point	18-87-11.7	SA ORW
	B9874000	ICW at US 74 and 76 at Wrightsville Beach	18-87-24	SB
	B9876000	ICW at CM 151 near Everett N	18-87-25.7	SA ORW
	B9879000	Carolina Beach Harbor at CM 7	18-87-31.2	SB

Appendix V

Other Water Quality Data in the Cape Fear River Basin

Other Water Quality Data

North Carolina actively solicits "existing and readily available" data and information for each basin as part of the basinwide planning process. Data meeting DWQ quality assurance objectives are used in making use support determinations. Data and information indicating possible water quality problems are investigated further. Both quantitative and qualitative information are accepted during the solicitation period.

DWQ data solicitation includes the following:

- Information, letters and photographs regarding the uses of surface waters for boating, drinking water, swimming, aesthetics and fishing.
- Raw data submitted electronically and accompanied by documentation of quality assurance methods used to collect and analyze the samples. Maps showing sampling locations must also be included.
- Summary reports and memos, including distribution statistics and accompanied by documentation of quality assurance methods used to collect and analyze the data.

Contact information must accompany all data and information submitted.

High levels of confidence must be present in order for outside quantitative information to carry the same weight as information collected from within DWQ. This is particularly the case when considering waters for the Impaired categories in the Integrated Report (303(d) list. Methodology for soliciting and evaluating outside data is presented in *North Carolina's 2002 Integrated Report* http://h2o.enr.state.nc.us/tmdl/2002%20Integrated%20Rept.pdf. The next data solicitation period for the Cape Fear River is planned for fall 2006.

Any data submitted to DWQ from other water sampling programs conducted in the Cape Fear River basin have been reviewed. Data that meet quality and accessibility requirements were considered for use support assessments and the 303(d) list. These data are also used by DWQ to adjust the location of biological and chemical monitoring sites.

DWQ also used data collected from three monitoring coalitions, USGS and the City of Greensboro. In coastal subbasins, DWQ used information from the DEH Shellfish Sanitation and Recreational Water Quality Monitoring Program. These data were used to assign use support ratings to waters in the Cape Fear River basin. The Haw River Assembly also collects information on benthic communities in subbasins 03-06-01 to 03-06-06. These data were not used to assign use support ratings; they were used to identify potential problem areas.

Upper Cape Fear River Basin Association

Ambient data were collected from 48 Upper Cape Fear River Basin Association stations in subbasins 03-06-01 to 03-06-12. Refer to http://www.cfra-nc.org/project.html for more information on the basin association. See subbasin chapters for detailed information on data collected at these stations. The station summary sheets are available in the *2003 Cape Fear River Basinwide Assessment Report* at http://www.esb.enr.state.nc.us/bar.html.

SUBBASIN	STATION	STORET	LOCATION	AU NUMBER
03-06-01	BA10	B0070010	TROUBLESOME CRK AT US 29 BUS NR REIDSVILLE	16-6-(3)
03-06-01	BA15	B0170000	HAW RIV AT SR 2614 HIGH ROCK RD NR WILLIAMSB	16-(1)c
03-06-01	BA3	B0050000	HAW RIV AT US 29A NR BENAJA	16-(1)c
03-06-02	BA117	B1980000	HAW RIV AT SR 2171 AT SAXAPAHAW	16-(1)e
03-06-02	BA118	B2000000	HAW RIV AT SR 1005 NR SAXAPAHAW	16-(1)e
03-06-02	BA38	B0400000	REEDY FORK AT SR 2719 HIGH ROCK RD NR MONTIC	16-11-(9)a3
03-06-02	BA42	B0480050	N BUFFALO CRK AT N BUFFALO CRK WWTP INFLUENT	16-11-14-1a2
03-06-02	BA45	B0540050	N BUFFALO CRK AT SR 2770 HUFFINE MILL RD NR	16-11-14-1b
03-06-02	BA50	B0670000	S BUFFALO CRK AT SR 3000 MCCONNELL RD NR GRE	16-11-14-2a
03-06-02	BA54	B0750000	S BUFFALO CRK AT SR 2821 AT MCLEANSVILLE	16-11-14-2c
03-06-02	BA58	B0840000	REEDY FORK AT NC 87 AT OSSIPEE	16-11-(9)b
03-06-02	BA59	B0850000	HAW RIV AT SR 1530 GERRINGER MILL RD NR OSSI	16-(1)d2
03-06-02	BA76	B1200000	HAW RIV AT NC 54 NR GRAHAM	16-(1)e
03-06-02	BA87	B1350000	MOADAMS CRK AT CORRIGDOR RD UPS OF DISCHARGE	16-18-7
03-06-02	BA88	B1380000	MOADAMS CRK AT SR 1940 GIBSON RD NR FLORENCE	16-18-7
03-06-02	BA90	B1440000	HAW RIV AT SR 2158 SWEPSONVILLE RD NR SWEPSO	16-(1)e
03-06-03	BA112	B1940000	BIG ALAMANCE CRK AT NC 87 NR SWEPSONVILLE	16-19-(4.5)b
03-06-03	BA114	B1960000	ALAMANCE CRK AT SR 2116 AT SWEPSONSVILLE	16-19-(4.5)b
03-06-04	BA139	B2210000	HAW RIV AT US 64 NR PITTSBORO	16-(36.3)
03-06-04	BA150	B2450000	ROBESON CRK AT SR 1943 NR HANKS CHAPEL	16-(37.5)
03-06-05	BA177	B3020000	NEW HOPE CRK AT NC 54 NR DURHAM	16-41-1-(11.5)b
03-06-05	BA178	B3025000	THIRD FORK CRK AT NC 54 NR DURHAM	16-41-1-12-(2)
03-06-05	BA181	B3040000	NEW HOPE CRK AT SR 1107 NR BLANDS	16-41-1-(11.5)c
03-06-05	BA197	B3300000	NORTHEAST CRK AT SR 1102 SEDGWICK ROAD NR RT	16-41-1-17-(0.7)a
03-06-05	BA210	B3670000	NORTHEAST CRK AT SR 1731 O KELLY CHURCH RD N	16-41-1-17-(0.7)b2
03-06-06	BA227	B3899180	MORGAN CRK AT MASON FARM WWTP ENTRANCE AT CH	16-41-2-(5.5)b

03-06-06	BA230	B3900000	MORGAN CRK AT SR 1726 NR FARRINGTON	16-41-2-(9.5)
03-06-07	BA257	B4080000	HAW RIV AT SR 1011 OLD US 1 NR HAYWOOD	16-(42)
03-06-08	BA273	B4350000	DEEP RIV AT SR 1113 KIVETT DR NR HAYWORTH SP	17-(4)a
03-06-08	BA275	B4378000	RICHLAND CRK AT SR 1193 BAKER RD NR HIGH POI	17-7-(0.5)
03-06-08	BA278	B4440000	DEEP RIV AT SR 1129 NR HIGH POINT	17-(4)b
03-06-08	BA292	B4626000	MUDDY CRK AT SR 1929 CEDAR SQUARE RD NR GLEN	17-(4)c
03-06-08	BA299	B4770500	DEEP RIV US 220 BUS MAIN ST AT RANDLEMAN	17-(10.5)a
03-06-08	BA301	B4800000	DEEP RIV AT SR 2122 AT WORTHVILLE	17-(10.5)b
03-06-09	BA304	B4850000	HASKETT CRK AT US 220 BUS NR NORTH ASHEBORO	17-12a
03-06-09	BA307	B4890000	HASKETT CRK AT SR 2128 NR CENTRAL FALLS	17-12b
03-06-09	BA309	B4920000	DEEP RIV AT SR 2261 OLD LIBERTY RD NR CENTRA	17-(10.5)d
03-06-09	BA317	B5070000	DEEP RIV AT SR 2615 AT RAMSEUR	17-(10.5)d
03-06-09	BA318	B5100000	DEEP RIV AT SR 2628 HINSHAW TOWN ROAD NR PAR	17-(10.5)d
03-06-10	BA339	B5390800	COTTON CRK AT SR 1372 AUMAN RD NR STAR	17-26-5-3b
03-06-10	BA347	B5520000	DEEP RIV AT NC 22 AT HIGH FALLS	17-(25.7)
03-06-10	BA355	B5575000	DEEP RIV AT NC 42 AT CARBONTON	17-(32.5)a
03-06-11	BA360	B5685000	DEEP RIV AT DEEP RIVER PARK BRIDGE NR CUMNO	17-(38.7)
03-06-11	BA366	B5820000	DEEP RIV AT US 15 AND 501 NR SANFORD	17-(38.7)
03-06-11	BA380	B6040300	DEEP RIV AT SR 1011 OLD US 1 NR MONCURE	17-(43.5)
03-06-11	BA383	B6050000	DEEP RIV AT CSX RR BRIDGE NR MONCURE	17-(43.5)
03-06-12	BA373	B5950000	ROCKY RIV AT US 64 NR SILER CITY	17-43-(8)a
03-06-12	BA374	B5980000	ROCKY RIV AT SR 2170 RIVES CHAPEL RD NR SILE	17-43-(8)b

Middle Cape Fear River Basin Association

Ambient data were collected from 39 Middle Cape Fear River Basin Association stations in subbasins 03-06-13 to 03-06-17. Refer to http://www.cfra-nc.org/project.html for more information on the basin association. See subbasin chapters for detailed information on data collected at these stations. The station summary sheets are available in the *2003 Cape Fear River Basinwide Assessment Report* at http://www.esb.enr.state.nc.us/bar.html.

SUBBASIN	STATION	STORET	LOCATION	AU NUMBER
03-06-07	BA388	B6130500	LICK CRK AT SR 1500 NR CORINTH	18-4-(2)
03-06-07	BA391	B6160000	CAPE FEAR RIV AT NC 42 NR CORINTH	18-(4.5)
03-06-07	BA397	B6200000	BUCKHORN CRK AT NC 42 NR FUQUAY VARINA	18-7-(11)
03-06-07	BA399	B6230000	AVENTS CRK AT SR 1418 NR COKESBURY	18-13-(2)
03-06-07	BA401	B6252000	NEILLS CRK AT US 401 NR LILLINGTON	18-16-(0.7)c2
03-06-07	BA404	B6320000	KENNETH CRK AT SR 1441 CHALYBEATE SPRINGS RD	18-16-1-(2)
03-06-07	BA407	B6370000	CAPE FEAR RIV AT US 401 AT LILLINGTON	18-(16.3)
03-06-07	BA411	B6480000	BUIES CRK AT US 421 AT BUIES CREEK	18-18
03-06-07	BA412	B6483000	E BUIES CRK AT SR 2054 AT BUIES CREEK	18-18-1-(2)
03-06-07	BA413	B6485000	BUIES CRK AT KEITH HILLS GOLF COURSE MAINT S	18-18
03-06-07	BA431	B6840000	CAPE FEAR RIV AT NC 217 AT ERWIN	18-(20.7)a
03-06-13	BA429	B6830000	UPPER LITTLE RIV AT SR 2021 NR LILLINGTON	18-20-(24.5)
03-06-14	BA459	B7280000	LOWER LITTLE RIV AT SR 1451 AT MANCHESTER	18-23-(24)
03-06-14	BA461	B7300000	LOWER LITTLE RIV AT NC 210 NR SPRING LAKE	18-23-(24)
03-06-15	BA471	B7480000	CAPE FEAR RIV AT HOFFER WTP INTAKE AT FAYETT	18-(20.7)b
03-06-15	BA472	B7500000	CAPE FEAR RIV AT I 95 BELOW FAYETTEVILLE	18-(26)b
03-06-15	BA490	B7589000	CROSS CRK AT WALKWAY AT PWC WWTP	18-27-(3)c
03-06-15	BA491	B7590000	CROSS CRK AT US 301 BUS AND I 95 BUS AT FAYE	18-27-(3)c
03-06-15	BA493	B7610000	CAPE FEAR RIV AT RIVERSIDE LANDING	18-(26)a
03-06-15	BA500	B7679000	ROCKFISH CRK AT SR 1300 VASS ROAD	18-31-(12)
03-06-15	BA501	B7679300	ROCKFISH CRK AT US 401 BYPASS NR RAEFORD	18-31-(12)
03-06-15	BA503	B7700000	ROCKFISH CRK AT SR 1432 NR RAEFORD	18-31-(15)
03-06-15	BA537	B8229000	ROCKFISH CRK AT SPECIAL FORCES CLUB	18-31-(23)
03-06-15	BA538	B8230000	ROCKFISH CRK AT NC 87 NR FAYETTEVILLE	18-31-(23)
03-06-15	BA543	B8290000	CAPE FEAR RIV AT DUPONT WATER INTAKE	18-(26)c
03-06-16	BA545	B8301000	CAPE FEAR RIV BELOW LOCK AND DAM 3 BOAT RAMP	18-(26)d
03-06-16	BA546	B8302000	CAPE FEAR RIV AT POWER LINES NR TOLARSVILLE	18-(26)d
03-06-16	BA547	B8305000	CAPE FEAR RIV AT SR 1316 AT TARHEEL	18-(26)d
03-06-16	BA549	B8306000	CAPE FEAR RIV BELOW HARRISON CRK NR RUSKIN	18-(26)d
03-06-16	BA550	B8315000	HARRISON CRK AT SR 1320 AT BURNEY	18-42b
03-06-16	BA553	B8320000	CAPE FEAR RIV AT US 701 AT ELIZABETHTOWN	18-(26)d
03-06-16	BA556	B8330000	CAPE FEAR RIV DNS MOUTH OF ELLIS CRK	18-(26)d
03-06-16	BA557	B8339000	CAPE FEAR RIV ABOVE LOCK AND DAM 2	18-(26)e
03-06-16	BA560	B8340100	TURNBULL CRK AT US 701 NC 53 AND NC 41 NR EL	18-46
03-06-16	BA561	B8340130	CAPE FEAR RIV AT RM 70	18-(26)f
03-06-16	BA564	B8340650	CAPE FEAR RIV AT RM 55	18-(49)
03-06-16	BA571	B8348000	CAPE FEAR RIV AT SR 1730 ELWELL FERRY RD NR	18-(53.5)
03-06-16	BA572	B8349000	CAPE FEAR RIV ABOVE LOCK AND DAM 1 NR EAST A	18-(58.5)
03-06-16	BA575	B8360000	CAPE FEAR RIV AT NC 11 NR KINGS BLUFF	18-(59)

Lower Cape Fear River Program

Ambient data were collected from 34 Lower Cape Fear River Program stations in subbasins 03-06-17 to 03-06-23. Refer to http://www.cfra-nc.org/projact.html for more information on the basin association and to http://www.uncwil.edu/cmsr/aquaticecology/LCFRP/ for other programs associated with the Lower Cape Fear River Program. See subbasin chapters for detailed information on data collected at these stations. The station summary sheets are available in the *2003 Cape Fear River Basinwide Assessment Report* at http://www.esb.enr.state.nc.us/bar.html.

SUBBASIN	STATION	STORET	LOCATION	AU NUMBER
03-06-16	BA559	B8340050	BROWNS CRK AT NC 87 MOUTH	18-45
03-06-16	BA562	B8340200	HAMMOND CRK AT SR 1704	18-50
03-06-17	BA584	B8445000	LIVINGSTON CRK AT MOUTH NR RIEGELWOOD	18-64
03-06-17	BA585	B8449000	CAPE FEAR RIV NR NEILS EDDY LANDING NR ACME	18-(63)a
03-06-17	BA587	B8450000	CAPE FEAR RIV AT NEILS EDDY LANDING NR ACME	18-(63)a
03-06-17	BA589	B8465000	CAPE FEAR RIV AT DUPONT INTAKE	18-(63)b
03-06-17	BA640	B9030000	Cape Fear Riv at Indian Creek	18-(63)b
03-06-17	BA642	B9050000	CAPE FEAR RIV AT NAVASSA	18-(71)a
03-06-17	BA644	B9050100	Cape Fear Riv at Horseshoe Bend	18-(71)a
03-06-17	BA707	B9790000	Brunswick Riv at boat ramp in Belville	18-77
03-06-17	BA708	B9795000	Cape Fear Riv at CM 54	18-(71)a
03-06-17	BA709	B9800000	CAPE FEAR RIV AT CM 61 AT WILMINGTON	18-(71)a
03-06-17	BA716	B9845100	Cape Fear Riv at CM 42	18-(71)a
03-06-17	BA722	B9850100	Cape Fear Riv at CM 35	18-(71)b
03-06-17	BA734	B9910000	Cape Fear Riv at CM 23	18-(87.5)b
03-06-17	BA736	B9921000	Cape Fear Riv at CM 18	18-88-3.5
03-06-17	BA740	B9980000	ICW 1000 ft west of Southport discharge	18-88-9b
03-06-18	BA590	B8470000	SOUTH RIV AT US 13 NR COOPER	18-68-12-(0.5)a
03-06-19	BA601	B8604000	GREAT COHARIE CRK AT SR 1214	18-68-1
03-06-19	BA603	B8610001	LITTLE COHARIE CRK AT SR 1207 NR INGOLD	18-68-1-17b
03-06-19	BA615	B8740000	SIX RUNS CRK AT SR 1003	18-68-2-(11.5)
03-06-20	BA634	B8981000	Colly Crk at NC 53	18-68-17
03-06-20	BA636	B9000000	BLACK RIV AT NC 210 ABOVE THOROFARE	18-68b
03-06-21	BA647	B9090000	NORTHEAST CAPE FEAR RIV AT NC 403 NR WILLIAM	18-74-(1)b
03-06-21	BA658	B9191500	Northeast Cape Fear Riv NR Sarecta	18-74-(1)c1
03-06-22	BA651	B9130000	Panther Branch below UT NR FAISON	18-74-19-3b
03-06-22	BA657	B9191000	Goshen Swamp at NC 11 and NC 903	18-74-19b
03-06-22	BA679	B9430000	Rockfish Crk at US 117	18-74-29c
03-06-22	BA681	B9460000	Little Rockfish Crk at NC 11	18-74-29-6
03-06-23	BA684	B9490000	ANGOLA CRK AT NC 53	18-74-33-3
03-06-23	BA686	B9500000	BURGAW CANAL AT SR 1345 WRIGHT ST AT BURGAW	18-74-39a
03-06-23	BA687	B9520000	BURGAW CANAL AT US 117	18-74-39b
03-06-23	BA694	B9580000	NORTHEAST CAPE FEAR RIV AT US 117 AT CASTLE	18-74-(47.5)
03-06-23	BA699	B9670000	Northeast Cape Fear Riv below GE	18-74-(52.5)

Appendix VI

NPDES Discharges
and
Individual Stormwater Permits
in the
Cape Fear River Basin

NPDES Dischargers in the Cape Fear River Basin (as of October 27, 2004)

Permit	Owner	Facility	County	Region	Type	Class	MGD	Subbasin	Receiving Stream
NC0003913	Glen Touch Yarn Company LLC	Glen Touch Yarn Company LLC	Alamance	Winston-Salem	Industrial Process & Commercial	Major	0.15	03-06-01	Haw River
NC0024881	City of Reidsville	Reidsville WWTP	Rockingham	Winston-Salem	Municipal, Large	Major	7.5	03-06-01	Haw River
NC0045161	Alamance-Burlington School System	Altamahaw/Ossipee Elementary School	Alamance	Winston-Salem	100% Domestic < 1MGD	Minor	0.012	03-06-01	Haw River
NC0046043	Oak Ridge Military Academy	Oak Ridge Military Academy	Guilford	Winston-Salem	100% Domestic < 1MGD	Minor	0.04	03-06-01	Haw River
NC0046809	Pentecostal Holiness Church	Pentecostal Holiness Church	Guilford	Winston-Salem	100% Domestic < 1MGD	Minor	0.02	03-06-01	Benaja Creek
NC0073571	Mervyn R King	Countryside Manor WWTP	Guilford	Winston-Salem	100% Domestic < 1MGD	Minor	0.015	03-06-01	Troublesome Creek
NC0046019	Episcopal Diocese of North Carolina	The Summit WWTP	Rockingham	Winston-Salem	100% Domestic < 1MGD	Minor	0.015	03-06-01	Haw River
NC0060259	Willow Oak Mobile Home Park	Willow Oak Mobile Home Park	Rockingham	Winston-Salem	100% Domestic < 1MGD	Minor	0.0175	03-06-01	Little Troublesome Creek
NC0065412	REA Enterprises LLC	Pleasant Ridge WWTP	Rockingham	Winston-Salem	100% Domestic < 1MGD	Minor	0.0235	03-06-01	Little Troublesome Creek
NC0066010	Rockingham County Board of Education	Williamsburg Elementary School	Rockingham	Winston-Salem	100% Domestic < 1MGD	Minor	0.004	03-06-01	Haw River
NC0046345	City of Reidsville	Reidsville WTP	Rockingham	Winston-Salem	Water Treatment Plant	Minor	not limited	03-06-01	Troublesome Creek (Lake Reidsville)
NC0085791	Gas Town Inc	Bill's Convenience Store	Guilford	Winston-Salem	Groundwater Remediation	Minor	0.0504	03-06-02	Beaver Creek
NC0085821	Tyco Electronics	Tyco Electronics/Greensboro	Guilford	Winston-Salem	Groundwater Remediation	Minor	0.0576	03-06-02	North Buffalo Creek
NC0038172	Guilford County Schools	McLeansville Middle School WWTP	Guilford	Winston-Salem	100% Domestic < 1MGD	Minor	0.0113	03-06-02	South Buffalo Creek
NC0001210	Monarch Hosiery Mills Inc	Monarch Hosiery Mills Incorporated	Alamance	Winston-Salem	Industrial Process & Commercial	Major	0.05	03-06-02	Reedy Fork (Hardys Mill Pond)
NC0021211	City of Graham	Graham WWTP	Alamance	Winston-Salem	Municipal, Large	Major	3.5	03-06-02	Haw River
NC0021474	City of Mebane	Mebane WWTP	Alamance	Winston-Salem	Municipal, Large	Major	2.5	03-06-02	Moadams Creek (Latham Lake)
NC0023868	City of Burlington	Eastside WWTP	Alamance	Winston-Salem	Municipal, Large	Major	12.0	03-06-02	Haw River
NC0031607	Alamance-Burlington School System	Western Alamance Middle School	Alamance	Winston-Salem	100% Domestic < 1MGD	Minor	0.015	03-06-02	Haw River
NC0042528	B Everett Jordan & Son-1927 LLC	B Everett Jordan 1927 LLC	Alamance	Winston-Salem	100% Domestic < 1MGD	Minor	0.015	03-06-02	Haw River
NC0045144	Alamance-Burlington School System	Western Alamance High School	Alamance	Winston-Salem	100% Domestic < 1MGD	Minor	0.0115	03-06-02	Haw River
NC0045152	Alamance-Burlington School System	Jordan Elementary School	Alamance	Winston-Salem	100% Domestic < 1MGD	Minor	0.0075	03-06-02	Haw River
NC0055271	Shields Mobile Home Park	Shields Mobile Home Park	Alamance	Winston-Salem	100% Domestic < 1MGD	Minor	0.006	03-06-02	Travis Creek
NC0077968	Horners Mobile Home Park	Horners Mobile Home Park	Alamance	Winston-Salem	100% Domestic < 1MGD	Minor	0.04	03-06-02	Reedy Fork
NC0084328	Saramar LLC	Saramar LLC	Alamance	Winston-Salem	Groundwater Remediation	Minor	0.15	03-06-02	Haw River
NC0078000	Brenntag Southeast Inc	Brenntag Southeast Inc	Guilford	Winston-Salem	Groundwater Remediation	Minor	0.216	03-06-02	South Buffalo Creek
NC0084778	Harvin Reaction Technology Inc	Harvin Reaction Technology	Guilford	Winston-Salem	Groundwater Remediation	Minor	0.11	03-06-02	North Buffalo Creek
NC0086380	BP Products North America Inc	Station 24154 remediation site	Guilford	Winston-Salem	Groundwater Remediation	Minor	0.0072	03-06-02	UT at Guilford College
NC0001384	Burlington Industries LLC	Burlington Industries LLC - Williamsburg Plant	Caswell	Winston-Salem	Industrial Process & Commercial	Minor	0.025	03-06-02	Buttermilk Creek

NPDES Dischargers in the Cape Fear River Basin (as of October 27, 2004)

Permit	Owner	Facility	County	Region	Type	Class	MGD	Subbasin	Receiving Stream
NC0045292	City of Graham	Graham / Mebane WTP	Alamance	Winston-Salem	Water Treatment Plant	Minor	not limited	03-06-02	Back Creek
NC0059625	South Saxapahaw Home Owners	South Saxapahaw Home Owners	Alamance	Winston-Salem	Water Treatment Plant	Minor	not limited	03-06-02	Haw River
NC0024325	City of Greensboro	North Buffalo Creek WWTP	Guilford	Winston-Salem	Municipal, Large	Major	16.0	03-06-02	North Buffalo Creek
NC0047384	City of Greensboro	T.Z. Osborne WWTP	Guilford	Winston-Salem	Municipal, Large	Major	40.0	03-06-02	South Buffalo Creek
NC0022691	Chateau Communities Inc	Autumn Forest Manuf. Home Community	Guilford	Winston-Salem	100% Domestic < 1MGD	Minor	0.082	03-06-02	Reedy Fork
NC0029726	NC Department of Correction	Guilford Correctional Center WWTP	Guilford	Winston-Salem	100% Domestic < 1MGD	Minor	0.025	03-06-02	North Buffalo Creek
NC0038156	Guilford County Schools	Northeast Middle & Senior High WWTP	Guilford	Winston-Salem	100% Domestic < 1MGD	Minor	0.032	03-06-02	Reedy Fork
NC0066966	Quarterstone Farm Association Inc	Quarterstone Farm WWTP	Guilford	Winston-Salem	100% Domestic < 1MGD	Minor	0.20	03-06-02	Buffalo Creek
NC0081426	City of Greensboro	N.L. Mitchell WTP	Guilford	Winston-Salem	Water Treatment Plant	Minor	not limited	03-06-02	North Buffalo Creek
NC0081671	City of Greensboro	Lake Townsend WTP	Guilford	Winston-Salem	Water Treatment Plant	Minor	1.5	03-06-02	Reedy Fork
NC0003671	Magellan Terminals Holdings L P	Greensboro Terminal II	Guilford	Winston-Salem	Industrial Process & Commercial	Minor	not limited	03-06-02	Horsepen Creek
NC0071463	Apex Oil Company	Apex Oil Company	Guilford	Winston-Salem	Industrial Process & Commercial	Minor	not limited	03-06-02	Horsepen Creek
NC0023876	City of Burlington	Southside WWTP	Alamance	Winston-Salem	Municipal, Large	Major	12.0	03-06-03	Big Alamance Creek (Alamance Creek)
NC0022098	Cedar Valley Communities LLC	Cedar Valley WWTP	Guilford	Winston-Salem	100% Domestic < 1MGD	Minor	0.01	03-06-03	Little Alamance Creek (Guilford County)
NC0022675	Country Club Communities LLC	Birmingham Place	Guilford	Winston-Salem	100% Domestic < 1MGD	Minor	0.043	03-06-03	Little Alamance Creek (Guilford County)
NC0038164	Guilford County Schools	Nathanael Greene Elementary School WWTP	Guilford	Winston-Salem	100% Domestic < 1MGD	Minor	0.0045	03-06-03	North Prong Stinking Quarter Creek
NC0048241	Staley Hosiery Mills	Staley Hosiery Mills	Alamance	Winston-Salem	Industrial Process & Commercial	Minor	0.005	03-06-03	Big Alamance Creek (Alamance Creek)
NC0083828	City of Burlington	J.D. Mackintosh, Jr. WTP	Alamance	Winston-Salem	Water Treatment Plant	Minor	not limited	03-06-03	Big Alamance Creek (Alamance Creek)
NC0045128	Alamance-Burlington School System	Sylvan Elementary School	Alamance	Winston-Salem	100% Domestic < 1MGD	Minor	0.0014	03-06-04	Cane Creek
NC0042285	Trails Property Owners Assoc	Trails WWTP	Orange	Raleigh	100% Domestic < 1MGD	Minor	0.04	03-06-04	Collins Creek
NC0087629	State of NC Department of Transportation	Asphalt Testing Site #6	Chatham	Raleigh	Groundwater Remediation	Minor	0.0144	03-06-04	Haw River
NC0020354	Town of Pittsboro	Pittsboro WWTP	Chatham	Raleigh	Municipal, < 1MGD	Minor	0.75	03-06-04	Robeson Creek
NC0035866	County of Chatham	Bynum WWTP	Chatham	Raleigh	Municipal, < 1MGD	Minor	0.025	03-06-04	Haw River
NC0080896	Town of Pittsboro	Pittsboro WTP	Chatham	Raleigh	Water Treatment Plant	Minor	not limited	03-06-04	Haw River
NC0086827	Brenntag	Brenntag Southeast, Inc.	Durham	Raleigh	Groundwater Remediation	Minor	not limited	03-06-05	Third Fork Creek
NC0026051	Durham County	Triangle WWTP	Durham	Raleigh	Municipal, Large	Major	12.0	03-06-05	Northeast Creek
NC0047597	City of Durham	South Durham WRF	Durham	Raleigh	Municipal, Large	Major	20.0	03-06-05	New Hope Creek

Permit	Owner	Facility	County	Region	Type	Class	MGD	Subbasin	Receiving Stream
NC0043257	Nature Trails Association CLP	Nature Trails Mobile Home Park WWTP	Chatham	Raleigh	100% Domestic < 1MGD	Minor	0.04	03-06-05	Cub Creek
NC0043559	Fearrington Utilities Inc	Fearrington Util/ WWTP	Chatham	Raleigh	100% Domestic < 1MGD	Minor	0.27	03-06-05	Bush Creek
NC0042803	Birchwood Mobile Home Park	Birchwood Mobile Home Park	Orange	Raleigh	100% Domestic < 1MGD	Minor	0.018	03-06-05	New Hope Creek
NC0074446	Hilltop Mobile Home Park	Hilltop Mobile Home Park	Orange	Raleigh	100% Domestic < 1MGD	Minor	0.012	03-06-05	Old Field Creek
NC0084093	County of Chatham	Jordan Lake WTP	Chatham	Raleigh	Water Treatment Plant	Minor	not limited	03-06-05	UT Camp New Hope (Camp New Hope Lake)
NC0081591	Town of Cary	Cary & Apex WTP	Wake	Raleigh	Water Treatment Plant	Minor	not limited	03-06-05	White Oak Creek
NC0048429	Cedar Village Apartments	Cedar Village Apartments	Chatham	Raleigh	100% Domestic < 1MGD	Minor	0.005	03-06-05	Cub Creek
NC0051314	North Chatham Water & Sewer Co LLC	Cole Park Plaza	Chatham	Raleigh	100% Domestic < 1MGD	Minor	0.05	03-06-05	Cub Creek
NC0025241	Orange Water And Sewer Authority	Mason Farm WWTP	Orange	Raleigh	Municipal, Large	Major	14.5	03-06-06	Morgan Creek
NC0056413	Whippoorwill LLC	Carolina Meadows WWTP	Chatham	Raleigh	100% Domestic < 1MGD	Minor	0.18	03-06-06	Morgan Creek
NC0025305	UNC-CH	UNC Cogeneration Facility	Orange	Raleigh	Industrial Process & Commercial	Minor	0.0922	03-06-06	Morgan Creek
NC0082210	Orange Water And Sewer Authority	Jones Ferry Road WTP	Orange	Raleigh	Water Treatment Plant	Minor	not limited	03-06-06	Morgan Creek
NC0000892	Dynea U.S.A., Inc.	Dynea U.S.A.	Chatham	Raleigh	Industrial Process & Commercial	Major	0.1	03-06-07	Haw River
NC0001899	Honeywell International Inc	Honeywell International Inc - Moncure, NC	Chatham	Raleigh	Industrial Process & Commercial	Major	0.244	03-06-07	Haw River
NC0003433	Progress Energy Carolinas, Inc.	Cape Fear Steam Electric Power Plant	Chatham	Raleigh	Industrial Process & Commercial	Major	10.0	03-06-07	Cape Fear River
NC0039586	Progress Energy Carolinas, Inc.	Shearon Harris Nuclear Power Plant	Wake	Raleigh	Industrial Process & Commercial	Major	1.62	03-06-07	Buckhorn Creek (Harris Lake)
NC0028118	Town of Fuquay-Varina	Kenneth Creek WWTP	Wake	Raleigh	Municipal, Large	Major	1.2	03-06-07	Kenneth Creek
NC0063096	Town of Holly Springs	Holly Springs WWTP	Wake	Raleigh	Municipal, Large	Major	2.4	03-06-07	Utley Creek
NC0023442	Weyerhaeuser Company	Moncure Plywood	Chatham	Raleigh	100% Domestic < 1MGD	Minor	0.008	03-06-07	Haw River
NC0048101	Diversicare Assisted Living Services	Senters Rest Home	Harnett	Fayetteville	100% Domestic < 1MGD	Minor	0.0048	03-06-07	Kenneth Creek
NC0055051	Country Lake Estates Inc	Country Lake Estates Incorporated	Wake	Raleigh	100% Domestic < 1MGD	Minor	0.09	03-06-07	Buckhorn Creek
NC0040711	Sierrapine Limited	Sierrapine Limited-Moncure	Chatham	Raleigh	Industrial Process & Commercial	Minor	not limited	03-06-07	Haw River
NC0021636	Harnett County	North Harnett Regional WWTP	Harnett	Fayetteville	Municipal, < 1MGD	Minor	0.75	03-06-07	Cape Fear River
NC0030091	Harnett County	Buies Creek WWTP	Harnett	Fayetteville	Municipal, < 1MGD	Minor	0.5	03-06-07	Cape Fear River
NC0082597	Town of Angier	Angier WWTP	Harnett	Fayetteville	Municipal, < 1MGD	Minor	0.5	03-06-07	Cape Fear River
NC0059242	Town of Broadway	Broadway WWTP	Lee	Raleigh	Municipal, < 1MGD	Minor	0.145	03-06-07	Daniels Creek
NC0007684	Harnett County	Harnett County Regional WTP	Harnett	Fayetteville	Water Treatment Plant	Minor	not limited	03-06-07	Cape Fear River
NC0002861	City of Sanford	Sanford WTP	Lee	Raleigh	Water Treatment Plant	Minor	not limited	03-06-07	Cape Fear River

Permit	Owner	Facility	County	Region	Type	Class	MGD	Subbasin	Receiving Stream
NC0069451	Rimmer Mobile Home Court	Rimmer Mobile Home Court	Randolph	Winston-Salem	100% Domestic < 1MGD	Minor	0.0204	03-06-08	Muddy Creek
NC0024210	City of High Point	East Side WWTP	Guilford	Winston-Salem	Municipal, Large	Major	16.0	03-06-08	Richland Creek
NC0025445	City of Randleman	Randleman WWTP	Randolph	Winston-Salem	Municipal, Large	Major	1.745	03-06-08	Deep River
NC0038091	Guilford County Schools	Southern Elementary School	Guilford	Winston-Salem	100% Domestic < 1MGD	Minor	0.0075	03-06-08	Hickory Creek
NC0038229	Guilford County Schools	Southern Guilford High School	Guilford	Winston-Salem	100% Domestic < 1MGD	Minor	0.012	03-06-08	Hickory Creek
NC0041483	Plaza Mobile Home Park	Plaza Mobile Home Park	Guilford	Winston-Salem	100% Domestic < 1MGD	Minor	0.003	03-06-08	Hickory Creek
NC0055255	Crown Mobile Home Park	Crown Mobile Home Park	Guilford	Winston-Salem	100% Domestic < 1MGD	Minor	0.042	03-06-08	Hickory Creek
NC0050792	Aqua North Carolina, Inc	Melbille Heights WWTP	Randolph	Winston-Salem	100% Domestic < 1MGD	Minor	0.0315	03-06-08	Muddy Creek
NC0055191	Aqua North Carolina, Inc	Penman Heights WWTP	Randolph	Winston-Salem	100% Domestic < 1MGD	Minor	0.025	03-06-08	Muddy Creek
NC0065358	Hidden Forest Estates	Hidden Forest Mobile Home Park WWTP	Randolph	Winston-Salem	100% Domestic < 1MGD	Minor	0.027	03-06-08	Deep River
NC0084492	RMC Metromont Materials Inc	RMC Carolina Materials Inc-Colfax	Guilford	Winston-Salem	Groundwater Remediation	Minor	not limited	03-06-08	West Fork Deep River
NC0000795	Kinder Morgan Southeast Terminals LLC	Kinder Morgan Southeast Terminals - Greensboro	Guilford	Winston-Salem	Industrial Process & Commercial	Minor	not limited	03-06-08	East Fork Deep River
NC0022209	Motiva Enterprises LLC	Greensboro Terminal	Guilford	Winston-Salem	Industrial Process & Commercial	Minor	not limited	03-06-08	Long Branch
NC0026247	TransMontaigne Product Services Inc	Southeast terminal	Guilford	Winston-Salem	Industrial Process & Commercial	Minor	not limited	03-06-08	East Fork Deep River
NC0031046	Colonial Pipeline Company	Greensboro Terminal	Guilford	Winston-Salem	Industrial Process & Commercial	Minor	not limited	03-06-08	East Fork Deep River
NC0036366	National Pipe And Plastics	National Pipe And Plastics	Guilford	Winston-Salem	Industrial Process & Commercial	Minor	not limited	03-06-08	West Fork Deep River
NC0042501	Charter Triad Terminals LLC	Charter Triad Terminals LLC	Guilford	Winston-Salem	Industrial Process & Commercial	Minor	not limited	03-06-08	East Fork Deep River
NC0051161	Plantation Pipe Line Company	Greensboro Petroleum Breakout Facility	Guilford	Winston-Salem	Industrial Process & Commercial	Minor	not limited	03-06-08	East Fork Deep River
NC0069256	TransMontaigne Product Services Inc	Greensboro Terminal	Guilford	Winston-Salem	Industrial Process & Commercial	Minor	not limited	03-06-08	East Fork Deep River
NC0074241	Associated Asphalt Greensboro Inc	Associated Asphalt Greensboro Inc	Guilford	Winston-Salem	Industrial Process & Commercial	Minor	not limited	03-06-08	East Fork Deep River
NC0074578	Magellan Terminals Holdings L P	Greensboro Terminal I	Guilford	Winston-Salem	Industrial Process & Commercial	Minor	not limited	03-06-08	Long Branch
NC0081256	City of High Point	Frank L. Ward WTP	Guilford	Winston-Salem	Water Treatment Plant	Minor	10.0	03-06-08	Richland Creek
NC0087866	Piedmont Triad Regional Water Authority	Randleman Lake Water Treatment Plant	Randolph	Winston-Salem	Water Treatment Plant	Minor	1.5	03-06-08	Deep River (Randleman Lake)
NC0026565	Town of Ramseur	Ramseur WWTP	Randolph	Winston-Salem	Municipal, < 1MGD	Minor	0.48	03-06-09	Deep River (Randleman Lake)
NC0026123	City of Asheboro	Asheboro WWTP	Randolph	Winston-Salem	Municipal, Large	Major	9.0	03-06-09	Haskett Creek
NC0039471	Chatham County Schools	Bennett Elementary School WWTP	Chatham	Raleigh	100% Domestic < 1MGD	Minor	0.005	03-06-09	Flat Creek
NC0023299	Oakwood Land Dev Corp	Woodlake Mobile Home Park	Guilford	Winston-Salem	100% Domestic < 1MGD	Minor	0.07	03-06-09	Polecat Creek
NC0055913	Monroe's Mobile Home Park	Monroe's Mobile Home Park	Guilford	Winston-Salem	100% Domestic < 1MGD	Minor	0.03	03-06-09	Polecat Creek
NC0040924	Randolph County Schools	Seagrove Elementary School	Randolph	Winston-Salem	100% Domestic < 1MGD	Minor	0.0088	03-06-09	Fork Creek

NPDES Dischargers in the Cape Fear River Basin (as of October 27, 2004)

Permit	Owner	Facility	County	Region	Type	Class	MGD	Subbasin	Receiving Stream
NC0040975	Randolph County Schools	Coleridge Elementary School	Randolph	Winston-Salem	100% Domestic < 1MGD	Minor	0.0056	03-06-09	Deep River (Randleman Lake)
NC0084816	Thomasville Furniture Industries, Inc.	Groundwater Remediation site	Guilford	Winston-Salem	Groundwater Remediation	Minor	0.0288	03-06-09	Polecat Creek
NC0084077	Hancock Country Hams Inc	Hancock Country Hams Incorporated	Randolph	Winston-Salem	Groundwater Remediation	Minor	0.1	03-06-09	Sandy Creek
NC0000639	Sapona Manufacturing Company Inc	Sapona Manufacturing Company	Randolph	Winston-Salem	Industrial Process & Commercial	Minor	0.01	03-06-09	Deep River (Randleman Lake)
NC0074454	Town of Ramseur	Ramseur WTP	Randolph	Winston-Salem	Water Treatment Plant	Minor	not limited	03-06-09	Sandy Creek
NC0038300	S S Construction & Rental Inc	S.S. Mobile Home Park	Chatham	Raleigh	100% Domestic < 1MGD	Minor	0.01	03-06-09	Brush Creek
NC0007820	Town of Franklinville	Town of Franklinville WWTP	Randolph	Winston-Salem	Municipal, < 1MGD	Minor	0.1	03-06-09	Deep River (Randleman Lake)
NC0062855	Town of Robbins	Robbins WWTP	Moore	Fayetteville	Municipal, Large	Major	1.3	03-06-10	Deep River
NC0087572	Southern Wood Piedmont Company	Southern Wood Piedmont Company	Chatham	Raleigh	Groundwater Remediation	Minor	0.032	03-06-10	Deep River
NC0058548	Town of Star	Star WWTP	Montgomery	Fayetteville	Municipal, < 1MGD	Minor	0.6	03-06-10	Cotton Creek
NC0024147	City of Sanford	Sanford WWTP	Lee	Raleigh	Municipal, Large	Major	6.8	03-06-11	Deep River
NC0030384	Piedmont Health Services Inc	Moncure Community Health Center	Chatham	Raleigh	100% Domestic < 1MGD	Minor	0.0025	03-06-11	Deep River
NC0039349	Chatham County Schools	Waters Elementary School	Chatham	Raleigh	100% Domestic < 1MGD	Minor	0.009	03-06-11	Cedar Creek
NC0072575	Gold Kist Inc	Gold Kist Incorporated- Cumnock	Lee	Raleigh	Industrial Process & Commercial	Minor	1.0	03-06-11	Deep River
NC0081493	Bost Distributing Corporation	Bost Distributing Corporation	Lee	Raleigh	Industrial Process & Commercial	Minor	0.003	03-06-11	Purgatory Branch
NC0081795	Goldston-Gulf Sanitary District	Goldston-Gulf WTP	Chatham	Raleigh	Water Treatment Plant	Minor	0.006	03-06-11	Deep River
NC0083852	Gold Kist Inc	Gold Kist WTP	Lee	Raleigh	Water Treatment Plant	Minor	not limited	03-06-11	Deep River
NC0026441	Town of Siler City	Siler City WWTP	Chatham	Raleigh	Municipal, Large	Major	4.0	03-06-12	Loves Creek
NC0038849	Bidco III LLC	Hill Forest Rest Home	Chatham	Raleigh	100% Domestic < 1MGD	Minor	0.003	03-06-12	Bear Creek
NC0039331	Chatham County Schools	Bonlee Elementary School	Chatham	Raleigh	100% Domestic < 1MGD	Minor	0.007	03-06-12	Bear Creek
NC0039381	Chatham County Schools	Central Chatham High School	Chatham	Raleigh	100% Domestic < 1MGD	Minor	0.01	03-06-12	Bear Creek
NC0001406	Swift Textiles Inc	Erwin Mills	Harnett	Fayetteville	Industrial Process & Commercial	Major	2.5	03-06-13	Cape Fear River
NC0043176	City of Dunn	Dunn WWTP	Harnett	Fayetteville	Municipal, Large	Major	3.0	03-06-13	Cape Fear River
NC0064521	Town of Erwin	Erwin WWTP	Harnett	Fayetteville	Municipal, Large	Major	1.2	03-06-13	Cape Fear River
NC0038831	Carolina Trace Utilities Inc	Carolina Trace Utilities Inc	Lee	Raleigh	100% Domestic < 1MGD	Minor	0.325	03-06-13	Upper Little River
NC0078955	City of Dunn	Dunn WTP	Harnett	Fayetteville	Water Treatment Plant	Minor	2.0	03-06-13	Juniper Creek

NPDES Dischargers in the Cape Fear River Basin (as of October 27, 2004)

Permit	Owner	Facility	County	Region	Type	Class	MGD	Subbasin	Receiving Stream
NC0080560	Town of Erwin	Erwin WTP	Harnett	Fayetteville	Water Treatment Plant	Minor	not limited	03-06-13	Cape Fear River
NC0003964	U S Army	Fort Bragg WWTP & WTP	Cumberland	Fayetteville	Industrial Process & Commercial	Major	8.0	03-06-14	Little River (Lower Little River)
NC0030970	Town of Spring Lake	Spring Lake WWTP	Cumberland	Fayetteville	Municipal, Large	Major	1.5	03-06-14	Little River (Lower Little River)
NC0022489	Bobby Miller Enterprises Inc	Dilton Mobile Home Park	Cumberland	Fayetteville	100% Domestic < 1MGD	Minor	0.015	03-06-14	Little River (Lower Little River)
NC0031470	Harnett County	South Central Water & Sewer District WWTP	Harnett	Fayetteville	100% Domestic < 1MGD	Minor	0.4	03-06-14	Jumping Run Creek
NC0057525	Crystal Lake Associates LLC	Crystal Lake Associates LLC	Moore	Fayetteville	100% Domestic < 1MGD	Minor	0.012	03-06-14	Mill Creek
NC0061719	Heater Utilities Inc	Woodlake Country Club WWTP	Moore	Fayetteville	100% Domestic < 1MGD	Minor	0.5	03-06-14	Little Crane Creek (White Oak Creek)
NC0074373	Moore County Public Utilities	Vass WWTP	Moore	Fayetteville	Municipal, < 1MGD	Minor	0.06	03-06-14	Little River (Lower Little River)
NC0077101	Carolina Water Service, Inc of NC	Whispering Pines WTP	Moore	Fayetteville	Water Treatment Plant	Minor	not limited	03-06-14	Whispering Pines Lake
NC0086100	Town of Cameron	Well #5 WTP	Moore	Fayetteville	Water Treatment Plant	Minor	not limited	03-06-14	Little Crane Creek (White Oak Creek)
NC0003719	DAK Resins LLC	DAK Resins LLC - Fayetteville	Cumberland	Fayetteville	Industrial Process & Commercial	Major	1.25	03-06-15	Cape Fear River
NC0023957	PWC/Fayetteville	Cross Creek WWTP	Cumberland	Fayetteville	Municipal, Large	Major	25.0	03-06-15	Cape Fear River
NC0050105	PWC/Fayetteville	Rockfish Creek WWTP	Cumberland	Fayetteville	Municipal, Large	Major	24.0	03-06-15	Cape Fear River
NC0026514	City of Raeford	Raeford WWTP	Hoke	Fayetteville	Municipal, Large	Major	3.0	03-06-15	Rockfish Creek
NC0024481	Days Inn	Days Inn- Fayetteville	Cumberland	Fayetteville	100% Domestic < 1MGD	Minor	0.025	03-06-15	Bakers Swamp
NC0076783	PWC/Fayetteville	Hoffer WTP	Cumberland	Fayetteville	Water Treatment Plant	Minor	not limited	03-06-15	Cape Fear River
NC0003522	Alamac American Knits LLC	Alamac Knit Fabics-Elizabethtown, NC Plant	Bladen	Fayetteville	Industrial Process & Commercial	Major	2.5	03-06-16	Cape Fear River
NC0003573	E I DuPont de Nemours and Company	Dupont Fayetteville Works	Bladen	Fayetteville	Industrial Process & Commercial	Major	2.0	03-06-16	Cape Fear River
NC0078344	Smithfield Packing Company Inc	Tarheel Plant	Bladen	Fayetteville	Industrial Process & Commercial	Major	3.0	03-06-16	Cape Fear River
NC0032913	Bladen County Schools	East Arcadia Elementary School WWTP	Bladen	Fayetteville	100% Domestic < 1MGD	Minor	0.006	03-06-16	Cape Fear River
NC0001121	Dynapar Corporation	Danaher Industrial Controls WWTP	Bladen	Fayetteville	Industrial Process & Commercial	Minor	5.0	03-06-16	Cape Fear River
NC0058297	Elizabethtown Power LLC	Elizabethtown Power LLC	Bladen	Fayetteville	Industrial Process & Commercial	Minor	not limited	03-06-16	Cape Fear River
NC0026671	Town of Elizabethtown	Elizabethtown WWTP	Bladen	Fayetteville	Municipal, < 1MGD	Minor	1.225	03-06-16	Cape Fear River
NC0023639	Holtrachem Manufacturing Company LLC	Holtrachem Mfg Co LLC	Columbus	Wilmington	Industrial Process & Commercial	Minor	not limited	03-06-17	Cape Fear River
NC0003298	International Paper Company	Riegelwood Mill	Columbus	Wilmington	Industrial Process & Commercial	Major	50.0	03-06-17	Cape Fear River
NC0001112	Invista, S.A.R.L.	Invista, S.A.R.L.	New Hanover	Wilmington	Industrial Process & Commercial	Major	1.7	03-06-17	Northeast Cape Fear River

NPDES Dischargers in the Cape Fear River Basin (as of October 27, 2004)

Permit	Owner	Facility	County	Region	Type	Class	MGD	Subbasin	Receiving Stream
NC0082295	Fortron Industries	Fortron Industries	New Hanover	Wilmington	Industrial Process & Commercial	Major	0.417	03-06-17	Cape Fear River
NC0000663	DAK Americas LLC	Cape Fear Site/Wilmington Brunswick	Brunswick	Wilmington	Industrial Process & Commercial	Major	3.5	03-06-17	Cape Fear River
NC0007064	Progress Energy Carolinas, Inc.	Brunswick Steam Electric Plant (Old WWTP)	Brunswick	Wilmington	Industrial Process & Commercial	Major	0.055	03-06-17	Atlantic Ocean
NC0027065	Archer Daniels Midland Company	Southport, NC Manufacturing Facility	Brunswick	Wilmington	Industrial Process & Commercial	Major	3.51	03-06-17	Southport Restricted Area
NC0086819	Brunswick County	Northeast Brunswick WWTP	Brunswick	Wilmington	Municipal, Large	Major	1.65	03-06-17	Cape Fear River
NC0081736	New Hanover County Water & Sewer District	Airport WWTP	New Hanover	Wilmington	Municipal, Large	Major	4.0	03-06-17	Cape Fear River
NC0029122	U S Army	Military Ocean Terminal / Sunny Point	Brunswick	Wilmington	100% Domestic < 1MGD	Minor	0.03	03-06-17	Cape Fear River
NC0043788	Columbus County Schools	Acme Delco High School WWTF	Columbus	Wilmington	100% Domestic < 1MGD	Minor	0.01	03-06-17	Lindscomb Branch
NC0043796	Columbus County Schools	Acme Delco Elementary School	Columbus	Wilmington	100% Domestic < 1MGD	Minor	0.009	03-06-17	Pretty Creek
NC0039527	New Hanover County Water & Sewer District	Walnut Hills WWTP	New Hanover	Wilmington	100% Domestic < 1MGD	Minor	0.1	03-06-17	Northeast Cape Fear River
NC0065099	Cogentrix Energy Inc	Southport Cogen plant	Brunswick	Wilmington	Industrial Process & Commercial	Minor	not limited	03-06-17	Atlantic Ocean
NC0058971	New Hanover County Water & Sewer District	Wastec site	New Hanover	Wilmington	Industrial Process & Commercial	Minor	not limited	03-06-17	Northeast Cape Fear River
NC0021334	City of Southport	Southport WWTP	Brunswick	Wilmington	Municipal, < 1MGD	Minor	0.8	03-06-17	Intracoastal Waterway
NC0075540	North Brunswick Sanitary District	Belville WWTP	Brunswick	Wilmington	Municipal, < 1MGD	Minor	0.8	03-06-17	Brunswick River
NC0025763	Town of Kure Beach	Kure Beach WWTP	New Hanover	Wilmington	Municipal, < 1MGD	Minor	0.285	03-06-17	Cape Fear River
NC0040061	Brunswick County	Beaverdam Creek WTP	Brunswick	Wilmington	Water Treatment Plant	Minor	not limited	03-06-17	Beaverdam Creek
NC0057533	Brunswick County	Hood Creek (Northwest) WTP	Brunswick	Wilmington	Water Treatment Plant	Minor	not limited	03-06-17	Hood Creek
NC0085553	Bald Head Island Devel Co	Bald Head Island WTP	Brunswick	Wilmington	Water Treatment Plant	Minor	not limited	03-06-17	Bald Head Island Marina Basin
NC0001422	Progress Energy Carolinas, Inc.	Sutton Steam Electric Plant	New Hanover	Wilmington	Industrial Process & Commercial	Major	not limited	03-06-17	Cape Fear River
NC0059234	BASF Corporation	BASF Corporation/ Wilmington	New Hanover	Wilmington	Industrial Process & Commercial	Major	0.33	03-06-17	Cape Fear River
NC0023256	Town of Carolina Beach	Carolina Beach WWTP	New Hanover	Wilmington	Municipal, Large	Major	3.0	03-06-17	Cape Fear River
NC0023965	City of Wilmington	Northside WWTP	New Hanover	Wilmington	Municipal, Large	Major	16.0	03-06-17	Cape Fear River
NC0023973	City of Wilmington	Southside WWTP	New Hanover	Wilmington	Municipal, Large	Major	12.0	03-06-17	Cape Fear River
NC0057703	Aqua North Carolina, Inc	Fairways - The Cape WWTP	New Hanover	Wilmington	100% Domestic < 1MGD	Minor	0.35	03-06-17	Cape Fear River
NC0059978	Aqua North Carolina, Inc	Ocean Forest WWTP	New Hanover	Wilmington	100% Domestic < 1MGD	Minor	0.4	03-06-17	Cape Fear River
NC0065480	Aqua North Carolina Inc	Beau Rivage Plantation	New Hanover	Wilmington	100% Domestic < 1MGD	Minor	0.1	03-06-17	Cape Fear River
NC0083658	AAF-McQuay Inc	Heathcraft remediation site	New Hanover	Wilmington	Groundwater Remediation	Minor	0.36	03-06-17	Barnards Creek
NC0003395	Wright Corporation	Wright Corporation	Columbus	Wilmington	Industrial Process & Commercial	Minor	0.2	03-06-17	Livingston Creek (Broadwater Lake)
NC0023477	Southern States Chemical Inc	Southern States Chemical Inc	New Hanover	Wilmington	Industrial Process & Commercial	Minor	not limited	03-06-17	Northeast Cape Fear River
NC0065307	Worsley Companies Inc	Dixie Boy No. 6	New Hanover	Wilmington	Industrial Process & Commercial	Minor	0.004	03-06-17	Northeast Cape Fear River

NPDES Dischargers in the Cape Fear River Basin (as of October 27, 2004)

Permit	Owner	Facility	County	Region	Type	Class	MGD	Subbasin	Receiving Stream
NC0066711	Amerada Hess	Amerada Hess Corporation	New Hanover	Wilmington	Industrial Process & Commercial	Minor	not limited	03-06-17	Cape Fear River
NC0073172	Vopak Terminal Wilmington Inc	Wilmington Terminal	New Hanover	Wilmington	Industrial Process & Commercial	Minor	not limited	03-06-17	Cape Fear River
NC0073181	Exxon Mobil Chemical Company	South Wilmington Terminal	New Hanover	Wilmington	Industrial Process & Commercial	Minor	not limited	03-06-17	Cape Fear River
NC0076732	Flint Hills Resources L P	New Hanover Terminal	New Hanover	Wilmington	Industrial Process & Commercial	Minor	0.1	03-06-17	Cape Fear River
NC0082970	CTI of North Carolina Inc	CTI Of North Carolina	New Hanover	Wilmington	Industrial Process & Commercial	Minor	0.0144	03-06-17	Cape Fear River
NC0087947	Columbus Co	Columbus County POTW	Columbus	Wilmington	Municipal, < 1MGD	Minor	0.125	03-06-17	Livingston Creek (Broadwater Lake)
NC0002879	City of Wilmington	Sweeney WTP	New Hanover	Wilmington	Water Treatment Plant	Minor	not limited	03-06-17	Northeast Cape Fear River
NC0055107	Aqua North Carolina, Inc	Dolphin Bay WWTP	New Hanover	Wilmington	100% Domestic < 1MGD	Minor	0.08	03-06-17	Snows Cut
NC0058793	Golden Years Nursing Home	Golden Years Nursing Home	Cumberland	Fayetteville	100% Domestic < 1MGD	Minor	0.05	03-06-18	South River
NC0083135	B&B Produce Inc	B&B Produce Incorporated	Johnston	Raleigh	Industrial Process & Commercial	Minor	0.025	03-06-18	Mingo Swamp
NC0024791	State of NC Department of Transportation	Sampson County Rest Area	Sampson	Fayetteville	100% Domestic < 1MGD	Minor	0.006	03-06-19	Six Runs Creek
NC0020346	Town of Magnolia	Magnolia WWTP	Duplin	Wilmington	Municipal, < 1MGD	Minor	0.09	03-06-19	Millers Creek
NC0021903	Town Of Warsaw	Warsaw WWTP	Duplin	Wilmington	Municipal, < 1MGD	Minor	0.915	03-06-19	Stewarts Creek
NC0025569	Town of Garland	Garland WWTP	Sampson	Fayetteville	Municipal, < 1MGD	Minor	0.126	03-06-19	Great Coharie Creek (Blackmans Pond)
NC0072877	Town of Newton Grove	Newton Grove WWTP	Sampson	Fayetteville	Municipal, < 1MGD	Minor	0.2	03-06-19	Beaverdam Swamp
NC0086649	City of Clinton	Well Field East WTP	Sampson	Fayetteville	Water Treatment Plant	Minor	not limited	03-06-19	Rowans Branch (Chestnut Pond)
NC0020117	City of Clinton	Norman H. Larkins WPCF	Sampson	Fayetteville	Municipal, Large	Major	5.0	03-06-19	Williams Old Mill Branch (Mill Branch)
NC0026816	Town of Roseboro	Roseboro WWTP	Sampson	Fayetteville	Municipal, < 1MGD	Minor	0.49	03-06-19	Little Coharie Creek (Sinclair Lake)
NC0036404	Lake Creek Corporation	Bay Tree Lakes WWTP	Bladen	Fayetteville	100% Domestic < 1MGD	Minor	0.02	03-06-20	Lake Creek
NC0023353	Town of White Lake	White Lake WWTP	Bladen	Fayetteville	Municipal, < 1MGD	Minor	0.8	03-06-20	Colly Creek
NC0001074	Mount Olive Pickle Company	Mount Olive Pickle Company	Wayne	Washington	Industrial Process & Commercial	Minor	0.4	03-06-21	Barlow Branch
NC0086941	Southeastern Wayne Sanitary District	Southeastern Wayne S D WTP	Wayne	Washington	Water Treatment Plant	Minor	not limited	03-06-21	Horsepen Branch
NC0020575	Town of Mount Olive	Mount Olive WWTP	Wayne	Washington	Municipal, Large	Major	1.0	03-06-21	Northeast Cape Fear River
NC0063711	Albertson Water & Sewer District	Albertson W&S District WTP	Duplin	Wilmington	Water Treatment Plant	Minor	not limited	03-06-21	Great Branch (Hussey Pond)
NC0003051	Town of Mount Olive	Mount Olive WTP #3	Wayne	Washington	Water Treatment Plant	Minor	not limited	03-06-21	Northeast Cape Fear River
NC0086801	Town of Mount Olive	Gordon Street WTP	Wayne	Washington	Water Treatment Plant	Minor	not limited	03-06-21	Northeast Cape Fear River

Permit	Owner	Facility	County	Region	Type	Class	MGD	Subbasin	Receiving Stream
NC0001970	Dean Pickle & Specialty Products Co	Dean Pickle & Specialty Prod	Duplin	Wilmington	Industrial Process & Commercial	Minor	0.5	03-06-22	Panther Creek
NC0003450	Town of Wallace	Wallace WWTP #2	Duplin	Wilmington	Municipal, Large	Major	4.42	03-06-22	Rock Fish Creek (New Kirk Pond)
NC0020702	Town of Wallace	Wallace WWTP	Duplin	Wilmington	Municipal, Large	Major	1.0	03-06-22	Rock Fish Creek (New Kirk Pond)
NC0085481	Pender County Board of Education	Penderlea Elementary School	Pender	Wilmington	100% Domestic < 1MGD	Minor	0.01	03-06-22	Crooked Run
NC0002763	National Spinning Company, Inc	Warsaw Mill	Duplin	Wilmington	Industrial Process & Commercial	Minor	not limited	03-06-22	Grove Creek
NC0003344	Circle S Foods	Wallace Processing Plant	Duplin	Wilmington	Industrial Process & Commercial	Minor	1.5	03-06-22	Rock Fish Creek (New Kirk Pond)
NC0058271	Green Power Energy Holdings LLC	Green Power Kenansville LLC	Duplin	Wilmington	Industrial Process & Commercial	Minor	not limited	03-06-22	Northeast Cape Fear River
NC0066320	House of Raeford Farms Inc	Rose Hill Plant	Duplin	Wilmington	Industrial Process & Commercial	Minor	not limited	03-06-22	Beaverdam Branch
NC0026018	Town of Beulaville	Beulaville WWTP	Duplin	Wilmington	Municipal, < 1MGD	Minor	0.26	03-06-22	Persimmon Branch
NC0036668	Town of Kenansville	Kenansville WWTP	Duplin	Wilmington	Municipal, < 1MGD	Minor	0.3	03-06-22	Grove Creek
NC0056863	Town of Rose Hill	Rose Hill WWTP	Duplin	Wilmington	Municipal, < 1MGD	Minor	0.45	03-06-22	Reedy Branch
NC0002933	Town of Calypso	Calypso WTP	Duplin	Wilmington	Water Treatment Plant	Minor	not limited	03-06-22	Dicks Branch
NC0002305	Guilford Mills Inc	Gulford East Mill WWTP	Duplin	Wilmington	Industrial Process & Commercial	Major	1.5	03-06-22	Northeast Cape Fear River
NC0049743	New Hanover County Water & Sewer District	Landfill WWTP	New Hanover	Wilmington	Industrial Process & Commercial	Minor	0.064	03-06-23	Northeast Cape Fear River
NC0003794	Corning Inc	Wilmington Plant	New Hanover	Wilmington	Industrial Process & Commercial	Minor	not limited	03-06-23	Spring Branch
NC0003875	Elementis Chromium L P	Castle Hayne, NC Manufacturing Facility (NPDES)	New Hanover	Wilmington	Industrial Process & Commercial	Major	1.07	03-06-23	Northeast Cape Fear River
NC0051969	Bowden Nursing Home Inc	Hermitage House Rest Home WWTP	New Hanover	Wilmington	100% Domestic < 1MGD	Minor	0.024	03-06-23	Prince George Creek
NC0042251	Pender County Board of Education	Pender High School WWTP	Pender	Wilmington	100% Domestic < 1MGD	Minor	0.02	03-06-23	Long Creek
NC0021113	Town Of Burgaw	Burgaw WWTP	Pender	Wilmington	Municipal, < 1MGD	Minor	0.75	03-06-23	Burgaw Creek
NC0001228	Global Nuclear Fuel	Global Nuclear Fuel-Americas	New Hanover	Wilmington	Industrial Process & Commercial	Major	1.875	03-06-23	Northeast Cape Fear River
NC0001091	LaQue Center for Corrosion Technology	Laque Centr For Corrosion Tech	New Hanover	Wilmington	Industrial Process & Commercial	Minor	not limited	03-06-24	Banks Channel
NC0025895	Town Of Holly Ridge	Holly Ridge WWTP	Onslow	Wilmington	Municipal, < 1MGD	Minor	0.1	03-06-24	King Creek Restricted Area (Spicer Bay)
NC0032221	Carolina Water Service, Inc of NC	Belvedere WTP	Pender	Wilmington	Water Treatment Plant	Minor	not limited	03-06-24	Intracoastal Waterway

NPDES Individual Stormwater Permits in the Cape Fear River Basin (as of November 10, 2004)

Permit #	Facility Name	Receiving Stream	Subbasin	County
NCS000030	Air Products and Chemicals, Inc.	UT Little Troublesome Creek	03-06-01	Rockingham
NCS000085	Safety-Kleen (TS)	UT Troublesome Creek	03-06-01	Rockingham
NCS000010	Stockhausen, Inc.	Mile Run Creek	03-06-02	Guilford
NCS000048	Chemol Co., Inc.	Mile Run Creek	03-06-02	Guilford
NCS000077	Dow Corning Corporation	UT South Buffalo Creek	03-06-02	Guilford
NCS000107	Unitex Chemical Corporation	South Buffalo Creek	03-06-02	Guilford
NCS000119	Unichem, Inc.	Haw River	03-06-02	Alamance
NCS000155	GKN Automotive Components, Inc.	Buffalo Creek	03-06-02	Lee
NCS000206	Duke Power Fairfax Ops Center	UT South Buffalo Creek	03-06-02	Guilford
NCS000253	Southern Foundries Corp.	North Buffalo Creek	03-06-02	Guilford
NCS000308	Air Products & Chemicals Inc.	UT Little Buffalo Creek	03-06-02	Guilford
NCS000353	H B Fuller Company - Guilford Co.	UT South Buffalo Creek	03-06-02	Guilford
NCS000090	Burlington Chemical Company	Gum Creek	03-06-03	Alamance
NCS000017	Glaxo Wellcome Inc. - Durham Co.	UT Northeast Creek	03-06-05	Durham
NCS000046	National Specialty Gases	UT Northeast Creek	03-06-05	Durham
NCS000050	SCM Metal Products, Inc.	UT Northeast Creek & Stirrup Iron Creek	03-06-05	Durham
NCS000201	UNC-CH Haz Mat Facility	UT Bolin Creek	03-06-06	Orange
NCS000087	PAC-FAB, Inc.	Little Buffalo Creek	03-06-07	Lee
NCS000100	Honeywell International Inc.	Shaddox Creek & Haw River	03-06-07	Chatham
NCS000150	Dynea USA, Inc.	Haw River	03-06-07	Chatham
NCS000151	SierraPine, Limited	Shaddox Creek	03-06-07	Chatham
NCS000078	Novartis, Crop Protection, Inc.	East Fork Long Branch Creek	03-06-08	Guilford
NCS000092	Marsh Furniture Company	UT Richland Creek	03-06-08	Guilford
NCS000280	Lester Group, Inc. - Fortress Wood Prod.	UT Bull Run Creek	03-06-08	Guilford
NCS000023	Pioneer Southern, Inc.	Rita Branch	03-06-10	Montgomery
NCS000122	General Timber, Inc.	George's Creek	03-06-11	Chatham
NCS000342	Pope Air Force Base	Little River	03-06-14	Cumberland
NCS000056	E.I. DuPont de Nemours and Company	Cape Fear River	03-06-15	Cumberland
NCS000088	Borden Chemical, Inc.	Cape Fear River	03-06-15	Cumberland
NCS000147	Wellman, Inc.	UT Cape Fear River	03-06-15	Cumberland
NCS000187	Black & Decker (US), Inc.	UT Lake Lynn	03-06-15	Cumberland

NPDES Individual Stormwater Permits in the Cape Fear River Basin (as of November 10, 2004)

Permit #	Facility Name	Receiving Stream	Subbasin	County
NCS000331	Fort Bragg Military Reservation	Cross Creek, Texas Pond, Smith Lake, Rose Lake	03-06-15	Cumberland
NCS000076	Corning, Inc.	Spring Branch	03-06-17	New Hanover
NCS000101	Federal Paper Board Co. - Riegelwood	Cape Fear River	03-06-17	Columbus
NCS000156	Wright Corporation	Mill Creek & Livingston Creek	03-06-17	Columbus
NCS000174	NC State Ports Auth. - Wilmington	Cape Fear River	03-06-17	New Hanover
NCS000208	Military Ocean Terminal - Sunny Pt	Cape Fear River	03-06-17	Brunswick
NCS000244	American Distillation Co.	Cape Fear River	03-06-17	Brunswick
NCS000258	Pressure Chemical Co.	Alligator Branch	03-06-17	Brunswick
NCS000344	American Crane Corp - New Hanover	UT Barnards Creek	03-06-17	New Hanover
NCS000392	DAK Americas LLC	Mulberry Branch	03-06-17	Brunswick
NCS000309	Schindler Elevator Corp	Old Williams Mill Branch	03-06-19	Sampson
NCS000022	GE Wilmington	Prince George Creek	03-06-23	New Hanover
NCS000084	South Atlantic Services, Inc.	Fishing Creek	03-06-23	New Hanover
NCS000118	Arteva Specialties, S.A.R.L.	Northeast Cape Fear River	03-06-23	New Hanover
NCS000214	Royster Clark Inc.	Northeast Cape Fear River	03-06-23	New Hanover
NCS000222	General Wood Preserving Co., Inc.	UT Sturgeon Creek & Alligator Branch	03-06-23	Brunswick

Appendix VII

303(d) Listing
and
Reporting Methodology

Integrated 305(b) and 303(d) Report Summary

The *North Carolina Water Quality Assessment and Impaired Waters List* is an integrated report that includes both the 305(b) and 303(d) reports of previous years. The *305(b) Report* is compiled biennially to update the assessment of water quality in North Carolina and to meet the Section 305(b) reporting requirement of the Clean Water Act. The 305(b) reports present how well waters support designated uses (e.g., swimming, aquatic life support, water supply), as well as likely causes (e.g., sediment, nutrients) and potential sources of impairment. The term "Use Support" refers to the process mandated by 305(b). The *303(d) List* is a comprehensive public accounting of all Impaired waterbodies that is derived from the 305(b) Report/Use Support. An Impaired waterbody is one that does not meet water quality uses, such as water supply, fishing or propagation of aquatic life. Best professional judgement along with numeric and narrative standards criteria and anti-degradation requirements defined in 40 CFR 131 is considered when evaluating the ability of a waterbody to serve its uses.

Section 303(d) of the federal Clean Water Act (CWA), which Congress enacted in 1972, required States, Territories and authorized Tribes to identify and establish a priority ranking for waterbodies for which technology-based effluent limitations required by Section 301 are not stringent enough to attain and maintain applicable water quality standards, establish total maximum daily loads (TMDLs) for the pollutants causing impairment in those waterbodies, and submit, from time to time, the list of Impaired waterbodies and TMDLs to the US Environmental Protection Agency (EPA). Current federal rules require states to submit 303(d) lists biennially, by April 1st of every even numbered year. EPA is required to approve or disapprove the state-developed 303(d) list within 30 days. For each water quality limited segment Impaired by a pollutant and identified in the 303(d) list, a Total Maximum Daily Load (TMDL) must be developed. TMDLs are not required for waters Impaired by pollution.

The Integrated Report includes descriptions of monitoring programs, the use support methodology, and the Impaired waters list. New guidance from EPA places all waterbody assessment units into one unique assessment category (EPA, 2001b). Although EPA specifies five unique assessment categories, North Carolina elects to use seven categories. Each category is described in detail below:

Category 1: Attaining the water quality standard and no use is threatened. This category consists of those waterbody assessment units where all applicable use support categories are rated " Supporting". Data and information are available to support a determination that the water quality standards are attained and no use is threatened. Future monitoring data will be used to determine if the water quality standard continues to be attained.

Category 2: Attaining some of the designated uses; no use is threatened; and insufficient or no data and information are available to determine if the remaining uses are attained or threatened. This category consists of those waterbody assessment units where at least one of the applicable use support categories are rated " Supporting" and the other use support categories are rated "Not Rated" or “No Data”. Also included in this category are waters where at least one of the applicable use support categories, except Fish Consumption, are rated "Supporting"; the remaining applicable use support categories, except Fish Consumption, are rated "Not Rated"; and the Fish Consumption category is rated "Impaired-Evaluated". Data and information are available to support a

determination that some, but not all, uses are attained. Attainment status of the remaining uses is unknown because there are insufficient or no data or information. Future monitoring data will be used to determine if the uses previously found to be in attainment remain in attainment, and to determine the attainment status of those uses for which data and information were previously insufficient to make a determination.

Category 3: Insufficient or no data and information to determine if any designated use is attained. This category consists of those waterbody assessment units where all applicable use support categories, except Fish Consumption, are rated "Not Rated", and the Fish Consumption category is rated "Impaired-Evaluated". Measured data or information to support an attainment determination for any use are not available. Supplementary data and information, or future monitoring, will be required to assess the attainment status.

Category 4: Impaired or threatened for one or more designated uses but does not require the development of a TMDL. This category contains three distinct sub-categories:

> **Category 4a: TMDL has been completed**. This category consists of those waterbody assessment units for which EPA has approved or established a TMDL and water quality standards have not yet been achieved. Monitoring data will be considered before moving an assessment unit from Category 4a to Categories 1 or 2.
>
> **Category 4b: Other pollution control requirements are reasonably expected to result in the attainment of the water quality standard in the near future**. This category consists of those waterbody assessment units for which TMDLs will not be attempted because other required regulatory controls (e.g., NPDES permit limits, Stormwater Program rules, etc.) are expected to attain water quality standards within a reasonable amount of time. Future monitoring will be used to verify that the water quality standard is attained as expected.
>
> **Category 4c: Impairment is not caused by a pollutant**. This category consists of assessment units that are Impaired by pollution, not by a pollutant. EPA defines pollution as "The man-made or man-induced alteration of the chemical, physical, biological and radiological integrity of the water." EPA staff have verbally stated that this category is intended to be used for impairments related to water control structures (i.e., dams). Future monitoring will be used to confirm that there continues to be an absence of pollutant-caused impairment and to support water quality management actions necessary to address the cause(s) of the impairment.

Category 5: Impaired for one or more designated uses by a pollutant(s) and requires a TMDL. This category consists of those waterbody assessment units that are Impaired by a pollutant and the proper technical conditions exist to develop TMDLs. As defined by the EPA, the term pollutant means "dredged spoil, solid waste, incinerator residue, sewage, garbage, sewage sludge, munitions, chemical wastes, biological materials, radioactive materials, heat, wrecked or discarded equipment, rock, sand, cellar dirt and industrial, municipal, and agricultural waste discharged into the water." When

more than one pollutant is associated with the impairment of a single waterbody assessment unit in this category, the assessment unit will remain in Category 5 until TMDLs for all listed pollutants have been completed and approved by the EPA.

Category 6: Impaired based on biological data. This category consists of waterbody assessment units historically referred to as "Biologically Impaired" waterbodies; these assessment units have no identified cause(s) of impairment although aquatic life impacts have been documented. The waterbody assessment unit will remain in Category 6 until TMDLs have been completed and approved by the EPA.

Category 7: Impaired, but the proper technical conditions do not yet exist to develop a TMDL. As described in the Federal Register, "proper technical conditions" refer to the availability of the analytical methods, modeling techniques and data base necessary to develop a technically defensible TMDL. These elements will vary in their level of sophistication depending on the nature of the pollutant and characteristics of the segment in question" (43 FR 60662, December 28, 1978). These are assessment units that would otherwise be in Category 5 of the integrated list. As previously noted, EPA has recognized that in some specific situations the data, analyses or models are not available to establish a TMDL. North Carolina seeks EPA technical guidance in developing technically defensible TMDLs for these waters. Open water and ocean hydrology fecal coliform Impaired shellfishing waters are included in this category.

For this integrated list, Categories 1 and 2 are considered fully supporting any assessed uses. This portion of the integrated list is extensive (thousands of segments); thus, a printed copy is not provided. A table of waters on Categories 1 through 3 is available for downloading on the DWQ website (http://h2o.enr.state.nc.us/tmdl/General_303d.htm). *Categories 5, 6 and 7 constitute the 2004 North Carolina 303(d) List for the State of North Carolina.*

Delisting Waters

In general, waters will move from Categories 5, 6 or 7 when data show that uses are fully supported or when a TMDL has been approved by EPA. In some cases, mistakes have been discovered in the original listing decision and the mistakes are being corrected. Waters appearing on the previously approved Impaired waters list will be moved to Categories 1, 2, 3 or 4 under the following circumstances:

- An updated 305(b) use support rating of Supporting, as described in the basinwide management plans.
- Applicable water quality standards are being met (i.e., no longer Impaired for a given pollutant) as described in either basinwide management plans or in technical memoranda.
- The basis for putting the water on the list is determined to be invalid (i.e., was mistakenly identified as Impaired in accordance with 40 CFR 130.7(b)(6)(iv) and/or *National Clarifying Guidance for State and Territory 1998 Section 303(d) Listing Decisions*. Robert Wayland, III, Director. Office of Wetlands, Oceans and Watersheds. Aug 27, 1997).
- A water quality variance has been issued for a specific standard (e.g., chloride).
- Removal of fish consumption advisories or modification of fish eating advice.
- Typographic listing mistakes (i.e., the wrong water was identified).
- EPA has approved a TMDL.

Scheduling TMDLs

Category 5 waters, those for which a TMDL is needed, are at many different stages on the path to an approved TMDL. Some require additional data collection to adequately define the problem in TMDL terms. Some require more outreach to increase stakeholder involvement. Others need to have a technical strategy budgeted, funded and scheduled. Some are ready for EPA submittal.

North Carolina has prioritized TMDL development for waters Impaired due to bacteria or turbidity. The approach of prioritizing TMDL development based on pollutant has been successfully used in other states. Limited resources are used more effectively with a focus on a particular pollutant. Waters Impaired by other pollutants (i.e., not bacteria) are not excluded from the schedule. However, the majority of waters prioritized for the next few years are associated with bacterial contamination. Compliance with TMDL development schedules provided in the Integrated Report depends upon DWQ and EPA resources.

North Carolina uses biological data to place the majority of waterbody assessment units on the 303(d) list. Additional consideration and data collection are necessary if the establishment of a TMDL for waters on Category 6 is to be expected. It is important to understand that the identification of waters in Category 6 does not mean that they are low priority waters. The assessment of these waters is a high priority for the State of North Carolina. However, it may take significant resources and time to determine the environmental stressors and potentially a cause of impairment. Assigning waters to Category 6 is a declaration of the need for more data and time to adequately define the problems and whether pollution, pollutants or a combination affects waters.

According to EPA guidance (EPA 2004), prioritization of waterbody assessment units for TMDLs need not be reflected in a "high, medium or low" manner. Instead, prioritization can be reflected in the TMDL development schedule. Generally, North Carolina attempts to develop TMDLs within 10 years of the original pollutant listing. Other information for each assessment unit is also utilized to determine the priority in the TMDL development schedule. This information includes the following:

- Year listed. Assessment units that have been on the 303(d) list for the longest period of time will receive priority for TMDL development and/or stressor studies.
- Reason for listing. (Applicable to Category 5 AUs only.) AUs with an impairment due to a standard violation will be prioritized based on which standard was violated. Standard violations due to bacteria or turbidity currently receive priority for TMDL development.
- Classification. AUs classified for primary recreation (Class B), water supply (Class WS-I through WS-V), trout (Tr), high quality waters (HQW), and outstanding resource waters (ORW) will continue to receive a higher priority for TMDL development and/or stressor studies.
- Basinwide Planning Schedule. (Applicable to Category 6 AUs only.). The basinwide schedule is utilized to establish priority for stressor studies.

Revising TMDLs

Current federal regulations do not specify when TMDLs should be revised. However, there are several circumstances under which it would seem prudent to revisit existing TMDLs. The TMDL analysis of targets and allocations is based upon the existing water quality standards, hydrology, water quality data (chemical and biological), and existing, active NPDES wastewater discharges. Conditions related to any of these factors could be used to justify a TMDL revision. Specific conditions that the Division will consider prior to revising an existing, approved TMDL include the following:

- A TMDL has been fully implemented and the water quality standards continue to be violated. If a TMDL has been implemented and water quality data indicate no improvement or a decline in overall water quality, the basis for the TMDL reduction or the allocation may need to be revised.
- A change of a water quality standard (e.g., fecal coliform to *Echerichia coli*). The Division will prioritize review of existing TMDLs and data to determine if a revision to TMDLs will be required.
- The addition or removal of hydraulic structures to a waterbody (e.g., dams). Substantial changes to waterbody hydrology and hydraulics have the potential to change many aspects of target setting, including the water quality standard upon which the TMDL was developed, the water quality data, and the water quality modeling.
- Incorrect assumptions were used to derive the TMDL allocations. This would include errors in calculations and omission of a permitted discharge.

Should a TMDL be revised due to needed changes in TMDL targets, the entire TMDL would be revised. This includes the TMDL target, source assessment, and load and wasteload allocations. However, the Division may elect to revise only specific portions of the TMDL. For example, changes may be justifiable to the load and wasteload allocation portions of a TMDL due to incorrect calculations or inequities. In these cases, revisions to the TMDL allocations would not necessarily include a revision of TMDL targets.

Appendix VIII

Cape Fear River Basin
Nonpoint Source Program
Description and Contacts

Statewide Nonpoint Source Management Program Description

The North Carolina Nonpoint Source Management Program consists of a broad framework of federal, state and local resource and land management agencies. More than 2,000 individuals administer programs that are directly related to nonpoint source pollution management within the state. A range of responsibilities have been delegated to county or municipal programs including the authority to inspect and permit land clearing projects or septic system performance. In the field of agriculture, a well-established network of state and federal agricultural conservationists provide technical assistance and program support to individual farmers.

Staff in the DWQ Water Quality Section's Planning Branch lead the Nonpoint Source Management Program, working with various agencies to insure that program goals are incorporated into individual agencies' management plans. The goals include:

- Coordinate implementation of state and federal initiatives addressing watershed protection and restoration.
- Continue to target geographic areas and waterbodies for protection based upon best available information.
- Strengthen and improve existing nonpoint source management programs.
- Develop new programs that control nonpoint sources of pollution not addressed by existing programs.
- Integrate the NPS Program with other state programs and management studies (e.g., Albemarle-Pamlico National Estuary Program).
- Monitor the effectiveness of BMPs and management strategies, both for surface and groundwater quality.

Coordination between state agencies is achieved through reports in the *North Carolina Nonpoint Source Management Program Update*. Reports are intended to keep the program document current and develop a comprehensive assessment identifying the needs of each agency to meet the state nonpoint source program goals. Annual reports are developed to describe individual program priorities, accomplishments, significant challenges, issues yet to be addressed, and resource needs. A copy of the latest Annual Report (FY1998) is available online: http://h2o.enr.state.nc.us/nps/nps_mp.htm.

The nature of nonpoint source pollution is such that involvement at the local level is imperative. Basinwide Water Quality Plans identify watersheds that are impaired by nonpoint sources of pollution. Identification, status reports and recommendations are intended to provide the best available information to local groups and agencies interested in improving water quality. The plans also make available information regarding federal, state and local water quality initiatives aimed at reducing or preventing nonpoint source pollution.

The following table is a comprehensive guide to contacts within the state's Nonpoint Source Management Program. For more information, contact Rich Gannon at (919) 733-5083 ext. 356.

Cape Fear River Basin Nonpoint Source Program Descriptions and Contacts

Agriculture

USDA Natural Resources Conservation Service:

Part of the US Department of Agriculture, formerly the Soil Conservation Service. Technical specialists certify waste management plans for animal operations; provide certification training for swine waste applicators; work with landowners on private lands to conserve natural resources, helping farmers and ranchers develop conservation systems unique to their land and needs; administer several federal agricultural cost share and incentive programs; provide assistance to rural and urban communities to reduce erosion, conserve and protect water, and solve other resource problems; conduct soil surveys; offer planning assistance for local landowners to install best management practices; and offer farmers technical assistance on wetlands identification.

Area 2 Conservationist	Michael E. Sugg	704-637-2400	600 West Innes Street, Salisbury NC 28144
Area 3 Conservationist	William J. Harrell	919-751-0976	Cashwell Office Park, 208 Malloy Street, Suite C, Goldsboro NC 27534
County	**District Conservationist**	**Phone**	**Address**
Alamance	Joseph R. Bailey	336-226-0477	Environmental Center, 209 North Graham Hopedale Road, Burlington NC 27215 (Burlington Field Office)
Bladen	Christopher W. Bordeaux	910-862-3179 x3	Agriculture Service Center, Room 122, Ice Plant Road, Elizabethtown NC 28337-9409
Brunswick		910-253-2830	10 Referendum Drive, PO Box 26, Bolivia NC 28422-0026
Caswell	Warren H. Mincey, Jr.	910-694-4581	Agriculture Building, 126 Court Square, PO Box 96, Yanceyville NC 27379
Chatham	Michael W. Sturdivant	919-542-2244	Chatham County Agriculture Building, 45 South Street, PO Box 309, Pittsboro NC 27312
Columbus	Donna G. Register	910-642-2196	45 Government Complex Road, Suite B, PO Box 545, Whiteville NC 28472-0545
Cumberland	John M. Ray, Jr.	910-484-8939	Charlie Rose Agri-Expo Center, Suite 229, 121 East Mountain Drive, Fayetteville NC 28306-3422
Duplin	Eric W. West	910-296-2120	Duplin County Soil Conservation Building, 105 East Hill Street, PO Box 219, Kenansville NC 28349-0219
Durham	E. Brent Bogue	919-644-1079 x3	County Planning/Agriculture Center, 306D Revere Road, PO Box 8181, Hillsborough NC 27278 (Hillsborough Field Office)
Forsyth	Randy Blackwood	336-767-0720	Forsyth Agriculture Building, 1450 Fairchild Drive, Winston-Salem NC 27105
Guilford	F. Gary Cox	336-333-5401 x3	County Agriculture Center, 3309 Burlington Road, Greensboro NC 27405
Harnett	Parks V. Blake	910-893-7584	County Office Building, 108 East Front Street, PO Box 267, Lillington NC 27546-9998
Hoke	John M. Ray, Jr.	910-484-8939	Charlie Rose Agri-Expo Center, Suite 229, 121 East Mountain Drive, Fayetteville NC 28306-3422 (Fayetteville FO)
Johnston	William D. Radford	919-934-7156 x3	County Agriculture Building, 806 North Street, Smithfield NC 27577
Lee	Darrly E. Harrington	919-776-2633	2410 Tramway Road, Sanford NC 27332-9174
Montgomery		910-572-2700	2270 North Main Street, Troy NC 27371
Moore	Jeffrey K. Williams	910-947-5183	County Agriculture Center, 707 Pinehurst Avenue, PO Box 908, Carthage NC 28327
New Hanover	Adrian Moon	910-798-6032	New Hanover SWCD, County Admin. Annex, 230 Marketplace Drive, Suite 100, Wilmington NC 28403

Agriculture (con't)			
Onslow	Carl G. Kirby, Sr.	910-455-4472 x3	Ag Center Complex, 4028 Richlands Hwy., Jacksonville NC 28640
Orange	E. Brent Bogue	919-644-1079 x3	County Planning/Agriculture Center, 306-D Revere Road, PO Box 8181, Hillsborough NC 27278 (Hillsborough Field Office)
Pender	Adrian Moon	910-798-6032	County Administration Annex, New Hanover SWCD, 230 Marketplace Drive, Wilmington NC 28403 (Wilmington Field Office)
Randolph	B. Barton Roberson	336-629-4449	Federal Building, 241 Sunset Avenue, Room 105, Asheboro NC 27203
Robeson	Dana Ashford	910-739-5478	County Office Bldg., 440-A Caton Road, Lumberton NC 28358
Rockingham	Harvey Campbell	336-342-0460 x3	Rockingham Agriculture Center, 525 NC 65, Suite 100, Reidsville NC 27320-8861
Sampson	Samuel Warren	910-592-7963 x3	New Agriculture Building, 84 County Complex Road, Clinton NC 28328-4727
Wake	Stephen C. Woodruff	919-250-1070	Agriculture Services Building, 4001-D Carya Drive, Raleigh NC 27610
Wayne	Patricia S. Gabriel	919-734-5281	Wayne Center, Room 104, 208 West Chestnut Street, Goldsboro NC 27530

Soil & Water Conservation Districts:

Boards and staff under the administration of the NC Soil and Water Conservation Commission (SWCC). Districts are responsible for: administering the *Agricultural Cost Share Program for Nonpoint Source Pollution Control* at the county level; identifying areas needing soil and/or water conservation treatment; allocating cost share resources; signing cost share contracts with landowners; providing technical assistance for the planning and implementation of BMPs; and encouraging the use of appropriate BMPs to protect water quality.

County	Phone	Address
Alamance	336-226-0477	PO Box 3185, Burlington, NC 27215-0185
Bladen	910-862-3179	122 Agriculture Services Center, Elizabethtown NC 28337
Brunswick	910-253-4448	10 Referendum Drive, PO Box 26, Bolivia NC 28422
Caswell	336-694-4581	Agriculture Building, PO Box 96, Yanceyville NC 27379
Chatham	919-542-8240	PO Box 309, Pittsboro NC 27312
Columbus	910-642-2348	PO Box 545, Whiteville NC 28472-0545
Cumberland	910-484-8479	Agri-Expo Center, 121 East Mountain Drive, Suite 229 Fayetteville, NC 28306-3422
Duplin	910-296-2120	PO Box 277, 302 North Main Street, Kenansville NC 28349
Durham	919-560-0558	721 Foster Street, Durham NC 27701-2110
Forsyth	336-767-0720	1450 Fairchild Drive, Room 11, Winston-Salem NC 27105
Guilford	336-375-5401	3309 Burlington Road, Greensboro NC 27405
Harnett	910-893-7584	PO Box 267, Lillington NC 27546
Hoke	910-875-8685	Federal Building, Room 202, 122 West Elwood Avenue, Raeford NC 28376-2800
Johnston	919-989-5381	County Agriculture Building, 806 North Street, Smithfield NC 27577
Lee	919-776-2633	225 South Steele Street, Sanford NC 27330
Montgomery	910-572-2700	227-D North Main Street, Troy NC 27371
Moore	910-947-5183	PO Box 908, 707 Pinehurst Avenue, Carthage NC 28327
New Hanover	910-762-6072	414 Chestnut Street, Room 305, Wilmington NC 28401

Soil and Water Conservation Districts (con't)			
Onslow		910-455-4472	Donald A. Halsey Agriculture Building, 604 College Street, Jacksonville NC 28540
Orange		919-644-1079	PO Box 8181, Hillsborough NC 27278
Pender		910-259-4305	PO Box 248, 801 South Walker Street, Burgaw NC 28425
Randolph		336-318-6490	Federal Building, Suite 105, 241 Sunset Avenue, Asheboro NC 27203
Robeson		910-739-5478	440 Caton Road, Lumberton NC 28358
Rockingham		336-342-8225	PO Box 201, Wentworth NC 27375-0201
Sampson		910-592-7963	84 County Complex Road, Clinton NC 28328
Wake		919-250-1070	4001-D Carya Drive, Raleigh NC 27610-2921
Wayne		919-731-1532	Wayne Center, Room 104, 208 West Chestnut Street, Goldsboro NC 27530-4708

Division of Soil and Water Conservation:

State agency that administers the *Agricultural Cost Share Program for Nonpoint Source Pollution Control* (ACSP). Allocates ACSP funds to the Soil & Water Conservation Districts; and provides administrative and technical assistance related to soil science and engineering. Distributes Wetlands Inventory maps for a small fee.

Central Office	Carroll Pierce	919-715-6110	512 North Salisbury Street, Raleigh NC 27604
Fayetteville Region	Jamie Revels	910-486-1541	225 Green Street, Suite 714, Fayetteville NC 28301
Raleigh Region	Margaret O'Keefe	919-571-4700	3800 Barrett Drive, Raleigh NC 27609
Wilmington Region	Brian Gannon	910-395-3900	127 Cardinal Drive Extension, Wilmington NC 28405-3845
Winston-Salem Region	Daphne Cartner	336-771-4600	585 Waughtown Street, Winston Salem NC 27107

NCDA Regional Agronomists:

The NC Department of Agriculture technical specialists: certify waste management plans for animal operations; provide certification training for swine waste applicators; track, monitor and account for use of nutrients on agricultural lands; operate the state *Pesticide Disposal Program*; and enforce the state pesticide handling and application laws with farmers.

Central Office	Kent Messick	919-733-2655	402 Willowbrook Drive, Cary NC 27511
Region 4	Tim Hall	910-324-9924	PO Box 444, Richlands NC 28574-0444
Region 5	Rick Morris	910-866-5485	3184 Old NC 41, Bladenboro NC 28320
Region 7	Kevin Johnson	919-736-1799	PO Box 890, Pikeville NC 27863
Region 8	Robin Watson	336-570-6850	1709 Fairview Street, Burlington NC 27215
Region 9	David Dycus	919-776-9338	39966 Center Church Road, Sanford NC 27330
Region 10	Tim Hambrick	336-386-4602	611 Gillespie Street, Dobson NC 27017

Education

NC Cooperative Extension Service:
Provides practical, research-based information and programs to help individuals, families, farms, businesses and communities.

County	Contact Person	Phone	Address
Alamance	Junius E. "Rett" Davis Jr.	336-570-6740	209-C North Graham-Hopedale Road, Burlington NC 27217
Bladen	Kent Wooten	910-862-4591	450 Smith Circle Drive, Elizabethtown NC 28337
Brunswick	Martha Warner	910-253-2610	Brunswick County Government Complex, 25 Referendum Drive, PO Box 109, Bolivia NC 28422
Caswell	Joey E. Knight, III	336-694-4158	126 Court Square, PO Box 220 Yanceyville NC 27379-0220
Chatham	Glenn Woolard	919-542-8202	45 South Street, PO Box 279, Pittsboro NC 27312
Columbus	Jacqueline D. Roseboro	910-640-6605	Columbus County Center, 45 Government Complex Road, Suite A, PO Box 569, Whiteville NC 28472
Cumberland	George Autry	910-484-7156	Charlie Rose Agri-Expo Center, 301 East Mountain Drive, PO Box 270, Fayetteville NC 28306
Duplin	Ed Emory	910-296-2143	103 Duplin Street, PO Box 949, Kenansville NC 28349
Durham	Cheryl L. Lloyd	919-560-0524	Agricultural Building, 721 Foster Street, Durham NC 27701
Forsyth	Mark Tucker	336-767-8213	1450 Fairchild Drive, Winston-Salem NC 27105
Guilford	Brenda Morris	336-375-5876	3309 Burlington Road, Greensboro NC 27405-7605
Harnett	Jennifer S. Walker	910-893-7530	PO Box 1089, 102 East Front Street, Lillington NC 27546
Hoke	Clinton A. McRae	910-875-3461	116 West Prospect Avenue, PO Box 578, Raeford NC 28376
Johnston	Kenneth R. Bateman	919-989-5380	Agricultural Center, 806 North Street, Smithfield NC 27577
Lee	Susan C. Condlin	919-775-5624	2420 Tramway Road, Sanford NC 27332-9174
Montgomery	Roger K. Galloway	910-576-6011	203 West Main Street, Troy NC 27371
Moore	Bert Coffer	910-947-3188	707 Pinehurst Avenue, Suite 105, Carthage NC 28327
New Hanover	Melissa Hight	910-452-6393	New Hanover County Center, 6206 Oleander Drive, Wilmington NC 28403
Onslow	Peggie Garner	910-455-5873	Onslow County Center, 4024 Richlands Highway, Jacksonville NC 28540
Orange	Fletcher Barber, Jr.	919-732-8181	306-E Revere Road, PO Box 8181, Hillsborough NC 27278
Pender	Wayne Batten	910-259-1235	Agricultural Building, 801 South Walker Street, Burgaw NC 28425
Randolph	Carolyn Langley	336-318-6000	Ira L. McDowell Center, 2222-A Fayetteville Street, Asheboro NC 27203
Robeson	Everett Davis	910-671-3276	455 Caton Road, PO Box 2280, Lumberton NC 28359
Rockingham	Scott Shoulars	336-342-8230	Rockingham County Center, PO Box 200, Wentworth NC 27375-0200
Sampson	George P. Upton	910-592-7161	Sampson County Center, 369 Rowan Road, Clinton NC 28328
Wake	Brent Henry	919-250-1100	Wake County Center, 4001-E Carya Drive, Raleigh NC 27610
Wayne	Howard Scott	919-731-1520	Wayne County Center, 208 West Chestnut Street, PO Box 68 Goldsboro NC 27533-0068

Forestry

Division of Forest Resources:
Develop, protect and manage the multiple resources of North Carolina's forests through professional stewardship, enhancing the quality of our citizens while ensuring the continuity of these vital resources.

Districts 3,5,6,8,10,11	Mike Hendricks	919-542-1515	3490 Big Woods Road, Chapel Hill NC 27514-7652
Central Office	Bill Swartley	919-733-2162	1616 Mail Service Center, Raleigh NC 27699-1616

Construction/Mining

DENR Division of Land Resources:
Administers the NC Erosion and Sedimentation Control Program for construction and mining operations. Conducts land surveys and studies, produces maps, and protects the state's land and mineral resources.

Central Office	Mel Nevills	919-733-4574	512 North Salisbury Street, Raleigh NC 27626
Fayetteville Region	Gerald Lee	910-486-1541	225 Green Street, Suite 714, Fayetteville NC 28301
Raleigh Region	John Holley	919-571-4700	3800 Barrett Drive, Raleigh NC 27609
Wilmington Region	Dan Sams	910-395-3900	127 Cardinal Drive Extension, Wilmington NC 28405-3845
Winston-Salem Region	Mathew Gantt	336-771-4600	585 Waughtown Street, Winston-Salem NC 27107

Local Erosion and Sedimentation Control Ordinances:
Several local governments in the basin have qualified to administer their own erosion and sedimentation control ordinances.

Town of Apex	Robert (Rocky) Ross	919-249-3397	PO Box 250, Apex, NC 27502
City of Asheboro	Bobby Kevitt	336-626-1234	146 North Church Street, PO Box 1106, Asheboro NC 27204
City of Burlington	Robert C. Patterson, Jr., P.E.	336-222-5050	PO Box 1358, Burlington NC 27215
Town of Chapel Hill	W. Calvin Horton George Small	919-968-2700	306 North Columbia Street, Chapel Hill NC 27514-3699
Durham/ Durham County	Bill Noyes	919-560-0735	120 East Parrish Street, Suite 100, Durham NC 27701
Forsyth County/ Winston-Salem	Jeff Kopf	336-727-2388	100 East First Street, Suite 328 Winston Salem NC 27101
City of Greensboro	Ken Cook	336-373-2158	PO Box 3136, Greensboro NC 27402-3136
Guilford County	Earl Davis	336-373-3803	PO Box 3427, Greensboro NC 27402
City of High Point	Brian Sullivan	336-883-3199	PO Box 230, High Point NC 27261
New Hanover County	Beth Easley	910-341-7139	414 Chestnut Street, Wilmington NC 28401
Orange County/ Chapel Hill	Ren Ivins	919-732-8181	PO Box 8181, Hillsborough NC 27278
Southern Pines	BB Teague/AH Davis Jr.	910-692-1983	140 Memorial Park Court, Southern Pines NC 28387
Wake County	Lee R. Squires	(919) 856-6194	PO Box 550, Raleigh NC 27602

General Water Quality

DWQ Planning Section:

Coordinate the numerous nonpoint source programs carried out by many agencies; coordinate the Neuse and Tar-Pamlico River Nutrient Sensitive Waters Strategies; administer the Section 319 grants program statewide; model water quality; and conduct water quality classifications and standards activities.

Planning Section Supervisor	Alan Clark	919-733-5083 x570	1617 Mail Service Center, Raleigh, NC 27699-1617
Modeling	Michelle Woolfolk	919-733-5083 x505	1617 Mail Service Center, Raleigh, NC 27699-1617
Classific'ns & Standards	Jeff Manning	919-733-5083 x579	1617 Mail Service Center, Raleigh, NC 27699-1617
NPS & Section 319	Rich Gannon	919-733-5083 x356	1617 Mail Service Center, Raleigh, NC 27699-1617
Basinwide Planning	Darlene Kucken	919-733-5083 x354	1617 Mail Service Center, Raleigh, NC 27699-1617
Groundwater Planning	Carl Bailey	919-733-5083 x522	1617 Mail Service Center, Raleigh, NC 27699-1617
Monitoring	Jimmie Overton	919-733-9960 x204	1621 Mail Service Center, Raleigh, NC 27699-1621

DWQ Surface Water Protection Section:

Conduct permitting and compliance in accordance with the federal National Pollutant Discharge Elimination System (NPDES); regulate sewage collection systems; control and document discharge of wastewater; oversight of the wetlands 401 certification program; nonpoint source compliance; and stormwater permitting.

Point Source	Dave Goodrich	919-733-5083 x517	1617 Mail Service Center, Raleigh, NC 27699-1617
NPDES (Western)	Susan Wilson	919-733-5083 x510	1617 Mail Service Center, Raleigh, NC 27699-1617
NPDES (Eastern)	Gil Vinzani	919-733-5083 x540	1617 Mail Service Center, Raleigh, NC 27699-1617
PERCS Supervisor	Jeff Poupart	919-733-5083 x527	1617 Mail Service Center, Raleigh, NC 27699-1617
Wetlands and Stormwater			
Program & Policy Development	John Dorney	919-733-9646	1650 Mail Service Center, Raleigh, NC 27699-1650
Transportation Permitting	John Hennessy	919-733-5694	1650 Mail Service Center, Raleigh, NC 27699-1650
401 Oversight/Express Permitting	Cyndi Karoly	919-733-9721	1650 Mail Service Center, Raleigh, NC 27699-1650
NPS Compliance	Danny Smith	919-733-7015	1650 Mail Service Center, Raleigh, NC 27699-1650
Stormwater Permitting	Bradley Bennett	919-733-5083 x525	1617 Mail Service Center, Raleigh, NC 27699-1617

DWQ Aquifer Protection Section:

Oversight of animal waste systems; characterizes the state's groundwater aquifers; investigates contamination cases; prevents and investigates groundwater contamination; conducts remediation permitting; oversees nondischarge wastewater treatment and recycle systems.

Animal Operations	Paul Sherman	919-715-6697	1636 Mail Service Center, Raleigh, NC 27699-1636
Groundwater Protection	Debra Watts	919-715-6699	1636 Mail Service Center, Raleigh, NC 27699-1636
Land Application	Kim Colson	919-715-6165	1636 Mail Service Center, Raleigh, NC 27699-1636

DWQ Regional Offices:

Conduct permitting and enforcement field work on point sources, stormwater, wetlands and animal operations; conduct enforcement on water quality violations of any kind; and perform ambient water quality monitoring.

Fayetteville	Belinda Hinson	910-486-1541	225 Green Street, Fayetteville NC 28301
Raleigh	Ken Schuster	919-571-4700	3800 Barrett Drive, Raleigh NC 27609
Wilmington	Ed Beck	910-395-3900	127 Cardinal Drive Extension, Wilmington NC 28405-2845
Winston-Salem	Steve Tedder	336-771-4600	585 Waughtown Street, Winston Salem NC 27107

Wildlife Resources Commission:

To manage, restore, develop, cultivate, conserve, protect and regulate the wildlife resources of the state; and to administer the laws enacted by the General Assembly relating to game, game and non-game freshwater fishes, and other wildlife resources in a sound, constructive, comprehensive, continuing and economical manner.

Central Office	Frank McBride	919-528-9886	PO Box 118, Northside NC 27564

US Army Corps of Engineers:

Responsible for: investigating, developing and maintaining the nation's water and related environmental resources; constructing and operating projects for navigation, flood control, major drainage, shore and beach restoration and protection; hydropower development; water supply; water quality control, fish and wildlife conservation and enhancement, and outdoor recreation; responding to emergency relief activities directed by other federal agencies; and administering laws for the protection and preservation of navigable waters, emergency flood control and shore protection. Responsible for wetlands and 404 Federal Permits.

Ask for the project manager covering your county.

Wilmington Field Office	Keith Harris	910-251-4511	PO Box 1890, Wilmington NC 28402-1890
Raleigh Field Office	Jean Manuele	919-876-8441	6508 Falls of the Neuse Road, Suite 120, Raleigh NC 27615

Solid Waste

DENR Division of Waste Management:

Management of solid waste in a way that protects public health and the environment. The Division includes three sections and one program -- Hazardous Waste, Solid Waste, Superfund and the Resident Inspectors program.

Central Office	Brad Atkinson	919-733-0692	401 Oberlin Road, Suite 150, Raleigh NC 27605

On-Site Wastewater Treatment

Division of Environmental Health and County Health Departments:

Safeguard life, promote human health, and protect the environment through the practice of modern environmental health science, the use of technology, rules, public education, and above all, dedication to the public trust.
Services include:

- Training of and delegation of authority to local environmental health specialists concerning on-site wastewater.
- Engineering review of plans and specifications for wastewater systems 3,000 gallons or larger and industrial process wastewater systems designed to discharge below the ground surface.
- Technical assistance to local health departments, other state agencies, and industry on soil suitability and other site considerations for on-site wastewater systems.

Central Office	Steve Steinbeck	919-715-3273	2728 Capital Boulevard, Raleigh NC 27604
Fayetteville Region	Andrew McCall	910-486-1541	Wachovia Building, Suite 714, Fayetteville NC 28301
Raleigh Region	Boyce Hudson	919-571-4700	3800 Barrett Drive, Raleigh NC 27609
Wilmington Region	Andrew McCall	252-395-3800	127 Cardinal Drive Extension, Wilmington NC 28401
Winston-Salem Region		336-771-4600	585 Waughtown Street, Winston Salem NC 27107-2241

County	Primary Contact	Phone	Address
Alamance	Tim Green	336-227-0101	319 North Graham-Hopedale Road, Suite B, Burlington NC 27217
Bladen	Myra Johnson	910-862-6900	PO Box 189, Elizabethtown NC 28337
Brunswick	Donald J, Yousey	888-428-4429	25 Courthouse Drive, PO Box 9, Bolivia NC 28422
Caswell	Fred Moore	336-694-4129	189 County Park Road, PO Box 1238, Yanceyville NC 27379
Chatham	Dorothy Cilenti	919-542-8214	80 East Street, PO Box 130, Pittsboro NC 27312
Columbus	Marian W. Duncan	910-641-3914	Miller Building, PO Box 810, Whiteville NC 28472

On-Site Wastewater Treatment (con't)			
County	**Primary Contact**	**Phone**	**Address**
Cumberland	Wayne Raynor	910-433-3700	227 Fountainhead Lane, Fayetteville NC 28301
Duplin	Illa Davis	910-296-2130	340 Seminary Street, PO Box 948, Kenansville NC 28349
Durham	Brian Letourneau	919-560-7600	414 East Main Street, Durham, NC 27701
Forsyth	Dr. Tim Monroe	336-703-3101	799 Highland Avenue, PO Box 686,Winston-Salem NC 27102-0686
Guilford	Dr. Ramesh Krishnaraj	336-641-3283	1203 Maple Street, Greensboro NC 27405
Harnett	John Rouse, Jr.	910-893-7550	307 Cornelius Harnett Boulevard, Lillington NC 27546
Hoke	Cynthia Oxendine	910-875-3717	429 East Central Avenue, Raeford NC 28376
Johnston	L. S. Woodall, M. D.	919-989-5180	517 North Bright Leaf Boulevard, Smithfield NC 27577
Lee	Mike Hanes	919-718-4641	106 Hillcrest Drive, PO Box 1528, Sanford NC 27331-1528
Montgomery	Kathleen D. Jones	910-572-1393	217 South Main Street, Troy NC 27371
Moore	Robert R. Whittmann	910-947-3300	705 Pinehurst Avenue, Box 279, Carthage NC 28327
New Hanover	David E. Rice	910-343-6591	2029 South 17th Street, Wilmington, NC 28401
Onslow	George O'Daniel	910-347-7042	612 College Street, Jacksonville NC 28540
Orange	Dr. Rosemary Summers	919-245-2411	PO Box 8181, Hillsborough NC 27278
Pender	Jack Griffith, Ph. D.	910-259-1328	803 West Walker Street, PO Box 1209, Burgaw NC 28425
Randolph	Mary M. Cooper	336-318-6217	2222-B South Fayetteville Street, Asheboro NC 27203
Robeson	William J. Smith	910-671-3200	460 Country Club Road, Lumberton, NC 28360
Rockingham	Glenn L. Martin	336-342-8132	PO Box 204, Wentworth NC 27375
Sampson	Wanda Robinson	910-592-1131	360 County Complex Road, Clinton NC 28328
Wake	Richard K. Rowe	919-856-7444	336 Fayetteville Street, Raleigh NC 27602
Wayne	Jim Roosen	919-731-1000	310 North Herman Street, Box CC, Goldsboro NC 27530

- **DENR Fayetteville Region Office covers the following counties:** Anson, Bladen, Cumberland, Harnett, Hoke, Montgomery, Moore, Richmond, Robeson, Sampson and Scotland.
- **DENR Raleigh Region Office covers the following counties:** Chatham, Durham, Edgecombe, Franklin, Granville, Halifax, Johnston, Lee, Nash, Northampton, Orange, Person, Vance, Wake, Warren and Wilson.
- **DENR Winston-Salem Region Office covers the following counties:** Alamance, Alleghany, Ashe, Caswell, Davidson, Davie, Forsyth, Guilford, Randolph, Rockingham, Stokes, Surry, Watauga, Wilkes and Yadkin.
- **DENR Wilmington Region Office covers the following counties:** Brunswick, Columbus, Duplin, New Hanover, Onslow and Pender.

Appendix IX

Cape Fear River Basin
Workshop Summaries

Pittsboro Issues and Problem Areas 5-27-2004 38 attended

Runoff related to road construction along 15-501 corridor	03-06-04
Subdivision development off Willis Road	03-06-04
Algal Production in Upper Jordan Lake	03-06-05
Land Clearing too close to stream on Fire Tower Road	03-06-04
Finding preservation sites on Haw River Tributaries	03-06-04
Chatham County ordinances and sediment and erosion control	
Algal growth in the Rocky River	03-06-12
Erosion in tributaries of Robeson Creek	03-06-04

Pittsboro Recommendations

Need for increased interagency cooperation
Lack of enforcement of private wastewater plants
Preservation of farmland in Chatham County
Recommend 100' buffers in CPF basin
Remove direct stormwater discharges
Improve water supply watershed regulations
Improve DLR enforcement habitat
Tax incentives for LID

Greensboro Issues and Problem Areas 5-5-2004 26 attended

Foam noted in Reedy Fork Creek	03-06-02
Severe erosion on North Buffalo Creek	03-06-02
Developments in Little Alamance Creek watershed	03-06-02
Odor at confluence of Haw and Big Alamance Creek	03-06-03

Greensboro Recommendations

Recommend more monitoring
Recommend buffers in CPF basin
Recommend removal of derelict dams on Deep and Haw Rivers
Recommend tax incentives for conservation easements
Bad maintenance of DOT BMPs
Recommend buffers for ephemeral streams
Increase local government officials education
Recommend post construction runoff control

Simplify 319 and CWMTF grant process

Wilmington Issues and Problem Areas 5-20-2004 26 attended

Howe Creek being impacted by sediment from construction	03-06-24
Sand dumping into Burnt Mill Creek	03-06-17
Litter debris in Burnt Mill Creek	03-06-17
Litter debris in Hurst Branch at Maides Park	03-06-17
Aquatic weeds in Greenfield Creek	03-06-17
Development in Hewletts Creek watershed	03-06-24
Heated runoff causing fish kills	03-06-17

Wilmington Recommendations

Train contractors to protect water quality
Make clean marinas program mandatory
Improve interagency coordination
Fund urban cost share program
Require landscaper certification
Increased enforcement of existing regulations
Credit developments that go above regulations
Expand CREP coverage
Increase stormwater BMPs selection
Increase erosion control staff
Increase watershed education in lower grades
Increase mass media about watersheds
Increase non-ag cost share
Mandatory septic system inspections

Clinton Issues and Problem Areas 5-11-2004 16 attended

Snags in Black River at bridge crossing	03-06-20
Plant growth in headwaters of Rockfish Creek	03-06-23
DOT fertilizer use	

Clinton Recommendations

Increase BMP Maintenance

Fayetteville Issues and Problem Areas	**5-11-2004**	**39 attended**	
Whispering Pines lakes monitoring			03-06-15
Chlorophyll *a* monitoring			03-06-15

Fayetteville Recommendations

Increase monitoring of animal operations
Recommend post construction runoff control
Recommend NRCS reevaluate snagging practices

Appendix X

Use Support Methodology
and
Use Support Ratings

Introduction to Use Support

All surface waters of the state are assigned a classification appropriate to the best-intended uses of that water. Waters are assessed to determine how well they are meeting the classified or best-intended uses. The assessment results in a use support rating for the use categories that apply to that water.

Use Support Categories

Beginning in 2000 with the *Roanoke River Basinwide Water Quality Plan*, DWQ assesses ecosystem health and human health risk through the use of five use support categories: aquatic life, recreation, fish consumption, water supply, and shellfish harvesting. These categories are tied to the uses associated with the primary classifications applied to NC rivers and streams. Waters are Supporting if data and information used to assign a use support rating meet the criteria for that use category. If these criteria are not met, then the waters are Impaired. Waters with inconclusive data and information are Not Rated. Waters where no data or information are available to make an assessment are No Data. The table below specifies which use support categories apply to which primary classifications.

A single water may have more than one use support rating corresponding to one or more of the use support categories, as shown in the following table. For many waters, a use support category will not be applicable (N/A) to the classification of that water (e.g., shellfish harvesting is only applied to Class SA waters). A full description of the classifications is available in the DWQ document titled: *Classifications and Water Quality Standards Applicable to Surface Waters of North Carolina* (15A NCAC 2b .0100 and .0200). Information can also be found at http://h2o.enr.state.nc.us/csu/.

Use Support Categories

Primary Classification	Ecosystem Approach	Human Health Approach			
	Aquatic Life	Fish Consumption	Recreation	Water Supply	Shellfish Harvesting
C	X	X	X	N/A	N/A
SC	X	X	X	N/A	N/A
B	X	X	X	N/A	N/A
SB	X	X	X	N/A	N/A
SA	X	X	X	N/A	X
WS I – WS IV	X	X	X	X	N/A

Assessment Period

Data and information are used to assess water quality and assign use support ratings using a five-year data window that ends on August 31 of the year of basinwide biological sampling. For example, if biological data are collected in a basin in 2004, then the five-year data window for

use support assessments would be September 1, 1999 to August 31, 2004. There are occasionally some exceptions to this data window, especially when follow up monitoring is needed to make decisions on samples collected in the last year of the assessment period.

Data and information for assessing water quality and assigning use support ratings for lakes uses a data window of October 1 to September 30. Any data collected by DWQ during the five-year data window that ends on September 30 of the year of biological sampling will be used to develop a Weight-of-Evidence approach to lakes assessment. Refer to page 16 of this appendix for more information.

Assessment Units

DWQ identifies waters by index numbers and assessment unit numbers (AU). The AU is used to track defined stream segments or waterbodies in the water quality assessment database, for the 303(d) Impaired waters list, and in the various tables in basin plans and other water quality documents. The AU is a subset of the DWQ index number (classification identification number). A letter attached to the end of the AU indicates that the AU is smaller than the DWQ index segment. No letter indicates that the AU and the DWQ index segment are the same.

Interpretation of Data and Information

When interpreting the use support ratings, it is important to understand the associated limitations and degree of uncertainty. Although these use support methods are used for analyzing data and information and determining use support ratings, best professional judgment is applied during these assessments. Use support ratings are intended to provide an assessment of water quality using a five-year data window, to describe how well surface waters support their classified uses, and to document the potential stressors contributing to water quality degradation and the sources of these contributions.

Use support methods continue to improve over time, and the information and technology used to make use support determinations also continue to become more accurate and comprehensive. These improvements sometimes make it difficult to make generalizations comparing water quality between basin plans. However, technology and methods improvements result in more scientifically sound use support assessments.

Assessment Methodology

Introduction

Many types of data and information are used to determine use support ratings and to identify stressors and sources of water quality degradation. All existing data pertaining to a stream segment for each applicable use support category are entered into a use support database. Assessments and data entries may include use support ratings for each of the five use support categories, basis of assessment, stressors and potential sources, biological, chemical/physical (ambient monitoring), and lakes assessment data, fish consumption advisories from the NC Department of Health and Human Services, swimming advisories and shellfish sanitation growing area classifications from the NC Division of Environmental Health, and available land

cover and land use information. The following describes the data and methodologies used to conduct use support assessments. These methods will continue to be refined as additional information and technology become available.

Basis of Assessment

Assessments are made on an overall basis of either monitored (M) or evaluated (E), depending on the level of information available. A monitored rating is based on the most recent five-year data window and site-specific data and is therefore treated with more confidence than an evaluated rating.

Rating Basis	Use Support Category	Assessment Applicability*
S/M	AL	Biological community data or ambient water quality parameters do not exceed criteria in AU during assessment period. Biological and ambient data are independently applied.
S/M	REC	Ambient fecal coliform bacteria levels do not exceed criteria in AU or AU with DEH sites is posted with advisories for 61 days or less during assessment period.
S/M	SH	AU is a DEH Approved shellfish growing area.
I/M	AL	Biological community data or ambient water quality parameters exceed criteria in AU during assessment period. Biological and ambient data are independently applied.
I/M	REC	Ambient fecal coliform bacteria levels exceeds criteria in AU or AU with DEH sites is posted with advisories for more than 61 days during assessment period.
I/M	FC	Fish tissue data collected in AU during assessment period and basin is under mercury advice or site-specific advisory.
I/M	SH	AU is a DEH Conditionally-Approved, Prohibited or Restricted shellfish growing area.
NR/M	AL	Biological community is Not Rated or inconclusive, or ambient water quality parameters are inconclusive or there are less than 10 samples in AU during assessment period. Biological and ambient data are independently applied.
NR/M	REC	Ambient fecal bacteria parameter exceeds annual screening criteria, but does not exceed assessment criteria of five samples in 30 days in AU during assessment period.
NR/M	FC	AU does not have site-specific advisory and is not under a mercury advice or drains to areas within a mercury advice; fish tissue data available.
S/E	AL	AU is a tributary to a S/M AU and land use is similar between AUs.
S/E	WS	AU is classified as WS, and DEH report notes no significant closures at time of assessment.
I/E	FC	AU is in basin under a mercury advice or drains to areas within a mercury advice and has no fish tissue data.
NR/E	AL	AU is tributary to I/M AU, or AU is in watershed with intensice and changing land use, or other information suggests negative water quality impacts to AU. Discharger in AU has noncompliance permit violations or has failed three or more WET tests during the last two years of the assessment period.
NR/E	REC	Discharger has noncompliance permit violations of fecal bacteria parameter during last two years of assessment period.
NR/E	FC	AU does not have site-specific advisory and is not under a mercury advice or drains to areas within a mercury advice, or has no fish tissue data.
ND	AL, REC, SH	No data available in AU during assessment period.

Note: S/M = Supporting/Monitored I/M = Impaired/Monitored NR/M = Not Rated/Monitored
S/E = Supporting/Evaluated I/E = Impaired/Evaluated NR/E = Not Rated/Evaluated
ND = No Data
AL = Aquatic Life REC = Recreation FC = Fish Consumption
SH = Shellfish Harvesting WS = Water Supply
AU = Assessment Unit WET = Whole Effluent Toxicity
DEH = Division of Environmental Health
* = for lakes assessments, see page 16

Supporting ratings are extrapolated up tributaries from monitored streams when there are no problematic dischargers with permit violations or changes in land use/cover. Supporting ratings may also be applied to unmonitored tributaries where there is little land disturbance (e.g., national forests and wildlife refuges, wilderness areas or state natural areas). Problem stressors or sources are not generally applied to unmonitored tributaries. Impaired ratings are not extrapolated to unmonitored tributaries.

Stressors

Biological and ambient samplings are useful tools to assess water quality. However, biological sampling does not typically identify the causes of impairment, and ambient sampling does not always link water quality standards to a biological response. Linking the causes of impairment and the biological response are a complex process (USEPA, 2000) that begins with an evaluation of physical, chemical or biological entities that can induce an adverse biological response. These entities are referred to as stressors. A stressor may have a measurable impact to aquatic health. Not all streams will have a primary stressor or cause of impairment. A single stressor may not be sufficient to cause impairment, but the accumulation of several stressors may result in impairment. In either case, impairment is likely to continue if the stressor or the various cumulative stressors are not addressed. Use support assessments evaluate the available information related to potential stressors impacting water quality.

A stressor identification process may be initiated after a stream appears on the 303(d) list in order to address streams that are Impaired based on biological data. Intensive studies are required to summarize and evaluate potential stressors to determine if there is evidence that a particular stressor plays a substantial role in causing the biological impacts. Intensive studies consider lines of evidence that include benthic macroinvertebrate and fish community data, habitat and riparian area assessment, chemistry and toxicity data, and information on watershed history, current watershed activities and land uses, and pollutant sources. These studies result in decisions regarding the probable stressors contributing to or causing impairment. The intensity of a stressor study may be limited due to a lack of resources. In these cases, it may still be appropriate to include stressors in use support assessments, but to also note where additional information is needed in order to evaluate other stressors.

Where an ambient parameter is identified as a potential concern, the parameter is noted in the DWQ database and use support summary table. Where habitat degradation is identified as a stressor, DWQ and others attempt to identify the type of habitat degradation (e.g., sedimentation, loss of woody habitat, loss of pools or riffles, channelization, lack of riparian vegetation, streambed scour and bank erosion). Habitat evaluation methods are being developed to better identify specific types of habitat degradation.

Aquatic Life Category

The aquatic life category is an ecosystem approach to assessing the biological integrity of all surface waters of the state. The biological community data and ambient water quality data are used in making assessments in this category. These represent the most important monitoring data for making water quality assessments in the aquatic life category. Evaluation information such as compliance and whole effluent toxicity information from NPDES dischargers, land cover, and other more anecdotal information are also used to identify potential problems and to refine assessments based on the monitoring data. The following is a description of each monitoring data type and the criteria used in assigning use support ratings. Criteria used to evaluate the other information and assign use support ratings are also described. Refer to page 14 for lakes and reservoir assessment methods as applied in the aquatic life category.

Biological Data

Benthic macroinvertebrate (aquatic insects) community and fish community samples are the best way to assess the biological integrity of most waterbodies. Unfortunately, these community measures cannot be applied to every stream size and are further limited by geographic region. These community measures are designed to detect current water quality and water quality changes that may be occurring in the watershed. However, they are only directly applied to the assessment unit where the sample was collected.

Where recent data for both benthic macroinvertebrates and fish communities are available, both are evaluated for use support assessments. When two biological monitoring data types conflict, best professional judgment is used to determine an appropriate use support rating. Where both ambient monitoring data and biological data are available, biological data may be given greater weight; however, each data type is assessed independently.

Benthic Macroinvertebrate Criteria

Criteria have been developed to assign bioclassifications to most benthic macroinvertebrate samples based on the number of taxa present in the pollution intolerant aquatic insect groups of *Ephemeroptera, Plecoptera* and *Trichoptera* (EPTs); and the Biotic Index (BI), which summarizes tolerance data for all taxa in each sample. Because these data represent water quality conditions with a high degree of confidence, use support ratings using these data are considered monitored.

If a Fair macroinvertebrate bioclassification is obtained under conditions (such as drought or flood conditions, recent spills, etc.) that may not represent normal conditions or is borderline Fair (almost Good-Fair), a second sample should be taken within 12-24 months to validate the Fair bioclassification. Such sites will be Not Rated until the second sample is obtained.

Use support ratings are assigned to assessment units using benthic macroinvertebrate bioclassifications as follows.

Waterbody Sample Type or Criteria	Bioclassification	Use Support Rating
Mountain, piedmont, coastal A[3]	Excellent	Supporting
Mountain, piedmont, coastal A[3]	Good	Supporting
Swamp[1]	Natural	Supporting
Mountain, piedmont, coastal A	Good-Fair	Supporting
Smaller than criteria but Good-Fair[2]	Not Impaired	Supporting
Swamp[1]	Moderate Stress	Supporting
Mountain, piedmont, coastal A[3]	Fair	Impaired
Swamp[1]	Severe Stress	Impaired
Mountain, piedmont, coastal A[3]	Poor	Impaired
Criteria not appropriate to assign bioclassification	Not Rated	Not Rated

1 Swamp streams for benthos sampling are defined as streams in the coastal plain that have no visible flow for a part of the year, but do have flow during the February to early March benthic index period.

2 This designation may be used for flowing waters that are too small to be assigned a bioclassification (less than three square miles drainage area), but have a Good-Fair or higher bioclassification using the standard qualitative and EPT criteria.

3 Coastal A streams are those located in the coastal plain that have flow year round and are wadeable.

Fish Community Criteria

The North Carolina Index of Biotic Integrity (NCIBI) is a method for assessing a stream's biological integrity by examining the structure and health of its fish community. The NCIBI incorporates information about species richness and composition, indicator species, trophic function, abundance and condition, and reproductive function. Because these data represent water quality conditions with a high degree of confidence, use support ratings using these data are considered monitored. Use support ratings are assigned to assessment units using the NCIBI bioclassifications as follows:

NCIBI	Use Support Rating
Excellent	Supporting
Good	Supporting
Good-Fair	Supporting
Fair	Impaired
Poor	Impaired

If a Fair fish bioclassification is obtained under conditions (such as drought or flood conditions, recent spills, etc.) that may not represent normal conditions or is borderline Fair (almost Good-Fair), a second sample should be taken within 12-24 months to validate the Fair bioclassification. Such sites will be Not Rated until the second sample is obtained.

The NCIBI was recently revised (NCDENR, 2001), and the bioclassifications and criteria have also been recalibrated against regional reference site data (NCDENR, 2000a, 2000b and 2001a).

NCIBI criteria are applicable only to wadeable streams in the following river basins: Broad, Catawba, Savannah, Yadkin-Pee Dee, Cape Fear, Neuse, Roanoke, Tar-Pamlico, French Broad, Hiwassee, Little Tennessee, New and Watauga. Additionally, the NCIBI criteria are only applicable to streams in the piedmont portion of the Cape Fear, Neuse, Roanoke and Tar-Pamlico River basins. The definition of "piedmont" for these four river basins is based upon a map of North Carolina watersheds (Fels, 1997). Specifically:

- In the Cape Fear River basin -- all waters except for those draining the Sandhills in Moore, Lee and Harnett counties, and the entire basin upstream of Lillington, NC.
- In the Neuse River basin -- the entire basin above Smithfield and Wilson, except for the south and southwest portions of Johnston County and eastern two-thirds of Wilson County.
- In the Roanoke River basin -- the entire basin in North Carolina upstream of Roanoke Rapids, NC and a small area between Roanoke Rapids and Halifax, NC.
- In the Tar-Pamlico River basin -- the entire basin above Rocky Mount, except for the lower southeastern one-half of Halifax County and the extreme eastern portion of Nash County.

NCIBI criteria have not been developed for:

- Streams in the Broad, Catawba, Yadkin-Pee Dee, Savannah, French Broad, Hiwassee, Little Tennessee, New and Watauga River basins which are characterized as wadeable first to third order streams with small watersheds, naturally low fish species diversity, coldwater temperatures, and high gradient plunge-pool flows. Such streams are typically thought of as "Southern Appalachian Trout Streams".
- Wadeable streams in the Sandhills ecoregion of the Cape Fear, Lumber and Yadkin-Pee Dee River basins.
- Wadeable streams and swamps in the coastal plain region of the Cape Fear, Chowan, Lumber, Neuse, Pasquotank, Roanoke, Tar-Pamlico and White Oak River basins.
- All nonwadeable and large streams and rivers throughout the state.

Ambient Water Quality Monitoring Criteria

Chemical/physical water quality data are collected through the DWQ Ambient Monitoring Program statewide and NPDES discharger coalitions in some basins. All samples collected (usually monthly) during the five-year assessment period are used to assign a use support rating. Ambient water quality data are not direct measures of biological integrity, but the chemical/physical parameters collected can provide an indication of conditions that may be impacting aquatic life. Because these data represent water quality conditions with a high degree of confidence, use support ratings assigned using these data are considered monitored. Where both ambient data and biological data are available, each data type is assessed independently.

The parameters used to assess water quality in the aquatic life category include dissolved oxygen, pH, chlorophyll *a* and turbidity. Criteria for assigning use support ratings to assessment units with ambient water quality data of a minimum of ten samples are as follows:

Ratings Criteria	Rating
Numerical standard exceeded in ≤10% of samples	Supporting
Numerical standard exceeded in >10% of samples	Impaired
Less than 10 samples collected	Not Rated
DO and pH standard exceeded in swamp streams	Not Rated

Some standards are written with more specific criteria than others and these specific criteria are used to assess use support. For example, the DO standard has a daily average of 5 mg/l and an instantaneous value of 4 mg/l for Class C waters. Because DWQ does not collect daily DO levels at the ambient stations, the instantaneous value is used for assessment criteria. In areas with continous monitoring, the daily average of 5 mg/l will also be assessed. In addition, pH has a standard of not less than 6 and not greater than 9; each level is assessed. To assess the fecal coliform bacteria standard, five samples must be collected within a 30 day period (see Recreation Category for more information).

Multiple Monitoring Sites

There are assessment units with more than one type of monitoring data. When the data from multiple biological data types are not in agreement, best professional judgment is used to assign a bioclassification and use support rating for that assessment unit. Biological monitoring is typically assessed independent of ambient monitoring data and either may be used to assign a use support rating for an assessment unit. Monitoring data are always used over the evaluation information; however, evaluation information can be used to lengthen or shorten monitored assessment units and to assign use support ratings on an evaluated basis to non-monitored assessment units.

NPDES Wastewater Whole Effluent Toxicity (WET) Information

Whole Effluent Toxicity (WET) tests are required for all major NPDES discharge permit holders, as well as those minor NPDES dischargers with complex effluent (defined as not being of 100 percent domestic waste). WET tests are evaluated to determine if the discharge could be having negative water quality impacts. If a stream with a WET test facility has not been sampled for instream chronic toxicity, biological community data or has no ambient water quality data, and that facility has failed three or more WET tests in the last two years of the assessment period, the assessment unit is Not Rated. Because this information is not a direct measure of water quality and the confidence is not as high as for monitoring data, this use support rating is considered evaluated rather than monitored. Problems associated with WET test failures are addressed through NPDES permits.

NPDES Discharger Daily Monitoring Report Information

NPDES effluent data monthly averages of water quality parameters are screened for the last two years of the assessment period. If facilities exceed the effluent limits by 20 percent for two or more months during two consecutive quarters, or have chronic exceedances of permit limits for four or more months during two consecutive quarters, then the assessment unit is Not Rated if no biological or ambient monitoring data are available. If biological or ambient data are available, that data will be used to develop a use support rating for appropriate stream segments. Because

this information is not a direct measure of water quality and the confidence is not as high as for monitoring data, this use support rating is considered evaluated rather than monitored.

Fish Consumption Category

The fish consumption category is a human health approach to assess whether humans can safely consume fish from a waterbody. This category is applied to all waters of the state. The use support rating is assigned using fish consumption advisories or advice as issued by the NC Department of Health and Human Services (DHHS). The fish consumption category is different from other categories in that assessments are based on the existence of a DHHS fish consumption advice or advisory at the time of assessment. The advice and advisories are based on DHHS epidemiological studies and on DWQ fish tissue data, so a fish tissue monitoring site will constitute a monitored assessment unit (AU) and all other AUs will be evaluated. DWQ fish tissue data are used to inform DHHS of potential fish tissue toxicity. DHHS is responsible for proclaiming a fish tissue advisory for any waterbody. Fish tissue monitoring data are not used directly for assigning a use support rating in this category.

If a limited site-specific fish consumption advisory or a no consumption advisory is posted at the time of assessment, the water is Impaired. If there are no site-specific advisories posted or the stream is not in a basin where mercury advice is applied, then the assessment unit will be Not Rated in this category.

The DHHS has developed regional fish consumption advice (all waters south and east of I-85) for certain fish species shown to have elevated levels of mercury in their tissue. DWQ applies the DHHS fish consumption advice for mercury on a basinwide scale rather than an AU scale in recognition that fish move up and downstream regardless of the presence of I-85. All AUs draining below or intersecting I-85 are Impaired in the fish consumption category. AUs with monitoring data are considered Impaired/Monitored, and AUs with no monitoring data are considered Impaired/Evaluated. When a DHHS site-specific advisory is in place for a parameter other than mercury, the assessment is based on that advisory and the mercury advice will take a lower ranking in the assessment. Therefore, when a site-specific advisory is in place in a basin with a mercury advice and the AU has fish tissue monitoring data, the AU will be considered Impaired/Monitored for the specific parameter, rather than Impaired/Evaluated for mercury.

Basins under the mercury advice are the Cape Fear, Chowan, Lumber, Neuse, Pasquotank, Roanoke, White Oak and Yadkin-Pee Dee. All waters in these basins are Impaired in the fish consumption category, even when there is a site-specific advisory. All waters are also considered Monitored or Evaluated, dependent upon the availability of monitoring data.

Only a small portion of the Catawba River basin is intersected by I-85 (lower Mecklenberg, Union and Gaston counties). Due to the presence of dams that impede fish travel throughout the Catawba River basin, only those waters draining to and entering the mainstem Catawba below I-85 and are not impeded by dams are considered Impaired/Evaluated.

Basins not under the mercury advice are the Broad, French Broad, Hiwassee, Little Tennessee, New, Savannah and Watauga. All waters in these basins are Not Rated in the fish consumption category if there is no site-specific advisory; waters are Impaired if there is a site-specific

advisory. All waters are also considered Monitored or Evaluated, dependent upon the availability of monitoring data.

In order to separate this regional advice from other fish consumption advisories and to identify actual fish populations with high levels of mercury, only waters with fish tissue monitoring data are presented on the use support maps.

Recreation Category

This human health related category evaluates waters for the support of primary recreation activities such as swimming, water-skiing, skin diving, and similar uses usually involving human body contact with water where such activities take place in an organized manner or on a frequent basis. Waters of the state designated for these uses are classified as Class B, SB and SA. This category also evaluates other waters used for secondary recreation activities such as wading, boating, and other uses not involving human body contact with water, and activities involving human body contact with water where such activities take place on an infrequent, unorganized or incidental basis. Waters of the state designated for these uses are classified as Class C, SC and WS.

The use support ratings applied to this category are currently based on the North Carolina fecal coliform bacteria water quality standard where ambient monitoring data are available or on the duration of local or state health agencies posted swimming advisories. Use support ratings for the recreation category may be based on other bacteriological indicators and standards in the future.

DWQ conducts monthly ambient water quality monitoring that includes fecal coliform bacteria testing. The Division of Environmental Health (DEH) tests coastal recreation waters (beaches) for bacteria levels to assess the relative safety of these waters for swimming. If an area has elevated bacteria levels, health officials will advise that people not swim in the area by posting a swimming advisory and by notifying the local media and county health department.

The North Carolina fecal coliform bacteria standard for freshwater is: 1) not to exceed the geometric mean of 200 colonies per 100 ml of at least five samples over a 30-day period; and 2) not to exceed 400 colonies per 100 ml in more than 20 percent of the samples during the same period. The AU being assessed for the five-year data window is Supporting in the recreation category if neither number (1) nor (2) of the standard are exceeded. The AU being assessed is Impaired in the recreation category if either number (1) or (2) is exceeded. Waters without sufficient fecal coliform bacteria data (five samples within 30 days) are Not Rated, and waters with no data are noted as having No Data.

Assessing the water quality standard requires significant sampling efforts beyond the monthly ambient monitoring sampling and must include at least five samples over a 30-day period. Decades of monitoring have demonstrated that bacteria concentrations may fluctuate widely in surface waters over a period of time. Thus, multiple samples over a 30-day period are needed to evaluate waters against the North Carolina water quality standard for recreational use support. Waters classified as Class SA, SB and B are targeted for this intensive sampling effort due to the greater potential for human body contact.

Waters with beach monitoring sites will be Impaired if the area is posted with an advisory for greater than 61 days of the assessment period. Waters with beach monitoring sites with advisories posted less than 61 days will be Supporting. Other information can be used to Not Rate unmonitored waters.

DWQ Ambient Monitoring Fecal Coliform Bacteria Screening Criteria

As with other information sources, all available information and data are evaluated for the recreation category using the assessment period. However, DWQ conducts an annual screening of DWQ ambient fecal coliform bacteria data to assess the need for additional monitoring or immediate action by local or state health agencies to protect public health.

Each March, DWQ staff will review bacteria data collections from ambient monitoring stations statewide for the previous sampling year. Locations with annual geometric means greater than 200 colonies per 100 ml, or when more than 20 percent of the samples are greater than 400 colonies per 100 ml, are identified for potential follow-up monitoring conducted five times within 30 days as specified by the state fecal coliform bacteria standard. If bacteria concentrations exceed either portion of the state standard, the data are sent to DEH and the local county health director to determine the need for posting swimming advisories. DWQ regional offices will also be notified.

Due to limited resources and the higher risk to human health, primary recreation waters (Class B, SB and SA) will be given monitoring priority for an additional five times within 30 days sampling. Follow-up water quality sampling for Class C waters will be performed as resources permit. Any waters on the 303(d) list of Impaired waters for fecal coliform will receive a low priority for additional monitoring because these waters will be further assessed for TMDL development.

DWQ attempts to determine if there are any swimming areas monitored by state, county or local health departments or by DEH. Each January, DEH, county or local health departments are asked to list those waters which were posted with swimming advisories in the previous year.

Shellfish Harvesting Use Support

The shellfish harvesting use support category is a human health approach to assess whether shellfish can be commercially harvested and is therefore applied only to Class SA waters. The following data sources are used to assign use support ratings for shellfish waters.

Division of Environmental Health (DEH) Shellfish Sanitation Surveys

DEH is required to classify all shellfish growing areas as to their suitability for shellfish harvesting. Estuarine waters are delineated according to DEH shellfish management areas (e.g., Outer Banks, Area H-5) which include Class SA, SB and SC waters. DEH samples growing areas regularly and reevaluates the areas by conducting shellfish sanitation surveys every three years to determine if their classification is still applicable. DEH classifications may be changed after the most recent sanitary survey. Classifications are based on DEH bacteria sampling, locations of pollution sources, and the availability of the shellfish resource. Growing waters are classified as follows.

DEH Classification	DEH Criteria
Approved (APP)	**Fecal Coliform Standard for Systematic Random Sampling:** The median fecal coliform Most Probable Number (MPN) or the geometric mean MPN of the water shall not exceed 14 per 100 milliliters (ml), and the estimated 90th percentile shall not exceed an MPN of 43 MPN per 100 ml for a 5-tube decimal dilution test. **Fecal Coliform Standard for Adverse Pollution Conditions Sampling:** The median fecal coliform or geometric mean MPN of the water shall not exceed 14 per 100 ml, and not more than 10 percent of the samples shall exceed 43 MPN per 100 ml for a 5-tube decimal dilution test.
Conditionally Approved-Open (CAO)	Sanitary Survey indicates an area can meet approved area criteria for a reasonable period of time, and the pollutant event is known and predictable and can be managed by a plan. These areas tend to be open more frequently than closed.
Conditionally Approved-Closed (CAC)	Sanitary Survey indicates an area can meet approved area criteria for a reasonable period of time, and the pollutant event is known and predictable and can be managed by a plan. These areas tend to be closed more frequently than open.
Restricted (RES)	Sanitary Survey indicates limited degree of pollution, and the area is not contaminated to the extent that consumption of shellfish could be hazardous after controlled depuration or relaying.
Prohibited (PRO)	No Sanitary Survey; point source discharges; marinas; data do not meet criteria for Approved, Conditionally Approved or Restricted Classification.

Assigning Use Support Ratings to Shellfish Harvesting Waters (Class SA)

DWQ use support ratings may be assigned to separate segments within DEH management areas. In assessing use support, the DEH classifications and management strategies are only applicable to DWQ Class SA (shellfish harvesting) waters. It is important to note that DEH classifies all actual and potential growing areas (which includes all saltwater and brackish water areas) for their suitability for shellfish harvesting. This will result in a difference of acreage between DEH areas classified as CAC, PRO and RES, and DWQ waters rated as Impaired. For example, if DEH classifies a 20-acre area CAC, but only 10 acres are Class SA, only those 10 acres of Class SA waters are rated as Impaired.

The DEH "Closed" polygon coverage includes CAC, RES and PRO classifications, and it is not currently possible to separate out the PRO from the RES areas. Therefore, these areas are a combined polygon coverage, and DWQ rates these waters as Impaired.

Sources of fecal coliform bacteria are more difficult to separate out for Class SA areas. DEH describes the potential sources in the sanitary surveys, but they do not describe specific areas affected by these sources. Therefore, in the past, DEH identified the same sources for all Class SA sections of an entire management area (e.g., urban runoff and septic systems). Until a better way to pinpoint sources is developed, this information will continue to be used. A point source discharge is only listed as a potential source when NPDES permit limits are exceeded.

DWQ and DEH are developing the database and expertise necessary to assess shellfish harvesting frequency of closures. In the interim, DWQ has been identifying the frequency of closures in Class SA waters using an interim methodology based on existing databases and GIS

shapefiles. There will be changes in reported acreages in future assessments using the permanent methods and tools that result from this project.

Past Interim Frequency of Closure-Based Assessment Methodology

The interim method was used for the 2001 White Oak, 2002 Neuse and 2003 Lumber River basin use support assessments. Shellfish harvesting use support ratings for Class SA waters using the interim methodology are summarized below.

Percent of Time Closed within Basin Data Window	DEH Growing Area Classification	DWQ Use Support Rating
N/A	Approved*	Supporting
Closed ≤10% of data window	Portion of CAO closed ≤10% of data window	Supporting
Closed >10% of the data window	Portion of CAO closed >10% of data window	Impaired
N/A	CAC and PRO/RES**	Impaired

* Approved waters are closed only during extreme meteorological events (hurricanes).

** CAC and P/R waters are rarely opened to shellfish harvesting.

For CAO areas, DWQ worked with DEH to determine the number of days and acreages that CAO Class SA waters were closed to shellfish harvesting during the assessment period. For each growing area with CAO Class SA waters, DEH and DWQ defined subareas within the CAO area that were opened and closed at the same time. The number of days these CAO areas were closed was determined using DEH proclamation summary sheets and the original proclamations.

The number of days that APP areas in the growing area were closed due to preemptive closures because of named storms was not counted. For example, all waters in growing area E-9 were preemptively closed for Hurricane Fran on September 5, 1996. APP waters were reopened September 20, 1996. Nelson Bay (CAO) was reopened September 30, 1996. This area was considered closed for ten days after the APP waters were reopened.

Current Assessment Methodology

Use support assessment is now conducted such that only the DEH classification will be used to assign a use support rating. By definition, CAO areas are areas that DEH has determined do not, or likely do not, meet water quality standards and these areas will be rated Impaired, along with CAC and PRO/RES areas. Only APP areas will be rated Supporting.

Growing areas that have been reclassified by DEH during the assessment period from a lower classification to APP will be rated Supporting. Areas that are reclassified from APP to any other classification during the assessment period will be rated Impaired.

Over the next few years, DWQ, DEH, Division of Coastal Management (DCM) and Division of Marine Fisheries (DMF) will be engaged in developing a database with georeferenced (GIS) shellfish harvesting areas. The new database and GIS tools will be valuable for the above agencies to continue to work together to better serve the public. Using the new database with

georeferenced areas and monitoring sites, DEH will be able to report the number of days each area was closed excluding closures related to named storms.

Water Supply Use Support

This human health related use support category is used to assess all Class WS waters for the ability of water suppliers to provide potable drinking water. Water quality standards established for drinking water apply to water delivered to consumers after it has been treated to remove potential contaminants that may pose risks to human health. Ambient standards established by states under the Clean Water Act are not intended to ensure that water is drinkable without treatment. Modern water treatment technologies are required to purify raw water to meet drinking water standards as established by the North Carolina Division of Environmental Health.

Water supply use support is assessed by DWQ using information from the seven DEH regional water treatment plant consultant staff. Each January, the DEH staff consultants are asked to submit a spreadsheet listing closures and water intake switch-overs for all water treatment plants in their region. This spreadsheet describes the length and time of the event, contact information, and the reason for the closure or switch.

The spreadsheets are reviewed by DWQ staff to determine if any closures/switches were due to water quality concerns. Those closures/switches due to water quantity problems and reservoir turnovers are not considered for use support. The frequency and duration of closures/switches due to water quality concerns are considered when assessing use support. Using these criteria, North Carolina's surface water supplies are currently rated Supporting on an Evaluated basis. Specific criteria for rating waters Impaired are to be determined on a case-by-case basis.

Use of Outside Data

DWQ actively solicits outside data and information in the year before biological sampling in a particular basin. The solicitation allows approximately 90 days for data to be submitted. Data from sources outside DWQ are screened for data quality and quantity. If data are of sufficient quality and quantity, they may be incorporated into use support assessments. A minimum of ten samples for more than a one-year period is needed to be considered for use support assessments.

The way the solicited data are used depends on the degree of quality assurance and quality control of the collection and analysis of the data as detailed in the 303(d) report and shown in the table below. Level 1 data can be use with the same confidence as DWQ data to determine use support ratings. Level 2 or Level 3 data may be used to help identify causes of pollution and stressors. They may also be used to limit the extrapolation of use support ratings up or down a stream segment from a DWQ monitoring location. Where outside data indicate a potential problem, DWQ evaluates the existing DWQ biological and ambient monitoring site locations for adjustment as appropriate.

Criteria Levels for Use of Outside Data in Use Support Assessments			
Criteria	**Level 1**	**Level 2**	**Level 3**
Monitoring frequency of at least 10 samples for more than a one-year period	Yes	Yes/No	No
Monitoring locations appropriately sited and mapped	Yes	Yes	No
State certified laboratory used for analysis according to 15A NCAC 2B .0103	Yes	Yes/No	No
Quality assurance plan available describing sample collection and handling	Yes, rigorous scrutiny	Yes/No	No

Lakes and Reservoir Use Assessment

Like streams, lakes are classified for a variety of uses. All lakes monitored as part of North Carolina's Ambient Lakes Monitoring Program carry the Class C (aquatic life) classification, and most are classified Class B and SB (recreation) and WS-I through WS-V (water supply). The surface water quality numeric standard specifically associated with recreation is fecal coliform. For water supplies, there are 29 numeric standards based on consumption of water and fish. Narrative standards for Class B and Class WS waters include aesthetics such as no odors and no untreated wastes. There are other numeric standards that also apply to lakes for the protection of aquatic life and human health. These standards also apply to all other waters of the state and are listed under the Class C rules. One of the major problems associated with lakes and reservoirs is increasing eutrophication related to nutrient inputs. Several water quality parameters help to describe the level of eutrophication.

For nutrient enrichment, one of the main causes of impacts to lakes and reservoirs, a more holistic or weight of evidence approach is necessary since nutrient impacts are not always reflected by the parameters sampled. For instance, some lakes have taste and odor problems associated with particular algal species, yet these lakes do not have chlorophyll *a* concentrations above 40 µg/l frequently enough to impair them based on the standard. In addition, each reservoir possesses unique traits (watershed area, volume, depth, retention time, etc.) that dramatically influence its water quality, but that cannot be evaluated through standards comparisons. In such waterbodies, aquatic life may be Impaired even though a particular indicator is below the standard. Where exceedances of surface water quality standards are not sufficient to evaluate a lake or reservoir, the weight of evidence approach can take into consideration indicators and parameters not in the standards to allow a more sound and robust determination of water quality.

The weight of evidence approach uses the following sources of information to determine the eutrophication (nutrient enrichment) level as a means of assessing lake use support in the aquatic life category:

- Quantitative water quality parameters - dissolved oxygen, chlorophyll *a*, pH, etc.
- Algal bloom reports
- Fish kill reports

- Hydrologic and hydraulic characteristics – watershed size, lake volume, retention time, volume loss, etc.
- Third party reports – citizens, water treatment plant operators, state agencies, etc.
    - Taste and odor
    - Sheens
    - Odd colors
    - Other aesthetic and safety considerations

In implementing the weight of evidence approach for eutrophication, more consideration is given to parameters that have water quality standards (see table). Each parameter is assessed for percent exceedance of the state standard. Parameters with sufficient (ten or more observations), quality-assured observations are compared to surface water quality standards. When standards are exceeded in more than 10 percent of the assessment period, portions or all of the waterbody are rated Impaired.

However, in many cases, the standards based approach is incapable of characterizing the overall health of a reservoir. The eutrophication-related parameters and water quality indicators without numeric standards are reviewed based on interpretation of the narrative standards in 15A NCAC 2B .0211(2) and (3).

A modification to lake use assessment is the evaluation and rating of a lake or reservoir by assessment units (AUs). Each lake or reservoir may have one or more AU based on the classification segments (DWQ index numbers). Each sampling date is considered one sample. Multiple sampling locations within one AU are considered one sample. A minimum of ten samples is needed to assess use support for any AU. Each AU with documented problems (sufficient data, ambient data above standards, and supporting public data) will be rated as Impaired while the other portions are rated as Supporting or Not Rated. The following table lists the information considered during a lake/reservoir use assessment, as well as the criteria used to evaluate that information.

Lake/Reservoir Weight of Evidence Use Assessment for Aquatic Life Category	
Assessment Type	**Criteria**
EUTROPHICATION	
Water Quality Standards (a minimum of 10 samples is required for use support assessment)	
Chl *a*	Above standard in >10% of samples.
DO	Below or above standard in >10% of samples.
pH	Below or above standard in >10% of samples.
Turbidity	Above standard in >10% of samples.
% Total Dissolved Gases	Above standard in >10% of samples.
Temperature	Minor and infrequent excursions of temperature standards due to anthropogenic activity. No impairment of species evident.
Metals (excluding copper, iron and zinc)	Above standard in >10% of samples.
Other Data	
% Saturation DO	>10% of samples above >120%
Algae	Blooms during 2 or more sampling events in 1 year with historic blooms.
Fish	Kills related to eutrophication.
Chemically/ Biologically Treated	For algal or macrophyte control - either chemicals or biologically by fish, etc.
Aesthetics Complaints	Documented sheens, discoloration, etc. - written complaint and follow-up by a state agency.
TSI	Increase of 2 trophic levels from one 5-year period to next.
Historic DWQ Data	Conclusions from other reports and previous use support assessments.
AGPT	Algal Growth Potential Potential Test ≥5 mg/L
Macrophytes	Limiting access to public ramps, docks, swimming areas; reducing access by fish and other aquatic life to habitat; clogging intakes.
Taste and Odor	Public complaints; Potential based on algal spp
Sediments	Clogging intakes - dredging program necessary.

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Appendix XI

Glossary
of
Terms and Acronyms

Glossary

§	Section.
30Q2	The minimum average flow for a period of 30 days that has an average recurrence of one in two years.
7Q10	The annual minimum 7-day consecutive low flow, which on average will be exceeded in 9 out of 10 years.
B (Class B)	Class B Water Quality Classification. This classification denotes freshwaters protected for primary recreation and other uses suitable for Class C. Primary recreational activities include frequent and/or organized swimming and other human contact such as skin diving and water skiing.
basin	The watershed of a major river system. There are 17 major river basins in North Carolina.
benthic macroinvertebrates	Aquatic organisms, visible to the naked eye (macro) and lacking a backbone (invertebrate), that live in or on the bottom of rivers and streams (benthic). Examples include, but are not limited to, aquatic insect larvae, mollusks and various types of worms. Some of these organisms, especially aquatic insect larvae, are used to assess water quality. See EPT index and bioclassification for more information.
benthos	A term for bottom-dwelling aquatic organisms.
best management practices	Techniques that are determined to be currently effective, practical means of preventing or reducing pollutants from point and nonpoint sources, in order to protect water quality. BMPs include, but are not limited to: structural and nonstructural controls, operation and maintenance procedures, and other practices. Often, BMPs are applied as system of practices and not just one at a time.
bioclassification	A rating of water quality based on the outcome of benthic macroinvertebrate sampling of a stream. There are five levels: Poor, Fair, Good-Fair, Good and Excellent.
BMPs	See *best management practices*.
BOD	Biochemical Oxygen Demand. A measure of the amount of oxygen consumed by the decomposition of biological matter or chemical reactions in the water column. Most NPDES discharge permits include a limit on the amount of BOD that may be discharged.
C (Class C)	Class C Water Quality Classification. This classification denotes freshwaters protected for secondary recreation, fishing, wildlife, fish and aquatic life propagation and survival, and others uses.
channelization	The physical alteration of streams and rivers by widening, deepening or straightening of the channel, large-scale removal of natural obstructions, and/or lining the bed or banks with rock or other resistant materials.
chlorophyll *a*	A chemical constituent in plants that gives them their green color. High levels of chlorophyll *a* in a waterbody, most often in a pond, lake or estuary, usually indicate a large amount of algae resulting from nutrient overenrichment or eutrophication.
coastal counties	Twenty counties in eastern NC subject to requirements of the Coastal Area Management Act (CAMA). They include: Beaufort, Bertie, Brunswick, Camden, Carteret, Chowan, Craven, Currituck, Dare, Gates, Hertford, Hyde, New Hanover, Onslow, Pamlico, Pasquotank, Pender, Perquimans, Tyrrell and Washington.
Coastal Plain	One of three major physiographic regions in North Carolina. Encompasses the eastern two-fifths of state east of the *fall line* (approximated by Interstate I-95).
conductivitiy	A measure of the ability of water to conduct an electrical current. It is dependent on the concentration of dissolved ions such as sodium, chloride, nitrates, phosphates and metals in solution.
degradation	The lowering of the physical, chemical or biological quality of a waterbody caused by pollution or other sources of stress.
DENR	Department of Environment and Natural Resources.

DO	Dissolved oxygen.
drainage area	An alternate name for a watershed.
DWQ	North Carolina Division of Water Quality, an agency of DENR.
dystrophic	Naturally acidic (low pH), "black-water" lakes which are rich in organic matter. Dystrophic lakes usually have low productivity because most fish and aquatic plants are stressed by low pH water. In North Carolina, dystrophic lakes are scattered throughout the Coastal Plain and Sandhills regions and are often located in marshy areas or overlying peat deposits. NCTSI scores are not appropriate for evaluating dystrophic lakes.
EEP	Ecosystem Enhancement Program (EEP)
effluent	The treated liquid discharged from a wastewater treatment plant.
EMC	Environmental Management Commission.
EPA	United States Environmental Protection Agency.
EPT Index	This index is used to judge water quality based on the abundance and variety of three orders of pollution sensitive aquatic insect larvae: Ephemeroptera (mayflies), Plecoptera (stoneflies) and Trichoptera (caddisflies).
eutrophic	Elevated biological productivity related to an abundance of available nutrients. Eutrophic lakes may be so productive that the potential for water quality problems such as algal blooms, nuisance aquatic plant growth and fish kills may occur.
eutrophication	The process of physical, chemical or biological changes in a lake associated with nutrient, organic matter and silt enrichment of a waterbody. The corresponding excessive algal growth can deplete dissolved oxygen and threaten certain forms of aquatic life, cause unsightly scums on the water surface and result in taste and odor problems.
fall line	A geologic landscape feature that defines the line between the piedmont and coastal plain regions. It is most evident as the last set of small rapids or rock outcroppings that occur on rivers flowing from the piedmont to the coast.
FS	Fully supporting. A rating given to a waterbody that fully supports its designated uses and generally has good or excellent water quality.
GIS	Geographic Information System. An organized collection of computer hardware, software, geographic data and personnel designed to efficiently capture, store, update, manipulate, analyze and display all forms of geographically referenced information.
habitat degradation	Identified where there is a notable reduction in habitat diversity or change in habitat quality. This term includes sedimentation, bank erosion, channelization, lack of riparian vegetation, loss of pools or riffles, loss of woody habitat, and streambed scour.
headwaters	Small streams that converge to form a larger stream in a watershed.
HQW	High Quality Waters. A supplemental surface water classification.
HU	Hydrologic unit. See definition below.
Hydrilla	The genus name of an aquatic plant - often considered an aquatic weed.
hydrologic unit	A watershed area defined by a national uniform hydrologic unit system that is sponsored by the Water Resources Council. This system divides the country into 21 regions, 222 subregions, 352 accounting units and 2,149 cataloging units. A hierarchical code consisting of two digits for each of the above four levels combined to form an eight-digit hydrologic unit (cataloging unit). An eight-digit hydrologic unit generally covers an average of 975 square miles. There are 54 eight-digit hydrologic (or cataloging) units in North Carolina. These units have been further subdivided into eleven and fourteen-digit units.
hypereutrophic	Extremely elevated biological productivity related to excessive nutrient availability. Hypereutrophic lakes exhibit frequent algal blooms, episodes of low dissolved oxygen or periods when no oxygen is present in the water, fish kills and excessive aquatic plant growth.
impaired	Term that applies to a waterbody that has a use support rating of partially supporting (PS) or not supporting (NS) its uses.

impervious	Incapable of being penetrated by water; non-porous.
kg	Kilograms. To change kilograms to pounds multiply by 2.2046.
lbs	Pounds. To change pounds to kilograms multiply by 0.4536.
loading	Mass rate of addition of pollutants to a waterbody (e.g., kg/yr)
macroinvertebrates	Animals large enough to be seen by the naked eye (macro) and lacking backbones (invertebrate).
macrophyte	An aquatic plant large enough to be seen by the naked eye.
mesotrophic	Moderate biological productivity related to intermediate concentrations of available nutrients. Mesotrophic lakes show little, if any, signs of water quality degradation while supporting a good diversity of aquatic life.
MGD	Million gallons per day.
mg/l	Milligrams per liter (approximately 0.00013 oz/gal).
NCIBI	North Carolina Index of Biotic Integrity. A measure of the community health of a population of fish in a given waterbody.
NH_3-N	Ammonia nitrogen.
nonpoint source	A source of water pollution generally associated with rainfall runoff or snowmelt. The quality and rate of runoff of NPS pollution is strongly dependent on the type of land cover and land use from which the rainfall runoff flows. For example, rainfall runoff from forested lands will generally contain much less pollution and runoff more slowly than runoff from urban lands.
NPDES	National Pollutant Discharge Elimination System.
NPS	Nonpoint source.
NR	Not rated. A waterbody that is not rated for use support due to insufficient data.
NS	Not supporting. A rating given to a waterbody that does not support its designated uses and has poor water quality and severe water quality problems. Both PS and NS are called impaired.
NSW	Nutrient Sensitive Waters. A supplemental surface water classification intended for waters needing additional nutrient management due to their being subject to excessive growth of microscopic or macroscopic vegetation. Waters classified as NSW include the Neuse, Tar-Pamlico and Chowan River basins; the New River watershed in the White Oak basin; and the watershed of B. Everett Jordan Reservoir (including the entire Haw River watershed).
NTU	Nephelometric Turbidity Units. The units used to quantify turbidity using a turbidimeter. This method is based on a comparison of the intensity of light scattered by the sample under defined conditions with the intensity of the light scattered by a standard reference suspension under the same conditions.
oligotrophic	Low biological productivity related to very low concentrations of available nutrients. Oligotrophic lakes in North Carolina are generally found in the mountain region or in undisturbed (natural) watersheds and have very good water quality.
ORW	Outstanding Resource Waters. A supplemental surface water classification intended to protect unique and special resource waters having excellent water quality and being of exceptional state or national ecological or recreational significance. No new or expanded wastewater treatment plants are allowed, and there are associated stormwater runoff controls enforced by DWQ.
pH	A measure of the concentration of free hydrogen ions on a scale ranging from 0 to 14. Values below 7 and approaching 0 indicate increasing acidity, whereas values above 7 and approaching 14 indicate a more basic solution.
phytoplankton	Aquatic microscopic plant life, such as algae, that are common in ponds, lakes, rivers and estuaries.
Piedmont	One of three major physiographic regions in the state. Encompasses most of central North Carolina from the Coastal Plain region (near I-95) to the eastern slope of the Blue Ridge Mountains region.

PS	Partially supporting. A rating given to a waterbody that only partially supports its designated uses and has fair water quality and severe water quality problems. Both PS and NS are called impaired.
riparian zone	Vegetated corridor immediately adjacent to a stream or river. See also SMZ.
river basin	The watershed of a major river system. North Carolina is divided into 17 major river basins: Broad, Cape Fear, Catawba, Chowan, French Broad, Hiwassee, Little Tennessee, Lumber, Neuse, New, Pasquotank, Roanoke, Savannah, Tar-Pamlico, Watauga, White Oak and Yadkin River basins.
river system	The main body of a river, its tributary streams and surface water impoundments.
runoff	Rainfall that does not evaporate or infiltrate the ground, but instead flows across land and into waterbodies.
SA	Class SA Water Classification. This classification denotes saltwaters that have sufficient water quality to support commercial shellfish harvesting.
SB	Class SB Water Classification. This classification denotes saltwaters with sufficient water quality for frequent and/or organized swimming or other human contact.
SC	Class SC Water Classification. This classification denotes saltwaters with sufficient water quality to support secondary recreation and aquatic life propagation and survival.
sedimentation	The sinking and deposition of waterborne particles (e.g., eroded soil, algae and dead organisms).
silviculture	Care and cultivation of forest trees; forestry.
SOC	Special Order by Consent. An agreement between the Environmental Management Commission and a permitted discharger found responsible for causing or contributing to surface water pollution. The SOC stipulates actions to be taken to alleviate the pollution within a defined time. The SOC typically includes relaxation of permit limits for particular parameters, while the facility completes the prescribed actions. SOCs are only issued to facilities where the cause of pollution is not operational in nature (i.e., physical changes to the wastewater treatment plant are necessary to achieve compliance).
streamside management zone (SMZ)	The area left along streams to protect streams from sediment and other pollutants, protect streambeds, and provide shade and woody debris for aquatic organisms.
subbasin	A designated subunit or subwatershed area of a major river basin. Subbasins typically encompass the watersheds of significant streams or lakes within a river basin. Every river basin is subdivided into subbasins ranging from one subbasin in the Watauga River basin to 24 subbasins in the Cape Fear River basin. There are 133 subbasins statewide. These subbasins are not a part of the national uniform hydrologic unit system that is sponsored by the Water Resources Council (see *hydrologic unit*).
Sw	Swamp Waters. A supplemental surface water classification denoting waters that have naturally occurring low pH, low dissolved oxygen and low velocities. These waters are common in the Coastal Plain and are often naturally discolored giving rise to their nickname of “blackwater” streams.
TMDL	Total maximum daily load. The amount of a given pollutant that a waterbody can assimilate and maintain its uses and water quality standards.
TN	Total nitrogen.
TP	Total phosphorus.
tributary	A stream that flows into a larger stream, river or other waterbody.
trophic classification	Trophic classification is a relative description of a lake's biological productivity, which is the ability of the lake to support algal growth, fish populations and aquatic plants. The productivity of a lake is determined by a number of chemical and physical characteristics, including the availability of essential plant nutrients (nitrogen and phosphorus), algal growth and the depth of light penetration. Lakes are classified according to productivity: unproductive lakes are termed "oligotrophic"; moderately productive lakes are termed "mesotrophic"; and very productive lakes are termed "eutrophic".

TSS	Total Suspended Solids.
turbidity	An expression of the optical property that causes light to be scattered and absorbed rather than transmitted in straight lines through a sample. All particles in the water that may scatter or absorb light are measured during this procedure. Suspended sediment, aquatic organisms and organic particles such as pieces of leaves contribute to instream turbidity.
UT	Unnamed tributary.
watershed	The region, or land area, draining into a body of water (such as a creek, stream, river, pond, lake, bay or sound). A watershed may vary in size from several acres for a small stream or pond to thousands of square miles for a major river system. The watershed of a major river system is referred to as a basin or river basin.
WET	Whole effluent toxicity. The aggregate toxic effect of a wastewater measured directly by an aquatic toxicity test.
WS	Class WS Water Supply Water Classification. This classification denotes freshwaters used as sources of water supply. There are five WS categories. These range from WS-I, which provides the highest level of protection, to WS-V, which provides no categorical restrictions on watershed development or wastewater discharges like WS-I through WS-IV.
WWTP	Wastewater treatment plant.