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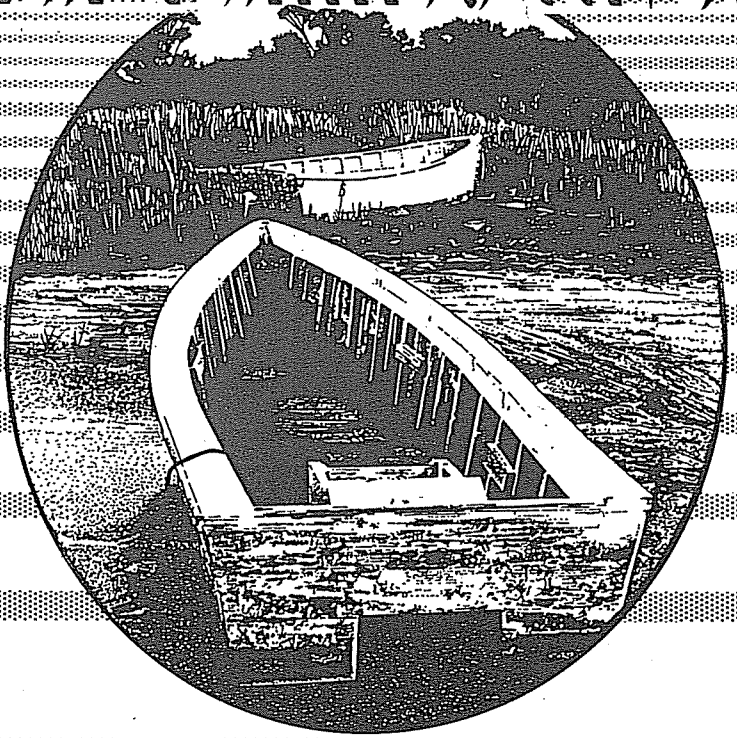
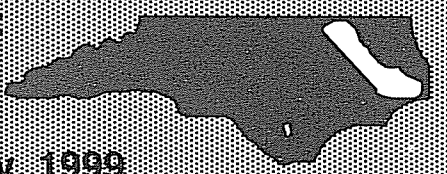
Tar-Pamlico River



Basinwide Water Quality Plan

North Carolina
Department of Environment
and Natural Resources

Division of Water Quality
Water Quality Section July, 1999



Michael F. Easley, Governor
William G. Ross Jr., Secretary
North Carolina Department of Environment and Natural Resources

Alan W. Klimek, P.E. Director
Division of Water Quality

April 22, 2003

Thank you for your interest in North Carolina's water quality issues. Enclosed is the basinwide water quality plan that you recently requested from the Division of Water Quality (DWQ).

The basinwide planning program aims to identify and restore full use to impaired waters, identify and protect highly valued resource waters, and protect the quality and intended uses of North Carolina's surface waters while allowing for sound economic planning and reasonable growth. North Carolina relies on the input and experience of its public to ensure that the water quality plans are effective. DWQ coordinates plan development; however, plan implementation and effectiveness entails the coordinated efforts and endorsement of many agencies, groups, local governments, and the general public. Your participation is essential for us to achieve our goals.

Our website (http://h2o.enr.state.nc.us/wqs/) provides detailed information on our program, other basin plans, current events, publications, and rules and regulations. Please visit us at this site.

DWQ appreciates your interest in water quality issues, and we hope to continue working with you into the future. Please contact me if you have any further questions or ideas on specific basins at (919) 733-5083, ext. 354.

Sincerely,

Darlene Kucken

Darlene Kucken
Basinwide Planning Program Coordinator

Enclosure

ADDENDUM: Use Support Changes for the Tar-Pamlico River Basin
March 2000

The fully supporting but threatened (support-threatened, ST) category is no longer used as a use support rating. In the past, ST was used to identify a water that was fully supporting but had some notable water quality problems. ST could represent constant, degrading, or improving conditions. North Carolina's use of ST was very different from that of the US Environmental Protection Agency (EPA), which uses it to identify waters that are characterized by declining water quality. In addition, the US EPA requires the inclusion of ST waters on the 303(d) list in its proposed revision (August, 1999) to the 303(d) list rules (Appendix II). Due to the difference between US EPA's and North Carolina's definitions of ST, North Carolina no longer uses this term. Because North Carolina has used fully supporting but threatened as a subset of fully supporting (FS) waters, those waters formerly called ST are now rated FS. This change is reflected in the 305(b) report for 2000. Based on this change, use support ratings for all basins have been altered.

Use support ratings of Little Cokey Swamp (subbasin 03) and Whitehurst Creek (subbasin 07) have been revised based on new biological information. Portions of these streams were formerly rated PS or NS but are now not rated (NR). These revised ratings are reflected in the 2000 303(d) list and 305(b) report.

Revised use support ratings for the Tar-Pamlico River basin are presented below.

Freshwater Streams and Rivers

Table A-22 Use Support Determinations for Monitored and Evaluated Freshwater Streams for Tar-Pamlico River Basin (*Found on p. 69 of this plan.*)

Tar-Pamlico Freshwater Use Support Ratings in Miles for 1993-1999					
Subbasin	**Fully Supporting**	**Partially Supporting**	**Not Supporting**	**Not Rated**	**Total Miles**
03-03-01	451.4	6.1	1.9	27.2	486.6
03-03-02	368.6	39.2	0	94.6	502.4
03-03-03	163.7	14.6	0	58.4	236.7
03-03-04	499.4	0	0	92.8	592.2
03-03-05	126.9	13	7.5	35.3	182.7
03-03-06	115.4	0	0	0	115.4
03-03-07	109.9	2.4	1.4	188.3	302.0
03-03-08	0	0	0	29.6	29.6
Total	1835.3	75.3	10.8	526.2	2447.6
Percent	75%	3%	<1%	21%	100%

Lakes

The Tar River Reservoir is now considered fully supporting. *(Refer to p. 95 of this plan.)*

Estuaries

Table A-23 Use Support Ratings for Estuarine Waters in the Tar-Pamlico River Basin (1993-1997) (*Found on p. 71 of this plan.*)

Area Name	DEH Area	Total Acres	Subbasin	Overall Use Support (Acres)			Major Causes	
				FS	PS	NS	Fecal	Chl *a*
Goose Creek	G1	17,000	03-03-07	16,700	300	0	300	
Pamlico River	G2	29,000	03-03-07	28,500	500	0	500	
Swanquarter Bay	G3	45,000	03-03-08	44,133	867	0	867	
Wysocking Bay	G4	23,000	03-03-08	22,745	255	0	255	
Long Shoal	G5	46,000	03-03-08	43,946	2,054	0	2,054	
Ocracoke	G6	13,300	03-03-08	13,165	135	0	135	
Open Water	G7	400,000	03-03-08	400,000	0	0		
Lower Pungo River	G8	13,200	03-03-07	12,486	714	0	714	
Upper Pungo River	G9	8,000	03-03-07	8,000	0	0		
Pamlico River	G10	15,500	03-03-07	15,500	0	0		
Pamlico River	G11	20,700	03-03-07	17,245	3,455	0		3,455
South Creek	G12	3,300	03-03-07	0	0	0	**	
Totals		634,000		622,420	8,280	0	4,825	3,455
% of Total Acres		100		98%	>1%	0%		

Tar-Pamlico Basinwide Water Quality Plan

July 1999

Prepared by:

North Carolina
Division of Water Quality
Water Quality Section
Mail Service Center Box 1617
Raleigh, NC 27699-1617

(919) 733-5083 ext. 354

This document was approved and endorsed by the NC Environmental Management Commission on July 8, 1999 to be used as a guide by the NC Division of Water Quality in carrying out its Water Quality Program duties and responsibilities in the Tar-Pamlico River Basin. It is the first five-year update to the original Tar-Pamlico Basinwide Water Quality Management Plan approved by the NC Environmental Management Commission December 7, 1994.

500 copies of this document were printed at a cost of $4,984.43 or $9.97 per copy.

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II List of 303(d) Waters in the Tar-Pamlico River Basin

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V Environmental Education Resources in the Tar-Pamlico Basin

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A. Atmospheric Stakeholder Team Report
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VIII Water Quality Data Collected by DWQ

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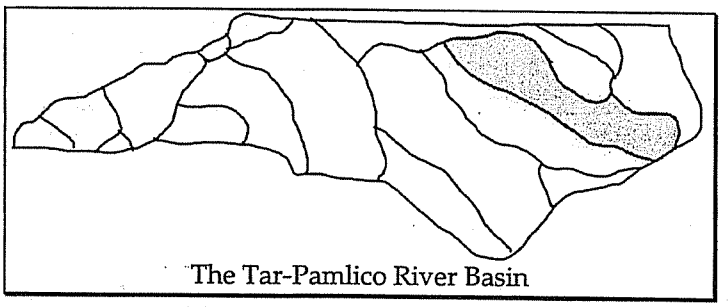
Executive Summary

The Tar-Pamlico Basin


The Tar-Pamlico River Basin

The Tar-Pamlico River basin is one of just four river basins contained entirely within the State of North Carolina. It covers a 5,440-square mile area making it the fourth largest river basin in the state. The basin originates in the upper Piedmont region in Person and Granville counties, west of Interstate 85, and flows southeastward toward the Pamlico Sound. Upstream of the City of Washington, the mainstem is called the Tar River. Below this point, it becomes the Pamlico River. The Tar River is primarily a free-flowing freshwater stream while the Pamlico River is entirely estuarine. Major tributaries include Fishing Creek, Swift Creek, Cokey Swamp, Tranters Creek and the Pungo River. The basin also includes North Carolina's largest natural lake - Lake Mattamuskeet.

Goals and Format of the Plan

This document is the first five-year update of the original Tar-Pamlico Basinwide Water Quality Management Plan that was approved by the Environmental Management Commission (EMC) on December 7, 1994. This basin plan identifies the known water quality problem areas, and where possible, recommends actions needed to correct them. As in the earlier plan, the primary goals of DWQ's basinwide program are to: 1) identify and restore full use to impaired waters; 2) identify and protect highly valued resource waters; and 3) protect those waters that are presently unimpaired while accommodating reasonable economic growth.

In response to comments received by various people interested in the basin plans, the format of this plan has been revised, and much more of the general information contained in the original plan has been replaced by more detailed information specific to the basin. A greater emphasis has been placed on identifying causes and sources of pollution on individual streams in order to facilitate restoration efforts at the local level. Comments from the public workshops that were held in the basin on June 3-4, 1998 were seriously considered during plan development. While not all of the comments may have been addressed to the satisfaction of the commentors, their input was given careful consideration.

Update on Addressing Nutrient Problems in the Basin

In the 1980s, much attention was focused on the Tar-Pamlico River basin, especially in the estuary which experienced severe symptoms of nutrient enrichment, including algal blooms and fish kills. This led the Environmental Management Commission to designate the entire river basin as Nutrient Sensitive Waters (NSW) in 1989. This designation carried with it rules and recommendations to reduce nutrient loads to the estuary from both point and nonpoint sources of pollution. To date, there have been a number of accomplishments in this area, but much remains

to be done to achieve further reductions in nutrient loads and protect the estuary in the years ahead. Most recently, the Environmental Management Commission directed Division of Water Quality (DWQ) staff to develop rules to address nutrient loading from nonpoint sources. Draft rules are now being formulated with the help of stakeholder groups and will be reviewed by the Environmental Management Commission prior to being presented for public review at hearings. Public hearings are likely to be held in September, and the Environmental Management Commission is likely to consider the final rules in December. The approved rules are expected to be available for review by the NC General Assembly in the year 2000.

Water Quality Overview

On the surface, water quality conditions appear to be better than they were during the last basin planning cycle in both freshwaters and the estuary. A number of biological samples taken in freshwater streams in 1997 yielded results that were better than those in 1992. Consequently, there were fewer monitored impaired stream segments listed in this plan than in the 1994 basinwide plan. DWQ biologists have noted that these improvements may be due, in part, to flow conditions in 1997 that were more favorable to aquatic life in some streams than the flow conditions during the previous 1992 sampling period. The 1997 summer flows were slightly lower than normal thereby possibly limiting the impacts from nonpoint sources of pollution. However, a decline in water quality in at least one stream was also attributed to the same low flow conditions. There were also stream improvements in the Tar River below Rocky Mount that appear to have resulted from improvements at that municipality's wastewater treatment plant.

Use support ratings have been assigned to 80 percent of the freshwaters in the river basin using both monitored and evaluated data. Overall, 76 percent of the freshwaters are considered supporting their uses, although roughly half of those are considered threatened. Four percent of the freshwaters are considered impaired. Water quality problems appear to be primarily attributable to nonpoint sources.

In estuarine waters, there were significantly fewer acres rated impaired in this plan than in the 1994 plan. For example, in the 1994 plan, there were 44,320 acres of the Pamlico River estuary, including portions of the Pungo River that were rated as impaired because of nutrient-related problems. This compares to 3,455 acres in this 1999 update. The reason for the reduction in the size of the impaired area is that data and information on fish kills and algal blooms during the years of 1993-1997 does not support identifying such a large area as impaired. This may be due to there being less information available for this time period (in the form of reports of fish kills and algal blooms) as opposed to actual water quality improvements. Also, the estuary's response to nutrient enrichment varies depending on other factors such as weather conditions. It will become clearer as to whether or not water quality has actually improved during the next five years of the following basin planning cycle, especially with the presence of the recently established Tar-Pamlico Rapid Response Team on the estuary and the installation of three new continuous monitoring platforms in the estuary. In the meantime, it will be important for DWQ and others to continue to minimize nutrient loads throughout the basin.

Stream Restoration Priorities

Consistent with the first goal, above, it will be a priority for DWQ during the next five-year basin cycle to promote actions to address those waters that continue to be impaired based on monitored information (i.e., waters either Partially Supporting (PS) or Not Supporting (NS) their uses based on data that is less than five years old - Table 1) and on those waters that are on the state's 303(d) list based on monitored data greater than five years old (Table 2). Other state and federal agencies and stakeholders are also encouraged to take actions to improve water quality in these areas.

The tables below present a list of these waters along with DWQ's recommendation to address the impairment. More information on each specific area can be obtained from Section B of the full basin plan.

Table 1 Monitored* Impaired Waters in the Tar-Pamlico River Basin

Waterbody	Subbasin	Use Support Rating*	On 303(d) List?	Basin Plan Recommendation
Freshwaters				
Foundary Br	03-03-01	PS	N	Resample: investigate urban NPS
Fishing Creek	03-03-01	NS & PS	Part	Impairment may be related to Oxford WWTP in addition to NPS
Sandy Creek	03-03-02	PS	Y	Resample; impact may be related to Hurricane Fran
Conetoe Creek	03-03-03	PS	Y	Bethel WWTP to tie to Greenville; investigate NPS
Chicod Creek	03-03-05	PS	Y	Continue BMP implementation; Assess need for more BMPs
Cow Creek	03-03-05	PS	N	(Same as Chicod Creek)
Kennedy Creek	03-03-07	PS	Y	Washington WWTP removed; monitor for WQ improvement
Estuarine Waters				
Goose Creek	03-03-07	PS	Y	Encourage local watershed project development
Pamlico River	03-03-07	PS	N	Continue implementation of NSW strategy
Lower Pungo R.	03-03-07	PS	Y	Encourage local watershed project development
Swanquarter Bay	03-03-08	PS	Y	Encourage local watershed project development
Wysocking Bay	03-03-08	PS	Y	Encourage local watershed project development
Long Shoal	03-03-08	PS	Y	Encourage local watershed project development
Near Ocracoke	03-03-08	PS	Y	Encourage local watershed project development

* Monitored streams are those that have been sampled within the last five years.
PS = Partially Supporting

Table 2 Impaired Freshwaters on the 1998 303(d) List Based on Monitored Data More than Five Years Old

Waterbody Name	Subbasin	Use Support	303(d) Recommendation
Stony Creek	03-03-02	PS	Management strategy development
Whiteoak Swamp	03-03-02	FS	Management strategy development
Little Cokey Swp	03-03-03	PS	Reevaluate with swamp criteria when available
Briery Branch	03-03-03	ST	Reevaluate with swamp criteria when available
UT to Otter Creek	03-03-03	NR	Reevaluate with swamp criteria when available
Jack Creek	03-03-07	NR	Reevaluate with swamp criteria when available
Whitehurst Creek	03-03-07	NS	Reevaluate with swamp criteria when available
Chocowinity Creek	03-03-07	NS	Reevaluate with swamp criteria when available

FS = Fully Supporting
ST = Fully Supporting but Threatened
PS = Partially Supporting
NS = Not Supporting
NR = Not Rated

Expanded Resources for Addressing Water Quality Problems

Since the last Tar-Pamlico Basinwide Water Quality Plan was completed in 1994, a number of new funding sources have become available to address water quality impairment. There are potentially tens of millions of dollars available for water quality improvement projects in the Tar-Pamlico Basin from a variety of programs. These include, but are not limited to, the Clean Water Management Trust Fund, the NC Wetlands Restoration Program, the NC Agricultural Cost Share Program, the recently approved $270 million Conservation Reserve Enhancement Program (CREP) and the 1998 Critical Needs Bond Act that makes funds available to local governments for water and wastewater improvements. These programs offer a tremendous opportunity for North Carolina to generate projects in watersheds with impaired water quality to reduce pollution to these waters. DWQ encourages the utilization of these resources to fund water quality improvement projects in the waters listed above in Tables 1 and 2.

Section A

General Basinwide Information

Chapter 1 -
Introduction to Basinwide Water Quality Planning

1.1 What is Basinwide Water Quality Planning

Basinwide water quality planning is a nonregulatory 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 for each of the seventeen major river basins in the state, as shown in Figure A-1 and Table A-1. Preparation of an individual basinwide management plan is a five-year process, which is broken down into four major phases as presented in Table A-2. While these plans are prepared by the Division of Water Quality, their implementation and the protection of water quality entails the coordinated efforts of many agencies, local governments and stakeholder groups in the state. The first round of plans was completed in 1998. Each plan is now being updated at five-year intervals during round two.

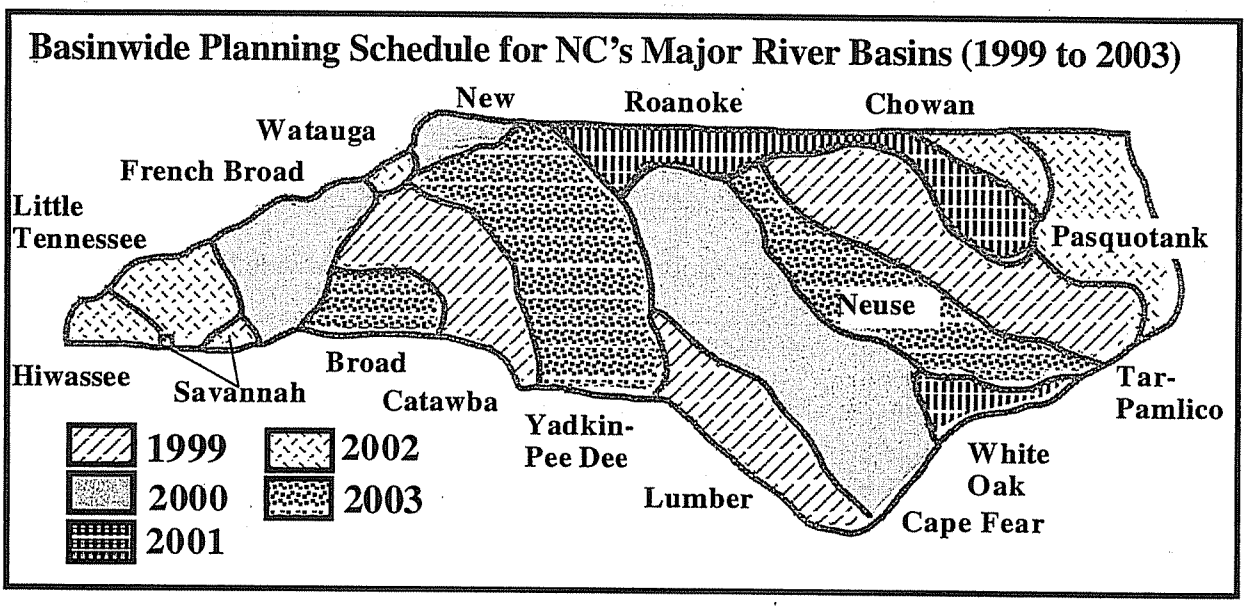


Figure A-1 Basinwide Planning Schedule (1998 to 2003)

1.2 Goals of Basinwide Water Quality Planning

The goals of basinwide management are to:

- identify water quality problems and restore full use to impaired waters;
- identify and protect high value resource waters;
- protect unimpaired waters while allowing for reasonable economic growth;
- develop appropriate management strategies;
- assure equitable distribution of waste assimilative capacity for dischargers; and
- improve public awareness and involvement in the management of the state's surface waters.

Table A-1 Schedule for Second Round of Basinwide Planning (1998 to 2003)

Basin	DQW Biological Data Collection	In-House Draft Due For Staff Review	EMC/WQC Approval For Public Meetings	Public Mtgs. and Draft Out For Review	Final Plan Receives EMC Approval	Begin NPDES Permit Issuance
Neuse	Summer 95	7/1998	7/1998	9/1998	12/1998	1/1999
Lumber	Summer 96	8/1998	12/1998	2/1999	5/1999	11/1999
Tar-Pamlico	Summer 97	8/1998	2/1999	4/1999	7/1999	1/2000
Catawba	Summer 97	5/1999	7/1999	9/1999	12/1999	3/2000
Fr. Broad	Summer 97	8/1999	12/1999	2/2000	5/2000	8/2000
New	Summer 98	9/1999	2/2000	4/2000	7/2000	11/2000
Cape Fear	Summer 98	10/1999	2/2000	4/2000	7/2000	12/2000
Roanoke	Summer 99	8/2000	12/2000	2/2001	7/2001	1/2002
White Oak	Summer 99	2/2001	7/2001	9/2001	12/2001	6/2002
Savannah	Summer 99	6/2001	9/2001	11/2001	2/2002	8/2002
Watauga	Summer 99	6/2001	10/2001	12/2001	3/2002	9/2002
Little Tenn.	Summer 99	6/2001	9/2001	11/2001	2/2002	10/2002
Hiwassee	Summer 99	6/2001	9/2001	11/2001	2/2002	8/2002
Chowan	Summer 2000	7/2001	10/2001	1/2002	5/2002	11/2002
Pasquotank	Summer 2000	7/2001	10/2001	1/2002	5/2002	12/2002
Broad	Summer 2000	4/2002	7/2002	9/2002	12/2002	7/2003
Yadkin	Summer 2001	4/2002	9/2002	12/2002	3/2003	9/2003

Note: A basinwide plan was completed for all 17 basins during Round 1 (1993 and 1998).

Table A-2 Five-Year Process for Development of an Individual Basinwide Management Plan

Years 1 to 3 **Water Quality Data Collection and Identification of Goals and Issues**	• Identify sampling needs • Canvass for information • Coordinate with other agencies and local interest groups to establish goals and objectives and identify and prioritize issues • Summarize data from ambient monitoring stations • Conduct biological monitoring activities • Conduct special studies and other water quality sampling activities
Years 3 to 4 **Data Assessment and Model Preparation**	• Gather data from special studies to prepare models and TMDLs • Develop preliminary pollution control strategies • Coordinate with local stakeholders and other agencies • Develop use support ratings
Year 4 **Preparation of Draft Basinwide Plan**	• Develop draft basinwide plan based on water quality data, use support ratings, modeling data and recommended pollution control strategies • Present preliminary findings at informal meetings and incorporate comments into draft plan
Year 5 **Public Review and Approval of Plan**	• Circulate draft plan for review • Hold public meetings after approval by NC Environmental Management Commission's Water Quality Committee • Revise plan after public review period • Submit final document to Environmental Management Commission for approval • Begin basinwide permitting and implementation at end of Year 5

1.3 Major Components of the Basinwide Plan

The second round of basinwide plans uses a different format from the earlier basinwide plans. Each plan is subdivided into three major sections. The intent of the format change is to make the plans easier to read and understand, but still comprehensive in content.

Section A: Basinwide Information

- Introduces the basinwide planning approach used by the state.
- Provides an overview of the river basin including: hydrology, land use, local government jurisdictions, population and growth trends, natural resources, wastewater discharges, animal operations and water usage.
- Presents general water quality information including summaries of water quality monitoring programs and use support ratings in the basin.

Section B: Subbasin Information

- Summarizes what was recommended in the first basin plan, what was achieved, what wasn't achieved and why, current priority issues and concerns, and goals and recommendations for the next five years by subbasin.

Section C: Current and Future Initiatives

- Presents current and future water quality initiatives and success stories by federal, state and local agencies, and corporate, citizen and academic efforts.
- Describes DWQ goals and initiatives beyond the five-year planning cycle for the basin.

1.4 Features of Basinwide Water Quality Planning

Basinwide water quality planning is a complex and comprehensive effort with many "moving parts". Some major features of this program include:

- increased opportunity for public participation in the state's water quality planning;
- a focused effort on one river basin at a time across the state;
- basinwide National Pollutant Discharge Elimination System (NPDES) permitting;
- integration of existing point and nonpoint source regulatory programs;
- preparation of basinwide water quality plans for each of the state's 17 river basins;
- five-year planning cycles.

1.5 Benefits of Basinwide Water Quality Planning

Several benefits of basinwide planning and management to water quality include:

- *Improved efficiency.* The state's efforts and resources are focused on one river basin at a time.
- *Increased effectiveness.* The basinwide approach is in agreement with basic ecological principles.

- *Better consistency and equability.* By clearly defining the program's long-term goals and approaches, basinwide plans encourage *consistent* decision-making on permits and water quality improvement strategies.
- *Increased public awareness of the state's water quality protection programs.* The basinwide plans are an educational tool for increasing public awareness of water quality issues.
- *Basinwide management promotes integration of point and nonpoint source pollution assessment and controls.* Once waste loadings from both point and nonpoint sources are established, management strategies can be developed to ensure compliance with water quality standards.

1.6 How to Get Involved

To assure that basinwide plans are accurately written and effectively implemented, it is important for citizens and other local stakeholders to participate in the planning process. DWQ offers two opportunities for the public to participate in the process:

- Public workshops: Held prior to writing the basinwide plans. DWQ staff present information about basinwide planning and the water quality of the basin. Participants then break into smaller groups where they can ask questions, share their concerns, and discuss potential solutions to water quality issues in the basin.
- Public meetings: Held after the draft basinwide plan has been approved by the Water Quality Committee of the Environmental Management Commission. DWQ staff present more detailed information about the draft basinwide plan and its major recommendations. Then, the public is invited to comment and ask questions.
- Public Comment Period: Held after the draft plan has been approved by the Water Quality Committee of the Environmental Management Commission. The comment period is at least thirty days in length from the date of the first public meeting.

Citizens seeking involvement in efforts to restore and protect water quality can call the DWQ Planning Branch at (919) 733-5083 and ask to speak to the basinwide planner for your river basin.

1.7 Other References

Documents

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

- *Tar-Pamlico River Basinwide Assessment Report.* May 1998. This technical report describes DWQ's monitoring programs in the Tar-Pamlico River basin and presents the physical, chemical and biological data that was found for each waterbody that was monitored between 1993 and 1997. 137 pages.
- *Tar-Pamlico River Basinwide Water Quality Management Plan.* December 1994. This is the first basinwide plan developed for the Tar-Pamlico River basin. The plan presents water

quality data, information and recommended management strategies based on data collected through 1992. Approx. 280 pages.

- *A Guide to Water Quality in North Carolina.* This document is in draft stage and will be available soon. The document will include general information about water quality issues and programs to address these issues. It is intended to be an informational document on water quality.
- *Tar-Pamlico River Nutrient Management Plan for Nonpoint Sources of Pollution.* December 1995. DWQ Water Quality Section. Approx. 200 pages.
- *Tar-Pamlico Nutrient Management Plan for Nonpoint Sources: First Annual Status Report to the Environmental Management Commission.* October 9, 1997. DWQ Water Quality Section. 68 pages.
- *Tar-Pamlico Nutrient Management Plan for Nonpoint Sources: Second Annual Status Report to the Environmental Management Commission.* July 9, 1997. DWQ Water Quality Section. Approx. 200 pages.
- *Basinwide Wetlands and Riparian Restoration Plan for the Tar-Pamlico River Basin.* DWQ NC Wetlands Restoration Program.
- *Tar-Pamlico NSW Implementation Strategy: Phase II.* December 8, 1994. This document outlines the Nutrient Sensitive Waters implementation strategy for point and nonpoint sources in the basin. It includes the Phase I agreement as an appendix. Approx. 35 pages.

Anyone interested in receiving these documents can contact the DWQ Planning Branch at (919) 733-5083.

Web Sites

There are also some web sites available on the Internet that provide on a variety of subjects that relate to the Tar-Pamlico basin.

- *Division of Water Quality Home Page: http://h2o.enr.state.nc.us/*
- Through this home page, you can click on the "Water Quality Section" and access a variety of information including fish kill data (click on the "Environmental Sciences Branch"), surface water classifications and water quality regulations. You can also get to the home page for the NC Department of Environment and Natural Resources through this site (go to bottom of page and click on "Go back to DENR home page.")
- *North Carolina Estuarium: www.washington-nc.com/estuarium*
- *Pfiesteria fact sheet: www.epa.gov/OWOW/estuaries/pfiesteria/fact.html*
- *Multipart series on Pfiesteria: www.pamlico-nc.com/PamNews/*

1.8 Division of Water Quality Functions and Locations

The major activities coordinated by DWQ through basinwide planning are listed in Figure A-2. Information on the location, address and phone numbers for each branch and regional office are also shown in Figure A-2 and Figure A-3.

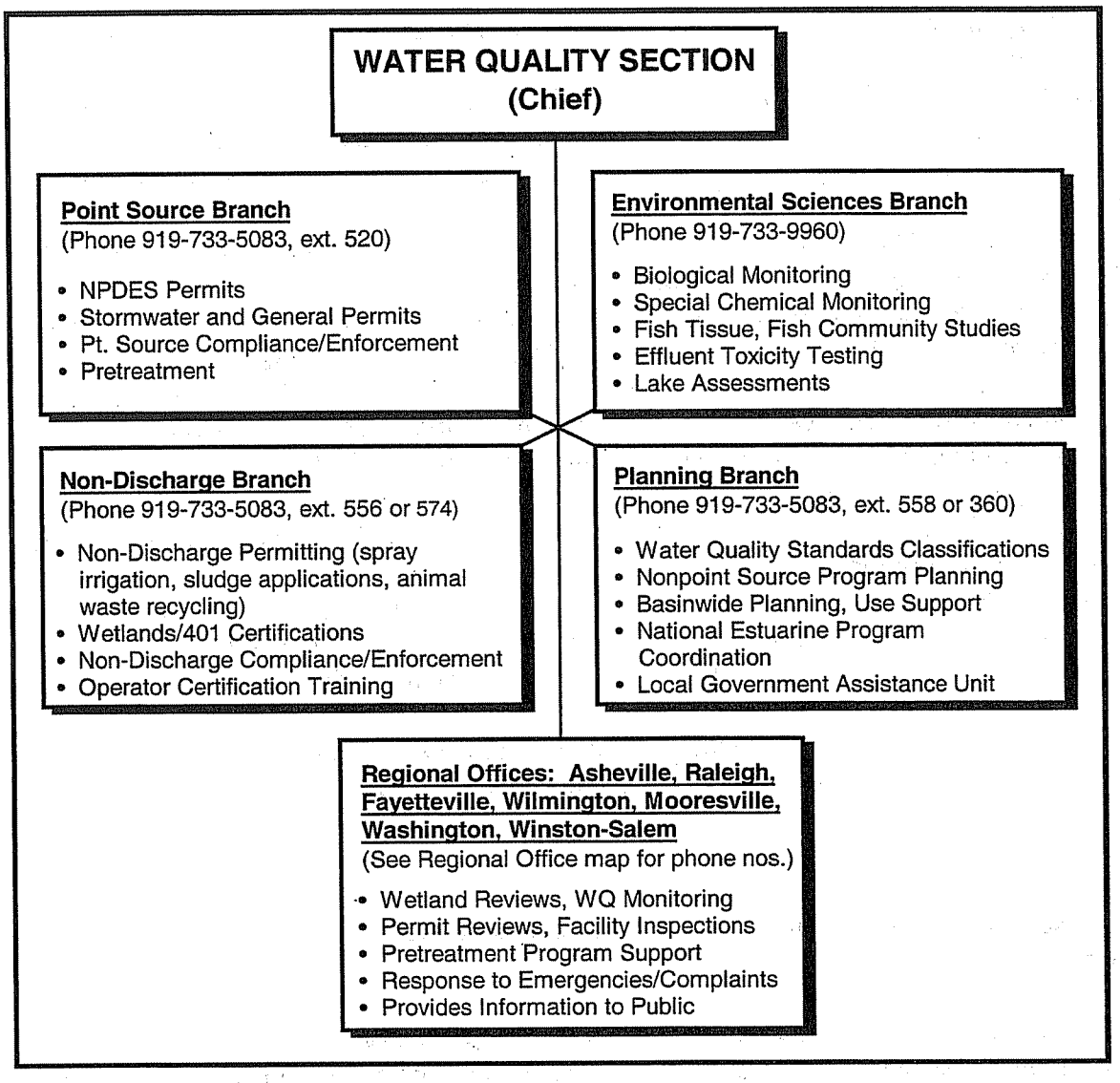
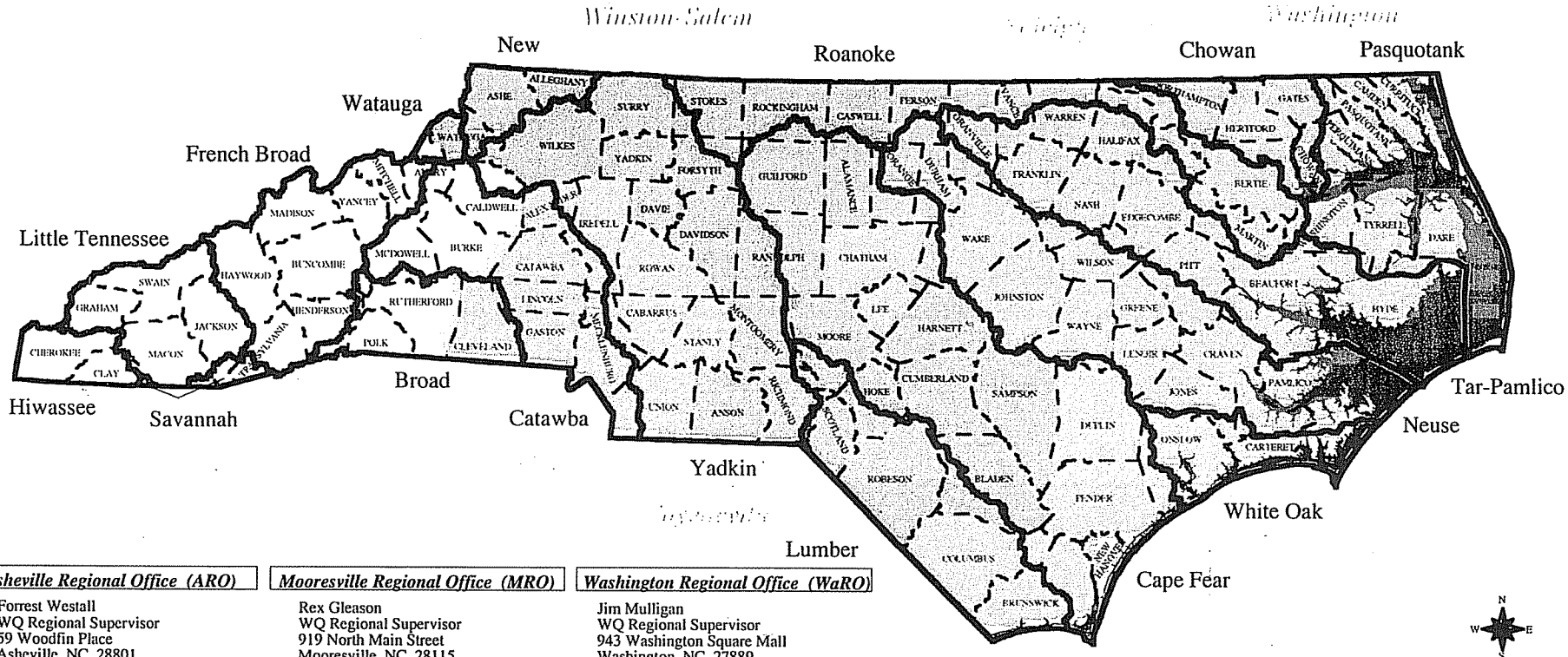


Figure A-2 Water Quality Section Organization Structure

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



Asheville Regional Office (ARO)

Forrest Westall
WQ Regional Supervisor
59 Woodfin Place
Asheville, NC 28801
COURIER 12-59-01
Phone: (828) 251-6208
Fax: (828) 251-6452

Avery	Haywood	Polk
Buncombe	Henderson	Rutherford
Burke	Jackson	Swain
Caldwell	Macon	Transylvania
Cherokee	Madison	Yancey
Clay	McDowell	
Graham	Mitchell	

Mooresville Regional Office (MRO)

Rex Gleason
WQ Regional Supervisor
919 North Main Street
Mooresville, NC 28115
COURIER 09-08-06
Phone: (704) 663-1699
Fax: (704) 663-6040

Alexander	Lincoln	
Cabarrus	Mecklenburg	
Catawba	Rowan	
Cleveland	Stanly	
Gaston	Union	
Iredell		

Washington Regional Office (WaRO)

Jim Mulligan
WQ Regional Supervisor
943 Washington Square Mall
Washington, NC 27889
COURIER 16-04-01
Phone: (252) 946-6481
Fax: (252) 946-9215

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)

Larry Coble
WQ Regional Supervisor
585 Waughtown Street
Winston-Salem, NC 27107
COURIER 13-15-01
Phone: (336) 771-4600
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
PO Box 29535
Raleigh, NC 27626-0535
COURIER 52-01-00
Phone: (919) 733-5083
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Fayetteville Regional Office (FRO)

Paul Rawls
WQ Regional Supervisor
225 Green Street
Suite 714 / Systel Building
Fayetteville, NC 28301-5043
COURIER 14-56-25
Phone: (910) 486-1541
Fax: (910) 486-0707

Anson	Moore
Bladen	Richmond
Cumberland	Robeson
Harnett	Sampson
Hoke	Scotland
Montgomery	

Raleigh Regional Office (RRO)

Ken Schuster
WQ Regional Supervisor
3800 Barrett Drive
Raleigh, NC 27609
INTEROFFICE
Phone: (919) 571-4700
Fax: (919) 571-4718

Chatham	Johnston	Vance
Durham	Lee	Wake
Edgecombe	Nash	Warren
Franklin	Northampton	Wilson
Granville	Orange	
Halifax	Person	

Wilmington Regional Office (WiRO)

Rick Shiver
WQ Regional Supervisor
127 Cardinal Drive Extension
Wilmington, NC 28405-2845
COURIER 04-16-33
Phone: (910) 395-3900
Fax: (910) 350-2004

Brunswick	New Hanover
Carteret	Onslow
Columbus	Pender
Duplin	

NCDENR

Planning Branch
June 4, 1999

Figure A-3 Division of Water Quality Regional Offices

Chapter 2 -
Basin Overview

2.1 General Overview

The Tar-Pamlico River basin is contained entirely within the state of North Carolina. It covers a 5,440-square mile area making it the fourth largest river basin in the state. The basin originates in the upper Piedmont region in Person and Granville counties, west of Interstate 85, and flows southeastward toward the Pamlico Sound. Upstream of the City of Washington, the mainstem is called the Tar River. Below this point, it becomes the Pamlico River which is an estuary. The Tar River is primarily freshwater while the Pamlico River is entirely estuarine. Major tributaries include Fishing Creek, Swift Creek, Cokey Swamp, Tranters Creek and the Pungo River. The basin also includes North Carolina's largest natural lake - Lake Mattamuskeet. Figure A-4 provides a map of the entire river basin.

Tar-Pamlico Basin Statistics

Total Area: 5,440 sq. miles
Stream Miles: 2,355
Saltwater Acres: 634,400
No. of Counties: 16
No. of Subbasins: 8
Population (1990): 364,862*
Estimated Pop. (2016): 459,853*
% Increase (1990-2016): 26%
Pop. Density (1990): 80 persons/sq. mi.

* based on % of county land area estimated to be within the basin

Tar-Pamlico River basin encompasses all or part of 16 counties and 51 municipalities. Population growth has generally been moderate, but steady overall, although areas around the larger municipalities such as Rocky Mount and Greenville have experienced a much sharper rise in the number of people.

The latest land cover data generated from satellite imagery indicates that most of the basin is in forested and wetland areas (54%), followed by cultivated cropland (22%), open water area (20%), pasture and other managed herbaceous areas (3%), and urban areas (1%).

The Tar-Pamlico basin contains numerous environmental resources including the Swift Creek watershed which is home to the endangered Tar River Spiny Mussel. At the lower end of the basin, the Pamlico River and Pamlico Sound sustain important fishery resources that are the livelihood for thousands of fishermen and women. The basin contains all or part of three National Wildlife Refuges (Lake Mattamuskeet, Pocosin Lakes and Swanquarter), two State Parks (Goose Creek and Medoc Mountain), and six significant natural heritage areas.

2.2 Local Governments and Planning Jurisdictions in the Basin

The Tar-Pamlico River basin encompasses all or portions of sixteen (16) counties and fifty-one (51) municipalities. Table A-3 provides a listing of these local governments, along with an identification of the regional planning jurisdiction (council of government) which it is in, and an estimation of what percentage of the county area is within the river basin. Figure A-4 provides a geographical illustration of the location of the majority of local governments in the basin.

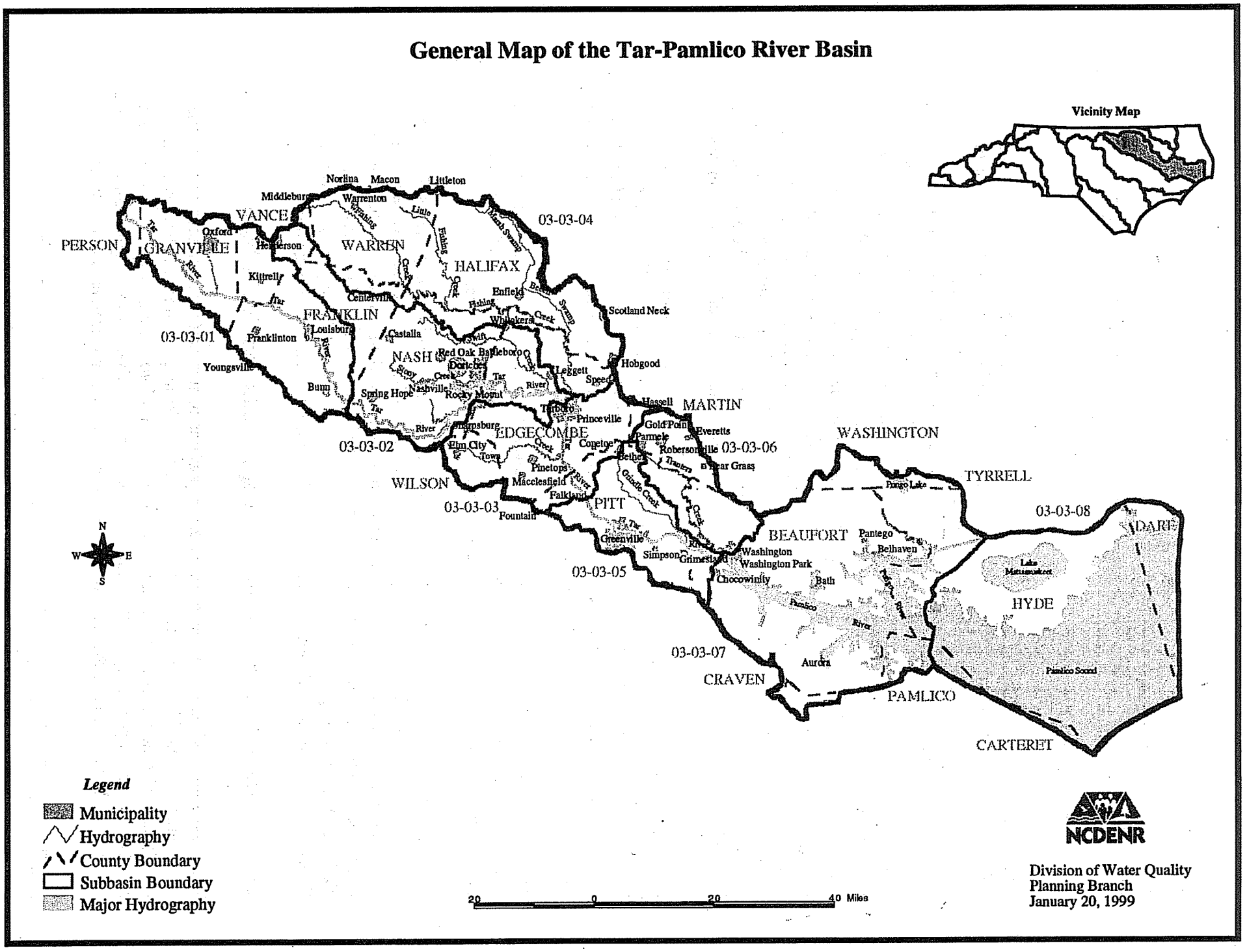


Figure A-4 General Map of the Tar-Pamlico River Basin

Table A-3 Local Governments and Planning Units within the Tar-Pamlico River Basin

County	% of County in Basin	Council of Government Region	Municipalities
Beaufort	97	Region Q Mid-East Commission	Aurora Bath Belhaven Chocowinity Pantego Washington Washington Park
Dare	11	Region R Albemarle Regional Planning and Development Commission	None
Edgecombe	99	Region L Upper Coastal Plain Council of Governments	Conetoe Leggett Macclesfield Pinetops Princeville Rocky Mount Sharpsburg Speed Tarboro Whitakers
Franklin	90	Region K Kerr-Tar Regional Council of Governments	Bunn Centerville Franklinton Louisburg Youngsville
Granville	43	K	Oxford
Halifax	60	L	Enfield Hobgood Littleton Scotland Neck
Hyde	91	R	None
Martin	25	Q	Bear Grass Everetts Hassell Parmele Robersonville
Nash	80	L	Castalia Dortches Momeyer Nashville Red Oak Rocky Mount Sharpsburg Spring Hope Whitakers
Pamlico	17	Region P Neuse River Council of Governments	None
Person	8	K	None
Pitt	58	Q	Bethel Falkland Fountain Greenville Grimesland Simpson
Vance	48	K	Henderson Kittrell Middleburg
Warren	62	K	Macon Norlina Warrenton
Washington	19	R	None
Wilson	19	L	Elm City Sharpsburg

2.3 Surface Water Hydrology

2.3.1 Major Hydrologic Divisions

Most federal government agencies, including the US Geological Survey and the US Natural Resources Conservation Service (NRCS), use a system of defining watersheds that is different from that used by the Division of Water Quality (DWQ) and many other state agencies in North Carolina. Under this approach, a nationally uniform hydrologic unit system was developed in 1974 by the US Geological Survey's Office of Water Data Coordination (USDA, NRCS, Nov. 1995). This system divides the country into 21 regions, 222 subregions, 352 accounting units and 2,149 cataloging units based on surface hydrologic features. Under the federal system, the Tar-Pamlico River basin is made up of five hydrologic areas referred to as cataloging units. Each cataloging unit is defined by an 8-digit number (see Table A-4 below). By contrast, DWQ has a two-tiered system in which the state is subdivided into 17 river basins, and each basin is subdivided into subbasins. The Tar-Pamlico River basin is subdivided by DWQ into 8 subbasins. Table A-4, below, compares the two systems. Maps of each subbasin are included in Section B of this basin plan.

Table A-4 Hydrologic Subdivisions in the Tar-Pamlico River Basin

Major Waterbody Name	USGS 8-digit Hydrologic Units	DWQ 6-digit Subbasin Codes
Upper Tar River	03020101	03-03-01, 03-03-02
Fishing Creek	03020102	03-03-04
Lower Tar River	03020103	03-03-03, 03-03-05, 03-03-06
Pamlico River	03020104	03-03-07
Pamlico Sound	03020105	03-03-07, 03-03-08

2.3.2 Physiography and Geology

Most (about four-fifths) of the basin is located in the coastal plain which is characterized by flat terrain, blackwater streams, low-lying swamplands and estuarine areas. Streams in this area are often slow flowing with extensive swamps, bottomland hardwood forests or marshes in their floodplains. These characteristics increase the difficulty in assessing water quality. Naturally stressful conditions are difficult to separate from anthropogenic (man-made) stresses.

The extreme upper portion of the basin (Franklin, Warren, Vance and Granville counties) is located in the piedmont physiographic region. This region typically has highly erodible clay soils, rolling topography with sharply indented stream valleys, and low gradient streams composed of a series of sluggish pools separated by riffles and occasional small rapids. Stream floodplains in this region are relatively narrow and mostly forested.

Want to find out more about the culture, history and ecology of the Tar-Pamlico River basin?

Visit the Estuarium in Washington! The new Estuarium focuses on the Albemarle-Pamlico estuarine system and the Tar-Pamlico River. Exhibits describe how they function and how they have both influenced and been influenced by human activity. For more information call (252) 974-1044 or visit the estuarium web site at www.washington-nc.com/estuarium/

The geology of the Tar-Pamlico River basin has an affect on both stream water quality and water quantity, including the ability of surface waters to assimilate wastes from runoff and treatment plants. The US Geological Survey (USGS) has defined ten low flow hydrologic areas for North Carolina. This information helps to describe flow characteristics in the Tar-Pamlico basin. Areas were defined by relating topography, geology, mean annual runoff and other features to low flow frequency characteristics including 7Q10 (annual minimum 7-day consecutive low flow, which on average, will be exceeded in 9 out of 10 years) and 30Q2 (annual minimum 30-day consecutive low flow, which on average, will be exceeded in 1 out of 2 years). The ten hydrologic areas typically form a southwest-northeast band across the state and lie within three physiographic areas - the Coastal Plain, the eastern and central Piedmont, and the western Piedmont and mountains (Giese and Mason, 1993). In general, the lowest potential for sustaining base flow to streams is in the clay and sandy soil areas of the Coastal Plain. As evidenced by the following discussion of the types of hydrologic areas in the basin, the majority of the Tar-Pamlico is characterized by low flow conditions.

The geology of the Coastal Plain physiographic area (in which the majority of the basin is contained) consists of alternating layers of sand, silt, clay and limestone. This area was divided into three hydrologic areas based on soil types and topography. These are clay soils, sandy soils and the Sand Hills. With the exception of the Sand Hills area, topographic relief is relatively flat, with the land surface dipping coastward at a rate of only a few feet per mile.

The large coastal plain area of the Tar-Pamlico basin is composed of clay soils and sandy soils. The clay soils have the lowest low flow values of the three Coastal Plain hydrologic areas (median 7Q10 is 0 cubic feet per second per square mile). Sandy soils have intermediate values (median 7Q10 is 0.006 cubic feet per second per square mile). The low topographic relief of these hydrologic areas (1 to 2 feet per mile) reflects the low hydraulic gradient and reduced potential to move water to streams than in areas with greater topographic relief. The lower low flow values for clay soils versus sandy soils result from the lower permeability of clay soils and that a higher percentage of precipitation that falls on clay soils is not absorbed and runs off directly into streams. Clay soils also have lower hydraulic conductivity than sandy soils, and thus, contribute less to base flow of streams than sandy soils.

There are two hydrologic areas in the Piedmont portion of the upper Tar-Pamlico basin. These hydrologic areas are called the Eastern Slate Belt and the Raleigh Belt, the latter of which is the region that is the furthest west. The Eastern Slate Belt is underlain by nearly impermeable types of rocks. The eastern portion of this hydrologic area contains overlaying soils more typical of the Coastal Plain. This area is characterized by very low flows, with a median 7Q10 value of 0 $[ft^3/s]/mi^2$ (as in the Coastal Plain). The Raleigh Belt hydrologic area is more rocky in nature, and low flow values are generally higher. The median 7Q10 for this area is 0.065 cubic feet per second per square mile.

2.3.3 Soil Conditions

A good indicator of the extent of use limitations posed by saturated soil conditions is the percentage of hydric soils in a given area. In these areas with high moisture content, activities such as agriculture, development and land application of wastewater are compromised. The presence of hydric soils has also been used to determine the extent of wetlands prior to European settlement.

Table A-5 presents the percentage of hydric soils in 10 of the 16 counties in the Tar-Pamlico River basin. These ten counties generally encompass the Coastal Plain portion of the basin. Of these ten, five (Hyde, Dare, Washington, Beaufort and Martin) have over 50 percent, and as much as 97.3 percent of their land area classified as hydric soils based on USDA soil classification. These five make up the outer Coastal Plain portion of the basin. The percentage of land area in the other five Coastal Plain counties, which generally represent the inner Coastal Plain portion of the basin, ranges from about 30 percent for Nash and Halifax counties to nearly 50 percent for Pitt County.

Table A-5 Percentage of Land Surface in Hydric Soils for Selected Counties in the Tar-Pamlico River Basin

County	Hydric Soils	County	Hydric Soils
Hyde	97.3%	Pitt	46.7%
Dare	89.7%	Wilson	38.3%
Washington	85.6%	Edgecombe	34.8%
Beaufort	71.4%	Halifax	30.0%
Martin	53.4%	Nash	29.5%

2.4 Land Cover

The most recent land cover information for the Tar-Pamlico River basin is based on satellite imagery collected from March 5, 1993 through March 20, 1995 and ground condition data collected in 1996. The source of the data is the North Carolina Corporate Geographic Database. Land cover data is divided into 24 categories. For the purposes of this report, those categories have been condensed into five broader divisions that are summarized by basin and subbasin in Table A-6.

Table A-6 Land Cover in the Tar-Pamlico Basin

	Urban		Cultivated Crop		Managed Herb./Past.		Forest/Wetland		Water		Totals	
Subbasin	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%
03-03-01	6,050.00	1.47%	50,116.20	12.20%	36,200.30	8.80%	315,331.10	76.70%	3,199.20	0.80%	410,896.80	11.50%
03-03-02	12,888.10	3.04%	115,006.00	27.10%	19,687.00	4.60%	272,301.50	64.20%	4,280.20	1.00%	424,162.80	11.90%
03-03-03	5,752.60	2.12%	109,668.00	40.50%	6,245.80	2.30%	148,155.30	54.70%	1,169.20	0.40%	270,990.90	7.60%
03-03-04	1,245.90	0.20%	129,163.00	22.60%	17,985.80	3.10%	421,470.80	73.80%	1,591.30	0.30%	571,456.80	16.00%
03-03-05	4,382.10	2.30%	62,763.70	33.00%	5,696.10	3.00%	115,337.80	60.60%	2,166.60	1.10%	190,346.30	5.30%
03-03-06	943.08	0.60%	49,519.10	31.90%	5,786.00	3.70%	98,623.20	63.50%	442.00	0.30%	155,313.38	4.40%
03-03-07	3,453.20	0.50%	193,903.00	25.50%	7,798.50	1.00%	422,913.10	55.50%	133,526.80	17.50%	761,594.60	21.40%
03-03-08	1,580.60	0.20%	57,295.20	7.30%	1,737.50	0.20%	166,003.30	21.30%	554,079.90	71.00%	780,696.50	21.90%
Totals	**36,295.58**	**1%**	**767,434.20**	**22%**	**101,137.00**	**3%**	**1,960,136.10**	**55%**	**700,455.20**	**20%**	**3,565,458.08**	**100.00%**

Land Cover Type - Land Cover Description

Urban (U) - Greater than 50% coverage by synthetic land cover (built-upon area) and municipal areas.

Cultivated (CC) - Areas that are covered by crops that are cultivated in a distinguishable pattern (such as rows).

Pasture/Managed Herbaceous (P/Mgd) - 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 (F/Wet) - Includes hardwood swamps, shrublands and all kinds of forested areas (such as needleleaf evergreens, conifers, deciduous hardwoods)

Water (H20) - Areas of open surface water, areas of exposed rock, and areas of sand or silt adjacent to tidal waters and lakes.

Figure A-5 provides an illustration of the relative amount of land area that falls into each cover type for the entire Tar-Pamlico Basin. In Section B of this plan, which provides detailed discussions of each of the eight subbasins in the basin, land cover data specific to each subbasin is presented.

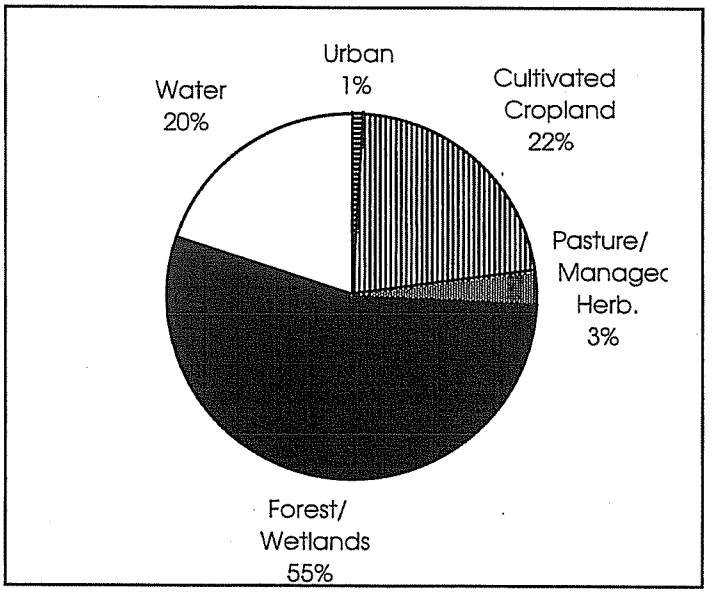


Figure A-5 Overall Percentages of Land Cover Categories in the Tar-Pamlico River Basin

Unfortunately, due to differences in the system of categorizing various land cover classes, it is not possible to establish trends in land cover changes by comparing this data set to that which was generated using satellite imagery during the Albemarle-Pamlico Estuarine Study. However, it is anticipated that comparisons will be possible with future satellite data since a strong consensus-based effort was made to develop the classification system that was used with the 1996 data.

The US Department of Agriculture's Natural Resource Conservation Service conducted a Natural Resources Inventory in both 1982 and 1992 which does allow for comparison of land cover data across time. These data for the Tar-Pamlico River basin are illustrated in Figure A-6. These data indicate that during that time period there was a dramatic increase in the amount of uncultivated cropland and a fairly strong increase in the amount of developed or urban land.

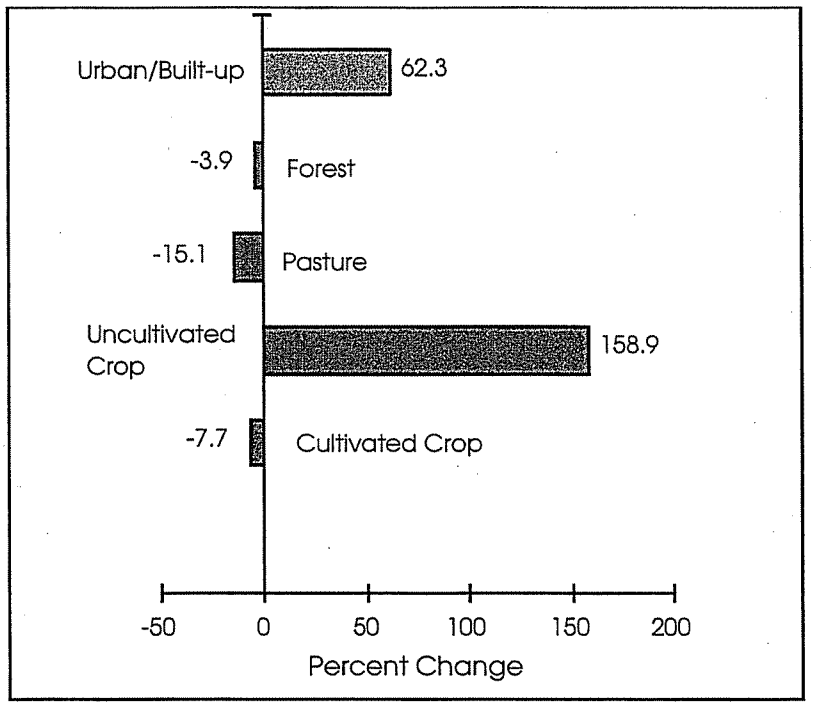


Figure A-6 Land Cover Changes in the Tar-Pamlico River Basin: 1982-1992 (USDA NRCS)

2.5 Population and Growth Trends

The Tar-Pamlico River basin includes both densely populated areas (around the larger municipalities) and more sparsely populated, rural areas. Figures A-7 and A-8 geographically present population density and growth information, based on 1990 census data. Table A-7 presents census data for 1970, 1980 and 1990 for each subbasin. It also includes land areas and population densities (persons/square mile) by subbasin based on the land area (excludes open water) for each subbasin. Based on this information, during the last census period (1980 to 1990) there was an 8 percent increase in the population of the Tar-Pamlico basin during those 10 years. This is compared to a statewide population growth of 12.7 percent during the same time period.

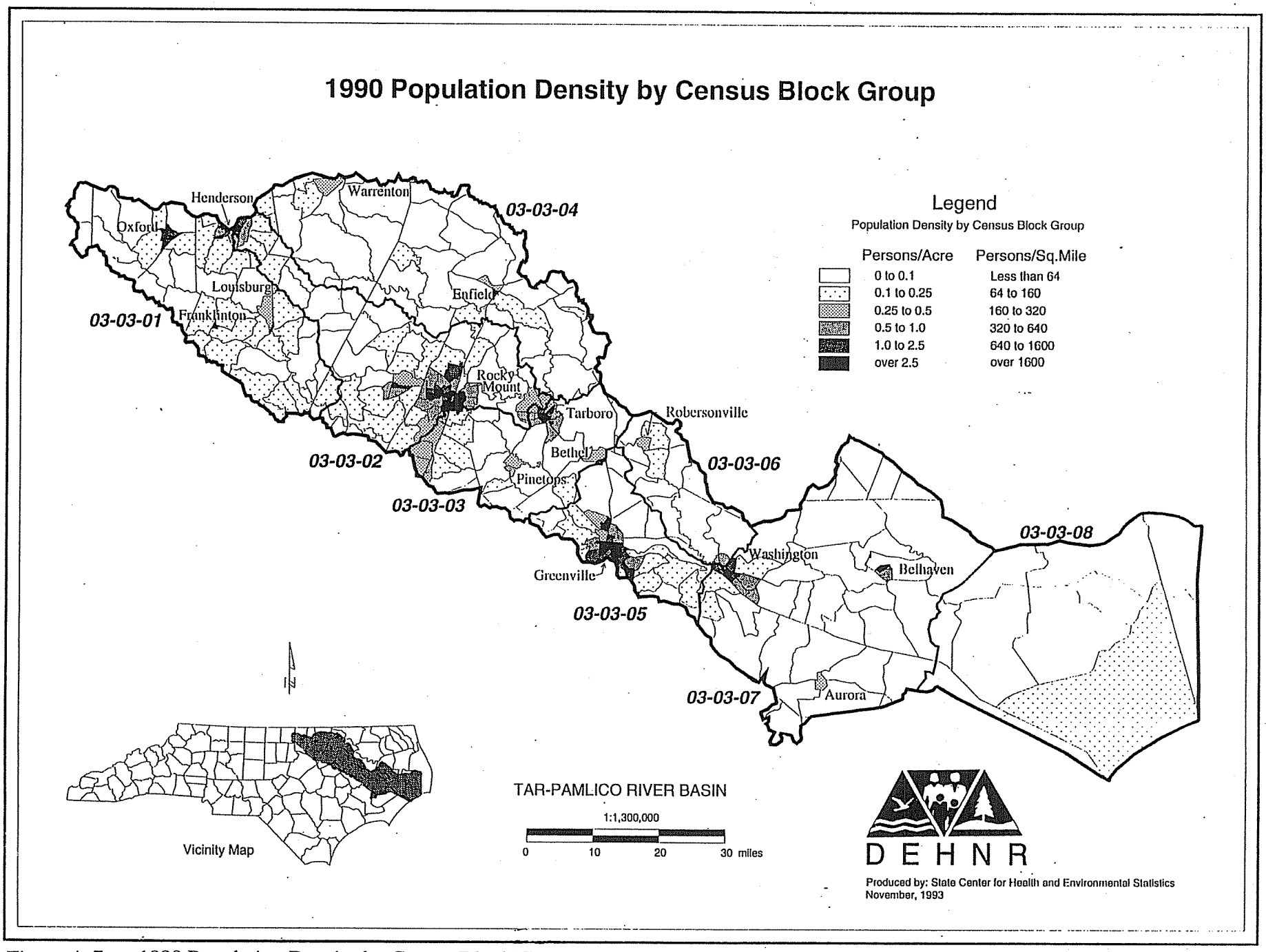


Figure A-7 1990 Population Density by Census Block Group

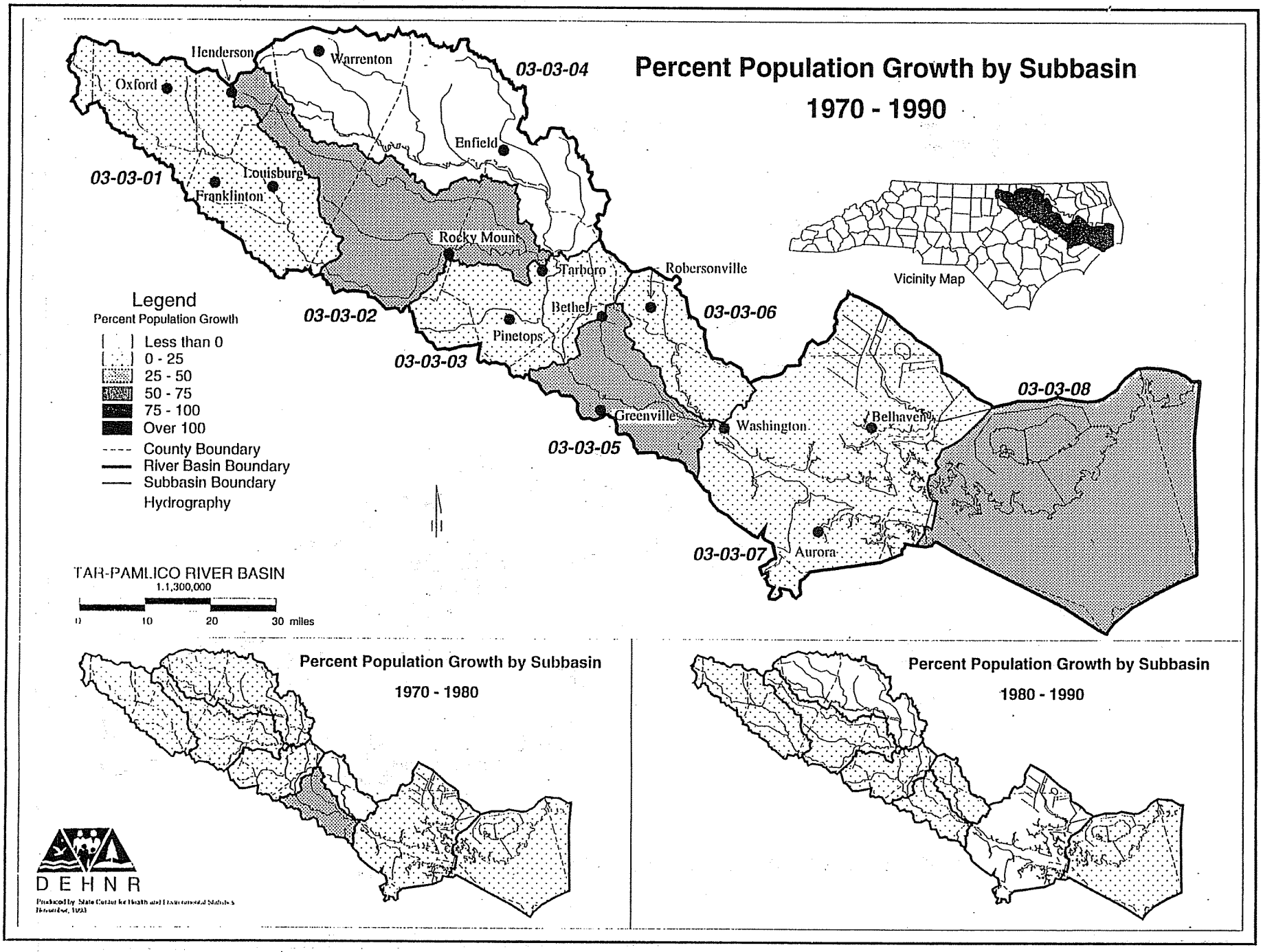


Figure A-8 Population Growth by Subbasin (1970 to 1990)

Table A-7 Tar-Pamlico Subbasin Population (1970, 1980 and 1990) and Land Area Summaries

SUBBASIN	POPULATION (Number of Persons)			POPULATION DENSITY (Persons/Square Mile)			LAND AND WATER AREAS			
							Total Land and Water Area		Water Area	Land Area
	1970	1980	1990	1970	1980	1990	(Acres)	(Sq. Miles)	(Sq. Miles)	(Sq. Miles)
03-03-01	47,485	51,559	57,544	72	78	87	424,960	664	3	661
03-03-02	76,629	87,672	100,777	121	138	159	408,320	638	3	635
03-03-03	43,867	47,474	48,211	104	112	114	272,000	425	2	423
03-03-04	37,369	38,860	35,582	42	43	40	572,800	895	1	894
03-03-05	44,039	56,615	65,799	150	193	225	189,440	296	3	293
03-03-06	13,626	13,043	14,177	56	54	58	155,520	243	0	243
03-03-07	33,727	38,869	37,658	34	39	38	762,880	1,192	206	986
03-03-08	4,000	4,111	5,114	10	10	12	784,000	1,225	813	412
TOTALS	300,742	338,203	364,862	66	74	80	3,569,920	5,578	1,031	4,547

In order to provide more up-to-date population statistics for the Tar-Pamlico basin, an attempt has been made to estimate the population for the basin (and its individual subbasins) for 1996 and 2016 (see Table A-8). In order to do this, population data by subbasin, generated for the first basin plan using 1990 census data, was used in conjunction with population statistics by county from the NC Office of State Planning for the years 1996 and 2016. Subbasins were broken into counties, and estimated percentages for the amount of the subbasin in each county were assigned and used to determine an estimate of the number of people in each county's portion of the subbasin in 1990. Then, 1990-1996 growth rates for each county (from the NC Office of State Planning) were applied to those numbers to provide an estimated number of people in each county's portion of each subbasin for 1996. Those estimates could then be summed for each subbasin. Similarly, the county data was used to project the growth in each subbasin into the year 2016 using county growth rates from the Office of State Planning. It is recognized that these numbers are rough estimates; however, they can provide a general sense of future population conditions in the Tar-Pamlico basin.

Table A-8 Estimated Population Statistics for the Years 1996 and 2016 for Subbasins in the Tar-Pamlico River Basin

Subbasin	Population in 1990	Estimated Population in 1996	Estimated % Growth 1990 - 1996	Estimated Population in 2016	Estimated % Growth 1996 - 2016
03-03-01	57,544	64,665	12%	82,603	28%
03-03-02	100,777	109,976	9%	133,201	21%
03-03-03	48,211	48,063	-0.3%	49,125	2%
03-03-04	35,582	36,961	4%	39,285	6%
00-03-05	65,799	72,059	10%	94,549	31%
03-03-06	14,177	14,889	5%	16,042	8%
03-03-07	37,658	38,107	1%	39,534	4%
03-03-08	5,114	4,958	-3%	5,514	11%
Totals	364,862	389,676	7%	459,853	18%

These figures are generally consistent with those for the years of 1970-1990, except that a higher rate of growth is predicted for subbasin 03-03-01 for the 20-year period between 1996 and 2016. This subbasin contains the municipalities of Franklinton and Louisburg and a portion of Franklin County, which is projected to experience a 63% increase in population from 1990-2016. Other subbasins with a robust growth rate are 03-03-02 and 03-03-05, which include the larger municipalities of Rocky Mount and Greenville, respectively.

2.6 Natural Resources

2.6.1 Fish and Shellfish Resources

North Carolina's commercial and recreational fisheries resources are both nationally and regionally significant. Based on data from 1987-1991, commercial harvest of fish and shellfish in North Carolina produces an average of 180.6 million pounds of marketable resource each year (Division of Marine Fisheries (DMF), 1993). The annual economic value of this resource is $1 billion and is a critical component of North Carolina's coastal economy. Management of these fisheries resources has recently become a critical issue in the state as fisheries are threatened by overfishing, habitat loss and water quality decline.

In the Tar-Pamlico River basin, there are approximately 264 seafood dealers and 4,419 endorsement vessels fishing the waters of the Pamlico River, the Pungo River and Pamlico Sound (DMF, 1998). Crabs are a particularly important fishery resource in the basin with over 7,000,000 pounds harvested from the Pamlico River during the 1997-1998 fiscal year. During that same year, over 17,000,000 pounds of crabs were taken from the Pamlico Sound.

The DMF classifies certain portions of the state's coastal waters as fishery nursery areas. Primary nursery areas (PNAs) are those areas in estuarine waters where initial post-larval development takes place. Secondary and special secondary nursery areas are those areas in estuarine waters where later juvenile development takes place. Although both areas are

important to the subsistence of coastal fisheries, populations in secondary nursery areas are not as vulnerable as the younger, less-developed larval population in the PNAs. As can be seen in Figure A-9, many of the headwaters of tributaries to the lower Pamlico River and the Pamlico estuary are primary or secondary nursery areas.

Some fish species such as river herring, shad, striped bass and sturgeon spend the majority of their life in saltwater, but migrate to freshwater areas to spawn. In the Tar-Pamlico basin, such species migrate upstream as far as Rocky Mount and Enfield in Nash and Halifax counties. Figure A-10 illustrates the location of anadromous fish spawning areas in the Tar-Pamlico River basin.

2.6.2 State Parks

Two state parks are located within the Tar-Pamlico River basin: Goose Creek and Medoc Mountain State Parks. Goose Creek State Park is located at the confluence of the Pamlico River and Goose Creek. Established in the early 1970s, the park is 1,596 acres in size. The park is known for its diversity of plant and animal life as it encompasses a number of high quality natural communities. As many as 11 different types of natural communities are found here. The US Department of Interior designated a portion of the park a National Natural Landmark due to the brackish and freshwater communities exemplary of the mid-Atlantic coast. A regional environmental education center was recently constructed. Many water-based activities are popular, including swimming, fishing, boating and canoeing.

Medoc Mountain State Park is found where the Little Fishing and Bear Swamp Creeks meet. This occurs near the fall line separating the piedmont and coastal plain regions. Established in 1973, the park is 2,380 acres in size and contains some high quality forest communities. Little Fishing Creek is one of the park's primary natural features, and it attracts many canoeists. Several rare aquatic species are found in the park, including the Neuse River waterdog (*Necturus lewisi*), an amphibian species of Special Concern in the state. An inventory of fish and aquatic invertebrates was conducted in 1996 by the NC Wildlife Resources Commission in the Little Fishing Creek subbasin near the park. Results indicate a great abundance and diversity of snails, and a good diversity and abundance of mussels, crayfish and fish. One fish species of Special Concern, the Carolina madtom (*Notorus furiosus*), was found. Reproducing populations of three rare mussel species also occur in Little Fishing Creek, making it very significant biologically.

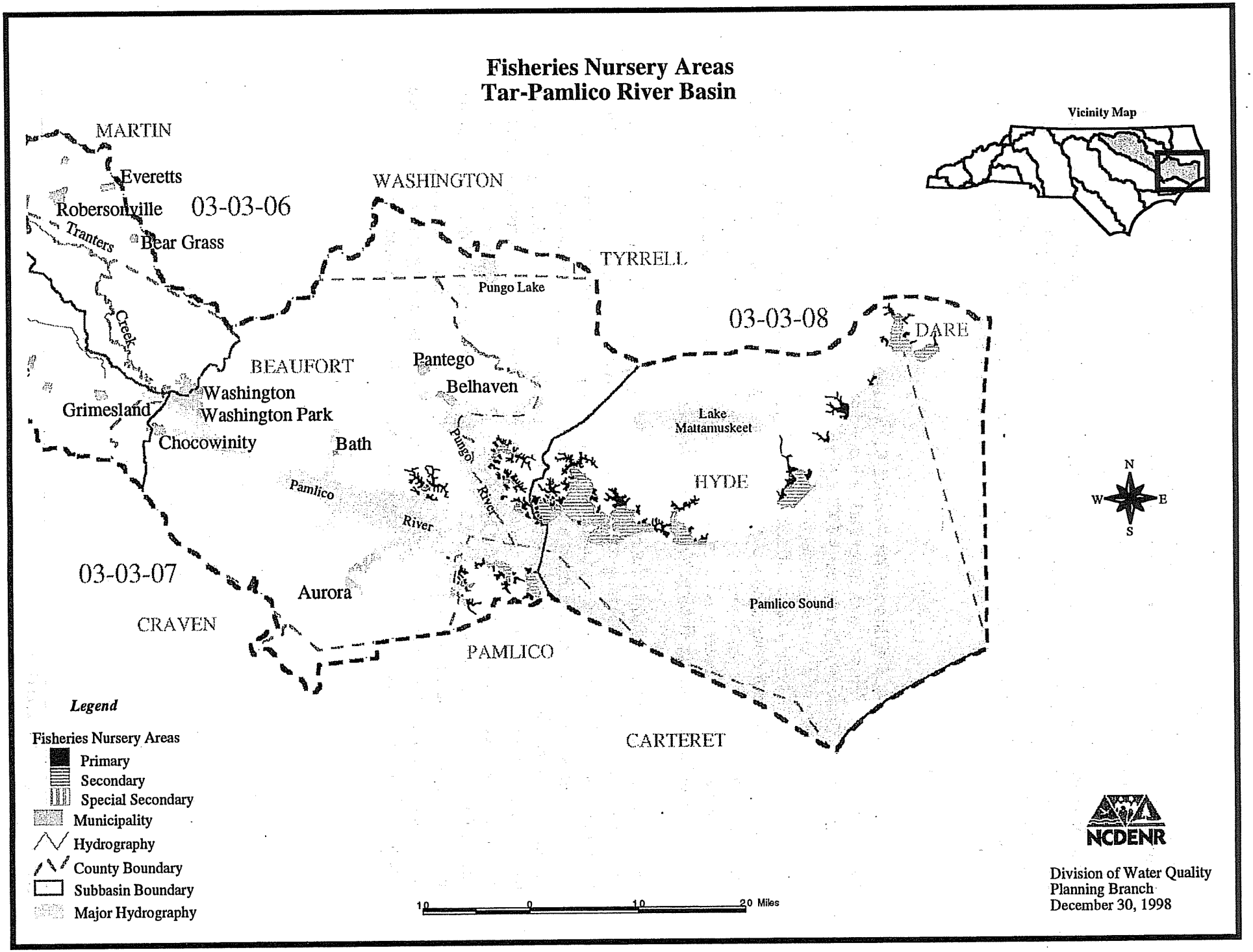


Figure A-9. Fisheries Nursery Areas in the Tar-Pamlico River Basin

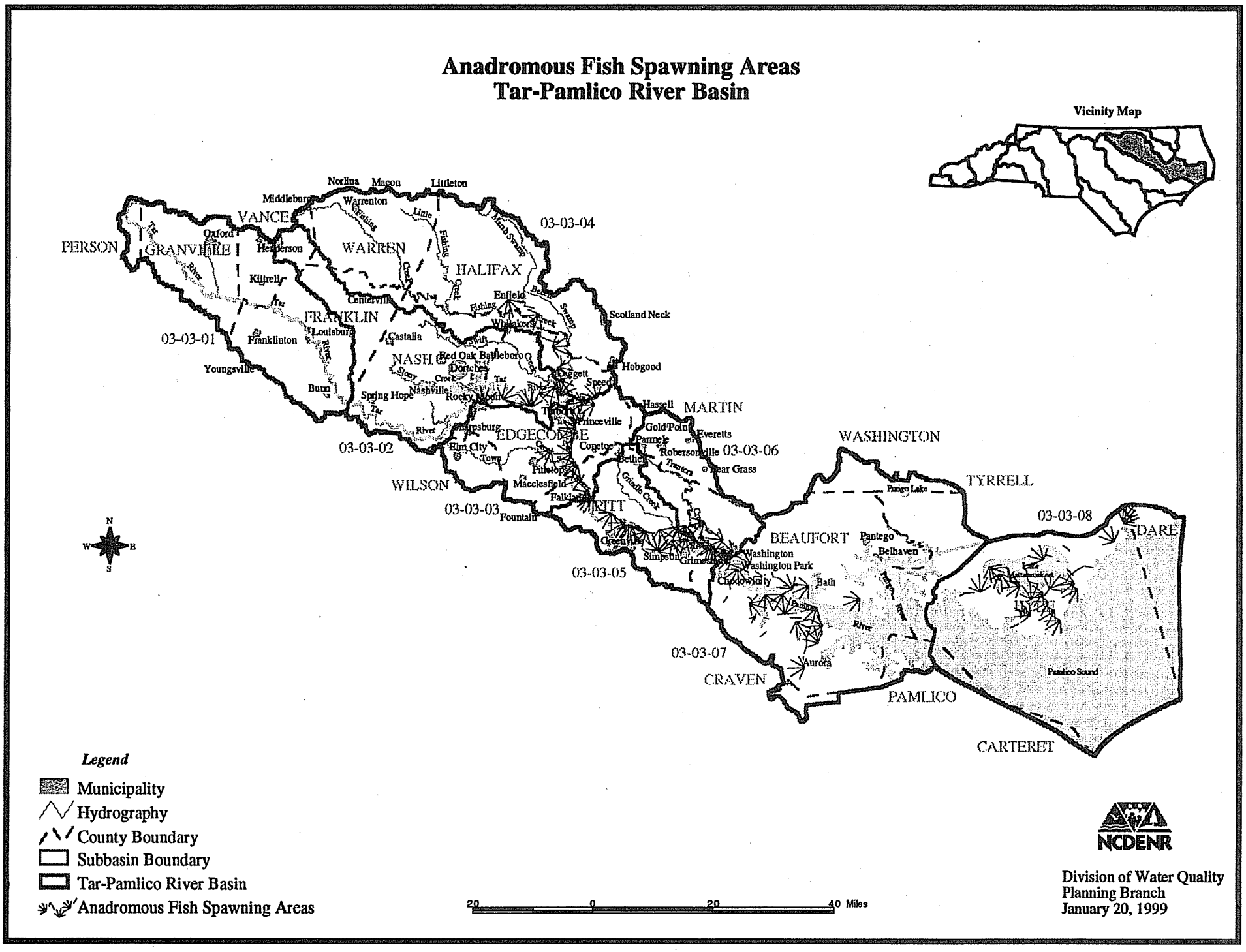


Figure A-10 Anadromous Fish Spawning Areas in the Tar-Pamlico River Basin

2.6.3 Ecological Significance of Tar-Pamlico River Basin

From the headwaters to the Pamlico Sound, the Tar-Pamlico River basin contains many elements of ecological significance. One reason for the variety of species and wetland communities is that the basin encompasses several ecological regions. The unique character of each of these regions allows different species and different natural communities, or assemblages of plants and animals, to become established.

Waterways in the Tar-Pamlico River basin support a healthy diversity of freshwater fishes, although their continued existence is dependent upon maintaining good water quality and undisturbed stream habitats. Nearly 800 freshwater fish species occur in North America north of Mexico (Page and Burr, 1991). Of these, more than 225 species occur in North Carolina, and nearly 100 of these are found in the Tar-Pamlico drainage basin (Menhinick, 1991). Because of water pollution and sedimentation, many aquatic species are now isolated in small areas of streams, creeks and rivers; their confined distribution makes them highly vulnerable to extirpation (Alderman, 1997). At present, nearly a quarter of North Carolina's freshwater fish species are listed as Endangered, Threatened or as species of Special Concern by the NC Wildlife Resources Commission.

The most significant aquatic habitats in the Tar-Pamlico River basin are in the Piedmont portion of the watershed, from the headwaters of the Tar River in Person County to the fall line, which separates the Piedmont from the Coastal Plain. These aquatic habitats -- especially Swift Creek, Fishing Creek, the upper Tar River and their tributaries -- support many rare aquatic species, including fish and amphibians such as the Roanoke bass and the Neuse River waterdog. However, the most outstanding biological feature of these streams, creeks and rivers is the variety of rare freshwater mussel species. In all, there are twelve known species of rare freshwater mussels within the upper Tar, Swift Creek and Fishing Creek subbasins. Also, at least one species, the Tar River spinymussel, is endemic, which means that it occurs nowhere else on earth.

In the Coastal Plain region, which covers Edgecombe and eastern Halifax counties down to the Pamlico Sound, the most significant ecological features are the numerous wetland natural communities. These wetland types range from swampy floodplain forests of the Tar River and its tributaries to vast, flat estuarine, tidal and nonriverine wetlands on the margins of Pamlico Sound. Many species, some of them rare, occupy these wetland habitats.

Of particular interest in the Coastal Plain wetlands are several species of rare birds. Some, such as the American bittern, northern harrier and yellow rail, are associated with coastal fresh or brackish marshes, while birds like the anhinga occupy wooded lakes, ponds or open freshwater swamps for nesting. The federally endangered red-cockaded woodpecker is found in mature, open pine forests. Bald eagles in the Tar-Pamlico River basin are associated with mature forests near large bodies of water, such as lakes and sounds. Other birds, including the snowy egret, little blue heron and tricolored heron, are rare birds that inhabit forests or thickets on maritime islands. Lake Mattamaskeet in Hyde County is one of the state's most popular overwintering spots for waterfowl and songbirds.

In addition to rare animal species, the wetlands of the Tar-Pamlico River basin offer habitat for rare plants. Rare plants found in Coastal Plain Bottomland Forests include: Carolina least trillium (*Trillium pusillum* var. *pusillum*), buttercup phacelia (*Phacelia covillei*) and Eastern isopyrum (*Enemion biternatum*). Tidal Freshwater Marshes may contain saltmarsh spikerush (*Eleocharis halophila*), beaked spikerush (*Eleocharis rostellata*) and riverbank quillwort (*Isoetes riparia*), while rare plants found in Nonriverine Swamp Forests may include crowfoot sedge (*Carex crus-corvi*), shadow-witch (*Ponthieva racemosa*) and yellow water-crowfoot (*Ranunculus flabellaris*).

Significant Natural Heritage Areas

Figure A-11 is a map of the Significant Natural Heritage Areas of the Tar-Pamlico River basin. The North Carolina Natural Heritage Program (NHP) compiles a list of Significant Natural Heritage Areas as required by the Nature Preserves Act. The list is based on the program's inventory of natural diversity in the state. Natural areas are evaluated on the basis of the occurrences of rare plant and animal species, rare or high quality natural communities, and geologic features. The global and statewide rarity of these elements and the quality of their occurrence at a site relative to other occurrences determine a site's significance. The sites included on this list are the best representatives of the natural diversity of the state, and therefore, have priority for protection. Inclusion on the list does not imply that any protection or public access exists.

Sites that directly contribute to the maintenance of water quality in the Tar-Pamlico basin are highlighted on the map and in the following text. More complete information on Significant Natural Heritage Areas may be obtained from the Natural Heritage Program.

1. Upper Tar Basin Aquatic Habitats

The streams and creeks of the upper Tar River, Swift Creek and Fishing Creek subbasins are outstanding aquatic habitats for many aquatic species, including twelve species of rare freshwater mussels, as well as rare fishes and amphibians. The Swift Creek subbasin, in particular, has been identified as possibly the most significant lotic creek ecosystem remaining along the Atlantic Seaboard (Alderman, et al., 1993). It contains populations of eleven rare freshwater mussel species, as well as two rare fish species and two rare amphibian species. However, the numbers alone do not provide the full picture of the species diversity present in the Swift Creek subbasin. Although the Swift Creek subbasin covers less than 300 square miles, it provides habitat for more than 7% of the fish species found on the North American continent north of Mexico and provides habitat for nearly 29% of the fish species present in the Atlantic drainages in North Carolina (Alderman, 1997).

Protection of water quality is crucial to maintaining the outstanding freshwater biodiversity of the upper Tar River basin. Toward that goal, efforts have been made to protect the riparian buffers along the waterways of the upper Tar basin. Champion International, a forest products company, has pledged to maintain 32 miles of riparian buffer within their ownership in these subbasins. The North Carolina Clean Water Management Trust Fund has dedicated funds to purchase conservation easements on properties adjoining the waterways to protect them from uses that would impact the quality of the waters. The Division of Soil and Water Conservation,

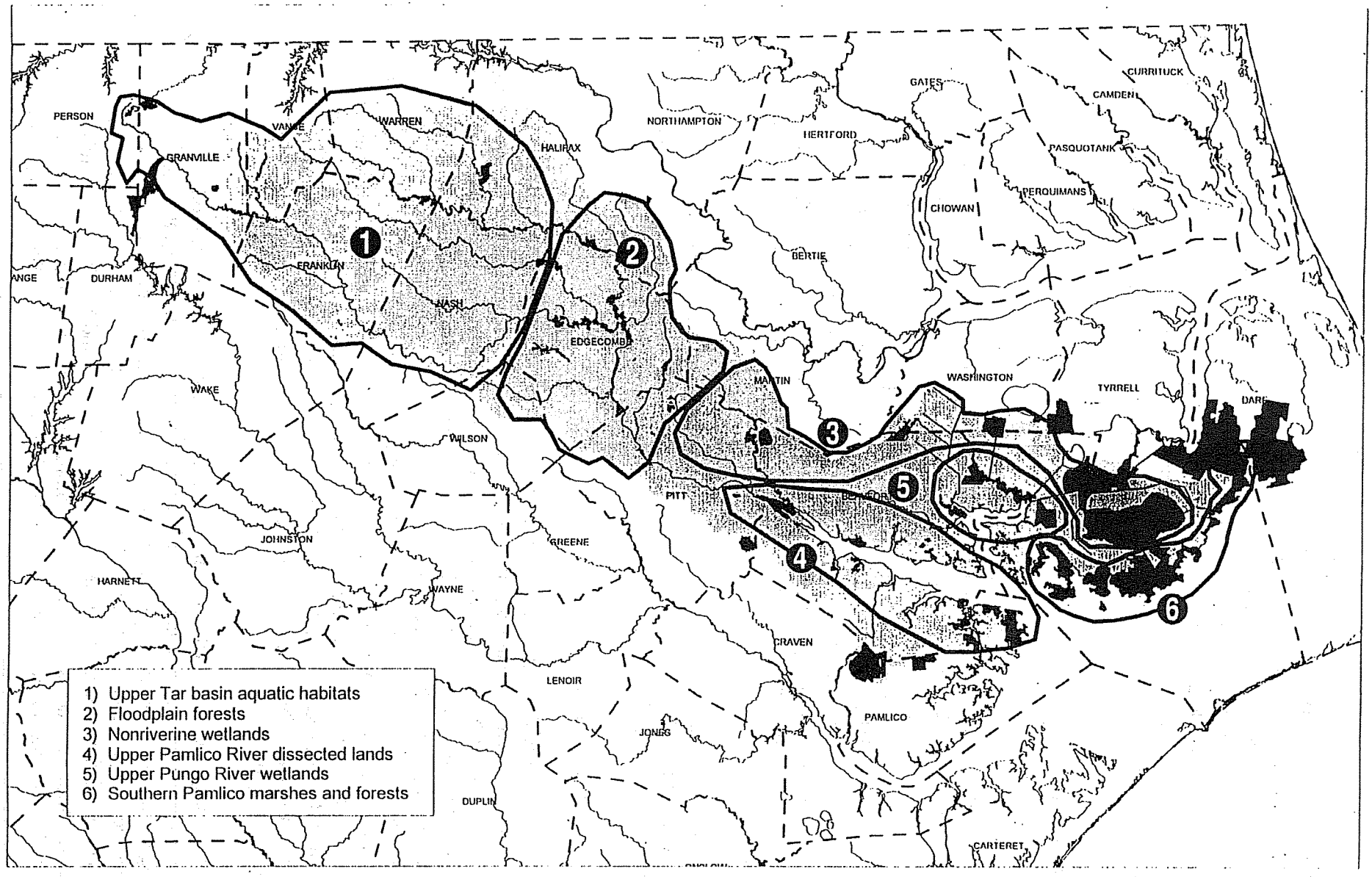


Figure A-11 Significant Natural Areas in the Tar-Pamlico River Basin

in cooperation with other farm agencies, has encouraged the use of best management practices (BMPs) on farms to reduce the amount of sediment and nutrients entering waterways.

2. Floodplain Forests

The floodplain forests of Swift Creek, Fishing Creek and the Tar River in Edgecombe County contain patches of extensive, high quality natural wetland communities with many special features. The best quality swamps contain collections of characteristic swamp forest species, and a few examples exhibit tremendous diversity, with over 45 species of trees in the canopy. Some also contain rare plants, such as yellow water-crowfoot (*Ranunculus flabellaris*). The floodplain communities in this area consist of Coastal Plain Levee Forest (Brownwater Subtype), Coastal Plain Bottomland Hardwoods (Brownwater Subtype), Cypress–Gum Swamp (Brownwater Subtype), Coastal Plain Small Stream Swamps (Blackwater Subtype), as well as other bottomland communities.

Although clearing of land up to the riverbanks has occurred in some areas, the river corridor is predominantly forested. The forested buffers provide habitat for a diversity of bird species, including bald eagles, ospreys, kingfishers, great blue herons, little blue herons, green herons, red-shouldered hawks, pileated woodpecker, Carolina wren and Carolina chickadees.

Several of the individual sites that make up the Tar River floodplain forests include: the Tar River Floodplain, Swift Creek Swamp Forest, Fishing Creek/Enfield Bottomland, Conetoe Creek Bottomland Forest, Fishing Creek Floodplain Forest and Tar River/Blue Banks Farm Slopes. Additional high quality bottomland sites may remain to be discovered.

3. Nonriverine Wetlands

Several examples of high quality nonriverine wetlands are found within the Coastal Plain ecoregions of the Tar-Pamlico River basin. Some of the rarest nonriverine wetlands are found on mineral soils and are dominated by oak trees. These are referred to as Nonriverine Wet Hardwood Forests, and high quality examples in the basin include Bethel-Grindle Hardwoods in Pitt County and Scranton Hardwoods in Hyde County. There are very few Nonriverine Wet Hardwoods in North Carolina -- or anywhere else -- that have been protected for conservation, and these in the Tar-Pamlico River basin are some of the best examples remaining.

Nonriverine wetlands on organic soils include Nonriverine Swamp Forests and Pocosins. Although both of these wetland community types are more common than Nonriverine Wet Hardwood Forests, high quality examples are still relatively rare. One high quality Nonriverine Swamp Forest being considered for acquisition by a conservation agency is Van Swamp, a 3500-acre swamp dominated by trees such as swamp black gum and red maple, with occasional bald cypress, loblolly pine, sweetbay and Atlantic white cedar. Several extensive pocosin communities, such as New Lake Fork Pocosin, are protected within the Pocosin Lakes National Wildlife Refuge, which lies to the north of Lake Mattamuskeet. Pocosins consist of low trees and shrubs atop several feet of peat soil and are unique wetlands found almost exclusively in North and South Carolina.

4. *Upper Pamlico River Dissected Lands*

Compared to other parts of the basin, there are few wetland areas along the upper Pamlico River. Rather, most of the Significant Natural Heritage Areas in the upper Pamlico River are uplands atop high bluffs. The bluffs are unusual features in an area generally characterized by low, flat wetlands. Proper management of these uplands is important for water quality, since a wetland buffer is limited.

5. *Upper Pungo River Wetlands*

The upper part of the Pungo River supports high quality natural wetlands of a diversity of types. They show a gradient from brackish marshes near Pamlico Sound to fresh marshes upstream. Inland, freshwater swamps of several types can be found. Reintroduction of periodic fire and some hydrological restoration may be needed to maintain the quality and diversity of these wetlands.

6. *Southern Pamlimarle Marshes and Forests*

Like the upper Pungo River wetlands, the northern edge of Pamlico Sound supports a large complex of high quality natural wetlands. This area is one of the largest expanses of brackish marsh in the state. Other high quality wetlands include some pocosins and Nonriverine Swamp Forests. Much of the area is protected as National Wildlife Refuge by the US Fish and Wildlife Service (i.e., Swanquarter and Alligator River National Wildlife Refuges) or as Game Land by the NC Wildlife Resources Commission (i.e., Gull Rock Game Land).

2.6.4 National Wildlife Refuges

There are three National Wildlife Refuges within the Tar-Pamlico River basin. Each one is individually described in this section.

Swanquarter National Wildlife Refuge

This refuge was established in 1932 and consists of 15,500 acres of marshland bordering Pamlico Sound in Hyde County. About 24,450 acres of the sound adjacent to this refuge have been closed to migratory waterfowl hunting by Presidential Proclamation. This refuge is a wintering ground for large numbers of Canada geese, pintails, black ducks, mallards and whistling swans.

Mattamuskeet National Wildlife Refuge

This refuge was established in 1934 and includes approximately 50,000 acres in Hyde County. The dominant feature of the refuge is Lake Mattamuskeet which is 18 miles long and 6 miles wide. This lake is the largest natural body of water in North Carolina. Cypress trees form most of the northern border of the lake while the eastern and southern shores are bordered by marsh and low swamplands. This refuge, like Swanquarter, is a wintering ground for a variety of birds. Ospreys nest in the low cypress trees at the northern edge of the lake. The pine woodlands at the back of the edge of the lake provide habitat for numerous small land birds.

Pocosin Lakes National Wildlife Refuge

This refuge was established in 1990 and is situated between the Albemarle and Pamlico Sounds in Washington, Hyde and Tyrrell counties. A portion of it, which surrounds Pungo Lake, is contained within the Tar-Pamlico River basin. The vegetation on the 107,718-acre refuge is predominantly southeastern shrub bog (pocosin), which is a unique habitat that supports a wide variety of mammals, reptiles and amphibians. A diverse fish population including largemouth bass, white perch, bluegill, chain pickerel and the longnose gar can be found in the refuge's lakes, rivers and canals. The refuge is undertaking large-scale restoration of the drained pocosin wetlands with restoration of the hydrology and planting of native wetland vegetation.

2.6.5 Water Supplies, Outstanding Resource Waters, High Quality Waters and Shellfishing Waters

Many waters in the Tar-Pamlico River basin have received a special surface water classification because of their high water quality or significance as a resource. Figures A-12 and A-13 identify the location of water supply watersheds, Outstanding Resource Waters (ORW) and High Quality Waters (HQW) in the upper and lower portions of the Tar-Pamlico River basin, respectively. All of these designations are applied through DWQ and come with regulatory measures to protect water quality. Surface water supplies, which are areas in the basin where water is taken from surface waters and then treated for human consumption, are prevalent in the upper Tar basin. The only existing ORW in the basin, the Swanquarter and Juniper Bay area, is located in the eastern portion of the basin adjacent to Pamlico Sound. Almost all of the waters east of the Pungo River are classified as SA for the protection of shellfish harvesting (Figure A-14).

2.7 Permitted Wastewater and Stormwater Discharge Facilities

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. Stormwater point source discharges include stormwater collection systems for municipalities which serve populations greater than 100,000 and stormwater discharges associated with certain industrial activities. 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.

The primary pollutants associated with point source discharges are:

* oxygen-consuming wastes,
* nutrients,
* color, and
* toxic substances including chlorine, ammonia and metals.

2.7.1 Wastewater Discharges in the Tar-Pamlico River Basin

There are 83 permitted wastewater discharges in the Tar-Pamlico River basin. Table A-9 provides summary information (numbers of facilities and permitted flows) regarding the

discharges by type and subbasin. The various types of dischargers characterized in the table are described in the inset box. A list of the dischargers is provided in Appendix VII. Ninety-two percent (92%) of the total wastewater flow in the basin is comprised by major facilities. Municipal facilities make up 65% of the total flow, followed by industrial facilities with 32%, and finally other types of discharges with a small 3% of the total flow.

Types of Wastewater Discharges

Major Facilities: Municipal Wastewater Treatment Plants with flows ≥1 MGD (million gallons per day); and some industrial facilities (depending on flow and potential impacts on public health and water quality).
Minor Facilities: Any facilities not meeting the definition of Major.
100% Domestic Waste: Facilities that only treat domestic-type waste (water from bathrooms, sinks, washers).
Municipal Facilities: Facilities that serve a municipality. Can treat waste from homes and industries.
Industrial Facilities: Facilities with wastewater from industrial processes such as textiles, mining, seafood processing, glass-making and power generation.
Other Facilities: This category includes a variety of facilities such as schools, nursing homes, groundwater remediation projects, water treatment plants and non-process industrial wastewater.

Figure A-15 provides a map showing the location of major and minor permitted wastewater discharges within the basin. The number of triangles on the map depicting major discharges do not correspond exactly to the number of major facilities listed in Table 11, since some major facilities have more the one outfall point. Each outfall point received its own triangle.

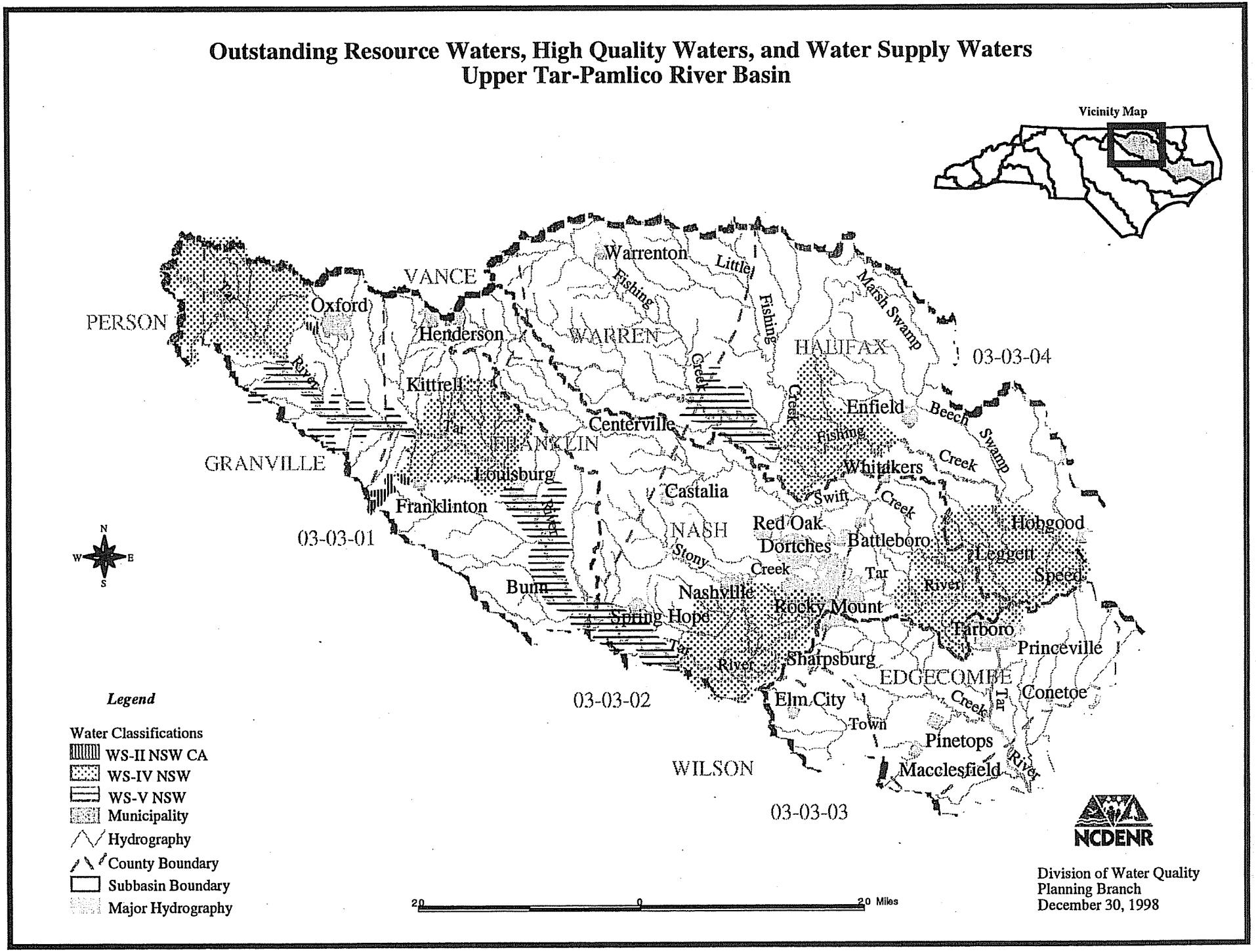
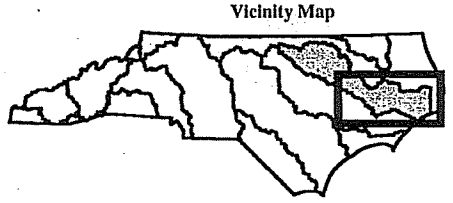


Figure A-12 Protective Surface Water Classifications in the Upper Tar-Pamlico River Basin

Outstanding Resource Waters, High Quality Waters, and Water Supply Waters
Lower Tar-Pamlico River Basin



MARTIN
Gold Point
Everetts
Parmele
Robersonville
03-03-06
Bethel
Tranters
Bear Grass
WASHINGTON
TYRRELL
Pungo Lake
Grindle Creek
Tar River
Creek
Greenville
BEAUFORT
Pantego
Belhaven
03-03-08
DARE
Simpson
Grimesland
Washington
Washington Park
Chocowinity
Bath
03-03-05
Lake Mattamuskeet
Pamlico River
Pungo River
HYDE
03-03-07
Aurora
Pamlico Sound
CRAVEN
PAMLICO
CARTERET

Legend

Water Classifications
- ORW
- HQW
- WS-IV NSW
- Municipality
- Hydrography
- County Boundary
- Subbasin Boundary
- Major Hydrography

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August 14, 1998

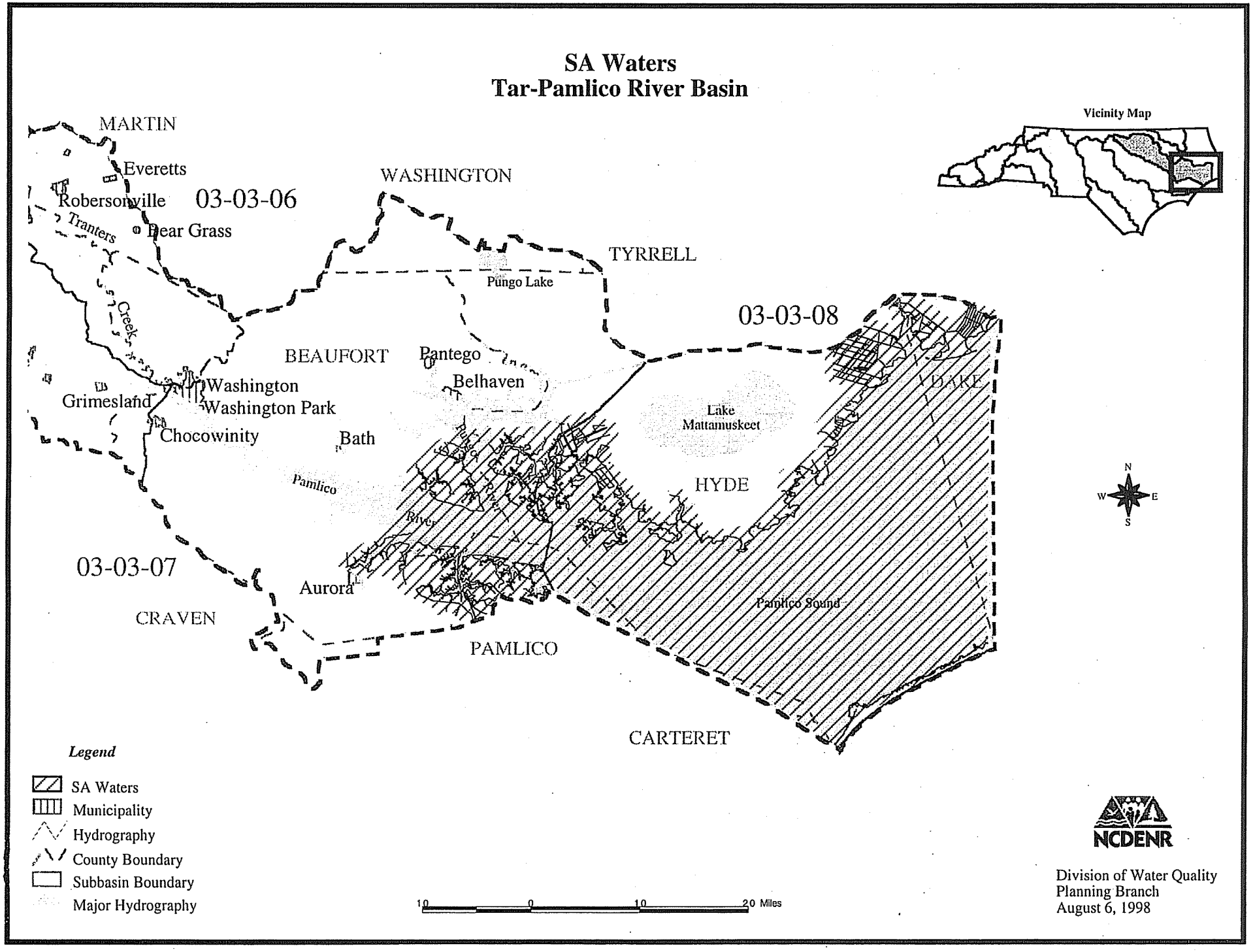


Figure A-14 Classified Shellfishing (SA) Waters in the Tar-Pamlico River Basin

Table A-9 Summary of NPDES Dischargers and Permitted Flows for the Tar-Pamlico River Basin

	Subbasin								
Facility Categories	**01**	**02**	**03**	**04**	**05**	**06**	**07**	**08**	**TOTAL**
Total Facilities	**19**	**16**	**5**	**9**	**4**	**4**	**25**	**1**	**83**
Total Permitted Flow (MGD)	4.3625	22.5539	6.325	3.5646	18.5	3.125	30.7505	0.0152	**88.1967**
Major Discharges	**3**	**1**	**1**	**1**	**1**	**1**	**3**	**0**	**11**
Total Permitted Flow (MGD)	4.04	21.0	5.0	2.0	17.5	1.8	29.37	0	**80.71**
Minor Discharges	**16**	**15**	**4**	**8**	**3**	**2**	**22**	**1**	**72**
Total Permitted Flow (MGD)	0.3225	1.5539	1.325	1.5646	1.0	0.325	1.3805	0.0152	**7.4867**
100% Domestic Waste	**13**	**3**	**3**	**6**	**1**	**1**	**4**	**0**	**31**
Total Permitted Flow (MGD)	3.8625	0.045	1.225	1.0646	1.0	0.005	0.072	0	**7.2741**
Municipal Facilities	**4**	**2**	**4**	**4**	**1**	**1**	**3**	**0**	**19**
Total Permitted Flow (MGD)	4.19	21.4	6.225	3.455	17.5	1.8	2.74	0	**57.31**
Industrial Facilities	**0**	**3**	**0**	**0**	**0**	**1**	**9**	**0**	**13**
Total Permitted Flow (MGD)	0	0.954	0	0	0	0.3	27.3892	0	**28.6432**
Other Facilities	**15**	**11**	**1**	**5**	**3**	**2**	**13**	**1**	**51**
Total Permitted Flow (MGD)	0.1725	0.1999	0.1	0.1096	1.0	0.025	0.6213	0.0152	**2.2435**

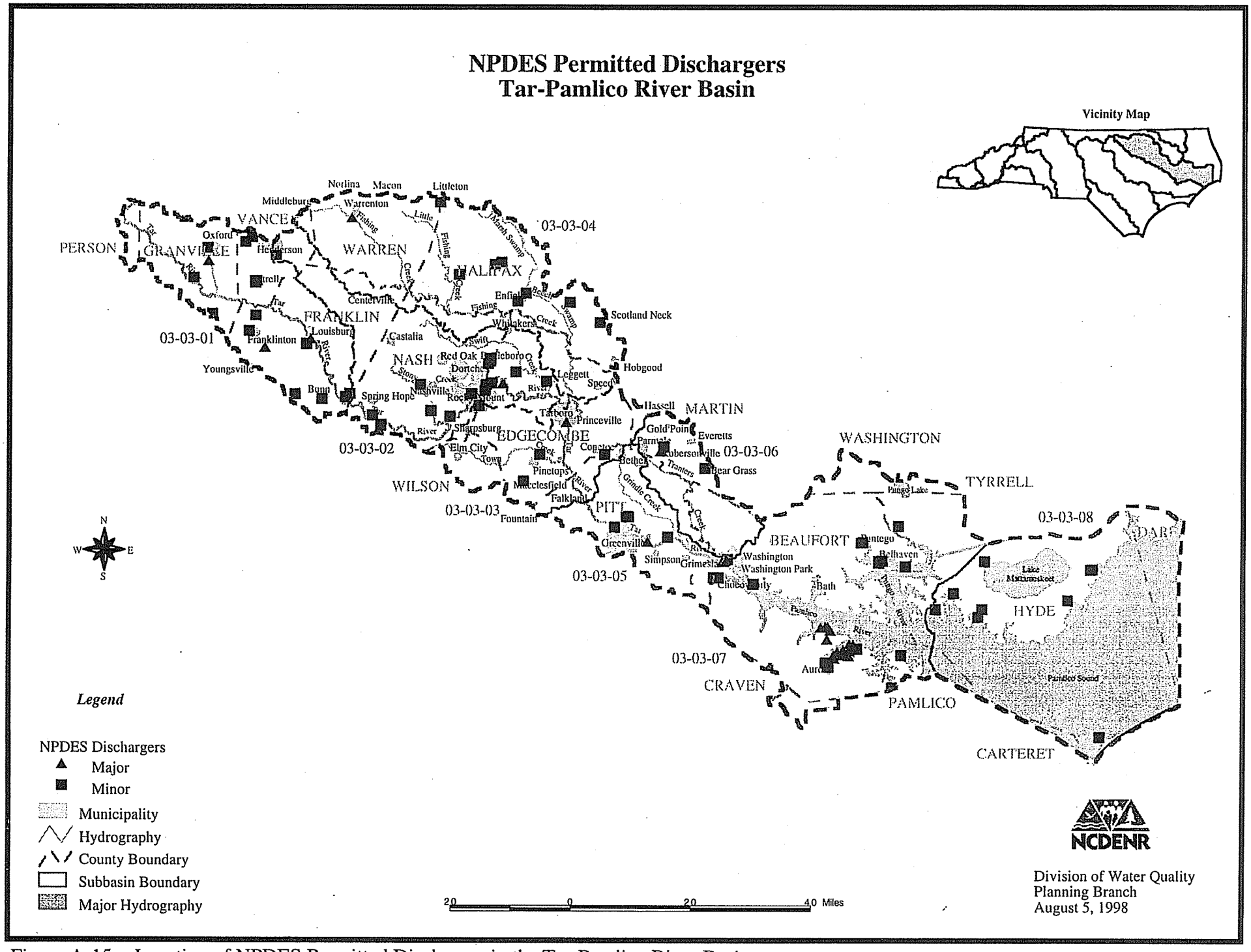


Figure A-15 Location of NPDES Permitted Discharges in the Tar-Pamlico River Basin.

2.7.2 Stormwater Discharges in the Tar-Pamlico River Basin

Excluding construction general permits, there are 168 general stormwater permits in the Tar-Pamlico River basin with the majority of them being in the wood products and metal fabricating industries. Of this total, there are 11 individual stormwater permits which are listed in Table A-10 below. A variety of activities are covered under general stormwater permits. Examples include construction, manufacturing of products, vehicle maintenance activities and landfills. Generally speaking, facilities that do not fit into general permit coverage require individual permits.

The primary source of concern from industrial facilities is the contamination of stormwater from contact with exposed materials. In addition, poor housekeeping can lead to significant contributions of sediment and other water quality pollutants. To address these issues, each NPDES stormwater permitted facility must develop a Stormwater Pollution Prevention Plan (SPPP) that addresses the facility's potential impacts on water quality. Facilities or activities identified as having significant potential to impact water quality are also required to perform analytical monitoring to characterize the pollutants in their stormwater discharges under individual NPDES stormwater permits.

Table A-10 Summary of Individual NPDES Stormwater Permits in the Tar-Pamlico River Basin

Permit #	Facility Name	Receiving Stream	Subbasin	County
NCS000115	Novo Nordisk Biochem	UT Buffalo Creek	03-03-01	Franklin
NCS000140	Certainteed Corporation	Hacher's Run, Fishing Creek	03-03-01	Granville
NCS000164	Perdue Farms, Inc.	UT Flat Swamp	03-03-06	Martin
NCS000171	Kenametal, Inc.	Joe's Branch, Martin Creek	03-03-01	Vance
NCS000281	Bandag, Inc.	UT Fishing Creek	03-03-01	Granville
NCS000302	Braswell Milling Company	UT Sapony Creek	03-03-02	Nash
NCS000305	Catalytica Pharmaceuticals	Parker Creek	03-03-05	Pitt
NCS000306	Perry Builders Outlet, Inc.	Rowland Pond, Sandy Creek	03-03-01	Vance
NCS000307	Perry Builders Outlet, Inc.	Ruin Creek, Joe's Branch	03-03-01	Vance
NCS000362	Amoco Fabric and Fibers Co.	Tar River	03-03-02	Edgecombe
NCS000363	Quality Forest Products, Inc.	Fishing Creek	03-03-04	Halifax

2.8 Agriculture

Agriculture is an extremely important component of the economy in the Tar-Pamlico River basin. As evidenced by the land cover data presented previously in this section, almost one-quarter of the entire area of the Tar-Pamlico basin is comprised of cultivated cropland. Within the entire state, Pitt County is ranked as number one in tobacco production and number two in wheat production, and Beaufort County is ranked as the top producer of corn, wheat and sorghum (NC Department of Agriculture, 1998).

Animal agriculture is also prominent in the Tar-Pamlico River basin. In the last several years, much attention has been given to this sector of agriculture due to concerns for environmental impacts associated with these operations. In 1992, the Environmental Management Commission 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 facilities are also required to obtain an approved waste management plan certification. In 1996, Senate Bill 1217 required any operator of a dry litter animal waste management system involving 30,000 or more birds to develop an animal waste management plan by January 1998. The plan must consist of 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.

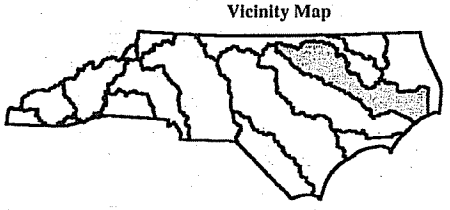
Table A-11 presents information on registered animal operations in the Tar-Pamlico River basin. Those facilities that have not yet received certification have entered into a special agreement with DWQ to do so by a date specified in each agreement. Figure A-16 provides a geographic presentation of the location of these operations within the basin.

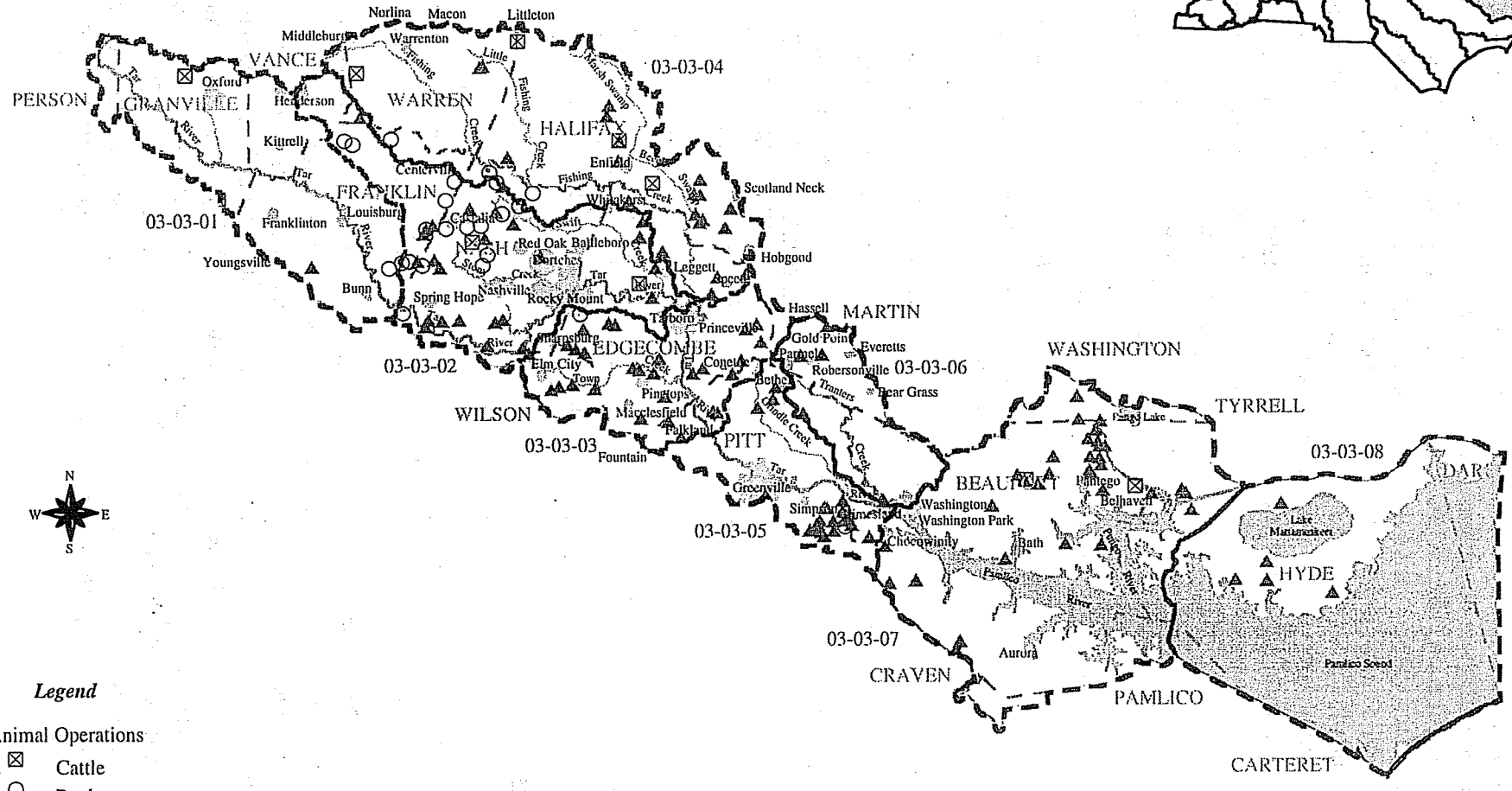
Table A-11 Registered Animal Operations in the Tar-Pamlico River Basin (as of 9/98)

Subbasin	Swine			Cattle			Poultry		
	No. of Facilities	Number Certified	No. of Animals	No. of Facilities	Number Certified	No. of Animals	No. of Facilities	Number Certified	No. of Animals
03-03-01	0	0	0	2	0	230	0	0	0
03-03-02	24	24	89,007	2	1	285	17	14	1,618,719
03-03-03	28	28	115,281	0	0	0	0	0	0
03-03-04	21	18	138,075	4	4	2,580	3	3	173,600
03-03-05	17	17	94,179	0	0	0	0	0	0
03-03-06	5	5	20,545	0	0	0	0	0	0
03-03-07	25	25	95,222	1	1	200	0	0	0
03-03-08	5	5	18,913	0	0	0	0	0	0
Totals	125	119	571,221	9	6	3,295	20	17	1,792,319

The North Carolina Department of Agriculture maintains statistics on the populations of farm animals in North Carolina's river basins. This information is for all animals, as opposed to the above information which only represents information from animal operations that are of a certain size, and therefore, must register with DWQ. The NCDA data for the Tar-Pamlico basin are presented in Table A-12. As indicated in the table, between 1994 and 1998, the number of swine and poultry both increased by 24%, while the number of dairy decreased by 10%. Between 1990 and 1998, the swine population in the Tar-Pamlico basin increased by 42%. These increases in the swine population are moderate compared to other comparable basins such as the Neuse, which experienced a 66% increase in the number of swine from 1994-1998 and almost a 260% increase in swine from 1990-1998.

Registered Animal Operations
Tar-Pamlico River Basin





Legend

Animal Operations
- Cattle
- Poultry
- Swine

Municipality
Hydrography
County Boundary
Subbasin Boundary
Major Hydrography

NCDENR

Division of Water Quality
Planning Branch
August 4, 1998

Table A-12 Estimated Populations of Swine (1998, 1994 and 1990), Dairy (1998 and 1994) and Poultry (1998 and 1994) in the Tar-Pamlico River Basin (NCDA Veterinary Division)*

Subbasin	Total Swine Capacity			Swine Change	Total Dairy Capacity		Dairy Change	Total Poultry Capacity		Poultry Change
	1998	1994	1990	94-98 (%)	1998	1994	94-98 (%)	1998	1994	94-98 (%)
03-03-01	18,940	17,986	6,540	5	2,465	2,585	-5	674,735	768,200	-12
03-03-02	112,110	73,543	85,284	52	360	420	-14	8,740,013	6,346,832	38
03-03-03	61,362	53,458	48,473	15	0	0	0	1,001,418	903,300	11
03-03-04	106,444	93,191	73,524	14	531	531	0	2,169,829	2,007,067	8
03-03-05	118,074	62,118	33,290	90	0	0	0	1,357,196	1,215,800	12
03-03-06	3,376	13,630	6,702	-75	0	0	0	52,000	52,000	0
03-03-07	87,240	94,794	103,671	-8	118	328	-64	33,570	46,570	-28
TOTALS	507,546	408,720	357,484	24	3,474	3,864	-10	14,028,761	11,339,769	24
% of State Total	5%	7%	14%		4%	3%		7%	6%	

Source : NC Department of Agriculture, Veterinary Division

* No data was available for subbasin 03-03-08.

2.9 Water Use and Minimum Streamflow

2.9.1 Local Water Supply Planning

The North Carolina General Assembly has mandated a local and state water supply planning process under North Carolina General Statute 143-355(l) and (m) to assure that communities have an adequate supply of water for future needs. Under this statute all units of local government that provide or plan to provide public water supply service are required to prepare a Local Water Supply Plan (LWSP) and to update that plan at least every five years. The information presented in a LWSP is an assessment of a water system's present and future water needs and its ability to meet those needs. The current LWSPs are based on 1992 data. Plans are being updated this year (1998) based on 1997 water supply and water use information. Table A-13 shows population and water use information contained in the LWSPs submitted by water systems located in the Tar-Pamlico River basin. These data only represent systems submitting a LWSP and do not reflect the needs of the many public water systems in this basin that are not required to prepare a plan because they are not operated by a unit of local government. The information is self-reported and has not been field verified. However, plans have been reviewed by staff engineers for consistency and reasonableness. More information is available for these and other systems across the state that submitted a Local Water Supply Plan from the Division's website at: www.dwr.ehnr.state.nc.us/home.htm.

Table A-13 Population and Water Use for Systems in the Tar-Pamlico Basin Submitting a LWSP

County	System	Population Served			Average Daily Water Use		
		1992	2000	2020	1992	2000	2020
					MGD	MGD	MGD
Beaufort	Aurora	654	700	800	0.071	0.081	0.072
Beaufort	Bath	200	250	400	0.021	0.026	0.042
Beaufort	Beaufort Co WD I	0	3913	4684	0	0.353	0.423
Beaufort	Beaufort Co WD II	0	4765	5369	0	0.43	0.485
Beaufort	Beaufort Co WD III	0	4834	6637	0	0.437	0.599
Beaufort	Beaufort Co WD IV	0	5591	6950	0	0.505	0.628
Beaufort	Beaufort Co WD V	0	3653	4129	0	0.33	0.373
Beaufort	Beaufort Co WD VI	0	5103	8820	0	0.461	0.796
Beaufort	Beaufort Co WD VII	0	4005	5394	0	0.362	0.487
Beaufort	Belhaven	2430	2700	3500	0.267	0.321	0.416
Beaufort	Chocowinity	1200	2100	3500	0.141	0.241	0.402
Beaufort	Washington	9648	10698	13852	1.402	1.65	2.47
Bertie	Bertie Co WD III	0	3682	3718	0	0.339	0.342
Edgecombe	Macclesfield	728	752	769	0.067	0.07	0.076
Edgecombe	Pinetops	2040	2105	2153	0.236	0.241	0.261
Edgecombe	Princeville	1652	2182	2510	0.148	0.195	0.225
Edgecombe	Tarboro	11142	12709	13658	2.945	3.24	4.005
Edgecombe	Whitakers	860	963	1273	0.068	0.076	0.1
Franklin	Franklin WSA	20	2800	4000	0.32	2	3
Franklin	Franklinton	2019	2398	3160	0.637	0.656	0.701
Franklin	Louisburg	3376	3530	3870	0.547	1.204	1.26
Franklin	Youngsville	500	600	700	0.049	0.059	0.069
Granville	Oxford	10000	12000	17000	1.16	1.55	2.28
Halifax	Enfield	3082	3124	3103	0.389	0.394	0.392
Halifax	Halifax Co	10012	13375	18700	1.24	2.422	3.545
Halifax	Hobgood	435	439	436	0.087	0.089	0.111
Halifax	Littleton	1219	1418	1684	0.153	0.164	0.184
Halifax	Scotland Neck	2576	2596	2636	0.3	0.33	0.39
Hyde	Hyde Co	4500	4930	5130	0.343	0.469	0.485
Martin	Bear Grass	99	100	110	0.008	0.009	0.009
Martin	Everetts	141	193	170	0.021	0.028	0.025
Martin	Robersonville	2230	2250	2287	1.419	1.606	2.203
Nash	Battleboro	1056	1108	1233	0.094	0.095	0.097
Nash	Castalia	325	339	367	0.016	0.017	0.018
Nash	Nashville	3560	4750	8250	0.395	0.558	0.924
Nash	Rocky Mount	60300	68000	86500	12.8	16.001	23
Nash	Sharpsburg	1776	2206	3722	0.169	0.21	0.354
Nash	Spring Hope	1234	1470	1744	0.101	0.155	0.778
Pamlico	Pamlico Co	11272	11790	12865	0.758	0.762	0.92
Pitt	Bethel	1850	1950	2500	0.167	0.177	0.225
Pitt	Greenville	57000	65300	84900	8.71	10.41	14.93
Pitt	Grimesland	517	613	797	0.123	0.147	0.192
Pitt	Stokes Regional WC	580	1700	2200	0.047	0.138	0.179
Pitt	Winterville	3598	4611	6381	0.32	0.397	0.541
Vance	Henderson	16847	19094	27626	2.23	3.584	5.781
Vance	Kerr Lake RWS	0	0	0	4.99	5.482	8.316
Warren	Norlina	1034	1100	1100	0.16	0.2	0.2
Warren	Warren Co	500	4350	4600	0.454	0.698	0.837
Warren	Warrenton	2500	2563	2695	0.242	0.248	0.26
Totals		234,712	311,402	398,582	43.815	59.617	84.408

2.9.2 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, in conjunction with the Wildlife Resources Commission, recommends conditions relating to release of flows to satisfy minimum instream flow requirements. The permits are issued by the Division of Land Resources. DWR has been involved in the following studies in this basin.

City of Rocky Mount -- *reviewing minimum release requirements.* The city is seeking to develop a water shortage response plan which would allow them to temporarily reduce required minimum releases during low flow periods.

Franklin County -- *water supply alternatives.* Division staff have been working with several communities and the county to identify potential sources of water for public supply. At this time, it appears a connection will be established with the Kerr Lake Regional Water Authority to supply water to the county from Kerr Lake in the Roanoke River Basin.

City of Greenville -- *increased withdrawal limit.* The Division reviewed a request by the city to increase the allowable withdrawal from 15 MGD to 22.5 MGD from the Tar River. DWR had no objections to the increase based on aquatic habitat needs.

2.9.3 Capacity Use Areas

Since July 1996, the Division of Water Resources has been responsible for administering the provisions of the Water Use Act of 1967. The Act allows the Environmental Management Commission to designate a capacity use area where use of groundwater and/or surface water requires coordination and limited regulation for protection of the interests and rights of property owners and residents or protection of the public interest. Capacity Use Area #1 (CUA#1), the only designated capacity use area at this time, was established in 1968 to monitor and control the effects of groundwater pumping associated with phosphate mining operations in Beaufort County. CUA#1 contains portions of seven counties. Permitting and reporting requirements under this Act affect withdrawals in the Pamlico River subbasin downstream from the Beaufort County line northwest of the Town of Washington.

The rules establishing CUA#1 require that no person shall withdraw, obtain or utilize surface waters or groundwaters or both in excess of 100,000 gallons per day without obtaining a water use permit. The total of permitted withdrawals from CUA#1 as of September 1998 are 393.7 million gallons per day, 164.6 MGD of groundwater and 229.1 MGD of surface water. Of this total, 106 MGD is from permitted withdrawals in the Pamlico River subbasin that are not local government water systems.

Analysis of well data from across eastern North Carolina continues to show declining groundwater levels in aquifers below the Central Coastal Plain. Current water use in the region is creating a situation where renewal and replenishment of groundwater is being impaired. In some locations, water levels are being drawn down below the top of the aquifer resulting in

aquifer dewatering. The Division is in the process of seeking the designation of a Central Coastal Plain Capacity Use Area. The proposed boundary encompasses 15 counties and will extend the requirements of the Water Use Act and the resulting Rules for the Central Coastal Plain Capacity Use Area upstream in the Tar-Pamlico Basin as far as the county line dividing Nash County from Wilson and Edgecombe counties. More information on withdrawals and proposed management of withdrawals in the Central Coastal Plain is available through the Division's website: www.dwr.enhr.state.nc.us/hms/gwbranch/GWB.htm.

2.9.4 Water Withdrawal Registrations

North Carolina General Statute 143-215.22H requires all persons who withdraw or transfer one million gallons of water or more on any day, to register with the state. DWR is responsible for collecting and storing the data submitted for these registrations. Initially, registration only applied to surface water withdrawals. In 1992, the statute was amended to include groundwater withdrawals. The following table (Table A-14) lists the parties that have registered withdrawals in the Tar-Pamlico River basin. This information is self-reported and has not been field verified. Entries in italics are permit holders in CUA#1.

Table A-14 Registered Water Withdrawals in the Tar-Pamlico River Basin

Water Withdrawal Registrations pursuant to NCGS 143-215.22H Data is self-reported and has not been field verified.				Average Withdrawal Report Year	Maximum Withdrawal	Maximum Withdrawal Capacity
County	**Owner**	**Source**	**Use**	**MGD**	**MGD**	**MGD**
Beaufort	Univ. Research Unit #8 *Pamlico Aquaculture Research Lab*	South Creek	Aquaculture	0.00	0.00	0.00
Beaufort	Texasgulf Inc	Castle Hayne Aquifer	Mining	39.013	51.162	75.000
Edgecombe	Nello L. Teer Company	Rocky Mt. Quarry	Mining	0.00	0.18	1.44
Edgecombe	Don M Anderson Farms	Tar River	Irrigation	1	0.800	0.800
Edgecombe	Cogentrix Of North Carolina	Rocky Mount	Ther Elec Pow	1.570	2.400	0.000
Edgecombe	Don M Anderson Farms	Fishing Creek	Irrigation	1	0.800	0.800
Edgecombe	Don M Anderson Farms	Fishing Creek	Irrigation	1	0.800	0.800
Edgecombe	Don M Anderson Farms	Fishing Creek	Irrigation	1	0.850	0.800
Edgecombe	Don M Anderson Farms	Fishing Creek	Irrigation	1	0.800	0.800
Edgecombe	Don M Anderson Farms	Fishing Creek	Irrigation	0.088	1.500	1.500
Edgecombe	Hassell Thigpen	Mitchell Swamp Canal	Irrigation	0.00	0.79	0.79
Edgecombe	Don M Anderson Farms	Tar River	Irrigation	1	0.800	0.800
Edgecombe	Don M Anderson Farms	Fishing Creek	Irrigation	1	0.800	0.800
Edgecombe	Don M Anderson Farms	Tar River	Irrigation	1	0.800	0.800
Edgecombe	Benchmark Carolina Agg. *Rocky Mt. Quarry*	Pit	Mining	0.500	1.400	0.000
Edgecombe	Hassell Thigpen	Mitchell Swamp Canal	Irrigation	0.00	0.86	0.86
Edgecombe	Don M Anderson Farms	Tar River	Irrigation	1	0.800	0.800
Edgecombe	Hassell Thigpen	Mitchell Swamp Canal	Irrigation	0.00	0.79	0.79
Edgecombe	W O Dail & Sons Inc	Fishing Creek	Irrigation	1.176	1.800	1.800
Edgecombe	W O Dail & Sons Inc	Fishing Creek	Irrigation	0.493	1.800	1.800
Edgecombe	K Renee Anderson	Tar River	Irrigation	0.000	1.800	1.800
Edgecombe	Hassell Thigpen	Cheek Creek Canal	Irrigation	0.00	0.86	0.86
Halifax	Jack H Winslow Farms Inc 3	Whites Mill Pond	Irrigation	0	0.720	0.720
Halifax	Jack H Winslow Farms Inc 2	Homeplace	Irrigation	0	0.650	0.650
Halifax	Jack H Winslow Farms Inc 4	Golf Course	Irrigation	0	0.440	0.440
Nash	Clay T Strickland	Dug Pond 2	Irrigation	0	0.040	5.000
Nash	Clay T Strickland	Dug Pond 4	Irrigation	0	0.040	5.000
Nash	Clay T Strickland	Tar River	Irrigation	0.056	1.360	0.000
Nash	Clay T Strickland	Dug Pond 3	Irrigation	0	0.040	5.000
Nash	J B Rose & Sons Inc	Dug Pond	Irrigation	0	0.900	1.500
Nash	Rocky Mount Mills	Tar River	Hydr Elec Pow	597.80	597.80	597.80
Nash	Wake Stone Corp. *Knightdale Quarry*	Nash County Quarry	Mining	0.00	0.00	0.86
Nash	J B Rose & Sons Inc	Dug Pond	Irrigation	0	0.800	0.800
Nash	J B Rose & Sons Inc	Dug Pond	Irrigation	0	0.900	1.500
Nash	J B Rose & Sons Inc	Impoundment	Irrigation	0.000	1.000	1.400
Nash	J B Rose & Sons Inc	Dug Pond	Irrigation	0	0.900	1.500
Nash	J B Rose & Sons Inc	Dug Pond	Irrigation	0	0.900	0.900
Nash	J B Rose & Sons Inc	Impoundment	Irrigation	0.000	1.000	1.400
Nash	Clay T Strickland	Dug Pond 1	Irrigation	0	0.040	5.000
Nash	J B Rose & Sons Inc	Dug Pond	Irrigation	0	0.900	1.800
Nash	J B Rose & Sons Inc	Dug Pond	Irrigation	0	0.900	1.200
Nash	J B Rose & Sons Inc	Dug Pond	Irrigation	0	0.900	2.500
Pamlico	Ronnie Watson	Castle Hayne Aquifer	Irrigation	0.039	1.296	1.296
Pitt	J.P. Davenport & Son, Inc.	Grindle Creek	Irrigation	0.00	0.47	1.87
Pitt	J.P. Davenport & Son, Inc.	Grindle Creek	Irrigation	0.00	1.08	2.16
Pitt	Hudson Brothers Farm	Black Creek Aquifer	Aquaculture	0.000	0.000	0.000
Pitt	J.P. Davenport & Son, Inc.	Grindle Creek	Irrigation	0.00	0.47	1.87
Vance	Vulcan Materials Co.	Greystone Quarry	Mining	0.00	0.26	0.00
Vance	Heater Utilities *Lynnbrook Estates*		PWS	0.000	0.000	0.072
Washington	Manning Farms Inc	Castle Hayne Aquifer	Irrigation	0.021	1.296	2.340
Washington	Dannenberg Farm & Grace Farm	Castle Hayne Aquifer	Irrigation	0.064	0.650	4.300
Washington	Thurmon L Harris Jr	Castle Hayne Aquifer	Irrigation	0.094	1.800	1.800
Wilson	Benchmark Carolina Agg. *Elm City Quarry*	Pit	Mining	0.500	1.400	0.000
Wilson	Nello L. Teer Company	Elm City Quarry Pit	Mining	0.00	0.30	1.44

2.9.5 Interbasin Transfers

The Division of Water Resources is responsible for the registration and certification of interbasin transfers under G.S. 143-215.22H. The river basin boundaries that apply to these requirements are designated on a map entitled *Major River Basins and Sub-basins in North Carolina* and filed in the Office of the Secretary of State on April 16, 1991. The table below lists transfers into or out of the Tar-Pamlico River basin. The transfer amounts shown are 1992 average daily amounts in million gallons per day (MGD) based on 1992 Local Water Supply Plans and registered withdrawal/transfer information. The primary transfer occurs in the Kerr Lake Regional System which supplies water from the Roanoke River basin to systems in the Tar and Fishing Creek subbasins. Several of the potential transfers listed cannot be quantified because of undocumented consumptive losses such as on-site wastewater disposal and landscape irrigation.

Table A-15 Interbasin Transfers in the Tar-Pamlico River Basin

Source System	Receiving System	Source Basin	Receiving Subbasin	Net Transfer to Tar-Pamlico Basin (MGD)[1]
Kerr Lake Regional	Henderson	Roanoke	Tar	Unknown (in)
Kerr Lake Regional	Oxford	Roanoke	Tar	1.11 (in)
Kerr Lake Regional	Warren County	Roanoke	Fishing Creek	Unknown (in)
Louisburg	Franklin	Tar	Neuse	Unknown (out)
Greenville	Greenville	Tar	Neuse	Unknown (out)
Greenville	Winterville	Tar	Neuse	Emergency (out)
Rocky Mount	Wilson	Tar	Contentnea Creek	Emergency (out)

[1] Transfer amounts are based on average daily water use reported in 1992 Local Water Supply Plans.
"Unknown" refers to undocumented consumptive use.
"Emergency" refers to an existing emergency connection between two public water systems.

Chapter 3 -
Summary of Water Quality Information for the Tar-Pamlico River Basin

3.1 General Sources of Pollution

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 proper management of wastes and land use activities, these impacts can be minimized.

Point sources are typically piped discharges from municipal wastewater treatment plants, industrial facilities, small package plants, and large urban and industrial stormwater systems. Point source pollution is controlled through regulatory programs administered by the state. All point source discharges in North Carolina must apply for and obtain a National Pollutant Discharge Elimination System (NPDES) permit from the state.

Every person living in or visiting a watershed contributes to impacts on water quality.

We are all part of the problem, and we must all be a part of the solution.

Nonpoint sources are from a broad range of land use activities including: land development, construction, stormwater runoff, forestry and mining operations, crop production, animal feeding lots, failing septic systems, landfills, roads and parking lots, and others. Nonpoint sources are typically carried to waters by rainfall, runoff or snowmelt. Sediment and nutrients are most often associated with nonpoint source pollution. Others include fecal coliform bacteria, heavy metals, oil and grease, and any other substance that may be washed off the ground or removed from the atmosphere and carried into surface waters. Unlike point source pollution, nonpoint pollution sources are very diffuse in nature and occur intermittently, depending on rainfall events and land disturbance. Given the diffuse nature of nonpoint source pollution, it is very difficult and resource intensive to quantify nonpoint contributions to water quality degradation in a given watershed. The state relies primarily on voluntary programs to address nonpoint source pollution.

3.2 Description of Surface Water Classifications and Standards

Program Overview

North Carolina established a water quality classification and standards program early in the 1950s, with classification and water quality standards for all the state's river basins adopted by 1963. The Water Quality Standards program in North Carolina has evolved over time and has been modified to be 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. Classifications and standards are applied to provide protection of the waters' best uses.

Statewide Classifications

All surface waters in the state are assigned a *primary* classification that is appropriate to the best uses of that waterbody. 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. Therefore, while all surface waters are assigned a primary classification, they may also have one or more supplemental classifications. For example, a freshwater stream in the mountains might have a C Tr classification, where C is the primary classification followed by the Tr (Trout) supplemental classification. A full description of the state's primary and supplemental classifications are available in the document titled: *Classifications and Water Quality Standards Applicable to Surface Waters of North Carolina* (derived from 15A NCAC 2B .0200). Information on this subject is also available at DWQ's Water Quality Section Internet web site: http://h2o.enr.state.nc.us/wqhome.html.

Table A-16 Primary and Supplemental Surface Water Classifications
(Primary classifications beginning with an "S" are assigned to saltwaters)

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.
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.
Tr	*Trout Waters*: Provides protection to freshwaters for natural trout propagation and survival of stocked trout.

Statewide Water Quality Standards

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. With the exception of Sw, all of 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. These waters may be rated as HQW or ORW.

High Quality Waters

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.

Criteria for HQW Classification

- Waters rated as Excellent based on DWQ's chemical and biological sampling.
- Streams designated as native and special native trout waters or primary nursery areas by the Wildlife Resources Commission.
- Waters designated as primary nursery areas by the Division of Marine Fisheries.
- Critical habitat areas designated by the Wildlife Resources Commission or the Department of Agriculture.
- Waters classified by DWQ as WS-I, WS-II and SA are HQW by definition, but these waters are not specifically assigned the HQW classification because the standards for WS-I, WS-II and SA waters are at least as stringent as those for waters classified HQW.

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 approved local erosion and sedimentation control program, and which drain to and are within one mile of HQWs, are required to control runoff from the development using either a low density or high density option. In addition, the Division of Land Quality requires more stringent sedimentation controls for land-disturbing projects within one mile and draining to HQWs.

Outstanding Resource Waters

A small percentage of North Carolina's surface waters have excellent water quality (rated based on biological and chemical sampling as with HQWs) and an associated outstanding resource.

The ORW rule defines outstanding resource values as:

- 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;
- being within a state or national park or forest; or
- having 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 stormwater controls for most 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.

Classifications and Standards in the Tar-Pamlico River Basin

The waters of the Tar-Pamlico River basin have a variety of surface water quality classifications applied to them. The majority of the surface waters are classified as C waters. Water Supply watersheds range from WS-II to WS-IV. Along the coastal area, many waters are classified as SA (tidal saltwaters protected for shellfishing for market purposes). Maps of water supply watersheds, Outstanding Resource Waters, High Quality Waters and SA waters are presented in part 2.6.5 of Chapter 2 within this section of the basin plan.

In September of 1989, the North Carolina Environmental Management Commission classified the entire Tar-Pamlico River basin as Nutrient Sensitive Waters (NSW). This action, which carries with it the application of management strategies to reduce nutrient loads from point and nonpoint source pollution, was taken in response to increases in algal blooms and fish kills in the upper Pamlico estuary that were linked to excessive nutrient levels. A description of the management strategies being applied in the basin as well as a description of the status of efforts to reduce nutrients are provided in Section B of this plan.

Classification and standards for the entire basin can be found in a separate document titled *Classifications and Water Quality Standards Assigned to the Waters of the Tar-Pamlico River Basin* available by calling the Planning Branch of DWQ at (919) 733-5083. They can also be accessed through DWQ's Water Quality Section Internet web site: http://h2o.enr.state.nc.us/wqhome.html.

Pending Reclassifications in the Tar-Pamlico River Basin

There are several pending reclassifications in the Tar-Pamlico River basin. The majority of these are located in the eastern portion of the basin and are inland primary nursery areas which, because of this designation, qualify for HQW classification. In addition, a portion of the Pungo River has been requested for reclassification from SB to SA to apply more protection for shellfish resources. Studies to determine whether or not the area meets the standards for the SA classification are ongoing. Finally, a 10-mile section of Swift Creek in the upper portion of the basin has been shown to meet the criteria for classification as ORW. DWQ is in the early stages of developing a management strategy for the area prior to pursuing ORW classification through rule making.

3.3 DWQ Water Quality Monitoring Programs in the Tar-Pamlico River Basin

The DWQ collects a variety of biological, chemical and physical data that can be used in a myriad of ways within the basinwide planning approach. In some areas, there may be adequate data from several programs to allow a fairly comprehensive analysis of water quality. In other areas, data may be limited to one program, such as only benthic macroinvertebrate data or only fisheries data, with no other information available. Such data may or may not be adequate to provide a definitive assessment of water quality, but can provide general indications of water quality. The following discussion contains a brief introduction to each program, followed by a summary of water quality data in the Tar-Pamlico River basin for that program. A more complete discussion on biological and chemical monitoring within the basin can be found in the *Tar-Pamlico River Basinwide Assessment Report* (DENR, May 1998).

DWQ monitoring programs for the Tar-Pamlico River Basin include:

* benthic macroinvertebrates (Section 3.3.1)
* fisheries assessments (Section 3.3.2)
* aquatic toxicity monitoring (Section 3.3.3)
* lakes assessment (Section 3.3.4)
* ambient monitoring system (Section 3.3.5)

3.3.1 Benthic Macroinvertebrates

Benthic macroinvertebrates, or benthos, are organisms that live in and on the bottom substrates of rivers and streams. In freshwaters, these organisms are primarily aquatic insect larvae. In saltwaters they are dominated by small crustaceans and polychaetes. 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.

In *freshwaters*, criteria have been developed to assign a bioclassification rating 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); or commonly referred to as EPTs. Different criteria have been developed for different ecoregions (mountains, piedmont and coastal plain) within North Carolina. The ratings fall into five categories ranging from Poor to Excellent. Likewise, ratings can be assigned with a North Carolina Biotic Index (BI). This index summarizes tolerance data for all taxa in each collection. The two rankings are given equal weight in final site classification. Higher taxa richness values are associated with better water quality. These bioclassifications primarily reflect the influence of chemical pollutants. The major physical pollutant, sediment, is poorly assessed by a taxa richness analysis.

For *estuarine* waters the effort to develop a method to assess water quality based on macroinvertebrates started in North Carolina in late 1990. An Estuarine Biotic Index designed for Florida was modified to create the North Carolina Estuarine Biotic Index (EBI) which more

closely reflects taxa and tolerances in North Carolina and can accurately rank sites of different water quality. Biocriteria based on these metrics are still being developed, so at the present time estuarine samples cannot be given a water quality rating.

Recent extensive work on swamp streams suggested that different criteria should be used for slow-flowing, swamp-like systems. DWQ has developed draft biological criteria ratings more specific to swamp waters. The criteria are draft and will remain so until DWQ is better able to evaluate several issues. Therefore, the draft criteria are not used for use support determinations.

Overview of Benthic Macroinvertebrate Data

Benthic macroinvertebrates have been collected at 90 freshwater sites in the Tar River basin since 1983 (see Appendix VIII for complete listing). Thirty-three of these sites were sampled during the 1997 basinwide surveys. For the 1997 collections, the following bioclassifications were found: Excellent (5), Good (12), Good-Fair (8), Fair (8) and Poor (0). Thirty-nine estuarine sites have been sampled in subbasins 03-03-07 and 03-03-08, although many could not be rated due to either a change in sampling method or the lack of criteria for low salinity areas. These samples can be used for comparative purposes and to evaluate changes over time. Of the 17 estuarine collections during 1997, nine sites were evaluated as Moderate Impact, while three sites in eastern Pamlico Sound were evaluated as having No Impact. In 1999, an additional three stations were sampled in a special study of Fishing Creek in Subbasin 03-03-01. Two stations were on Fishing Creek and one was on Tabbs Creek.

Table A-17 lists the most recent ratings between 1983 and 1999 (by subbasin) for all freshwater benthos sites in the Tar River basin, including special studies.

Table A-17 Summary of Benthic Macroinvertebrate Ratings for All Freshwater Benthos Sites (using the most recent rating for each site) in the Tar-Pamlico River Basin

Subbasin 03-03-01 to 03-03-08	Excellent	Good	Good-Fair	Fair	Poor	Not Rated*
Headwaters: 01	1	6	11	2	3	-
Tar R/Swift Cr: 02	6	6	6	6	0	-
Middle Tar & tribs: 03	1	3	1	4	6	2
Fishing Cr: 04	1	4	2	1	0	2
Greenville Area: 05	1	0	2	7	1	-
Tranters Cr: 06	-	-	1	-	-	-
Lower Tar/Pamlico & tribs: 07	0	0	0	3	3	-
Total	10	19	22	22	12	4

* Swamp streams with insufficient data to assign rating

High quality streams in the Tar River basin (Good and Excellent ratings) are concentrated in three areas: the mainstem of the Tar River through Granville County (subbasins 03-03-01, 03-03-02 and 03-03-03), Swift Creek (subbasin 03-03-02) and Fishing Creek (subbasin 03-03-04). Swift Creek has been evaluated for designation as Outstanding Resource Waters (ORW) and has

been determined to meet the criteria for that designation. The Tar River at NC 96 (Franklin County) warrants further investigation for the potential to be reclassified as ORW or High Quality Waters. The eastern portion of Pamlico Sound (subbasin 03-03-08) was evaluated as having No Impact at all estuarine sites.

Macroinvertebrate sampling has found the greatest number of water quality problems for streams in agricultural catchments, although there are some isolated problems associated with urban runoff and point source dischargers. A variety of problems can be observed at estuarine sites with Moderate Impact ratings assigned to most sites in the upper and middle portion of Pamlico Sound. Some areas have elevated chironomid mentum deformity rates, suggesting sediment toxicity. Some swamp streams with draft low ratings may eventually be assigned higher ratings as DWQ develops better criteria for rating streams with very low pH (example: Van Swamp).

Macroinvertebrate ratings generally agree with fish community ratings, although the fish ratings tended to be slightly higher in subbasin 03-03-01. This may be due to the negative effect of low flow on the macroinvertebrates in the slate belt streams of this area. Older macroinvertebrate samples also show a greater number of Fair and Poor sites, but this reflects a greater number of invertebrate special studies which focused on specific water quality problems: Little Cokey Swamp, Whitehurst Creek and the Chicod Creek catchment.

Long-term changes in water quality were evaluated at 27 sites in the Tar River basin (see Table A-18 for summary). Ten of these sites had a short-term (5-year) improvement in bioclassification, but all of these changes appear to be due to the lower flow observed in 1997 relative to 1992. The lower summertime 1997 low flows may have limited the effects of nonpoint source pollution without being low enough to stress the benthic community in most streams. Most of the latest biological sampling was conducted in July and August 1997. The USGS provides streamflow statistics for the 1997 water year (October 1996 – September 1997), which includes flow data for the 9 to 10 months prior to the period of the benthos sampling. According to the USGS, the flow in the Tar River at Tarboro, NC for the 1997 water year averaged slightly above the long-term annual mean for the period of record (1896-1997). Most of the gauged streams in the basin also had annual mean flows for the 1997 water year, slightly higher than the long-term average. Streamflows during the summer of 1997 tended to be below the annual average.

Table A-18 Summary of Trends Over Time in Benthic Macroinvertebrate Ratings Assigned in the Tar-Pamlico River Basin

Subbasin 03-03-01 to 03-03-08	# Trend Sites	5-year change			Long-term (>5 years) change		
		None	+	-	None	+	-
Headwaters: 01	6	2	4(4*)	0	1	1	0
Tar R/Swift Cr: 02	4	1	1(1*)	0	2	2	0
Middle Tar & tribs: 03	4	2	1(1*)	1(1*)	1	1	0
Fishing Cr: 04	5	3	2(2*)	0	2	0	0
Greenville Area: 05	3	1	2(2*)	0	1	1	0
Tranters Cr: 06	1	1	0	0	0	1	0
Lower Tar/Pamlico & tribs: 07	3	3	0	0	2	0	0
Outer Pamlico Sound: 08	1	1	0	0	1	0	0
Total	27	14	10(10*)	1(1*)	10	6	0

* Number of changes in bioclassification related to between-year differences in flow, not indicative of any long-term change in water quality.

3.3.2 Fish Assessments

Overview of Fish Community Assessment Data

The fish communities in the Tar-Pamlico River basin were sampled in 1997 using methods developed for the application of the North Carolina Index of Biotic Integrity (NCIBI) (NCDEHNR, 1995). The NCIBI is a modification of the Index of Biotic Integrity initially proposed by Karr (1981) and Karr, et al. (1986). The Index has been subsequently modified and is continually being refined for applicability to wadeable streams in North Carolina.

Based on evaluations of all the accumulated recent coastal fisheries data, the modified NCIBI scoring criteria may be inappropriate for lower coastal plain streams that have a swamp-like character. These systems have natural low productivity and pH and dissolved oxygen stresses that are not found in more typical flowing water streams. Therefore, streams that had these characteristics are not rated. Studies will be undertaken to sample reference swamp streams to evaluate what changes need to be made to the NCIBI metrics to give better evaluations of these streams.

The assessment of biological integrity using the NCIBI is provided by the 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. Finally, the NCIBI score is then used to determine the ecological integrity class, as proposed by Karr (1981), of the stream from which the sample was collected (Table A-19).

Table A-19 Scores, Integrity Classes and Class Attributes for Evaluating a Wadeable Stream Using the North Carolina Index of Biotic Integrity

NCIBI Scores	NCIBI Classes	Class Attributes
56 - 60	Excellent	Comparable to the best situations without human disturbance. All regionally expected species for the habitat and stream size, including the most intolerant forms are present, along with a full array of size classes and a balanced trophic structure.
50 - 54	Good	Species richness somewhat below expectation, especially due to the loss of the most intolerant species; some species are present with less than optimal abundances or size distributions; and the trophic structure shows some signs of stress.
44 - 48	Good-Fair	Signs of additional deterioration include the loss of intolerant species, fewer species and a highly skewed trophic structure.
38 - 42	Fair	Dominated by omnivores, tolerant species and habitat generalists; few top carnivores; growth rates and condition factors commonly depressed; and diseased fish often present.
< 36	Poor	Few fish present, mostly introduced or tolerant species; and disease fin damage and other anomalies are regular.

The NCIBI has been revised since the 1992 Tar-Pamlico River basinwide monitoring was conducted. Recently, the focus of using and applying the Index has been restricted to wadeable streams that can be sampled by a crew of 2-4 persons using backpack electrofishers and following the NCDWQ Standard Operating Procedures (NCDENR, 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 the benthos sampling, several years of reference site data will be needed before criteria can be developed to evaluate biological integrity using the fish community.

In an effort to simplify and standardize the evaluation of a stream's ecological integrity and water quality bioclassification whether using a fish community or benthic invertebrate assessment, the fish community integrity classes were also modified.

In 1997, 28 sites, representing 7 of the 8 subbasins, were sampled and evaluated using the North Carolina Index of Biotic Integrity. Streams in subbasin 03-03-08 were not sampled because of their brackish water and estuarine nature. The NCIBI classes at these 28 sites ranged from Excellent (Tar River in Granville County and Swift Creek in Nash County) to Fair; one site was not rated (UT Turkey Swamp). The distribution of NCIBI classes was as follows: Excellent (2), Good (13), Good-Fair (8), Fair (4) and Not Rated (1).

Of the 28 sites sampled in 1997, 17 of the sites were previously sampled between 1990 and 1993. In general, the streams in the upper part of the river basin (i.e., from Shelton Creek to Swift Creek) saw an improvement in the NCIBI scores, whereas several of the streams in the middle part of the watershed (i.e., the Fishing Creek watershed and Otter Creek) saw a decline in the NCIBI scores. The fish communities in Tabbs Creek and Otter Creek experienced the greatest change in NCIBI scores between 1992 and 1997 of all the previously monitored sites (+10 units and -8 units, respectively).

Streams that physically appeared to have been influenced by Hurricanes Bertha and Fran (Summer and Fall 1996, respectively) included Shelton Creek, Cedar Creek, Crooked Creek, Sapony Creek, Big Peachtree Creek and Otter Creek. High water marks and an abundance of blowdowns either in the stream or throughout the riparian zone were indicative of hurricane influences. The blowdowns, although an obstacle to effectively sampling the stream, should enhance instream habitat for fish over future years.

The overall impact of the hurricanes on these fish communities in the Tar River basin was inconsistent. The NCIBI class for Shelton Creek and Cedar Creek did not change (Good and Good-Fair, respectively), Otter Creek declined from Good-Fair to Fair, and Big Peachtree Creek increased from Fair to Good-Fair. Two streams, Crooked Creek and Sapony Creek, that appeared impacted from the hurricane, but from which prior data did not exist, were both rated as Fair.

According to Menhinick (1991), 84 species of freshwater fish have been collected from the Tar River basin. The known Tar River species assemblage includes 19 species of minnows, 16 species of sunfish and bass, 8 species of suckers, 9 species of darters and 9 species of catfish. In 1997, 56 of the 84 possible species were collected during the basinwide monitoring program. The most commonly collected species was pirate perch (25 sites), redbreast sunfish (22 sites), and creek chubsucker and bluegill (21 sites). The most abundant species collected was the white shiner.

Overview of Fish Tissue Sampling Data

Since fish spend their entire lives in the aquatic environment, they incorporate chemicals from this environment into their body tissues. Contamination of aquatic resources has been documented for heavy metals, pesticides and other complex organic compounds. Once these contaminants reach surface waters, they may be available for bioaccumulation, either directly or through aquatic food webs, and may accumulate in fish and shellfish tissues. Results from fish tissue monitoring can serve as an important indicator of further contamination of sediments and surface water. Fish tissue analysis results are used as indicators for human health concerns, fish and wildlife health concerns, and the presence and concentrations of various chemicals in the ecosystem.

In evaluating fish tissue analysis results, several different types of criteria are used. Human health concerns related to fish consumption are screened by comparing results with Federal Food and Drug Administration (FDA) action levels, US Environmental Protection Agency (EPA) recommended screening values, and criteria adopted by the North Carolina State Health Director.

Fish tissue was sampled at 12 stations within the Tar-Pamlico River basin from 1994 to 1997. Fish tissue surveys were conducted in the basin as part of mercury assessments of fish in the eastern part of the state and during routine basinwide assessments. Most fish samples collected during the period contained metals and organics at non-detectable levels or at levels below FDA and EPA criteria. Significant elevations in mercury were, however, measured in largemouth bass and bowfin samples collected from the Tar River near Grimesland and Tranters Creek at US 264. Nearly one half of the total samples collected at the two stations contained mercury above FDA and/or EPA limits.

The presence and accumulation of mercury in North Carolina's aquatic environment is similar to contamination observed in other states where conditions are favorable. Mercury bioaccumulation in North Carolina appears to be most prevalent in top predator fish species found in coastal plain waterbodies (I-95 eastward). Bass and bowfin throughout the state have exhibited total mercury levels exceeding EPA and FDA limits, even when these species are associated with remote or minimally impacted waterbodies. Atmospheric deposition may be a significant source for the observed levels of mercury, but the exact pathways and extent of mercury contamination in North Carolina fish, or across the nation, have yet to be characterized.

A small number of fish were analyzed for chlorinated pesticides and PCBs during the 1997 assessment. Results showed only trace amounts of DDE, a DDT metabolite, present in fish from the Tar River near Falkland and Tranters Creek. Targeted organic analytes were not detected at other stations during the 1997 survey.

At present, there are no specific fish tissue consumption advisories posted in the Tar-Pamlico basin. There is, however, a statewide mercury advisory on bowfin. Consumption of bowfin is limited to no more than 2 meals per month for the general population. Children and women of childbearing age are advised not to consume bowfin.

Tar-Pamlico Basin Fish Kills

Investigators reported 19 fish kills in the Tar Pamlico basin from 1993 to 1997. Mortality counts ranged from less than 25 to over 30,000 individuals. Thirteen (13) of these events had mortalities in excess of 5,000 fish. Causes for kill events in the Tar-Pamlico varied, but were typical of those observed in coastal basins in North Carolina. Causes for kills in the upper part of the basin were often attributed to low dissolved oxygen and municipal/industrial waste spills. Several events in 1997 resulted in the release of nearly 2 million gallons of sewage, killing 4,000 fish. Kill events in the lower Tar-Pamlico have generally resulted from chronic water quality problems such as low dissolved oxygen, algal blooms and fish mortality associated with stress and disease. Most fish kill activity was reported in subbasin 03-03-07, from Washington to the mouth of the Pamlico River, and most often involved Atlantic menhaden. *Pfiesteria*-like organisms were identified at three kills in the lower Tar-Pamlico (1994-1997), but the organism was not confirmed as a cause in any of the events.

3.3.3 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 by their NPDES permit or by administrative letter. Other facilities may be tested by DWQ's Aquatic Toxicology Laboratory.

The Aquatic Toxicology Unit maintains a compliance summary for all facilities required to perform tests and provides a monthly update 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. A summary of compliance for the Tar-Pamlico River basin from 1986 through 1997 is presented in Table A-20 below.

Table A-20 Summary of Compliance with Aquatic Toxicity Tests in the Tar-Pamlico River Basin

Year	Number of Facilities	Number of Tests	% Meeting Permit Limit*
1986	1	8	87.5
1987	3	15	33.3
1988	8	70	62.8
1989	11	104	65.4
1990	14	116	69.8
1991	17	186	76.3
1992	19	205	86.8
1993	19	220	90.4
1994	19	220	85.9
1995	21	238	88.6
1996	22	248	92.3
1997	19	223	95.1

* This number was calculated by determining whether a facility was meeting its ultimate permit limit during the given time period, regardless of any SOCs in force.

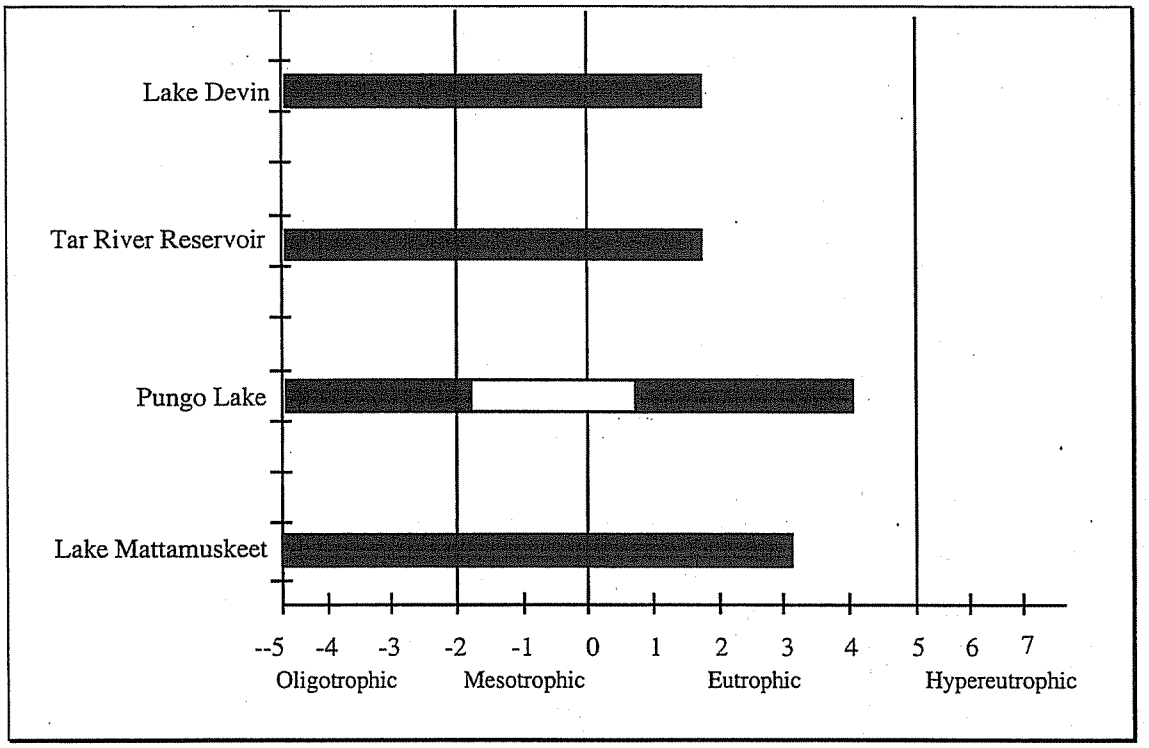
† "No. Tests" is not the actual number of tests performed, but the number of opportunities for limit compliance evaluation. Assumptions were made about compliance for months where no monitoring took place based on data previous to that month. Facilities compliant in a given month were assumed to be in compliance during months following, until the next actual monitoring event. This same policy was applied to facilities in noncompliance.

3.3.4 Lakes Assessment Program

The North Carolina Lakes Assessment Program has conducted assessments at publicly accessible lakes, at lakes which supply domestic drinking water, and lakes (public or private) where water quality problems have been observed. Data are used to determine the trophic state of each lake, a relative measure of nutrient enrichment and productivity.

Four lakes were sampled during basinwide monitoring in the Tar-Pamlico River basin. They are Lake Devin (subbasin 03-03-01), Tar River Reservoir (subbasin 03-03-02), Pungo Lake (subbasin 03-03-07) and Lake Mattamuskeet (subbasin 03-03-08).

Each lake is individually discussed in the appropriate subbasin section with a focus on the most recent available data. The inset frame below shows the most recent NCTSI (North Carolina Trophic Status Index) scores for the four lakes sampled in the Tar-Pamlico River basin. Lake Devin, Tar River Reservoir and Lake Mattamuskeet were monitored by DWQ in 1997. Pungo Lake was most recently sampled in 1992.



3.3.5 Ambient Monitoring System Program

The Ambient Monitoring System (AMS) is a network of stream, lake and estuarine stations strategically located for the collection of physical and chemical water quality data. Water quality data for this plan were evaluated for the period 1993-1997. DWQ has 28 stations in the Tar-Pamlico River basin. These sites are listed below in Table A-21 and are located geographically on the subbasin maps contained in Section B of this basin plan.

A general description of the results of ambient monitoring conducted during the years of 1993-1997 is presented below. Where appropriate, more detailed information is included in Section B in the individual subbasin descriptions.

Tar River Mainstem

Along the length of the river, the median dissolved oxygen concentrations are relatively stable from station to station. There are slightly lower concentrations at the upper and lower stations, and these are the areas where the samples below the water quality criterion for dissolved oxygen concentration were collected.

Total phosphorus concentrations from the mainstem Tar River stations exhibit a typical pattern of low concentration at the headwaters and higher concentrations towards the mouth of the river. This pattern is also evident with total nitrogen concentrations.

The Tar River station near Bunn has shown high fecal coliform concentrations. Extremely high maximum fecal coliform numbers were recorded during this basinwide cycle (38,000/100 ml), and nearly 40% of all samples collected from this location were above the water quality standard.

Maximum fecal coliform numbers were much higher during the 1997 basinwide reporting period (1/93-9/97) than during the 1993 basinwide reporting period (9/91-8/93). In comparison, the maximum fecal coliform number for the Bunn location during the 1993 reporting period was 8,600/100 ml.

Table A-21 Ambient Monitoring System Stations within the Tar-Pamlico River Basin

Primary No	Storet No	Station Name	Subbasin
Tar River Mainstem			
02081500	O0100000	Tar River Near Tar River NC	03-03-01
02081747	O1100000	Tar River at US Hwy 401 at Louisburg NC	03-03-01
02081854	O2000000	Tar River at SR 1001 Near Bunn NC	03-03-01
02082585	O3180000	Tar River at NC Hwy 97 at Rocky Mount NC	03-03-02
02082626	O3600000	Tar River at SR 1252 Near Hearstease NC	03-03-02
02083500	O5250000	Tar River at US Hwy 64 at Tarboro NC	03-03-03
02083692	O6200000	Tar River at SR 1400 Near Falkland NC	03-03-03
02084171	O6500000	Tar River Near Grimesland NC	03-03-05
Tar River Tributaries			
02081547	O0600000	Fishing Creek at SR 1643 Near Clay NC	03-03-01
0208273350	O3830000	Sandy Ck at SR 1432 Near Gupton Inact-841015	03-03-02
02082770	O3870000	Swift Creek Near Hillardston NC	03-03-02
02083000	O4680000	Fishing Creek Near Enfield NC	03-03-04
02083800	O6205000	Conetoe Ck at SR 1409 Near Bethel NC	03-03-03
02084160	O6450000	Chicod Creek at SR 1760 Near Simpson NC	03-03-05
02084392	O7300000	Tranters Creek at SR 1403 Near Washington	03-03-06
Pamlico River			
02084472	O7650000	Pamlico River at Washington NC	03-03-07
0208450705	O7680000	Pamlico R at Marker #16 Near Whichard Beach NC	03-03-07
0208451950	O7870000	Pamlico River at Mouth of Broad Cr Near Bunyan NC	03-03-07
02084533	O8498000	Pamlico R at Light 5 Near Cove Point	03-03-07
0208454253	O8650000	Pamlico R at Light 4 Near Gum Point	03-03-07
0208454450	O9059000	Pamlico River at Hickory Pt Near South Creek NC	03-03-07
02084580	O9825000	Pamlico R at Mid Pt Between Pamlico Pt and Rose B	03-03-07
Pamlico River Tributaries			
0208451525	O7710000	Chocowinity Bay above Silas Ck Near Whichards Beh	03-03-07
02084534	O8495000	Bath Creek at NC Hwy 92 Near Bath NC Peat	03-03-07
0208457020	O9750500	Pungo Ck at NC Hwy 92 at Sidney Crossroads NC Peat	03-03-07
0208455850	O9751000	Pantego Creek at NC Hwy 92 at Belhaven NC Peat	03-03-07
02084557	O9755000	Van Swamp at NC Hwy 32 Near Hoke NC	03-03-07
0208455650	O9758500	Pungo River at US Hwy 264 Near Ponzer NC Peat	03-03-07

Tar River Tributaries

Chicod Creek had a number of low dissolved oxygen concentrations. Overall the tributaries in the lower end of the Tar River tended to have slightly lower dissolved oxygen concentrations.

Total phosphorus concentrations are high in Chicod Creek relative to other tributaries. Concentrations from the other creeks are not nearly as high as those found in Chicod Creek. Tranters and Fishing Creeks also have elevated concentrations, although not as high as Chicod Creek. On the whole, Conetoe Creek does not have high total phosphorus concentrations, but there were a few samples with very high concentrations, which indicate a possible intermittent runoff or discharge problem.

Chicod Creek also exhibits very high concentrations of total nitrogen. Tranters and Fishing Creeks have comparatively high levels, but as with phosphorus, not as high as Chicod Creek. Conetoe Creek has high concentrations of total nitrogen, and the data indicate this is a fairly regular condition (as opposed to the sporadic nature of elevated phosphorus concentrations).

Pamlico River Mainstem

Dissolved oxygen concentrations along the Pamlico River varies little from station to station. The stations at Broad Creek and Gum Point have some high extreme values, and the Gum Point station has some extreme low values. There is a slight drop in the concentration of total phosphorus out to the Rose Bay station, and beginning with the Broad Creek station, there are some very high concentrations recorded for all the stations. Total nitrogen concentrations drop similar to the phosphorus concentrations moving eastward out of the estuary.

Pamlico River Tributaries

Van Swamp exhibited some low dissolved oxygen concentrations; however, it is classified as swamp water and is naturally predisposed to lower concentrations. In general, the Pamlico River tributaries do not appear to have problems with low dissolved oxygen. All these stations have low concentrations of total phosphorus on average, but there are occasional high values recorded at all but the Chocowinity Bay station. This, as in the case of some of the Tar River tributary stations, is probably due to one or more specific runoff sources. The total nitrogen concentrations are also indicative of effects of runoff conclusion for these tributary stations. Total nitrogen concentrations are relatively high in Pantego Creek, Van Swamp and Pungo River.

3.3.6 Effects of Hurricane Fran on Basinwide Monitoring

The impacts of Hurricane Fran must be taken into account when analyzing the biological and chemical data collected in 1997 during basinwide assessment. Hurricane Fran passed through North Carolina on September 5-6, 1996, resulting in some of the most severe and widespread flooding in recent times. Peak flows in the Tar River near the Town of Tar River and at Louisburg exceeded the 500-year recurrence interval. Peak flows around Rocky Mount had recurrence intervals of between 10 and 25 years, and the peak flow at Tarboro had a recurrence interval of between 5 and 10 years. All along the Tar River, water levels rose more than 20 feet above pre-hurricane levels (USGS, 1996). Very low dissolved oxygen concentrations were measured in the Tar River at Tarboro (3.3 mg/l on September 11) by USGS, and low dissolved oxygen levels were measured by regional office staff throughout the coastal plain in the hurricane impact area after the storm. Numerous reports of fish kills came from the coastal plain. The NC Forest Service estimated 50-75% destruction of trees in an area northwest of Rocky Mount near Gold Rock. The rest of the basin had 1-25% tree destruction with pockets of 25-50% tree destruction. The natural, dramatic changes in water quality caused by Hurricane Fran were documented by biological sampling primarily in October 1996, after flows had receded enough to allow sampling. Both benthos and fish community sampling found little changes in Piedmont streams and rivers, where low dissolved oxygen levels were not found immediately after the storm. Many coastal plain streams, however, showed severe effects from Hurricane Fran, including declines in taxa richness and in abundance of organisms. Sampling in 1997 during

basinwide assessment, noted changes in flow patterns due to the instream obstructions caused by downed trees. In addition, some areas could not be sampled because there was no safe access to the stream.

3.3.7 Historical Overview of Pamlico River Nutrient-Related Water Quality Issues and Studies

The first studies to characterize water quality and phytoplankton were initiated in the mid-1960s when Texasgulf Sulfur Company (now PCS Phosphate) began to operate a phosphate mining facility on the south shore of the Pamlico River near Aurora, NC. The major concerns at this time were to determine whether phosphate enriched discharges from this facility would change primary production and affect the composition of algal communities. These studies were supported partially by Texasgulf.

These early studies (Copeland and Hobbie, 1972; Hobbie et al., 1972; Hobbie, 1974; Kuenzler, 1979) described the seasonal patterns of nutrients and the interactions between nutrients and phytoplankton. Phosphate concentrations were high throughout the estuary as the result of continuous inputs from the Tar River and the sporadic discharges from phosphate mining. Concentrations of particulate phosphorus increased in the upper estuary during the study (1965-1971). [Although these patterns were noted during the 1970s, current fluxes of phosphorus have changed (i.e., decrease in P concentration) as the result of the 1988 phosphate detergent ban and the 1992 change in wastewater treatment at the PCS phosphate mine.]

The single most important parameter implicated in eutrophication in these early studies was inorganic nitrogen (nitrite, nitrate and ammonia) that was found to be related to the flow of the Tar River. During low flow, inflowing waters contained high concentrations of nitrate, but the total mass of inorganic nitrogen was low. During high flows a large amount of nitrate (mostly from runoff) was delivered to the upper Pamlico estuary and at times reached the middle estuary (Hobbie, 1974).

High rates of photosynthesis by phytoplankton occurred during the summer and ended in September or October. A second peak occurred in January through March. These peaks were related to increased nitrate concentrations in the estuary. The high rates of photosynthesis were the result of high populations (blooms) of phytoplankton. Algal blooms occurred during the winter in the middle reaches of the estuary, whereas turbid waters in the upper estuary were thought to inhibit algal blooms even though nitrate concentrations were high (ca. 0.4-0.6 mg/l).

Dissolved oxygen during Hobbie's studies was usually abundant in the surface waters of the estuary, but often became depleted in the bottom waters. This oxygen depletion often caused large kills of benthic life such as clams and snails. The kills occurred in the summer or fall when stratification prevented reaeration of the bottom waters.

Stanley and Nixon (1992) studied stratification and bottom-water hypoxia in the Pamlico estuary using data collected biweekly over a 15-year period and recent continuous monitoring data. Results showed that hypoxia develops only when there is both vertical water column stratification and warm temperatures (>15° C). Since stratification can form or disappear in a short period (hours to days), episodes of hypoxia are short-lived. Hypoxia occurs more

frequently in the upper half of the estuary than towards the mouth. No trend of lower bottom water dissolved oxygen concentrations could be detected over the 15-year period.

Stanley (1992, 1993) provides a summary of water quality trends based on water quality data collected during a variety of studies conducted since 1967. Briefly, statistically significant trends ($p<0.05$) were found for ammonia (-), nitrate (-) and phosphate (+) in one or more segments of the estuary. Symbols within the parentheses indicate whether the constituents increased (+) or decreased (-) between 1969 and 1991.

Chlorophyll *a* is used as an indicator of phytoplankton biomass and has been monitored in the Pamlico River since 1970. Chlorophyll *a* values show that algal blooms occur in late winter and early spring in the middle reaches of the estuary (Stanley, 1992, 1993).

The original Tar-Pamlico Basinwide Water Quality Management Plan (NCDEHNR, 1994) estimated that point sources contributed 5 percent of the nitrogen and 12 percent of the phosphorus to the basin, while agriculture was estimated to contribute 45 percent of the nitrogen and 55 percent of the phosphorus. Atmospheric deposition on open waters of the Pamlico River and Sound accounted for roughly 33 percent of the nitrogen and 21 percent of the phosphorus. These percentages were based on contributions from all eight subbasins in the basin. They are also based on 1987-88 Landsat land use coverage and 1992 point source loading data. If one were to look at contributions from just subbasins 03-03-01 through 03-03-06 (that portion of the basin upstream from Washington) to the upper Pamlico River, the distribution would show higher percentages from agriculture, point sources and urban development and much lower percentages from atmospheric deposition to open water. Updated data are expected to be produced for development of new Tar-Pamlico Basin nutrient rules using 1994-95 Landsat land use coverage, refined export coefficients and more recent point source loading data. Relative contributions from each source would be expected to change somewhat; however, the need to reduce loadings equally (30 percent) from each source is still the goal of proposed NSW regulations.

Recent studies by USGS researchers in North Carolina have revealed that the levels of nitrogen phosphorus and suspended sediment in the Tar-Pamlico, Neuse, Chowan and Pasquotank River basins have generally declined since 1980. These reductions may be attributed to the phosphate detergent ban, improvements in agricultural practices and better wastewater treatment (Harned, 1999). However, they caution that present levels of nutrients are still significantly higher than levels recommended by the Environmental Protection Agency for preventing nutrient-related problems such as algal blooms and fish kills. They find that further reductions of 30% summertime nitrogen and phosphorus in the Tar River will be needed to meet the EPA guidelines (Spruill et al., 1998).

In summary, studies have shown that nitrate concentrations decrease upstream to downstream within the estuary and that nitrogen is the limiting nutrient for phytoplankton growth. Algal blooms are more common in the middle reaches of the estuary and winter blooms almost always occur. Bottom water hypoxia has been responsible for benthic organism kills and only occurs when there is stratification and warm temperatures.

3.4 Other Water Quality Monitoring and Research

United States Geological Survey (USGS)

The USGS has an extensive water quality monitoring and research program in place in the Albemarle-Pamlico Sounds region which includes the Tar-Pamlico River. This program is part of a nationwide program called the National Water Quality Assessment (NAQWA). Some findings are presented in the previous section. Data and publications generated by USGS are available through their national and state office websites, below.

- Water Resources in North Carolina: http://nc.water.usgs.gov/
- Water Resources of the United States - http://water.usgs.gov/
- National Water Quality Assessment Program (NAQWA): http://wwwrvares.er.usgs.gov/nawqa/nawqa_home.html

East Carolina University (ECU), Institute of Coastal and Marine Resources

The Institute of Coastal and Marine Resources at ECU has been heavily involved in monitoring the Pamlico River estuary since 1975. This sampling project is funded by PCS Phosphate and has resulted in numerous scientific reports, many of which have been authored by project coordinator Don Stanley. One such report titled, *Water Quality in the Pamlico River Estuary: 1989 - 1996* (Stanley, 1997), presents sampling results on a variety of parameters (phosphorus, nitrogen, chlorophyll *a* and fluoride) over a several-year time frame. Some of these results illustrate the positive effects of actions taken by PCS Phosphate to reduce the amount of wastewater they generate. Most notable of these was a major reduction of phosphorus in the estuary. Stanley estimates that the reduction of phosphorus in the PCS effluent caused a decrease in phosphorus concentrations in the estuary by at least 50%.

Albemarle-Pamlico Citizens Water Quality Monitoring Program

The Albemarle-Pamlico Citizens Water Quality Monitoring Program (CWQMP) is a volunteer estuarine monitoring program begun in 1987 with funding from the Albemarle-Pamlico Estuarine Study (APES). Approximately 65 volunteers monitor surface water quality from over 100 monitoring sites in the Albemarle-Pamlico estuary located in southeastern Virginia and northeastern North Carolina. In the Tar-Pamlico River basin there are 17 sampling locations. These locations are listed below.

1) Tar River - River Bend Park in Louisburg
2) Tar River - 8 miles upriver from Tarboro
3) Tar River - Wildlife landing @ Faukland
4) Tar River - Greenville, near Town Commons
5) Green Mill Run - Green Springs Park, Greenville
6) Pamlico River - Washington
7) Pamlico River - Haven's Wharf, Washington
8) Pamlico River - Bayside Shores, Washington
9) Pamlico River - Chocowinity Bay

10) Pamlico River - Blount's Bay
11) Pamlico River - Broad Creek @ Pamlico Plantation
12) Pamlico River - Bath Creek, Bath
13) Pamlico River - Back Creek, Bath
14) Pamlico River - Goose Creek State Park
15) Pamlico River - Lake Mattamuskeet Canal; Far Creek
16) Pamlico River - Culvert @ Nebraska Canal
17) Pamlico River - Far Creek

Housed at East Carolina University (ECU), the program has two basic goals: to promote stewardship of the region's surface water resources by encouraging public participation in volunteer monitoring, and to collect high quality scientific data to provide baseline information characterizing the condition of the estuary's water quality.

The CWQMP is a perfect example of how those concerned with water quality can benefit from volunteer monitoring. The program coordinator works closely with the northeastern regional office of the NC Department of Environment and Natural Resources in providing data to the Division of Water Quality. The program is actively involved in education, through monitoring efforts, involving school children, scouting clubs and camps. The data are also used by graduate and undergraduate students at ECU in class projects. The program coordinates monitoring efforts with local nonprofit organizations including the Pamlico-Tar River Foundation, Pungo River Fisherman Association, Carteret Crossroads and the NC Coastal Federation.

Surface water quality samples are collected weekly during the summer and twice monthly during the winter. The samples are taken at the same site, at approximately the same time of day and on the same day of the week. This ensures that the data are easily compared, and any changes (at the site) are quickly evident. The parameters monitored are: air and water temperature, turbidity, water depth, salinity, dissolved oxygen, pH, rainfall and other climatic observations. These tests are made using a bucket of surface water collected at the site.

Data are received monthly by the coordinator from the volunteers. Following verification, the data are entered into a database where they are stored. The database is available, free of charge, by contacting the program coordinator.

3.5 Use Support Summary

3.5.1 Introduction to Use Support

Waters are classified according to their best intended uses. Determining how well a waterbody supports its designated uses (*use support* status) is another important method of interpreting water quality data and assessing water quality. Use support assessments for the Tar-Pamlico River basin are summarized in this section and presented in the appropriate subbasin chapters in Section B.

The use support ratings refer to whether the classified uses of the water (such as water supply, aquatic life protection and swimming) are supported, partially supported or not supported. For instance, waters classified for fishing and water contact recreation (Class C) are rated as fully supporting if data used to determine use support (such as chemical/physical data collected at ambient sites or benthic macroinvertebrate bioclassifications) did not exceed specific criteria. However, if these criteria were exceeded, then the waters would be rated as ST, PS or NS, depending on the degree of exceedence.

Use support ratings for streams, lakes or estuaries:

- *fully supporting (FS)*
- *fully supporting but threatened (ST)*
- *partially supporting (PS)*
- *not supporting (NS)*
- *not rated (NR)*

Streams rated as either partially supporting or not supporting are considered *impaired.* There must be a specified degree of degradation before a stream is considered impaired. This differs from the word impacted, which can refer to any noticeable or measurable change in water quality, good or bad.

A waterbody is fully supporting but threatened (ST) for a particular designated use when it fully supports that use now, but may not in the future unless pollution prevention or control action is taken. This rating describes waters for which actual monitored or monitored/evaluated data indicate an apparent declining trend (i.e., water quality conditions have deteriorated compared to earlier assessments, but the waters still support uses). Although these waters are currently supporting uses, they are treated as a separate category from waters fully supporting uses. Streams which had no data to determine their use support were listed as not rated (NR). For a more complete description of use support methodology, refer to Appendix I.

3.5.2 Revisions to Methodology Since 1992-1993 305(b) Report

Methodology for determining use support has been revised. In the 1992-1993 305(b) Report, evaluated information from older reports and workshops were included in the use support process. Streams rated using this information were considered to be rated on an evaluated basis. In the current use support process, this older, evaluated information has been discarded, and streams are now rated using only monitored information (including current and older monitoring data). Streams are rated on a monitored basis if the data is less than five years old. Streams are rated on an evaluated basis under the following conditions:

- If the only existing data for a stream is more than five years old.
- If a stream is a tributary to a monitored segment of a stream rated fully supporting (FS) or fully supporting but threatened (ST), the tributary will receive the same rating on an evaluated basis. If a stream is a tributary to a monitored segment rated partially supporting (PS) or not supporting (NS), the stream is considered not rated (NR).

These changes resulted in a reduction in streams rated on an evaluated basis. In addition, fish consumption advisories are no longer used in determining the use support rating.

In addition to the changes described above, there have been some more recent changes in the way use support is assigned to estuarine waters. In general, estuarine use support ratings were derived

similarly to the previous cycle, but there has been a change in the way shellfish closure information is used. Previously, all SA waters classified by DEH as conditionally approved for shellfish harvesting were given a use support rating of fully supporting but threatened. Currently, conditionally approved-open areas (waters normally open to shellfish harvesting but closed on a temporary basis in accordance with management plan criteria) continue to be rated fully supporting but threatened, but conditionally approved-closed areas (waters normally closed to shellfish harvesting but open on a temporary basis in accordance with management plan criteria) are now rated as partially supporting. This change more accurately reflects the status of conditionally approved-closed waters.

3.5.3 Comparison of Use Support Ratings to Streams on the 303(d) List

Section 303(d)(1) of the Clean Water Act requires states, with EPA review and approval, to identify waters not meeting standards. A list of the waters not meeting standards is submitted to EPA biennially. Waters placed on this list, termed the 303(d) list, require the establishment of total maximum daily loads (TMDLs) intended to guide the restoration of water quality. See Appendix II for a description of 303(d) listed waters in the Tar-Pamlico River basin.

Waters are placed on North Carolina's 303(d) list primarily due to partially or nonsupporting use support ratings determined in the 305(b) or basinwide planning process. These use support ratings are based on biological and chemical data. When the state water quality criterion is exceeded, then this constituent is listed as the problem parameter. TMDLs must be developed for problem parameters on the 303(d) list. Other strategies may be implemented to restore water quality; however, the waterbody must remain on the 303(d) list until improvement has been realized based on either benthos communities or water quality standards.

The 303(d) list and accompanying data are updated as the basin plans are revised. In some cases, the new data will demonstrate water quality improvement, and waters may receive a better use support rating. These waters may be removed from the 303(d) list since water quality improvement has been attained. In other cases, the new data will show a stable or decreasing trend in overall water quality resulting in the same, or worse, use support rating. These waters remain on the 303(d) list until either water quality has improved, or a TMDL has been developed and approved by EPA.

In some cases, a waterbody appears on the 303(d) list, but supports its uses according to the 305(b) report or basin plan. There are two major reasons for this: 1) biological data show full use support, but chemical impairment continues; and 2) fish consumption advisories exist on the water. Such waters will remain on the 303(d) list until the problem pollutant meets water quality standards or a TMDL is developed. Thus, there are inconsistencies between the impaired waters in the use support and the 303(d) listed waters. Waters considered supporting their uses may continue to appear on the 303(d) list because of standards violations.

3.5.4 Use Support Ratings for the Tar-Pamlico River Basin

For the Tar-Pamlico River basin, the assignment of use support designations is grouped into two categories: freshwaters and estuarine (or salt) waters. Figures A-17a, b, c provide a geographical color illustration of all use support designations in the basin.

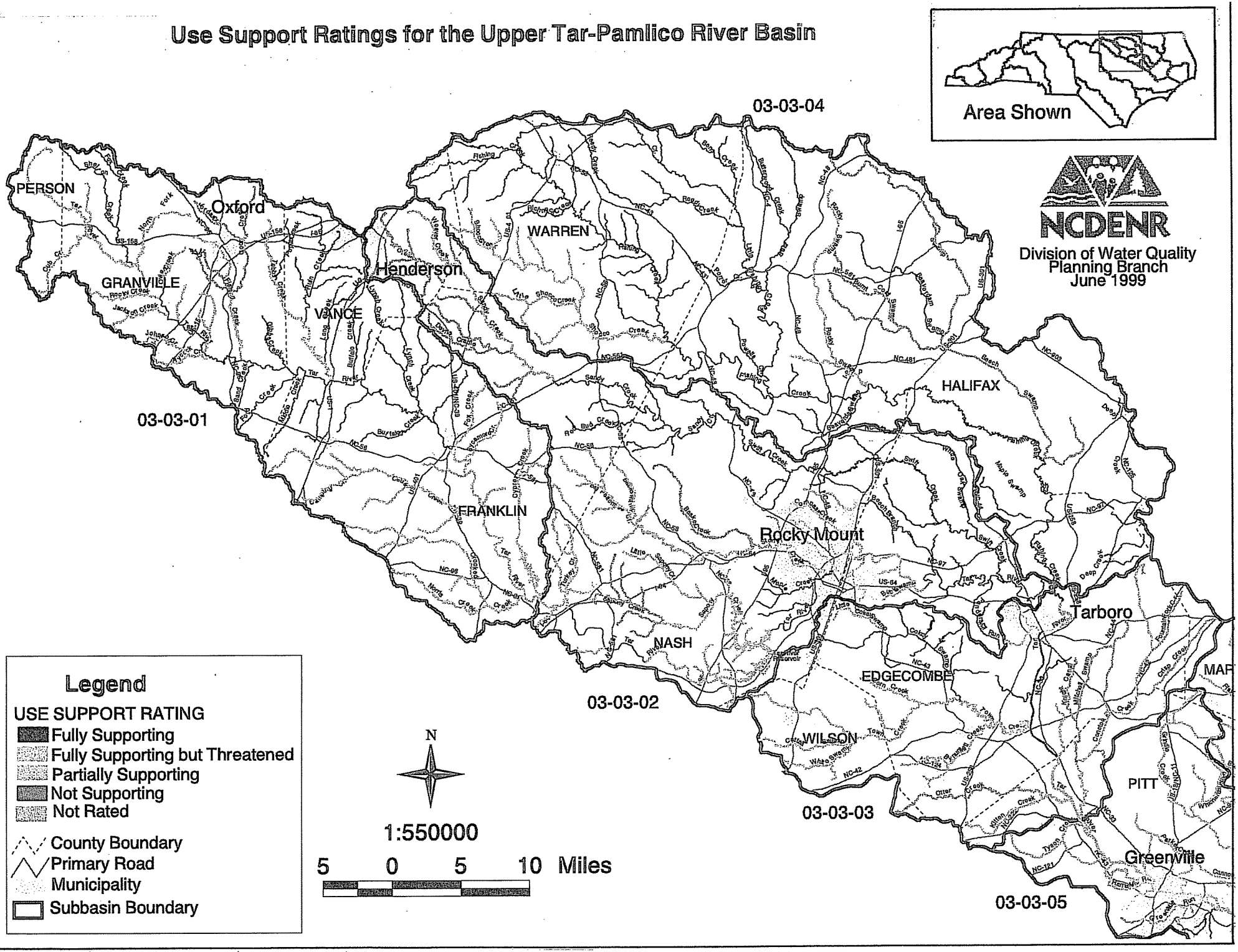


Figure A-17a Use Support Ratings for the Upper Tar-Pamlico River Basin

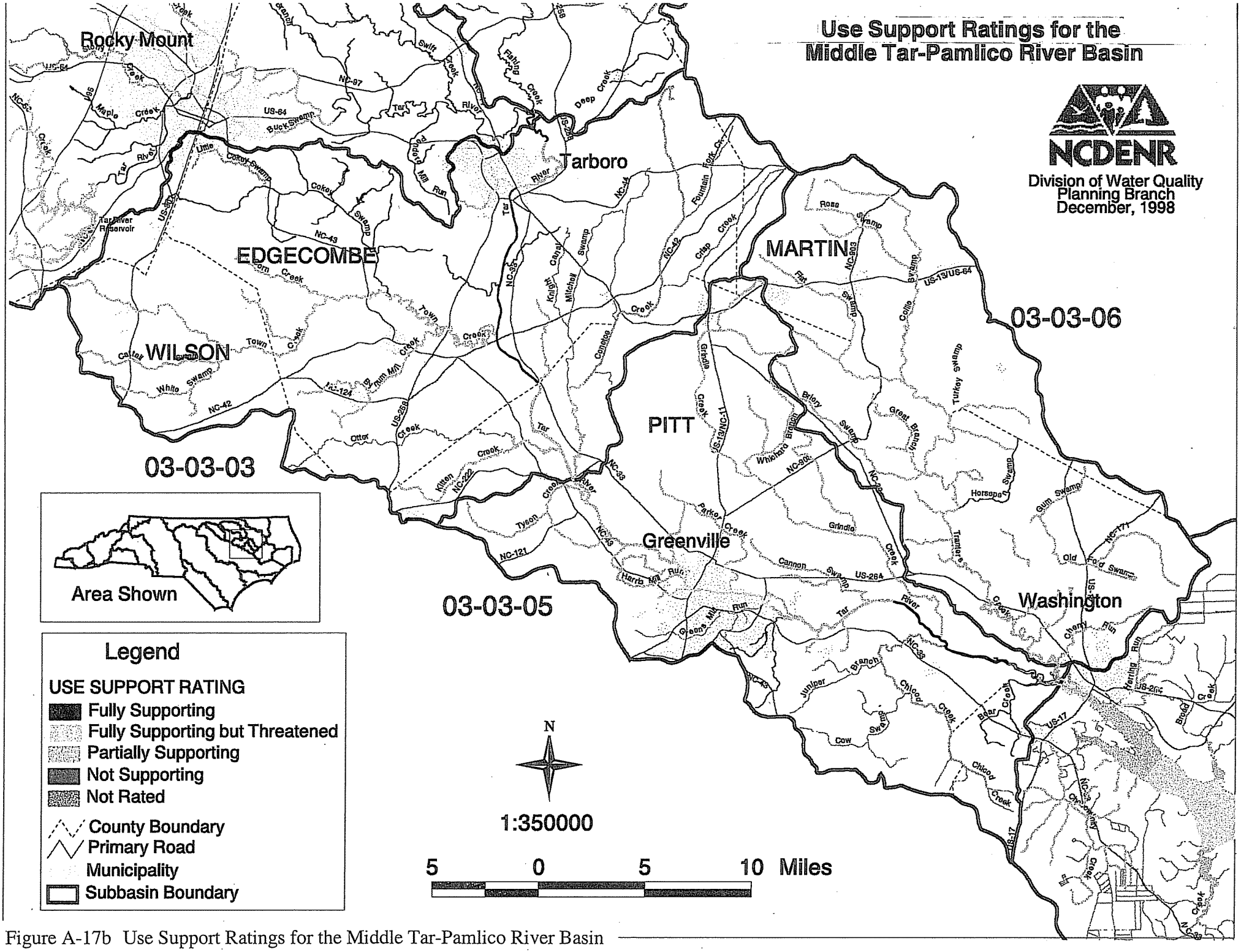


Figure A-17b Use Support Ratings for the Middle Tar-Pamlico River Basin

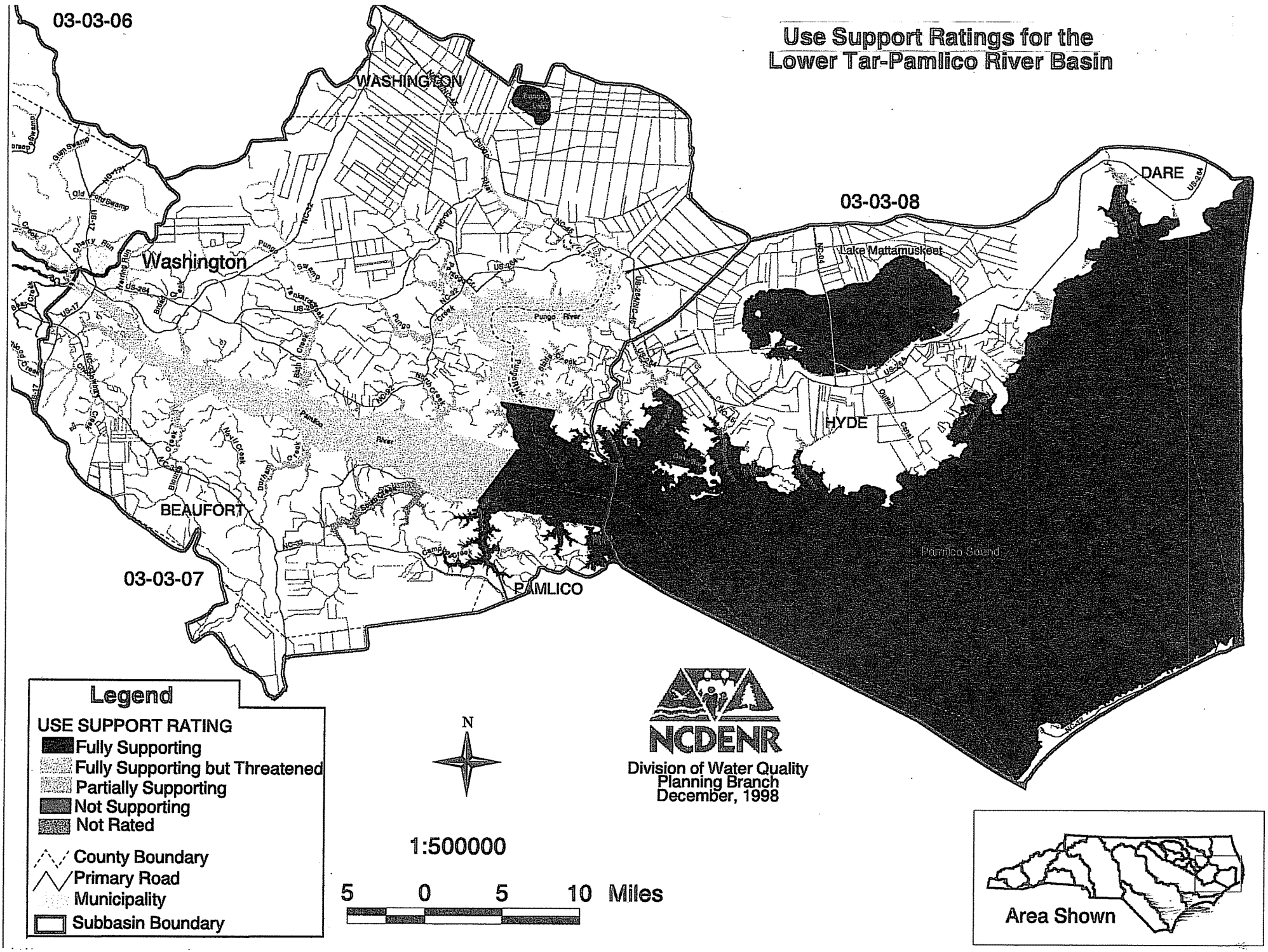
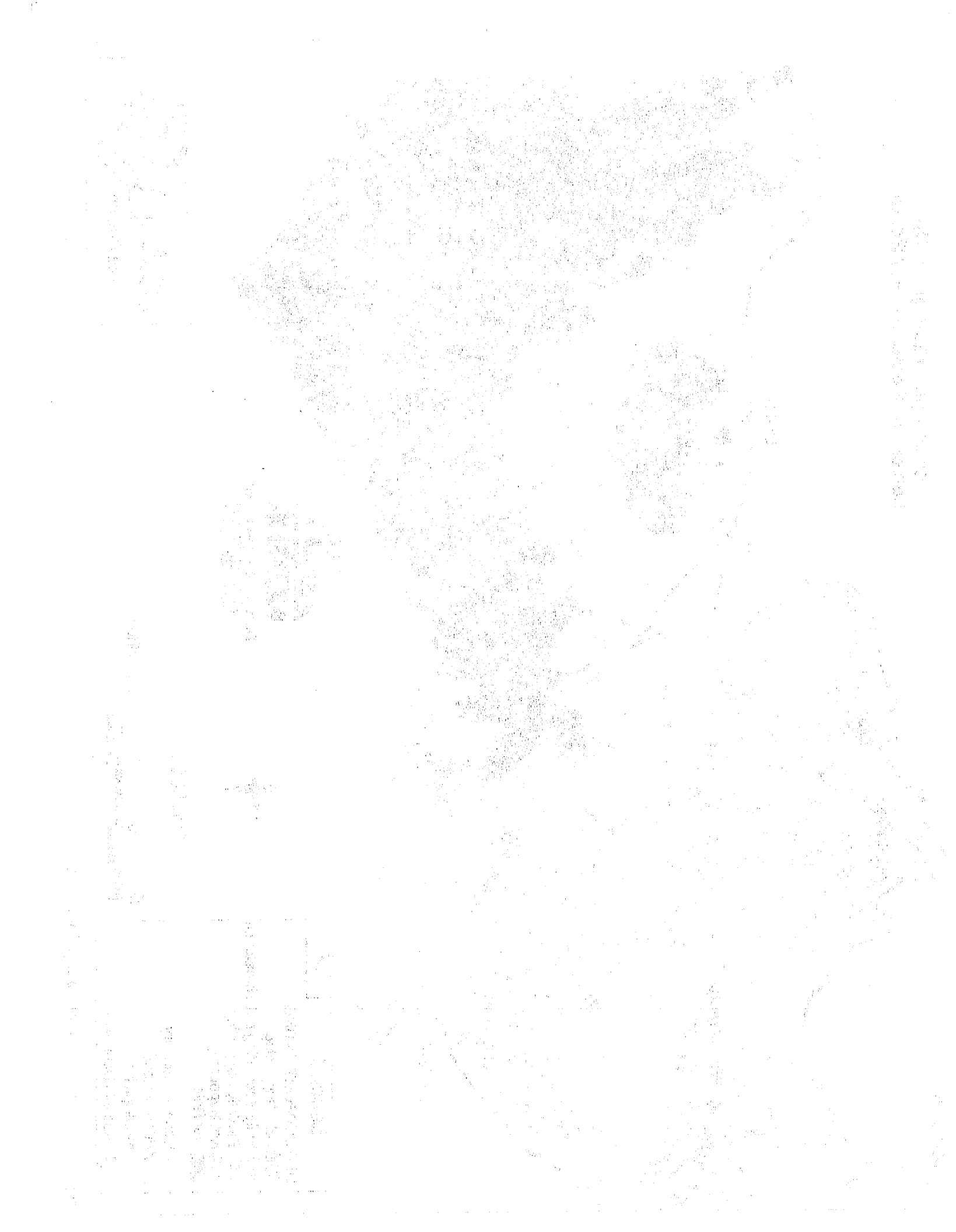


Figure A-17c Use Support Ratings for the Lower Tar-Pamlico River Basin



Freshwaters

Of the 2,448 miles of freshwater streams and rivers in the Tar-Pamlico River basin, use support ratings were determined for 80 percent or 1,957 miles. The majority of the basin's freshwaters (76%) are considered to be supporting their uses. Impaired freshwaters make up 4% of the total, with less than 1% of those being considered NS (not supporting).

In comparison to the last basin plan, a number of waters received improved biological ratings. In many cases this translated into a change from an impaired status (usually PS) to an unimpaired status (ST or FS). The primary reason for these changes appears to be related to flow in these areas when the basinwide assessment was conducted in 1997. Flows in 1997 were such that water quality impacts from nonpoint source pollution were minimized, resulting in higher biological ratings in areas influenced by nonpoint sources.

Table A-22 shows the total number of stream miles in each use support category for each subbasin. This table presents use support for both the monitored and evaluated streams in the basin. In addition, the subbasin summaries in Section B of this plan present use support information for monitored waters in each subbasin.

Table A-22 Use Support Determinations for Monitored and Evaluated Freshwater Streams

Tar-Pamlico Freshwater Use Support Ratings in Miles for 1993-1999						
Subbasin	**Fully Supporting**	**Fully Supporting but Threatened**	**Partially Supporting**	**Not Supporting**	**Not Rated**	**Total**
03-03-01	206.3	245.1	6.1	1.9	27.2	486.6
03-03-02	222.6	146.0	39.2	0	94.6	502.4
03-03-03	53.2	110.5	20.8	0	52.2	236.7
03-03-04	415.3	84.1	0	0	92.8	592.2
03-03-05	25.5	101.4	13	7.5	35.3	182.7
03-03-06	5.7	109.7	0	0	0	115.4
03-03-07	3.2	106.7	2.4	3.8	185.9	302.0
03-03-08	0	0	0	0	29.6	29.6
TOTAL	931.8	903.5	86.5	13.2	512.6	2447.6
%	38%	38%	3%	<1%	20%	100%

Estuarine Waters

Table A-23 presents use support information for the estuarine portion of the Tar-Pamlico River basin. These designations are assigned based on Division of Environmental Health (DEH) shellfish management areas. Figure A-18 provides a map of the DEH areas in the Tar-Pamlico basin.

The most significant change in the estuarine use support for this basin since the 1994 basinwide plan is that a large portion of the Pamlico River estuary has gone from PS (or impaired) to ST (or unimpaired). Based on extensive review of algal bloom, chlorophyll *a* and fish kill data for these waters for the period of 1993 to 1997, it was determined that water quality conditions during that time period did not reflect impairment.

It is unclear whether this outcome is the result of actual improvements in water quality, or rather a reflection of a decrease in information and data related to conditions associated with impairment (blooms, fish kills) for the time period of interest. During the previous basinwide cycle (1987-1992), the Pamlico River estuary was the focus of significant attention. Reports of fish kills and algae blooms are influenced by the degree of attention being given to a waterbody. This attention has been greater in years prior to the current reporting period, meaning that there was more information available in making a use support assessment in the Pamlico River estuary during the last reporting period. With the establishment of the Tar-Pamlico Rapid Response Team in 1998, DWQ has a more regular presence on the estuary, as well as a user-friendly link to the public (a toll free phone number: 1-877-337-2383) through which to obtain reports on blooms and fish kills. Therefore, information gathered during the next basinwide cycle will help determine whether conditions in the estuary are reflecting improvements in water quality or whether impairment still exists.

For this basinwide plan, the use support status is based on information gathered between 1993 and 1997. As indicated, the information and data available for this time period do not reflect impairment during those five years. Given the natural variability in the estuary, this should not indicate any intention of lessening efforts to reduce nutrient loading to the estuary. Continued and improved monitoring during the next basin cycle should reflect if these apparent improvements are real or due to reductions in effort and interest in reporting blooms and fish kills.

The primary cause of impairment in the Tar-Pamlico basin's estuarine waters is elevated levels of fecal coliform bacteria. These are areas that are closed to shellfish harvesting because fecal coliform bacteria exceed the standard for this use (14/100 ml). This is a stringent standard designed to protect human health and is not indicative that the waters are unsafe for other uses such as recreation.

Table A-23 Use Support Ratings for Estuarine Waters in the Tar-Pamlico River Basin (1993-1997)

Area Name	DEH Area	Total Acres	Subbasin	Overall Use Support (Acres)				Major Causes	
				S	ST	PS	NS	Fecal	Chl *a*
Goose Cr.	G1	17,000	03-03-07	0	16,700	300	0	300	
Pamlico R.	G2	29,000	03-03-07	28,500	0	500	0	500	
Swanquarter Bay	G3	45,000	03-03-08	44,133	0	867	0	867	
Wysocking Bay	G4	23,000	03-03-08	22,745	0	255	0	255	
Long Shoal	G5	46,000	03-03-08	43,946	0	2054	0	2,054	
Ocracoke	G6	13,300	03-03-08	13,165	0	135	0	135	
Open Water	G7	400,000	03-03-08	400,000	0	0	0		
Lower Pungo R.	G8	13,200	03-03-07	0	12,486	714	0	714	
Upper Pungo R.	G9	8,000	03-03-07	0	8,000	0	0		
Pamlico R.	G10	15,500	03-03-07	0	15,500	0	0		
Pamlico R.	G11	20,700	03-03-07	0	17,245	3,455	0		3,455
South Cr.	G12	3,300	03-03-07	0	0	0	0	**	
Totals		634,000		552,489	69,931	8,280	0	4,825	3,455
% of Total Ac.		100		87%	11%	1%	0%		

** South Creek is considered not rated due to lack of water quality data for the area. It is closed to shellfish harvesting because Shellfish Sanitation no longer conducts sampling within the creek because there is little or no commercial shellfish resource within it. It is a federal requirement that areas that are not sampled be closed to harvesting.

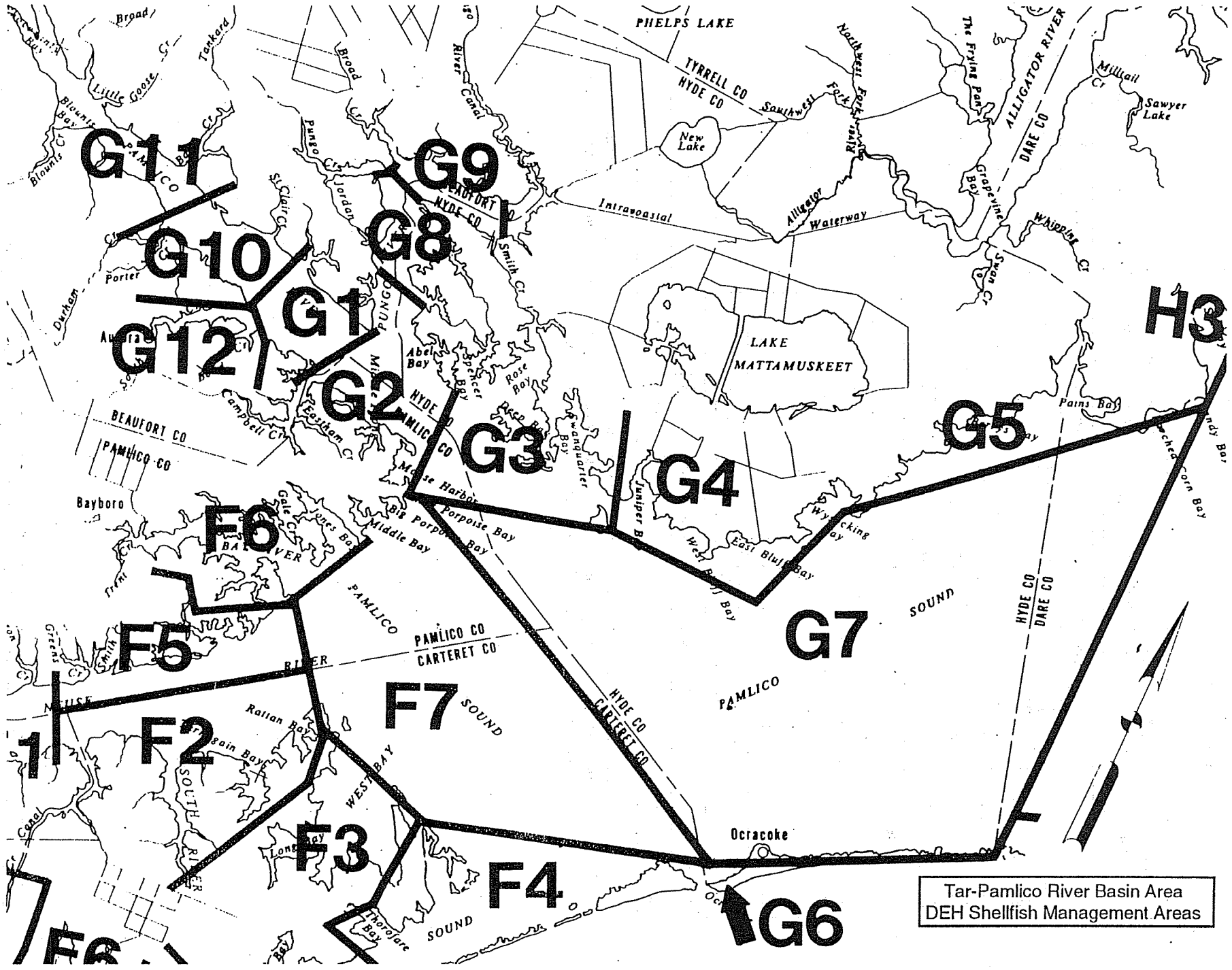


Figure A-18 DEH Shellfish Management Areas in the Tar-Pamlico River Basin

Chapter 4 -
Water Quality Issues Related to the Entire Tar-Pamlico River Basin

4.1 Prior Basin Plan Recommendations and Achievements for Issues Related to Entire Basin

4.1.1 Introduction

The Tar-Pamlico Basinwide Water Quality Management Plan that was approved in December of 1994 included a number of statements or recommendations to address water quality issues in the basin. Some of these recommendations were pertinent to the basin as a whole, while others were specific to a particular stream or area within a subbasin. A status of the more specific recommendations is reported within the individual subbasin discussions presented in Section B of this document. In this portion of Chapter 4 of Section A, recommendations from the 1994 plan that were related to the whole basin are addressed. These issues have been grouped into four categories: nutrient management and modeling; priorities for strengthening updates of the Tar-Pamlico Basinwide Plan; actions to address monitoring issues in swamp systems; and addressing waters impaired based on evaluated information. Each statement or recommendation from the 1994 basin plan will be described and followed by a description of efforts that have (or have not) been made related to the task.

4.1.2 Nutrient Management and Modeling

The 1994 basin plan included a number of recommendations related to nutrient management throughout the basin. Many of these were broad statements related to the need to reduce nutrient loadings from nonpoint sources of pollution.

The Division of Water Quality has been working with other agencies through the implementation of the Tar-Pamlico NSW strategy to address nonpoint sources of pollution in the basin. These efforts, which are described in more detail in part 4.2 of this chapter, have recently shifted from a voluntary focus to the proposal of mandatory measures. Since the approval of the last basin plan, the Environmental Management Commission (EMC) has approved the *Tar-Pamlico River Nutrient Management Plan for Nonpoint Sources of Pollution* (DEM, 1995) and has received status reports on the progress of the implementation of the plan (DWQ, 1997; DWQ, 1998). When the last status report was received, the Commission requested, and subsequently approved, a schedule under which DWQ should pursue the establishment of rules to address nonpoint sources in the basin. Again, these efforts are further described in Part 4.1 of this chapter.

The 1994 basin plan indicated that DWQ should work with other nonpoint source agencies to develop a good database for best management practices in the basin.

This effort is related to accounting for nutrient reductions for different categories of nonpoint sources (agriculture, urban, forestry). Although a database has not yet been established, progress has been made in addressing this complex issue for agriculture. In 1997, a workgroup was convened to work to address the issue, and it is anticipated that the third status report to the EMC (due in May of 1999) will include nutrient reduction estimates generated from such a database.

The 1994 basin plan indicated that 40% of nitrogen applied as fertilizer is lost to the environment and that research should be done to see if this number can be reduced.

Although the plan suggested that this effort be made, it did not identify a responsible party to undertake it. In this plan and other, more recent plans, an effort is being made to highlight issues or subjects for research and study so that users of the plan can see possible projects for themselves or their colleagues. (See Chapter 3 of Section C).

The 1994 plan indicates that a portion of the federal 319 grants and state cost share monies should be used to perform monitoring before and after BMP implementation to generate information on the cost-effectiveness of various BMPs.

There are several projects underway in North Carolina to address this subject, two of which are in the Tar-Pamlico River basin. In the Tar-Pamlico basin, BMPs have been applied in the Chicod Creek watershed and on a dairy near the Tar River. See Section C for a more detailed description of these efforts.

The 1994 plan recommended that monthly monitoring be conducted and that a flow gage be installed in the lower Tar River.

A US Geological Survey gaging station was installed near Greenville in the spring of 1997. At this same site, and at the same time the gage was installed, DWQ began monthly monitoring of nutrients and other water quality parameters. The data generated from this effort will be used to judge progress toward nutrient reduction goals and to calibrate models for the Tar-Pamlico basin. Flow data from this site can be obtained at the following website: *http://wwwnc.usgs.gov/rt-cgi/gen_tbl_pg.*

In addition, three continuous water quality monitoring stations have been installed in the Pamlico River at Washington, Light #5 and Light #3. Data from these stations are available at the following website: *http://sgi1dncrlg.er.usgs.gov/qw/PamlicoRiver.html.*

The 1994 plan recommended further studies on the fate and transport of nutrients and on the development of methods to perform fate and transport modeling.

This is an area that is still in need of attention. Much effort has been put into establishing resources to address this issue in the Neuse River basin, and this task is currently ongoing. Results from the Neuse modeling and monitoring efforts will be helpful in addressing nutrient issues in the Tar-Pamlico basin because of the similarity of the systems.

4.1.3 Priorities for Strengthening Updates of the Tar-Pamlico Basinwide Plan

The 1994 Tar-Pamlico Basinwide Plan outlined five actions that were priorities for future updates of the plan. These are addressed individually below.

Increasing Public Participation and Stakeholder Involvement in the Basinwide Planning Process

DWQ is committed to involving the public in its water quality program through the basinwide planning process. Efforts to do so include organizing and conducting workshops in the basin prior to development of the plan, and holding pubic meetings to receive comments on the plan after it has been drafted but before it has been finalized. In recent years, the workshops have become more elaborate and have included speakers that are involved in projects affecting water quality in the basin and breakout sessions that provide participants with an opportunity to share their concerns about water quality in their river basin.

Integration of Water Resources Planning with Water Quality Protection

During plan development, DWQ now solicits information from the Division of Water Resources that describes basinwide water resource issues.

Discussion of Groundwater and Wetlands as They Relate to Water Quality

The basin plans are beginning to include groundwater and wetland components. In addition, the North Carolina Wetlands Restoration Program (NCWRP) has developed a "Basinwide Wetlands and Riparian Restoration Plan" for each river basin. These plans will be updated using the same time line as the basinwide water quality management plans and will complement this program. The restoration plans address water quality impairment identified in the water quality management plans through wetlands and stream restoration and watershed restoration planning. The NCWRP is also initiating efforts to coordinate various local interest groups, local governments and resource agencies to develop watershed restoration plans on the 14-digit hydrologic units in subbasins that the NCWRP has designated high priorities due to impaired water quality.

Costs Associated with Pollution Control Measures

The plans have not begun to address the issue of costs associated with plan recommendations. Such efforts are complicated and require significant staff resources to develop. Within the water quality program in general, DWQ is required to address the costs of pollution control measures associated with proposed regulations. As rules are proposed within the next year to address nutrient reduction from nonpoint sources in the Tar-Pamlico River basin, a fiscal analysis will be performed to estimate the costs associated with the proposal. A fiscal analysis was performed on the rules that were proposed for the Neuse River Basin Nutrient Sensitive Waters Management Strategy. This 168-page document analyzed potential costs associated with various sectors' requirements to reduce nutrient inputs to surface waters from both point and nonpoint sources. Such efforts could lay the groundwork for estimating the costs associated with the implementation of basinwide plan recommendations in the future.

APES CCMP and the Tar-Pamlico Basin Plan

This priority action is related to the Albemarle-Pamlico Estuarine Study Comprehensive Conservation and Management Plan which recommended the establishment of a river basin stakeholder group (a Regional Council) for the Tar-Pamlico River basin as well as the four other river basins in the Albemarle-Pamlico Region. The Tar-Pamlico Basin Regional Council was established in 1997 and has been meeting on a regular basis. They have identified priority issues that they want to address in the river basin and have been gathering information related to those issues. For more information on regional council efforts, please contact Guy Stefanski in Raleigh at (919) 733-5083, extension 585, or Joan Giordano in Washington, NC at (252) 946-6481.

4.1.4 Actions to Address Monitoring Issues in Swamp Systems

For a number of streams listed as impaired in the 1994 basin plan, it was recommended that DWQ study swamp systems to more accurately determine natural versus man-made impacts in these areas. The reasoning for this recommendation was that data may indicate impairment, but that impairment could be due to natural conditions of swamp waters such as low dissolved oxygen concentration.

Recent extensive work on swamp streams suggested that different criteria should be used for slow-flowing, swamp-like systems. DWQ has developed draft biological criteria ratings more specific to swamp waters. Draft swamp stream rating criteria evaluate a stream based on benthic macroinvertebrate data collected in winter, fish community data and a habitat score. Benthos data collected outside of the winter high flow period are not used to assign ratings. At least two of the data types must be collected to assign a rating. Each of these components is assigned a point value, and the points are averaged to assign an overall site rating. Ratings for the benthos are based entirely on the BI value. Deep (nonwadeable) coastal rivers with little or no visible current have different EPT criteria (Coastal B) that are being used on a provisional basis until more data can be gathered. Details of benthos sampling, criteria and data analysis can be found in the Biological Monitoring SOP Manual (NCDEHNR, 1997).

The draft swamp criteria were developed after collecting data for over four years. That data indicated that the BI values could separate differences in impact, but only during winter high flow conditions. During normal summer sampling, all sites were too similar to provide meaningful data. However, DWQ believes there is insufficient sampling of reference swamp streams to use the ratings without reservation for use support determinations. It must be stressed that the criteria are draft and will remain so until DWQ is better able to evaluate such things as: year-to-year variation at reference swamp sites, variation among reference swamp sites, the effect of small changes in pH on the benthos community, whether the habitat evaluation can be improved, and the role fisheries data should play in the evaluation. In this light, the ratings can be used for comparative purposes only and have not been used for use support.

However, much work has and will continue to be done to allow biological communities to provide meaningful information for swamp-like waters. For example:

- In 1992, 1993 and 1995 benthos samples were collected each year from 27 swamp streams during February or March throughout the NC coastal plain. The intent of this sampling was to develop draft swamp stream criteria, primarily using benthos data and habitat evaluations.
- Since 1995, benthos swamp sampling methods have been used at almost 40 sites, including 13 reference sites sampled in 1998.
- Validation of the swamp criteria will require several years of data from the reference sites to determine variations due to flow conditions and changes in pH, and to see if the present draft criteria will allow differentiation between reference sites and known impacted sites.

4.1.5 Addressing Waters Impaired Based on Evaluated Information

The 1994 basin plan identified a number of streams that were considered impaired based on evaluated information. This means that the use support rating was determined using dated (>5 years old) data or best professional judgement. The primary management strategy for these areas was to "continue existing programs". Impaired streams that were assessed based on monitored (or more recent) data were given priority for action over the evaluated impaired streams. DWQ and other agencies did continue the implementation of existing programs during the last five years.

4.2 Nutrient Management

4.2.1 Overview

In the late 1980s, increases in algal blooms and fish kills in the upper Pamlico estuary created public concern for water quality in the Tar-Pamlico River basin. These blooms were linked to excessive nutrient levels and led the state Environmental Management Commission (EMC) to designate the entire Tar-Pamlico River basin as Nutrient Sensitive Waters (NSW). This designation required the state to develop a nutrient management strategy for the entire basin. This strategy is composed of two 'Phases'. Phase I was implemented between 1991 and 1994. Implementation of Phase II began in 1995 and will continue through 2004. The strategy, along with a description of recent efforts to regulate nonpoint sources of nutrient runoff into the Tar-Pamlico River basin, is described in the following subsections.

4.2.2 Phase I

The first phase of the NSW strategy targeted wastewater treatment plants and other "point source" discharges of water, since they were better understood, easier to control, and made significant nutrient contributions to the river. The first NSW strategy approved by the EMC, in December 1989, simply set tight nutrient limits on point source discharges. In February 1992, the strategy was revised to include an innovative nutrient trading program between point and nonpoint sources of pollution. The resulting Agreement contract launched a nationwide benchmark point source/nonpoint source nutrient trading program. An association of point source dischargers known as the Tar-Pamlico Basin Association (Association) agreed to either reduce their nutrient loading to the basin, or if they exceeded an annual collective loading cap, to fund agricultural Best Management Practices (BMPs).

This Agreement allowed Association dischargers to find the most cost-effective way to collectively meet their loading cap, and it provided a more cost-effective nutrient reduction alternative through agricultural BMPs if they couldn't meet their cap. The parties to this innovative Agreement, called Phase I of the NSW strategy, were the Association, the Division of Water Quality, two environmental groups (the Environmental Defense Fund and the Pamlico-Tar River Foundation), and the Division of Soil and Water Conservation.

The Phase I Agreement covered the period 1990-1994 and called for other actions by the Association as well. The Association agreed to:

- develop an estuarine water quality model that would allow estimates of nutrient reductions needed to meet water quality standards rather than reducing nutrients based on best available technology;
- do an efficiency study of all Association facilities and make minor capital, operation and maintenance changes to optimize their nutrient reduction performance; and
- provide up-front funding for nonpoint source BMPs and for staff to administer them.

Phase I Accomplishments. The Phase I Agreement yielded progress in several respects:

- Every year, the Association kept nutrient loading beneath an annually decreasing cap, reducing overall nitrogen and phosphorus loads by about 20% despite growth as reflected in a flow increase of about 7%. They did so largely by improving treatment facilities' efficiencies following the optimization study.
- The estuary model was completed, setting the stage for establishment in Phase II of an overall reduction goal for the estuary based on water quality standards. Such a reduction goal could be applied to nonpoint sources in addition to point sources.
- The Association provided up-front funding of almost $1 million worth of agricultural BMPs, in large part through a federal EPA grant. They banked credit from this for future cap exceedences.
- Fourteen dischargers equaling about 90% of all point source flows to the river joined the Association.

4.2.3 Phase II

Phase II of the NSW Strategy was adopted by the EMC in December 1994 and covers the period 1995-2004. The major thrust of Phase II was to establish instream reduction goals for nonpoint sources and point sources of nutrients and to implement a plan for achieving the NPS reductions.

Nonpoint sources of pollution stem largely from rainfall runoff, which picks up pollutants as it flows over land and into streams. Nonpoint sources of nutrients include yard and cropland fertilizer, livestock and pet waste, poorly operating septic systems, and atmospheric deposition of nitrogenous compounds that originate as combustion by-products and as gas emissions from animal waste.

Based on the estuary model completed in Phase I, a 30 percent reduction in total nitrogen loads to the estuary from 1991 conditions was set as an interim goal in Phase II, along with no increase in phosphorus loads. These goals may be adjusted in future years as progress and better

understanding develop. Parties to the Phase II Agreement are the Association, DWQ, and the Division of Soil and Water Conservation. The environmental groups opted out, primarily because they were not satisfied with the percent goal, and they felt that the point source cap should be lower.

A plan for achieving the 30 percent nitrogen reduction goal from nonpoint sources was adopted by the EMC in December 1995. Although Phase II runs through 2004, the NPS Plan held agencies to achieving the goal by the end of 2000. The NPS Plan relies on existing programs to achieve the goal through better targeting, coordination and increased effort. It includes action plans for nine different nonpoint source and resource categories: agriculture, forestry, urban stormwater, construction, on-site wastewater, solid waste disposal, wetlands, groundwater and atmospheric deposition.

Phase II Progress. Annual status reports to the EMC on the progress of NPS Plan implementation began in May 1997. These reports allow the EMC to reevaluate the adequacy of the current approach and to consider the need for mandatory measures to expedite progress toward the goal.

The EMC had strong reservations over progress described in the first annual status report. The second report in May 1998 showed that substantial numbers of agricultural BMPs had been implemented since 1991, but that based on progress to date, a greater rate of implementation was needed to reach the agricultural goal by 2000. This was true particularly in light of the rapidly growing number of animal operations in the coastal plain. Since DWQ had estimated that agriculture was responsible for most of the NPS nutrient loading to the estuary and had tasked agriculture with achieving most of the NPS reductions needed, agriculture's progress was a key element. The other categories, urban and atmospheric deposition, could not quantify changes in loading. There are many unknowns on atmospheric deposition issues, but a multiparty research effort is underway that will begin to answer some of these questions. Accounting for changes in NPS loading is a challenging issue nationwide, but the agencies are working to provide answers. The report emphasized that lack of resources is a key limitation to making and accounting for progress in all categories.

4.2.4 Rule-Making Effort to Reduce Nonpoint Source Nutrient Inputs

EMC members felt that progress under the "existing programs" approach was inadequate. After receiving the second annual report, the EMC called for a schedule for development of mandatory nutrient reduction measures for the basin. They approved this rule-making schedule in September 1998. The schedule proposes an effective date of August 2000 for new rules and includes a full stakeholder input process prior to formal rule making to guide rule development. Stakeholder teams were formed for the following subject areas: agriculture, atmospheric emissions, urban stormwater, on-site wastewater, construction erosion and sedimentation control, nonagricultural nutrient management, riparian area protection and restoration. While there is no mandate to adopt Neuse-type rules, the Neuse NSW rules served as a useful starting point for discussion. The teams, using a consensus process and professional facilitation, met intensively from November 1998 through February 1999 and submitted draft rules to the EMC at its May 1999 meeting.

Draft rules produced by the stakeholder teams were scheduled to go through public hearings in summer 1999 and be adopted by the EMC in December 1999. Any rules adopted by the EMC must undergo review by the Rules Review Commission and the General Assembly before becoming effective and could be modified or eliminated during that review. Since rules would not be effective until at least August 2000, and would likely be implemented in stages over several years, it will be necessary to revise the target date for achieving the 30 percent reduction goal. A revised target date will be established as part of rule making, and may be set for the end of Phase II, December 2004.

Stakeholder Team Recommendations

Agriculture

- Use a zero-acre threshold as in the Neuse agriculture rule, and clearly include horticulture.
- Use the Neuse agriculture rule as a template, including both the local strategy and standard BMP options.
- On potential loading from soluble phosphorus:
  - * The science on soluble phosphorus currently contains gaps that present management challenges.
  - * Federal agricultural policy related to this issue is currently evolving; USDA-NRCS may release new phosphorus management policy in the near future.
  - * Any rules to limit waste application based on phosphorus measures could involve significant new costs to agriculture.
- Require the Basin Oversight Committee to appoint a technical advisory committee to monitor advances in scientific understanding related to phosphorus loading issues. The TAC will report its findings to the Basin Oversight Committee and the EMC on an annual basis.
- The team agreed to encourage local agriculture agencies in the basin to begin advocating site-specific phosphorus analysis and BMP implementation on a voluntary basis until phosphorus management requirements are established.
- The team identified difficulties related to estimating the nitrogen load from agriculture in 1991 (the baseline load), from which reductions are to be measured. The team also identified issues associated with current methods of load reduction accounting and with accounting alternatives. It was unable to resolve these challenging technical issues, which may have significant bearing on implementation of the agricultural rules in both the Neuse and Tar-Pamlico basins, in the available time. The team agreed to request that the EMC form an Agriculture Nutrient Accounting Task Force as detailed below.

Urban Stormwater

- The team determined that the portion of the basin land area identified as urban under-represents the significant contribution of stormwater from developed areas to the total nonpoint source nutrient load to the estuary.
- The team agreed to the requirements of the Neuse Stormwater Rule, except for the two following changes.
  - * It established specific thresholds for the size of local governments affected by the rule: 5,000 for municipalities or 30,000 for counties. This encompasses 83% of the basin's

population. It also added an automatic threshold; local governments will become subject to the rule once they reach these thresholds.

* It added two elements to the local governments' stormwater management programs: a requirement to prioritize potential retrofit sites and a requirement to map municipal storm sewer and sanitary sewer systems.

Nutrient Management

- The agriculture team agreed to use the Neuse Nutrient Management Rule requirements with two additions:
  * Add crop consultants as a regulated group.
  * Add a phosphorus component to nutrient management training.
- The nutrient management team for nonagricultural lands agreed to use the Neuse Nutrient Management with the following two modifications:
  * Eliminate the 50-acre threshold used in the Neuse Nutrient Management Rule for nonagricultural lands.
  * Exempt residential homeowners who apply nutrients to their own lawns.

Atmospheric Emission

Funding provided by the General Assembly in 1996 for atmospheric ammonia research is largely exhausted, and DAQ's historical funding for such research was recently ended. In December 1998, team members Dr. Viney Aneja (NCSU-MEAS), Dr. Ron Sheffield (NCSU-ARS) and Dr. Bill Cure (DAQ) submitted research funding proposals to DENR for inclusion in the departmental expansion budget. They requested funding to continue collecting data on ammonia emissions, ambient levels and deposition; to continue modeling these data; and to develop on-farm demonstrations of BMPs to control emissions from different sources. See Appendix VI for a more complete summary of the atmospheric emissions stakeholder group including a discussion of ammonia emissions.

On-site Wastewater

- The team agreed to forward a resolution from the EMC to the General Assembly requesting the following steps:
  * Fund research that will address the following issues in the basin: identify high-risk areas for nitrogen loading, quantify on-site system failures, estimate actual nitrogen loading, and develop a risk-based on-site management strategy for the basin.
  * Require counties to implement risk-based on-site management strategies, including inspection of all systems on a 5-year cycle and requiring denitrifying technology as needed.
  * Provide funding and authority for counties to conduct the required management activities and to determine septage treatment needs and capacity, for a program to fund homeowners to install denitrifying technology, and for training and education.

Construction Erosion and Sedimentation

- The team developed the following recommendations for the EMC to forward to the Sedimentation Control Commission in a resolution:
  * Adopt more stringent erosion and sedimentation requirements for NSWs similar to those required for High Quality Waters.
  * Implement mandatory training/certification for contractors/developers.
  * Increase enforcement staffing.
  * Strengthen existing training and education, and support research to better quantify nutrient loading from land-disturbing activities and to improve control technology.

In addition to the resolution, the team agreed the Land Quality Section should have the opportunity to present a report to the EMC on sedimentation control program improvements since 1991.

Riparian Area Protection

The Steering Committee agreed to pursue rule making to protect existing riparian areas, as was done in the Neuse basin.

Restoration

- The team agreed to request that the EMC take the following actions:
  * Establish an explicit, voluntary restoration goal.
  * Forward a resolution to the General Assembly requesting funding to accomplish this goal.
  * Establish the North Carolina Wetlands Restoration Program as lead agency and chair of a technical advisory committee that will help identify restoration sites and increase the number of projects in the basin.

The current NPS approach, relying on existing programs, continues while rule development and adoption occurs. Since any new rules will not be effective early enough to make significant changes on the ground by the end of 2000, the delay will allow us to see how effective a largely voluntary approach can be in solving the nutrient problems of a river basin.

Want to stay informed about the progress of the rule-making effort?

The Environmental Resource Program at UNC-Chapel Hill has set up a listserve for information related to the rule-making efforts in the Tar-Pamlico basin. Minutes of stakeholder meetings and details of public hearings will be distributed through the listserve. To subscribe send an e-mail to listproc@listserv.oit.unc.edu with the following message and NO subject: subscribe checctarpam [your first name and last name].

New Opportunities. The challenge of reducing nutrient loading to the Tar-Pamlico estuary will require participation from everyone that lives or works in the basin, since everyone contributes to nonpoint sources of nutrients. Nonpoint sources of nutrients are widespread and numerous and come from developed areas as well as rural ones. Everyone in the basin is a stakeholder, including homeowners, farmers, loggers and other natural resource users, developers, businesses, municipalities and counties. Greater financial and other resources will help stakeholder

groups in the basin tackle this challenging job. DWQ hopes to provide resources to stakeholder groups in the form of education, technical assistance, water quality information, access to funding sources and other incentives. We would like to see sufficient progress through voluntary efforts by stakeholder groups to minimize the need for new regulation.

Several programs and initiatives may help stakeholders to pick up the pace or join in efforts toward the 30% goal as December 2000 approaches:

- The state's Clean Water Management Trust Fund was established by the 1996 General Assembly. This program offers as much as $40 million each year for grants to restore and protect water quality statewide. Projects approved through March 1998 included three in the Tar-Pamlico basin.
- The statewide NC Wetlands Restoration Program (NCWRP) was also established by the 1996 General Assembly. Program objectives consist of implementing restoration projects to create a net increase in wetland acres, functions and values over current levels, to compensate for historical losses. Subbasins within the Tar-Pamlico basin which have been designated high priorities by the NCWRP due to water quality impairment will be the focus of its initial restoration efforts. A preliminary restoration plan for the basin was adopted in 1998. Currently, the NCWRP is updating its Tar-Pamlico restoration plan to correspond with the schedule for updating the basinwide water quality management plan.
- In August 1998, the Division of Soil and Water Conservation received a $220 million grant from the USDA under the Conservation Reserve Enhancement Program. This grant will be used for buffer restoration and protection in the Tar-Pamlico basin and other Nutrient Sensitive Waters in the state, such as the Neuse, Chowan and upper Cape Fear basins.
- The federal Coastal Nonpoint Pollution Control Program, coordinated by EPA and NOAA under Section 6217 of the Coastal Zone Act amendments of 1990, is calling for comprehensive NPS management measures in states' coastal areas over the next 15 years.

4.3 Priority Issues and Recommendations for the Entire Basin During the Next Five Years

4.3.1 Addressing Waters on the State's 303(d) List

For the next several years, addressing water quality impairment in waters that are on the state's 303(d) list will be an important priority. The waters in the Tar-Pamlico River basin that are on this list are presented in the individual subbasin descriptions in Section B and in Appendix II.

The "303(d) list" is related to section 303(d) of the federal Clean Water Act that requires states to develop a list of waters not meeting water quality standards or which have impaired uses. As part of this, states are also required to develop Total Maximum Daily Loads (TMDLs) for 303(d) listed waters to address impairment in these areas. In the last few years, the TMDL program has received a great deal of attention as the result of a number of law suits that have been filed across the country against the Environmental Protection Agency (EPA), arguing that TMDLs have not adequately been developed for specific impaired waterbodies. As a result of these lawsuits, EPA issued a guidance memorandum in August of 1997 that called for states to develop schedules for

developing TMDLs for all waters on the 303(d) list. The schedules for TMDL development, according to this EPA memo, are to span 8-13 years.

Across the State of North Carolina there are approximately 500 waters identified on the 303(d) list. The rigorous and demanding task of developing TMDLs for each of these waters during an 8 to 13-year time frame will require the focus of much of the water quality program's resources. Therefore, it will be a priority for North Carolina's water quality program over the next several years to develop TMDLs for 303(d) listed waters. This task will be accomplished through the basinwide planning process and schedule.

4.3.2 Nutrient Management

During the next five years, it will continue to be a priority in the Tar-Pamlico River basin to pursue nutrient reductions throughout the basin. This effort has been described in detail in Part 4.2 of this chapter.

4.3.3 Addressing Monitored Impaired Waters

For waters that have been identified as impaired based on recent (<5 years old) monitoring data, it will be a priority for DWQ to take action and/or to encourage other agencies or entities to take action, if appropriate to address the sources of impairment. In many cases, streams that are considered monitored impaired will also be on the 303(d) list which also distinguishes these areas as a priority for TMDL development.

4.3.4 Growth-Related Issues

As the population of the Tar-Pamlico Basin increases, so will the potential for water quality impacts to creeks, river, lakes and estuaries unless steps are taken to minimize or avoid these impacts. These impacts occur through a number of growth-related activities. Land-disturbing activities such as grading for roads and new development render the land susceptible to erosion. Conversion of forest and farmland to subdivisions, roads and shopping centers increases the amount of impervious surface area. This in turn allows water to flow more rapidly from the land resulting in streambank erosion and sedimentation.

Land Use Planning

Counties in the Tar-Pamlico basin are encouraged to consider land use planning as one means of protecting water quality. Clustered development, use of riparian buffers, avoidance of sensitive land areas, providing for adequate wastewater treatment are several means that can be used by local governments to ensure that water quality and quality of life of residents are protected.

Reducing Urban Stormwater Pollution

Several keys to reduce pollution and stream erosion from urban areas include minimizing impervious surfaces to slow runoff, promoting filtration and infiltration of the water before it reaches a creek or storm drain inlet, keeping pollutants out of the runoff, and encouraging local governments to consider water quality impacts during long-range planning. Local governments

should have stormwater ordinances that serve to minimize the impacts of new development on water quality. The stormwater component of the proposed NSW should help to reduce pollutant loading from urban areas. To assist local governments in addressing stormwater pollution, the state should consider providing funds for planning and stormwater control technology. One approach would be to include a recommendation in the Governor's next biennial budget for a more significant funding mechanism for local governments to develop and implement already mandated stormwater programs.

Continue to Improve the Level of Wastewater Treatment and Address Inflow and Infiltration Problems

Wastewater treatment plants will be required to upgrade treatment in the future in order to assure that water quality standards are not violated as the amount of wastewater increases with a rising population. Continued improvements in technology should support this recommendation, but treatment costs will likely be higher. Customers should, therefore, expect to pay higher costs for waste treatment in the future. Also, old wastewater collection systems will need to be improved and/or replaced. Municipalities should embark on long-range operation and maintenance programs. This should include allocating funds to replace deteriorating collection systems and cross-connections with stormwater pipes.

Promote Water Reuse, Recycling and Conservation for Long-Range Water Supply Needs

With a growing population and a limited water supply, particularly in the lower portion of the basin, water supply needs are likely to become more acute. DWQ will be working more closely with the Division of Water Resources (DWR) on coordinating water supply and water quality issues over the next basin cycle. This is being brought about in part by Senate Bill 1229, which requires that future basinwide plans consider the cumulative impacts of all water transfers into and out of a river basin. DWR will also be pursuing water supply management options for addressing dropping aquifer levels in the lower portion of the basin. One of these options will need to be the reuse of highly treated wastewater effluent for irrigation and possible industrial water supply purposes.

Reduce Erosion and Sedimentation from Development and Support Strengthening of the Sedimentation Control Program

Erosion and sedimentation are two major causes of stream impairment in the Tar-Pamlico basin, particularly in rapidly developing areas. The Division of Land Resources (DLR) is the agency responsible for administration of the state's sedimentation control law. DLR needs support in its efforts to improve the program by adding more inspectors, strengthening its rules, and improving enforcement. The program also includes training and education for contractors and others.

Increase Public Awareness and Participation in Preserving Easements and Property under such Programs as the NC Conservation Tax Credit Program, CWMTF, CREP and Others

There are now many more programs available for funding water quality protection and restoration efforts. It is important that local governments, state agencies and other qualifying entities put these dollars to good use.

4.3.5 Swine Industry Growth

The swine population increased by 40 percent in the Tar-Pamlico basin from 1990 to 1998. The General Assembly has imposed a moratorium on swine industry growth in the state until October 1999, and there is the likelihood that this will be extended. While the effects of the swine operations on water quality in the basin are not well understood, there are concerns about the long-term cumulative effects of these operations on both surface water quality and groundwater. Hence the need for the moratorium. Continued research is needed on nutrient loadings from spray field runoff, atmospheric deposition and groundwater (under lagoons and spray fields). Some local governments, including Nash and Halifax counties, have passed ordinances to protect surface and ground waters.

4.3.6 Promoting HQW and ORW Waters

Waters considered to be biologically sensitive or of high resource value may be afforded protection through reclassification to HQW (high quality waters), ORW (outstanding resource waters) or WS (water supply), or they may be protected through more stringent permit conditions. Waters eligible for reclassification to HQW or ORW may include those approved for commercial shellfish harvesting (SA), designated primary nursery areas, waters having excellent water quality, or those used for domestic water supply purposes (WS-I and II). The HQW, ORW and WS classifications generally require more stringent point and nonpoint source pollution controls than do basic water quality classifications such as C or SC.

In addition, where waters are known to support state or federally listed endangered or threatened species or species of concern, but where water quality is not Excellent and where no critical habitat has been designated, consideration will be given during NPDES permitting to minimize impacts to these habitat areas consistent with the requirements of the federal Endangered Species Act and North Carolina's endangered species statutes. The federally endangered dwarf-wedge mussel (*Alasmidonta heterodon*) is known to occur in subbasins 03-03-02, 03-03-03, 03-03-06 and 03-03-07, and most subbasins provide habitat for threatened species or species of concern. Possible protection measures may include dechlorination or alternative disinfection, tertiary or advanced tertiary treatment, outfall relocation, backup power provisions to minimize accidental plant spills, and others. The need for special provisions will be determined on a case-by-case basis during review of individual permit applications and take into account the degree of impact and the costs of protection.

4.3.7 Tar-Pamlico Cooperative Extension Education Team

The formation of a Tar-Pamlico Cooperative Extension Education Team, like the team in the Neuse River Basin, is recommended. Such a team could consist of five agents including a river basin education coordinator, three area extension environmental educators, and one area extension natural habitat educator. A primary purpose of the team would be to help farmers, local governments and citizens meet the requirements of proposed nutrient reduction rules that are being develop by the NC Environmental Management Commission (discussed above in 4.2).

Section B

Water Quality Data and Information by Subbasin

Chapter 1 -
Tar-Pamlico River Subbasin 03-03-01
Tar River Headwaters

1.1 Water Quality Overview

Subbasin 03-03-01 at a Glance

Land and Water Area (sq. mi.)

Total area:	664
Land Area:	661
Water Area:	3

Population Statistics

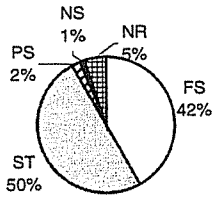
1990 Est. Pop.: 57,544 people
Pop. Density: 87 persons/mi^2

Land Cover (%)

Forest/Wetland:	76%
Water:	1%
Urban:	2%
Cultivated Crop:	12%
Pasture/ Managed Herbaceous:	9%

Use Support Summary

Freshwater Streams:



Lakes:
Lake Devin – Fully Supporting

This subbasin contains the uppermost reaches of the Tar River from its headwaters in Person County to the community of Spring Hope in Nash County. Primary urban areas contained within the subbasin are Louisburg, Franklinton and Oxford. Figure B-1 provides a map of the subbasin which includes the location of DWQ sampling sites.

Large sections of this subbasin are within the Carolina Slate Belt and Piedmont ecoregions. Streams in the Carolina Slate Belt (i.e., Tar River at Tar River) are characterized by extremely low flows during periods of little rainfall, because there is little groundwater recharge. Headwater reaches of the upper Tar River, within this subbasin, are expected to receive relatively high amounts of nitrogen and sediment, second only to the Pamlico River estuary (RTI, 1994). Based on 1996 satellite data, land cover in the subbasin is dominated by forested and wetland areas (see box to left).

There are four ambient monitoring locations in this subbasin. Three of these locations are mainstem Tar River sites: Tar River near Tar River, at Louisburg and near Bunn. The fourth ambient location is Fishing Creek which is near the confluence with the Tar River below the Oxford wastewater treatment plant outfall. Water quality of the upper Tar River within this subbasin is generally good with few exceedences of North Carolina water quality criteria. Median fecal coliform concentrations and the percent of observations above NC water quality standards increase from Tar River downstream to Bunn. Extremely high maximum fecal coliform numbers were recorded at the Bunn location (38,000/100 ml), and nearly 40% of all samples collected from this location were above the water quality standard. Maximum fecal coliform numbers were much higher during the 1997 basinwide reporting period (1/93 - 9/97) at each of these three locations than during the 1993 basinwide reporting period (9/91 - 8/93). In comparison, the maximum fecal coliform number for the Bunn location during the 1993 reporting period was 8,600/100 ml. Median nutrient concentrations were lower from Fishing Creek in summer collections during the 1997 reporting

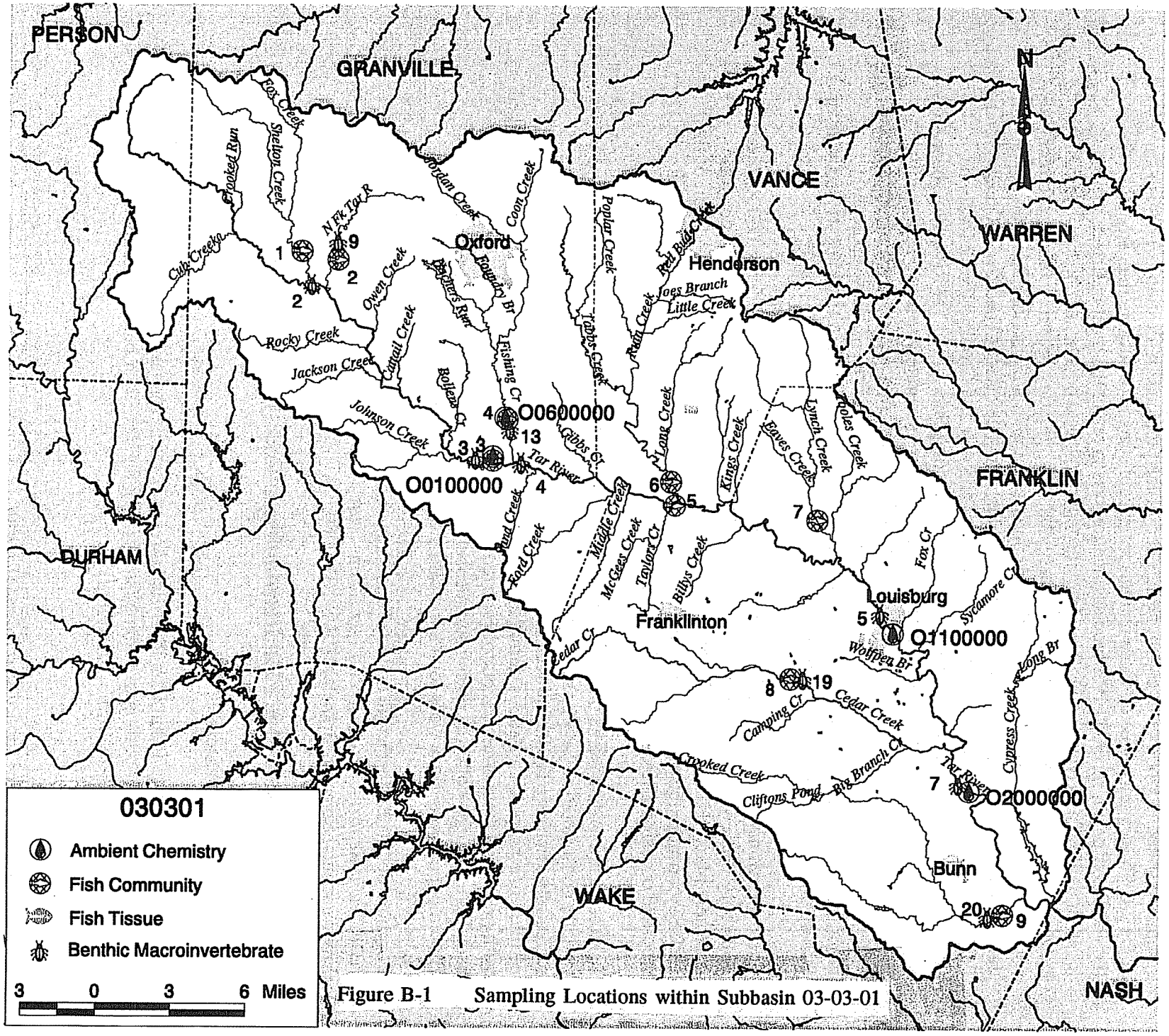


Figure B-1 Sampling Locations within Subbasin 03-03-01

period than during the 1993 reporting period. These lower nutrient values from Fishing Creek are following the upgrades at the Oxford wastewater treatment plant.

Biological data were collected from 13 stations within this subbasin during the basinwide planning process. During the 1997 surveys, benthic macroinvertebrate and fish community samples resulted in Good or Excellent ratings at 5 of the 6 mainstem locations. The fish survey at the NC 96 location collected more native species and species of suckers than any other site in the Tar River basin. A Good-Fair bioclassification was given to the most upstream mainstem location on the Tar River (SR 1150 in Granville County) based on a benthic macroinvertebrate survey. Good and Good-Fair ratings were assigned to all tributary locations based on biological data. Benthic macroinvertebrates and fish community samples were collected in common at 4 of the 7 tributary locations. Ratings were similar at Fishing Creek (Good) and Cedar Creek (Good-Fair), but were slightly different at the North Fork Tar River and Crooked Creek locations. Historically, benthic macroinvertebrate data from the North Fork of the Tar River have been flow dependent. Therefore, fish community structure may more accurately reflect water quality conditions. On the other hand, fish data from Crooked Creek may not have accurately reflected water quality conditions due to the various effects of Hurricane Fran. Follow-up benthic monitoring in Fishing Creek in 1999 resulted in Poor and Fair ratings at two sites downstream of the Oxford wastewater treatment plant.

There are twenty permitted discharges in this subbasin and three large (>0.5 MGD) facilities: Louisburg wastewater treatment plant, Oxford Southside and Franklin County wastewater treatment plant. Each of these facilities is currently monitoring effluent toxicity as part of their NPDES permit requirements. The Franklin County and Oxford Southside facilities have recorded occasional toxicity test failures since 1994.

Lake assessment data were collected from one reservoir in this subbasin. Lake Devin was initially constructed as a water supply for the Town of Oxford, but is currently used for recreational fishing. In 1997, three collections were made at Lake Devin. Water quality data resulted in eutrophic conditions during all three investigations. In 1996, Lake Devin was stocked with grass carp in an effort to control *Hydrilla* and other aquatic macrophytes. Phytoplankton samples have been collected during summer surveys in 1994 and 1996 from Lake Royale. Bloom populations algae were found, indicating eutrophic conditions.

For more detailed information on water quality in this subbasin, refer to the *Basinwide Assessment Report - Tar-Pamlico River Basin - May 1998,* available from the DWQ Environmental Sciences Branch at (919) 733-9960.

1.2 Prior Basinwide Plan Recommendations (1994) and Achievements

1.2.1 Impaired Waters

The 1994 Tar-Pamlico Basin Plan identified three streams in subbasin 03-03-01 as impaired. These were: an upper portion of Fishing Creek (NS); the Tar River between Louisburg and Bunn (NS); and the North Fork of the Tar River (PS).

Fishing Creek

1994 Recommendation(s)

A small portion of Fishing Creek was rated as not supporting its uses based on biological data collected in 1989 and 1990. These data were collected as a part of a special study to assess the instream water quality impacts of the City of Oxford's wastewater treatment plant. The 1994 basin plan recommended that impairment be addressed through control strategies at the treatment plant.

Status of Progress

The city has upgraded its wastewater treatment plant, and in 1997, it appeared that this had resulted in water quality improvements. Biological sampling (benthic macroinvertebrate and fish community) yielded Good results at that time. However, follow-up monitoring in spring 1999, stimulated by permit violations, revealed water quality impacts below the wastewater treatment plant. The 1999 monitoring found that Fishing Creek was rated Poor at SR 1608 and Fair at SR 1643. The plant is now under a moratorium by the NC Division of Water Quality that disallows any new sewer line extensions until additional plant upgrades have been achieved to the satisfaction of the DWQ.

1999 Recommendation(s)

Before any new or expanding wastewater discharges can connect to Oxford's wastewater treatment plant, the moratorium imposed by DWQ must first be lifted. This would require upgrading the plant to the point where it is capable of handling additional wasteloads while meeting permitted limits.

Tar River

1994 Recommendation(s)

The Tar River between Louisburg and Bunn was rated as not supporting its uses in the last basinwide plan due to elevated concentrations of fecal coliform bacteria. The plan recommended that the sources of the fecal coliform bacteria be investigated and that a water quality model be developed for this portion of the river.

Status of Progress

Originally, it was thought that a large dairy operation in this area was the cause of the high coliform counts. This dairy, Daniels & Daniels, has been involved in an extensive cleanup effort to implement BMPs on their operation (see Chapter 1 of Section C for a description of the project). While a considerable amount of state cost share funds were provided, the dairy's owners spent hundreds of thousands of their own dollars to help correct the problems. Nevertheless, fecal coliform counts are still high in this section of the river. DWQ staff have observed numerous cattle operations in this part of the watershed, and in many cases, cattle have direct access to the river.

Data for the development of a calibrated water quality model for this area had been collected; however, the need for development of the model has not been strong enough to make it a priority for existing resources.

Because of a change in the way use support is determined for fecal coliform data (previously it was based on the percentage of exceedences of the standard, now it is based on the median calculated from all samples), this area is not considered impaired for this basin planning cycle. A 1997 biological sample collected near the ambient site near Bunn (where high levels of fecal coliform bacteria are recorded) resulted in a Good rating.

1999 Recommendation(s)

For the section of the Tar River between Louisburg and Bunn that continues to show elevated concentrations of fecal coliform bacteria, it is recommended that projects similar to the one conducted on Daniels & Daniels Dairy to apply BMPs to animal agricultural operations be pursued in the watershed. At this point, our best information indicates that the elevated coliform levels could be due to multiple cattle pastures where livestock have direct access to the river. There are numerous resources available for pursuing such projects, including the Agricultural Cost Share Program, Section 319 grants, the NC Wetlands Restoration Program, the Clean Water Management Trust Fund, and the Conservation Reserve Enhancement Program. DWQ has available a document entitled *A Guide to Water Quality Management in North Carolina* which provides, among other things, a description of funding sources available for water quality projects. To obtain a copy contact the DWQ Planning Branch at (919) 733-5083.

North Fork Tar River

Recommendation(s)

The North Fork Tar River was rated as partially supporting its uses and considered impaired during the last basinwide cycle due to a biological sample that yielded a Fair rating. The basin plan recommended the implementation of existing programs for NSW and nonpoint sources.

Status of Progress

A biological sample taken in 1997 resulted in a Good-Fair rating, and the stream is no longer considered impaired. It is thought that the improved rating is attributable to flow conditions. Flows in 1997 were such that water quality impacts from nonpoint source pollution were minimized, resulting in higher biological ratings in areas influenced by nonpoint sources.

1.2.2 Other Recommendations

The 1994 basin plan recommended nutrient control strategies for three lakes or ponds in subbasin 03-03-01: Lake Devin, Lake Royal and Hart Pond. For Lake Devin, the recommendation was for DWQ to continue to monitor the lake to gage water quality improvements after a PL-566 Watershed Protection Project. This project was initiated in the Fishing Creek watershed to decrease the sediment and nutrient loads to the stream systems, some of which flow into Lake Devin. DWQ has resampled the lake and determined that it is fully supporting its uses.

It was recommended that DWQ work to determine the source of nutrient problems in Lake Royal and Hart Pond. Due to resource constraints, no action has been taken to achieve this.

1.3 Summary of Current Use Support Ratings

Table B-1 presents the current use support ratings for all monitored streams in subbasin 03-03-01. All of the waters in this subbasin are currently supporting their uses. However, a large subset (75%) is considered threatened.

1.4 Current Priority Issues and Concerns and Recommendations for Next Five Years

1.4.1 303(d) Listed Water and Monitored Impaired Waters

No waters in this subbasin are considered impaired and none are on the state's 303(d) list. During the next five years it will be important to maintain existing programs to protect water quality.

1.4.2 Point Source Management Strategy for Fishing Creek

Throughout the Fishing Creek watershed, it is recommended that any new or expanding wastewater discharges examine the feasibility of connecting to Oxford's treatment facility. This same recommendation was made in the 1994 basin plan due to concerns for instream dissolved oxygen levels.

Table B-1 Use Support Ratings for Monitored Freshwater Streams in Subbasin 03-03-01 of the Tar-Pamlico River Basin

Name of Stream	Index #	Description	Station Location	Class	Stream Miles	Chem. Rating 93-97	Benthos - 1997	Benthos - 1999	Fish - 1997	Overall Rating
TAR RIVER	28-(1)	From source to SR 1138	Tar River at SR 1138, Granville Co.	WS-IV NSW	15.1		Good-Fair			ST
TAR RIVER	28-(1)	From SR 1138 to a point 0.6 mile upstream of Oxford Water Supply	Tar River SR 1150, Granville Co.	WS-IV NSW	4.6		Good-Fair			ST
Shelton Creek	28-4	From source to Tar River	Shelton Ck at US 158, Granville Co.	WS-IV NSW	12.8				Good	FS
North Fork Tar River	28-5	From source to Tar River	N Fork Tar River, US 158, Granville	WS-IV NSW	7.6		Good-Fair		Good	ST
TAR RIVER	28-(5.3)	From a point 0.6 mile upstram from Oxford Water Supply to Oxford Water Supply intake		WS-IV CA NSW	0.6		Good-Fair			ST
TAR RIVER	28-(5.7)	From Oxford Water Supply Intake to NC 96	Tar River near Tar River, NC Hwy 96, Granville Co.	WS-V NSW	11.4	PS	Good		Exc	FS
TAR RIVER	28-(5.7)	From NC 96 to point 0.6 mi upstream of Taylors Creek	Tar River SR 1622, Granville Co.	WS-V NSW	7.9		Excellent		Good	FS.
Fishing Creek	28-11	From source to SR 1649	Fishing Creek at SR 1649, Granville Co.	C NSW	2					NE
Fishing Creek	28-11	From SR 1649 to #1 outfall	Fishing Creek 200 meters below, Granville Co.	C NSW	0.9					NE
Fishing Creek	28-11	From #1 outfall to SR 1608	Fishing Creek at SR 1608, Granville Co.	C NSW	1.9			Poor		NS
Fishing Creek	28-11	From SR 1608 to Tar River	Fishing Creek at SR 1643, Granville Co.	C NSW	6.1	S	Good	Fair	Good	PS
Hachers Run (Devin Lake)	28-11-3-(1)	From source to dam at Devin Lake		WS-II NSW CA	1					FS
Tabbs Creek	28-17-(0.5)	From source to Vance County SR 1100	Tabbs Creek at SR 1100, Vance Co.	C NSW	18.3					ST
Tabbs Creek	28-17-(4)	From Vance County SR 1100 to Tar River		WS-IV NSW	1.4				Good	ST
TAR RIVER	28-(24.7)	From Louisburg Water Supply Intake to Hwy 401 Franklin Co.	Tar River at NC 401, Franklin Co.	WS-V NSW	1		Good			FS
TAR RIVER	28-(24.7)	From Hwy 401 to SR 1001 Franklin County	Tar River at SR 1001 Franklin Co.	WS-V NSW	11.5		Good			ST
TAR RIVER	28-(24.7)	From SR 1001 to Hwy 64 Nash County	Tar River at NC 64, Nash Co.	WS-V NSW	11.3					ST
Cedar Creek	28-29-(1)	From source to 0.8 mi downstream of Franklin Co. SR 1127		WS-II NSW	2.6					ST
Cedar Creek (New	28-29-(1.5)	From 0.8 mi downstream of Franklin Co. SR 1127 to Dam at New Franklinton Lake		WS-II NSW	0.8					ST
Cedar Creek	28-29-(2)	From dam at New Franklinton Lake to SR 1116	Cedar Creek at SR 1116, Franklin Co.	WS-II NSW	4.9		Good-Fair		Fair	ST
Cedar Creek	28-29-(2)	From SR 1116 to Tar River	Cedar Creek at SR 1105, Franklin Co.	WS-II NSW	13.2					ST
Crooked Creek	28-30	From source to Tar River	Crooked Cr. NC 98, Franklin Co	C NSW	19.5		Good-Fair			ST

Chapter 2 -
Tar-Pamlico River Subbasin 03-03-02
Upper Tar River and Swift Creek

2.1 Water Quality Overview

Subbasin 03-03-02 at a Glance

Land and Water Area (sq. mi.)

Total area:	638
Land area:	635
Water area:	3

Population Statistics

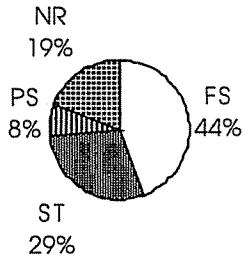
1990 Est. Pop.: 100,777 people
Pop. Density: 159 persons/mi^2

Land Cover (%)

Forest/Wetland:	64%
Surface Water:	1%
Urban:	3%
Cultivated Crop:	27%
Pasture/ Managed Herbaceous:	5%

Use Support Summary

Freshwater Streams:



Lakes:
Tar River Reservoir –
Fully Supporting but Threatened

This subbasin contains an approximate 50-mile stretch of the Tar River from the community of Spring Hope in Nash County to below the confluence of Swift Creek in Edgecombe County. This reach contains two ambient monitoring locations: Tar River at NC 97 in Rocky Mount and SR 1252 near Heartsease. (See Figure B-2 for a map of the subbasin including the location of DWQ monitoring sites.) Major towns include Henderson, Nashville and Rocky Mount. This subbasin also contains the entire Swift Creek catchment. Streams in this subbasin are within the Piedmont ecoregion. The majority of the land cover within this subbasin is forest/wetland, followed by cultivated cropland. Predicted sediment and nutrient loading into streams within this subbasin are considerably less than 03-03-01 (RTI, 1994).

There are four ambient monitoring stations in this subbasin. Two of these locations (Tar River at Rocky Mount and Heartsease) are mainstem Tar River sites which are located above and below the Rocky Mount WWTP. The Heartsease location is approximately 10-river miles below the Rocky Mount facility. Sandy Creek near Gupton and Swift Creek near Hillardston are the two tributary locations. Very few exceedences of North Carolina water quality criteria were noted at either of the mainstem Tar River locations during this reporting period (01/93 - 09/97), nor were there many differences between these data and data collected during the first basinwide monitoring period (1/88 - 6/93). The one exception is nitrate/nitrite nitrogen which is consistently higher at the Heartsease location during both reporting periods. Fecal coliform numbers were much lower at these two locations than mainstem Tar River monitoring locations in 03-03-01. Water quality data from the Sandy and Swift Creek monitoring locations appear to be normal with few exceedences in water quality criteria. In addition, there does not appear to be any trends in data between reporting periods.

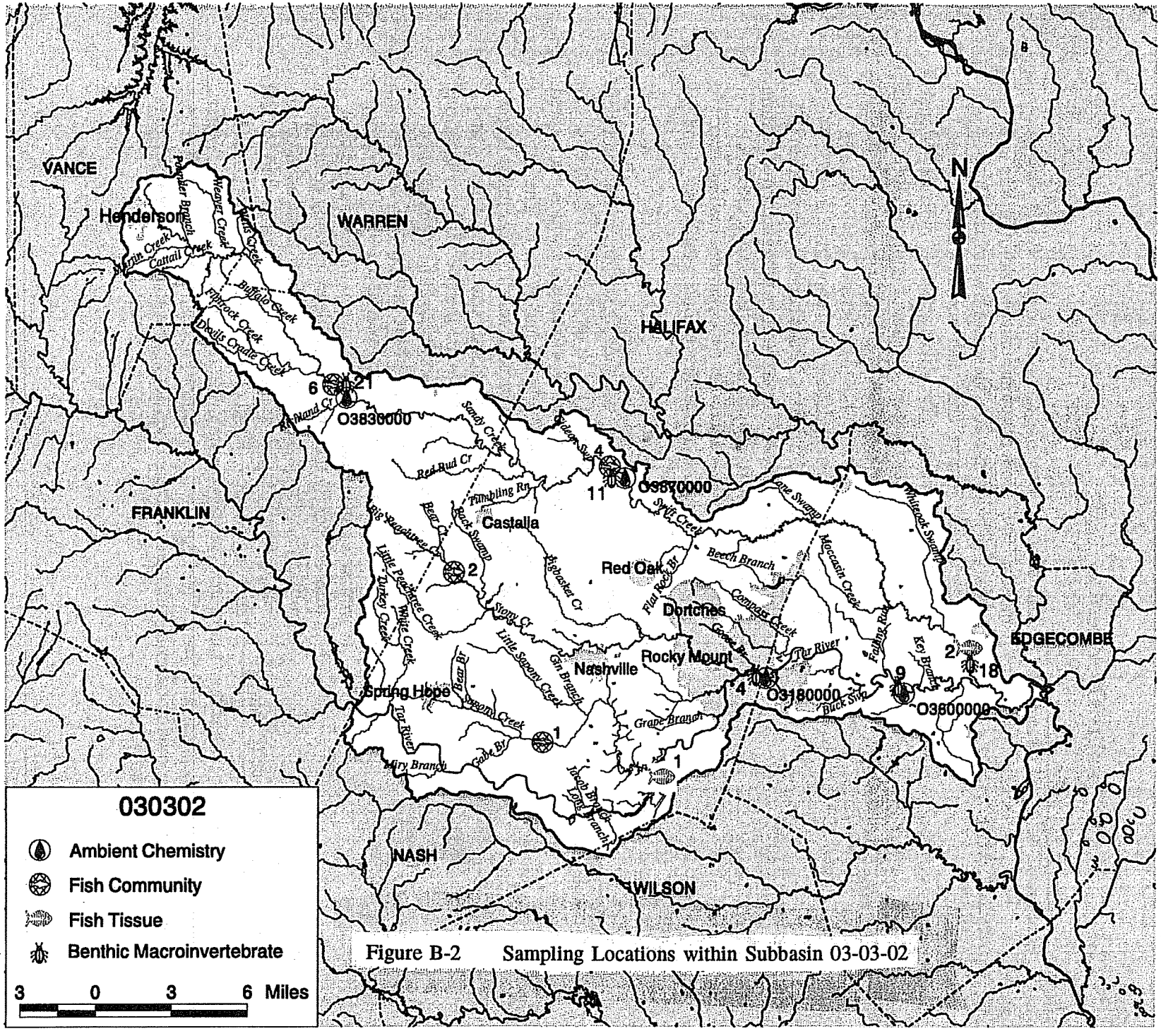


Figure B-2 Sampling Locations within Subbasin 03-03-02

Biological data were collected from seven locations in this subbasin during 1997. Good bioclassifications were recorded from the Tar River at Rocky Mount and Heartsease using benthic macroinvertebrate data. The Good bioclassification at the Heartsease location is significantly better than data collected from this site in 1988 (Fair), suggesting an improvement in water quality for this reach of the Tar River. Good and Excellent ratings were given to Swift Creek Hillardston using benthic macroinvertebrate and fish community data. Furthermore, an Excellent bioclassification was given to Swift Creek at SR 1253 near the confluence with the Tar River based on a benthic macroinvertebrate survey. These data support the pursuance of the supplemental ORW classification for this creek. In addition, Swift Creek supports populations of the federally endangered Tar River spiny mussel, *Elliptio (Canthyria) steinstansana*, as well as healthy populations of the proposed federally endangered Atlantic pigtoe, *Fusconaia masoni.* Benthic macroinvertebrates and fish community samples were collected in common at Sandy Creek at SR 1412 in Franklin County.

Sandy Creek at this location is somewhat unique in that it appears to have coastal plain characteristics, such as tannin-colored water, but is clearly within the piedmont ecoregion. Water quality conditions may be more accurately represented by fish community structure at this location. Fish community structure samples also were collected from Sapony Creek (Fair rating) and Big Peachtree Creek (Good-Fair rating) in this subbasin.

Fish tissue samples were collected from two locations in this subbasin during 1997: Tar River Reservoir in Rocky Mount and Swift Creek at SR 1253. Results for metal analyses were below FDA and EPA criteria at both locations.

There are 16 permitted discharges in this subbasin, and only two facilities (Rocky Mount WWTP and Cogtentrix) have permitted flows of ≥0.5 MGD. Five of the 16 facilities are currently monitoring effluent toxicity as part of their NPDES permit requirements. Toxicity test failures were noted only at Ingersoll-Rand/Schlage Corporation in 1995 and one test at the Rocky Mount WWTP in 1994. Complete compliance was recorded at all facilities in this subbasin in 1996 and 1997.

Lake assessment investigations have been conducted at one reservoir in this subbasin: Tar River Reservoir in Rocky Mount. Data were collected during three surveys in 1997, and each survey resulted in NCTSI values within the eutrophic category. Eutrophic conditions also were recorded from this reservoir in 1992 and 1989.

For more detailed information on water quality in subbasin 03-03-02, refer to the *Basinwide Assessment Report - Tar-Pamlico River Basin - May 1998*, available from the DWQ Environmental Sciences Branch at (919) 733-9960.

2.2 Prior Basinwide Plan Recommendations (1994) and Achievements

2.2.1 Impaired Waters

The 1994 basin plan identified three areas in subbasin 03-03-02 as impaired: a portion of the Tar River, Stoney Creek and Whiteoak Swamp. All were listed as partially supporting their uses. Each of these areas is reported on below.

Tar River

1994 Recommendation(s)

Two locations on the Tar River in subbasin 03-03-02 received Fair biological ratings resulting in an impaired use support status. The first site was at SR 1001 in Nash County which had been sampled as a part of an HQW investigation. The second site was at SR 1252 in Edgecombe County which was sampled to assess the impact of Rocky Mount's wastewater treatment plant. The basin plan recommended sources of pollution be investigated and that controls on point sources be applied to manage water quality. Specifically for point sources, the plan recommended that new or expanded discharges to the Tar River from Rocky Mount to Greenville receive limits of 15 mg/l BOD_5, 4 mg/l ammonia and 5 mg/l dissolved oxygen. For subbasin 03-03-02, the coverage of this strategy only affects that part of the Tar River below Rocky Mount.

Status of Progress

The site at SR 1001 was not resampled during this basinwide cycle nor were sources of pollution investigated. The site at SR 1252 was resampled and received a Good biological rating indicating that the area is no longer impaired. Since the 1992 sample was taken at this site (when it received a Fair biological rating), the City of Rocky Mount has upgraded its wastewater treatment. The results of the 1997 sample indicate that the treatment plant's current level of treatment is maintaining water quality instream.

Stoney Creek

1994 Recommendation

Stoney Creek received a Fair biological rating when it was sampled as part of basinwide assessment in 1992. The basin plan recommended the implementation of existing programs for NSW and nonpoint sources.

Status of Progress

Stoney Creek was not resampled in 1997, and although it is not listed as a monitored impaired waterbody in this basin plan (it is impaired on an evaluated basis), it is on the state's list of 303(d) waters. The reason it was not resampled is that there was no flow in the stream, and the biological criteria could not be applied.

Whiteoak Swamp

1994 Recommendation

Whiteoak Swamp was investigated as part of an HQW investigation in 1988 when it received a Fair biological rating. The basin plan recommended the implementation of existing programs for NSW and nonpoint sources.

Status of Progress

Whiteoak Swamp was not resampled in 1997, and although it is not listed as a monitored impaired waterbody in this basin plan, it is on the state's list of 303(d) waters. The creek will remain on the 303(d) list until resampling shows water quality improvement or a TMDL is developed and approved for the stream.

2.2.2 Other Recommendations

Swift Creek

1994 Recommendation(s)

The 1994 basin plan had a couple of recommendations related to Swift Creek. The first was related to the stream's function as a habitat for federally endangered mussels and the need for DWQ to work with stakeholders to develop a management strategy to protect the creek. The plan also indicated that elevated concentrations of nitrogen had been detected in the creek and recommended that it be also given a high priority for BMP implementation.

Status of Progress

Since the development of the 1994 basin plan, DWQ has determined that a portion of the Swift Creek watershed qualifies for ORW designation. This portion stretches for 10 miles from SR 1003 to SR 1004 in Nash County. This classification carries with it regulatory measures to protect water quality. Because of the unique nature of the system and the interest that it holds for a number of agencies and interest groups, it is DWQ's intent to convene a stakeholder group to develop a management strategy to protect water quality and the endangered species. This management strategy would then be translated into rule format and ushered through the state's formal rule-making process in order to gain its designation as an ORW. It is anticipated that the stakeholder group will be convened in the spring of 1999 and that the rule-making effort will begin the following summer.

During the last five years, a number of agricultural BMPs have been applied in the Swift Creek watershed through the Division of Soil and Water's Agricultural Cost Share Program (ACSP). For a summary of ACSP efforts in the Tar-Pamlico River basin, please see Section C.

1999 Recommendation

DWQ has determined that a portion of Swift Creek meets the regulatory criteria for ORW designation. It will be a priority during the next five years to work with local and agency stakeholders to develop an appropriate management strategy for the watershed and to undertake rule making to obtain the ORW designation for the stream.

Tar River Reservoir

1994 Recommendation

The 1994 basin plan indicated that this lake had elevated levels of chlorophyll *a* and recommended that DWQ continue to monitor the lake to ensure that conditions do not worsen.

Status of Progress

DWQ did monitor this lake again during this basinwide cycle and found conditions to be basically unchanged (still eutrophic). Based on concerns for protecting this lake which is Rocky Mount's water supply, the US Geological Survey will be conducting an in-depth study of the reservoir. The study will assess current water quality conditions, establish a database to document changes in the reservoir's water quality, and determine travel time and dilution ratios from selected locations to the two City of Rocky Mount water supply intakes.

1999 Recommendation

Although this lake is not considered impaired, data collected by DWQ indicate that there are concerns with chlorophyll *a* and nutrient levels. It will be a priority during the next five years to resample the lake to determine whether or not conditions are worsening. In addition, DWQ staff will stay apprised of the USGS study and use the results of their intensive investigation to determine whether or not there are any actions that can be taken by DWQ to maintain or improve water quality conditions in the lake so that they do not deteriorate.

2.3 Summary of Current Use Support Ratings

The vast majority of waters in subbasin 03-03-02 are considered to be supporting their uses. Table B-2 presents the status of monitored streams in the subbasin. Sandy Creek in Franklin County is considered impaired based on biological data.

2.4 Current Priority Issues and Concerns and Recommendations for Next Five Years

2.4.1 303(d) Listed Waters

The Tar River at SR 1001, Stoney Creek and Whiteoak Swamp will need to be resampled during the next basinwide cycle to determine whether or not impairment still exists. Because of samples

collected during the previous basin planning cycle (1987-1992), these streams remain on the state's 303(d) list of impaired waters and are considered impaired on an evaluated basis.

2.4.2 Monitored Impaired Waters

Sandy Creek in Franklin County

This upstream portion of Sandy Creek was sampled both for benthic macroinvertebrates and fish community. It received a Fair rating for benthic macroinvertebrates and a Good-Fair rating for fish community. A number of factors were noted by DWQ staff as possible contributors to the depressed biological rating. These factors were: the effects of a large mill dam (on flow and habitat) located immediately above the collection site; impacts from Hurricane Fran; and evidence of extensive logging adjacent to the stream (this activity would have occurred prior to the 1997 sampling event).

1999 Recommendation

It is recommended that this site be resampled during the next basinwide cycle to determine whether or not impacts seen instream at the time of sampling were related primarily to the effects of the Hurricane.

2.4.3 Point Source Management Strategy for the Tar River Mainstem

The 1994 basin plan recommended certain controls on new or expanding discharges into the Tar River between Rocky Mount and Greenville. It is recommended that this strategy continue through the next five-year planning cycle. Specifically, new or expanding discharges to the Tar River below Rocky Mount will receive limits no less stringent than the following in order to protect instream water quality standards: BOD of 15 mg/l; and ammonia of 4 mg/l.

Table B-2 Use Support Ratings for Monitored Freshwater Streams in Subbasin 02 of the Tar-Pamlico River Basin

Name of Stream	Index #	Description	Station Location	Class	Stream Miles	Chemical Rating 93-97	Benthos - 1997	Fish - 1997	Overall Problem Parameter	Overall Rating
TAR RIVER	28-(36)	From Nash County SR 1933 to 4000 feet upstream from dam at City of Rocky Mt Res.		WS-IV NSW CA	6.6					ST
TAR RIVER	28-(63)	From a point 4,000 feet upstream from dam at City of Rocky Mt Res to dam at City of Rocky Mt Res.		WS-IV NSW CA	0.8					ST
Big Peachtree Creek	28-68-1	From source to Stony Creek	Big Peachtree Creek at SR 1321, Nash Co.	C NSW	11.9			Fair		ST
TAR RIVER	28-(69)	Fromdam at Rocky Mt Mills to Rocky Mount/NC-97	Tar River at NC 97, Rocky Mount, Edgecombe Co,	C NSW	1	S	Good			ST
TAR RIVER	28-(69)	From Rocky Mount/NC-97 to SR 1400/1250	Tar River at SR1400, Edgecombe Co.	C NSW	2.7					ST
TAR RIVER	28-(69)	From SR 1400 to 0.9 mi downstream of Buck Sw	Tar River at SR 1243, be WWTP, Edgecombe	C NSW	6.9					ST
TAR RIVER	28-(74)	From 0.9 mi downstream of Buck Sw to SR 1252	Tar R. at SR 1252 Edgecombe Co.	WS-IV NSW	5.3	S	Good			S
TAR RIVER	28-(74)	From SR 1252 to 0.5 mi upstream of Tarboro Water Supply Intake	Tar R. At NC 44 Edgecombe	WS-IV NSW	18					S
Swift Creek	28-78-(0.5)	Source to Tar River/SR-1310, Hillardston, Nash Co.	Swift Creek near Hillardston, SR-1310	C NSW	2.8	S	Good	Excellent		S
Swift Creek	28-78-(0.5)	From SR 1310 to SR 1003	Swift Creek at SR-1003, Nash Co.	C NSW	7.2					S
Swift Creek	28-78-(0.5)	From SR 1003 to above/1/4mi & 1/2 mi below Wake Stone	Swift Creek at Wake Stone, Nash Co.	C NSW	2.7					S
Swift Creek	28-78-(0.5)	From Wake Stone outfall to 1.4 mi upstream of SR 1409 Edgecombe Co.	Swift Creek at I-95	C NSW	26.4		Excellent			S
Weaver Creek	28-78-1-7	From source to Southerlands Pond	Weaver Creek at SR 1533, Vance Co.	C NSW	6.6					ST
Sandy Creek	28-78-1-(8)	From dam at Southerlands Pond to NC Hwy 401	Sandy Cr NC 401 Franklin	B NSW	3.8					PS
Sandy Creek	28-78-1-(8)	From Hwy 401 to NC Hwy 561	Sandy Cr at SR1432 nr Gupton Inact 841015	B NSW	12.2	S	Fair	Good-Fair		PS
Sandy Creek	28-78-1-(14)	From N.C. Hwy. 561 to Swift Creek		C NSW	21.7					S
Swift Creek	28-78-(6.5)	From 1.4 mi upstream of SR 1409 Edgecombe Co. to Tar River	Swift Creek at SR-1253, Edgecombe	WS-IV NSW	7.6		Excellent			S

Chapter 3 -
Tar-Pamlico River Subbasin 03-03-03
Mid Tar River (from Swift Creek to Conetoe Creek)

3.1 Water Quality Overview

Subbasin 03-03-03 at a Glance

Land and Water Area (sq. mi.)

Total area:	425
Land area:	423
Water area:	2

Population Statistics

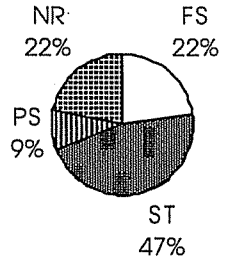
1990 Est. Pop.: 48,211 people
Pop. Density: 114 persons/mi^2

Land Cover (%)

Forest/Wetland:	55%
Surface Water:	0%
Urban:	2%
Cultivated Crop:	41%
Pasture/ Managed Herbaceous:	2%

Use Support Summary

Freshwater Streams



This subbasin includes approximately 40-river miles of the Tar River from the confluence of Swift Creek in Edgecombe County to the confluence of Conetoe Creek in Pitt County (see Figure B-3). This subbasin also includes the entire catchments of Conetoe Creek, Otter Creek, Town Creek and Cokey Swamp. Streams in this subbasin are primarily within the coastal plain ecoregion. In such swamp streams, stress may be associated with low dissolved oxygen, low current velocity and low pH. Many streams in this area were channelized prior to 1970, when "stream improvement" included dredging and straightening the channel, with removal of most riparian vegetation. The area is characterized by large amounts of agricultural land (41% of the land cover is categorized as cultivated cropland). Tarboro is the largest urban area, but parts of Rocky Mount are also in this subbasin. There are two large dischargers in this subbasin: Tarboro WWTP (5.0 MGD) and Bethel WWTP (0.75 MGD). The two areas with the greatest potential for nonpoint source pollution (crops and grazing) were the Cokey Swamp and Conetoe Creek catchments (USDA, 1995). Cokey Swamp also receives urban runoff from Rocky Mount.

Two ambient monitoring locations on the Tar River are at Tarboro, near the top of the subbasin, and near Falkland, near the bottom, just upstream of Conetoe Creek. Water chemistry changes little between the two; decreased pH and dissolved oxygen reflect the swampy nature of the tributaries. Mercury was found above the EPA criteria of 0.6 ppm in three of ten bowfin collected at these sites, but in no other fish. Benthos data from Tarboro have consistently produced a Good bioclassification, with consistent EPT taxa richness values (23-29). The river at this point also supports a population of rare and endangered mussel species: *Elliptio (Canthyria) steinstansana*, the Tar River spiny mussel and *Alasmidonta heterodon*, the dwarf wedge mussel. Benthos samples from NC 42 have given an Excellent bioclassification in both 1992 and 1997. The Tarboro WWTP has passed every toxicity test but one since 1994.

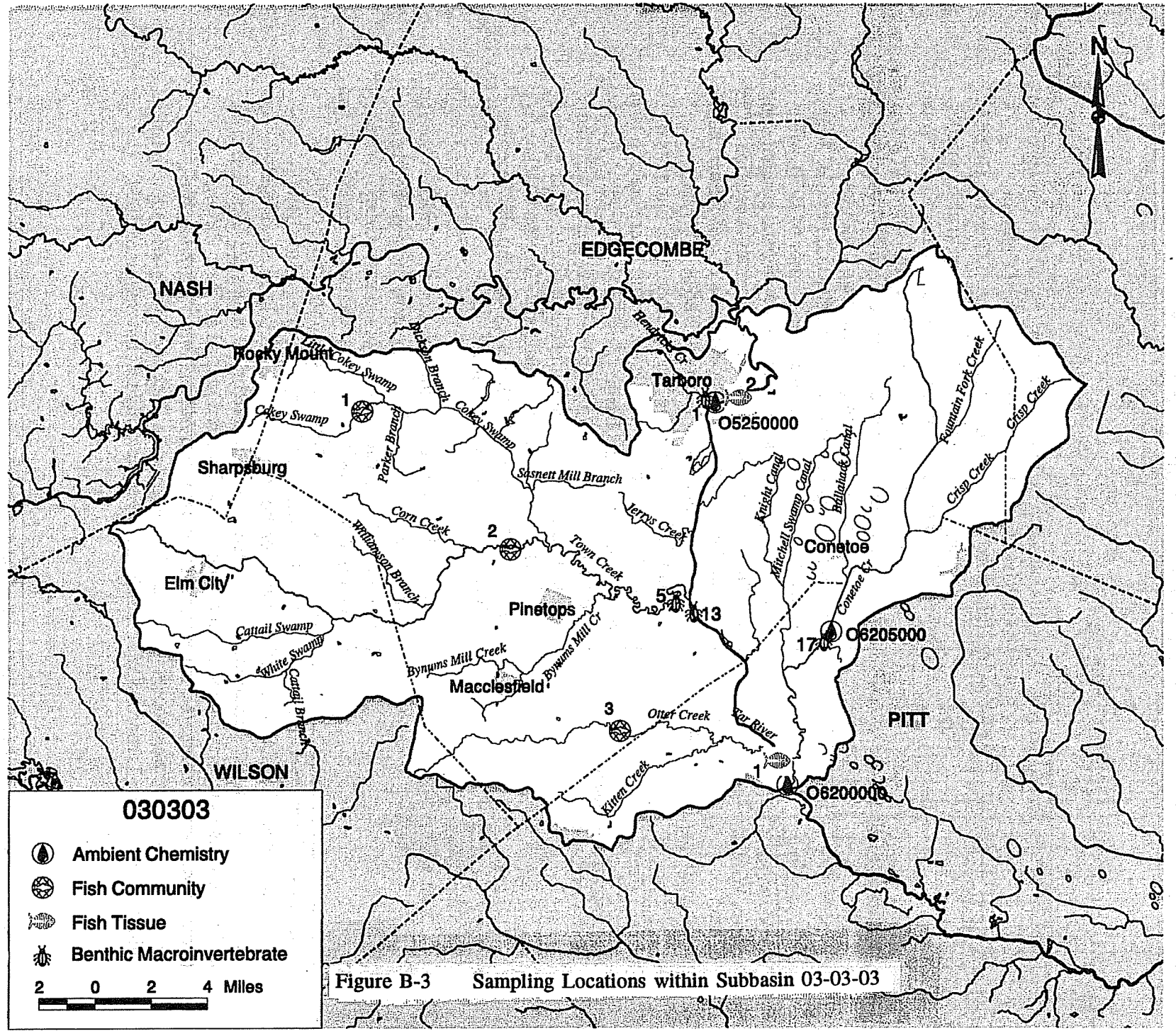


Figure B-3 Sampling Locations within Subbasin 03-03-03

Benthos and fisheries sampling resulted in a Good bioclassification for Cokey Swamp. Fish sampling on Town Creek has consistently yielded a Good-Fair bioclassification while Otter Creek was given a Fair rating in 1996 and 1997, down from a Good-Fair rating in 1992, before Hurricane Fran. Pinetops WWTP, which discharges to Town Creek, has only failed one toxicity test since 1996. Benthic macroinvertebrate information from the ambient location on Conetoe Creek near Bethel has been consistently Fair from 1985 to 1992, but rated Poor in 1997 due to low flow. Nutrients also appear to be a problem here, with the highest median NO_2/NO_3 value (1.7 mg/l) of any ambient site in the Tar basin.

3.2 Prior Basinwide Plan Recommendations (1994) and Achievements

3.2.1 Impaired Waters

The 1994 basin plan identified several waters in subbasin 03-03-03 as impaired. Each of these is presented and addressed below.

Cokey Swamp and Little Cokey Swamp

1994 Recommendation

The 1994 basin plan identified Cokey Swamp as partially supporting its uses and Little Cokey Swamp as not supporting its uses based on biological samples that resulted in Fair and Poor ratings, respectively. The plan recommended the implementation of existing programs for NSW and nonpoint sources.

Status of Progress

Cokey Swamp was resampled in 1997, and the biological sampling results demonstrated a marked improvement over the last sampling event in 1992. It is believed that the water quality improvement may be due to reduced nonpoint source runoff from the Rocky Mount area (1997 was a relatively dry year resulting in less runoff from nonpoint sources).

Little Cokey Swamp was not resampled, and remains on North Carolina's list of 303(d) waters.

1999 Recommendation

Because Little Cokey Swamp is on the 303(d) list, it will be a priority to demonstrate that conditions in the stream do not exhibit impairment.

Briery Branch

1994 Recommendation

Briery Branch was sampled in 1990 as part of a study to assess the water quality impacts of the Macclesfield wastewater treatment plant. This was part of a larger study to assess impacts of treatment plants in zero flow streams. The results of the sampling yielded a Poor biological

rating, and the stream was considered not supporting its uses in the basin plan. It was recommended that existing programs (NSW, NPS, NPDES) be used to address the water quality problems. In addition, it was recommended that the stream be reclassified to swamp waters and that DWQ further investigate the source of the problems in this stream.

Status of Progress

Briery Branch was not resampled as a part of this basin planning cycle and is on the state's 303(d) list of impaired waters. Because of the size of the stream (one meter wide), biological criteria do not accurately reflect water quality conditions, and this stream is considered 'not rated' based on current guidelines. The Macclesfield wastewater treatment plant is meeting its permit limits.

1999 Recommendation

Because Briery Branch is on the 303(d) list, it will be a priority to demonstrate that conditions in the stream do not exhibit impairment.

Unnamed Tributary (UT) to Otter Creek

1994 Recommendation

An unnamed tributary to Otter Creek was sampled in 1990, and the results yielded a poor biological rating. The stream was considered not supporting its uses in the basin plan. It was recommended that existing programs be used to address problems and that the source of the problems be investigated.

Status of Progress

Although this UT was not resampled during this basinwide cycle, the stream into which it flows (Otter Creek) was sampled for benthic macroinvertebrates and fish community. The benthic macroinvertebrate sampling was part of a special study to standardize collections in swamp systems. This indicates that waters in this watershed are characteristically swampy and that the results of the 1990 sampling in the unnamed tributary may be misleading. However, the fish community sample taken from Otter Creek resulted in a Fair rating, which is indicative of impairment. It should be noted, however, that these results may have been influenced by Hurricane Fran.

1999 Recommendation

Because the UT to Otter Creek is on the 303(d) list, it will be a priority to resample the stream and assess it using swamp criteria when such criteria become available.

Town Creek

1994 Recommendation

Town Creek received a Fair biological rating in 1992, resulting in an impaired use support status (PS). The 1994 basin plan recommended that existing NSW and NPS programs be used to address problems.

Status of Progress

Town Creek was resampled in 1997 for fish community, which yielded a Good-Fair biological rating. Based on this, the stream is no longer considered impaired.

Conetoe Creek

1994 Recommendation

Conetoe Creek was considered impaired (PS) in the 1994 basin plan based on biological and chemical data. The basin plan recommended the application of existing programs, as well as an investigation into whether or not the stream should be reclassified to swamp waters (the chemical data showed low dissolved oxygen concentrations and pH values - characteristic of swamp systems). The plan also noted that the Town of Bethel's wastewater discharge to the creek had compliance problems that were being addressed.

Status of Progress

Conetoe Creek was sampled in 1997 for benthic macroinvertebrates and received a poor biological rating. It was noted that the stream at the sample site, which was upstream of the Bethel wastewater discharge, had a very low flow at the time. Therefore, it is believed that the apparent decline in taxa richness between the 1992 and 1997 samples is attributable to the flow conditions. DWQ has not pursued the swamp reclassification for this stream because it is not a current program priority. The Town of Bethel is scheduled to connect to the City of Greenville's sewer system in July of the year 2000, which will relieve some stress on the system. The stream is considered monitored impaired for this basin plan and is on the state's list of 303(d) waters.

1999 Recommendation

It is recommended that DWQ continue to work with the Town of Bethel to achieve their connection to the City of Greenville's sewer system. In addition, it is recommended that the watershed be investigated for nonpoint sources of pollution to rule out obvious anthropogenic sources for the monitored impairment. It may be that this stream will always have low taxa richness due to depressed flows resulting from beaver dams.

3.3 Summary of Current Use Support Ratings

Table B-3 presents the monitored use support assessments for subbasin 03-03-03. Although the majority of waters in this subbasin are considered to be supporting their uses, a significant portion of them has been determined to be threatened. Two streams, Otter Creek and Conetoe Creek, are impaired (PS) based on biological data.

3.4 Current Priority Issues and Concerns and Recommendations for Next Five Years

3.4.1 303(d) Listed Waters

Little Cokey Swamp, Briery Branch and the UT to Otter Creek will need to be investigated during the next basinwide cycle to determine whether or not conditions in these streams reflect impairment. Because of samples collected during the previous basin planning cycle (1987-1992), these streams remain on the state's 303(d) list of impaired waters. However, the data may misrepresent actual conditions given the small size and swampy nature of these streams. Conetoe Creek is on the 303(d) list and has been assessed as impaired during this basinwide cycle. It will be important during the next five years to address water quality problems as recommended in the next section.

3.4.2 Monitored Impaired Waters

During the next five years, addressing monitoring impaired waterbodies will be a priority. In this subbasin, Conetoe Creek is considered monitored impaired. Recommendations for this creek have been made in Section 3.2.1.

Table B-3 Use Support Ratings for Monitored Freshwater Streams in Subbasin 03 of the Tar-Pamlico River Basin

Name of Stream	Index #	Description	Station Location	Class	Stream Miles	Chemical Rating 93-97	Benthos - 1997	Fish - 1997	Overall Problem Parameter	Overall Rating
TAR RIVER	28-(80)	From Tarboro Raw Water Supply Intake to Hwy 64 Edgecombe Co.	Tar River at Tarboro, NC Hwy. 64 Edgecomb	C NSW	4.3	S	Good			ST
TAR RIVER	28-(80)	From Hwy 64 Edgcombe, to Suggs Cr	Tar River at NC 42 Edgecombe	C NSW	10.5		Excellent			S
Town Creek	28-83	From source to SR 1202 ab Pinetops, Edgecombe	Town Cr, SR 1202 ab Pinetops, Edgecombe	C NSW	18			Good-Fair		ST
Town Creek	28-83	From SR 1202 ab Pinetops, Egecombe, to SR 1601	Town CR SR 1200, be Pinetops, Edgecombe	C NSW	5.5					ST
Town Creek	28-83	From SR 1601 Edgecombe Co, to Tar River	Town CR SR 1601, Edgecombe	C NSW	2.3					ST
Cokey Swamp	28-83-3	From source to Town Creek	Cokey Swamp at SR-1141,Edgecomb Co.	C NSW	13.8			Good		S
TAR RIVER	28-(84)	From Suggs Creek to Johnsons Mill Creek	Tar River at SR 1400 (222) near Falkland, Pitt	WS-IV NSW	12.7	S				ST
Conetoe Creek	28-87-(0.5)	Source to SR 1404 Pitt Co	Conetoe Creek near Bethel Hill, SR-1409	C NSW	15.3	S	Fair			PS

Chapter 4 -
Tar-Pamlico River Subbasin 03-03-04
Fishing Creek Watershed

4.1 Water Quality Overview

Subbasin 03-03-04 at a Glance

Land and Water Area (sq. mi.)

Total area:	895
Land area:	894
Water area:	1

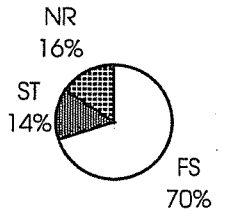
Population Statistics

1990 Est. Pop.: 35,582 people
Pop. Density: 40 persons/mi^2

Land Cover (%)

Forest/Wetland:	74%
Surface Water:	0%
Urban:	0%
Cultivated Cropland:	23%
Pasture/ Managed Herbaceous:	3%

Use Support Ratings



Subbasin 03-03-04 contains the entire Fishing Creek watershed from its headwaters near Warrenton to the confluence with the Tar River near Tarboro. A map of the subbasin is provided in Figure B-4. Most stream reaches in the upper section of the subbasin are typical piedmont streams, while streams in the eastern section are swamp streams typical of the coastal plain. Many of these swamp streams may have stress associated with low dissolved oxygen, low current velocity and low pH. Warrenton and Enfield are the only metropolitan areas in the subbasin, and they, in addition to Scotland Neck WWTP, are the only major dischargers in the subbasin. This watershed is considered to have a high potential for nonpoint source pollution, especially from croplands and animal operations (USDA, 1995).

Benthos and fisheries data from Fishing Creek indicated Good to Excellent water quality at all mainstem sites. The improvement in water quality from previous years reflects the reduced effects of nonpoint sources of water pollution in the subbasin in a low flow year. Water chemistry values from Enfield also indicate a minimally impaired stream with elevated fecal coliform counts occurring only occasionally.

Benthos and fish data resulted in a Good bioclassification for Little Fishing Creek, while Shocco Creek and Rocky Swamp had Good-Fair bioclassifications. Fisheries data also gave Beaverdam Creek a Good bioclassification. Scotland Neck WWTP, which discharges to Canal Creek, failed two toxicity tests in 1996, but has passed all tests in 1997. The Enfield WWTP, discharging to Beech Swamp, regularly failed their toxicity tests until May 1997 and have passed since. Warren County WWTP has passed all of its toxicity tests since 1996.

For more detailed information on water quality in subbasin 03-03-04, refer to the *Basinwide Assessment Report - Tar-Pamlico River Basin - March 1998*, available from the DWQ Environmental Sciences Branch at (919) 733-9960.

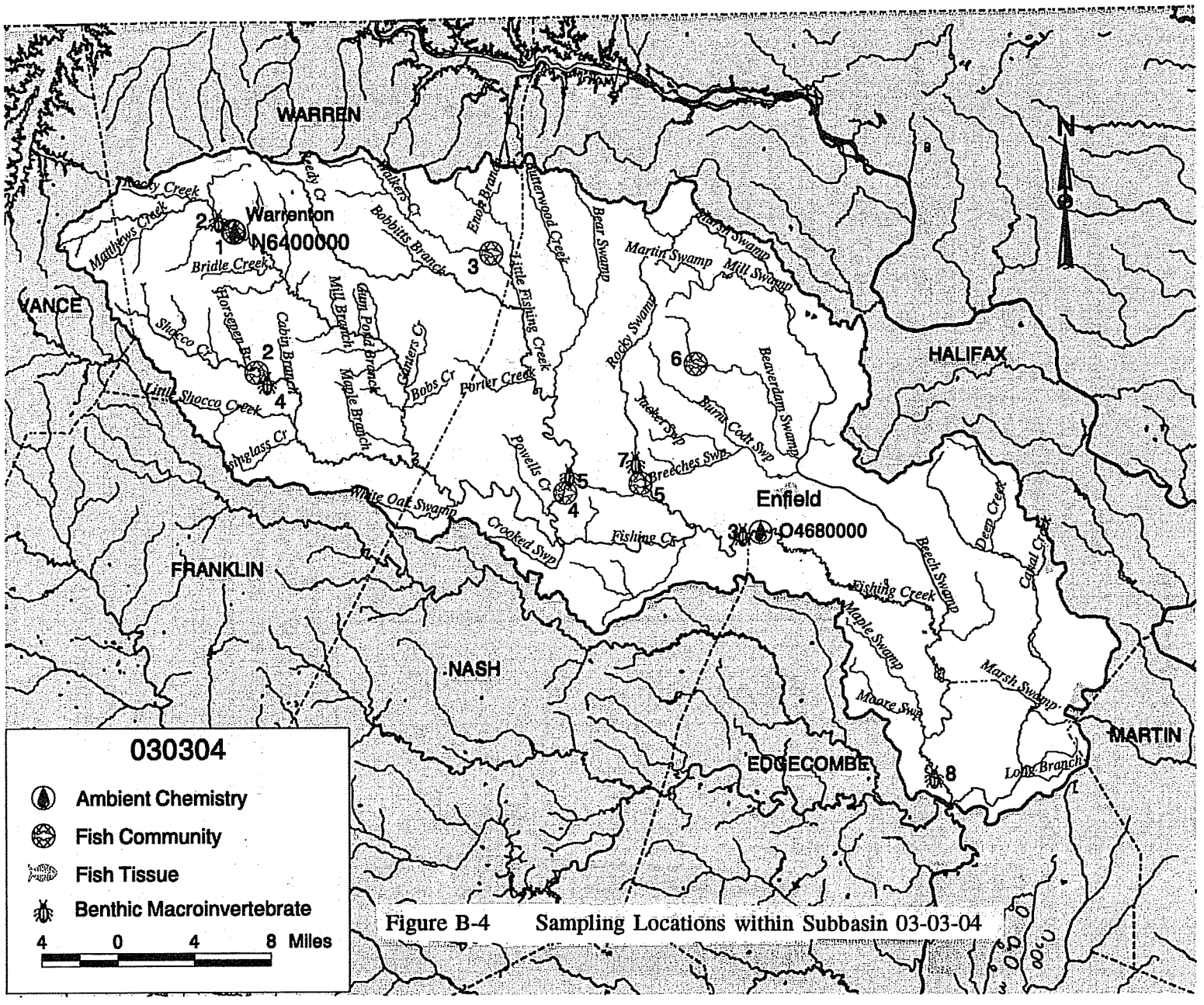


Figure B-4 Sampling Locations within Subbasin 03-03-04

4.2 Prior Basinwide Plan Recommendations (1994) and Achievements

4.2.1 Impaired Waters

Fishing Creek

1994 Recommendation

A sampling site on the upper portion of Fishing Creek (near Warrenton) yielded a Fair biological rating in 1992 resulting in an impaired use support status. The basin plan recommended the application of existing NPS and NSW programs to address the impairment.

Status of Progress

Fishing Creek was resampled at the same site in 1997 and received high biological ratings for both benthic macroinvertebrates and fish community. Therefore, the stream is no longer considered impaired.

4.3 Summary of Current Use Support Ratings

Table B-4 presents the most recent use support ratings for monitored streams in subbasin 03-03-04. No waters in this subbasin are considered impaired based on data collected during the last five years. Only one area, Chocco Creek is considered threatened.

4.4 Current Priority Issues and Concerns and Recommendations for Next Five Years

During the next five years it will be important to continue the implementation of existing programs to maintain water quality in this subbasin. No waters are considered impaired and no waters are on the 303(d) list.

Table B-4 Use Support Ratings for Monitored Freshwater Streams in Subbasin 04 of the Tar-Pamlico River Basin

Name of Stream	Index #	Description	Station Location	Class	Stream Miles	Chemical Rating 93-97	Benthos - 1997	Fish - 1997	Overall Problem Parameter	Overall Rating
Fishing Creek	28-79-(1)	From source to ab Warrenton WWtp, Warren	Fishing Cr, ab Warrenton WWTP, Warren	C NSW	14.2		Good or Excellent	Good		S
Fishing Creek	28-79-(1)	From above Warrenton WWTP to Shocco Cr	Fishing Cr., SR 1600 be Warrenton, Warren	C NSW	23.3					S
Shocco Creek	28-79-22	From source to Fishing Creek	Shocco Cr SR 1613 Warren	C NSW	30.7		Good-Fair	Good-Fair		ST
Little Fishing Creek	28-79-25	From source to Fishing Creek	Little Fishing CreekSR 1338, Halifax	C NSW	30.2		Good	Good		S
Fishing Creek	28-79-(25.5)	From Little Fishing Cr to 0.6 mi upstream of Enfield Raw Water Supply Intake	Fishing Creek nr Enfield	WS-IV NSW	14.8	S	Good			S
Fishing Creek	28-79-(28.5)	From 0.6 mi upstream of Enfield Raw Water Supply Intake to Enfield Water Sup. In		WS-IV CA NSW	0.6					S
Beaverdam Swamp	28-79-30-1-1	From source to Marsh Swamp	Beaverdam Swamp at NC 561, Halifax Co.	C Sw	14.7			Good		S
Fishing Creek	28-79-(30.5)	From 1.7 mi downstream of Beech Sw to Tar River	Fishing Cr SR 1500 Edgecombe	WS-IV NSW	15.1		Good			S

Chapter 5 -
Tar-Pamlico River Subbasin 03-03-05
Lower Tar River (from Conetoe Creek to Tranters Creek)

5.1 Water Quality Overview

Subbasin 03-03-05 at a Glance

Land and Water Area (sq. mi.)

Total area:	296
Land area:	293
Water area:	3

Population Statistics

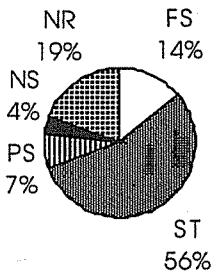
1990 Est. Pop.: 65,799 people
Pop. Density: 225 person/mi^2

Land Cover (%)

Forest/Wetland:	61%
Surface Water:	1%
Urban:	2%
Cultivated Crop:	33%
Pasture/ Managed Herbaceous:	3%

Use Support Ratings

Freshwater Streams:



This subbasin contains the most downstream freshwater reach of the Tar River and is located completely within the coastal plain ecoregion (see map in Figure B-5). The Tar River becomes deeper and much slower flowing in this area, compared to upstream reaches. This area is characterized by large amounts of forest/wetland (61%) areas as well as cultivated cropland (33%). The highest potential for nonpoint source pollution comes from the Chicod Creek watershed (USDA, 1995). While runoff from crop and forage lands has been historic problems here, a large influx of intensive poultry and hog operations within the last five years has become the largest nonpoint concern. The only major metropolitan area is Greenville. There are two major dischargers in this subbasin: Greenville WWTP discharges 17.5 MGD into the Tar River, and Burroughs-Wellcome discharges 0.5 MGD into an unnamed tributary of Parker Creek.

The only ambient monitoring station on the lower Tar River is the station at Grimesland. Benthos data from this location have indicated mostly Good to Excellent water quality conditions for the period of record, except in 1986 when water quality dropped to Good-Fair. The Tar River at Grimesland appears to be impacted more by the effects of agricultural and urban runoff than the discharge associated with Greenville. Nutrients are slightly elevated here (median values for Total P and NO_2/NO_3 were 0.12 and 0.58 mg/l, respectively); however, algae growth is usually not a problem as long as the water keeps flowing. Growths of filamentous green algae are common in quiet waters, and Greenville Utilities has documented blue-green algae blooms in their holding impoundment for drinking water. Fish tissue collected from the Tar River found elevated levels (>0.6 ppm) of mercury in 3 of 5 bowfin near Greenville and 12 of 32 bowfin and largemouth bass near Grimesland.

Fisheries data from Hardee Creek indicate Good water quality. Grindle Creek was rated Good-Fair from both benthos and fisheries data. Benthos and fish data from Chicod Creek have indicated Fair water quality. Nutrient values were also high here, with median Total P higher

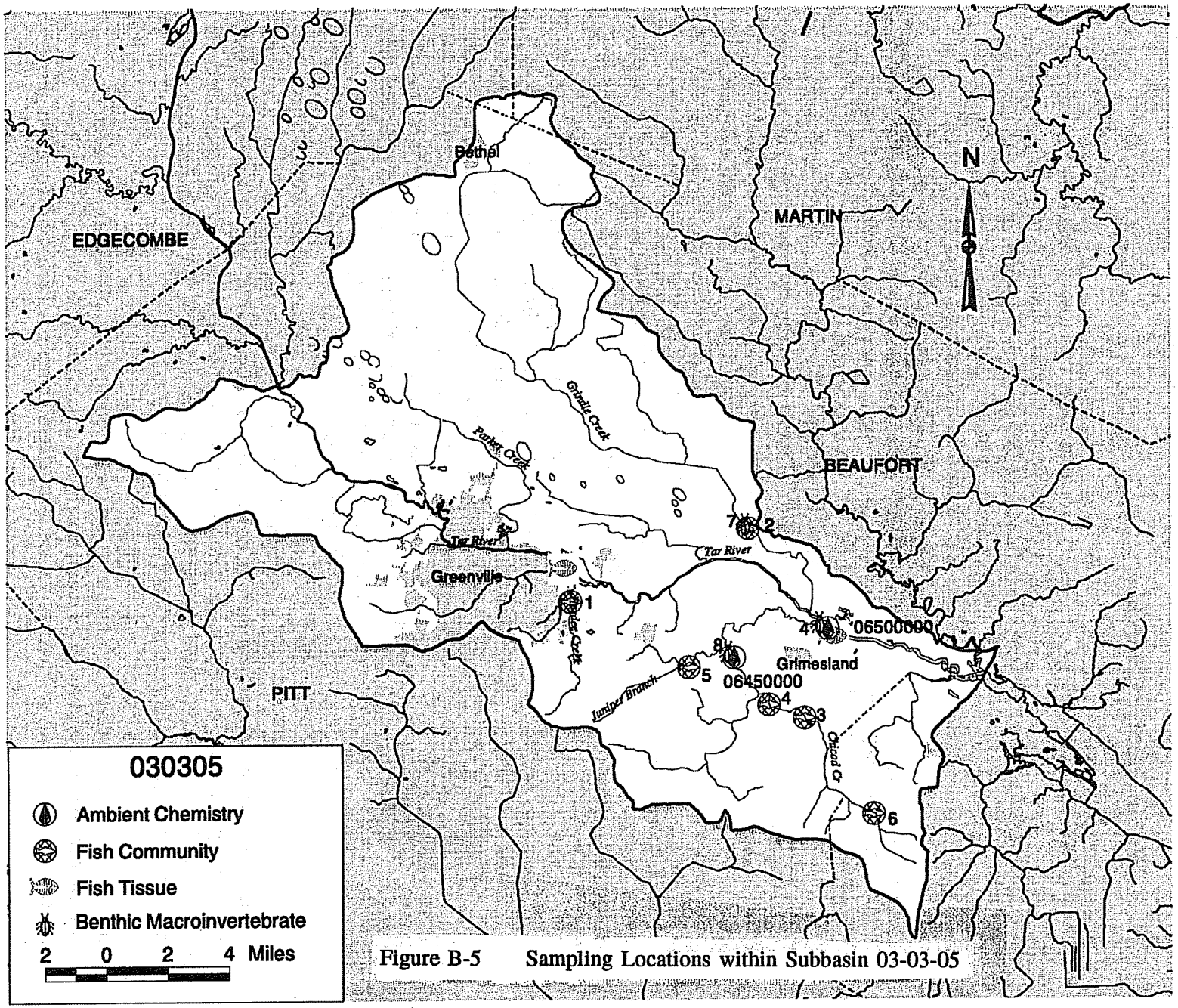


Figure B-5 Sampling Locations within Subbasin 03-03-05

here (0.35 mg/l) than at any other ambient site in the Tar River basin. This nutrient enrichment appears to be due to an increase in high density animal operations in the watershed. Depressed oxygen levels in the creek appear to have some correlation with high phosphorus levels, but it is unclear if this is due to respiration from algae growth or elevated BOD from bacterial activity.

For more detailed information on water quality in subbasin 03-03-05, refer to the *Basinwide Assessment Report - Tar-Pamlico River Basin - May 1998*, available from the DWQ Environmental Sciences Branch at (919) 733-9960.

5.2 Prior Basinwide Plan Recommendations (1994) and Achievements

The 1994 basin plan identified four streams as impaired. These are described below along with their associated recommendations.

Tar River

1994 Recommendation

The Tar River was given a Fair biological rating in 1992 which led to its impaired use support status (PS). The plan recommended the implementation of existing programs (NSW and NPS) and the application of point source controls (new and expanding discharges capped at 15 mg/l BOD and 4 mg/l ammonia).

Status of Progress

This site was resampled in 1997 and different criteria to determine the biological rating were applied. It was determined that "coastal B" criteria, which are used for deep coastal rivers with little or no visible current, were the appropriate criteria to apply at this site. The result was an Excellent biological rating and an unimpaired status.

Grindle Creek

1994 Recommendation

Grindle Creek received a Fair biological rating in 1992 and was listed as impaired in the 1994 basin plan. The plan recommended the implementation of existing management strategies (NSW and NPS) to address impairment.

Status of Progress

This creek was resampled in 1997 for both benthic macroinvertebrates and fish community. Both samples yielded Good-Fair ratings, and the stream is no longer considered impaired.

Chicod Creek and Cow Swamp

1994 Recommendation

Several locations in the Chicod Creek watershed, including its tributary Cow Swamp, were sampled in 1992 and 1993. All sites received Fair biological ratings and were listed as impaired in the 1994 basin plan. The plan recognized that nutrient loading in the watershed was a major concern and acknowledged the initiation of efforts to apply BMPs throughout the watershed in conjunction with an intensive monitoring effort.

Status of Progress

DWQ undertook a study to identify improvements in water quality following installation of BMPs in the Chicod Creek watershed. The BMPs were applied through funding (104(b)(3) grant) acquired by the Tar-Pamlico Basin Association. Very little difference was observed in the biological data following BMP implementation. Hurricane Fran (09/96) and beavers have significantly altered flow patterns in the watershed, making fish collections impossible and severely affecting water chemistry and flow information, and making before and after comparisons difficult. A statistical (step trend) analysis was performed by DWQ staff on nutrient data (nitrogen and phosphorus) collected before and after BMP implementation to determine if statistically significant changes in nutrient loads and concentrations were observed after BMP implementation. This analysis indicated that there was a statistically significant decrease in nitrogen concentrations and loads, but no significant changes were detected for the phosphorus data.

Chicod Creek and two of its tributaries, Cow Swamp and Juniper Branch, are still considered impaired in this basin plan (based on biological data) and are on the state's 303(d) list of impaired waters.

1999 Recommendation

Additional work is needed in this watershed to attain further water quality improvements. There are some remaining BMPs that will be implemented over the next year or so using the remainder of the 104(b)(3) grant. Also, the Division of Soil and Water intends to assess the need for additional BMPs in the watershed so they may be implemented as appropriate. DWQ will continue biological and ambient monitoring in the watershed.

5.3 Summary of Current Use Support Ratings

Table B-5 presents the current use support ratings for monitored streams in subbasin 03-03-05. Three out of the seven streams assessed in this subbasin are considered impaired. All three of these partially supporting streams are in the Chicod Creek watershed.

5.4 Current Priority Issues and Concerns and Recommendations for Next Five Years

5.4.1 303(d) Listed Waters

It will be a priority during the next five years to address water quality problems in Chicod Creek which is on the 303(d) list in subbasin 03-03-05.

5.4.2 Monitored Impaired Waters

It is a priority for DWQ during the next five years to work to address problems in monitored impaired waterbodies. Chicod Creek is the only monitored impaired waterbody in subbasin 03-03-05.

5.4.3 Point Source Management Strategy for the Tar River Mainstem

The 1994 basin plan recommended certain controls on new or expanding discharges into the Tar River between Rocky Mount and Greenville. It is recommended that this strategy continue through the next five-year planning cycle. Specifically, new or expanding discharges to the Tar River below Rocky Mount will receive limits no less stringent then the following in order to protect instream water quality standards: BOD of 15 mg/l; and ammonia of 4 mg/l.

Table B-5 Use Support Ratings for Monitored Freshwater Streams in Subbasin 05 of the Tar-Pamlico River Basin

Name of Stream	Index #	Description	Station Location	Class	Stream Miles	Chemical Rating 93-97	Benthos - 1997	Fish - 1997	Overall Problem Parameter	Overall Rating
Hardee Creek	28-97	From source to Tar River		C NSW	4.6			Good		S
TAR RIVER	28-(99.5)	From 1.2 miles downstream of mouth of Broad Run to upstream side of mouth of Tranters Creek	Tar River near Grimsland, SR-1565	B NSW	9.2	PS	Excellent			S
Grindle Creek	28-100	From source to Tar River	Grindle Cr, US 264	C NSW	27.3		Good-Fair	Good-Fair		ST
Chicod Creek	28-101	From source to Tar River	Chicod Creek at SR 1760 near Simpson, Pitt Co.	C NSW	13	NS	Fair	1993 fish were Fair	DO, fecal	PS

Chapter 6 -
Tar-Pamlico River Subbasin 03-03-06
Tranters Creek Watershed

6.1 Water Quality Overview

Subbasin 03-03-06 at a Glance

Land and Water Area (sq. mi.)

Total area:	243
Land area:	243
Water area:	0

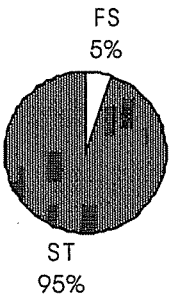
Population Statistics

1990 Est. Pop.:	14,177 people
Pop. Density:	58 persons/mi^2

Land Cover (%)

Forest/Wetland:	63%
Surface Water:	0%
Urban:	1%
Cultivated Crop:	32%
Pasture/ Managed Herbaceous:	4%

Use Support Ratings



The entire Tranters Creek catchment is a relatively small subbasin contained completely within the coastal plain ecoregion. Streams in this subbasin are typical swamp streams having low current velocities, dissolved oxygen and pH. Many streams in this area were channelized prior to 1970. The largest urban area within this subbasin is Robersonville. The two major dischargers in this subbasin, Robersonville WWTP (1.8 MGD) and Eagle Snacks (0.5 MGD), discharge into Flat Swamp. The potential for nonpoint source pollution is generally low in this subbasin with the greatest potential coming from forestry (USDA, 1995). Figure B-6 provides a map of the subbasin.

Very few biological investigations have been conducted in this subbasin. Macroinvertebrate data have only been collected from the ambient location on Tranters Creek near Washington where an improvement in water quality, from Fair to Good-Fair, appears to have occurred in the late 1980s. Fish community data indicates Good water quality in Horsepen Swamp, a tributary of Tranters Creek. Fish tissue sampling on Tranters Creek at US 264 found nearly half of the bass, bowfin and warmouth sampled to have elevated levels of mercury.

Water quality problems in this subbasin appear to be primarily limited to the naturally low dissolved oxygen and pH of swamp waters. Occasionally elevated fecal coliform values also seem to be related to swamp flushing. Of the two dischargers in this subbasin who monitor their toxicity, Eagle Snacks did not discharge in 1997, and Robersonville WWTP has passed all but one toxicity test in 1996 and 1997.

For more detailed information on water quality in subbasin 03-03-06, refer to the *Basinwide Assessment Report - Tar-Pamlico River Basin - May 1998*, available from the DWQ Environmental Sciences Branch at (919) 733-9960.

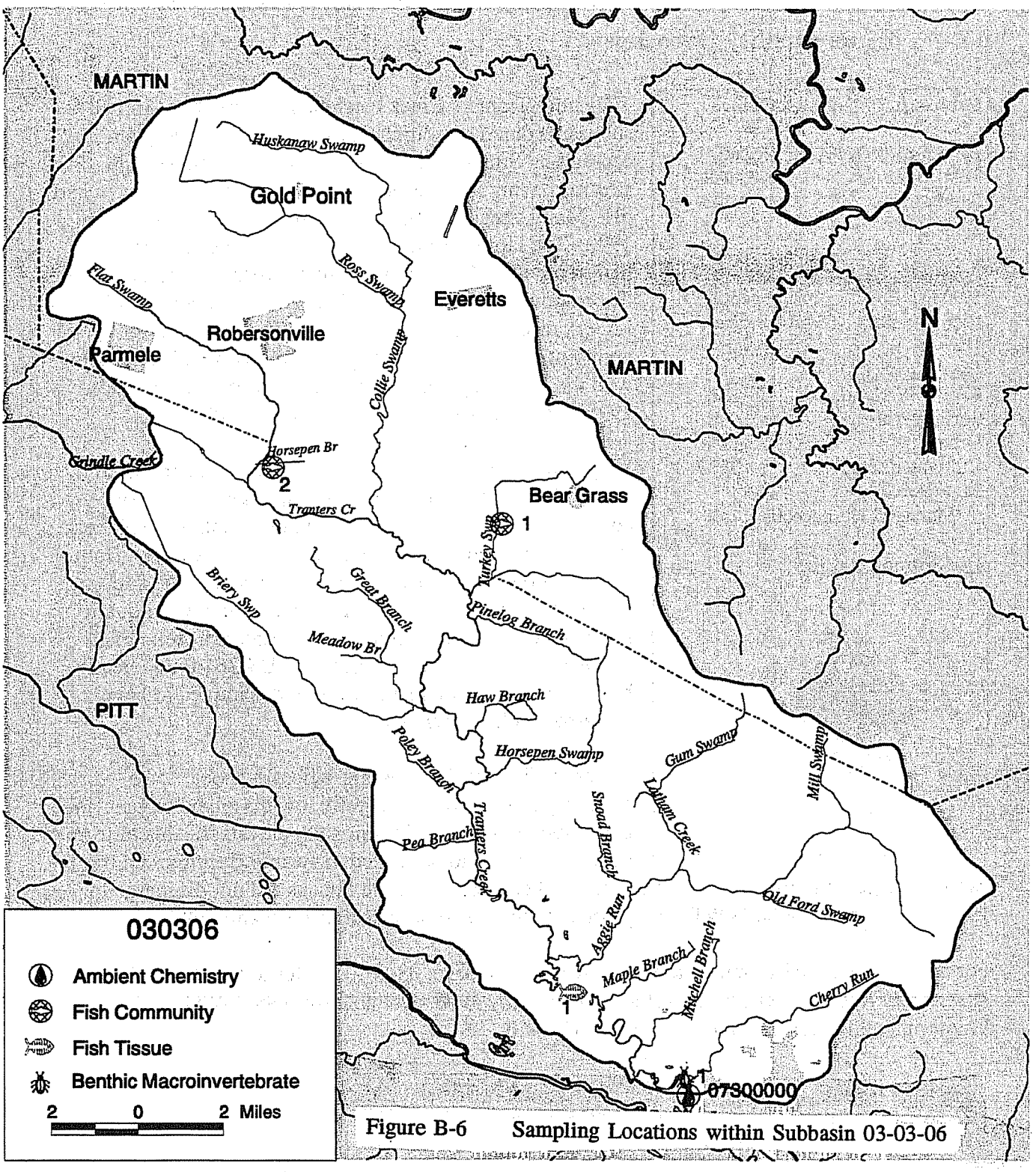


Figure B-6 Sampling Locations within Subbasin 03-03-06

6.2 Prior Basinwide Plan Recommendations (1994) and Achievements

Tranters Creek was listed as an impaired waterbody in the 1994 basin plan.

Tranters Creek

Recommendation

In the 1994 basin plan, Tranters Creek was considered partially supporting its uses due to a Fair biological rating, and results of chemical sampling that indicated fecal coliform bacteria and sediment were at problematic levels. The plan recommended the implementation of existing NSW and NPS programs as well as the application of CZARA (Coastal Zone Act Reauthorization Amendments).

Status of Progress

CZARA includes provisions to reduce nonpoint source pollution in coastal areas and is an effort that DWQ and DCM continue to pursue, although no specific actions have yet occurred. Tranters Creek was resampled in 1997 and received a Good-Fair biological rating. It is no longer considered impaired.

6.3 Summary of Current Use Support Ratings

Table B-6 presents the use support ratings for monitored streams in subbasin 03-03-06. No streams are considered impaired. Only two were rated on a monitored basis due to the low monitoring coverage in this subbasin.

Table B-6 Monitored Use Support for 03-03-06

Name of Stream	Index #	Description	Station Location	Class	Stream Miles	Benthos - 1997	Fish - 1997	Overall Rating
Tranters Creek	28-103	From source to Tar River	Tranters Creek at SR 1403 nr Washington	C Sw NSW	6.3	Good-Fair		ST
Horsepen Swamp	28-103-10	From source to Tranters Creek	SR 1001 Beaufort County	C Sw NSW	5.7		Good	S

6.4 Current Priority Issues and Concerns and Recommendations for Next Five Years

During the next five years it will be important to continue the implementation of current water quality programs in order to maintain water quality.

Also, as indicated in the 1994 basin plan, assimilative capacity in the upper portion of the Tranters Creek watershed is limited. Therefore, it is recommended that no new discharges be allowed to Flat Swamp and the upper portion of Tranters Creek (down to Turkey Swamp Creek).

Chapter 7 -
Tar-Pamlico River Subbasin 03-03-07
Pamlico River

7.1 Water Quality Overview

Subbasin 03-03-07 at a Glance

Land and Water Area (sq. mi.)

Total area:	1,192
Land area:	986
Water area:	206

Population Statistics

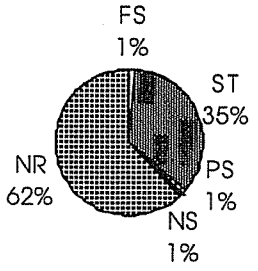
1990 Est. Pop.:	37,658 people
Pop. Density:	38 persons/mi^2

Land Cover (%)

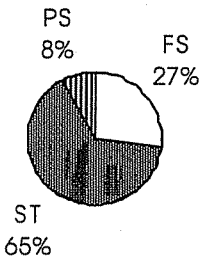
Forest/Wetland:	55%
Surface Water:	18%
Urban:	1%
Cultivated Crop:	25%
Pasture/Managed Herbaceous:	1%

Use Support Ratings

Freshwater Streams:



Estuarine Waters:



Lakes:
Pungo Lake – Fully Supporting

This area is primarily estuarine in nature, extending from tidal freshwater areas around Washington to Roos Point, east of the Pungo River (see Figure B-7). Tides in these estuarine areas tend to be wind dominated rather than following a lunar cycle. Freshwater streams in this subbasin are limited to headwaters of estuarine creeks and the East Dismal Swamp. Most streams in the East Dismal Swamp are ditched canals. Primary land use is agriculture with an urban area around Washington and a phosphate mine near Aurora. Four major discharges, the largest being the PCS phosphate mine, are permitted to discharge into this subbasin.

The Tar River is a source of NO_2/NO_3 for the Pamlico estuary. Highest incidences of copper (>30% of observations above the NC action level of 3 mg/l), an ingredient in boat anti-fouling paint and wood preservative, were found in areas with the largest amount of boat traffic (Washington and Broad Creek). Near Washington, the phytoplankton community is dominated by diatoms, greens and cryptophytes. Further down the estuary, greens were replaced by dinoflagellates. Chlorophyll *a* and phytoplankton biovolume and density increased from US 17 to a peak at Gum Point, then falls downstream. Hypoxic events have been recorded at all mainstem locations upstream of Pungo River. *Pfiesteria* is common in this subbasin, especially in the middle section of the Pamlico River, where it can be found in up to 50% of the samples. The greatest impact to the benthos in the Pamlico River is the PCS outfall, which may have an impact as far away as Long Point (4 km). Recycling of pit water in 1992 has reduced fluoride and total phosphorus levels in the PCS discharge by nearly 90%, and they have passed their toxicity tests since 1994.

Most tributaries to the Pamlico River appear to be impacted to a greater or lesser degree. Kennedy Creek, which had

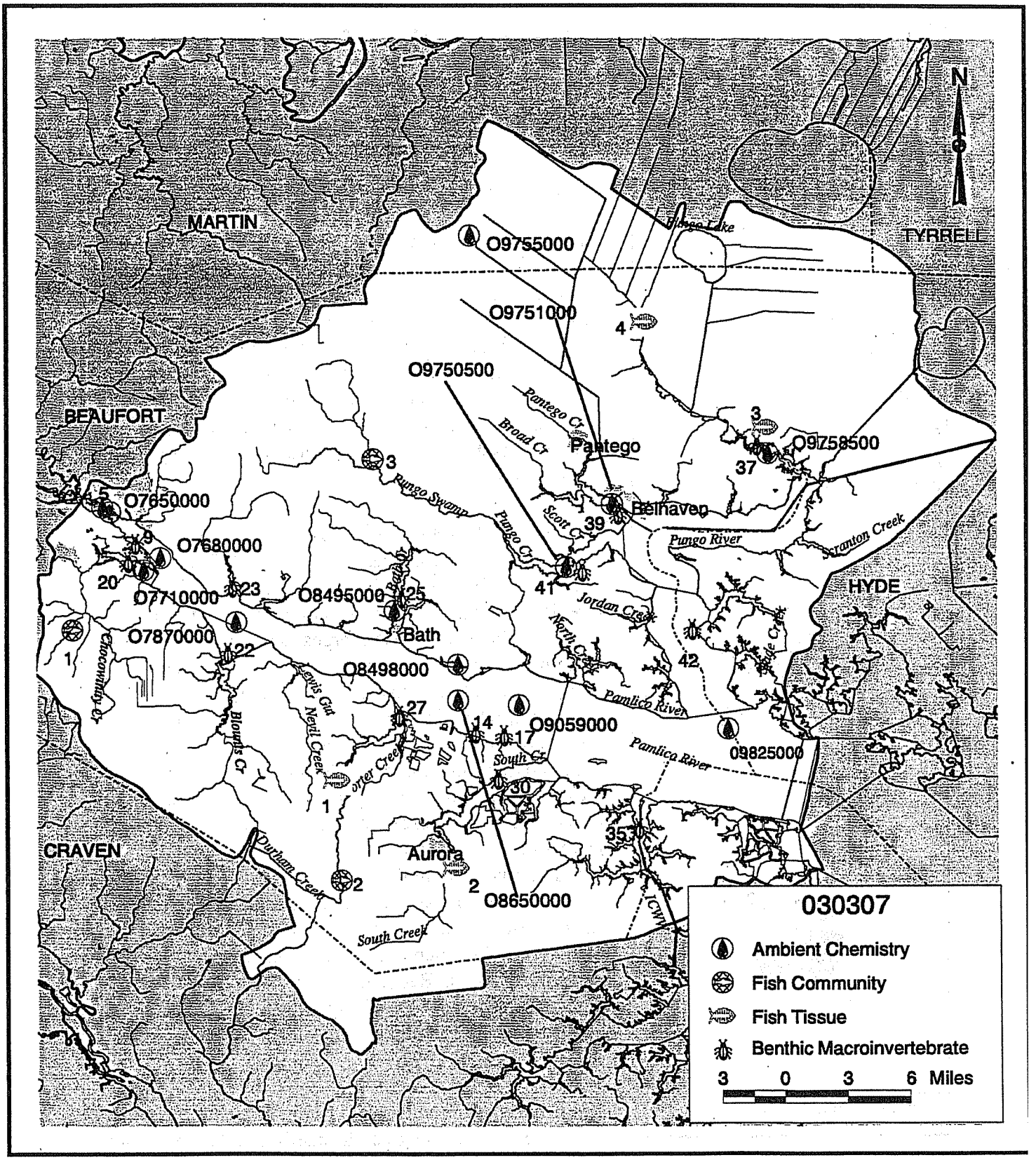


Figure B-7 Sampling Locations within Subbasin 03-03-07

been the receiving waters for the Washington WWTP and the National Spinning Company, is one of the more heavily impacted tributaries despite the removal of both dischargers. Tributaries in the upper portion of the estuary were more likely to be impacted by development (Runyon Creek, Chocowinity Bay, Blounts Bay and Broad Creek), whereas streams in the middle and lower section of this subbasin (Durham Creek, Bath Creek and Goose Creek) were more likely to be impacted by agriculture. Durham Creek was given a Fair bioclassification using fish, and two largemouth bass out of 20 fish collected near Bonnerton had mercury in their tissues above EPA criteria of 0.6 ppm. No fish collected in South Creek near Aurora were found to have high levels of mercury. Bailey Creek, a tributary to South Creek, might be suffering water quality problems, while impacts further downstream on South Creek may be linked to a spill and leaks from ponds on PCS property.

Pungo River is the largest tributary to the Pamlico River. Elevated levels of nitrogen, both NH_3 and NO_2/NO_3, and some coliforms have been documented at US 264. Major tributaries to the Pungo are Pantego Creek and Pungo Creek. Pantego Creek, near Belhaven, has occasional coliform problems, and both creeks have occasional algal blooms. Benthos data suggest moderate impacts from pollution in these three waterbodies; however, Pungo River appears to have recovered before its confluence with the Pamlico. Van Swamp, which has been channelized to drain East Dismal Swamp, is notable for its low pH (median 3.9, minimum 2.6) and dissolved oxygen (median 6.1 mg/l, minimum 0.3 mg/l). A Good-Fair bioclassification, based on fisheries data, was assigned to Acre Swamp, a tributary to Pungo Creek. No metals, pesticides or PCBs were found in fish tissue from the Pungo River Canal or Pungo River at US 264. Belhaven WWTP discharges into Battalina Creek, and while the WWTP has passed all its toxicity tests since March 1996, there is some evidence that the sediments still retain some toxicity.

Pungo Lake is a small dystrophic lake in the north of the subbasin. Water quality has improved here from 1981 until 1992, when it was last sampled. Between 1981 and 1992, NCTSI dropped from 9.9 to 4.1, Chlorophyll *a* dropped from 43 mg/l to <1 mg/l, and total organic nitrogen (TON) fell from 2.4 mg/l to 1.2 mg/l.

7.2 Prior Basinwide Plan Recommendations (1994) and Achievements

7.2.1 Impaired Waterbodies

The 1994 basin plan identified four areas in subbasin 03-03-07 as impaired. Each of these impaired waterbodies is addressed below.

Whitehurst Creek

1994 Recommendation

Whitehurst Creek, which is part of a mitigation project by PCS Phosphate, received a Poor biological rating when it was sampled in 1992. This stream is actually a ditch. As a result of the Poor rating, this creek was considered not supporting in the 1994 plan. The plan recommended that sources of the problem be investigated, including whether or not the data were reflecting

natural swamp conditions as opposed to stress due to pollution. It also recommended CZARA (Coastal Zone Act Reauthorization Amendments) be used to address NPS pollution in this area.

Status of Progress

PCS Phosphate is actively mining in the area of Whitehurst Creek. Once the mining is complete, there is a plan to restore the stream and associated wetlands. This will occur during the next five years. The stream is on the state's list of 303(d) waters and will be resampled by DWQ during the next basinwide cycle.

DWQ and the Division of Coastal Management (DCM) continue to pursue the implementation of CZARA. To date, no specific actions have been taken, although it is anticipated that more tangible progress will occur during the next five years.

Pamlico River and Pungo River

1994 Recommendation

A large portion of the Pamlico River estuary (36,200 acres), including the Pungo River (8,120 acres), was considered partially supporting its uses in the 1994 basin plan. The reasons that it was considered impaired were that there were elevated levels of chlorophyll *a* and frequent instances of low dissolved oxygen levels. These are characteristics of nutrient enrichment. The basin plan recommended a 30% reduction of Total Nitrogen and existing Total Phosphorus loads for the whole Tar-Pamlico River basin at Washington.

Status of Progress

Significant efforts have been made by both point and nonpoint sources of pollution in the basin to achieve the nutrient reduction goals. Chapter 4, Part 1 of Section A of this document provides a detailed status of efforts in basinwide nutrient reduction. The EMC recently determined that nonpoint sources of nutrient loading were not making adequate progress in achieving their portion of the loading reduction and directed DWQ staff to pursue rule making to address this issue. It is anticipated that a set of rules will be reviewed by the legislature in the year 2000.

The use support determination for this basin plan presents a much smaller portion of the Pamlico River estuary as impaired in comparison to the previous plan (see Section 7.3). It is unclear whether the perceived improved conditions correlate to actual improvement in water quality or are the result of external forces such as weather conditions during the five-year period of interest (1993-1997).

1999 Recommendation

The continuance of current efforts to reduce nitrogen loads to the estuary from both point and nonpoint sources of pollution is recommended. Section A, Part 3.5.4 provides a detailed description of these efforts.

South Creek

1994 Recommendation

Three thousand three hundred (3,300) acres of South Creek were considered partially supporting in the 1994 basin plan due to this area being closed to shellfish harvesting.

Status of Progress

DWQ had considered South Creek as impaired in the 1994 basin plan because a portion of it is classified for shellfishing (SA) and is closed to shellfishing by DEH. DEH no longer samples this creek because they have determined that there is little or no shellfish resource, and it is therefore not an efficient use of their resources to sample the area. It is a policy that any areas not sampled by DEH be closed to shellfish harvesting. In this plan, the creek is considered 'not rated' due to lack of data in which to make an assessment.

1999 Recommendation

It is recommended that, resources permitting, DWQ conduct sampling in South Creek to determine whether or not these waters are impaired.

Waters Impaired Due to DEH Shellfish Closures

1994 Recommendation

Portions of Goose Creek, the Pamlico River and the Pungo River were listed as impaired in the 1994 basin plan due to shellfish closures. The plan identified a number of ongoing efforts that could address this type of impairment in coastal waters in general. The efforts identified were: the Coastal Zone Act Reauthorization Amendments (CZARA); the Governor's Coastal Future's Committee; the Comprehensive Conservation and Management Plan (CCMP) that was generated from the Albemarle-Pamlico Estuarine Study; and the proposed (by DWQ) Use Restoration Waters program.

Status of Progress

Efforts continue in all of the program areas mentioned in the basin plan, although to date, specific actions that will reduce fecal coliform contamination in shellfish waters have not yet resulted from them. It is important to continue to work through the programs identified, as well as other existing programs, to generate actual projects in impaired watersheds that will result in pollution reduction.

7.2.2 Other Recommendations/Issues

Kennedy Creek

1994 Recommendation

The 1994 basin plan identified Kennedy Creek as an area that experienced periodic violations of the dissolved oxygen standard. The plan recommended that no new discharges be allowed to the creek and that more stringent limits be applied to the City of Washington's discharge if it was not relocated to another receiving stream.

Status of Progress

The City of Washington did remove its discharge from Kennedy Creek in August of 1995. Sampling in 1997 indicates that the creek is still impacted. DWQ will monitor it again in the next basinwide cycle to determine whether or not there has been improvement in water quality since the removal of the discharge.

1999 Recommendation

Two significant discharges have been removed from this creek in recent years, including the City of Washington in August of 1995. It is recommended that monitoring continue in the creek to determine if conditions will improve subsequent to these actions.

Pfiesteria piscicida

1994 Recommendation

The 1994 basin plan identified this toxic dinoflagellate as an issue of concern in the Pamlico River estuary. It encouraged further study of the issue, including whether or not nutrient enrichment stimulated the organism's activity.

Status of Progress

This organism has been the focus of significant attention during the last five years. Here, a general summary of what is known to date is provided. In addition, it should be noted that the Tar-Pamlico Rapid Response Team has been formed and is available to quickly respond to fish kills and other events of concern that may occur in the estuary.

One of the dominant coastal water quality issues has been the discovery of a microscopic toxic alga that can kill fish and has been reported to affect human health. The alga, *Pfiesteria piscicida*, belongs to the taxonomic class Dinophyceae. The earliest known observation of *Pfiesteria* occurred as the result of the death of fish in a marine aquarium. Later, fish pathologists observed the sudden death of cultured tilapia (*Oreochromis aureus* and *O. mossambica*) after exposure to water collected from the Pamlico River (Burkholder et al., 1992). It was speculated that if *Pfiesteria* could cause the death of fish in aquaria, then it may also kill fish where ecological conditions support populations of the alga.

Pfiesteria piscicida and possibly morphologically similar species have been documented since phytoplankton monitoring by the NC Division of Water Quality (DWQ) began in the Neuse and Pamlico estuaries in 1984, but they were not identified as toxic species until 1991. Since the initial identification of *Pfiesteria piscicida* in 1991, researchers have also found at least three other species that so closely resemble *Pfiesteria piscicida* that their identities can only be confirmed with the aid of an electron microscope. These species now comprise what is referred to as the "*Pfiesteria* complex" (J. Burkholder, Dept. of Botany, North Carolina State University (NCSU), personal communication, 1997; Burkholder and Glasgow, 1997) and belong to a division of microalgae known as dinoflagellates. *Pfiesteria piscicida* and at least one other toxic *Pfiesteria*-like dinoflagellate have been found in the Albemarle-Pamlico estuary (Burkholder and Glasgow, 1997). *Pfiesteria* complex species have been implicated as the causative agent of many fish kills in North Carolina estuaries and throughout other coastal areas in the southeastern United States (Burkholder et al., 1995; Burkholder and Glasgow, 1997).

Toxic activity of *Pfiesteria piscicida* usually occurs in the warmer months from May-October when large schools of finfish are abundant in the estuary. Once cysts of *Pfiesteria* in the sediment detect an unknown substance excreted or secreted by finfish, they develop into a stage which releases toxins into the water which narcotize fish, slough fish epidermal tissue, and cause formation of open ulcerative lesions (Noga et al., 1995). As the fish are dying, the *Pfiesteria* cells consume sloughed epidermal tissue and blood cells from affected fish. After the fish have died, *Pfiesteria* can either transform into mostly nontoxic amoeboid stages, encyst back in the sediment, or remain in the water column as nontoxic flagellated stages which can feed upon microalgal prey (Burkholder and Glasgow, 1995, Burkholder et al., 1995). During the cooler months of the year and when they are not preying upon fish, *Pfiesteria* can rely upon microalgal prey and even temporarily retain chloroplasts from ingested algae in order to perform photosynthesis for short periods of time (Steidinger et al., 1995).

Laboratory research has shown that *Pfiesteria piscicida* can transform into at least twenty-four different life stages and survive a wide range of salinities and temperatures, but the optimum ranges for toxic activity are 15 psu (brackish) and 26°C (approximately room temperature), respectively (Burkholder and Glasgow, 1997). Toxic activity does not seem to be affected by light and can occur throughout a 24-hour cycle (Burkholder and Glasgow, 1997). The nutritional requirements of *Pfiesteria* are complex, and its toxic and nontoxic stages can be stimulated by nutrients such as nitrogen and phosphate as well as algal prey. In laboratory settings, nontoxic stages of *Pfiesteria* have been observed to consume a wide variety of plankton including bacteria, microalgae and ciliates (Burkholder and Glasgow, 1995; Burkholder and Glasgow, 1997).

Before their discovery, *Pfiesteria* complex species were easily overlooked as a possible causative agent of fish kills since they often comprise only a small percentage of the algal biomass and may be confused with other dinoflagellate species due to their small, nondescript appearance in phytoplankton samples. In addition, salt wedges and low dissolved oxygen (DO) concentrations (hypoxia) were usually present during fish kill episodes. Unlike other toxic algae such as "red tide" dinoflagellate species, *Pfiesteria* and *Pfiesteria*-like dinoflagellates are usually colorless with toxic stages remaining in the water column for only a short period of time, and toxic outbreaks usually last less than 24 hours (Burkholder et al., 1992).

Due to their cryptic behavior and the array of different factors which can influence a fish kill, the NCSU Aquatic Botany laboratory produced a checklist to aid in determining whether toxic *Pfiesteria* complex species are a causative factor during a kill (Burkholder, 1997, personal communication; Burkholder and Glasgow, 1997):

- If dissolved oxygen (DO) is low in more than the lower one-third of the water column at dawn, low DO is the primary cause of the fish kill and not *Pfiesteria.*
- If other causative factors in the fish kill are detected (e.g., chemical, fertilizer, sewage spills, low DO, other pathogens), *Pfiesteria* is considered to be a secondary cause of the fish kill.
- *Pfiesteria* at toxic levels in the water column (250-400 cells/ml).
- Confirmation of the presence of *Pfiesteria piscicida* and other toxic *Pfiesteria*-like dinoflagellates by scanning electron microscopy (SEM).
- Confirmation of biotoxic activity with live fish bioassays.

At present, only the NCSU Aquatic Botany laboratory and Dr. Karen Steidinger's laboratory at the Florida Marine Research Institute (Florida Department of Environmental Protection) are equipped to positively identify *Pfiesteria* complex species by electron microscopy and fish bioassays. At DWQ, detection of *Pfiesteria* and *Pfiesteria*-like species is restricted to cursory identification by light microscopy. In order to assess other possible factors involved in a fish kill, physical (DO, temperature, salinity) and chemical (nutrients, pH) analyses of water samples are conducted.

Researchers who were exposed to aerosols of toxic *Pfiesteria* cultures have encountered health problems such as skin lesions, difficulty breathing, stomach cramping, disorientation, short-term memory loss, compromised immune system, and/or severe cognitive impairment (Glasgow et al., 1995; Burkholder and Glasgow, 1997). Other researchers have found that five people who had worked on the Pocomoke River in Maryland before or during a summer 1997 *Pfiesteria*-related fish kill experienced similar health problems. In order to pinpoint the exact mechanisms of *Pfiesteria*'s toxic activity and more precisely confirm its presence during a fish kill, research is in progress to isolate *Pfiesteria piscicida's* toxin(s) (Burkholder and Glasgow, 1997; Burkholder, 1997, personal communication).

General questions about *Pfiesteria* can be addressed to the Department of Health and Human Services (DHHS) Public Affairs Office at (919) 733-9190 or (919) 715-4174, or for questions about exposure to *Pfiesteria* or fish kills, please call 1-800-662-7030. There are also several websites on the Internet with information on *Pfiesteria,* but the following may be of particular interest.

Internet web sites containing information about *Pfiesteria.*

Internet Worldwide Web Site	Internet Address
Neuse River Rapid Response Team	www.ehnr.state.nc.us/EHNR/neuse
NCSU Aquatic Botany Laboratory	www2.ncsu.edu/unity/lockers/project/aquatic_botany
University System of Maryland	www.mdsg.umd.edu/fish-health/pfiesteria/
Maryland Sea Grant	www.mdsg.umd.edu/Whatisnew.html
ECOHAB	www.redtide.whoi.edu/hab/nationplan/ECOHAB/ECOHABhtml.html

7.3 Summary of Current Use Support Ratings

Tables B-7 and B-8 present the current use support ratings for fresh and estuarine waters in subbasin 03-03-07. The most notable change in use support ratings for this subbasin is the reduction in the area of the estuary that is listed as impaired due to nutrient enrichment. In the previous plan over 25,000 acres of the estuary were considered impaired. This plan identifies just over 3,000 acres as impaired. This assessment is based on data collected within a five-year window (1993-1997). It is important to note that it is unclear whether this outcome is the result of actual improvements in water quality, or rather a reflection of a decrease in information and data related to conditions associated with impairment (blooms, fish kills) for the time period of interest (see Part 3.5.4 of Section A). Additionally, the estuary's response to nutrient enrichment is strongly influenced by factors such as weather conditions. During the next basinwide cycle more information will be generated that will help determine whether the use support determination for the estuary based on data collected between 1993 and 1997 was the result of water quality improvements. The flow gauge and monitoring station at Greenville will allow for the estimation of nutrient loads in the basin, and the presence of the Tar-Pamlico Rapid Response Team on the estuary will provide a more accurate and consistent assessment of the frequency and duration of algal blooms and fish kills.

With regard to areas impaired due to shellfish closures, there has been a net decrease in the amount of area of waters considered impaired since the 1994 plan (2,426 acres of waters are no longer considered impaired).

7.4 Current Priority Issues and Concerns and Recommendations for Next Five Years

7.4.1 303(d) Listed Waters

During the next five years, it will be a priority of DWQ to begin to address waters listed on the state's 303(d) list. In this subbasin, those waters listed (Chocowinity Creek, Jack Creek and Whitehurst Creek) are planned to be reevaluated once swamp criteria are available for application. These streams were evaluated using biological criteria that may be inappropriate for these systems due to their swamp-like nature.

7.4.2 Monitored Impaired Waters

Several areas in this subbasin are considered impaired based on data collected during the last five years. They are addressed below.

Kennedy Creek

Kennedy Creek is considered impaired due to the severity, extent and frequency of algal blooms that occur in the creek.

Estuarine Waters Impaired by DEH Shellfish Closures

Portions of Goose Creek, the Pamlico River and the lower Pungo River are considered impaired because they are classified for shellfishing but closed to that use by DEH.

Recommendation

Addressing elevated fecal coliform concentrations in shellfishing waters is a complex issue. The sources of pollution that contribute to the problem are very diverse and site-specific. In order to adequately address the issue, the watershed of each problem area needs to be thoroughly investigated to identify sources of pollution which can be used to develop appropriate solutions. Such efforts are extremely resource intensive.

It is recommended that stakeholders in the basin consider pursuing a project in the areas identified as closed to shellfishing. There are a number of funding sources available that could be applied for and used to subsidize such a project. (The document entitled *A Guide to Water Quality Management in North Carolina* provides a listing of grant monies available for various projects. It can be obtained by contacting the Water Quality Section's Planning Branch at (919) 733-5083.)

Pamlico River

A portion of the Pamlico River estuary is considered impaired based on symptoms of nutrient enrichment (elevated chlorophyll *a*, algal blooms).

Table B-7 Use Support Ratings for Monitored Freshwater Streams in Subbasin 07 of the Tar-Pamlico River Basin

Name of Stream	Index #	Description	Station Location	Class	Stream Miles	Chemical Rating 93-97	Benthos - 1997	Fish - 1997	Overall Problem Parameter	Overall Rating
Kennedy Creek	28-104	From source to Tar River		C NSW	0.8					PS
Horse Branch	29-6-2-1-6-2	From source to Bay Branch	Horse Branch at SR 1136, Beaufort Co.	C NSW	3.6					ST
Pungo Lake	29-34-3-1	Entire Lake		C Sw NSW	3.2					S
Acre Swamp	29-34-35-1-1	From source to Pungo Swamp	Acre Swamp at NC 32, Beaufort, Co.	C Sw NSW	7.8			Good-Fair		ST

Table B-8 Estuarine Use Support Ratings for Subbasin 07

Area Name	DEH Area	Total Acres	Overall Use Support (Acres)				Major Causes		Major Sources	
			S	ST	PS	NS	Fecal	Chl-a	Point	Non-Point
Goose Creek	G1	17000		16700	300		300			NP
Pamlico River	G10	15500		15500						
Pamlico River	G11	20700		17245	3455			3455	P	NP
South Creek	G12	3300			3300					
Pamlico River	G2	29000	28500		500		500			NP
Lower Pungo R.	G8	13200		12486	714		714			NP
Upper Pungo R.	G9	8000		8000						
Totals		106700	28500	69931	8269	0	1514	3455		
Percent of total acrage			27%	65%	8%	0%	1%	3%		

Chapter 8 -
Tar-Pamlico River Subbasin 03-03-08
Pamlico Sound and Lake Mattamuskeet

8.1 Water Quality Overview

Subbasin 03-03-08 at a Glance

Land and Water Area (sq. mi.)

Total area:	1,225
Land area:	412
Water area:	813

Population Statistics

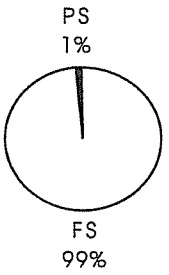
1990 Est. Pop.: 5,114 people
Pop. Density: 12 persons/mi^2

Land Cover (%)

Forest/Wetland:	21%
Surface Water:	72%
Urban:	0%
Cultivated Crop:	7%
Pasture/ Managed Herbaceous:	0%

Use Support Ratings

Estuarine Waters:



Lakes:
Lake Mattamuskeet –
Fully Supporting

This area is primarily estuarine in nature, extending from Roos Point west of the Swanquarter National Wildlife Refuge to Ocracoke Island, including most of Pamlico Sound (see Figure B-8). Tides in these estuarine areas tend to be more wind dominated than lunar. Freshwater streams in this subbasin are limited to headwaters of estuarine creeks and canals to Lake Mattamuskeet. Much of this subbasin is undeveloped, including the Mattamuskeet and Swanquarter National Wildlife Refuges. Primary land use is agriculture with Swan Quarter and Engelhard the largest urban areas. There are no major dischargers in this subbasin.

Data from all programs point to Good water quality in most natural waterbodies in this subbasin, while most canals seem to be impacted by nonpoint sources - usually the agricultural lands that they drain. There are no major dischargers in this subbasin. There is one Outstanding Resource Water area in this subbasin, in the Swanquarter National Wildlife Refuge, which includes Swanquarter Bay, Juniper Bay, Shell Bay and most of their tributaries. Other creeks in this subbasin, Far Creek, Kitty Creek, Waupopin Creek and Cumberland Creek have received a High Quality Waters designation because of their importance as primary nursery areas.

Lake Mattamuskeet, located on a vast peninsula between Albemarle Sound on the north and the Pamlico River on the south, is the largest natural lake in North Carolina. It is a shallow lake with no natural inlets or outlets. Recharge is the result of precipitation and water intrusion from a man-made canal system. The lake is a very popular site for recreational fishermen, hunters and wildlife enthusiasts who come to watch and photograph flocks of migratory waterfowl. DWQ has sampled the lake periodically from 1981 to 1997. Lake Mattamuskeet has always been eutrophic, but chlorophyll *a* values have increased over time. No major changes were noted between 1992 and 1997.

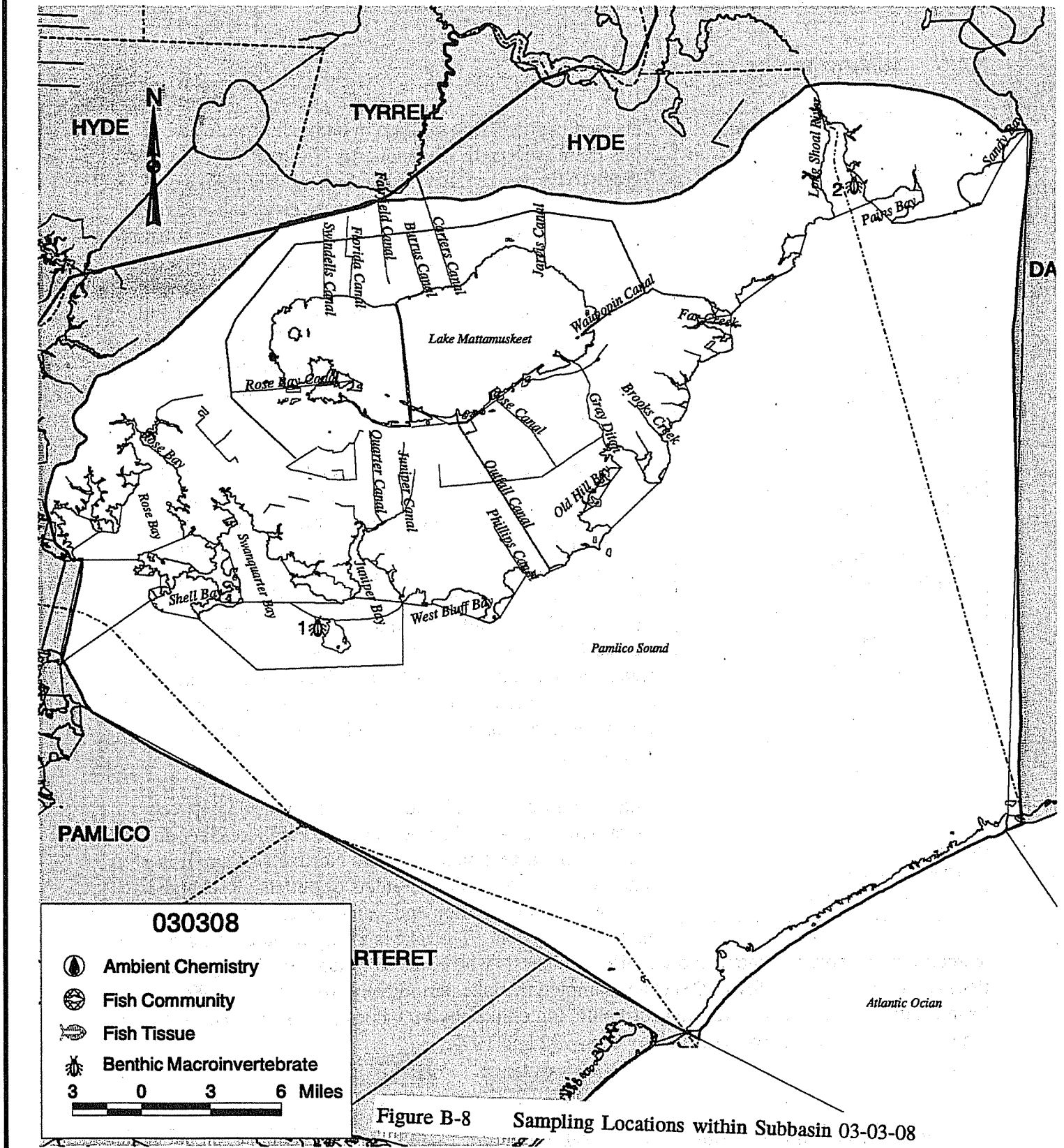


Figure B-8 Sampling Locations within Subbasin 03-03-08

For more detailed information on water quality in subbasin 03-03-08, refer to the *Basinwide Assessment Report - Tar-Pamlico River Basin - May 1998*, available from the DWQ Environmental Sciences Branch at (919) 733-9960.

8.2 Prior Basinwide Plan Recommendations (1994) and Achievements

Waters Impaired Due to DEH Shellfish Closures

1994 Recommendation

Portions of Swanquarter, Wysocking Bay, Long Shoal and waters near Ocracoke were listed as impaired in the 1994 basin plan due to shellfish closures. The plan identified a number of ongoing efforts that could address this type of impairment in coastal waters in general.

The efforts identified were: the Coastal Zone Act Reauthorization Amendments (CZARA); the Governor's Coastal Future's Committee; the Comprehensive Conservation and Management Plan (CCMP) that was generated from the Albemarle-Pamlico Estuarine Study; and the proposed (by DWQ) Use Restoration Waters program.

Status of Progress

Efforts continue in all of the program areas mentioned in the basin plan, although to date, specific actions that will reduce fecal coliform contamination in shellfish waters have not yet resulted from them. It is important to continue to work through the programs identified, as well as other existing programs, to generate actual projects in impaired watersheds that will result in pollution reduction.

1999 Recommendation

Addressing elevated fecal coliform concentrations in shellfishing waters is a complex issue. The sources of pollution that contribute to the problem are very diverse and site-specific. In order to adequately address the issue, the watershed of each problem area needs to be thoroughly investigated to identify sources of pollution which can be used to develop appropriate solutions. Such efforts are extremely resource intensive.

It is recommended that stakeholders in the basin consider pursuing a project in the areas identified as closed to shellfishing. There is a number of funding sources available that could be applied for and used to subsidize such a project. (The document entitled *A Guide to Water Quality Management in North Carolina* provides a listing of grant monies available for various projects. It can be obtained by contacting the Water Quality Section's Planning Branch at (919) 733-5083.)

8.3 Summary of Current Use Support Ratings

Table B-9 presents the current use support ratings for waters in subbasin 03-03-08. Impairment in this subbasin is related to shellfish closures due to nonpoint source pollution. Since the last plan, there has been an increase in the amount of impaired waters area by 513 acres.

Table B-9 Use Support for Subbasin 03-03-08

Area Name	DEH Area	Total Acres	Overall Use Support (Acres)				Major Causes		Major Sources	
			S	ST	PS	NS	Fecal	Chl *a*	Point	Nonpoint
Swan Quarter	G3	45000	44133		867		867			NP
Wysocking Bay	G4	23000	22745		255		255			NP
Long Shoal	G5	46000	43946		2054		2054			NP
Ocracoke	G6	13300	13165		135		135			NP
Open	G7	400000	400000							
Totals		527300	523989	0	3311	0	3311	0		
% of tot. acreage			99%	0%	1%	0%	1%	0%		

8.4 Current Priority Issues and Concerns and Recommendations for Next Five Years

During the next five years, it will be a priority to address the quality of waters listed on the 303(d) list and also considered impaired based on monitored information. In subbasin 03-03-08, these waters are the same and are those areas that are classified for shellfishing (SA) but are closed to shellfish harvesting by DEH. Specifically, these areas are: portions of the Swanquarter area, Wysocking Bay, Long Shoal and waters near Ocracoke.

Section C

Current and Future Water Quality Initiatives

Chapter 1 -
Workshop Summaries

As part of the basinwide planning process, the Division of Water Quality conducts public workshops in each river basin. The purpose of the workshops is to gain information from individuals who live and work in the basin, as well as to share with them information regarding the river basin, basinwide planning and the water quality program in general. This chapter presents information gathered at the workshops held in the Tar-Pamlico basin.

Tar-Pamlico River Basinwide Planning Workshops were conducted on June 3 and 4, 1998 in Greenville and Nashville, North Carolina. There was a total of 91 registered participants representing the following interests:

* 31 from City and County Government
* 6 from Business and Industry
* 7 from Farmers and Landowners
* 26 from State and Federal Government
* 6 from Citizen Organizations
* 2 from Academic Institutions
* 7 from Cooperative Extension Service

Workshop participants divided into small discussion groups organized by the following four categories: Animal Agriculture, Row Crop Agriculture, Waste Treatment Issues and Urban Stormwater/Construction Issues. Participants were asked to address the following discussion questions in relation to the category of their group:

1) Characterize your perception of the contributions from this category to water quality problems in the Tar-Pamlico River basin.

2) Describe what you think to be realistic and achievable solutions to reduce water quality impacts from this category.

3) Are new or stronger measures needed to reduce nonpoint source pollution from this category?

The discussions on these questions within the various groups were very productive. Comments and responses were recorded during each session. The detailed reports on the sessions are presented in the attached records. A general summary providing common ideas and viewpoints that were expressed among many of the participants is presented below.

Animal Agriculture Focus Groups

Problem Characterization:

A variety of sentiments were expressed by the participants in these groups. These ranged from concern about animal agriculture taking too much blame for water quality problems to concern about the over application of wastes to spray fields. Other comments were related to the variability of impact from different operations and the need to better understand the role of atmospheric contributions of nutrients.

Description of Realistic Solutions:

The application of best management practices (BMPs), the use of innovative technologies (including phasing out of lagoons), better education and training for farmers on implementing waste management plans, better enforcement of existing rules and providing monetary help to farmers to address these issues were key points raised in response to this discussion question.

Assessment of Need for Stronger Measures:

The general sentiment of both groups was that there were currently enough regulations to address animal agriculture's impact on water quality. There is a need to enforce existing laws and regulations and to accurately assess how much progress there is toward the nutrient reduction goal. In time we will better understand if there is a need to go further.

Urban Stormwater/Construction Focus Groups

Problem Characterization:

The groups focused on urban stormwater and construction issues believed that runoff from impervious surfaces and small, unregulated construction areas were contributing pollutants such as nutrients, pesticides and sediment to surface waters.

Description of Realistic Solutions:

Increased funding for state staff and more studies was a solution expressed by both groups. The need for increased education was highlighted a number of times.

Assessment of Need for Stronger Measures:

The general sentiment on this discussion question seemed to be that there should be an emphasis on voluntary measures and enforcement of existing laws, but that there may be a need for additional regulation.

Row Crop Agriculture Focus Groups

Problem Characterization:

It was generally felt that row crop agriculture contributes nutrients and sediment to surface waters, but there is a need for additional field studies and monitoring to better understand the extent to which this occurs. It was also felt that better nutrient management and tillage practices that have been implemented in recent years has reduced the impact on water quality from row crop agriculture.

Description of Realistic Solutions:

Generally, the application of BMPs is needed but without cutting into the farmers profits. Increased cost share funding, education and technical assistance is necessary.

Assessment of Need for Stronger Measures:

The response to this question was mixed. Some felt that regulations were necessary to protect water quality, while others felt that no additional regulations were needed and that a voluntary approach is better.

Waste Management Focus Groups

Problem Characterization:

Failing and inappropriately sited septic systems are believed to be polluting surface and groundwaters. Also, older wastewater treatment systems (including infrastructure) can cause pollution.

Description of Realistic Solutions:

Funding for upgrading waste treatment plants and collection systems is needed. There is also a need for better education and land use planning. Septic systems need to be inspected more and used less often.

Assessment of Need for Stronger Measures:

There is a need for more regulation and enforcement for septic systems. Wastewater treatment plants are regulated sufficiently but need support for applying appropriate and current technology that provides better treatment.

Chapter 2 -
Current Water Quality Initiatives

2.1 Federal Initiatives

2.1.1 Section 319 Projects

Section 319 of the Clean Water Act provides grant monies for nonpoint source demonstration projects. There are four projects in the Tar-Pamlico River basin that have been funded through this program. They are described individually below.

Cropland Wetland Restoration, Beaufort County

A wetland that had been converted for cropland use in previous years, referred to as a "prior converted" wetland, was monitored as part of a Section 319-funded project to assess the effectiveness of restoration techniques. The site is located in the Tidewater Region of the Lower Coastal Plain in Beaufort County near the town of Aurora and is owned by the PCS Phosphate Company. PCS was restoring the site to fulfill wetland mitigation requirements. The NC Cooperative Extension Service, NC Agricultural Research Service and the USDA NRCS used Section 319 funds to monitor water quality and model hydroperiod, or the pattern of wetness, at the site. Other funding was provided by the Cooperative State Research, Education and Economics Service and the National Research Initiative Competitive Grants Program.

Researchers restored the wetland in spring of 1995. To restore wetland hydrology, they installed water control structures in ditches draining the wetlands. They also did soil contouring and tree planting. Based on hydroperiod monitoring data, the effort was successful. In both 1996 and 1997, data showed that the site was wet enough for long enough to have wetland hydrology as defined by the Army Corp of Engineers. The use of rough microtopography grading in the wetland helped detain stormwater longer on the site, benefiting both the wetland and water quality. Water quality monitoring revealed lower nitrate-nitrogen and sediment concentrations leaving the wetlands relative to adjacent crop fields, but little difference in phosphorus concentrations between the two.

Devil's Cradle Creek Watershed Demonstration Project

The Devil's Cradle Creek watershed lies in northern Franklin County in subbasin 03-03-02. The primary crop in this area is flue-cured tobacco, which has the potential to lose up to 12 tons of sediment per acre per year when grown using traditional practices. Cucumbers, a secondary crop in the region, can contribute similar sediment loads. No-till technology has been proven to curb soil erosion from corn, soybeans and wheat, but little work has been done on development of no-till production technology for tobacco or cucumbers. The Cooperative Extension Service led a 319 project in this 30-square mile watershed to demonstrate the use of no-till technology on tobacco and cucumbers. The project made specialized no-till equipment available to tobacco farmers and provided cost share to reduce the expense of adopting this new technology and to

lessen the risk of crop failure. The project also demonstrated field borders, grassed waterways, animal waste management and pesticide recycling, and containment systems.

Cooperating farmers modified a no-till transplanter for tobacco and planted a total of 48 acres in no-till. The transplanter successfully planted tobacco into conditions ranging from 10-year old fescue sod to bare ground. NRCS staff involved in the project estimated the following average savings on the no-till tobacco sites: soil loss reduction of 12 tons/acre, nitrogen loss reduction of 33 lb/ac, and phosphorus loss reduction of 4 lb/ac. Participants found herbicide products that gave excellent control of problem weeds in the no-till setting. In general, no-till fields were estimated to have one-half to one-third of the soil erosion from the conventional fields. One measure of project success is adoption of demonstrated technology by others. At least five other farmers in Franklin and Vance counties applied this no-till technology to about 40 acres of tobacco in 1997. Extension's Neuse River Education Team plans to transfer the experience gained in Devil's Cradle to the Neuse basin. Cost analysis was performed on conventional versus no-till tobacco on five farms in the project. No-till production was consistently lower in cost.

Cucumbers play an important role in the agricultural economy of Franklin County. However, using clean cultivation, cucumbers are subject to severe erosion, drought stress and poor fruit quality. As part of the project, five acres of no-till cucumbers were planted in 1996, and five acres were planted in 1997. The 1996 no-till crop demonstrated that no-till cucumbers are more heat tolerant, more drought-tolerant, produce cleaner fruit, and are easier to pick. The NRCS estimated the following savings using the no-till method on cucumbers: soil loss reduction of 12 tons/ac, nitrogen loss reduction of 31 lb/ac, and phosphorus loss reduction of 4 lb/ac. Following a field day in June 1996, pickle company and local grower interest was high. About 60 acres of no-till cucumbers were planted elsewhere in Franklin County in 1997 and 50 acres in Duplin County. The Neuse Education Team has adopted the no-till cucumber technology developed in the Devil's Cradle Creek project and has purchased a 2-row no-till planter to further demonstrate the technology.

Each farm in the project also participated in a comprehensive whole-farm planning program that included soil and nematode sampling, plant tissue analysis of crops, greenhouse solution analysis, crop insect and disease scouting, and nutrient management planning. Farmers were shown how to perform these diagnostic procedures and how to interpret the results. Nutrient management plans were written for each cooperator. One farmer noted that he saved $15,000 in nematicide costs alone in the first year of the project.

Educational meetings were conducted throughout the project for the cooperators, and several field days were held to demonstrate the technology to other farmers. A project newsletter was also produced regularly throughout the project.

Atlantic White Cedar Wetland

The US Fish and Wildlife Service is working with the Pocosin Lakes National Wildlife Refuge and North Carolina State University to restore an 18,000-acre (7,280-hectare) Atlantic white cedar/bald cypress pocosin bog in Washington and Hyde counties on the Pamlemarle peninsula. In the 1980s, the Atlantic white cedar bog was owned by a commercial operation that proposed to mine the area's peat and construct a large peat-to-methanol synthetic fuel plant. The proposal

was later abandoned, but the area had already been cleared, ditched and drained. The site became part of the Pocosin Lakes National Wildlife Refuge in 1990. Although the transfer of property to federal ownership ended the threat of peat mining in the area, the site remained devoid of a natural community of plants and animals, and the water that drained from the site exceeded North Carolina water quality standards for mercury. Also, the nitrogen in the runoff was likely contributing to eutrophication in Albemarle and Pamlico Sounds.

This site is of particular interest, not only because the area contributes drainage to the estuaries, but also because the Atlantic white cedar ecosystem is categorized as globally endangered by The Nature Conservancy. Mature Atlantic white cedar bogs provide a unique habitat that has naturally acidic waters and is cooler than surrounding hardwood swamps or pinelands. Cedar bogs support high breeding densities of species such as ovenbirds (*Seiurus aurocapillus*), yellowthroats (*Geothlypus trichas*) and prairie, prothonotary and hooded warblers (*Dendroica discolor*, *Protonotaria citrea* and *Wilsonia citrna*, respectively). Hessel's hairstreak (*Mitouri hesseli*), a butterfly, uses Atlantic white cedar exclusively. Black bear (*Ursus americanus*), river otter (*Lutra canadensis*) and bobcat (*Felis rufus*) are numerous in cedar bogs, as is the state-listed eastern diamondback rattlesnake (*Crotalus adamanteus*). The federally listed red-cockaded woodpecker (*Picoides borealis*) inhabits mature pond pines that are scattered around cedar bogs.

The Fish and Wildlife Service obtained a FY94 Section 319 grant to restore hydrology on the first 2,000 acres (810 HA) and do plantings on 640 of those acres. The Fish and Wildlife Service built the water control structures in 1995 and planted the 640 acres with cypress and cedar in 1995 and 1996. To date, a total of 2,000 acres have been replanted to bald cypress and Atlantic white cedar.

The project is intended not only to benefit wildlife, but to improve water quality by stemming the flow of nitrogen from the degraded wetlands. Peat in the project site and surrounding area (the old East Dismal Swamp) formed over the last 9,000 years, retaining a tremendous amount of nitrogen that had been stored by growing plants. The peat also sequestered mercury from the rain cycle. Ditching the bog lowered the water table and aerated the peat causing decomposition and nutrient release. The peat on the 640-acre 319 demonstration plot alone contains as much stored nitrogen as 75 years of the City of Raleigh's 60 million gallons per day wastewater discharge. Improvements to the site's hydrology and vegetative community have already reduced mercury runoff to levels that are below the state water quality standard. Nitrogen levels in runoff have decreased since 1995, but are still above the 1 mg/l goal for the project.

The bog's restored hydrology has also encouraged the growth of moss (Sphagnum spp.) and improved habitat for small mammals and amphibians. In 3 to 4 more years, the trees should be large enough to provide nesting sites for the many neotropical songbirds that are known to do well in the Atlantic white cedar ecosystem.

Restoration of the Atlantic white cedar ecosystem is a long-term effort. The Service and NCSU will continue to monitor under the 319 project through June 1999. Beyond that, the project team recently received funding to develop a Master Plan for restoration of wetland hydrology on the entire 18,000 acres using a total of 14 water control structures on drainage canals. Planting of Atlantic white cedar and bald cypress will continue under this plan until the area is revegetated.

The ultimate goal for all of the restored bog areas is to have water leaving the site with mercury and nitrogen concentrations equal to, or less than, rainfall concentrations.

Groundwater Recharge/Discharge Mapping

DWQ's Groundwater Section recently completed a project to map groundwater recharge and discharge areas in the Tar-Pamlico basin. Section 319 FY95 and FY96 funds made the project possible. The project extended DWQ's statewide recharge/discharge mapping effort.

This effort is based on the concept that within the basin, water flows beneath the land surface from upland recharge areas to lower riverine areas of groundwater discharge. Staff divided the basin into landscape units of upland flats, valley slopes and valley bottoms. They had to consider several factors that govern the rate of groundwater recharge. These factors include: depth to the water table; slope of the land surface; and the infiltration capacity of the unsaturated soil profile. They used detailed county soil surveys to delineate areas with similar recharge characteristics and assigned each hydrogeologic area a groundwater recharge rate. They calculated groundwater discharge separately using stream gage data and mathematical models.

As a result, Groundwater Section staff were able to produce a recharge map for the Tar-Pamlico River basin at a 1:250,000 scale. The map shows the different landscape settings in the basin and estimates recharge rates for water infiltrating into the groundwater system for each setting. On the discharge side, staff also estimated groundwater discharge, or the groundwater contribution to streamflow, for each of the 49 sub-watershed areas where detailed soils had been mapped. This knowledge will help us understand sources of pollutants and the long-term impacts of introducing excessive nutrients into the groundwater system. Staff estimated that groundwater discharge, or base flow, represents approximately 70 percent of the water flowing into the basin's Coastal Plain streams and rivers.

2.1.2 104(b)3 Projects

Section 104(b)3 of the Clean Water Act provides grant monies for the coordination and acceleration of research, investigations, experiments, training, demonstrations, surveys and studies relating to the causes, effects, extent, prevention, reduction and elimination of pollution. The two projects in the Tar-Pamlico River basin described below are funded by 104(b)3 grants.

Daniels and Daniels Dairy, Franklin County

One animal operation in the basin in particular accomplished major improvements between 1996 and 1998. Daniels and Daniels Dairy lies adjacent to the mainstem of the Tar River in Franklin County, in subbasin 03-03-01. It is the largest dairy in the state, milking 1,350 cows three times a day. Before improvements, the large herd of cows roamed free, wading in creeks, causing massive erosion problems and putting waste into the river. The dairy instituted major structural improvements with funds and other assistance from the NRCS, Franklin County Soil and Water Conservation District, the Cooperative Extension Service, DSWC and Clean Water Act Section 104(b)3 funds acquired by the Tar-Pamlico Basin Association. The Association received credit for point source nutrient reductions through its funding of these improvements (see NSW strategy, Section A, Chapter 4). The dairy built four total confinement barns with flush systems

to house their herd. They also completed a 3-acre lagoon to collect the animals' waste and installed two solids separators. They put up fences to keep cows out of the streams and other drainage ways, and they established vegetation in the fenced-out creek buffers to stop the erosion. They installed diversions to control runoff and are presently composting manure and building another lagoon. Water quality data collected at regular intervals by DWQ from the main stream draining the dairy show marked reductions in levels of phosphorus, ammonia and fecal coliform. Total nitrogen levels did not show reductions.

DWQ staff applied the AGNPS model to the dairy's watershed to estimate potential nitrogen loading reductions from installation of the BMP systems. AGNPS is an event-based model and annual reductions were not estimated. Thirteen storms that occurred during 1995 were modeled. The modeling predicted significant decreases in nitrogen loading; it estimated cumulative average nitrogen load decreases of 70% to 80% from implementation of all planned BMPs. DWQ did not conduct an uncertainty analysis on these model outputs. Other researchers have published results of sensitivity analyses using the same input parameters, and their findings were considered throughout the database development process. This analysis assumed that planned improvements to the land were complete and that disturbed areas had recovered. Actual load reductions due to BMP installation can vary depending on pre-BMP site conditions.

Chicod Creek Watershed

The Chicod Creek watershed in subbasin 03-03-05 between Greenville and Washington was identified as a high nitrogen contributor in the first Tar-Pamlico Basinwide Plan. A significant effort has been made to implement BMPs in the watershed, supported by Section 104(b)(3) funds acquired with the help of the Association. From these funds, a total of $363,659 was spent on the implementation of BMPs in the Chicod Creek watershed. In addition, $40,330 in NC Agricultural Cost Share Program funds were spent on BMPs in the watershed. The watershed is approximately 29,000 acres of diverse land cover including a large number of confined animal operations.

A total of 33 animal operations exist in the Chicod Creek watershed. All swine operations that are populated with livestock are now in compliance with 15A NCAC 2H.0200 non-discharge rules. A variety of BMPs were employed to accomplish this. Examples include litter storage, waste utilization plans and land application. Four of the swine operations that are no longer populated with livestock have lagoons that need to be treated through a closure procedure to pump out remaining waste and sludge, land apply the waste, and fill the lagoon with fresh water. Two of the poultry operations are in need of dry stack storage structures and composters, and one poultry operation needs a dry stack litter storage structure.

Water quality was monitored before and after the bulk of BMPs was implemented in the watershed to gauge improvements due to the BMPs. Daily nutrient monitoring was conducted for a full year from February 1993 to February 1994 and again from February 1997 to February 1998. Small but statistically significant decreases in both total nitrogen concentration (0.7 mg/l) and load (20.6 kg/day) were observed. No change was observed in phosphorus levels. These results are not conclusive since a longer sampling period is recommended for full confidence in the results of the statistical test. Benthic macroinvertebrates were also sampled, and showed improvements from poor to fair at two locations within the watershed between 1993 and 1997.

Two notable factors should be kept in mind when interpreting the results of these monitoring efforts. Between 1993 and 1997, several new animal operations moved into the watershed. Also, Hurricane Fran moved through the area in September 1996. The hurricane significantly changed the flow characteristics of the streams in the watershed by causing many deadfalls and debris piling. Both of these factors could have affected nutrient levels in the creek independent of improvements made by BMP implementation, making the results less clear.

2.1.3 Conservation Reserve Enhancement Program (CREP)

In September 1998, the US Department of Agriculture awarded a $221 million, 5-year grant under its Conservation Reserve Enhancement Program (CREP) to the Division of Soil and Water Conservation. The federal grant will be matched by $54 million in state dollars from the Clean Water Management Trust Fund and other sources for a total of $275 million. The monies will be obligated over the next 5 years to place 100,000 acres of agricultural land next to streams, ditches, wetlands and estuaries into long-term contracts for buffers and best management practices (BMPs). These efforts will be targeted to the Tar-Pamlico, Neuse, Chowan and upper Cape Fear basins. These are state-designated "Nutrient Sensitive" watersheds where agricultural runoff is a major contributor of nutrients. The goal for the Tar-Pamlico basin is to enroll 30,000 acres of farmland in these buffers. Once enrolled, lands will be removed from agricultural production for contract lengths of 10, 15 or 30 years, or permanently. Attractive payment rates will be used to induce farmers to enroll their environmentally sensitive farmland. In addition, USDA and the state will offer to cost share up to 50 percent of the costs of installing BMPs on these lands to improve their water quality treatment functions. A total of 36 local Soil and Water Conservation Districts have been invited to participate in the program.

2.2 State Initiatives

2.2.1 Fisheries Reform Act of 1997

The Fisheries Reform Act was signed into law on August 14, 1997. This reform package was developed to ensure healthy fishing stocks, the recovery of depleted stocks and the wise use of fisheries resources. One of the areas of reform requires the Marine Fisheries Commission (MFC), the Environmental Management Commission (EMC) and the Coastal Resources Commission (CRC) to jointly develop and approve Coastal Habitat Protection Plans for wetlands, spawning areas, threatened/endangered species habitat, primary and secondary nursery areas, shellfish beds, submerged aquatic vegetation and outstanding resource waters. All coastal Habitat Protection Plans are to be completed by July 1, 2003 and will be reviewed every five years. The plans must:

- describe and classify biological systems in the habitat;
- evaluate the function, value to coastal fisheries, status and trends of the habitats;
- identify existing and potential threats to the habitats and the impact on coastal fishing; and
- recommend actions to protect and restore habitats.

An interagency working team has formed and worked to develop an outline for developing the plans.

The framework for plan development is to be based on critical habitats within a river basin framework. An analysis of function and value of the habitats will be conducted as specified by the law. The Newport River in the White Oak basin has been designated as the pilot area for initial assessment of the framework. GIS data analysis will be relied on heavily for analyzing the many existing data layers available from several agencies.

When the Fisheries Reform Act was made into law, no expansion budget was created to support the implementation of the law. Currently, staff from two of the divisions are required to fit this additional work into existing workloads. DMF is anticipating the addition of three new staff in early 1999.

2.2.2 NC Wetlands Restoration Program

The North Carolina Wetlands Restoration Program (NCWRP) was created as a nonregulatory program for the acquisition, maintenance, restoration, enhancement and creation of wetland and riparian resources. Its purpose is to restore degraded wetlands and riparian areas throughout all of North Carolina's river basins to compensate for the loss of vital functions and values that has occurred through wetlands conversion. The NCWRP must develop restoration plans for every major river basin in North Carolina, then implement restoration projects in accordance with those plans.

The NCWRP has developed a Basinwide Wetlands and Riparian Restoration Plan for the Tar-Pamlico River basin. Basinwide Wetlands and Riparian Restoration Plans are watershed-based plans that detail the NCWRP's methodology for prioritizing degraded or functioning wetland and riparian areas, which, when restored or protected, could contribute significantly to protecting and enhancing water quality, fish and wildlife habitat, flood water retention, and recreational opportunities in that watershed.

2.2.3 Nonpoint Source Teams

Successful management of nonpoint source pollution problems usually requires the knowledge and cooperation of a number of interested parties. DWQ's Planning Branch began establishing teams of NPS stakeholders in 1994 in many of the state's 17 river basins to foster cooperation among basin stakeholders and to tap their expertise. The goal of these teams is to use local knowledge, expertise and support to develop and implement management strategies that restore and protect priority NPS waterbodies in the basin in a targeted, coordinated and ongoing manner. Key elements of this goal are the participation of local stakeholders, prioritization of NPS-affected waters, and developing coordination among various agencies to more effectively manage problem sources. The teams involve a wide array of interests, including federal, local and state agencies, local governments, industries and citizens' groups.

DWQ and the teams have worked as partners to address NPS problems in the basins. DWQ has provided initial coordination of teams and shared the state's water quality data and technical advice with them. The teams have provided information on current NPS programs and initiatives in the basin. They have identified NPS issues and problem waters in their areas. Teams have prioritized NPS issues and/or NPS-impaired waterbodies and have selected a waterbody for management action. Management actions have included public education, best management

practice implementation, ecosystem restoration, monitoring and local water quality planning. The teams have submitted proposals for grant funding under Section 319 to help carry out their projects. Members have voluntarily participated on the teams as the resource constraints of their occupations have allowed.

DWQ assembled a team for the Tar-Pamlico basin in 1994 to develop and implement its Nutrient Sensitive Waters NPS plan; however, that team, referred to as the NSW Team, was not a locally based, project-specific effort. DWQ currently has limited staff resources to continue NPS teams and to expand them into the Tar-Pamlico and other basins. For the Tar-Pamlico basin, DWQ staff resources are currently dedicated to developing mandatory NPS management strategies that were called for by the EMC in September 1998. Inadequate staff resources currently limit DWQ's and other agencies' and organizations' abilities to address NPS-impaired waters through watershed restoration projects in all basins statewide. Without additional resources, very limited progress in dealing with NPS impairments can be expected statewide for the foreseeable future.

2.2.4 Clean Water Management Trust Fund

The Clean Water Management Trust Fund offers about $40,000,000 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 (for a more detailed discussion of the Fund, refer to *A Guide to Water Quality Management in North Carolina*). In the Tar-Pamlico River basin, four projects have been funded. The total amount of funds that have been allocated to the basin is $1,688,000. These projects are presented in Table C-1. The Fund has also dedicated $54 million to be used as a match for a federal grant of $221 million from USDA under the Conservation Reserve Enhancement Program (see Federal Initiatives).

For more information on the CWMTF or these grants, contact Dave McNaught at (919) 830-3222.

Table C-1 Projects in the Tar-Pamlico River Basin Funded by the Clean Water Management Trust Fund (as of 11/98)

Responsible Party	Purpose of Project	Amount Funded
Pamlico-Tar River Foundation	acquisition of buffers	$793,000
City of Greenville	acquisition of buffers	$270,000
Town of Grimesland	wastewater treatment	$425,000
City of Rocky Mount	acquisition of greenways	$200,000

2.2.5 Agricultural Cost Share Program

In 1984, the North Carolina General Assembly budgeted approximately $2 million to assist landowners in 16 counties within the "Nutrient Sensitive Water" (NSW) watersheds including the Tar-Pamlico to implement BMPs for agricultural and silvicultural activities. These funds were increased in May 1987 to include 17 additional coastal counties by the passage of a General Statute formally creating the *Agriculture Cost Share Program for Nonpoint Source Pollution*

Control (NCACSP). In 1989, the NCACSP became a statewide program. The NCACSP will pay a farmer 75 percent of the average cost of implementing approved BMPs and offer technical assistance to the landowners or users, which would provide the greatest benefit for water quality protection. The primary purpose of this voluntary program is water quality protection.

This program has been an important component of the NSW strategy to reduce nutrient loads from agricultural runoff in the Tar-Pamlico River basin. Table C-2 provides a breakdown of cost share monies spent in the Tar-Pamlico River basin during the last five program years (PY). Program years span the months of July through June. The various types of best management practices that were funded are listed.

2.2.6 Tar-Pamlico River Basin Regional Council

In March 1995, Governor Hunt issued an Executive Order calling for the creation of Regional Councils in the five river basins located in the Albemarle-Pamlico sounds region. Regional Councils were originally recommended as part of the Albemarle-Pamlico Estuarine Study Comprehensive Conservation and Management Plan (APES CCMP) to foster public input from each of the five river basins. A primary role of the Regional Councils is to advise and consult with environmental management agencies and groups on the implementation of environmental management activities in the river basins. The Regional Councils represent a consortium of local governments and stakeholders from all 36 counties located in the Albemarle-Pamlico region. They have no regulatory authority. The Tar-Pamlico River Basin Regional Council (TPRBRC) consists of 48 members, representing 16 counties which lie in the basin. It was formed in September 1997 and has been meeting regularly since (usually every other month).

Over the long-term, the TPRBRC is providing input to the DENR, EMC and others in implementing the goals of the APES CCMP. Since its formation, the TPRBRC has developed a 2-year Program of Work, which identifies a number of issues of concern in the basin. In its Program of Work, the TPRBRC has specifically considered undertaking initiatives in the areas of protecting the river's edge, promoting sustainable agriculture, strengthening local planning capacity, managing urban run-off, and focusing on septic system failures, groundwater protection and municipal wastewater treatment system failures.

Currently, the TPRBRC is seeking state legislation and appropriations from the 1999 NC General Assembly for the creation of a Cooperative Extension Service Education Team for the Tar-Pamlico basin (modeled after the Neuse Education Team). In discharging its duties as an advisory body, the TPRBRC passed a resolution in April 1999 supporting efforts by the Clean Water Management Trust Fund by recommending that the funds currently allocated to the CWMTF remain and not be used for any purposes other than those established by the CWMTF.

The Regional Councils have been encouraged to develop and implement strategies which are most amenable to local action. Funds from an existing EPA grant have been dedicated to help support local demonstration projects developed and implemented by the Regional Councils. Total funds available for demonstration projects are approximately $130,000. Individual projects approved for funding are eligible to receive about $26,000. As of June 1999, the TPRBRC is considering two potential demonstration projects: 1) Warren County Pasture Aeration and Precision Farming Project; and 2) Alternative Septic System Implementation Project.

Table C-2 Best Management Practices Funded by the Agricultural Cost Share Program in the Tar-Pamlico River Basin During the Last Five Program Years

Best Management Practice	Units	PY94	PY95	PY96	PY97	PY98	Totals
Conservation Tillage	acres	2172	9709	11468	13,153	100	36602
Terraces	feet	95323	44710	97548	50562	2130	290273
Diversions	feet	58892	34714	40460	16538	3850	
Critical Areas	acres	2	7	3	4	1	17
Sod Based Rotation	acres	186	27	84	29	38	364
Stripcropping	acres	186	17	14	0	0	217
Cropland Conversion-grass	acres	497	576	338	679	67	2157
Cropland Conversion-trees	acres	21	43	75	27	38	204
Grade Stabilization Structure	units	49	40	18	5	0	112
Long-term No Till	acres	0	0	224	100	0	324
Filter Strip	acres	0	0	0	4	0	4
Field Border	acres	73	81	52	43	7	256
Grassed Waterway	acres	108	87	88	84	10	377
Water Control Structure	units	11	20	27	83	20	161
Heavy Use Area	units	0	0	3	1	0	4
Spring Development	units	0	4	0	0	2	6
Stock Trail	units	0	0	0	3	0	3
Stream Crossing	units	0	0	0	1	1	2
Trough/Tank	units	0	4	0	0	8	12
Livestock Exclusion	feet	700	19,166	19407	39493	45500	124266
Nutrient Management	acres	0	0	0	0	0	0
Wells	units	0	0	0	0	1	1
Pesticide Loading Facility	units	0	0	1	1	0	2
Portable Watering Facility	units	0	0	0	0	1	1
Windmill	units	0	0	0	0	0	
Sediment Basin	units	0	0	1	1	0	2
Stormwater Management	units	1		3	1	0	5
Retrofit	units	0	1	7	7	5	20
Lagoon	units	2	3	4	4	2	15
Pond	units	1	3	8	3	1	16
Dry Stack	units	0	0	2	1	0	3
Composter	units	0	2	1	2	0	5
Loafing Lot	units	0	0	1	0	0	1
Abandon CAO	units	0	0	2	3	3	8
Solid Set	units	4	4	8	10	0	26
Hydrant	units	1	1	2	16	4	24
Mobile Irrigation	units	1	1	11	23	3	39
Waste Applied	gallons	20717731	22220120	0	0	0	42937851
Waste Applied	tons	5157	7638	0	0	0	12795
Total Contract Amount	dollars	588,235	677,632	1,013,034	2009401	457,833	4,746,135

For more information on the Tar-Pamlico River Basin Regional Council (and the other four Regional Councils), please access the Albemarle-Pamlico National Estuary Program's website at *http://h2o.enr.state.nc.us/nep/default.htm*.

2.2.7 Environmental Education

The goal of environmental education in North Carolina is to have a citizenry with the knowledge, understanding and skills necessary to nurture this "goodliest land under the cope of heaven" through sound decision-making and responsible stewardship of North Carolina's environment.

Environmental Education is an active process that increases awareness, knowledge and skills that result in understanding, commitment, informed decisions and constructive action to ensure stewardship of all interdependent parts of the earth's environment. The goals, principles and concepts of environmental education are learned through formal and non-formal education. North Carolina's environmental education program addresses both avenues of learning for adults and young people alike.

Environmental Education River Basin Program

To raise public awareness statewide, the Department of Environment and Natural Resources has developed a River Basin Awareness Program under the theme "Discover Your Ecological Address" that encourages North Carolinians to discover which river basin they live in and how their actions affect water quality in that river basin. The goal of this strategy is to increase the public's awareness and understanding of natural systems and the interconnectedness of all things. With this understanding, citizens can make more informed decisions affecting the environment and be more responsible stewards. The Environmental Education River Basin Program is carried out with networks to deliver the statewide adult education program.

For example, as part of the river basin program, the Office of Environmental Education in the Department of Environment and Natural Resources, in partnership with the NC Department of Transportation, has furthered the River Basin Awareness Program to encourage North Carolina's citizens to be good stewards of their river basin by collaborating to provide highway signs marking the locations of river basins along major highways and river crossings. River basin signs have been installed in two river basins. NCDOT and DENR are expanding this partnership statewide to include other river basins including the Tar-Pamlico basin.

To understand one's individual connection to water quality in the state's river basins, citizens need to know what river basin they live in, and that it is part of their ecological address. The goal of the awareness program is to inform travelers that every citizen of this state lives in one of these 17 river basins, and that many of our individual actions influence the water quality of the river basin in which we live and work.

Through the Environmental Education River Basin Program, river basin organizations collaborate with schools, environmental education centers, state, federal and local governments, business and industry, and nonprofit organizations to promote environmental education programs and river basin awareness.

Visit Environmental Education Centers in your river basin, participate in exciting Environmental Education Programs to become knowledgeable about your ecological address.

For more information on environmental education opportunities see Appendix V or check out the Office of Environmental Education's web site at http://www.enr.state.nc.us/ENR/ee.

Environmental Education Programs

Environmental education programs are available to the public through DENR facilities such as Educational State Forests, the Museum of Natural Sciences, the North Carolina Zoological Park, the State Parks, Aquariums, the National Estuarine Research Reserve, and the Pisgah Wildlife Education Center managed by the Wildlife Resources Commission.

In addition to educational facilities, environmental education programs and resources are also provided throughout the state at sites provided by other agencies and organizations such as schools, colleges or community buildings upon request. These structured programs are conducted by the Wildlife Resources Commission (Project WILD, Aquatic WILD, CATCH); the Division of Solid Waste Management (Waste in Place); the Division of Air Quality (Air Awareness and the Air Avenger); the Division of Pollution Prevention and Environmental Assistance (Beyond Recycling); the Division of Soil and Water (Envirothon and "Food, Land and People"); the Division of Land Resources (Erosion Patrol, Muddy Waters Essay); Division of Water Resources (Project WET – Water Education for Teachers); and the Office of Environmental Education (Using GIS to Access Environmental Data for the Classroom).

Environmental Education Programs and facilities are available through a number of divisions within DENR and also through many other organizations. In 1993, the General Assembly established the Office of Environmental Education within DENR to, among other things, serve as the state's central Clearinghouse of Environmental Education resources to provide the public easier access to all of the state's environmental education programs and resources provided through federal, state and local governments, business and industry, nonprofit organizations, and colleges and universities.

The environmental education experiences provided by DENR come in several forms. They range from very causal to very structured, and also vary widely in the range of educational depth and complexity. For instance, some environmental awareness is acquired from a family outing at an environmental education center, through a walk on a park trail, or visiting self-guided exhibits. Youth and adults may participate in more organized group events led by professional educators, such as wildlife observations or field trips to unique ecological sites. Educator training workshops are yet another level of environmental education experience. The most structured level of environmental education is the Environmental Education Certification Program, an arduous 200-hour program requiring educator training workshops, teaching, leadership and community action.

Certified Environmental Educators in the Tar-Pamlico River Basin

The North Carolina Environmental Education Certification Program was established to recognize and honor educators who complete a required number of professional development experiences

in environmental education. Individuals who elect to take environmental education courses or workshops demonstrate a desire to develop a sense of stewardship towards North Carolina natural resources and to instill that sense of stewardship in their students. The North Carolina Environmental Education Certification Program is designed to recognize those educators.

There are 16 Certified Environmental Educators and 22 Environmental Educators enrolled in the Certification Program who live in the Tar-Pamlico River basin.

Environmental Education Centers in Tar-Pamlico River Basin

Environmental Education Centers are open to the public and provide programs and resources which promote environmental education that increase awareness, knowledge and skills, and result in understanding, informed decision-making, constructive action, and making the commitment to ensure stewardship of all interdependent parts of the earth's environment.

There are seven Environmental Education Centers in the Tar-Pamlico River basin including:

- Medoc Mountain State Park
- Rocky Mount Children's Museum
- River Park North
- North Carolina Estuarium
- Goose Creek State Park
- Lake Mattamuskeet Lodge
- Gull Rock Art and Nature Center

The entire Guide to Environmental Education Centers in North Carolina can be found on the Office of Environmental Education's web site at http://www.enr.state.nc.us/ENR/ee.

See Appendix V for a complete listing for these Environmental Education Centers.

2.3 Local Initiatives

Land Use Planning and Management Project Reports as Required by CAMA

Local land use plans must be written for those local governments within the North Carolina Coastal Area Management Act (CAMA) Coastal Zone. Land use plans must address several elements of land use planning that balance future economic development and resource protection. In the Tar-Pamlico River basin there are five counties and five municipalities that are required to develop land use plans. The municipalities are: Aurora, Bath, Belhaven, Chocowinity and Washington. The counties are: Beaufort, Dare, Hyde, Pamlico and Washington.

2.4 Corporate Initiatives

2.4.1 PCS Phosphate

In 1988, PCS Phosphate (then Texasgulf), a large industrial mining operation on the Pamlico River estuary, committed to radically change its historical water use practices at its phosphate mining and manufacturing complex by installing a water recycle and reuse system. This would optimize use of groundwater that is available to the facility and reduce discharges to the Pamlico River. This new Water Management System was designed to recycle and reuse fresh groundwater that must be withdrawn from the underlying aquifer to allow safe-dry open pit phosphate mining at the complex. An additional subsequential benefit, to reduce phosphorus and fluoride discharges into adjacent surface waters by 90% and 75%, respectively, as compared to historical averages, was also a goal of the system. Additional water storage capacity (lined holding ponds), cooling towers, transfer pumps and miles of piping were installed at the facility to enable the conceptual goals of water reuse and recycling to result. The system began full operation on September 1, 1992.

In order to mine the phosphate reserve, it is necessary to locally depressurize a prolific aquifer which underlies the phosphate ore. In water handling practices of the past, water that was removed from the aquifer was almost fully circulated through the mining and manufacturing complex for processing, then discharged into the Pamlico River. In addition to this water, well water was also supplied to the facility through multiple utility wells that were located throughout the complex. Installation of the Water Management System provided a means which allowed for the recycle and reuse of water generated from mining depressurization. It also has eliminated the necessity for use of utility wells for process purposes. The majority of the depressurization water now is discharged directly to the Pamlico River without entering any part of the manufacturing process. All process waters and most stormwater runoff is collected, recycled and reused in plant processes to substantially reduce the quantities of phosphorus, fluoride and solids that historically had been discharged.

After initiating the recycling, total phosphorus decreased in the effluent by 94% (Stanley, 1997). Using ambient data collected by DWQ, DWQ staff conducted a step-trend analysis of nutrient data before and after the recycling of wastewater began. The analysis indicates that total phosphorus concentrations in the middle portion of the Tar-Pam estuary dropped by over 60% at that time.

For many years (since 1975) PCS Phosphate has funded the Institute for Coastal and Marine Resources at East Carolina University to conduct comprehensive nutrient water quality monitoring in the Pamlico River estuary. Bimonthly sampling is conducted year-round at sites from Grimesland to Pamlico Point. This has produced one of the longest and most thorough estuarine monitoring studies in the US. The monitoring effort continues with PCS Phosphate's support.

2.4.2 Champion International

In February of 1998, Champion International Corporation signed a Memorandum of Understanding (MOU) with several conservation groups and agencies to protect riparian buffers within the upper Tar River basin. The other signatory parties included the US Fish and Wildlife Service, the Nature Conservancy, the NC Wildlife Resources Commission, North Carolina Partners in Flight, and the NC Department of Environment and Natural Resources. In the MOU, Champion agreed to work with other partners to identify and map riparian buffers that are 200 feet in width on land owned by Champion in the upper Tar River basin. The agreement specifies a no-harvest zone within 50 feet adjacent to streams and selective harvesting in the remaining buffer. Other parties will assist Champion in the management of riparian buffers and will survey and monitor rare and common organisms that live in the buffers and the streams.

2.4.3 Partnership for the Sounds, Inc.

The mission of the Partnership for the Sounds, Inc. (PfS) is to stimulate local, sustainable, community-driven economic well-being within the Albemarle-Pamlico region through the promotion of eco/cultural tourism, environmental stewardship and education.

PfS was chartered in 1993 as a nonprofit organization and is overseen by a Board of Directors comprised of representatives from local governments, nonprofit organizations, businesses and industries in the Albemarle-Pamlico region. The focus area of Partnership activities includes Beaufort, Bertie, mainland Dare, Hyde, Tyrrell and Washington counties.

The diverse groups represented by the Partnership were brought together by a common interest in developing environmental/cultural education facilities that would provide focal points for tourism in the region. With coordinated infrastructure improvement, the area could become an appealing destination to the rapidly growing ecotourism and heritage tourism markets. By helping to develop that infrastructure, PfS hopes to foster an economic niche that celebrates and conserves the region's unique ecology and ways of life.

1997-98 CCMP Implementation Achievements

The NC General Assembly has appropriated funds to the Partnership each year since 1993-94. Capital funding has been provided for the construction or renovation of PfS educational facilities while a recurring line item has helped cover staffing and administrative costs.

The Partnership is coordinating the development of five education-oriented sites, as well as several other ecotourism-related projects on the Albemarle-Pamlico peninsula. Each site will interpret different aspects of the ecosystem that encompasses the region, promote visitation to the other facilities, and be associated with natural areas and historic sites - including other points of interest - in the five-county PfS area. The five PfS sites are:

1. The North Carolina Estuarium

The North Carolina Estuarium opened in January 1998. The Estuarium's focus is on North Carolina coastal estuarine systems as exemplified by the Pamlico Sound and the Tar-Pamlico

River. Located on the waterfront in downtown Washington, the Estuarium will have direct access to the Pamlico River.

2. *Lake Mattamuskeet Lodge*

Refurbishment of the Lake Mattamuskeet Lodge has continued to the point where the facility is usable for meetings, gatherings and short-term overnight use. A complete renovation plan for the Lodge was finalized with funds from an earlier appropriation. PfS continues to work closely with US Fish and Wildlife Service officials in seeking federal funds to carry out the full plan. The interpretive focus of the Lodge is the natural and human history of Lake Mattamuskeet, and the lake's role in the Atlantic Flyway for migratory waterfowl.

3. *Walter B. Jones Center for the Sounds*

A preliminary design scheme was completed for the Center for the Sounds through a previous appropriation. Since this facility will house the staff for the Pocosin Lakes National Wildlife Refuge and will be on US Fish and Wildlife Service land, federal funding will be necessary to complete the Center. The Partnership worked with the US Fish and Wildlife Service to secure funding during this year's federal budget cycle. A previous appropriation went to construct an interpretive boardwalk and outdoor classroom along the Scuppernong River in front of the Center site.

4. *Columbia Theater Cultural Resources Center*

The Cultural Resources Center, formerly the old Columbia Theater in downtown Columbia, NC, opened in October 1998 following two years of renovation and exhibit preparation. The focus of the center is on human interaction with the environment on the upper Albemarle-Pamlico peninsula, especially as witnessed through the heritage of farming, fishing and forestry.

5. *Roanoke/Cashie River Visitor's Center*

The Roanoke/Cashie River Center made excellent progress toward completion this year. Renovation plans for the building that will serve as the Center are finished and an exhibit scheme has been devised. A boardwalk and park area are open on site. The Roanoke/Cashie Center will focus on the vast floodplain and bottomland swamp system of the lower Roanoke basin. This system is the largest of its type east of the Mississippi River.

2.5 Citizen Efforts

Pamlico-Tar River Foundation

The Pamlico-Tar River Foundation (PTRF) is an educational nonprofit organization. PTRF, an established nonprofit environmental education/advocacy organization of approximately 2,000 members, is recognized as a credible voice for environmental protection in the affairs of eastern North Carolina. PTRF's members seek to be a voice for the rivers, dedicated to protecting water quality, wetlands and other critical habitat for fisheries, wildlife and waterfowl in the Tar-

Pamlico watershed. Examples of issues in which PTRF has been involved include municipal wastewater treatment, development plans, wetland loss, nutrient enrichment and fisheries regulation. They have also been very involved in activities associated with the Albemarle-Pamlico National Estuary Program and were a driving force behind the concept and development of the NC Estuarium in Washington, NC.

Chapter 3 -
Future Water Quality Initiatives

3.1 Overall DWQ Goals for the Future

The long-term goal of basinwide management is to protect the water quality standards and uses of the surface waters while accommodating reasonable economic growth. Attainment of these goals and objectives will require determined, widespread public support; the combined cooperation of state, local and federal agencies; agriculture; forestry; industry and development interests; and considerable financial expenditure on the part of all involved. With the needed support and cooperation, DWQ believes that these goals are attainable through the basinwide water quality management approach.

There are several near-term initiatives underway for the Tar-Pamlico River basin as described earlier in Section A, Chapter 4. These DWQ initiatives include:

In addition to these efforts, DWQ will continue to pursue several programmatic initiatives intended to protect or restore water quality across the state. These include NPDES Program Initiatives, better coordination of basinwide planning, and improving database management and use of GIS capabilities. Summaries of these initiatives are provided below.

NPDES Program Initiatives

In the next five years, efforts will be continued to:

- improve compliance with permitted limits;
- improve pretreatment of industrial wastes discharged to municipal wastewater treatment plants so as to reduce effluent toxicity;
- encourage pollution prevention at industrial facilities in order to reduce the need for pollution control;
- require dechlorination of chlorinated effluents or use of alternative disinfection methods for new or expanding facilities;
- require multiple treatment trains at wastewater facilities; and
- require plants to begin plans for enlargement well before they reach capacity.

Long-term point source control efforts will stress reduction of wastes entering wastewater treatment plants, seeking more efficient and creative ways of recycling by-products of the treatment process (including reuse of nonpotable treated wastewater), and keeping abreast of and recommending the most advanced wastewater treatment technologies.

DWQ requires all new and expanding dischargers to submit an alternatives analysis as part of its NPDES permit application. Non-discharge alternatives, including connection to an existing WWTP or land-applying wastes, are preferred. If the Division determines that there is an economically reasonable alternative to a discharge, DWQ may deny the NPDES permit.

DWQ will continue to make greater use of discharger self-monitoring data to augment the data it collects. Quality assurance, timing and consistency of data from plant to plant are issues of importance. Also, a system will need to be developed to enter the data into a computerized database for later analysis.

Coordinating Basinwide Planning With Other Programs

The basinwide planning process can be used by other programs as a means of identifying and prioritizing waterbodies in need of restoration or protection efforts and provides a means of disseminating this information to other water quality protection programs. For example, the plan can be used to identify and prioritize wastewater treatment plants in need of funding through DWQ's Construction Grants and Loan Program. The plans can also assist in identifying projects and waterbodies applicable to the goals of the Clean Water Management Trust Fund, Wetlands Restoration Program or Section 319 grants program. Information and finalized basin plans are provided to these offices for their use and to other state and federal agencies.

Improved Data Management and Expanded Use of Geographic Information System (GIS) Computer Capabilities

DWQ is in the process of centralizing and improving its computer data management systems. Most of its water quality program data (including permitted dischargers, waste limits, compliance information, water quality data, stream classifications, etc.) will be put in a central data center which will then be made accessible to most staff at desktop computer stations. Some of this information is also being submitted into the NC Geographic Data Clearinghouse (Center for Geographic Information and Analysis or CGIA). As this and other information (including land use data from satellite or air photo interpretation) is made available to the GIS system, the potential to graphically display the results of water quality data analysis will be tremendous.

Additional Research and Monitoring Needs

DWQ staff have identified some additional research and monitoring needs that would be useful for assessing, and ultimately, protecting and restoring the water quality of the Tar-Pamlico River basin. The following list is not inclusive. Rather, it is meant to stimulate ideas for obtaining more information to better address water quality problems in the basin. With the newly available funding programs (Clean Water Management Trust Fund and Wetlands Restoration Program) and the existing Section 319 grant program, it may be desirable for grant applicants to focus proposals on the following issues:

- *More resources are needed to address nonpoint sources of pollution*. Identifying nonpoint sources of pollution and developing management strategies for impaired waterbodies, given the current limited resources available, is an overwhelming task. Therefore, only limited progress towards restoring NPS impaired waterbodies can be expected unless substantial resources are put towards solving NPS problems.
- *Fate and Transport of Nutrients*. More data on the fate and transport of nutrients through the Tar-Pamlico River system is needed to provide a more accurate modeling tool to use to manage nutrient loads to protect water quality.

- *Additional Monitoring in Pamlico Sound*. At a 1998 Albemarle-Pamlico National Estuary Program Conference, it was noted that little monitoring is conducted in the large sounds and that these areas need more attention.

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Appendix I

Use Support Methodology
and
Use Support Ratings

Use Support: Definitions and Methodology

A. Introduction to Use Support

Waters are classified according to their best intended uses. Determining how well a waterbody supports its designated uses (*use support* status) is another important method of interpreting water quality data and assessing water quality. Use support assessments are presented in Section A, Chapter 3 and for each subbasin in Section B.

Surface waters (streams, lakes or estuaries) are rated as either *fully supporting* (FS), *fully supporting but threatened* (ST), *partially supporting* (PS) or *not supporting* (NS). The terms refer to whether the classified uses of the water (such as water supply, aquatic life protection and swimming) are fully supported, partially supported or are not supported. For instance, waters classified for fishing and water contact recreation (Class C for freshwaters or SC for saltwaters) are rated as fully supporting if data used to determine use support (such as chemical/physical data collected at ambient sites or benthic macroinvertebrate bioclassifications) did not exceed specific criteria. However, if these criteria were exceeded, then the waters would be rated as ST, PS or NS, depending on the degree of exceedence.

Streams rated as either partially supporting or nonsupporting are considered *impaired.* A waterbody is fully supporting but threatened (ST) for a particular designated use when it fully supports that use, but has some notable water quality problems. Although threatened waters are currently supporting uses, they are treated as a separate category from waters fully supporting uses. Streams which had no data to determine their use support were listed as not rated (NR).

For the purposes of this document, the term *impaired* refers to waters that are rated either partially supporting or not supporting their uses based on specific criteria discussed more fully below. There must be a specified degree of degradation before a stream is considered impaired. This differs from the word impacted, which can refer to any noticeable or measurable change in water quality, good or bad.

B. Interpretation of Data

The assessment of water quality presented in this document involved evaluation of available water quality data to determine a waterbody's use support rating. In addition, an effort was made to determine likely causes (e.g., sediment or nutrients) and sources (e.g., agriculture, urban runoff, point sources) of pollution for impaired waters. Data used in the use support assessments include biological data, chemical/physical data, lakes assessment data and DEH shellfish sanitation surveys (as appropriate). Although there is a general procedure for analyzing the data and determining a waterbody's use support rating, each stream segment is reviewed individually, and best professional judgment is applied during these determinations.

Interpretation of the use support ratings compiled by DWQ should be done with caution. The methodology used to determine the ratings must be understood, as should the purpose for which the ratings were generated. The intent of this use support assessment was to gain an overall

picture of the water quality; how well these waters support the uses for which they were classified; and the relative contribution made by different categories of pollution within the basin. In order to comply with guidance received from EPA to identify likely sources of pollution for all impaired stream mileage, DWQ used the data mentioned above.

The data are not intended to provide precise conclusions about pollutant budgets for specific watersheds. Since the assessment methodology is geared toward general conclusions, it is important not to manipulate the data to support policy decisions beyond the accuracy of these data. For example, in many areas nonpoint source pollution has been determined to be the greatest source of water quality degradation. However, this does not mean that there should be no point source control measures. All categories of point and nonpoint source pollution have the potential to cause significant water quality degradation if proper controls and practices are not utilized.

The threat to water quality from all types of activities heightens the need for point and nonpoint source pollution control. It is important to consider any source (or potential source) of pollution in developing appropriate management and control strategies. The potential for further problems remains high as long as the activity in question continues carelessly. Because of this potential, neglecting one pollution source in an overall control strategy can mask the benefits achieved from controlling all other sources.

C. Assessment Methodology - Freshwater Bodies

Many types of information were used to determine use support assessments and to determine causes and sources of use support impairment. A use support data file is maintained for each of the 17 river basins. In these files, stream segments are listed as individual records. All existing data pertaining to a stream segment (from the above list) is entered into its record. In determining the use support rating for a stream segment, corresponding ratings are assigned to data values where this is appropriate. The following data and the corresponding use support ratings are used in the process. (Note: The general methodology for using these data and translating the values to use support ratings corresponds closely to the 305(b) guidelines with some minor modifications.)

1. Biological Data

Benthic Macroinvertebrate Bioclassification

Criteria have been developed to assign bioclassifications ranging from Poor to Excellent to each benthic sample based on the number of taxa present in the intolerant groups Ephemeroptera, Plecoptera and Trichoptera (EPTs) and the Biotic Index (BI) which summarizes tolerance data for all taxa in each collection. The bioclassifications are translated to use support ratings as follows:

Bioclassification	Rating
Excellent	Fully Supporting
Good	Fully Supporting
Good-Fair	Fully Supporting but Threatened
Fair	Partially Supporting
Poor	Not Supporting

Fish Community Structure

The North Carolina Index of Biotic Integrity (NCIBI) is a method for assessing a streams biological integrity by examining the structure and health of its fish community. The index incorporates information about species richness and composition, trophic composition, fish abundance and fish condition. The index is translated to use support ratings as follows:

NCIBI	Rating
Excellent	Fully Supporting
Good	Fully Supporting
Good-Fair	Fully Supporting but Threatened
Fair	Partially Supporting
Poor	Not Supporting

Phytoplankton and Algal Bloom Data

Prolific growths of phytoplankton, often due to high concentrations of nutrients, sometimes result in "blooms" in which one or more species of alga may discolor the water or form visible mats on top of the water. Blooms may be unsightly and deleterious to water quality, causing fish kills, anoxia, or taste and odor problems. An algal sample with a biovolume larger than 5,000 mm3/m3, density greater than 10,000 units/ml, or chlorophyll *a* concentration approaching or exceeding 40 micrograms per liter (the NC state standard) constitutes a bloom. Best professional judgment is used on a case-by-case basis in evaluating how bloom data should be used to determine the use support rating of specific waters. The frequency, duration, spatial extent, severity of blooms, associated fish kills or interference with recreation or water supply uses are all considered.

Chemical/Physical Data

Chemical/physical water quality data are collected through the Ambient Monitoring System as discussed in Section A, Chapter 3. These data are downloaded from STORET to a desktop computer for analysis. Total number of samples and percent exceedences of the NC state standards are used for use support ratings. Percent exceedences correspond to use support ratings as follows:

Standards Violation	Rating
Criteria exceeded <10%	Fully Supporting
Criteria exceeded 11-25%	Partially Supporting
Criteria exceeded >25%	Not Supporting

It is important to note that some waters may exhibit characteristics outside the appropriate standards due to natural conditions. These natural conditions do not constitute a violation of water quality standards.

Lakes Program Data

Assessments have been made for all publicly accessible lakes, lakes which supply domestic drinking water, and lakes where water quality problems have been observed.

2. Sources and Cause Data

In addition to the above data, existing information was entered for potential sources of pollution (point and nonpoint). It is important to note that not all impaired streams will have a potential source and/or cause listed for them. Staff and resources do not currently exist to collect this level of information. Much of this information is obtained through the cooperation of other agencies (federal, state and local), organizations and citizens.

a. Point Source Data

Whole Effluent Toxicity Data

Many facilities are required to monitor whole effluent toxicity by their NPDES permit or by administrative letter. Streams that receive a discharge from a facility that has failed its whole effluent toxicity tests may be rated ST (unless water quality data indicated otherwise) and have that facility listed as a potential source of impairment.

Daily Monitoring Reports

Streams which receive a discharge from a facility significantly out of compliance with permit limits may be rated ST (unless water quality data indicated otherwise) and have that facility listed as a potential source of impairment.

b. Nonpoint Source Data

Information related to nonpoint source pollution (i.e., agricultural, urban and construction) was obtained from monitoring staff, other agencies (federal, state and local), land use reviews, and workshops held at the beginning of each basin cycle.

c. Problem Parameters

Causes of use support impairment (problem parameters), such as sedimentation and low dissolved oxygen, were also identified for specific stream segments. For ambient water quality stations, those parameters which exceeded the water quality standard >10% of the time for the review period were listed as a problem parameter. For segments without ambient stations, information from reports, other agencies and monitoring staff was used if it was available.

3. Monitored vs. Evaluated

Assessments were made on either a monitored (M) or evaluated (E) basis, whichever, depending on the level of information that was available. Streams are rated on a monitored basis if the data are less than five years old. Streams are rated on an evaluated basis under the following conditions:

- If the only existing data for a stream is more than five years old.
- If a stream is a tributary to a monitored segment of a stream rated fully supporting (FS) or fully supporting but threatened (ST), the tributary will receive the same rating on an evaluated basis. If a stream is a tributary to a monitored segment of a stream rated partially supporting (PS) or not supporting (NS), the stream is considered not rated (NR).
- Because a monitored rating is based on more recent and site-specific data, it is treated with more confidence than an evaluated rating.

Refer to the following summary for an overview of assigning use support ratings.

Summary of Basis for Assigning Use Support Ratings to Freshwater Streams

Overall Basis	Specific Basis	Description
Monitored	Monitored (M)	Monitored stream segments* with data** <5 years old.
	Monitored/Evaluated (ME)	Stream segment* is unmonitored but is assigned a use support rating based on another segment of same stream for which data** <5 years old are available.
Evaluated	Evaluated (E)	Unmonitored streams that are direct or indirect tributaries to stream segments rated FS or ST.
	Evaluated/Old Data (ED)	Monitored stream segments* with available data** >5 years old.
Not Rated	Not Rated (NR)	No data available to determine use support. Includes unmonitored streams that are direct or indirect tributaries to stream segments rated PS or NS.

* A stream segment is a stream, or a portion thereof, listed in the Classifications and Water Quality Standards for a river basin. Each segment is assigned a unique identification number (Index No.).

** Major data sources include: Benthic Macroinvertebrate Bioclassification; Fish Community Structure (NCIBI); Chemical/Physical Monitoring Data.

D. Assessment Methodology - Saltwater Bodies

Estuarine areas are assessed by the Division of Environmental Health (DEH) shellfish management areas. The following data sources are used when assessing estuarine areas.

1. DEH Sanitary Surveys

The DEH is required to classify all shellfish growing areas as to their suitability for shellfish harvesting. Growing areas are sampled continuously and reevaluated every three years to determine if their classification is still applicable. Growing waters are classified as follows:

- *Approved Area* - an area determined suitable for the harvesting of shellfish for direct market purposes.
- *Conditionally Approved-Open* - waters that are normally open to shellfish harvesting but are closed on a temporary basis in accordance with management plan criteria.
- *Conditionally Approved-Closed* - waters that are normally closed to shellfish harvesting but are open on a temporary basis in accordance with management plan criteria.
- *Restricted Area* - an area from which shellfish may be harvested only by permit and subjected to an approved depuration process or relayed to an approved area.
- *Prohibited Area* - an area unsuitable for the harvesting of shellfish for direct market purposes.

2. Chemical/Physical Data

Water quality data are collected from estuarine ambient monitoring stations. Parameters are evaluated based on the salt waterbody classification and corresponding water quality standards.

3. Phytoplankton and Algal Bloom Data

Prolific growths of phytoplankton, often due to high concentrations of nutrients, sometimes result in "blooms" in which one or more species of algae may discolor the water or form visible mates on top of the water. Blooms may be unsightly and deleterious to water quality, causing fish kills, anoxia, or taste and odor problems. An algal sample with a biovolume larger than 5000 mm3/m3, density greater than 10,000 units/ml, or chlorophyll *a* concentrations approaching or exceeding 40 micrograms per liter (the NC standard) constitutes a bloom. Best professional judgment is used on a case-by-case basis in evaluating how bloom data should be used to determine the use support rating of specific waters. The frequency, duration, spatial extent, severity of blooms, associated fish kills or interference with recreation or water supply uses are all considered.

Saltwaters are classified according to their best use. When assigning a use support rating, the waterbody's assigned classification is used with the above parameters to make a determination of use support. The following table describes how these factors are combined in use support determination.

DWQ Classification	DEH Shellfish Classification	Chemical/ Physical Data	Phytoplankton Data
Fully Supporting			
SA	Approved	standard exceeded ≤10% of measurements	no blooms
SB & C	Does not Apply	standard exceeded ≤10% of measurements	no blooms
Fully Supporting but Threatened			
SA	Conditionally Approved-Open	no criteria	no blooms
SB & SC	Does not Apply	no criteria	no blooms
Partially Supporting			
SA	Prohibited, Restricted or Conditionally Approved-Closed	standard exceeded 11-25% of measurements	blooms
SB & SC	Does not Apply	standard exceeded 11-25% of measurements	blooms
Not Supporting			
SA	Prohibited or Restricted	standard exceeded >25% of measurements	blooms
SB & SC	Does not Apply	standard exceeded >25% of measurements	blooms

In addition to the above categories, SA estuarine waters are not rated when categorized by DEH as prohibited because DEH does not sample them due to the absence of a shellfish resource. It is a federal requirement that DEH prohibit harvesting in such areas, although actual coliform concentrations are unknown.

It is important to note that DEH classifies all actual and potential growing areas (which includes all saltwater and brackish water areas) as to their suitability for shellfish harvesting, but different DWQ use classifications may be assigned to separate segments within DEH management areas. In determining use support, the DEH classifications and management strategies are only applicable to those areas that DWQ had assigned the use classification of SA. This will result in a difference of acreage between DEH areas classified as Prohibited or Restricted and DWQ waterbodies rated as PS. For example, if DEH classifies a 20-acre waterbody as prohibited, but only 10 acres have a DWQ use classification of SA, only those 10 acres classified as SA will be rated as partially supporting their uses. DWQ areas classified as SB and SC are rated using chemical/physical data and phytoplankton data.

E. Assigning Use Support Ratings

At the beginning of each assessment, all data are reviewed by subbasin with the monitoring staff, and data are adjusted where necessary based on best professional judgment. Discrepancies between data sources are resolved during this phase of the process. For example, a stream may be sampled for both benthos and fish community structure, and the bioclassification may differ from the NCIBI (i.e., the bioclassification may be FS while the NCIBI may be PS). To resolve

this, the final rating may defer to one of the samples (resulting in FS or PS), or it may be a compromise between both of the samples (resulting in ST).

After reviewing the existing data, ratings are assigned to the streams. If one data source exists for the stream, the rating is assigned based on the translation of the data value as discussed above. If more than one source of data exists for a stream, the rating is assigned according to the following hierarchy:

Benthic Bioclassification/Fish Community Structure
Chemical/Physical Data
Monitored Data >5 years old
Compliance/Toxicity Data

This is only a general guideline for assigning use support ratings and not meant to be restrictive. Each segment is reviewed individually, and the resulting rating may vary from this process based on best professional judgment, which takes into consideration site specific conditions.

After assigning ratings to streams with existing data, streams with no existing data were assessed. Streams that were direct or indirect tributaries to streams rated FS or ST received the same rating (with an evaluated basis) if they had no known significant impacts, based on a review of the watershed characteristics and discharge information. Streams that were direct or indirect tributaries to streams rated PS or NS, or that had no data, were assigned a NR rating.

F. Revisions to Methodology Since 1992-1993 305(b) Report

Two significant changes to use support methodology have been made since the 1992-1993 305(b) report pertaining to the use of older information and fish consumption advisories.

Methodology for determining use support has been revised to more accurately reflect water quality conditions. In the 1992-1993 305(b) report, information from older reports and workshops were included in making use support determinations. Streams assessed using this information were rated on an evaluated basis, because the reports were considered outdated, and the workshops relied on best professional judgment since actual monitoring data were not available. In place of these older reports and workshop information, DWQ is now relying more heavily on data from its expanded monitoring network. These changes resulted in a reduction in streams rated on an evaluated basis. The basinwide process allows for concentrating more resources on individual basins during the monitoring phase. See the discussion above for more information on how 'monitored' versus 'evaluated' is defined.

Mercury levels in surface waters are primarily related to increases in atmospheric mercury deposition from global/regional sources, rather than from local surface water discharges. As a result, fish consumption advisories due to mercury have been posted in many areas (primarily coastal areas) of the state.

Waters with fish consumption advisories (mercury, dioxin, etc.) are no longer considered for use support determination. However, these waters will continue to appear on the 303(d) list, and management strategies will be developed for these waters as required by the Clean Water Act.

Appendix II

List of 303(d) Waters in the Tar-Pamlico River Basin

LIST OF 303(D) WATERS IN THE TAR-PAMLICO RIVER BASIN

What is the 303(d) list?

Section 303(d) of the Clean Water Act (CWA) requires states to develop a list of waters not meeting water quality standards or which have impaired uses. Waters may be excluded from the list if existing control strategies for point and nonpoint source pollution will improve water quality to the point that standards or uses are being met. Listed waters must be prioritized, and a management strategy or total maximum daily load (TMDL) must subsequently be developed for all listed waters. A summary of the 303(d) process follows. More complete information can be obtained from *North Carolina's 1998 303(d) List* (DENR, 1998), which can be obtained by calling the Planning Branch of DWQ at (919) 733-5083.

303(d) List Development

Generally, there are four steps to preparing North Carolina's 303(d) list. They are: 1) gathering information about the quality of North Carolina's waters; 2) screening those waters to determine if any are impaired and should be listed; 3) determining if a total maximum daily load (TMDL) has been developed; and 4) prioritizing impaired waters for TMDL development. This document also indicates whether the Division of Water Quality (DWQ) intends to develop a TMDL as part of a Management Strategy (MS) to restore the waterbody to its intended use. The following subsections describe each of these steps in more detail.

Sources of Information

For North Carolina, the primary sources of information are the basinwide management plans, 305(b) reports and accompanying assessment documents, which are prepared on a five-year cycle. Basinwide management plans include information concerning permitting, monitoring, modeling and nonpoint source assessment by basin for each of the 17 major river basins within the state. Basinwide management allows the state to examine each river basin in detail and to determine the interaction between upstream and downstream, point and nonpoint pollution sources. As such, more effective management strategies can be developed across the state.

Many types of information were used to make use support assessments and to determine causes and sources of use support impairment. Chemical, physical and biological data collected by DWQ were the primary sources of information used to make use support assessments. North Carolina has an extensive ambient and biological monitoring network throughout the state. Benthic macroinvertebrate data, which indicate taxa richness and species diversity, are an important data source. North Carolina also collects fish tissue and fish community structure data, and phytoplankton bloom data that are used in the assessments. Shellfish closure data, fish kill data, predictive modeling results, toxicity data and self-monitoring data are considered when making final use support determinations.

In addition, data from all readily available sources outside of DWQ are considered when evaluating use support. Many other agencies, universities, industries, point sources and environmental groups collect data on North Carolina's surface waters. Published reports and data from ongoing studies that the DWQ has knowledge of are actively solicited during the assessment phase of the basin planning cycle. Data that are not collected and analyzed following procedures outlined by the Environmental Protection Agency (EPA) are used to qualitatively

support other monitoring that may occur in the same water and identify areas to monitor in the future. The Division, therefore, uses all readily available data.

Listing Criteria

Waters whose use support ratings were not supporting (NS), partially supporting (PS) and fully supporting but threatened (ST), based on monitored information in the 305(b) report, were considered as initial candidates for the 303(d) list. Although support threatened waters currently meet their intended uses, if sufficient data indicate that they will become impaired in the next two years, they will be included on the 303(d) list.

Fish consumption advisory information was then reviewed to determine if other waters should be added to the list. Fish consumption advisories are no longer considered when determining use support ratings since a fish advisory for mercury contamination in Bowfin was posted for the entire state in June 1997. While fish consumption advisories do indicate impairment, DWQ did not want to mask other causes and sources of impairment by having the entire state (or an entire basin) listed as impaired due to fish consumption advisories. However, DWQ believes that advisories on specific waters are cause to include the water on the 303(d) list. Consumption advisories other than the statewide Bowfin posting were considered when developing North Carolina's 303(d) list. Waters listed due to fish consumption advisories may have overall ratings of fully supporting (FS) or fully supporting but threatened (ST) because fish advisories are not considered in the 305(b) use support process.

Guidance from EPA on developing 1998 303(d) lists indicates that impaired waters without an identified problem parameter should not be included on the 303(d) list. The Clean Water Act, however, states that chemical, physical and biological characteristics of waters shall be restored. DWQ feels that waters listed in the 305(b) report as impaired for biological reasons where problem parameters have not yet been identified should remain on the 303(d) list. The absence of a problem parameter does not mean that the waterbody should not receive attention. Instead, DWQ should resample or initiate more intensive studies to determine why the waterbody is impaired. Thus, biologically impaired waters without identifiable problem parameters are on the North Carolina's 303(d) list.

Assigning Priority

North Carolina is required to prioritize its 303(d) list in order to direct resources to those waters in greatest need of management. The CWA states that the degree of impairment (use support rating) and the uses to be made of the water (stream classification) are to be considered when developing the prioritization. In addition, DWQ reviews the degree of public interest and the technical probability of success when prioritizing 303(d) listed waters. Waters harboring endangered species are given additional priority.

Estuarine areas were also prioritized. Fecal coliforms have impacted shellfish water use in the Tar-Pamlico River basin. Estuarine responses to fecal coliform loads are difficult to capture using deterministic water quality models, and the results tend to be more suspect than results for processes that are better understood, such as those for nutrients. The probability of developing a defensible numeric loading target may be low for fecal coliforms.

The prioritization process results in ratings of high, medium and low. Generally, waters rated with the highest priority are classified for water supply, rated not supporting, and harbor an endangered species. Waters receiving a high priority are important natural resources for the State of North Carolina and generally serve significant human and ecological uses. High priority waters will likely be addressed first within their basin cycles.

EPA recently issued guidance that suggested states should develop TMDLs and management strategies on all of their impaired waters within the next eight to thirteen years. To meet this federal guidance, the DWQ is striving to address all waters on the 1998 303(d) list that have a priority of high, medium or low within the next 10 years. Numeric TMDLs, if proper technical conditions exist, and management strategies will be developed for these waters. The DWQ is currently reviewing its resource needs in order to meet this aggressive schedule.

Other priorities have also been assigned to waters. A monitor priority indicates that the waterbody is listed based on: 1) data older than 5 years; 2) biological monitoring and no problem pollutant has been identified; or 3) biological monitoring that occurred in waters where we now have evidence that the biological criteria should not have been applied. These waters will be resampled before a restorative approach is developed because more information is required about the actual use support or cause of impairment. Further information on the monitoring approaches that have a monitor priority is provided in the next section.

Additional Guidance on Using the 303(d) List

The column headings in the 303(d) list refer to the following:

Class – The information in this column indicates the classification assigned to the particular waterbody. Stream classifications are based on the existing and anticipated best usage of the stream as determined through studies and information obtained at public hearings. The stream classifications are described in 15A NCAC 2B .0300.

Subbasin – The number in this column refers to the DWQ subbasin in which the waterbody is located.

Problem Parameter(s) – Impairment identified in the use support rating process. When a chemical problem parameter is identified, the parameter listed exceeded the state's water quality standards for that parameter. Biological impairment is based on data relating to benthic and fish habitat as well as community structure. Problem parameter(s) show a potential cause of impairment. There may be other unidentified causes contributing to the impairment. Problem parameters included in the Tar-Pamlico portion of the 303(d) list are listed below:

Chla – chlorophyll *a*
Cl – chlorine
DO – dissolved oxygen
Fecal – fecal coliform bacteria
NH3 – ammonia
Nutr – nutrients
pH – pH
Sed – sediment
Turb – turbidity
Blooms – algal blooms
Biological Impairment – Impairment based on benthic/fish data

Overall Rating – This column lists the overall use support rating. These values may be **NS** (not supporting), **PS** (partially supporting), **ST** (fully supporting but threatened), **FS** (fully supporting) and **NR** (not rated). A NR rating is typically assigned to waters that were sampled using biocriteria that may not apply, or where there is no data available on the water. These waters appeared on earlier 303(d) lists, and they continue to be listed for administrative reasons, but no TMDL or management strategy will be developed until we have updated information that the water continues to be impaired. The 305(b) report describes these use support ratings further.

Source – This column indicates the *potential* major sources of impairment. A list describing what each number means is provided in Table 1.

Approach – This column indicates the approach DWQ will take to restore the waterbody. More than one approach may be listed. TMDLs are typically developed for DO, nutrients, ammonia and metals. Management strategies are typically done for pH, sediment, turbidity and fecal coliforms. Further information on each approach is provided below.

> **TMDL** – A numeric TMDL (total, maximum, daily, load), as defined by EPA, will be developed.
>
> **MS** – Management Strategy. These waters are on the list based on data collected within the five years prior to when the use support assessment was completed. A problem pollutant has been identified, but North Carolina cannot develop a numeric TMDL as EPA currently defines it. A management strategy may contain the following elements: further characterization of the causes and sources of impairment, numeric water quality goals other than TMDLs, and best management practices to restore the water.
>
> **RES** – Resample. This waterbody was identified as being impaired based on water quality data that were greater than 5 years old at the time the use support assessment was performed. This waterbody will be resampled prior to TMDL or management strategy development to ensure the impairment continues to exist.
>
> **PPI** – Problem Parameters Identification. Available chemical data do not show any parameters in violation of applicable standards, but biological impairment has been noted within the five years prior to use support assessment. DWQ will resample these waters for chemical and biological data to attempt to determine the potential problem pollutants. TMDLs or management strategies will be developed within 2 basin cycles of problem parameter identification.
>
> **SWMP** – Swamp waters. This water may not actually be impaired. Swamp waters previously evaluated using freshwater criteria will continue to be monitored and will be reevaluated when swamp criteria are available.

Priority – Priorities of high, medium and low were assigned for waters identified as being impaired based on data that were not greater than 5 years of age at the time the use support assessment was done and for which a problem pollutant has been identified. All waters assigned a priority of high, medium or low will be addressed within the next two basin cycles. Priorities

of monitor and N/A have also been assigned where appropriate. Further explanation on each of these is provided below:

High – Waters rated high are important resources for the state in terms of human and ecological uses. Typically, they are classified as water supplies, harbor federally endangered species, and are rated as not supporting. These waters will be addressed first within their basin cycles.

Medium – Waters rated medium may be classified for water supply or primary recreational use, may have state endangered or other threatened species, and may be rated as partially or not supporting.

Low – Waters rated low generally are classified for aquatic life support and secondary recreation (i.e., Class C waters) and harbor no endangered or threatened species.

Monitor – The waterbody is included on the 303(d) list based on:

1. Data that is greater than 5 years of age when use support assessment is done (denoted by RES in approach column).
2. Biological data collected within 5 years of use support assessment, but no problem pollutant has been identified (available chemical data show full use support – denoted by PPI in approach column).
3. Freshwater biological criteria applied to swamp waters (denoted by SWMP in approach column).

In general, waters given this priority based on recent biological data will be sampled prior to waters listed based on older information. All waters with this priority will be resampled as resources allow. Waters with a monitor priority will not have a management strategy or TMDL developed for it before updated sampling or analyses of the biological criteria is complete. Once updated sampling is done and problem pollutants have been identified, these waters will be addressed by either a management strategy or TMDL within two basin planning cycles (10 years).

North Carolina's 303(d) List: Streams

Name of Stream	Description	Class	Index #	Subbasin	Miles	Problem parameter(s)	Overall rating	Potential Sources	Approach	List Priority	TMDL Status
Tar Pamlico											
Fishing Creek	From source to SR1649	C NSW	28-11a	30301	2	Biologically impaired	NR		PPI	Monitor	
Fishing Creek	From SR1649 to Oxford WWTP	C NSW	28-11b	30301	0.4	Biologically impaired	NR		PPI	Monitor	
Fishing Creek	From Oxford WWTP to SR 1608	C NSW	28-11c	30301	0.9	Biologically impaired	NS	200, 4000	PPI	Monitor	
Fishing Creek	From SR1608 to Coon Creek	C NSW	28-11d	30301	1.04	Biologically impaired	NS	200, 4000	PPI	Monitor	
Fishing Creek	From Coon Creek to Tar River	C NSW	28-11e	30301	6.1	Biologically impaired	PS	4000	PPI	Monitor	
Stony Creek	From source to Tar River	C NSW	28-68	30302	23.2	Biologically impaired	PS	9000	PPI	Monitor	
Sandy Creek	From dam at Southerlands Pond to NC Hwy 401	B NSW	28-78-1-(8)a	30302	3.8	Biologically impaired	PS		PPI	Monitor	
Sandy Creek	From Hwy 401 to NC Hwy 561	B NSW	28-78-1-(8)b	30302	12.2	Biologically impaired	PS		PPI	Monitor	
Whiteoak Swamp	From 1.8 mi upstream of SR 1428 Edgecombe, to Swift Creek	WS-IV NSW	28-78-7-(2)	30302	2.7	Biologically impaired	S	1000	PPI	Monitor	
Briery Branch	From source to Bynums Mill Run	C NSW	28-83-4-1-1	30303	0.6	Biologically impaired	ST	200	SWMP	Monitor	
Conetoe Creek	Source to SR 1404 Pitt Co	C NSW	28-87-(0.5)	30303	15.3	Biologically impaired	PS	1100, 7100, 200	PPI	Monitor	
Chicod Creek	From source to Tar River	C NSW	28-101	30305	13	DO ,fecal Biologically impaired	PS	1000	TMDL	Low	
Kennedy Creek	From source to Tar River	C NSW	28-104	30307	0.8	Biologically impaired	PS	225	PPI	Monitor	

Name of Stream	Description	Class	Index #	Subbasin	Miles	Problem parameter(s)	Overall rating	Potential Sources	Approach	List Priority	TMDL Status
Jack Creek	From source to a point three-fourths above mouth	C NSW	29-12-4-(1)	30307	1.1	Biologically impaired	NR		SWMP	Monitor	
Whitehurst Creek	From source to SR 1937	C Sw NSW	29-28-7-(1)a	30307	0.4	Biologically impaired	NS		SWMP	Monitor	
Whitehurst Creek	From SR 1937 to NC Hwy 306	C Sw NSW	29-28-7-(1)b	30307	2	Biologically impaired	NS		SWMP	Monitor	
Chocowinity Creek and connecting canals	From source to N.C. Hwy. 33	C Sw NSW	29-6-2-1-(1)	30307	9.6	Biologically impaired	ST	4000	SWMP	Monitor	

Tar Pamlico

Total miles appearing in basin:	95.1	**Number of stream segments in basin:**	17

Source Key:

200	Municipal Point Sources
225	Municipal pretreatment (indirect dischargers)
1000	Agriculture
1100	Nonirrigated Crop Production
4000	Urban Runoff/Storm Sewers
7100	Channelization
9000	Source Unknown

Approach Key:

TMDL	Total Maximum Daily Load. Proper technical conditions exist to develop a TMDL for this waterbody/pollutant. Usual approach for nutrients, DO, and metals.
PPI	Problem Parameter Identification. Biologically impaired waters will be resampled for biological and chemical data to attempt to determine potential problem parameters.
SWMP	Swamp Waters. This water may not actually be impaired. Swamp waters previously evaluated using freshwater criteria will continue to be monitored and will be re-evaluated when swamp criteria are available.

Newsletter Information

SciTimes — Published three times per year. Memberships are $15.00 for individuals and $30.00 for families (other levels available also). Memberships include free admission to the museum, 10% discount to programs and the sales desk, and many other benefits.

Program/Site Features

The museum offers a variety of science and environmental programs and exhibits. Emphasis is placed: 1) on the unique features of eastern North Carolina, as in the Indians of the Tar River, the Living Marsh and Get The Lead Out exhibits, and the fossil program; and 2) on fun, hands-on science geared for the young child, as in the SciPlay Gallery. Other exhibits include the live animal collection, Thomas Alva Edison exhibit, NewsZone, Health Awareness room and traveling exhibits, which change approximately three times yearly.

Unique Site Features

The Museum is located in Sunset Park along the banks of the Tar River. The park offers playgrounds, ball fields, tennis courts, swimming pools, picnic areas and a merry-go-round and miniature train which operate daily in the summer.

largest pond, April through September. Feeders are used to keep them healthy, growing and concentrated in an area where fishermen have easy access to catch them. The other program makes rods and reels available for loan to people fishing at the park.

Unique Site Features

The park encompasses 324 acres of land and water with 1.2 miles of frontage on the Tar River. It includes over 250 acres of rich bottomland forest, over 20 acres of open grassland and 45 acres of small lakes. A new 900-square foot fishing pier is now open. Handicap accessible with low rails and a 12-car handicap parking area.

Rocky Mount Children's Museum
Rocky Mount, NC

Mission

The Museum provides an educational program for the young people of the community by collecting, preserving, interpreting and exhibiting significant objects and enriches their lives through the development of proper attitudes through creative outlets.

Contact Information

Rocky Mount Children's Museum
1610 Gay Street
Rocky Mount, NC 27804
Phone: (252) 972-1167
Fax: (252) 972-1535
World Wide Web Address: http://www.ci.rocky-mount.nc.us

Operator

City of Rocky Mount (support from nonprofit organizations)

Location

From US 64 Bypass, take the Falls Road exit. Go east on Falls Road to the stop light at the "T" intersection at River Drive into Falls Road. Take a right on River Drive and follow until River Drive intersects Taylor Street. Take a left on Taylor Street and follow until it intersects with Gay Street. Follow Gay Street until it terminates in the parking lot of the Children's Museum.

Visitor Information

Main target groups are children pre-kindergarten through 5th grade and teachers/educators, but the museum has exhibits and programs that appeal to all ages and educational levels.
Open Monday through Friday from 10:00 a.m. - 5:00 p.m.; Saturday from noon - 5:00 p.m.; Sunday from 2:00 p.m. - 5:00 p.m. Closed Thanksgiving, December 24-26 and New Year's Day. Other Holiday hours are from noon - 4:00 p.m.

Total Annual Visitation

45,000 (includes visitors and environmental education program participants)

River Park North - Walter L. Stasavich Science and Nature Center
Greenville, NC

Mission

Our goal is to provide visitors with educational information about the natural world around them. Our primary focus is local wildlife and environmental conditions. We also provide health education through "The Adventures in Health Children's Museum."

Contact Information

Carolyn Smith, Parks Program Assistant
River Park North - Walter L. Stasavich Science and Nature Center
Post Office Box 7207
Greenville, NC 27835
Phone: (252) 329-4562 or (252) 329-4561
Fax: (252) 329-5999
World Wide Web Address: http://www.healthy-kids.net

Operator

Greenville Recreation and Parks Department

Location

1000 Mumford Road; one mile east of Pitt/Greenville Airport

Visitor Information

Audience served: General public, school groups and other organized groups. Open March through October from 1:00 p.m. - 6:00 p.m.; November through February from 1:00 p.m. - 5:00 p.m. Open Tuesday through Sunday (closed Monday). The building is available mornings for school groups, tours and programs. Non-resident of Greenville: $.50; Greenville resident: $.25.

Total Annual Visitation

10,000 (includes visitors and environmental education program participants)

Program Participants:	142 groups, 4,638 total
Student Participants:	2843
Adult Program Participants:	562
Outreach Program Participants:	635

Program/Site Features

Recreational activities include: fishing, pedal boating, canoe outings, picnicking, hiking and bird watching. Two established groups offering programs and field trips include the Greenville-River Park North Bird Club (for adults) and the Junior Bird Club (for children). Exhibits include: the North American Mammal Exhibit, Animals of Africa, Shells are Everywhere, Animals after Dark, Waterfowl of the Atlantic Flyway, and Snakes and Turtles of Eastern North Carolina. Hands-on exhibits include: touch tank, touch table and quiz board. Other programs and activities include fishing clinics and contests, astronomy programs, night hikes, wildflower programs, Environmental Education programs and workshops. Hunter Education Certification and much more. Also located in the center is the Adventures in Health Children's Museum with hands-on action oriented exhibits designed for children. Exhibit subject areas include: first aid/safety, anatomy/physiology, fitness, stress, and human growth and development. A souvenir shop is available upon request for groups or individuals. Two joint programs with the NC Wildlife Resources Commission are: the Community Fishing Program where 800-1000 channel catfish are stocked in our

North Carolina Estuarium
Washington, NC

Mission

To interpret North Carolina's estuaries and coastal rivers, especially as exemplified by the Tar-Pamlico River and Pamlico Sound.

Contact Information

Randy Rouse, Exhibits Curator
North Carolina Estuarium
223 East Water Street
Washington, NC 27889
Phone: (252) 948-0000
Fax: (252) 948-4747
E-mail: estuary@washingtonnc.com
World Wide Web Address: http://www.estuarium.com

Operator

Partnership for the Sounds, Inc.

Location

From Highway 17 at the Tar-Pamlico River Bridge go east two blocks on Main Street, taking the first right turn onto Stewart Parkway. Follow the waterfront to the Estuarium at the east end of Stewart Parkway.

Visitor Information

Audience served: General public, school groups (K- university level) and other organized groups. Open fall, winter and spring: Tuesday through Saturday from 10:00 a.m. - 4:00 p.m.; Summer: Wednesday through Sunday from 10:00 a.m. - 4:00 p.m.; holidays may differ. Adults: $3.00; Students K-12: $2.00; Younger than 5 years: Free; Groups of 15+: $2.00 each.

Total Annual Visitation

24,000 (includes visitors and environmental education program participants)
Program Participants: 6,322

Newsletter Information

Soundwaves — Published quarterly. Free to officials and public. Call (252) 796-1000 for more information.

Program/Site Features

Special programs on estuarine ecology and animals; Estuarium located right on Pamlico River in downtown Washington.

Unique Site Features

Environmental artworks; 13-minute introductory film; historic artifacts; aquariums; touch tank; Aqualab boat trip available for small groups.

Contact Information

Medoc Mountain State Park
Post Office Box 400
Hollister, NC 27844
Phone: (252) 445-2280
Fax: (252) 445-4826
E-mail: medocmtn@coastalnet.com
World Wide Web Address: http://ils.unc.edu/parkproject/ncparks.html

Operator

North Carolina Department of Environment and Natural Resources, Division of Parks and Recreation

Location

Highway 48, SR 1002

Visitor Information

Audience served: General public, school groups and other organized groups. Open daily: November - February from 8:00 a.m. - 6:00 p.m.; March and October from 8:00 a.m. - 7:00 p.m.; April, May and September from 8:00 a.m. - 8:00 p.m.; June - August from 8:00 a.m. - 9:00 p.m.

Total Annual Visitation

47,000 (includes visitors and environmental education program participants)

Newsletter Information

The Steward — Published monthly. Contact: Public Information Office, North Carolina Division of Parks and Recreation, Post Office Box 27687, Raleigh, NC 27611-7687.

Program/Site Features

Programs at Medoc Mountain State Park are geared for different grade levels and include topics such as geology, animal adaptations, soil conservation and predator/prey relationships. Groups are also welcome to visit the park for self-guided expeditions. Facilities include restrooms, picnic areas, almost ten miles of trails, and family and group camping. The environmental education program for school groups centers around a curriculum packet called the Environmental Education Learning Experience (EELE). The EELE contains pre-visit, on-site and post-site activities that focus on the park's unique natural features and are correlated to North Carolina Department of Public Instruction objectives. Contact the park for more information about the park's EELE and other environmental education programs and activities for the general public.

Unique Site Features

Medoc Mountain State Park is a wonderful place to learn about geology. The land-forming influences on the Piedmont and the Coastal plain have both had an effect on the formation of the area as the park sits near the fall line.

Lake Mattamuskeet Lodge
Swan Quarter, NC

Mission

To stimulate, community-driven economic well-being within the Albemarle-Pamlico region through the promotion of responsible, nature-based tourism, environmental stewardship and education.

Contact Information

Lake Mattamuskeet Lodge
Route 1, Box N-2
Swan Quarter, NC 27885
Phone: (252) 926-1422
Fax: (252) 926-1743

Operator

Partnership for the Sounds, Inc.

Location

Lake Mattamuskeet National Wildlife Refuge, Hyde County, North Carolina

Visitor Information

Audience served: K-12, college and general public. Open Tuesday through Sunday 8:00 a.m. - 5:00 p.m. Evenings by reservation.

Newsletter Information

Sound Bites — Published quarterly. Contact Partnership for the Sounds, Post Office Box 55, Columbia, North Carolina 27925.

Program/Site Features

Research and education and programming focusing on migratory waterfowl and the Atlantic Flyway system.

Unique Site Features

121 step observation tower, North Carolina's largest freshwater lake, lodge on Historic Register, Field Station for Coastal Research (East Carolina University), Pump station and canal system from early 1900's effort to drain lake for farming.

Medoc Mountain State Park
Hollister, NC

Mission

The North Carolina state parks system exists for the enjoyment, education, health and inspiration of all our citizens and visitors. The mission of the state parks system is to conserve and protect representative examples of the natural beauty, ecological features and recreational resources of statewide significance; to provide outdoor recreation opportunities in a safe and healthy environment; and to provide environmental education opportunities that promote stewardship of the state's natural heritage.

Unique Site Features

Seven miles of trails, 3/4 mile trail through a hardwood swamp, swim beach, canoe trail, campground, picnic shelter and a 9,000-square foot Environmental Education Visitors Center.

Gull Rock Art and Nature Center
Engelhard, NC

Mission

To offer opportunities and discoveries in wetland culture, art and nature.

Contact Information

Joan Mullen, Owner/Coordinator
Gull Rock Art and Nature Center
3697 Gull Rock Road
Engelhard, NC 27824
Phone: (252) 925-4641
E-mail: joansmullen@hotmail.com

Operator

Private ownership

Location

Located near the end of Gull Rock Road, six miles east of the Mattamuskeet Lodge, turn off Great Ditch Road at Lake Landing at the camping sign. Follow the signs that read "Gull Rock" and "Camping." We are six miles off Hwy 264 and located next to the camping facility.

Visitor Information

Audience served: Pre-K through adult. Open Monday through Friday 9:00 a.m. - 5:00 p.m. Weekends by appointment. Admission free.

Total Annual Visitation

Newly opened

Program/Site Features

140 acres of wetland habitat located on the coast of Hyde County. Privately owned and allows for plant and wildflower collecting. Can coordinate workshops with current classroom studies SA: Animal Kingdoms, Astrology, etc., Birding, Night Hikes and Seasonal Owl Hootings, National Wildlife Federation Backyard Wildlife Habitat #21863. CATCH booklets and materials free.

Unique Site Features

The center's features include: art gallery, studio, museum and lab; fishing equipment, wooden boats are built and restored on site; nature trails and canals suitable for canoeing; campground with hot showers and RV hookups; primitive camping sites; professional outdoor educator/artist on staff; extreme remote area offers excellent star-gazing opportunities.

Goose Creek State Park Environmental Education and Visitors Center
Washington, NC

Mission

The Environmental Education Center at Goose Creek State Park exists for the enjoyment, inspiration and awareness of outdoor education opportunities. Its mission is to increase the awareness, knowledge and understanding of natural systems -- the interdependence of all living things and the impact of human activities; and to provide environmental education opportunities that promote stewardship of the state's natural heritage.

Contact Information

Goose Creek State Park Environmental Education and Visitors Center
2190 Camp Leach Road
Washington, NC 27889
Phone: (252) 923-2191 Fax: (252) 923-0052
E-mail: goosecreek@beaufortco.com
World Wide Web Address: http://ils.unc.edu/parkproject/ncparks.html

Operator

North Carolina Department of Environment and Natural Resources, Division of Parks and Recreation

Location

Eight miles east of Washington on 264, make a right onto Camp Leach Road, continue on this road until you see the park entrance on the right.

Visitor Information

Audience served: General public, teachers, students and adults. Open daily 8:00 a.m. - 6:00 p.m. Admission free.

Total Annual Visitation

100,000 (includes visitors and environmental education program participants)

Newsletter Information

The Steward — Published monthly. Contact: Public Information Office, North Carolina Division of Parks and Recreation, Post Office Box 27687, Raleigh, NC 27611-7687.

Program/Site Features

Goose Creek offers many environmental programming opportunities. The park offers many wetland programs and programs on the species found in the area. The park offers canoe tours and programming available as it is surrounded by creeks and the Pamlico River. Many scenic hikes are also available in the park. Trails venture through cypress swamps, freshwater marshes, brackish marshes, upland pine forests and river front views among the live oaks. The environmental education program for school groups centers around a curriculum packet called the Environmental Education Learning Experience (EELE). The EELE contains pre-visit, on-site and post-visit activities that focus on the park's unique natural features and are correlated to North Carolina Department of Public Instruction objectives. Contact the park for more information about the park's EELE and other environmental education programs and activities for the general public.

CONTACTS FOR FURTHER INFORMATION

Name	Internet E-Mail Address
Anne Taylor, Director	anne_taylor@mail.enr.state.nc.us
Judy Pope, Educational Program Manager *Project Tomorrow Grants, Curriculum Correlation*	judy_pope@mail.enr.state.nc.us
Denis DuBay, Information Resource Manager *GIS, Clearinghouse, Pre-Service*	denis_dubay@mail.enr.state.nc.us
Lisa Tolley, River Basin Adult Education *River Basins, Adult Education*	lisa_tolley@mail.enr.state.nc.us
Linda Rhoads, Business/Industry Program Manager *Partnerships, Love A Tree Program*	linda_rhoads@mail.enr.state.nc.us
Betty Blades, River Basin Adult Education *River Basins, Adult Education*	betty_blades@mail.enr.state.nc.us
Lin Frye, Certification Program Manager *NC EE Certification Program, EE Garden*	lin_frye@mail.enr.state.nc.us
Sharon Springs, Administrative Assistant	sharon_springs@mail.enr.state.nc.us
Linda Riddle, Budget Manager	linda_riddle@mail.enr.state.nc.us
Milli Hayman, Project Tomorrow Associate	milli_hayman@mail.enr.state.nc.us
Fiona Clem, Department Librarian	fiona_clem@mail.enr.state.nc.us

June 1999

Neuse River Basin Supplement to the Teachers' Guide to Environmental Education

Intended as a supplement to the Teachers' Guide listed above, this booklet provides program, audience, location, schedule and contact information for over 52 resources specifically addressing water quality and water basin issues and available in the Neuse River basin region. Resource sponsors include state and local governments, environmental education centers and private organizations.

Guide to Environmental Education Centers in North Carolina

The Guide provides program information, site features, directions, contact information, state location map and a matrix of 26 services for over 120 environmental education centers across North Carolina. Centers are listed alphabetically and by county.

Environmental Education Correlation

Available on computer diskette or by downloading from the Internet's World Wide Web, this database correlates activities in the teacher manuals of Project Learning Tree, Project WILD, Aquatic WILD, Project Estuary, Sound Ideas, and eight State Park Environmental Education Learning Experiences (EELEs) with the Standard Course of Study objectives for Science, Social Studies, Mathematics and English Language Arts. Request DOS or Mac format for grades K-5, 6-8 or 9-12. The Macintosh version is a stand-alone database program, but the DOS version requires Microsoft Works software to access the database.

Environmental Education Certification Program

This program recognizes any educator who completes a specified number of requirements in environmental education skill areas. Certification requires completion of environmental education workshops, other experiences and demonstration of teaching skills. A brochure and complete application package as well as eligibility criteria for workshop sponsors is available. A $25 filing fee is required when submitting an application.

Project Tomorrow Grants

The Project Tomorrow Model Environmental Education Library program provides financial and other support to develop and enhance model environmental education library collections, field trips to environmental education centers, materials for hands-on learning activities that promote problem solving, critical thinking, and the integration of environmental education in the teaching of North Carolina's competency-based curriculum. Grant time lines and application materials as well as a suggested bibliography are available upon request.

Discover Your Ecological Address

Features a brochure describing several components of your ecological address, including river basin and airshed, also includes suggested activities and resources to use in learning more about your place in North Carolina's ecosystems. A colorful Ecological Address poster with a 4" X 7" map of North Carolina's river basins is available. A large format 40" X 19" full-color map of North Carolina's River Basins, suitable for mounting, is currently out of print, but upon reprinting, will be available one per school library or media center. Others may purchase this map for $5.

Citizen's Guide to Neuse River Basin Environmental Education Programs and Resources

Developed in response to a mandate from the Senate Select Committee on River Water Quality and Fish Kills, the Citizen's Guide identifies 150 environmental education programs and resources of the Neuse River Basin. It includes a color map of the Neuse River Basin, sections on "Your Ecological Address" and "What You Can Do", and is indexed by program, organization, audience, program type and counties served.

Office of Environmental Education

North Carolina Department of Environment and Natural Resources
PO Box 27687, Raleigh, North Carolina 27611-7687
(919) 733-0711 or (800) 482-8724, Fax: (919) 733-1616
Internet Electronic Mail - *ncee@mail.enr.state.nc.us*
World Wide Web URL - http://www.enr.state.nc.us/ENR/ee

Environmental education is an active process that increases awareness, knowledge and skills that result in understanding, commitment, informed decisions and constructive action to ensure stewardship of all interdependent parts of the earth's environment.

- Definition from the North Carolina Environmental Education Plan

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The Office of Environmental Education serves a coordinating role among schools, colleges, state and federal agencies, citizens groups and the business/industrial community in promoting environmental education and natural resource stewardship. As a guardian of the North Carolina Environmental Education Plan, the Office looks to that plan's fourteen objectives to guide its efforts. The following items describe the coordination activities of the Office and provide contact information needed to get more information about specific activities.

These resources are available free upon request:

North Carolina Environmental Education Clearinghouse

Many of the documents described here are available in an interactive electronic format on the World Wide Web via the NC Environmental Education Clearinghouse home page. The URL is http://www.enr.state.nc.us/ENR/ee/. Point your web browser to that address and take a look. While browsing you may send us a message, respond to a question, post your review of an EE resource, and download the curriculum correlation guide. If you'd like to get more out of your e-mail box you can subscribe to the NC Environmental Education electronic mail list and receive updates as well as participate in discussions over the Internet. We also distribute via the US Mail, as well as over e-mail, monthly News Tips to newsletter editors for use in organization newsletters or bulletins.

The North Carolina Environmental Education Plan

The North Carolina Environmental Education Plan is the culmination of 18 months of public input from 1,300 people. Developed in response to the Environmental Education Act of 1993, each objective of the Plan was formulated from the ideas and experiences of educators, citizens and representatives of business, industry and government agencies. Implementation of many objectives is already underway and strategies for the remainder are being formulated.

Teacher's Guide to Environmental Education Programs and Resources

K-12 programs and resources of the North Carolina Zoo, Aquariums, Forests, Parks, Museum of Natural Sciences, Wildlife Resources Commission and many others are catalogued for easy reference. The guide is organized into four main categories: Environmental Education Programs and Activities That Come To You, Environmental Education Field Trips and Site Visits, Educational Opportunities For Teachers, and Environmental Education Support Materials.

Appendix V

Environmental Education Resources in the Tar-Pamlico Basin

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.

	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*).
TMDL	Total maximum daily load. The amount of a given pollutant that a waterbody can assimilate and maintain its uses.
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 testing. The aggregate toxic effect of a wastewater measured directly by an aquatic toxicity test.

river basin	The watershed of a major river system. North Carolina is divided into 17 major river basins. These include the 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.
ST	Fully supporting but threatened. A rating given to a waterbody that fully supports it designated uses, but has notable water quality problems.
sedimentation	The sinking and deposition of waterborne particles (e.g., sediment, algae and dead organisms).
silviculture	Care and cultivation of forest trees; forestry.
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.
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.
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

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.
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.
phytoplankton	Aquatic microscopic plant life, such as algae, that are common in ponds, lakes, rivers and estuaries.
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.

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.
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.
mg/l	Milligrams per liter (approximately 0.00013 oz/gal).
MGD	Million Gallons Per Day.
NCIBI	North Carolina Index of Biotic Integrity. A measure of water quality factors affecting the 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.

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.
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.

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.
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.
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 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).
degradation	The lowering of the physical, chemical or biological quality of a waterbody caused by pollution or other sources of stress.
drainage area	An alternate name for a watershed.
DO	Dissolved oxygen.
DENR	Department of Environment and Natural Resources.
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.
effluent	The treated liquid discharged from a wastewater treatment plant.
EMC	Environmental Management Commission.
EPA	United States Environmental Protection Agency.

Glossary

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.
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.
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.
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.

Appendix IV

Glossary of Terms and Acronyms

Water Resources			
NC Division of Water Resources:			
Management of water quantity and flow. The Division includes three sections: Planning, Water Supply and Hydrology. Its responsibilities include, but are not limited to, administering the state's public water supply plan and Stream Watch Program; establishing minimum instream flows below and releases from impoundments; regulating interbasin transfers; and establishing and managing capacity use areas such as exists around the PCS Phophate plant.			
Central Office	John Sutherland	919-733-4064	412 North Salisbury Street, Raleigh, NC 27605
US Geologic Survey:			
The US Geological Survey is the Nation's largest earth-science agency and has the principal responsibility within the Federal government for providing hydrologic information and for appraising the Nation's water resources. The USGS, in cooperation with other state and federal agencies collects continuous streamflow records at about 170 sites across the state. Intermittent measurements of streamflow are made in support of the state's water quality management program at about 70 sites. The USGS collects water quality records at more than 60 stream and lake sites and water level information from more than 80 observation wells. These data are required for daily and long-term management of the state's water resources; for determining the extent and severity of droughts; for characterizing and predicting conditions during floods; and for monitoring and interpreting the effects of human activities on streamflow and water quality. For online access to water quality, flow data, publications and more, contact the NC office at the following web address: *http://nc.water.usgs.gov/*			
USGS - NC Office	NC Information Officer	919-571-4021	3916 Sunset Road, Raleigh, NC 27607

* **DENR Raleigh Region** covers the following counties within the Tar-Pamlico basin: Edgecombe, Franklin, Granville, Halifax, Nash, Person, Vance, Warren and Wilson.

* **DENR Washington Region** covers the following counties within the Tar-Pamlico basin: Beaufort, Hyde, Martin, Pamlico, Pitt and Washington.

Water Quality continued

NC Division of Air Quality:

Management of air quality in a way that protects human health and the environment. The division regulates sources of air pollution, monitors air quality, conducts public awareness campaigns and develops rules to protect air quality such as those involving air quality and hog lagoons.

Central Office	Bill Kure	919-733-3340	2728 Capital Boulevard, Raleigh, NC 27604

Solid Waste

NC 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
Raleigh Region*	Ben Barnes	919-571-4700	3800 Barrett Drive, Raleigh, NC 27609
Washington Region*	Billy Morris	252-946-6481	943 Washington Square Mall, Washington, 27889

On-Site Wastewater Treatment

NC 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	919-715-0141	2728 Capital Boulevard, Raleigh, NC 27604
Beaufort	Al Gerard, Jr.	252-946-6048	PO Box 579, Washington, 27889
Edgecombe	Clancie Pullen	252-641-7535	2909 North Main St., Tarboro, 27886
Franklin	Al Peoples	919-496-8100	107 Industrial Drive, Suite C, Louisburg, 27549
Granville	Bobby E. Greene	919-693-2141	PO Box 367, Oxford, 27565
Halifax	Jeffrey Dillard	252-583-6651	PO Box 10, Halifax, 27839
Hyde	Hubert Watson, III	252-926-3561	PO Box 100, Swan Quarter, 27885
Martin	Robert Martin	252-792-7811	210 West Liberty St., Williamston, 27892
Nash	Bennie Hicks	252-459-9829	PO Box 849, Nashville, 27856
Pamlico	David Stein	252-745-5634	PO Box 306, Bayboro, 28515
Person	Harold Brian Phillips	336-597-2371	325 South Morgan St., Roxboro, 27573
Pitt	Paul Andrews	252-413-1253	1717 West 5th St., Greenville, 27834
Vance	Mitchell T. Arnold	252-492-7915	115 Emergency Road., Henderson, 27536
Warren	Paul E. Gower	252-257-1538	201 East Macon St., Warrenton, 27589
Washington	SEE MARTIN LISTING		
Wilson	Milburn Ray Hudnell	252-291-0468	1801 Glendale Avenue., Wilson, 27893

Water Quality / Wetlands / Wildlife

NC Division of Water Quality - Water Quality Section:

Coordinate the numerous nonpoint source programs carried out by many agencies; coordinate the Tar-Pamlico and Neuse River Nutrient Sensitive Waters Strategies; administer the Section 319 grants program statewide; conduct stormwater permitting; model water quality; conduct water quality monitoring; perform wetlands permitting; conduct animal operation permitting and enforcement; and conduct water quality classifications and standards activities.

NPS Planning	Rich Gannon	919-733-5083 x356	PO Box 29535, Raleigh NC 27626
Urban Stormwater	Bradley Bennett	919-733-5083 x525	PO Box 29535, Raleigh NC 27626
Modelling	Ruth Swanek	919-733-5083 x503	PO Box 29535, Raleigh NC 27626
Monitoring	Jimmie Overton	919-733-9960 x204	4405 Reedy Creek Rd, Raleigh, NC 27609
Wetlands	John Dorney	919-733-1786	4405 Reedy Creek Rd, Raleigh, NC 27609
Animal Operations	Dennis Ramsey	919-733-5083 x528	PO Box 29535, Raleigh NC 27626
Classific'ns/Standards	Boyd DeVane	919-733-5083 x559	PO Box 29535, Raleigh NC 27626

NC Division of Water Quality - 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.

Raleigh Region*	Ken Schuster	919-571-4700	3800 Barrett Drive, Raleigh, NC 27609
Washington Region*	Jim Mulligan	252-946-6481	943 Washington Square Mall, Washington, 27889

NC 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
Tar-Pamlico Basin	Wayne Jones	919-459-3536	5044 Sapony Creek Drive, Nashville, NC 27856

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.

Wilmington District	W.C. Long, II	910-251-4745	PO Box 1890, Wilmington, NC 28402-1890
Washington Field Off.	David Lekson	252-975-1616	Washington, NC 27889

NC Division of Water Quality - Groundwater Section:

Groundwater classifications and standards; enforcement of groundwater quality protection standards and cleanup requirements; review of permits for wastes discharged to groundwater; issuance of well construction permits; underground injection control; administration of the underground storage tank (UST) program (including the UST Trust Funds); well head protection program development; and ambient groundwater monitoring.

Central Office	Carl Bailey	919-733-3221	PO Box 29578, Raleigh, NC 27626-0578
Raleigh Region*	J. Zimmerman	919-571-4700	3800 Barrett Drive, Raleigh, NC 27609
Washington Region*	W. Hardison	252-946-6481	943 Washington Square Mall, Washington, 27889

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
Beaufort	Ann Darkow	252-946-0111	111 West 2nd St., PO Box 1967, Washington, 27889
Edgecombe	James Pearce	252-641-7815	201 Saint Andrews St, PO Box 129, Tarboro, 27886
Franklin	Cedric Jones	919-496-3344	103 South Bickett Blvd, Louisburg, 27549
Granville	Johnsie Cunningham	919-603-1350	PO Box 926, Oxford, 27565
Halifax	Wanda Sykes	252-583-5161	359 Ferrell Lane, PO Box 39, Halifax, 27839
Hyde	Jean Ballance	252-926-3201	Courthouse Sq S., PO Box 219, Swan Quarter, 27885
Martin	Justus Coltrain, Jr.	252-792-1621	205 East Main St., PO Box 1148, Williamston, 27892
Nash	John Gibson, Jr.	252-459-9810	1006 Eastern Avenue, Room 102, Nashville, 27856
Pamlico	Fred May	252-745-4121	302 Main St., PO Box 8, Bayboro, 28515
Person	Derek Day	336-599-1195	304 South Morgan St., Room 123, Roxboro, 27573
Pitt	Mitchell Smith	252-757-2801	403 Government Circle, Greenville, 27834
Vance	Peter Hight	252-438-8188	305 Young St., PO Box 1028, Henderson, 27536
Warren	Philip McMillan	252-257-3640	PO Box 708, Warrenton, 27589
Washington	Richard Rhodes	252-793-2163	128 East Water St., PO Box 70, Plymouth, 27962
Wilson	Walter Earle	252-237-0111	1806 S. Goldsboro St., PO Box 3027, Wilson, 27895

Forestry

NC 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 4, 5, 11, 13	Roy Butler	252-442-1626	249 Airport Road, Rocky Mount, NC 27804
Central Office	Moreland Gueth	919-733-2162	PO Box 29581, Raleigh, NC 27626-0581

Construction/Mining

NC 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 St., Raleigh NC 27626
Raleigh Region*	John Holley	919-571-4700	3800 Barrett Drive, Raleigh, NC 27609
Washington Region*	Pat McClain	252-946-6481	943 Washington Square Mall, Washington, NC 27889

Local Erosion and Sedimentation Control Ordinances:

Several local governments in the basin have qualified to administer their own erosion and sedimentation control ordinances.

City of Greenville	Tom Tysinger	252-830-4480	PO Box 7207, Greenville, 27835-7207
City of Henderson	Frank Frazier	252-492-6111	PO Box 1434, Henderson, 27536
Pitt County	P.G. Dickerson	252-830-6354	1717 West 5th St., Greenville, 27834
City of Rocky Mount	Russell Byrd	252-972-1121	1 Gov't Plaza, PO Box 1180, Rocky Mount, 27802

Soil and 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	Board Chairman	Phone	Address
Beaufort	Dan Windley	252-322-5693	111 West 2nd St., Washington, 27889-4939
Edgecombe	L.G. Calhoun	252-442-7310	201 Saint Andrews St., PO Box 10, Tarboro, 27886
Franklin	Gene Mullen	919-496-5382	101 South Bickett Blvd, Suite B, Louisburg, 27549
Granville	Bobby Green	919-693-4907	146 Main St., Room 108, PO Box 10, Oxford, 27565
Halifax	Kenneth Brantley	252-537-2206	Co. Ag. Center, Hwy 301, PO Box 8, Halifax, 27839
Hyde	David O'Neal	252-926-5721	Co Courthouse, PO Box 264, Swan Quarter, 27885
Martin	Ricky Cannon	252-792-4350	222 East Main St., PO Box 483, Williamston, 27892
Nash	John Finch	252-459-9850	1006 Eastern Avenue, Room 107, Nashville, 27856
Pamlico	Reginald Caroon	252-745-4303	County Courthouse, PO Box 305, Bayboro, 28515
Person	Bruce Whitfield	336-599-0917	304 South Morgan St., Room 126, Roxboro, 27573
Pitt	Ralph Tucker	252-752-5595	403 Government Circle, Suite 4, Greenville, 27834
Vance	Bennie Harris, Jr.	252-492-4648	305 Young St., Room 1, Henderson, 27536
Warren	Avis Fleming	252-586-3635	133 South Main St., Warrenton, 27589
Washington	Mike Martin	252-797-7133	128 East Water St., Suite 202, Plymouth, 27962
Wilson	J.F. Scott	252-284-2540	1806 Goldsboro Street SW, Wilson, 27893

NC 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 and 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	Archdale Building, 512 North Salisbury St., Raleigh, 27626
Raleigh Region*	Steve Bennett	919-571-4700	3800 Barrett Drive, Suite 101, Raleigh, 27609
Washington Region*	George Stewart	919-946-6481	943 Washington Square Mall, Washington, 27889

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	Tom Ellis	919-733-7125	Box 27647, Raleigh, NC 27611
Rgn 2 (Beaufort, Hyde, Martin, Pamlico, Washington)	Roger Sugg	252-793-4118	Tidewater Research Station, 207 Research Station Road, Plymouth, 27962
Rgn 3 (Pitt)	Bob Edwards	252-523-2949	PO Box 801, Kinston, 28502
Rgn 6 (Edgecombe, Franklin, Halifax, Nash, Vance, Warren)	Charlie Tyson	252-443-4404	5091 South NC 58, Nashville, 27856
Rgn 7 (Wilson)	Kevin Johnson	919-736-1799	PO Box 1970, Pikeville, 27863
Rgn 8 (Granville, Person)	Robin Watson	336-570-6850	1709 Fairview St., Burlington, 27215

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	Thomas Wetmore	704-637-2400	530 West Innes St., Salisbury, NC 28144
Area 3 Conservationist	David Combs	252-734-0961	Federal Building, 134 North John St., Room 108, Goldsboro, NC 27530

County	Contact Person	Phone	Address
Beaufort	Rodney Woolard	252-946-4989	111 West 2nd St., Washington, 27889-4939
Edgecombe	A.B. Whitley, III	252-641-7900	201 Saint Andrews St., PO Box 10, Tarboro, 27886
Franklin	Kim York	919-496-3137	101 South Bickett Blvd, Suite B, Louisburg, 27549
Granville	Diana Lewis	919-693-4603	146 Main St., Room 108, Oxford, 27565
Halifax	Wayne Short	252-583-3481	Co. Ag. Center, Hwy 301, PO Box 8, Halifax, 27839
Hyde	Rodney Woolard	252-946-4989	111 West 2nd St., Washington, 27889-4939
Martin	Rupert Hasty, Jr.	252-792-4350	222 East Main St., PO Box 483, Williamston, 27892
Nash	Terry Best	252-459-4115	1006 Eastern Avenue, Room 107, Nashville, 27856
Pamlico	Andrew Metts	252-637-2547	County Courthouse, PO Box 305, Bayboro, 28515
Person	James Huey	336-597-2973	304 South Morgan St., Room 126, Roxboro, 27573
Pitt	Tim Etheridge	252-752-2720	403 Government Circle, Suite 4, Greenville, 27834
Vance	Tansel Hudson	252-438-5727	305 Young St., Room 1, Henderson, 27536
Warren	David Little	252-257-3836	133 South Main St., Warrenton, 27589
Washington	Rufus Croom	252-793-4561	128 East Water St., Suite 202, Plymouth, 27962
Wilson	Donald Pittman	252-237-2711	1806 Goldsboro Street SW, Wilson, 27893

Appendix III

Tar-Pamlico River Basin Nonpoint Source Program Description and Contacts

Tar Pamlico River Basin 303(d) List: Estuarine Areas

		Use Support (Acres)		Major Causes (Acres)				Major Sources (Acres)				
Area Name	DEH Area	Partially Supporting (PS)	Not Supporting (NS)	Fecal	DO	Chl-a	Metals	Point	Nonpoint	Source Descriptions	Approach	Priority
Goose Creek	G1	300		300					300		MS	Low
Pamlico River	G2	500		500					500		MS	Low
Swan Quarter	G3	867		867					867		MS	Low
Wysocking Bay	G4	255		255					255		MS	Low
Long Shoal	G5	2,054		2,054					2,054	Ag, septic tanks, marinas	MS	Low
Ocracoke	G6	135		135					135	Residential/Commercial Development.	MS	Low
Lower Pungo River	G8	714		714					714		MS	Low
Total Acres		4,825	0	4,825	0	0	0	0	4,825			
Percent		0.76%	0.00%	0.76%	0.00%	0.00%	0.00%	0.00%	0.76%			

Major Sources:
Fecal coliform only.

Approach:
MS - A management strategy will be developed for this waterbody/pollutant.
TMDL - A Total Maximum Daily Load will be developed for this waterbody/pollutant

Notes:
A portion of G1 may be reopened.

DEH recommends closing 40 additional acres of G6.

DEH recommends reopening 612 acres on Slade Creek and 102 acres on Jordan Creek in area G8.

Appendix VI

Atmospheric Emissions:

A. Atmospheric Stakeholder Team Report

B. Table of Atmospheric Nitrogen Emissions from Sources in the Tar-Pamlico Basin (NC Division of Air Quality)

A. Atmospheric Emissions Stakeholder Report

BACKGROUND

In September 1989, the EMC adopted the supplemental classification of Nutrient Sensitive Waters (NSW) for the Tar-Pamlico River basin. The EMC approved an initial strategy, later labeled Phase I, that would reduce excessive nutrient loading from point sources. In December 1994, the EMC adopted Phase II of the NSW strategy for the period 1995-2004, which established instream reduction goals for point and nonpoint sources of nutrients.

Point sources were addressed in Phase II through continuation of the point source/nonpoint source trading agreement established in Phase I with new nutrient loading caps for nitrogen and phosphorus. In each year of Phase II, the association of point source dischargers must make payments for any exceedences of its annual loading caps. These offset payments will be used for agricultural Best Management Practices that reduce nutrient loading to the basin.

In 1996 under Phase II, a plan was implemented to manage nonpoint sources using existing programs with annual progress reports to the EMC. After two years of implementing this "voluntary" approach, in May 1998, the EMC called for development of rules to achieve the nonpoint source reduction goals.

STAKEHOLDER PROCESS

To initiate rule making, DWQ staff began a stakeholder input process in September 1998 by convening a steering committee of stakeholders to identify potential rule subject areas. With input from the steering committee, staff formed stakeholder teams around seven subjects and held intensive meetings from November 1998 through February 1999.

The purpose of the stakeholder team meetings was to allow maximum up-front opportunity for input from all interests, to allow differing interests to attempt to find mutually acceptable solutions. Meetings were intended to provide a working environment for affected interests and staff to consider options and sort through technical details. Stakeholder teams had primary responsibility for developing draft rules for public hearing with review by the steering committee. The teams were designed to represent all interests. Meetings operated on a consensus basis and were managed by professional facilitators. The consensus-based format required active participation from all, and an atmosphere where disagreements were respected and participants attempted to revise or fashion criteria to meet all interests. DWQ staff's role was that of a stakeholder with equal authority to all other stakeholders.

DWQ staff believes that the stakeholder process has been of great benefit by providing a forum for working with all affected interests and discussing the issues facing them and for reaching better understanding of each other's constraints. The process has provided opportunity for creating mutually acceptable solutions. At the same time, the limited total time available to conduct the process made it very challenging, impacting all aspects of the stakeholder effort. Consensus seeking is by nature a time intensive process. It requires the fullest, most consistent representation possible. A more appropriate time span for such a process, as suggested by the

team facilitators, is on the order of a year. As a result of the teams' limited time frames, some issues went unresolved, and some were not discussed beyond the conceptual level.

RESULTS OF THE STAKEHOLDER TEAM MEETINGS

Stakeholder teams were convened on seven subjects. On an eighth subject, protection of existing riparian buffers, the steering committee agreed to accept the product of the legislatively established Neuse basin stakeholder advisory committee unless the steering committee found significant deficiencies with that product. The charge to all teams was to produce a draft rule or rules that provided for reduction of nitrogen loading from a given source to the Pamlico estuary of 30 percent from 1991 levels and that provided for holding phosphorous loads to the estuary constant at 1991 levels. If a team did not draft rules, it was asked to provide a rationale and any recommendations for other action.

The following report addresses these eight potential rule subject areas. In four areas, the teams agreed to forward draft rule language. These four areas are as follows:

1. Agriculture
2. Urban stormwater
3. Nutrient management
4. Riparian buffer protection

In the other four areas, the teams agreed to forward draft resolution language. These four areas are as follows:

5. Atmospheric emissions
6. On-site wastewater
7. Construction erosion and sedimentation control
8. Restoration

Recommendations from each of the teams have been included in Chapter 4 of Section A of this plan. Presented below is a more complete summary of the atmospheric stakeholder team's efforts. This summary contained a technical issues section on atmospheric ammonia emissions. Summaries of all of the stakeholder teams as well as draft rules language (and eventually the final rules language) can be obtained from the Division of Water Quality's Planning Branch ((919) 733-5083, ext. 360).

ATMOSPHERIC EMISSIONS STAKEHOLDER TEAM SUMMARY

A team met to evaluate the significance of nitrogen loading to the estuary from atmospheric emissions and to determine management needs and options for these emissions. The team held a total of five meetings.

PARTICIPANTS

Meetings were fairly well attended, averaging 13 people per meeting; total representation included four industry groups, several farmers, five state/federal agencies, several local agriculture offices, two environmental interests, an affected landowner and academia.

MAJOR ISSUES DISCUSSED

The team focused on ammonia emissions from animal operations. It did not address the other major input to atmospheric nitrogen, nitrogen oxide emissions from combustion sources, because federal regulations and the Division of Air Quality have traditionally handled that area. The team evaluated the following issues:

- Preliminary estimates of ammonia emissions and deposition.
- The status of the science of estimating ammonia emissions, transport, transformation and deposition.
- The status of ammonia emissions control technology.
- The feasibility of developing rules for control of ammonia emissions from confined animal operations.

TECHNICAL DETERMINATIONS

The Issue of Ammonia Emissions

The study of ammonia emissions and fate in North Carolina is currently in early stages. Estimates of ammonia emissions and deposition are not yet available for the basin; however, the Division of Air Quality (DAQ) has made preliminary estimates of emissions for the entire state. DAQ has estimated that ammonia emissions comprise about 42% of all nitrogen emissions in the state; nitrogen oxides from combustion sources comprise the other 58%. Of the state's ammonia emissions, animal operations comprise about 98.3%. The other 1.7% comes from point source gas emissions. DAQ currently lacks values for two other minor sources of ammonia gas emissions, wastewater treatment plants and human breathing. DAQ believes that these sources are very small, but it has only roughly characterized them to date. Estimates of ammonia emissions from animal operations relied on European data developed by Dutch researcher Battye et al. (1994), which are the best data currently available. DAQ staff adjusted these factors for the different animal numbers, animal husbandry and climatic conditions in North Carolina.

The Division of Water Quality staff has made preliminary estimates of atmospheric nitrogen deposition based on literature data. DWQ staff estimates that direct atmospheric deposition of nitrogen to open water in the Tar-Pamlico basin may comprise up to 42% of the controllable nonpoint source nitrogen load to the entire basin, including the estuary.

Many questions on ammonia emissions, deposition and fate in the US have not been adequately answered to allow well-informed management decisions. Researchers in North Carolina expect to have preliminary insights on some questions in the near future. However, long-term research will be needed to adequately answer most of them. Research in this country has only begun to measure emissions from animal operations and has not yet obtained measurements from some types of operations. It has not confirmed the relative magnitudes of different sources on a farm, such as houses, lagoons and sprayfields and has not begun to determine the relative magnitudes of the different types of animal operations. Research has not yet established the geographic area that contributes ammonia to the Tar-Pamlico basin. It has only begun to understand the transport and transformation of ammonia compounds and to quantify the behavior of each. Research has only begun in this country on the impacts of increased nitrogen deposition on terrestrial ecosystems and resulting changes to nitrogen loading to streams. The fate of ammonia that deposits on managed lands is not yet known. Technologies for measuring atmospheric ammonia emissions and deposition are similarly in early stages of development. Current methods are cumbersome, and deposition instruments as yet measure only certain components of ammonia deposition.

Progress in these areas will allow agencies to better understand the importance and urgency of the issue; to set geographic boundaries for regulation; to develop efficient, prioritized management strategies that are most easily applied and that are least burdensome.

While much about ammonia remains unknown, based on the information available to date, ammonia emissions from confined animal operations should be considered a significant issue, particularly in coastal Nutrient Sensitive Waters. Unlike many other air pollutants, all ammonia that is emitted returns to the land or water either as ammonia gas or as a particulate. Ammonia that deposits on water is immediately available for biological uptake. Ammonia that deposits on impervious surfaces is carried to receiving waters with rainfall. From 1991 to 1997, hog production in eastern North Carolina more than doubled, to almost 9 million animals. During the same period, broiler production increased 55%, and cattle production increased 34%. A significant portion of the nitrogen in these animals' waste is released as ammonia gas into the atmosphere. None of the regulations currently in place on animal operations in North Carolina require control of ammonia emissions.

Control of Ammonia Emissions

To date there has been very little research in NC on technologies that are geared specifically to minimizing the impacts of ammonia emissions from animal operations on the environment. Most ammonia control research

has been driven by human and animal health concerns within confinement houses. Current research that focuses on minimizing odors from animal operations has some potential application to ammonia.

Three major ammonia source areas can be identified on existing animal operations – confinement houses, waste storage and treatment areas such as lagoons and waste application lands. Scientists at North Carolina State University have identified a number of control technologies that can be applied in each of these areas for odor control, and many of these practices could be applied for ammonia control also. Little work has been done to develop many of these systems for use in production.

Economic Considerations of Controlling Ammonia Emissions

Proposals to control ammonia emissions from existing animal waste systems raise an important issue. Practices that retain ammonia in animal waste leave greater amounts of nitrogen to be disposed of in some other manner. Currently, animal operations are designed assuming the loss of a portion of waste nitrogen to the atmosphere. As ammonia-retaining BMPs are applied to existing animal waste management systems, operators will need significantly greater acreage for waste application, which entails additional expense. Alternative waste management systems can be used that convert ammonia to an inert gas, but these technologies also entail greater expense.

Livestock farmers operate in a very competitive market. Profit margins are small and highly variable through time. Producers in competitive markets have virtually no control over the prices they receive for their products. They seek to maximize profits by minimizing costs through increased efficiency and reduced waste. Costs of retrofitting existing farms differ from costs of installing systems on new farms in that producers must still amortize investments in existing manure treatment systems as well as pay the full costs of installing and operating the retrofits.

ACTIONS TAKEN

Funding provided by the General Assembly in 1996 for atmospheric ammonia research is largely exhausted, and DAQ's historical funding for such research was recently ended. In December 1998, team members Dr. Viney Aneja (NCSU-MEAS), Dr. Ron Sheffield (NCSU-ARS) and Dr. Bill Cure (DAQ) submitted research funding proposals to DENR for inclusion in the departmental expansion budget. They requested funding to continue collecting data on ammonia emissions, ambient levels and deposition; to continue modeling these data; and to develop on-farm demonstrations of BMPs to control emissions from different sources.

ISSUES ON WHICH CONSENSUS WAS NOT REACHED

Most of the team felt that it was premature to propose rules without better knowledge of atmospheric ammonia and of ammonia control technology. The team did not reach consensus on this issue. Several members felt that

the magnitude of the problem as estimated with currently available data suggests the need to take steps now. The team did agree that the need for rules should be periodically reexamined and linked to the annual NPS status report to the EMC.

STEERING COMMITTEE COMMENTS

The steering committee had the following suggestions to the team. The team's responses are provided below.

- The EMC would like to see rule recommendations. A similar message appears to be coming from EPA in its Neuse TMDL negotiations.
- The team should consider steps or incentives to foster implementation.
- The team should consider the lagoon phase-out committee's recommendations.
- A timetable is lacking.

A participant also commented that the river basin is likely not the most appropriate level at which to control ammonia emissions.

AMMONIA EMISSIONS TECHNICAL ADVISORY COMMITTEE

The team recommends that the EMC appoint an advisory committee, to be referred to as the Ammonia Emissions Technical Advisory Committee, to evaluate issues related to ammonia emissions. This committee should monitor advances in scientific understanding related to ammonia emissions from animal operations and should periodically examine the need for rule making to address this source with respect to nutrient loading of water resources. The committee should report its findings to the EMC on an annual basis, through the annual Tar-Pamlico basin NPS status report or independently. The annual report should describe, at minimum, the state of scientific understanding of emissions, transport, transformation, deposition and loading from animal operations, the state of development of control technologies, the implications for water quality, and the need for rules or other management action. If possible, the report should also comment on the geographic scope of such rules and their nature. The committee should include, at minimum, representatives from DWQ, NCSU, DAQ, one agricultural interest and one environmental interest.

RESPONSES TO THE STEERING COMMITTEE'S CONCERNS

The atmospheric emissions team chose not to meet in the brief remaining time to address the issues raised by the Steering Committee. In response to the comments, DAQ staff reiterated concerns they expressed in team meetings. They emphasized that all of their emissions measurements have been confined to one farm; that they have no data from different production settings and systems; that they lack a year-round characterization of farm sources and relative strengths; and that they have not begun to estimate relative effectiveness of different BMPs. They feel that rules or a timetable for them would be premature, since they should depend on funding for more data collection. On enabling cost share, DAQ staff pointed out that BMPs must pass some effectiveness review before the SWCC approves them for cost share and that such information does not yet exist. In addition, BMP recommendations should be well considered to avoid inter-media transfer of the problem.

The team requested that the EMC forward a resolution to the General Assembly.

B. Table of Atmospheric Emissions of Nitrogen from Sources Within the Tar-Pamlico Basin, 1996[8]

This table has been added based on comments received during the public review of the draft plan. It is not part of the stakeholder report summarized above in Section A of this appendix. This information was compiled by the NC Division of Air Quality upon request of the NC Division of Water Quality.

Source Type	NOx-N ($kg \times 10^3$)	NH_3-N ($kg \times 10^3$)	Percent of Total N Emissions
Point [1]	14,692		31.2
Area & Non-Road Mobile [1]	5,137		10.9
Mobile [1]	5,712		12.1
Biogenic (fertilizer denitrification) [1]	2,353		5.0
NOx Subtotal	**27.894**		**59.2**
Swine [2]		7,498	15.9
Cattle [2,3]		1,991	4.2
Broilers + Other Chickens [2,4]		1,200	2.5
Fertilizer Losses [2,5]		5,641	12.0
Point Sources (industry) [1,6]		2,862	6.1
NH_3 Subtotal[7]		**19,192**	**40.8**

Values compiled by NC Division of Air Quality, Planning Section:

[1] From USEPA National Emissions Trends annual air emissions inventory.

[2] Animal numbers from North Carolina Agricultural Statistics, NC Department of Agriculture and Consumer Services.
Emission factors applied to animal numbers are taken from:
Battye, R., W. Battye, C. Overcash and S. Fudge. 1994. *Development and Selection of Ammonia Emission Factors*. Final Report to the EPA. August, 1994.

[3] Number of cattle on farms January 1, 1997, by census.

[4] Number of broilers produced for period December 1, 1995 - November 30, 1996. Other chickens are number on farms December 1, 1996, by census.

[5] Estimated based on corn, wheat and cotton fertilization. Assumptions: corn = 110 lb/ac; wheat = 2.4 lb/bushel; cotton = 0.12 lb/lb lint, per 1999 NC Agricultural Chemicals Manual. Assumed all fertilizer in urea form, yielding a loss of 15% of applied fertilizer, the maximum case.

[6] Only two major point sources were identified in basin counties, summing to the value given: PCS Phosphate (Aurora) and Weyerhaeuser Corp (Plymouth).

[7] Two minor ammonia sources, WWTPs and human breathing emissions, together totaling <5.4 million kg statewide, have been omitted. These values are based on very limited data and are currently being reevaluated.

[8] A total of 19 counties have some area within Tar-Pamlico basin boundaries.

Appendix VII

NPDES Permitted Facilities in the Tar-Pamlico Basin

Permit	Facility	County	Region	City	Type	Ownership	Issued	Expires	D1	D2	D3	D4	D5	Flow	Subbasin	Stream
NC0042269	BUNN WWTP	FRANKLIN	Raleigh	BUNN	Minor	Municipal	2/28/95	1/31/00	1					0.15	03-03-01	CROOKED CREEK
NC0069311	FRANKLIN COUNTY WWTP	FRANKLIN	Raleigh	FRANKLINTON	Major	Municipal	8/23/95	1/31/00	1	55	2			0.5	03-03-01	CEDAR CREEK
NC0002852	FRANKLINTON WTP	FRANKLIN	Raleigh	FRANKLINTON	Minor	Non-Municipal	12/31/94	1/31/00	22	21				Not limited	03-03-01	TAYLORS CREEK
NC0043109	GRANVILLE CO BOE-WILTON ELEM	GRANVILLE	Raleigh	OXFORD	Minor	Non-Municipal	12/29/94	1/31/00	3					0.0053	03-03-01	UT TAR RIVER
NC0035521	HENDERSON HEAD START CENTER	VANCE	Raleigh	HENDERSON	Minor	Non-Municipal	12/30/94	1/31/00	3					0.0012	03-03-01	UT RUIN CRK
NC0047279	HERITAGE MEADOWS LONG TERM CARE	GRANVILLE	Raleigh	OXFORD	Minor	Non-Municipal	12/31/94	1/31/00	11					0.01	03-03-01	UT N. FORK TAR RVR
NC0029131	KITTRELL JOB CORP. CENTER	VANCE	Raleigh	KITTRELL	Minor	Non-Municipal	1/5/95	1/31/00	11					0.025	03-03-01	LONG CREEK
NC0068276	LAKE VANCE MOBILE HOME ESTATES	VANCE	Raleigh	DURHAM	Minor	Non-Municipal	4/3/95	1/31/00	8					0.048	03-03-01	RUIN CREEK
NC0058009	LAUREL HILLS HEALTH CARE	FRANKLIN	Raleigh	LOUISBURG	Minor	Non-Municipal	12/29/94	1/31/00	11	8				0.006	03-03-01	UT WOLFPEN BRANCH
NC0071871	LITTLE HUFF, INC/WOODY'S S & S	GRANVILLE	Raleigh	ROXBORO	Minor	Non-Municipal	12/30/94	1/31/00	66					Not limited	03-03-01	UT FISHING CREEK
NC0048631	LONG CREEK COURT LIMITED	VANCE	Raleigh	CHARLOTTE	Minor	Non-Municipal	2/28/95	1/31/00	11					0.007	03-03-01	LONG CREEK
NC0020231	LOUISBURG WWTP	FRANKLIN	Raleigh	LOUISBURG	Major	Municipal	3/1/95	1/31/00	1					1.37	03-03-01	TAR RIVER
NC0025054	OXFORD (RENOVATED WWTP)	GRANVILLE	Raleigh	OXFORD	Major	Municipal	4/20/95	1/31/00	1					2.17	03-03-01	FISHING CREEK
NC0068985	PINES MOBILE HOME PARK #2	FRANKLIN	Raleigh	HENDERSON	Minor	Non-Municipal	12/30/94	1/31/00	8					0.01	03-03-01	UT TAYLORS CREEK
NC0084905	RIVERIA UTIL-CHUCKWAGON DR	FRANKLIN	Raleigh	LOUISBURG	Minor	Non-Municipal	12/15/95	1/31/00	22					Not limited	03-03-01	LAKE SAGAMORE
NC0084891	RIVERIA UTIL-SHAWNEE DRIVE	FRANKLIN	Raleigh	LOUISBURG	Minor	Non-Municipal	12/15/95	1/31/00	22					Not limited	03-03-01	CYPRESS CREEK
NC0084883	RIVERIA UTIL-WOUNDED KNEE DR.	FRANKLIN	Raleigh	LOUISBURG	Minor	Non-Municipal	11/9/95	1/31/00	22					Not limited	03-03-01	UT LAKE ROYALE - CYPRESS CR
NC0042510	RIVIERA UTIL. OF NC, INC	FRANKLIN	Raleigh	LOUISBURG	Minor	Non-Municipal	12/27/94	1/31/00	5	8				0.08	03-03-01	CYPRESS CREEK
NC0001589	ABBOTT LABORATORIES	NASH	Raleigh	ROCKY MOUNT	Minor	Non-Municipal	12/29/94	1/31/00	14	16	17			Not limited	03-03-02	UT BEECH BRANCH
NC0085162	ABF FREIGHT SYSTEM, INC.	NASH	Raleigh	FORT SMITH	Minor	Non-Municipal	2/29/96	1/31/00	66					0.0216	03-03-02	UT TAR RIVER
NC0083038	BALL-FOSTER GLASS CONTAINER CO	VANCE	Raleigh	MUNCIE	Minor	Non-Municipal	6/30/95	1/31/00	15	64				0.05	03-03-02	UT MARTIN CREEK
NC0077437	COGENTRIX - ROCKY MOUNT	EDGECOMBE	Raleigh	BATTLEBORO	Minor	Non-Municipal	3/8/95	10/31/99	16	17	68	70		0.904	03-03-02	TAR RIVER
NC0050431	EDGECOMBE CO SCH-N. EDGECOMBE	EDGECOMBE	Raleigh	TARBORO	Minor	Non-Municipal	1/30/95	1/31/00	3					0.02	03-03-02	SWIFT CREEK
NC0050415	EDGECOMBE CO SCH-PHILLIPS	EDGECOMBE	Raleigh	TARBORO	Minor	Non-Municipal	12/29/94	1/31/00	3					0.01	03-03-02	MOCCASIN CREEK
NC0079227	INGERSOLL-RAND-SCHLAGE LOCK CO	NASH	Raleigh	SAN FRANCISCO	Minor	Non-Municipal	3/6/95	1/31/00	66					0.124	03-03-02	UT BEECH BRANCH
NC0084361	JORDAN OIL COMPANY OF NASHVILLE	NASH	Raleigh	NASHVILLE	Minor	Non-Municipal	3/29/95	1/31/00	66					0.0021	03-03-02	UT SAPONY CREEK
NC0046302	MAYODAN WTP	ROCKINGHAM	Winston-Salem	MAYODAN	Minor	Non-Municipal	12/23/96	1/31/02	21					Not limited	03-03-02	UT MAYO RIVER
NC0085251	NASH COUNTY (GWR)	NASH	Raleigh	NASHVILLE	Minor	Non-Municipal	4/26/96	1/31/00	66					0.0072	03-03-02	UT STONEY CREEK
NC0037885	NASH/ROCKY MT. SCHOOLS-S. NASH	NASH	Raleigh	NASHVILLE	Minor	Non-Municipal	12/27/94	1/31/00	3					0.015	03-03-02	TAR RIVER
NC0084697	PHILLIPS PETROLEUM CO	EDGECOMBE	Raleigh	BARTLESVILLE	Minor	Non-Municipal	8/7/95	1/31/00	66					Not limited	03-03-02	TAR RIVER
NC0072133	ROCKY MOUNT - SUNSET WTP	NASH	Raleigh	ROCKY MOUNT	Minor	Non-Municipal	12/29/94	1/31/00	21					Not limited	03-03-02	TAR RIVER
NC0072125	ROCKY MOUNT - TAR RIVER WTP	NASH	Raleigh	ROCKY MOUNT	Minor	Non-Municipal	12/29/94	1/31/00	21					Not limited	03-03-02	TAR RIVER
NC0030317	ROCKY MOUNT - TAR RIVER WWTP	EDGECOMBE	Raleigh	ROCKY MOUNT	Major	Municipal	2/28/95	1/31/00	1	55	57			21	03-03-02	TAR RIVER
NC0020061	SPRING HOPE WWTP	NASH	Raleigh	SPRING HOPE	Minor	Municipal	12/29/94	1/31/00	1	14				0.4	03-03-02	TAR RIVER
NC0061514	BETHEL WWTP	PITT	Washington	BETHEL	Minor	Municipal	8/25/95	2/28/00	1					0.75	03-03-03	CONETOE CREEK
NC0001503	CSX TRANSPORTATION	EDGECOMBE	Raleigh	JACKSONVILLE	Minor	Non-Municipal	3/8/95	2/29/00	73	37				0.1	03-03-03	UT LITTLE COKEY SWAMP
NC0050661	MACCLESFIELD WWTP	EDGECOMBE	Raleigh	MACCLESFIELD	Minor	Municipal	1/30/95	2/28/00	1					0.175	03-03-03	UT BYNUM MILL CRK
NC0020435	PINETOPS WWTP	EDGECOMBE	Raleigh	PINETOPS	Minor	Municipal	2/6/95	2/29/00	1					0.3	03-03-03	TOWN CREEK
NC0020605	TARBORO WWTP	EDGECOMBE	Raleigh	TARBORO	Major	Municipal	4/28/95	2/29/00	1	55				5	03-03-03	TAR RIVER
NC0084034	ENFIELD WTP	HALIFAX	Raleigh	ENFIELD	Minor	Non-Municipal	1/27/95	2/28/00	21					Not limited	03-03-04	UT FISHING CREEK
NC0025402	ENFIELD WWTP	HALIFAX	Raleigh	ENFIELD	Minor	Municipal	12/16/94	10/31/99	1	14				0.5	03-03-04	BEECH SWAMP
NC0038644	HALIFAX CO BOE-DAWSON ELEM.	HALIFAX	Raleigh	HALIFAX	Minor	Non-Municipal	4/28/95	8/15/00	3					0.0073	03-03-04	UT DEEP CREEK
NC0038580	HALIFAX CO BOE-EASTMAN MIDDLE	HALIFAX	Raleigh	HALIFAX	Minor	Non-Municipal	4/7/95	2/29/00	3					0.0048	03-03-04	UT LT FISHING CRK
NC0038610	HALIFAX CO BOE-PITTMAN ELEM.	HALIFAX	Raleigh	HALIFAX	Minor	Non-Municipal	2/6/95	2/29/00	3					0.096	03-03-04	UT BURNT COAT SWAMP
NC0025691	LITTLETON WWTP	HALIFAX	Raleigh	LITTLETON	Minor	Municipal	2/6/95	2/29/00	1					0.28	03-03-04	BUTTERWOOD CREEK
NC0037397	ROBBIES,INC. - TEXACO	HALIFAX	Raleigh	HALIFAX	Minor	Non-Municipal	2/20/95	2/29/00	2					0.0015	03-03-04	UT BEAVERDAM SWAMP
NC0023337	SCOTLAND NECK WWTP	HALIFAX	Raleigh	SCOTLAND NECK	Minor	Municipal	2/7/95	2/29/00	1					0.675	03-03-04	CANAL CREEK
NC0020834	WARRENTON WWTP	WARREN	Raleigh	WARRENTON	Major	Municipal	5/5/95	2/29/00	1	78				2	03-03-04	FISHING CREEK
NC0066583	BLOUNT PROPERTY	PITT	Washington	GREENVILLE	Minor	Non-Municipal	2/28/95	2/29/00	5					1	03-03-05	TAR RIVER
NC0001058	CATALYTICA PHARMACEUTICALS,INC	PITT	Washington	GREENVILLE	Minor	Non-Municipal	1/27/95	2/28/00	14	16				Not limited	03-03-05	PARKER CREEK
NC0082139	GREENVILLE UTIL COMM WTP	PITT	Washington	GREENVILLE	Minor	Non-Municipal	4/7/95	2/29/00	21					Not limited	03-03-05	TAR RIVER
NC0023931	GREENVILLE UTIL COMM WWTP	PITT	Washington	GREENVILLE	Major	Municipal	4/21/95	2/29/00	1	33	55	47	57	17.5	03-03-05	TAR RIVER
NC0051195	EKSTAM, GIBBS & ROEBUCK, LLC	MARTIN	Washington	ROBERSONVILLE	Minor	Non-Municipal	5/20/98	11/30/99	24	14	76			0.3	03-03-06	FLAT SWAMP
NC0086151	HAMILTON BEACH / PROCTOR-SILEX	BEAUFORT	Washington	GLEN ALLEN	Minor	Non-Municipal	11/24/97	11/30/99	66					0.02	03-03-06	UT CHERRY RUN
NC0037231	MARTIN CO SCH-BEAR GRASS ELEM	MARTIN	Washington	WILLIAMSTON	Minor	Non-Municipal	2/17/95	3/31/00	3					0.005	03-03-06	UT TURKEY SWAMP
NC0026042	ROBERSONVILLE WWTP	MARTIN	Washington	ROBERSONVILLE	Major	Municipal	3/8/95	3/31/00	1	23				1.8	03-03-06	FLAT SWAMP CRK

NC0004081	AURORA PACKING CO	BEAUFORT	Washington	AURORA	Minor	Non-Municipal	4/28/95	3/31/00	25					0.0012	03-03-07	UT SOUTH CREEK
NC0021521	AURORA WWTP	BEAUFORT	Washington	AURORA	Minor	Municipal	4/17/95	3/31/00	1	25	78			0.12	03-03-07	SOUTH CREEK
NC0036919	BEAUFORT CO SCH-BEAUFORT ELEM.	BEAUFORT	Washington	WASHINGTON	Minor	Non-Municipal	3/31/95	3/31/00	3					0.006	03-03-07	PANTEGO CREEK
NC0002925	BELHAVEN WTP	BEAUFORT	Washington	BELHAVEN	Minor	Non-Municipal	2/28/95	3/31/00	22					Not limited	03-03-07	UT PANTEGO CREEK
NC0026492	BELHAVEN WWTP	BEAUFORT	Washington	BELHAVEN	Minor	Municipal	7/13/98	3/31/00	1	25				0.5	03-03-07	BATTALINA CREEK
NC0000744	CAPTAIN CHARLIE'S, INC.	HYDE	Washington	ENGELHARD	Minor	Non-Municipal	3/29/95	3/31/00	25	30				Not limited	03-03-07	FAR CREEK
NC0004057	CAROLINA SEAFOOD	BEAUFORT	Washington	AURORA	Minor	Non-Municipal	2/24/95	3/31/00	25					Not limited	03-03-07	MUDDY CREEK
NC0083216	CHOCOWINITY WTP (1)	BEAUFORT	Washington	CHOCOWINITY	Minor	Non-Municipal	2/28/95	3/31/00	22					Not limited	03-03-07	UT MAPLE BRANCH
NC0083224	CHOCOWINITY WTP (2)	BEAUFORT	Washington	CHOCOWINITY	Minor	Non-Municipal	2/28/95	3/31/00	22					Not limited	03-03-07	UT MAPLE BRANCH
NC0039268	COASTAL WATER SYSTEMS, INC	BEAUFORT	Washington	WASHINGTON	Minor	Non-Municipal	2/28/95	3/31/00	22					Not limited	03-03-07	UT KENNEDY CREEK
NC0038296	CRYOTECH INDUSTRIES INC.	BEAUFORT	Washington	AURORA	Minor	Non-Municipal	4/28/95	3/31/00	25	30				Not limited	03-03-07	MUDDY CREEK
NC0084379	DARE COUNTY BOMBING RANGE	DARE	Washington	SEYMOUR JOHNSON	Minor	Non-Municipal	3/8/95	3/31/00	61					0.0003	03-03-07	UT LONG SHOAL RIVER
NC0069426	DOWRY CREEK COMMUNITY ASSOC.	BEAUFORT	Washington	BELHAVEN	Minor	Non-Municipal	3/4/99	3/31/00	5					0.05	03-03-07	PUNGO RIVER
NC0076571	GULLROCK SEAFOOD	HYDE	Washington	FAIRFIELD	Minor	Non-Municipal	2/28/95	3/31/00	25					0.005	03-03-07	UT GRAY DITCH
NC0077992	HYDE CO. WATER SYS/PONZER WTP	HYDE	Washington	SWAN QUARTER	Minor	Non-Municipal	4/28/95	3/31/00	22					0.108	03-03-07	UT PUNGO LAKE CANAL
NC0001627	NATIONAL SPINNING CO-WASHINGTO	BEAUFORT	Washington	WASHINGTON	Major	Non-Municipal	7/31/95	3/31/00	55	14	16	2		2.25	03-03-07	TAR RIVER
NC0003255	PCS PHOSPHATE COMPANY -AURORA	BEAUFORT	Washington	AURORA	Major	Non-Municipal	8/18/97	3/31/00	74	42	73			Not limited	03-03-07	UT PAMLICO RIVER
NC0084808	RICHLAND TOWNSHIP WTP	BEAUFORT	Washington	WASHINGTON	Minor	Non-Municipal	7/10/95	3/31/00	22					Not limited	03-03-07	SOUTH CREEK
NC0070211	ROSE BAY OYSTER COMPANY	HYDE	Washington	SWAN QUARTER	Minor	Non-Municipal	2/28/95	3/31/00	25	30				Not limited	03-03-07	ROSE BAY CREEK
NC0046647	SEA SAFARI, LTD.	BEAUFORT	Washington	BELHAVEN	Minor	Non-Municipal	2/14/95	3/31/00	25	30				0.088	03-03-07	PANTEGO CREEK
NC0040584	SPENCER'S REST HOME	BEAUFORT	Washington	PANTEGO	Minor	Non-Municipal	3/29/95	3/31/00	11					0.004	03-03-07	UT PANTEGO CREEK
NC0081191	WASHINGTON WTP	BEAUFORT	Washington	WASHINGTON	Minor	Non-Municipal	2/28/95	3/31/00	22					0.341	03-03-07	PAMLICO RIVER
NC0020648	WASHINGTON WWTP	BEAUFORT	Washington	WASHINGTON	Major	Municipal	4/7/95	3/31/00	1	21	25	27	50	2.12	03-03-07	KENNEDY CREEK
NC0085502	COX SERVICE CNTR/EASTERN FUEL	HYDE	Washington	AHOSKIE	Minor	Non-Municipal	6/14/96	7/31/01	66					0.0152	03-03-08	UT FAR CREEK
NC0068233	HYDE COUNTY WATER SYSTEM	HYDE	Washington	SWAN QUARTER	Minor	Non-Municipal	4/18/95	3/31/00	22					0.1	03-03-08	UT LAKE MATTAMUSKETT
NC0035751	MID-EAST REGIONAL HOUSING AUTH	HYDE	Washington	WASHINGTON	Minor	Non-Municipal	3/31/95	3/31/00	7					0.012	03-03-08	UT SWAN QUARTER BAY
NC0041530	OCRACOKE SAN. DIST.-HYDE WTP	HYDE	Washington	OCRACOKE	Minor	Non-Municipal		3/31/98	22					Not limited	03-03-08	PAMLICO SOUND

CODES FOR COLUMNS D1 THROUGH D5 IN NPDES LIST

1	Domestic - Municipal
2	Domestic - Industrial/Commercial
3	Domestic - Schools
4	Domestic - Single Family Residence
5	Domestic - Subdivisions
6	Domestic - Condominiums
7	Domestic - Apartments
8	Domestic - Mobile Home Parks
9	Domestic - Hospitals
10	Domestic - Restaurants
11	"Domestic - Institutions (colleges, academies, nursing homes, prisons, etc.)"
12	Domestic - Child Care facilities
13	"Domestic - Lodging (hotels, motels,, guest houses, campgrounds rest areas, etc.)"
14	Non-contact cooling water/condensate
15	Contact cooling water
16	Boiler Blowdown
17	Cooling Tower Blowdown
18	Pulp and Paper
19	Wood products
20	Wood treatment
21	Water plants (Surface water)
22	Water plants & Water conditioning (Groundwater)
23	Meat processing & rendering
24	Vegetable & Fruit processing
25	Seafood or Fish processing
26	Tobacco processing
27	Beverage production
28	Agricultural animal waste
29	Fish or Seafood farms
30	Seafood or Fish packing
31	Organic chemical manufacturing
32	Inorganic chemical manufacturing
33	Drug manufacturing
34	Pesticide & Herbicide production
35	Fertilizer production
36	Plastics & Synthetics manufacturing
37	Oil separator
38	Oil refinery
39	Oil terminal
40	Laundry waste
41	Mining and Material processing
42	Mine dewatering
43	Sand dredging
44	Gem mining
45	Swimming pool backwash
46	Peat mining
47	Battery manufacturing
48	Hydroelectric turbines
49	Paint & Ink formulation
50	Printing and Publishing
51	Photo Equipment & Supplies /Film Processing
52	Soap & Detergent manufacturing
53	Dairy product processing
54	Cement manufacturing
55	Textiles
56	Metal plating
57	Metal finishing
58	Metal forming
59	Electrical / Electronic components
60	Railway yards
61	Porcelin enameling
62	Porcelain enameling
63	Rubber processing
64	Glass manufacturing
65	Leather tanning & processing
66	Groundwater remediation
67	Non-Ferrous Metals manufacturing
68	Ash Ponds & Coal Piles
69	Metal Cleaning (Steam Electric plants
70	Low-Volume Wastes (Steam Electric plants)
71	Brick manufacturing wastewater ponds
72	Landfill leachate
73	Stormwater
74	Aquifer depressurization
75	Phosphate rock – Clay Pond wastewater
76	Bakeries & Confectionery products
77	Marine Fisheries Research station
78	Other wasteswater from Industrial & Commercial (Not otherwise listed)
79	Laboratory wastewater
80	Saltwater corrosion research
81	Food Preparation (Not classified elsewhere)
82	Contaminated soils
83	Truck washout (Concrete Plant)
84	Inorganic chemical processing
85	Organic chemical processing
86	Animal Shelters/Pounds/Hospital

Appendix VIII

Water Quality Data Collected by DWQ

- **Benthic Macroinvertebrate Collections**
- **Fish Community Assessments**

Appendix VIII Benthic macroinvertebrate Collections in the Tar River Basin, 1983-1997

Tar 01

Site	Site #	Index #	Date	S/EPT S	BI/BIEPT	Bioclass
Tar R, SR 1138, Granville	B-1	28-(1)	02/89	-/25	-/3.77	Good
Tar R, SR 1150, Granville	B-2	28-(1)	07/97	-/14	-/5.59	Good-Fair
			09/92	65/12	6.38/5.17	Fair
Tar R at Tar R, NC 96, Granville	B-3	28-(1)	07/97	69/24	5.74/4.94	Good
			07/92	78/19	5.95/5.58	Good-Fair
			07/89	86/20	6.15/5.49	Good-Fair
			07/86	59/7	6.27/5.91	Fair
			09/84	78/25	5.59/4.88	Good
Tar R, SR 1622, Granville	B-4	28-(1)	07/97	76/28	5.02/4.49	Excellent
			01/97	72/32	4.92/4.12	Good
			07/92	89/23	5.31/4.90	Good
Tar R nr Louisburg, SR 1229, Franklin	B-5	28-(1)	07/97	74/28	5.39/4.49	Good
Tar R at Louisburg, US 401, Franklin	B-6	28-(1)	09/92	74/27	5.66/4.70	Good
			07/86	73/24	6.24/5.07	Good-Fair
			07/83	58/17	6.35/5.01	Good-Fair
Tar R, SR 1609, Franklin	B-7	28-(1)	07/97	73/23	5.15/4.45	Good
Shelton Cr, NC 158, Granville	B-8	28-4	07/92	-/15	-/5.02	Good-Fair
North Fk Tar R, NC 158, Granville	B-9	28-5	07/97	-/17	-/5.32	Good-Fair
			07/92	-/8	-/6.25	Fair
Fishing Cr, SR 1649 ab WWTP, Granville	B-10	28-11	09/90	55/11	7.47/6.61	Fair
			06/89	27/0	-/8.96	Poor
Fishing Cr, be old WWTP, Granville	B-11	28-11	06/89	-/16	-/9.15	Poor
Fishing Cr, SR 1608, be new WWTP, Granville	B-12	28-11	09/90	54/3	7.95/7.59	Poor
Fishing Cr, SR 1643, Granville	B-13	28-11	07/97	61/18	5.58/5.12	Good
			07/92	79/18	6.00/5.30	Good-Fair
			09/90	-/11	-/5.62	Fair
Coon Cr, SR 1515, Granville	B-14	28-11-5	06/89	-/19	-/4.72	Good-Fair
Cedar Cr, SR 1116, ab WASA, Franklin	B-15	28-29-(2)	07/92	-/14	-/5.56	Good-Fair
			09/90	72/15	6.48/5.32	Good-Fair
Cedar Cr, ab WWTP, Franklin	B-16	28-29-(2)	10/94	47/10	6.31/4.43	Good-Fair
Cedar Cr, be WWTP, Franklin	B-17	28-29-(2)	10/94	54/15	5.90/3.88	Good-Fair
Cedar Cr, SR 1105, be WASA, Franklin	B-18	28-29-(2)	07/92	-/13	-/4.92	Good-Fair
			09/90	80/18	6.10/5.34	Good-Fair
Cedar Cr, SR 1109, Franklin	B-19	28-29-(2)	07/97	-/14	-/4.38	Good-Fair
Crooked Cr, NC 98, Franklin	B-20	28-30	07/97	-/12	-/5.30	Good-Fair
		07/92	-/16	-/5.06	Good-Fair	

Tar 02

Site	Site #	Index #	Date	S/EPT S	BI/BIEPT	Bioclass
Tar R, NC 581, Nash	B-1	28-(36)	05/86	79/22	5.04/3.97	Good-Fair
Tar R, US 64, Nash	B-2	28-(36)	09/92	-/19	-/4.42	Good-Fair
Tar R, SR 1001, Nash	B-3	28-(36)	02/89	-/15	-/5.24	Fair
Tar R, NC 97, Edgecombe	B-4	28-(67)	07/97	72/27	5.72/4.58	Good
			07/92	79/24	5.86/4.75	Good-Fair
			07/90	77/23	5.48/4.55	Good
			07/87	63/18	5.77/5.09	Good-Fair
			05/86	78/25	5.77/4.80	Good-Fair
			07/85	79/21	6.32/4.76	Good-Fair
			08/83	62/17	5.98/4.63	Good-Fair
Tar R, SR 1404, Edgecombe	B-5	28-(67)	03/88	66/15	5.91/4.93	Good-Fair
Tar R, NC 97, ab WWTP, Edgecombe	B-6	28-(67)	10/94	65/18	5.63/4.96	Good
Tar R, NC 97, be WWTP, Edgecombe	B-7	28-(67)	10/94	53/7	7.01/5.07	Fair
Tar R, SR 1243, be WWTP, Edgecombe	B-8	28-(67)	07/92	81/21	6.34/5.25	Good-Fair

Tar 02 cont'

Site	Site #	Index #	Date	S/EPT S	BI/BIEPT	Bioclass
Tar R, SR1252, Edgecombe	B-9	28-(67)	07/97	69/27	5.24/4.17	Good
			03/88	66/14	6.90/5.08	Fair
Stoney Cr, SR 1603, Nash	B-10	28-68	07/92	-/9	-/5.29	Fair
Swift Cr, SR 1310, Hilliardston, Nash	B-11	28-78	07/97	62/20	5.17/4.05	Good
			11/96	-/20	-/4.08	Good-Fair
			03/96	87/33	4.58/2.92	Excellent
			07/95	71/26	4.99/4.14	Excellent
			09/92	54/16	5.09/4.25	Good
			06/91	94/27	5.31/3.81	Excellent
			10/90	77/29	5.16/3.87	Excellent
			07/90	82/28	5.06/4.38	Excellent
			06/90	78/31	5.224.40	Excellent
			04/90	83/33	5.07/3.74	Excellent
			01/90	80/32	5.15/4.09	Excellent
			07/89	79/22	5.64/4.15	Good
			05/88	-/25	-/4.32	Excellent
			07/86	92/24	5.58/4.16	Good
			07/84	63/22	5.01/4.16	Excellent
Swift Cr, SR 1004, Nash	B-12	28-78	03/96	87/39	4.20/3.12	Excellent
Swift Cr, SR 1003, Nash	B-13	28-78	03/96	90/33	4.66/2.94	Excellent
			02/89	-/31	-/3.02	Excellent
Swift Cr, ab Wake Stone, Nash	B-14	28-78	03/96	67/28	4.54/3.49	Good
			06/91	85/26	5.19/3.99	Excellent
			06/90	68/27	5.03/4.21	Excellent
Swift Cr, 0.2 mi be Wake Stone, Nash	B-15	28-78	05/91	-/28	-/4.10	Excellent
			06/90	-/22	-/4.84	Good
Swift Cr, 0.5 mi be Wake Stone, Nash	B-16	28-78	06/91	93/28	5.38/3.88	Excellent
			06/90	65/24	5.55/4.69	Good
Swift Cr, I-95, Nash	B-17	28-78	07/95	69/23	4.66/3.67	Excellent
			05/91	-/23	-/4.01	Good
			06/90	-/23	-/4.83	Good
Swift Cr, SR 1253, Edgecombe	B-18	28-78	07/97	73/24	4.93/3.62	Excellent
			02/89	74/29	5.07/3.71	Excellent
Sandy Cr, US 401, Franklin	B-19	28-78-1-(1)	05/88	-/27	-/4.78	Good
Weaver Cr, SR 1533, Vance	B-20	28-78-1-7	03/95	71/23	5.74/4.88	Good-Fair
Sandy Cr, SR 1412, Franklin	B-21	28-78-1-(8)	07/97	-/11	-/4.67	Fair
Sandy Cr, SR 1436, Franklin	B-22	28-78-1-(8)	07/92	-/20	-/5.26	Good-Fair
Devils Cradle Cr, US 401, Granville	B-23	28-78-1-12-1	11/84	71/15	7.12/5.71	Fair
			06/84	80/12	7.11/6.01	Fair
			04/84	77/14	6.48/5.25	Fair
			01/84	60/13	6.42/5.96	Fair
White Oak Swp, SR 1428, Edgecombe	B-24	28-79-23	05/88	-/11	-/5.13	Fair

Tar 03

Site	Site #	Index #	Date	S/EPT S	BI/BIEPT	Bioclass
Tar R, US Bus 64, Tarboro, Edgecombe	B-1	28-(80)	08/97	80/29	5.23/4.34	Good
			07/92	82/30	5.71/4.59	Good
			07/90	71/30	5.34/4.52	Good
			07/88	84/24	5.56/4.62	Good
			07/87	82/24	5.80/4.79	Good-Fair
			07/86	92/27	6.06/4.93	Good
			05/86	93/28	6.04/4.85	Good-Fair
			07/85	73/23	5.78/5.07	Good
			07/83	78/27	5.88/4.69	Good-Fair
Town Cr, SR 1202 ab Pinetops, Edgecombe	B-2	28-83	05/92	76/14	6.74/5.73	Fair

Tar 03 cont'

Site	Site #	Index #	Date	S/EPT S	BI/BIEPT	Bioclass
Town Cr, SR 1200 be Pinetops, Edgecombe	B-3	28-83	05/92	64/17	6.37/5.37	Good-Fair
Cokey Swp, SR 1141, Edgecombe	B-4	28-83-3	04/89	36/3	7.89/4.10	Fair
Cokey Swp, SR 1601, Edgecombe	B-5	28-83-3	08/97	84/24	5.87/4.61	Good
			07/92	64/14	6.06/5.46	Good-Fair
Little Cokey Swp, at Branch Cr, Edgec.	B-6	28-83-3-1	04/89	26/0	7.67/-	Poor
Little Cokey Swp, SR 1614, Edgecombe	B-7	28-83-3-1	04/89	11/0	8.66/-	Poor
Little Cokey Swp, SR 1158 ab UT, Edge.	B-8	28-83-3-1	05/92	42/0	8.44/-	Poor
Little Cokey Swp, be UT, Edgecombe	B-9	28-83-3-1	05/92	46/1	8.15/6.22	Poor
Little Cokey Swp, SR 1141, Edgecombe	B-10	28-83-3-1	04/89	39/2	8.19/2.96	Fair
Bynums Mill Cr, SR 1200, Edgecombe	B-11	28-83-4	08/93	29/2	8.53/7.64	NR
			05/93	49/2	8.02/7.98	NR
			02/93	51/3	7.93/8.59	NR
			08/92	31/2	8.77/9.24	NR
			05/92	44/1	8.10/4.72	NR
			02/92	48/4	7.96/7.23	NR
Briery Br, NC 124, Edgecombe	B-12	28-83-4-1-1	09/90	51/3	7.47/5.70	Poor
Tar R, NC 42, Edgecombe	B-13	28-(84)	08/97	-/26	-/4.48	Excellent
			07/92	-/27	-/4.17	Excellent
Otter Cr, SR 1009, Edgecombe	B-14	28-86	02/92	83/15	6.91/5.66	Good
Otter Cr, SR 1614, Edgecombe	B-15	28-86	05/93	71/10	7.21/5.69	NR
			02/93	62/9	7.08/5.56	NR
			08/92	31/1	8.38/9.85	NR
			05/92	62/9	7.13/5.47	NR
			02/92	83/15	6.91/5.45	NR
UT Otter Cr, SR 1113, Edgecombe	B-16	28-86	09/90	51/1	7.70/6.22	Poor
Conetoe Cr, SR 1409 nr Bethel, Pitt	B-17	28-27	08/97	-/4	-/3.35	Fair
			07/92	51/7	6.75/5.58	Fair
			10/89	62/13	6.66/5.03	Fair
			07/89	62/8	6.93/5.33	Fair
			07/88	55/8	6.55/4.96	Fair
			07/85	44/7	6.27/5.27	Fair

Tar 04

Site	Site #	Index #	Date	S/EPT S	BI/BIEPT	Bioclass
Fishing Cr, ab Warrenton WWTP, Warren	B-1	28-79-(1)	07/92	-/10	-/4.67	Fair
Fishing Cr, SR 1600 be Warrenton, Warren	B-2	28-79-(1)	08/97	-/22	-/4.04	Good
			07/92	-/18	-/4.05	Good-Fair
Fishing Cr, US 301, nr Enfield, Edgecombe	B-3	28-79-21	08/97	85/23	5.68/4.14	Good
			07/92	93/27	5.60/4.31	Good
			07/88	75/21	6.02/4.65	Good-Fair
			07/85	89/27	5.49/4.41	Good
			07/83	72/28	5.62/4.55	Good
Shocco Cr, SR 1613, Warren	B-4	28-97-22	08/97	-/16	-/4.61	Good-Fair
			07/92	-/15	-/4.25	Good-Fair
Little Fishing Cr, SR 1338, Halifax	B-5	28-79-25-66	08/97	85/23	5.33/3.99	Good
			09/92	64/18	5.49/4.54	Good-Fair
			07/88	89/24	5.33/3.80	Good
Rocky Sw, SR 1002, Halifax	B-6	28-79-28-(0.7)	08/97	-/13	-/4.39	Good-Fair
Fishing Cr, SR 1429, Edgecombe	B-7	28-79-29	03/89	71/29	4.82/3.51	Good
Fishing Cr, SR 1500, Edgecombe	B-8	28-79-29	08/97	-/28	-/3.85	Excellent
			07/92	-/23	-/3.74	Good
Beech Sw, US 301, Halifax	B-9	28-79-30	05/92	34/3	8.68/7.09	NR
Beech Sw, SR 1001, Halifax	B-10	28-79-30	05/92	70/7	7.62/5.48	NR

Tar 05

Site	Site #	Index #	Date	S/EPT S	BI/BIEPT	Bioclass
Tar R, NC 222 ab Greenville, Pitt	B-1	28-(84)	11/85	75/22	5.64/4.83	Good-Fair
Tar R, SR 1533, Pitt	B-2	28-(94)	11/85	50/12	6.84/4.27	Fair
Tar R, Rainbow Banks, Pitt	B-3	28-(94)	11/85	51/9	7.19/4.33	Fair
Tar R, SR 1565 at Grimesland, Pitt	B-4	28-(94)	08/97	67/13	7.42/5.23	Excellent
			06/92	59/10	7.44/6.26	Good
			07/89	66/16	6.90/5.86	Excellent
			07/86	70/8	7.84/6.91	Good-Fair
			11/85	53/10	7.50/5.91	Good
			07/84	74/15	7.18/6.00	Excellent
Greens Mill Run, Arlington Rd, Pitt	B-5	28-96	05/95	44/1	7.66/6.22	Poor
Hardee Cr, SR 1310, Pitt	B-6	28-97	05/95	52/6	6.66/5.46	Fair
Grindle Cr, US 264, Pitt	B-7	28-100	08/97	67/13	6.68/5.54	Good-Fair
			07/92	-/10	-/5.25	Fair
Chicod Cr, SR 1760 nr Simpson, Pitt	B-8	28-101	07/97	39/2	7.63/7.14	NR
			03/97	51/7	7.11/5.88	Fair
			06/93	41/4	7.18/6.15	NR
			03/93	38/4	7.17/6.24	Fair
			07/92	55/4	7.23/6.54	Fair
			07/90	42/6	7.37/6.08	Fair
			07/87	51/2	8.32/7.62	Poor
Chicod Cr, SR 1777, Pitt	B-9	28-101	07/97	45/4	7.04/6.01	NR
			03/97	56/5	6.78/5.58	Fair
			06/93	31/4	6.65/6.11	NR
			03/93	35/4	7.00/5.31	Poor
Cow Swp, SR 1756, Pitt	B-10	28-101-5	07/97	30/3	8.14/6.85	NR
			03/97	54/4	6.68/5.86	Fair
			06/93	45/1	8.22/9.85	NR
			03/93	35/5	8.09/5.71	Poor
Juniper Br, SR 1766, Pitt	B-11	28-101-6	07/97	46/5	6.72/5.51	NR
			03/97	47/7	6.73/5.09	Fair
			06/93	44/2	7.42/6.41	NR
			03/93	44/8	6.57/5.62	Fair

Tar 06

Site	Site #	Index #	Date	S/EPT S	BI/BIEPT	Bioclass
Tranters Cr, SR 1403, Beaufort	B-1	28-103-(3)	06/97	52/7	7.97/4.90	Good-Fair
			07/89	51/8	7.88/6.62	Good-Fair
			07/86	36/3	8.39/6.80	Fair
			07/83	43/5	8.11/6.98	Fair

Tar 07

Freshwater Sites	Site #	Index #	Date	S/EPT S	BI/BIEPT	Bioclass
Horse Br, SR 1136, Pitt	B-21	29-6-2-1-6-2	03/97	62/6	7.30/6.83	Fair
			06/93	49/3	7.256.93	NR
Durham Cr, SR 1949 nr Edward, Beaufort	B-26	29-21-(1)	02/92	48/5	7.46/6.28	Fair
			07/87	38/3	7.53/5.84	Fair
Whitehurst Cr W-Pr, SR 1937, Beaufort	B-32	29-28-7-(1)	02/92	13/1	8.76/2.52	Poor
Whitehurst Cr S-Pr, SR 1937, Beaufort	B-33	29-28-7-(1)	02/92	18/2	8.77/4.37	Poor
Whitehurst Cr, SR 1941, Beaufort	B-34	29-28-7-(1)	02/92	30/2	8.58/3.49	Poor
Van Swamp, NC 32, Washington	B-36	29-34-2-3	02/92	30/5	6.84/4.85	Fair

Estuarine Sites	Site #	Index #	Date	S/A&C	BI/Points	Bioclass
Tar R nr marker 4, Beaufort	B-1	28-(94)	04/92	15/0		NR
Tar R ab Kennedy Cr, nr Nat Spin, Beauf.	B-2	28-(94)	04/92	17/1		NR
Tar R nr Washington, Beaufort	B-3	28-(94)	04/92	15/0		NR
Tar R ab US 17, Beaufort	B-4	28-(94)	04/92	16/1		NR
Kennedy Cr ab Nat Spinning outfall	B-5	28-104	06/97	40/2	7.60/5.40	NR
Kennedy Cr, at point, Beaufort	B-6	28-104	04/92	17/1		NR
Kennedy Cr, nr Washingon WWTP,Beauf.	B-7	28-104	04/92	10/1		NR
Kennedy Cr, be black water tank, Beaufort	B-8	28-104	04/92	10/1		NR
Runyon Cr, NC 32, Beaufort	B-9	29-3-(2)	06/97			NR
Pamlico R ab Texas Gulf, Beaufort	B-10	29-(5)	02/92	11/0		NR
Pamlico R at Texas Gulf, Beaufort	B-11	29-(5)	02/92	12/0		NR
Pamlco R nr Texas Gulf marina, Beaufort	B-12	29-(5)	03/92	11/0		NR
Pamlico R nr Bath Cr, Beaufort	B-13	29-(5)	03/92	15/0		NR
Pamlico R off PCS outfall, Beaufort	B-14	29-(5)	06/97	24/1	1.76/6	Mod Impact
Pamlico R nr Ferry, Beaufort	B-15	29-(5)	03/92	15/0		NR
Pamlico R nr marker 1, Beaufort	B-16	29-(5)	03/92	17/0		NR
Pamlico R at Long Point, Beaufort	B-17	29-(5)	06/97	16/0	2.31/9	Mod Impact
Pamlico R at Hickory Pt, Beaufort	B-18	29-(5)	06/92	40/0		NR
			07/89	26/0		NR
			07/87	23/0		NR
			07/85	21/0		NR
			07/83	22/0		NR
Chocowinity Bay, Beaufort	B-19	29-6-(1)	10/92	7/0		NR
			07/92	7/0		NR
			04/92	10/0		NR
			02/92	9/0		NR
Chocowinity Bay, Beaufort	B-20	29-6-(1)	06/97			NR
Blounts Cr nr mouth, Beaufort	B-22	29-9	06/97			NR
Broad Cr, nr marina, Beaufort	B-23	29-10-(3)	06/97	45/5	7.62/4.60	NR
Broad Cr, nr McCotters Marina, Beaufort	B-24	29-10-(3)	02/92	11/0		NR
Bath Cr, NC 92 nr Bath, Beaufort	B-25	29-19-(1)	06/97	34/0	2.15/9	Mod Impact
			06/92	33/0		NR
			06/83	31/0		NR
Durham Cr, nr mouth, Beaufort	B-27	29-21-(2)	06/97	27/0	2.33/11	Mod Impact
South Cr, be Aurora WWTP, Beaufort	B-28	29-28-(6.5)	03/92	16/0		NR
South Cr, nr marker 10, Beaufort	B-29	29-28-(6.5)	03/92	16/0		NR
South Cr, at Jacobs Cr, Beaufort	B-30	29-28-(6.5)	06/97	28/1	1.91/8	Mod Impact
South Cr, btw markers 14 &16, Beaufort	B-31	29-28-(6.5)	03/92	17/0		NR
Goose Cr nr house, Beaufort	B-35	29-33	06/97	22/0	2.67/11	Mod Impact
Pungo R, US 264 nr Ponzer, Beaufort	B-37	29-34-(12)	06/97	23/1	2.10/7	Mod Impact
			07/92	32/0		NR
			07/89	17/0		NR
			07/87	22/0		NR
			07/86	21/0		NR
			07/85	20/0		NR
			07/84	20/0		NR
			06/83	30/0		NR
			06/83	29/2		NR
Battalina Cr, be Belhaven WWTP	B-38	29-34-32	06/92	23/0		NR
Pantego Cr, NC 92 nr Belhaven, Beaufort	B-39	29-34-34-(2)	06/97	35/0	1.89/7	Mod Impact
			06/92	41/0		NR
			04/92	17/0		NR
			07/84	27/0		NR
			06/83	33/2		NR
Pantego Cr, ab Belhaven, Beaufort	B-40	29-34-34-(2)	04/92	17/0		NR
Pungo Cr, Beaufort	B-41	29-34-35	06/97	32/0	2.19/10	Mod Impact
Pungo R, Sandy Pt, Hyde	B-42	29-34-(38)	06/97	26/0	2.17/13	No Impact

TAR 08

Sites	Site #	Index #	Date	S/A&C	BI/Points	Bioclass
Pamlico R at Great Island, Hyde	B-1	29-(46.5)	06/97	43/9	2.04/13	No Impact
			09/93	39/6	2.72/13	No Impact
			06/92	49/1		NR
			07/85	21/4		NR
			07/84	23/6		NR
			07/83	23/5		NR
Caffee Bay, Hyde	B-2	29-49-5	09/93	42/4	2.19/13	No Impact
Long Shoals River, nr oyster lease, Hyde	B-3	29-73-(2)	06/97	55/10	1.81/13	No Impact

Appendix VIII Fish Community Assessments in the Tar River Basin, 1990-1997

Subbasin 030301

Stream	Road	County	Map #	Index #	D.A. (mi^2)	Date	NCIBI Score	NCIBI Class[1]
Shelton Cr	US 158	Granville	1	28-4	23.8	04/14/97	54	G
						04/07/92	50	G
N Fk Tar R	US 158	Granville	2	28-5	15.6	04/14/97	50	G
						04/07/92	44	G-F
Tar R	NC 96	Granville	3	28-(5.7)	167	09/09/97	56	E
						09/02/92	58	E
Fishing Cr	SR 1643	Granville	4	28-11	44.1	04/14/97	50	G
						04/07/92	44	G-F
Tar R	US 1	Franklin	5	28-(15.5)	328	09/09/97	54	G
						09/02/92	50	G
Tabbs Cr	SR 1100	Vance	6	28-17-(0.5)	70.8	04/15/97	52	G
						04/08/92	42	F
Lynch Cr	SR 1235	Franklin	7	28-21-(0.3)	23.9	04/15/97	52	G
						06/18/92	50	G
Cedar Cr	SR 1109	Franklin	8	28-29-(2)	40.2	04/16/97	48	G-F
						04/08/92	48	G-F
Crooked Cr	NC 98	Franklin	9	28-30	52.1	04/17/97	40	F

Subbasin 030302

Stream	Road	County	Map #	Index #	D.A. (mi^2)	Date	NCIBI Score	NCIBI Class[1]
Sapony Cr	SR 1145	Nash	1	28-55-(1)	12.6	04/02/97	38	F
Big Peachtree Cr	SR 1321	Nash	2	28-68-1	13.2	04/03/97	48	G-F
	SR 1310	Nash	3		19.2	02/04/93	44	F
Swift Cr	SR 1310	Nash	4	28-78-(0.5)	166	04/11/97	56	E
						06/19/96	54	G
						07/27/90	48	G-F
	SR 1003	Nash	5	28-78-(0.5)	183	06/19/96	56	E
Sandy Cr	SR 1412	Franklin	6	28-78-1-(1)	54.1	04/15/97	44	G-F

Subbasin 030303

Stream	Road	County	Map #	Index #	D.A. (mi^2)	Date	NCIBI Score	NCIBI Class[1]
Town Cr	NC 43	Edgecombe	1	28-83	92	08/28/97	44	G-F
						07/08/92	46	G-F
Cokey Swp	SR 1135	Edgecombe	2	28-83-3	14.2	04/02/97	50	G
Otter Cr	SR 1614	Edgecombe	3	28-86-(0.3)	20	04/02/97	40	F
						10/29/96	42	F
						07/08/92	48	G-F

Subbasin 030304

Stream	Road	County	Map #	Index #	D.A. (mi^2)	Date	NCIBI Score	NCIBI Class[1]
Fishing Cr	SR 1600	Warren	1	28-79-(1)	58.4	04/16/97	52	G
						02/04/93	54	G
Shocco Cr	SR 1613	Warren	2	28-79-22	25.3	04/16/97	46	G-F
						06/18/92	46	G-F
L Fishing Cr	SR 1509	Warren	3	28-79-25-1	28.5	04/16/97	50	G
						02/03/93	50	G
L Fishing Cr	SR 1338	Halifax	4	28-79-25-1	177	08/28/97	52	G
Rocky Swp	SR 1002	Halifax	5	28-79-28	19.5	04/03/97	44	G-F
						02/03/93	50	G-F
Beaverdam Swp	NC 561	Halifax	6	28-79-30-1-1	9.4	04/03/97	50	G

Appendix FC4. (continued).

Subbasin 030305

Stream	Road	County	Map #	Index #	D.A. (mi^2)	Date	NCIBI Score	NCIBI Class[1]
Hardee Cr	NC 33	Pitt	1	28-97	9.9	04/01/97	52	G
Grindle Cr	US 264	Pitt	2	28-100	71.8	04/01/97	48	G-F
						07/07/92	46	G-F
Chicod Cr	SR 1565	Pitt	3	28-101	11	04/15/93	40	F
	SR 1777	Pitt	4	28-101	24	05/06/93	46	G-F
						07/07/92	40	F
Juniper Swp	SR 1766	Pitt	5	28-101-1	7.5	04/15/93	40	F
Cow Swp	SR 1756	Pitt	6	28-101-5	17	04/15/93	40	F

Subbasin 030306

Stream	Road	County	Map #	Index #	D.A. (mi^2)	Date	NCIBI Score	NCIBI Class[1]
UT Turkey Swp	SR 1134	Martin	1	28-103-5-(0.3)	3.1	04/01/97	36	NR
Horsepen Swp	SR 1001	Beaufort	2	28-103-10	10	04/01/97	52	G

Subbasin 030307

Stream	Road	County	Map #	Index #	D.A. (mi^2)	Date	NCIBI Score	NCIBI Class[1]
Horse Br	SR 1136	Beaufort	1	29-6-2-1-6-2	3.3	05/06/93	46	G-F
Durham Cr	SR 1932	Beaufort	2	29-21-(1)	35.6	03/31/97	40	NR
Acre Swp	NC 32	Beaufort	3	29-34-35-1-1	29.5	03/31/97	44	G-F

[1] The NCIBI Classs are:

E = Excellent
G = Good
G-F = Good-Fair
F = Fair
NR = Not Rated