White Oak River Basinwide Water Quality Plan

October 2001

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This document was approved and endorsed by the NC Environmental Management Commission on September 13, 2001 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 White Oak River basin. This plan is the first five-year update to the original White Oak River Basinwide Water Quality Management Plan approved by the NC Environmental Management Commission on February 13, 1997

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North Carolina's Basinwide Approach to Water Quality Management

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 (DWQ) for each of the seventeen major river basins in the state. Each basinwide plan is revised at five-year intervals. While these plans are prepared by the DWQ, their implementation and the protection of water quality entails the coordinated efforts of many agencies, local governments and stakeholders in the state. The first basinwide plan for the White Oak River basin was completed in 1997.

This document is the first five-year update of the *White Oak River Basinwide Water Quality Plan*. The format of this plan was revised in response to comments received during the first planning cycle. DWQ replaced much of the general information in the first plan with more detailed information specific to the White Oak River basin. A greater emphasis was placed on identifying causes and sources of pollution for individual streams in order to facilitate local restoration efforts.

DWQ seriously considered comments from two public workshops held in the basin during plan development. The plan was revised based on comments from a public meeting to review the draft plan. This input will help guide continuing DWQ activities in the basin.

Goals of the Basinwide Approach

The goals of DWQ's basinwide program 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 to protect and restore water quality;
- assure equitable distribution of waste assimilative capacity for dischargers; and
- improve public awareness and involvement in the management of the state's surface waters.

White Oak River Basin Overview

The White Oak River Basin lies entirely within the southern coastal plain. The name of the basin is a bit of a misnomer in that it includes four separate river systems: the New River and its tributaries in the southwestern section; the White Oak River and its tributaries; the Newport River and its tributaries; and the North River in the eastern section. The basin also includes Bogue, Back and Core Sounds as well as significant portions of the Intracoastal Waterway.

The White Oak River watershed (subbasin 03-05-01), the basin's namesake, is located immediately east of the New River. It is the second largest watershed in the basin. There are 132 stream miles and 12,050 estuarine acres in this subbasin as well as eight miles of Atlantic

coastline. The river flows past the western end of Bogue Sound and into the Atlantic Ocean at Bogue Inlet.

The New River watershed (subbasin 03-05-02) is the westernmost of the four major river systems in the basin. It is also the largest and most populated and includes the City of Jacksonville. The New River is a coastal blackwater river with a watershed entirely within Onslow County. The watershed above Jacksonville is characterized by gum-cypress swamps with upland areas used primarily for forestry and agriculture. At Jacksonville, the river widens into a broad, slow-moving tidal embayment. It eventually discharges in the Atlantic Ocean through a narrow opening called New River Inlet. The City of Jacksonville and the US Marine Corps, with the operation of Camp Lejeune, comprise the majority of land in the lower watershed (that area below the US 17 bridge). There are 223 stream miles, 22,810 estuarine acres and 15 miles of Atlantic coastline in this subbasin.

The Newport River watershed (subbasin 03-05-03) is located just east of the White Oak River. It flows into the eastern end of Bogue Sound before entering the Atlantic Ocean near Morehead City. The Newport River watershed begins in Craven County and flows through Newport. There are 85 stream miles, 33,211 estuarine acres and 25 miles of Atlantic coastline.

The North River watershed (subbasin 03-05-04) is located on the western side of Core Sound and is mostly rural. The headwaters of the North River originate in Carteret County and flow directly into Back Sound near Harkers Island. Jarrett and Nelson Bays also drain inland areas in this subbasin. There are 4 stream miles and 49,077 estuarine acres in this subbasin.

The eastern most subbasin (03-05-05) is sparsely populated, and most of the land area is in the Cape Lookout National Seashore. There are 12,861 estuarine acres and 43 miles of Atlantic coastline in this subbasin.

There are 4 counties and 16 municipalities located in whole or in part in the basin. Based on 1990 data, the population of the basin is 146,240 people. The most populated areas are located in Jacksonville and Camp Lejeune on the New River, and Morehead City and Beaufort on Bogue Sound and the Newport River. The overall population density is 143 persons per square mile versus a statewide average of 139 persons per square mile. There are areas in the basin with very sparse populations (subbasins 03-05-04 and 03-05-05). The population density in the remainder of the basin exceeds the average state population density.

Large portions of the basin are publicly-owned areas, such as the Croatan National Forest on the White Oak River, and the Hoffman State Forest and Camp Lejeune on the New River. Statistics provided by the US Department of Agriculture, Natural Resources Conservation Service indicate that during the last decade there has been a 35,000-acre (65.6%) increase in the amount of developed land, and a 9,000-acre (15.1%) decrease in cultivated cropland, and a 29,000-acre (9.7%) decrease in forestland. Uncultivated croplands and pasturelands have increased by nine acres.

Assessment of Water Quality in the White Oak River Basin

Surface waters are classified according to their best intended uses. Determining how well a water supports its designated uses (use support status) is an important method of interpreting water quality data and assessing water quality. Waters are rated fully supporting (FS), partially supporting (PS) or not supporting (NS). The terms refer to whether the classified uses of the water (i.e., aquatic life protection, recreation and water supply) are being met. For example, waters classified for aquatic life protection and secondary recreation (Class C for freshwater or SC for saltwater) are rated FS if data used to determine use support did not exceed specific criteria. However, if these criteria were exceeded, then the waters would be rated as PS or NS, depending on the degree of degradation. Waters rated PS or NS are considered to be impaired. Waters lacking data, or having inconclusive data, are listed as not rated (NR).

Beginning in 2000 with the *Roanoke River Basinwide Water Quality Plan*, DWQ assesses ecosystem health and human health risk through several use support categories. Six categories are used to assess water quality under this approach: aquatic life/secondary recreation, fish consumption, shellfish harvesting, primary recreation, water supply and "other" uses. Each of these categories is related to the primary classifications applied to NC rivers and streams. A single water could have more than one use support rating corresponding to one or more of the multiple use support categories. For many waters, a use support category will not be applicable (N/A) to the best use classification of that water (e.g., drinking water supply is not the best use of a Class C water). The current method of determining use support differs from that done prior to 2000; in that, there is no longer an *overall* use support rating for a water.

The aquatic life/secondary recreation use support category is applied to all waters in North Carolina. Therefore, this category is applied to the total number of stream miles (416.9), estuarine acres (131,215.9), and coastal miles (91) in the White Oak River basin. A basinwide summary of current aquatic life/secondary recreation use support ratings is presented in Table 1.

Approximately 13 percent of stream miles (54 mi.) and 87 percent of estuarine acres (114,565) were monitored for the protection of aquatic life and secondary recreation by DWQ during this basinwide planning cycle. The 91 miles of Atlantic coastline are not currently monitored by DWQ to assess the aquatic life and secondary recreation use support category. There were no impaired stream miles and no impaired estuarine waters in this use support category in the basin during this planning cycle.

Table 1 Aquatic Life/Secondary Recreation Use Support Summary Information for Waters in the White Oak River Basin (1999)

Aquatic Life/Secondary Recreation Use Support Ratings	Monitored, Evaluated and Not Rated Streams*			Monitored Streams Only**	
	Miles or Acres	%		Miles or Acres	%
Fully Supporting	**71.8 mi. 118,450 ac**	**17.0% 90%**		**54 mi. 114,565 ac**	**13% 87%**
Impaired	**0**	**0%**		**0**	**0%**
Partially Supporting	*0*	*0%*		*0*	*0%*
Not Supporting	*0*	*0%*		*0*	*0%*
Not Rated	**339.4 mi. 12,766 ac**	**83% 10%**		**84.9 mi. 721 ac**	**20% 0.5%**
Total	**416.9 mi. 131,216.4 ac**			**139 mi. 115,286 ac**	

* = Percent based on total of all waters, both monitored and evaluated. ** = Percent based on total of all monitored waters.

Like the aquatic life/secondary recreation use support category, the fish consumption use support category is also applied to all waters in the state. Approximately 7.5 percent of stream miles (31.3 miles) and 100 percent of Atlantic coastline (91 miles) in the White Oak River basin were monitored for the fish consumption use support category during this basinwide cycle. Fish consumption use support ratings are based on fish consumption advisories issued by the NC Department of Health and Human Services (DHHS). Currently, there is a statewide advisory limiting consumption of bowfin due to high mercury concentrations. Because of this advisory, all waters in the state are considered partially supporting the fish consumption use. However, many waters across the state do not contain bowfin. A summary of current fish consumption use support ratings for monitored and evaluated streams in the White Oak River basin is presented in Table 2.

Table 2 Fish Consumption Use Support Summary Information for Waters in the White Oak River Basin (2000)

Fish Consumption Use Support Ratings	Monitored, Evaluated and Not Rated Streams*			Monitored Streams Only**	
	Miles or Acres	%		Miles or Acres	%
Fully Supporting	**0**			**0**	
Impaired	**416.8 mi. 131,216.7 ac 91 cmi**	**100%**		**31.3 mi. 91 cmi**	**7.5% 100%**
Partially Supporting	*416.8 mi. 131,216.7 ac 91 cmi*	*100%*		*31.3 mi. 91 cmi*	*7.5% 100%*
Not Supporting	*0*			*0*	
Not Rated	**0**			**0**	
TOTAL	**416.8 mi. 131,216.7 ac 91 coastal mi**			**31.3 mi. 91 coastal mi**	

* = Percent based on total of all streams, both monitored and evaluated. ** = Percent based on total of all monitored streams.
cmi = coastline miles.

There are 36.3 stream miles, 91 coastal miles and 118,131.7 estuarine acres currently classified for primary recreation in the White Oak River basin. Approximately 80 percent of estuarine acres were monitored by DWQ over the past five years and by Division of Environmental Health Shellfish Sanitation over the last two years; all are fully supporting the primary recreation use. A basinwide summary of current primary recreation use support ratings is presented in Table 3.

Table 3 Primary Recreation Use Support Summary Information for Waters in the White Oak River Basin (1999)

Primary Recreation Use Support Ratings	Monitored, Evaluated and Not Rated Streams*			Monitored Streams Only**	
	Miles or Acres	%		Miles or Acres	%
Fully Supporting	**94,503.9 ac 91 cmi**	**80% 100%**		**94,503.9 ac 91 cmi**	**80%**
Impaired	**0**	**0**		**0**	**0**
Partially Supporting	*0*	*0*		*0*	*0*
Not Supporting	*0*	*0*		*0*	
Not Rated	**36.3 mi. 23,627.9 ac**	**100% 20%**		**0**	
TOTAL	**36.3 mi. 118,131.8 ac 91 cmi**			**94,503.9 ac 91 cmi**	

* = Percent based on total of all streams, both monitored and evaluated. ** = Percent based on total of all monitored streams.
cmi = coastline miles.

There are 32 stream miles and 117,659 estuarine acres classified for shellfish harvesting (Class SA) in the White Oak River basin. All were monitored during the past five years by DEH Shellfish Sanitation. A basinwide summary of current shellfish harvest use support ratings is presented in Table 4.

Table 4 Shellfish Harvest Use Support Summary Information for Waters in the White Oak River Basin (1999)

Shellfish Harvest Use Support Ratings	Monitored Streams	
	Acres	%
Fully Supporting	**89,601**	**76%**
Impaired	**28,058**	
Partially Supporting	***18,187***	***16%***
Not Supporting	***9,872***	***8%***
Not Rated	**0**	**0%**
Total	**117,659**	

Note: There are also 30 of 32 Class SA stream miles that are considered impaired as well.

Recommended Management Strategies for Restoring Impaired Waters

The long-range mission of basinwide planning is to provide a means of addressing the complex problem of planning for increased development and economic growth while maintaining, protecting and enhancing water quality and intended uses of the White Oak River basin's surface waters.

Within this basinwide plan, DWQ presents management strategies and recommendations for those waters considered to be impaired or that exhibit some notable water quality problem.

Major water quality problems in the basin include fecal coliform bacteria contamination (affecting shellfish harvesting) and high levels of mercury in fish tissue (affecting fish consumption). Fecal coliform bacteria contamination is primarily attributed to nonpoint source pollution (NPS). Sources of nonpoint source pollution include runoff from urban areas and agricultural lands. High levels of mercury are likely from atmospheric sources.

For streams and estuarine waters degraded by point source pollution, the plan presents a management strategy to reduce the impacts from that pollutant source. The task of quantifying nonpoint sources of pollution and developing management strategies for these impaired waters is very resource intensive. This task is overwhelming, given the current limited resources of DWQ, other agencies (e.g., Division of Land Resources, Division of Soil and Water Conservation, Cooperative Extension Service, etc.) and local governments.

DWQ plans to further evaluate impaired waters in the White Oak River basin in conjunction with other agencies that deal with nonpoint source pollution issues and develop management strategies for a portion of these impaired waters for the next *White Oak River Basinwide Water Quality Plan* (2006).

Addressing Waters on the State's Section 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 a DWQ priority. Section 303(d) of the federal Clean Water Act requires states to develop a list of waters not meeting water quality standards or which have impaired uses. The waters in the White Oak River basin that are on this list are discussed in the individual subbasin descriptions in Section B. States are also required to develop Total Maximum Daily Loads (TMDLs) or management strategies for 303(d) listed waters to address impairment. EPA issued guidance in August 1997 that called for states to develop schedules for developing TMDLs for all waters on the 303(d) list within 8-13 years.

There are approximately 2,387 impaired stream miles on the 2000 303(d) list in NC. The rigorous and demanding task of developing TMDLs for each listed water during a 13-year time frame will require the focus of many resources. It will be a priority for North Carolina's water quality programs over the next several years to develop TMDLs for 303(d) listed waters.

Challenges Related to Achieving Water Quality Improvements

To achieve the goal of restoring impaired waters throughout the basin, DWQ will need to work more closely with other state agencies and stakeholders to identify and control pollutants. The costs of restoration will be high, but several programs exist to provide funding for restoration efforts. These programs include the Clean Water Management Trust Fund, the NC Agricultural Cost Share Program, the Wetlands Restoration Program and the federally funded Conservation Reserve Enhancement Program.

With increased development occurring, there will be significant challenges ahead in balancing economic growth with the protection of water quality in this basin. Point source impacts on surface waters can be measured and addressed through the basinwide planning process. Nonpoint sources of pollution can be identified through the basinwide plan, but actions to address these impacts must be taken at the local level. Such actions should include: development and enforcement of local erosion control ordinances; requirement of stormwater best management practices for existing and new development; development and enforcement of buffer ordinances; and land use planning that assesses impacts on natural resources. This basinwide plan presents many water quality initiatives and accomplishments that are underway within the basin. These actions provide a foundation on which future initiatives can be built.

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 (DWQ) 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 water quality plan is a five-year process, which is broken down into three 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 cycle of plans was completed in 1998, but each plan is updated at five-year intervals.

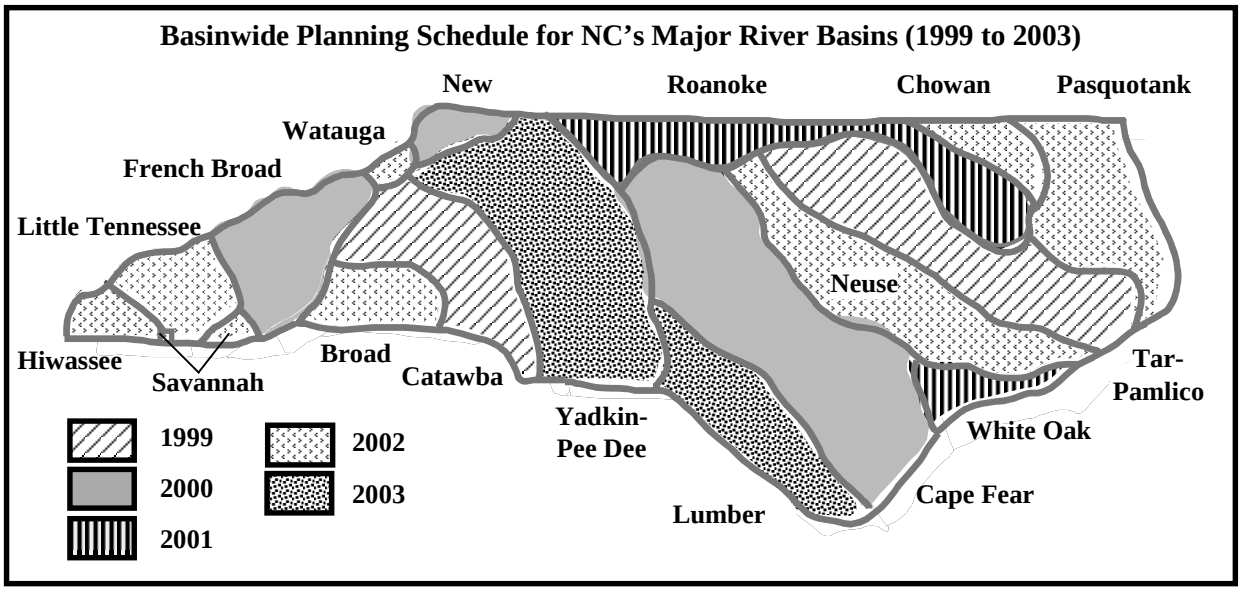


Figure A-1 Basinwide Planning Schedule (1999 to 2003)

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 to protect and restore water quality;
- 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	River Basin Public Workshops	Public Mtgs. and Draft Out For Review	Final Plan Receives EMC Approval	Begin NPDES Permit Issuance
Neuse	Summer 2000	6/2001	4/2002	7/2002	1/2003
Lumber	Summer 2001	12/2002	9/2003	12/2003	7/2004
Tar-Pamlico	Summer 97	6/1998	4/1999	7/1999	1/2000
Catawba	Summer 97	2/1999	10/1999	12/1999	3/2000
French Broad	Summer 97	5/1999	2/2000	5/2000	8/2000
New	Summer 98	6/1999	4/2000	7/2000	11/2000
Cape Fear	Summer 98	7/1999	4/2000	7/2000	12/2000
Roanoke	Summer 99	4/2000	2/2001	7/2001	1/2002
White Oak	**Summer 99**	**10/2000**	**7/2001**	**9/2001**	**6/2002**
Savannah	Summer 99	10/2000	12/2001	3/2002	8/2002
Watauga	Summer 99	10/2000	12/2001	2/2002	9/2002
Little Tennessee	Summer 99	3/2001	12/2001	4/2002	10/2002
Hiwassee	Summer 99	10/2000	12/2001	3/2002	8/2002
Chowan	Summer 2000	3/2001	1/2002	5/2002	11/2002
Pasquotank	Summer 2000	3/2001	1/2002	5/2002	12/2002
Broad	Summer 2000	11/2001	9/2002	12/2002	7/2003
Yadkin Pee-Dee	Summer 2001	4/2002	12/2002	3/2003	9/2003

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

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

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

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 recommendations from first basin plan, achievements made, 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 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 participation in the state's water quality protection programs*. The basinwide plans are an educational tool for increasing public involvement awareness of water quality issues.
- *Increased 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.

1.5 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 three 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.

1.6 Other References

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

- *White Oak River Basinwide Assessment Report*. June 2000. This technical report presents the physical, chemical and biological data in the White Oak River basin. 96 pages.
- *White Oak River Basinwide Water Quality Management Plan*. February 1997. This first basinwide plan for the White Oak River basin presents water quality data, information and recommended management strategies for the first five-year cycle. 204 pages.
- *A Citizen's Guide to Water Quality Management in North Carolina*. August 2000. This document includes general information about water quality issues and programs to address these issues. It is intended to be an informational document on water quality. 156 pages.
- *NC Basinwide Wetlands and Riparian Restoration Plan for the White Oak River Basin.* DWQ NC Wetlands Restoration Program. Raleigh, NC.
- *North Carolina's Basinwide Approach to Water Quality Management: Program Description*. Creager, C.S. and J.P. Baker. 1991. DWQ Water Quality Section. Raleigh, NC.
- NC Division of Water Quality Basinwide Planning Website at http://h2o.enr.state.nc.us/. Then click on Water Quality Section and scroll down the menu to Basinwide Planning Program.
- NC Division of Water Quality Environmental Sciences Branch Website at http://www.esb.enr.state.nc.us/.

Anyone interested in receiving these documents can contact the DWQ Planning Branch at (919) 733-5083 or by internet http://h2o.enr.state.nc.us/basinwide/.

1.7 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. Additional information can be found on the Division of Water Quality website at http://h2o.enr.state.nc.us/.

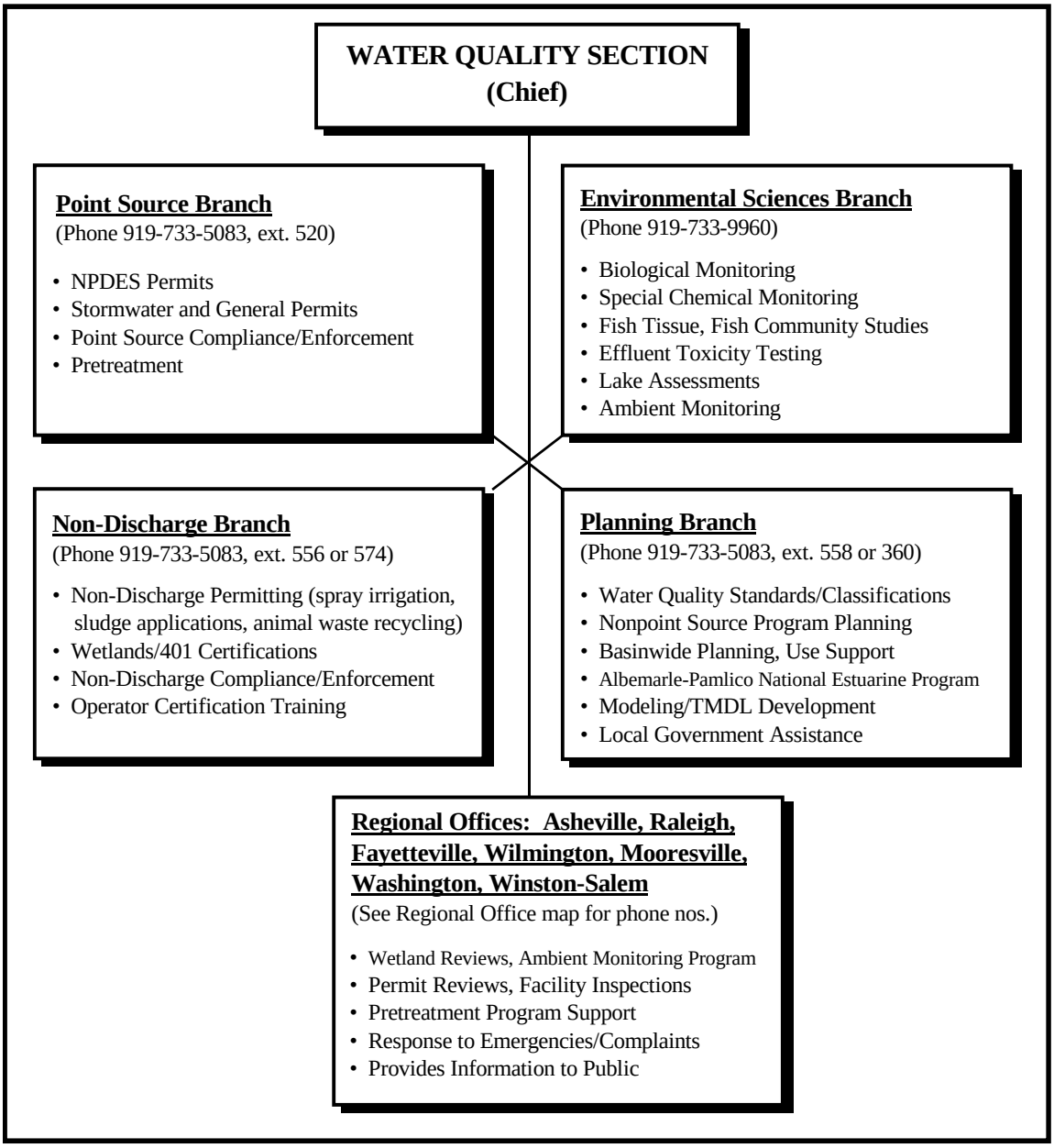
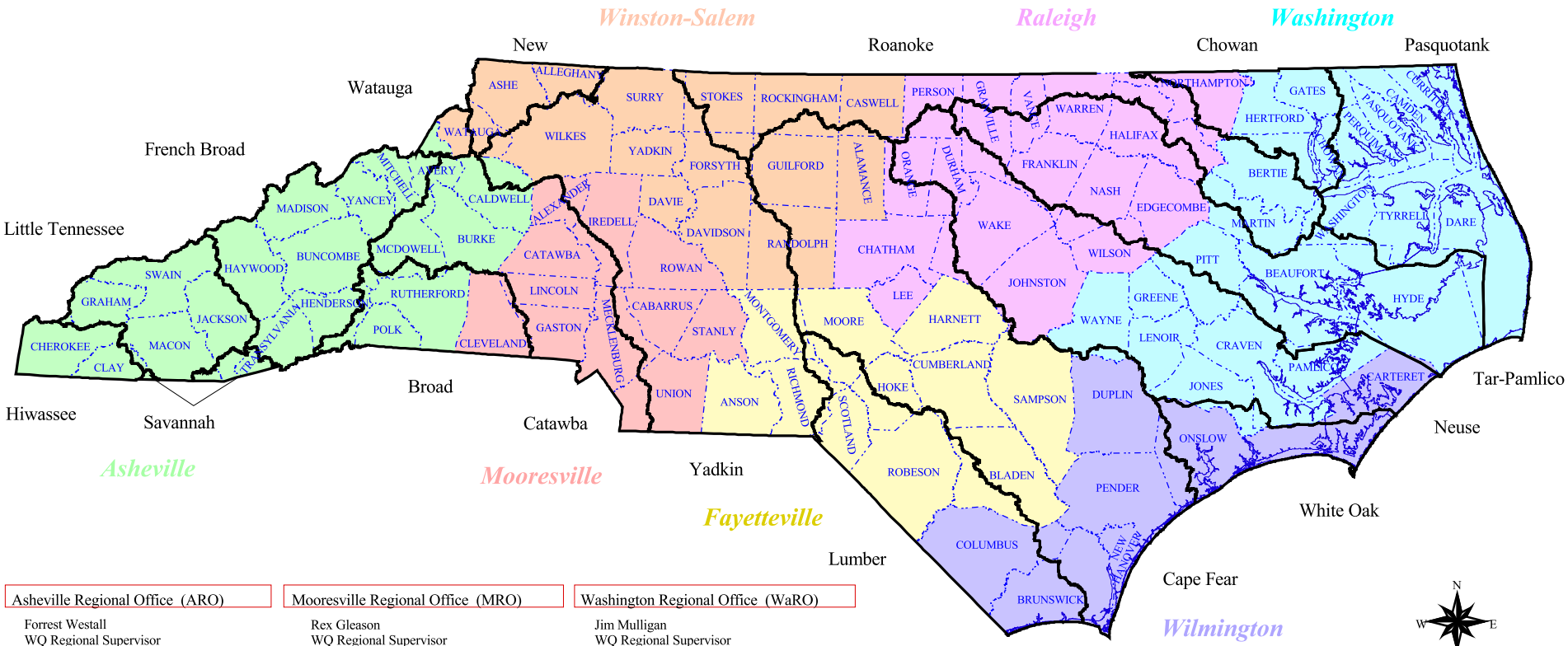


Figure A-2 Water Quality Section Organization Structure

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



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Burke	Jackson	Swain
Caldwell	Macon	Transylvania
Cherokee	Madison	Yancey
Clay	McDowell	
Graham	Mitchell	

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Cabarrus	Mecklenburg
Catawba	Rowan
Cleveland	Stanly
Gaston	Union
Iredell	

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WQ Regional Supervisor
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Beaufort	Gates	Pamlico
Bertie	Greene	Pasquotank
Camden	Hertford	Perquimans
Chowan	Hyde	Pitt
Craven	Jones	Tyrrell
Currituck	Lenoir	Washington
Dare	Martin	Wayne

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WQ Regional Supervisor
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Winston-Salem, NC 27107
COURIER 13-15-01
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Fax: (336) 771-4630

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

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Anson	Moore
Bladen	Richmond
Cumberland	Robeson
Harnett	Sampson
Hoke	Scotland
Montgomery	

Raleigh Regional Office (RRO)

Ken Schuster
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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
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Fax: (910) 350-2004

Brunswick	New Hanover
Carteret	Onslow
Columbus	Pender
Duplin	

NCDENR

Planning Branch
Planning & Assessment Unit
September 1, 1999

Chapter 2 -
White Oak River Basin Overview

2.1 General Overview

The White Oak River basin lies entirely within the southern coastal plain (Figure A-4). The name of the basin is a bit of a misnomer in that it includes four separate river systems: the New River and its tributaries in the southwestern section; the White Oak River and its tributaries; the Newport River and its tributaries; and the North River in the eastern section. The basin also includes Bogue and Core Sounds.

White Oak River Basin Statistics

Total Area: 1,264 sq. miles
Stream Miles: 446
Estuarine Acres: 130,009
Atlantic Coastline: 91 miles
No. of Counties: 4
No. of Municipalities: 16
No. of Subbasins: 5
Population (2000): 150,501*****
Estimated Pop. (2020): 176,318*****
% Increase (2000-2020): 17 %
Pop. Density (1990): 143 persons / sq. mi.

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

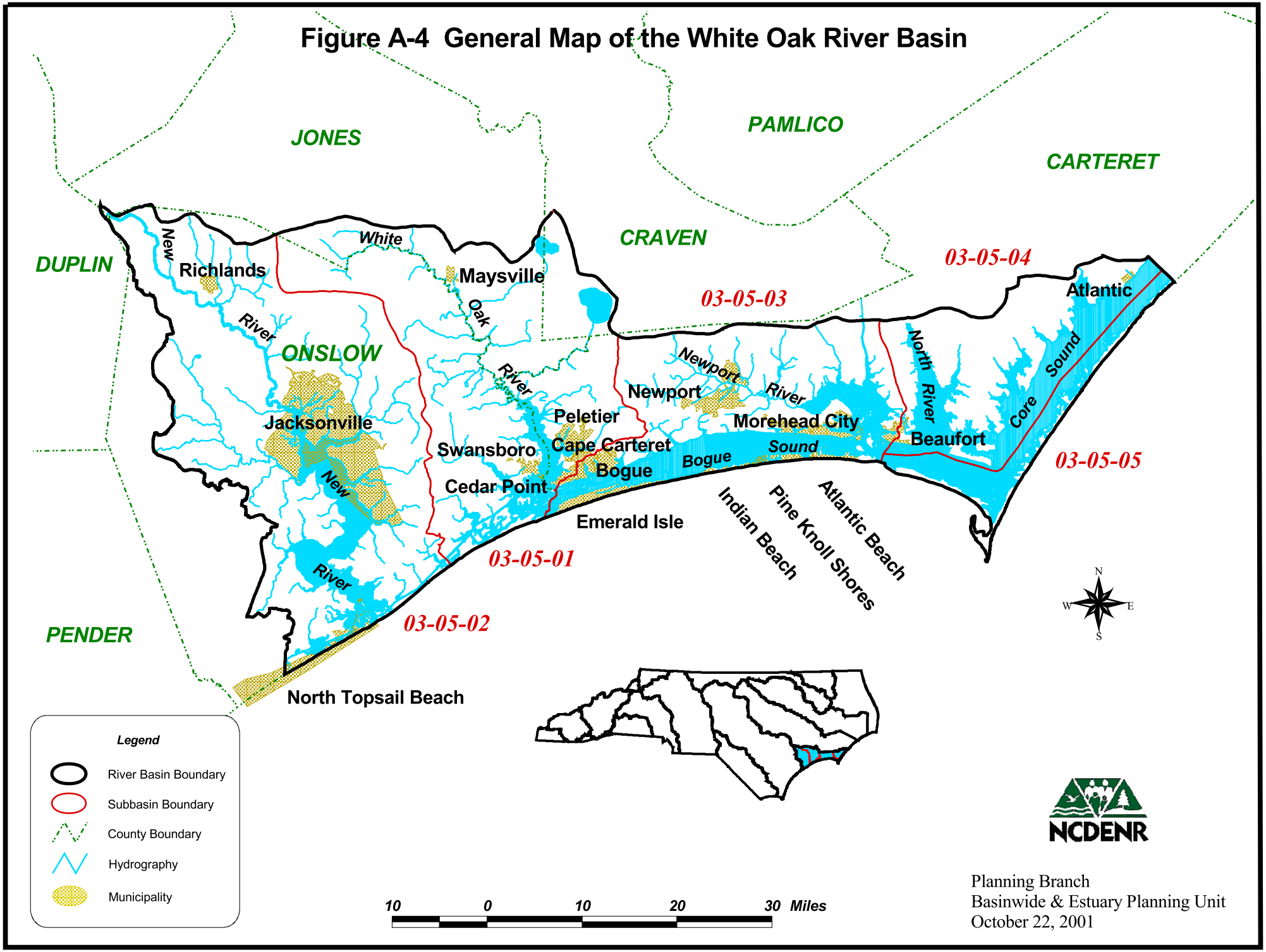
The White Oak River watershed (subbasin 03-05-01), the basin's namesake, is located immediately east of the New River. It is the second largest watershed in the basin. There are 132 stream miles and 12,050 estuarine acres in this subbasin as well as eight miles of Atlantic coastline. The river flows past the western end of Bogue Sound and into the Atlantic Ocean at Bogue Inlet.

The New River watershed (subbasin 03-05-02) is the westernmost of the four major river systems in the basin. It is also the largest and most populated and includes the City of Jacksonville. The New River is a coastal blackwater river with a watershed entirely within Onslow County. The watershed above Jacksonville is characterized by gum-cypress swamps with upland areas used primarily for forestry and agriculture. At Jacksonville, the river widens into a broad, slow-moving tidal embayment. It eventually discharges in the Atlantic Ocean through a narrow opening called New River Inlet. The City of Jacksonville and the US Marine Corps, with the operation of Camp Lejeune, comprise the majority of land in the lower watershed (that area below the US 17 bridge). There are 223 stream miles, 22,810 estuarine acres and 15 miles of Atlantic coastline in this subbasin.

The Newport River watershed (subbasin 03-05-03) is located just east of the White Oak River. It flows into the eastern end of Bogue Sound before entering the Atlantic Ocean near Morehead City. The Newport River watershed begins in Craven County and flows through Newport. There are 85 stream miles, 33,211 estuarine acres and 25 miles of Atlantic coastline.

The North River watershed (subbasin 03-05-04) is located on the western side of Core Sound and is mostly rural. The headwaters of the North River originate in Carteret County and flow directly into Back Sound near Harkers Island. Jarrett and Nelson Bays also drain inland areas in this subbasin. There are 4 stream miles and 49,077 estuarine acres in this subbasin.

Figure A-4 General Map of the White Oak River Basin



The eastern most subbasin (03-05-05) is sparsely populated, and most of the land area is in the Cape Lookout National Seashore. There are 12,861 estuarine acres and 43 miles of Atlantic coastline in this subbasin.

There are 4 counties and 16 municipalities located in whole or in part in the basin. Based on 1990 data, the population of the basin is 146,240 people. The most populated areas are located in Jacksonville and Camp Lejeune on the New River, and Morehead City and Beaufort on Bogue Sound and the Newport River. The overall population density is 143 persons per square mile versus a statewide average of 139 persons per square mile. There are areas in the basin with very sparse populations (subbasins 03-05-04 and 03-05-05). The population density in the remainder of the basin exceeds the average state population density.

Large portions of the basin are publicly-owned areas, such as the Croatan National Forest on the White Oak River, and the Hoffman State Forest and Camp Lejeune on the New River. Statistics provided by the US Department of Agriculture, Natural Resources Conservation Service indicate that during the last decade there has been a 35,000-acre (65.6%) increase in the amount of developed land, and a 9,000-acre (15.1%) decrease in cultivated cropland, and a 29,000-acre (9.7%) decrease in forestland. Uncultivated croplands and pasturelands have increased by nine acres.

2.2 Local Governments and Planning Jurisdictions in the Basin

The White Oak River basin encompasses all or portions of four counties and sixteen municipalities. Table A-3 provides a listing of these municipalities, along with an identification of the regional planning jurisdiction (Council of Governments), and an estimation of what percentage of the county area is within the river basin.

Table A-3 Local Governments and Planning Units within the White Oak River Basin

County	% of County in basin**	Region	Municipalities
Carteret	49%	Region P Neuse River Council of Governments New Bern	Atlantic Beach Beaufort Bogue Cape Carteret Cedar Point Emerald Isle Indian Beach Morehead City Newport Peletier Pine Knolls Shore
Craven	4%	Region P	None
Jones	19%	Region P	Maysville
Onslow	77%	Region P	Jacksonville North Topsail Beach * Richlands Swansboro

Key:

* Located in more than one major river basin.

** Estimated by Center for Geographic Information and Analysis.

Note: Counties are not included as part of a river basin if only a trace amount of the county (<2%) is located in that basin unless there is a municipality.

2.3 Surface Water Hydrology

Most federal government agencies, including the US Geological Survey (USGS) 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 the federal system, the White Oak River basin is made up of two hydrologic areas referred to as hydrologic units. One of these units includes the entire White Oak basin, except the New River watershed area, which is assigned to the other unit. Each hydrologic unit is defined by an 8-digit number. DWQ has a two-tiered system in which the state is subdivided into 17 river basins with each basin further subdivided into subbasins. Table A-4 compares the two systems. The White Oak River basin is subdivided by DWQ into five subbasins. Maps of each subbasin are included in Section B of this basinwide plan.

Table A-4 Hydrologic Subdivisions in the White Oak River Basin

Watershed Name and Major Tributaries	USGS 8-digit Hydrologic Units	DWQ Subbasin 6-digit Codes
New River	03030001	03-05-02
Bogue-Core Sounds	03020106	03-05-01
White Oak River	"	03-05-01
Newport River	"	03-05-03
North River	"	03-05-04
Jarrett Bay and Nelson Bay	"	03-05-04
Core Sound and Back Sound		03-05-05

2.4 Land Cover

Land cover information in this section is from the most current National Resources Inventory (NRI), as developed by the Natural Resources Conservation Service (USDA, 1999). The NRI is a statistically based longitudinal survey that has been designed and implemented to inventory land cover types and acreages. The NRI provides results that are nationally and temporally consistent for four points in time – 1982, 1987, 1992 and 1997.

In general, NRI protocols and definitions remain fixed for each inventory year. However, part of the inventory process includes reviewing previously recorded data when determinations are made for the new inventory year. For those cases where a protocol or definition needs to be modified, all historical data must be edited and reviewed on a point-by-point basis to make sure that data for all years are consistent and properly calibrated. The following excerpt from the *Summary Report: 1997 National Resources Inventory* provides guidance for use and interpretation of current NRI data:

> *"The 1997 NRI database has been designed for use in detecting significant changes in resource conditions relative to the years 1982, 1987, 1992 and 1997. All comparisons for two points in time should be made using the new 1997 NRI database. Comparisons made using data published for the 1982, 1987 and 1992 NRI may provide erroneous results, because of changes in statistical estimation protocols, and because all data collected prior to 1997 were simultaneously reviewed (edited) as 1997 NRI data were collected."*

Table A-5 summarizes acreage and percentage of land cover from the 1997 NRI for the basin as a whole and for the major watersheds within the basin, as defined by the USGS 8-digit hydrologic units and compares the coverages to 1982 land cover. Refer to Part 2.3 for a comparison between state and federal hydrologic divisions. Descriptions of land cover types identified by the NRI are found in Table A-6.

Forest and wetlands (both private and federal forests) cover approximately 48.8% of the basin. The "other" category covers approximately 37%. Agriculture (including cultivated and uncultivated cropland and pastureland) covers approximately 6% of the land area. The urban and built-up category comprises roughly 8% and exhibited a dramatic change since 1982. Cultivated cropland and forestland cover both decreased in the basin. Uncultivated cropland and pastureland cover had the most significant changes. These land cover changes are presented in Figure A-5.

Table A-5 Land Cover in the White Oak River Basin by Major Watersheds (June 2001) (Source: USDA-NRCS, 1982 and 1997 NRI)

	MAJOR WATERSHED AREAS *								
	New River Watershed		Bogue-Core Sounds Watershed		1997 TOTALS		1982 TOTALS		% change
LAND COVER	Acres (1000s)	%	Acres (1000s)	%	Acres (1000s)	% of TOTAL	Acres (1000s)	% of TOTAL	since 1982
Cult. Crop	12.4	3.5	45.5	5.7	57.9	5.0	67.0	5.8	-13.6
Uncult. Crop	0.0	0.0	5.0	0.6	5.0	0.4	0.0	0.0	500.0
Pasture	4.2	1.2	1.7	0.2	5.9	0.5	1.7	0.1	247.1
Forest	207.4	58.5	144.4	18.1	351.8	30.5	381.3	33.1	-7.7
Urban & Built-Up	38.6	10.9	51.0	6.4	89.6	7.8	54.1	4.7	65.6
Federal	48.0	13.5	163.3	20.5	211.3	18.3	211.2	18.3	0.0
Other	43.9	12.4	386.9	48.5	430.8	37.4	437.0	37.9	-1.4
Totals	354.5	100.0	797.8	100.0	1152.3	100.0	1152.3	100.0	
% of Total Basin		30.8		69.2		100.0			
SUBBASINS	03-05-02		03-05-01 03-05-03 03-05-04 03-05-05						
8-Digit Hydraulic Units	03030001		03020106						

* = Watershed areas defined by the 8-Digit Hydraulic Units do not necessarily coincide with subbasin titles used by DWQ.

Source: USDA, Soil Conservation Service - 1982 and 1997 NRI

Note: Cape Fear River subbasin 03-06-24 is included in the hydrologic unit 03030001 in the White Oak River Basin Plan. Neuse River subbasin 03-04-14 is included in hydrologic unit 03020106 in the White Oak River Basin Plan. These hydrologic units are discussed in the White Oak River Basinwide Water Quality Plan.

Table A-6 Description of Land Cover Types (1992 NRI-USDA SCS)

Type	Description
Cultivated Cropland	Harvestable crops including row crops, small-grain and hay crops, nursery and orchard crops, and other specialty crops.
Uncultivated Cropland	Summer fallow or other cropland not planted.
Pastureland	Includes land that has a vegetative cover of grasses, legumes and/or forbs, regardless of whether or not it is being grazed by livestock.
Forestland	At least 10 percent stocked (a canopy cover of leaves and branches of 25 percent or greater) by single-stemmed trees of any size which will be at least 4 meters at maturity, and land bearing evidence of natural regeneration of tree cover. The minimum area for classification of forestland is 1 acre, and the area must be at least 1,000 feet wide.
Urban and Built-up Areas	Includes airports, playgrounds with permanent structures, cemeteries, public administration sites, commercial sites, railroad yards, construction sites, residences, golf courses, sanitary landfills, industrial sites, sewage treatment plants, institutional sites, water control structure spillways and parking lots. Includes highways, railroads and other transportation facilities if surrounded by other urban and built-up areas. Tracts of less than 10 acres that are completely surrounded by urban and built-up lands.
Other	*Rural Transportation*: Consists of all highways, roads, railroads and associated rights-of-way outside urban and built-up areas; private roads to farmsteads; logging roads; and other private roads (but not field lanes). *Small Water Areas*: Waterbodies less than 40 acres in size and streams less than one-half mile wide. *Census Water*: Large waterbodies consisting of lakes and estuaries greater than 40 acres and rivers greater than one-half mile in width. *Minor Land*: Lands not in one of the other categories.

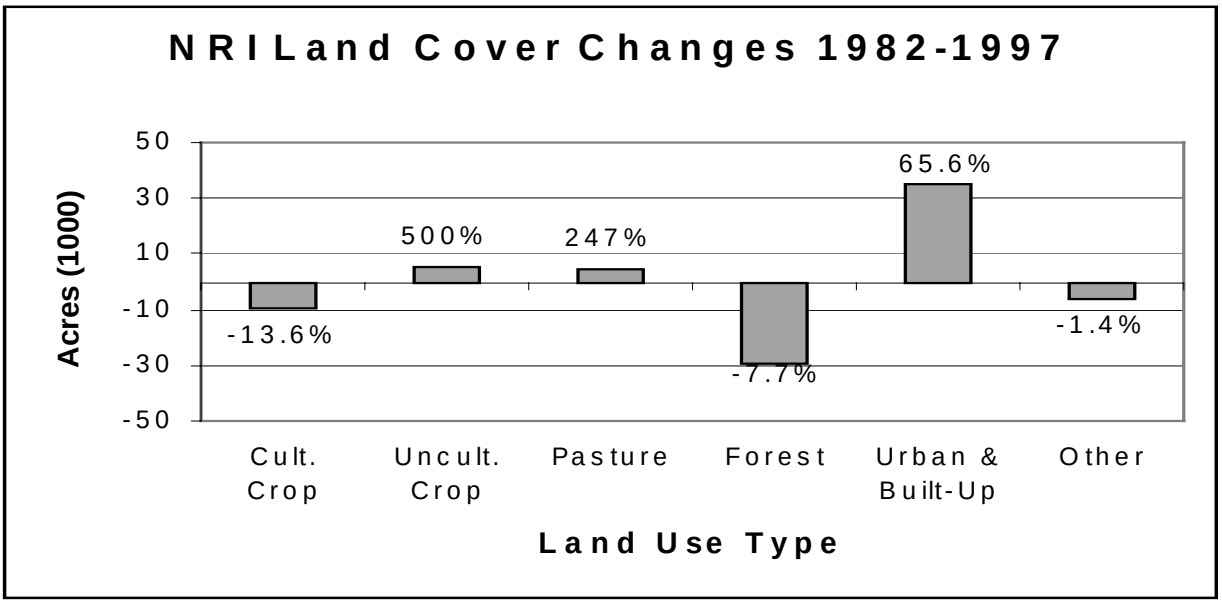


Figure A-5 Land Cover Changes from 1982 to 1997 for the White Oak River Basin (Source: USDA-NRCS 1997 NRI)

The North Carolina Corporate Geographic Database contains land cover information for the White Oak River basin based on satellite imagery from 1993-1995. The state's Center for Geographic Information and Analysis (CGIA) developed 24 categories of statewide land cover information. For the purposes of this report, those categories have been condensed into five broader categories as described in Table A-7. An important distinction between this land cover dataset and that of the NRI is that there is no actual groundtruthing of the satellite-generated data. Figure A-6 provides an illustration of the relative amount of land area that falls into each major cover type for the White Oak River basin. Section B of this plan provides land cover data specific to each subbasin.

Unfortunately, due to differences in the system of categorizing various land cover classes, it is not currently possible to establish trends in land cover changes by comparing this data set to previously attained land cover data. 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.

Table A-7 Description of Land Cover Categories

Land Cover Type	Land Cover Description
Urban	Greater than 50% coverage by synthetic land cover (built-upon area) and municipal areas.
Cultivated	Areas that are covered by crops that are cultivated in a distinguishable pattern (such as rows).
Pasture/Managed Herbaceous	Areas used for the production of grass and other forage crops and other managed areas such as golf courses and cemeteries. Also includes upland herbaceous areas not characteristic of riverine and estuarine environments.
Forest/Wetland	Includes salt and freshwater marshes, hardwood swamps, shrublands and all kinds of forested areas (such as needleleaf evergreens, conifers, deciduous hardwoods).
Water	Areas of open surface water, areas of exposed rock, and areas of sand or silt adjacent to tidal waters and lakes.

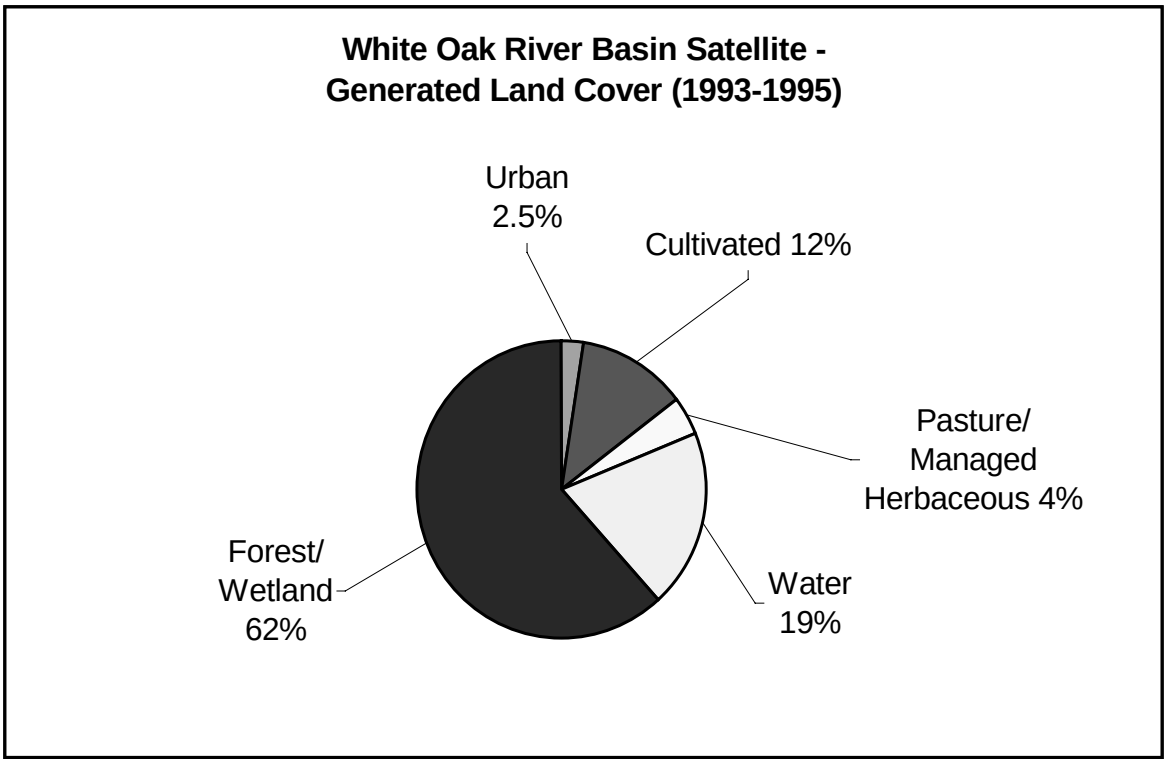


Figure A-6 White Oak River Basin Satellite Generated Land Cover (1993-1995)

2.5 Population and Growth Trends

Population

The White Oak River basin has an estimated population of 149,032 based on the most recent census data (1998 OSP). Table A-8 presents population data for 1970, 1980 and 1990. It also includes population density (persons/square mile) based on *land area* for each subbasin. Overall, the population in the basin has grown by 47% between 1970 and 1990. The cities of Jacksonville and Richlands have both had significant population increases due to the annexation of other areas. In contrast, Atlantic Beach and Cape Carteret have experienced population increases above the state average, and they have not annexed populated areas.

Figure A-7 displays estimated 1998 population densities by county for the White Oak River basin. The overall population density was 146 persons per square mile versus a statewide average of 139 persons per square mile.

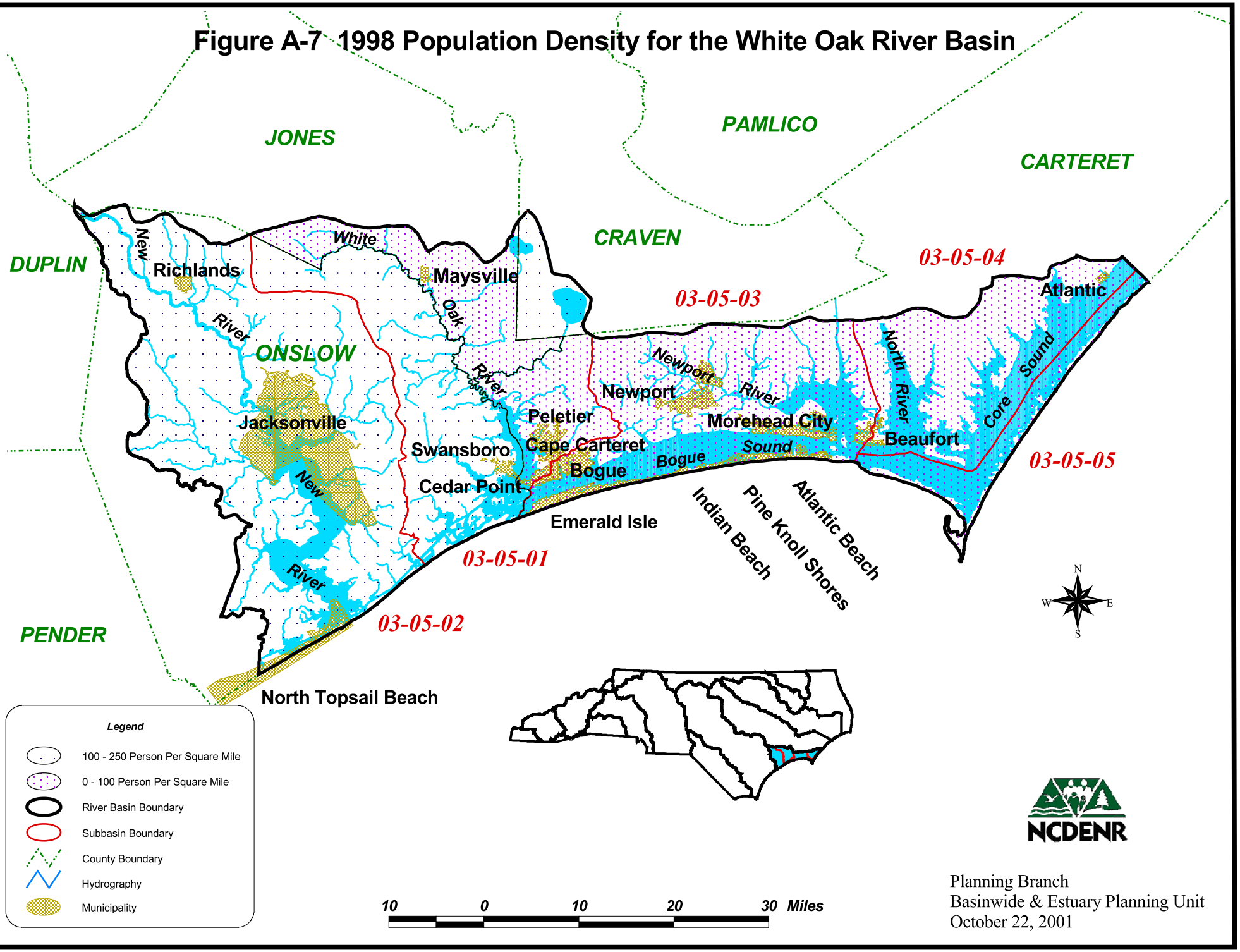
Table A-8 White Oak River Subbasin Populations, Population Density and Land Area Summaries (Source: Office of State Planning 2000)

	POPULATION (Number of Persons)			POPULATION DENSITY (Persons/Square Mile)			LAND AND WATER AREAS			
							Total Land and Water Area		Water Area	Land Area
SUBBASIN	1970	1980	1990	1970	1980	1990	(Acres)	(Sq. Miles)	(Sq. Miles)	(Sq. Miles)
03-05-01	27,748	30,640	39,388	86	95	122	224,923	351	29	322
03-05-02	58,060	63,497	84,359	139	152	201	295,882	462	43	419
03-05-03	6,858	8,917	11,404	41	53	68	146,026	228	60	168
03-05-04	5,120	6,657	8,514	50	65	83	108,875	170	67	103
03-05-05*	1,549	2,014	2,575	194	252	322	33,063	52	44	8
TOTALS	99,335	111,725	146,240	97	110	143	808,769	1,263	243	1,020

* Subbasin 03-05-05 is mostly National Seashore and very sparsely populated; therefore, density data is not considered to be representative of actual density in this subbasin.

In using these data, it should be noted that some of the population figures are estimates because the census block group boundaries do not generally coincide with subbasin boundaries. The census data are collected within boundaries such as counties and municipalities. By contrast, the subbasin lines are drawn along natural drainage divides separating watersheds. Therefore, where a census block group straddles a subbasin line, the percentage of the population that is located in the subbasin is estimated, assuming that population density is evenly distributed throughout a census block group. This is not always the case; however, the level of error associated with this method is not expected to be significant for the purposes of this document. It is also important to note that the census block groups change every ten years so comparisons between years must be considered approximate. Subbasin 03-05-05 is overestimated, as there are very few residents in this subbasin.

Figure A-7 1998 Population Density for the White Oak River Basin



Planning Branch
Basinwide & Estuary Planning Unit
October 22, 2001

Growth Trends

The population in the basin increased by almost 35,000 people (26%) between 1980 and 1990. The basin population is projected to increase another 25,000 by 2020. Table A-9 presents population data for municipalities located wholly or partly within the basin. Growth of municipalities can be a combination of population and annexation. Table A-10 shows the projected percent change in growth between 2000 and 2020 for counties within the basin. Since river basin boundaries do not coincide with county boundaries, these numbers are not directly applicable to the White Oak River basin. They are instead presented as an estimate of possible countywide population changes.

Table A-9 Population and Percent Change (1980, 1990, 2000) for Municipalities Located Wholly or Partly in the White Oak River Basin
(Source: North Carolina Municipal Population, April 2001)

Municipality	County	Apr-80	Apr-90	Apr-2000	Percent Change (1980-90)	Percent Change (1990-2000)
Atlantic Beach	Carteret	941	1,938	1,781	106.0	-8.1
Beaufort	Carteret	3,826	3,808	3,771	-0.5	-1.0
Bogue	Carteret	---	351	590	---	68.1
Cape Carteret	Carteret	944	1,013	1,214	7.3	19.8
Cedar Point	Carteret	479	628	929	31.1	47.9
Emerald Isle	Carteret	865	2,434	3,488	181.4	43.3
Indian Beach	Carteret	54	153	95	183.3	-37.9
Jacksonville	Onslow	18,259	30,398	66,715	66.5	119.5
Maysville	Jones	877	892	1,002	1.7	12.3
Morehead City	Carteret	4,359	6,046	7,691	38.7	27.2
Newport	Carteret	1,883	2,516	3,349	33.6	33.1
North Topsail Beach •	Onslow	301	947	843	214.6	-11.0
Peletier	Carteret	---	304	487	---	60.2
Pine Knoll Shores	Carteret	646	1,360	1,524	110.5	12.1
Richlands	Onslow	825	996	928	20.7	-6.8
Swansboro	Onslow	976	1,165	1,426	19.4	22.4

• - The numbers reported reflect municipality population; however, these municipalities are not entirely within the basin. The intent is to demonstrate growth for municipalities located wholly or partially within the basin.

Table A-10 Past, Projected and Change in Population (1990, 2000, 2020) by County (Source: Office of State Planning, May 2001)

County	1990	2000	Estimated Population 2020	Estimated Population Change 2000-2020
Carteret	25,679	29,098	34,479	5,381
Craven *	3,272	3,657	4,239	582
Jones	1,779	1,972	2,263	291
Onslow	115,375	115,773	135,337	19,564
Subtotal	146,105	150,500	176,318	25,818

* Less than 5% of the county is in this basin.

Note: These numbers have been adjusted based on the percent of the county (>2%) located in the White Oak River basin (Table A-3).

For more information on past, current, and projected population estimates, contact the Office of State Planning at (919) 733-4131 or visit their website at http://www.ospl.state.nc.us/demog/.

2.6 Natural Resources

2.6.1 Fish and Shellfish Resources

In the White Oak basin, the Core Sound area produces the most catch with total landings of over 10 million pounds with a value in excess of $7,700,000 (1994 data from DMF). The other areas of the White Oak River basin are much less productive, probably due to much smaller water areas. The most productive areas after Core Sound are Bogue Sound and the Newport River area with commercial landings in 1994 of 672,419 and 685,223 pounds, respectively.

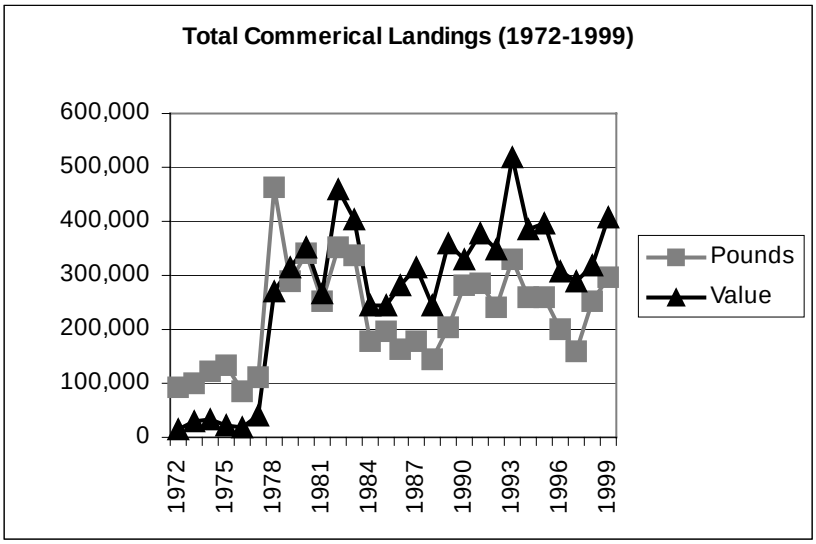


Figure A-8 Overall Trends in Commercial Landing Statistics for the White Oak River Basin by Total Pounds and Total Value
(Source: North Carolina Division of Marine Fisheries, 2001)

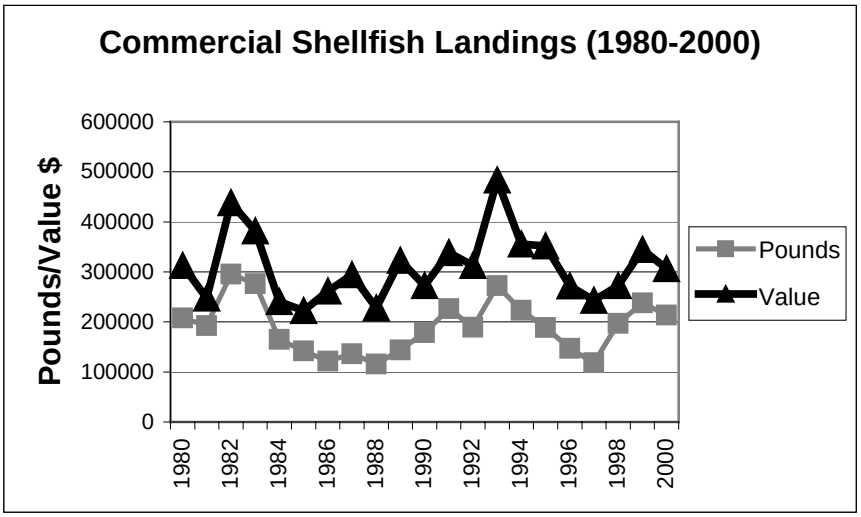


Figure A-9 Commercial Shellfish Landing Statistics for the White Oak River Basin by Total Pounds and Total Value
(Source: North Carolina Division of Marine Fisheries, 2001)

2.6.2 Public Lands in the White Oak River Basin

The White Oak River basin contains many public lands (Figure A-10). In addition to Croatan National Forest, the federal government also owns Camp Lejeune Marine Base and Cape Lookout National Seashore. The state owns a number of smaller but significant properties including: Hammocks Beach and Fort Macon State Parks, Theodore Roosevelt Natural Area, Rachel Carson Estuarine Reserve, and White Oak River Impoundment Game Land.

2.6.3 Significant Natural Heritage Areas

The White Oak River basin contains some of the most biologically significant habitats along the entire US Atlantic Coast. Because the White Oak River basin contains so many individual significant natural areas, many more that can be described here; the discussion of natural areas will focus on three of the largest sites in the basin (Figure A-10).

Camp Lejeune Marine Corps Base contains some of the highest quality longleaf pine and pocosin habitat in the state, as well as high quality examples of the Pine Savanna, Wet Pine Flatwoods and Small Depression Ponds. Often termed "limesinks" because of the way they are formed, the Small Depression Pond community occurs where depressions in the uplands intersect the watertable. The seasonally exposed margin of this wetland supports a high diversity of herbs, including many rare plants.

In addition to the numerous limesinks, Camp Lejeune also contains large wetlands called "Domed Pocosins", so named because they are higher than the surrounding lands. The low relief and a gradual accumulation of organic matter from previous generations of plants promoted the development of this deep peat layer. (The word "pocosin" is traceable to an Algonquin Indian word translatable as "swamp-on-a-hill".) Pocosins are easy to drain, and for this reason, the best examples are preserved in public areas like Croatan National Forest and Camp Lejeune.

Pocosins are found nowhere else in the world except North and South Carolina and a few areas in southern Virginia. North Carolina has 70 percent of the remaining pocosins, and some of the highest quality areas lie within Camp Lejeune. The deep, peaty soils absorb rainwater and release it slowly into adjacent estuaries, preserving the proper mix of saltwater and freshwater that is critical for many fish and shellfish.

Bogue Inlet includes considerable area of the lower White Oak River and serves as an important link between the Croatan National Forest and Camp Lejeune. This nationally significant site contains some of the highest quality environments remaining along the coastal edge of North Carolina, with excellent examples of maritime forest and dune communities, and extensive areas of unditched marshes and tidal creeks.

The White Oak River Marsh is a significant natural heritage area that contains exemplary freshwater tidal marsh and swamp communities, including one of the best examples of the rare Tidal Red Cedar Forest natural community. This tidal forest type is known only from the area around the New River and White Oak River.

2.6.4 Rare Aquatic and Wetland-Dwelling Animal Species

The following information on rare aquatic and wetland-dwelling species (Table A-11) was obtained from the NC Natural Heritage Program, Division of Parks and Recreation (January 2001).

Table A-11 Rare and Aquatic Animals in the White Oak River Basin

Major Taxon	Common Name	Scientific Name	State Status	Federal Status
reptile	American Alligator	*Alligator mississippiensis*	T	T (S/A)
reptile	Loggerhead Turtle	*Caretta caretta*	T	T
reptile	Leatherback Turtle	*Dermochelys coriacea*	E	E
fish	Shortnose Sturgeon	*Acipenser brevirostrum*	E	E
reptile	Carolina Diamondback Terrapin	*Malaclemys terrapin centrata*	SC	
mammal	Manatee	*Trichecus manatus*	E	E

Rare Species Listing Criteria

E = Endangered (those species in danger of becoming extinct)
T = Threatened (considered likely to become endangered within the foreseeable future)
SC = Special Concern (have limited numbers and vulnerable populations in need of monitoring)
SR = Significantly Rare (those whose numbers are small and whose populations need monitoring)

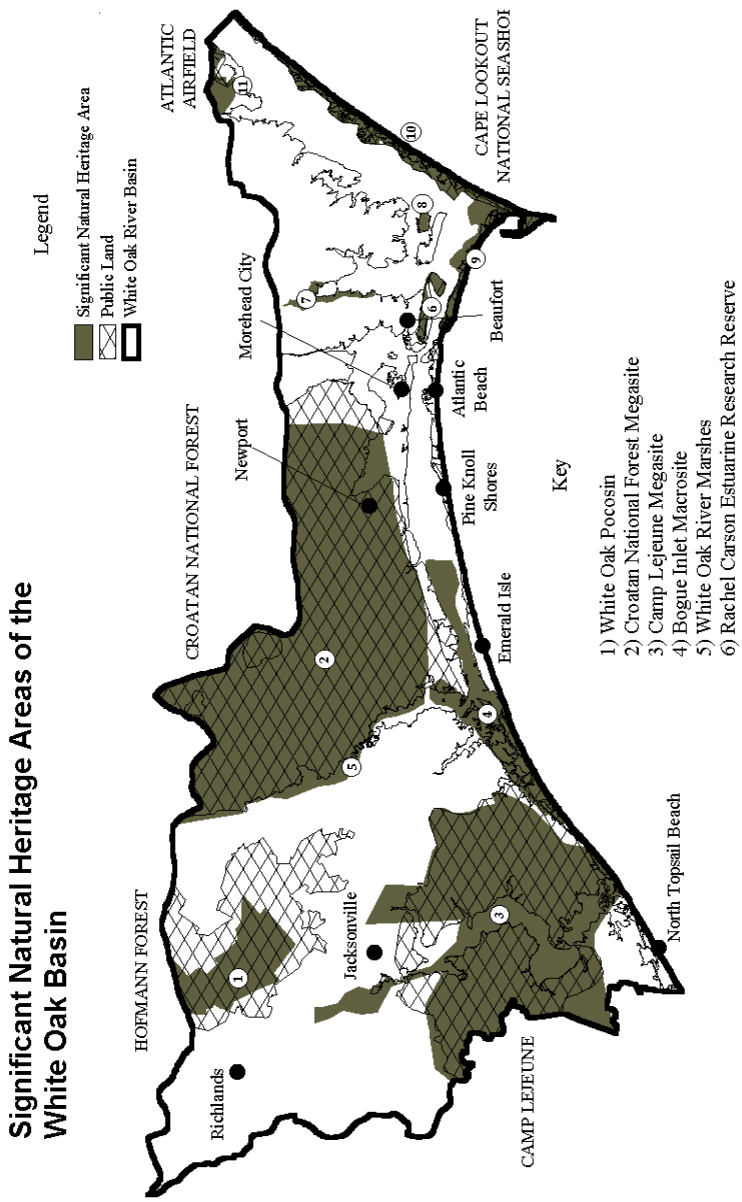


Figure A-10 Significant Natural Heritage Areas and Public Lands of the White Oak River Basin

2.7 Permitted Wastewater and Stormwater Discharge Facilities

The primary pollutants associated with point source discharges are:

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

Discharges that enter surface waters through a pipe, ditch or other well-defined point of discharge are broadly referred to as 'point sources'. Wastewater point source discharges include municipal (city and county) and industrial wastewater treatment plants and small domestic wastewater treatment systems serving schools, commercial offices, residential subdivisions and individual homes. 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.

2.7.1 Wastewater Discharges in the White Oak River Basin

There are 50 permitted wastewater discharges in the White Oak River basin. Table A-12 provides summary information (by type and subbasin) about the discharges. Various types of dischargers listed in the table are described in the inset box. A list of all facilities can be found in Appendix I.

Figure A-11 shows the location of major and minor permitted wastewater discharges within the basin. The number of sites on the map depicting major discharges differs from the number of major facilities listed in Table A-12. Since some major facilities have more than one outfall point, each outfall received a symbol on the map. For more information and recommendations regarding NPDES permit holders, refer to page 62.

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.

Table A-12 Summary of NPDES Dischargers and Permitted Flows for the White Oak River Basin

	Subbasin					
Facility Categories	**01**	**02**	**03**	**04**	**05**	**TOTAL**
Total Facilities	9	30	6	5	0	50
Total Permitted Flow (MGD)	0.535	18.448	2.213	4.543	0	25.729
Major Discharges	0	1	1	2	0	4
Total Permitted Flow (MGD)	0	16	1.7	4.5	0	22.2
Minor Discharges	9	29	5	3	0	46
Total Permitted Flow (MGD)	0.535	2.448	0.513	0.034	0	3.529
100% Domestic Waste	5	24	2	2	0	33
Total Permitted Flow (MGD)	0.535	17.904	2.2	1.52	0	22.154
Municipal Facilities	2	1	2	1	0	6
Total Permitted Flow (MGD)	0.48	0.25	2.2	1.5	0	4.45
Nonmunicipal Facilities	7	29	4	4	0	44
Total Permitted Flow (MGD)	0.055	18.198	0.013	3.034	0	21.30

2.7.2 Stormwater Discharges in the White Oak River Basin

Amendments were made to the Clean Water Act in 1990 and most recently in 1999 pertaining to permit requirements for stormwater discharges associated with industrial activities and municipal separate storm sewer systems (MS4s). DWQ administers these regulations in North Carolina through the state's NPDES stormwater program. The goal of the DWQ stormwater discharge permitting regulations is to prevent pollution via stormwater runoff by controlling the source(s) of pollutants.

The municipal permitting requirements are designed to lead into the formation of comprehensive stormwater management programs for municipal areas. No municipalities in the White Oak River basin were required to obtain a NPDES permit for stormwater sewer systems under the Phase I

EPA Stormwater Rules

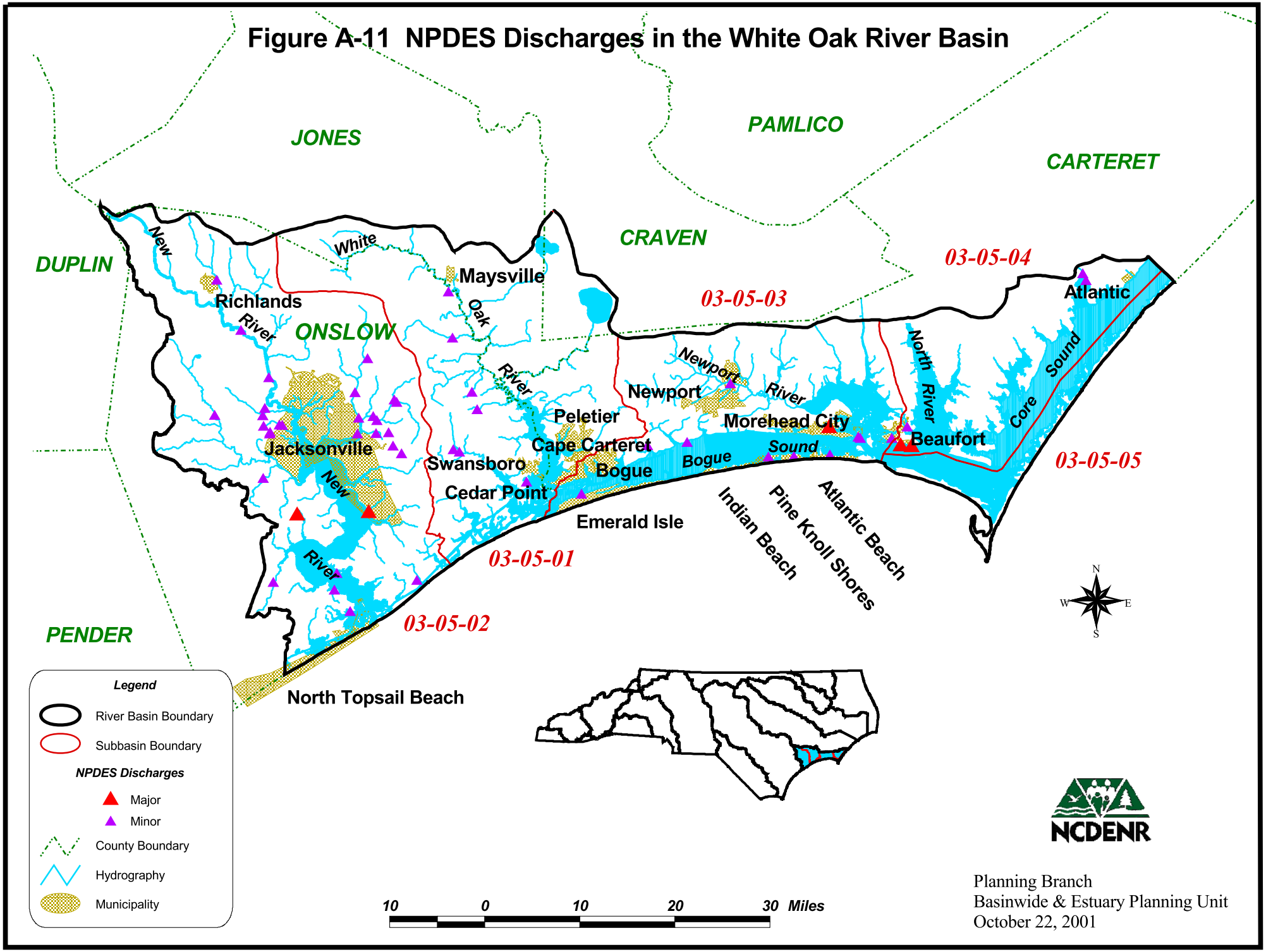
Phase I – December 1990

- Requires a NPDES permit for municipal storm sewer systems (MS4s) serving populations of 100,000 or more.
- Requires a NPDES stormwater permit for ten categories of industry.
- Requires a NPDES stormwater permit for construction sites that are 5 acres or more.

Phase II – December 1999

- Requires a NPDES permit for some municipal storm sewer systems serving populations under 100,000, located in urbanized areas.
- Provides a "no stormwater exposure" exemption to industrial facilities covered under Phase I.
- Requires a NPDES stormwater permit for construction sites that are 1-5 acres.

Figure A-11 NPDES Discharges in the White Oak River Basin



rules (population >100,000). Additionally, no municipalities in the basin are automatically required (US Census designated Urban Areas) to obtain a NPDES stormwater permit under the Phase II rules. However, Jacksonville will be considered for inclusion under the Phase II rules because of a population greater than 10,000 and/or a population density greater than 1000 persons per square mile. DWQ is currently developing criteria that will be used to determine whether these and other municipalities should be required to obtain a NPDES permit.

Industrial activities which require permitting are defined in categories ranging from sawmills and landfills to manufacturing plants and hazardous waste treatment, storage or disposal facilities. Stormwater permits are granted in the form of general permits (which cover a wide variety of more common activities) or individual permits. Excluding construction stormwater general permits, there are 59 general stormwater permits and one individual permit active within the White Oak River basin. Individual permit holders are presented in Appendix I.

The primary concern with runoff from industrial facilities is the contamination of stormwater from contact with exposed materials. 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 identified as having significant potential to impact water quality may also be required to conduct analytical monitoring to characterize pollutants in stormwater discharges.

The state stormwater management rules (15A NCAC 2H .1000) regulate development activities in 20 coastal counties and on lands statewide that drain to Outstanding Resource Waters (ORW) and/or High Quality Waters (HQW). Under this program, development is permitted as either low density or high density. Low density limits the impervious, or built upon, area and allows natural infiltration and attenuation of stormwater runoff. High density requires installation and maintenance of structural best management practices to control and treat stormwater runoff from the site. For more information on stormwater issues, refer to page 58.

2.8 Animal 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. Within the past five years, there have been several additional pieces of legislation enacted that affect animal operations in North Carolina (see text box).

Key Animal Operation Legislation (1995-1999)

1995 – Senate Bill 974 requires owners of swine facilities with 250 or more animals to hire a certified operator. Operators are required to attend a six-hour training course and pass an examination for certification. Senate Bill 1080 established buffer requirements for swine houses, lagoons and land application areas for farms sited after October 1, 1995.

1996 – Senate Bill 1217 required all facilities (above threshold populations) to obtain coverage under a general permit, beginning in January 1997, for all new and expanding facilities. DWQ was directed to conduct annual inspections of all animal waste management facilities. Poultry facilities with 30,000+ birds and a liquid waste management system were required to hire a certified operator by January 1997 and facilities with dry litter animal waste management systems were required to develop an animal waste management plan by January 1998. The plan must address three specific items: 1) periodic testing of soils where waste is applied; 2) development of waste utilization plans; and 3) completion and maintenance of records on-site for three years. Additionally, anyone wishing to construct a new, or expand an existing, swine farm must notify all adjoining property owners.

1997 – House Bill 515 placed a moratorium on new or existing swine farm operations and allows counties to adopt zoning ordinances for swine farms with a design capacity of 600,000 pounds (SSLW) or more. In addition, owners of potential new and expanding operations are required to notify the county (manager or chair of commission) and local health department, as well as adjoining landowners. DENR was required to develop and adopt economically feasible odor control standards by March 1, 1999.

1998 – House Bill 1480 extended the moratorium on construction or expansion of swine farms. The bill also requires owners of swine operations to register with DWQ any contractual relationship with an integrator.

1999 – House Bill 1160 extended (again) the moratorium on new construction or expansion of swine farms, required DENR to develop an inventory of inactive lagoons, and requires owners/operators of an animal waste treatment system to notify the public in the event of a discharge to surface waters of the state of 1,000 gallons or more of untreated wastewater.

Table A-13 summarizes, by subbasin, total animal capacities and change in capacities from 1994 to 1998. There has been a noted decline in dairy operations but a large increase in swine capacity, especially in subbasin 03-05-02.

Table A-14 summarizes, by subbasin, the number of registered livestock operations, total animals, total acres in operation and total steady state live weight as of January 2000. These numbers reflect only operations required by law to be registered, and therefore, do not represent the total number of animals in each subbasin. Figure A-12 shows the general location of the registered operations in the basin.

Steady State Live Weight (SSLW) is the result, in pounds, after a conversion factor has been applied to the number (head count) of swine, cattle or poultry on a farm. The conversion factors, which come from the US Department of Agriculture (USDA), Natural Resource Conservation Service (NRCS) guidelines, vary depending on the type of animals on the farm and the type of operation (for example, there are five types of hog farms). Since the amount of waste produced varies by hog size, SSLW is the best way to compare the sizes of the farms.

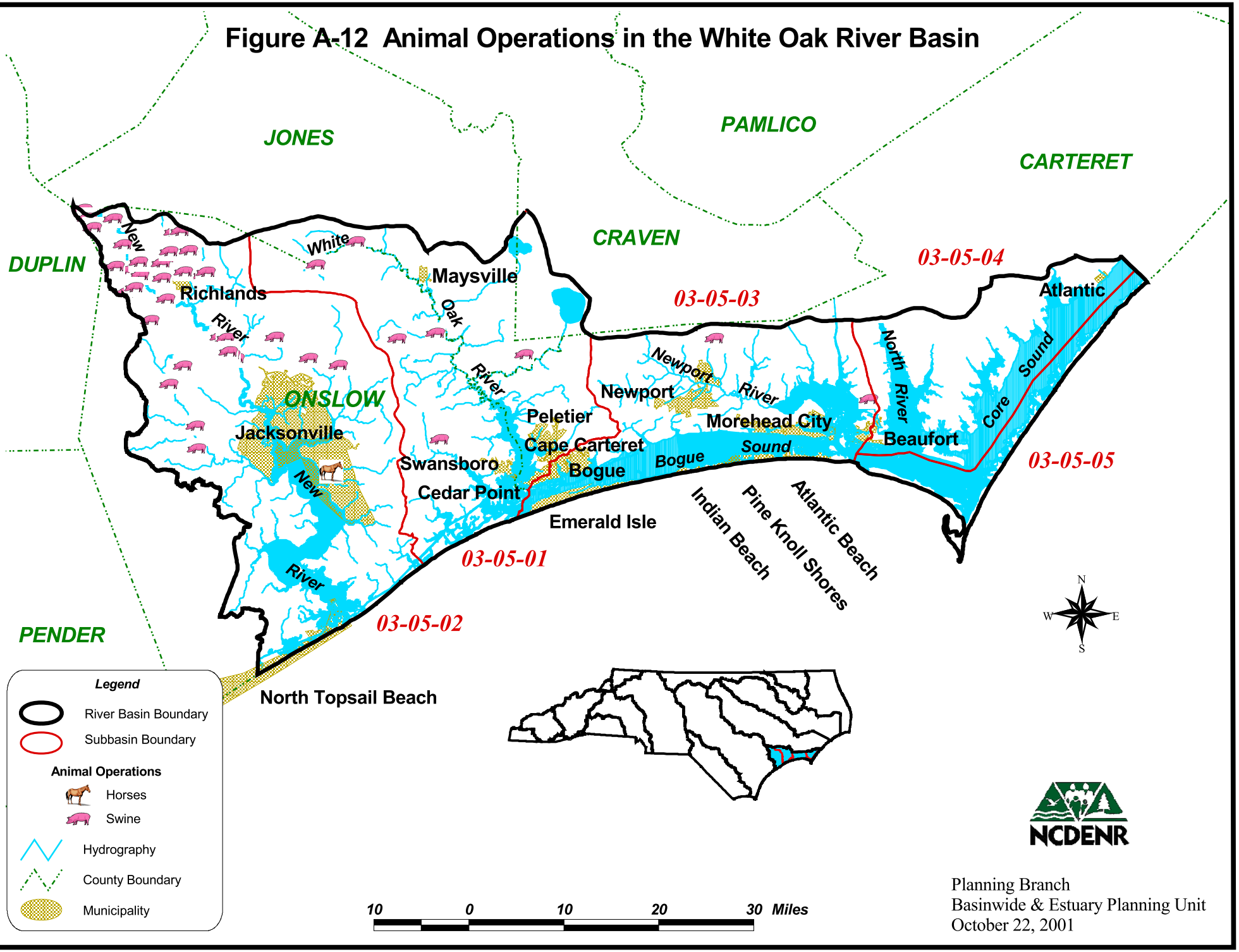
Table A-13 Estimated Populations of Swine, Dairy and Poultry in the White Oak River Basin (Source: USDA, Division of Veterinary Health)

Subbasin	Total Swine Capacity		Swine Change	Total Dairy Capacity		Dairy Change	Poultry Capacity		Poultry Change
	1998	1994	94-98 (%)	1998	1994	94-98 (%)	1998	1994	94-98 (%)
03-05-01	28,036	14,666	91	0	230	-100	64,000	64,000	0
03-05-02	132,513	82,944	60	0	0	0	867,681	758,000	14
03-05-03	3,503	2,432	44	0	0	0	48,000	48,000	0
03-05-04	0	0	0	0	0	0	0	0	0
03-05-05	0	0	0	0	0	0	0	0	0
TOTALS	164,052	100,042	64	0	230	-100	979,681	870,000	13
% of State Total	2%	2%		0%	<1%		<1%	<1%	

Table A-14 Registered Animal Operations in the White Oak River Basin (as of 1/20/2000)

Subbasin	Swine		
	No. of Facilities	No. of Animals	Total Steady State Live Weight
03-05-01	6	20,852	2,263,920
03-05-02	38	150,427	17,956,695
03-05-03	2	3,375	542,655
03-05-04	--	--	--
03-05-05	--	--	--
TOTALS	46	174,654	20,763,270

Figure A-12 Animal Operations in the White Oak River Basin



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October 22, 2001

Chapter 3 -
Summary of Water Quality Information for the White Oak 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. With proper management of wastes and land use activities, these impacts can be minimized. Pollutants that enter waters can be grouped into two general categories: *point sources* and *nonpoint sources*.

Point Sources

- Piped discharges from municipal wastewater treatment plants
- Industrial facilities
- Small package treatment plants
- Large urban and industrial stormwater systems

Point sources are typically piped discharges and are controlled through regulatory programs administered by the state. All regulated point source discharges in North Carolina must apply for and obtain a National Pollutant Discharge Elimination System (NPDES) permit from the state.

Nonpoint Sources

- Stormwater runoff
- Timber harvesting
- Agricultural lands
- Rural residential development
- Septic systems
- Mining

Nonpoint sources are from a broad range of land use activities. Nonpoint source pollutants are typically carried to waters by rainfall, runoff or snowmelt. Sediment and nutrients are most often associated with nonpoint source pollution. Other pollutants associated with nonpoint source pollution include fecal coliform bacteria, heavy metals, oil and grease, and any other substance that may be washed off the ground or deposited from the atmosphere into surface waters.

Unlike point source pollution, nonpoint pollution sources are diffuse in nature and occur intermittently, depending on rainfall events and land disturbance. Given the diffuse nature of nonpoint source pollution, it is difficult and resource intensive to quantify nonpoint contributions to water quality degradation in a given watershed. While nonpoint source pollution control often relies on voluntary actions, the state has many programs designed to reduce nonpoint source pollution.

Every person living in or visiting a watershed contributes to impacts on water quality. Therefore, each individual should be aware of these contributions and take actions to reduce them.

Cumulative Effects

While any one activity may not have a dramatic effect on water quality, the cumulative effect of land use activities in a watershed can have a severe and long-lasting impact.

3.2 Description of Surface Water Classifications and Standards

Program Overview

North Carolina's Water Quality Standards program adopted classifications and water quality standards for all the state's river basins by 1963. The program remains consistent with the Federal Clean Water Act and its amendments. Water quality classifications and standards have also been modified to promote protection of surface water supply watersheds, high quality waters, and the protection of unique and special pristine waters with outstanding resource values.

Statewide Classifications

All surface waters in the state are assigned a *primary* classification that is appropriate to the best uses of that water. In addition to primary classifications, surface waters may be assigned a *supplemental* classification. Most supplemental classifications have been developed to provide special protection to sensitive or highly valued resource waters. Table A-15 briefly describes the best uses of each classification. A full description is available in the document titled: *Classifications and Water Quality Standards Applicable to Surface Waters of North Carolina*. Information on this subject is also available at DWQ's website: http://h2o.enr.state.nc.us/wqhome.html.

Table A-15 Primary and Supplemental Surface Water Classifications

PRIMARY FRESHWATER AND SALTWATER CLASSIFICATIONS	
Class	**Best Uses**
C and SC	Aquatic life propagation/protection and secondary recreation.
B and SB	Primary recreation and Class C uses.
SA	Waters classified for commercial shellfish harvesting.
WS	*Water Supply watershed*. There are five WS classes ranging from WS-I through WS-V. WS classifications are assigned to watersheds based on land use characteristics of the area. Each water supply classification has a set of management strategies to protect the surface water supply. WS-I provides the highest level of protection and WS-IV provides the least protection. A Critical Area (CA) designation is also listed for watershed areas within a half-mile and draining to the water supply intake or reservoir where an intake is located.
SUPPLEMENTAL CLASSIFICATIONS	
Class	**Best Uses**
Sw	*Swamp Waters*: Recognizes waters that will naturally be more acidic (have lower pH values) and have lower levels of dissolved oxygen.
Tr	*Trout Waters*: Provides protection to freshwaters for natural trout propagation and survival of stocked trout.
HQW	*High Quality Waters*: Waters possessing special qualities including excellent water quality, Native or Special Native Trout Waters, Critical Habitat areas, or WS-I and WS-II water supplies.
ORW	*Outstanding Resource Waters*: Unique and special surface waters which are unimpacted by pollution and have some outstanding resource values.
NSW	*Nutrient Sensitive Waters*: Areas with water quality problems associated with excessive plant growth resulting from nutrient enrichment.

* Primary classifications beginning with "S" are assigned to saltwaters.

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 (WRC).
- Critical habitat areas designated by the WRC or the Department of Agriculture.
- Waters classified by DWQ as WS-I and WS-II are HQW by definition, but these waters are not specifically assigned the HQW classification because the standards for WS-I and WS-II waters are sometimes more stringent than those 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 an 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. The low density option requires a 30-foot vegetated buffer between development activities and the stream; whereas, the high density option requires structural stormwater controls. In addition, the Division of Land Resources requires more stringent erosion controls for land-disturbing projects within 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 including one or more of the following:

- an outstanding fisheries resource;
- a high level of water-based recreation;
- a special designation such as National Wild and Scenic River or a National Wildlife Refuge;
- within a state or national park or forest; or
- a special ecological or scientific significance.

The requirements for ORW waters are more stringent than those for HQWs. Special protection measures that apply to North Carolina ORWs are set forth in 15A NCAC 2B .0225. At a minimum, no new discharges or expansions are permitted, and a 30-foot vegetated buffer or stormwater controls for new developments are required. In some circumstances, the unique characteristics of the waters and resources that are to be protected require that a specialized (or customized) ORW management strategy be developed.

Nutrient Sensitive Waters

Nutrient sensitive waters (NSW) is a supplemental classification that the Environmental Management Commission may apply to surface waters that are experiencing or are subject to growths of microscopic or macroscopic vegetation. Nutrient strategies are developed to control these growths. For more information on NSW waters and nutrient strategies in the White Oak River, refer to page 62. Refer to 15A NCAC 2B .0223 for specifics on NSW rules.

Class SA Waters

The best uses of Class SA waters are for shellfishing for market purposes and any other usage specified by the "SB" or "SC" classification. Fecal coliform bacteria in class SA waters shall meet the current sanitary and bacteriological standards as adapted by the Commission for Health Services. Domestic wastewater discharges are not allowed, and there are provisions for stormwater controls. Refer to 15A NCAC 2B .0221 for specifics on water quality standards in Class SA waters.

Classifications and Standards in the White Oak River Basin

Most of the waters in the White Oak River basin are estuarine or swampy. There are 1,235 acres of HQW waters, 60,494 acres of ORW waters, and 10,565 acres and 203 stream miles of NSW waters (Figure A-13). There are also 117,085 acres of Class SA waters (Figure 14). Appendix III lists the individual indexed segments along with its classification.

Figure A-13 High Quality Waters, Outstanding Resource Waters and Nutrient Sensitive Waters in the White Oak River Basin

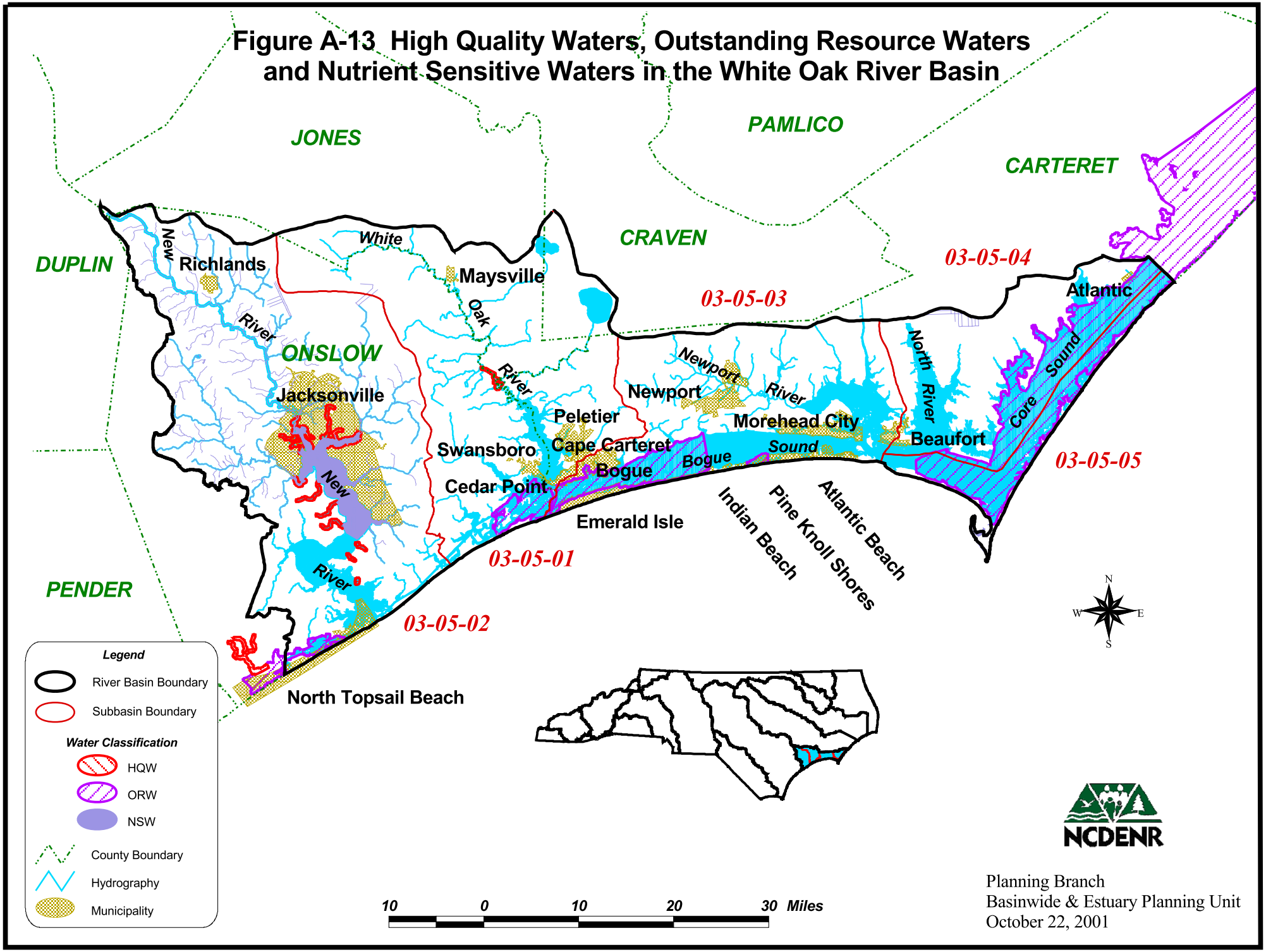

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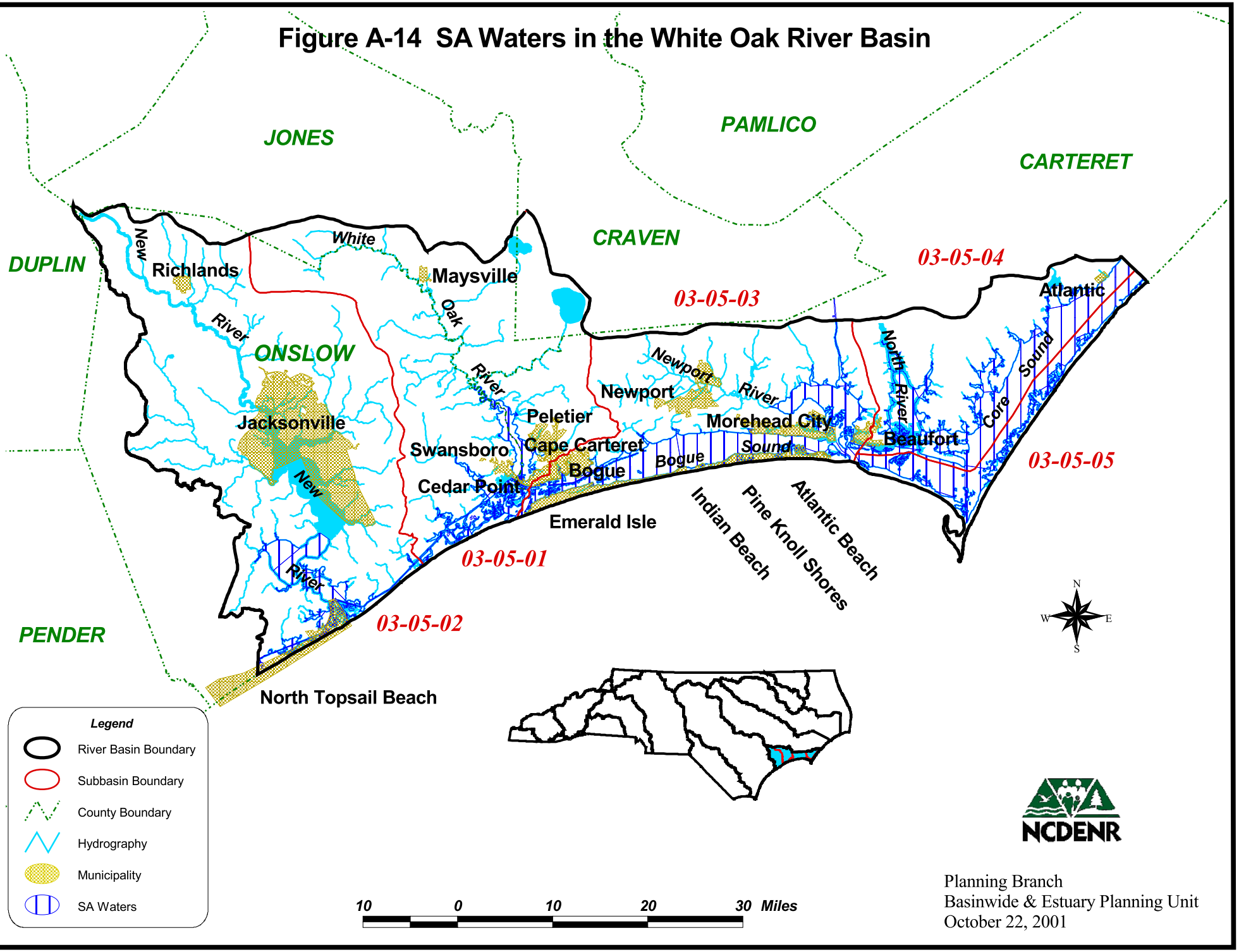
Figure A-14 SA Waters in the White Oak River Basin



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3.3 DWQ Water Quality Monitoring Programs in the White Oak River Basin

Staff in the Environmental Sciences Branch and Regional Offices of DWQ collect a variety of biological, chemical and physical data. The following discussion contains a brief introduction to each program, followed by a summary of water quality data in the White Oak River basin for that program. For more detailed information on sampling and assessment of streams in this basin, refer to the *Basinwide Assessment Report* for the White Oak River basin, available from the Environmental Sciences Branch website at http://www.esb.enr.state.nc.us/bar.html or by calling (919) 733-9960.

DWQ monitoring programs for the White Oak River Basin include:

- benthic macroinvertebrates (Section 3.3.1)
- fish assessments (Section 3.3.2)
- aquatic toxicity monitoring (Section 3.3.3)
- ambient monitoring system (Section 3.3.4)

3.3.1 Benthic Macroinvertebrates

Benthic macroinvertebrates, or benthos, are organisms that live in and on the bottom substrates of rivers, streams, swamps and estuaries. These organisms are primarily aquatic insect larvae in freshwater and polychyeates, mollusks and crustaceans in saltwater. 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 a few weeks to over one year, the effects of short-term pollution (such as a spill) will generally not be overcome until the following generation appears. The benthic community also integrates the effects of a wide array of potential pollutant mixtures.

Criteria have been developed to assign a bioclassification 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), commonly referred to as EPTs, and a Biotic Index value, which gives an indication of overall community pollution tollerance. Different benthic macroinvertebrate criteria have been developed for different ecoregions (mountains, piedmont and coastal plain) within North Carolina. Bioclassifications fall into five categories ranging from Poor to Excellent.

Extensive evaluation of swamp streams across eastern North Carolina suggests that current coastal plain criteria are not appropriate for assessing the condition of water quality in these special systems. Swamp streams are characterized by slower flow, lower dissolved oxygen, lower pH, and sometimes very complex braided channels and dark-colored water. DWQ is working to develop biological criteria for swamps. Criteria for estuaries have also been proposed, but not yet adopted, that may be used in the future to assign bioclassifications to these waters. Refer to page 59 for more detailed information on development of criteria.

Overview of Benthic Macroinvertebrate Data

Appendix A-II lists all the benthic macroinvertebrate collections in the White Oak River basin between 1983 and 1999, giving site location, collection date, taxa richness, biotic index values and bioclassifications. Most of the benthic macroinvertebrates were collected from swamp or estuarine sites and not used to develop use support ratings. Refer to page 59 for more information on biological monitoring issues.

3.3.2 Fish Community Assessments

During the late 1990s, application of the NCIBI has been restricted to wadeable streams that can be sampled by a crew of 2-4 persons using backpack electrofishers and following the DWQ Standard Operating Procedures (NCDEHNR, 1997). Work began in 1998 to develop a fish community boat sampling method that could be used in non-wadeable 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 solid criteria can be developed to evaluate biological integrity of large streams and rivers using the fish community.

Overview of Fish Tissue Sampling

Fish tissue surveys were conducted by DWQ at three stations within the basin from 1994 to 1999. These surveys were conducted as part of special mercury contamination assessments in the eastern part of the state and during routine basinwide assessments.

The majority of fish tissue samples collected from the White Oak River basin in 1994 and 1999 contained metal and organic contaminants at undetectable levels or levels less than the EPA, Food and Drug Administration, and State of North Carolina consumption criteria. Fish tissue samples were also collected by the Division of Marine Fisheries in the Atlantic to assess mercury levels in king mackerel. Mercury levels appear to be elevated for larger fish. For more detailed information regarding these sampling events and fish consumption advisories, refer to page 61.

White Oak River Basin Fish Kills

The Division of Water Quality has systematically monitored and reported on fish kill events across the state since 1996. Field investigators reported 14 fish kill events in the White Oak River basin from 1994 to 1999. Most events occurred in subbasin 03-05-02 on the New River near Jacksonville.

During June 1995, a large kill of approximately 3,000 fish occurred from the headwaters of the New River to Jacksonville due to a dike rupture at the Ocean View Farms LTD, near the Town of Richlands. A spill of 25 million gallons of hog waste into the New River depleted dissolved oxygen to lethal levels in the river for at least five days. Other large kills on the New River often involved menhaden and were attributed to low dissolved oxygen concentrations and to diseases (NCDENR, 1999a).

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.

Four active facility permits in the White Oak River basin currently require whole effluent toxicity (WET) monitoring with a limit. The compliance rates of these four facilities, in recent years, have stabilized at approximately 95-100% (Figure A-15).

The discharges located at the USMC Camp Lejeune base were consolidated into a single advanced wastewater treatment plant at Frenchs Creek in October of 1998. Prior to then, some of the discharges experienced toxicity problems associated with excess total residual chlorine from the time they initiated monitoring in 1990 until mid-1992. Since consolidating the Camp Johnson, the Hadnot Point 001 and the Tarawa Terrace discharges, the Hadnot Point 002 facility has been in compliance with its permit limits.

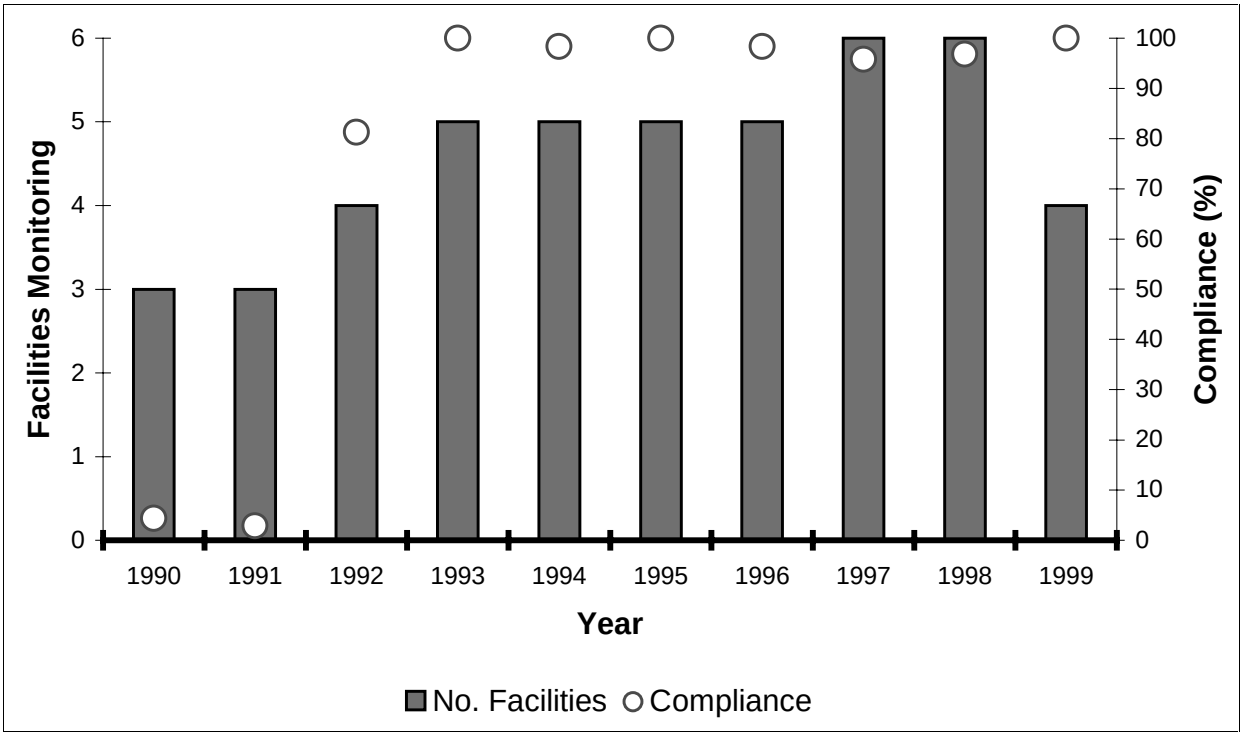


Figure A-15 Summary of Compliance with Aquatic Toxicity Tests in the White Oak River Basin

3.3.4 Ambient Monitoring System Program

The Ambient Monitoring System (AMS) is a network of stream, lake and estuarine sample stations strategically located for the collection of physical and chemical water quality data. North Carolina has 20 stations in the White Oak River basin (Table A-16). There was a decrease in nutrients and fecal coliform bacteria at the New River station near Gum Branch. Six stations had a high proportion of samples with less than 5.0 mg/l of dissolved oxygen (DO) that was attributed mostly to drainage from swampy areas. Extremely low DO was observed following hurricanes. There were also noted increases in turbidity and total suspended solids during periods of runoff.

Eleven additional stations were established in the New River Estuary to evaluate water quality after removal of several discharges in this subbasin. The stations have also been used to monitor algal community activity in the New River. Refer to page 62 for more information.

Fecal coliform bacteria are widely used as an indicator of the potential presence of pathogens typically associated with the intestinal tract of warm-blooded animals. The water quality standard for fecal coliform bacteria is based on a geometric mean of 200 colonies/100ml except in SA waters where waters shall meet the current sanitary and bacteriological standards as adapted by the Commission for Health Services. DEH Shellfish Sanitation does extensive monitoring of estuarine waters for fecal coliform bacteria as part of a shellfish sanitation program and beach monitoring program. Most of the impairment in the White Oak River basin is related to fecal coliform bacteria contamination of Class SA waters. Refer to page 49 for more information on shellfish harvesting issues.

Table A-16 Ambient Monitoring System Stations within the White Oak River Basin

Primary No	STORET No	Station Name	Subbasin
White Oak River Drainage			
02092744	P6400000	White Oak River near Stella NC	03-05-01
02137500	P6850000	White Oak River at Swansboro NC	03-05-01
New River Drainage			
O2093000	P0600000	New River at SR 1313 near Gum Branch NC	03-05-02
O2093032	P1200000	New River at US Hwy 17 at Jacksonville NC	03-05-02
O209317585	P3100000	Little Northeast Creek @ SR 1406 near Jacksonville NC	03-05-02
O2093186	P3700000	Northeast Creek at NC Hwy 24 @ Jacksonville NC	03-05-02
O209319360	P4400000	Wallace Creek @ River Drive @ Camp Lejeune NC	03-05-02
O2093197	P4750000	New River near Sneads Ferry NC	03-05-02
Newport River Drainage			
O2092702	P7300000	Newport River at SR 1247 at Newport NC	03-05-03
WOK037C	P8700000	Newport River @ CM G1 @ Newport Marshes	03-05-03
WOK039C4	P8965500	Morehead City Harbor @ CM G15 near Morehead City	03-05-03
O209270870	P9580000	Bogue Sound @ CM G15 near Salter Path NC	03-05-03
O209270940	P9600000	Bogue Sound at Emerald Isle NC	03-05-03
North River Drainage			
O209270760	P8975000	North River @ US Hwy 70 near Bettie NC OPGF-Q	03-05-04
O209270780	P8976000	Ward Creek @ US Hwy 70 near Otway NC OPGF-Q	03-05-04
O209268982	P8978000	Broad Creek @ US Hwy 70 near Masontown NC OPGF-Q	03-05-04
O209270790	P8990000	North River at CM R56 near Beaufort NC	03-05-04
Coastal Drainage			
WOK045	P9720000	Back Sound at CM G3 at Harkers Island NC	03-05-04
WOK046	P9730000	Core Sound @ CM R36 near Jarrett Bay	03-05-04
WOK047	P9740000	Core Sound @ CM G1 @ entrance to Nelson Bay CA	03-05-04

3.3.5 Division of Environmental Health Shellfish Sanitation and Recreational Water Quality Section

The Shellfish Sanitation and Recreational Water Quality Section of the Division of Environmental Health is responsible for monitoring and classifying coastal waters as to their suitability for shellfish harvesting for human consumption and inspection and certification of shellfish and crustacea processing plants. The section also administers the recreational beach monitoring program and posts advisories under the guidance of the State Health Director of those waters not suitable for bodily contact activities.

The Shellfish Sanitation Program is conducted in accordance with the guidelines set by the Interstate Shellfish Sanitation Conference (ISSC) contained in the *National Shellfish Sanitation Program (NSSP) Guide for the Control of Molluscan Shellfish Model Ordinance*. The NSSP is administered by the US Food and Drug Administration (FDA). Classifications of coastal waters for shellfish harvesting are done by means of a Sanitary Survey, which includes: a shoreline survey of sources of pollution, a hydrographic and meteorological survey, and a bacteriological survey of growing waters. Sanitary Surveys are conducted of all potential shellfish growing areas in coastal North Carolina and recommendations are made to the Division of Marine Fisheries of which areas should be closed for shellfish harvesting.

The Recreational Beach Monitoring Program determines the quality of coastal waters and beaches for suitability for bodily contact activities. Shoreline surveys of potential sources of pollution that could affect the area are also conducted. Swimming advisories are posted when bacteriological standards are exceeded or point source discharges are found.

Water samples are collected and analyzed for fecal coliform bacteria from numerous sampling stations located throughout the coastal area for both the shellfish and recreational programs. The recreational monitoring program also tests waters for *Escherichia coli*. The White Oak River basin comprises 17 shellfish growing areas with 377 stations sampled a minimum of six times per year. The recreational monitoring program has 63 sampling stations located in the White Oak River basin that are sampled approximately 24 times per year. Refer to page 49 for more information on shellfish harvesting issues.

3.4 Other Water Quality Research

There are many other water quality sampling programs being conducted throughout the White Oak River basin. Any data submitted to DWQ from other water sampling programs conducted in the White Oak River basin have been reviewed. These research efforts may be used by DWQ to adjust the location of biological and chemical monitoring sites or to better assess impacts to waters. Some of the programs or research that developed these data are presented in Section C.

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 water supports its uses (*use support* status) is an important method of interpreting water quality data and assessing water quality. Surface waters are rated *fully supporting* (FS), *partially supporting* (PS) or *not supporting* (NS). The terms refer to whether the classified uses of the water (such as shellfish harvesting, aquatic life protection and swimming) are being met.

For example, waters classified for fishing and secondary contact recreation (Class SC for saltwater) are rated as fully supporting if data used to determine use support did not exceed specific criteria. However, if these criteria were exceeded, then the waters would be rated as PS or NS, depending on the degree of degradation. Waters rated PS or NS are considered to be impaired. Waters lacking data, or having inconclusive data, are listed as not rated (NR).

Use support ratings for surface waters:

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

Impaired waters categories:

- Partially Supporting
- Not Supporting

Historically, the non-impaired category was subdivided into fully supporting and fully supporting but threatened (ST). ST was used to identify waters that were fully supporting but had some notable water quality concerns and could represent constant, degrading or improving conditions. North Carolina's past use of ST was very different from that of the US Environmental Protection Agency (EPA), which uses it to identify waters that demonstrate declining water quality (EPA Guidelines for Preparation of the Comprehensive State Water Quality Assessments [305(b) Reports] and Electronic Updates, 1997). Given the difference between the EPA and North Carolina definitions of ST and the resulting confusion that arises from this difference, North Carolina no longer subdivides the non-impaired category. However, these waters and the specific water quality concerns remain identified in the subbasin chapters in Section B so that data, management and the need to address the identified concerns are not lost.

Beginning in 2000 with the Roanoke River basin, an approach to assess ecosystem health and human health risk is applied to use support categories. Six categories are used to assess this approach: aquatic life and secondary recreation, fish consumption, shellfish harvesting, primary recreation, water supply and "other" uses. Each of these categories relates to the primary classifications applied to NC rivers and streams. A single water could have more than one use support rating corresponding to one or more of the multiple use support categories. For many waters, a use support category will not be applicable (NA) to the best use classification of that water (e.g., drinking water supply is not the best use of a Class C water).

This method of determining use support differs from that done prior to 2000; in that, there is no *overall* use support rating for a water. For more detailed information regarding use support methodology, refer to Appendix III.

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

Section 303(d) of the Clean Water Act requires states to identify waters not meeting standards. EPA must then provide review and approval of the listed waters. A list of 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 IV for a description of 303(d) listing methodology.

Waters are placed on North Carolina's 303(d) list primarily due to a partially or not supporting use support rating. These use support ratings are based on biological and chemical data. When the state water quality standard 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 biological ratings or water quality standards.

The 303(d) list and accompanying data are updated as the basinwide 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 lower, use support rating. Attention remains focused on these waters until water quality standards are being met.

3.5.3 Use Support Ratings for the White Oak River Basin

Aquatic Life and Secondary Recreation

The aquatic life/secondary recreation use support category is applied to all waters in North Carolina. Therefore, this category is applied to the total number of stream miles (416.9), estuarine acres (131,215.9), and coastal miles (91) in the White Oak River basin. Table A-17 presents use support ratings by subbasin for both monitored and evaluated waters in the aquatic life/secondary recreation category. A basinwide summary of current aquatic life/secondary recreation use support ratings is presented in Table A-18.

Approximately 13 percent of stream miles (54 mi.) and 87 percent of estuarine acres (114,565) were monitored for the protection of aquatic life and secondary recreation by DWQ during this basinwide planning cycle. The 91 miles of Atlantic coastline are not currently monitored by DWQ to assess the aquatic life and secondary recreation use support category. There were no impaired stream miles and no impaired estuarine waters in this use support category in the basin during this planning cycle.

Table A-17 Aquatic Life/Secondary Recreation Use Support Ratings for Monitored and Evaluated Waters Listed by Subbasin in Miles and Acres (1995-1999)

Subbasin	Fully Supporting	Partially Supporting	Not Supporting	Not Rated	Total
03-05-01	39.0 mi. 9,658 ac	0 0	0 0	77.0 mi. 2,862.8 ac 8 coastal mi.	116.0 mi. 12,520.8 ac 8 coastal mi.
03-05-02	28.4 mi. 17,997.8 ac	0	0	174.3 mi. 4,497.9 ac 15 coastal mi.	208.4 mi. 22,495.7 ac 15 coastal mi.
03-05-03	0 mi. 31,113.4 ac	0	0	86.9 mi. 3,611.3 ac 25 coastal mi.	86.9 mi. 34,726.8 ac 25 coastal mi.
03-05-04	4.4 mi. 37,705.8	0	0	1.2 mi. 1,792.4 ac	5.6 mi. 39,498.2 ac
03-05-05	21,975.2 ac	0	0	43 coastal mi.	21,975.2 ac 43 coastal mi.
Total Miles **Total Acres** **Total Coast Miles**	**71.8** **118,450**	**0** **0**	**0** **0**	**339.4** **12,766** **91**	**416.9** **131,215.9** **91**
Percent miles	17%	0%	0%	83%	100%
Percent acres	90%	0%	0%	10%	100%

Table A-18 Aquatic Life/Secondary Recreation Use Support Summary Information for Waters in the White Oak River Basin (1999)

Aquatic Life/Secondary Recreation Use Support Ratings	Monitored, Evaluated and Not Rated Streams*			Monitored Streams Only**	
	Miles or Acres	%		Miles or Acres	%
Fully Supporting	**71.8 mi. 118,450 ac**	**17.0% 90%**		**54 mi. 114,565 ac**	**13% 87%**
Impaired	**0**	**0%**		**0**	**0%**
Partially Supporting	*0*	*0%*		*0*	*0%*
Not Supporting	*0*	*0%*		*0*	*0%*
Not Rated	**339.4 mi. 12,766 ac**	**83% 10%**		**84.9 mi. 721 ac**	**20% 0.5%**
Total	**416.9 mi. 131,216.4 ac**			**139 mi. 115,286 ac**	

* = Percent based on total of all waters, both monitored and evaluated. ** = Percent based on total of all monitored waters.

Fish Consumption

Like the aquatic life/secondary recreation use support category, the fish consumption use support category is also applied to all waters in the state. Approximately 7.5 percent of stream miles (31.3 miles) and 100 percent of Atlantic coastline (91 miles) in the White Oak River basin were

monitored for the fish consumption use support category during this basinwide cycle. Fish consumption use support ratings are based on fish consumption advisories issued by the NC Department of Health and Human Services (DHHS). Currently, there is a statewide advisory limiting consumption of bowfin due to high mercury concentrations. Because of this advisory, all waters in the state are considered partially supporting the fish consumption use. Refer to page 61 for more information on fish consumption advisories.

Table A-19 presents use support ratings by subbasin for monitored streams in the fish consumption use support category. A basinwide summary of current fish consumption use support ratings is presented in Table A-20.

Table A-19 Fish Consumption Use Support Ratings for Monitored Waters Listed by Subbasin (1994-1999)

Subbasin	Fully Supporting	Partially Supporting	Not Supporting	Not Rated	Total
03-05-01	0	8 coastal miles	0	0	8 coastal miles
03-05-02	0	15 coastal miles 31.3 stream miles	0	0	15 coastal miles 31.3 stream miles
03-05-03	0	25 coastal miles	0	0	25 coastal miles
03-05-04	0	0	0	0	0
03-05-05	0	43 coastal miles	0	0	43 coastal miles
Total	**0**	91 coastal miles 41 stream miles	**0**	**0**	91 coastal miles 41 stream miles
Percent	0%	100%	0%	0%	100%

Table A-20 Fish Consumption Use Support Summary Information for Waters in the White Oak River Basin (2000)

Fish Consumption Use Support Ratings	Monitored, Evaluated and Not Rated Streams*			Monitored Streams Only**	
	Miles or Acres	%		Miles or Acres	%
Fully Supporting	**0**			**0**	
Impaired	**416.8 mi. 131,216.7 ac 91 coastal miles**	**100%**		**31.3 mi. 91 coastal miles**	**7.5% 100%**
Partially Supporting	*416.8 mi. 131,216.7 ac 91 coastal miles*	*100%*		*31.3 mi. 91 coastal miles*	*7.5% 100%*
Not Supporting	*0*			*0*	
Not Rated	**0**			**0**	
TOTAL	**416.8 mi. 131,216.7 ac 91 coastal miles**			**31.3 mi. 91 coastal miles**	

* = Percent based on total of all streams, both monitored and evaluated. ** = Percent based on total of all monitored streams.

Primary Recreation

There are 36.3 stream miles, 91 coastal miles and 118,131.7 estuarine acres currently classified for primary recreation in the White Oak River basin. Approximately 80 percent of estuarine acres were monitored by DWQ over the past five years and by Division of Environmental Health Shellfish Sanitation over the last two years; all are fully supporting the primary recreation use. Table A-21 presents use support ratings by subbasin for monitored streams in the primary recreation use support category. A basinwide summary of current primary recreation use support ratings is presented in Table A-22.

Table A-21 Primary Recreation Use Support Ratings for Monitored Waters Listed by Subbasin (1994-1999)

Subbasin	Fully Supporting	Partially Supporting	Not Supporting	Not Rated	Total
03-05-01	0 mi. 7,298.8 ac 8 coastal miles	0	0	6.6 mi. 3,940.4 ac	6.6 mi. 11,239.2 ac 8 coastal miles
03-05-02	0 mi. 9,051.1 ac 15 coastal miles	0	0	9.3 mi. 2,520 ac	9.3 mi. 11,571.1 ac 15 coastal miles
03-05-03	0 mi. 22,895 ac 25 coastal miles	0	0	17.7 mi. 11,274.4 ac	17.7 mi. 34,169.4 ac 25 coastal miles
03-05-04	0 mi. 33,283.9 ac	0	0	2.7 mi. 5,893 ac	2.7 mi. 39,176.9 ac
03-05-05	0 mi. 21,975.2 ac 43 coastal miles	0	0	0	0 mi. 21,975.2 ac 43 coastal miles
Total	0 mi. 94,503.9 ac 91 coastal miles	0	0	36.3 mi. 23,627.9 ac	36.3 mi. 118,131.8 ac 91 coastal miles
Percent	80% ac 100% coastal miles	0%	0%	100% mi. 20% ac	100%

Table A-22 Primary Recreation Use Support Summary Information for Waters in the White Oak River Basin (1999)

Primary Recreation Use Support Ratings	Monitored, Evaluated and Not Rated Streams*			Monitored Streams Only**	
	Miles or Acres	%		Miles or Acres	%
Fully Supporting	**94,503.9 ac 91 coastal miles**	**80% 100%**		**94,503.9 ac 91 coastal miles**	**80%**
Impaired	**0**	**0**		**0**	**0**
Partially Supporting	*0*	*0*		*0*	*0*
Not Supporting	*0*	*0*		*0*	
Not Rated	**36.3 mi. 23,627.9 ac**	**100% 20%**		**0.0**	
TOTAL	**36.3 mi. 118,131.8 ac 91 coastal miles**			**94,503.9 ac 91 coastal miles**	

* = Percent based on total of all streams, both monitored and evaluated. ** = Percent based on total of all monitored streams.

Shellfish Harvesting

There are 32 stream miles and 117,659 estuarine acres classified for shellfish harvesting (Class SA) in the White Oak River basin. All were monitored during the past five years by DEH Shellfish Sanitation (refer to page 40). Table A-23 presents use support ratings by subbasin for monitored streams in the shellfish harvesting use support category. A basinwide summary of current shellfish harvest use support ratings is presented in Table A-24. For more information on shellfish harvesting issues, refer to page 49.

Table A-23 Shellfish Harvesting Use Support Ratings for Monitored Waters Listed by Subbasin (1994-1999) in Acres

Subbasin	Fully Supporting	Partially Supporting	Not Supporting	Not Rated	Total
03-05-01	4,608.6	3,581.3	3,049.3	0	11,239.2
03-05-02	8,691.3	1,711	719.5	0	11,122.2
03-05-03	26,683.2	2,762.5	4,699.8	0	34,145.5
03-05-04	27,641.8	10,132.1	1,403	0	39,176.9
03-05-05	21,975.2	0	0	0	21,975.2
Total	89,600.1	18,186.9	9,871.6	0	117,659
Percent	76%	16%	8%	0%	100%

Table A-24 Shellfish Harvest Use Support Summary Information for Waters in the White Oak River Basin (1999)

Shellfish Harvest Use Support Ratings	Monitored Streams	
	Acres	%
Fully Supporting	**89,601**	**76%**
Impaired	**28,058**	
Partially Supporting	***18,187***	***16%***
Not Supporting	***9,872***	***8%***
Not Rated	**0**	**0%**
Total	**117,659**	

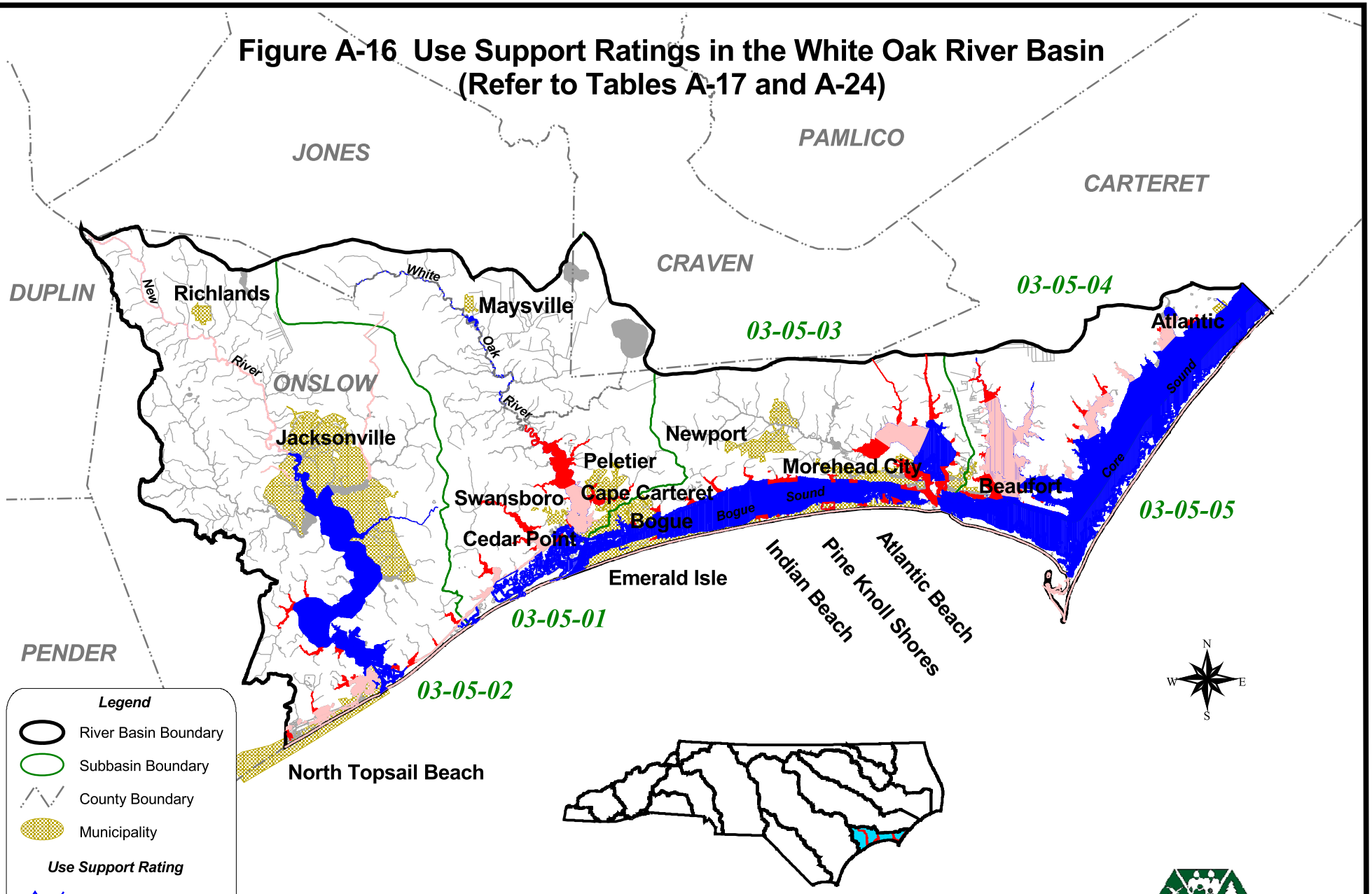
Note: There are also 30 of 32 Class SA stream miles that are considered impaired as well.

Use Support Summary

There are no impaired stream miles or estuarine acres in the aquatic life and secondary recreation use support category and no impaired waters in the primary recreation use support category. All waters are considered impaired for the fish consumption use support category due to a statewide fish consumption advisory for bowfin, although only three streams and the Atlantic Ocean were monitored to assess this category. There are 28,058 estuarine acres impaired for the shellfish harvesting use support category. The water supply use support category was not assessed in this basin because there are no surface water drinking water supplies. Descriptions of impaired segments, as well as problem parameters, are outlined in Appendix III. Management strategies for each water are discussed in detail in the appropriate subbasin chapter.

Color maps showing current use support ratings for the White Oak River basin are presented in Figure A-16. Only waters where fish tissue has been monitored during this basinwide cycle are shown as impaired for fish consumption on the maps. When use support ratings have been assigned to more than one category for a particular water, the rating that represents the most severe impairment is shown on the map.

Figure A-16 Use Support Ratings in the White Oak River Basin
(Refer to Tables A-17 and A-24)



Planning Branch
Basinwide & Estuary Planning Unit
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Chapter 4 -
Water Quality Issues Related to Multiple Watersheds in the White Oak River Basin

4.1 Overview

The 1997 White Oak River Basinwide Water Quality Management Plan included a number of recommendations to address water quality issues in the basin. Some of these recommendations were pertinent to several watersheds or the basin as a whole, while others were specific to a particular stream or area within a subbasin. Status of the more specific recommendations is reported within the subbasin chapters in Section B. This chapter will present issues that are not related to a specific watershed.

4.2 Shellfish Harvesting Issues

Water polluted by human or animal wastes can harbor numerous pathogens that may threaten human health. This is of particular concern in waters where shellfish are harvested for human consumption. Because of the tendency of clams and oysters to concentrate the material they filter from the water column, shellfish can potentially become too contaminated for safe consumption by humans, even when fecal coliform concentrations are relatively low. Therefore, while water quality may be safe enough for swimming, fishing or other forms of recreation, the waters may be closed to shellfish harvesting and require both corrective and preventive action.

Since routine tests for individual pathogens are not practical, fecal coliform bacteria are widely used as an indicator of the potential presence of disease-causing microorganisms. Fecal coliform bacteria are typically associated with the intestinal tract of warm-blooded animals, and their number is generally assumed to be correlated with the number of pathogens in a water sample. They enter surface waters from a number of sources including urban stormwater, agricultural runoff, improperly designed or managed animal waste facilities, failing on-site wastewater systems, broken sewer lines, improperly treated discharges of domestic wastewater, and wild or domestic animal waste.

There are 117,659 acres of shellfish harvesting waters (Class SA) in the White Oak River basin. There are 28,058 (24%) acres currently rated as impaired in the shellfish harvesting use support category. Many of the impaired waters are in areas that have a high value shellfish resource. The following sections describe programs that monitor shellfish harvesting waters, methods for determining use support in class SA waters, and recommendations for addressing impairment class SA waters.

4.2.1 Division of Environmental Health Shellfish Sanitation (DEH SS)

Division of Environmental Health Shellfish Sanitation (DEH SS) is the agency responsible for monitoring shellfish and shellfish harvesting waters in North Carolina to evaluate the risk to

public health from consuming shellfish meats (refer to page 40). DEH SS monitors all coastal waters that have the potential to support shellfish. Table A-25 and the following paragraphs describe DEH SS growing area classifications. In the White Oak River basin, there are approximately 130,000 acres of estuarine waters (SC, SB and SA) monitored by DEH SS. Waters are closed to shellfish harvest because of contamination by fecal coliform bacteria.

Table A-25 DEH Shellfish Sanitation Growing Area Classifications

DEH Classification	DEH Criteria
Approved	The median fecal coliform Most Probable Number (MPN) or geometric mean MPN of water shall not exceed 14 per 100 milliliters, and the estimated 90th percentile shall not exceed an MPN of 43 per 100 milliliters for a five tube decimal dilution test.
Conditionally Approved-Open	Sanitary Survey indicates an area can meet approved area criteria for a reasonable period of time, and the pollutant event is known and predictable and can be managed by a plan.
Conditionally Approved-Closed	Sanitary Survey indicates an area can meet approved area criteria for a reasonable period of time, and the pollutant event is known and predictable and can be managed by a plan.
Restricted	Sanitary Survey indicates limited degree of pollution, and the area is not contaminated to the extent that consumption of shellfish could be hazardous after controlled depuration or relaying.
Prohibited	No Sanitary Survey; point source discharges; marinas; data does not meet criteria for Approved, Conditionally Approved or Restricted Classification.

Approved

There are 89,600 acres of shellfish harvesting (Class SA) waters that are classified as approved by DEH Shellfish Sanitation in the White Oak River basin. These areas are always open to shellfishing harvesting and close only after rare heavy rainfall events such as hurricanes.

Conditionally Approved-Open Shellfish Areas

There are 18,187 acres of shellfish harvesting (Class SA) waters that are classified as conditionally approved-open by DEH Shellfish Sanitation in the White Oak River basin. This growing area classification allows for the utilization of valuable shellfish resources by permitting harvesting when environmental conditions result in fecal coliform bacteria levels lower than the state standard in areas that otherwise might be closed to harvesting. These areas are open to harvesting much of the year, but are immediately closed after certain rainfall events (refer to DEH Shellfish Sanitation growing area management plans for specific closure strategies). There are concerns that these areas may be closed more often and stay closed for longer periods as development proceeds in coastal areas adjacent to Class SA waters. Refer to the subbasin chapters in Section B for more specific information on individual conditionally approved-open waters.

Conditionally Approved-Closed Shellfish Areas

There are 4,007 acres of shellfish harvesting (Class SA) waters that are classified as conditionally approved-closed by DEH Shellfish Sanitation in the White Oak River basin. This growing area

classification allows for the utilization of valuable shellfish resources by permitting harvesting when environmental conditions result in fecal coliform bacteria levels lower than state standards in areas that are typically closed to shellfish harvesting. These areas are regularly monitored to determine if temporary openings are possible. These waters are rarely opened to shellfish harvesting. Refer to the subbasin chapters in Section B for more specific information on individual conditionally approved-closed waters.

Prohibited/Restricted Shellfish Harvest Areas

There are 5,865 acres of shellfish harvesting (Class SA) waters that are prohibited or restricted for shellfish harvesting in the White Oak River basin. Most of these areas receive runoff that consistently results in fecal coliform bacteria levels above the state standard. As noted above, the sources of fecal coliform bacteria may be many. DEH Shellfish Sanitation shoreline surveys attempt to identify possible sources. In many areas, the contamination may be from several different sources at different times of the year.

4.2.2 Changes in Shellfish Harvesting Use Support Assessment

The 1997 White Oak River basin use support assessment rated approved waters as fully supporting, conditionally approved waters as fully supporting but threatened (ST), and prohibited waters as partially supporting (PS). As described on page 41, the ST subcategory of fully supporting is no longer used. In the 1997 assessment, there were 109,934 acres rated FS and 11,941 acres rated partially supporting (PS). Of the impaired acres, 3,005 were in Class SC waters where DEH classifications were not used to make use support determinations. Class SA acres were reported by the 17 DEH SS growing areas (e.g., C1: Chadwick Bay, 223 acres). For the 2001 White Oak River basin assessment, DWQ will use an interim frequency of closures based method to assign use support ratings to Class SA waters.

Interim Frequency of Closures Based Method

DWQ and DEH SS are developing the database and expertise necessary to assess shellfish harvesting use support using a frequency of closure based approach. This database will allow DWQ to better assess the extent and duration of closures in Class SA waters. These tools are not available for use support determinations in Class SA waters for the 2001 White Oak River basin assessment. DWQ believed it important to identify frequency of closures in these waters, so an interim methodology was used based on existing databases and GIS shapefiles. There will likely be changes in reported acreages in future assessments using the permanent methods and tools that define areas and closure frequency.

Based on preliminary evaluation of DEH SS Reports of Sanitary Survey for the White Oak River basin growing areas, conditionally approved-closed and prohibited/restricted Class SA waters were closed from 87 percent to 100 percent of the time. These waters are rated not supporting (NS) for shellfish harvesting. Approved Class SA waters were closed less than 10 percent of the time and are rated fully supporting (FS) for shellfish harvesting. The conditionally approved-open Class SA waters were found to be closed from 4.67 percent to 21 percent of the time. After more rigorous evaluation (described below) of the conditionally approved-open waters in the

White Oak River basin, interim frequency of closure based use support ratings of partially supporting were assigned.

DWQ worked with DEH SS to determine the number of days and acreages that identified conditionally approved-open Class SA waters were closed to shellfish harvesting in the White Oak River basin during the assessment period (September 1, 1994 to August 31, 1999). For each of the eight growing areas with conditionally approved-open Class SA waters, DEH SS and DWQ staff defined subareas (within the larger conditionally approved-open area) that were opened and closed at the same time. The number of days these conditionally approved-open waters were closed was determined using proclamation summary sheets and the original proclamations. The number of days that approved areas in the growing area were closed due to pre-emptive closures because of named storms was not counted. For example, all waters in growing area E-9 were pre-emptively closed for Hurricane Fran on September 5, 1996. Approved waters were reopened September 20, 1996. Nelson Bay (conditionally approved-open) was reopened September 30, 1996. This area was considered closed for 10 days after the approved waters were reopened.

It is important to note that the interim methodology makes use support determinations and reports acreages using existing closure data and non-georeferenced areas. Future assessments using the permanent methodology will likely report different acreages that may not necessarily be associated with water quality changes or changes in DEH SS growing area classifications. Changes that are related to water quality or DEH SS growing area reclassifications will be explained in detail in the subbasin chapters. Refer to Appendix III and the subbasin chapters in Section B for more specific information on individual waters.

4.2.3 Addressing Impaired Shellfish Harvesting Waters

Fecal coliform bacteria are the primary pollutant that causes closures in shellfish harvesting waters. Fecal coliform bacteria are relatively short lived in saltwater. Many of the impacted waters are where freshwater flows from the land into shellfish harvesting areas. Larger waters like the Newport and North Rivers are impacted from the cumulative effect of freshwater runoff transporting bacterial contaminants farther out into the estuary. The runoff increases with increasing development (impervious surface). Research over the past 15 years consistently demonstrates a strong correlation between the imperviousness of a drainage basin and the health of its receiving waters (Arnold and Gibbons, 1996). Mallin et al. (2000) showed that with increasing impervious surface there is an increase in fecal coliform delivery to estuarine waters. Larger waters like the Newport and North Rivers are being impacted from the cumulative effect of freshwater runoff from increasing upstream development, which in turn is transporting bacterial contaminants farther out into the estuary. Restoration strategies that address the source and transport of bacterial contamination are more appropriate than developing complicated models, because of the complex hydrology of coastal waters and the life-cycle of fecal coliform bacteria.

A study by Duke University Marine Labs (Reilly and Kirby-Smith, 1999) developed recommendations to restore impaired shellfish harvesting waters that included controlling the sources of fecal coliform bacteria and slowing the movement of fecal coliform bacteria from source to receiving waters.

North Carolina Blue Ribbon Advisory Council on Oysters

The NC Blue Ribbon Advisory Council on Oysters (NCBRACO) issued its final *Report on Studies and Recommendations* in October 1995. In the report, the council "reaches the inescapable conclusion that oyster harvests have declined sufficiently in North Carolina to justify bold new action and to require initiation of that action immediately."

The council's report along with a report from the Council's Public Bottom Production Committee makes a series of specific water quality recommendations (NC Blue Ribbon Advisory Council on Oysters, 1995). The objective of these recommendations is to "restore and protect coastal water quality to create an environment suitable for oysters that are safe for human consumption." These recommendations include, but are not limited to:

- Institution of regulatory mechanisms for control of NPS runoff, particularly fecal coliform bacteria and nutrients.
- Mandatory 100-foot buffers along all SA waters.
- Reducing the allowable built-upon area for low density development.
- Promote and fund research on oyster reefs that documents their positive impact on water quality.
- Urge the Marine Fisheries and Environmental Management Commissions to work together to establish and implement a "Use Restoration Waters" classification in order to restore closed shellfish beds.
- DEHNR should "augment its basinwide management plans to include mechanisms for controlling both point and nonpoint source nutrient additions" and "develop and fund a coastal water quality monitoring system capable of measuring oxygen levels in bottom waters in historically important shellfish grounds."
- Work with the NCDOT to reverse past road construction activity that has adversely affected oyster beds through restrictions on normal water flow.

The following sets of recommendations address or start to address some of the recommendations from the Blue Ribbon Advisory Panel listed above. The DENR agencies will first work to identify and quantify the extent and duration of shellfish harvest area closures. Then through education and involvement in land use plan review help, local governments identify these closed areas. The various agencies will work together with local governments to reduce frequency and duration of closures.

Recommendations for DENR Agencies to Address Impairment in Class SA Waters

Better Identification of Growing Areas and Database Development

To better identify impairment of shellfish waters, DWQ, DEH SS, DCM and DMF are developing the tools necessary to use a frequency of closures based assessment of Class SA waters as described on page 51. DWQ, DEH SS and DMF have received funding from the NC Coastal Nonpoint Source Program (described below) to georeference growing areas and monitoring sites and develop a new tracking database. Shellfish harvesting use support assessments will be completed for the next assessment period using these tools. The tools will also help:

- identify waters where bacterial contamination is increasing or decreasing with changes in land use;
- provide a means to share this information with the public and local governments; and
- identify areas where best management practices and restoration projects are needed, as well as providing a means of evaluating the implementation of these projects.

Continued Enforcement of DWQ ORW Program

In addition to the stringent water quality standards for Class SA waters, DWQ also has the supplemental classification of ORW (Outstanding Resource Waters) for 61,133 acres of Class SA waters in the White Oak River basin. The rules provide for stormwater management and shellfish habitat protection. Currently 3,155 acres (five percent) of Class SA ORW waters are considered impaired for shellfish harvesting in the White Oak River basin. These waters are more specifically identified in Section B subbasin chapters. DWQ will continue to implement this program.

Reclassification of Waters to Identify Shellfish Harvesting Uses

DWQ, DMF and DEH SS are pursuing the reclassification of segments of the New River that are currently classified as SC waters. These waters were recently reopened to shellfish harvesting by DMF based on recommendations from DEH SS after removal of discharges in these areas (refer to page 33). DWQ, DMF and DEH SS will continue to pursue reclassifications to Class SA of areas that are approved for shellfish harvesting.

Developing Coastal Habitat Protection Plans

DMF is in the process of developing Coastal Habitat Protection Plans (CHPP) with DWQ and DCM. These plans will identify existing and potential threats to habitats important to coastal fisheries and recommend actions to restore and protect them. The plans will also provide a framework for adoption of rules to protect habitats vital to coastal fisheries. The plans will help to assure consistent actions among the Coastal Resources Commission (CRC), Environmental Management Commission (EMC) and the Marine Fisheries Commission (MFC). The CHPPs for the New and White Oak Rivers and for the Core and Bogue Sounds are expected to be finalized in August 2002. For more information on these plans, contact the Habitat Protection Section at (252) 726-7021 or visit the CHPP website at http://www.ncfisheries.net/habitat/chpp1.htm.

Oyster and Clam Fisheries Management Plans Recommendations

The major recommendations of the most recent oyster and clam fisheries management plans include increasing use of existing authority to reverse trends in shellfish closures and to restore conditionally approved-open areas. For more information on these plans, contact the Division of Marine Fisheries at (252) 726-7021 or visit the website at http://www.ncfisheries.net/.htm.

North Carolina Coastal Nonpoint Source Program (Section 6217)

Section 6217 of the Federal 1990 Coastal Zone Act Reauthorization Amendments (CZARA) requires every state participating in the Coastal Zone Management Act program to develop a

Coastal Nonpoint Pollution Control Program(CNPCP). The purpose of this requirement, as stated in the Act, is to "strengthen the links between Federal and State coastal zone management and water quality management programs and to enhance State and local efforts to manage land use activities that degrade coastal waters and coastal habitats." To accomplish these goals, the federal agencies established 56 Management Measures that are to be used by each state to address the following nonpoint source pollution categories:

- *Agricultural Sources*
- *Forestry*
- *Urban Areas* (urban runoff; construction activities; existing development; on-site disposal systems; pollution prevention; and roads, highways and bridges)
- *Marinas and Recreational Boating* (siting and design; and marina and boat operation/maintenance)
- *Hydrologic Modification* (channelization and channel modification; dams; and streambank and shoreline erosion)
- *Wetlands, Riparian Areas and Vegetated Treatment Systems*

At the federal level, the CNPCP is administered jointly by the National Oceanic and Atmospheric Administration (NOAA) and the Environmental Protection Agency (EPA). Within North Carolina, the state program, referred to as the Coastal Nonpoint Source Program (CNPSP), is administered by DWQ and the DCM. The state program currently has one full-time staff person located in the Nonpoint Source Planning Unit of DWQ.

The core of the state's CNPSP will be increased through communication and coordination between DWQ and key state agencies that have regulatory responsibilities for controlling nonpoint sources of pollution. This increased dialogue will be facilitated in part by the state's CNPSP Coordinator and will allow for identification of gaps, duplications, inadequacies or inefficiency of existing programs and policies. Responsibilities of the state program coordinator will include participation in the NPS Workgroup to represent coastal water quality interests. The workgroup is involved with the continual refinement of the 319 Grant Program and development of North Carolina's 2001 NPS Management Program Update. The CNPSP Coordinator will also participate in the development and implementation of the basinwide management plans for the coastal draining rivers; serve as a liaison between DWQ and DCM; and participate in the development of nonpoint source educational materials. For more information about this program, contact the Coastal Nonpoint Source Program Coordinator at (919) 733-5083 or visit http://h2o.enr.state.nc.us/nps/czara.htm.

Implementation of Coastal Resources Commission 30-Foot Buffer Rules

In November 1999, the Coastal Resources Commission (CRC) enacted rules designed to protect coastal waters. The rules require a 30-foot buffer for new development along coastal shorelines in the 20 CAMA counties. The new rules became effective in August 2000. Visit http://dcm2.enr.state.nc.us/ for more information on these rules.

Land Use Planning

A Land Use Plan Review Team authorized by the CRC has recommended better implementation of land use plans and involvement of local governments in the basinwide planning process. In 1998, the CRC suspended the Coastal Area Management Act land use plan updates in order to review and improve the program. Seeking input from local stakeholders, DCM convened a group of external experts, the Land Use Plan Review Team, representing different interests in coastal North Carolina. In September 2000, the team provided the CRC with a set of recommendations to restructure the existing land use planning program. Since land use plans affect permit decisions, growth patterns and community visions, any revisions to the process can potentially have widespread impact to coastal decision-making and inevitably water quality. Therefore, DWQ will play an active role in land use planning discussions, especially with respect to water quality concerns.

The team developed several recommendations, some of which directly impact DWQ. DWQ provided feedback during the development of these recommendations, actively seeks to improve existing communication links with DCM, and continues to stay abreast of events as the recommendations evolve into implementation.

The new coastal land use planning guidelines under consideration by the CRC stress the importance of healthy water. From the requirements of the pre-planning scoping process to the elements of local plans, the new guidelines will ask local governments to do more to protect water quality. One of the goals of the proposed guidelines is to maintain, protect and, where possible, enhance water quality in all coastal wetlands, rivers, streams and estuaries. That effort begins at the local level. The guidelines will require local governments to adopt policies to ensure that coastal water quality is improved or maintained. Chief among these policies are those that prevent or control stormwater discharges, as it is a leading cause of water quality problems along the coast. Local policies, such as impervious surface limits, vegetated riparian buffer creation and wetlands protection, can help lessen the negative impacts of stormwater runoff on coastal waters. The guidelines also will require local governments to develop policies and land use categories that protect open shellfish waters and restore closed or conditionally approved shellfish waters. The Coastal Resources Commission anticipates the revision and adoption of new land use planning rules to go into effect by August 2002.

A detailed summary of the Land Use Plan Review Team recommendations is available through the DCM website at http://dcm2.enr.state.nc.us/. DWQ continues to support these team suggestions, including:

- Development of a "how to" manual to assist local governments in developing high quality land use plans.
- Involvement of coastal local governments in state basinwide planning and seeking application of a land use planning requirement in all areas of coastal river basins are strongly encouraged.
- Strengthen the ties between basinwide planning for water quality and CAMA land use plans, especially focusing on participation in basinwide planning. The team also recommends that the CRC coordinate with the Environmental Management Commission to expand the role of

local government and local land use plans in the basinwide water quality planning process. Three specific steps are recommended:

  - ► The database and strategies contained in the basinwide plans should be loosely tailored to the requirements for land use plans.
  - ► The EMC should incorporate local land use policies in basinwide plans.
  - ► Local governments should be encouraged by the CRC to participate in the scoping process for basinwide plans.

- Measures to encourage greater intergovernmental coordination in the development of land use plans.

DWQ will review local land use plans with DCM for communities in the White Oak River basin to help identify impaired or impacted shellfish harvesting waters and make recommendations to reduce future increases in bacterial contamination related to development and land use changes. DWQ will also support local government and community group endeavors to protect and improve shellfish harvesting waters. This will include providing educational opportunities to increase the understanding of technical issues, as well as assisting with identifying funds for restoration and protection projects.

Recommendations for Local Governments, Community Groups and White Oak River Basin Citizens to Address Impairment in Class SA Waters

Because of limited resources and authority, the various state agencies listed above cannot completely address impairment in shellfish harvesting waters. Shellfish harvesting is a potentially stable and sustainable economic resource for coastal areas and for the state. The state agencies can help to reduce temporary closures, restore areas that are permanently closed, and help in managing a healthy shellfish harvesting industry through existing regulations and authorities. Local governments, community groups and citizens have more local knowledge and are directly affected by a degraded coastal environment, and therefore, have a responsibility for protecting and restoring shellfish harvesting in coastal waters.

Local Governments

Local governments should consider water quality impacts in all aspects of government operations. Land use planning should discourage development in wetlands and areas draining to sensitive coastal areas. Land use plans should incorporate preservation and limited development of land adjacent to approved shellfish harvesting areas. Best management practices should be implemented during all land-disturbing activities to reduce runoff and delivery of bacterial contaminants to shellfish harvesting waters. Local governments with jurisdictions around the large areas of conditionally approved-open waters should work together and with the DENR agencies to develop strategies for reducing sources and delivery of bacterial contaminants to these waters in an effort to reduce the extent and duration of temporary closures. A long-term strategy should be put in place to eventually restore shellfish harvesting to prohibited areas where human activities have caused these closures.

Community Groups

Environmental groups, community organizations and fisherman groups should make efforts to address coastal water quality issues by becoming involved. Attendance and participation in DWQ's Basinwide Planning Program, The Coastal Habitat Protection Planning Program, City Council meetings, County Commissioner and Planning Board meetings will be essential in addressing coastal water quality issues.

Marina Operators

Many marina areas on the coast are closed to shellfish harvesting. Marina operators should enroll in programs like the Clean Marinas Program to minimize impacts of these activities on coastal water quality. For more information on this program, visit the NC Marine Trade Association's webpage at http://www.ncmta.com/ or call (910) 962-3351.

4.3 Growth and Development and Stormwater Management

Urbanization often has greater hydrologic effects than any other land use, as native watershed vegetation is replaced with impervious surfaces in the form of paved roads, buildings, parking lots, and residential homes and yards. Urbanization results in increased surface runoff and correspondingly earlier and higher peak flows after storms. Flooding frequency is also increased. These effects are compounded when small streams are channelized (straightened) or piped and storm sewer systems are installed to increase transport of drainage waters downstream. Bank scour from these frequent high flow events tends to enlarge urban streams and increases suspended sediment. Scouring also destroys the variety of habitat in streams leading to degradation of benthic macroinvertebrate populations and loss of fisheries (EPA, 1999).

The population in the White Oak River basin is expected to increase by 40,000 people in the next 15 years (OSP, 1999). Most of the growth will be on the coast and around existing urban areas. As populations expand, so do developed areas. Some local governments have prioritized water quality planning. However, proactive planning efforts at the local level are needed across the entire basin in order to assure that development is done in a manner that minimizes impacts to water quality. A lack of good environmental planning was identified by participants at the public workshops as a threat to water quality in the White Oak River basin.

Urban runoff also carries a wide variety of contaminants to streams including oil and grease from roads and parking lots, street litter, bacterial contaminates and pollutants from the atmosphere. Generally, there are a larger number of point source discharges in urban areas. Cumulative impacts from habitat alterations, point and nonpoint source pollution can cause severe impairment to urban streams.

The presence of intact riparian buffers and/or wetlands in urban areas can lessen these impacts, and restoration of these watershed features should be considered where feasible; however, the amount of impervious cover should be limited as much as possible. Wide streets, huge cul-de-sacs, long driveways and sidewalks lining both sides of the street are all features of urban development that create excess impervious cover and consume natural areas.

4.3.1 Planning Efforts

At the Governor's request, a series of public meetings were held across the state in 1999 to kick off the "21st Century Communities Task Force". The seven-member task force conducted public meetings to look at growth issues across the state. The task force will report its findings to a special legislative commission on growth and issue a final report in January 2001.

Public education is needed in the White Oak River basin in order for citizens to understand the value of urban planning and stormwater management. Action should be taken by county governments and municipalities to plan for new development in urban and rural areas. For more detailed information regarding recommendations for new development found in the text box, refer to EPA's website at www.epa.gov/owow/watershed/wacademy/acad2000/protection.

Proactive planning efforts at the local level are needed to assure that development is done in a manner that maintains water quality. These planning efforts will need to find a balance between water quality protection, natural resource management and economic growth. Growth management requires planning for the needs of future population increases, as well as developing and enforcing environmental protection measures. These actions are critical to water quality management and the quality of life for the residents of the basin.

Planning Recommendations for New Development

- Minimize number and width of residential streets.
- Minimize size of parking areas (angled parking & narrower slots).
- Place sidewalks on only one side of residential streets.
- Minimize culvert pipe and hardened stormwater conveyances.
- Vegetate road right-of-ways, parking lot islands and highway dividers to increase infiltration.
- Plant and protect natural buffer zones along streams and tributaries.

4.3.2 Stormwater Programs

In addition to the current NPDES stormwater permitting, DWQ is developing a permitting and program strategy to address the EPA proposed Phase II stormwater permitting program requirements. The Phase II program will be directed towards smaller municipalities and construction sites. At present, Phase II requirements will be handled with existing state staff. Onslow County and Jacksonville in the White Oak River basin will fall within the Phase II requirements. For more information on the state NPDES stormwater program, contact the Stormwater and General Permits Unit at (919) 733-5083.

DWQ administers a number of programs aimed at controlling stormwater runoff in the White Oak River basin. These include: 1) in the "coastal" counties as defined by the Coastal Area Management Act (CAMA); 2) NPDES stormwater permit requirements for industrial activities and municipalities; and 3) NPDES stormwater permit requirements for construction or land development activities on one acre of land or more. For more detailed information on current and proposed stormwater rules, visit the NPDES website at http://h2o.enr.state.nc.us/su/stormwater.html.

4.4 Biological Monitoring Issues

DWQ strives to properly evaluate the health of biological communities throughout the state. Swamp stream systems, small streams, and estuarine waters have presented unique challenges for

benthic macroinvertebrate evaluation, while non-wadeable waters and trout streams have done the same for fish community evaluations. This section discusses some of these challenges. Refer to Appendix II for further information.

4.4.1 Assessing Benthic Macroinvertebrates in Swamp Streams

Extensive evaluation, conducted by DWQ, of swamp streams across eastern North Carolina suggests that different criteria must be used to assess the condition of water quality in these systems. Swamp streams are characterized by seasonally interrupted flows, lower dissolved oxygen and sometimes, lower pH. Sometimes they also have very complex braided channels and dark-colored water. Since 1995, benthic macroinvertebrates swamp sampling methods have been used at over 100 sites in the coastal plain of North Carolina, including more than 20 reference sites. In 1999, 10 sites on swamp streams in the White Oak River basin were sampled by DWQ. Preliminary investigations indicate that there are at least five unique swamp ecoregions in the NC coastal plain, and each of these may require different biocriteria. The lowest "natural" diversity has been found in low-gradient streams (especially in the outer coastal plain) and in areas with poorly drained soils.

DWQ has developed draft biological criteria that may be used in the future to assign bioclassifications to these streams (as is currently done for other streams and rivers across the state). However, validation of the swamp criteria will require collecting data for several years from swamp stream reference sites. The criteria will remain in draft form until DWQ is better able to evaluate such things as: year-to-year variation at reference swamp sites, effects of flow interruption, variation among reference swamp sites, and the effect of small changes in pH on the benthos community. Other factors, such as whether the habitat evaluation can be improved and the role fisheries data should play in the evaluation, must also be resolved. While it may be difficult to assign use support ratings to these swamp streams, these data can be used to evaluate changes in a particular stream between dates or to evaluate effects of different land uses on water quality within a relatively uniform ecoregion.

4.4.2 Assessing Benthic Macroinvertebrate Communities in Small Streams

The benthic macroinvertebrate community of small streams is naturally less diverse than the streams used to develop the current criteria for freshwater, flowing streams. The benthic macroinvertebrate database is being evaluated, and a study to systematically look at small reference streams in different ecoregions is being developed with the goal of finding a way to evaluate water quality conditions in such small streams.

4.4.3 Assessing Fish Communities

Fish communities in most wadeable streams can be sampled by a crew of 2-4 persons using backpack electrofishers and following the DWQ Standard Operating Procedures. The data are evaluated using the North Carolina Index of Biotic Integrity (NCIBI) (NCDENR, 2001). The NCIBI uses a cumulative assessment of twelve 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.

In order to obtain data from non-wadeable coastal plain streams (that are difficult to evaluate using benthic macroinvertebrates), a fish community boat sampling method is being developed with the goal of expanding the geographic area that can be evaluated using fisheries data. This project may many years to complete.

The naturally less diverse fish fauna of high elevation trout streams also cannot be evaluated using the NCIBI. A multiagency workgroup is looking at ways to evaluate fish communities in these waters. Current benthic macroinvertebrate monitoring provides a good tool for evaluation of these waters.

4.5 Fish Consumption Advisories

The NC Department of Health and Human Services (DHHS) has developed guidelines to advise people as to safe levels of fish consumption. DWQ considers uses of waters with a consumption advisory for one or more species of fish to be impaired. Currently, there are two different fish consumption advisories in the White Oak River basin.

In 1997, DHHS issued a statewide fish consumption advisory due to elevated levels of mercury in bowfin (also known as blackfish). As a result of this advisory, DWQ considers all waters in the White Oak River basin to be partially supporting the fish consumption use support category. (Refer to Appendix III for more information regarding use support ratings and assessment methodology.) DWQ has sampled a variety of fish species from three locations in the White Oak River basin. Mercury levels in bowfin from the New River, Brinson Creek and Northeast Creek did not exceed the North Carolina action level for mercury in fish.

From August 1998 through August 1999, the Division of Marine Fisheries collected samples of king mackerel off the coast for mercury contaminant analysis. The samples were collected after health agencies in Texas and Florida issued consumption advisories for king mackerel due to potentially harmful levels of mercury.

King mackerel larger than 95 cm or 6.5 kg were found to have concentrations of mercury in excess of the North Carolina criteria of 1 µg/g. Based on these results, North Carolina joined together with South Carolina, Georgia and Florida in March 2000 to issue a joint health advisory concerning high levels of mercury in large king mackerel. The advisory states:

- king mackerel less than 33 inches fork-length (from nose to where the tail forks) are safe to eat;
- king mackerel over 39 inches should not be eaten;
- people should limit their consumption of 33 to 39-inch fish;
- women of child bearing age and children age 12 and younger should eat no more than one, 8-ounce portion a month; and
- other adults should eat no more than four, 8-ounce portions a month.

The advisory does not prevent commercial fisherman or recreational anglers from landing king mackerel. Recreational anglers are allowed to land three fish/person/day with a minimum-size limit of 24-inch fork length. Federally permitted commercial fishermen are limited to 3,500 pounds/trip with a 24-inch fork length minimum size.

The presence and accumulation of mercury in North Carolina's aquatic environment is similar to contamination observed throughout the country. Mercury has a complex life in the environment, moving from the atmosphere to soil, to surface water and into biological organisms. Mercury circulates in the environment as a result of natural and human (anthropogenic) activities. A dominant pathway of mercury in the environment is through the atmosphere. Mercury that has been emitted from industrial and municipal stacks into the ambient air can circulate across the globe. At any point, mercury may then be deposited onto land and water. Once in the water, mercury can accumulate in fish tissue and humans. Mercury is also commonly found in wastewater. However, mercury in wastewater is typically not at levels that could be solely responsible for elevated levels in fish.

DWQ will continue to monitor concentrations of various contaminants in fish tissue across the state and will work to identify and reduce wastewater contributions of mercury to surface waters. The Division of Air Quality (DAQ) evaluates mercury levels in rainwater on a regular basis through the EPA Mercury Deposition Network. EPA continues to focus on nationwide mercury reductions from stack emissions and through pollution prevention efforts. Given the global scale of mercury cycling, it may be difficult for state and federal agencies to recognize significant reductions of mercury in fish over the short-term. Governmental and scientific agencies and organizations will continue efforts to reduce mercury cycling on a national and global scale.

For more information regarding fish consumption advisories, visit the NC Department of Health and Human Services website at http://www.schs.state.nc.us/epi/fish/current.html or call (919) 733-3816.

4.6 White Oak River Basin Wastewater Discharger Issues

4.6.1 New River Nutrient Sensitive Waters (NSW) Strategy

1997 Recommendations

In 1991, much of the New River drainage was classified as nutrient sensitive waters (NSW). There had been persistent water quality problems associated with algal blooms, especially in the upper estuary. Prior to 1997, point sources accounted for 59 percent of the phosphorus load and 44 percent of the nitrogen load. Four Camp Lejeune discharges and the City of Jacksonville discharge contributed over 94 percent of point source nutrient inputs. The 1997 plan recommended the following as part of the New River NSW strategy to reduce point source contributions of nutrients to the upper New River estuary.

- Existing facilities with permitted capacity of 0.05 MGD or greater should continue to receive total phosphorus (TP) limits of 2.0 mg/l.
- New and expanding facilities should continue to receive TP limits of 0.5 mg/l.
- New and expanding facilities greater than 1 MGD should receive total nitrogen limits (TN) similar to Camp Lejeune of 5.0 mg/l (summer) and 10.0 mg/l (winter).
- All facilities without limits will be required to monitor TN and TP.

It was also recommended that no new discharges be permitted and expansions of existing facilities only be allowed if there is no increase in permitted loading of oxygen-consuming waste.

Current Status

The City of Jacksonville is now land applying 6 MGD of wastewater and ceased to discharge into the New River in 1998. Camp Lejeune has consolidated its discharges into one advanced wastewater treatment facility at Frenchs Creek. Preliminary results of a DWQ phytoplankton study indicate that algal blooms in the New River estuary have declined in extent and duration since removal of the discharges. The removal of the Jacksonville discharge and the higher quality effluent from Hadnot Point have also greatly reduced the load of oxygen-consuming waste in the New River.

2001 Recommendations

The New River NSW recommendations from 1997 will remain in effect.

4.6.2 Discharges of Oxygen-Consuming Waste to Swamp Waters

1997 Recommendations

Most of the freshwater in the White Oak River basin is swampy with naturally low dissolved oxygen (DO), low pH, and low or zero flow during summer months. There are a few small point source discharges that may further reduce DO in these swampy streams. Models to evaluate the impact of discharges to swamp streams have not been developed. The 1997 plan recommended that new discharges be permitted at limits no less stringent than 15 mg/l BOD_5 and 4 mg/l NH_3-N. More stringent limits may be required on a case-by-case basis. Expanding facilities will receive current permit limits unless available information indicates that more stringent limits are required.

2001 Recommendations

DWQ will pursue reclassification of streams that have swampy characteristics to include the supplemental classification Sw that identifies the swampy nature of these streams. New and expanding discharges will be carefully considered on a case-by-case basis.

4.7 Habitat Degradation

Instream habitat degradation is identified in the use support summary (Appendix III) where there is a notable reduction in habitat diversity or a negative change in habitat. This term includes sedimentation, bank erosion, channelization, lack of riparian vegetation, loss of pools or riffles, loss of woody habitat, and streambed scour. Good instream habitat is necessary for aquatic life to survive and reproduce. Streams that typically show signs of habitat degradation are in watersheds that have a large amount of land-disturbing activities (construction, mining, timber harvest and agricultural activities) or a large percentage of impervious surfaces. A watershed in which most of the riparian vegetation has been removed from streams or channelization has occurred also exhibits instream habitat degradation. Streams that receive a discharge quantity that is much greater than the natural flow in the stream often have degraded habitat as well.

Determining the cause and quantifying amounts of habitat degradation is very difficult in most cases. To assess instream habitat degradation in most streams would require extensive technical and monetary resources and perhaps even more resources to restore the stream. DWQ is working to develop a reliable habitat assessment methodology.

Although DWQ and other agencies are starting to address this issue, local efforts are needed to prevent further instream habitat degradation and to restore streams that have been impaired by activities that cause habitat degradation. As point sources become less of a source of water quality impairment, nonpoint sources that pollute water and cause habitat degradation will need to be addressed to further improve water quality in North Carolina's streams, rivers and estuaries.

4.8 Wetland Loss

4.8.1 Introduction

Wetlands provide a variety of benefits to society and are very important in watershed planning because of the functions they perform. Wetlands provide important protection for flood prevention to protect property values; streambank stabilization to prevent erosion and downstream sedimentation; water purification and pollutant removal (especially for nitrogen and phosphorus); habitat for aquatic life and wildlife and endangered species protection. These values vary greatly with wetland type. Wetlands adjacent to intermittent and permanent streams are most important to protecting water quality in those streams, as well as downstream lakes and estuaries. However, wetlands located away from streams also have important water storage capacity and pollutant removal potential. Chapter 2, Part 2.6.2 contains more specific information on the ecological significance of wetlands in the White Oak River basin.

4.8.2 Wetland Fill Activities

In 1989, the Environmental Management Commission passed a rule directing DWQ to review wetland fill using a review sequence of avoidance, minimization and mitigation of wetland fill. After extensive public review, the EMC passed rules, effective October 1, 1996, to restructure the 401 Water Quality Certification Program. These rules are not a new regulatory program since DWQ has issued approvals for wetland fill since the mid-1980s. The rules consider wetland values - whether or not the wetland is providing significant uses or whether the activity would remove or degrade uses. The rules also specify mitigation ratios, locations and types to make the mitigation process more predictable and certain for the regulated community. DWQ's emphasis continues to be on water quality and the essential role that wetlands play in maintaining water quality.

4.9 Effects of Hurricanes on Water Quality

The White Oak River basin in North Carolina is periodically subjected to hurricanes and tropical storms. Aquatic ecosystems and water quality can, and do, recover from the wind damage and extensive flooding that result from these storms. However, human activities in hurricane-prone areas can greatly increase the extent and severity of water quality and ecosystem impacts, as well as the system's recovery time.

In September 1999, Hurricane Floyd made landfall in North Carolina, only a few days after Hurricane/Tropical Storm Dennis made two passes across the eastern part of the state. Wind damage was not as severe as what has occurred during these types of storms in the past; however, flooding in eastern North Carolina was higher and more extensive than any ever recorded. Many

towns and homes were completely inundated, and in some areas because of extended rainfall after Floyd, flooding continued for weeks. Bridges and buildings were washed downstream, animal waste lagoons breached, and wastewater treatment plants were inundated. Floyd resulted in more fatalities than any hurricane to strike the United States since 1972. More than 50 people in North Carolina were killed and thousands were left homeless.

4.9.1 Contaminants

Floods can transport large amounts of materials from the land into surface waters, inundate areas that are contaminated with various substances, flood wastewater treatment facilities that may be located in or near the floodplain, and result in the failure of animal waste lagoons. The large volume of water transported during the Hurricane Floyd flooding demonstrated that even low concentrations of pollutants can result in the transport of an extremely large mass of these materials through watersheds and into the estuaries of eastern North Carolina. Pollutants that can be carried into waters during large floods include excess nutrients (nitrogen, phosphorus and organic carbon), bacteria and other pathogens, pesticides and fuels, and sediment. As a result of contamination by these pollutants, dissolved oxygen can be depleted, causing stress (or death) to fish and other aquatic life. Salt concentrations in the estuaries can also be affected by the large volume of freshwater flowing into the system within a short period of time.

4.9.2 De-Snagging

Emergency de-snagging (removal of piles of woody debris from stream and river channels) began after the storm as part of Natural Resources Conservation Services' (NRCS) Emergency Watershed Protection (EWP). NRCS intends for this activity to be used only to prevent imminent flooding around bridges and economic loss of property. Therefore, much of the NRCS-supervised de-snagging operations affected only the areas in streams and rivers immediately upstream and downstream of road crossings. NRCS also intends to remove only debris that was deposited during the storm, leaving in place snags that predated the event such as those associated with beavers. However, there were difficulties assessing snag origins and ages because most of the de-snagging projects did not start until almost a year after the storm.

In addition to the Emergency Watershed Protection program, funding from the Federal Emergency Management Agency (FEMA) was also made available to some local governments for additional de-snagging activities. There was no requirement associated that the operations be monitored to prevent excessive or improper removal of woody debris. Several stream segments and wetland areas in nonemergency situations were completely cleared of debris and snags and, in some cases, relocated and channelized using this funding.

Woody debris is the predominant habitat for benthic macroinvertebrates in larger, slower-moving coastal stream and wetland systems. Therefore, removal of these snags removes most of the habitat available for aquatic life. If care is not taken in properly removing woody debris, the streambanks and streambed can be altered as well as causing moderate to severe habitat degradation. Although no de-snagging activities have been reported or observed in the White Oak River basin following Hurricane Floyd, it is important for citizens to be aware of water quality concerns associated with this activity.

4.9.3 Recommendations

Benthic macroinvertebrate data collected prior to the hurricanes in coastal river basins were from summer or winter collections with little fall sampling available for comparisons. It is not yet possible to conduct a detailed analysis of post-hurricane samples at many stream sites, because some normal seasonal differences would be present in fall samples. However, some sampling of reference swamp streams was conducted by DWQ in November 1999. These collections did not indicate any significant damage from Hurricane Floyd (DENR-DWQ, December 1999). The next *White Oak River Basinwide Water Quality Plan* will summarize data collected in the basin over the next five-year (2000-2004) cycle.

DWQ is aware of the need to remove obstructions to water flow, including snags, in the vicinity of bridges or other structures in emergency situations because of safety concerns and to reduce economic loss in the event of natural disasters. However, NRCS should reevaluate allowing de-snagging after the immediate emergency situation has passed. The method in which snags are removed, the amount of debris that is removed, and the sites selected could all be approached, during a non-emergency situation, in such a manner as to reduce impacts to the stream channel and aquatic communities. Local governments that receive additional funding for this type of activity should also take water quality into consideration.

4.10 Protecting Headwaters

Many streams in a given river basin are only small trickles of water that emerge from the ground. A larger stream is formed at the confluence of these trickles. This constant merging eventually forms a large stream or river. Most monitoring of fresh surface waters evaluates these larger streams. The many miles of small trickles, collectively known as headwaters, are not directly monitored and in many instances are not even indicated on maps. However, impairment of headwater streams can (and does) impact the larger stream or river.

Headwater areas are found from the mountains to the coast along all river systems and drain all of the land in a river basin. Because of the small size of headwater streams, they are often overlooked during land use activities that impact water quality. All landowners can participate in the protection of headwaters by keeping small tributaries in mind when making land use management decisions on the areas they control. This includes activities such as retaining vegetated stream buffers and excluding cattle from streams. Local rural and urban planning initiatives should also consider impacts to headwater streams when land is being developed.

For a more detailed description of watershed hydrology, refer to EPA's Watershed Academy website at http://www.epa.gov/OWOW/watershed/wacademy/acad2000/watershedmgt/principle1.html.

4.11 Priority Issues for the Next Five Years

Clean water is crucial to the health, economic and ecologic well-being of the state. Tourism, water supplies, recreation and a high quality of life for residents are dependent on the water resources within any given river basin. Water quality problems are varied and complex. Inevitably, water quality impairment is due to human activities within the watershed. Solving

these problems and protecting the surface water quality of the basin in the face of continued growth and development will be a major challenge. Looking to the future, water quality in this basin will depend on the manner in which growth and development occur.

The long-range mission of basinwide management is to provide a means of addressing the complex problem of planning for increased development and economic growth while protecting and/or restoring the quality and intended uses of the White Oak River basin's surface waters. In striving towards its mission, DWQ's highest priority near-term goals are to:

- identify and restore impaired waters in the basin;
- identify and protect high value resource waters and biological communities of special importance; and
- protect unimpaired waters while allowing for reasonable economic growth.

4.11.1 Strategies for Restoring and Protecting Impaired Waters

Impaired waters are those waters identified in Section A, Chapter 3 as partially supporting (PS) or not supporting (NS) their designated uses based on DWQ monitoring data. These waters are impaired, mostly due to nonpoint sources (NPS) of pollution. The tasks of identifying nonpoint sources of pollution and developing management strategies for these impaired waterbodies are very resource intensive. Accomplishing these tasks is overwhelming, given the current limited resources of DWQ, other agencies (e.g., Division of Land Resources, Division of Soil and Water Conservation, Cooperative Extension Service, etc.) and local governments. Therefore, only limited progress towards restoring NPS impaired waters can be expected during this five-year cycle unless substantial resources are put toward solving NPS problems. Due to these restraints, this plan has no specific NPS management strategies for most of the streams with identified NPS problems.

DWQ plans to further evaluate the impaired waterbodies in the White Oak River basin in conjunction with other NPS agencies and develop management strategies for a portion of these impaired waterbodies for the next White Oak River Basinwide Water Quality Plan, in accordance with the requirements of Section 303(d) (see Part 4.11.2 below).

4.11.2 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 a priority. The waters in the White Oak River basin that are on the state's year 2000 (not yet EPA approved) 303(d) list are presented in the individual subbasin chapters in Section B.

Section 303(d) of the federal Clean Water Act requires states to develop a 303(d) list of waters not meeting water quality standards or which have impaired uses. States are also required to develop Total Maximum Daily Loads (TMDLs) or management strategies for 303(d) listed waters to address impairment. In the last few years, the TMDL program has received a great deal of attention as the result of a number of lawsuits filed across the country against EPA. These lawsuits argue that TMDLs have not adequately been developed for specific impaired waters. As a result of these lawsuits, EPA issued a guidance memorandum in August 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.

There are approximately 2,387 impaired stream miles on the 303(d) list in NC. 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 programs 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.

Section B

Water Quality Data
and
Information by Subbasin

Chapter 1 -
White Oak River Subbasin 03-05-01
Includes White Oak River, Queens Creek and Bear Creek

1.1 Water Quality Overview

Subbasin 03-05-01 at a Glance

Land and Water Area (sq. mi.)

Total area:	351
Land Area:	322
Water Area:	29

Population

1990 Est. Pop.:	39,388 people
Pop. Density:	122 persons / mi^2

Land Cover (%)

Forest / Wetland:	76
Water:	8
Urban:	1
Cultivated Crop:	11
Pasture / Managed Herbaceous:	3

Water Area

Stream Miles:	116
Estuarine Acres:	11,567
Coastal Miles:	8
Shellfish Harvest Acres:	11,239

This subbasin contains the White Oak River and its tributaries in Onslow, Jones, Craven and Carteret counties. Most of this area, including its two lakes (Catfish Lake and Great Lake), lies relatively undisturbed within the Croatan National Forest and Hoffman State Forest. A map of this subbasin including water quality sampling locations is presented in Figure B-1. Biological ratings as well as ambient water quality information at these sites are presented in Table B-1. Use support ratings for monitored waters are presented in Table B-2.

Most of the land area in the subbasin is forested. With the exception of Maysville, most urbanization is along NC 24 near Swansboro and Cape Carteret. There is also substantial agricultural land use on the west of the White Oak River.

Tributaries on the west of the White Oak River appear more impacted by agriculture and development than the streams draining the Croatan National Forest and Hoffman State Forest. There are indications of excess nutrient input in the White Oak River mainstem. Many tributaries in this subbasin are characteristic of swamp streams. The low dissolved oxygen (DO) and low pH measurements collected during this assessment period were attributed to swamp drainage into the White Oak River. Estuarine water quality was generally high in this subbasin. There was a noted increase in oysters near Swansboro possibly related to decreased variation in the salinity regime because of low rainfall in 1999.

A significant portion of waters in this subbasin are estuarine, including the waters around Hammocks Beach State Park, the Intracoastal Waterway (ICWW), Bogue Sound, much of the White Oak River, and most of Queens Creek and Bear Creek. There are 2,888 acres of ORW waters in this subbasin, mostly around Bear Island.

There are nine minor dischargers in this subbasin with a permitted flow less than 0.5 MGD. Swansboro WWTP is the largest with a discharge of 0.3 MGD. There are six registered animal operations in the subbasin as well.

Figure B-1 White Oak River and Portion of Bogue Sound Subbasin 03-05-01

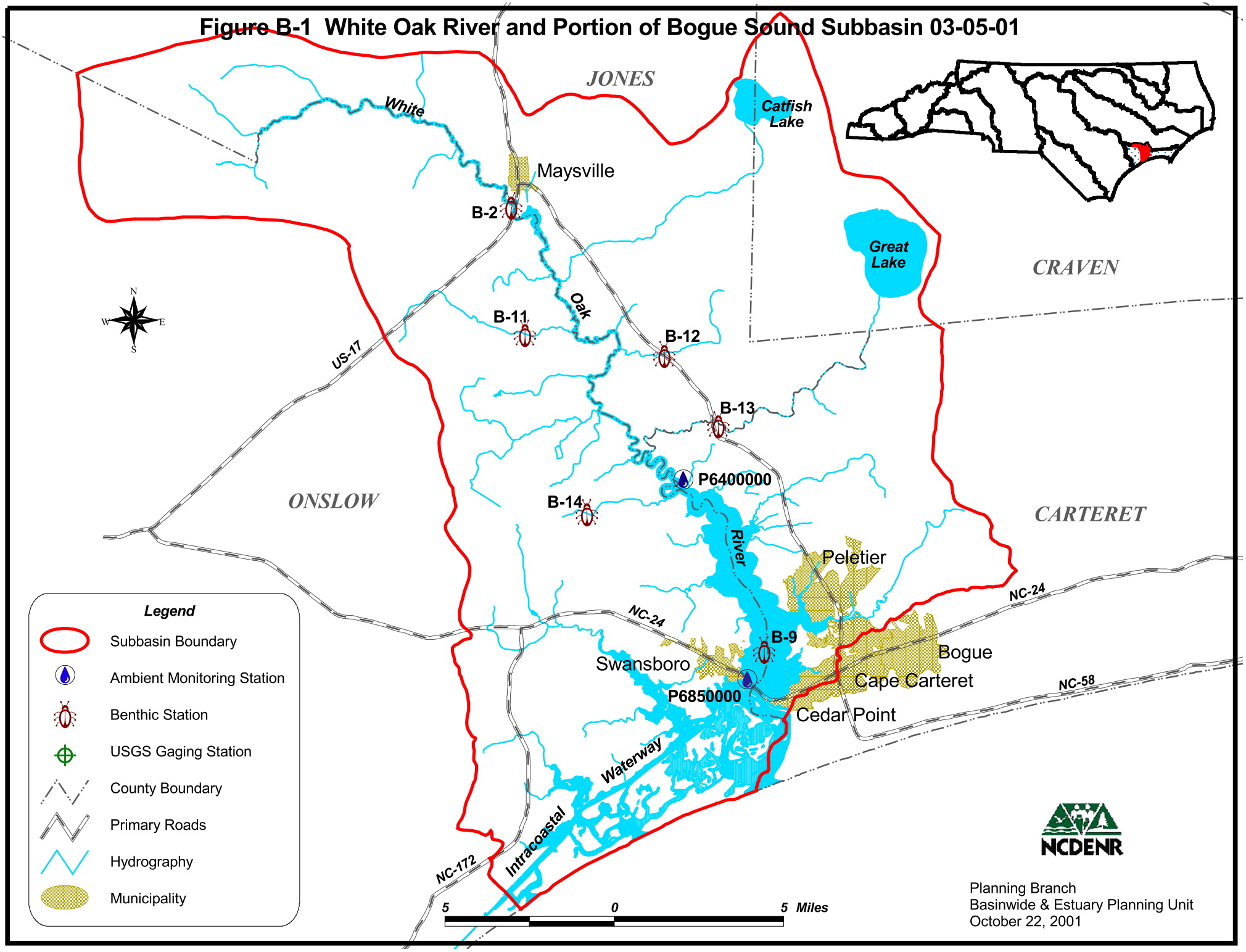


Table B-1 DWQ Monitoring Locations and Benthic Macroinvertebrate Bioclassifications (1999) for White Oak River Subbasin 03-05-01

Site	Stream	County	Road	Bioclassification
Benthic Macroinvertebrates				
B-2*	White Oak River	Onslow	US 17	Good-Fair
B-9*	White Oak River	Carteret	Swansboro	Not Rated
B-11	Starkeys Creek	Onslow	SR 1434	Not Rated
B-12*	Holston Creek	Jones	NC 58	Not Rated
B-13	Hunters Creek	Carteret	SR 1100	Not Rated
B-14	Webb Creek	Onslow	SR 1432	Not Rated
Ambient Monitoring				**Parameters In Excess of State Standards**
P6400000	White Oak River	Onslow	Stella	DO and pH
P6850000	White Oak River	Carteret	Swansboro	

* Historical data are available; refer to Appendix III.

** Assessment period 9/1/94 to 8/31/99

Table B-2 Use Support Ratings for Monitored Waters in Subbasin 03-05-01

Use Support Category	Use Support Ratings				
	FS	PS	NS	NR	Total
Aquatic Life and Secondary Recreation	21.3 mi. 5,772.6 ac	0	0	19 mi. 0 ac 8 coastal mi.*	40.3 mi. 5,772.6 ac 8 coastal mi.*
Fish Consumption	0	8 coastal mi.*	0	0	8 coastal mi.*
Primary Recreation	0 mi. 7,298.7 ac 8 coastal mi.*	0	0	6.6 mi. 3,940.4 ac	6.6 mi. 11,239.1 8 coastal mi.*
Shellfish Harvesting	0 mi. 4,609 ac	1.4 mi. 3,581 ac	5.3 mi. 3,049 ac	0	6.7 mi. 11,239 ac

* Refers to miles along Atlantic coastline.

For more information, refer to the *White Oak River Basinwide Assessment Report* (June 2000) or contact Environmental Sciences Branch at (919) 733-9960 or visit the web site at http://www.esb.enr.state.nc.us/.

1.2 Status and Recommendations for Previously Impaired Waters

This section reviews the status of recommendations made in the 1997 White Oak River Basinwide Water Quality Management Plan, reviews current status and use support ratings, and makes recommendations for the next five years. Previously impaired Class SA waters are discussed in Section 1.4 below. There were no other waters identified as impaired in the 1997 plan.

1.3 Status and Recommendations for Newly Impaired Waters

All waters in subbasin 03-05-01 are currently partially supporting (PS) the fish consumption use support category on an evaluated basis because of a statewide fish consumption advisory for bowfin. Fish tissue samples were not collected in this subbasin. Eight miles of Atlantic coastline in this subbasin are currently partially supporting (PS) fish consumption because of a consumption advisory for king mackerel. Refer to page 61 for more information on fish consumption advisories. There are no other newly impaired waters in this subbasin. Class SA waters are discussed below in Section 1.4.

1.4 Impaired Class SA Waters

There are 11,239 acres and 6.7 stream miles of Class SA waters in subbasin 03-05-01 that were assessed in the shellfish harvesting use support category. In this subbasin, 6,631 acres (59%) are considered impaired in the shellfish harvesting use support category. Refer to Figure B-2 to identify locations of DEH SS growing areas and growing area classifications. Refer to page 49 for DEH SS growing area criteria. Data for making use support determinations were provided by DEH SS (refer to page 40). The larger water areas in this subbasin are described below with reference to DEH SS growing areas. The problem parameter for all waters listed below is fecal coliform bacteria contamination. Refer to page 49 for recommendations to address impaired Class SA waters.

The differences in acreage estimates between years are not necessarily related to changes in water quality, but to different methods of estimating acreage and changes in use support methodology. For more information on changes in use support methodology, refer to page 51. Refer to Appendix III for use support methodology and a complete listing of individual monitored waters.

Bear Creek (Area D-1)

The upper 113 acres of Bear Creek are not supporting shellfish harvesting. This portion of Bear Creek is DEH SS classified as prohibited/restricted and permanently closed to shellfish harvesting. The lower 196 acres of Bear Creek are partially supporting shellfish harvesting. This area is DEH SS classified as conditionally approved-open and was closed to shellfish harvesting 15.5 percent of the five-year assessment period. The population of the watershed has remained stable. Potential sources of pollution include forestry, agriculture and wildlife (DENR, 1999).

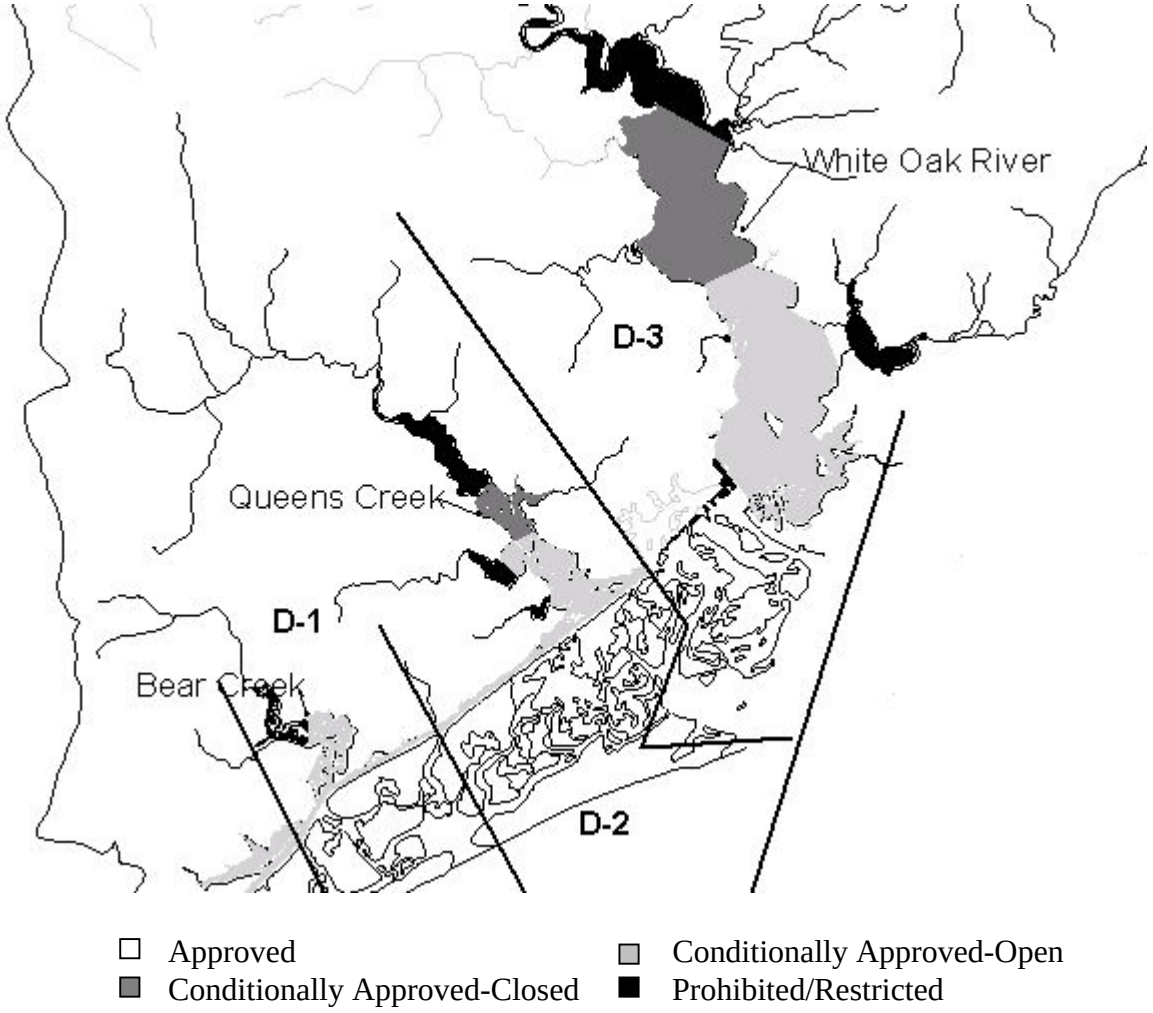


Figure B-2 DEH Shellfish Growing Area Classifications in Subbasin 03-05-01

The NC Cooperative Extension Service is using BMPs in the Bear Creek watershed to help reduce fecal coliform bacteria transport to Bear Creek in an effort to restore shellfish harvesting. Refer to page 102 for more information on this project.

Queens Creek and Tributaries (Area D-2)

The upper 234 acres of Queens Creek are not supporting shellfish harvesting. This portion of Queens Creek is DEH SS classified as prohibited/restricted and permanently closed to shellfish harvesting. The middle 161 acres of Queens Creek are also not supporting shellfish harvesting. This portion is DEH SS classified as conditionally approved-closed and was closed to shellfish harvesting most of the assessment period. The lower 270.6 acres of Queens Creek are rated partially supporting. This portion is DEH SS classified as conditionally approved-open and was closed to shellfish harvesting 15.6 percent of the five-year assessment period. The population of this watershed has grown substantially since 1994. Potential sources of pollution include runoff from subdivisions and forest clearing. There were also noted problems with a septic system in the watershed (DENR, 1998a).

North Carolina Coastal Federation (NCCF) has purchased conservation easements along Queens Creek (refer to page 104).

White Oak River and Tributaries (Area D-3)

The upper 468 acres of the White Oak River are not supporting shellfish harvesting. This portion of the White Oak River is DEH SS classified as prohibited/restricted and permanently closed to shellfish harvesting. The middle 1,422 acres of the White Oak River are also not supporting. This portion is DEH SS classified as conditionally approved-closed and was closed to shellfish harvesting most of the assessment period. The lower 2,124 acres of the White Oak River are rated partially supporting. They are DEH SS classified as conditionally approved-open, and the three different subareas were closed to shellfish harvesting from 15.6 percent to 17.1 percent of the five-year assessment period. The population of the watershed has grown substantially since 1995 and continues to experience rapid growth. Potential sources of pollution include runoff from subdivisions and agricultural land especially in the upper portions of the watershed. There have been noted septic system problems near the NC 24 causeway as well (DENR, 1999b). There are also concerns that NC 24 causeway reduces tidal flushing of the mouth of the White Oak River which could result in slower dissipation of bacteria and lower salinity.

North Carolina Coastal Federation (NCCF) has purchased land along the White Oak River for conservation and demonstration projects (refer to page 104).

Intracoastal Waterway (Areas D-1, D-2 and D-3)

The 739 acres of the ICWW (four subareas) in this subbasin west of Queens Creek are rated partially supporting. These subareas are DEH SS classified as conditionally approved-open and were closed to shellfish harvesting from 11.4 percent to 13.8 percent of the five-year assessment period. There are also 281 acres of impaired ORW waters in this subbasin including parts of the ICWW and Bear Island. Potential sources are the same as those described above in the upstream waterbodies.

1.5 303(d) Listed Waters

There are 2,392 acres in DEH growing areas C4, D1, D2 and D3 in subbasin 03-05-01 that are on the year 2000 303(d) list. These waters were classified by DEH Shellfish Sanitation as prohibited/restricted. Refer to Appendix IV for more information on the state's 303(d) list and listing requirements.

1.6 Others Issues and Recommendations

Upper White Oak River

Although the Aquatic Life /Secondary Recreation use support category in the upper White Oak River is not currently impaired there are indications of nutrient loading, channelization, habitat removal and habitat degradation. Continued development, road building, wetland ditching and draining, and poor de-snagging practices have the potential to cause degradation of aquatic

habitats and water quality in the White Oak River as well as increase the potential for eutrophication problems in the estuary. These land use practices should implement best management practices to reduce water quality impacts.

Trash in the form of litter and larger items (washing machines, chairs, old coolers and farm implements) has been identified as a problem in the White Oak River. While this problem is widespread, it has been noted as a particular problem in the White Oak River by canoeists and other recreational water users. Several local groups are participating in clean up and educational efforts to help prevent further aesthetic degradation of the river. Refer to page 107 for more information. Citizen efforts to clean up the river and educate people are needed to reduce trashing in the White Oak River.

There are also concerns regarding removal of storm debris (desnagging) from the White Oak River after recent hurricanes. While desnagging is needed to maintain navigation and water flow, care should be taken to maintain enough snag material to provide for aquatic habitat for fish and macroinvertebrates. Refer to page 65 for more information on this topic.

The Town of Maysville WWTP exceeded permit limits for BOD_5, NH_3-N and total suspended solids a few times during the assessment period. The WWTP received a CWMTF grant to make upgrades to the treatment plant. Refer to page 105 for more information on this project.

The NCCF (refer to page 107) has joined the effort to designate the White Oak River as a Wild and Scenic River. Many citizens' groups and businesses also support this effort which would lead to preservation of the river and river activities at the level they are today. The White Oak would be the first coastal blackwater river in the national system.

Bell Swamp

Hewitts Mobile Home Park discharges into a UT to Bell Swamp which is a tributary to Bear Creek. The facility exceeded permit limits for BOD and fecal coliform bacteria a few times between 1997 and 1999.

Bear Island

The North Carolina Division of Parks and Recreation, with CWMTF funding, has acquired buffers on Bear Island. Refer to page 105 for more information on this project. North Carolina Wetlands Restoration Program also has a two-acre restoration project at the state park.

White Oak River Restricted Area Swansboro

The Town of Swansboro WWTP received CWMTF funding to make upgrades to the treatment plant. Refer to page 105 for more information on this project.

Chapter 2 -
White Oak River Subbasin 03-05-02
Includes New River, Northeast Creek and ICWW

2.1 Water Quality Overview

Subbasin 03-05-02 at a Glance

Land and Water Area (sq. mi.)	
Total area:	462
Land area:	419
Water area:	43
Population Statistics	
1998 Est. Pop.:	84,359 people
Pop. Density:	201 persons / mi^2
Land Cover (%)	
Forest / Wetland:	67
Surface Water:	9
Urban:	4
Cultivated Crop:	13
Pasture / Managed Herbaceous:	7
Water Area	
Stream Miles:	208
Estuarine Acres:	21,865
Coastal Miles:	15
Shellfish Harvest Acres:	11,122

This subbasin includes the New River, its tributaries and several small coastal streams as well as the Intracoastal Waterway (ICWW). It is located in the western portion of the White Oak River basin and lies entirely within Onslow County. A map of this subbasin including water quality sampling locations is presented in Figure B-3. Biological ratings as well as ambient water quality information at these sites are presented in Table B-3. Use support ratings for monitored waters are presented in Table B-4.

This is the most densely populated area in the basin, with populations projected to increase by 15,000 people by 2010. Most of the development in this subbasin is on the New River: Richlands near the headwaters, the City of Jacksonville and Camp Lejeune Military Reservation in the middle reaches, and Sneads Ferry near the mouth. There are many animal operations and agricultural land use in the headwaters area north of Richlands.

Nutrient enrichment has been a significant problem in the estuarine portions of the New River, and periodic elevated fecal coliform bacteria levels also appear to be a recurring problem in this subbasin. Jacksonville removed its discharge from the upper New River estuary in 1998, and Camp Lejeune consolidated its seven discharges into one tertiary treatment facility also in 1998. These discharges were considered a major source of nutrients into the upper estuarine portions of the New River. Preliminary results of a DWQ phytoplankton study in the New River indicate reductions in algal blooms since the discharges were removed.

Most of the waters in this subbasin are estuarine. The headwaters of the New River, Southwest Creek and Northeast Creek drain swampy areas and have a supplemental classification of nutrient sensitive waters (NSW). Refer to page 62 for more information on NSW waters. The New River near Jacksonville is classified for primary recreation. The lower estuary of the New River near Sneads Ferry is classified for shellfish harvesting.

Figure B-3 New River Subbasin 03-05-02

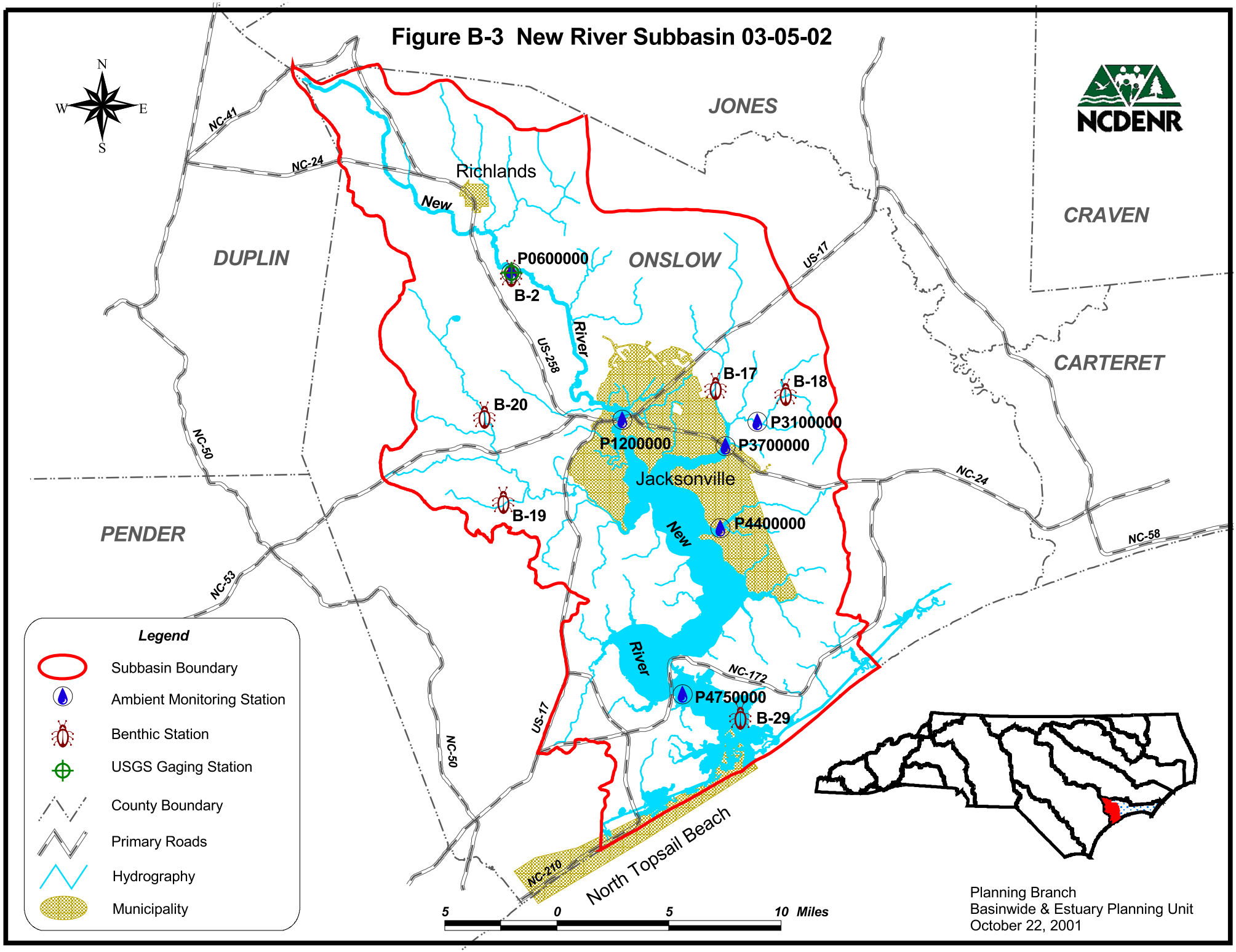


Table B-3 DWQ Monitoring Locations and Benthic Macroinvertebrate Bioclassifications (1999) for White Oak River Subbasin 03-05-02

Site	Stream	County	Road	Bioclassification
Benthic Macroinvertebrates				
B-2*	New River	Onslow	SR 1314	Good-Fair
B-17	Northeast Creek	Onslow	SR 1434	Not Rated
B-18	Little Northeast Creek	Onslow	SR 1423	Not Rated
B-19	Harris Creek	Onslow	SR 1109	Not Rated
B-20	Southwest Creek	Onslow	SR 1213	Not Rated
B-29*	New River	Onslow	Sneads Ferry	Not Rated
Ambient Monitoring				**Parameters In Excess of State Standards**
P0600000	New River	Onslow	SR 1314	
P1200000	New River	Onslow	US 17	DO, pH, chlor *a*
P3100000	Little Northeast Creek	Onslow	SR 1406	DO
P3700000	Northeast Creek	Onslow	NC 24	DO, pH, chlor *a*
P4400000	Wallace Creek	Onslow	R Drive	chlor *a*
P4750000	New River	Onslow	Sneads Ferry	

* Historical data are available; refer to Appendix III.

** Assessment period 9/1/94 to 8/31/99

Table B-4 Use Support Ratings for Monitored Waters in Subbasin 03-05-02

Use Support Category	Use Support Ratings				
	FS	**PS**	**NS**	**NR**	**Total**
Aquatic Life and Secondary Recreation	28.4 mi. 17,997.8 ac	0	0	43.8 mi. 680 ac 15 coastal mi.*	72.2 mi. 18,677.8 ac 15 coastal mi.*
Fish Consumption	0	31.3 mi. 15 coastal mi.*	0	0	31.3 mi. 15 coastal mi.*
Primary Recreation	0 mi. 9,051.1 ac 15 coastal mi.*	0	0	9.3 mi. 2,520 ac	9.3 mi. 11,571.1 ac 15 coastal mi.*
Shellfish Harvesting	2.3 mi. 8,692 ac	0 mi. 1,711 ac	2.7 mi. 720 ac	0	5.0 mi. 11,123 ac

* Refers to miles along Atlantic coastline.

For more information, refer to the *White Oak River Basinwide Assessment Report* (June 2000) or contact Environmental Sciences Branch at (919) 733-9960 or visit the web site at http://www.esb.enr.state.nc.us/.

2.2 Status and Recommendations for Previously Impaired Waters

This section reviews the status of recommendations made in the 1997 White Oak River Basinwide Water Quality Management Plan, reviews current status and use support ratings, and makes recommendations for the next five years. Little Northeast Creek, lower Southwest Creek and upper estuarine portions of the New River were considered impaired and are discussed in this section. Previously impaired Class SA waters are discussed in Section 2.4 below.

Little Northeast Creek – C NSW (8.3 miles from source to Northeast Creek)

Status of 1997 Recommendations
Little Northeast Creek was considered impaired because of low dissolved oxygen (DO) recorded at the monitoring station on Little Northeast Creek. At that time, the source of the low dissolved oxygen was attributed to both point (four minor discharges with permitted flow of 0.155 MGD) and nonpoint sources, possibly from residential development in the watershed. Because a reliable model to assess assimilative capacity in Little Northeast Creek had not been developed, it was recommended that the four discharges should pursue non-discharge alternatives as soon as possible. All four facilities are currently discharging to Little Northeast Creek.

Current Status
Little Northeast Creek (8.3 miles) is currently not rated (NR) for aquatic life/secondary recreation. The low DO consistently recorded at the monitoring station (AMS P3100000) on Little Northeast Creek is indicative of swamp drainage in this watershed. There was one significant violation above the permitted limit of 30 mg/l BOD_5 from Sentry Utilities. DWQ biologists indicated that the benthic macroinvertebrate community in this creek was healthy. However, a bioclassification was not assigned because the criteria for evaluating benthic macroinvertebrate communities in swampy waters are in draft form.

Although fish tissue samples were not collected in Little Northeast Creek, it is considered partially supporting (PS) for the fish consumption use support category because of a statewide fish consumption advisory for bowfin. Refer to page 61 for more information on this issue.

2001 Recommendations
The four minor discharges in Little Northeast Creek should continue to pursue alternatives to discharge. DWQ will continue to monitor Little Northeast Creek to assess the impacts of development and the eventual removal of the discharges. Criteria to assess the benthic macroinvertebrate communities in swampy waters should be finalized in the near future. DWQ will pursue the reclassification of Little Northeast Creek and its indexed tributaries from Class C NSW to Class C NSW Sw to reflect the swampy conditions in this watershed. Refer to page 62 for more information on the New River NSW strategy.

Southwest Creek – C NSW (19.3 miles from source to Mill Run)
C HQW NSW (1.5 miles from Mill Run to New River)

Status of 1997 Recommendations
Southwest Creek (lower 1.5 miles) was considered impaired because of low dissolved oxygen (DO) in conjunction with algal blooms in the New River estuary. The algal blooms were associated with high nutrient levels in wastewater being discharged by the City of Jacksonville into Wilson Bay (upper New River estuary) and seven discharges from Camp Lejeune. As part of the New River NSW strategy, it was recommended that dischargers pursue options other than discharge to the New River estuarine waters. The City of Jacksonville is now land applying waste and ceased to discharge into the New River in 1998. Camp Lejeune has consolidated its discharges into one advanced wastewater treatment facility at Frenchs Creek. Since then, there has been a noted decline in algal blooms in the estuarine portion of Southwest Creek (DWQ special study, not yet published).

Current Status
Southwest Creek (20.8 miles from source to New River) is currently not rated (NR) for aquatic life and secondary recreation. The upper 19 miles of Southwest Creek are characteristic of swampy waters. DWQ biologists indicated that the benthic macroinvertebrate community in this creek showed moderate impacts; however, a bioclassification was not assigned because the criteria for evaluating benthic macroinvertebrate communities in swampy waters are in draft form.

Although fish tissue samples were not collected in Southwest Creek, it is considered partially supporting (PS) on an evaluated basis for the fish consumption use support category because of a statewide consumption advisory for bowfin. Refer to page 61 for more information on this issue.

2001 Recommendations
Because of the nutrient sensitive nature of Southwest Creek, no new or expanding discharges should be permitted. Criteria to assess the benthic macroinvertebrate communities in swampy waters should be finalized in the near future. DWQ will pursue the reclassification of Southwest Creek (upper 19.3 miles) and its indexed tributaries from Class C NSW to Class C NSW Sw to identify the swampy conditions that have been observed in this watershed. The lower 1.5 miles of Southwest Creek should be reclassified from C HQW NSW to SC HQW NSW to reflect the estuarine nature of this segment. Refer to page 62 for more information on the New River NSW strategy.

New River – C NSW (28.35 miles from source to Blues Creek)
SB NSW (116 acres from Blues Creek to US 17 Bridge)
SB HQW NSW (49 acres from US 17 Bridge to Rail Line Bridge)
SC NSW (397 acres from Rail Line Bridge to Mumford Point)

Status of 1997 Recommendations
The upper estuarine segments of the New River (SB and SC) were considered impaired because of low dissolved oxygen (DO) and high chlorophyll *a* in conjunction with algal blooms. The algal blooms were associated with high nutrient levels in wastewater being discharged by the City of Jacksonville into Wilson Bay (upper New River estuary) and three discharges from Camp

Lejeune. As part of the New River NSW strategy, it was recommended that discharges pursue options other than discharge to New River estuarine waters. The City of Jacksonville is now land applying waste and ceased to discharge into the New River in 1998. Camp Lejeune has consolidated its discharges into one tertiary treatment facility at Hadnot Point. Since then, there has been a noted decline in algal blooms in the estuarine portion of the New River (DWQ special study, not yet published).

Current Status

Preliminary results of a DWQ phytoplankton study in the New River estuary indicate that algal blooms have decreased in frequency, extent and severity since 1998.

Although fish tissue samples were not collected in these segments of New River estuary (SB and SC), they are considered partially supporting (PS) for the fish consumption use support category because of a statewide consumption advisory for bowfin. Fish tissue samples were collected in the upper New River (C NSW, 28.35 miles from source to Blues Creek). None of the samples were in excess of state standards. However, because bowfin were collected and because of a statewide consumption advisory for bowfin, this segment is currently partially supporting (PS) on a monitored basis for the fish consumption use support category. Refer to page 61 for more information on this issue.

The upper two segments of the New River estuary (Class SB, 165 acres) are classified for primary recreation. During this assessment period, there were no swimming advisories in place in these two segments. Based on DWQ ambient monitoring station data and DEH beach monitoring program reports, these segments are currently rated fully supporting (FS) for primary recreation. Because these waters are in a heavily urbanized area, caution should be used when swimming in these waters. The former Wilson Bay WWTP is being converted to an environmental education center (refer to page 104).

2001 Recommendations

Jacksonville will be developing a stormwater program as part of Phase II requirements. DWQ recommends that the city consider protection of primary recreation as well as aquatic life in the New River estuary as part of the stormwater program. Refer to page 58 for more information on urban stormwater runoff.

DWQ will continue to monitor nutrients in the New River to assess the risk of algal blooms to aquatic life. Refer to page 62 for more information on the New River NSW strategy.

North Carolina Water Resources Program with the City of Jacksonville is restoring five acres at Sturgeon City to a brackish marsh to treat stormwater runoff. Refer to page 104.

2.3 Status and Recommendations for Newly Impaired Waters

All waters in subbasin 03-05-02 are currently partially supporting (PS) the fish consumption use support category on an evaluated basis because of a statewide fish consumption advisory for bowfin. Fish tissue samples were collected from Northeast Creek, Brinson Creek and the New River (discussed above in 2.2) in this subbasin. Fifteen miles of Atlantic coastline in this subbasin are currently partially supporting (PS) the fish consumption use support category

because of a consumption advisory for king mackerel. Refer to page 61 for more information on this issue. There are no other newly impaired waters in this subbasin. Impaired Class SA waters are discussed below in Section 2.4.

Northeast Creek – C NSW (10.3 miles from source to NC 24)
Brinson Creek – C NSW (2.9 miles from source to New River)

Fish tissue samples were collected in these two streams. None of the samples were in excess of state standards; however, because bowfin were collected and because of a statewide consumption advisory for bowfin, this segment is currently partially supporting (PS) on a monitored basis for fish consumption. Therefore, these segments are currently partially supporting (PS) on a monitored basis for the fish consumption use support category. Refer to page 61 for more information on this issue.

2.4 Impaired Class SA Waters

There are 11,122 acres and 5.1 stream miles of Class SA waters in subbasin 03-05-02 that were assessed in the shellfish harvesting use support category. In this subbasin, 2,431 acres (22%) are considered impaired in the shellfish harvesting use support category. Refer to Figure B-4 to identify locations of DEH SS growing areas and growing area classifications. Refer to page 49 for DEH SS growing area criteria. Data for making use support determinations were provided by DEH SS (refer to page 40). The larger water areas in this subbasin are described below with reference to DEH SS growing areas. The problem parameter for all waters listed below is fecal coliform bacteria contamination. Refer to page 49 for recommendations to address impaired Class SA waters.

The differences in acreage estimates between years are not necessarily related to changes in water quality, but to different methods of estimating acreage and changes in use support methodology. For more information on changes in use support methodology, refer to page 51. Refer to Appendix III for use support methodology and a complete listing of individual monitored waters.

Stones Bay and New River Tributaries (Area C-2 and C-3)

There are 339 acres in Stones Bay, the New River and smaller tributaries including Stones Creek, Everett Creek, Wheeler Creek and Millstone Creek that are not supporting shellfish harvesting. These areas are DEH SS classified as prohibited/restricted and permanently closed to shellfish harvesting. Most of land around these tributaries drains Camp Lejeune. Potential sources of pollution include runoff from subdivisions, septic systems and wildlife. Failing septic systems have been noted at a mobile home park on Wheeler Creek. There has been little noted change in bacteriological water quality in these areas (NCDENR, 1998d and NCDENR, 1999).

Fullards Creek, Rogers Bay, Chadwick Bay, Alligator Bay and ICWW (Area B-9 and C-1)

There are 167 acres of Fullards Creek, Alligator Bay and tributaries that are not supporting shellfish harvesting. These areas are DEH SS classified as prohibited/restricted and permanently

closed to shellfish harvesting. Rogers Bay (51 acres) is also not supporting shellfish harvesting. Rogers Bay is DEH SS classified as conditionally approved-closed and was closed to shellfish harvesting most of the assessment period. The ICWW, Alligator Bay and Chadwicks Bay are rated partially supporting. These areas are DEH SS classified as conditionally approved-open and were closed to shellfish harvesting from 12.2 percent to 12.5 percent of the five-year assessment period. There are also 875 acres of ORW waters impaired in this subbasin. Potential sources of pollution include runoff from subdivisions and wildlife. There were also noted problems with septic systems along the ICWW (DENR, 1998d).

Salliers Bay, Gillets Creek, Freemans Creek and ICWW (Area C-4)

There are 80 acres of Salliers Bay, Gillets and the ICWW that are not supporting shellfish harvesting. These areas are DEH SS classified as prohibited/restricted and permanently closed to shellfish harvesting. Freemans Creek (65 acres) is also not supporting shellfish harvesting. Freemans Creek is DEH SS classified as conditionally approved-closed and was closed to shellfish harvesting most of the assessment period. The ICWW (154 acres) in the eastern half of the subbasin is rated partially supporting. This area is DEH SS classified as conditionally approved-open and was closed to shellfish harvesting 11.4 percent of the five-year assessment period. The 68,000 gallons per day Camp Lejeune WWTP outfall at Onslow Beach was removed. There are few permanent residents in the area. Potential sources of pollution include runoff from forest clearing and wildlife (DENR, 1998c).

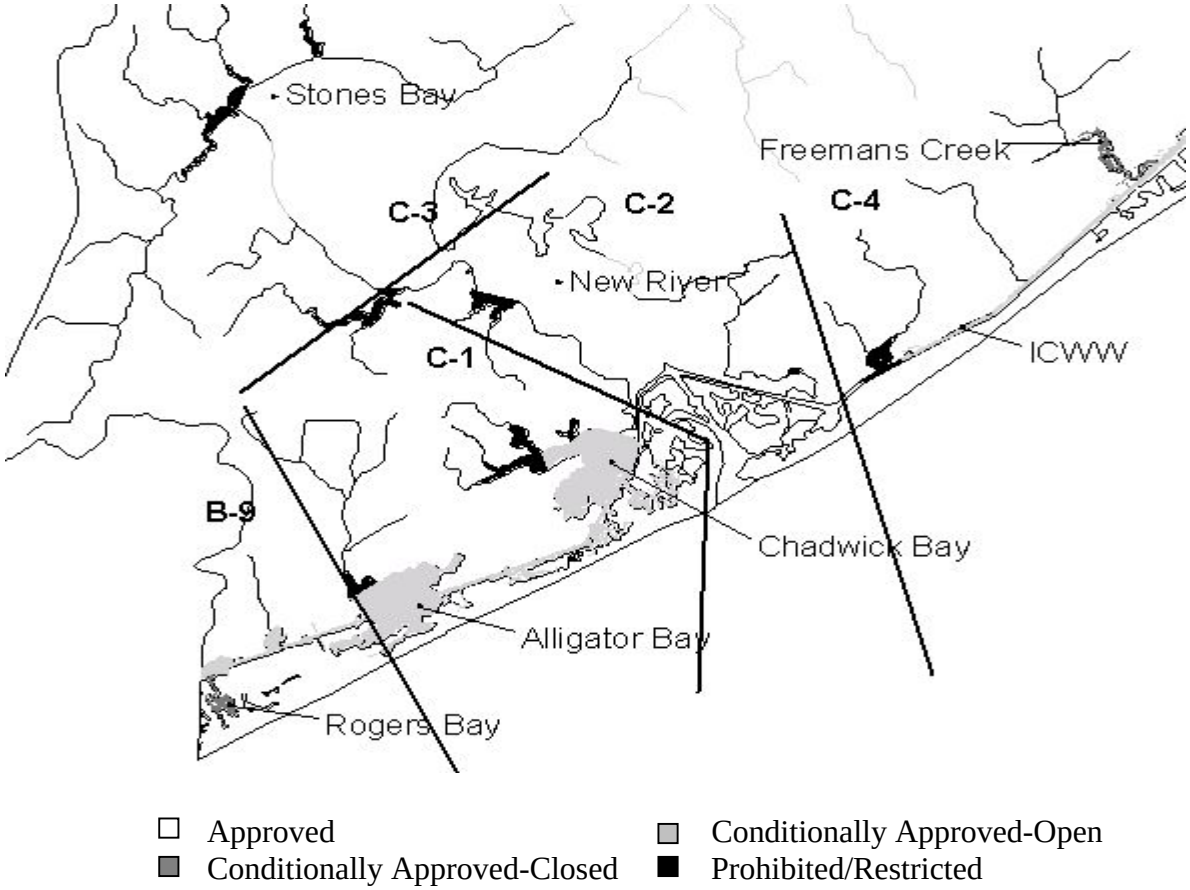


Figure B-4 DEH Shellfish Growing Area Classifications in Subbasin 03-05-02

2.5 303(d) Listed Waters

Little Northeast Creek (8.3 miles) and Southwest Creek (2.6 miles) are on the year 2000 303(d) list. These waters are discussed above. There are 1,163 acres in DEH growing areas C1, C2, C3, C4 and B9 also on the 303(d) list because they were classified by DEH Shellfish Sanitation as prohibited/restricted. The reported acreages for these areas were based on DEH Shellfish Sanitation growing area acreage estimates. Refer to Appendix IV for more information on the state's 303(d) list and listing requirements.

2.6 Others Issues and Recommendations

Nonpoint Source Issues in the Upper New River

Although the aquatic life/secondary recreation use support category in the upper New River (C NSW from source to Blues Creek, 28.35 miles) is not currently impaired, there are indications of nutrient loading, channelization, habitat removal and habitat degradation. Continued development, road building, wetland ditching and draining, and poor de-snagging practices have the potential to cause degradation of aquatic habitats and water quality in the upper New River as well as increase the potential for eutrophication problems in the New River estuary. These land uses should implement best management practices to reduce water quality impacts.

The City of Jacksonville with CWMTF funding developed a stormwater project. Refer to page 104 for more information on this project.

New River Restricted Areas Reclassifications to SA

DWQ and DEH SS are pursuing the reclassifications of New River Restricted #1 and #2 from Class C to Class SA. These two areas were originally classified as C waters to identify the buffer zones around two Camp Lejeune discharges. These discharges were removed in 1998, and DEH SS has reclassified these areas to approved after extensive sampling of waters and shellfish meats (NCDENR, 1998d).

NC Wetlands Restoration Program Local Watershed Plan

The NCWRP will be developing a local watershed plan for areas of subbasin 03-05-02 including Bachelors Delight Swamp, Juniper Swamp, Squires Run, Wilson Bay and the upper New River. Refer to page 103 for more information on this program.

Chapter 3 -
White Oak River Subbasin 03-05-03
Includes Bogue Sound and the Newport River

3.1 Water Quality Overview

Subbasin 03-05-03 at a Glance

Land and Water Area (sq. mi.)	
Total area:	228
Land area:	168
Water area:	60
Population Statistics	
1990 Est. Pop.:	11,404 people
Pop. Density:	68 persons / mi^2
Land Cover (%)	
Forest / Wetland:	59
Surface Water:	26
Urban:	4
Cultivated Crop:	6.5
Pasture / Managed Herbaceous:	4
Water Area:	
Stream Miles:	18
Estuarine Acres:	34,723
Coastal Miles:	25
Shellfish Harvest Acres:	34,146

This subbasin contains the center of Carteret County, extending from the Croatan National Forest to Beaufort and Beaufort Inlet. A map of this subbasin including water quality sampling locations is presented in Figure B-5. Biological ratings for these sample locations are presented in Table B-5. Use support ratings for monitored waters are presented in Table B-6.

With the exception of Newport, most of the development in this subbasin is along the coast: Morehead City, Beaufort, Atlantic Beach and Bogue Banks. Land use in this subbasin is mostly forested. The highest population densities are in the Beaufort and Morehead City areas along the waterfront.

There are indications of nutrient inputs in the upper Newport River. There are also elevated fecal coliform bacteria levels after rainfall events. The tributaries to the Newport River are characteristic swamp streams. Water quality in estuarine waters of this subbasin is generally good.

Most of the waters in this subbasin are estuarine with the Newport River as the only major source of freshwater. There are 34,146 acres of estuarine water classified for shellfish harvesting; 11,368 of these acres are ORW.

For more information, refer to the *White Oak River Basinwide Assessment Report* (June 2000) or contact Environmental Sciences Branch at (919) 733-9960 or visit the web site at http://www.esb.enr.state.nc.us/.

Figure B-5 Newport River and Tributaries to Bogue Sound Subbasin 03-05-03

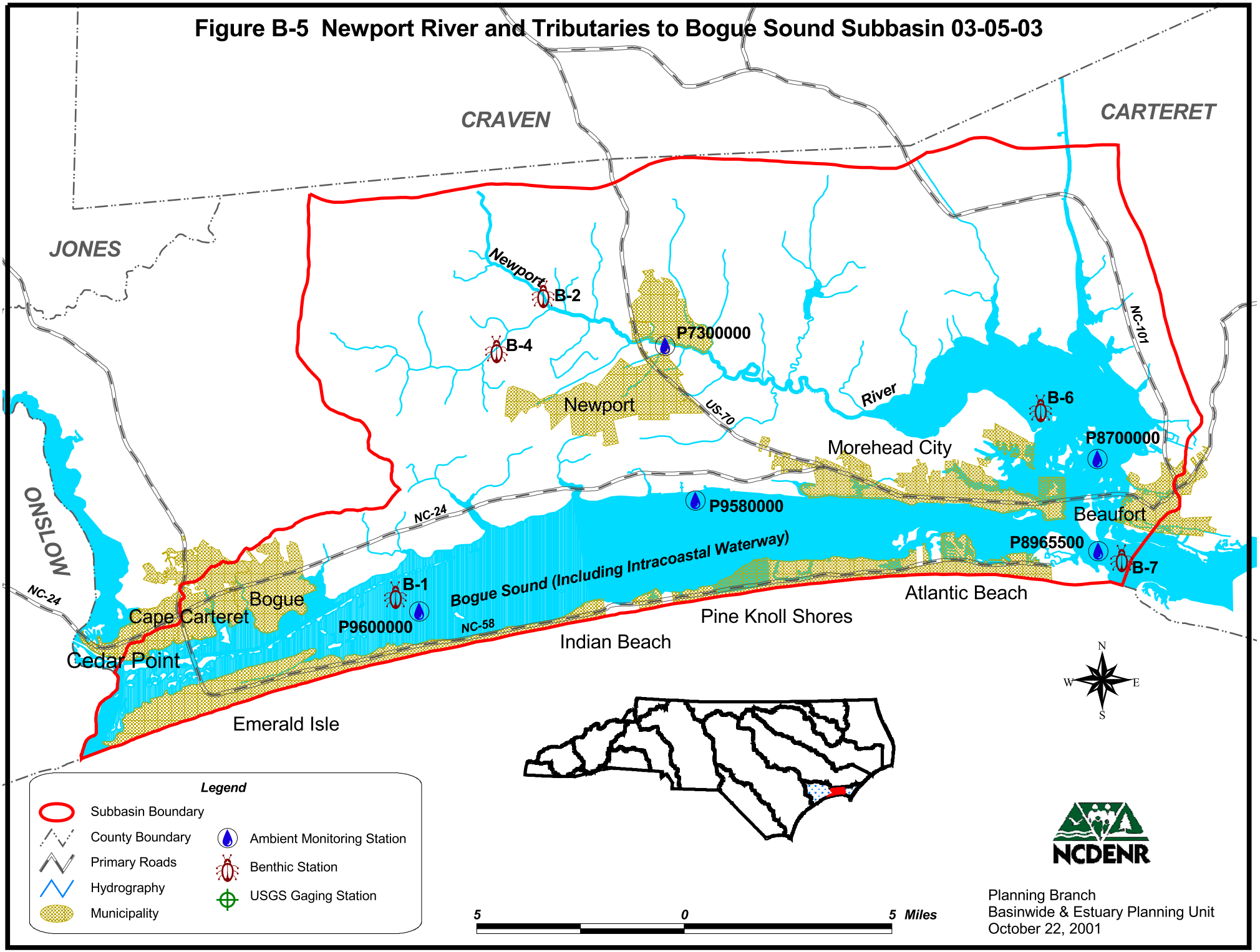


Table B-5 DWQ Monitoring Locations and Benthic Macroinvertebrate Bioclassifications (1999) for White Oak River Subbasin 03-05-03

Site	Stream	County	Road	Bioclassification
Benthic Macroinvertebrates				
B-1*	Bogue Sound	Carteret	Emerald Isle	Not Rated
B-2	NW Prong Newport River	Carteret	SR 1206	Not Rated
B-4	SW Prong Newport River	Carteret	SR 1124	Not Rated
B-6	Newport River	Carteret	Crab Point	Not Rated
B-7	Morehead Harbor	Carteret	Radio Island	Not Rated
Ambient Monitoring**				**Parameters In Excess of State Standards**
P7300000	Newport River	Carteret	Newport	DO
P6850000	Newport River	Carteret	Channel Marker G15	
P8965500	Morehead Harbor	Carteret	Morehead	
P9580000	Bogue Sound	Carteret	Salter Path	
P9600000	Bogue Sound	Carteret	Emerald Isle	

* Historical data are available; refer to Appendix III.

** Assessment period 9/1/94 to 8/31/99

Table B-6 Use Support Ratings for Monitored Waters in Subbasin 03-05-03

Use Support Category	Use Support Ratings				
	FS	**PS**	**NS**	**NR**	**Total**
Aquatic Life and Secondary Recreation	0 mi. 31,113.4 ac	0	0	21.6 mi. 0 ac 25 coastal mi.*	21.6 mi. 31,113.4 ac 25 coastal mi.*
Fish Consumption	0	25 coastal mi.*	0	0	25 coastal mi.*
Primary Recreation	22,895.0 ac 25 coastal mi.*	0	0		22,895.0 ac 25 coastal mi.*
Shellfish Harvesting	0 mi. 26,683 ac	2.0 mi. 2,763 ac	15.7 mi. 4,700 ac	0	17.7 mi. 34,146 ac

* Refers to miles along Atlantic coastline.

3.2 Status and Recommendations for Previously Impaired Waters

This section reviews the status of recommendations made in the 1997 White Oak River Basinwide Water Quality Management Plan, reviews current status and use support ratings, and

makes recommendations for the next five years. Previously impaired Class SA waters are discussed in Section 3.4 below. There were no other waters identified as impaired in the 1997 plan.

3.3 Status and Recommendations for Newly Impaired Waters

All waters in subbasin 03-05-03 are currently partially supporting (PS) on an evaluated basis for the fish consumption use support category because of a statewide fish consumption advisory for bowfin. Fish tissue samples were not collected in this subbasin. Twenty-five miles of Atlantic coastline are currently partially supporting (PS) the fish consumption use support category because of a consumption advisory for king mackerel. Refer to page 61 for more information on this issue. There are no other newly impaired waters in this subbasin. Class SA waters are discussed below in Section 3.4.

3.4 Impaired Class SA Waters

There are 34,146 acres and 17.7 stream miles of Class SA waters in subbasin 03-05-03 that were assessed in the shellfish harvesting use support category. In this subbasin, 7,463 acres (22%) are considered impaired in the shellfish harvesting use support category. Refer to Figure B-6 to identify locations of DEH SS growing areas and growing area classifications. Refer to page 49 for DEH SS growing area criteria. Data for making use support determinations were provided by DEH SS (refer to page 40). The larger water areas in this subbasin are described below with reference to DEH SS growing areas. The problem parameter for all waters listed below is fecal coliform bacteria contamination. Refer to page 49 for recommendations to address impaired Class SA waters.

The differences in acreage estimates between years are not necessarily related to changes in water quality, but to different methods of estimating acreage and changes in use support methodology. For more information on changes in use support methodology, refer to page 51. Refer to Appendix III for use support methodology and a complete listing of individual monitored waters.

Bogue Sound and Tributaries (Areas D-4, E-1, E-2 and E-3)

There are 1,344 acres of Bogue Sound and tributaries including Spooner Creek, Broad Creek and Money Island Bay that are not supporting shellfish harvesting. These areas are DEH SS classified as prohibited/restricted and permanently closed to shellfish harvesting. Bogue Sound adjacent to Jumping Run (367 acres) is also not supporting shellfish harvesting. This area is DEH SS classified as conditionally approved-closed and was closed to shellfish harvesting most of the assessment period. The northern shoreline of Bogue Sound is experiencing rapid growth. Emerald Isle, Cape Carteret and Atlantic Beach are continuing to grow as well. These areas have very large seasonal populations and associated campgrounds and marinas. Bacterial water quality continues to decline along the north shore of Bogue Sound. There are also 146 acres of impaired ORW waters in the western portion of Bogue Sound. The Highway 24 causeway also alters flow into Broad and Gales Creeks. Potential sources of pollution include runoff from urbanized areas and subdivisions (NCDENR, 1999e; NCDENR, 1998e; and NCDENR, 1999c).

North Carolina Coastal Federation has acquired buffers at Atlantic Beach (Hoop Hole Creek) to permanently protect shellfish waters from development. Refer to page 105 for more information on this project.

North Carolina Wetlands Restoration Program has a restoration project on 4.4 acres in the Jumping Run Creek Watershed (refer to page 105) and a 2.8-acre shoreline stabilization and salt marsh restoration at the Maritime Museum near Beaufort.

Newport River and Tributaries (Area E-4)

There are 1,606 acres of the Newport River and adjacent bays and tributaries extending to the Atlantic Ocean including Harlowe Creek, Core Creek and Crab Point Bay that are not supporting shellfish harvesting. These areas are DEH SS classified as prohibited/restricted and permanently closed to shellfish harvesting. There are 1,380 acres of the Newport River, Harlowe Creek and Core Creek that are also not supporting. These areas are DEH SS classified as conditionally approved-closed and were closed to shellfish harvesting most of the assessment period. The middle portion of the Newport River (2,763 acres) is rated partially supporting. This area is DEH SS classified as conditionally approved-open and was closed to shellfish harvesting 11.7 percent of the five-year assessment period. The population of the area continues to grow around Newport, Morehead City and Beaufort. There are many subdivisions in this subbasin as well. Potential sources of pollution include runoff from urban areas and subdivisions as well as agricultural and forestry land uses (DENR, 1998f).

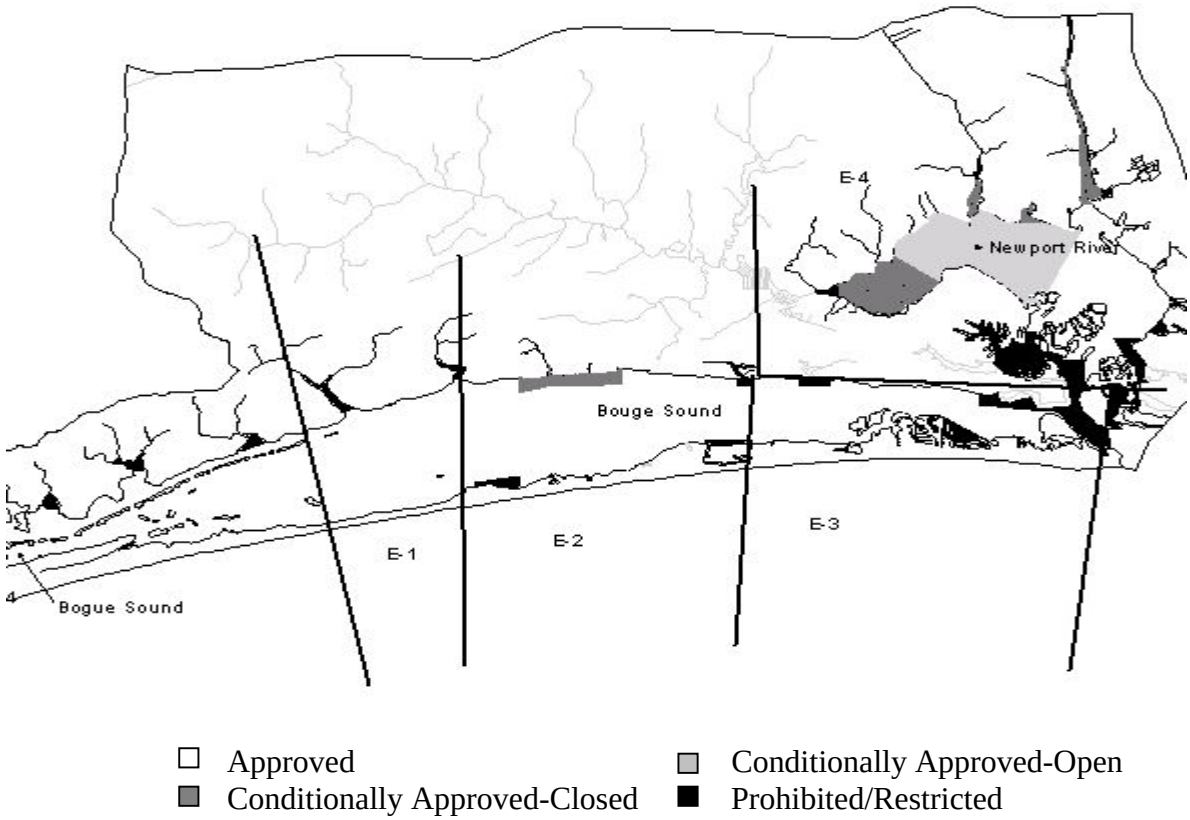


Figure B-6 DEH Shellfish Growing Area Classifications in Subbasin 03-05-03

3.5 303(d) Listed Waters

There are 4,046 acres in DEH growing areas D4, E1, E2, E3, E4 and E5 in subbasin 03-05-03 that are on the year 2000 303(d) list. These waters were classified by DEH Shellfish Sanitation as prohibited/restricted. The reported acreages for these areas were based on DEH Shellfish Sanitation growing area acreage estimates. Refer to Appendix IV for more information on the state's 303(d) list and listing requirements.

3.6 Others Issues and Recommendations

Nonpoint Source Issues in the Upper Newport River

Although the aquatic life/secondary recreation use support category in the upper Newport River are not currently impaired, there are indications of nutrient loading, channelization, habitat removal and habitat degradation. Continued development, road building, wetland ditching and draining, and poor de-snagging practices have the potential to cause degradation of aquatic habitats and water quality in the upper Newport River as well as increase the potential for eutrophication problems in the Newport River estuary. These land uses should implement best management practices to reduce water quality impacts.

Bogue Sound Growing Area Reclassifications

Because bacteriological water quality no longer meets approved area criteria, DEH SS is reclassifying areas along the north shore of Bogue Sound to conditionally approved-open. These areas are currently rated fully supporting the shellfish harvesting use support category. During the next basinwide assessment, these areas may be rated partially supporting if temporary closures continue to increase in frequency.

Stormwater Pumping

There have been swimming advisory signs posted at Emerald Isle by DEH SS in response to stormwater pumping. Because this pumping can close shellfish harvesting areas and swimming areas, it is recommended that stormwater pumping be done only during emergencies. Emerald Isle has been issued violations for pumping stormwater during non-emergency situations. Emerald Isle is pursuing funding to purchase land to be used for stormwater treatment. DEH SS and DWQ will continue to monitor this situation and pursue a resolution that does not involve potential contamination of surface waters with stormwater.

Calico Creek

Calico Creek is currently not rated; however, studies in 1999 indicate water quality impacts from urban nonpoint sources as well as the Morehead City WWTP (1.7 MGD). Calico Creek is poorly flushed and any additional inputs of nutrients or BOD may increase the potential for adverse water quality impacts. Several tidal periods are needed to flush the creek.

Chapter 4 -
White Oak River Subbasin 03-05-04
Includes North River, Jarrett Bay, Nelson Bay and Core Sound

4.1 Water Quality Overview

Subbasin 03-05-04 at a Glance

Land and Water Area (sq. mi.)	
Total area:	170
Land area:	102
Water area:	68
Population Statistics	
1998 Est. Pop.:	8,514 people
Pop. Density:	83 persons / mi^2
Land Cover (%)	
Forest / Wetland:	35
Surface Water:	40
Urban:	1
Cultivated Cropland:	23
Pasture / Managed Herbaceous:	1
Water Area:	
Stream Miles:	6
Estuarine Acres:	39,498
Coastal Miles:	0
Shellfish Harvest Acres:	39,176

This subbasin contains major waterbodies, including North River, Jarrett Bay and Nelson Bay, plus the landward halves of Back Sound and Core Sound. A map of this subbasin, including water quality sampling locations, is presented in Figure B-7. Use support ratings for monitored waters are presented in Table B-7.

Atlantic, at the northern end of the subbasin, and Harkers Island, at the south, are the two most densely developed areas within the subbasin. A large part of the subbasin is in cultivated cropland (Open Grounds Farm).

Water quality in this subbasin is generally high. Ambient monitoring data at one station indicated drainage from swampy areas near Open Grounds Farm. Open Grounds Farm has implemented many BMPs over the years to reduce potential impacts from agricultural activities in this subbasin.

Most of this subbasin is estuarine with freshwater drainage from adjacent land. There are no freshwater streams in this subbasin. There are 39,176 acres of shellfish harvesting waters in the subbasin. Most of these waters (25,958 acres) are classified as ORWs in the Core Sound. There are no coastal miles in this subbasin.

The most densely populated areas are near the Town of Atlantic in the northern part of the basin and Harkers Island in the southern portion. The Town of Beaufort discharges 1.2 MGD from its WWTP into Taylor Creek. Beaufort Fisheries also discharges 3 MGD of industrial wastewater to Taylor Creek. The other two wastewater discharges in the subbasin are small.

There are seven ambient monitoring sites in subbasin 03-05-04. The ambient site on Broad Creek detected dissolved oxygen and pH levels in excess of state standards; however, these levels were attributed to drainage of swampy waters in the watershed.

For more information, refer to the *White Oak River Basinwide Assessment Report* (June 2000) or contact Environmental Sciences Branch at (919) 733-9960 or visit the web site at http://www.esb.enr.state.nc.us/.

Figure B-7 North River and Tributaries to Core Sound Subbasin 03-05-04

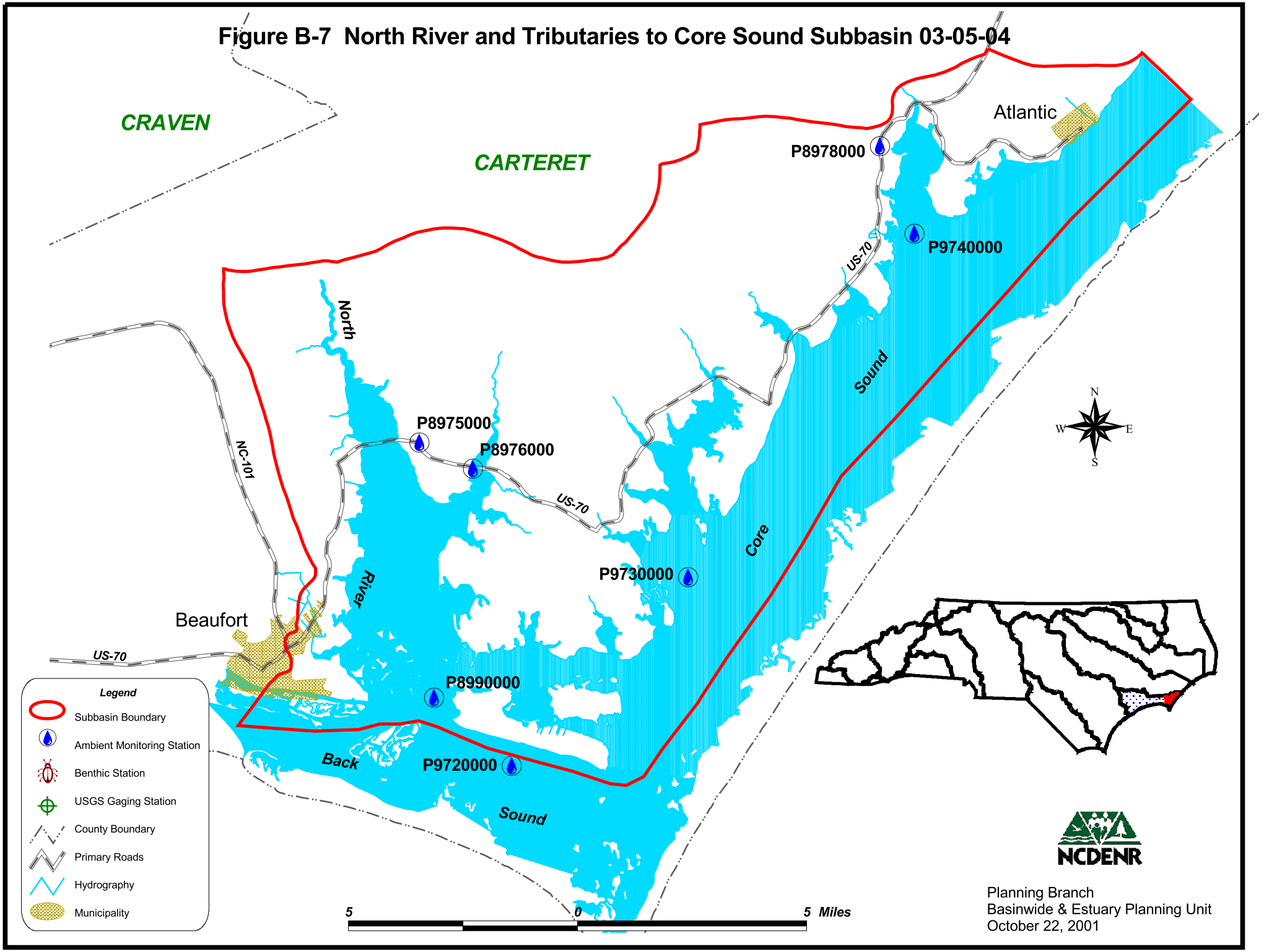


Table B-7 Use Support Ratings for Monitored Waters in Subbasin 03-05-04

Use Support Category	Use Support Ratings				
	FS	PS	NS	NR	Total
Aquatic Life and Secondary Recreation	4.4 mi. 37,705.8 ac	0	0	0 mi. 40.6 ac	4.4 mi. 37,746.4 ac
Fish Consumption	0	0	0	0	0
Primary Recreation	33,283.9 ac	0	0	0	33,283.9 ac
Shellfish Harvesting	0 mi. 27,642 ac	2.7 mi. 10,132 ac	0 mi. 1,403 ac	0	2.7 mi. 39,177 ac

4.2 Status and Recommendations for Previously Impaired Waters

This section reviews the status of recommendations made in the 1997 White Oak River Basinwide Water Quality Management Plan, reviews current status and use support ratings, and makes recommendations for the next five years. Previously impaired Class SA waters are discussed in Section 4.4 below. There were no other waters identified as impaired in the 1997 plan.

4.3 Status and Recommendations for Newly Impaired Waters

All waters in this subbasin are currently partially supporting (PS) on an evaluated basis for the fish consumption use support category because of a statewide fish consumption advisory for bowfin. Fish tissue samples were not collected in this subbasin. Refer to page 61 for more information on this issue. There are no other newly impaired waters in this subbasin. Class SA waters are discussed below in Section 4.4.

4.4 Impaired Class SA Waters

There are 39,177 acres and 2.7 stream miles of Class SA waters in subbasin 03-05-04 that were assessed in the shellfish harvesting use support category. In this subbasin, 11,535 acres (29%) are considered impaired in the shellfish harvesting use support category. There are 1,904 acres of ORW waters that impaired in Core Sound. Refer to Figure B-8 to identify locations of DEH SS growing areas and growing area classifications. Refer to page 49 for DEH SS growing area criteria. Data for making use support determinations were provided by DEH SS (refer to page 40). The larger water areas in this subbasin are described below with reference to DEH SS growing areas. The problem parameter for all waters listed below is fecal coliform bacteria contamination. Refer to page 49 for recommendations to address impaired Class SA waters.

The differences in acreage estimates between years are not necessarily related to changes in water quality, but to different methods of estimating acreage and changes in use support methodology. For more information on changes in use support methodology, refer to page 51.

Refer to Appendix III for use support methodology and a complete listing of individual monitored waters.

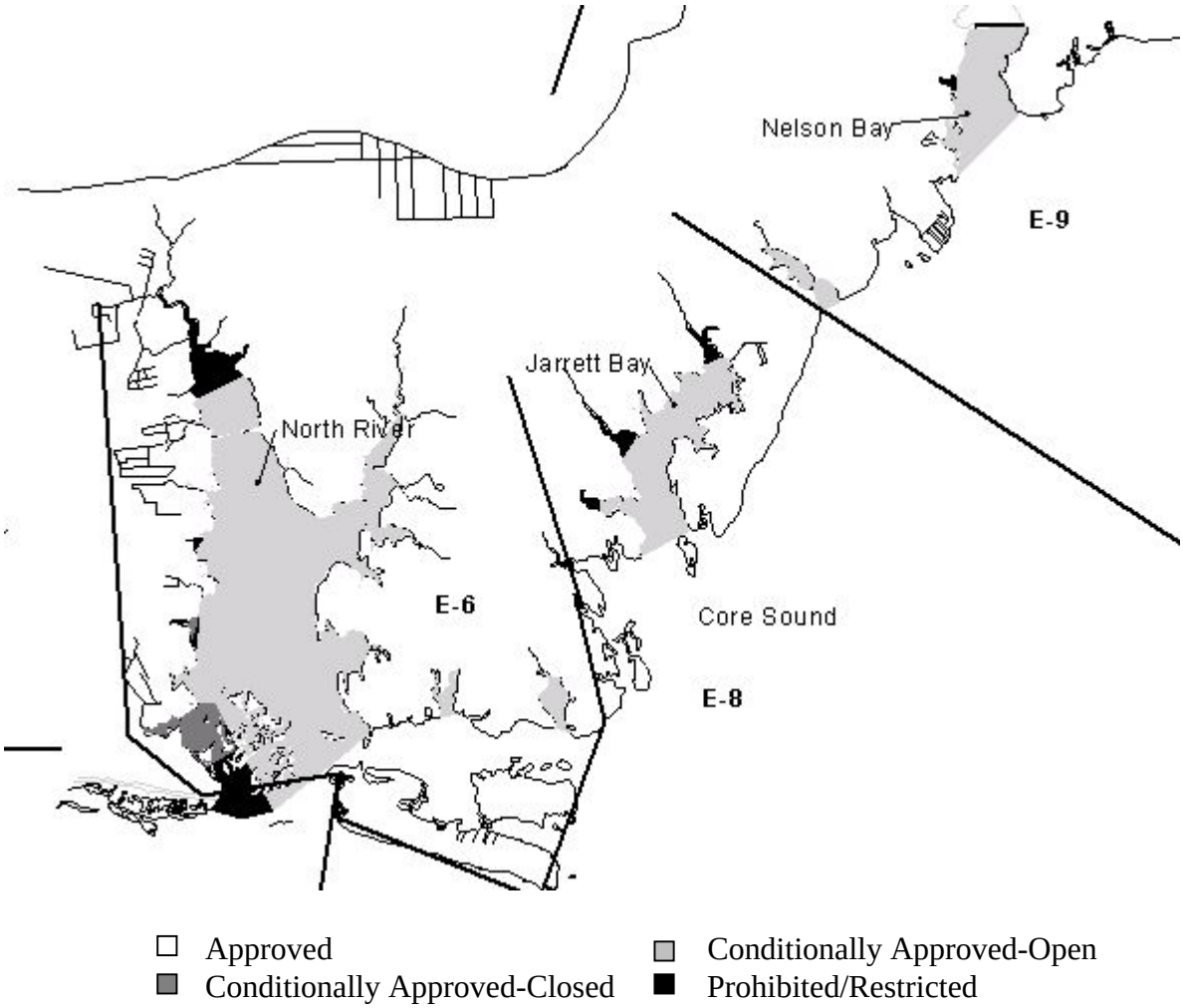


Figure B-8 DEH Shellfish Growing Area Classifications in Subbasin 03-05-04

North River and Tributaries (Area E-6)

There are 782 acres of the North River and adjacent bays and tributaries including Ward Creek, Goose Creek, The Straits, Davis Bay and a small portion of Back Sound that are not supporting shellfish harvesting. These areas are DEH SS classified as prohibited/restricted and permanently closed to shellfish harvesting. There are 361 acres of the North River, Newby Creek and Davis Bay that are also not supporting. These areas are DEH SS classified as conditionally approved-closed and were closed to shellfish harvesting most of the assessment period. The North River, Ward Creek and northern bays of the Straits (8,218 acres) are rated partially supporting. These areas are DEH SS classified as conditionally approved-open and were closed to shellfish harvesting from 11.7 percent to 16.6 percent of the five-year assessment period. The population of the area continues to grow around Beaufort. Potential sources of pollution include runoff from subdivisions, agricultural land and wildlife. Septic system problems have been noted around the community of North River (DENR, 1998g).

The North Carolina Coastal Federation with CWMTF funding has acquired 1,981 acres of wetlands adjacent to the North River to conduct a number of water quality enhancement projects. Refer to page 105 for more information on this project.

Core Sound and Western Bays and Tributaries (Areas E-8 and E-9)

There are 261 acres of tributaries to Jarrett Bay and Nelson Bay that are not supporting shellfish harvesting. These areas are DEH SS classified as prohibited/restricted and permanently closed to shellfish harvesting. Jarrett Bay, Oyster Creek, Nelson Bay and adjacent areas of Core Sound (2,775 acres) are rated partially supporting. These areas are DEH SS classified as conditionally approved-open and were closed to shellfish harvesting from 11.0 percent to 13.7 percent of the five-year assessment period. Potential sources of pollution include runoff from subdivisions, agricultural land, domesticated animals, forestry practices and wildlife. Septic systems have been a noted problem in low lying areas (DENR, 1998i).

4.5 303(d) Listed Waters

There are 1,335 acres in DEH growing areas E6 and portions of E8, E9, E5 and E7 in subbasin 03-05-04 that are on the year 2000 303(d) list. These waters were classified by DEH Shellfish Sanitation as prohibited/restricted. The reported acreages for these areas were based on DEH Shellfish Sanitation growing area acreage estimates. Refer to Appendix IV for more information on the state's 303(d) list and listing requirements. Refer to page 49 more information on changes in methodology.

4.6 Others Issues and Recommendations

Nonpoint Source Issues in the North River

Although the aquatic life/secondary recreation use support category in the upper North River is not currently impaired, there are indications of nutrient loading, channelization, habitat removal and habitat degradation. Continued development, road building, wetland ditching and draining, and poor de-snagging practices have the potential to cause degradation of aquatic habitats and water quality in the upper North River as well as increase the potential for eutrophication problems in the North River estuary. These land uses should implement best management practices to reduce water quality impacts.

Chapter 5 -
White Oak River Subbasin 03-05-05
Includes Core Sound and Atlantic Ocean

5.1 Water Quality Overview

Subbasin 03-05-05 at a Glance

Land and Water Area (sq. mi.)

Total area:	52
Land area:	8
Water area:	44

Population Statistics

1990 Est. Pop.:	2,575 people
Pop. Density:	0 person / mi^2

Land Cover (%)

Forest / Wetland:	14
Surface Water:	84
Urban:	0.2
Cultivated Crop:	0
Pasture / Managed Herbaceous:	2

Water Area:

Stream Miles:	0
Estuarine Acres:	21,975
Coastal Miles:	43
Shellfish Harvest Acres:	21,975

This subbasin includes the eastern side of Core Sound and the southern side of Back Sound in Carteret County. The entire subbasin is estuarine. The land within this subbasin, Shackleford Banks, Cape Lookout and Core Banks, is part of the Cape Lookout National Seashore and is nearly undeveloped. A map of this subbasin including water quality sampling locations is presented in Figure B-9. Use support ratings for monitored waters are presented in Table B-8.

There are very few permanent residences in this subbasin, and water quality is very good.

All of the waters in this subbasin are Class SA, and 20,094 acres are classified as ORW.

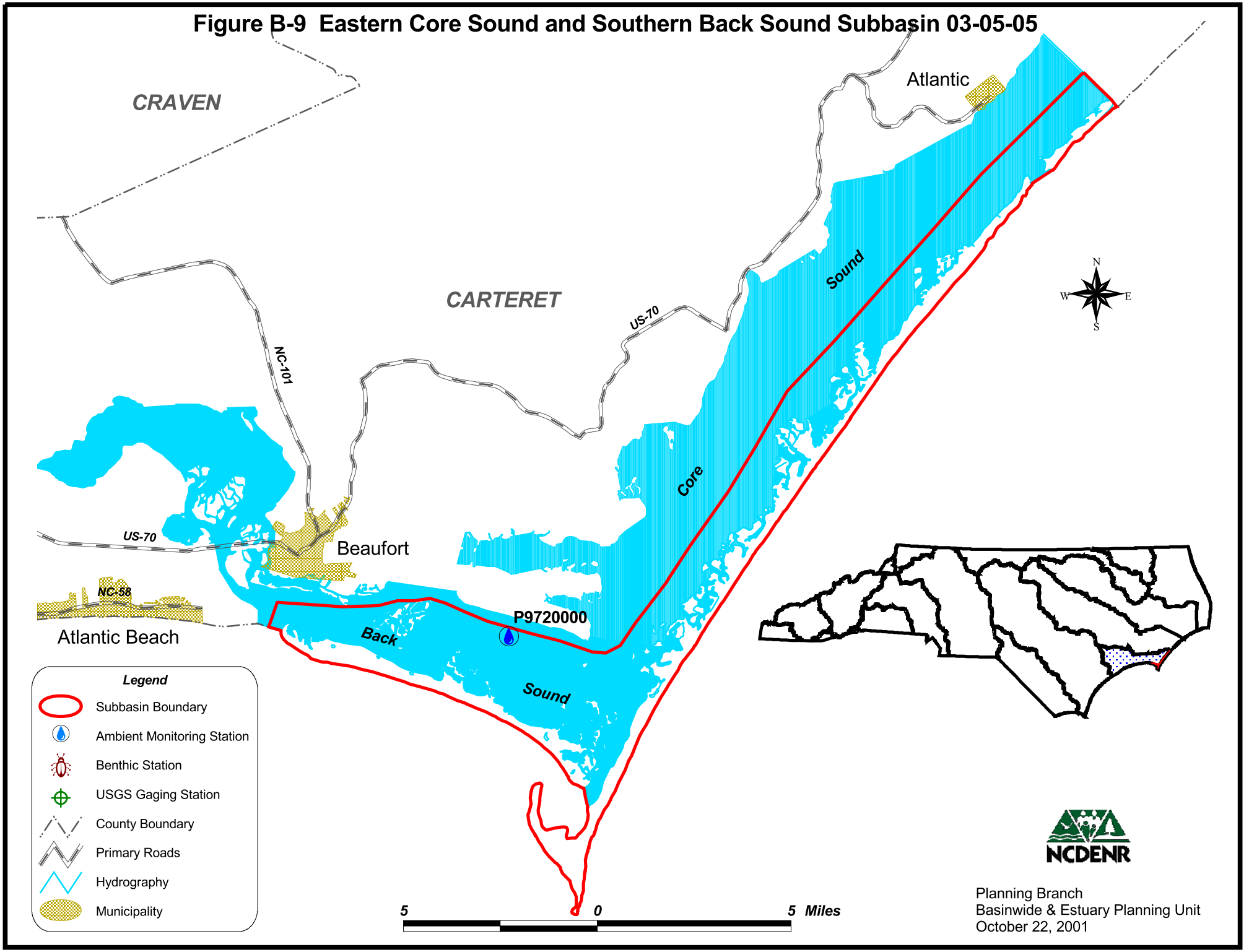
For more information, refer to the *White Oak River Basinwide Assessment Report* (June 2000) or contact Environmental Sciences Branch at (919) 733-9960 or visit the web site at http://www.esb.enr.state.nc.us/.

Table B-8 Use Support Ratings for Monitored Waters in Subbasin 03-05-05

Use Support Category	Use Support Ratings				
	FS	PS	NS	NR	Total
Aquatic Life and Secondary Recreation	21,975 ac	0	0	43 coastal mi.*	21,975 ac
Fish Consumption	0	43 coastal mi.*	0	0	43 coastal mi.*
Primary Recreation	21,975 ac 43 coastal mi.*	0	0		21,975 ac 43 coastal mi.*
Shellfish Harvesting	21,975 ac	0	0	0	21,975 ac

* Refers to miles along Atlantic coastline.

Figure B-9 Eastern Core Sound and Southern Back Sound Subbasin 03-05-05



5.2 Status and Recommendations for Previously Impaired Waters

There were no impaired waters in this subbasin in the 1997 plan.

5.3 Status and Recommendations for Newly Impaired Waters

All waters in this subbasin are currently partially supporting (PS) on an evaluated basis for the fish consumption use support category because of a statewide fish consumption advisory for bowfin. There are no bowfin in this subbasin as all the waters are estuarine. Fish tissue samples were not collected in this subbasin. Forty-three miles of Atlantic coastline are currently partially supporting (PS) the fish consumption use support category because of a consumption advisory for king mackerel. Refer to page 61 for more information on this issue. There are no other newly impaired waters in this subbasin.

5.4 Impaired Class SA Waters

All the waters in the subbasin are DEH SS classified as approved and currently rated fully supporting. Refer to page 49 for DEH SS growing area criteria. Data for making use support determinations were provided by DEH SS (refer to page 40). The differences in acreage estimates between years are not necessarily related to changes in water quality, but to different methods of estimating acreage and changes in use support methodology. Refer to Appendix III for use support methodology and a complete listing of individual monitored waters.

5.5 303(d) Listed Waters

Forty-three miles of Atlantic coastline are on the year 2000 303(d) list because of a consumption advisory for king mackerel.

Section C

Current and Future Water Quality Initiatives

Chapter 1 -
Current Water Quality Initiatives

1.1 Workshop Summaries

In October 2000, there were two workshops held by DWQ in the White Oak River basin at Beaufort and Jacksonville. There were 50 people in attendance representing a variety of interests.

DWQ staff gave presentations about general water quality in the White Oak River basin, basinwide planning and the Wetlands Restoration Program. Participants at each workshop also gave brief presentations about local water quality initiatives. Workshop attendees were asked to discuss the following questions in small groups:

1. What are the main threats to water quality in the White Oak River basin?
2. Where are the problem areas or waters? And what recommendations do you have for addressing these problems/waters?
3. What local agencies or organizations should be involved in addressing the problems?

A detailed outline of each small group's discussion of these questions is provided in Appendix V. Good discussion was generated at each workshop, and all of the information was considered, and in some cases incorporated, into this draft plan. The most frequently cited threats to water quality identified by workshop participants are listed below.

Important Issues Basinwide

- Sedimentation
- Nonpoint source pollution (agriculture, urban runoff, silviculture)
- Lack of local planning
- Wastewater treatment (collection system failures, discharges, failing septic systems)
- Closed shellfish harvest areas

1.2 Federal Initiatives

1.2.1 Section 319 – Base Program

Section 319 of the Clean Water Act provides grant money for nonpoint source demonstration projects. Approximately $1 million is available annually for demonstration and education projects across the state. Project proposals are reviewed and selected by the North Carolina Nonpoint Source Workgroup, made up of state and federal agencies involved in regulation or research associated with nonpoint source pollution. Information on the North Carolina 319 grant program, including application deadlines and requests for proposals, are available online at http://h2o.enr.state.nc.us/nps/bigpic.htm.

Table C-1 319 Projects in the White Oak River Basin

Funding Year	Project	Contractor	Grant
FY 1998	Bear Creek Shellfish Restoration Project	NC Cooperative Extension Service	$100,000
FY 1997	BMP Demonstration Project	NC Cooperative Extension Service	$120,000

Bear Creek Shellfish Restoration Project (Subbasin 03-05-01)

The objective of this project is to reduce fecal coliform levels in Bear Creek sufficiently to enable opening of its SA waters to shellfishing with greater frequency and to maintain acceptable fecal coliform levels on a long-term basis. Residential, agricultural, roadway and forestry best management practices will be installed and evaluated for their ability to reduce fecal coliform, sediment and nutrient loads. Potential indicators of success will be an increase in the number of shellfish acres conditionally approved-open or to increase the amount of rainfall required for closure of conditionally approved-open shellfish areas.

Best Management Practice (BMP) Demonstration Project (Subbasin 03-05-01, 03-05-02 and 03-05-03)

A primary water quality concern along the coast and in the White Oak River basin is the condition of shellfishing waters. This 319 project is aimed at this issue. It addresses sedimentation and shellfish closures in the White Oak River basin by demonstrating and quantifying the effectiveness of urban and agricultural best management practices (BMPs) to reduce sediment, nutrients and pathogen loading.

Pollution sources will be inventoried using a geographic information system, which will facilitate the coordination and development of a comprehensive system of BMPs and educational programs. Three agricultural/forest runoff demonstration sites, one each in the New, Newport and White Oak Rivers, will be selected to demonstrate bacterial, nutrient and sediment reduction resulting from detention ponds, livestock exclusion, streambank restoration and/or wetland construction. Two urban runoff demonstration sites, one each in the New and White Oak River watersheds, will be used to demonstrate the effectiveness of urban BMPs. Water quality monitoring will be used to evaluate effectiveness in reducing sediment, nutrients and pathogen loads.

The project's educational component includes conducting workshops to inform local elected officials, agency officials, the development community, students, local leaders and citizens about the purpose and effectiveness of BMPs. It also includes production of newsletters and fact sheets to promote BMP implementation in the watershed.

1.2.2 Clean Water Act Section 319 (h) – Incremental Program

In 1998, the President's Clean Water Action Plan Initiative required states to compile and rate water quality conditions at the 8-digit hydrologic unit scale. This evaluation by the state resulted in the identification of 23 HUs as 'needing restoration'. The Category I rating makes these areas

eligible for additional funding through the incremental 319 program. There are two 8-digit hydrologic units within the White Oak River basin (Table C-2), both of which were rated as needing restoration in the 1998 Unified Watershed Assessment.

Table C-2 Hydrologic Units within the White Oak River Basin

HU Name	HUC	UWA Rating
White Oak River	03030001	Category I
New River	03020106	Category I - High Priority

Funding for implementation of the Clean Water Action Plan Initiative is provided through the Section 319 Incremental Grant Program. With a separate funding source, these grant resources are to be allocated by the state for assessment and implementation in hydrologic units defined as "Needing Restoration" in the 1998 North Carolina Unified Watershed Assessment. This funding was first available for FY 1999, and continued funding of this program will be decided by Congress. Project proposals are reviewed and selected by the North Carolina Nonpoint Source Workgroup, made up of state and federal agencies involved in regulation or research associated with nonpoint source pollution. Information on the North Carolina 319 grant program, including application deadlines and requests for proposals, are available online at http://h2o.enr.state.nc.us/nps/bigpic.htm.

1.3 State Initiatives

1.3.1 NC Wetlands Restoration Program

The North Carolina Wetlands Restoration Program (NCWRP) is a nonregulatory program responsible for implementing wetland and stream restoration projects throughout the state. The focus of the program is to improve water quality, flood prevention, fisheries, wildlife habitat and recreational opportunities. The NCWRP is not a grant program. Instead, the program funds wetland, stream and riparian area projects directly through the Wetlands Restoration Fund.

Restoration sites are targeted through the use and development of the Basinwide Wetlands and Riparian Restoration Plans. These plans were developed, in part, using information compiled in DWQ's Basinwide Water Quality Plans. The Basinwide Wetlands and Riparian Restoration Plans are updated every five years on the same schedule as DWQ's Basinwide Water Quality Plans.

The NCWRP is also working to develop comprehensive Local Watershed Restoration Plans within the some targeted local watersheds. These more locally-based plans will identify wetland areas, contiguous reaches of stream, and contiguous strips of buffer vegetation that, once restored, will provide significant water quality and other environmental benefits to watersheds. The NCWRP will coordinate with local community groups, local governments and others to develop and implement these plans.

The NCWRP can perform restoration projects cooperatively with other state or federal programs or environmental groups. For example, the NCWRP's efforts can complement projects funded through the Section 319 Program. Integrating wetlands or riparian area restoration components with 319 funded or proposed projects will often improve the overall water quality benefits of the project. The NCWRP actively seeks landowners within the White Oak River basin who have restorable wetland, riparian and stream sites.

For more information about participating in the NCWRP, please contact Crystal Braswell at (919) 733-5208 or visit the website at http://h2o.enr.state.nc.us/, then click on Wetlands Restoration Program.

1.3.2 Clean Water Management Trust Fund

The Clean Water Management Trust Fund offers approximately $40 million annually in grants for projects within the broadly focused areas of restoring and protecting state surface waters and establishing a network of riparian buffers and greenways. In the White Oak River basin, nine projects have been funded for a total of $10,086,141. For more information on the CWMTF or these grants, call (919) 733-6375 or visit the website at http://www.cwmtf.net/.

Table C-3 Projects in the White Oak River Basin Funded by the Clean Water Management Trust Fund (as of July 1999)

Stream or Watershed	Project	Project Lead	Amount Funded
New River	Stormwater Improvements	Jacksonville	$572,043
White Oak River	Land Acquisition-Buffers	NC Coastal Federation	$2,134,818
White Oak River	Land Acquisition-Buffers	NC Coastal Federation	$100,000
Hoop Pole Creek	Land Acquisition-Buffers	NC Coastal Federation	$2,520,000
North River	Restoration	NC Coastal Federation	$1,250,000
Bear Island	Land Acquisition-Buffers	NC Division of Parks and Recreation	$1,480,000
Jumping Run Creek	Stormwater Improvements	NC Sea Grant	$200,000
White Oak River	Wastewater Improvements	Swansboro	$1,740,000
White Oak River	Wastewater Improvements	Maysville	$71,280
Total to Date			$10,086,141

Jacksonville Stormwater Project (Subbasin 03-05-02)

The NCWRP with the City of Jacksonville and CWMTF is restoring five acres of brackish marsh adjacent to Wilson Bay to treat stormwater from this urban watershed before it enters Wilson Bay. Sturgeon City is in the former site of the Wilson Bay WWTP. The overall project and associated environmental education center is aimed at returning sturgeon to the New River. More information is available at the following website http://www.sturgeoncity.org/.

White Oak Buffer Acquisition (Subbasin 03-05-01)

The White Oak River is a relatively pristine coastal river system. However, human activity is threatening the water quality along the 48-mile river. The NCCF received a $2.1 million grant from the CWMTF to purchase a 780-acre parcel of river front land. A portion of the property will be used to demonstrate appropriate development that is compatible with maintaining a healthy river system. Funds derived from remarketing land will be used for additional land purchases along the river. The NCCF was also awarded $100,000 from the CWMTF to identify and secure purchase options for property along the White Oak River in 1999.

Hoop Pole Creek Buffer Acquisition (Subbasin 03-05-03)

NCCF became the first organization to buy land with a grant from the new North Carolina Clean Water Management Trust Fund. With a $2.5 million grant, a 31-acre water quality buffer was purchased in Atlantic Beach to protect shellfish water from urban development. The property known as Hoop Pole Creek is permanently protected from development.

North River Restoration Project (Subbasin 03-05-04)

NCCF has completed acquisition of 1,981 acres of prior converted wetlands next to the North River in Carteret County with a grant from the CWMTF for $1.25 million. The NCCF will conduct a number of water quality enhancement projects, which will restore the property to its original state. The property will treat runoff from another 10,000 acres of cropland. It will be one of the largest habitat and water quality restoration projects in the country.

Bear Island Buffer Acquisition (Subbasin 03-05-01)

NCCF with the State Parks and Recreation is obtaining a grant from the Clean Water Management Trust Fund to purchase Huggins Island in Bogue Sound. Under heavy pressure to be developed, the island was incorporated into the Park System and permanently protected. Huggins Island, a 110-acre "developable" island is located in the estuarine waters of the White Oak River.

Jumping Run Creek Stormwater Project (Subbasin 03-05-03)

This project is part of a watershed wide effort to test techniques to decrease closures of shellfish harvesting waters. The project will restore wetlands in the watershed to treat stormwater. The site was donated by Craven Carteret Electric Cooperative (see below) with NCWRP and DWQ 319 program participation.

Swansboro WWTP Improvements (Subbasin 03-05-01)

The Swansboro received a CWMTF grant to improve WWTP operations and start land application of wastewater.

Maysville WWTP Improvements (Subbasin 03-05-01)

Maysville received $70,281 to evaluate the sewer system for extraneous flow. This project is currently under way. The town is also refurbishing the WWTP to help improve operating conditions while a long-term solution to address high flows is pursued.

Queens Creek (Subbasin 03-05-01)

In 1999, NCCF closed on the purchase of conservation easements on 104 acres of Queens Creek shoreline in Onslow County. The property owner also drafted a conservation easement on 142 acres of interior land limiting it to 20 single family homes with the same minimum lot size.

1.3.3 NC Agricultural Cost Share Program

The North Carolina Agriculture Cost Share Program was established in 1984 to help reduce the sources of agricultural nonpoint source pollution to the state's waters. The program helps owners and renters of established agricultural operations improve their on-farm management by using Best Management Practices (BMPs). These BMPs include vegetative, structural or management systems that can improve the efficiency of farming operations while reducing the potential for surface and ground water pollution. The Agriculture Cost Share Program is a voluntary program that reimburses farmers up to 75 percent of the cost of installing an approved BMP. The cost share funds are paid to the farmer once the planned control measures and technical specifications are completed. The annual statewide budget for BMP cost sharing is approximately 6.9 million.

In Onlsow County, $294,839 was expended from 1995 through 1999 on a wide variety of nonpoint source pollution reduction projects.

Soil and Water Conservation District contacts for the White Oak River basin are included in Appendix VI or visit the website at http://www.enr.state.nc.us/DSWC/files/acs.htm for more information.

1.4 Local Initiatives

1.4.1 White Oak River Advisory Board

The White Oak River Advisory Board is a 25-citizen stakeholder-based organization coordinated by the Watershed Education for Communities and Officials (WECO). The board reviews technical water quality and policy information to develop consensus-based management strategies and policy options targeted at water quality problems in the river. For more information, contact Christy Perrin by email Christy_perrin@ncsu.edu.

1.4.2 Onslow County Water Quality Study

The Onslow County Commissioners, NC Cooperative Extension Service, Onslow County Health Department, researchers, environmental groups and others have established 30 monitoring sites in Onslow County along the New River and western tributaries of he White Oak River. The end

goal of the study is to make recommendations for managing and maintaining the recreational and commercial uses of Onslow County's waterways. For more information, visit the website at http://www.ces.ncsu.edu/onslow/staff/drashash/enved/OnslowWQ.html.

1.5 Corporate Initiatives

1.5.1 Craven County Electric Cooperative

The Craven County Electric Cooperative donated 4.4 acres of property on Jumping Run Creek for a project with NCWRP and others to restore a cypress-gum swamp to treat stormwater runoff.

1.6 Citizen Efforts

1.6.1 The Stewards of the White Oak River Watershed

This local group is dedicated to cleaning trash from the White Oak River as well as educating and recruiting more people to help clean up and prevent further trashing. For more information on this effort, contact Elmer Eddy at eeddy@ee.rr.com or call (910) 325-0819.

1.6.2 New River Foundation and New Riverkeeper

This organization monitors water quality in the New River using boats and fly overs to find pollution and polluters. The Riverkeeper participates in events and with groups to educate residents and local officials of the importance of the New River as a resource in coastal North Carolina. For more information, contact Tom Mattison, New Riverkeeper, at newriver@onslowonline.net or (910) 353-3352.

1.7 Regional Activities

1.7.1 North Carolina Coastal Federation

The North Carolina Coastal Federation (NCCF) is the state's largest non-profit organization working to restore and protect the coast. Formed in 1982, the NCCF has grown to serve more than 7,000 members and 200 member groups. The Coastal Federation publishes a quarterly newsletter, the Coastal Review, and an annual State of the Coast Report. The NCCF focuses on three main areas of work including habitat restoration and protection, environmental education, and the encouragement of sound environmental programs and their enforcement.

NCCF is working towards restoration of estuarine shoreline through alternative methods of erosion control. A newly developed cost share program encourages landowners to install vegetated marshes and small stone sills to prevent erosion on their properties instead of ecologically harmful bulkheads. Alternative erosion control projects have already been implemented at Hammock's Beach State Park and other sites in the White Oak River Basin. A brochure, *Erosion Control: Non-structural alternatives, A shorefront Property Owner's Guide,* is available free to the public. For more information, visit http://www.nccoast.org/.

Chapter 2 -
Future Water Quality Initiatives

2.1 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 in the state 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 this needed support and cooperation, DWQ believes that these goals are attainable through the basinwide water quality management approach.

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, use restoration waters program for nonpoint source pollution, 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 wastewater 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 from an environmental standpoint. 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.

Use Restoration Waters (URW) Program for Nonpoint Source Impairment

DWQ has developed a conceptual strategy to manage watersheds with nonpoint source impairments as determined through the use support designations. In July 1998, the state Environmental Management Commission approved the Use Restoration Waters (URW) program concept which will target all NPS impaired waters in the state using a two-part approach. As envisioned, this concept will apply to all watersheds that are not supporting or partially supporting their designated uses. The program will catalyze voluntary efforts by stakeholder groups in impaired watersheds to restore those waters by providing various incentives and other support. Simultaneously, the program will develop a set of mandatory requirements for NPS pollution categories for locations where local groups choose not to take responsibility for restoring their impairments. This URW concept offers local governments an opportunity to implement site-specific projects at the local level as an incentive ("the carrot"). If the EMC is not satisfied with the progress made towards use restoration by local committees, impairment based rules will become mandatory in those watersheds ("the stick"). These mandatory requirements may not be tailored to specific watersheds but may apply more generically across the state or region.

With more than 400 impaired watersheds or stream segments in the state, it is not realistic for DWQ to attempt to develop watershed specific restoration strategies for nonpoint source pollution. By involving the stakeholders in these watersheds, DWQ can catalyze large-scale restoration of impaired waters. One of the major implementation challenges of this new program will be educating public officials and stakeholders at the local level as to the nature and solutions to their impairments. To address this challenge, the state plans to develop a GIS-based program to help present information at a scale that is useful to local land management officials. Other incentives that the state might provide include seed grants and technical assistance, as well as retaining the authority to mandate regulations on stakeholders who are not willing to participate.

In cases where incentives and support do not result in effective watershed restoration strategies, mandatory impairment source management requirements would be implemented in the watershed. This is not the state's preferred alternative, as it would add to state monitoring and enforcement workload. However, in areas where it is necessary, DWQ plans to implement such requirements. In the management area, DWQ would be assisted by regulatory staff from the Division of Coastal Management, Division of Environmental Health, Division of Land Resources and the Division of Marine Fisheries to insure compliance.

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.

2.2 DWQ Compliance and Enforcement Policy Revisions

DENR began implementing a new two-stage compliance and enforcement policy in 1997. Both stages of the revised policy are in effect as of July 1, 1999. The five major elements of the policy are intended to provide a comprehensive route to strengthen enforcement and heighten compliance for all dischargers and nonpoint sources of water pollution in North Carolina. The five major components of the policy are to:

1. Foster compliance through pollution prevention, technical assistance and training, reevaluate existing grant and loan funding priority criteria, and develop recognition and incentive programs.
2. Enhance enforcement through increased penalties, penalties for sewer collection systems, reduced thresholds for noncompliance, and delegation of civil penalty assessment authority to the DWQ regional office supervisors.
3. Focus on chronic and willful violators through increased use of moratoriums on expanding and additional connections, expansion of notification to the public of violators, clarification of process of determining "noncompliance", and initiation of discussion with stakeholders on possible legislative actions.
4. Assure improvement in compliance and enforcement through development of accountability measures.
5. Find and use all available resources for compliance needs with local, state and nonprofit groups.

DENR is also in the process of conducting assessment of its enforcement programs. The goal of the assessment is to identify potential areas for improvement in DENR's efforts to enforce environmental laws and ultimately improve compliance. This effort got underway in July 1999 with two focus group meetings. If you would like to see the Scope of Work for the enforcement assessment, see DENR's web page at http://www.ehnr.state.nc.us/EHNR/novs/scope.htm/.

2.3 Coordination with Other Agencies

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.

DWQ would like to work more closely with the Conservation Districts in each county of the White Oak River basin to identify nonpoint sources of pollution, develop land use and land cover data, and to develop water quality management strategies for impaired watersheds within the White Oak River basin.

DWQ is also working with DEH Shellfish Sanitation to develop databases and other tools to better identify impairment in shellfish harvesting waters. Refer to page 49 for more information on this process.

Division of Soil and Water Conservation and Division of Water Quality are working together to better identify causes and sources of impairment in rural streams. The two agencies will be working together to target those streams that are impaired and where implementation of best management practices would improve water quality. Refer to page 106 for more information on the Agricultural Cost Share Program.

DWQ and DCM are working to ensure that local governments consider water quality impacts in their land use plan. Refer to page 49 for more information.

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Appendix I

NPDES Dischargers in the White Oak River Basin

NPDES Dischargers in the White Oak River Basin

Permit	Facility	County	Type	Ownership	D1	D2	D3	D4	D5	Qw	Subbasin	Receiving Stream
NC0083321	Onslow County - Hubert WTP	Onslow	Minor	Non-municipal	22					not limited	03-05-01	Queen Creek
NC0083089	Bogue Banks Water Corporation	Carteret	Minor	Non-municipal	22					not limited	03-05-01	Bogue Sound
NC0077143	West Carteret Water Corporation	Carteret	Minor	Non-municipal	22					not limited	03-05-01	East Prong Sanders Creek
NC0050849	Onslow County Schools - Silverdale Elementary	Onslow	Minor	Non-municipal	3					0.003	03-05-01	Calebs Creek
NC0043672	Onslow County Schools - Tabernacle Elementary	Onslow	Minor	Non-municipal	3					0.017	03-05-01	Starkey's Creek
NC0036153	Town of Swansboro WWTP	Onslow	Minor	Municipal	1					0.3	03-05-01	Foster Creek
NC0030431	Hewitt's Mobile Home Park	Onslow	Minor	Non-municipal	8	6				0.03	03-05-01	UT Bell Swamp
NC0021482	Town of Maysville WWTP	Jones	Minor	Municipal	1					0.18	03-05-01	White Oak River
NC0002445	R.W. Jones Fish Company	Carteret	Minor	Non-municipal	30	25				0.005	03-05-01	Bogue Sound
NC0084395	Foster Wheeler Environmental Corporation	Onslow	Minor	Non-municipal	66					0.216	03-05-02	Northeast Creek
NC0084123	Bayshore Marina & Racquet Club	Onslow	Minor	Non-municipal	14					not limited	03-05-02	Chadwick Bay
NC0083551	Onslow County - Dixon WTP	Onslow	Minor	Non-municipal	22					not limited	03-05-02	UT Stones Creek
NC0078328	USMC MCB-Cl / Onslow Beach WTP	Onslow	Minor	Non-municipal	22					0.01	03-05-02	UT Gillets Creek
NC0071706	Hinson Arms Apartments	Onslow	Minor	Non-municipal	7					0.015	03-05-02	UT New River
NC0071536	Windmill Restaurant	Onslow	Minor	Non-municipal	10					0.005	03-05-02	Northeast Creek
NC0063029	USMC MCB-Cl / Hadnot Point WWTP	Onslow	Major	Non-municipal	11	2				16	03-05-02	New River
NC0062642	Webb Creek Water & Sewer, Inc.	Onslow	Minor	Non-municipal	5	61				0.3	03-05-02	Wallace Creek
NC0062359	Horse Creek Farms Utilities Company	Onslow	Minor	Non-municipal	5					0.1	03-05-02	UT Little Northeast Creek
NC0062294	Rock Creek Environmental Company	Onslow	Minor	Non-municipal	5					0.1152	03-05-02	New River
NC0057053	Sentry Utilities - Springdale Acres	Onslow	Minor	Non-municipal	5					0.05	03-05-02	Brinson Creek
NC0056952	Blue Creek Utilities, Inc.	Onslow	Minor	Non-municipal	2	3	4	5	7	0.1	03-05-02	Blue Creek
NC0051853	Aragona Brothers - Southgate MHP	Onslow	Minor	Non-municipal	8	7				0.02	03-05-02	UT Brinson Creek
NC0051471	Big Pines Mobile Home Park	Onslow	Minor	Non-municipal	8					0.0065	03-05-02	UT Wallace Creek
NC0049387	Viking Utilities / Hunters Creek WWTP	Onslow	Minor	Non-municipal	5					0.25	03-05-02	Mott Creek
NC0043711	Onslow County Schools - Morton Elementary	Onslow	Minor	Non-municipal	3					0.0075	03-05-02	Little Northeast Creek
NC0036676	Rexon, LTD / Collins Estates MHP	Onslow	Minor	Non-municipal	8					0.025	03-05-02	UT Rocky Run
NC0036226	Scientific Water And Sewer, Inc.	Onslow	Minor	Non-municipal	5	7	2			0.4	03-05-02	New River
NC0034991	Sentry Utilities - Hickory Grove	Onslow	Minor	Non-municipal	5					0.0225	03-05-02	Little Northeast Creek
NC0034339	Cabin Creek Campground & MHP	Onslow	Minor	Non-municipal	8					0.018	03-05-02	UT Hicks Run
NC0032239	Mercer Environ Corp - Regalwood WWTP	Onslow	Minor	Non-municipal	5					0.125	03-05-02	Northeast Creek
NC0031577	Mercer Environ Corp - White Oak Estates	Onslow	Minor	Non-municipal	5					0.12	03-05-02	Northeast Creek
NC0030813	Onslow County - Kenwood Homes WWTP	Onslow	Minor	Non-municipal	5					0.049	03-05-02	Southwest Creek
NC0028223	Beacham Apartments #1	Onslow	Minor	Non-municipal	7					0.04	03-05-02	UT Brinson Creek
NC0028215	Beacham Apartments #2	Onslow	Minor	Non-municipal	7					0.1	03-05-02	UT Brinson Creek

NPDES Dischargers in the White Oak River Basin

Permit	Facility	County	Type	Ownership	D1	D2	D3	D4	D5	Qw	Subbasin	Receiving Stream
NC0023825	Webb Apartments	Onslow	Minor	Non-municipal	7					0.025	03-05-02	Little Northeast Creek
NC0023230	Town of Richlands WWTP	Onslow	Minor	Municipal	1					0.25	03-05-02	Squires Run
NC0022462	Sherwood Mobile Home Park	Onslow	Minor	Non-municipal	8					0.06	03-05-02	UT Mott Creek
NC0007633	B.F. Millis & Sons Seafood	Onslow	Minor	Non-municipal	25	30				0.01	03-05-02	Wheeler Creek
NC0002585	A-1 Cleaners & Laundry, Inc.	Onslow	Minor	Non-municipal	40	2	16			0.008	03-05-02	UT Brinson Creek
NC0082520	Carolina Water Service / Pine Knoll	Carteret	Minor	Non-municipal	21	22				0.0126	03-05-03	Pine Knoll Shores Canal
NC0077666	Morehead City Terminals	Carteret	Minor	Non-municipal	73					not limited	03-05-03	Newport River Restricted Area
NC0072699	Town of Beaufort / Pine Street WTP	Carteret	Minor	Non-municipal	22					not limited	03-05-03	UT Town Creek
NC0044806	Town of Atlantic Beach WTP	Carteret	Minor	Non-municipal	22					not limited	03-05-03	Bogue Sound
NC0026611	Town of Morehead City WWTP	Carteret	Major	Municipal	1					1.7	03-05-03	Calico Creek
NC0021555	Town of Newport WWTP	Carteret	Minor	Municipal	1					0.5	03-05-03	Newport River
NC0072702	Town of Beaufort / Glenda Drive WTP	Carteret	Minor	Non-municipal	22					not limited	03-05-04	UT Turner Creek
NC0047759	Taylor Hospital & Extended Care	Carteret	Minor	Non-municipal	9	22				0.014	03-05-04	Nelson Bay
NC0028827	Sailor's Snug Harbor (The)	Carteret	Minor	Non-municipal	11					0.02	03-05-04	Salter's Creek
NC0021831	Town of Beaufort WWTP	Carteret	Major	Municipal	1					1.5	03-05-04	Taylor Creek
NC0000728	Beaufort Fisheries, Inc.	Carteret	Major	Non-municipal	25	23				3	03-05-04	Taylor Creek

LIST OF DISCHARGE CODES

INDICATING TYPES OF WASTEWATER DISCHARGED

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.)
14	Non-Contact cooling water/condensate	
16	Boiler Blowdown	
21	Water plants (Surface water)	
22	Water plants and Water conditioning (Groundwater)	
23	Meat processing and rendering	
25	Seafood and Fish processing	
30	Seafood or Fish packing	
40	Laundry waste	
61	Car wash facilities	
66	Groundwater remediation	
73	Stormwater	

Appendix II

Water Quality Data Collected by DWQ

- **Benthic Macroinvertebrate Collections**

Benthic Macroinvertebrate Sampling Methodology and Bioclassification Criteria

Benthic macroinvertebrates can be collected using two sampling procedures. DWQ's standard qualitative sampling procedure includes 10 composite samples: two kick-net samples, three bank sweeps, two rock or log washes, one sand sample, one leafpack sample, and visual collections from large rocks and logs. The purpose of these collections is to inventory the aquatic fauna and produce an indication of relative abundance for each taxon. Organisms are classified as Rare (1-2 specimens), Common (3-9 specimens) or Abundant (≥10 specimens).

Several data analysis summaries (metrics) can be produced from standard qualitative samples to detect water quality problems. These metrics are based on the idea that unimpaired streams and rivers have many invertebrate taxa and are dominated by intolerant species. Conversely, polluted streams have fewer numbers of invertebrate taxa and are dominated by tolerant species. The diversity of the invertebrate fauna is evaluated using taxa richness counts; the tolerance of the stream community is evaluated using a biotic index.

EPT taxa richness (EPT S) is used with DWQ criteria to assign water quality ratings (bioclassifications). "EPT" is an abbreviation for Ephemeroptera + Plecoptera + Trichoptera, insect groups that are generally intolerant of many kinds of pollution. Higher EPT taxa richness values usually indicate better water quality. Water quality ratings are also based on the relative tolerance of the macroinvertebrate community as summarized by the North Carolina Biotic Index (NCBI). Both tolerance values for individual species and the final biotic index values have a range of 0-10, with higher numbers indicating more tolerant species or more polluted conditions.

Water quality ratings assigned with the biotic index numbers are combined with EPT taxa richness ratings to produce a final bioclassification, using criteria for mountain/piedmont/coastal plain streams. EPT abundance (EPT N) and total taxa richness calculations also are used to help examine between-site differences in water quality. If the EPT taxa richness rating and the biotic index differ by one bioclassification, the EPT abundance value is used to determine the final site rating.

Benthic macroinvertebrates can also be collected using the DWQ's EPT sampling procedure. Four composite samples are taken at each site instead of the 10 taken for the qualitative sample: 1 kick, 1 sweep, 1 leafpack and visual collections. Only intolerant EPT groups are collected and identified, and only EPT criteria are used to assign a bioclassification.

The expected EPT taxa richness values are lower in small high quality mountain streams, <4 meters in width or with a drainage area <3.5 square miles. For these small mountain streams, an adjustment to the EPT taxa richness values is made prior to applying taxa richness criteria. Both EPT taxa richness and biotic index values also can be affected by seasonal changes. DWQ criteria for assigning bioclassification are based on summer sampling (June-September). For samples collected in other seasons, EPT taxa richness can be adjusted. The biotic index values can also be seasonally adjusted for samples collected outside the summer season.

Criteria have been developed to assign bioclassifications ranging from Poor to Excellent to each benthic sample. These bioclassifications primarily reflect the influence of chemical pollutants. The major physical pollutant, sediment, is not assessed as well by a taxa richness analysis.

Swamp Streams

Extensive evaluation, conducted by DWQ, of swamp streams across eastern North Carolina suggests that different criteria should be used to assess the condition of water quality in these systems. Swamp streams are characterized by slower flow, lower dissolved oxygen, lower pH, and sometimes very complex, braided channels and dark-colored water. DWQ has developed draft biological criteria that may be used in the future to assign bioclassification ratings to these streams. However, DWQ believes that there has been insufficient sampling of reference swamp streams to assign these ratings and use them for aquatic life use support determinations in the White Oak River basin at this time.

Draft swamp stream rating criteria evaluate swamp streams based on benthic macroinvertebrate data (collected in winter), fish community data and a habitat score. Benthic data collected outside of the winter high flow period are not used to assign ratings. At least two of the above-referenced data types must be collected in order to assign a rating. Each of these data types is assigned a point value of 10 (Good), 5 (Fair) or 1 (Poor), and the points are averaged to assign an overall site rating (OSR): Good-Excellent (>7.5), Fair-Good (5.0-7.5), Fair (2.0-4.9) and Poor (<2.0). Ratings for the benthic macroinvertebrate communities are based entirely on the biotic index value: Good <6.99, Fair 7.75-7.00, Poor >7.75. Deep (nonwadeable) coastal rivers with little or no visible current have different EPT criteria that are being used on a provisional basis until more data can be gathered.

Estuarine Waters

Circulation patterns, salinity and substrate variability make estuarine areas more dynamic than freshwater streams. DWQ has developed and tested biological criteria for estuarine waters with salinities greater than 8-10 ppt. These criteria, based on DWQ's freshwater criteria, use three metrics, Total Taxa Richness, Intolerant Taxa Richness (Amphpods and Caridean Shrimp) and a Biotic Index (EBI) to assign one of five water quality classes (Impact levels). One to five points are assigned to the value of each of the three metrics at a site, then summed to give a site score of 3-15 points. Proposed criteria for estuaries are: No Impact (13-15 points), Slight Impact (11-12 points), Moderate Impact (8-10 points), Elevated Impact (6-7 points), and Heavy Impact (3-5 points). Eaton (2001) demonstrates that this method is robust over time, salinity and substrate types over an area of several miles. DWQ has not adopted these criteria, so they cannot be used for aquatic use and life support determinations.

For estuarine areas with salinities below 8 ppt, the Estuarine Biotic Index (EBI) appears to be the only metric that can reliably separate Impacted from Reference sites. While no rigorous studies have been performed for these areas and no draft criteria proposed, it appears that sites with EBI values above 2.1 are usually unimpacted, while sites with EBI values less than that are usually suffering some sort of stress.

Flow Measurement

Changes in the benthic macroinvertebrate community are often used to help assess between-year changes in water quality. However, some between-year changes in the macroinvertebrate community may be due largely to changes in flow. High flow years magnify the potential effects of nonpoint source runoff, leading to scour, substrate instability and reduced periphyton. Low

flow years may accentuate the effects of point source dischargers by providing less dilution of wastes.

For these reasons, all between-year changes in the biological communities are considered in light of flow conditions (high, low or normal) for one month prior to the sampling date. Daily flow information is obtained from the closest available USGS monitoring site and compared to the long-term mean flows. High flow is defined as a mean flow >140% of the long-term mean for that time period, usually July or August. Low flow is defined as a mean flow <60% of the long-term mean, while normal flow is 60-140% of the mean. While broad scale regional patterns are often observed, there may be large geographical variation within the state, and large variation within a single summer period.

Habitat Evaluation

DWQ has developed a habitat assessment form to better evaluate the physical habitat of a stream. The habitat score has a potential range of 1-100, based on evaluation of channel modification, amount of instream habitat, type of bottom substrate, pool variety, bank stability, light penetration and riparian zone width. Higher numbers suggest better habitat quality, but no criteria have been developed for assigning ratings indicating Excellent, Good, Fair or Poor habitat.

Table A-II-1 Benthic Macroinvertebrate Data Collected in the White Oak River Basin, 1983 – 1999
(Current basinwide monitoring sites have the map number bolded.)

Subbasin/ Site	Location	County	Map No.	Index No.	Date	S/EPT S (S/A & C S)[1]	BI/BIEPT (EBI)[1]	Bio Class/ Final score[1]
03-05-01								
Freshwater								
White Oak R	US 17	Jones	**B-2**	20-(1)	7/99	70/15	7.07/6.16	G-F
					2/99	61/11	7.11/5.83	NR
White Oak R	Haywoods Landing	Jones	**B-3**	20-(1)	8/94	36/4	8.77/4.31	F
					6/86	49/5	7.87/5.83	F
					7/84	58/8	7.80/7.04	G-F
Starkeys Cr	SR 1434	Onslow	**B-11**	20-10	2/99	93/15	7.28/5.66	NR-22
Holston Cr	NC 58	Jones	**B-12**	20-12	11/99	-/13	-/4.99	NR
					2/99	58/17	6.26/4.44	NR-30
					3/98	50/15	5.85/4.92	NR-30
Hunters Cr	SR 1100	Carteret	**B-13**	20-17	2/99	56/11	6.80/6.04	NR-28
Webb Cr	SR 1432	Onslow	**B-14**	20-19	2/99	30/3	7.34/4.06	NR-10
Pettiford Cr	USFS Rd	Carteret	**B-15**	20-29-1	2/99	38/10	6.38/4.71	NR-30
					3/98	30/8	6.39/5.45	NR-30
Estuarine								
Queen Cr	Atm outh	Onslow	**B-1**	19-41-16	8/94	103/17	2.26	NR-11
White Oak R	Holland Pt	Onslow	**B-4**	20-(14.5)	2/96	32/2	1.72	NR-8
White Oak R	Cahoon Pt	Onslow	**B-5**	20-(14.5)	2/96	65/9	1.65	NR-11
White Oak R	Robinson Pt	Onslow	**B-6**	20-(14.5)	2/96	69/8	1.98	NR-8
White Oak R	North of Jones Isl	Onslow	**B-7**	20-(14.5)	2/96	88/15	2.40	NR-10
White Oak R	Above Swansboro	Carteret	**B-8**	20-(18)	9/94	65/12	2.03	NR-9
White Oak R	Near Swansboro	Carteret	**B-9**	20-(18)	6/99	145/26	2.66	NR-15
					2/96	111/16	2.23	NR-11
White Oak R	Near Huggins Isl	Onslow	**B-10**	20-(18)	2/96	137/23	2.48	NR-13
Fosters Cr	Off outfall	Onslow	**B-16**	20-35	8/94	64/14	2.68	NR-12
03-05-02								
Freshwater								
New R	NC 24	Onslow	**B-1**	19-(1)	7/95	-/10	-/5.90	F
New R	SR 1314	Onslow	**B-2**	19-(1)	7/99	53/11	6.40/6.08	G-F
					7/95	74/12	6.63/6.05	G-F
					8/94	52/3	7.18/5.27	NR
					6/90	70/15	6.43/5.13	G-F
					7/88	88/24	6.04/4.19	G
					6/86	84/24	6.16/4.97	G
					7/85	96/24	6.19/4.61	G
					7/84	92/25	6.19/4.76	G
					7/83	83/20	6.32/5.28	G-F
Blue Cr	Above Blue Cr Utility	Onslow	**B-15**	19-8	2/97	40/6	6.89/5.76	F
Blue Cr	Below Blue Cr Utility	Onslow	**B-16**	19-8	2/97	53/7	7.57/5.40	F
Northeast Cr	SR 1434	Onslow	**B-17**	19-16-(0.5)	2/99	62/10	6.97/5.20	NR-22
L Northeast Cr	SR 1423	Onslow	**B-18**	19-16-2	2/99	62/15	6.60/5.48	NR-30
Harris Cr	SR 1109	Onslow	**B-19**	19-17-3	2/99	63/13	7.13/5.70	NR-26
Southwest Cr	SR 1213	Onslow	**B-20**	19-17-(0.5)	2/99	69/11	7.54/5.98	NR-22
Southwest Cr	SR 1105	Onslow	**B-21**	19-17-(6.5)	8/94	59/5	7.04/6.57	F
Wallace Cr	Above NC 24	Onslow	**B-22**	19-20	5/95	37/2	7.70/5.67	NR
UT Wallace Cr	Below Pine t Green	Onslow	**B-23**	19-20	5/95	15/0	9.16/-	NR
NW Mill Cr	Upstream NC 210	Onslow	**B-24**	19-39-3-1	8/85	58/5	7.49/5.18	NR
					2/84	43/5	7.11/5.98	NR
NW Mill Cr	Downstream NC 210	Onslow	**B-25**	19-39-3-1	8/85	44/2	7.57/3.22	NR
					2/84	22/3	6.35/5.93	NR
NE Mill Cr	Near confluence	Onslow	**B-26**	19-39-3-1	8/85	49/1	7.81/6.37	NR
N Mill Cr	Near confluence	Onslow	**B-27**	19-39-3-1	8/85	26/2	7.40/5.84	NR
E Mill Cr	Below confluence	Onslow	**B-28**	19-39-3-1	8/85	34/0	7/83/-	NR
					2/84	36/2	7.50/3.53	NR
Estuarine								
New R	Near Ethridge Pt	Onslow	**B-3**	19-(11)	8/94	11/-	1.0*	NR
Brinson Cr	Atm outh	Onslow	**B-4**	19-(12)	8/94	7/-	1.0*	NR
Wilson Bay	At outfall	Onslow	**B-5**	19-(14)	6/99	15/1	1.67	NR
					5/97	2/0	1.00	NR
					6/96	2/0	1.00	NR

Subbasin/ Site	Location	County	Map No.	Index No.	Date	S/EPT S (S/A & C S)[1]	BI/BIEPT (EBI)[1]	Bio Class/ Final score[1]
Wilson Bay	Offpoint	Onslow	B-6	19-(14)	6/99	9/0	1.70	NR
					5/97	9/0	1.12	NR
					6/96	4/0	1.00	NR
					8/94	2/-	1.0*	NR
Wilson Bay	In center	Onslow	B-7	19-(14)	6/99	10/2	1.34	NR
					5/97	5/0	1.02	NR
					6/96	4/0	1.00	NR
Wilson Bay	South side	Onslow	B-8	19-(14)	6/99	9/2	1.16	NR
					5/97	14/1	1.38	NR
					6/96	11/0	1.35	NR
New R	Off Spring Pt		B-9	19-(15.5)	6/99	34/7	1.77	NR-7
					5/97	26/6	1.54	NR-9
					6/96	26/5	1.98	NR-9
					8/94	19/1	2.47	NR-8
New R	Near Hadnot WWTP	Onslow	B-10	19-(15.5)	6/99	35/8	1.73	NR-6
					5/97	25/5	1.93	NR-8
					6/96	30/5	2.11	NR-9
					8/94	21/1	2.12	NR-6
New R	Stones Bay WWTP	Onslow	B-11	19-(15.5)	6/96	22/3	1.88	NR-6
New R	Stones Bay	Onslow	B-12	19-(15.5)	6/96	23/2	1.76	NR-6
New R	Near Courthouse Bay	Onslow	B-13	19-(15.5)	6/96	65/12	2.47	NR-7
New R	Near Hall Pt	Onslow	B-14	19-(15.5)	6/96	76/15	2.29	NR-8
New R (ICWW)	Near Sneads Ferry	Onslow	B-29	19-41-(0.5)	7/99	141/29	2.71	NR-15
					11/96	103/16	2.35	NR-11
					6/96	161/26	2.66	NR-15
					8/94	153/29	2.48	NR-13
					6/93	92/19	2.50	NR-14
					6/90	81/17	2.63	NR
					6/89	71/12	2.22	NR
					7/88	66/13	2.60	NR
					6/87	67/11	2.59	NR
					6/86	65/13	2.64	NR
					7/85	70/10	2.36	NR
					7/83	37/4	2.37	NR
03-05-03								
Freshwater								
NW Pr Newport R	SR 1206	Carteret	B-2	21-2	2/99	40/6	6.53/3.34	NR-26
SW Pr Newport R	Fire Service Rd,	Carteret	B-3	21-3	3/98	16/2	6.82/6.27	NR-26
SW Pr Newport R	SR 1124	Carteret	B-4	21-3	2/99	38/10	6.54/4.66	NR-26
Newport R	US-70	Carteret	B-5	21-(1)	7/83	24/2	7.82/5.70	NR
Estuarine								
Bogue Sound	Near Emerald Isle	Carteret	B-1	20-36-(0.5)	6/99	112/23	2.72	NR-15
					11/96	116/21	2.80	NR-15
					11/96	132/26	2.82	NR-15
					11/96	116/22	2.81	NR-15
					9/94	131/27	2.80	NR-15
					6/94	125/26	2.72	NR-15
					6/91	121/22	2.61	NR-15
					6/90	95/19	2.59	NR
					6/89	97/15	2.59	NR
					6/88	80/14	2.60	NR
					6/87	67/9	2.75	NR
					6/86	81/14	2.72	NR
					7/85	82/12	2.71	NR
					7/84	67/9	2.62	NR
					7/83	59/10	2.74	NR
Newport R	Near Crab Pt	Carteret	B-6	21-(17)	6/99	129/20	2.33	NR-12
					8/94	102/12	2.42	NR-10
					6/91	94/15	2.14	NR
					6/90	48/9	2.22	NR
					6/88	76/12	2.46	NR
					7/87	67/10	2.29	NR
					6/86	52/6	2.17	NR
					7/85	44/6	2.22	NR

Subbasin/ Site	Location	County	Map No.	Index No.	Date	S/EPT S (S/A & C S)[1]	BI/BIEPT (EBI)[1]	Bio Class/ Final score[1]
Morehead Harbor	SW of Radio Is	Carteret	B-7	21-(17)	7/99	161/33	2.86	NR-15
					8/94	105/22	2.62	NR-15
					6/94	132/31	2.97	NR-15
					6/91	116/30	2.72	NR
					6/90	77/18	2.44	NR
					6/88	111/16	2.47	NR
					6/86	72/12	2.70	NR
					7/85	73/10	2.73	NR
Beaufort Inlet	Ft Macon jetty	Carteret	B-8	21-(17)	6/94	32/10	3.48	NR-10
Willis Cr	at point	Carteret	B-9	21-29	7/99	105/14	2.16	NR-11
Calico Cr	Piggotts Br	Carteret	B-10	21-32	7/99	37/6	1.69	NR-3
					8/94	22/2	1.76	NR-3
Calico Cr	at mouth	Carteret	B-11	21-32	7/99	53/4	1.91	NR-4
Taylors Cr	Rachel Carson Re	Carteret	B-12	21-34	6/88	65/10	2.23	NR
03-05-04								
Taylors Cr	W of Beaufort WWTP	Carteret	B-1	21-34	9/94	19/0	2.9*	NR
Taylors Cr	E of Beaufort WWTP	Carteret	B-2	21-34	9/94	11/1	3.4*	NR
North R	US-70	Carteret	B-3	21-35-1	8/94	55/6	2.27	NR-7
North R	At mouth	Carteret	B-4	21-35-1	8/94	99/25	2.84	NR-15
Ward Cr	US 70	Carteret	B-5	21-35-1-7	8/94	35/6	2.10	NR-6
					7/85	40/9	2.32	NR
Back Sound	Marker 3	Carteret	B-6	21-35-(1.5)	8/94	118/22	2.59	NR-15
Nelson Bay	Marker 1	Carteret	B-7	21-35-7-10-(5)	8/94	77/20	2.84	NR-12
Jarrett Bay	Midden Pt	Carteret	B-8	21-35-7-22	8/94	87/26	2.95	NR-13
03-05-05								
Back Sound	Marker 30	Carteret	B-1	21-35-(1.5)	8/94	100/26	2.90	NR-15
Core Sound	Goose Isl	Carteret	B-2	21-35-7	8/94	105/22	2.83	NR-15
Core Sound	Marker 25	Carteret	B-3	21-35-7	8/94	101/28	2.91	NR-15

[1]Abbreviations

S = Number of taxa

EPT S = Number of EPT taxa

A & C S = Number of species of amphipods and caridean shrimps

BI = Biotic Index

BIEPT = Biotic Index of EPT taxa

EBI = Estuarine Biotic Index

G = Good

G-F = Good-Fair

NR = not rated

*These samples were collected using a petite Ponar dredge, and thus, should not be compared with samples collected by sweep.

Fish Tissue Criteria

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.
- Environmental Protection Agency (EPA) recommended screening values.
- Criteria adopted by the North Carolina State Health Director. Refer to Table 1 below.

Sample results which exceed these levels are a human health concern and are evaluated by the NC Division of Occupational and Environmental Epidemiology at DWQ's request.

The FDA levels were developed to protect humans from the chronic effects of toxic substances consumed in foodstuffs, and thus, employ a "safe level" approach to fish tissue consumption. Presently, the FDA has only developed metals criteria for mercury.

The EPA has recommended screening values for target analytes which are formulated from a risk assessment procedure (EPA, 1995). These are the concentrations of analytes in edible fish tissue that are of potential public health concern. DWQ compares fish tissue results with EPA screening values to evaluate the need for further intensive site-specific monitoring.

Table A-II-2 Fish Tissue Criteria

Contaminant	FDA Action Levels	US EPA Screening Values	NC Health Director
Metals			
Cadmium		10.0	
Mercury	1.0	0.6	
Selenium		50.0	5.0
Organics			
Aldrin	0.3		
Chlorpyrifos		30	
Total chlordane [1]		0.08	
Cis-chlordane	0.3		
Trans-chlordane	0.3		
Total DDT [2]		0.3	
Dieldrin		0.007	
Dioxins (total)		0.7	3.0
Endosulfan (I and II)		60.0	
Endrin	0.3	3.0	
Heptachlorepoxide		0.01	
Hexachlorobenzene		0.07	
Lindane		0.08	
Mirex		2.0	
Total PCBs		0.01	
PCB-1254	2.0		
Toxaphene		0.1	

[1] Total chlordane includes the sum of cis- and trans-isomers as well as nonachlor and oxychlordane.

[2] Total DDT includes the sum of all its isomers and metabolites (i.e., p,p DDT, o,p DDT, DDE, and DDD).

Note: All wet weight concentrations are reported in parts per million (ppm, µg/g), except for dioxin which is in parts per trillion (ppt, pg/g).

The North Carolina State Health Director has adopted a selenium limit of 5 µg/g for issuing an advisory. Although the EPA has suggested a screening value of 0.7 ppt (pg/g) for dioxins, the State of North Carolina currently uses a value of 3.0 ppt in issuing an advisory.

Table A-II-2 Wet Weight Concentrations of Mercury (Hg), Arsenic (As), Cadmium (Cd) and Total Chromium (Crt) in Fish Tissue from the White Oak River Basin, 1994-1999

Site	County	Date	Species	Length (cm)	Weight (g)	Hg (ug/g)	As (ug/g)	Cd (ug/g)	Crt (ug/g)
Brinson Creek	Onslow	04/01/98	*Amia calva*	55.3	1562	0.29	ND	ND	ND
			Amia calva	60.8	2300	0.25	ND	ND	ND
			Lepomis gibbosus	9.95	20.5	0.04	ND	ND	ND
			Lepomis gibbosus	15.2	93	0.08	ND	ND	ND
			Lepomis gibbosus	16	98	0.10	ND	ND	ND
			Micropterus salmoides	30	417	0.26	ND	ND	ND
			Micropterus salmoides	31.5	598	0.12	ND	ND	ND
			Micropterus salmoides	32.5	465	0.31	ND	ND	ND
			Micropterus salmoides	33	589	0.16	ND	ND	ND
			Micropterus salmoides	33.7	579	0.14	ND	ND	ND
			Micropterus salmoides	34.5	520	0.92	ND	ND	ND
			Micropterus salmoides	34.5	605	0.25	ND	ND	ND
			Micropterus salmoides	34.5	695	0.28	ND	ND	ND
			Micropterus salmoides	36	666	0.25	ND	ND	ND
			Micropterus salmoides	36	677	0.27	ND	ND	ND
			Micropterus salmoides	36.7	733	0.34	ND	ND	ND
			Micropterus salmoides	36.7	734	0.27	ND	ND	ND
			Micropterus salmoides	37.5	878	0.32	ND	ND	ND
			Micropterus salmoides	38.8	1036	0.30	ND	ND	ND
			Micropterus salmoides	40	875	0.32	ND	ND	ND
			Micropterus salmoides	41.2	1275	0.30	ND	ND	ND
New River above Jacksonville	Onslow	07/16/97	*Ameiurus catus*	29.8	366.5	0.12	ND	ND	ND
			Amia calva	44.2	839	0.16			
			Amia calva	47.7	1020	0.24			
			Amia calva	48.4	1097	0.30	ND	ND	ND
			Amia calva	52.8	1425	0.32			
			Amia calva	53.8	1713	0.19			
			Amia calva	54.8	1647	0.31	ND	ND	ND
			Amia calva	55.7	1847	0.43	ND	ND	ND
			Lepomis auritus	18.7	121	0.08	ND	ND	ND
			Lepomis auritus	20.5	274	0.07	ND	ND	ND
			Lepomis auritus	23	245	0.15			
			Lepomis auritus	24	285	0.10			
			Lepomis auritus	25.4	358	0.36	ND	ND	ND
			Lepomis gibbosus	13.3	55.5	0.24			
			Lepomis gibbosus	15.8	91.5	0.08			
			Lepomis gibbosus	16.2	96	0.08			
			Lepomis gibbosus	18	129	0.15	ND	ND	ND
			Lepomis macrochirus	19.3	189	0.09	ND	ND	ND
			Lepomis macrochirus	21.1	228	0.18			
			Lepomis macrochirus	21.5	267	0.15	ND	ND	ND
			Lepomis macrochirus	21.7	281	0.20			
			Lepomis macrochirus	21.8	264	0.16	ND	ND	ND
			Lepomis macrochirus	22	265	0.28			
			Lepomis macrochirus	23.2	326	0.24			
			Micropterus salmoides	26.5	240	0.19	ND	ND	ND
			Micropterus salmoides	27.8	334	0.22			
			Micropterus salmoides	29	361	0.16	ND	ND	ND
			Micropterus salmoides	33.2	514	0.23			
			Micropterus salmoides	33.7	559	0.25			
			Micropterus salmoides	36.9	703	0.30	ND	ND	ND

Site	County	Date	Species	Length (cm)	Weight (g)	Hg (ug/g)	As (ug/g)	Cd (ug/g)	Crt (ug/g)
Northeast Creek above NC 24	Onslow	04/01/98	*Lepomis gibbosus*	13.7	59.6	0.12	ND	ND	0.39
			Lepomis gibbosus	14.9	84.3	0.09	ND	ND	0.35
			Lepomis gibbosus	15.9	98.3	0.09	ND	ND	ND
			Lepomis microlophus	17.8	142.5	0.10	ND	ND	ND
			Lepomis microlophus	20	172	0.06	ND	ND	ND
			Lepomis microlophus	21	215	0.23	ND	ND	ND
			Lepomis microlophus	22	224	0.27	ND	ND	ND
			Lepomis microlophus	24.2	309	0.27	ND	ND	ND
			Lepomis microlophus	25	362	0.27	ND	ND	ND
			Micropterus salmoides	26.1	247	0.91	ND	ND	ND
			Micropterus salmoides	27.6	317	0.20	ND	ND	ND
			Micropterus salmoides	28.4	326	0.21	ND	ND	ND
			Micropterus salmoides	28.6	336	0.27	ND	ND	ND
			Micropterus salmoides	33.1	555	0.28	ND	ND	0.41
			Micropterus salmoides	33.5	530	0.50	ND	ND	ND
			Micropterus salmoides	37.8	833	0.71	ND	ND	ND
			Micropterus salmoides	38.5	1004	0.30	ND	ND	ND
			Micropterus salmoides	40.5	1175	0.34	ND	ND	ND
			Micropterus salmoides	42.5	1435	0.45	ND	ND	ND

ND = non detect. Detection levels were 1 ug/g for arsenic, 0.1 ug/g for cadmium, and 0.25 ug/g for chromium (total).

Appendix III

Use Support Methodology
and
Use Support Ratings

Multiple-Category Use Support Methods

DRAFT August 30, 2001

A. Introduction to Use Support

Surface waters are classified according to their best intended uses. Determining how well a waterbody supports its uses (*use support* status) is an important method of interpreting water quality data and assessing water quality.

Surface waters are rated *fully supporting* (FS), *partially supporting* (PS) or *not supporting* (NS). The terms refer to whether the classified uses of the water (i.e., aquatic life protection, recreation and water supply) are being met. For example, waters classified for fishing and secondary contact recreation (Class C for freshwater or SC for saltwater) are rated FS if data used to determine use support did not exceed specific criteria. However, if these criteria were exceeded, then the waters would be rated as PS or NS, depending on the degree of degradation. Waters rated PS or NS are considered to be impaired. Waters lacking data, or having inconclusive data, are listed as not rated (NR). More specific methods are presented in Part C of this appendix.

Historically, the non-impaired category was subdivided into fully supporting and fully supporting but threatened (ST). ST was used to identify waters that were fully supporting but had some notable water quality concerns and could represent constant, degrading or improving conditions. North Carolina's past use of ST was very different from that of the US Environmental Protection Agency (EPA), which uses it to identify waters that demonstrate declining water quality (EPA Guidelines for Preparation of the Comprehensive State Water Quality Assessments [305(b) Reports] and Electronic Updates, 1997). Given the difference between the EPA and North Carolina definitions of ST and the resulting confusion that arises from this difference, North Carolina no longer subdivides the non-impaired category. However, these waters and the specific water quality concerns remain identified in the basin plans so that data, management and the need to address the identified concerns are not lost.

B. Interpretation of Data and Information

Data used in the use support assessments include biological data, chemical/physical data, lakes assessment data, fish consumption advisories from the NC Department of Health and Human Services, and swimming advisories and shellfish sanitation growing area classification from the NC Division of Environmental Health (as appropriate). Available land cover and land use information is also used, along with water supply reports from regional water treatment plant consultants.

Although there is a general procedure for analyzing the data and information for determining use support ratings, each waterbody is reviewed individually, and best professional judgment is applied during these determinations. Assessments are made on either a monitored (M) or evaluated (E) basis depending on the level of information available. Refer to Part E for more information on the basis of assessments.

When interpreting the use support ratings, it is important to understand its associated limitations and degree of uncertainty. The assessments are not intended to provide precise conclusions

about pollutant budgets for specific watersheds. Rather, the intent of use support assessments is to gain an overall picture of water quality, to describe how well surface waters support the uses for which they were classified, and to document the potential contribution made by different pollution sources.

C. Assessment Methodology

Beginning in 2000 with the *Roanoke River Basinwide Water Quality Plan*, DWQ assesses ecosystem health and human health risk through several use support categories. Six categories are used to assess this approach: aquatic life and secondary recreation, fish consumption, shellfish harvesting, primary recreation, water supply and "other" uses. These categories are tied to the primary classifications applied to NC rivers and streams. A single water could have more than one use support rating corresponding to one or more of the multiple use support categories, as shown in the table below. For many waters, a use support category will not be applicable (N/A) to the best use classification of that water (e.g., shellfish harvesting is not a best use of a Class SC water). A full description of the stream classifications is available in the DWQ document titled: *Classifications and Water Quality Standards Applicable to Surface Waters of North Carolina*.

	Use Support Categories					
Primary Classification	**Ecosystem Approach**	**Human Health Approach**				
	Aquatic Life/Secondary Recreation	**Fish Consumption**	**Primary Recreation**	**Water Supply**	**Shellfish Harvesting**	**Other**
C	X	X	N/A	N/A	N/A	X
SC	X	X	N/A	N/A	N/A	X
B	X	X	X	N/A	N/A	X
SB	X	X	X	N/A	N/A	X
SA	X	X	X	N/A	X	X
WS I – WS IV	X	X	N/A	X	N/A	X

Many types of information are used to determine use support ratings and to identify 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 are entered into its record. The following describes the data and methodologies used to make use support assessments for the surface water classifications (described in Section A, Chapter 3 of each basin plan) using the six use support categories. These methods will continue to be refined, as additional information becomes available.

Aquatic Life and Secondary Recreation Use Support

The aquatic life and secondary recreation use support category is an ecosystem approach to assess whether aquatic life (benthic macroinvertebrates and fish) can live in and reproduce in the waters of the state and whether waters support secondary recreation (i.e., wading, boating and

minimal human body contact with water). This category is applied to all waters of the state. Biological data, ambient monitoring data and NPDES discharger data are all considered in assessing the aquatic life and secondary recreation use support category. The following is a description of each data type and methods used to assess how well a water is meeting the criteria for aquatic life and secondary recreation protection.

Biological Data

There are two main types of biological data: benthic marcoinvertebrates and fish community. Where recent data for both benthic macroinvertebrates and fish communities are available, both are evaluated in assessing use support. It is important to note that where both ambient data and biological data are available, biological data are given greater weight.

Benthic Macroinvertebrate Bioclassification

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

Bioclassification	Use Support Rating
Excellent	Fully Supporting (FS)
Good	Fully Supporting (FS)
Good-Fair	Fully Supporting (FS)
Fair	Partially Supporting (PS)
Poor	Not Supporting (NS)

Due to the increased emphasis put on Fair or Poor bioclassifications and the borderline nature of some bioclassifications, sites should be resampled within 12-24 months after a Fair rating is obtained in 1999 and beyond, if this Fair rating will result in a lower use support rating or if data are from a site never sampled before. This resampling will be done to validate the Fair bioclassification. Such sites will not be given a use support rating until the second sample is obtained. The table below shows how a final use support rating is obtained for sites that are resampled.

New Benthic Macroinvertebrate Classifications (1999 and Beyond) and Data Causing a Decline in Use Support Ratings				
Pre-1999 Bioclassification	**1st sample Bioclassification**	**Draft Use Support Rating**	**2nd sample Bioclassification**	**Final Use Support Rating**
N/A	Fair	NR; resample	Good-Fair, Good or Excellent	FS
N/A	Fair	NR; resample	Fair	PS
N/A	Fair	NR; resample	Poor	NS
N/A	Poor	NS	N/A	NS
Good-Fair, Good or Excellent	Fair	NR; resample	Good-Fair, Good or Excellent	FS
Good-Fair, Good or Excellent	Fair	NR; resample	Fair	PS
Good-Fair, Good or Excellent	Fair	NR; resample	Poor	NS
Good-Fair, Good or Excellent	Poor	NS	N/A	NS

N/A – Not Applicable NR = Not Rated

The use of benthic macroinvertebrate data can be limited in some waters. The accumulation of swamp stream data over nearly a decade suggests that not all swamp streams support similar fauna. The development of swamp stream criteria is complex, and one set of criteria is likely not appropriate for all swamp streams. Benthic macroinvertebrate data will not be used in waters characterized or classified by DWQ as swamp waters until the biological rating criteria for these waters can be used with confidence.

Benthic macroinvertebrate data are not used to develop use support ratings for estuarine waters. DWQ is attempting to develop biological rating criteria for estuarine waters.

Benthic macroinvertebrate data are used to provide bioclassifications for high elevation trout streams. These benthos data, while not a direct measure of the trout population, are a robust measure of stream integrity. Loss of canopy, increase in stream temperature, increased nutrients, toxicity and increased sedimentation will affect the benthos and fish community. For these reasons, the benthos bioclassifications provide a valuable assessment of the integrity of trout waters.

Fish Community Bioclassification

The North Carolina Index of Biotic Integrity (NCIBI) is a method for assessing a stream's biological integrity by examining the structure and health of its fish community. The index incorporates information about species richness and composition, indicator species, trophic function, abundance and condition, and reproductive function. The index is translated to use support rating according to the following scheme:

NCIBI	Use Support Rating
Excellent	Fully Supporting (FS)
Good	Fully Supporting (FS)
Good-Fair	Fully Supporting (FS)
Fair	Partially Supporting (PS)
Poor	Not Supporting (NS)

The NCIBI was recently revised by DWQ (NCDENR, 2001). Currently, the focus of using and applying the NCIBI is restricted to wadeable streams that can be sampled by a crew of four persons. Infrequently, larger wadeable streams can be sampled if there is a crew of six persons. The bioclassifications and criteria have also been recalibrated against regional reference site data (BAU, 2000a, 2000b and 2001).

Criteria and ratings are applicable only to wadeable streams in the following river basins: Broad, Catawba, Savannah, Yadkin-Pee Dee, Cape Fear, Neuse, Roanoke, Tar-Pamilco, French Broad, Hiwassee, Little Tennessee, New and Watauga. In the Cape Fear, Neuse, Roanoke and Tar River basins, the criteria and ratings are only applicable to streams in the piedmont portion of these basins. The definition of the "piedmont" for these four river basins is based upon a map of North Carolina watersheds (Fels, 1997). Specifically:

- In the Cape Fear River basin -- except for the streams draining the Sandhills in Moore, Lee and Harnett counties; the entire basin upstream of Lillington, NC.
- In the Neuse River basin -- the entire basin above Smithfield and Wilson, NC, except for the south and southwest portions of Johnston County and the eastern two-thirds of Wilson County.
- In the Roanoke River basin -- the entire basin in North Carolina upstream of Roanoke Rapids, NC and a small area between Roanoke Rapids and Halifax, NC.
- In the Tar-Pamlico River basin -- the entire basin above Rocky Mount, NC, except for the lower southeastern one-half of Halifax County and the extreme eastern portion of Nash County.

Criteria and ratings have not been developed for:

- Streams in the Broad, Catawba, Yadkin-Pee Dee, Savannah, French Broad, Hiwassee, Little Tennessee, New and Watauga River basins which are characterized as wadeable first to third order streams with small watersheds, naturally low fish species diversity, cold water temperatures, and high gradient plunge-pool flows. Such streams are typically thought of as "Southern Appalachian Trout Streams".
- Wadeable streams in the Sandhills ecoregion of the Cape Fear, Lumber and Yadkin-Pee Dee River basins.
- Wadeable streams and swamps in the coastal plain region of the Cape Fear, Chowan, Lumber, Neuse, Pasquotank, Roanoke, Tar-Pamlico and White Oak River basins.
- All non-wadeable and large streams and rivers throughout the state.

Due to the increased emphasis put on Fair or Poor bioclassifications and the borderline nature of some bioclassifications, sites should be resampled within 12-24 months after a Fair rating is obtained in 1999 and beyond, if this Fair rating will result in a lower use support rating or if data

are from a site never sampled before. This resampling will be done to validate the Fair bioclassification. Such sites will not be given a use support rating until the second sample is obtained. The table below shows how a final use support rating is obtained for sites that are resampled.

New Fish Community Classifications (1999 and Beyond) and Data Causing a Decline in Use Support Ratings				
Pre-1999 Bioclassification	**1st sample Bioclassification**	**Draft Use Support Rating**	**2nd sample Bioclassification**	**Final Use Support Rating**
N/A	Fair	NR; resample	Good-Fair, Good or Excellent	FS
N/A	Fair	NR; resample	Fair	PS
N/A	Fair	NR; resample	Poor	NS
N/A	Poor	NS	N/A	NS
Good-Fair, Good or Excellent	Fair	NR; resample	Good-Fair, Good or Excellent	FS
Good-Fair, Good or Excellent	Fair	NR; resample	Fair	PS
Good-Fair, Good or Excellent	Fair	NR; resample	Poor	NS
Good-Fair, Good or Excellent	Poor	NS	N/A	NS

N/A – Not Applicable NR = Not Rated

Ambient Monitoring Data

Chemical/physical water quality data are collected through the DWQ Ambient Monitoring System. These data are downloaded from the ambient database, the Surface Water Information Management System, for analysis. Total number of samples and percent of samples exceeding the NC standards are used for use support ratings along with other data or alone when other data are not available. Where both ambient data and biological data are available, biological data are given greater weight.

When reviewing ambient data, a five-year window of data that ends on August 31 of the year of biological sampling is used. For example, if a basin is sampled in 2000, then the five-year window for the basin would be September 1, 1995 to August 31, 2000. Selected ambient parameters are used to assess aquatic life/secondary recreation use support. These parameters include NH_3, dissolved oxygen, pH, Cl, As, Cd, Cr, Ni and Pb. These parameters are measured against standards for a minimum of ten samples as follows:

Standards Violation	Rating
Criterion exceeded ≤10%	Fully Supporting (FS)
Criterion exceeded 11-25%	Partially Supporting (PS)
Criterion exceeded >25%	Not Supporting (NS)

Data for copper, iron and zinc are not used according to the percent criterion exceeded scheme outlined above. These metals have action level standards because they are generally not bioaccumulative and have variable toxicity to aquatic life depending on chemical form, solubility and stream characteristics. In order for an action level standard to be violated, there must be a toxicological test that documents an impact on a sensitive aquatic organism. The action level standard is used to screen waters for potential problems with copper, iron and zinc.

Metals data for Cu and Fe are screened at the 85^{th} percentile of five years of ambient data ending on August 31 of the year of biological sampling. Sites, other than estuarine and swamp waters, with an 85^{th} percentile of $\geq$20 µg/l of Cu and/or $\geq$2000 µg/l of Fe are identified and flagged for instream chronic toxicity testing by DWQ. Chronic toxicity testing in estuarine and swamp waters is not ecologically meaningful. Criteria are still being developed for zinc. If a stream does not have biological data that would deem a FS rating, then the stream can be rated PS or NS for aquatic life if instream chronic toxicity is found. Criteria for evaluating instream chronic toxicity are three chronic pass/fail tests over three months using *Ceriodaphnia*. Three fails result in a NS rating, and two fails result in a PS rating.

It is important to note that some waters may exhibit characteristics outside the appropriate standards due to natural conditions (e.g., many swamp waters are characterized by low pH and dissolved oxygen). These natural conditions do not constitute a violation of water quality standards.

NPDES Discharger Data

Aquatic Toxicity Data

For facilities that perform Whole Effluent Toxicity (WET) tests per state NPDES discharge permit requirements, a review of the results of a five-year window of data that ends on August 31 of the year of biological sampling is used. For example, if a basin is sampled in 2000, then the five-year window for the basin would be September 1, 1995 to August 31, 2000. If a stream with a WET test facility has not been sampled for instream chronic toxicity, biological community data or has no ambient data, and that facility has $\geq$3 fails in the most recent 2 years, the stream is not rated. If failures continue, DWQ will work with the facility to correct the failures and assess stream impacts before the next basin sampling cycle begins with either a biological survey or instream chronic toxicity testing, if possible.

Discharge Effluent Data

NPDES effluent data are reviewed by analyzing monthly averages of water quality parameters over a two-year period (date ending on August 31 of the year of biological sampling). Prior to May 31, 2000, facilities are screened for criterion 40 percent in excess of state standards for conventional pollutant limitations or 20 percent in excess of state standards for toxic pollutants for two or more months during two consecutive quarter review periods or chronic violations of either conventional or toxic pollutant limitations for four or more months during 2 consecutive quarter review periods. After May 31, 2000, facilities are screened for criterion 20 percent in excess of state standards for both conventional and toxic pollutants for two or more months during two consecutive quarter review periods or chronic violations of either conventional or toxic pollutant limitations for four or more months during 2 consecutive quarter review periods.

Streams with discharges that are in excess of permit limits will not be rated if no biological or ambient monitoring data are available. Therefore, streams will not be rated PS or NS based on effluent data alone. Appropriate DWQ staff will be given a list of these facilities for follow-up.

In special situations, where there are currently insufficient biological data available, the basinwide planner will make a request of the DWQ Environmental Sciences Branch to determine whether a biological survey is appropriate. If a biological survey is appropriate, the stream rating will be determined by the bioclassification resulting from the survey. If a biological survey is not appropriate, then the stream will be given a NR rating.

Problem Parameters

Where an ambient parameter is identified as a potential concern, the parameter is listed in the DWQ database and use support summary table. Where habitat degradation is identified by DWQ biologists based on site visits, it is listed and attempts are made to identify the type of habitat degradation (e.g., sedimentation, loss of woody habitat, loss of pools, loss of riffles, channelization, lack of riparian vegetation, streambed scour and bank erosion). Habitat evaluation methods are being developed to better identify specific types of habitat degradation.

Sources

General nonpoint sources (NPS) and point sources (PS) of pollution are identified where there is sufficient information.

Basis of Assessment

FS ratings are extrapolated up tributaries from monitored streams when no problematic dischargers or change in land use/cover are identified. The FS rating may be applied to unmonitored tributaries where there is little land disturbance (e.g., national forests). Problem parameters or sources (except general NPS) are not applied to unmonitored tributaries. PS or NS ratings are not extrapolated to unmonitored tributaries. Refer to Part E for more information.

Fish Consumption Use Support

The fish consumption use support category is a human health approach to assess whether humans can safely consume fish from a water. This use support category is applied to all waters of the state. The use support rating is assigned using fish consumption advisories issued by the NC Department of Health and Human Services.

If a limited fish consumption advisory is posted at the time of use support assessment, the water is rated PS. If a no consumption advisory is posted at the time of use support assessment, the water is rated NS.

The current statewide limited fish consumption advisory for bowfin due to elevated levels of mercury in fish tissue is an exception. It is recognized that bowfin only live and reproduce in waters of the piedmont and coastal plain. Therefore, the use support ratings will be based on the combination of current statewide fish consumption advisory for bowfin and the documented presence of bowfin in each river basin as found in *Freshwater Fisheries of North Carolina*

(Menhinick, 1991). In river basins where there are documented populations of bowfin (Roanoke, Chowan, Pasquotank, White Oak, Lumber, Neuse, Tar-Pamilco, Cape Fear, Yadkin and Catawba), the waters will be rated PS for the fish consumption category. In river basins where there are no documented populations of bowfin (Little Tennesee, Hiwassee, Savannah, Watauga, New, French Broad and Broad), the waters will be rated FS for the fish consumption category unless there is a site-specific advisory. In order to separate out other fish consumption advisories and to identify actual bowfin populations with high levels of mercury, only waters with fish tissue monitoring data are presented on the use support maps and in the use support summary tables. A review of the present methods for assessing the fish consumption use support category is being conducted, and methods may be modified in the future.

Only those waters that have been monitored for fish tissue and do not have an advisory are rated FS. Only waters sampled from 1989 on are considered, because these waters were sampled using more rigorous methods than those sampled before this date. All waters not monitored or evaluated and without advisories are not rated.

Primary Recreation Use Support

In addition to the use support categories applicable to Class C and SC waters, the primary recreation use support category will be assessed for all Class B, Class SA and Class SB waters where data are available. This use support category is a human health approach to assess whether waters support primary recreation activities such as swimming, water-skiing, skin diving, and similar uses involving human body contact in an organized or frequent basis. The use support rating is based on swimming advisories issued by local health departments and by the NC Division of Environmental Health (DEH) beach monitoring program.

Freshwaters

Fecal coliform bacteria data are used to assess Class B waters. Each January, the geometric mean for ambient stations in Class B waters for the prior sampling year is obtained, and a screen is conducted for waters with geometric means >200 colonies per 100 ml. Monitored Class B waters are rated FS if the geometric mean is ≤200 colonies per 100 ml. If the geometric mean is >200 colonies per 100 ml during the past year, fecal coliform bacteria are noted as a problem parameter, and a request is made of the DWQ regional office to sample this water 5 times/30 days in June during non-runoff events, if possible. If this 5 times/30-day monitoring, as required to assess the NC standard, indicates a geometric mean above 200 colonies per 100 ml, then the data are sent to DEH for consideration of posting swimming advisories. The DWQ regional office should continue to sample the stream 5 times/30 days during the months of July and August and send the data to DEH.

If a water is posted with an advisory for at least two months in the past five years ending on August 31 of the year of biological sampling, it is rated as PS unless DEH staff believes that the cause of fecal problems is not persistent. Those waters posted as "Do Not Swim" for more than two months in the past five years are rated NS. Class B waters without fecal or advisory data are not rated.

DWQ attempts to determine if there are any inland swimming areas monitored by county or local health departments. County or local health departments are asked to list those waters with

swimming advisories posted for at least two months in the past five years ending on August 31 of the year of biological sampling.

Estuarine waters

DEH fecal coliform data are used to assess estuarine (SA and SB) waters. Each January, DEH submits a letter to DWQ stating which coastal waters were posted with an advisory reporting an increased risk from swimming during the prior year. Those Class SA or SB waters with an advisory for at least two months in the past five years ending on August 31 of the year of biological sampling are rated PS, unless DEH staff believes that the cause of fecal problems is not persistent. Those waters posted as "Do Not Swim" for more than two months in the past five years are rated NS. If DEH has no data on a water, that water will not be rated. If ambient data show fecal coliform bacteria geometric mean of >200 colonies per 100 ml, then a request is made of the DWQ regional office to sample this water 5 times/30 days in June during non-runoff events, if possible. If this 5 times/30-day monitoring, as required to assess the NC standard, indicates a geometric mean above 200 colonies per 100 ml, then the data are sent to DEH for consideration of posting swimming advisories. The DWQ regional office should continue to sample the water 5 times/30 days during the months of July and August and send the data to DEH. Because North Carolina's fecal coliform bacteria standard is 200 colonies per 100 ml for the geometric mean of *five samples taken in a thirty-day period*, fecal coliform bacteria are listed as a cause of impairment for the 303(d) list only when additional sampling has determined that the standard is being exceeded.

Shellfish Harvesting Use Support

The shellfish harvesting use support category is a human health approach to assess whether shellfish can be harvested for commercial purposes and is therefore applied only to Class SA waters. Many types of information are used to determine use support ratings for shellfish waters and to determine causes and sources of impairment for these waters. The following data sources are used when assessing estuarine areas.

DEH Shellfish Sanitation Surveys

DEH is required to classify all shellfish growing areas as to their suitability for shellfish harvesting. DEH samples growing areas continuously and reevaluates the areas every three years to determine if their classification is still applicable. Classifications are based on DEH fecal coliform bacteria sampling, locations of pollution sources and the availability of the shellfish resource. Growing waters are classified as follows:

DEH Classification	DEH Criteria
Approved (APP)	No contamination with fecal material, pathogenic organisms, poisonous or deleterious substances, or marine biotoxins.
Conditionally Approved-Open (CAO)	Sanitary Survey indicates an area can meet approved area criteria for a reasonable period of time, and the pollutant event is known and predictable and can be managed by a plan.
Conditionally Approved-Closed (CAC)	Sanitary Survey indicates an area can meet approved area criteria for a reasonable period of time, and the pollutant event is known and predictable and can be managed by a plan.
Restricted (RES)	Sanitary Survey indicates limited degree of pollution, and the area is not contaminated to the extent that consumption of shellfish could be hazardous after controlled depuration or relaying.
Prohibited (PRO)	No Sanitary Survey; point source discharges; marinas; data does not meet criteria for Approved, Conditionally Approved or Restricted Classification.

Assigning Use Support Ratings to Shellfish Harvesting Waters (Class SA)

Estuarine waters are delineated according to Division of Environmental Health (DEH) shellfish management areas (e.g., Outer Banks, Area H-5) which include SA, SB and SC waters. DEH shellfish classifications are gleaned from the most recent sanitary survey (updated every 3 years). DEH classifications may be changed after the most recent sanitary survey.

It is important to note that DEH classifies all actual and potential growing areas (which includes all saltwater and brackish water areas) for their suitability for shellfish harvesting. Thus, the DWQ classified SA waters must be separated out and rated for shellfish harvesting use support. The acreage of FS, PS and NS waters are calculated using GIS showing DWQ and DEH classifications as attribute information attached to the polygon coverage. However, the DEH "Closed" polygon coverage includes CAC, RES and PRO classifications, and it is not currently possible to separate out the PRO from the RES areas. Therefore, these areas are a combined polygon coverage, and DWQ rates these waters as NS.

DWQ use support ratings may be assigned to separate segments within DEH management areas. In assessing use support, the DEH classifications and management strategies are only applicable to those areas that DWQ has classified as SA (shellfish harvesting waters). This will result in a difference of acreage between DEH areas classified as CAC, PRO, RES and DWQ waters rated as PS or NS. For example, if DEH classifies a 20-acre area CAC, but only 10 acres have a DWQ classification of SA, only those 10 acres classified as SA are rated as PS.

Sources of fecal coliform bacteria are more difficult to separate out for SA areas. DEH describes the potential sources in the sanitary surveys, but they do not describe specific areas affected by specific sources. Therefore, in the past, DEH identified the same sources for all SA sections of an entire management area (e.g., urban runoff and septic systems). Until a better way to pinpoint sources is developed, this procedure will continue to be used. A point source discharger is only listed as a potential source when permit parameters are exceeded.

DWQ and DEH SS are developing the database and expertise necessary to assess shellfish harvesting use support using a frequency of closures based approach. This database will allow DWQ to better assess the extent and duration of closures in Class SA waters. These tools will not be available for use support determinations in Class SA waters for the 2001 White Oak, 2002 Neuse and 2003 Lumber River basin use support assessments. DWQ believes it is important to identify frequency of closures in these waters, so an interim methodology will be used based on existing databases and GIS shapefiles. There will likely be changes in reported acreages in future assessments using the permanent methods and tools that result from this project. DWQ and DEH hope to have these tools fully developed for using the permanent frequency of closure based methods for the 2005 Cape Fear River basin plan use support assessment.

Interim Frequency of Closure Based Assessment Methodology

The interim method will be used for the 2001 White Oak, 2002 Neuse and 2003 Lumber River basin assessments. Shellfish harvesting use support ratings for Class SA waters using the interim methodology are summarized below.

Interim Frequency of Closure Based Use Support Ratings

Percent of Time Closed within Basin Data Window	DEH SS Growing Area Classification	DWQ Use Support Rating
N/A	Approved*	FS
Closed ≤10% of data window	Portion of CAO closed ≤10%	FS
Closed >10% to ≤25% of data window	Portion of CAO closed >10% to ≤25% of data window	PS
Closed >25% of data window	Portion of CAO closed >25% of data window	NS
N/A	CAC and P/R**	NS

* Approved waters are closed only during extreme meteorological events (hurricanes).

** CAC and P/R waters are rarely opened to shellfish harvesting.

For CAO areas, DWQ will work with DEH SS to determine the number of days and acreages that CAO Class SA waters were closed to shellfish harvesting during a five-year window of data that ends on August 31 of the year of biological sampling. For example, if a basin is sampled in 2000, then the five-year window for the basin would be September 1, 1995 to August 31, 2000. For each growing area with CAO Class SA waters, DEH SS and DWQ staff will define subareas (within the larger conditionally approved-open area) that were opened and closed at the same time. The number of days these CAO waters were closed will be determined using proclamation summary sheets and the original proclamations.

The number of days that approved areas in the growing area were closed due to pre-emptive closures because of named storms are not counted. For example, all waters in growing area E-9 were pre-emptively closed for Hurricane Fran on September 5, 1996. APP waters were reopened September 20, 1996. Nelson Bay (conditionally approved-open) was reopened September 30, 1996. This area was considered closed for 10 days after the APP waters were reopened.

Proposed Permanent Frequency of Closures Based Assessment Methodology

Over the next few years DWQ, DEH SS, Division of Coastal Management (DCM) and Division of Marine Fisheries (DMF) will be engaged in developing a fully functionally database with related georeferenced (GIS) shellfish harvesting areas. The new database and GIS tools will be valuable for the above agencies to continue to better serve the public. DWQ proposes to use information generated by these new tools to do frequency of closures based shellfish harvesting use support assessments in Class SA waters, starting with the 2005 Cape Fear River basin use support assessment.

Using the new database with georeferenced areas and monitoring sites, DEH SS will be able to report the number of days each area was closed excluding closures related to named storms. The percent of the five-year data window that individual Class SA waters are closed will be used to make use support determinations for areas that are classified by DEH SS as CAO. PRO, RES and CAC waters will be rated NS and CAO waters will be rated FS, PS or NS based on the methodology outlined above in the interim methods. Waters that have been reclassified (by DEH SS) during the data window from a lower classification to APP will be rated FS. Waters that are reclassified from APP to CAO during the data window will be rated as described above in the interim methods, taking into account the total days closed during the data window, including when the area was classified as APP.

Water Supply Use Support

This use support category is used to assess all Class WS waters. The water supply use support category is a human health approach to assess whether a water can be safely consumed after adequate treatment. Most drinking water supplies in NC are drawn from human-made reservoirs that often have multiple uses.

Water supply use support is assessed using information from the seven regional water treatment plant (WTP) consultants. Each January, the WTP consultants will submit a spreadsheet listing each closure and water intake switch-over for every water treatment plant in their region. This spreadsheet will describe the length and time of the event, contact information for the WTP, and the cause of the closure or switch.

Use support for water supply will be fine-tuned to determine what closures/switches were due to water quality concerns. Those closures/switches due to water quantity and reservoir turnovers will not be considered for use support. The frequency and duration of closures/switches due to water quality concerns are considered when assessing use support. In general, North Carolina's surface water supplies are in good condition and most, if not all, will be rated FS. Specific criteria for rating waters PS or NS are yet to be determined.

Other Uses: All Waters in the State

This category of use will be assessed infrequently but could be applied to any water in the state. Examples of uses that fall into this category are aesthetics and industrial and agricultural water supply. This category allows for the assessment of any use that is not considered by aquatic life and secondary recreation, primary recreation, fish consumption, shellfish harvesting or water supply.

D. Use of Outside Data

DWQ actively solicits outside data and information in October prior to the basinwide sampling year. The solicitation allows for approximately 60 days to submit data. Data from sources outside DWQ are screened for data quality and quantity. If data are of sufficient quality and quantity, they may be incorporated into use support assessments. A minimum of ten samples for more than a one-year period is needed to be considered for use support assessments. The way the data are used depends on the degree of quality assurance and quality control of the collection and analysis of the data as detailed in the draft 2000 303(d) report and shown in the table below. Level 1 data can be used in the same fashion as DWQ data to determine use support ratings. Level 2 or Level 3 data may be used to help identify causes of pollution and problem parameters. They may also be used to limit the extrapolation of use support ratings up or down a stream from a DWQ monitoring location. Where outside data indicate a potential problem, DWQ evaluates the existing DWQ biological and ambient monitoring site locations for adjustment as appropriate.

Criteria Levels for Use of Outside Data in Use Support Assessments

Criteria	Level 1	Level 2	Level 3
Monitoring frequency of at least 10 samples for more than a one-year period	Yes	Yes/No	No
Monitoring locations appropriately sited and mapped	Yes	Yes	No
State certified laboratory used for analysis according to 15A NCAC 2B .0103	Yes	Yes/No	No
Quality assurance plan available describing sample collection and handling	Yes, rigorous scrutiny	Yes/No	No

E. Monitored vs. Evaluated

Assessments are made on either a monitored (M) or evaluated (E) basis depending on the level of information that was available. Because a monitored rating is based on the most recent five-year window and site-specific data, it is treated with more confidence than an evaluated rating.

FS ratings are extrapolated up tributaries to monitored streams where there are no dischargers with permit violations or changes in land use/cover. Problem parameters or sources (except general NPS) are not applied to unmonitored tributaries. PS or NS ratings are not applied to unmonitored tributaries. Refer to the following summary for the basis 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[a] with data[b] ≤5[c] years old.
	Monitored/Evaluated (ME)	Stream segment[a] is unmonitored, but is assigned a use support rating based on another segment of same stream for which data[b] ≤5[c] years old are available.
Evaluated	Evaluated (E)	Unmonitored streams that are direct or indirect tributaries to monitored stream segments rated FS. Must share similar land use to the monitored stream segment.
	Evaluated/Old Data (ED)	Monitored stream segments[a] with available data[b] >5[c] years old.
Not Rated	Not Rated (NR)	Insufficient or no data available to determine use support. Includes unmonitored streams that are direct or indirect tributaries to stream segments rated PS or NS.

a) 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 number).
b) Major data sources include benthic macroinvertebrate bioclassifications and chemical/physical monitoring data.
c) From the year that basin monitoring was done.

F. Nutrient Enrichment Issues

The complex and dynamic ecosystem interactions that link chemical and physical water quality parameters and biological response variables must be considered when evaluating use support. In general, North Carolina assesses use support by determining if a water's *uses*, such as water supply, fishing and recreation, are met. Violations of water quality standards in lakes or estuaries are not equated with use impairment unless uses are not met. In following this approach, use support for aquatic life propagation, maintenance of biological integrity, recreation and water supply can be holistically evaluated.

One of the main causes of impacts to lakes is nutrient enrichment, or eutrophication. Several water quality variables may help to describe the level of eutrophication. These include pH, chlorophyll *a*, dissolved oxygen, phosphorus, nitrogen, turbidity, total dissolved gases and other quantitative indicators, some of which have specific water quality standards. It is generally agreed that excessive amounts of nitrogen and phosphorus are the principal culprits in eutrophication related use impairment. These variables are important concerns; however, climate, hydrology and biological response factors (chlorophyll, phytoplankton, fish kills, etc.) are also essential to evaluate because they may control the frequency of episodes related to potential use impairment. In addition, many of North Carolina's lakes are human-made reservoirs that do not mimic natural systems.

North Carolina does not determine eutrophication related use impairment with the quantitative assessment of an individual water quality variable (i.e., chlorophyll *a*). Likewise, North Carolina does not depend on a fixed index composed of several water quality variables, which does not have the flexibility to adapt to numerous hydrological situations, to determine use impairment. Instead, the weight of evidence approach is most appropriate to determine use support in terms of

nutrient enrichment in lakes. This approach can be flexibly applied depending on the amount and quality of available information. The approach uses the following sources of information:

- multiple quantitative water quality variables (e.g., dissolved oxygen, chlorophyll *a*)
- third party reports
- analysis of water quality complaints
- algal bloom reports
- macrophyte observations
- reports from water treatment plant operators
- reports from lake associations
- fish kill reports
- taste and odor observations
- aesthetic complaints
- frequency of noxious algal activity
- reports/observations of the NC Wildlife Resources Commission

References

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Name	Description	Class	Subbasin	Miles	Acres	Rating	Basis	Source	Problem Parameter	Potential Source
NEW RIVER	From source to Blue Creek	C NSW	030502	28	0	FS	M	NP		
NEW RIVER	From U. S.Hwy. 17 bridge to Atlantic Coast Line Railroad Trestle	SB HQW NSW	030502	0	49	FS	ME			
NEW RIVER	From Atlantic Coast Line Railroad Trestle to Mumford Point	SC HQW NSW	030502	0	574	FS	ME			
NEW RIVER	From Mumford Point to a line extending across the river from Grey Point to point of land approximately 2200 yards downstream from mouth of Duck Creek	SC NSW	030502	0	6,581	FS	M			
NEW RIVER	From a line extending across New River from Grey Point to a point of land approximately 2200 yards downstream from mouth of Duck Creek to Atlantic Ocean; including all unnamed bays, creeks, and other waters except restricted area # 2 described below and DEH closed areas at the mouths of Everett Bay and Fannie and Wheeler Creeks.	SA	030502	0	5,753	FS	M			
NEW RIVER	From Everett Bay to DEH closure line.	SA	030502	0	18	FS	M			
NEW RIVER	From Fannie Creek and Wheeler Creek to DEH closure line.	SA	030502	0	50	FS	M			
NEW RIVER	From Blue Creek to U. S. Hwy. 17 bridge	SB NSW	030502	0	116	FS	M			
Wilson Bay	Entire Bay	SC HQW NSW	030502	0	109	FS	ME			
Northeast Creek	From source to N. C. Hwy. 24	SC NSW	030502	10	0	NR	M	NP	ph and low DO	Swamp Drainage
Northeast Creek	From N. C. Hwy.24 to downstream side of mouth of Scales Creek	SC NSW	030502	0	680	NR	M	NP		
Northeast Creek	From the downstream side of mouth of Scales Creek to New River	SC NSW	030502	0	451	FS	ME			

Name	Description	Class	Subbasin	Miles	Acres	Rating	Basis	Source	Problem Parameter	Potential Source
Little Northeast Creek	From source to Northeast Creek	C NSW	030502	8	0	NR	M		Low DO	Small discharges in watershed, Swamp Drainage
Southwest Creek	From source to Mill Run	C NSW	030502	19	0	NR	M	NP		
Harris Creek	From source to Southwest Creek	C NSW	030502	6	0	NR	M			
Morgan Bay	Entire Bay	SC NSW	030502	0	987	FS	ME			
Wallace Creek	From source to New River	SB NSW	030502	0	248	FS	M			
Farnell Bay	Entire Bay	SC NSW	030502	0	228	FS	ME			
Stones Bay	Entire Bay except for the area enclosed by the DEH closure at the mouth of Stones Creek.	SA	030502	0	1,824	FS	ME			
New River Restricted Area # 1	All waters within 1,000 yards of earthen dock at the United States Marine Corps Rifle Range	SC	030502	0	296	FS	ME			
New River Restricted Area # 2	All waters within a line beginning at the Government Dock in from of U.S. Coast Guard Detachment Barracks at Marines and running a southwest course 1,000 yards to Channel Marker #13, thence a southeasterly course 1,000 yards to Flash Beacon # 11, thence a northeasterly course 500 yards to al point on the mainland at Wilkins' Bluff, thence following the shoreline to the Government Dock	SC	030502	0	242	FS	ME			
Traps Bay	Entire Bay	SA	030502	0	471	FS	ME			
WHITE OAK RIVER	From source to Spring Branch	C	030501	21	0	FS	M	NP, P		

Name	Description	Class	Subbasin	Miles	Acres	Rating	Basis	Source	Problem Parameter	Potential Source
WHITE OAK RIVER	From Spring Branch to Hunters Creek	C HQW	030501	3	0	NR	ME			
WHITE OAK RIVER	DEH closed area from Hunters Creek to DEH closure line.	SA	030501	0	468	FS	M			
WHITE OAK RIVER	From DEH closure line to DEH Conditionally Approved Closed line.	SA	030501	0	1,422	FS	M			
WHITE OAK RIVER	From DEH Conditionally Approved Closed line to the DEH Conditionally Approved Open line	SA	030501	0	2,124	FS	M			
WHITE OAK RIVER	From the DEH Conditionally Approved Open line to the Atlantic Ocean excluding the ICWW	SA	030501	0	1,169	FS	ME			
Starkeys Creek	From source to White Oak River	C	030501	7	0	NR	M	NP		
Holston Creek	From source to White Oak River	C	030501	5	0	NR	M			
Webb Creek	From source to White Oak River	C	030501	4	0	NR	M	NP	Habitat degradation	
Hampton Bay	Entire Bay	SA	030501	0	82	FS	ME			
Pettiford Creek Bay	Entire Bay	SA	030501	0	239	FS	ME			
White Oak River Restricted Area	That portion of White Oak River within an area bounded by a line running in an easterly direction from a point below Foster Creek to east end of Swansboro Bridge (N.C. Hwy. 24), thus across bridge to west end of bridge, thus running along shore line to a point below Foster Creek	SC	030501	0	268	FS	ME			

Name	Description	Class	Subbasin	Miles	Acres	Rating	Basis	Source	Problem Parameter	Potential Source
Bogue Sound (Including Intracoastal Waterway)	From Bogue Inlet (from a line running from the eastern mouth of Bogue Inlet to SR 1117 on the mainland) to a line across Bogue Sound from the southwest side of mouth of Gales Creek to Rock Point excluding DEH closed areas at mouths of Hunting Island Creek and Sanders Creek	SA ORW	030503	0	11,081	FS	M			
Bogue Sound (Including Intracoastal Waterway)	DEH closed area at mouth of Hunting Island Creek	SA ORW	030503	0	55	FS	M			
Bogue Sound (Including Intracoastal Waterway)	DEH closed area at mouth of Sanders Creek	SA ORW	030503	0	34	FS	M			
Bogue Sound (Including Intracoastal Waterway)	DEH closed area 870 meters west of mouth of Broad Creek	SA ORW	030503	0	4	FS	M			

Name	Description	Class	Subbasin	Miles	Acres	Rating	Basis	Source	Problem Parameter	Potential Source
Bogue Sound (Including Intracoastal Waterway to Beaufort Inlet)	From a line across Bogue Sound from the southwest side of mouth of Gales Creek to Rock Point to Beaufort Inlet excluding the DEH Conditionally Approved Closed area near Jumping Run Creek and the following DEH closed areas; on outer banks near Salter Path, three areas between Salter Path and Theodore Roosevelt Natural Area, waters near Hoophole Woods, mouth of Spooner Creek, mouth of Peltier Creek, adjacent to Hoophole Creek, waters near Money Island Slough, and area from Newport Restricted Area to Fort Macon Creek	SA	030503	0	10,876	FS	M			
Bogue Sound (Including Intracoastal Waterway to Beaufort Inlet)	DEH closed area from a line across Bogue Sound from the southwest side of mouth of Gales Creek to Rock Point extending east approximately 1500 meters along sound side of outer banks near Salter Path	SA	030503	0	109	FS	M			
Bogue Sound (Including Intracoastal Waterway to Beaufort Inlet)	DEH Conditionally Approved Closed area near Jumping Run Creek	SA	030503	0	367	FS	M			
Bogue Sound (Including Intracoastal Waterway to Beaufort Inlet)	DEH closed area in unnamed bay approximately 2500 meters east of line across Bogue Sound from the southwest side of mouth of Gales Creek to Rock Point	SA	030503	0	7	FS	M			

Name	Description	Class	Subbasin	Miles	Acres	Rating	Basis	Source	Problem Parameter	Potential Source
Bogue Sound (Including Intracoastal Waterway to Beaufort Inlet)	DEH closed area in unnamed bay approximately 3500 meters east of line across Bogue Sound from the southwest side of mouth of Gales Creek to Rock Point	SA	030503	0	3	FS	M			
Bogue Sound (Including Intracoastal Waterway to Beaufort Inlet)	DEH closed area in unnamed bay area near Hoophole Woods approximately 7400 meters east of line across Bogue Sound from the southwest side of mouth of Gales Creek to Rock Point	SA	030503	0	75	FS	M			
Bogue Sound (Including Intracoastal Waterway to Beaufort Inlet)	DEH closed area at mouth of Spooner Creek	SA	030503	0	45	FS	M			
Bogue Sound (Including Intracoastal Waterway to Beaufort Inlet)	DEH closed area at mouth of Peltier Creek	SA	030503	0	84	FS	M			
Bogue Sound (Including Intracoastal Waterway to Beaufort Inlet)	DEH closed area near Hoophole Creek west of Atlantic Beach	SA	030503	0	37	FS	M			
Bogue Sound (Including Intracoastal Waterway to Beaufort Inlet)	DEH closed areas west at Atlantic Beach Bridge and Cedar Hammock	SA	030503	0	109	FS	M			

Name	Description	Class	Subbasin	Miles	Acres	Rating	Basis	Source	Problem Parameter	Potential Source
Bogue Sound (Including Intracoastal Waterway to Beaufort Inlet)	DEH closed area from Newport River Restricted area to Fort Macon Creek	SA	030503	0	341	FS	M			
Taylor Bay	Entire Bay	SA ORW	030503	0	82	FS	ME			
NEWPORT RIVER	From source to Little Creek Swamp	C	030503	11	0	NR	M	NP		
NEWPORT RIVER	From DEH Conditionally approved closed line to DEH Conditionally approved open line extending from Penn Point to west mouth of Core Creek	SA	030503	0	2,663	FS	M			
NEWPORT RIVER	From DEH conditionally approved open line extending from Penn Point to the west shore of Core Creek to the Atlantic Ocean excluding closed areas around Morehead City and Beaufort	SA	030503	0	3,559	FS	M			
NEWPORT RIVER	DEH closed area north of Morehead City Harbor restricted area including Crap Point Thorofare and Calico Creek Marsh to Hwy 70 Bridge.	SA	030503	0	654	FS	ME			
NEWPORT RIVER	DEH closed area from Hwy 70 Bridge to a line extending form the south point of Radio Island to Fort Macon including Morehead City Channel	SA	030503	0	220	FS	M			
NEWPORT RIVER	DEH closed area around Gallant Point south to Hwy 70 Bridge including Beaufort Channel	SA	030503	0	166	FS	M			
NEWPORT RIVER	Deh closed area south of Hwy 70 Bridge and west of Pivers Island including Bulkhead Channell	SA	030503	0	188	FS	M			

Name	Description	Class	Subbasin	Miles	Acres	Rating	Basis	Source	Problem Parameter	Potential Source
Northwest Prong Newport River	From source to Newport River	C	030503	4	0	NR	M	NP		
Southwest Prong Newport River	From source to Newport River	C	030503	6	0	NR	M			
Back Sound	Portion of the following in subbasin 030503 From Newport River to a point on Shackleford Banks at lat. 34 40’57" and long 76 37’30" north to the western most point of Middle Marshes and along the northeast shoreline of Middle Marshes to Rush Point on Harkers Island with the exception of the DEH closed areas at the east mouth of Taylor Creek near the mouth of the North River and the west mouth of Taylor Creek around Pivers Island	SA	030503	0	310	FS	M			
Back Sound	Portion of the following in subbasin 030504 From Newport River to a point on Shackleford Banks at lat. 34 40’57" and long 76 37’30" north to the western most point of Middle Marshes and along the northeast shoreline of Middle Marshes to Rush Point on Harkers Island with the exception of the DEH closed areas at the east mouth of Taylor Creek near the mouth of the North River and the west mouth of Taylor Creek around Pivers Island	SA	030504	0	935	FS	M			

Name	Description	Class	Subbasin	Miles	Acres	Rating	Basis	Source	Problem Parameter	Potential Source
Back Sound	Portion of the following in subbasin 030505 From Newport River to a point on Shackleford Banks at lat. 34 40’57" and long 76 37’30" north to the western most point of Middle Marshes and along the northeast shoreline of Middle Marshes to Rush Point on Harkers Island with the exception of the DEH closed areas at the east mouth of Taylor Creek near the mouth of the North River and the west mouth of Taylor Creek around Pivers Island	SA	030505	0	1,475	FS	M			
Back Sound	DEH closed area at west mouth of Taylor Creek around Pivers Island	SA	030503	0	43	FS	M			
Back Sound	DEH closed area at the east mouth of Taylor Creek near the mouth of the North River	SA	030504	0	171	FS	M			
Back Sound	Portion of the following in subbasin 030504 From a point on Shackleford Banks at lat. 34 40’57" and long 76 37’30" north to the western most point of Middle Marshes and along the northwest shoreline of Middle Marshes (to include all of Middle Marshes) to Rush Point on Harkers Island and along the southern shore of Harkers Island back to Core Sound with the exception of four DEH closed areas on the south shore of Harkers Island.	SA ORW	030504	0	733	FS	ME			

Name	Description	Class	Subbasin	Miles	Acres	Rating	Basis	Source	Problem Parameter	Potential Source
Back Sound	Portion of the following in subbasin 030505 From a point on Shackleford Banks at lat. 34 40’57" and long 76 37’30" north to the western most point of Middle Marshes and along the northwest shoreline of Middle Marshes (to include all of Middle Marshes) to Rush Point on Harkers Island and along the southern shore of Harkers Island back to Core Sound with the exception of four DEH closed areas on the south shore of Harkers Island.	SA ORW	030505	0	6,553	FS	M			
Eastmouth Bay	Entire Bay	SA	030504	0	336	FS	ME			
Westmouth Bay	Entire Bay with the exception of DEH closed area on south side of Bay	SA	030504	0	383	FS	ME			
Westmouth Bay	DEH closed area on south side of Bay	SA	030504	0	7	FS	ME			
The Straits	From Core Sound to North River excluding conditionally approved open section in north west portion adjacent to North River	SA	030504	0	1,704	FS	ME			
The Straits	Conditionally approved open section in north west portion adjacent to North River	SA	030504	0	102	FS	ME			
Ward Creek	From source to North River	SA	030504	2	582	FS	M			
North Leopard Creek	From source to Ward Creek	SA	030504	0	95	FS	ME			
South Leopard Creek	From source to Ward Creek	SA	030504	0	78	FS	ME			
Goose Bay	Entire Bay	SA	030504	0	266	FS	ME			
North River	From source to DEH closure line south of Crabbing Creek	SA	030504	0	291	FS	M			

Name	Description	Class	Subbasin	Miles	Acres	Rating	Basis	Source	Problem Parameter	Potential Source
North River	From DEH closure line south of Crabbing Creek to Back Sound excluding DEH conditionally approved closed and closed areas between Davis Bay and North River Marsh	SA	030504	0	5,868	FS	M			
North River	DEH conditionally approved closed area between Davis Bay and North River Marsh	SA	030504	0	102	FS	M			
North River	DEH closed area between Davis Bay and North River Marsh	SA	030504	0	162	FS	M			
North River	DEH conditionally approved closed area ato mouth of Newby Creek	SA	030504	0	19	FS	ME			
Whale Creek	From source to Back Sound	SA ORW	030505	0	34	FS	ME			
Cabs Creek	From source to Back Sound	SA ORW	030505	0	46	FS	ME			
Bald Hill Bay	Entire Bay	SA ORW	030505	0	81	FS	ME			
Johnson Bay	Entire Bay	SA ORW	030505	0	91	FS	ME			
Blinds Hammock Bay	Entire Bay	SA ORW	030505	0	71	FS	ME			
The Ditch	From Lighthouse Bay to Blinds Hammock Bay	SA ORW	030505	0	83	FS	ME			
Point of Grass Creek	From source to Core Sound	SA ORW	030504	0	0	FS	ME			
Nelson Bay	From mouth of Salters Creek to a line extending from mouth of Broad Creek due east across Nelson Bay	SC	030504	0	235	FS	ME			
Nelson Bay	From a line extending from mouth of Broad Creek due east across Nelson Bay to Core Sound	SA	030504	0	861	FS	ME			
Broad Creek	From source to Nelson Bay	SC	030504	0	41	NR	M			
Fulchers Creek	From source to Core Sound	SA ORW	030504	0	40	FS	ME			
Brett Bay	Entire Bay	SA ORW	030504	0	186	FS	ME			
Head of the Hold	Entire Bay	SA ORW	030505	0	22	FS	ME			

Name	Description	Class	Subbasin	Miles	Acres	Rating	Basis	Source	Problem Parameter	Potential Source
The Swash	Entire Bay	SA ORW	030505	0	113	FS	ME			
Great Island Creek	From source to Core Sound	SA	030505	0	105	FS	ME			
Horse Island Creek	From source to Great Island Creek	SA	030505	0	7	FS	ME			
Fortin Bay	Entire Bay	SA	030505	0	118	FS	ME			
Great Island Bay	Entire Bay	SA ORW	030505	0	310	FS	ME			
Little Port Branch	From source to Core Sound (including Atlantic Harbor)	SC	030504	3	0	FS	ME			
Johnson Creek	From source to Core Sound	SA	030505	0	138	FS	ME			
Spit Bay	Entire Bay	SA	030504	0	38	FS	ME			
Jarrett Bay	From head of bay to DEH conditionally approved open line	SA ORW	030504	0	38	FS	ME			
Jarrett Bay	From DEH conditionally approved open line to Core Sound	SA ORW	030504	0	1,111	FS	ME			
Jarrett Bay	DEH closed area at embayment at mouth Williston Creek	SA ORW	030504	0	58	FS	ME			
Great Marsh Creek	From source to Core Sound	SA ORW	030504	0	130	FS	ME			
Deer Pond	Entire pond	SA ORW	030505	0	31	FS	ME			
Horsepen Creek	From source to Core Sound	SA ORW	030505	0	26	FS	ME			
Lewis Creek	From source to Core Sound	SA ORW	030505	0	16	FS	ME			
Zack Creek	From source to Core Sound	SA ORW	030505	0	40	FS	ME			
Mullet Cove	Entire cove	SA ORW	030505	0	23	FS	ME			
Sheep Pen Creek	From source to Core Sound	SA ORW	030505	0	140	FS	ME			
Codds Creek	From source to Core Sound	SA ORW	030505	0	18	FS	ME			
Try Yard Creek	From source to Codds Creek	SA ORW	030505	0	8	FS	ME			
Styron Creek	From DEH closure line at mouth of Cedar Creek to Core to Styron Bay	SA	030504	0	9	FS	ME			

Name	Description	Class	Subbasin	Miles	Acres	Rating	Basis	Source	Problem Parameter	Potential Source
Hogpen Bay	Entire Bay	SA ORW	030505	0	91	FS	ME			
Caggs Creek	From source to Hogpen Bay	SA ORW	030505	0	22	FS	ME			
Rawson Creek	From source to Core Sound	SA ORW	030505	0	17	FS	ME			
Iron Creek	From source to Core Sound	SA ORW	030505	0	31	FS	ME			
Lighthouse Bay	Entire Bay	SA ORW	030505	0	383	FS	ME			
Barden Inlet	From Atlantic Ocean to Core Sound	SA ORW	030505	0	200	FS	ME			
Styron Bay	Entire Bay with exception of DEH closed area	SA ORW	030504	0	420	FS	ME			
Styron Bay	DEH closed area	SA ORW	030504	0	10	FS	ME			
Negro Creek	From source to Core Sound	SA	030505	0	2	FS	ME			
Horsepen Creek	From source to Core Sound	SA	030505	0	1	FS	ME			
Sheep Pen Creek	From source to Core Sound	SA	030505	0	1	FS	ME			
Gutter Creek	From source to Core Sound	SA	030505	0	35	FS	ME			
Cedar Inlet	From Old Channel to Core Sound	SA ORW	030505	0	70	FS	ME			
Old Channel	From Core Sound to Cedar Inlet	SA ORW	030505	0	110	FS	ME			
Yaupon Hammock Gut	Entire Gut	SA ORW	030505	0	9	FS	ME			
Core Sound	Portion of the following in subbasin 030504, from northern boundary of White Oak River Basin (a line from Hall Point to Drum Inlet) to Back Sound, excluding conditionally approved areas at the mouths of Nelson and Jarrett Bays and Oyster Creek	SA ORW	030504	0	22,404	FS	M			
Core Sound	Conditionally approved open area at the mouth of Jarrett Bay	SA ORW	030504	0	81	FS	ME			
Core Sound	Conditionally approved open area at the mouth of Nelson Bay	SA ORW	030504	0	166	FS	ME			
Core Sound	Conditionally approved open area at the mouth Oyster Creek	SA ORW	030504	0	87	FS	ME			

Name	Description	Class	Subbasin	Miles	Acres	Rating	Basis	Source	Problem Parameter	Potential Source
Core Sound	Portion of the following in subbasin 030505, from northern boundary of White Oak River Basin (a line from Hall Point to Drum Inlet) to Back Sound, excluding conditionally approved areas at the mouths of Nelson and Jarrett Bays and Oyster Creek	SA ORW	030505	0	11,453	FS	ME			

NOTES

*"Ag" denotes agriculture, which could include row crops and animal operations. Where "cattle" is noted, cattle were observed on site at the time of sampling or the watershed hosts many cattle farms.

"Rating" = Use Support Rating

"Basis"=Rating basis

"Habitat degradation" is identified where there is a notable reduction in habitat diversity or change in habitat quality. This term includes sedimentation, bank erosion, channelization, lack of riparian vegetation, loss of pools or riffles, loss of woody habitat, and stream bed scour.

"Non-urban develop" is residential and/or commercial develop outside urban areas.

"Rural runoff" is non-point source runoff from rural areas, including that from low density residential and commercial areas.

ABBREVIATION KEY

P = Point Source Pollution (Major source)	nut = high nutrient levels
NP = Non-point Source Pollution	turb = turbidity
M = Monitored	fecal = fecal coliform bacteria
ME = Monitored-evaluated	sed = sediment
FS = Fully Supporting	ab = above
PS = Partially Supporting	nr = near
NS = Not Supporting	be = below
NR = Not Rated	

Name	Description	Class	Subbasin	Miles	Acres	Source	Rating	Basis	Potential Source
NEW RIVER	From U. S.Hwy. 17 bridge to Atlantic Coast Line Railroad Trestle	SB HQW NSW	030502	0	49		FS	ME	
NEW RIVER	From a line extending across New River from Grey Point to a point of land approximately 2200 yards downstream from mouth of Duck Creek to Atlantic Ocean; including all unnamed bays, creeks, and other waters except restricted area # 2 described below and DEH closed areas at the mouths of Everett Bay and Fannie and Wheeler Creeks.	SA	030502	0	5,753		FS	M	
NEW RIVER	From Blue Creek to U. S. Hwy. 17 bridge	SB NSW	030502	0	116		FS	M	
Wallace Creek	From source to New River	SB NSW	030502	0	248		FS	M	
Stones Bay	Entire Bay except for the area enclosed by the DEH closure at the mouth of Stones Creek.	SA	030502	0	1,824		FS	ME	
Intracoastal Waterway	From northeastern boundary of Cape Fear River Basin to Daybeacon #17 including all unnamed bays, guts, and channels	SA ORW	030502	0	231		FS	M	
Intracoastal Waterway	From Daybeacon #17 to DEH conditionally approved open line at north mouth of Chadwick Bay including all unnamed bays, guts, and channels	SA	030502	0	67		FS	M	
Intracoastal Waterway	From DEH conditionally approved open line at north mouth of Chadiwick Bay to New River	SA	030502	0	31		FS	M	
Chadwick Bay	Entire Bay	SA	030502	0	579		FS	ME	
Intracoastal Waterway	From DEH Conditionally Approved Open area line northeast of mouth of Salliers Bay to subbasin boundary	SA	030502	0	154		FS	M	
Intracoastal Waterway	From subbasin boundary to southwest mouth of Bear Creek	SA	030501	0	282		FS	M	
Intracoastal Waterway	From southwest mouth of Bear Creek to mouth of Goose Creek	SA	030501	0	81		FS	M	
Bear Creek	From DEH closed area line to intracoastal waterway.	SA	030501	0	196		FS	M	

Name	Description	Class	Subbasin	Miles	Acres	Source	Rating	Basis	Potential Source
Queen Creek	From DEH Conditionally Approved closed line at Queens Creek Road Bridge to DEH Conditionally Approved Open line at northeast mouth of Parrot Swamp.	SA	030501	0	161		FS	M	
Queen Creek	From DEH Conditionally Approved Open line at northeast mouth of Parrot Swamp to Intracoastal Waterway.	SA	030501	0	271		FS	ME	
Bear Island ORW Area	All waters within an area north of Bear Island defined by a line from the western most point on Bear Island and running along the eastern shore of Sanders Creek to the northeast mouth of Goose Creek on the mainland, east to the southwest mouth of Queen Creek, then south to green marker #49, then northeast to the northeastern most point on Huggins Island, then southeast along the shoreline of Huggins Island to the southeastern most point of Huggins Island, then south to the northeastern most point on Dudley Island, then southwest along the shoreline of Dudley Island to the eastern tip of Bear Island, then to the western most point on Bear Island excluding DEH closed area adjacent to south side of the White Oak River Restricted Area	SA ORW	030501	0	2,225		FS	M	

Name	Description	Class	Subbasin	Miles	Acres	Source	Rating	Basis	Potential Source
Bear Island ORW Area	All waters within an area north of Bear Island defined by a line from the western most point on Bear Island and running along the eastern shore of Sanders Creek to the northeast mouth of Goose Creek on the mainland, east to the southwest mouth of Queen Creek, then south to green marker #49, then northeast to the northeastern most point on Huggins Island, then southeast along the shoreline of Huggins Island to the southeastern most point of Huggins Island, then south to the northeastern most point on Dudley Island, then southwest along the shoreline of Dudley Island to the eastern tip of Bear Island, then to the western most point on Bear Island	SA ORW	030501	0	70		FS	M	
WHITE OAK RIVER	DEH closed area from Hunters Creek to DEH closure line.	SA	030501	0	468		FS	M	
WHITE OAK RIVER	From DEH closure line to DEH Conditionally Approved Closed line.	SA	030501	0	1,422		FS	ME	
WHITE OAK RIVER	From DEH Conditionally Approved Closed line to the DEH Conditionally Approved Open line	SA	030501	0	2,124		FS	M	
Bogue Sound (Including Intracoastal Waterway)	From Bogue Inlet (from a line running from the eastern mouth of Bogue Inlet to SR 1117 on the mainland) to a line across Bogue Sound from the southwest side of mouth of Gales Creek to Rock Point excluding DEH closed areas at mouths of Hunting Island Creek and Sanders Creek	SA ORW	030503	0	11,081		FS	M	
Bogue Sound (Including Intracoastal Waterway)	DEH closed area 870 meters west of mouth of Broad Creek	SA ORW	030503	0	4		FS	M	

Name	Description	Class	Subbasin	Miles	Acres	Source	Rating	Basis	Potential Source
Bogue Sound (Including Intracoastal Waterway to Beaufort Inlet)	From a line across Bogue Sound from the southwest side of mouth of Gales Creek to Rock Point to Beaufort Inlet excluding the DEH Conditionally Approved Closed area near Jumping Run Creek and the following DEH closed areas; on outer banks near Salter Path, three areas between Salter Path and Theodore Roosevelt Natural Area, waters near Hoophole Woods, mouth of Spooner Creek, mouth of Peltier Creek, adjacent to Hoophole Creek, waters near Money Island Slough, and area from Newport Restricted Area to Fort Macon Creek	SA	030503	0	10,876		FS	M	
Goose Creek	From DEH closure line to Bogue Sound	SA	030503	0	135		FS	M	
Broad Creek	From source to Bogue Sound	SA	030503	0	91		FS	M	
NEWPORT RIVER	DEH closed area around Gallant Point south to Hwy 70 Bridge including Beaufort Channel	SA	030503	0	166		FS	M	
NEWPORT RIVER	Deh closed area south of Hwy 70 Bridge and west of Pivers Island including Bulkhead Channell	SA	030503	0	188		FS	M	
Back Sound	Portion of the following in subbasin 030503 From Newport River to a point on Shackleford Banks at lat. 34 40’57" and long 76 37’30" north to the western most point of Middle Marshes and along the northeast shoreline of Middle Marshes to Rush Point on Harkers Island with the exception of the DEH closed areas at the east mouth of Taylor Creek near the mouth of the North River and the west mouth of Taylor Creek around Pivers Island	SA	030503	0	310		FS	M	

Name	Description	Class	Subbasin	Miles	Acres	Source	Rating	Basis	Potential Source
Back Sound	Portion of the following in subbasin 030504 From Newport River to a point on Shackleford Banks at lat. 34 40’57" and long 76 37’30" north to the western most point of Middle Marshes and along the northeast shoreline of Middle Marshes to Rush Point on Harkers Island with the exception of the DEH closed areas at the east mouth of Taylor Creek near the mouth of the North River and the west mouth of Taylor Creek around Pivers Island	SA	030504	0	935		FS	M	
Back Sound	Portion of the following in subbasin 030505 From Newport River to a point on Shackleford Banks at lat. 34 40’57" and long 76 37’30" north to the western most point of Middle Marshes and along the northeast shoreline of Middle Marshes to Rush Point on Harkers Island with the exception of the DEH closed areas at the east mouth of Taylor Creek near the mouth of the North River and the west mouth of Taylor Creek around Pivers Island	SA	030505	0	1,475		FS	M	
Back Sound	DEH closed area at west mouth of Taylor Creek around Pivers Island	SA	030503	0	43		FS	M	
Back Sound	DEH closed area at the east mouth of Taylor Creek near the mouth of the North River	SA	030504	0	171		FS	ME	
Back Sound	DEH closed areas in and around Carrot Island	SA	030504	0	64		FS	M	
Back Sound	Portion of the following in subbasin 030504 From a point on Shackleford Banks at lat. 34 40’57" and long 76 37’30" north to the western most point of Middle Marshes and along the northwest shoreline of Middle Marshes (to include all of Middle Marshes) to Rush Point on Harkers Island and along the southern shore of Harkers Island back to Core Sound with the exception of four DEH closed areas on the south shore of Harkers Island.	SA ORW	030504	0	733		FS	ME	

Name	Description	Class	Subbasin	Miles	Acres	Source	Rating	Basis	Potential Source
Back Sound	Portion of the following in subbasin 030505 From a point on Shackleford Banks at lat. 34 40’57" and long 76 37’30" north to the western most point of Middle Marshes and along the northwest shoreline of Middle Marshes (to include all of Middle Marshes) to Rush Point on Harkers Island and along the southern shore of Harkers Island back to Core Sound with the exception of four DEH closed areas on the south shore of Harkers Island.	SA ORW	030505	0	6,553		FS	M	
Back Sound	Four DEH closed areas on the south shore of Harkers Island.	SA ORW	030504	0	7		FS	ME	
The Straits	From Core Sound to North River excluding conditionally approved open section in north west portion adjacent to North River	SA	030504	0	1,704		FS	M	
The Straits	Conditionally approved open section in north west portion adjacent to North River	SA	030504	0	102		FS	M	
North River	From DEH closure line south of Crabbing Creek to Back Sound excluding DEH conditionally approved closed and closed areas between Davis Bay and North River Marsh	SA	030504	0	5,868		FS	M	
North River	DEH conditionally approved closed area between Davis Bay and North River Marsh	SA	030504	0	102		FS	ME	
Whale Creek	From source to Back Sound	SA ORW	030505	0	34		FS	ME	
Cabs Creek	From source to Back Sound	SA ORW	030505	0	46		FS	ME	
Bald Hill Bay	Entire Bay	SA ORW	030505	0	81		FS	ME	
Johnson Bay	Entire Bay	SA ORW	030505	0	91		FS	ME	
Blinds Hammock Bay	Entire Bay	SA ORW	030505	0	71		FS	ME	
The Ditch	From Lighthouse Bay to Blinds Hammock Bay	SA ORW	030505	0	83		FS	ME	
Nelson Bay	From a line extending from mouth of Broad Creek due east across Nelson Bay to Core Sound	SA	030504	0	861		FS	M	
Head of the Hold	Entire Bay	SA ORW	030505	0	22		FS	ME	
The Swash	Entire Bay	SA ORW	030505	0	113		FS	ME	

Name	Description	Class	Subbasin	Miles	Acres	Source	Rating	Basis	Potential Source
Great Island Creek	From source to Core Sound	SA	030505	0	105		FS	ME	
Horse Island Creek	From source to Great Island Creek	SA	030505	0	7		FS	ME	
Fortin Bay	Entire Bay	SA	030505	0	118		FS	ME	
Great Island Bay	Entire Bay	SA ORW	030505	0	310		FS	ME	
Johnson Creek	From source to Core Sound	SA	030505	0	138		FS	ME	
Deer Pond	Entire pond	SA ORW	030505	0	31		FS	ME	
Horsepen Creek	From source to Core Sound	SA ORW	030505	0	26		FS	ME	
Lewis Creek	From source to Core Sound	SA ORW	030505	0	16		FS	ME	
Zack Creek	From source to Core Sound	SA ORW	030505	0	40		FS	ME	
Mullet Cove	Entire cove	SA ORW	030505	0	23		FS	ME	
Sheep Pen Creek	From source to Core Sound	SA ORW	030505	0	140		FS	ME	
Codds Creek	From source to Core Sound	SA ORW	030505	0	18		FS	ME	
Try Yard Creek	From source to Codds Creek	SA ORW	030505	0	8		FS	ME	
Hogpen Bay	Entire Bay	SA ORW	030505	0	91		FS	ME	
Caggs Creek	From source to Hogpen Bay	SA ORW	030505	0	22		FS	ME	
Rawson Creek	From source to Core Sound	SA ORW	030505	0	17		FS	ME	
Iron Creek	From source to Core Sound	SA ORW	030505	0	31		FS	ME	
Lighthouse Bay	Entire Bay	SA ORW	030505	0	383		FS	ME	
Barden Inlet	From Atlantic Ocean to Core Sound	SA ORW	030505	0	200		FS	ME	
Negro Creek	From source to Core Sound	SA	030505	0	2		FS	ME	
Horsepen Creek	From source to Core Sound	SA	030505	0	1		FS	ME	
Sheep Pen Creek	From source to Core Sound	SA	030505	0	1		FS	ME	
Gutter Creek	From source to Core Sound	SA	030505	0	35		FS	ME	
Cedar Inlet	From Old Channel to Core Sound	SA ORW	030505	0	70		FS	ME	
Old Channel	From Core Sound to Cedar Inlet	SA ORW	030505	0	110		FS	ME	
Yaupon Hammock Gut	Entire Gut	SA ORW	030505	0	9		FS	ME	

Name	Description	Class	Subbasin	Miles	Acres	Source	Rating	Basis	Potential Source
Core Sound	Portion of the following in subbasin 030504, from northern boundary of White Oak River Basin (a line from Hall Point to Drum Inlet) to Back Sound, excluding conditionally approved areas at the mouths of Nelson and Jarrett Bays and Oyster Creek	SA ORW	030504	0	22,404		FS	M	
Core Sound	Conditionally approved open area at the mouth of Jarrett Bay	SA ORW	030504	0	81		FS	M	
Core Sound	Conditionally approved open area at the mouth of Nelson Bay	SA ORW	030504	0	166		FS	M	
Core Sound	Conditionally approved open area at the mouth Oyster Creek	SA ORW	030504	0	87		FS	M	
Core Sound	Portion of the following in subbasin 030505, from northern boundary of White Oak River Basin (a line from Hall Point to Drum Inlet) to Back Sound, excluding conditionally approved areas at the mouths of Nelson and Jarrett Bays and Oyster Creek	SA ORW	030505	0	11,453		FS	M	
Atlantic Ocean	The waters of the Atlantic Ocean contiguous to that portion of the White Oak River Basin that extends from the northern boundary of White Oak River Basin (southwest side of Drum Inlet) to the southern boundary of White Oak River Basin (northern boundary of Cape Fear River Basin at the southwest side of the mouth of Goose Bay in the Intracoastal Waterway.	SB		91	0	NP	FS	M	Stormwater Pumping, Bogue Banks Communities

Name	Description	Class	Subbasin	Miles	Acres	Source	Rating	Basis	Potential Source
NOTES									
*"Ag" denotes agriculture, which could include row crops and animal operations. Where "cattle" is noted, cattle were observed on site at the time of sampling									
or the watershed hosts many cattle farms.									
"Rating" = Use Support Rating									
"Basis"=Rating basis									
"Habitat degradation" is identified where there is a notable reduction in habitat diversity or change in habitat quality. This term includes sedimentation, bank erosion, channelization,									
lack of riparian vegetation, loss of pools or riffles, loss of woody habitat, and stream bed scour.									
"Non-urban develop" is residential and/or commercial develop outside urban areas.									
"Rural runoff" is non-point source runoff from rural areas, including that from low density residential and commercial areas.									
ABBREVIATION KEY									
P = Point Source Pollution (Major source)			nut = high nutrient levels						
NP = Non-point Source Pollution			turb = turbidity						
M = Monitored			fecal = fecal coliform bacteria						
ME = Monitored-evaluated			sed = sediment						
FS = Fully Supporting			ab = above						
PS = Partially Supporting			nr = near						
NS = Not Supporting			be = below						

White Oak River Basin Use Support **Shellfish Harvesting** **October 2001**

Name	Description	Class	Subbasin	Miles	Acres	Rating	Basis	DEH Class	% closed
NEW RIVER	From a line extending across New River from Grey Point to a point of land approximately 2200 yards downstream from mouth of Duck Creek to Atlantic Ocean; including all unnamed bays, creeks, and other waters except restricted area # 2 described below and DEH closed areas at the mouths of Everett Bay and Fannie and Wheeler Creeks.	SA	030502	0	5,753	FS	M	APP	
NEW RIVER	From Everett Bay to DEH closure line.	SA	030502	0	18	NS	M	PRO	
NEW RIVER	From Fannie Creek and Wheeler Creek to DEH closure line.	SA	030502	0	50	NS	M	PRO	
Mill Creek	From source to Stones Bay	SA	030502	0	35	NS	ME	PRO	
Muddy Creek	From source to Stones Bay	SA	030502	0	17	NS	ME	PRO	
Stones Creek	From source to Stones Bay	SA	030502	0	74	NS	ME	PRO	
Millstone Creek	From source to Stones Creek	SA	030502	0	6	NS	ME	PRO	
Stones Bay	Entire Bay except for the area enclosed by the DEH closure at the mouth of Stones Creek.	SA	030502	0	1,824	FS	M	APP	
Stones Bay	From Stones Creek to DEH closure line.	SA	030502	0	32	NS	ME	PRO	
Everett Creek	From source to New River	SA	030502	0	76	NS	ME	PRO	
Ellis Cove	Entire Cove	SA	030502	0	111	FS	M	APP	
Sneads Creek	From source to Ellis Cove Bay	SA	030502	0	44	FS	M	APP	
Fannie Creek	From source to New River	SA	030502	0	10	NS	M	PRO	
Wheeler Creek	From source to New River	SA	030502	0	11	NS	M	PRO	
Courthouse Bay	Entire Bay except for DEH closure area in south arm of bay.	SA	030502	0	182	FS	M	APP	
Courthouse Bay	DEH closure area in south arm of bay.	SA	030502	0	2	NS	ME	PRO	
Traps Bay	Entire Bay	SA	030502	0	471	FS	M	APP	
Traps Creek	From source to Traps Bay	SA	030502	0	11	FS	ME	APP	
Toms Creek	From source to Traps Bay	SA	030502	2	0	FS	ME	APP	
Intracoastal Waterway	From northeastern boundary of Cape Fear River Basin to Daybeacon #17 including all unnamed bays, guts, and channels	SA ORW	030502	0	231	PS	M	CAO	12.35
Intracoastal Waterway	From Daybeacon #17 to DEH conditionally approved open line at north mouth of Chadwick Bay including all unnamed bays, guts, and channels	SA	030502	0	67	PS	M	CAO	12.24

Fecal coliform bacteria are the problem parameter in shellfish harvesting waters. Fecal coliform bacteria in Class SA waters shall meet the sanitary and bacterialogical standards as adapted by the Commission for Health Services

White Oak River Basin Use Support **Shellfish Harvesting** **October 2001**

Name	Description	Class	Subbasin	Miles	Acres	Rating	Basis	DEH Class	% closed
Intracoastal Waterway	From DEH conditionally approved open line at north mouth of Chadiwick Bay to New River	SA	030502	0	31	PS	M	CAO	12.24
Rogers Bay	Entire Bay	SA	030502	0	51	NS	M	CAC	
Goose Bay	Entire Bay	SA ORW	030502	0	39	PS	M	CAO	12.35
Mill Creek	From source to Alligator Bay	SA	030502	0	18	NS	ME	PRO	
Alligator Bay	Bay south of ICWW	SA ORW	030502	0	260	PS	M	CAO	12.24
Alligator Bay	DEH closure area at mouth of Mill Creek.	SA ORW	030502	0	29	NS	M	PRO	
Alligator Bay	Bay north of ICWW except DEH closure area at mouth of Mill Creek.	SA ORW	030502	0	266	PS	M	CAO	12.52
Chadwick Bay	Entire Bay	SA	030502	0	579	PS	M	CAO	12.24
Biglins Creek	From source to Fullard Creek	SA	030502	0	6	NS	ME	PRO	
Charles Creek	From source to Fullard Creek	SA	030502	0	39	NS	M	PRO	
Bumps Creek	From source to Fullard Creek	SA	030502	0	14	NS	M	PRO	
Fullard Creek (Salt Branch)	From source to DEH closure line at west side of mouth of Charles Creek.	SA	030502	0	71	NS	M	PRO	
Fullard Creek (Salt Branch)	From DEH closure line at west side of mouth of Charles Creek to Chadwick Bay.	SA	030502	0	85	PS	M	CAO	12.24
Fullard Creek (Salt Branch)	Small embayments at northeast mouth of Fullard Creek.	SA	030502	0	8	NS	M	PRO	
Hell Gate Creek	From source to Intracoastal Waterway	SA	030502	0	14	FS	ME	APP	
Wards Channel	From Intracoastal Waterway to New River	SA	030502	0	101	FS	ME	APP	
Intracoastal Waterway	From New River to DEH closure line at southwest mouth of Salliers bay	SA	030502	0	72	FS	M	APP	
Intracoastal Waterway	From DEH closure line at southwest mouth of Salliers Bay to DEH Conditionally Approved Open area line northeast of mouth of Salliers Bay	SA	030502	0	16	NS	M	PRO	
Intracoastal Waterway	From DEH Conditionally Approved Open area line northeast of mouth of Salliers Bay to subbasin boundary	SA	030502	0	154	PS	M	CAO	11.4
Intracoastal Waterway	From subbasin boundary to southwest mouth of Bear Creek	SA	030501	0	282	PS	M	CAO	11.4
Intracoastal Waterway	From southwest mouth of Bear Creek to mouth of Goose Creek	SA	030501	0	81	PS	M	CAO	11.4

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Name	Description	Class	Subbasin	Miles	Acres	Rating	Basis	DEH Class	% closed
Intracoastal Waterway	From the northeast mouth of Goose Creek to the southwest mouth of Queen Creek	SA ORW	030501	0	211	PS	M	CAO	13.82
Intracoastal Waterway	Unnamed area south of ICWW between Bear Creek and Saunders Creek	SA ORW	030501	0	172	FS	M	APP	
Intracoastal Waterway	From the southwest mouth of Queen Creek to the west side of the Whiteoak River Restricted Area	SA	030501	0	165	PS	M	CAO	13.82
Intracoastal Waterway	ICWW in southern segment of White Oak River form the White Oak River Restricted Area to ICWW in Bogue Sound	SA	030501	0	64	FS	M	APP	
Howard Bay	Entire Bay	SA	030502	0	53	FS	M	APP	
Bear Creek	From Shacklefoot Channel to Intracoastal Waterway	SA	030501	0	49	FS	M	APP	
Mill Creek	From source to Bear Creek	SA	030501	0	15	NS	M	PRO	
Bear Creek	From source to DEH closed area line	SA	030501	0	113	NS	M	PRO	
Bear Creek	From DEH closed area line to intracoastal waterway.	SA	030501	0	196	PS	M	CAO	15.51
Saunders Creek	From Bear Creek to Intracoastal Waterway	SA	030501	0	164	FS	M	APP	
Bear Inlet	From Atlantic Ocean to Intracoastal Waterway	SA	030501	0	241	FS	ME	APP	
Goose Creek	From source to Intracoastal Waterway	SA	030501	1	3	PS	ME	CAO	13.82
Cow Channel	From Bogue Inlet to Intracoastal Waterway	SA ORW	030501	0	17	FS	M	APP	
Bell Swamp	From source to Queen Creek	SA	030501	0	1	NS	ME	PRO	
Pasture Branch	From source to Queen Creek	SA	030501	0	1	NS	ME	PRO	
Halls Creek	From source to Queen Creek	SA	030501	0	27	NS	ME	CAC	
Parrot Swamp	From source to DEH closure line.	SA	030501	0	75	NS	ME	PRO	
Parrot Swamp	From DEH closure line to Queen Creek	SA	030501	0	45	PS	ME	CAO	15.62
Dicks Creek	From source to Queen Creek	SA	030501	0	22	NS	M	PRO	
Queen Creek	DEH closed area from source to DEH Conditionally Approved closed line at Queens Creek Road Bridge.	SA	030501	0	234	NS	M	PRO	
Queen Creek	From DEH Conditionally Approved closed line at Queens Creek Road Bridge to DEH Conditionally Approved Open line at northeast mouth of Parrot Swamp.	SA	030501	0	161	NS	M	CAC	
Queen Creek	From DEH Conditionally Approved Open line at northeast mouth of Parrot Swamp to Intracoastal Waterway.	SA	030501	0	271	PS	M	CAO	15.62
Queen Creek	DEH closed area at mouth of Dicks Creek	SA	030501	0	3	NS	M	PRO	
Bogue Inlet	From Atlantic Ocean to Intracoastal Waterway	SA ORW	030501	0	195	FS	M	APP	

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White Oak River Basin Use Support **Shellfish Harvesting** **October 2001**

Name	Description	Class	Subbasin	Miles	Acres	Rating	Basis	DEH Class	% closed
Bear Island ORW Area	All waters within an area north of Bear Island defined by a line from the western most point on Bear Island and running along the eastern shore of Sanders Creek to the northeast mouth of Goose Creek on the mainland, east to the southwest mouth of Queen Creek, then south to green marker #49, then northeast to the northeastern most point on Huggins Island, then southeast along the shoreline of Huggins Island to the southeastern most point of Huggins Island, then south to the northeastern most point on Dudley Island, then southwest along the shoreline of Dudley Island to the eastern tip of Bear Island, then to the western most point on Bear Island excluding DEH closed area adjacent to south side of the White Oak River Restricted Area	SA ORW	030501	0	2,225	FS	M	APP	
Bear Island ORW Area	All waters within an area north of Bear Island defined by a line from the western most point on Bear Island and running along the eastern shore of Sanders Creek to the northeast mouth of Goose Creek on the mainland, east to the southwest mouth of Queen Creek, then south to green marker #49, then northeast to the northeastern most point on Huggins Island, then southeast along the shoreline of Huggins Island to the southeastern most point of Huggins Island, then south to the northeastern most point on Dudley Island, then southwest along the shoreline of Dudley Island to the eastern tip of Bear Island, then to the western most point on Bear Island	SA ORW	030501	0	70	NS	M	PRO	
Mile Hammock Bay	Entire Bay except for DEH closed rectangular area on north side of bay.	SA	030502	0	55	FS	M	APP	
Mile Hammock Bay	Closed DEH rectangular area on north side of bay	SA	030502	0	8	NS	M	PRO	
Salliers Bay	Entire Bay	SA	030502	0	56	NS	M	PRO	
Holover Creek	From source to Salliers Bay	SA	030502	0	5	NS	ME	PRO	
Gillets Creek	From source to Intracoastal Waterway	SA	030502	0	3	NS	ME	PRO	
Freeman Creek	From source to Intracoastal Waterway	SA	030502	0	65	NS	M	CAC	
Browns Swamp	From source to Freeman Creek	SA	030502	1	0	NS	ME	PRO	

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White Oak River Basin Use Support **Shellfish Harvesting** **October 2001**

Name	Description	Class	Subbasin	Miles	Acres	Rating	Basis	DEH Class	% closed
Clay Bank Branch	From source to Freeman Creek	SA	030502	1	0	NS	ME	PRO	
Mirey Branch	From source to Freeman Creek	SA	030502	1	0	NS	ME	PRO	
Banks Channel	From Browns Inlet to Intracoastal Waterway	SA	030501	0	62	FS	M	APP	
Browns Inlet	From Atlantic Ocean to Intracoastal Waterway	SA	030501	0	150	FS	ME	APP	
Browns Creek	From source to Intracoastal Waterway	SA	030501	0	53	PS	ME	CAO	11.40
Shacklefoot Channel	From Bear Creek to Intracoastal Waterway	SA	030501	0	102	FS	ME	APP	
WHITE OAK RIVER	DEH closed area from Hunters Creek to DEH closure line.	SA	030501	0	468	NS	M	PRO	
WHITE OAK RIVER	From DEH closure line to DEH Conditionally Approved Closed line.	SA	030501	0	1,422	NS	M	CAC	
WHITE OAK RIVER	From DEH Conditionally Approved Closed line to the DEH Conditionally Approved Open line	SA	030501	0	2,124	PS	M	CAO	15.72
WHITE OAK RIVER	DEH closed area adjacent to the east side of the White Oak River Restricted Area	SA	030501	0	47	NS	M	PRO	
WHITE OAK RIVER	From the DEH Conditionally Approved Open line to the Atlantic Ocean excluding the ICWW	SA	030501	0	1,169	FS	M	APP	
Pitts Creek (Hargetts Creek)	From source to White Oak River	SA	030501	0	0	NS	ME	PRO	
Cales Creek	From source to White Oak River	SA	030501	0	7	NS	ME	PRO	
Hadnot Creek	From source to White Oak River	SA	030501	0	43	NS	ME	PRO	
Schoolhouse Branch	From source to Hadnot Creek	SA	030501	1	0	NS	ME	PRO	
Steep Hill Branch	From source to Hadnot Creek	SA	030501	1	0	NS	ME	PRO	
Caleb Branch (City Weeks Branch)	From source to Hadnot Creek	SA	030501	2	0	NS	ME	PRO	
Godfry Branch	From source to White Oak River	SA	030501	0	3	NS	ME	PRO	
Holland Mill Creek	From source to White Oak River	SA	030501	0	24	NS	ME	PRO	

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Name	Description	Class	Subbasin	Miles	Acres	Rating	Basis	DEH Class	% closed
Cartwheel Branch	From source to Holland Mill Creek	SA	030501	0	4	NS	ME	PRO	
Hampton Bay	Entire Bay	SA	030501	0	82	PS	M	CAO	15.89
Stevens Creek	From source to White Oak River	SA	030501	0	6	NS	ME	PRO	
Pettiford Creek Bay	Entire Bay	SA	030501	0	239	NS	M	PRO	
Pettiford Creek	From source to Pettiford Creek Bay	SA	030501	0	35	NS	M	PRO	
Mill Creek	From source to Pettiford Creek	SA	030501	2	0	NS	ME	PRO	
Starkey Creek	From source to Pettiford Creek Bay	SA	030501	0	29	NS	ME	PRO	
Mullet Gut	From source to Starkey Creek	SA	030501	0	1	NS	ME	PRO	
Dubling Creek	From source to White Oak River	SA	030501	0	53	PS	M	CAO	17.13
Boathouse Creek	From source to White Oak River	SA	030501	0	16	PS	ME	CAO	17.13
Bogue Sound (Including Intracoastal Waterway)	From Bogue Inlet (from a line running from the eastern mouth of Bogue Inlet to SR 1117 on the mainland) to a line across Bogue Sound from the southwest side of mouth of Gales Creek to Rock Point excluding DEH closed areas at mouths of Hunting Island Creek and Sanders Creek	SA ORW	030503	0	11,081	FS	M	APP	
Bogue Sound (Including Intracoastal Waterway)	DEH closed area at mouth of Hunting Island Creek	SA ORW	030503	0	55	NS	M	PRO	
Bogue Sound (Including Intracoastal Waterway)	DEH closed area at mouth of Sanders Creek	SA ORW	030503	0	34	NS	M	PRO	
Bogue Sound (Including Intracoastal Waterway)	DEH closed area 870 meters west of mouth of Broad Creek	SA ORW	030503	0	4	NS	M	PRO	

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Name	Description	Class	Subbasin	Miles	Acres	Rating	Basis	DEH Class	% closed
Bogue Sound (Including Intracoastal Waterway to Beaufort Inlet)	From a line across Bogue Sound from the southwest side of mouth of Gales Creek to Rock Point to Beaufort Inlet excluding the DEH Conditionally Approved Closed area near Jumping Run Creek and the following DEH closed areas; on outer banks near Salter Path, three areas between Salter Path and Theodore Roosevelt Natural Area, waters near Hoophole Woods, mouth of Spooner Creek, mouth of Peltier Creek, adjacent to Hoophole Creek, waters near Money Island Slough, and area from Newport Restricted Area to Fort Macon Creek	SA	030503	0	10,876	FS	M	APP	
Bogue Sound (Including Intracoastal Waterway to Beaufort Inlet)	DEH closed area from a line across Bogue Sound from the southwest side of mouth of Gales Creek to Rock Point extending east approximately 1500 meters along sound side of outer banks near Salter Path	SA	030503	0	109	NS	M	PRO	
Bogue Sound (Including Intracoastal Waterway to Beaufort Inlet)	DEH Conditionally Approved Closed area near Jumping Run Creek	SA	030503	0	367	NS	M	CAC	
Bogue Sound (Including Intracoastal Waterway to Beaufort Inlet)	DEH closed area in unnamed bay approximately 2500 meters east of line across Bogue Sound from the southwest side of mouth of Gales Creek to Rock Point	SA	030503	0	7	NS	M	PRO	
Bogue Sound (Including Intracoastal Waterway to Beaufort Inlet)	DEH closed area in unnamed bay approximately 3500 meters east of line across Bogue Sound from the southwest side of mouth of Gales Creek to Rock Point	SA	030503	0	3	NS	M	PRO	

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Name	Description	Class	Subbasin	Miles	Acres	Rating	Basis	DEH Class	% closed
Bogue Sound (Including Intracoastal Waterway to Beaufort Inlet)	DEH closed area in unnamed bay area near Hoophole Woods approximately 7400 meters east of line across Bogue Sound from the southwest side of mouth of Gales Creek to Rock Point	SA	030503	0	75	NS	M	PRO	
Bogue Sound (Including Intracoastal Waterway to Beaufort Inlet)	DEH closed area at mouth of Spooner Creek	SA	030503	0	45	NS	M	PRO	
Bogue Sound (Including Intracoastal Waterway to Beaufort Inlet)	DEH closed area at mouth of Peltier Creek	SA	030503	0	84	NS	M	PRO	
Bogue Sound (Including Intracoastal Waterway to Beaufort Inlet)	DEH closed area near Hoophole Creek west of Atlantic Beach	SA	030503	0	37	NS	M	PRO	
Bogue Sound (Including Intracoastal Waterway to Beaufort Inlet)	DEH closed areas west at Atlantic Beach Bridge and Cedar Hammock	SA	030503	0	109	NS	M	PRO	
Bogue Sound (Including Intracoastal Waterway to Beaufort Inlet)	DEH closed area from Newport River Restricted area to Fort Macon Creek	SA	030503	0	341	NS	M	PRO	
Deer Creek	From source to Bogue Sound	SA ORW	030503	0	53	FS	M	APP	
Spooner Creek	From source to Bogue Sound	SA	030503	0	24	NS	M	PRO	

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Name	Description	Class	Subbasin	Miles	Acres	Rating	Basis	DEH Class	% closed
Hoop Pole Creek	From source to Bogue Sound	SA	030503	0	163	FS	M	APP	
Money Island Slough	From source to Money Island Bay	SA	030503	0	8	NS	ME	PRO	
Allen Slough	From source to Money Island Bay	SA	030503	0	6	FS	ME	APP	
Money Island Bay	Closed DEH area in western portion of Bay	SA	030503	0	103	NS	M	PRO	
Money Island Bay	DEH approved area near Allen Slough in eastern portion of Bay	SA	030503	0	46	FS	M	APP	
Tar Landing Bay	Entire Bay	SA	030503	0	116	FS	M	APP	
Fishing Creek	From source to Tar Landing Bay	SA	030503	0	11	FS	ME	APP	
Fort Macon Creek	From source to Bogue Sound	SA	030503	0	26	NS	ME	PRO	
Hunting Island Creek	From source to Bogue Sound	SA	030503	0	3	NS	M	PRO	
Taylor Bay	Entire Bay	SA ORW	030503	0	82	FS	ME	APP	
Sanders Creek	From source to Goose Creek	SA	030503	1	0	NS	ME	PRO	
Goose Creek	From source to DEH closure line Bogue Sound	SA	030503	0	67	NS	M	PRO	
Goose Creek	From DEH closure line to Bogue Sound	SA	030503	0	135	FS	M	APP	
Archer Creek (Piney Cr.)	From source to Bogue Sound	SA ORW	030503	0	18	NS	M	PRO	
Sanders Creek	From source to Bogue Sound	SA ORW	030503	0	35	NS	ME	PRO	
East Prong Sanders Cr.	From source to Sanders Creek	SA	030503	0	3	NS	ME	PRO	
Sikes Branch	From source to East Prong Sanders Creek	SA	030503	0	1	NS	ME	PRO	
Broad Creek	From source to Bogue Sound	SA	030503	0	91	NS	M	PRO	
West Prong Broad Creek	From source to Broad Creek	SA	030503	0	8	NS	ME	PRO	
Hannah Branch	From source to West Prong Broad Creek	SA	030503	1	0	NS	ME	PRO	
Sandy Branch	From source to Hannah Branch	SA	030503	1	0	NS	ME	PRO	
Wolf Branch	From source to West Prong Broad Creek	SA	030503	1	0	NS	ME	PRO	

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Name	Description	Class	Subbasin	Miles	Acres	Rating	Basis	DEH Class	% closed
East Prong Broad Creek	From source to Broad Creek	SA	030503	0	8	NS	ME	PRO	
Gales Creek	From source to Bogue Sound	SA	030503	0	46	NS	M	PRO	
East Prong Gales Creek	From source to Gales Creek	SA	030503	1	0	NS	ME	PRO	
Jumping Run	From source to Bogue Sound	SA	030503	0	2	NS	M	CAC	
Roosevelt Natural Area Swamp	All of the saline waters within the boundaries of the natural area including brackish marsh and salt marsh	SA Sw ORW	030503	0	6	FS	ME	APP	
NEWPORT RIVER	From Little Creek Swamp to DEH closure line	SA	030503	0	18	NS	M	PRO	
NEWPORT RIVER	From DEH closure line to DEH Conditionally Approved Closed line	SA	030503	0	963	NS	M	CAC	
NEWPORT RIVER	From DEH Conditionally approved closed line to DEH Conditionally approved open line extending from Penn Point to west mouth of Core Creek	SA	030503	0	2,663	PS	M	CAO	16.68
NEWPORT RIVER	From DEH conditionally approved open line extending from Penn Point to the west shore of Core Creek to the Atlantic Ocean excluding closed areas around Morehead City and Beaufort	SA	030503	0	3,559	FS	M	APP	
NEWPORT RIVER	DEH closed area north of Morehead City Harbor restricted area including Crap Point Thorofare and Calico Creek Marsh to Hwy 70 Bridge.	SA	030503	0	654	NS	M	PRO	
NEWPORT RIVER	DEH closed area from Hwy 70 Bridge to a line extending form the south point of Radio Island to Fort Macon including Morehead City Channel	SA	030503	0	220	NS	M	PRO	
NEWPORT RIVER	DEH closed area around Gallant Point south to Hwy 70 Bridge including Beaufort Channel	SA	030503	0	166	NS	M	PRO	
NEWPORT RIVER	Deh closed area south of Hwy 70 Bridge and west of Pivers Island including Bulkhead Channell	SA	030503	0	188	NS	M	PRO	
Little Creek Swamp	From source to Newport River	SA	030503	6	0	NS	M	PRO	
Mill Creek	From source to Newport River	SA	030503	6	0	NS	ME	CAC	

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White Oak River Basin Use Support **Shellfish Harvesting** **October 2001**

Name	Description	Class	Subbasin	Miles	Acres	Rating	Basis	DEH Class	% closed
Big Creek	From source to Newport River	SA	030503	0	0	PS	ME	CAO	16.68
Little Creek	From source to Newport River	SA	030503	2	0	PS	ME	CAO	16.68
Harlowe Canal	From Neuse River Basin Boundary (at Craven-Carteret County Line) to Harlowe Creek (at N.C. Hwy. # 101)	SA	030503	0	5	NS	M	PRO	
Alligator Creek	From source to Harlowe Creek	SA	030503	0	2	NS	M	PRO	
Harlowe Creek	DEH closed area from source (at N.C. Hwy. # 101) to DEH closure line south of mouth of Alligator Creek	SA	030503	0	19	NS	M	PRO	
Harlowe Creek	From DEH closure line south of mouth of Alligator Creek to DEH Conditionally Approved Closed line near Newport River	SA	030503	0	94	NS	M	CAC	
Harlowe Creek	From DEH Conditionally Approved Closed line near Newport River to Newport River	SA	030503	0	99	PS	M	CAO	16.68
Oyster Creek	From source to Newport River	SA	030503	0	50	NS	M	CAC	
Eastman Creek	From source to Core Creek	SA	030503	0	13	NS	M	PRO	
Bell Creek	From source to DEH closed line	SA	030503	0	18	NS	ME	PRO	
Bell Creek	From DEH closed line to Core Creek	SA	030503	0	46	NS	M	CAC	
Core Creek (Intracoastal Waterway Adams Creek Canal)	From Neuse River Basin boundary to DEH closed line	SA	030503	0	29	NS	M	PRO	
Core Creek (Intracoastal Waterway Adams Creek Canal)	From DEH closed line to DEH Conditionally Approved Closed line	SA	030503	0	227	NS	M	CAC	
Core Creek (Intracoastal Waterway Adams Creek Canal)	From DEH Conditionally Approved Closed line to Newport River	SA	030503	0	197	FS	M	APP	
Ware Creek	From source to Newport River	SA	030503	0	42	FS	M	APP	
Russell Creek	From source to Newport River	SA	030503	0	16	NS	M	PRO	
Wading Creek	From source to Newport River	SA	030503	0	16	NS	M	PRO	

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Name	Description	Class	Subbasin	Miles	Acres	Rating	Basis	DEH Class	% closed
Gable Creek	From source to Newport River	SA	030503	0	50	NS	M	PRO	
Willis Creek	From source to Newport River	SA	030503	0	15	NS	ME	PRO	
Crab Point Bay	Entire Bay	SA	030503	0	134	NS	ME	PRO	
Back Sound	Portion of the following in subbasin 030503 From Newport River to a point on Shackleford Banks at lat. 34 40’57" and long 76 37’30" north to the western most point of Middle Marshes and along the northeast shoreline of Middle Marshes to Rush Point on Harkers Island with the exception of the DEH closed areas at the east mouth of Taylor Creek near the mouth of the North River and the west mouth of Taylor Creek around Pivers Island	SA	030503	0	310	FS	M	APP	
Back Sound	Portion of the following in subbasin 030504 From Newport River to a point on Shackleford Banks at lat. 34 40’57" and long 76 37’30" north to the western most point of Middle Marshes and along the northeast shoreline of Middle Marshes to Rush Point on Harkers Island with the exception of the DEH closed areas at the east mouth of Taylor Creek near the mouth of the North River and the west mouth of Taylor Creek around Pivers Island	SA	030504	0	935	FS	M	APP	
Back Sound	Portion of the following in subbasin 030505 From Newport River to a point on Shackleford Banks at lat. 34 40’57" and long 76 37’30" north to the western most point of Middle Marshes and along the northeast shoreline of Middle Marshes to Rush Point on Harkers Island with the exception of the DEH closed areas at the east mouth of Taylor Creek near the mouth of the North River and the west mouth of Taylor Creek around Pivers Island	SA	030505	0	1,475	FS	M	APP	
Back Sound	DEH closed area at west mouth of Taylor Creek around Pivers Island	SA	030503	0	43	NS	M	PRO	
Back Sound	DEH closed area at the east mouth of Taylor Creek near the mouth of the North River	SA	030504	0	171	NS	M	PRO	
Back Sound	DEH closed areas in and around Carrot Island	SA	030504	0	64	NS	M	PRO	

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Name	Description	Class	Subbasin	Miles	Acres	Rating	Basis	DEH Class	% closed
Back Sound	Portion of the following in subbasin 030504 From a point on Shackleford Banks at lat. 34 40’57" and long 76 37’30" north to the western most point of Middle Marshes and along the northwest shoreline of Middle Marshes (to include all of Middle Marshes) to Rush Point on Harkers Island and along the southern shore of Harkers Island back to Core Sound with the exception of four DEH closed areas on the south shore of Harkers Island.	SA ORW	030504	0	733	FS	M	APP	
Back Sound	Portion of the following in subbasin 030505 From a point on Shackleford Banks at lat. 34 40’57" and long 76 37’30" north to the western most point of Middle Marshes and along the northwest shoreline of Middle Marshes (to include all of Middle Marshes) to Rush Point on Harkers Island and along the southern shore of Harkers Island back to Core Sound with the exception of four DEH closed areas on the south shore of Harkers Island.	SA ORW	030505	0	6,553	FS	M	APP	
Back Sound	Four DEH closed areas on the south shore of Harkers Island.	SA ORW	030504	0	7	NS	ME	PRO	
Feltons Creek	From source to North River	SA	030504	0	4	NS	ME	PRO	
Gibbs Creek	From source to North River	SA	030504	0	65	PS	ME	CAO	11.74
Turner Creek	From source to Davis Bay	SA	030504	0	52	NS	M	CAC	
Davis Bay (Cheney Bay)	DEH closed area in southern part of bay	SA	030504	0	13	NS	ME	PRO	
Davis Bay (Cheney Bay)	DEH Conditionally Approved Closed area northern part of bay	SA	030504	0	189	NS	M	CAC	
Sleepy Creek	From source to The Straits	SA	030504	0	155	PS	M	CAO	13.25
Whitehurst Creek	From source to The Straits	SA	030504	0	86	PS	M	CAO	12.63
Eastmouth Bay	Entire Bay	SA	030504	0	336	FS	ME	APP	
Henry Jones Creek	From source to Westmouth Bay	SA	030504	0	47	FS	ME	APP	
Westmouth Bay	Entire Bay with the exception of DEH closed area on south side of Bay	SA	030504	0	383	FS	M	APP	

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Name	Description	Class	Subbasin	Miles	Acres	Rating	Basis	DEH Class	% closed
Westmouth Bay	DEH closed area on south side of Bay	SA	030504	0	7	NS	ME	PRO	
Janes Creek	From source to The Straits	SA	030504	0	23	FS	ME	APP	
The Straits	From Core Sound to North River excluding conditionally approved open section in north west portion adjacent to North River	SA	030504	0	1,704	FS	M	APP	
The Straits	Conditionally approved open section in north west portion adjacent to North River	SA	030504	0	102	PS	M	CAO	11.74
Brooks Creek	From source to North River	SA	030504	0	20	NS	M	PRO	
Deep Creek	From source to North River	SA	030504	0	22	NS	ME	PRO	
Crabbing Creek	From source to North River	SA	030504	0	2	NS	ME	PRO	
Lynch Creek	From source to North River	SA	030504	0	7	PS	ME	CAO	16.56
Thomas Creek	From source to North River	SA	030504	0	5	PS	ME	CAO	13.70
Fulcher Creek	From source to DEH closure line From DEH closure line to North River	SA	030504	0	11	NS	ME	PRO	
Fulcher Creek	From DEH closure line to North River	SA	030504	0	41	PS	ME	CAO	13.70
Ward Creek	From source to North River	SA	030504	2	582	PS	M	CAO	14.26
Gilliklin Creek	From source to Ward Creek	SA	030504	1	6	PS	ME	CAO	14.26
North Leopard Creek	From source to Ward Creek	SA	030504	0	95	PS	M	CAO	14.26
South Leopard Creek	From source to Ward Creek	SA	030504	0	78	PS	M	CAO	14.26
Newby Creek	From source to DEH closure line	SA	030504	0	9	NS	ME	PRO	
Goose Bay	Entire Bay	SA	030504	0	266	PS	M	CAO	11.74
North River	From source to DEH closure line south of Crabbing Creek	SA	030504	0	291	NS	M	PRO	
North River	From DEH closure line south of Crabbing Creek to Back Sound excluding DEH conditionally approved closed and closed areas between Davis Bay and North River Marsh	SA	030504	0	5,868	PS	M	CAO	11.74
North River	DEH conditionally approved closed area between Davis Bay and North River Marsh	SA	030504	0	102	NS	M	CAC	
North River	DEH closed area between Davis Bay and North River Marsh	SA	030504	0	162	NS	M	PRO	
North River	DEH conditionally approved closed area ato mouth of Newby Creek	SA	030504	0	19	NS	M	CAC	

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White Oak River Basin Use Support **Shellfish Harvesting** **October 2001**

Name	Description	Class	Subbasin	Miles	Acres	Rating	Basis	DEH Class	% closed
Whale Creek	From source to Back Sound	SA ORW	030505	0	34	FS	ME	APP	
Cabs Creek	From source to Back Sound	SA ORW	030505	0	46	FS	ME	APP	
Bald Hill Bay	Entire Bay	SA ORW	030505	0	81	FS	ME	APP	
Johnson Bay	Entire Bay	SA ORW	030505	0	91	FS	ME	APP	
Blinds Hammock Bay	Entire Bay	SA ORW	030505	0	71	FS	ME	APP	
The Ditch	From Lighthouse Bay to Blinds Hammock Bay	SA ORW	030505	0	83	FS	ME	APP	
Point of Grass Creek	From source to Core Sound	SA ORW	030504	0	0	FS	ME	APP	
Nelson Bay	From a line extending from mouth of Broad Creek due east across Nelson Bay to Core Sound	SA	030504	0	861	PS	M	CAO	12.75
Lewis Creek	From source to Nelson Bay	SA	030504	0	21	NS	M	PRO	
Pasture Creek	From source to Nelson Bay	SA	030504	0	6	PS	ME	CAO	12.75
Willis Creek	From source to Core Sound	SA ORW	030504	0	51	PS	M	CAO	14.37
Fulchers Creek	From source to Core Sound	SA ORW	030504	0	40	FS	M	APP	
Brett Bay	Entire Bay	SA ORW	030504	0	186	FS	ME	APP	
Maria Creek	From source to Brett Bay	SA ORW	030504	0	38	FS	M	APP	
Fork Creek	From source to Brett Bay	SA ORW	030504	0	18	FS	ME	APP	
Head of the Hold	Entire Bay	SA ORW	030505	0	22	FS	ME	APP	
The Swash	Entire Bay	SA ORW	030505	0	113	FS	ME	APP	
Great Island Creek	From source to Core Sound	SA	030505	0	105	FS	ME	APP	
Horse Island Creek	From source to Great Island Creek	SA	030505	0	7	FS	ME	APP	
Fortin Bay	Entire Bay	SA	030505	0	118	FS	ME	APP	
Oyster Creek	From source to Core Sound	SA ORW	030504	0	128	PS	ME	CAO	13.86
Great Island Bay	Entire Bay	SA ORW	030505	0	310	FS	ME	APP	
Johnson Creek	From source to Core Sound	SA	030505	0	138	FS	ME	APP	
Spit Bay	Entire Bay	SA	030504	0	38	FS	ME	APP	
Smyrna Creek	From source to Jarrett Bay	SA	030504	0	27	NS	ME	PRO	
Ditch Cove	From source to Jarrett Bay	SA ORW	030504	0	32	PS	M	CAO	11.02

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White Oak River Basin Use Support **Shellfish Harvesting** **October 2001**

Name	Description	Class	Subbasin	Miles	Acres	Rating	Basis	DEH Class	% closed
Broad Creek	From source to Jarrett Bay	SA ORW	030504	0	37	PS	ME	CAO	11.02
Great Creek	From source to Jarrett Bay	SA ORW	030504	0	72	PS	M	CAO	11.02
Howland Creek	From source to Jarrett Bay	SA ORW	030504	0	26	PS	M	CAO	11.02
Williston Creek	From source to Jarrett Bay	SA	030504	0	25	NS	ME	PRO	
Wade Creek	From source to DEH closure line	SA	030504	0	25	NS	M	PRO	
Wade Creek	From DEH closure line to Jarrett Bay	SA	030504	0	117	PS	ME	CAO	11.02
Jarrett Bay	From head of bay to DEH conditionally approved open line	SA ORW	030504	0	38	NS	M	PRO	
Jarrett Bay	From DEH conditionally approved open line to Core Sound	SA ORW	030504	0	1,111	PS	M	CAO	11.02
Jarrett Bay	DEH closed area at embayment at mouth Williston Creek	SA ORW	030504	0	58	NS	M	PRO	
Jump Run	From source to Core Sound	SA ORW	030504	0	42	FS	ME	APP	
Middens Creek	From source to DEH closure line	SA	030504	0	20	NS	M	PRO	
Middens Creek	From DEH closure line to Core Sound	SA	030504	0	113	FS	M	APP	
Tush Creek	From source to Core Sound	SA ORW	030504	0	43	FS	ME	APP	
Great Marsh Creek	From source to Core Sound	SA ORW	030504	0	130	FS	M	APP	
Deer Pond	Entire pond	SA ORW	030505	0	31	FS	ME	APP	
Horsepen Creek	From source to Core Sound	SA ORW	030505	0	26	FS	ME	APP	
Lewis Creek	From source to Core Sound	SA ORW	030505	0	16	FS	ME	APP	
Zack Creek	From source to Core Sound	SA ORW	030505	0	40	FS	ME	APP	
Mullet Cove	Entire cove	SA ORW	030505	0	23	FS	ME	APP	
Glover Creek	From source to Styron Bay	SA	030504	0	10	NS	M	PRO	
Sheep Pen Creek	From source to Core Sound	SA ORW	030505	0	140	FS	ME	APP	
Annis Run	From source to Styron Bay	SA	030504	0	4	NS	ME	PRO	
Codds Creek	From source to Core Sound	SA ORW	030505	0	18	FS	ME	APP	
Cedar Creek	From source to Styron Creek	SA	030504	0	16	NS	ME	PRO	
Try Yard Creek	From source to Codds Creek	SA ORW	030505	0	8	FS	ME	APP	
Styron Creek	From source to DEH closure line at mouth of Cedar Creek	SA	030504	0	8	NS	ME	PRO	
Styron Creek	From DEH closure line at mouth of Cedar Creek to Core to Styron Bay	SA	030504	0	9	FS	ME	APP	
Hogpen Bay	Entire Bay	SA ORW	030505	0	91	FS	ME	APP	
Caggs Creek	From source to Hogpen Bay	SA ORW	030505	0	22	FS	ME	APP	

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White Oak River Basin Use Support **Shellfish Harvesting** **October 2001**

Name	Description	Class	Subbasin	Miles	Acres	Rating	Basis	DEH Class	% closed
Rawson Creek	From source to Core Sound	SA ORW	030505	0	17	FS	ME	APP	
Iron Creek	From source to Core Sound	SA ORW	030505	0	31	FS	ME	APP	
Lighthouse Bay	Entire Bay	SA ORW	030505	0	383	FS	ME	APP	
Barden Inlet	From Atlantic Ocean to Core Sound	SA ORW	030505	0	200	FS	ME	APP	
Styron Bay	Entire Bay with exception of DEH closed area	SA ORW	030504	0	420	FS	ME	APP	
Styron Bay	DEH closed area	SA ORW	030504	0	10	NS	M	PRO	
Negro Creek	From source to Core Sound	SA	030505	0	2	FS	ME	APP	
Horsepen Creek	From source to Core Sound	SA	030505	0	1	FS	ME	APP	
Sheep Pen Creek	From source to Core Sound	SA	030505	0	1	FS	ME	APP	
Gutter Creek	From source to Core Sound	SA	030505	0	35	FS	ME	APP	
Cedar Inlet	From Old Channel to Core Sound	SA ORW	030505	0	70	FS	ME	APP	
Old Channel	From Core Sound to Cedar Inlet	SA ORW	030505	0	110	FS	ME	APP	
Yaupon Hammock Gut	Entire Gut	SA ORW	030505	0	9	FS	ME	APP	
Core Sound	Portion of the following in subbasin 030504, from northern boundary of White Oak River Basin (a line from Hall Point to Drum Inlet) to Back Sound, excluding conditionally approved areas at the mouths of Nelson and Jarrett Bays and Oyster Creek	SA ORW	030504	0	22,404	FS	M	APP	
Core Sound	Conditionally approved open area at the mouth of Jarrett Bay	SA ORW	030504	0	81	PS	M	CAO	11.02
Core Sound	Conditionally approved open area at the mouth of Nelson Bay	SA ORW	030504	0	166	PS	M	CAO	12.75
Core Sound	Conditionally approved open area at the mouth Oyster Creek	SA ORW	030504	0	87	PS	M	CAO	13.70
Core Sound	Portion of the following in subbasin 030505, from northern boundary of White Oak River Basin (a line from Hall Point to Drum Inlet) to Back Sound, excluding conditionally approved areas at the mouths of Nelson and Jarrett Bays and Oyster Creek	SA ORW	030505	0	11,453	FS	M	APP	

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White Oak River Basin Use Support **Shellfish Harvesting** **October 2001**

Name	Description	Class	Subbasin	Miles	Acres	Rating	Basis	DEH Class	% closed
NOTES									
*"Ag" denotes agriculture, which could include row crops and animal operations. Where "cattle" is noted, cattle were observed on site at the time of sampling									
or the watershed hosts many cattle farms.									
"Rating" = Use Support Rating									
"Basis"=Rating basis									
"Habitat degradation" is identified where there is a notable reduction in habitat diversity or change in habitat quality. This term includes sedimentation, bank erosion, channelization,									
lack of riparian vegetation, loss of pools or riffles, loss of woody habitat, and stream bed scour.									
"Non-urban develop" is residential and/or commercial develop outside urban areas.									
"Rural runoff" is non-point source runoff from rural areas, including that from low density residential and commercial areas.									
ABBREVIATION KEY									
P = Point Source Pollution (Major source)			nut = high nutrient levels						
NP = Non-point Source Pollution			turb = turbidity						
M = Monitored			fecal = fecal coliform bacteria						
ME = Monitored-evaluated			sed = sediment						
FS = Fully Supporting			ab = above						
PS = Partially Supporting			nr = near						
NS = Not Supporting			be = below						
NR = Not Rated									
APP= Approved									
CAO= Conditionally Approved Open (closed greater than 10% = PS)									
CAC= Conditionally Approved Closed									
PRO= Prohibited or Restricted									

Fecal coliform bacteria are the problem parameter in shellfish harvesting waters. Fecal coliform bacteria in Class SA waters shall meet the sanitary and bacterialogical standards as adapted by the Commission for Health Services

Appendix IV

303(d) Listing
and
Reporting Methodology

303(d) LISTING AND REPORTING REQUIREMENTS

What is the 303(d) List?

Section 303(d) of the Clean Water Act (CWA) requires states to develop a comprehensive public accounting of all impaired waters. North Carolina's list of impaired waters must be submitted to EPA by April 1 of every even year (40 CFR 130.7). The list includes waters impaired by pollutants, such as nitrogen, phosphorus and fecal coliform bacteria, and by pollution, such as hydromodification and habitat degradation. The source of impairment might be from point sources, nonpoint sources or atmospheric deposition. Some sources of impairment exist across state lines. North Carolina lists impaired waters regardless of whether the pollutant or source of pollution is known and whether the pollutant/pollution source(s) can be legally controlled or acted upon by the State of North Carolina. More complete information can be obtained from *North Carolina's Draft 2000 303(d) List* (http://h2o.enr.state.nc.us/mtu/), which can be obtained by calling the Planning Branch of DWQ at (919) 733-5083.

303(d) List Development

Generally, there are three 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; and 3) prioritizing listed waters for TMDL development. The following subsections describe each of these steps in more detail.

Sources of Information

North Carolina considers all practical existing and readily available data and information in preparing the 303(d) list. Sources solicited for "existing and readily available data and information" include, but are not limited to the following:

- The previous 303(d) list.
- Basinwide Water Quality Plans and Assessment Reports.
- 305(b) reports.
- 319 nonpoint source pollution assessments.
- Waters where specific fish or shellfish consumption bans and/or advisories are currently in effect.
- Waters for which effluent toxicity test results indicate possible or actual excursions of state water quality standards.
- Waters identified by the state as impaired in its most recent Clean Lakes Assessment.
- Drinking water source water assessments under the Safe Drinking Water Act.
- Trend analyses and predictive models used for determining numeric and narrative water quality standard compliance.
- Data, information and water quality problems reported from local, state or federal agencies, Tribal governments, members of the public and academic institutions.

Listing Criteria

Waters whose use support ratings were not supporting (NS) or partially supporting (PS) based on monitored information in the 305(b) report are considered as initial candidates for the 303(d) list. Waters that were listed on the previously approved 303(d) list are evaluated and automatically included if the use support rating was NS, PS or not rated (NR).

Guidance from EPA on developing the 1998 303(d) lists indicates that impaired waters without an identifiable problem parameter should not be included on the 303(d) list. However, DWQ feels that waters listed in the 305(b) report as impaired for biological reasons, where problem parameters have not been identified, should remain on the 303(d) list. The Clean Water Act states that chemical, physical and biological characteristics of waters shall be restored. The absence of an identified cause of impairment does not mean that the water should not receive attention. Instead, DWQ should resample or initiate more intensive studies to determine why the water is impaired. Thus, biologically impaired waters without an identified cause of impairment are on the draft 2000 303(d) list.

Assigning Priority

North Carolina has developed a TMDL priority ranking scheme that reflects the relative value and benefits that a water provides to the state. The priority ranking system is designed to take into account the severity of the impairment, especially when threats to human health, endangered species or the designated uses of the water are present.

A priority of High, Medium or Low has been assigned to all waters on Parts 1, 4, 5 and 6 of the list (the following section describes these parts in more detail). A high priority is assigned to all waters that are classified as water supplies. A high priority is also automatically assigned to all waters harboring species listed as endangered or threatened under the federal Endangered Species Act (ESA). A medium priority has minimally been assigned to waters harboring state listed endangered and threatened species. As a way of addressing anti-degradation concerns, classified Outstanding Resource Waters and High Quality Waters start at the medium priority. The remaining waters on the list are prioritized according to severity of the impairment.

New Format of the List

North Carolina has begun to make the structural changes prescribed in EPA's July 13, 2000 final TMDL rule. The *Draft 2000 §303(d) List* reflects many of these changes. EPA's final rule will likely eventually require 303(d) lists to be divided into four sections. North Carolina's 2000 list has been divided into six parts and reflects comments made on the proposed rules by North Carolina and other states. This six-part format meets the requirements of existing rules, and future lists will meet requirements of revised federal rules (when implemented). A summary of each part of the list is provided below. A more detailed discussion is found in the preface to the actual list document.

Part 1 - Waters impaired by a *pollutant* as defined by EPA.

"The term pollutant means dredged spoil, solid waste, incinerator residue, sewage, garbage, sewage sludge, munitions, chemical wastes, biological materials, radioactive materials, heat, wrecked or discarded equipment, rock, sand, cellar dirt and industrial, municipal, and agricultural waste discharged into the water." TMDLs will be submitted for all water/pollutant combinations listed in Part 1.

Part 2 - Waters impaired by *pollution*, not by a *pollutant*.

EPA defines *pollution* as "The man-made or man-induced alteration of the chemical, physical, biological and radiological integrity of the water" in the CWA section 502(19). EPA believes that in situations where the impairment is not caused by a *pollutant*, a TMDL is generally not the appropriate solution to the problem. In keeping with the principle that the §303(d) list is an

accounting of all impaired waters; however, these types of waters will remain on Part 2 of the list until water quality uses and standards are attained by some other means.

Part 3 - Waters for which EPA has approved or established a TMDL and water quality standards have not yet been attained.
Monitoring data will be considered when evaluating Part 3 waters for potential delisting. Waters will be moved to Part 1 of the list if updated information and data demonstrate that the approved TMDL is inadequate.

Part 4 - Waters for which TMDLs are not required.
Other required regulatory controls (e.g., NPDES permit limits, Phase I Federal Stormwater Permits, etc.) are expected to attain water quality standards by the next regularly scheduled listing cycle.

Part 5 - Biologically impaired waters with no identified cause of impairment.
Roughly half of the waters on North Carolina's §303(d) list appear on Part 5. Identification of the cause(s) of impairment will precede movement of these waters to Parts 1 and 2 of the list. EPA recognized that in specific situations the data are not available to establish a TMDL, and that these specific waters might be better placed on a separate part of the 2000 §303(d) list (64 FR, 46025). Data collection and analysis will be performed in an attempt to determine a cause of impairment. North Carolina's proposed plan for managing biologically impaired waters can be found in the preface to Part 5 of the list.

Part 6 – The *proper technical conditions* do not yet exist to develop a TMDL.
"*Proper technical conditions* refers to the availability of the analytical methods, modeling techniques and data base necessary to develop a technically defensible TMDL. These elements will vary in their level of sophistication depending on the nature of the pollutant and characteristics of the segment in question" (43 FR 60662). These are waters that would otherwise be on Part 1 of the list. In the proposed TMDL regulations, EPA again recognized that in some specific situations the data, analyses or models are not available to establish a TMDL, and that these specific waters might be better off on a separate part of the 2000 §303(d) list (64 FR, 46025). North Carolina seeks EPA technical guidance in developing technically defensible TMDLs for these waters. DWQ has included fecal impaired shellfish waters on this part of the list. North Carolina's approach to managing shellfish waters impaired because of fecal coliform violations is outlined in the preface to Part 6 of the list.

Scheduling TMDLs

North Carolina will submit TMDLs for each water within 13 years of its first listing, starting with the EPA-approved 1998 §303(d) list. TMDLs for waters first listed in 1998 or earlier will be developed by 2011. As a general rule, TMDLs will be addressed according to highest priority in accordance with the rotating basinwide planning approach. Due to the wide range of complexities encountered in TMDL development, TMDLs will not necessarily be submitted to EPA in order of priority.

TMDLs on Part 1 of the §303(d) list are at many different stages on the path to an approved TMDL. Some require additional data collection to adequately define the problem in TMDL terms. Some require more outreach to increase stakeholder involvement and "buy-in". Others

need to have a technical strategy budgeted and scheduled. Some are almost ready for submittal to EPA for approval. As the current regulations require, North Carolina has listed waters targeted for TMDL development within the next two years.

North Carolina has used "biological impairment" to place the majority of waters on the §303(d) list. Additional consideration and data collection are necessary if the establishment of a TMDL for waters on Part 5 is to be expected. It is important to understand that the identification of waters on Part 5 of the list does not mean that they are low priority waters. The problem parameter identification (PPI) approach is a high priority for the State of North Carolina. However, it should be noted that it may take significant resources and time to determine the cause of impairment. The PPI approach is also a declaration of need for more data and more time to adequately define the problems and whether they are affected by *pollution, pollutants* or a combination.

North Carolina believes it to be both practical and honest to schedule TMDL development for only those waters where we have some information about the cause of impairment. Scheduling TMDLs for waters that may not be impaired by a *pollutant* is misleading and counterproductive.

Delisting Waters

North Carolina relies heavily on the existing § 305(b) reporting methodology to complete the §303(d) process. In general, waters will be removed from the §303(d) list when data show that a water is fully supporting its uses. In some cases, mistakes have been discovered in the original listing decision and the mistakes are being corrected. Waters appearing on the previously approved §303(d) list will be removed from the §303(d) lists under the following circumstances:

- An updated § 305(b) use support rating of fully supporting.
- Applicable water quality standards are being met (i.e., no longer impaired for a given *pollutant*).
- The basis for putting the water on the list is determined to be in invalid (i.e., was mistakenly identified as impaired in accordance with 40 CFR 130.7(b)(6)(iv) and/or *National Clarifying Guidance for State and Territory 1998 Section 303(d) Listing Decisions*. Robert Wayland III, Director. Office of Wetlands, Oceans, and Watersheds. Aug 27, 1997.)
- A water quality variance has been issued for a specific standard (e.g., chloride).
- Removal of fish consumption advisories.
- Typographic listing mistakes (i.e., the wrong water was identified).

Appendix V

White Oak River Basin
Workshop Summaries

Appendix available upon request or at
http://h2o.enr.state.nc.us/basinwide/

Appendix VI

White Oak River Basin Nonpoint Source Program Description and Contacts

Statewide Nonpoint Source Management Program Description

The North Carolina Nonpoint Source Management Program consists of a broad framework of federal, state and local resource and land management agencies. More than 2,000 individuals administer programs that are directly related to nonpoint source pollution management within the state. A range of responsibilities have been delegated to county or municipal programs including the authority to inspect and permit land clearing projects or septic system performance. In the field of agriculture, a well established network of state and federal agricultural conservationists provide technical assistance and program support to individual farmers.

Staff in the DWQ Water Quality Section's Planning Branch lead the Nonpoint Source Management Program, working with various agencies to insure that program goals are incorporated into individual agencies' management plans. The goals include:

1. Coordinate implementation of state and federal initiatives addressing watershed protection and restoration.
2. Continue to target geographic areas and waterbodies for protection based upon best available information.
3. Strengthen and improve existing nonpoint source management programs.
4. Develop new programs that control nonpoint sources of pollution not addressed by existing programs.
5. Integrate the NPS Program with other state programs and management studies (e.g., Albemarle-Pamlico National Estuary Program).
6. Monitor the effectiveness of BMPs and management strategies, both for surface and groundwater quality.

Coordination between state agencies is achieved through reports in the *North Carolina Nonpoint Source Management Program Update*. Reports are intended to keep the program document current and develop a comprehensive assessment identifying the needs of each agency to meet the state nonpoint source program goals. Annual reports are developed to describe individual program priorities, accomplishments, significant challenges, issues yet to be addressed, and resource needs. A copy of the latest Annual Report (FY1998) is available online: http://h2o.enr.state.nc.us/nps/nps_mp.htm.

The nature of nonpoint source pollution is such that involvement at the local level is imperative. Basinwide Water Quality Plans identify watersheds that are impaired by nonpoint sources of pollution. Identification, status reports and recommendations are intended to provide the best available information to local groups and agencies interested in improving water quality. The plans also make available information regarding federal, state and local water quality initiatives aimed at reducing or preventing nonpoint source pollution.

The following table is a comprehensive guide to contacts within the state's Nonpoint Source Management Program. For more information, contact Alan Clark at (919) 733-5083 ext. 570.

Appendix V White Oak River Basin Nonpoint Source Program Descriptions and Contacts

Agriculture

USDA Natural Resources Conservation Service:

Part of the US Department of Agriculture, formerly the Soil Conservation Service. Technical specialists certify waste management plans for animal operations; provide certification training for swine waste applicators; work with landowners on private lands to conserve natural resources, helping farmers and ranchers develop conservation systems unique to their land and needs; administer several federal agricultural cost share and incentive programs; provide assistance to rural and urban communities to reduce erosion, conserve and protect water, and solve other resource problems; conduct soil surveys; offer planning assistance for local landowners to install best management practices; and offer farmers technical assistance on wetlands identification.

Area 3, Conservationist	William J. Harrell	919-734-0961	Room 108, Federal Building, 134 North John Street, Goldsboro, NC 27530-3676
County	**District Conservationist**	**Phone**	**Address**
Carteret	Andy Metts	252-728-4078	PO Box 125, PO Building, Room 120, 701 Front Street, Beaufort, NC 28516-0125
Craven	Andy Metts	252-637-2547	302 Industrial Drive, New Bern, NC 28562
Jones	Andy Metts	252-448-2731	PO Box 40, Post Office Building, Room 117 Market Street, Trenton, NC 28585-0040
Onslow	Harry Tyson	910-455-4472 x3	Donald A. Halsey Agriculture Building, 604 College Street, Jacksonville, NC 28540

Soil & Water Conservation Districts:

Boards and staff under the administration of the NC Soil and Water Conservation Commission (SWCC). Districts are responsible for: administering the *Agricultural Cost Share Program for Nonpoint Source Pollution Control* at the county level; identifying areas needing soil and/or water conservation treatment; allocating cost share resources; signing cost share contracts with landowners; providing technical assistance for the planning and implementation of BMPs; and encouraging the use of appropriate BMPs to protect water quality. For detail information, please visit the web site of the Division of Soil and Water Conservation at http://www.enr.state.nc.us/DSWC/files/nsp.htm.

County	**Board Chairman**	**Phone**	**Address**
Carteret	Herbert F. Page	252-393-8297	114 Hunting Bay Drive, Swansboro, NC 28584
Craven	James K. Spruill	252-244-0908	150 Spruill Town Road, Vanceboro, NC 28586
Jones	William V. Griffin	252-224-6951	1505 Island Creek Road, Pollocksville, NC 28573
Onslow	Jerome Shaw	910-324-2323	628 Huffmantown Road, Richlands, NC 28574

Division of Soil and Water Conservation:

State agency that administers the *Agricultural Cost Share Program for Nonpoint Source Pollution Control* (ACSP). Allocates ACSP funds to the Soil & Water Conservation Districts; and provides administrative and technical assistance related to soil science and engineering. Distributes Wetlands Inventory maps for a small fee.

Central Office	David B. Williams	919-715-6103	Archdale Building, 512 North Salisbury Street, Raleigh, NC 27626
Area 6, Wilmington	Sandra Wietzel	910-395-3900	127 Cardinal Drive, Wilmington, NC 28405

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	Dr. Donald Eaddy	919-733-7125	2 West Edenton Street, Raleigh, NC 27601
Region 3 (Carteret, Craven and Jones)	Bob Edwards	252-523-2949	PO Box 801, Kinston, NC 28502
Region 4 (Onslow)	Tim Hall	910-324-9924	104 Jaclane Drive, Clinton, NC 28502-3867

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
Carteret	A. Ray Harris	252-222-6352	CMAST Building, 303 College Circle, Morehead City, NC 28557
Craven	Billy Dunham	252-633-1477	300 Industrial Drive, New Bern, NC 28562
Jones	Minton C. Small	252-448-9621	110 South Market Street, Trenton, NC 28585
Onslow	F. Daniel Shaw	910-455-5873	604 College Street, Room 8, Jacksonville, NC 28540

Forestry

Division of Forest Resources:

Develop, protect and manage the multiple resources of North Carolina's forests through professional stewardship, enhancing the quality of our citizens while ensuring the continuity of these vital resources.

Districts 4 (Carteret, Craven, Jones, Onslow)	Ralf McCullom	252-514-4764	3810 Clarendon Blvd., New Bern, NC 28562-2236 ralph.cullom@ncmail.net
Central Office	Bill Swartley	919-733-2162	1616 Mail Service Center, Raleigh, NC 27699-1616
County Rangers			
Carteret	John W. Dunn	252-728-3793	2721 Highway 101, Beaufort, NC 28516 ncfscarteret@mail.clis.com
Craven	Jim Hines	252-244-0295	860 Weyerhaeuser Road, Vanceboro, NC 28586 ncfscraven@cconnect.net
Jones	Wayne Bell	252-448-5531	Route 2, Box 218-A, Dover, NC 28526 ncfsjones@eastlink.net
Onslow	Donald L. Edwards	910-324-3633	185 Firetower Road, Richlands, NC 28574 onslowforestry@gibralter.net

Construction/Mining

DENR Division of Land Resources:

Administers the NC Erosion and Sedimentation Control Program for construction and mining operations. Conducts land surveys and studies, produces maps, and protects the state's land and mineral resources.

Central Office	Mel Nevills	919-733-4574	1612 Mail Service Center, Raleigh, NC 27699-1621
Washington Region	Floyd Williams	252-946-6481	943 Washington Square Mall, Washington, NC 27889 (Courier 16-04-01)
Wilmington Region	Dan Sams	910-395-3900	127 Cardinal Drive Extension, Wilmington, NC 28405-3845

Local Erosion and Sedimentation Control Ordinances:

Several local governments in the basin have qualified to administer their own erosion and sedimentation control ordinances.

Onslow County/ Jacksonville	Tom Anderson	910-938-5332	PO Box 128, Jacksonville, NC 28541-0128

General Water Quality

DWQ Water Quality Section:

Coordinate the numerous nonpoint source programs carried out by many agencies; coordinate the French Broad 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	Alan Clark	919-733-5083 x570	1617 Mail Service Center, Raleigh, NC 27699-1617
Urban Stormwater	Bradley Bennett	919-733-5083 x525	1617 Mail Service Center, Raleigh, NC 27699-1617
Modeling	Andy McDaniel	919-733-5083	1617 Mail Service Center, Raleigh, NC 27699-1617
Monitoring	Jimmie Overton	919-733-9960 x204	1621 Mail Service Center, Raleigh, NC 27699-1621
Wetlands	John Dorney	919-733-1786	1621 Mail Service Center, Raleigh, NC 27699-1621
Animal Operations	Dennis Ramsey	919-733-5083 x528	1617 Mail Service Center, Raleigh, NC 27699-1617
Classific'ns/Standards	Jeff Manning	919-733-5083 x579	1617 Mail Service Center, Raleigh, NC 27699-1617

DWQ Regional Offices:

Conduct permitting and enforcement fieldwork on point sources, stormwater, wetlands and animal operations; conduct enforcement on water quality violations of any kind; and perform ambient water quality monitoring.

Washington Region	Jim Mulligan	252-946-6481	943 Washington Square Mall, Washington, NC 27889
Wilmington Region	Rick Shiver	910-395-3900	127 Cardinal Drive Extension, Wilmington, NC 28405

Wildlife Resources Commission:

To manage, restore, develop, cultivate, conserve, protect and regulate the wildlife resources of the state; and to administer the laws enacted by the General Assembly relating to game, game and non-game freshwater fishes, and other wildlife resources in a sound, constructive, comprehensive, continuing and economical manner.

Central Office	Frank McBride	919-528-9886	PO Box 118, Northside, NC 27564

US Army Corps of Engineers:

Responsible for: investigating, developing and maintaining the nation's water and related environmental resources; constructing and operating projects for navigation, flood control, major drainage, shore and beach restoration and protection; hydropower development; water supply; water quality control, fish and wildlife conservation and enhancement, and outdoor recreation; responding to emergency relief activities directed by other federal agencies; and administering laws for the protection and preservation of navigable waters, emergency flood control and shore protection. Responsible for wetlands and 404 Federal Permits.

Ask for the project manager covering your county.

Wilmington Field Office	Ernest Jahnke	910-251-4511	Post Office Box 1890, Wilmington, NC 28402-1890

DWQ 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	1636 Mail Service Center, Raleigh, NC 27699-1636
Washington Region	Willie Hardison	252-946-6481	943 Washington Square Mall, Washington, NC 27889
Wilmington Region	Charlie Stehman	910-395-3900	127 Cardinal Drive Extension, Wilmington, NC 28405

Solid Waste

DENR Division of Waste Management:

Management of solid waste in a way that protects public health and the environment. The Division includes three sections and one program – Hazardous Waste, Solid Waste, Superfund and the Resident Inspectors program.

Central Office	Brad Atkinson	919-733-0692	401 Oberlin Road, Suite 150, Raleigh, NC 27605

On-Site Wastewater Treatment

Division of Environmental Health and County Health Departments:

Safeguard life, promote human health, and protect the environment through the practice of modern environmental health science, the use of technology, rules, public education, and above all, dedication to the public trust.

Services include:

- Training of and delegation of authority to local environmental health specialists concerning on-site wastewater.
- Engineering review of plans and specifications for wastewater systems 3,000 gallons or larger and industrial process wastewater systems designed to discharge below the ground surface.
- Technical assistance to local health departments, other state agencies, and industry on soil suitability and other site considerations for on-site wastewater systems.

Central Office	Steve Steinbeck	919-570-6746	2728 Capital Boulevard, Raleigh, NC 27604
Washington Region	Bob Uebler	252-946-6481 x330	943 Washington Square Mall, Washington, NC 27889
Wilmington Region	David Mccloy	910-692-4118	127 Cardinal Drive Extension, Wilmington, NC 28405

County	**Primary Contact**	**Phone**	**Address**
Carteret	Dr. J. T. Garrett	252-728-8401	Courthouse Square, Beaufort, NC 28516 (Courier 11 13 12)
Craven	Ms. Wanda Sandelé	252-636-4960	2818 Neuse Blvd, PO Drawer 12610, New Bern, NC 28561 (Courier 16 66 01)
Jones	Ms. Ruth Little	252- 448-9111	401 Highway 58 South, PO Box 216, Trenton, NC 28585 (Courier 11 18 07)
Onslow	Mr. George O'Daniel	910- 347-7042	612 College Street, Jacksonville, NC 28540 (Courier 11 06 19)

- **DENR Wilmington Region Office covers the following counties:** Brunswick, Carteret, Columbus, Duplin, New Hanover, Onslow and Pender.

Appendix VII

Glossary
of
Terms and Acronyms

Glossary

§	Section.
30Q2	The minimum average flow for a period of 30 days that has an average recurrence of one in two years.
7Q10	The annual minimum 7-day consecutive low flow, which on average will be exceeded in 9 out of 10 years.
B (Class B)	Class B Water Quality Classification. This classification denotes freshwaters protected for primary recreation and other uses suitable for Class C. Primary recreational activities include frequent and/or organized swimming and other human contact such as skin diving and water skiing.
basin	The watershed of a major river system. There are 17 major river basins in North Carolina.
benthic macroinvertebrates	Aquatic organisms, visible to the naked eye (macro) and lacking a backbone (invertebrate), that live in or on the bottom of rivers and streams (benthic). Examples include, but are not limited to, aquatic insect larvae, mollusks and various types of worms. Some of these organisms, especially aquatic insect larvae, are used to assess water quality. See EPT index and bioclassification for more information.
benthos	A term for bottom-dwelling aquatic organisms.
best management practices	Techniques that are determined to be currently effective, practical means of preventing or reducing pollutants from point and nonpoint sources, in order to protect water quality. BMPs include, but are not limited to: structural and nonstructural controls, operation and maintenance procedures, and other practices. Often, BMPs are applied as system of practices and not just one at a time.
bioclassification	A rating of water quality based on the outcome of benthic macroinvertebrate sampling of a stream. There are five levels: Poor, Fair, Good-Fair, Good and Excellent.
BMPs	See *best management practices*.
BOD	Biochemical Oxygen Demand. A measure of the amount of oxygen consumed by the decomposition of biological matter or chemical reactions in the water column. Most NPDES discharge permits include a limit on the amount of BOD that may be discharged.
C (Class C)	Class C Water Quality Classification. This classification denotes freshwaters protected for secondary recreation, fishing, wildlife, fish and aquatic life propagation and survival, and others uses.
chlorophyll *a*	A chemical constituent in plants that gives them their green color. High levels of chlorophyll *a* in a waterbody, most often in a pond, lake or estuary, usually indicate a large amount of algae resulting from nutrient overenrichment or eutrophication.
coastal counties	Twenty counties in eastern NC subject to requirements of the Coastal Area Management Act (CAMA). They include: Beaufort, Bertie, Brunswick, Camden, Carteret, Chowan, Craven, Currituck, Dare, Gates, Hertford, Hyde, New Hanover, Onslow, Pamlico, Pasquotank, Pender, Perquimans, Tyrrell and Washington.
Coastal Plain	One of three major physiographic regions in North Carolina. Encompasses the eastern two-fifths of state east of the *fall line* (approximated by Interstate I-95).
conductivitiy	A measure of the ability of water to conduct an electrical current. It is dependent on the concentration of dissolved ions such as sodium, chloride, nitrates, phosphates and metals in solution.
degradation	The lowering of the physical, chemical or biological quality of a waterbody caused by pollution or other sources of stress.
DENR	Department of Environment and Natural Resources.
DO	Dissolved oxygen.
drainage area	An alternate name for a watershed.

DWQ	North Carolina Division of Water Quality, an agency of DENR.
dystrophic	Naturally acidic (low pH), "black-water" lakes which are rich in organic matter. Dystrophic lakes usually have low productivity because most fish and aquatic plants are stressed by low pH water. In North Carolina, dystrophic lakes are scattered throughout the Coastal Plain and Sandhills regions and are often located in marshy areas or overlying peat deposits. NCTSI scores are not appropriate for evaluating dystrophic lakes.
effluent	The treated liquid discharged from a wastewater treatment plant.
EMC	Environmental Management Commission.
EPA	United States Environmental Protection Agency.
EPT Index	This index is used to judge water quality based on the abundance and variety of three orders of pollution sensitive aquatic insect larvae: Ephemeroptera (mayflies), Plecoptera (stoneflies) and Trichoptera (caddisflies).
eutrophic	Elevated biological productivity related to an abundance of available nutrients. Eutrophic lakes may be so productive that the potential for water quality problems such as algal blooms, nuisance aquatic plant growth and fish kills may occur.
eutrophication	The process of physical, chemical or biological changes in a lake associated with nutrient, organic matter and silt enrichment of a waterbody. The corresponding excessive algal growth can deplete dissolved oxygen and threaten certain forms of aquatic life, cause unsightly scums on the water surface and result in taste and odor problems.
fall line	A geologic landscape feature that defines the line between the piedmont and coastal plain regions. It is most evident as the last set of small rapids or rock outcroppings that occur on rivers flowing from the piedmont to the coast.
FS	Fully supporting. A rating given to a waterbody that fully supports its designated uses and generally has good or excellent water quality.
GIS	Geographic Information System. An organized collection of computer hardware, software, geographic data and personnel designed to efficiently capture, store, update, manipulate, analyze and display all forms of geographically referenced information.
habitat degradation	Identified where there is a notable reduction in habitat diversity or change in habitat quality. This term includes sedimentation, bank erosion, channelization, lack of riparian vegetation, loss of pools or riffles, loss of woody habitat, and streambed scour.
headwaters	Small streams that converge to form a larger stream in a watershed.
HQW	High Quality Waters. A supplemental surface water classification.
HU	Hydrologic unit. See definition below.
Hydrilla	The genus name of an aquatic plant - often considered an aquatic weed.
hydrologic unit	A watershed area defined by a national uniform hydrologic unit system that is sponsored by the Water Resources Council. This system divides the country into 21 regions, 222 subregions, 352 accounting units and 2,149 cataloging units. A hierarchical code consisting of two digits for each of the above four levels combined to form an eight-digit hydrologic unit (cataloging unit). An eight-digit hydrologic unit generally covers an average of 975 square miles. There are 54 eight-digit hydrologic (or cataloging) units in North Carolina. These units have been further subdivided into eleven and fourteen-digit units.
hypereutrophic	Extremely elevated biological productivity related to excessive nutrient availability. Hypereutrophic lakes exhibit frequent algal blooms, episodes of low dissolved oxygen or periods when no oxygen is present in the water, fish kills and excessive aquatic plant growth.
impaired	Term that applies to a waterbody that has a use support rating of partially supporting (PS) or not supporting (NS) its uses.
impervious	Incapable of being penetrated by water; non-porous.
kg	Kilograms. To change kilograms to pounds multiply by 2.2046.
lbs	Pounds. To change pounds to kilograms multiply by 0.4536.

loading	Mass rate of addition of pollutants to a waterbody (e.g., kg/yr)
macroinvertebrates	Animals large enough to be seen by the naked eye (macro) and lacking backbones (invertebrate).
macrophyte	An aquatic plant large enough to be seen by the naked eye.
meotrophic	Moderate biological productivity related to intermediate concentrations of available nutrients. Mesotrophic lakes show little, if any, signs of water quality degradation while supporting a good diversity of aquatic life.
MGD	Million gallons per day.
mg/l	Milligrams per liter (approximately 0.00013 oz/gal).
NCIBI	North Carolina Index of Biotic Integrity. A measure of the community health of a population of fish in a given waterbody.
NH_3-N	Ammonia nitrogen.
nonpoint source	A source of water pollution generally associated with rainfall runoff or snowmelt. The quality and rate of runoff of NPS pollution is strongly dependent on the type of land cover and land use from which the rainfall runoff flows. For example, rainfall runoff from forested lands will generally contain much less pollution and runoff more slowly than runoff from urban lands.
NPDES	National Pollutant Discharge Elimination System.
NPS	Nonpoint source.
NR	Not rated. A waterbody that is not rated for use support due to insufficient data.
NS	Not supporting. A rating given to a waterbody that does not support its designated uses and has poor water quality and severe water quality problems. Both PS and NS are called impaired.
NSW	Nutrient Sensitive Waters. A supplemental surface water classification intended for waters needing additional nutrient management due to their being subject to excessive growth of microscopic or macroscopic vegetation. Waters classified as NSW include the Neuse, Tar-Pamlico and Chowan River basins; the New River watershed in the White Oak basin; and the watershed of B. Everett Jordan Reservoir (including the entire Haw River watershed).
NTU	Nephelometric Turbidity Units. The units used to quantify turbidity using a turbidimeter. This method is based on a comparison of the intensity of light scattered by the sample under defined conditions with the intensity of the light scattered by a standard reference suspension under the same conditions.
oligotrophic	Low biological productivity related to very low concentrations of available nutrients. Oligotrophic lakes in North Carolina are generally found in the mountain region or in undisturbed (natural) watersheds and have very good water quality.
ORW	Outstanding Resource Waters. A supplemental surface water classification intended to protect unique and special resource waters having excellent water quality and being of exceptional state or national ecological or recreational significance. No new or expanded wastewater treatment plants are allowed, and there are associated stormwater runoff controls enforced by DWQ.
pH	A measure of the concentration of free hydrogen ions on a scale ranging from 0 to 14. Values below 7 and approaching 0 indicate increasing acidity, whereas values above 7 and approaching 14 indicate a more basic solution.
phytoplankton	Aquatic microscopic plant life, such as algae, that are common in ponds, lakes, rivers and estuaries.
Piedmont	One of three major physiographic regions in the state. Encompasses most of central North Carolina from the Coastal Plain region (near I-95) to the eastern slope of the Blue Ridge Mountains region.

PS	Partially supporting. A rating given to a waterbody that only partially supports its designated uses and has fair water quality and severe water quality problems. Both PS and NS are called impaired.
riparian zone	Vegetated corridor immediately adjacent to a stream or river. See also SMZ.
river basin	The watershed of a major river system. North Carolina is divided into 17 major river basins: Broad, Cape Fear, Catawba, Chowan, French Broad, Hiwassee, Little Tennessee, Lumber, Neuse, New, Pasquotank, Roanoke, Savannah, Tar-Pamlico, Watauga, White Oak and Yadkin River basins.
river system	The main body of a river, its tributary streams and surface water impoundments.
runoff	Rainfall that does not evaporate or infiltrate the ground, but instead flows across land and into waterbodies.
SA	Class SA Water Classification. This classification denotes saltwaters that have sufficient water quality to support commercial shellfish harvesting.
SB	Class SB Water Classification. This classification denotes saltwaters with sufficient water quality for frequent and/or organized swimming or other human contact.
SC	Class SC Water Classification. This classification denotes saltwaters with sufficient water quality to support secondary recreation and aquatic life propagation and survival.
sedimentation	The sinking and deposition of waterborne particles (e.g., eroded soil, algae and dead organisms).
silviculture	Care and cultivation of forest trees; forestry.
SOC	Special Order by Consent. An agreement between the Environmental Management Commission and a permitted discharger found responsible for causing or contributing to surface water pollution. The SOC stipulates actions to be taken to alleviate the pollution within a defined time. The SOC typically includes relaxation of permit limits for particular parameters, while the facility completes the prescribed actions. SOCs are only issued to facilities where the cause of pollution is not operational in nature (i.e., physical changes to the wastewater treatment plant are necessary to achieve compliance).
streamside management zone (SMZ)	The area left along streams to protect streams from sediment and other pollutants, protect streambeds, and provide shade and woody debris for aquatic organisms.
subbasin	A designated subunit or subwatershed area of a major river basin. Subbasins typically encompass the watersheds of significant streams or lakes within a river basin. Every river basin is subdivided into subbasins ranging from one subbasin in the Watauga River basin to 24 subbasins in the Cape Fear River basin. There are 133 subbasins statewide. These subbasins are not a part of the national uniform hydrologic unit system that is sponsored by the Water Resources Council (see *hydrologic unit*).
Sw	Swamp Waters. A supplemental surface water classification denoting waters that have naturally occurring low pH, low dissolved oxygen and low velocities. These waters are common in the Coastal Plain and are often naturally discolored giving rise to their nickname of “blackwater” streams.
TMDL	Total maximum daily load. The amount of a given pollutant that a waterbody can assimilate and maintain its uses and water quality standards.
TN	Total nitrogen.
TP	Total phosphorus.
tributary	A stream that flows into a larger stream, river or other waterbody.
trophic classification	Trophic classification is a relative description of a lake's biological productivity, which is the ability of the lake to support algal growth, fish populations and aquatic plants. The productivity of a lake is determined by a number of chemical and physical characteristics, including the availability of essential plant nutrients (nitrogen and phosphorus), algal growth and the depth of light penetration. Lakes are classified according to productivity:

	unproductive lakes are termed "oligotrophic"; moderately productive lakes are termed "mesotrophic"; and very productive lakes are termed "eutrophic".
TSS	Total Suspended Solids.
turbidity	An expression of the optical property that causes light to be scattered and absorbed rather than transmitted in straight lines through a sample. All particles in the water that may scatter or absorb light are measured during this procedure. Suspended sediment, aquatic organisms and organic particles such as pieces of leaves contribute to instream turbidity.
UT	Unnamed tributary.
watershed	The region, or land area, draining into a body of water (such as a creek, stream, river, pond, lake, bay or sound). A watershed may vary in size from several acres for a small stream or pond to thousands of square miles for a major river system. The watershed of a major river system is referred to as a basin or river basin.
WET	Whole effluent toxicity. The aggregate toxic effect of a wastewater measured directly by an aquatic toxicity test.
WS	Class WS Water Supply Water Classification. This classification denotes freshwaters used as sources of water supply. There are five WS categories. These range from WS-I, which provides the highest level of protection, to WS-V, which provides no categorical restrictions on watershed development or wastewater discharges like WS-I through WS-IV.
WWTP	Wastewater treatment plant.