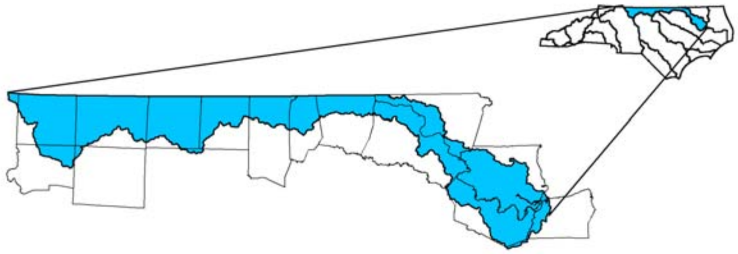
Roanoke River Basinwide Water Quality Plan

September 2006



North Carolina Department of Environment and Natural Resources

Division of Water Quality Basinwide Planning Unit

Roanoke River Basinwide Water Quality Plan

September 2006

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Cover Photograph taken by Mike Yount

This Document was approved by the NC Environmental Management Commission on September 14, 2006 to be used as a guide by the NC Division of Water Quality for carrying out its Water Quality Program duties and responsibilities in the Roanoke River basin. This plan is the third five-year update to the Roanoke River Basinwide Water Quality Plan approved by the NC Environmental Management Commission in September 1996.

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Roanoke River Basin - Executive Summary

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

The goals of basinwide planning are to:

- identify water quality problems and restore full use to Impaired waters,
- identify and protect high value resource waters, and
- protect unimpaired waters while allowing for reasonable economic development.

DWQ accomplishes these goals through the following objectives:

- collaborate with regional and local agencies to develop appropriate management strategies (This includes providing agencies information related to financial and funding opportunities.),
- assure equitable distribution of waste assimilative capacity,
- evaluate cumulative effects of pollution,
- improve public awareness and involvement, and
- regulate point and nonpoint sources of pollution where other approaches are not successful.

This document is the third five-year update of the Roanoke River Basinwide Water Quality Plan. The first basinwide plan for the Roanoke River basin was completed in 1996 and the second in 2001. The format of this third plan was revised in response to comments received during the first and second planning cycles. DWQ replaced much of the general information in the first two plans with more detailed information specific to the Roanoke River basin. For this plan, a greater emphasis is placed on watershed level information in order to facilitate protection and restoration efforts.

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

Basin Overview

The Roanoke River begins in the Blue Ridge Mountains of northwestern Virginia and flows in a generally southeastern direction for 400 miles before emptying into the Albemarle Sound in eastern North Carolina (Figure i). By the time it reaches the fall line near Roanoke Rapids, it has captured water from nearly 8,000 square miles of land. From Roanoke Rapids to the coast, the river drains another 2,000 square miles, carrying more water than any other river in North

Carolina. The North Carolina portion of the basin (roughly 36 percent of the entire watershed) is composed of two major drainages: the Dan River and its tributaries in the western section; and the Roanoke River from Virginia to the Albemarle Sound in the eastern section (Figure ii and iii). The Roanoke River enters North Carolina through John H. Kerr Reservoir and then flows into Lake Gaston and Roanoke Rapids Lake before regaining its riverine form.

The upper Dan River is classified as trout waters and part of the area is also designated a State Water Trail by the NC Division of Parks and Recreation. The lower portion of the basin also includes large tracts of bottomland hardwood forests owned by the NC Wildlife Resources Commission, the US Fish and Wildlife Services, and The Nature Conservancy. The NC Wildlife Resources Commission has designated a portion of the river as an Inland Primary Nursery Area due to its great importance as spawning habitat for anadromous fish and world-class recreational fisheries for striped bass and hickory shad. Anadromous fish spawned in the Roanoke River migrate into the Atlantic Ocean, so the importance of the Roanoke River as a spawning and nursery area for these fish has wide reaching implications. This area is also an important habitat for black bear, bobcat, large populations of wild turkey, 14 species of waterfowl, as well as an additional 220 bird species.

There are 11 major reservoirs in the North Carolina portion of the basin. Most of them are located in the upper portion of the basin on tributaries of the Dan and Roanoke Rivers (notably Belews Lake, Hyco Lake and Mayo Reservoir). Three reservoirs, Kerr, Gaston and Roanoke Rapids, are impoundments of the Roanoke River mainstem. They are managed by Dominion and the US Army Corps of Engineers for electrical energy production and flood control. Flow from these reservoirs directly influences the quality of water in the lower Roanoke River.

Information presented in this basinwide water quality plan is based on data collected from September 1999 to August 2004. Maps of each subbasin are included in each of the subbasin chapters. Each subbasin has its own characteristics and water quality concerns. These are discussed in Chapters 1 through 10.

DWQ identifies the stressors of water quality impact as specifically as possible depending on the amount of information available in a watershed. Most often, the source of the stressor is based on the predominant land use in a watershed. In the Roanoke River basin, new development/construction activities, land clearing, agriculture, municipal and industrial point source and impoundments were all identified as possible stressors. These are discussed in detail in Chapter 13. Water quality decline can often be attributed to a combination of many stressors that lead to habitat and water quality degradation. In some way, every person, industry, landowner and municipality in the basin impacts water quality. Therefore, every resident of the basin should play a role in management strategies designed to protect and restore the streams, lakes and rivers of the basin.

Population Growth and Changes in Land Use

The Roanoke River basin encompasses all or portions of 15 counties and 42 municipalities. In 2000, the overall population in the basin (based on the percent of the county land area in the basin) was 344,638. The most populated areas are located north of the Winston-Salem/Greensboro area and around the larger municipalities in the basin, such as Roanoke Rapids, Eden, Williamston and Plymouth.

Population in Forsyth, Granville, Persons and Stokes counties is projected to increase 20-30 percent from 2000 to 2020. Between 1990 and 2000, the fastest growing county was Granville, which had an increase of 20.9 percent and is expected to grow by another 29.3 percent by 2020 for an estimated total population of 68,600 people. Population growth trends and the accompanying impacts to water quality are discussed in Chapters 12 and 13.
Expanding populations are typically characterized by a loss of natural areas and an increase in impervious surfaces. Based on the most current land cover information provided by the National Resources Inventory (USDA-NRCS, 2001), there was a 136 percent increase in Urban and Built-up areas adding 74,700 acres to this land cover category in the Roanoke River basin from 1982 to 1997. Uncultivated cropland also increased by 22,200 acres (89.5 percent), while cultivated croplands decreased by 97,000 acres (20.4 percent). Forest and pastureland cover significantly decreased by 7,000 (0.5 percent) and 24,000 (21.5 percent) acres, respectively. Most land cover change is accounted for in the lower Roanoke River. Land cover tables and statistics are included in Appendix III.

Roanoke River Basin Statistics (North Carolina Portion)

Total Area: 3,503 sq. miles
Freshwater Stream Miles: 2,213
No. of Counties: 15
No. of Municipalities: 42
No. of Subbasins: 10
Population (2000): 344,638
Pop. Density (2000): 98 persons/sq. mile*

Water Quality Statistics

Aquatic Life
Monitored Streams: 37.8%
Supporting: 30.0%
Impaired: 5.7%
Not Rated: 4.2%

Recreation
Monitored Streams: 10.5%
Supporting: 8.1%
Impaired: 2.0%
Not Rated: 4.3%

Identified Water Quality Stressors
Habitat Degradation: 223 miles
Fecal Coliform Bacteria: 87.4 miles
Low Dissolved Oxygen: 70.4 miles
Turbidity: 58.6 miles
Toxic Impacts: 25.5 miles

* Estimated based on % of county land area that is partially or entirely within the basin, not the entire county population.

Growing populations not only require more water, but they also lead to the discharge and runoff of greater quantities of waste and pollutants into the state's streams and groundwater. The impacts on rivers, lakes and streams can be significant and permanent if stormwater runoff is not controlled. Just as demand and use increases, some of the potential water supply is also lost (Orr and Stuart, 2000).

Water Quality Standards and 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. 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. The Primary classifications and best uses in the Roanoke River basin are; Class C, aquatic life propagation/protection and secondary recreation; Class B, primary recreation and all Class C uses; and WS I-V, water supply (the classification is based on specific land use characteristics). Chapter 11 further describes the water quality standards and classifications and includes a map showing the designated Water Supply (WS) watersheds, and the supplemental classifications of High Quality Waters (HQW) and Outstanding Resource Waters (ORW) (Figure 16).

HQW and ORW are supplemental classifications to the primary freshwater classification placed on a waterbody. Special management strategies are often associated with the supplemental HQW and ORW classification and are intended to prevent degradation of water quality below present levels from point and nonpoint sources of pollution. Two creeks in subbasin 03-02-01 (Archies Creek and Peters Creek) received an excellent aquatic life use support rating which make them eligible for reclassification to HQW or ORW. In the Roanoke River basin, there are currently only two small segments making up a total of 1.6 stream miles in subbasin 03-02-01 that are classified as ORW.

Use Support Summary

Use support assessments based on surface water classifications form the foundation of this basinwide plan. Surface waters are classified according to their best-intended use. Determining how well a waterbody supports its use (*use support* rating) is an important method of interpreting water quality data and assessing water quality.

Use support methods were developed to assess ecosystem health and human health risk through the development of use support ratings for five categories: aquatic life; fish consumption; recreation; shellfish harvesting; and water supply. These categories are tied to the uses associated with the primary classifications applied to North Carolina rivers, streams and lakes discussed in the previous section. There are no shellfish harvesting waters located in the Roanoke River basin.

Biological, chemical and physical monitoring data collected between September 1999 and August 2004 were used to assign use support ratings in the Roanoke River basin. A total of 832.4 stream miles for aquatic life, 230.6 stream miles for recreation and 49.4 stream miles for fish consumption were monitored within the Roanoke River basin. Of these, 124, 43 and 49 stream miles were impaired respectively. Table *i* presents the totals of all the streams, lakes and sound monitored and gives a summary of those Impaired and Supporting. Table *ii* lists all of the monitored Impaired waters in the Roanoke River basin. Use support summary tables, which also identify potential stressors and their sources as well as maps showing the current ratings, are presented in each subbasin chapter (Chapters 1-10). Current status and recommendations for restoration of water quality for each Impaired segment is also discussed in each subbasin chapter.

Use support methodology has changed significantly since the 2001 revision of the *Roanoke River Basinwide Water Quality Plan*. The *2002 Integrated Water Quality Monitoring and Assessment Report Guidance* issued by the U.S. Environmental Protection Agency (EPA) requests that states no longer subdivide the Impaired category. In agreement with this guidance, North Carolina currently rates waters as Supporting (S), Impaired (I), Not Rated (NR) or No Data (ND). NR is used to identify those waters that had inconclusive data. These ratings refer to whether the classified uses of the water (e.g., water supply, aquatic life, primary/secondary recreation) are being met. Detailed information on use support methodology is provided in Appendix IX.

Water Quality Stressors

Water quality stressors are identified when impacts have been noted to biological (fish and benthic) communities or water quality standards have been violated. Whenever possible, water quality stressors are identified for Impaired waters as well as waters with notable impacts.

Stressors identified during this assessment are briefly discussed below and in more detail in Chapter 13 as well as in each subbasin chapter (Chapters 1-10).

Certain stressors are associated with specific use support categories. For example, in the recreation category, violations of the fecal coliform bacteria standard are the reason for impairment; therefore, fecal coliform bacteria is the stressor for Impaired waters in this category. In the aquatic life category, Impaired waters result from violations of one or more numerical water quality standards or because a biological community sample (fish or benthic) did not meet use support criteria. Stressors to aquatic life can be numerical water quality standards that are violated, or a host of aquatic habitat quality indicators such as excessive sediment or lack of organic habitat. The following discussion summarizes stressors identified during this assessment period and possible sources of the stressors.

Table i – Summary of Monitored Waters in the Roanoke River Basin

Use Support Category	Units	Total Monitored Waters	Total Impaired Waters		Total Supporting Waters		Total Not Rated Monitored & Evaluated	Total No Data
		Miles/ Acres	Miles/ Acres	%	Miles/ Acres	%	Miles/ Acres	Miles/ Acres
Aquatic Life	Freshwater acres (impoundments)	36,485	0	0	3162	8.4	33,323	1058
Aquatic Life	Freshwater miles (streams)	834.4	124.7	5.7	661	30	91.4	1327
Aquatic Life	Estuarine acres	0	0	0	0	0	0	1476
Recreation	Freshwater acres (impoundments)	0	0	0	0	0	0	37543
Recreation	Freshwater miles (streams)	230.6	43	2	179	8.1	96	1886
Recreation	Estuarine acres	0	0	0	0	0	0	1476
*Fish Consumption	Freshwater acres (impoundments)	0	0	0	0	0	0	37543
*Fish Consumption	Freshwater miles (streams)	49.4	49.4	2.2	0	0	0	2155
*Fish Consumption	Estuarine acres	1476	1476	100	0	0	0	0

* Fish Consumption data is for Dioxin only. All waters within the Roanoke River basin are Impaired on an evaluated basis for mercury (37,543 freshwater acres, 2,204 freshwater stream miles and 1,476 saltwater acres).

DWQ identifies the source of a stressor as specifically as possible depending on the amount of information available in a watershed. Most often the source is based on the predominant land use in a watershed. Stressor sources identified in the Roanoke River basin during this assessment period include urban or impervious surface areas, construction sites, land clearing, agriculture and water impoundments. Because land disturbance is one of the main stressor sources, there has been increased funding to the Division of Land Resources to help address these source. Point source discharges are also a water quality stressor sources in the Roanoke River basin.

Habitat Degradation
One of the most noted water quality stressors is instream habitat degradation. Instream habitat degradation is identified where there is a notable reduction in habitat diversity or a negative change in habitat. Sedimentation, streambank erosion, channelization, lack of riparian vegetation, loss of pools or riffles, loss of woody habitat, and streambed scour are all associated with habitat degradation. These stressors are typically a result of increased flow of stormwater runoff due to land use changes or to sediment runoff from land-disturbing activities. In the Roanoke River basin, 60 streams miles are Impaired and another 163 stream miles were negatively impacted where at least one form of habitat degradation is the suspected stressor. Streams with noted habitat degradation are discussed in the subbasin chapters (Chapters 1-10).

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

DWQ recommends the use of careful planning to maintain riparian buffers and the use of good land use management practices during all land disturbing activities to prevent habitat degradation. In addition, watersheds that are being developed need to maintain management practices for long periods to prevent excessive runoff that is the ultimate source of the habitat degradation noted above.

Low Dissolved Oxygen
Maintaining an adequate amount of dissolved oxygen (DO) is critical to the survival of aquatic life and to the general health of surface waters. A number of factors influence DO concentrations including water temperature, depth and turbulence. Additionally, in the Roanoke River basin, a large swampy floodplain drainage system and flow management from upstream impoundments also influences DO. Oxygen-consuming wastes such as decomposing organic matter and some chemicals can reduce DO levels in surface water through biological activity and chemical reactions. NPDES permits for wastewater discharges set limits on certain parameters in order to control the effects that oxygen depletion can have in receiving waters.

In the Roanoke River basin during this assessment period, there were over 20 stream miles Impaired because of dissolved oxygen (DO) standards violations. This includes a portion of the Lower Roanoke River (Chapter 9 and 13). There were also over 18 stream miles where dissolved oxygen levels were low enough to be of concern, although this area has a supplemental classification of swamp waters (Sw) where low DO levels are possibly due to natural conditions.

Turbidity
In the Roanoke River basin during this assessment period, there were 55 stream miles Impaired because of turbidity standards violations. All of the turbidity violations occurred in the western portion of the basin. Almost the entire North Carolina portion of the Dan River and the entire 5.1 stream mile portion of the Smith River are Impaired due to noted turbidity violations. In this same region of the basin, elevated turbidity levels were also seen in the Mayo River. These are discussed in detail in each of the subbasin chapters (Chapters 1-4). Only 14.2 stream miles of

the Dan River were impaired for turbidity during the last basin cycle. The turbidity violations during this assessment period were mostly associated with unknown nonpoint source pollution as well as with land clearing activities.

Fecal Coliform Bacteria
Water quality standards for fecal coliform bacteria are intended to ensure safe use of waters for recreational uses, therefore only class B waters are intensively sampled to assess the standard. In the Roanoke River basin there were 43 stream miles where the fecal coliform bacteria standard was violated, these waters are Impaired for recreation. As with turbidity, almost the entire North Carolina portion of the Dan River and the entire portion of the Smith River are Impaired due to fecal coliform bacteria violations. These are discussed in detail in each of the subbasin chapters (Chapters 1-4). These violations were mostly associated with unknown nonpoint source pollution.

Dioxin
The 36.1 mile stretch of the Roanoke River from Highway 17 bridge in Martin County to the Albemarle Sound, as well as 1,476 saltwater acres of the Albemarle Sound/Batchelor Bay are Impaired for fish consumption based on a dioxin advisory from the NC Department of Health and Human Services' (DHHS) for carp and catfish. This advisory also includes all of Welch Creek (13.3 miles) that flows into this section of the Roanoke River. This is discussed in Chapter 9.

The fish consumption Impairments are due to the NC DHHS fish consumption advisory posted in October 2001 for carp and catfish. It is advised that carp and catfish from these waters may contain low levels of dioxins. Swimming, boating, and other recreational activities present no health risks and are not affected by this advisory. For more information regarding fish consumption advisories, call (919) 707-5900 or visit the NC DHHS Division of Public Health website at http://www.schs.state.nc.us/epi/fish/current.html.

Mercury in Fish Tissue
The presence and accumulation of mercury in North Carolina's aquatic environment are similar to contamination observed throughout the country. Mercury has a complex life in the environment, moving from the atmosphere to soil, to surface water and into biological organisms. 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.

All waters within the Roanoke River basin are Impaired on an evaluated basis in the fish consumption category. This is based on a fish consumption advise from the NC Department of Health and Human Services. For more information on fish consumption advisories and advice, contact NC DHHS (see contact information above or see discussion in Chapter 13).

Agriculture and Water Quality
Excess nutrient loading, pesticide and/or herbicide contamination, bacterial contamination and sedimentation are often associated with agricultural activities, and all can impact water quality.

Chapter 16 provides information related to the impacts of agriculture on water quality. Impacts to water quality from agricultural sources may decrease over the next basin cycle due to substantial increases in urban/built-up areas throughout the river basin.

DWQ will identify streams where agricultural activities may be impacting water quality and aquatic habitat. This information will be related to local Division of Soil and Water Conservation (DSWC) and Natural Resources Conservation Service staff to investigate impacts in these watersheds and to reduce these impacts. The DSWC Ag Cost Share Program has spent over $3 million on various management practices in the Roanoke River basin. DWQ recommends that funding and technical support for agricultural BMPs be continued and increased. Refer to Chapter 16 for specific BMP information and Appendix VIII for agricultural nonpoint source agency contact information.

Forestry and Water Quality

Based on land cover information provided by the North Carolina Corporate Geographic Database (CGIA) and the USDA-NRCS, 73 percent of land in the Roanoke River Basin consists of forest/wetland. Several stream miles were potentially identified as being impacted by stressors associated with forestry activities. Where forest harvesting is identified as a potential source of water quality impact, DWQ will notify the Division of Forest Resources (DFR) to investigate potential violations and the enforcement of management strategies. Chapter 17 presents more information related to the impacts of forestry on water quality.

Wastewater Treatment and Disposal

Currently, there are 77 permitted wastewater discharges in the Roanoke River basin with a permitted flow of approximately 188 MGD. Chapter 14 provides summary information (by type and subbasin) about the discharges. This chapter also provides guidance for permitting in various watersheds that may be water quality limited and also contains general information related to wastewater treatment disposal associated with registered animal operations. Maps of permitted facilities are provided in each subbasin chapter. For a complete listing of permitted facilities in the basin, refer to Appendix VI. The majority of NPDES permitted wastewater discharges into the waters of the Roanoke River basin are from major municipal wastewater treatment plants. Nonmunicipal discharges also contribute substantial wastewater into the Roanoke River basin.

There are 155 stream miles noted throughout this plan where point sources may have negatively impacted the water quality. Facilities, large or small, where recent data show problems with a discharge are discussed in each subbasin chapter. DWQ will determine if any violations are ongoing and address them using the NPDES permitting process. Many watersheds are adversely impacted by the cumulative effects of discharges and nonpoint source runoff.

Impacts from Stormwater Runoff

Stormwater runoff is rainfall or snowmelt that runs off the ground or impervious surface (e.g., buildings, roads, parking lots, etc.) instead of absorbing into the soil. In some cases, stormwater runoff drains directly into streams, rivers, lakes and oceans. In other cases, particularly urbanized areas, stormwater drains into streets and manmade drainage systems consisting of inlets and underground pipes, commonly referred to as a storm sewer system. Stormwater runoff is a primary carrier of nonpoint source pollution in both urbanized and rural areas. The impact of stormwater runoff is particularly severe in developing areas where recently graded lands are highly susceptible to erosion. Water quality impacts are also evident in urbanized areas where stormwater runoff is increased by impervious surfaces and is rapidly channeled through ditches or curb and gutter systems into nearby streams. For more information on stormwater as it relates to growth and development, refer to Chapter 12.

There are many different stormwater programs administered by DWQ. One or more of these programs affect many communities in the Roanoke River basin. The goal of the DWQ stormwater discharge permitting regulations and programs is to prevent pollution from entering the waters of the state via stormwater runoff. These programs try to accomplish this goal by controlling the source(s) of pollutants. These programs include NPDES Phase I and II, coastal county stormwater requirements, HQW/ORW stormwater requirements, and requirements associated with the Water Supply Watershed Program. Chapter 14 includes more information on the statewide stormwater programs and a list of Local governments that are or may be affected by these programs.

Water Resources

Chapter 18 presents information related to minimum streamflow requirements, interbasin transfers, water quality during drought conditions, and source water protection. The chapter also includes the federal cataloging units (commonly referred to as hydrologic units) as they relate to the state subbasin boundaries.

Significant Ecological Resources and Endangered Species

The Roanoke River basin is ecologically significant and diverse in numerous ways, and contains habitat for over 140 rare plant and animal species. The character of the basin as it enters North Carolina, contains some natural communities often associated with mountains. The Roanoke then flows about 100 miles through the Piedmont and the Coastal Plain. The Piedmont provides habitat for a number of rare fish and mussels, as well as small-anthered bittercress (*Cardamine micranthera*), a species only known to Stokes County and adjacent Hentry County, Virginia. This endemic plant requires small or intermittent streams and seepage areas, and is found in the wet soil and rocks along small stream banks in hardwood forest with intact forest cover. This species was presumed extinct, however it was rediscovered in 1985, nearly 30 years after it had last been seen. The Coastal Plain section of the Roanoke River contains high-quality examples of wetland communities such as Coastal Plain Bottomland Hardwoods and Cypress-Gum Swamps. Some of these natural communities are extensive, and the large blocks of habitat are excellent for wildlife. Finally, the Roanoke River is the major contributor of freshwater to Albemarle Sound.

The Natural Heritage Program has identified over 145 individual natural areas in the Roanoke River basin. Several of these areas are discussed in Chapter 19. A table of rare animals associated with aquatic habitats in the Roanoke River basin is also provided. There are 11 rare mollusks, five rare insects, one rare crustacean, and nine rare fish in the basin. The James Spinymussle is a federally listed endangered species found in the Roanoke River subbasins 03-02-01 and 03-02-02. Some of these rare species are also noted in the individual subbasin chapters.

Water Quality Initiatives

Local organizations and agencies are able to combine professional expertise and local knowledge not present at the state and federal level. This allows groups to holistically understand the challenges and opportunities of local water quality concerns. Involving a wide array of people in water quality projects also brings together a wide range of knowledge and interests and encourages others to become involved and invested in these projects. Working in cooperation across jurisdictional boundaries and agency lines opens the door to additional funding opportunities and eases the difficulty of generating matching or leveraged funds. This could potentially allow local entities to do more work and be involved in more activities because funding sources are diversified. The most important aspect of these local endeavors is that the more localized the project, the better the chances for success.

The collaboration of local efforts is key to water quality improvements, and DWQ applauds the foresight and proactive response by locally based organizations and agencies to protect water quality. There are many excellent examples of local agencies and groups using these cooperative strategies throughout the state. Several local watershed projects are highlighted throughout the subbasin chapters (Chapters 1-10). Chapter 20 also summarizes monies spent by federal and state programs to help implement water quality improvement projects. Over $48,000 was granted by the Clean Water Act Section 319 program for one project in this basin and over $13 million was made available over the last several years through the Clean Water Management Trust Fund. This chapter also contains information about the Ecosystem Enhancement Program.

Waters on the North Carolina 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 (Table *i*). 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 Roanoke River basin that are on this list are discussed in the individual subbasin chapters (Chapters 1-10). 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 to 13 years. Information regarding 303(d) listing and reporting methodology can be found in Appendix VII.

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. Roanoke River Basin TMDLs are discussed in the individual subbasin chapters. There are many new impaired segments in the Roanoke River basin. These are likely to be placed on the 2008 303(d) list and will require TMDL development for the next several years.

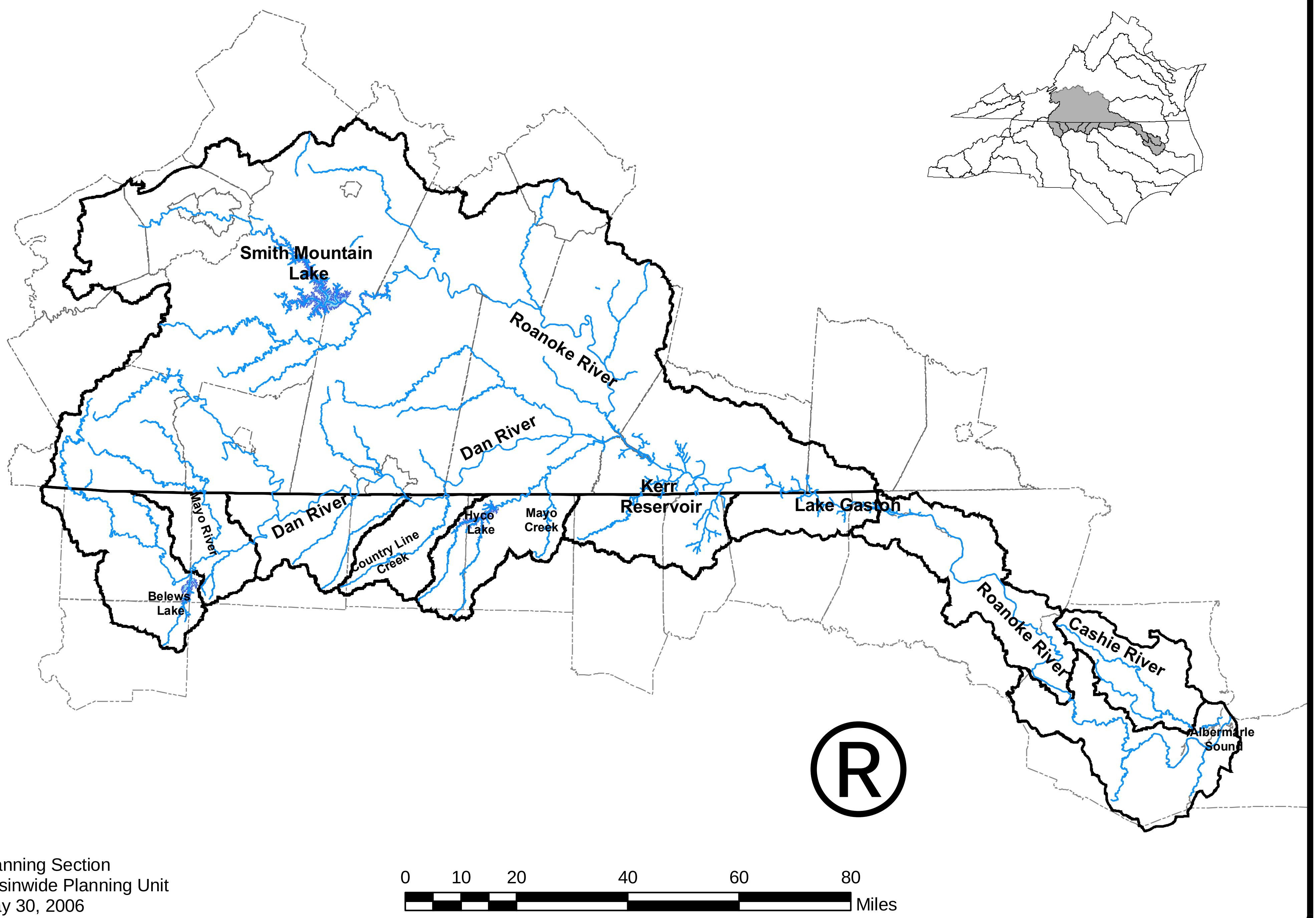
Challenges Related to Achieving Water Quality Improvements

To achieve the goal of restoring Impaired waters throughout the basin, DWQ will need to work closely with other state agencies and stakeholders to identify and control pollutants. The costs of restoration can be high, but several programs exist to provide funding for restoration efforts. These programs include the NC Clean Water Management Trust Fund (CWMTF), the NC

Agricultural Cost Share Program (NCACSP) and the Ecosystem Enhancement Program (NCEEP).

Balancing economic development and water quality protection will be a tremendous challenge. Point source impacts on surface waters can be measured and addressed through the basinwide planning process. Nonpoint source 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 BMPs 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 throughout the Roanoke River basin. These actions provide a foundation on which future initiatives can be built.

Figure i General Map of the Entire Roanoke River Basin



Planning Section
Basinwide Planning Unit
May 30, 2006

Figure ii General Map of Western Portion of the Roanoke River Basin in North Carolina

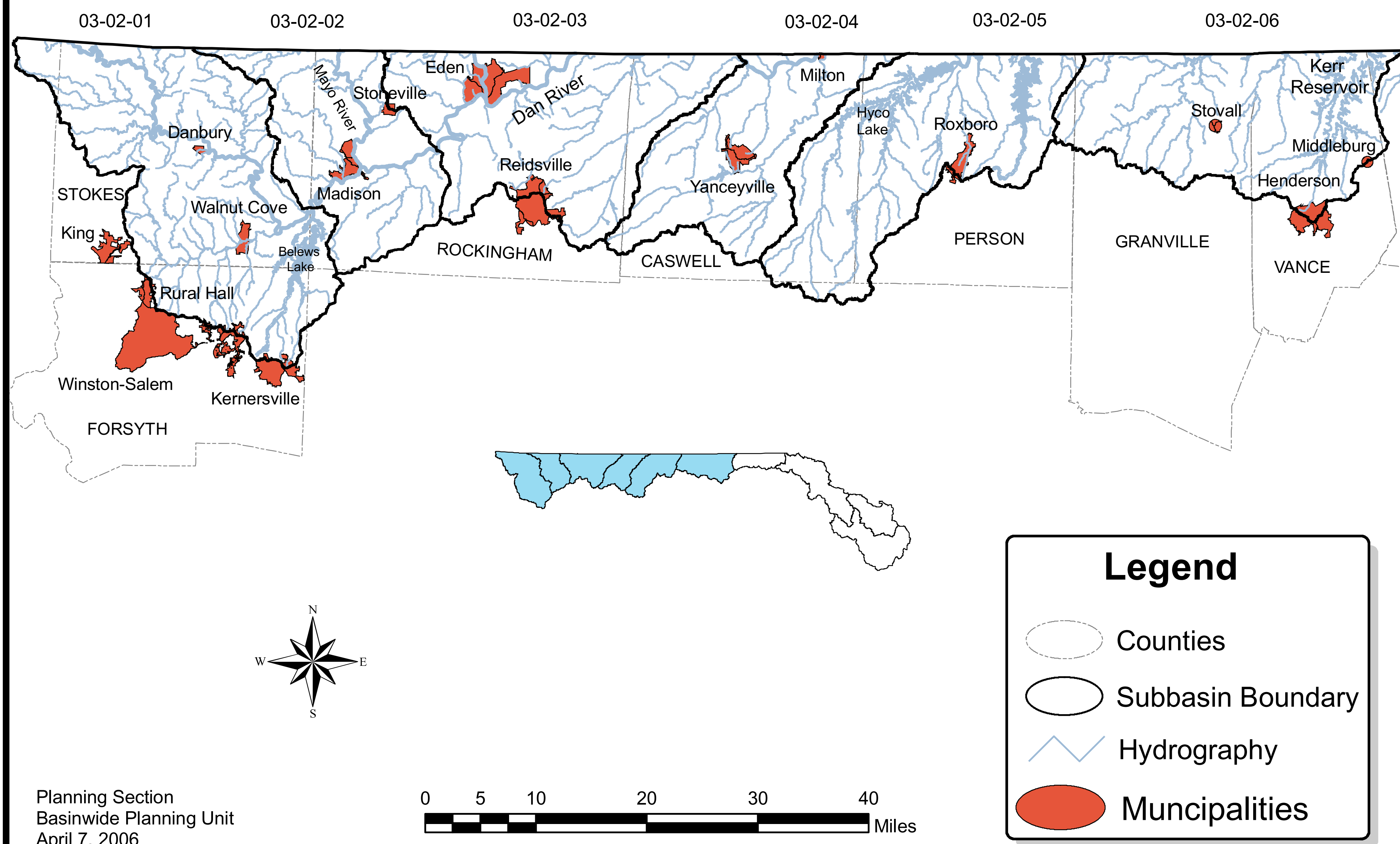


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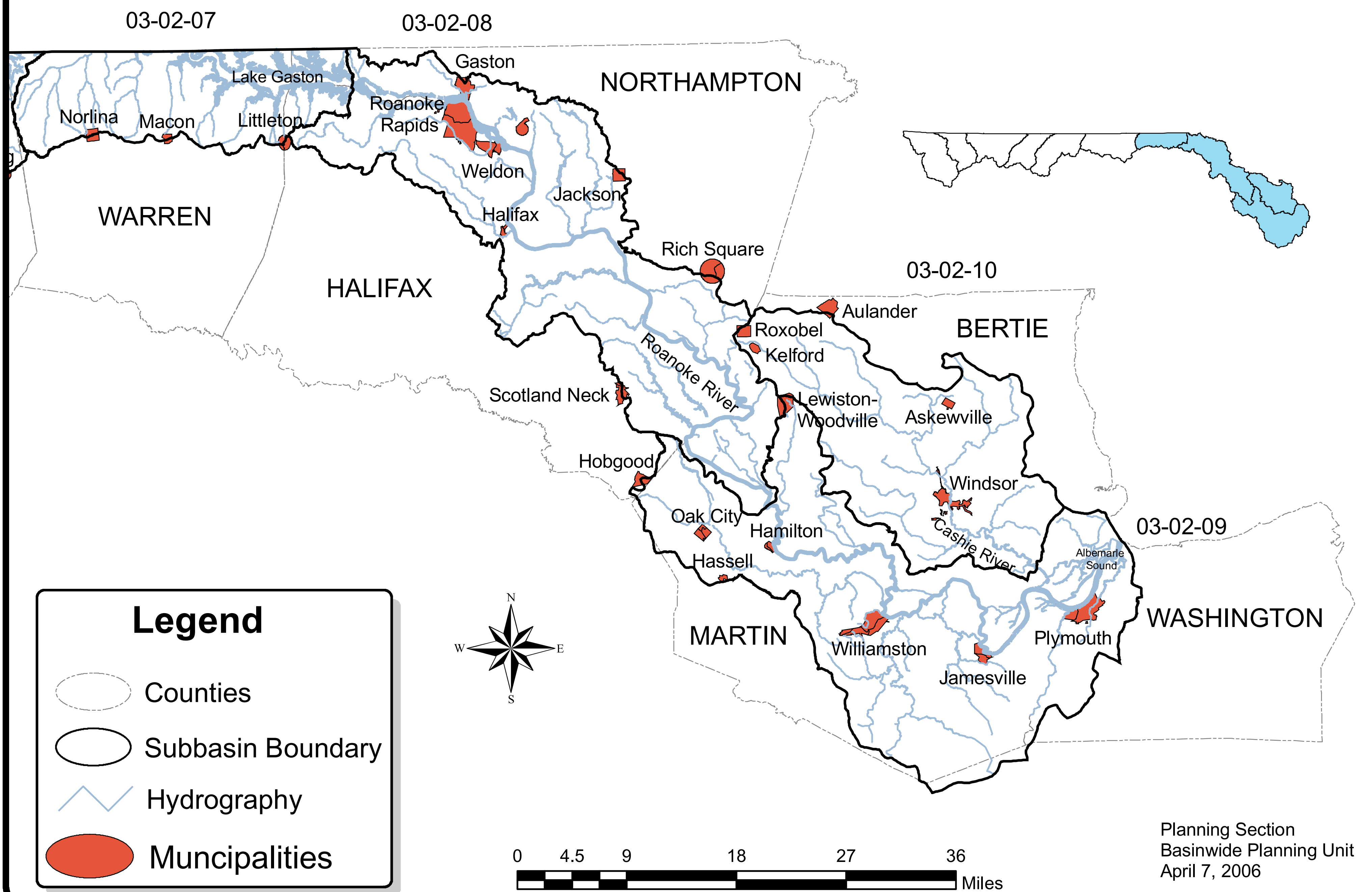
Figure iii General Map of Eastern Portion of the Roanoke River Basin in North Carolina



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Monitored Impaired Waters in Roanoke River Basin

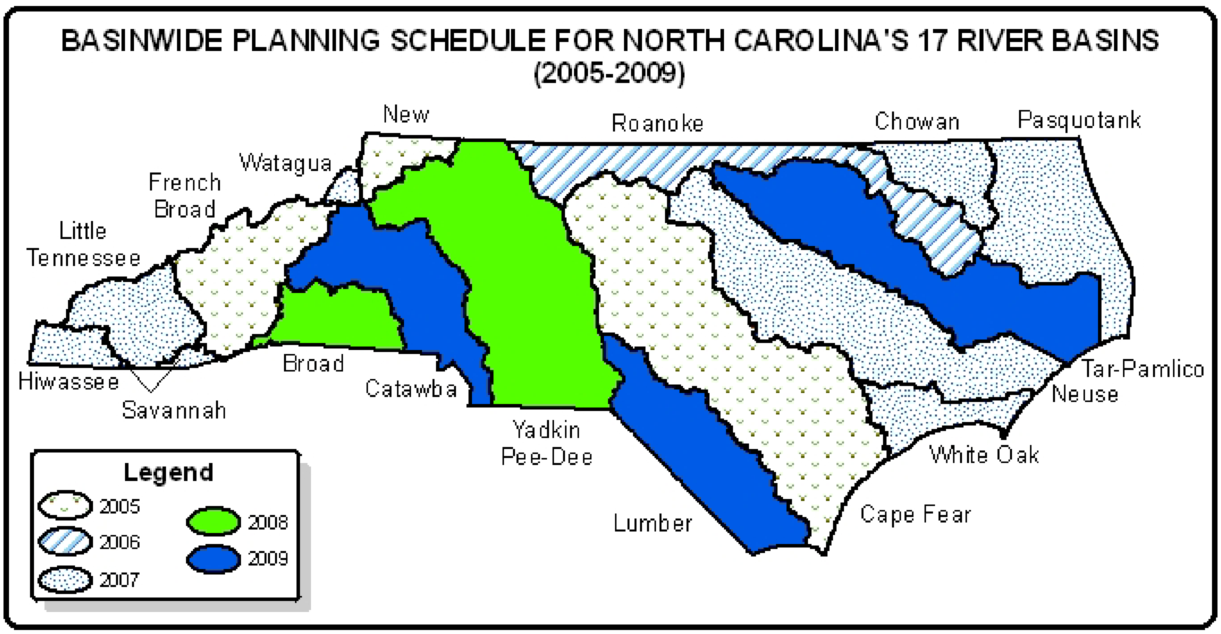
Subbasin	Stream Name	AU Number	Length/Area	Reason for Impairment
03-02-01	DAN RIVER (North Carolina portion)	22-(1)b	11.6 FW Miles	High Turbidity
03-02-02	DAN RIVER	22-(31.5)a	4.8 FW Miles	High Turbidity
				High Fecal Coliform Bacteria
03-02-03	DAN RIVER	22-(31.5)b	9.4 FW Miles	High Turbidity
				High Fecal Coliform Bacteria
03-02-03	DAN RIVER	22-(38.5)	0.6 FW Miles	High Turbidity
				High Fecal Coliform Bacteria
03-02-03	DAN RIVER (North Carolina portion)	22-(39)a	13.8 FW Miles	High Turbidity
				High Fecal Coliform Bacteria
03-02-03	Smith River	22-40-(3)	1.8 FW Miles	High Turbidity
				High Fecal Coliform Bacteria
03-02-03	Smith River	22-40-(1)	2.8 FW Miles	High Turbidity
				High Fecal Coliform Bacteria
03-02-03	Smith River	22-40-(2.5)	0.5 FW Miles	High Turbidity
				High Fecal Coliform Bacteria
03-02-04	DAN RIVER (North Carolina portion)	22-(39)b	9.6 FW Miles	High Turbidity
				High Fecal Coliform Bacteria
03-02-05	Hyco Creek (North Hyco Creek)	22-58-1	16.8 FW Miles	Fish Community Impaired
03-02-05	Marlowe Creek	22-58-12-6a	6.6 FW Miles	Benthic Community Impaired
03-02-06	Little Island Creek (Vance County)	23-4-3	11.8 FW Miles	Fish Community Impaired
03-02-06	Nutbush Creek (Including Nutbush Creek Arm of John H. Kerr Reservoir below normal pool elevation)	23-8-(1)b	1.6 FW Miles	Benthic Community Impaired
				Fish Community Impaired
03-02-07	Newmans Creek (Little Deep Creek)	23-10-2	6.1 FW Miles	Benthic Community Impaired
03-02-07	Smith Creek	23-10a	6.1 FW Miles	Benthic Community Impaired
03-02-07	Smith Creek	23-10c	3.0 FW Miles	Fish Community Impaired
				Benthic Community Impaired
				Low Dissolved Oxygen
03-02-09	ALBEMARLE SOUND (Batchelor Bay)	24	1,475.5 S Acres	Fish Consumption Advisory Dioxin
03-02-09	ROANOKE RIVER	23-(26)b3	17.8 FW Miles	Low Dissolved Oxygen
03-02-09	ROANOKE RIVER	23-(53)	18.3 FW Miles	Fish Consumption Advisory Dioxin
03-02-09	Welch Creek	23-55	13.3 FW Miles	Fish Consumption Advisory Dioxin

Introduction

What is Basinwide Water Quality Planning?

Basinwide water quality planning is a watershed-based approach to restoring and protecting the quality of North Carolina's surface waters. Basinwide water quality plans are prepared by the NC Division of Water Quality (DWQ) for each of the 17 major river basins in the state (Figure 1 and Table 1). Preparation of a basinwide water quality plan is a five-year process, which is broken down into three phases (Table 2). While these plans are prepared by DWQ, their implementation and the protection of water quality entail the coordinated efforts of many agencies, local governments and stakeholder groups throughout the state. The first cycle of plans was completed in 1998. Each plan is updated at five-year intervals.

Figure 1 - Basinwide Planning Schedule (2002 to 2007)



Goals of Basinwide Water Quality Planning

The goals of basinwide planning are to:

- identify water quality problems and restore full use to Impaired waters;
- identify and protect high value resource waters; and
- protect unimpaired waters while allowing for reasonable economic development.

DWQ accomplishes these goals through the following objectives:

- collaborate with other agencies to develop appropriate management strategies (This includes providing agencies information related to financial and funding opportunities.);
- assure equitable distribution of waste assimilative capacity;
- evaluate cumulative effects of pollution;
- improve public awareness and involvement; and
- regulate point and nonpoint sources of pollution where other approaches are not successful.

Benefits of Basinwide Water Quality Planning

Basinwide planning and management benefits water quality by:

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

How You Can Get Involved

To assure that basinwide plans are accurately written and effectively implemented, it is important for citizens and local stakeholders to participate in all phases of the planning process. DWQ is continually coordinating with the local Soil and Water Conservation Districts (SWCD), council of governments, NC Cooperative Extension Service, the county Natural Resources Conservation Service (NRCS) and stakeholder groups to develop language and identify water quality concerns throughout the basin. Citizens and local communities can be involved throughout the planning process by contacting their county extension service or local SWCD and reporting water quality concerns.

During the public comment period, the draft plan is available online and by request for a period of at least 30 days. DWQ welcomes written comments and questions during this phase of the planning process and will incorporate comments and suggestions when appropriate. Remember, you may contact the basinwide planner responsible for your basin anytime during the plan's development.

Division of Water Quality Functions and Locations

For more information on the basinwide planning process, DWQ activities or contacts, visit http://h2o.enr.state.nc.us/basinwide/ or call (919) 733-5083 and ask for the basin planner responsible for your basin of interest. You can also contact the appropriate Regional Office (Figure 2) for additional information. For general questions about the Department of Environment and Natural Resources, contact the Customer Service Center at 1-877-623-6748.

Table 1 - Basinwide Planning Schedule (2000 to 2007)

Basin	DWQ Biological Data Collection	Public Mtgs. And Draft Out For Review	Final Plan Receives EMC Approval	Begin NPDES Permit Issuance
Chowan	Summer 2010	5/2007	9/2007	11/2007
Pasquotank	Summer 2010	5/2007	9/2007	12/2007
Neuse	Summer 2010	3/2007	7/2007	1/2008
Broad	Summer 2010	7/2007	1/2008	7/2008
Yadkin-Pee Dee	Summer 2006	1/2008	4/2008	9/2008
Lumber	Summer 2006	1/2008	1/2008	7/2009
Tar-Pamlico	Summer 2007	1/2009	5/2009	9/2009
Catawba	Summer 2007	1/2009	5/2009	12/2009
French Broad	Summer 2007	1/2009	5/2009	7/2010
New	Summer 2008	1/2010	5/2010	1/2011
Cape Fear	Summer 2008	3/2010	9/2010	2/2011
Roanoke	Summer 2004	7/2006	9/2006	1/2007
White Oak	Summer 2004	3/2007	5/2007	6/2007
Savannah	Summer 2004	1/2007	3/2007	8/2007
Watauga	Summer 2004	11/2006	1/2007	9/2007
Hiwassee	Summer 2004	1/2007	3/2007	8/2007
Little Tennessee	Summer 2004	1/2007	3/2007	10/2007

Note: A basinwide plan was completed for all 17 basins during the second cycle (1998 to 2003).

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

Years 1 – 2 **Water Quality Data Collection** **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 identified in current basinwide plan
Years 2 – 3 **Data Analysis and Collect** **Information from State** **Local Agencies**	• Gather and analyze data from sampling activities • Develop use support ratings • Conduct special studies and other water quality sampling activities • Work with state and local agencies to establish goals and objectives • Identify and prioritize issues for the next basin cycle • Develop preliminary pollution control strategies • Coordinate with local stakeholders and other state/local agencies
Years 3 – 5 **Preparation of Draft** **Basinwide Plan** **Public Review** **Approval of Plan** **Issue NPDES Permits** **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 for public review • Revise plan (when appropriate) to reflect public comments • 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

Some Other Reference Materials

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

- *A Citizen's Guide to Water Quality Management in North Carolina* (August 2000) This document includes general information about water quality issues and programs to address these issues. It is intended to be an informational document on water quality. Visit the website at http://h2o.enr.state.nc.us/basinwide/basinwide_wq_planning.htm to download this document.
- *Basinwide Assessment Report Roanoke River Basin* (NCDENR-DWQ, April 2005). This technical report presents physical, chemical, and biological data collected in the Roanoke River basin. This report can be found on the DWQ Environmental Sciences Section (ESS) website at http://h2o.enr.state.nc.us/esb/Basinwide/ROA2005.pdf
- *Roanoke Basinwide Water Quality Management Plan* (September 1996; July 2001). These first basinwide plans for the Roanoke River basin present water quality data, information, and recommended management strategies for the first two five-year cycles. Visit the website at http://h2o.enr.state.nc.us/basinwide/ to download this document.
- *North Carolina's Basinwide Approach to Water Quality Management: Program Description* (Creager and Baker, 1991). NC DWQ Water Quality Section. Raleigh, NC.

How to Read the Basinwide Plan

Chapters 1 - 10: Subbasin and Watershed Information

- **Summarizes information and data by subbasin, including:**
  - **Recommendations from the previous basin plan.**
  - **Achievements, current priority issues and concerns.**
  - **Impaired waters and waters with notable impacts.**
  - **Goals and recommendations for the next five years by subbasin.**

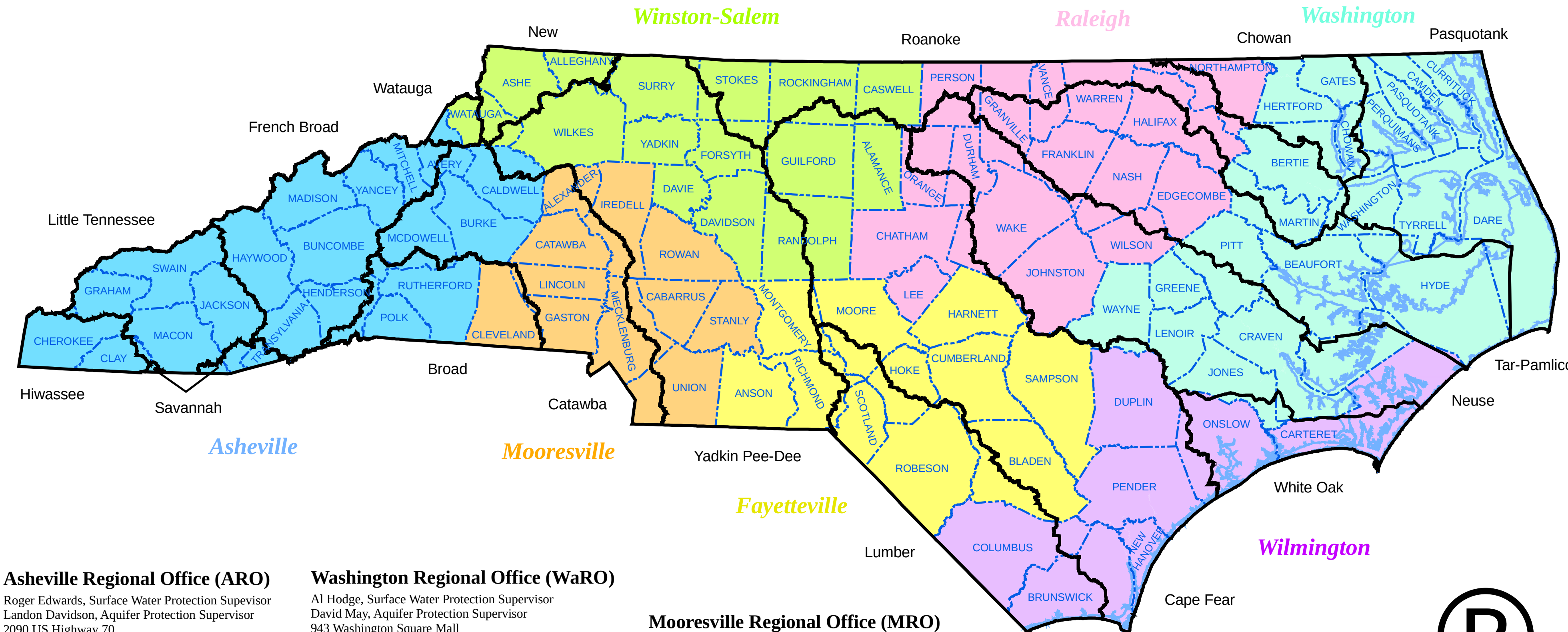
Chapter 11 – 20

- **Presents information on various topics of interest to protect and restore water quality in the basin, including:**
  - **Stream classifications.**
  - **Population and land cover changes.**
  - **Water Quality stressors.**
  - **Agricultural, forestry and permitting activities in the basin.**
  - **Water and natural resources.**
  - **Local initiatives.**

Appendices

- **Population and land use changes over time.**
- **Local governments in the basin.**
- **Water quality data collected by DWQ, use support methodology and 303(d) listing.**
- **NPDES dischargers and general stormwater permits.**
- **Points of contact.**
- **Glossary of terms and acronyms.**

Figure 2 North Carolina Department of Environment and Natural Resources Division of Water Quality Regional Offices



Asheville Regional Office (ARO)

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

Fayetteville Regional Office (FRO)

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

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

Mooresville Regional Office (MRO)

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Fax: (704) 663-6040

Alexander, Cabarrus, Catawba, Cleveland, Gaston, Iredell, Lincoln, Mecklenburg, Rowan, Stanly, Union

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Fax: (910) 350-2004

Brunswick, Carteret, Columbus, Duplin, New Hanover, Onslow, Pender

Winston-Salem Regional Office (WSRO)

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Winston-Salem, NC 27107
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Fax: (336) 771-4631

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

Central Office

DENR
DIVISION OF WATER QUALITY
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RALEIGH NC 27699-1617
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NCDENR
Planning Section
Basinwide Planning Unit
July 12, 2006

Chapter 1
Roanoke River Subbasin 03-02-01
Including: Dan River, Big Creek, Town Fork, Belews Creek and Snow Creeks

1.1 Subbasin Overview

Subbasin 03-02-01 at a Glance

Land and Water Area

Total area:	453 mi^2
Land area:	445 mi^2
Water area:	8 mi^2

Population

2000 Est. Pop.: 108,615 people
Pop. Density: 240 persons/mi^2

Land Cover (percent)

Forest/Wetland:	72.8%
Water:	1.9%
Urban:	0.6%
Cultivated Crop:	2.9%
Pasture:	21.8%

Counties

Surry, Stokes, Rockingham, Guilford and Forsyth

Municipalities

Danbury, Kernersville, Rural Hall, Walkertown and Walnut Cove

Monitored Stream Statistics

Aquatic Life

Total Streams:	153.7 mi/2867.7 ac
Total Supporting:	142.1 mi/2668.1 ac
Total Impaired:	11.6 mi
Total Not Rated:	46.1 mi

Recreation

Total Streams:	11.6 mi
Total Supporting:	11.6 mi

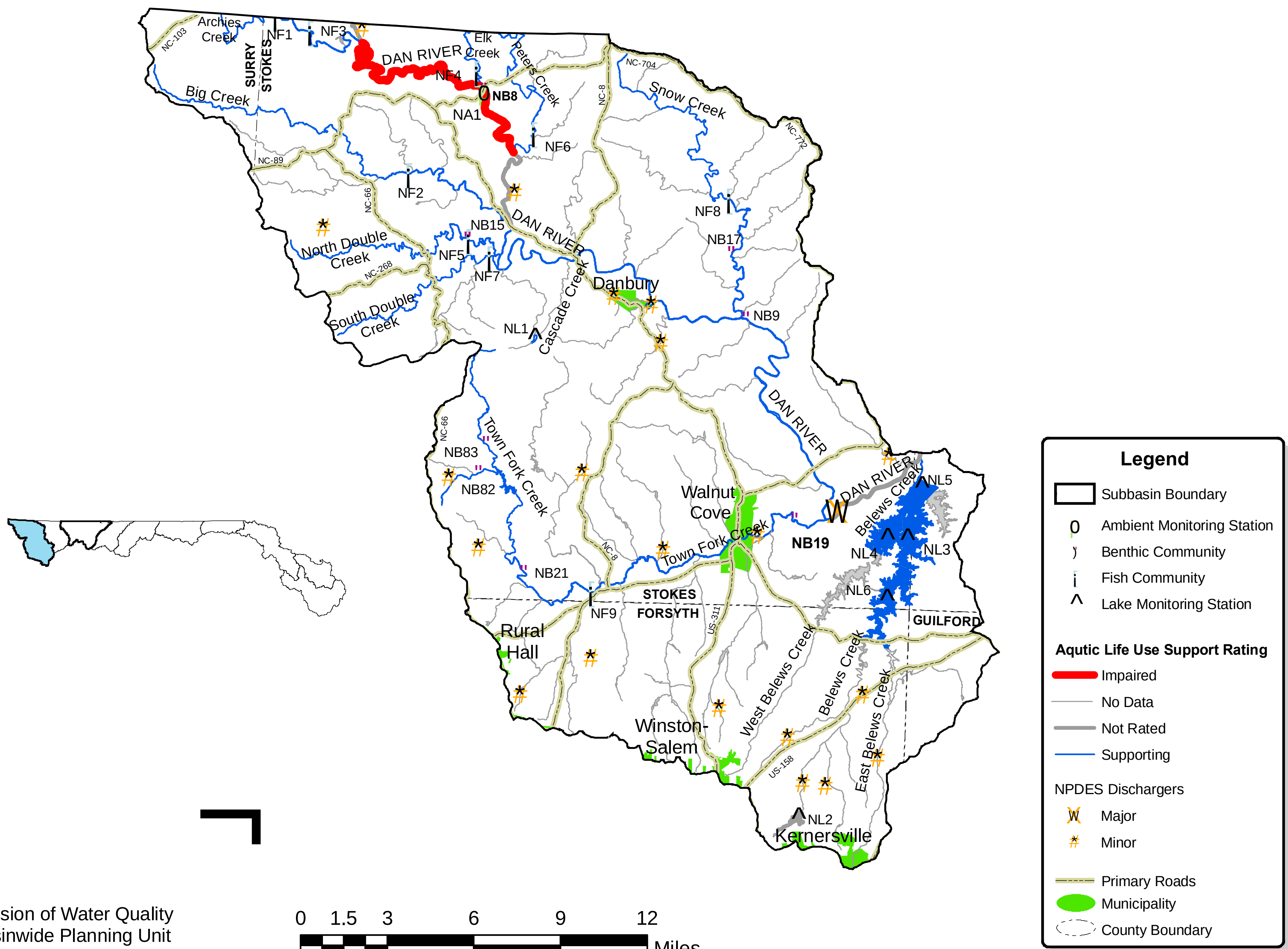
Although the headwaters of the Dan River originate in Virginia, this subbasin contains the uppermost reaches of the Dan River in North Carolina. More than seventy percent of this subbasin is forested, and less than three percent is in cultivated crop, the lowest percentage of this type land use in any of the subbasins. The percentage of the subbasin utilized for pasture was the greatest of any of the subbasins. Hanging Rock State Park is the largest publicly owned property in this subbasin.

By the year 2020, populations within Stokes and Forsyth counties are expected to increase by 24 percent and 21 percent, respectively. Of particular concern is residential and urban development occurring in the suburbanizing areas of northeastern Winston-Salem. Consequently, streams in these areas may be negatively impacted by sediment and streambank erosion commonly associated with development activities. Information regarding population growth, trends and impacts can be found in Chapter 12 and Appendix I.

Several water quality improvement programs have been implemented in this subbasin. The NC Agriculture Cost Share Program (NCACSP), which helps reduce agricultural runoff by helping farmers implement best management practices, is one of these programs. The NCACSP provided $164,929 towards implementing sediment and nutrient reduction practices, animal waste management, and livestock stream access elimination within this subbasin. For more information on this and other programs, refer to watershed discussion throughout this chapter as well as in Chapters 16 (Agriculture and Water Quality) and 20 (Water Quality Initiatives).

Twenty-one individual NPDES discharge permits are issued in this subbasin, five of which are required to conduct whole effluent toxicity testing. Refer to Appendix VI for more information on NPDES permit holders. Two registered cattle and one registered swine operations are located in this subbasin. Refer to Chapter 16 for more information regarding animal operations within this basin.

Figure 3 Roanoke River Subbasin 03-02-01



Division of Water Quality
Basinwide Planning Unit
May 30, 2006

Table 3 ROANOKE Subbasin 03-02-01

AU Number / Description	Classification	Length/Area		AL Rating	Station	Result	Year/ Parameter	% Exc	REC Rating	Station	Result	Stressors	Sources
Archies Creek													
22-2	C;Tr	7.3	FW Miles	**S**					ND				
North Carolina portion					NF1	E	'2004						
Belews Creek (including Belews Lake below elevation 725) (1)													
22-27-(7)	C	789.7	FW Acres	**S**	NL6	NCE			ND				
From Southern Railroad Bridge to to a point 1.8 mile downstream of Forsyth-Stokes County Line													
22-27-(7.5)	WS-IV	1,283.8	FW Acres	**S**	NL5	NCE			ND				
					NL3	NCE							
From a point 1.8 mile downstream of the Forsyth-Stokes County Line to Dan River, excluding the Arm of Belews Lake described below which are classified "WS-IV&B"													
Belews Creek (Kernersville Lake)													
22-27-(1.5)	WS-IV;CA	46.1	FW Acres	**NR**	NL2	ID			ND				
From a point 0.5 mile upstream of backwaters of Kernersville Lake to Town of Kernersville Water Supply Dam													
Big Creek													
22-9	C;Tr	19.9	FW Miles	**S**					ND				
From source to Dan River					NF2	G	'2004						
Brushy Fork Creek													
22-25-1	C	3.0	FW Miles	**S**					ND				
From source to Town Fork Creek					NB82	G	'2004						
Cascade Creek (Hanging Rock Lake)													
22-12-(2)a	B	12.2	FW Acres	**S**	NL1	NCE			ND				
From backwaters to dam at swimming lake													

Table 3 ROANOKE Subbasin 03-02-01

AU Number / Description	Classification	Length/Area	AL Rating	Station	Result	Year/ Parameter	% Exc	REC Rating	Station	Result	Stressors	Sources
DAN RIVER												
22-(8)	WS-V	25.9 FW Miles	S					ND				
From Big Creek to to a point 0.2 mile downstream of Town Fork Creek				NB9	G	2004						
DAN RIVER (North Carolina portion)												
22-(1)a	C;Tr	5.1 FW Miles	S					ND				
From North Carolina-Virginia State Line to Little Dan River				NF3	G	2004						
22-(1)b	C;Tr	11.6 FW Miles	I	NA1	CE	Turbidity	24.1	S	NA1	NCE	Turbidity	
From Little Dan River to Peters Creek				NB8	E	2004						
Elk Creek												
22-5	C;Tr	2.9 FW Miles	S					ND			Habitat Degradation	Land Clearing
From North Carolina-Virginia State Line to Dan River				NF4	GF	2004						
North Double Creek												
22-10	C	14.0 FW Miles	S					ND			Habitat Degradation	Impervious Surface
From source to Dan River				NB15	G	2004					Nutrient Impacts	Unknown
				NF5	GF	2004						
Peters Creek												
22-6	C;Tr	9.1 FW Miles	S					ND				
From North Carolina-Virginia State Line to Dan River				NF6	E	2004						
Snow Creek												
22-20	C	18.9 FW Miles	S					ND				
From source to Dan River				NB17	G	2000						
				NB17	G	2004						
				NF8	G	2004						
South Double Creek												
22-11	B	9.9 FW Miles	S					ND				
From source to Dan River				NF7	G	2004						

Table 3 ROANOKE Subbasin 03-02-01

AU Number / Description	Classification	Length/Area		AL Rating	Station	Result	Year/ Parameter	% Exc	REC Rating	Station	Result	Stressors	Sources
Town Fork Creek													
22-25a	C	8.0	FW Miles	**S**					ND				
From source to Timmons Cr.					NB83	G	'2004						
22-25b	C	18.0	FW Miles	**S**					ND			Habitat Degradation	Unknown
From Timmons Cr. to Dan River					NB19	G	'2004						
					NB21	GF	'2004						
					NF9	G	'2004						
West Belews Creek (West Belews Creek Arm of of Belews Lake below elevation 725)													
22-27-9-(4)	WS-IV	582.4	FW Acres	**S**	NL4	NCE			ND				
From a point 0.4 mile downstream of Powerplant to Belews Creek													

Table 3 ROANOKE Subbasin 03-02-01

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

Use Categories:	**Monitoring data type:**	**Results:**	**Use Support Ratings 2005:**
AL - Aquatic Life	NF - Fish Community Survey	E - Excellent	S - Supporting, I - Impaired
REC - Recreation	NB - Benthic Community Survey	G - Good	NR - Not Rated
	NA - Ambient Monitoring Site	GF - Good-Fair	NR*- Not Rated for Recreation (screening criteria exceeded)
	NL- Lake Monitoring	F - Fair	ND-No Data Collected to make assessment
		P - Poor	
		NI - Not Impaired	
Miles/Acres	m- Monitored	N- Natural	**Results**
FW- Fresh Water	e- Evaluated	M - Moderate	CE-Criteria Exceeded > 10% and more than 10 samples
		S-Severe	NCE-No Criteria Exceeded
			ID- Insufficeint Data Available

Aquatic Life Rating Summary

S	m	142.1	FW Miles
I	m	11.6	FW Miles
S	m	2,668.1	FW Acres
NR	m	46.1	FW Acres
NR	e	13.8	FW Miles
ND		262.9	FW Miles
ND		326.5	FW Acres

Recreation Rating Summary

S	m	11.6	FW Miles
NR	e	18.2	FW Miles
ND		400.5	FW Miles
ND		3,040.7	FW Acres

Fish Consumption Rating Summary

I	e	430.3	FW Miles
I	e	3,040.7	FW Acres

Nine benthic macroinvertebrate community samples and nine fish community samples (Figure 3 and Table 3) were collected during this assessment period in this subbasin. Data were also collected at one ambient monitoring station and three lakes. Refer to the *2005 Roanoke River Basinwide Assessment Report* at http://www.esb.enr.state.nc.us/bar.html and Appendix IV for more information on monitoring.

A map including the locations of NPDES discharges and water quality monitoring stations is presented in Figure 3. Table 3 contains a summary of assessment units and lengths, streams monitored, monitoring data types, locations and results, along with use support ratings for waters in this subbasin. Refer to Appendix IX for more information about use support ratings.

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

1.2 Use Support Assessment Summary

Use support ratings were assigned for waters in subbasin 03-02-01 in the aquatic life, recreation, fish consumption and water supply categories. All waters are Impaired on an evaluated basis in the fish consumption category because of fish consumption advice that applies to the entire basin. In the water supply category, all waters are Supporting on an evaluated basis based on reports from DEH regional water treatment plant consultants.

There were 153.7 stream miles (35.7 percent) and 2714.2 freshwater acres (89.3 percent) monitored during this assessment period in the aquatic life category. Of this, 142.1 stream miles (33 percent) and 2,668.1 freshwater acres (87.8 percent) were supporting and 11.6 stream miles (2.7 percent) were impaired for aquatic life. In the recreation category, all 11.6 monitored stream miles (2.7 percent) were supporting. Refer to Table 3 for a summary of use support ratings for waters in subbasin 03-02-01.

1.3 Status and Recommendations of Previously and Newly Impaired Waters

The following waters were either identified as Impaired in the previous basin plan (2001) or are newly Impaired based on recent data. If previously identified as Impaired, the water will either remain on the state's 303(d) list or will be delisted based on recent data showing water quality improvements. If the water is newly Impaired, it will likely be placed on the 2008 303(d) list. The current status and recommendations for addressing these waters are presented below, and each are identified by the assessment unit number (AU#). Information regarding 303(d) listing and reporting methodology is presented in Appendix VII.

1.3.1 Town Fork Creek Watershed [AU# 22-25a & b & 22-25-1]

2001 Recommendation

The 2001 Basinwide Plan identified 8 miles of Town Fork Creek [AU# 22-25a], from source to Timmons Creek, as partially supporting for aquatic life due to a Poor benthic community bioclassification in 1995 at SR 1700 located less than 500 meters downstream from an impoundment. The plan recommended that more field investigation was needed in order to determine the actual sources of pollution in the watershed.

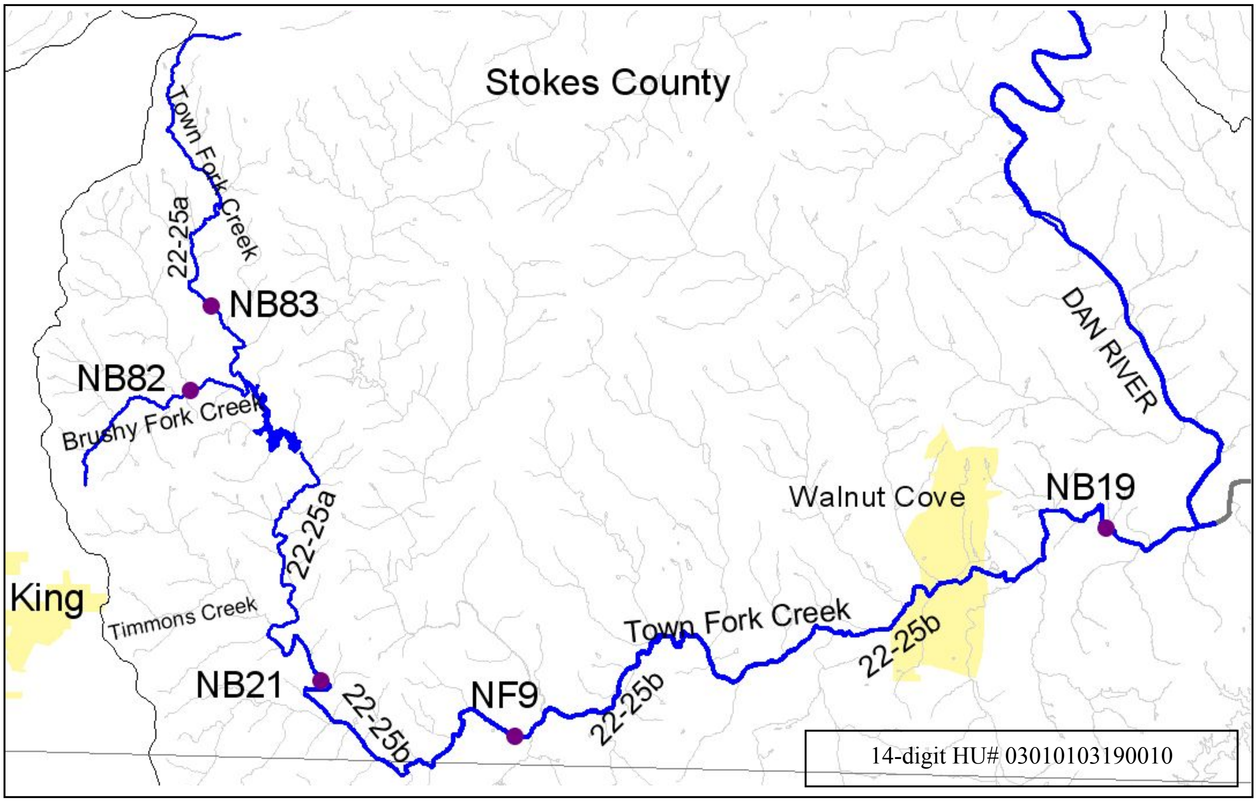


Figure 4 - Upper Town Fork Creek Watershed

Current Status

Town Fork Creek (AU# 22-25a & b), from source to Dan River is Supporting aquatic life due to Good and Good-Fair benthic community bioclassifications at sites NB83 and NB21. A TMDL stressor study was conducted in 2004 in the upper Town Fork Creek watershed, see Figure 4. One benthos site NB83 was sampled upstream and another site NB21 was sampled well below the impoundment. In addition, Town Fork Creek (AU#22-25b) received a Good fish community bioclassification at site NF9, and a Good benthic community rating at site NB19, see Figure 3 and 4. Both sites NB83 and NB21 indicated the portion of the stream sampled in close proximity to the impoundment in 1995 was not representative of conditions in the upper Town Fork Creek watershed.

Brushy Fork Creek (AU# 22-25-1), from source to Town Fork Creek, was also sampled as part of the stressor study and is Supporting aquatic life due to a Good benthic community bioclassification at site NB82.

2006 Recommendation
Town Fork Creek [AU# 22-25a] will be removed from the 303(d) list due to the Good-Fair benthic community bioclassification.

Water Quality Initiatives
Several agricultural BMPs were installed in the upper Town Fork Creek watershed during this basinwide cycle. These practices include the installation of 22.8 acres of conservation tillage, 0.3 acres of critical area plantings, 0.5 acres of grassed waterways, and 0.8 acres of field borders. In addition, a stormwater management system, 2 tanks, 3,645 feet of livestock exclusion fencing, 2 heavy use areas, and a stock trail were also installed. Funding was provided by the NCACSP for a total cost of $46,504. In addition, there is one Environmental Quality Incentives Program (EQIP) contract planned for this watershed for $26,283. This project would include one well, one stock trail for 415 linear feet, one large heavy use area protection (approx. 2,500 sq. ft.), three watering facilities, three small (20' x 20') heavy use areas under the waterers, 2,550 feet pipeline, fencing (livestock exclusion from streams) for 8,340 linear feet and one roof runoff management system.

Refer to Chapter 16 for more information about the NCACSP and EQIP or contact the Stokes County Soil and Water Conservation District (SWCD) for more information.

1.3.2 Dan River [AU# 22-(1)b]

2001 Recommendation
The 2001 Basinwide Plan identified this segment of the Dan River as exceeding the turbidity standard in 35 percent of the samples collected from 1995 to 1999 at NC 704. However, this segment of the river was Supporting aquatic life due to a Good benthic community bioclassification at the same site location.

Current Status
The Dan River from Little Dan River to Peters Creek (11.6 miles), is Impaired for aquatic life because the turbidity standard of 10 NTUs was exceeded in 24 percent of the samples at site NA1. This segment is classified as Trout (Tr) waters, which are “suitable for natural trout propagation and maintenance of stocked trout” (15A NCAC02B.0301). A concurrent site (NB8) received an Excellent benthic community bioclassification. However, because each data type is assessed independently, the segment will remain Impaired for aquatic life. Refer to Appendix IX for more information.

This segment of the Dan River is Supporting for recreation because the fecal coliform bacteria screening criteria was not exceeded at site NA1.

DWQ conducted a trends and annual load analysis on data collected from 1990 to 2004 at site NA1. The analysis included trends on total nitrogen (TN), defined as the sum of total Kjeldahl nitrogen and nitrate-nitrogen, total phosphorus (TP), water temperature, turbidity and total suspended solids (TSS). Results indicated that average TN and TP concentrations peaked in February and August respectively and decreased to a minimum in October. TSS and turbidity levels peaked in the late spring and early summer months. There were no trends significant at the 95 percent confidence level.

2006 Recommendation
High levels of turbidity over a sustained period of time have the potential to negatively impact aquatic communities. In 1991, trout buffer language was added to the NC Sedimentation Pollution Control Act, stating that waters classified as trout waters shall have an undisturbed buffer zone of 25 feet wide or of sufficient width to confine siltation within the twenty-five percent of the buffer zone nearest the land disturbing activity. This law also pertains to all unnamed tributaries that drain to classified trout waters. DWQ will continue to monitor the Dan River. DWQ will also work with local agencies to identify sediment sources and assist agency personnel to locate resources for water quality protection funding. It is recommended that local agencies work to install BMPs and implement a sediment and erosion control program.

The NC Wildlife Resources Commission (WRC) has identified this portion of the Dan River as an area that supports listed and otherwise rare and sensitive aquatic species. The James spinymussel (*Pleurobema collina*) was listed as federally endangered in 1988 and at the time of listing was known only from the James River drainage in Virginia and West Virginia. Primary threats to the James spinymussel include: habitat loss and modification; siltation due to agriculture, forestry, and urban development; interactions with the non-native Asiatic clam (*Corbicula fluminea)*; impoundments; and pollution by municipal, industrial, and agricultural sources (USFWS 1990). The first collection of the James spinymussel in North Carolina occurred in 2000 from the Dan River in Stokes County. As of 2006, a comprehensive surveys has not been completed in the Dan River drainage by WRC.

The Green floater (*Lasmigona subviridis*) is classified as a federal species of concern and state endangered species and is also found in the Dan River drainage. Future surveys into tributaries and additional mainstem surveys may yield further data regarding species populations within the area. Based on known occurrences, the Dan River in Stokes County and the Mayo River in Rockingham County currently support a diversity of rare mussel species. Good environmental management decision should be made to protect these species and their aquatic habitats (WRC, memo August 2005).

See Chapter 4, section 4.3.1 for Dan River summary.

1.4 Status and Recommendations for Waters with Noted Impacts

The surface waters discussed in this section are not Impaired. However, notable water quality problems and concerns were documented for these waters during this assessment. Attention and resources should be focused on these waters to prevent additional degradation and facilitate water quality improvements. DWQ will notify local agencies of these water quality concerns and work with them to conduct further assessments and to locate sources of water quality protection funding. Additionally, education on local water quality issues and voluntary actions are useful tools to prevent water quality problems and to promote restoration efforts. Nonpoint source program agency contacts are listed in Appendix VIII.

1.4.1 Elk Creek [AU# 22-5]

Current Status and 2006 Recommendation

Elk Creek, from North Carolina-Virginia State Line to Dan River (2.9 miles) is Supporting due to a Good-Fair fish community bioclassification at site NF4. Despite the occurrence of wild brown trout, five species of darters, and three endemic species including one cutlip minnow, this site and its fish community suffer from altered riparian habitats (narrow zones that offer minimal shading; riparian zones that have been periodically burned and riparian zones with numerous breaks that contribute nonpoint source nutrients and sediment to the stream). Stream restoration activities are desirable along Elk Creek to stabilize and improve the overall creek habitat.

1.4.2 North Double Creek [AU# 22-10]

Current Status and 2006 Recommendation

North Double Creek, from source to Dan River (14.0 miles), is Supporting aquatic life because of a Good-Fair fish community bioclassification at site NF5 and a Good benthic community bioclassification at site NB15. Site NF5 was one of only two sites in Stokes and Rockingham counties where no intolerant fish species were collected (the other site being Pawpaw Creek in subbasin 03-02-02). However, the intolerant chainback darter was collected upstream in 2002 - 2003 by the NCWRC (Hodges 2004). The predominant land use is agricultural and nonpoint sources of nutrients from upstream sources may have contributed to the abundance of the bluehead chub; 43 percent of all the fish collected were this species. This site and others within the watershed should be resampled to determine what is preventing the community from being rated Good or Excellent.

1.4.3 Snow Creek [AU# 22-20]

Current Status and 2006 Recommendation

Snow Creek, from source to Dan River (18.9 miles) is Supporting aquatic life based on Good fish and benthic community bioclassifications at sites NF8 and NB17. The 2001 Roanoke River Basinwide Water Quality Plan identified nonpoint source pollution impacts in this watershed. Sedimentation, infrequent riffle areas and a significant lack of riparian vegetation were observed. DWQ will continue to monitor Snow Creek.

Water Quality Initiatives

The Ecosystems Enhancement Program conducted a stream restoration project on Snow Creek from Snow Hill Church Rd to Moir Farm Road, just upstream of site NF8. The project was completed in January 2005 and restored 3,400 linear feet of Snow Creek and over 650 linear feet on two tributaries. The project also included a conservation easement of 970 feet. In addition, 9,300 ft of fencing was installed for cattle exclusion and 2,200 ft as alternative pasture management. Additional BMPs are planned and will be installed through the federally funded Environmental Quality Incentives Program (EQIP).

1.4.4 Dan River [AU# 22-(25.5)]

Current Status and 2006 Recommendation

Dan River, from a point 0.2 mile downstream of Town Fork Creek to a point 0.3 mile upstream of Reed Creek, in subbasin 03-02-02 (9.2 miles) is Not Rated on an evaluated basis for aquatic life. KobeWieland Copper Products, Inc experienced noncompliance with their whole effluent toxicity (WET) testing permit requirement in early 2004. DWQ worked with the facility to identify and correct the toxicity problem. The facility has since been in compliance with the WET requirement and will continue to conduct WET testing per their permit requirement.

See Chapter 4, section 4.3.1 for Dan River summary.

1.5 Additional Water Quality Information within Subbasin 03-02-01

The following section discusses lakes assessments, other water quality issues and identifies those surface waters given an Excellent bioclassification, and therefore, may be eligible for reclassification to a High Quality Water (HQW) or an Outstanding Resource Water (ORW). It should be noted that these are streams that were sampled by DWQ during this basinwide cycle. There may be other tributaries eligible for reclassification in addition to the ones listed below. For more information regarding water quality standards and classifications, refer to Chapter 11.

1.5.1 Cascade Creek (Hanging Rock Lake) [AU# 22-12-(2)a]

Current Status and 2006 Recommendation

Hanging Rock Lake (12.2 acres) is Supporting aquatic life due to lakes assessment data from site NL1. This small reservoir located inside Hanging Rock State Park was sampled in the summers of 2000, 2001, 2002 and 2004. Low chlorophyll *a* and nutrient concentrations were found throughout the summers of 2002 and 2004 indicating low biological productivity. Assessment of parameters related to biological productivity indicated low biological productivity and oligotrophic status. Water clarity was good and Hanging Rock Lake exhibits excellent water quality.

1.5.2 Belews Creek (Kernersville Lake) [AU#22-27-(1.5)]

Current Status and 2006 Recommendation

Kernersville Lake (Belews Creek), from a point 0.5 mile upstream of backwaters of Kernersville Lake to Town of Kernersville Water Supply Dam (46.1 acres), is Not Rated for aquatic life due to the small number of samples (less than 10) taken at site NL2. Kernersville Lake is a backup water supply for the Town of Kernersville, and was sampled in 2000, 2001 and 2004. Water quality monitoring indicated moderately high nutrient and chlorophyll *a* levels. Assessment of parameters related to biological productivity indicated eutrophic conditions. Water clarity was somewhat reduced and typical of a eutrophic lake. Manganese levels were slightly elevated, probably due to bottom disturbances resuspending manganese in the sediments. This is expected in a small, fairly shallow reservoir such as Kernersville. There were no drinking water problems associated with these levels of manganese reported by the Town of Kernersville.

1.5.3 Belews Lake [AU# 22-27-(7), 22-27-(7.5), (West Belews Creek) 22-27-9-(4)]

Current Status and 2006 Recommendation

Belews Lake (Belews Creek) [AU# 22-27-(7)], from Southern Railroad Bridge to a point 1.8 mile downstream of Forsyth-Stokes County Line (789.7 acres) is Supporting aquatic life based on data from samples taken at site NL6. Belews Lake (Belews Creek) [AU# 22-27-(7.5)], from a point 1.8 mile downstream of the Forsyth-Stokes County Line to Dan River, excluding the Arm of Belews Lake described below which are classified "WS-IV&B" (1,283.8 acres), is Supporting aquatic life based on data from samples collected at sites NL3 and NL5. It was noted that the percent dissolved oxygen saturation exceeded the target of 120 percent in 9 percent of the samples taken, indicating potential algal activity. However, no other parameters were elevated in this segment. Belews Lake (West Belews Creek) [AU# 22-27-9-(4)], from a point 0.4 mile downstream of Power plant to Belews Creek (582.4 acres), is Supporting aquatic life based data from samples taken at site NL 4.

The lake provides condenser cooling water for the Belews Creek Duke Power Steam Station. Water quality sampling during the summers of 2000, 2001, 2002 and 2004 indicated low concentrations of nutrients and chlorophyll *a*. Assessment of parameters related to biological productivity indicated low biological productivity and oligotrophic conditions, as has been seen in historical sampling. Water temperatures were above the state water quality standard for temperature on some sampling visits but this has been seen in historical sampling and is due to the discharge from Duke Power's Belews Creek Steam Station coal-fired power plant. Duke Power has a temperature variance for the lake that allows exceedance of the state temperature standard above the dam.

Duke Power has performed chemical treatment on about 100 acres in 2004 to control *Hydrilla sp.* in Belews Lake (Rob Emens, N.C. Division of Water Resources, personal communication) in the vicinity of NC 158 outside the area where DWQ sampling sites are located.

A fish consumption advisory against eating fish contaminated with selenium due to a now closed coal ash disposal basin at the power plant was rescinded in August 2000 as selenium levels in the fish were below concentrations of concern (Luanne Williams, NC Division of Public Health, personal communication). This reduction resulted in the removal of Belews Lake from the 303(d) list of impaired waters.

Duke Power also conducts water quality sampling and benthic macroinvertebrate and fisheries monitoring of Belews Lake (Duke Power, 2001). This monitoring has shown that Belews Lake water chemistry has improved since the mid 1980's. The dry fly ash discharge from the Belews Creek Steam Station was rerouted from Belews Lake to the Dan River in 1985. Sediment arsenic and selenium levels in the lake have remained elevated relative to non-impacted sites but have gradually declined. Selenium levels in benthic macroinvertebrates have also declined but levels in macroinvertebrates collected in the downstream portion of the lake were higher than those collected in the upstream portion of the lake. The benthic macroinvertebrate species diversity indicates that the Belews Creek Steam Station is not impacting the benthic macroinvertebrate community. Selenium concentrations in the fish in Belews Lake are not high enough to pose a threat to fish or human populations. The fish community in Belews Lake was found to be typical of that in a piedmont lake of similar productivity and indicates no impact from the power plant.

1.5.4 Archies Creek [AU# 22-2]

Current Status and 2006 Recommendation
Archies Creek, North Carolina portion (7.3 miles), is Supporting aquatic life due to an Excellent fish community bioclassification at site NF1 making it eligible for reclassification to HQW or ORW. At site NF1, five species of darters and three endemic species including eleven cutlip minnows were collected. The current DWQ classification is class C Tr.

1.5.5 Peters Creek [AU# 22-6]

Current Status and 2006 Recommendation
Peters Creek, from North Carolina-Virginia State Line to Dan River (9.1 miles), is Supporting aquatic life due to an Excellent fish community bioclassification at site NF6 making it eligible for reclassification to HQW or ORW. At site NF6, the instream and riparian habitats were of exceptional high quality and was qualified as a new fish community regional reference site by DWQ biologists. At site NF6, twenty-four species (the second greatest number of species collected from any site in the basin), six species of darters (the most number of species collected from any site in the basin) and three endemic species including two bigeye jumprocks were collected. This was the only site in the basin where the State Threatened bigeye jumprock (*Scartomyzon ariommus*) was collected and was the only site in the basin where five intolerant species were collected. The current DWQ classification is class C Tr.

1.6 Additional Water Quality Issues within Subbasin 03-02-01

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

1.6.1 Land Clearing Activities

Most of the terrain is hilly in this subbasin; therefore sedimentation problems are more intense during land clearing and grading activities. Sediment, when not properly controlled by BMPs, frequently causes excessive damage to the aquatic ecosystems. As land is converted from forest or agriculture to residential developments, the proper enforcement and oversight of BMPs is necessary to avoid water quality impacts and impairment. Local governments are encouraged to implement a stricter local sediment and erosion control ordinance, which would target land clearing activities that are less than a half acre.

Chapter 2
Roanoke River Subbasin 03-02-02
Including: Dan and Mayo Rivers, Pawpaw and Jacobs Creek

2.1 Subbasin Overview

Subbasin 03-02-02 at a Glance

Land and Water Area

Total area:	231 mi²
Land area:	229 mi²
Water area:	2 mi²

Population Statistics

2000 Est. Pop.: 33,541 people
Pop. Density: 146 persons/mi²

Land Cover (percent)

Forest/Wetland:	76%
Surface Water:	0.8%
Urban:	1.3%
Cultivated Crop:	3.6%
Pasture/ Managed Herbaceous:	18.2%

Counties

Stokes, Rockingham and Guilford

Municipalities

Madison, Mayodan and Stoneville

Monitored Stream Statistics

Aquatic Life

Total Streams:	39.9 mi
Total Supporting:	35.1 mi
Total Impaired:	4.8 mi

Recreation

Total Streams:	8.3 mi
Total Not Rated:	3.5 mi
Total Impaired:	4.8 mi

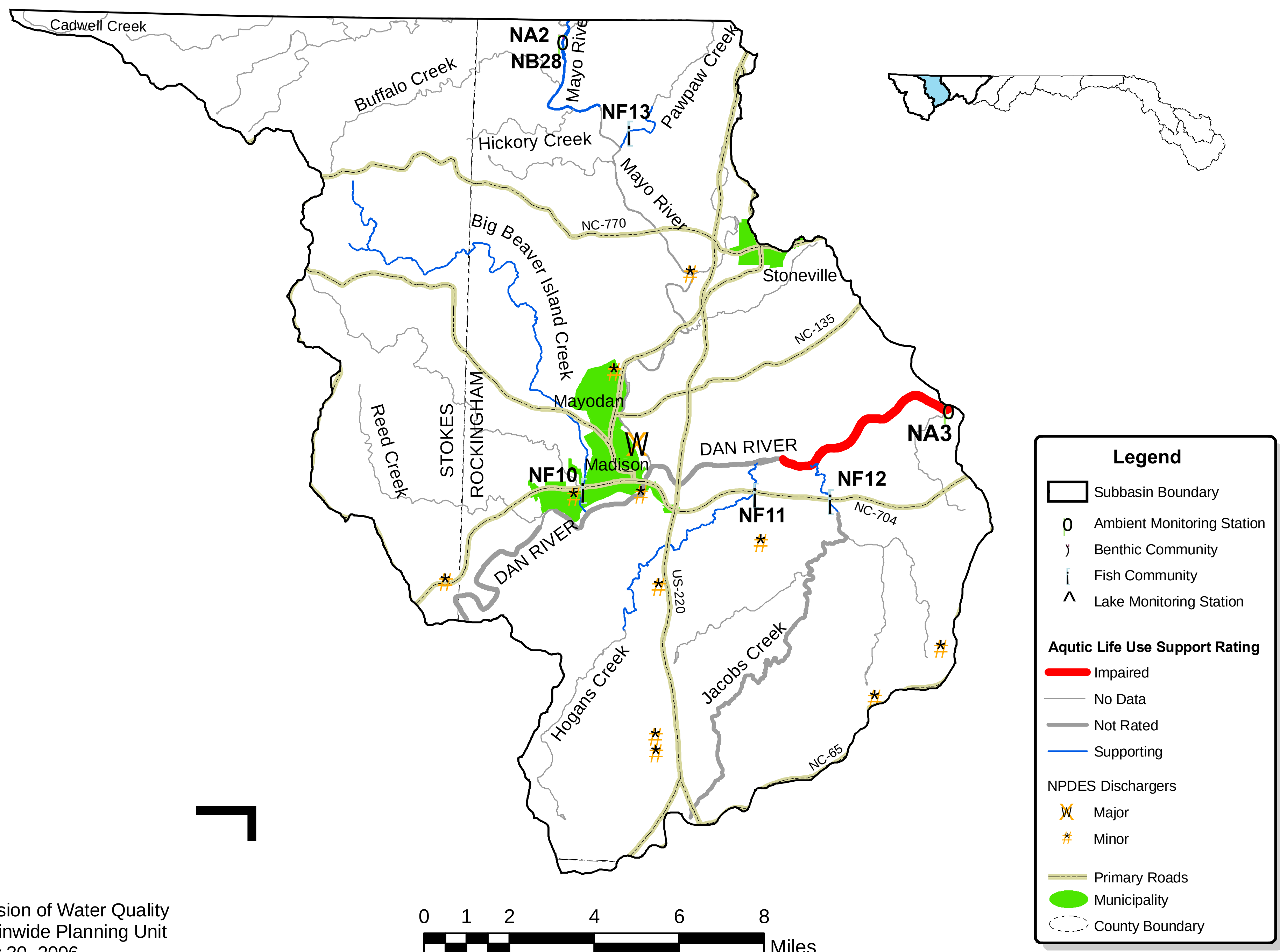
This subbasin contains a very short reach of the Dan River (approximately 10 miles) and the entire North Carolina section of the Mayo River. However, most of the Mayo River watershed is located in Virginia. Most of the land is forested (76 percent), but a significant portion is also in use as cultivated cropland and pasture (22 percent). Population is expected to increase by 24 percent in Stokes County and by 8.5 percent in Rockingham County by the year 2020. However, Madison and Mayodan experienced a decline in percent change from 1990-2000 by 4.6 percent and 2.2 percent, respectively. For more information regarding population growth and trends, refer to Appendix I.

Several water quality improvement programs have been implemented in this subbasin. The NC Agriculture Cost Share Program (NCACSP), which helps reduce agricultural runoff by helping farmers implement best management practices, is one of these programs. The NCACSP provided $226,506 towards implementing sediment and nutrient reduction practices, animal waste management, and livestock stream access elimination within this subbasin. For more information on this and other programs, refer to watershed discussion throughout this chapter as well as in Chapters 16 and 20.

Ten individual NPDES wastewater discharge permits are issued in this subbasin with a total permitted flow of 5.37 MGD. One facility is required to conduct whole effluent toxicity testing. Refer to Appendix VI for more information on NPDES permit. One registered swine operation is located in this subbasin. Refer to Chapter 16 for more information regarding animal operations within this basin.

One benthic macroinvertebrate community sample and four fish community samples (Figure 5 and Table 4) were collected during this assessment period. Data were also collected from one ambient monitoring station. Refer to the *2005 Roanoke River Basinwide Assessment Report* at http://www.esb.enr.state.nc.us/bar.html and Appendix IV for more information on monitoring.

Figure 5 Roanoke River Subbasin 03-02-02



Division of Water Quality
Basinwide Planning Unit
May 30, 2006

Table 4 ROANOKE Subbasin 03-02-02

AU Number / Description	Classification	Length/Area	AL Rating	Station	Result	Year/ Parameter	% Exc	REC Rating	Station	Result	Stressors	Sources
Big Beaver Island Creek												
22-29	C	15.2 FW Miles	S					ND				
From source to Dan River				NF10	G	'2004						
DAN RIVER												
22-(31.5)a	WS-IV	4.8 FW Miles	I	NA3	CE	Turbidity	16.4	I	NA3	CE	Turbidity	Unknown
From a point 0.7 mile upstream of Jacobs Creek to subbasin 03-02-02/03 boundary											Habitat Degradation	Land Clearing
											Fecal Coliform Bacteria	Unknown
Hogans Creek												
22-31	C	12.7 FW Miles	S					ND				
From source to Dan River				NF11	G	'2004						
Jacobs Creek												
22-32-(3)	WS-IV	1.8 FW Miles	S					ND				
From N.C. Hwy. 704 to Dan River				NF12	G	'2004						
Mayo River												
22-30-(1)	WS-V	3.5 FW Miles	S	NA2	NCE	Turbidity	8.6	NR*	NA2	CE	Fecal Coliform Bacteria	Unknown
From North Carolina-Virginia State Line to a point 0.6 mile downstream of Hickory Creek				NB28	G	'2004					Turbidity	Unknown
Pawpaw Creek												
22-30-6-(2)	WS-IV	1.8 FW Miles	S					ND			Nutrient Impacts	Unknown
From a point 1.3 mile upstream of Rockingham County SR 1360 to Mayo R.				NF13	GF	'2004						

Table 4 ROANOKE Subbasin 03-02-02

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

Aquatic Life Assessment — Recreation Assessment

Use Categories:	Monitoring data type:	Results:	Use Support Ratings 2005:
AL - Aquatic Life	NF - Fish Community Survey	E - Excellent	S - Supporting, I - Impaired
REC - Recreation	NB - Benthic Community Survey	G - Good	NR - Not Rated
	NA - Ambient Monitoring Site	GF - Good-Fair	NR*- Not Rated for Recreation (screening criteria exceeded)
	NL- Lake Monitoring	F - Fair	ND-No Data Collected to make assessment
		P - Poor	
		NI - Not Impaired	
Miles/Acres	m- Monitored	N- Natural	**Results**
FW- Fresh Water	e- Evaluated	M - Moderate	CE-Criteria Exceeded > 10% and more than 10 samples
		S-Severe	NCE-No Criteria Exceeded
			ID- Insufficeint Data Available

Aquatic Life Rating Summary

S	m	35.1	FW Miles
I	m	4.8	FW Miles
NR	e	9.1	FW Miles
ND		89.6	FW Miles

Recreation Rating Summary

NR*	m	3.5	FW Miles
I	m	4.8	FW Miles
NR	e	13.2	FW Miles
ND		117.1	FW Miles

Fish Consumption Rating Summary

I	e	138.6	FW Miles

A map including the locations of NPDES discharges and water quality monitoring stations is presented in Figure 5. Table 4 contains a summary of assessment units and lengths, streams monitored, monitoring data types, locations and results, along with use support ratings for waters in this subbasin. Refer to Appendix IX for more information about use support ratings.

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

2.2 Use Support Assessment Summary

Use support ratings were assigned for waters in subbasin 03-02-02 in the aquatic life, recreation, fish consumption and water supply categories. All waters are Impaired on an evaluated basis in the fish consumption category because of fish consumption advice applies to the entire basin. In the water supply category, all waters are Supporting on an evaluated basis based on reports from DEH regional water treatment plant consultants.

There were 39.9 stream miles (28.8 percent) monitored during this assessment period in the aquatic life category. In the recreation category, 8.3 stream miles (6 percent) were monitored. A total of 4.8 stream miles (3.5 percent) are Impaired, for both the aquatic life and recreational use categories. Refer to Table 4 for a summary of use support ratings for waters in subbasin 03-02-02.

2.3 Status and Recommendations of Previously and Newly Impaired Waters

The following waters were either identified as Impaired in the previous basin plan (2001) or are newly Impaired based on recent data. If previously identified as Impaired, the water will either remain on the state's 303(d) list or will be delisted based on recent data showing water quality improvements. If the water is newly Impaired, it will likely be placed on the 2008 303(d) list. The current status and recommendations for addressing these waters are presented below, and each are identified by an assessment unit number (AU#). Information regarding 303(d) listing and reporting methodology is presented in Appendix VII.

2.3.1 Dan River [AU# 22-(31.5)a]

2001 Recommendations

The Dan River [AU# 22-(31.5)a], from a point 0.7 miles upstream of Jacobs Creek to subbasin 03-02-03 boundary (4.8 miles), and [AU# 22-(31.5)b, in subbasin 03-02-03] from the 03-02-02 boundary to a point 0.8 miles downstream of Matrimony Creek (9.4 miles), was Impaired due to turbidity standard violation. The 2001 basin plan recommended that DWQ would work with the Division of Land Resources to evaluate and reduce turbidity from permitted instream mining operations in the Dan River. As permits are renewed, monitoring upstream and downstream of mining operations and instream BMPs (such as those used by the NC Department of Transportation during bridge construction) could be required. In addition, DWQ will notify local agencies of water quality concerns regarding these waters and work with them to conduct further monitoring and to locate sources of water quality protection funding.

Current Status and 2005 Recommendations
The Dan River [AU# 22-(31.5)a], from a point 0.7 mile upstream of Jacobs Creek to subbasin 03-02-03 boundary (4.8 miles), is Impaired for aquatic life and recreation due to turbidity and fecal coliform bacteria standards violations at site NA3. This section of the Dan River spans across two subbasin boundaries, refer to subbasin 03-02-03 section 3.3.1 [AU# 22-(31.5)b] for more details about data collection and recommendations for this section of the Dan River.

This section of the Dan River will be placed on the 2008 303(d) list for Fecal Coliform violations.

See Chapter 4, section 4.3.1 for Dan River summary.

2.4 Status and Recommendations for Waters with Noted Impacts

The surface waters discussed in this section are not Impaired. However, notable water quality problems and concerns were documented for these waters during this assessment. Attention and resources should be focused on these waters to prevent additional degradation and facilitate water quality improvements. DWQ will notify local agencies of these water quality concerns and work with them to conduct further assessments and to locate sources of water quality protection funding. Additionally, education on local water quality issues and voluntary actions are useful tools to prevent water quality problems and to promote restoration efforts. Nonpoint source program agency contacts are listed in Appendix VIII.

2.4.1 Pawpaw Creek [AU# 22-30-6-(2)]

Current Status and 2006 Recommendations
Pawpaw Creek, from a point 1.3 mile upstream of Rockingham County SR 1360 to Mayo River (1.8 miles), is Supporting aquatic life due to a Good-Fair fish community bioclassification at site NF13. The overall habitat was noted as high quality but no intolerant species were collected at this site. The predominant land use is agricultural and nonpoint sources of nutrients may be contributing to the abundance of the bluehead chub. DWQ will continue to monitor this site.

2.4.2 Mayo River [AU# 22-30-(1)]

Current Status and 2006 Recommendations
Mayo River, from North Carolina-Virginia State Line to a point 0.6 miles downstream of Hickory Creek (3.5) miles is Supporting aquatic life due to a Good benthic community bioclassification at site NB28. However, data from the ambient monitoring station at site NA2 show the turbidity parameter is elevated, exceeding the standard in 8.6 percent of the samples taken. DWQ will continue to monitor this site.

This section of Mayo River is Not Rated in the recreation category due to 2003 ambient monitoring fecal coliform bacteria screening criteria exceeded 25 percent of the samples were greater than 400 colonies/100 ml at site NA2. Further assessment of the fecal coliform bacteria standard was not conducted due to resource constraints.

During 2002-2003, the Mayodan WWTP received a State Revolving Loan from the DWQ Construction Grants and Loans Section to upgrade and expand from 3.0 MGD to 4.5 MGD. This was a regionalization effort to serve Stoneville WWTP and Madison. Stoneville WWTP was tied into Mayodan in 2004 which discharges 4.5 MGD into the Mayo River.

In addition to the Dan River in Stokes County, the Wildlife Resources Commission conducted mussel surveys on the Mayo River in Rockingham County between 2001 and 2002. Species collected included: the federally endangered, James spinymussel, federal species of concern green floater, and state species of concern notched rainbow (*Villosa constricta*) mussel. All mussels have a unique life cycle dependent upon habitat suitability, especially water quality. With maintenance and improvement of water quality in the basin, continued existence and possible range expansion of these rare species may be observed (WRC, memo August 2005).

Water Quality Initiatives
The NC Ecosystems Enhancement Program (EEP) is working with landowners to establish conservation easements with 300' buffers along 9,355 linear feet of river frontage on one-side of the Mayo River [AU 22-30-(1)]. EEP is also working on a similar easement on 4,038 linear feet of one side of the Mayo River [AU 22-30-(5.5)] approximately one mile downstream. The tracts targeted for protection also encompass several thousand feet of tributaries, including 2,430 feet on Buffalo Creek (AU 22-30-4), 3,154 feet on Hickory Creek (AU 22-30-5), and 2,176 feet on an unnamed tributary to the Mayo River [AU 22-30-(1)].

In addition, the Division of Parks and Recreation targeted the Mayo River for development of a new state park. The Mayo River State Park was authorized as a new unit of the state parks system in the 2003 session of the NC General Assembly. That action allows the division to further develop plans for a park and to consider land acquisition strategies. The division has worked closely with the Dan River Basin Association and the Rockingham County Planning Department to identify a study area along the river corridor from the Virginia/North Carolina border south to just above the town of Mayodan. The division hopes to assemble more than 2,000 acres for the park. The EEP preservation tracts listed above have contributed to this effort. The Dan River Basin Association and the Piedmont Land Conservancy have done much of the groundwork and continue to work with the local landowners to acquire new lands to be incorporated into the Mayo River State Park system.

2.4.3 Jacobs Creek [AU# 22-32-(3)]

Current Status and 2006 Recommendations
Jacobs Creek, from N.C. Hwy. 704 to Dan River (1.8 miles) is Supporting aquatic life due to a Good fish community bioclassification at site NF12. However, the stream exhibited substantial nonpoint source impacts such as sedimentation, bank erosion, deep scour pools, and riparian bank instability. Prolonged high water (possibly from early spring 2003 to early spring 2004)

may have contributed to the severe bank erosion, sedimentation, and resulted in the low number of fish that were collected. DWQ will continue to monitor this site.

2.4.4 Cadwell Creek [AU# 22-30-2-1-1]

The Virginia Department of Environmental Quality developed a fecal coliform bacterium TMDL for the South Mayo River. The TMDL was approved by the USEPA on February 27, 2004. Cadwell Creek was included in the TMDL since it is in the South Mayo River watershed. The TMDL recommended that in order for the standard to be met, the bacteria load would have to be reduced by 98 percent (VADEQ, 2004). To view the entire document visit, http://www.deq.virginia.gov/tmdl/apptmdls/roankrvr/smayo.pdf. Currently, there are no permitted facilities discharging into the North Carolina segment of Cadwell Creek. This portion of the creek makes up only 1.3 percent of the whole South Mayo River watershed.

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

The following section discusses issues that may threaten water quality in the subbasin that are not specific to particular streams, lakes or reservoirs.

2.5.1 Land Clearing Activities

Most of the terrain is hilly in this subbasin. Therefore, sedimentation problems are more intense during land clearing and grading activities. Sediment, when not properly controlled by BMPs, frequently causes excessive damage to the aquatic ecosystems. As land is converted from forest or agriculture to residential developments, the proper enforcement and oversight of BMPs is necessary for avoiding water quality impacts and impairments. Local governments are encouraged to implement a stricter local sediment and erosion control ordinance, which would target land-clearing activities that are less than a half acre.

Chapter 3
Roanoke River Subbasin 03-02-03
Including: Dan River, Smith River, Hogans Creek and Wolf Island Creek

3.1 Subbasin Overview

Subbasin 03-02-03 at a Glance

Land and Water Area

Total area:	340 mi^2
Land area:	335 mi^2
Water area:	5 mi^2

Population Statistics

2000 Est. Pop.: 48,270 people
Pop. Density: 142 persons/mi^2

Land Cover (percent)

Forest/Wetland:	74%
Surface Water:	1.2%
Urban:	2.1%
Cultivated Crop:	3.3%
Pasture/ Managed Herbaceous:	19.4%

Counties

Rockingham and Caswell

Municipalities

Eden, Reidsville and Wentworth

Monitored Stream Statistics

Aquatic Life

Total Streams:	105.1 mi
Total Supporting:	76.1 mi
Total Impaired:	29.0 mi

Recreation

Total Streams:	29.0 mi
Total Impaired:	29.0 mi

This subbasin contains approximately 25 river miles of the Dan River, prior to it flowing back into Virginia. The Smith River is a major tributary of the Dan River in this subbasin, but most of its watershed is in Virginia and its flow is regulated by upstream releases primarily from Philpott Reservoir and secondarily from Martinsville Reservoir. Other smaller tributaries include Matrimony Creek, Rock House Creek, Wolf Island Creek and Hogans Creek. Approximately three-fourths of this subbasin is forested. By the year 2020, overall county population is expected to increase by 8.5 percent and 16 percent in Rockingham and Caswell counties, respectively. Refer to Appendix I for more information for population growth and trends.

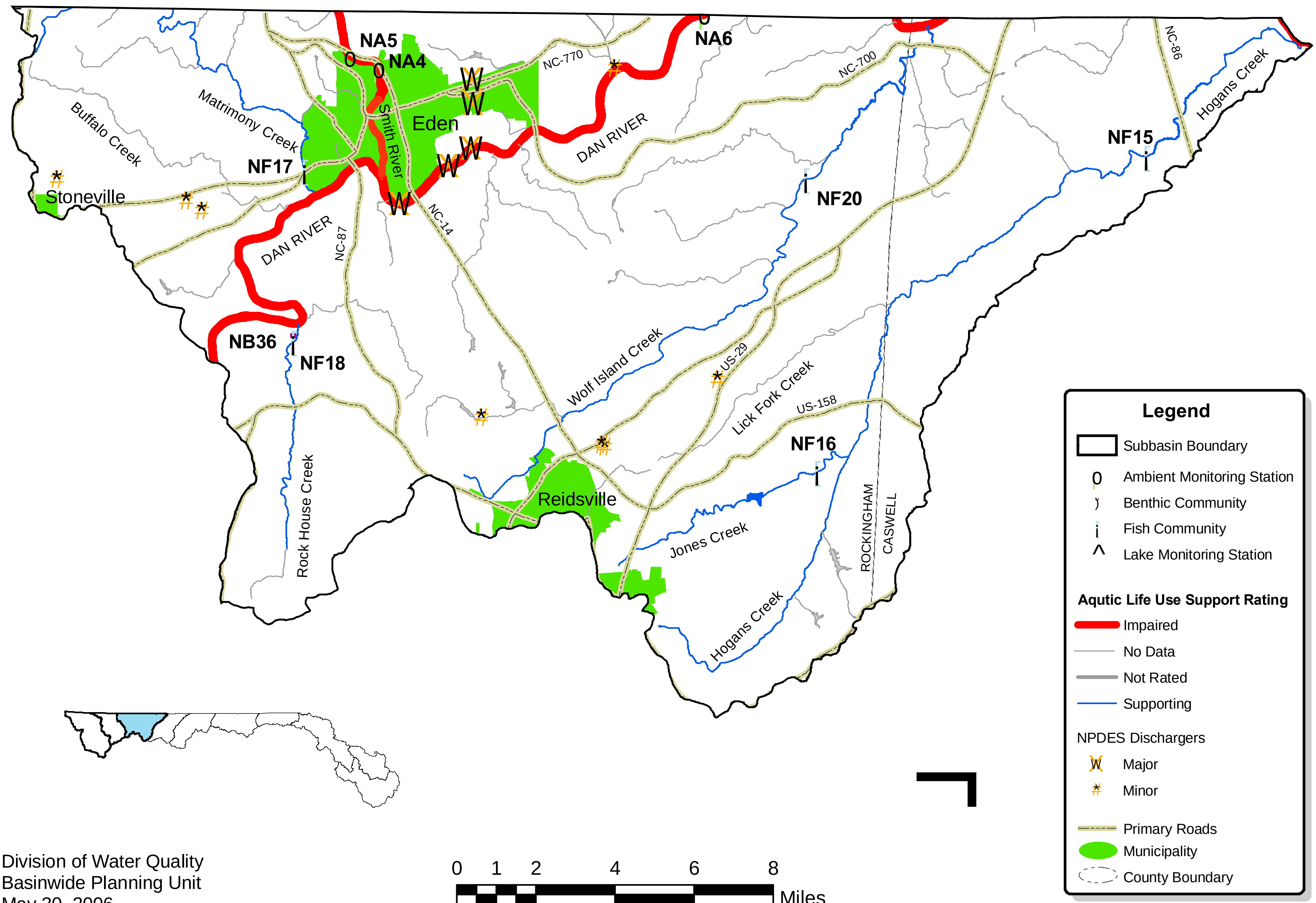
Several water quality improvement programs have been implemented in this subbasin. The NC Agriculture Cost Share Program (NCACSP), which helps reduce agricultural runoff by helping farmers implement best management practices, is one of these programs. The NCACSP provided $118,375 towards implementing sediment and nutrient reduction practices, and livestock stream access elimination within this subbasin. For more information on this and other programs, refer to the watershed discussion throughout this chapter as well as in Chapters 16 and 20.

Eleven individual NPDES wastewater discharge permits are issued in this subbasin, four of which are major dischargers. Refer to Appendix VI for identification and more information on individual NPDES permit holders. One registered animal operation is located in this subbasin. Refer to Chapter 16 for more information regarding animal operations within this basin.

A map including the locations of NPDES discharges and water quality monitoring stations is presented in Figure 6. Table 5 contains a summary of assessment units and lengths, streams monitored, monitoring data types, locations and results, along with use support ratings for waters in this subbasin. Refer to Appendix IX for more information about use support ratings.

One benthic macroinvertebrate community sample and five fish community samples (Figure 6 and Table 5) were collected during this assessment period. Data were also collected from four

Figure 6 Roanoke River Subbasin 03-02-03



Division of Water Quality
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Table 5 ROANOKE Subbasin 03-02-03

AU Number / Description	Classification	Length/Area	AL Rating	Station	Result	Year/ Parameter % Exc	REC Rating	Station	Result	Stressors	Sources
DAN RIVER											
22-(31.5)b	WS-IV	9.4 FW Miles	I	NA3	CE	Turbidity 16.4	I	NA3	CE	Fecal Coliform Bacteria	Unknown
From 03-02-02 boundary to a point 0.8 mile downstream of Matrimony Creek										Turbidity	Unknown
22-(38.5)	WS-IV;CA	0.6 FW Miles	I	NA6	CE	Turbidity 17.5	I	NA6	CE	Turbidity	Unknown
From a point 0.8 mile downstream of Matrimony Creek to Mill Branch (Town of Eden water supply intake)										Fecal Coliform Bacteria	Unknown
DAN RIVER (North Carolina portion)											
22-(39)a	C	13.8 FW Miles	I	NA6	CE	Turbidity 17.5	I	NA6	CE	Fecal Coliform Bacteria	
From Mill Branch to NC/VA crossing downstream of Wolf Island Creek										Turbidity	
Hogans Creek											
22-50	C	29.1 FW Miles	S				ND				
From source to Dan River				NF15	G	2004					
Jones Creek (Lake Wade)											
22-50-3	C	7.6 FW Miles	S				ND				
From source to Hogans Creek				NF16	G	2004					
Matrimony Creek (North Carolina portion)											
22-38	WS-IV	11.2 FW Miles	S				ND				
From source to Dan River				NF17	G	2004					
Rock House Creek											
22-34-(2)	WS-IV	6.5 FW Miles	S				ND			Habitat Degradation	
From Rockingham Countly SR 2381 to Dan River				NB36	GF	2001					
				NF18	G	2004					

Table 5 ROANOKE Subbasin 03-02-03

AU Number / Description	Classification	Length/Area	AL Rating	Station	Result	Year/Parameter	% Exc	REC Rating	Station	Result	Stressors	Sources
Smith River												
22-40-(1)	WS-IV	2.8 FW Miles	I	NA4	CE	Turbidity	12.5	I	NA4	NCE	Turbidity	Unknown
				NA5	ID				NA5	CE	Fecal Coliform Bacteria	Unknown
From North Carolina-Virginia State Line to a point 0.8 mile downstream of Rockingham County SR 1714 (Aiken Road)											Habitat Degradation	Impervious Surface
22-40-(2.5)	WS-IV;CA	0.5 FW Miles	I	NA4	CE	Turbidity	12.5	I	NA4	NCE	Turbidity	Unknown
				NA5	ID				NA5	CE	Fecal Coliform Bacteria	Unknown
From a point 0.8 mile downstream of Rockingham County SR 1714 (Aiken Road) to Fieldcrest Mills Water Supply Intake											Habitat Degradation	Impervious Surface
22-40-(3)	C	1.8 FW Miles	I	NA4	CE	Turbidity	12.5	I	NA4	NCE	Turbidity	Unknown
				NA5	ID				NA5	CE	Fecal Coliform Bacteria	Unknown
From Fieldcrest Mills Water Supply Intake to Dan River											Habitat Degradation	Impervious Surface
Wolf Island Creek												
22-48	C	21.8 FW Miles	S					ND				
From source to Dan River				NF20	G	2004						

Table 5 ROANOKE Subbasin 03-02-03

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

Use Categories:	**Monitoring data type:**	**Results:**	**Use Support Ratings 2005**:
AL - Aquatic Life	NF - Fish Community Survey	E - Excellent	S - Supporting, I - Impaired
REC - Recreation	NB - Benthic Community Survey	G - Good	NR - Not Rated
	NA - Ambient Monitoring Site	GF - Good-Fair	NR*- Not Rated for Recreation (screening criteria exceeded)
	NL- Lake Monitoring	F - Fair	ND-No Data Collected to make assessment
		P - Poor	
		NI - Not Impaired	
Miles/Acres	m- Monitored	N- Natural	**Results**
FW- Fresh Water	e- Evaluated	M - Moderate	CE-Criteria Exceeded > 10% and more than 10 samples
		S-Severe	NCE-No Criteria Exceeded
			ID- Insufficeint Data Available

Aquatic Life Rating Summary

S	m	76.1	FW Miles
I	m	29.0	FW Miles
NR	e	11.1	FW Miles
ND		133.9	FW Miles

Recreation Rating Summary

I	m	29.0	FW Miles
NR	e	11.1	FW Miles
ND		210.0	FW Miles

Fish Consumption Rating Summary

I	e	250.0	FW Miles

ambient monitoring stations. Refer to the *2005 Roanoke River Basinwide Assessment Report* at http://www.esb.enr.state.nc.us/bar.html and Appendix IV for more information on monitoring data.

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

3.2 Use Support Assessment Summary

Use support ratings were assigned for waters in subbasin 03-02-03 in the aquatic life, recreation, fish consumption and water supply categories. All waters are Impaired on an evaluated basis in the fish consumption category because of fish consumption advice that applies to the entire basin. In the water supply category, all waters are Supporting on an evaluated basis based on reports from DEH regional water treatment plant consultants.

There were 102.7 stream miles (41.1 percent) monitored during this assessment period in the aquatic life category. In the recreation category, 26.6 stream miles (10.6 percent) were monitored. A total of 26.6 stream miles (10.6 percent) are Impaired, for both the aquatic life and recreational use categories. Refer to Table 5 for a summary of use support ratings by use category for waters in subbasin 03-02-03.

3.3 Status and Recommendations of Previously and Newly Impaired Waters

The following waters were either identified as Impaired in the previous basin plan (2001) or are newly Impaired based on recent data. If previously identified as Impaired, the water will either remain on the state's 303(d) list or will be delisted based on recent data showing water quality improvements. If the water is newly Impaired, it will likely be placed on the 2008 303(d) list. The current status and recommendations for addressing these waters are presented below, and each are identified by an assessment unit number (AU#). Information regarding 303(d) listing and reporting methodology is presented in Appendix VII.

3.3.1 Dan River [AU# 22-(31.5)b]

2001 Recommendations

The Dan River, from a point 0.7 miles upstream of Jacobs Creek to Mill Branch (14.8 miles; includes both 22-(31.5)a & b), was Impaired for aquatic life due to a turbidity standard violation at site NA3 (N2300000). The site exceeded the standard in 18 percent of samples. The 2001 basin plan recommended that DWQ work with the Division of Land Resources to evaluate and reduce turbidity from permitted instream mining operations in the Dan River. As permits are renewed, monitoring upstream and downstream of mining operations and instream BMPs (such as those used by the NC Department of Transportation during bridge construction) could be required. In addition, DWQ will notify local agencies of water quality concerns regarding these waters and work with them to conduct further monitoring and to locate sources of water quality protection funding.

Current Status

The Dan River [AU#22-(31.5)b], from the 03-02-02 boundary to a point 0.8 miles downstream of Matrimony Creek (9.4 miles), is Impaired for aquatic life due to turbidity standard violation at site NA3. The turbidity standard was violated in 16.4 percent of samples in this assessment period. This segment will remain on the 303(d) list (category 4a; for more information on 303(d) listing and reporting, see appendix VII). DWQ developed a TMDL for turbidity for this section of the Dan River. The TMDL was finalized by the USEPA on January 11, 2005 and recommended that a 59 percent total suspended solids reduction distributed over both point and nonpoint sources should be achieved in order to meet the turbidity standard. Since the 2001 basin plan, several instream mining operations have become inactive and permits have been rescinded to the Division of Land Resources mostly due to permit modifications of required upstream and downstream monitoring.

This section of the Dan River is also Impaired for recreation because the fecal coliform bacteria standard was exceeded at site NA3. Intensive fecal coliform bacteria monitoring in 2004 was also part of supporting an interstate TMDL with Virginia since the Dan River is 303(d) listed in Virginia for bacteria. This section will be added to North Carolina's 303(d) list for fecal coliform bacteria.

2006 Recommendations

Local agencies are encouraged to secure funding opportunities for restoration projects to control nonpoint sources of pollution.

See Chapter 4, section 4.3.1 for Dan River summary.

3.3.2 Dan River [AU # 22-(38.5) & 22-(39)a]

Current Status

The Dan River (North Carolina portion) [AU#22-(38.5)], from a point 0.8 miles downstream of Matrimony Creek to Mill Branch (Town of Eden water supply intake) (0.6 miles), and [AU# 22-(39)a] from Mill Branch to NC/VA crossing downstream of Wolf Island Creek (13.8 miles), is Impaired for aquatic life due to turbidity standard violation at site NA6. The turbidity standard was violated in 17.5 percent of samples in this assessment period. This segment will be added to the 303(d) list of impaired waters.

This section of the Dan River is also Impaired for recreation because the fecal coliform bacteria standard was exceeded at site NA6. Intensive fecal coliform bacteria monitoring in 2004 was also part of supporting an interstate TMDL with Virginia since the Dan River is 303(d) listed in Virginia for fecal coliform bacteria. This segment will be added to North Carolina's 303(d) list for fecal coliform bacteria.

2006 Recommendations

DWQ will continue to monitor the Dan River. Local agencies are encouraged to secure funding opportunities for restoration projects to control nonpoint sources of pollution.

See Chapter 4, section 4.3.1 for Dan River summary.

3.3.3 Smith River [AU # 22-40-(1), 22-40-(2.5) & 22-40-(3)]

2001 Recommendations

The 2001 basin plan recommended that DWQ work with the NC Division of Water Resources, the Virginia Department of Environmental Quality (VADEQ) and the Town of Martinsville, Virginia to address flow fluctuation issues. However, nonpoint source pollution in the North Carolina portion of the watershed may also contribute to degradation of habitat and water quality downstream. It is imperative that, in addition to citizen and municipality lead actions in Virginia, citizens and municipalities in North Carolina implement best management practices as well. Of particular concern are urban areas and construction activities in and around Eden.

Current Status

Smith River, from North Carolina-Virginia State Line to the Dan River (5.1 miles) is Impaired for aquatic life because 12.5 percent of the samples taken at site NA4 exceeded the turbidity standard.

This same section of the Smith River is Impaired for recreation due to fecal coliform bacteria standard violation at site NA5. Intensive fecal coliform bacteria monitoring in 2004 was also part of supporting an interstate TMDL with Virginia since the Dan River is 303(d) listed in Virginia for bacteria.

The entire North Carolina segment of the Smith River will be added to North Carolina's 303(d) list for fecal coliform bacteria and turbidity standard violations. This section is already on the 303(d) list for impaired biological integrity due to a Fair benthic rating in 1999.

The Eden WWTP has experienced significant inflow and infiltration problems during this assessment period. As of January 2004, Eden was under a Special Order of Consent for their collection system and upgrading including resizing pump stations. Eden is starting a four million dollar sewer line rehabilitation project, which will be followed up with an anticipated two million dollar sewer pump station upgrade.

The Philpott Reservoir located on the Smith River approximately 33 miles from the Virginia-North Carolina State line is owned and operated by the US Army Corps of Engineers (ACOE). The minimum flow out of Philpott dam is 59 cubic feet per second (cfs) and can reach maximum flow releases of 1,400 cfs during power generation operation. In 2003, the ACOE proposed to conduct a reconnaissance study under Section 216 of the Flood Control Act of 1970. Unfortunately funds were cut in federal fiscal year 2005 and the study was not funded. The study would have begun to identify the needs and opportunities for improvements to the Philpott Dam and Reservoir. From Philpott Reservoir the river flows to the Martinsville Reservoir near Martinsville, Virginia. The Martinsville Reservoir (Smith River) is a small hydropower operation with minimal holding capacity. This hydropower is exempt from obtaining a Federal Energy Regulatory Commission license because they generate less than five megawatts of power (VADEQ, B. LaRoche pers. comm.).

2006 Recommendations
DWQ will continue to monitor the Smith River and work with the town of Eden on discharge requirements. It is also recommended that VADEQ and NCDWQ support future ACOE studies, including a Section 216 study for Philpott Reservoir and Dam.

3.4 Status and Recommendations for Waters with Noted Impacts

The surface waters discussed in this section are not Impaired. However, notable water quality problems and concerns were documented for these waters during this assessment. Attention and resources should be focused on these waters to prevent additional degradation and facilitate water quality improvements. DWQ will notify local agencies of these water quality concerns and work with them to conduct further assessments and to locate sources of water quality protection funding. Additionally, education on local water quality issues and voluntary actions are useful tools to prevent water quality problems and to promote restoration efforts. Nonpoint source program agency contacts are listed in Appendix VIII.

3.4.1 Hogans Creek [AU #22-50]

Current Status
Hogans Creek, from source to Dan River (29.1 miles) is Supporting aquatic life due to a Good fish community bioclassification at site NF15.

Water Quality Initiative
In 1997, the Caswell County Soil and Water Conservation District and the Wetlands Restoration Program conducted a stream restoration project on an unnamed tributary of Hogans Creek. Approximately, 900 feet of stream was restored to 1,800 feet. DWQ conducted pre and post stream project data collections in 1996 and 1998. Since then, beavers have populated the restored area. Due to the lack of flow, primarily from beaver ponding activity, DWQ was not able to sample for post mitigation comparison in 2004.

2006 Recommendations
DWQ does not have a state standard regarding beaver activities on streams. Best management practices do exist to reduce ponding activities.

3.4.2 Rock House Creek [AU#22-34-(2)]

Current Status and 2006 Recommendations
Rock House Creek, from Rockingham County SR 2381 to Dan River (6.5 miles) is Supporting aquatic life due to Good fish community and Good-Fair benthic community bioclassifications at sites NF18 and NB36. Most of the land use is predominantly agriculture and during sampling it was noted that the stream exhibited substantial nonpoint source erosion impacts such as sedimentation and riparian bank instability problems. Also, nonpoint nutrients from upstream sources may have contributed to the abundance of the bluehead chub; 37 percent of all the fish collected were this species. It is recommended that local agencies work with landowners to assess the need for and prioritize the installation of BMPs to improve the riparian zones and restore the streambanks along this creek.

3.5 Additional Water Quality Issues within Subbasin 03-02-03

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

3.5.1 Land Clearing Activities

Most of the terrain is hilly in this subbasin. Therefore sedimentation problems are more intense during land clearing and grading activities. Sediment when not properly controlled by BMPs frequently cause excessive damage to the aquatic ecosystems. As land is converted from forest or agriculture to residential developments, the proper enforcement and oversight of BMPs is necessary for avoiding water quality impacts and impairments.

Chapter 4
Roanoke River Subbasin 03-02-04
Including: Dan River, Country Line Creek, Rattlesnake Creek and Moon Creek

4.1 Subbasin Overview

Subbasin 03-02-04 at a Glance

Land and Water Area

Total area:	239 mi²
Land area:	236 mi²
Water area:	3 mi²

Population Statistics

2000 Est. Pop.:	13,495 people
Pop. Density:	57 persons/mi²

Land Cover (percent)

Forest/Wetland:	75.9%
Surface Water:	1%
Urban:	0.5%
Cultivated Cropland:	2.3%
Pasture/ Managed Herbaceous:	20.4%

Counties

Rockingham, Caswell and Person

Municipalities

Yanceyville and Milton

Monitored Stream Statistics

Aquatic Life

Total Streams:	65.0 mi/361.8 ac
Total Supporting:	55.4 mi
Total Impaired:	9.6 mi
Total Not Rated:	361.8 ac

Recreation

Total Streams:	9.6 mi
Total Impaired:	9.6 mi

This subbasin contains an eight-mile reach of the Dan River, from Virginia at Danville to North Carolina near Milton, before it flows into the Roanoke River. The subbasin is mostly rural. By the year 2020, population in Caswell County is expected to increase by 16 percent.

Four individual NPDES wastewater discharge permits are issued in this subbasin with a total permitted flow of 0.66 MGD (only 2 of the 4 permits are currently active). Refer to Appendix VI for identification and more information on individual NPDES permit holders. Refer to Appendix I for more information regarding population growth and trends. Two cattle operations are registered in this subbasin. Refer to Chapter 16 for more information regarding animal operations within this basin.

Several water quality improvement programs have been implemented in this subbasin. The NC Agriculture Cost Share Program (NCACSP), which helps reduce agricultural runoff by helping farmers implement best management practices, is one of these programs. The NCACSP provided $169,139 towards implementing sediment and nutrient reduction practices, and livestock stream access elimination within this subbasin. For more information on this and other programs, refer to watershed discussion throughout this chapter as well as in Chapters 16 and 20.

A map including the locations of NPDES discharges and water quality monitoring stations is presented in Figure 7. Table 6 contains a summary of assessment units and lengths, streams monitored, monitoring data types, locations and results, along with use support ratings for waters in this subbasin. Refer to Appendix IX for more information about use support ratings.

Two benthic macroinvertebrate community samples and three fish community samples (Figure 7 and Table 6) were collected during this assessment period. Data were also collected from one ambient monitoring station and one lake. Refer to the *2005 Roanoke River Basinwide Assessment Report* at http://www.esb.enr.state.nc.us/bar.html and Appendix IV for more information on monitoring.

Figure 7 Roanoke River Subbasin 03-02-04

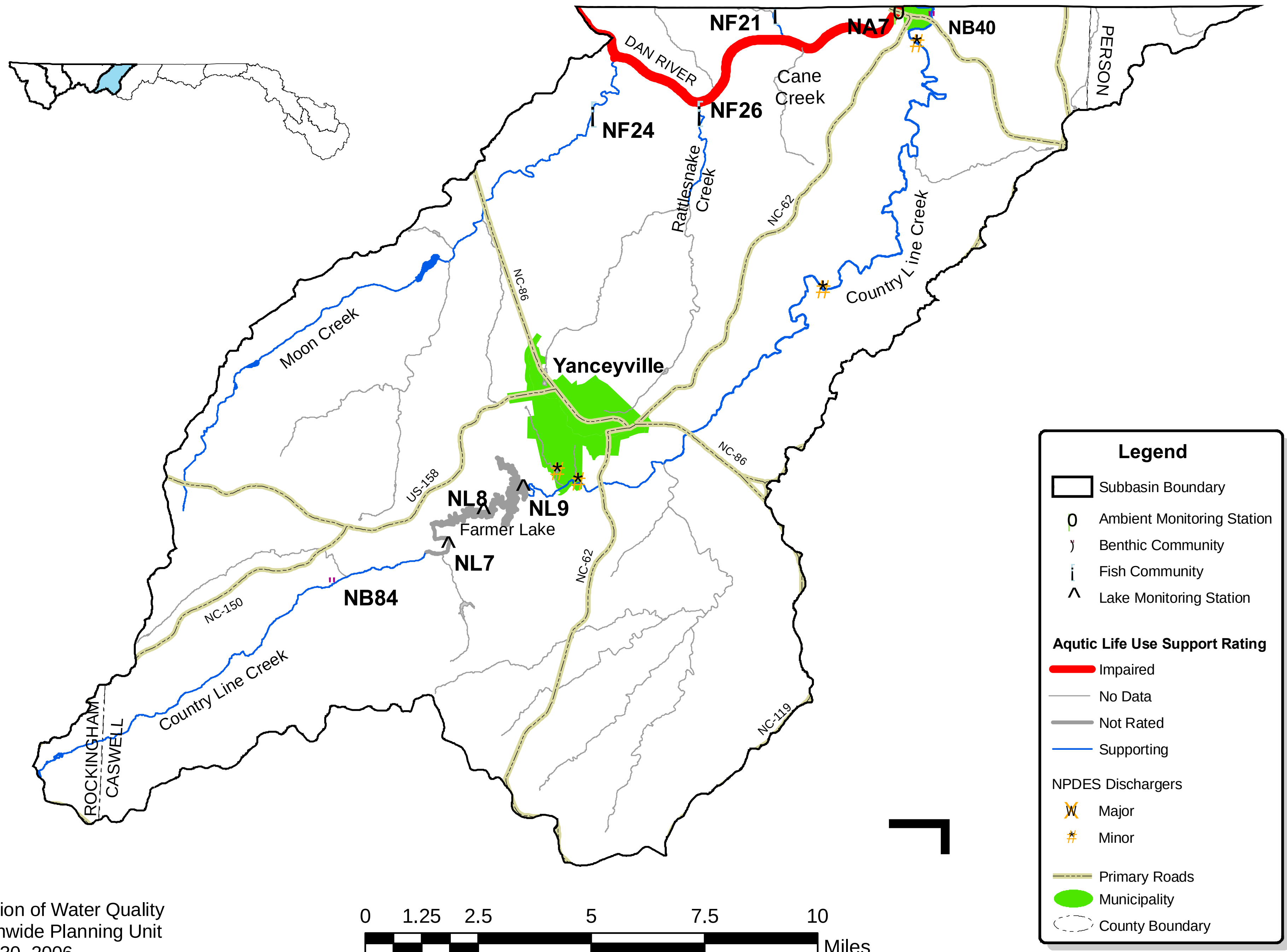

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Table 6 ROANOKE Subbasin 03-02-04

AU Number / Description	Classification	Length/Area		AL Rating	Station	Result	Year/ Parameter	% Exc	REC Rating	Station	Result	Stressors	Sources
Cane Creek													
22-54	C	0.8	FW Miles	**S**					ND				
From North Carolina-Virginia State Line to Dan River					NF21	G	2004						
Country Line Creek													
22-56-(1)	WS-II;HQW	10.5	FW Miles	**S**					ND				
From source to a point 0.5 mile upstream of mouth of Nats Fork					NB84	G	2004						
22-56-(3.7)	C	24.5	FW Miles	**S**					**NR**				
From dam at Farmer Lake to Dan River					NB40	G	2004						
Country Line Creek (Farmers Lake)													
22-56-(3.5)	WS-II;HQW,CA	361.8	FW Acres	**NR**	NL7	ID			ND			Turbidity	Unknown
					NL9	ID						Nutrient Impacts	Unknown
					NL8	ID							
From a point 0.5 mile upstream of mouth Nats Fork to dam at Farmer Lake (Town of Yanceyville water supply intake located 1.8 mile upstream of N.C. Hwy. 62)													
DAN RIVER (North Carolina portion)													
22-(39)b	C	9.6	FW Miles	**I**	NA7	CE	Turbidity	16.1	**I**	NA7	CE	Fecal Coliform Bacteria	Unknown
From NC/VA crossing downstream of Wolf Island Creek to last crossing of North Carolina-Virginia State Line												Turbidity	Unknown
Moon Creek (Wildwood Lake)													
22-51	C	17.0	FW Miles	**S**					ND				
From source to Dan River					NF24	G	2004						
Rattlesnake Creek													
22-52	C	2.7	FW Miles	**S**					ND				
From source to Dan River					NF26	G	2004						

Table 6 ROANOKE Subbasin 03-02-04

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

Use Categories:	Monitoring data type:	Results:	Use Support Ratings 2005:
AL - Aquatic Life	NF - Fish Community Survey	E - Excellent	S - Supporting, I - Impaired
REC - Recreation	NB - Benthic Community Survey	G - Good	NR - Not Rated
	NA - Ambient Monitoring Site	GF - Good-Fair	NR*- Not Rated for Recreation (screening criteria exceeded)
	NL- Lake Monitoring	F - Fair	ND-No Data Collected to make assessment
		P - Poor	
		NI - Not Impaired	
Miles/Acres	m- Monitored	N- Natural	**Results**
FW- Fresh Water	e- Evaluated	M - Moderate	CE-Criteria Exceeded > 10% and more than 10 samples
		S-Severe	NCE-No Criteria Exceeded
			ID- Insufficeint Data Available

Aquatic Life Rating Summary

S	m	55.4	FW Miles
I	m	9.6	FW Miles
NR	m	361.8	FW Acres
ND		83.7	FW Miles

Recreation Rating Summary

I	m	9.6	FW Miles
NR	e	24.5	FW Miles
ND		114.6	FW Miles
ND		361.8	FW Acres

Fish Consumption Rating Summary

I	e	148.7	FW Miles
I	e	361.8	FW Acres

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

4.2 Use Support Assessment Summary

Use support ratings were assigned for waters in subbasin 03-02-04 in the aquatic life, recreation, fish consumption and water supply categories. All waters are Impaired on an evaluated basis in the fish consumption category because of fish consumption advice that applies to the entire basin. In the water supply category, all waters are Supporting on an evaluated basis based on reports from DEH regional water treatment plant consultants.

There were 65 stream miles (43.7 percent) and 361.8 freshwater acres (100 percent; Farmers Lake) monitored during this assessment period in the aquatic life category. In the recreation category, 9.6 stream miles (6.5 percent) were monitored. A total of 9.6 stream miles (6.5 percent) are Impaired, for both the aquatic life and recreational use categories. Refer to Table 6 for a summary of use support rating by category for waters in subbasin 03-02-04.

4.3 Status and Recommendations of Previously and Newly Impaired Waters

The following waters were either identified as Impaired in the previous basin plan (2001) or are newly Impaired based on recent data. If previously identified as Impaired, the water will either remain on the state's 303(d) list or will be delisted based on recent data showing water quality improvements. If the water is newly Impaired, it will likely be placed on the 2008 303(d) list. The current status and recommendations for addressing these waters are presented below, and each are identified by an assessment unit number (AU#). Information regarding 303(d) listing and reporting methodology is presented in Appendix VII.

4.3.1 Dan River [AU # 22-(39)b]

Current Status

The Dan River (North Carolina portion), from NC/VA crossing downstream of Wolf Island Creek to the last crossing of North Carolina-Virginia State Line (9.6 miles), is Impaired for aquatic life due to turbidity standard violations at site NA7. The turbidity standard was violated in 16.1 percent of samples in this assessment period. This segment will be added to the 303(d) list of impaired waters.

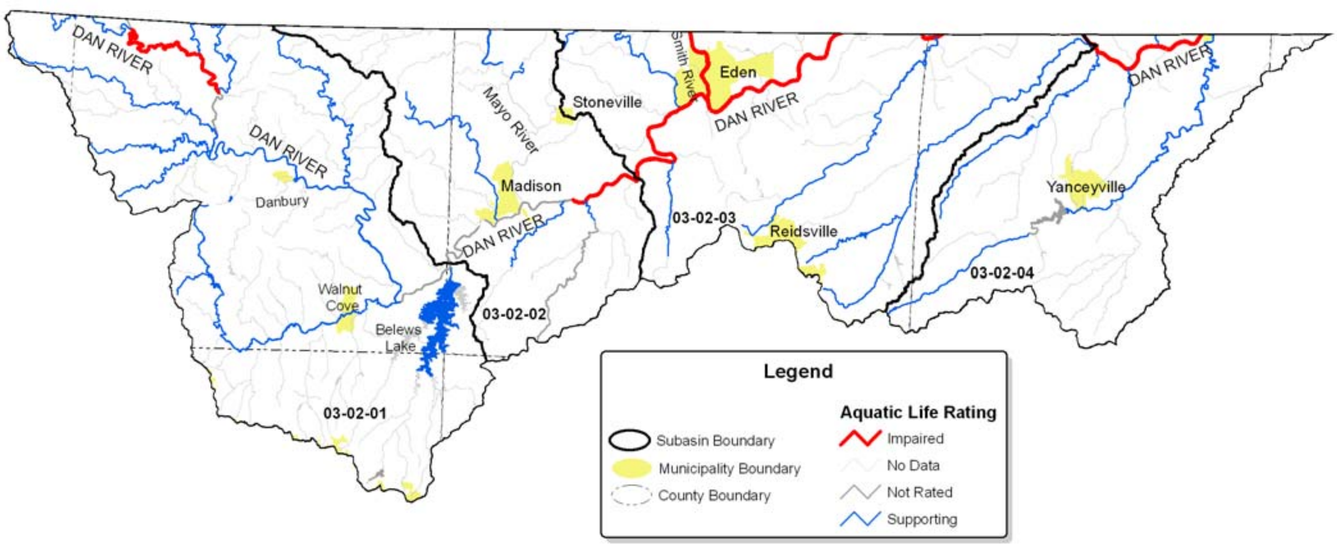
This section of the Dan River is also Impaired for recreation because the fecal coliform bacteria standard was exceeded at site NA7. Intensive fecal coliform bacteria monitoring in 2004 was also part of supporting an interstate TMDL with Virginia since the Dan River is 303(d) listed in Virginia for bacteria. This segment will be added to North Carolina's 303(d) list for fecal coliform bacteria.

2006 Recommendations
DWQ will continue to monitor the Dan River. Local agencies are encouraged to secure funding opportunities for restoration projects in controlling nonpoint sources of pollution.

Water Quality Initiative
The NCEEP is developing a project along the Dan River [22-(39)b] that has the potential to restore 82 acres of riverine wetland. This project will also include the preservation of approximately 3 acres of bottomland hardwood wetlands.

Dan River Summary

Figure 8 - Dan River



There are a total of 49.8 miles of the Dan River impaired for turbidity standard violations as well as 38.2 miles impaired for fecal coliform bacteria standard violations.

Subbasin No.	Distance Impaired (miles)		Turbidity Impairment (% exceeded)	New Turbidity Impairment		Fecal Impairment	New Fecal Impairment
03-02-01	11.6		24 %	Yes		No	
03-02-02	4.8		16.4 %	No		Yes	Yes
03-02-03	9.4		16.4 %	No		Yes	Yes
	15.6		17.5 %	Yes		Yes	Yes
03-02-04	9		16.1 %	Yes		Yes	Yes

The 11.6 miles in the upper Dan River (subbasin 01) are in trout waters where the allowable turbidity levels are at or below 10 NTUs. These same waters received an Excellent and a Good benthic bioclassification during the last two basin cycles. This segment of the Dan River had elevated turbidity during the last assessment period as well, however each data type was not assessed independently unlike during this assessment period.

The remaining 38.2 miles of the Dan River are impaired for both turbidity and fecal coliform bacteria. Of these, 14.2 miles were impaired for turbidity during that last basin cycle (4.8 miles in subbasin 02 and 9.4 miles in subbasin 03). A TMDL for this 14.2 miles segment was approved by the USEPA in January 2005, which recommends a 59 percent reduction in Total Suspended Solids distributed over both point and nonpoint sources in order to achieve acceptable water quality levels in this area. A TMDL will have to be developed for the remaining 24 miles. This new segment will be added to the 2008 303(d) list of impaired waters and a TMDL will be completed within 13 years of listing. The entire 38.2 miles will also be added to the impaired waters list for fecal coliform and a TMDL will also be required.

In the past, the Dan River was often called the “Muddy Dan” by locals. The river almost always ran brown due to sediment in the river. There were several instream sand mining operations as well as a lot of agricultural activity along the river. All of the mining operations are gone and many of the tobacco fields in this area have been converted to other agricultural practices such as cattle farming. Many of these fields have also been converted to permanent grasslands or to natural vegetation with help from the NC agriculture cost share program. While more environmentally friendly agricultural practices have started to occur in this area, a lot more timber harvesting is occurring in both North Carolina and Virginia. Since the Dan River flows back and forth across the state line, timber harvesting practices in one state ultimately affects the water quality in the other. Development of single family homes have increased in this area as well. Sediment and erosion controls are generally lacking on these smaller size lots. The use of ATV’s was also noted as an activity in this area that is likely contributing to the sediment load in the small tributaries that flow into the Dan River. With a continued push to improve agricultural and forestry BMPs in the area as well as better sediment and erosion control ordinances along the Dan River, improvements should be achievable.

4.4 Status and Recommendations for Waters with Noted Impacts

The surface waters discussed in this section are not Impaired. However, notable water quality problems and concerns were documented for these waters during this assessment. Attention and resources should be focused on these waters to prevent additional degradation and facilitate water quality improvements. DWQ will notify local agencies of these water quality concerns and work with them to conduct further assessments and to locate sources of water quality protection funding. Additionally, education on local water quality issues and voluntary actions are useful tools to prevent water quality problems and to promote restoration efforts. Nonpoint source program agency contacts are listed in Appendix VIII.

4.4.1 Moon Creek [AU# 22-51]

Current Status and 2006 Recommendations

Moon Creek, from source to Dan River (17.0 miles), is Supporting aquatic life due to a Good fish community bioclassification at site NF24. The fish community was noted as very unstable, which was likely related to the instream and riparian habitats and lingering effects from the 2002 drought. The land use is predominantly agriculture and like other streams in subbasins 02 - 04, Moon Creek appeared to have been impacted by very substantial nonpoint source erosion including sedimentation, a shifting sand substrate, bank “blowouts”, scour pools, and channel and riparian bank instabilities. DWQ will continue to monitor water quality in Moon Creek. It is recommended that local agencies work with landowners to install BMPs to improve the riparian areas.

4.4.2 Rattlesnake Creek [AU# 22-52]

Current Status and 2006 Recommendations
Rattlesnake Creek, from source to Dan River (0.8 miles), is Supporting aquatic life due to a Good fish community bioclassification at site NF26. Rattlesnake Creek appeared to have been impacted by very substantial nonpoint source erosion including sedimentation, bank "blowouts", deep scour pools, entrenchment, and channel and riparian bank instabilities. DWQ will continue to monitor water quality in this segment of the river. It is recommended that local agencies work with landowners to install BMPs to improve the riparian areas.

4.4.3 Cane Creek [AU# 22-54)]

Current Status and 2006 Recommendations
Cane Creek, from the North Carolina-Virginia State Line to the Dan River (0.8 miles), is Supporting aquatic life due to a Good fish community bioclassification at site NF21. The majority of the creek's watershed lies in southwestern Pittsylvania County, Virginia. The monitoring site was located at the State line, approximately 0.8 miles above its mouth. Like other streams in the area, the banks are sloughing, the substrate is sand, and a large quantity of sediment is transported during high flow events. DWQ will continue to monitor water quality in Cane Creek. It is recommended that local agencies in North Carolina and Virginia work with landowners to install BMPs to improve the riparian areas.

4.4.4 Country Line Creek [AU# 22-56-(3.7)]

Current Status and 2006 Recommendations
Country Line Creek, from dam at Farmer Lake to the Dan River (24.5 miles), is Supporting aquatic life for a Good benthic community bioclassification at site NB40. At this site, there were indications of deeply incised banks and signs of moderate erosion; the channel was filled with sediment and sand bar development was noted. Habitat deficiencies included sandy substrate, marginal instream habitat, bank vegetation, canopy and insufficient pools and riffles. It is recommended that local agencies work with landowners to install BMPs to improve the riparian area along Country Line Creek.

4.4.5 Country Line Creek (Farmer Lake) [AU# 22-56-(3.5)]

Current Status and 2006 Recommendations
Farmer Lake (Country Line Creek), from a point 0.5 mile upstream of mouth of Nats Fork to the dam at Farmer Lake (Town of Yanceyville water supply intake located 1.8 mile upstream of N.C. Hwy. 62) (361.8 acres), is Not Rated for aquatic life. Farmer Lake was monitored at sites NL7, NL8 and NL9.in 2000, 2001, 2002, and 2004. Moderate nutrient and chlorophyll *a* levels were generally found each year, indicating biological productivity. Assessment of parameters related to biological productivity indicated eutrophic conditions confirming biological productivity. High dissolved oxygen saturation values were also noted, indicating algal activity.

Algal analyses of samples collected in August 2004 at the upper lake and in mid-lake indicated a moderate to severe blue-green algal bloom at both stations. The algal bloom was composed primarily of the blue-green algae Cylindrospermopsis. Some strains of this species have the ability to produce toxins, but there are no reports in North Carolina of humans becoming ill from blue-green toxins or evidence that this strain exhibited toxicity. Water clarity in this lake is somewhat reduced due to sedimentation, especially at the most upstream station.

While surface water quality standards were not exceeded in more than 10 percent of the samples taken on Farmer Lake, this lake is not being rated due to concerns related to the elevated turbidity, low water clarity and elevated percent dissolved oxygen saturation. If resources are available, further study of this lake will be conducted.

Water Quality Initiatives

The NCEEP is working with a landowner to place a conservation easement with 300 foot buffers along 2,304 feet of two unnamed tributaries to Country Line Creek [22-56-(3.5)].

Chapter 5
Roanoke River Subbasin 03-02-05
Including: Hyco Creek, Hyco Lake, Marlowe Creek, Mayo Creek and Mayo Reservoir

5.1 Subbasin Overview

Subbasin 03-02-05 at a Glance

Land and Water Area

Total area:	337 mi^2
Land area:	322 mi^2
Water area:	15 mi^2

Population Statistics

2000 Est. Pop.:	28,648 people
Pop. Density:	85 persons/mi^2

Land Cover (percent)

Forest/Wetland:	71.9%
Surface Water:	4.5%
Urban:	1.3%
Cultivated Crop:	2.4%
Pasture/ Managed Herbaceous:	19.8%

Counties

Caswell, Person, Granville, Alamance and Orange

Municipalities

Roxboro

Monitored Stream Statistics

Aquatic Life

Total Streams:	35.9 mi/7594.8 ac
Total Supporting:	12.5 mi/493.6 ac
Total Impaired:	23.4 mi
Total Not Rated:	7101.2 ac

Recreation

Total Streams:	28.5 mi
Total Supporting:	24.0 mi
Total Not Rated:	4.5 mi

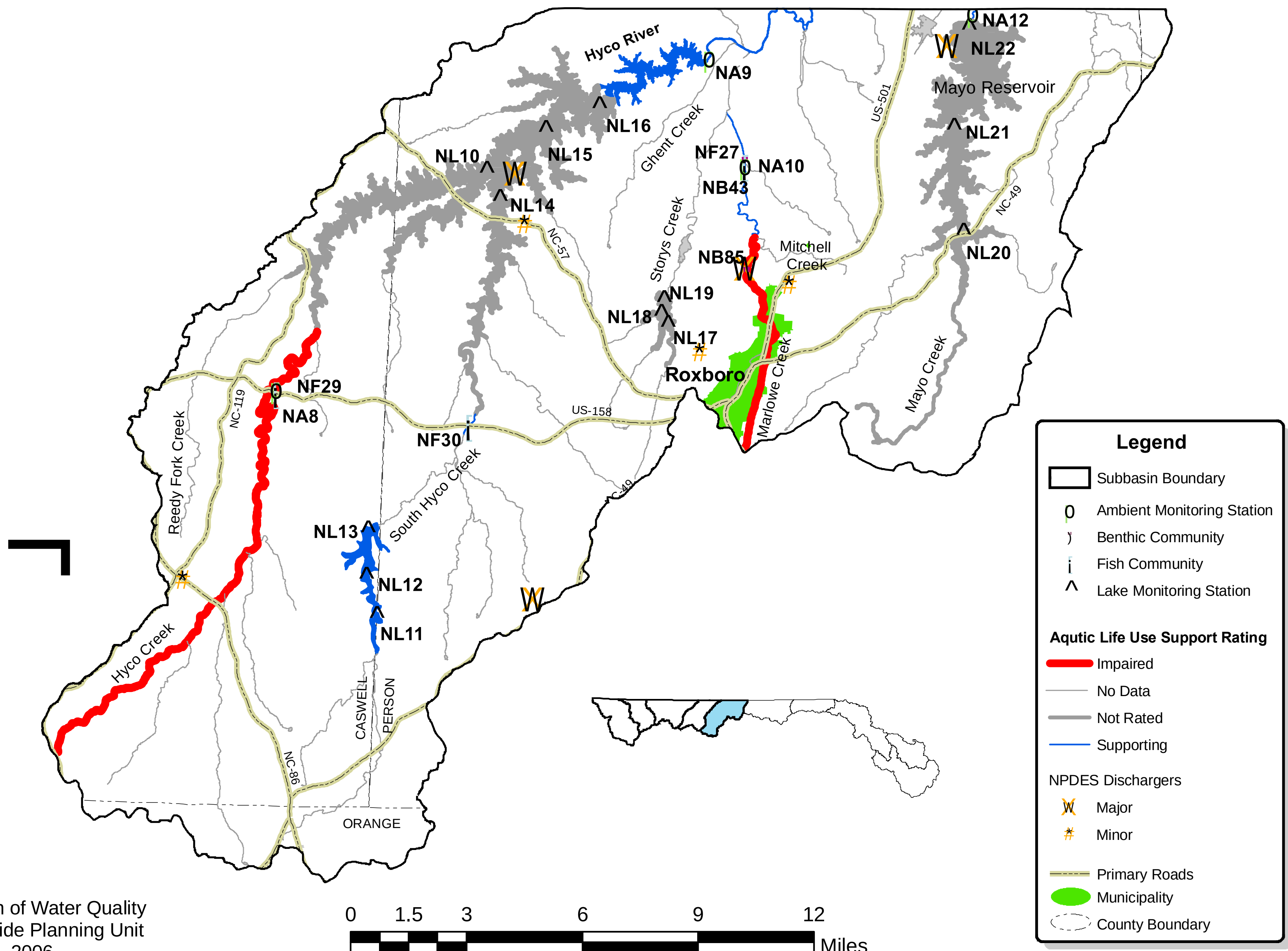
The entire Hyco River and Mayo Creek watershed including reservoirs, largely make up this subbasin. Other major tributaries include Storys Creek and Marlowe Creek. All major streams flow generally northward into Virginia. By the year 2020, populations throughout Caswell and Person counties are expected to increase by 16 percent and 22 percent, respectively. For more information regarding population growth and trends, refer to Appendix I.

Several water quality improvement programs have been implemented in this subbasin. The NC Agriculture Cost Share Program (NCACSP), which helps reduce agricultural runoff by helping farmers implement best management practices, is one of these programs. The NCACSP provided $230,976 towards implementing sediment and nutrient reduction practices, animal waste management, and livestock stream access elimination within this subbasin. For more information on this and other programs, refer to watershed discussion throughout this chapter as well as in Chapters 16 and 20.

Seven individual NPDES wastewater discharge permits are issued in this subbasin with a total permitted flow of 26.0 MGD three are major dischargers. Four facilities are required to conduct whole effluent toxicity testing, all of which have been in compliance during this assessment period. Refer to Appendix VI for identification and more information on individual NPDES permit holders. Five registered animal operations (1 cattle and 4 swine) are located in this subbasin. Refer to Chapter 16 for more information regarding animal operations within this basin.

A map including the locations of NPDES discharges and water quality monitoring stations is presented in Figure 9. Table 7 contains a summary of assessment units and lengths, streams monitored, monitoring data types, locations and results, along with use support ratings for waters in this subbasin. Refer to Appendix IX for more information about use support ratings.

Figure 9 Roanoke River Subbasin 03-02-05



Division of Water Quality
Basinwide Planning Unit
May 30, 2006

Table 7 ROANOKE Subbasin 03-02-05

AU Number / Description	Classification	Length/Area		AL Rating	Station	Result	Year/ Parameter	% Exc	REC Rating	Station	Result	Stressors	Sources
Hyco Creek (North Hyco Creek)													
22-58-1	C	16.8	FW Miles	I	NA8	NCE			S	NA8	NCE	Habitat Degradation	Agriculture
From source to Hyco Lake, Hyco River					NF29	P	'2004					Habitat Degradation	Impoundment
Hyco River													
22-58-(9.5)	C	6.8	FW Miles	S	NA9	NCE			S	NA11	NCE		
										NA9	NCE		
From dam of Hyco Lake to North Carolina-Virginia State Line, including all portions in North Carolina													
Hyco River, including Hyco Lake below elevation 410													
22-58-(0.5)	WS-V,B	4,297.9	FW Acres	NR	NL16	ID			ND				
					NL10	ID							
					NL15	ID							
					NL14	ID							
From source in Hyco Lake to dam of Hyco Lake, including tributary arms below elevation 410													
Marlowe Creek													
22-58-12-6a	C	6.6	FW Miles	I					ND			Habitat Degradation	Impervious Surface
From source to Mitchell Creek					NB85	F	'2004						
22-58-12-6b	C	4.5	FW Miles	S	NA10	NCE			NR*	NA10	CE	Fecal Coliform Bacteria	Unknown
From Mithcell Creek to Storys Creek					NB43	GF	'2004					Toxic Impacts	WWTP NPDES
					NF27	GF	'2004						
Mayo Creek (Maho Creek)													
22-58-15-(3.5)	C	0.5	FW Miles	S	NA12	NCE			S	NA12	NCE		
From dam of Mayo Reservoir to North Carolina-Virginia State Line													

Table 7 ROANOKE Subbasin 03-02-05

AU Number / Description	Classification	Length/Area		AL Rating	Station	Result	Year/ Parameter	% Exc	REC Rating	Station	Result	Stressors	Sources
Mayo Creek (Maho Creek) (Mayo Reservoir)													
22-58-15-(0.5)	WS-V	2,613.8	FW Acres	**NR**	NL22	ID			ND				
					NL20	ID							
					NL21	ID							
From source to dam of Mayo Reservoir													
South Hyco Creek													
22-58-4-(3)	WS-II;HQW,CA	0.7	FW Miles	**S**					ND				
From a point 0.6 mile downstream of Double Creek to Hyco Lake, Hyco River (City of Roxboro water supply intake)					NF30	G	'2004						
South Hyco Creek (Lake Roxboro)													
22-58-4-(1.4)	WS-II,B;HQW	493.6	FW Acres	**S**	NL13	NCE			ND				
					NL12	NCE							
					NL11	NCE							
From backwaters of Lake Roxboro to dam at Lake Roxboro													
Storys Creek [Roxboro City Lake (Lake Issac Walton)]													
22-58-12-(1.5)	WS-II;HQW,CA	189.5	FW Acres	**NR**	NL19	ID			ND				
					NL18	ID							
					NL17	ID							
From a point 0.9 mile downstream of N.C. Hwy. 57 to Roxboro City Lake Dam													

Table 7 ROANOKE Subbasin 03-02-05

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

Use Categories:	Monitoring data type:	Results:	Use Support Ratings 2005:
AL - Aquatic Life	NF - Fish Community Survey	E - Excellent	S - Supporting, I - Impaired
REC - Recreation	NB - Benthic Community Survey	G - Good	NR - Not Rated
	NA - Ambient Monitoring Site	GF - Good-Fair	NR*- Not Rated for Recreation (screening criteria exceeded)
	NL- Lake Monitoring	F - Fair	ND-No Data Collected to make assessment
		P - Poor	
		NI - Not Impaired	
Miles/Acres	m- Monitored	N- Natural	**Results**
FW- Fresh Water	e- Evaluated	M - Moderate	CE-Criteria Exceeded > 10% and more than 10 samples
		S-Severe	NCE-No Criteria Exceeded
			ID- Insufficeint Data Available

Aquatic Life Rating Summary

S	m	12.5	FW Miles
I	m	23.4	FW Miles
S	m	493.6	FW Acres
NR	m	7,101.2	FW Acres
ND		147.7	FW Miles

Recreation Rating Summary

S	m	24.0	FW Miles
NR*	m	4.5	FW Miles
ND		155.1	FW Miles
ND		7,594.8	FW Acres

Fish Consumption Rating Summary

I	e	183.6	FW Miles
I	e	7,594.8	FW Acres

Two benthic macroinvertebrate community samples, three fish community samples (Figure 9 and Table 7) and one fish tissue sample were collected during this assessment period. Data were collected from five ambient monitoring stations and four lakes. Refer to the *2005 Roanoke River Basinwide Assessment Report* at http://www.esb.enr.state.nc.us/bar.html and Appendix IV for more information on monitoring.

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

5.2 Use Support Assessment Summary

Use support ratings were assigned for waters in subbasin 03-02-05 in the aquatic life, recreation, fish consumption and water supply categories. All waters are Impaired on an evaluated basis in the fish consumption category because of fish consumption advice that applies to the entire basin. In the water supply category, all waters are Supporting on an evaluated basis based on reports from DEH regional water treatment plant consultants.

There were 35.9 stream miles (19.6 percent) and 7,594.8 freshwater acres (100 percent) monitored during this assessment period in the aquatic life category. Of these, 12.5 stream miles (6.8 percent) and 493.6 freshwater acres (6.5 percent; Lake Roxboro) were supporting. There are 23.4 miles (12.8 percent) Impaired in this same category. Of the 28.5 steam miles (15.5 percent) monitored in the recreation category, 24.0 miles (13.1 percent) were classified as supporting. Refer to Table 7 for a summary of use support ratings for waters in subbasin 04-03-05.

5.3 Status and Recommendations of Previously and Newly Impaired Waters

The following waters were either identified as Impaired in the previous basin plan (2001) or are newly Impaired based on recent data. If previously identified as Impaired, the water will either remain on the state's 303(d) list or will be delisted based on recent data showing water quality improvements. If the water is newly Impaired, it will likely be placed on the 2008 303(d) list. The current status and recommendations for addressing these waters are presented below, and each is identified by an assessment unit number (AU#). Information regarding 303(d) listing and reporting methodology is presented in Appendix VII.

5.3.1 Hyco River (Hyco Lake) [AU# 22-58-(0.5)]

2001 Recommendations
DWQ, in cooperation with Carolina Power & Light Company, will continue to monitor Hyco Lake and the permitted discharge to insure a continued decline in selenium concentrations. DWQ will work closely with the Department of Health and Human Services to lift the advisory when there is no longer a risk to human health from consumption of fish from Hyco Lake.

Current Status

Hyco River (Hyco Lake), from source in Hyco Lake to dam of Hyco Lake, including tributary arms below elevation 410 (4,297.9 acres), is Not Rated for aquatic life due to insufficient number of samples within the assessment period; however, data indicate a healthy aquatic system. Hyco Lake was monitored by DWQ in June, July, and September of 2004 at sites NL10, NL14, NL15 and NL16. Low concentrations for most nutrient parameters and chlorophyll *a* were generally found each month. Assessment of parameters related to biological productivity indicated moderate biological productivity and mesotrophic conditions.

Progress Energy has conducted water quality sampling of Hyco Lake applicable to the basinwide schedule and has published reports for this data (Progress Energy 2001, 2002, 2003, 2004). Historical problems of selenium accumulation due to the power plant discharge were addressed in 1990 with a conversion to a dry fly ash handling system. Work is underway to determine if Progress Energy's sampling meets the quality assurance objectives for use in 303(d) reporting. If it does, that data will be used in the future to assist with use assessments on their reservoirs.

This same segment is no longer Impaired in the fish consumption category for selenium, although it is still Impaired for fish consumption on an evaluated basis due to the NC Department of Health and Human Services (NCDHHS) fish consumption advice for mercury that encompasses the entire Roanoke basin (see section 13.4). NCDHHS rescinded the selenium advisory in August 2001. The advisory, enacted by the State Health Director in 1988, had advised the public to limit consumption of fish from the lake due to elevated selenium levels. The advisory was partially rescinded in 1994 to include only carp, white catfish and green sunfish and was further modified in 1999 to include only carp. The order to remove the advisory followed several years of fish tissue sampling. The tests showed that the average selenium levels for carp and other fish were safe. Visit the NCDHHS website for more information at www.epi.state.nc.us/epi/fish.

In addition, three largemouth bass samples were collected from Hyco Reservoir during 2004 and analyzed for pesticide and polychloratinated biphenyls (PCB) contaminants at site NT1. The samples were collected as part of an ongoing statewide organics assessment. Two bass samples contained trace amounts of dichlordiphenylethylene (DDE), a DDT metabolite, but concentrations were well below US EPA, US FDA, and State of North Carolina criteria. PCB contaminants were not detected in any samples.

2006 Recommendations

DWQ will continue to monitor Hyco Lake for lakes assessment and fish tissue. Hyco Lake will be removed from the 303(d) list for selenium.

Water Quality Initiatives

The NCEEP is working with a landowner to place a conservation easement with 300 foot buffers along 12,333 feet of unnamed tributaries to Hyco River (22-58-(0.5)).

5.3.2 Hyco Creek (North Hyco Creek) [AU # 22-58-1]

Current Status and 2006 Recommendations

Hyco Creek (North Hyco Creek), from source to Hyco Lake, Hyco River (16.8 miles), is Impaired for aquatic life due to a Poor fish community bioclassification at site NF29. This site received the lowest score of any stream in the basin in 2004. The watershed drains an area of rural southeastern and eastern Caswell County. It was recommended that this creek and others within it's watershed be resampled to verify the 2004 results and to identify, if possible, the factors causing the low fish community rating. However, due to drought conditions in 2005 and 2006 a re-evaluation could not be done. DWQ will reassess this watershed during the next basinwide assessment period.

This section of Hyco Creek will be added to the 2008 303(d) list of Impaired waters.

This same section of Hyco Creek is Supporting in the recreation category due to no criteria exceeded at site NA8.

DWQ conducted a trends and annual load analysis on data collected from 1990 to 2004 at site NA8. The analysis included trends on total nitrogen (TN), defined as the sum of total Kjeldahl nitrogen and nitrate-nitrogen, total phosphorus (TP), water temperature, turbidity and total suspended solids (TSS). Results showed that average TN and TP concentrations peaked in July and decreased to a low in October. TSS and turbidity both exhibited increased levels in February and July. Water temperature followed a seasonal cycle, peaking in July. Results indicated a statistically significant negative trend in flow-adjusted TN. There were no other significant trends at the 95 percent confidence level.

5.3.3 Marlowe Creek [AU # 22-58-12-6a & b]

2001 Recommendations

DWQ will continue to work with the Town of Roxboro's WWTP and Cogentrix to correct remaining problems at these facilities and Roxboro's collection system. However, it is possible that aquatic life will remain impaired because of significant habitat degradation in the stream. The Town of Roxboro should begin to install urban stormwater controls and best management practices to prevent further degradation by runoff from urban areas and construction sites. DWQ will continue to monitor the stream and work with local NPS agencies to restore water quality.

Current Status

Marlowe Creek [22-58-12-6a], from source to Mitchell Creek (6.6 miles) is Impaired for aquatic life due to a Fair benthic community bioclassification at site NB85. Upgrades were made to the Roxboro WWTP in 2003, and more intensive sampling of Marlowe Creek was conducted to determine if improvements at the facility resulted in improvements in the benthic community. An upstream site was located at SR 1351, site NB85, above the WWTP, (approximately 300 meters) to compare to results at the basin site (NB43) at SR 1322 (approximately 3 miles downstream of the facility). Due to the fact that the headwaters of Marlowe Creek originate in the center of Roxboro, any benthic community improvements may be masked by urbanized impacts following the upgrades at the Roxboro WWTP. While urban effects are evident at the upstream location, downstream the cumulative effect of the influences of Roxboro and the

WWTP may be difficult to separate. However, during this assessment period, Roxboro did frequently experience sewer system collection overflows. This segment [22-58-12-6a] will remain on the 2008 303(d) list of Impaired waters for Impaired Biological Integrity.

Marlowe Creek [22-58-12-6b], from Mitchell Creek to Storys Creek (4.5 miles) is Supporting aquatic life due to Good-Fair fish and benthic community bioclassifications at sites NF27 and NB43. This site showed water quality improvement from the 2001 basin plan. Previously this site received a Fair benthic bioclassification. Several impacts were noted during benthic sampling, such as eroding banks, marginal instream habitat, which includes undercut banks and exposed root mats, few pools, and unproductive riffles. Riparian areas were intact and bank vegetation was generally healthy. Cogentrix-Roxboro completed a Special Order of Consent for rectifying toxicity issues in 2003 and have been in compliance. This segment [22-58-12-6b] will be removed from the 303(d) list.

Marlowe Creek [22-58-12-6b], from Mitchell Creek to Storys Creek (4.5 miles) is Not Rated for recreation due to bacteria screening criteria exceeded at site NA10. Further assessment of the standard was not conducted due to lack of resources.

2006 Recommendations
DWQ will continue to monitor Marlowe Creek. It is recommended that Roxboro work towards implementing a stormwater program.

Water Quality Initiative
The city of Roxboro received a State Emergency Loan (SEL) from the DWQ Construction, Grants and Loans Section in 2001. The purpose of the project is for sewer rehabilitation in replacing sewer pipes.

5.4 Status and Recommendations for Waters with Noted Impacts

The surface waters discussed in this section are not Impaired. However, notable water quality problems and concerns were documented for these waters during this assessment. Attention and resources should be focused on these waters to prevent additional degradation and facilitate water quality improvements. DWQ will notify local agencies of these water quality concerns and work with them to conduct further assessments and to locate sources of water quality protection funding. Additionally, education on local water quality issues and voluntary actions are useful tools to prevent water quality problems and to promote restoration efforts. Nonpoint source program agency contacts are listed in Appendix VIII.

5.4.1 Mayo Creek (Maho Creek) [AU # 22-58-15-(3.5)]

Current Status and 2006 Recommendations
Mayo Creek, from dam of Mayo Reservoir to North Carolina-Virginia State Line (0.5 miles) is Supporting aquatic life and recreation due to no criteria exceeded at site NA12.

DWQ conducted a trends and annual load analysis on data collected from 1990 to 2004 at site NA12. The analysis included trends on total nitrogen (TN), defined as the sum of total Kjeldahl nitrogen and nitrate-nitrogen, total phosphorus (TP), water temperature, turbidity and total suspended solids (TSS). Results showed that the distributions of TN and TP did not show a high degree of seasonality. Average TSS concentrations were generally lower in summer months and peak in March. Average turbidity peaked in December. Water temperature followed the standard seasonal trend, with peak average temperature in August. There were no trends significant at the 95 percent confidence level.

5.4.2 Mayo Creek (Mayo Reservoir) [AU #22-58-15-(0.5)]

Current Status and 2006 Recommendations

Mayo Reservoir, from source to dam of Mayo Reservoir (2,613.8 acres), is Not Rated for aquatic life due to the small number of samples taken during this assessment period. However, water quality appears to be good and improving over previous years although the presence of *Hydrilla* is a concern. DWQ sampled Mayo Reservoir in June, July and August 2004 from sites NL20, NL21 and NL22. Water quality sampling indicated low to moderate nutrient and chlorophyll *a* concentrations. Assessment of parameters related to biological productivity confirmed moderate biological productivity with a mesotrophic status. Mayo Reservoir has generally rated as oligotrophic (low biological productivity) in historical sampling. Water clarity was very good. The aquatic weed *Hydrilla* was observed in the lake, especially in the cove areas, but not yet at problematic conditions. No aquatic weed control measures are currently in place. A Progress Energy power plant is located near the dam at this lake and most of the shoreline was forested.

Progress Energy has conducted water quality sampling applicable to the basinwide schedule and has published reports for this data (Progress Energy 2001, 2002, 2003, 2004). In general, concentrations of most variables were highest near the power plant ash pond discharge and decreased rapidly with distance away from the discharge. All trace element concentrations were below the state water quality standards except for arsenic values near the ash pond discharge in 2000, 2002 and 2003. Selenium concentrations in fish tissues were also higher at the station near the ash pond discharge. Arsenic concentrations in fish tissue decreased from 2000 through 2003, with no significant concentrations found in 2003. The fish community composition was determined to be typical of a southeastern reservoir from 2000 through 2003. Work is underway to determine if Progress Energy's sampling meets the quality assurance objectives for use in 303(d) reporting. If it does, that data will be used in the future to assist with use assessments on their reservoirs.

5.4.3 Storys Creek (Roxboro City Lake) (Lake Isaac Walton) [AU # 22-58-12-(1.5)]

Current Status

Roxboro City Lake (Lake Issac Walton), from a point 0.9 mile downstream of N.C. Hwy. 57 to Roxboro City Lake Dam (189.5 acres), is Not Rated for aquatic life because of insufficient number of samples taken during this assessment period. DWQ monitored Roxboro City Lake at sites NL17, NL18 and NL19 in June, July, August and September of 2004. Moderate nutrient and chlorophyll *a* concentrations were generally found in the lake each month. Assessment of parameters related to biological productivity indicated slightly eutrophic conditions.

5.4.4 South Hyco Creek (Lake Roxboro) [AU # 22-58-4-(1.4)]

Current Status

Lake Roxboro, from backwaters of Lake Roxboro to dam at Lake Roxboro (493.6 acres), is Supporting aquatic life due to lakes assessments data from sites NL11, NL12 and NL13. DWQ monitored Lake Roxboro in 2000, 2001, 2002, and 2004. This water quality monitoring indicated moderate to elevated nutrient and chlorophyll *a* concentrations. Some exceedances of the state standard for chlorophyll *a* were found at this reservoir; however, in-lake averages were never above the standard. Assessment of parameters related to biological productivity indicated eutrophic conditions and high biological productivity. High dissolved oxygen saturation values (9 percent) were also found confirming algal activity. Algal analyses of samples collected in the summer of 2004 indicated moderate algal blooms all three months. These blooms were composed of a diverse assemblage and included species associated with agricultural runoff and species that may cause taste and odor problems in drinking water.

5.4.5 Hyco River [AU # 22-58-(9.5)]

Current Status and 2006 Recommendations

Hyco River, from dam of Hyco Lake to North Carolina-Virginia State Line, including all portions in North Carolina (6.8 miles) is Supporting aquatic life at site NA9 and recreation at sites NA9 and NA11due to no criteria exceedances at these sites.

DWQ conducted a trends and annual load analysis on data collected from 1990 to 2004 at site NA9. The analysis included trends on total nitrogen (TN), defined as the sum of total Kjeldahl nitrogen and nitrate-nitrogen, total phosphorus (TP), water temperature, turbidity and total suspended solids (TSS). Results indicated that the distributions of TN and TP concentrations showed some seasonality, with both nutrients peaking in average concentration in November. Average concentrations of TSS peak in January at a much higher concentration than for any other month. The monthly distribution of turbidity indicated peak turbidity in March with a gradual decline in turbidity until October when turbidity begins to increase. Water temperature followed the standard seasonal trend, with peak average temperature in August. There were no trends significant at the 95 percent confidence level.

Chapter 6
Roanoke River Subbasin 03-02-06
Including: Little Island Creek, Nutbush Creek and J.H. Kerr Reservoir

6.1 Subbasin Overview

Subbasin 03-02-06 at a Glance

Land and Water Area

Total area:	329 mi²
Land area:	295 mi²
Water area:	34 mi²

Population Statistics

2000 Est. Pop.: 38,992 people
Pop. Density: 119 persons/mi²

Land Cover (percent)

Forest/Wetland:	75%
Surface Water:	6.4%
Urban:	1.1%
Cultivated Crop:	8.6%
Pasture/ Managed Herbaceous:	9%

Counties

Person, Granville, Vance and Warren

Municipalities

Stovall and Henderson

Monitored Stream Statistics

Aquatic Life

Total Streams:	61.8 mi/9690.1 ac
Total Supporting:	20.4 mi
Total Impaired:	13.4 mi
Total Not Rated:	28.0 mi/9690.1 ac

Recreation

Total Streams:	1.6 mi
Total Supporting:	1.6 mi

This subbasin contains many small to medium-sized headwater tributaries of John H. Kerr Reservoir. Granville County has the highest estimated population growth in the Roanoke River basin at 29 percent by the year 2020. Population increases of 22 percent, 16 percent and 17 percent are projected for Person, Vance and Warren counties, respectively. For more information regarding population growth and trends, refer to Appendix I.

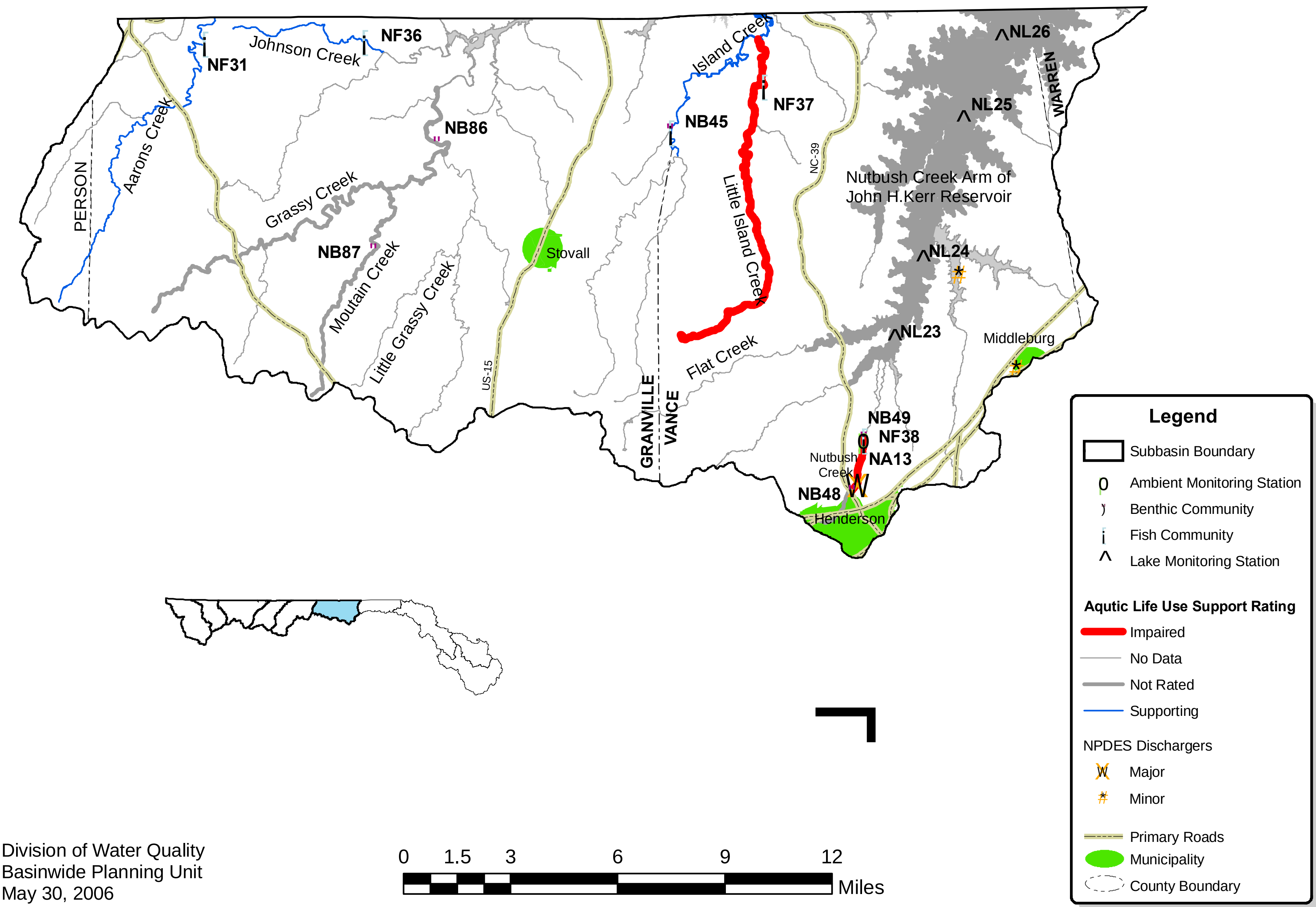
Three individual NPDES discharge permits are issued in this subbasin with a total permitted flow of 6 MGD. The largest is Henderson Water Reclamation Facility (WRF). Refer to Appendix VI for identification and more information on individual NPDES permit holders. Two registered swine operations are located in this subbasin. Refer to Chapter 16 for more information regarding animal operations within this basin.

Several water quality improvement programs have been implemented in this subbasin. The NC Agriculture Cost Share Program (NCACSP), which helps reduce agricultural runoff by helping farmers implement best management practices, is one of these programs. The NCACSP provided $881,669 towards implementing sediment and nutrient reduction practices, animal waste management, and livestock stream access elimination within this subbasin. For more information on this and other programs, refer to watershed discussion throughout this chapter as well as in Chapters 16 and 20.

A map including the locations of NPDES discharges and water quality monitoring stations is presented in Figure 10. Table 8 contains a summary of assessment units and lengths, streams monitored, monitoring data types, locations and results, along with use support ratings for waters in this subbasin. Refer to Appendix IX for more information about use support ratings.

Five benthic macroinvertebrate community samples and four fish community samples (Figure 10 and Table 8) were collected during this assessment period. Data were collected from one ambient monitoring station and one fish tissue site. Refer to the *2005 Roanoke River Basinwide*

Figure 10 Roanoke River Subbasin 03-02-06



Division of Water Quality
Basinwide Planning Unit
May 30, 2006

Table 8 ROANOKE Subbasin 03-02-06

AU Number / Description	Classification	Length/Area		AL Rating	Station	Result	Year/ Parameter	% Exc	REC Rating	Station	Result	Stressors	Sources
Aarons Creek													
22-59	C	8.6	FW Miles	**S**					ND				
From source to North Carolina-Virginia State Line					NF31	G	'2004						
Grassy Creek (Grass Creek)													
23-2-(1)	C	18.3	FW Miles	**NR**					ND				
From source to John H. Kerr Reservoir at Granville County SR 1431					NB86	NR	'2004						
Island Creek (Island Creek Reservoir)													
23-4	C	6.4	FW Miles	**S**					ND			Habitat Degradation	Agriculture
From source to North Carolina-Virginia State Line, including that portion of Island Creek Reservoir in North Carolina below normal operating elevation					NB45	GF	'2004					Habitat Degradation	Land Clearing
Johnson Creek													
23-2-7-(1)	C	5.3	FW Miles	**S**					ND			Habitat Degradation	Impoundment
From source to Little Johnson Creek					NF36	GF	'2004						
Little Island Creek (Vance County)													
23-4-3	C	11.8	FW Miles	**I**					ND			Toxic Impacts	Land Clearing
From source to Island Creek Reservoir, Island Creek					NF37	P	'2004					Habitat Degradation	Impoundment
Mountain Creek													
23-2-3	C	8.1	FW Miles	**NR**					ND				
From source to Grassy Creek					NB87	NR	'2004						

Table 8 ROANOKE Subbasin 03-02-06

AU Number / Description	Classification	Length/Area		AL Rating	Station	Result	Year/ Parameter	% Exc	REC Rating	Station	Result	Stressors	Sources
Nutbush Creek (Including Nutbush Creek Arm of John H. Kerr Reservoir below normal pool elevation)													
23-8-(1)a	C	1.7	FW Miles	**NR**					ND				
From source to NC 39					NB48	NR	2004						
23-8-(1)b	C	1.6	FW Miles	**I**	NA13	NCE			**S**	NA13	NCE		
From NC 39 to SR 1317					NB49	F	2004						
					NF38	F	2004						
Nutbush Creek Arm of John H. Kerr Reservoir (below normal pool elevation 300 feet MSL or as this elevation may be adjusted by the Corps of Engineers)													
23-8-(2)	B	9,690.1	FW Acres	**NR**	NL25	ID			ND				
					NL24	ID							
					NL23	ID							
					NL26	ID							
From Crooked Run to North Carolina-Virginia State Line													

Table 8 ROANOKE Subbasin 03-02-06

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

Use Categories:	Monitoring data type:	Results:	Use Support Ratings 2005:
AL - Aquatic Life	NF - Fish Community Survey	E - Excellent	S - Supporting, I - Impaired
REC - Recreation	NB - Benthic Community Survey	G - Good	NR - Not Rated
	NA - Ambient Monitoring Site	GF - Good-Fair	NR*- Not Rated for Recreation (screening criteria exceeded)
	NL- Lake Monitoring	F - Fair	ND-No Data Collected to make assessment
		P - Poor	
		NI - Not Impaired	
Miles/Acres	m- Monitored	N- Natural	**Results**
FW- Fresh Water	e- Evaluated	M - Moderate	CE-Criteria Exceeded > 10% and more than 10 samples
		S-Severe	NCE-No Criteria Exceeded
			ID- Insufficeint Data Available

Aquatic Life Rating Summary

S	m	20.4	FW Miles
NR	m	28.0	FW Miles
I	m	13.4	FW Miles
NR	m	9,690.1	FW Acres
ND		121.6	FW Miles
ND		731.0	FW Acres

Recreation Rating Summary

S	m	1.6	FW Miles
ND		181.8	FW Miles
ND		10,421.1	FW Acres

Fish Consumption Rating Summary

I	e	183.4	FW Miles
I	e	10,421.1	FW Acres

Assessment Report at http://www.esb.enr.state.nc.us/bar.html and Appendix IV for more information on monitoring.

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

6.2 Use Support Assessment Summary

Use support ratings were assigned for waters in subbasin 03-02-06 in the aquatic life, recreation, fish consumption and water supply categories. All waters are Impaired on an evaluated basis in the fish consumption category because of fish consumption advice that applies to the entire basin. In the water supply category, all waters are Supporting on an evaluated basis based on reports from DEH regional water treatment plant consultants.

There were 61.8 stream miles (33.7 percent) and 9,690 freshwater acres (93 percent) monitored during this assessment period in the aquatic life category. Of these, 13.4 stream miles (7.3 percent) are Impaired. In the recreation category 1.6 stream miles (0.9 percent) were monitored, these are classified as Supporting. Refer to Table 8 for a summary of use support ratings by category for waters in the subbasin 03-02-06.

6.3 Status and Recommendations of Previously and Newly Impaired Waters

The following waters were either identified as Impaired in the previous basin plan (2001) or are newly Impaired based on recent data. If previously identified as Impaired, the water will either remain on the state's 303(d) list or will be delisted based on recent data showing water quality improvements. If the water is newly Impaired, it will likely be placed on the 2008 303(d) list. The current status and recommendations for addressing these waters are presented below, and each is identified by an assessment unit number (AU#). Information regarding 303(d) listing and reporting methodology is presented in Appendix VII.

6.3.1 Nutbush Creek (AU#23-8-(1)a & b)

2001 Recommendations
DWQ will continue to work with the Town of Henderson's WWTP to correct remaining problems from their discharge and collection system. However, it is likely that aquatic life will remain impaired because of habitat degradation in the stream. Urban stormwater issues need to be addressed by the Town of Henderson. Best management practices to prevent further degradation by runoff from urban areas and construction sites should be installed. DWQ will continue to monitor the stream and work with local agencies to restore water quality.

Current Status
Nutbush Creek [AU#23-8-(1)a], from source to NC39 (1.7 miles), is Not Rated for aquatic life due to a Not Rated benthic community bioclassification at site NB48. The stream could not be rated because it is too small and does not fit the criteria to assign a bioclassification. The benthic community is degraded however, and urban influences are of concern since the stream's origin is in Henderson making it difficult to sustain colonization of benthic communities. A lack of flow and low dissolved oxygen were also observed.

Nutbush Creek [AU#23-8-(1)b], from NC 39 to SR1317 (1.6 miles), is Impaired for aquatic life based on a fair fish and benthic community bioclassifications at concurrent sites NF38 and NB49. It is Supporting recreation because the fecal coliform bacteria screening criteria was not exceeded at site NA13 (also concurrent with sites NF38 and NB49). Sites NB49 and NF38 were sampled approximately 1.3 miles below the Henderson WRF. The specific conductance at NF38 was elevated at 467 µmhos/cm in April 2004, and was the highest of any fish community sites in the basin. During the benthic community sampling at NB49 in June 2004, the conductivity was 501 µmhos/cm; in the summer of 1999 the conductivity was 601 µmhos/cm. Likewise, the 50th percentile of specific conductance at site NA13 was 423 µmhos/cm. Heavy filamentous algal growths were present on the bedrock in the lower reaches. The habitat reflected an abundance of sand, few riffles (the single riffle was bedrock), few pools, modest instream habitat (roots were abundant, however), and severely eroding, sparsely vegetated banks. The flow was moderate and the water was slightly turbid at the time of sampling. An elevated pH of 8.0 s.u. could also be traced to the WWTP, as the addition of lime is a component of the treatment process. Unlike other streams in this subbasin that may have reduced flow during dry periods, this stream keeps flowing because of the upstream discharge.

2006 Recommendations
DWQ will continue to monitor Nutbush Creek. DWQ is working to develop biocriteria for assigning bioclassifications to streams with watersheds that are less than 3 square miles. Nutbush Creek [AU#23-8-(1)b], will remain on the 303(d) list.

6.3.2 Little Island Creek [AU# 23-4-3]

Current Status and 2006 Recommendations
Little Island Creek, from source to Island Creek, Island Creek Reservoir (11.8 miles), is Impaired for aquatic life based on a Poor fish community bioclassification at site NF37. The fish community species diversity was low and habitat score was also low. This site and the lower part of the adjacent Island Creek watershed encompass the defunct Tungsten Queen Mine, an inactive hazardous site (NCDENR's Division of Waste Management, NCD082362989). The mine ceased operations in 1971 but at one time was one of the largest tungsten mines in the country. The tailings (sands) in Little Island Creek appeared to be similar to those at the tungsten mine and may have similar contaminant metals of concern including lead, arsenic, antimony, cadmium and zinc. Currently, the area including the tailings (sands) is under a remedial action by the Inactive Hazardous Site Branch of Superfund (Keith Snavley, DWM, pers. com., February 14, 2005). Like other streams in this subbasin, it is probable that the flow in this stream becomes very reduced during dry periods. Recolonization of the fish community from downstream sources is hindered by the barrier of the backwaters of Island Creek Reservoir.

These three factors -- flow, recolonization sources, and potential impacts from the abandoned tailings – may all play a role in the fish community.

It was recommended that this creek be resampled to verify the 2004 results and to identify, if possible, the factors causing the low fish community rating. However, due to drought conditions in 2005 and 2006 a re-evaluation could not be done. DWQ will reassess this watershed during the next basinwide assessment period. Little Island Creek will be added to the 303(d) list of Impaired waters.

6.4 Status and Recommendations for Waters with Noted Impacts

The surface waters discussed in this section are not Impaired. However, notable water quality problems and concerns were documented for these waters during this assessment. Attention and resources should be focused on these waters to prevent additional degradation and facilitate water quality improvements. DWQ will notify local agencies of these water quality concerns and work with them to conduct further assessments and to locate sources of water quality protection funding. Additionally, education on local water quality issues and voluntary actions are useful tools to prevent water quality problems and to promote restoration efforts. Nonpoint source program agency contacts are listed in Appendix VIII.

6.4.1 Island Creek [AU# 23-4]

Current Status and 2006 Recommendations
Island Creek, from source to North Carolina-Virginia State Line, including that portion of Island Creek Reservoir in North Carolina below normal operating elevation (6.4 miles), is Supporting aquatic life based on a Good-Fair benthic community bioclassification at site NB45. Riparian areas were intact (though narrow on the right bank), instream habitat included a variety of types, and the substrate was a good mix of gravel, cobble, and boulders. However, riffles were infrequent and moderately embedded and pools were infrequent. Banks were severely eroded with sparse vegetation, the channel appeared filled in with sediment in places, and the stream was only partially shaded. The land use is predominantly agriculture and it is recommended that local agencies work with landowners to install BMPs to improve riparian zones and the overall water quality in Island Creek.

6.4.2 Nutbush Creek Arm of J.H. Kerr Reservoir (below normal pool elevation 300 feet MSL or as this elevation may be adjusted by the Corps of Engineers) [AU# 23-8-(2)]

Current Status
Arm of J.H. Kerr Reservoir (Nutbush Creek), from Crooked Run to North Carolina-Virginia State Line (9,690.1 acres), is Not Rated due to insufficient samples taken from sites NL23, NL24, NL25 and NL26. DWQ monitored Nutbush Arm of Kerr Reservoir in June, July, and August of 2004. Moderate nutrient and chlorophyll *a* levels were found. Assessment of parameters related to biological productivity indicated moderate biological productivity and mesotrophic status. The reservoir has historically rated either mesotrophic or slightly eutrophic (biologically productive) in historical water quality sampling. Some high dissolved oxygen

saturation values were found in 2004 indicating algal activity, although no visible algal blooms or chlorophyll *a* water quality standards violations were found.

One largemouth bass and two golden redhorse sucker samples were collected from the Nutbush Creek arm of Kerr Lake during 2003 and analyzed for pesticide and PCB contaminants. The samples were collected as part of an ongoing statewide organics assessment. All samples contained trace amounts of DDE, a DDT metabolite, but concentrations were well below US EPA, US FDA, and State of North Carolina criteria. The golden redhorse sucker samples also contained trace amounts of chlordane and tetrabromodiphenyl ether (a PCB-like contaminant) however, the concentrations were below any level of concern.

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

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

6.5.1 Significant Ecological Indicator

<u>Aarons Creek (AU# 22-59)</u>
Aarons Creek, from source to North Carolina-Virginia State Line is Supporting aquatic life due to a Good fish community bioclassification at site NF31. From the confluence of Crooked Fork (just upstream of NC 96) to the NC/VA state line, is considered to be an Aquatic Habitat Site of regional significance because of the presence of four species of rare freshwater mussels in the creek (Sarah McRae, Natural Heritage Program, pers. com. February 15, 2005). At this crossing, the instream, riparian, and watershed characteristics are of high quality and qualified the site as a new fish community regional reference site. It is possible that the flow in this stream becomes very reduced during dry periods and this may have caused the lower than expected fish community score and bioclassification.

Chapter 7
Roanoke River Subbasin 03-02-07
Including: Smith Creek, Sixpound Creek and Lake Gaston

7.1 Subbasin Overview

Subbasin 03-02-07 at a Glance

Land and Water Area

Total area:	195 mi^2
Land area:	174 mi^2
Water area:	21 mi^2

Population Statistics

2000 Est. Pop.:	9,252 people
Pop. Density:	48 persons/mi^2

Land Cover (percent)

Forest/Wetland:	75.1%
Surface Water:	10.9%
Urban:	0.1%
Cultivated Crop:	7.4%
Pasture/ Managed Herbaceous:	6.4%

Counties

Warren, Northampton and Halifax

Municipalities

Portions of Norlina, Macon and Littleton

Monitored Stream Statistics

Aquatic Life

Total Streams:	23.1 mi/11939.2 ac
Total Supporting:	7.9 mi
Total Impaired:	15.2 mi
Total Not Rated:	11939.2 ac

Recreation

Total Streams:	3.0 mi
Total Supporting:	3.0 mi

This subbasin consists mainly of Lake Gaston (Reservoir) and many small tributaries that flow to the reservoir. Urbanized land represents the least amount of land cover in the entire basin at only 0.1 percent. The majority of the subbasin lies with in Warren County. Warren County is predicted to grow by 17 percent by the year 2020. Refer to Appendix I for more information regarding population growth and trends.

Several water quality improvement programs have been implemented in this subbasin. The NC Agriculture Cost Share Program (NCACSP), which helps reduce agricultural runoff by helping farmers implement best management practices, is one of these programs. Within this subbasin, the NCACSP provided $144,924 towards the application of sediment and nutrient reduction practices and elimination of livestock stream access. For more information on this and other programs, refer to recommendations throughout this chapter as well as in Chapters 16 and 20.

There are no NPDES wastewater discharge permits issued in this subbasin. Refer to Appendix VI for identification and more information on individual NPDES permit holders. Seven registered animal operations (3 cattle and 4 swine) are located in this subbasin. Refer to Chapter 16 for more information regarding animal operations within this basin.

A map including the locations of the water quality monitoring stations is presented in Figure 11. Table 9 contains a summary of assessment units and lengths, streams monitored, monitoring data types, locations and results, along with use support ratings for waters in this subbasin. Refer to Appendix IX for more information about use support ratings.

Five benthic macroinvertebrate community samples and one fish community sample (Figure 11 and Table 9) were collected during this assessment period. Data were also collected from one ambient monitoring station and one lake (3 monitoring stations). Refer to the *2005 Roanoke River Basinwide Assessment Report* at http://www.esb.enr.state.nc.us/bar.html and Appendix IV for more information on monitoring.

Figure 11 Roanoke River Subbasin 03-02-07

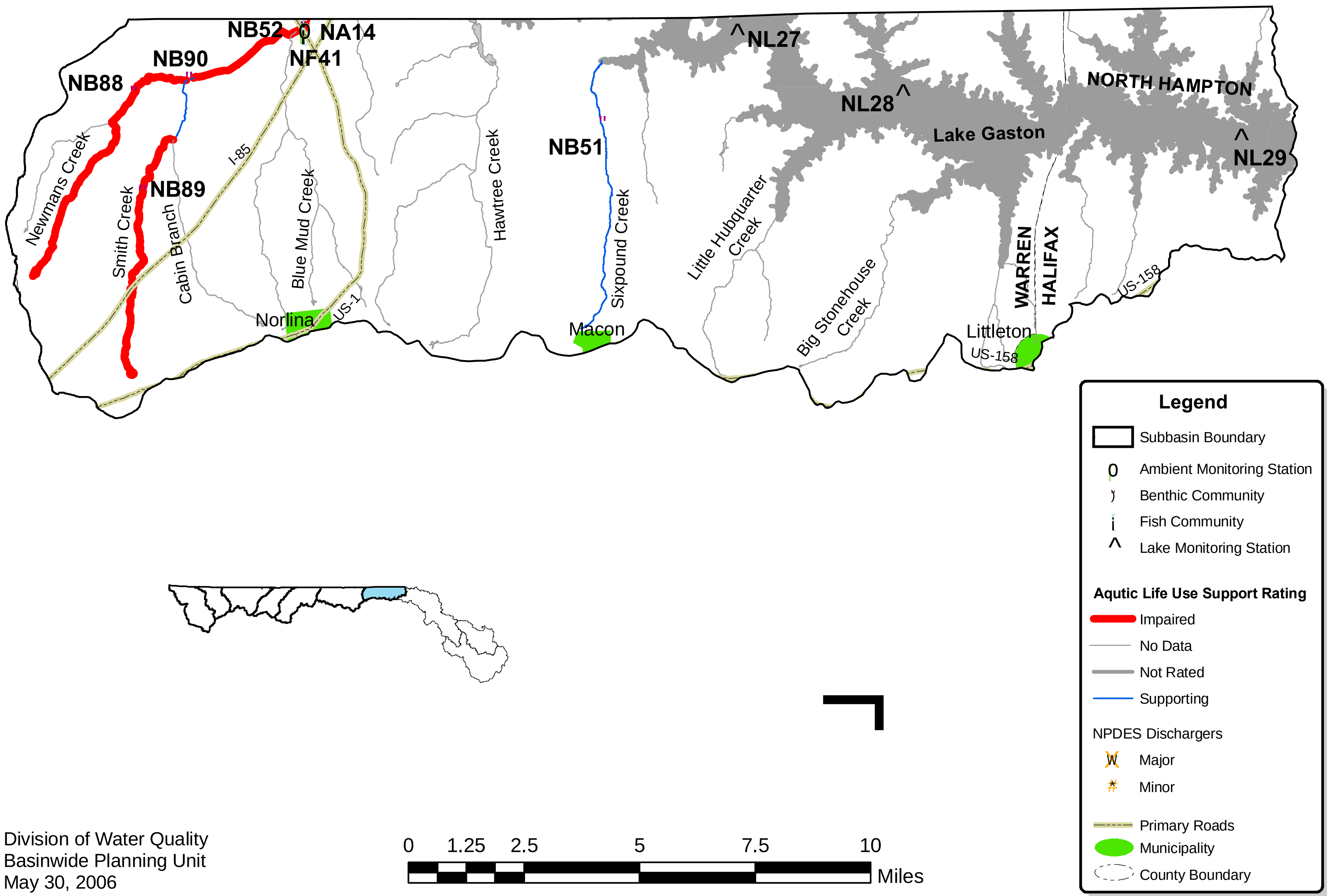


Table 9 ROANOKE Subbasin 03-02-07

AU Number / Description	Classification	Length/Area		AL Rating	Station	Result	Year/ Parameter	% Exc	REC Rating	Station	Result	Stressors	Sources
Newmans Creek (Little Deep Creek)													
23-10-2	C	6.1	FW Miles	I					ND			Habitat Degradation	Unknown
From source to Smith Creek					NB88	F	'2004						
ROANOKE RIVER (Lake Gaston below normal full power pool elevation 200 MSL)													
23-(12)	WS-V,B	7,964.8	FW Acres	NR	NL28	ID			ND				
					NL27	ID							
From North Carolina-Virginia State Line to a line across Lake Gaston following the Warren-Northampton County Line													
23-(20.2)	WS-IV,B	3,974.4	FW Acres	NR	NL29	ID			ND				
From a line across Lake Gaston following the Warren-Northampton County Line to a line across Lake Gaston 0.5 mile upstream of Lake Gaston Dam													
Sixpound Creek													
23-13	C	6.3	FW Miles	S					ND			Habitat Degradation	Unknown
From source to Lake Gaston, Roanoke River					NB51	GF	'2004						
Smith Creek													
23-10a	C	6.1	FW Miles	I					ND			Habitat Degradation	Unknown
From source to Cabin Branch					NB89	F	'2004						
23-10b	C	1.6	FW Miles	S					ND				
From Cabin Branch to SR1208					NB90	GF	'2004						
23-10c	C	3.0	FW Miles	I	NA14	CE	Low DO	12.5	S	NA14	NCE	Habitat Degradation	Impoundment
From SR1208 to North Carolina-Virginia State Line					NB52	F	'2004					Low Dissolved Oxygen	Unknown
					NF41	F	'2004						

Table 9 ROANOKE Subbasin 03-02-07

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

Use Categories:	**Monitoring data type:**	**Results:**	**Use Support Ratings 2005:**
AL - Aquatic Life	NF - Fish Community Survey	E - Excellent	S - Supporting, I - Impaired
REC - Recreation	NB - Benthic Community Survey	G - Good	NR - Not Rated
	NA - Ambient Monitoring Site	GF - Good-Fair	NR*- Not Rated for Recreation (screening criteria exceeded)
	NL- Lake Monitoring	F - Fair	ND-No Data Collected to make assessment
		P - Poor	
		NI - Not Impaired	
Miles/Acres	m- Monitored	N- Natural	**Results**
FW- Fresh Water	e- Evaluated	M - Moderate	CE-Criteria Exceeded > 10% and more than 10 samples
		S-Severe	NCE-No Criteria Exceeded
			ID- Insufficeint Data Available

Aquatic Life Rating Summary

S	m	7.9	FW Miles
I	m	15.2	FW Miles
NR	m	11,939.2	FW Acres
ND		73.3	FW Miles

Recreation Rating Summary

S	m	3.0	FW Miles
ND		93.4	FW Miles
ND		11,939.2	FW Acres

Fish Consumption Rating Summary

I	e	96.4	FW Miles
I	e	11,939.2	FW Acres

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

7.2 Use Support Assessment Summary

Use support ratings were assigned for waters in subbasin 03-02-07 in the aquatic life, recreation, fish consumption and water supply categories. All waters are Impaired on an evaluated basis in the fish consumption category because of basin wide fish consumption advice. In the water supply category, all waters are Supporting on an evaluated basis based on reports from DEH regional water treatment plant consultants.

There were 23.1 stream miles (24 percent) and 11,939.2 freshwater acres (100 percent) monitored during this assessment period in the aquatic life category. Of these, 15.2 stream miles (15.8 percent) are Impaired. In the recreation category, 3.0 stream miles (3.1 percent) were monitored and classified as Supporting. Refer to Table 9 for a summary of use support ratings for waters in subbasin 03-02-07.

7.3 Status and Recommendations of Previously and Newly Impaired Waters

The following waters were either identified as Impaired in the previous basin plan (2001) or are newly Impaired based on recent data. If previously identified as Impaired, the water will either remain on the state's 303(d) list or will be delisted based on recent data showing water quality improvements. If the water is newly Impaired, it will likely be placed on the 2008 303(d) list. The current status and recommendations for addressing these waters are presented below. Each is identified by an assessment unit number (AU#). Information regarding 303(d) listing and reporting methodology is presented in Appendix VII.

7.3.1 Smith Creek [AU#23-10a, b & c] watershed, Newmans Creek [AU#23-10-2]

2001 Recommendations
Smith Creek was Impaired in the 2001 basin plan. There are no NPDES permitted dischargers in the Smith Creek watershed; therefore most, if not all, impacts to this stream are from nonpoint sources of pollution. DWQ will continue to work cooperatively with agencies that administer sediment control programs in order to maximize effectiveness of these programs and to take appropriate enforcement action to protect or restore water quality. However, more voluntary implementation of BMPs on agricultural lands is needed in order to substantially improve water quality in this watershed. Funding is available through numerous federal and state agencies for farmers to restore and/or protect water quality on their land.

Current Status

Smith Creek [AU#23-10a], from source to Cabin Branch (6.1 miles) is Impaired for aquatic life due to a Fair benthic community bioclassification at site NB89. Smith Creek [AU#23-10b], from

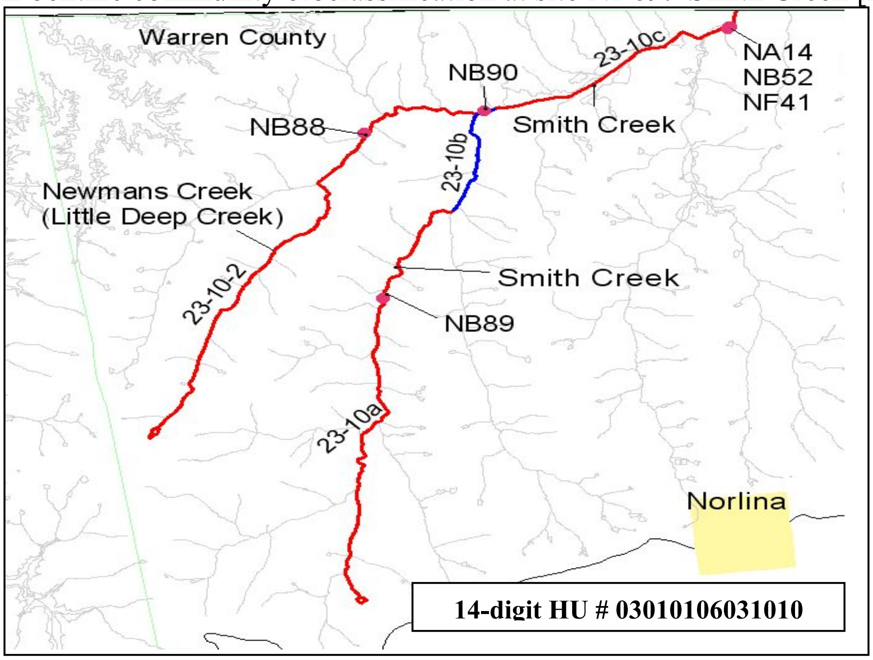


Figure 12 - Map of Smith Creek Watershed

Cabin Branch to SR 1208 (1.6 miles) is Supporting aquatic life due to a Good-Fair benthic community bioclassification at site NB90. Smith Creek [AU#23-10c], from SR 1208 to North Carolina-Virginia State Line (3.0 miles) is Impaired for aquatic life due to Fair fish and benthic community bioclassifications at sites NF41 and NB52 and at site NA14 where 12.5 percent of the samples were below the dissolved oxygen criteria. See Figure 12 for Smith Creek watershed map.

Newmans Creek (Little Deep Creek) [AU#23-10-2], from source to Smith Creek (6.1 miles) is Impaired for aquatic life due to a Fair benthic community bioclassification at site NB88 (Figure 12).

The Smith Creek watershed was evaluated for a 303(d) related stressor study in 2004 that involved a more intensive sampling regime. Physical, chemical and biological (benthos) parameters were assessed within the watershed. The study indicated low dissolved oxygen values, sedimentation, nutrient enrichment, lack of flow or no flow and reduced habitat. However, it was noted that site NB90 (AU# 23-10b) had the highest habitat score, suggesting that the riparian and instream habitats of the other sites may be limiting the benthic communities at those sites since land use is similar among all sites. In addition, this site had a high species richness, thus showing signs of possible water quality improvement. Newmans Creek will be added to the 2008 303(d) list.

2006 Recommendations and Water Quality Initiatives
DWQ will continue to monitor Smith Creek and Newmans Creek. With the many efforts from the Warren County Soil and Water Conservation District (SWCD) projects in this watershed, water quality is expected to improve by the end of the next assessment period (August 2009). In March 2005, Warren County SWCD received an EPA Section 319 grant totaling over $48,000 to restore Smith Creek by targeting nonpoint source pollution and implementing BMPs. Such practices include livestock exclusion, heavy use protection and erosion control. In addition, Warren County SWCD was granted approximately $150,000 to carry out their projects in the Smith Creek watershed over the next three years. For more information on the Smith Creek project contact the Warren County SWCD.

7.4 Status and Recommendations for Waters with Noted Impacts

The surface waters discussed in this section are not Impaired. However, notable water quality problems and concerns were documented for these waters during this assessment. Attention and resources should be focused on these waters to prevent additional degradation and to facilitate water quality improvements. DWQ will notify local agencies (Chapter 20) of these water quality concerns and work with them to conduct further assessments and to locate sources of water quality protection funding. Additionally, education on local water quality issues and voluntary actions are useful tools to prevent water quality problems and to promote restoration efforts. Nonpoint source program contacts are listed in Appendix VIII.

7.4.1 Sixpound Creek (AU# 23-13)

Current Status and 2006 Recommendations
Sixpound Creek, from source to Lake Gaston, Roanoke River (6.3 miles), is Supporting based on a Good-Fair benthic community bioclassification at site NB51. Poor habitat with very few pools and riffles as well as eroding banks was noted at this site. Water quality and habitat conditions are likely influenced by nonpoint source runoff from agriculture and large amounts of (not forested) land. BMPs are needed to improve water quality. DWQ will continue to monitor Sixpound Creek.

7.4.2 Roanoke River (Lake Gaston below normal full power pool elevation 200 MSL) [AU# 23-(12) & 23-(20.2)]

Current Status and 2006 Recommendation
Lake Gaston [AU# 23-(12)], from North Carolina-Virginia State Line to a line across Lake Gaston following the Warren-Northampton County Line (7,964.8 acres), is Not Rated for aquatic life due to insufficient number of samples taken at sites NL27 and NL28. Lake Gaston [AU# 23-(20.2)] from a line across Lake Gaston following the Warren-Northampton County Line to a line across Lake Gaston 0.5 mile upstream of Lake Gaston Dam (3,974.4 acres) is Not Rated for aquatic life due to insufficient number of samples taken at site NL29.

Lake Gaston was monitored by DWQ in June, July and August of 2004. Moderate nutrient and chlorophyll *a* levels were found. Assessment of parameters related to biological productivity indicated mesotrophic conditions and moderate biological productivity. This lake has generally rated as mesotrophic since sampling was first performed in 1981. The aquatic weed *Hydrilla* was observed in the lake in 2004, especially near the shoreline in the upstream part of the lake. Aquatic weed control measures have been conducted in recent years. These measures included the stocking of grass carp and chemical spraying (Rob Emens, N.C. Division of Water Resources, personal communication). The spraying is funded by the Lake Gaston Association and is being conducted in the coves. For more information on Lake Gaston Association's weed control projects, visit their website at: http://www.lakegastonassoc.com/. The aquatic weeds are problematic; and a more comprehensive survey of the coverage is recommended.

Chapter 8
Roanoke River Subbasin 03-02-08

Including: Roanoke Rapids Lake, Roanoke River, Chockoyotte Creek, Quankey Creek, Conoconnara Swamp, Occoneechee Creek and Kehukee Swamp

8.1 Subbasin Overview

Subbasin 03-02-08 at a Glance

Land and Water Area

Total area:	513 mi²
Land area:	473 mi²
Water area:	40 mi²

Population Statistics

2000 Est. Pop.:	30,274 people
Pop. Density:	59 persons/mi²

Land Cover (percent)

Forest/Wetland:	65.2%
Surface Water:	2.8%
Urban:	1.5%
Cultivated Crop:	28.4%
Pasture/ Managed Herbaceous:	2.0%

Counties

Halifax, Northampton, Martin and Bertie

Municipalities

Roanoke Rapids, Gaston, Weldon, Garysburg, Halifax, Jackson, Scotland Neck, Rich Square, Roxobel, Lewiston Woodville

Monitored Stream Statistics

Aquatic Life

Total Streams:	152.6 mi/4185.0 ac
Total Supporting:	152.6 mi
Total Not Rated:	4185.0 ac

Recreation

Total Streams:	76.6 mi
Total Not Rated:	76.6 mi

This subbasin contains the largest intact and least-disturbed bottomland hardwood forest floodplain in the mid-Atlantic region and encompasses subbasins 03-02-09 and 03-02-10. The lower Roanoke River is one of five major brownwater ecosystems in the Southeast. By the year 2020, population in Halifax, Northampton and Martin counties are expected to increase by 3, 6 and 0.6 percent respectively. Bertie County is estimated to experience an 8 percent decrease in population by 2020. For more information regarding population growth and trends, refer to Appendix I.

Several water quality improvement programs have been implemented in this subbasin. The NC Agriculture Cost Share Program (NCACSP), which helps reduce agricultural runoff by helping farmers implement BMPs, is one of these programs. The NCACSP provided $472,693 towards implementing sediment and nutrient reduction practices, animal waste management and livestock stream access elimination within this subbasin. For more information on this and other programs, refer to recommendations throughout this chapter as well as in Chapters 16 and 20.

Ten individual NPDES wastewater discharge permits are issued in this subbasin with a total permitted flow of 41.9 MGD; three are major dischargers. Seven facilities are required to conduct whole effluent toxicity testing. Five individual stormwater permits are issued in this subbasin. Refer to Appendix VI for identification and more information on individual NPDES permit holders. Sixteen registered animal operations (4 cattle, 1 poultry and 11 swine) are located in this subbasin. Refer to Chapter 16 for more information regarding animal operations within this basin.

A map including the locations of NPDES discharges and water quality monitoring stations is presented in Figure 13. Table 10 contains a summary of assessment units and lengths, streams monitored, monitoring data types, locations and results,

Figure 13 Roanoke River Subbasin 03-02-08

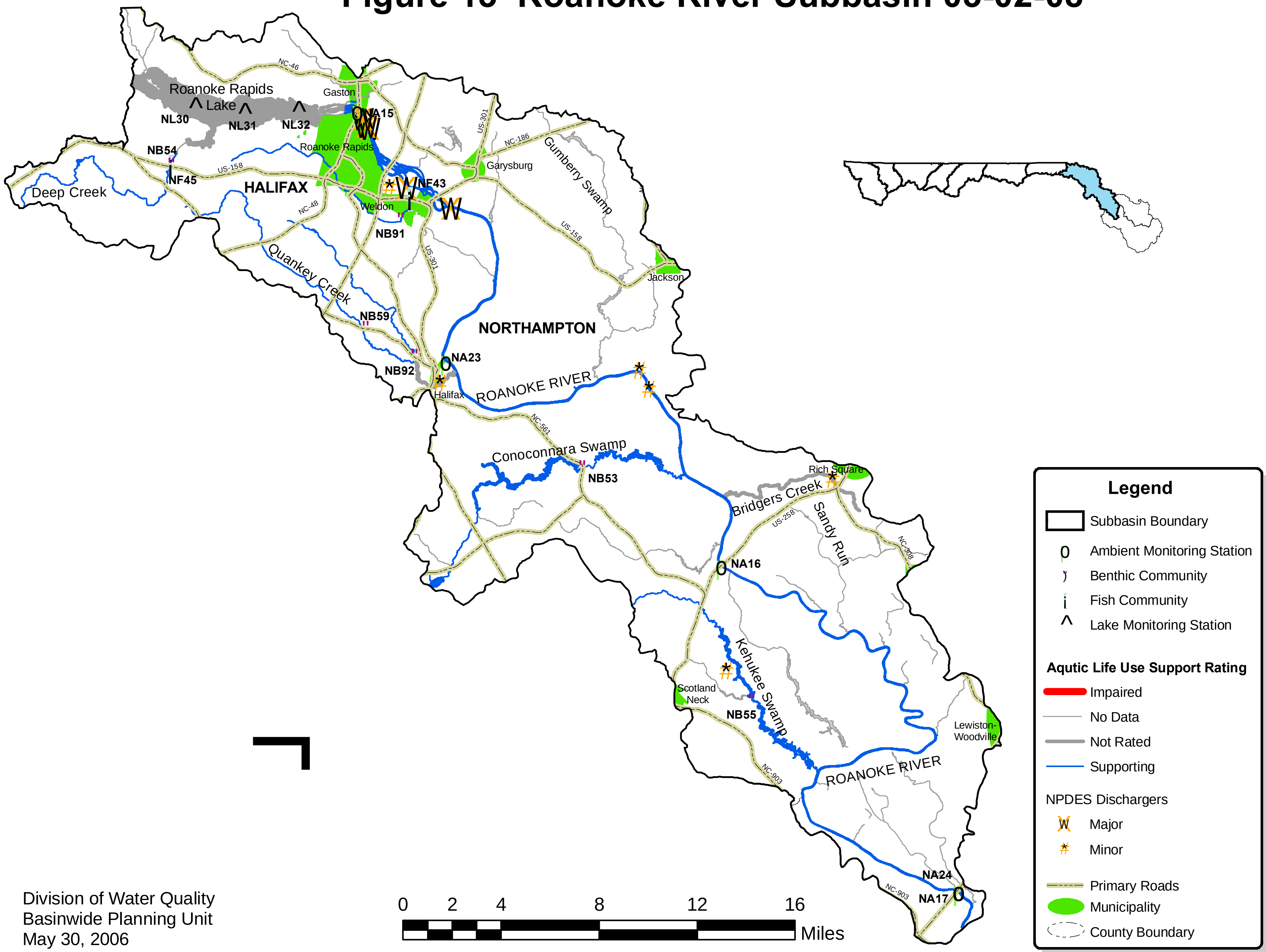


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Table 10 ROANOKE Subbasin 03-02-08

AU Number / Description	Classification	Length/Area	AL Rating	Station	Result	Year/ Parameter	% Exc	REC Rating	Station	Result	Stressors	Sources
Chockoyotte Creek												
23-29	C	10.6 FW Miles	S					ND			Habitat Degradation	Impervious Surface
From source to Roanoke River				NB91	M	2004					Habitat Degradation	Impoundment
				NF43	NR	2004					Habitat Degradation	Land Clearing
Conoconnara Swamp												
23-33	C	17.7 FW Miles	S					ND				
From source to Roanoke River				NB53	M	2004						
Deep Creek												
23-24-(1)	WS-IV	11.6 FW Miles	S					ND				
From source to a point 0.5 mile upstream of mouth				NB54	N	2004						
				NF45	G	2004						
Kehukee Swamp (White Millpond)												
23-42	C	10.6 FW Miles	S					ND				
From source to Roanoke River				NB55	M	2004						
Little Quankey Creek												
23-30-1	C	9.5 FW Miles	S					ND				
From source to Quankey Creek				NB92	M	2004						
Quankey Creek												
23-30a	C	16.0 FW Miles	S					ND				
From source to Little Quankey Creek				NB59	N	2004						

Table 10 ROANOKE Subbasin 03-02-08

AU Number / Description	Classification	Length/Area		AL Rating	Station	Result	Year/ Parameter	% Exc	REC Rating	Station	Result	Stressors	Sources
ROANOKE RIVER													
23-(25.5)	WS-IV;CA	1.7	FW Miles	**S**	NA15	NCE			**S**	NA15	NCE		
From a point 0.6 mile upstream of N.C. Hwy. 48 bridge to a line across river 50 feet downstream of N.C. Hwy. 48 (City of Roanoke Rapids, Town of Weldon water supply intakes)													
23-(26)a	C	50.1	FW Miles	**S**	NA16	NCE			**S**	NA16	NCE	Total Suspended Solids	Impoundment
					NA23	NCE						Habitat Degradation	Impoundment
From a line across the river 50 ft downstream of NC Hwy 48 bridge to the confluence of Sandy Run Cr at the Bertie													
23-(26)b1	C	24.8	FW Miles	**S**	NA17	NCE			**S**	NA17	NCE		
					NA24	NCE							
From the confluence of Sandy Run Cr at the Bertie/Northampton/Halifax Co. line to subbasin 8/9 boundary													
ROANOKE RIVER (Lake Gaston below normal full power pool elevation 200 MSL and Roanoke Rapids Lake below normal full power pool elevation 132 feet MSL)													
23-(22.5)	WS-IV,B;CA	4,185.0	FW Acres	**NR**	NL30	ID			ND				
					NL31	ID							
					NL32	ID							
From a line across Lake Gaston 0.5 mile upstream of Lake Gaston Dam to Roanoke Rapids Dam													

Table 10 ROANOKE Subbasin 03-02-08

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

Aquatic Life Assessment: AL Rating, Station, Result, Year/Parameter, % Exc
Recreation Assessment: REC Rating, Station, Result

Use Categories:	**Monitoring data type:**	**Results:**	**Use Support Ratings 2005**:
AL - Aquatic Life	NF - Fish Community Survey	E - Excellent	S - Supporting, I - Impaired
REC - Recreation	NB - Benthic Community Survey	G - Good	NR - Not Rated
	NA - Ambient Monitoring Site	GF - Good-Fair	NR*- Not Rated for Recreation (screening criteria exceeded)
	NL- Lake Monitoring	F - Fair	ND-No Data Collected to make assessment
		P - Poor	
		NI - Not Impaired	
Miles/Acres	m- Monitored	N- Natural	**Results**
FW- Fresh Water	e- Evaluated	M - Moderate	CE-Criteria Exceeded > 10% and more than 10 samples
		S-Severe	NCE-No Criteria Exceeded
			ID- Insufficeint Data Available

Aquatic Life Rating Summary

S	m	152.6	FW Miles
NR	m	4,185.0	FW Acres
NR	e	11.2	FW Miles
ND		142.7	FW Miles

Recreation Rating Summary

S	m	76.6	FW Miles
NR	e	3.4	FW Miles
ND		226.4	FW Miles
ND		4,185.0	FW Acres

Fish Consumption Rating Summary

I	e	306.4	FW Miles
I	e	4,185.0	FW Acres

along with use support ratings for waters in this subbasin. Refer to Appendix IX for more information about use support ratings.

Benthic biocriteria for swamp streams have been developed since the previous basin plan (2001). Where appropriate, those criteria have been applied to sites that were previously Not Rated (Deep Creek, Quankey Creek, Conoconnara Swamp and Kehukee Swamp). Six benthic macroinvertebrate community samples, two fish community samples (Figure 13 and Table 10) and one fish tissue sample were collected during this assessment period. Data were collected from three ambient monitoring stations and one lake (3 monitoring stations). Refer to the *2005 Roanoke River Basinwide Assessment Report* at http://www.esb.enr.state.nc.us/bar.html and Appendix IV for more information on monitoring.

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

8.2 Use Support Assessment Summary

Use support ratings were assigned for waters in subbasin 03-02-08 in the aquatic life, recreation, fish consumption and water supply categories. All waters are Impaired on an evaluated basis in the fish consumption category because of basin wide fish consumption advice. In the water supply category, all waters are Supporting on an evaluated basis based on reports from DEH regional water treatment plant consultants.

There were 152.6 stream miles (50 percent) and 4,185 freshwater acres (100 percent) monitored during this assessment period in the aquatic life category. Of these, all 152.6 stream miles (50 percent) were Supporting. In the recreation category, all of the 76.6 monitored stream miles (25 percent) were Supporting. Refer to Table 10 for a summary of use support ratings for waters in subbasin 03-02-08.

8.3 Status and Recommendations of Previously and Newly Impaired Waters

The following waters were either identified as Impaired in the previous basin plan (2001) or are newly Impaired based on recent data. If previously identified as Impaired, the water will either remain on the state's 303(d) list or will be delisted based on recent data showing water quality improvements. If the water is newly Impaired, it will likely be placed on the 2008 303(d) list. The current status and recommendations for addressing these waters are presented below, and each is identified by an assessment unit number (AU#). Information regarding 303(d) listing and reporting methodology is presented in Appendix VII.

8.3.1 Roanoke Rapids Lake (Roanoke River) [AU# 23-(22.5)]

2001 Recommendations

DWQ will work the Roanoke Rapids Lake Management Council and DWR to reduce aquatic weeds. Water quality could also benefit from nutrient reduction in this lake. Additionally, a public education campaign is recommended so that introduction of additional aquatic macrophytes from boats that have been in other waters is minimized.

Current Status

Roanoke Rapids Lake, from a line across Lake Gaston 0.5 mile upstream of Lake Gaston Dam to Roanoke Rapids Dam (4,768.0 acres), is Not Rated for aquatic life due to insufficient number of samples taken at sites NL30, NL31 and NL32. Roanoke Rapids Lake was monitored by DWQ in June, July and August of 2004. Low nutrient and chlorophyll *a* concentrations found indicated low biological productivity with respect to algal activity. Assessment of parameters related to biological productivity indicated this low biological productivity with slightly oligotrophic conditions. Water clarity was generally good. Large areas of invasive aquatic weeds were observed in 2004, primarily in the center of the lake. These weeds were *Hydrilla sp.*, Brazilian Elodea (*Egeria densa*) and Eurasian Watermilfoil (*Myriophyllum spicatum* L.). No aquatic weed control measures have been conducted at this reservoir due to economic reasons (Rob Emens, N.C. Division of Water Resources, personal communication).

Roanoke Rapids Lake is on the 303(d) list for impaired aquatic life due to aquatic weeds. A draft management strategy plan for aquatic weeds has been developed for Roanoke Rapids Lake and five other lakes and has been sent to EPA for approval.

Two largemouth bass and two common carp samples were collected from Roanoke Rapids Lake at site NT3 during 2003 and analyzed for pesticide and PCB contaminants. The samples were collected as part of an ongoing statewide organics assessment. Both carp and one bass sample contained trace amounts of DDE, a DDT metabolite, but concentrations were well below EPA, FDA, and State of North Carolina criteria. PCB contaminants were not detected in any samples.

2006 Recommendations

The draft aquatic weeds management strategy plan recommends development of an implementation plan since aquatic weed control is an ongoing concern that requires long-term commitment. The plan should focus on regular evaluations of the control measures and allow for modification as conditions change. Integration of control measures and modification should be sought through evaluating program effectiveness, organizing public outreach for a noxious and invasive weed prevention program and developing funding strategies. Roanoke Rapids Lake will be moved to a lower priority category, removing it from the 303(d) list, pending approval of the draft management strategy plan by the EPA. DWQ will continue to monitor Roanoke Rapids Lake.

8.3.2 Quankey Creek [AU #23-30a & b]

2001 Recommendations

DWQ will continue to work with the Town of Halifax to resolve problems with the WWTP discharge. The town received a grant in March 2000 to begin addressing the most critical maintenance problems at the facility. More funding is needed to complete collection system rehabilitation and construction of new sewer lines to eliminate failing septic systems in the Town of Halifax.

Additionally, DWQ will continue to monitor Quankey Creek and, as resources allow, sample Little Quankey Creek during the next basinwide cycle to assess its contribution to degraded water quality in this watershed.

Current Status
Quankey Creek [AU# 23-30a], from source to Little Quankey Creek is Supporting aquatic life based on a Natural benthic community bioclassification at site NB59. Quankey Creek [AU 23-30b], from Little Quankey Creek to Roanoke River is No Data because it was not resampled in 2004. This segment of Quankey Creek will remain on the 303(d) list for impaired biological integrity.

2006 Recommendations
DWQ will resample Quankey Creek in the next basinwide assessment. The Town of Halifax WWTP has chronic problems with exceeding their discharge limits for BOD, DO and fecal coliform bacteria. There have been numerous NOV's and civil penalties levied against the WWTP. The Town was granted an SOC to relax their BOD limits in March 2006. The Town paid an upfront SOC penalty of $16,166. The SOC requires the Town of Halifax to complete construction and eliminate discharge by tying into the Town of Weldon's WWTP by April 2007.

8.4 Status and Recommendations for Waters with Noted Impacts

The surface waters discussed in this section are not Impaired. However, notable water quality problems and concerns were documented for these waters during this assessment. Attention and resources should be focused on these waters to prevent additional degradation and facilitate water quality improvements. DWQ will notify local agencies of these water quality concerns and work with them to conduct further assessments and to locate sources of water quality protection funding. Additionally, education on local water quality issues and voluntary actions are useful tools to prevent water quality problems and to promote restoration efforts. Nonpoint source program agency contacts are listed in Appendix VIII.

8.4.1 Bridgers Creek [AU #23-34]

Current Status and Recommendation
Bridgers Creek, from source to Roanoke River (7.8 miles) is Not Rated on an Evaluated basis for aquatic life. The Rich Square WWTP is currently completing construction for a land application discharge system. In early 2004, DWQ Regional Office staff discovered an illegal bypass from their spray irrigation lagoon. DWQ is working with Rich Square to get them under a SOC that will provide for a schedule for a properly engineered removal of the bypass. In June 2004, Rich Square had received a Clean Water Bond grant for sewer rehabilitation including inflow and infiltration for the spray irrigation system but not for the bypass. DWQ will continue to work with Rich Square.

8.4.2 Chockoyotte Creek [AU #23-29]

Current Status

Chockoyotte Creek, from source to Roanoke River (10.6 miles) is Supporting aquatic life due to a Moderate Stress benthic community bioclassification at site NB91. The habitat was severely impacted at this site. Sedimentation, bank erosion, partial shading, inadequate riparian zones and an absence of instream habitat were all noted. It appeared that the stream had once been dammed at the sampling location and there were remains of large concrete blocks and rocks. Although Chockoyotte Creek received a Moderate Stress bioclassification, it has a highly degraded habitat due to urban impacts from the cities of Roanoke Rapids and Weldon. The Roanoke Rapids Sanitary District relocated their discharge pipe from Chockoyotte Creek to the Roanoke River in winter 2004/2005 and received new permit limits. Chockoyotte Creek was not rated in the fish community bioclassification due to questions regarding the applicability of the Piedmont or Coastal Plain regional criteria at site NF43. The overall community was abundant, diverse (19 species including 5 species of sunfish) and the species were well represented by multiple age groups. Multiple species were found from both regional criteria. The American eel and the redbreast sunfish represented the most abundant species making up 74 percent of all the fish collected. This is the only site where the American eel was collected. This is likely the case because of the numerous dams on the Roanoke River impeding upstream migrations and the colonization of historical habitats.

2006 Recommendations

DWQ will continue to monitor Chockoyotte Creek. The towns of Roanoke Rapids and Weldon are encouraged to develop a stormwater program to address the severe habitat degradation from lack of controlling stormwater runoff.

8.4.3 Conoconnara Swamp [AU # 23-33]

Current Status and 2006 Recommendations

Conoconnara Swamp, from source to Roanoke River (17.7 miles), is Supporting aquatic life due to a Moderate Stress benthic community bioclassification at site NB53. In comparing this 2004 sample to the previous 1999 sample, which would have received a Natural bioclassification, the 2004 data indicated a decline in the benthic community. A narrow riparian zone was noted on the left bank and an open canopy slightly decreased the habitat score. The decline in the benthic community could be a sign of increasing stress in the watershed and warrants future monitoring.

8.4.4 Kehukee Swamp (White Millpond) [AU # 23-42]

Current Status and 2006 Recommendations

Kehukee Swamp, from source to Roanoke River (10.6 miles), is Supporting aquatic life due to a Moderate Stress benthic bioclassification at site NB55. The benthic community resembled mostly pollution-tolerant species. In addition, undercut banks and root mats were rare. However, the riparian zone was wide and intact on both sides of the stream. DWQ will continue to monitor Kehukee Swamp.

8.4.5 Little Quankey Creek [AU # 23-30-1]

Current Status and 2006 Recommendations

Little Quankey Creek, from source to Quankey Creek (9.5 miles), is Supporting aquatic life due to a Moderate Stress benthic community bioclassification at site NB92. High erosion potential and a narrow riparian zone were observed at this site. A slightly more pollution-tolerant benthic community was collected, indicating signs of water quality stress. DWQ will continue to monitor Little Quankey Creek.

8.4.6 Roanoke River [AU# 23-(26)a & 23-(26)b1]

Current Status and 2006 Recommendations

Roanoke River [AU# 23-(26)a], from a line across the river 50 ft downstream of NC Hwy 48 bridge to the confluence of Sandy Run Creek at the Bertie/Northampton/Halifax Co. line (50.1 miles) (sites NA16 and NA 23) and Roanoke River [23-(26)b1], from the confluence of Sandy Run Creek at the Bertie/Northampton/Halifax Co. line to subbasin 08/09 boundary (24.8 miles) (sites NA17 and NA24), is Supporting aquatic life due to DWQ and USGS concurrent ambient monitoring at these sites. During this assessment period no benthic or fish community sites were sampled on the Roanoke River due to resource constraints and high flows. The two historic sites (at Halifax and US 258) should be sampled in future basinwide assessments.

This section of the Roanoke River is also Supporting recreation because the fecal coliform bacterial screening criteria was not exceeded at sites NA16 or NA17.

A 74-stream mile portion of the Roanoke River mainstem from Roanoke Rapids (at hwy NC-48) to Hamilton (at the wildlife boat ramp) was modeled for a dissolved oxygen TMDL. A model was used to determine the assimilative capacity of this section of the Roanoke River under critical low flow/warm weather conditions. This water quality management tool allows DWQ to develop allocations for oxygen consuming wastes and established an oxygen-consuming TMDL. The USEPA approved the TMDL in November 1996. This section of the Roanoke includes just above AU# 23-(26)a, 23-(26)b1 and part of 23-(26)b2 in subbasin 03-02-09.

It is noted that severe bank erosion is occurring on the Roanoke River. River flows are managed for flood control by the US Army Corp of Engineers and for hydropower generation by private industries. These managed flows are not similar to natural seasonal flow conditions and subsequently extend the length of time flooding occurs on the floodplain and in backswamps. In addition, frequent managed high flows at bankfull heights further accelerate river bank erosion.

The NC Department of Corrections, Caledonia WWTP was granted an SOC in October 2003 for fecal coliform bacteria. They were required to have an upgrade to their system by March 31, 2005; however they continued to have fecal coliform violations. DWQ will continue to purse corrections to these violations.

Water Quality Initiatives

The NCEEP purchased two tracts on the Roanoke River [23-(26)b1] in coordination with The Nature Conservancy. This acquisition protects 25,718 feet on one side of the river, 23,572 feet of streams in the interior of the tracts and 523 acres of riverine cypress gum swamp and bottomland hardwood wetlands. The two tracts lie approximately three miles apart, with the Roanoke River Wetlands Game Lands situated between. With the exception of one mile of privately owned land, this acquisition creates a 9-mile block of protected land along the north shore of this segment of the Roanoke River.

8.5 Additional Water Quality Issues within Subbasin 03-02-08

The following section discusses water quality topics downstream from the major reservoirs; J.H. Kerr, Gaston and Roanoke Rapids. The topics discussed may be related to water quality protection primarily concerning flow fluctuations from upstream dam releases.

8.5.1 Primary Nursery Area

The Roanoke River, from the Roanoke Rapids Dam to US 258 is designated as a Primary Nursery Area (PNA) by the Wildlife Resources Commission (WRC), per rules set forth in the NC Administrative Code 15ANCAC 10C.0501. Inland PNAs "are defined as those areas inhabited by the embryonic, larval or juvenile life stages of marine or estuarine fish or crustacean species due to favorable physical, chemical or biological factors". These rules are "to establish and protect fragile inland waters which support embryonic, larval or juvenile populations of marine or estuarine fish or crustacean species. Nursery areas are necessary for the early growth and development of virtually all of North Carolina's important marine or estuarine fish or crustacean species. Nursery areas need to be maintained, as much as possible, in their natural state, and the fish and crustacean populations within them must be permitted to develop in a normal manner with as little interference from man as possible". This designation is based primarily upon evidence that this section of the Roanoke River, approximately 35 miles, is the spawning reach for the Roanoke River/Albemarle Sound striped bass stock.

Because the continued health and reproduction of many aquatic species and wildlife is directly linked to good water quality, the WRC goal of conservation, management and enhancement of these species and habitats is key in protecting this valuable and complex ecosystem. WRC frequently conducts research and survey projects in the Roanoke River basin to assure that resource management decisions are based upon current data. The results of these projects demonstrate the diversity of aquatic species within portions of the basin as well as the importance of the Roanoke River as a spawning and nursery area to anadromous fish species. Because of the significance of diadromous fishes throughout the entire river basin including upper reaches extending into Virginia, a Diadromous Fish Restoration Technical Advisory Committee (DFRTAC) was formed as part of the Federal Energy Regulatory Commission, relicensing project number 2009. This is a multi-agency, collaborative effort between the United States Fish and Wildlife Service, National Marine Fisheries Service, United States Geological Survey, North Carolina Wildlife Resources Commission, North Carolina Division of Marine Fisheries, Virginia Department of Game and Inland Fisheries, United States Army Corps of Engineers, local universities, and Dominion Power. Initial efforts are focusing on restoration of American eel and American shad in the upper portions of the Roanoke River basin, in which historical migration paths have been blocked by dams in the lower portion of the river basin. Projects have been conducted in subbasins 03-02-08, 03-02-09 and 03-02-10. These projects included analysis of striped bass and American Shad spawning stock attributes and evaluations of American shad restoration techniques. For more information regarding these WRC studies contact WRC, Division of Inland Fisheries.

8.5.2 US Army Corps of Engineers

The US Army Corps of Engineers (ACOE) owns and operates John H. Kerr Reservoir. The project is located in Mecklenburg County, Virginia; 20.3 miles downstream from Clarksville, Virginia and 18 miles upstream from the Virginia-North Carolina State line. The main purpose of the reservoir is for reduction of flood damage, generation of hydroelectric power and low water control for pollution abatement and conservation of fish and wildlife.

The flow regime from the dam is managed. How the flow is released has the potential to affect water quality downstream. Carelessly managing a high flow release to a lower flow, especially in hot weather, could have significant potential to reduce downstream dissolved oxygen. High flow releases inundate the adjacent downstream back swamps. The surface of these areas is high in organic material, which when decomposed by bacteria, will strip dissolved oxygen from the downstream waters. As these swamps continue to flood, their slope is generally less, increasing the time required for them to drain. New flood flow to these areas will then cover more land per unit volume of water in contact with oxygen removing materials. The subsequent drainage of these waters into the river can increase the risk of anoxic or hypoxic conditions downstream.

In a cooperative effort with state and federal fish and wildlife agencies, the ACOE Wilmington District formed a water management group to discuss water quality conditions in the lower Roanoke River. These regular discussions also include immediate weather forecasts, river and reservoir conditions and forecast lake levels. This effort has been very useful in avoiding potentially devastating fish kill events. A key resource tool in the decision making process has been the water quality gage stations which are maintained by USGS. These water quality gage stations provide real-time data of dissolved oxygen levels in the Roanoke River mainstream.

8.5.3 Dominion Power Generation

Dominion Power Generation owns and operates Lake Gaston and Dam and Roanoke Rapids Lake and Dam for the purpose of hydropower generation. Lake Gaston and Roanoke Rapids Lake are located directly downstream from John H. Kerr Reservoir. Per the Federal Energy Regulatory Commission (FERC) license requirements, Dominion Power is to conduct water quality monitoring for dissolved oxygen when the dissolved oxygen standard is not met at the Roanoke Rapids Dam. Subsequent reporting of the standard violation and water quality data results are required to be submitted to DWQ.

8.5.4 Conservation Tillage

Conservation tillage is a practice that has been implemented throughout the Roanoke River Basin, with particular success in this subbasin. Conservation tillage practices produce environmental benefits that may include reduced soil erosion, sedimentation, and pollution from dissolved and sediment-attached substances.

Through the NCACSP, there were three eligible practices that provided cost share assistance to farmers utilizing conservation tillage: long-term no-till (5 year), conservation tillage (3 year) and conservation tillage (1 year). The one-year contract was removed from the program in 2003. According to the NCACSP, the three-year conservation tillage practice means any tillage and planting system in which at least 60 percent of the at-plant soil surface is covered by plant residue. The long-term no-till practice means planting all crops for five consecutive years with at least 80 percent of the at-plant soil surface covered by plant residue from preceding crops. The goal of implementing these practices is to improve water quality.

During this basinwide cycle, 1999-2004, the following conservation tillage BMPs were installed in this subbasin through the NCACSP:

Practice	Acres Enrolled	Cost
Conservation Tillage (1 year)	166.68 acres	$17,719
Conservation Tillage (3 years)	1,257.1 acres	$158,674
Long-term No-Till (5 years)	547.4 acres	$52,291

Chapter 9
Roanoke River Subbasin 03-02-09
Including: Roanoke River, Conoho Creek, Sweetwater Creek, Devils Gut, Hardison Mill Creek and Welch Creek

9.1 Subbasin Overview

Subbasin 03-02-09 at a Glance

Land and Water Area
Total area: 559 mi^2
Land area: 435 mi^2
Water area: 124 mi^2

Population Statistics
2000 Est. Pop.:25,359 people
Pop. Density: 45 persons/mi^2

Land Cover (percent)
Forest/Wetland: 71.5%
Surface Water: 2.4%
Urban: 0.6%
Cultivated Crop: 24.8%
Pasture/
Managed Herbaceous: 0.8%

Counties
Halifax, Martin, Bertie, Washington, Edgecombe and Beaufort

Municipalities
Oak City, Hassell, Hamilton, Williamston, Jamesville and Plymouth

Monitored Stream Statistics
Aquatic Life
Total Streams: 116.4 mi
Total Supporting: 80.3 mi
Total Impaired: 17.8 mi
Total Not Rated: 18.3 ac

Recreation
Total Streams: 47.2 mi
Total Supported: 47.2 mi

This subbasin contains a very expansive floodplain ecosystem with many inlets and outlets. In addition, there is a complex distributary system at the mouth of the Roanoke River that may, during periods of low flow experience saltwater intrusion and tidal effects that extend more than halfway up the Roanoke River (Bales and others, 1993). Over 55,000 acres of land are owned either by US Fish and Wildlife Service, NC Wildlife Resources Commission or The Nature Conservancy. The area is mostly rural, consisting largely of forest and agricultural land. Martin County has an estimated growth of 0.6 percent by the year 2020 and Bertie County may decrease by 8 percent in population by 2020. For more information regarding population growth and trends, refer to Appendix I.

Several water quality improvement programs have been implemented in this subbasin. The NC Agriculture Cost Share Program (NCACSP), which helps reduce agricultural runoff by helping farmers implement best management practices, is one of these programs. The NCACSP provided $431,084 towards implementing sediment and nutrient reduction practices and animal waste management within this subbasin. For more information on this and other programs, refer to watershed discussion throughout this chapter as well as in chapters 16 and 20.

Eight individual NPDES discharge permits are issued in this subbasin with a total permitted flow of 86 MGD, the largest permitted flow in the basin. Three facilities are required to conduct whole effluent toxicity (WET) testing. McMurray Fabrics Inc. had significant noncompliance for WET testing requirements in this assessment period. One individual stormwater permit is issued in this subbasin. Refer to Appendix VI for identification and more information on individual NPDES permit holders. Six registered animal operations are located in this subbasin. Refer to Chapter 16 for more information regarding animal operations within this basin.

A map including the locations of NPDES discharges and water quality monitoring stations is presented in Figure 14. Table 11 contains a summary of assessment units and lengths, streams

Figure 14 Roanoke River Subbasin 03-02-09

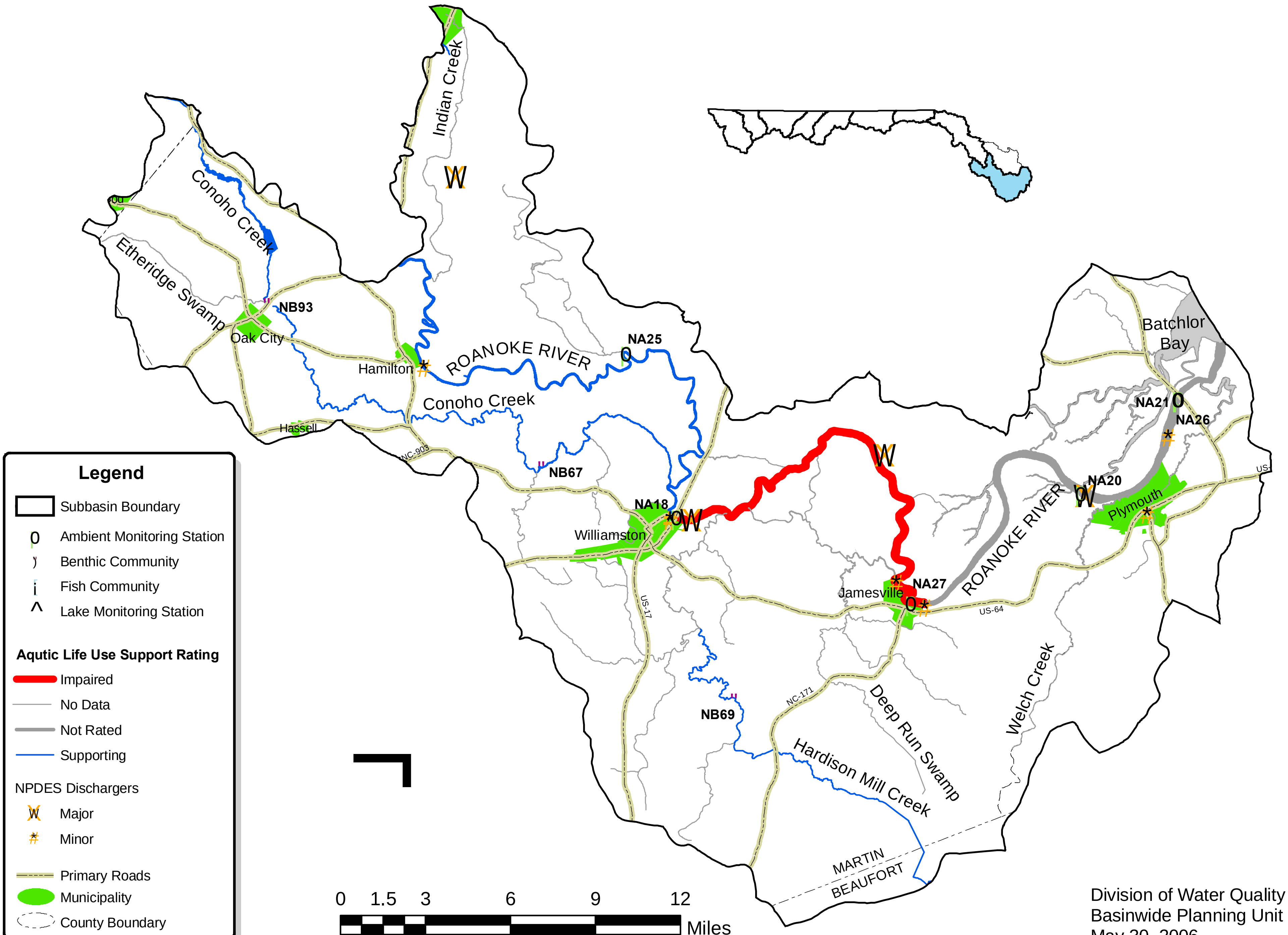

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Table 11 ROANOKE Subbasin 03-02-09

AU Number / Description	Classification	Length/Area		AL Rating	Station	Result	Year/Parameter	% Exc	REC Rating	Station	Result	Stressors	Sources
ALBEMARLE SOUND (Batchelor Bay)													
24	B;Sw	1,475.5	S Acres	ND					ND			Dioxin	
West of a line extending from a point of land 0.3 mile north of mouth of Morgan Swamp in a southerly direction to a point of land on the eastside of the mouth of Roanoke River													
Conoho Creek													
23-49a	C	24.5	FW Miles	S					ND				
From source to Martin Co 1417 below Beaverdam Cr					NB93	M	'2004						
23-49b	C	7.0	FW Miles	S					ND				
From Martin Co 1417 to Roanoke River					NB67	N	'2004						
Hardison Mill Creek													
23-50-3	C	19.9	FW Miles	S					ND			Habitat Degradation	Unknown
From source to Sweetwater Creek					NB69	M	'2004						
ROANOKE RIVER													
23-(26)b2	C	28.9	FW Miles	S	NA18	NCE			S	NA18	NCE		
					NA25	NCE							
From subbasin 8/9 boundary to Hwy 17 Bridge in Williamston													
23-(26)b3	C	17.8	FW Miles	I	NA27	CE	Low DO	16.3	NR			Fecal Coliform Bacteria	WWTP NPDES
From Hwy 17 bridge at Williamston to the 18 mile marker at Jamesville												Dioxin	WWTP NPDES
												Low Dissolved Oxygen	Impoundment
23-(53)	C;Sw	18.3	FW Miles	NR	NA20	NCE			S	NA20	NCE	Dioxin	WWTP NPDES
					NA21	NCE				NA21	NCE	Low Dissolved Oxygen	Unknown
					NA26	NCE	Low DO	22.9					
From 18 mile marker at Jamesville to Albemarle Sound (Batchelor Bay)													

Table 11 ROANOKE Subbasin 03-02-09

AU Number / Description	Classification	Length/Area		AL Rating	Station	Result	Year/ Parameter	% Exc	REC Rating	Station	Result	Stressors	Sources
Welch Creek													
23-55 From source to Roanoke River	C;Sw	13.3	FW Miles	ND					ND			Dioxin	WWTP NPDES

Use Categories:	**Monitoring data type:**	**Results:**	**Use Support Ratings 2005:**
AL - Aquatic Life	NF - Fish Community Survey	E - Excellent	S - Supporting, I - Impaired
REC - Recreation	NB - Benthic Community Survey	G - Good	NR - Not Rated
	NA - Ambient Monitoring Site	GF - Good-Fair	NR*- Not Rated for Recreation (screening criteria exceeded)
	NL- Lake Monitoring	F - Fair	ND-No Data Collected to make assessment
		P - Poor	
		NI - Not Impaired	
Miles/Acres	m- Monitored	N- Natural	**Results**
FW- Fresh Water	e- Evaluated	M - Moderate	CE-Criteria Exceeded > 10% and more than 10 samples
		S-Severe	NCE-No Criteria Exceeded
			ID- Insufficeint Data Available

Aquatic Life Rating Summary

S	m	80.3	FW Miles
NR	m	18.3	FW Miles
I	m	17.8	FW Miles
ND		1,475.5	S Acres
ND		194.3	FW Miles

Recreation Rating Summary

S	m	47.2	FW Miles
NR	e	17.8	FW Miles
ND		1,475.5	S Acres
ND		245.7	FW Miles

Fish Consumption Rating Summary

I	m	1,475.5	S Acres
I	m	49.4	FW Miles
I	e	261.3	FW Miles

monitored, monitoring data types, locations and results, along with use support ratings for waters in this subbasin. Refer to Appendix IX for more information about use support ratings.

Benthic community biocriteria for swamp streams have been developed since the previous basinwide plan (2001). Where appropriate, those criteria were applied to sites Not Rated in the 2001 basin plan (Conoho Creek and Hardison Mill Creek). Three benthic macroinvertebrate community samples (Figure 14 and Table 11) were collected during this assessment period. Data were also collected from one ambient monitoring station. Refer to the *2005 Roanoke River Basinwide Assessment Report* at http://www.esb.enr.state.nc.us/bar.html and Appendix IV for more information on monitoring.

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

9.2 Use Support Assessment Summary

Use support ratings were assigned for waters in subbasin 03-02-09 in the aquatic life, recreation, fish consumption and water supply categories. All waters are Impaired on an evaluated basis in the fish consumption category because of fish consumption advice that applies to the entire basin. In the water supply category, all waters are Supporting on an evaluated basis based on reports from DEH regional water treatment plant consultants.

There were 116.4 stream miles (37.5 percent) monitored during this assessment period in the aquatic life category. Of these, 17.8 stream miles (5.7 percent) are Impaired and 80.3 stream miles (25.8 percent) were Supporting. In the recreation category, all 47.2 monitored stream miles (15.2 percent) were Supporting. There were also 49.4 stream miles (15.9 percent) and 1,475.5 saltwater acres (100 percent) that were Impaired on a monitored basis in the fish consumption category for dioxin contamination. All surface waters within this basin are Impaired on an evaluated basis for mercury based on an advice by NC Department of Heath and Human Services. Refer to Table 11 for a summary of use support ratings by category for waters in the subbasin 03-02-09.

9.3 Status and Recommendations of Previously and Newly Impaired Waters

The following waters were either identified as Impaired in the previous basin plan (2001) or are newly Impaired based on recent data. If previously identified as Impaired, the water will either remain on the state's 303(d) list or will be delisted based on recent data showing water quality improvements. If the water is newly Impaired, it will likely be placed on the 2008 303(d) list. The current status and recommendations for addressing these waters are presented below, and each is identified by an assessment unit number (AU#). Information regarding 303(d) listing and reporting methodology is presented in Appendix VII.

9.3.1 Roanoke River [AU# 23-(26)b3 & 23-(53)], Welch Creek [AU# 23-55], Albemarle Sound (Batchelor Bay)[AU# 24]

2001 Recommendations

DWQ, in cooperation with Weyerhaeuser Company, will continue to monitor the lower Roanoke River and Welch Creek and will work closely with the Department of Health and Human Services' Division of Public Health to lift the advisory when there is no longer a risk to human health from consumption of fish due to dioxin concentrations.

Current Status

The Roanoke River [AU# 23-(26)b3], from Hwy 17 bridge at Williamston to the 18 mile marker at Jamesville (17.8 miles), is Impaired for aquatic life based on the dissolved oxygen standard violation at site NA27. A US Geological Survey (USGS) conducted a study entitled, "Relations Among Floodplain Water Levels, Instream Dissolved-Oxygen Conditions, and Streamflow in the Lower Roanoke River, North Carolina, 1997-2001" (USGS Water-Resources Investigations Report 03-4295). Data from this study indicated that from September 1999 through August 2004, 16.3 percent of the samples taken were below the continuous monitoring dissolved oxygen standard for the daily average of 5 mg/l. This section of the Roanoke River will be placed on the 2008 303(d) list.

McMurray Fabrics Inc. had significant noncompliance for their Whole Effluent Toxicity (WET) testing requirements in this assessment period. DWQ is working with the facility to rectify the problem. The facility will continue to conduct WET testing per their permit requirements.

The Town of Williamston WWTP has had chronic problems exceeding their discharge limits for fecal coliform bacteria and total suspended solids. They have had civil penalties levied in excess of $70,000 over the past several years. The town was issued an SOC for fecal coliform in February 2006. They are required to upgrade their chlorination and dechlorination system by December 2007. They paid an upfront SOC penalty of $5,000.

The Roanoke River [AU# 23-(53)] from the 18 mile marker at Jamesville to Albemarle Sound (Batchelor Bay) (18.3 miles), is not rated for aquatic life due to inconclusive data available in the swamp area. Dissolved oxygen was below the standard for the daily average of 5 mg/l in 22.95 percent of the samples taken at USGS site NA26 (swamp water area). This section of the Roanoke River is supporting for recreation because the fecal coliform bacterial screening criteria was not exceeded at sites NA20 and NA21.

The Town of Plymouth were awarded a nearly $2 million dollar grant from the NC Clean Water Management Trust Fund. The Plymouth sewer system has experienced a large amount of groundwater infiltration, which is overburdening lift stations after heavy rain events. Sewer lines and possibly waterlines will be replaced or repaired using funds from this grant. This project is divided into two phases. Construction on phase I is projected to start in January 2007 and will result in the replacement of sewer and waterlines. Phase II will involve slip lining of sewer pipes and manhole replacement. Phase II construction should start in January 2008.

It is noted that severe bank erosion is occurring on the Roanoke River. River flows are managed for flood control by the US Army Corp of Engineers and for hydropower generation by private industries. These managed flows are not similar to natural seasonal flow conditions and subsequently extends the length of time flooding occurs on the floodplain and in backswamps. In addition, frequent managed high flows at bankfull heights further accelerate river bank erosion. The Federal Energy Regulatory Commission (FERC) re-licensing requirements for Dominion North Carolina Power (Dominion) are be discussed in Section 9.5 (Additional Water Quality Issues).

Dioxin Fish Consumption Advisory
These same areas of the Roanoke River (from Hwy 17 bridge [AU# 23-(26)b3] to the Albemarle Sound [AU# 23-(53)]) (36.1 miles total) as well as Albemarle Sound (Batchelor Bay) [AU# 24] from west of a line extending from a point of land 0.3 miles north of mouth of Morgan Swamp in a southerly direction to a point of land on the eastside of the mouth of Roanoke River (1,475.5 saltwater acres) and Welch Creek [AU# 23-55], from the source to Roanoke River (13.3 miles), is Impaired for fish consumption based on an advisory from the NC Department of Health and Human Services' (DHHS) for dioxin in carp and catfish.

The Albemarle Sound, from Bull Bay to Harvey Point, west to mouth of the Roanoke River and to the mouth of the Chowan River to the US Hwy 17 Bridge, is also Impaired for fish consumption under this same dioxin advisory.

The fish consumption impairments are due to the fish consumption advisory posted in October 2001 for carp and catfish. It is advised that carp and catfish from these waters may contain low levels of dioxins. Women of childbearing age and children should not eat any carp or catfish from these areas. All other persons should eat no more than one meal per person per month of carp and catfish from these areas. Swimming, boating, and other recreational activities present no health risks and are not affected by this advisory. For more information regarding fish consumption advisories, call (919) 707-5900 or visit the NC DHHS Division of Public Health website at http://www.schs.state.nc.us/epi/fish/current.html.

2006 Recommendations
DWQ, in cooperation with Weyerhaeuser Company, will continue to monitor the lower Roanoke River and Welch Creek and will work closely with the DHHS to lift the advisory when there is no longer a risk to human health from consumption of fish. The EPA approved a dioxin TMDL in 1996. Discussions between multiple state and federal agencies regarding alternative dioxin clean up options have ensued. Such alternatives look at site remediation and testing, removal and capping of the dioxin contaminant in Welch Creek.

9.4 Status and Recommendations for Waters with Noted Impacts

The surface waters discussed in this section are not Impaired. However, notable water quality problems and concerns were documented for these waters during this assessment. Attention and resources should be focused on these waters to prevent additional degradation and facilitate water quality improvements. DWQ will notify local agencies of these water quality concerns and work with them to conduct further assessments and to locate sources of water quality protection funding. Additionally, education on local water quality issues and voluntary actions are useful tools to prevent water quality problems and to promote restoration efforts. Nonpoint source program agency contacts are listed in Appendix VIII.

9.4.1 Conoho Creek [AU# 23-49a & 23-49b]

Current Status and 2006 Recommendations
Conoho Creek [AU# 23-49a], from source to Martin Co. 1417 below Beaverdam Creek (24.5 miles) and [AU#23-49b] from Martin Co. 1417 to Roanoke River (7.0 miles), is Supporting aquatic life based on Moderate Stress and Natural benthic community bioclassifications at sites NB93 and NB67. Riparian areas were intact at site NB93 and considering the range of Moderate Stress scores, this site nearly scored a Natural. The downstream site NB67 scored Natural likely due to the larger drainage area (increased flow and dilution of impacts), which may contribute to the better benthic community bioclassfication. DWQ will continue to monitor Conoho Creek.

9.4.2 Hardison Mill Creek [AU# 23-50-3)]

Current Status and 2006 Recommendations
Hardison Mill Creek, from source to Sweetwater Creek (19.9 miles), is Supporting aquatic life based on a Moderate Stress benthic community bioclassification at sites NB69. A large clear cut area on the right bank and adjacent riparian zone was noted. Actual cutting was in progress during the sampling effort. Microhabitats were also lacking at this site. DWQ will continue to monitor Hardison Mill Creek.

9.5 Additional Water Quality Issues within Subbasin 03-02-09

9.5.1 Indian Creek [AU# 23-47)]

Water Quality Initiatives
The NCEEP is facilitating the transfer of the Roquist Pocosin tract from the NC Department of Transportation to the Wildlife Resource Commission. The tract provides water quality protection to Indian Creek (AU# 23-47). This will be discussed in more detail in section 10.5.1.

9.5.2 Roanoke River [AU # 23-(26)b2]

Current Status
Roanoke River, from subbasin 03-02-08/-09 boundary to Hwy 17 bridge in Williamston (28.9 miles), is Supporting aquatic life due to DWQ and USGS concurrent ambient monitoring at sites NA18 and NA25. During this assessment period, no benthic or fish community sites were sampled on the Roanoke River due to resource constraints and high flows.

This section of the Roanoke River is also Supporting recreation because the fecal coliform bacterial screening criteria was not exceeded at site NA18.

DWQ as well as other state and federal agencies are extensively involved with Dominion Power's Federal Energy Regulatory Commission (FERC) new license requirements to conduct several studies including monitoring and reporting of water quality conditions in the Roanoke River and upstream reservoirs.

A comprehensive Section 216 study was initiated to study the potential impacts John H Kerr dam has on the lower Roanoke River. The relationship between river flow, floodplain water level, and instream dissolved oxygen (DO) concentrations are important but poorly understood for the lower Roanoke River. Flooding and floodplain inundation of this area no longer follows a natural seasonal pattern, but are instead primarily governed by upstream reservoir releases.

The objective of the proposed study is to provide the flow and water quality modeling tools that can be used to assess the effects of changes in John H. Kerr operations on Roanoke River flows; duration, extent, depth, and timing of floodplain inundation; DO levels in the river; and intrusion of brackish water from Albemarle Sound upstream into the river. These objectives will be met by performing the following tasks:

(1) review existing data and develop a hydrologic and water quality monitoring plan to support modeling,
(2) review existing modeling frameworks for the Roanoke River,
(3) implement the hydrologic and water quality monitoring program,
(4) develop, calibrate, and test hydrodynamic models that are capable of simulating upstream and downstream movement of water, as well as the storage and release of water from the floodplains,
(5) develop, calibrate, and test unsteady water quality models that simulate DO dynamics in the main channel and the floodplain and accounts for the effects of brackish water intrusion from Albemarle Sound on flow and DO processes, and
(6) apply these models to determine effects of selected water management scenarios on downstream flows, floodplain inundation, and DO.

As of August 2006, task 1 and 2 have been completed and task 3 (monitoring) has been initiated. The hydrodynamic modeling activities are proposed to begin concurrently with data collection. The entire project is scheduled to be complete by mid-2008.

The study will provide policy makers and water resource managers in North Carolina and Virginia with the tools and data that are essential to assessing management strategies for maintaining and enhancing Roanoke River water quality and riparian habitat. The flow and transport model for the Roanoke River can be used to assess the effects of flow management scenarios on dissolved-oxygen in the river.

Chapter 10
Roanoke River Subbasin 03-02-10
Including: Cashie River, Roquist Creek and Hoggard Mill Creek

10.1 Subbasin Overview

Subbasin 03-02-10 at a Glance

Land and Water Area

Total area:	307 mi^2
Land area:	290 mi^2
Water area:	17 mi^2

Population Statistics

2000 Est. Pop.:	8,192 people
Pop. Density:	27 persons/mi^2

Land Cover (percent)

Forest/Wetland:	79.2%
Surface Water:	0.6%
Urban:	0.3%
Cultivated Crop:	19.4%
Pasture/ Managed Herbaceous:	0.6%

Counties

Bertie and Northampton

Municipalities

Roxobel, Kelford, Askewville and Windsor

Monitored Stream Statistics

Aquatic Life

Total Streams:	79.0 mi
Total Supporting:	79.0 mi

Recreation

Total Streams:	15.2 mi
Total Supporting:	15.2 mi

This subbasin is located entirely within the lower coastal plain. Most of the streams are slow moving and often stop flowing in the summer months. This subbasin is the least densely populated and has the lowest estimated population projection in the entire river basin. Most of this subbasin is located in Bertie County, which is expected to decrease by 8 percent in population by 2020. For more information regarding population growth and trends, refer to Appendix I.

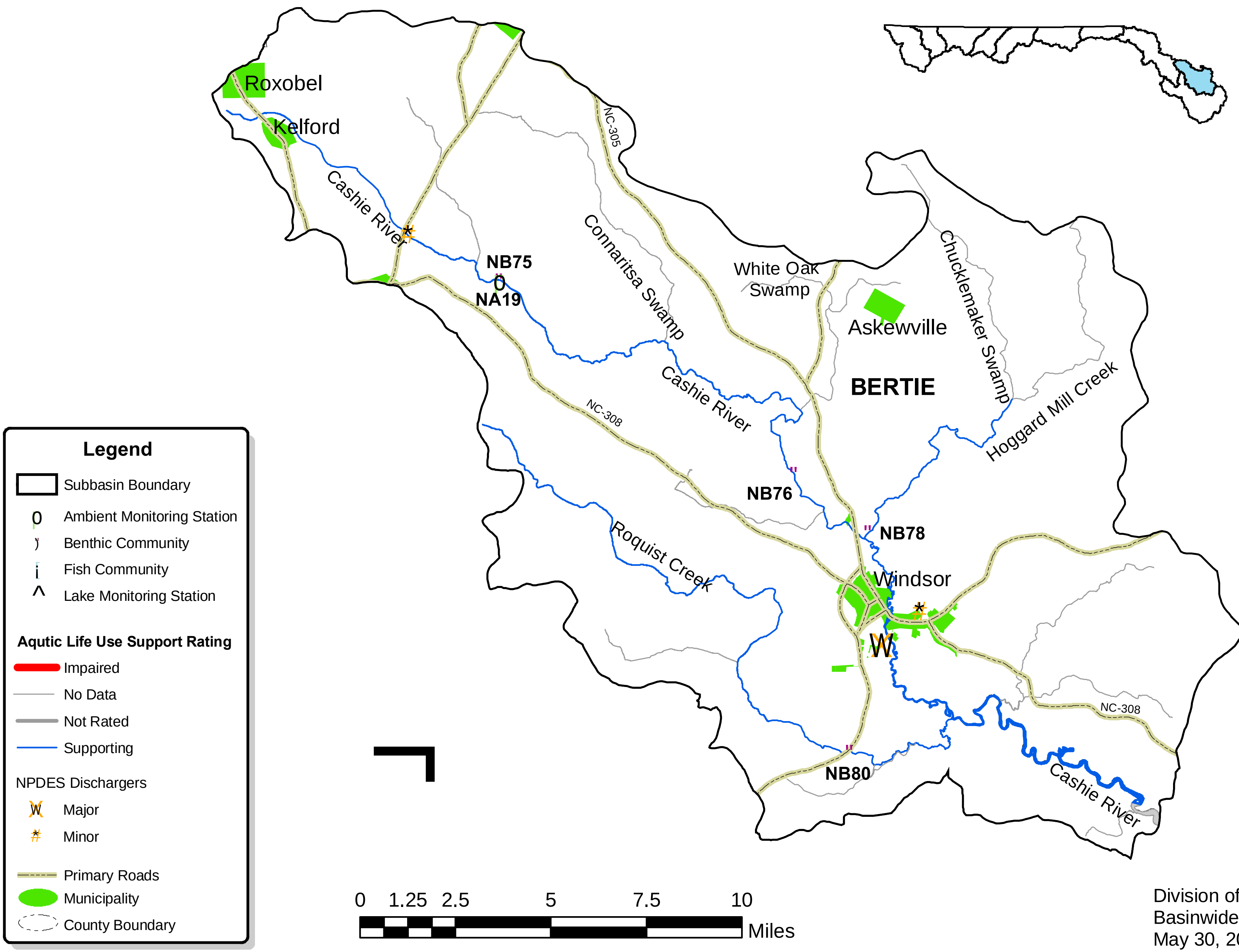
Several water quality improvement programs have been implemented in this subbasin. The NC Agriculture Cost Share Program (NCACSP), which helps reduce agricultural runoff by helping farmers implement best management practices, is one of these programs. The NCACSP provided $199,373 towards implementing sediment and nutrient reduction practices, and animal waste management. For more information on this and other programs, refer to watershed discussion throughout this chapter as well as in Chapters 16 and 20.

Three individual NPDES discharge permits are issued in this subbasin with a total permitted flow of 1.3 MGD. Windsor WWTP is required to conduct whole effluent toxicity testing per their NPDES permit and have been in compliance during this assessment period. Refer to Appendix VI for identification and more information on individual NPDES permit holders. Three registered animal operations are located in this subbasin. Refer to Chapter 16 for more information regarding animal operations within this basin.

A map including the locations of NPDES discharges and water quality monitoring stations is presented in Figure 15. Table 12 contains a summary of assessment units and lengths, streams monitored, monitoring data types, locations and results, along with use support ratings for waters in this subbasin. Refer to Appendix IX for more information about use support ratings.

Benthic community biocriteria for swamp streams have been developed since the previous basinwide plan (2001) for the Roanoke River basin. Where appropriate, those criteria were applied to sites Not Rated in the 2001 basin plan (Cashie River, Roquist Creek and Hoggard Mill Creek). Four benthic macroinvertebrate community samples (Figure 15 and Table 12) were collected during this assessment period. Data were collected from one ambient monitoring

Figure 15 Roanoke River Subbasin 03-02-10



Division of Water Quality
Basinwide Planning Unit
May 30, 2006

Table 12 ROANOKE Subbasin 03-02-10

AU Number / Description	Classification	Length/Area		AL Rating	Station	Result	Year/ Parameter	% Exc	REC Rating	Station	Result	Stressors	Sources
Cashie River													
24-2-(1)a	C;Sw	15.2	FW Miles	S	NA19	NCE			S	NA19	NCE	Habitat Degradation	Unknown
From source to Bertie County SR 1225					NB75	M	2004						
					NB75	M	2004						
24-2-(1)b	C;Sw	30.1	FW Miles	S					ND				
From Bertie County SR 1225 to a point 1 mile upstream from Bertie Co. SR 1500					NB76	N	2004						
					NB76	N	2004						
24-2-(11)	C;Sw	5.8	FW Miles	ND					ND				
From the Thoroughfare (The Gut between Cashie and Roanoke Rivers) to N.C. Hwy. 45													
24-2-(15)	B;Sw	1.2	FW Miles	ND					ND				
From N.C. Hwy. 45 to Albemarle Sound (Batchelor Bay)													
24-2-(9)	B;Sw	2.3	FW Miles	ND					ND				
From a point 1.0 mile upstream from Bertie County SR 1500 to the Thoroughfare (The Gut between Cashie and Roanoke Rivers)													
Hoggard Mill Creek													
24-2-6	C;Sw	7.4	FW Miles	S					ND			Habitat Degradation	Land Clearing
From source to Cashie River					NB78	M	2004						
					NB78	M	2004						
Roquist Creek													
24-2-7	C;Sw	26.3	FW Miles	S					ND				
From source to Cashie River					NB80	N	2004						

Table 12 ROANOKE Subbasin 03-02-10

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

Use Categories:	**Monitoring data type:**	**Results:**	**Use Support Ratings 2005**:
AL - Aquatic Life	NF - Fish Community Survey	E - Excellent	S - Supporting, I - Impaired
REC - Recreation	NB - Benthic Community Survey	G - Good	NR - Not Rated
	NA - Ambient Monitoring Site	GF - Good-Fair	NR*- Not Rated for Recreation (screening criteria exceeded)
	NL- Lake Monitoring	F - Fair	ND-No Data Collected to make assessment
		P - Poor	
		NI - Not Impaired	
Miles/Acres	m- Monitored	N- Natural	**Results**
FW- Fresh Water	e- Evaluated	M - Moderate	CE-Criteria Exceeded > 10% and more than 10 samples
		S-Severe	NCE-No Criteria Exceeded
			ID- Insufficeint Data Available

Aquatic Life Rating Summary				Recreation Rating Summary				Fish Consumption Rating Summary			
S	m	79.0	FW Miles	S	m	15.2	FW Miles	I	e	156.1	FW Miles
ND		77.1	FW Miles	ND		140.9	FW Miles				

station and one fish tissue site. Refer to the *2005 Roanoke River Basinwide Assessment Report* at http://www.esb.enr.state.nc.us/bar.html and Appendix IV for more information on monitoring.

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

10.2 Use Support Assessment Summary

Use support ratings were assigned for waters in subbasin 03-02-10 in the aquatic life, recreation, fish consumption and water supply categories. All waters are Impaired on an evaluated basis in the fish consumption category because of fish consumption advice that applies to the entire basin. In the water supply category, all waters are Supporting on an evaluated basis based on reports from DEH regional water treatment plant consultants.

All 79 stream miles (50.6 percent) monitored in the aquatic life category and 15.2 stream miles (9.7 percent) monitored in the recreation category are rated as Supporting. All other surface waters within this basin are Impaired on an evaluated basis for mercury based on an advice by NC Department of Heath and Human Services. Refer to Table 12 for a summary of use support ratings by category for waters in the subbasin 03-02-10.

10.3 Status and Recommendations of Previously and Newly Impaired Waters

The following waters were either identified as Impaired in the previous basin plan (2001) or are newly Impaired based on recent data. If previously identified as Impaired, the water will either remain on the state's 303(d) list or will be delisted based on recent data showing water quality improvements. If the water is newly Impaired, it will likely be placed on the 2008 303(d) list. The current status and recommendations for addressing these waters are presented below, and each is identified by an assessment unit number (AU#). Information regarding 303(d) listing and reporting methodology is presented in Appendix VII.

10.3.1 Cashie River [AU# 24-2-(1)a, 24-2-(1)b, 24-2-(9), 24-2-(11), & 24-2-(15)]

2001 Recommendations
DWQ will continue to monitor fish tissue in the Cashie River and will work to identify sources of mercury. Given the global scale of mercury cycling, it may be difficult for DWQ to recognize significant reductions of mercury in fish over the short-term.

Current Status and 2006 Recommendations
Cashie River [AU# 24-2-(1)a], from source to Bertie County SR 1225 (15.2 miles), is Supporting aquatic life based on a Moderate Stress benthic community bioclassification at site NB75. The habitat scores differed considerably from 94 in 1999 versus 78 in 2004. The habitat score

decreased due to both a homogeneous benthic substrate of detritus and to the lack of favorable reach available for colonization. Low water depths in 1999 versus high levels in 2004 may account for some of the differences. Beaver activity was also observed at this site. This decline appeared to result in the lower number of macroinvertebrate taxa, with 29 collected in 2004 versus 41 in 1999. The biotic index of both samples was identical in both years (7.5) suggesting that water quality may not have decreased as much as the loss of nearly 30 percent of the taxa may suggest. Although a 50 percent reduction in EPT taxa, from six in 1999 to three in 2004, was observed, there was only a decrease of three (from 10 to seven) in EPT abundance. This site has been sampled four times (1983 and 1984 in summer; 1999 and 2004 in winter) with the 2004 results showing the lowest number of total taxa thus far. This is a concern since swamp site diversity is nearly always greater in the winter when flow is sustained than in summer, when they are stagnant. However, high water may have limited the collection effort. One species, *Tvetenia* sp NC (Epler), which is not commonly encountered in North Carolina was collected in 2004. A tolerant species of heavily polluted conditions, *Procladius* sp., was collected in 2004 and not collected in 1999. But, as in 1999, the overall benthic macroinvertebrate fauna does not signal a specific nutrient-loading problem from the upstream Lewiston/Woodville WWTP.

This section of the Cashie River is Supporting the recreation category because the fecal coliform bacteria screening criteria was not exceeded at site NA19.

The Cashie River [AU# 24-2-(1)b], from Bertie County SR 1225 to a point 1 mile upstream from Bertie Co. SR 1500 (30.1 miles), is Supporting aquatic life based on a Natural benthic community bioclassification at site NB76.

All waters within the Roanoke River basin are Impaired on an evaluated basis in the fish consumption category. This is based on a fish consumption advise from the NC Department of Health and Human Services. For more information on fish consumption advisories and advice, contact NC DHHS. Largemouth bass, sunfish, yellow perch, and catfish samples were collected from the Cashie River near Windsor during 2003 and analyzed for mercury contamination. The samples were collected as part of an eastern North Carolina mercury assessment. Largemouth bass, yellow perch and redear sunfish (10 of 23 samples) contained mercury concentrations exceeding the state criteria of 0.4 ppm. Mercury levels in all samples ranged from 0.09 to 1.5 ppm. This data is used to support the NC DHHS mercury advice for this region. In 2004, DWQ developed a *draft* Mercury TMDL for the Cashie River. The *draft* TMDL has been submitted to the USEPA for final approval. To view the *draft* TMDL visit: http://h2o.enr.state.nc.us/tmdl/TMDL_list.htm. DWQ will continue to monitor Cashie River.

10.4 Status and Recommendations for Waters with Noted Impacts

The surface waters discussed in this section are not Impaired. However, notable water quality problems and concerns were documented for these waters during this assessment. Attention and resources should be focused on these waters to prevent additional degradation and facilitate water quality improvements. DWQ will notify local agencies of these water quality concerns and work with them to conduct further assessments and to locate sources of water quality protection funding. Additionally, education on local water quality issues and voluntary actions are useful tools to prevent water quality problems and to promote restoration efforts. Nonpoint source program agency contacts are listed in Appendix VIII.

10.4.1 Hoggard Mill Creek [AU# 24-2-6]

Current Status and 2006 Recommendations
Hoggard Mill Creek, from source to Cashie River (7.4 miles), is Supporting aquatic life due to a Moderate Stress bioclassification at site NB78. The effects of Hurricane Isabel were very apparent at this site, especially the considerable blow down of the riparian area. A more pollution tolerant benthic community and fewer total taxa were found in 2004 (30) than 1999 (46). Only three of the seven EPT taxa collected in 1999 were found in 2004. DWQ will continue to monitor Hoggard Mill Creek.

10.5 Additional Water Quality Issues within Subbasin 03-02-10

10.5.1 Roquist Creek [AU# 24-2-7] and Indian Creek [AU# 23-47]

Current Status
Roquist Creek [AU# 24-2-7] from source to Cashie River (26.3 miles) is supporting for aquatic life based on a Natural swamp bioclassification at site NB80. This swamp appears to be stable with no change in the biotic index from 1999 to 2004.

Water Quality Initiatives
The NCEEP is facilitating the transfer of the Roquist Pocosin tract from the NC Department of Transportation to the Wildlife Resource Commission. The tract provides water quality protection to Indian Creek [AU# 23-47 (in subbasin 03-02-09)] and Roquist Creek [AU# 24-2-7]. The Roquist Pocosin is not actually a pocosin but rather a large area of nonriverine swamp forest and nonriverine wet hardwood forest, both of which are significantly rare wetland communities. The tract contains 3,776 acres of these wetland types in various stages of succession. At least several hundred acres of nonriverine wet hardwood forest is entirely intact, not having been timbered in over 90 years. In addition, the EEP is carrying out restoration of 52 acres of nonriverine wet hardwood forest in the Roquist Pocosin, which drain to Indian Creek and Roquist Creek. The restoration involves removal of roads to restore hydrology and replanting of native wetland species.

Chapter 11
North Carolina Water Quality Standards and Classifications

11.1 Description of Surface Water Classifications and Standards

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

11.1.1 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 13 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/csu/.

11.1.2 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. 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.

High Quality Waters (Class HQW)

There are no stream miles classified as HQW waters in the Roanoke River basin except for the WS-II waters that have a supplemental HQW classification (Figure 16). 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.

Table 13 - 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 and SC uses.
SA	Suitable for commercial shellfish harvesting and SB and SC uses.
WS	*Water Supply (WS)*: Assigned to watersheds based on land use characteristics. The WS classifications have management strategies to protect the surface water supply. For WS-I through WS-IV, these include limits on point source discharges and local programs to control nonpoint source and stormwater runoff. A WS Critical Area (CA) has more stringent protection measures and is designated within one-half mile from a WS intake or WS reservoir. All WS classifications are suitable for Class C uses.
WS-I	Generally located in natural and undeveloped watersheds.
WS-II	Generally located in predominantly undeveloped watersheds.
WS-III	Generally located in low to moderately developed watersheds.
WS-IV	Generally located in moderately to highly developed watersheds.
WS-V	Generally upstream of and draining to Class WS-IV waters. No categorical restrictions on watershed development or treated wastewater discharges.
SUPPLEMENTAL CLASSIFICATIONS	
Class	**Best Uses**
Sw	*Swamp Waters*: Waters that have low velocities and other natural characteristics that are different from adjacent streams (e.g., lower pH, 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 that have excellent water quality, primary nursery areas and other functional nursery areas, WS-I and WS-II or SA waters.
ORW	*Outstanding Resource Waters*: Unique and special waters of exceptional state or national recreational or ecological significance, which require special protection.
NSW	*Nutrient Sensitive Waters*: Waters subject to excessive plant growth and requiring limitations on nutrient inputs.

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

Criteria for HQW Classification

- Waters rated as Excellent based on DWQ's chemical and biological sampling.
- Streams designated as native or special native trout waters by the Wildlife Resources Commission.
- Waters designated as primary nursery areas or other functional nursery areas by the Division of Marine Fisheries.
- Waters classified by DWQ as WS-I, WS-II or SA.

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 setback between development activities and the stream; whereas, the high-density option requires structural stormwater controls (e.g., stormwater infiltration system, wet detention ponds). In addition, the Division of Land Resources (DLR) requires more stringent erosion controls for land-disturbing projects within one mile of and draining to HQWs.

> ***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.

Outstanding Resource Waters (Class ORW)
There are 1.6 stream miles of ORW waters in the Roanoke River basin (Figure 16). These waters have excellent water quality (rated based on biological and chemical sampling as with HQWs) and an associated outstanding resource.

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 setback 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.

Primary Recreation (Class B)
There are 111 stream miles, 31,543 freshwater acres and 1,475.5 estuarine acres classified for primary recreation in the Roanoke River basin. Waters classified as Class B are protected for primary recreation, include frequent and/or organized swimming, and must meet water quality standards for fecal coliform bacteria. Sewage and all discharged wastes into Class B waters must be treated to avoid potential impacts to the existing water quality.

Trout Waters
There are 92.0 stream miles classified as Trout (Tr) waters in the Roanoke River basin (Figure 16). Different water quality standards for some parameters, such as dissolved oxygen, temperature and turbidity, have been developed to protect freshwaters for natural trout propagation and survival of stocked trout. These water quality standards result in more restrictive limits for wastewater discharges to trout water streams. There are no watershed development restrictions associated with the Tr classification; however, the NC Division of Land Resources (DLR), under the NC Sedimentation and Pollution Control Act (SPCA), has requirements for protecting trout streams from land-disturbing activities. The SPCA states that "waters that have been classified as trout waters by the Environmental Management Commission (EMC) shall have an undisturbed zone either 25 feet wide or of sufficient width to confine visible siltation within the twenty-five percent (25 percent) of buffer zone nearest the land-disturbing activity, whichever is greater" [G.S. 113A-57(1)]. This rule applies to all named and unnamed tributaries flowing to the affected trout water stream. For more information regarding land-disturbing activities along designated trout streams, refer to the DLR website at www.dlr.enr.state.nc.us/.

The NC Wildlife Resources Commission administers a state fishery management classification known as the Designated Public Mountain Trout Waters. It provides for public access to streams for fishing and regulates fishing activities (seasons, size limits, creel limits, and bait and lure restrictions). Although many of these waters are also classified Tr by DWQ, this is not the same classification.

Swamp Waters
There are 237.3 stream miles and 1,475.5 estuarine acres classified as Swamp (Sw) waters in the Roanoke River basin. These waters are recognized as waters that will naturally be more acidic (have lower pH values) and have lower levels of dissolved oxygen.

Water Supply Watersheds (Class WS)
There are 246 stream miles and 26,320 freshwater acres currently classified for water supply in the Roanoke River basin (Figure 16). The purpose of the Water Supply Watershed Protection Program is to provide a proactive drinking water supply protection program for communities. Local governments administer the program based on state minimum requirements. There are restrictions on wastewater discharges, development, landfills and residual application sites to control the impacts of point and nonpoint sources of pollution to water supplies.

There are five water supply classifications (WS-I to WS-V) that are defined according to the land use characteristics of the watershed. The WS-I classification carries the greatest protection for water supplies. No development is allowed in these watersheds. Generally, WS-I lands are publicly owned. WS-V watersheds have the least amount of protection and do not require development restrictions. These are either former water supply sources or sources used by industry. WS-I and WS-II classifications are also HQW by definition because requirements for these levels of water supply protection are at least as stringent as those for HQWs. Those watersheds classified as WS-II through WS-IV require local governments having jurisdiction within the watersheds to adopt and implement land use ordinances for development that are at least as stringent as the state's minimum requirements. A minimum 30-foot setback is required on perennial streams in those watersheds in low-density areas; a minimum 100 feet setback is required in high-density areas. The Roanoke River basin currently contains, WS-II, WS-III, WS-IV and WS-V water supply watersheds. Water supply watersheds in the Roanoke River basin cover 26,320 Acres and 246 stream miles.

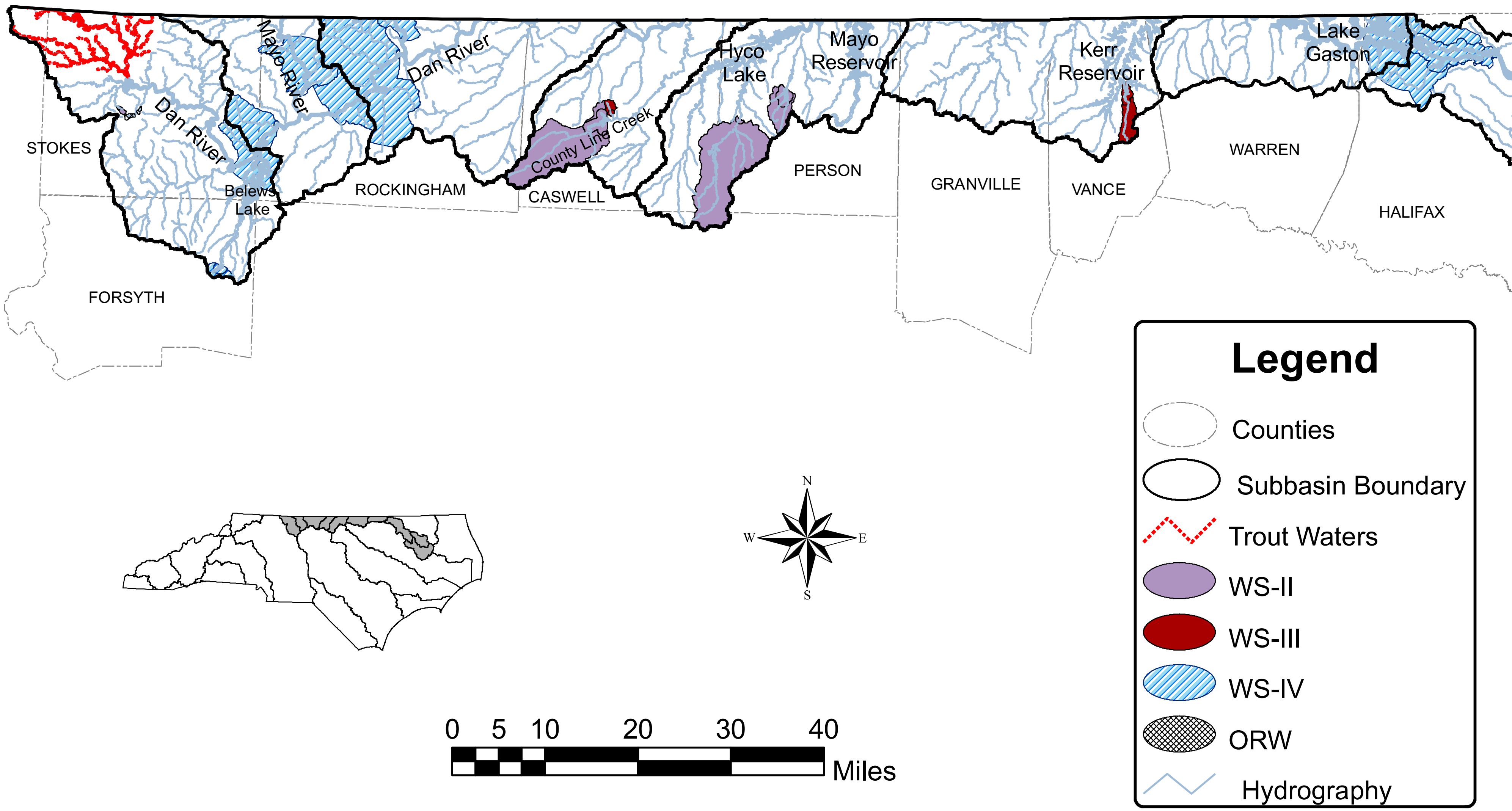
11.2 Reclassification of Surface Waters

The classification of a surface water may be changed if a request is submitted by a local government, watershed group, or a local citizen. DWQ reviews each request for reclassification and conducts an assessment of the surface water to determine if the reclassification is appropriate. If it is determined that a reclassification is justified, the request must proceed through the state rule-making process. To initiate a reclassification, the "Application to Request Reclassification of NC Surface Waters" must be completed and submitted to DWQ's Classification and Standards Unit. For more information on requests for reclassification and contact information, visit http://h2o.enr.state.nc.us/csu/.

11.2.1 Pending and Recent Reclassifications in the Roanoke River Basin

In Chapters 1 through 10, DWQ identified those surface waters as having Excellent bioclassification, and therefore, may be eligible for reclassification. There may also be many other surface waters eligible for reclassification that were not identified with the subbasin chapters. Both private and public stakeholders play an important role in the reclassification process and are responsible for filing formal requests with DWQ for reclass consideration.

Figure 16 ORW* , Water Supply Watershed, and Trout Waters in the Roanoke River Basin**



Planning Section
Basinwide Planning Unit
May 30, 2006

*The only ORW for this basin is in Stokes County, southwest of Danbury.
**All ORW's, WSW's and Trout Waters are located between subbasins 03-02-01 and 03-02-08.

Chapter 12
Population Growth, Land Cover Changes and Water Quality

12.1 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 fall 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 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.

Nonpoint Sources

- Construction activities
- Roads, parking lots and rooftops
- Agriculture
- Failing septic systems and straight pipes
- Timber harvesting
- Hydrologic modifications

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

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.

12.2 Managing the Impacts of Growth, Development, and Stormwater Runoff

12.2.1 Introduction

Urban growth poses one of the greatest threats to aquatic resources. The impacts on rivers, lakes and streams as development surrounding metropolitan areas consumes neighboring forests and fields can be significant and permanent if stormwater runoff is not controlled. Greater numbers of homes, stores and businesses require greater quantities of water. Growing populations not only require more water, but they also lead to the discharge and runoff of greater quantities of waste and pollutants into the state's streams and groundwater. Thus, just as demand and use increase, some of the potential water supply is lost (Orr and Stuart, 2000).

In addition, as watershed vegetation is replaced with impervious surfaces in the form of paved roads, buildings, parking lots, and residential homes and driveways, the ability of the environment to absorb and diffuse the effects of natural rainfall is diminished. Urbanization results in increased surface runoff and correspondingly earlier and higher peak streamflows after rainfall. Flooding frequency is also increased. These effects are compounded when small streams are channelized (straightened) or piped and storm sewer systems are installed to increase transport of drainage waters downstream. Bank scour from these frequent high flow events tends to enlarge urban streams and increase suspended sediment. Scouring also destroys the variety of habitat in streams, leading to degradation of benthic macroinvertebrate populations and loss of fisheries (EPA, 1999).

Most of the impacts result in habitat degradation (Chapter 13), but urban runoff also carries a potentially toxic cocktail including oil and grease from roads and parking lots, street litter and pollutants from the atmosphere. Cumulative impacts from developing and urban areas can cause severe impairment to urban streams.

12.2.2 Effects of Growth and Development in the Roanoke River Basin

Although the Roanoke River basin is not one of the fastest developing basins in the state, the effects of development are impacting water quality. Seven of the fifteen counties in the basin experienced growth rates in excess of 13 percent in the last decade of the 20th century. The sparsely developed watersheds the western foothills portion of the basin generally contain streams with high water quality, excellent aquatic species populations, and Supporting use support ratings. Water quality declines dramatically in streams in the central piedmont watersheds, in rural and urbanized areas.

Populations of counties that are wholly or partly contained within the basin increased by over 115,000 people between 1990 and 2000. Appendix I presents projected population growth by county for the Roanoke River basin from 2000 to 2020. Forsyth, Granville, Orange, Person and Stokes counties are growing the fastest in the basin. These counties have an estimated growth rate of over 20 percent by 2020. Wentworth, Rural Hall and Kernersville had high growth rates. Walkertown increased population substantially in the last ten years. Although the Roanoke River basin population is growing slower than some other river basins, there will be increased drinking water demands and wastewater discharges. There will also be loss of natural areas and increases in impervious surfaces associated with construction of new homes and businesses.

The overall population of the basin based on 2000 Census data is 344,638, with approximately 98 persons/square mile. Population density estimated by subbasin is presented in Appendix I.

Refer to Appendix II for local governments' listing and Appendix III for land cover changes related to urbanization.

The Roanoke River basin has an abundance of surface water that has supported industrial and domestic expansions of the mid-20th century. Even today, there is sufficient water to serve its diverse domestic, agricultural, industrial, energy production and recreational needs except in periods of severe drought. However, as population increases in the basin, the availability and needs of those water supplies will need to be carefully planned and coordinated between state and local governments. Clean water can likely be provided in sufficient quantity to supply the future needs of the basin, but only with inspired foresight, planning and management. See Chapter 18 on Water Resources for more information.

Also, in times of drought much coordination between state and local agencies needs to be maintained to assure not only sufficient flows for water supply but also for downstream water quality.

12.2.3 The Role of Local Governments

A summary of necessary management actions needed by local authorities is provided here, followed by discussions on large, watershed management issues. These actions are necessary to address current sources of impairment and to prevent future degradation in all streams. The intent of these recommendations is to describe the types of actions necessary to improve stream conditions, not to specify particular administrative or institutional mechanisms for implementing remedial practices. Those types of decisions must be made at the local level.

Because of uncertainties regarding how individual remedial actions cumulatively impact stream conditions and how aquatic organisms will respond to improvements, the intensity of management effort necessary to bring about a particular degree of biological improvement cannot be established in advance. The types of actions needed to improve biological conditions can be identified, but the mix of activities that will be necessary – and the extent of improvement that will be attainable – will only become apparent over time as an adaptive management approach is implemented. Management actions are suggested below to address individual problems, but many of these actions are interrelated.

Actions one through five are important to restoring and sustaining aquatic communities in the watershed, with the first three recommendations being the most important.

1. **Feasible and cost-effective stormwater retrofit projects should be implemented throughout the watershed to mitigate the hydrologic effects of development** (increased stormwater volumes and increased frequency and duration of erosive and scouring flows). This should be viewed as a long-term process. Although there are many uncertainties, costs in the range of $1 million per square mile can probably be anticipated.

a. Over the short-term, currently feasible retrofit projects should be identified and implemented.
b. In the longer term, additional retrofit opportunities should be implemented in conjunction with infrastructure improvements and redevelopment of existing developed areas.
c. Grant funds for these retrofit projects may be available from EPA initiatives, such as Section 319 funds, or the North Carolina Clean Water Management Trust Fund.

2. **A watershed scale strategy to address toxic inputs should be developed and implemented, including a variety of source reduction and stormwater treatment methods.** As an initial framework for planning toxicity reduction efforts, the following general approach is proposed:
    a. Implementation of available BMP opportunities for control of stormwater volume and velocities. As recommended above to improve aquatic habitat potential, these BMPs will also remove toxics from stormwater.
    b. Development of a stormwater and dry weather sampling strategy in order to facilitate the targeting of pollutant removal and source reduction practices.
    c. Implementation of stormwater treatment BMPs, aimed primarily at pollutant removal, at appropriate locations.
    d. Development and implementation of a broad set of source reduction activities focused on: reducing non-storm inputs of toxics; reducing pollutants available for runoff during storms; and managing water to reduce storm runoff.

3. **Stream channel restoration activities should be implemented in target areas, in conjunction with stormwater retrofit BMPs, in order to improve aquatic habitat.** Before beginning stream channel restoration, a geomorphologic survey should be conducted to determine the best areas for stream channel restoration. Additionally, it would probably be advantageous to implement retrofit BMPs before embarking on stream channel restoration, as restoration is probably best designed for flows driven by reduced stormwater runoff. Costs of approximately $200 per foot of channel should be anticipated (Haupt et al., 2002 and Weinkam et al., October 2001). Grant funds for these retrofit projects may be available from federal sources, such as EPA's Section 319 funds, or state sources including North Carolina Clean Water Management Trust Fund.

4. Actions recommended above (e.g., stormwater quantity and quality retrofit BMPs) are likely to reduce nutrient/organic loading and associated impacts to some extent. Activities recommended to address this loading include the identification and elimination of illicit discharges; education of homeowners, commercial applicators, and others regarding proper fertilizer use; street sweeping; catch basin clean-out practices; and the installation of additional BMPs targeting BOD and nutrient removal at appropriate sites.

5. Prevention of further channel erosion and habitat degradation will require effective post-construction stormwater management for all new development in the study area.

6. Effective enforcement of sediment and erosion control regulations will be essential to the prevention of additional sediment inputs from construction activities. Development of improved erosion and sediment control practices may be beneficial.

7. Watershed education programs should be implemented and continued by local governments with the goal of reducing current stream damage and preventing future degradation. At a minimum, the program should include elements to address the following issues:
    a. redirecting downspouts to pervious areas rather than routing these flows to driveways or gutters;
    b. protecting existing woody riparian areas on all streams;
    c. replanting native riparian vegetation on stream channels where such vegetation is absent; and
    d. reducing and properly managing pesticide and fertilizer use.

12.2.4 Maintain and Develop Riparian Buffers

The presence of intact riparian buffers and/or wetlands can reduce the impacts of stormwater flow from development in urban and rural areas as well as from various agricultural practices. Establishment and protection of buffers should be considered where feasible, and the amount of impervious cover should be limited as much as possible. Wide streets, large cul-de-sacs, and long driveways and sidewalks lining both sides of the street are all features of urban development that create excess impervious cover and consume natural areas.

Preserving the natural streamside vegetation (riparian buffer) is one of the most economical and efficient BMPs. Forested buffers in particular provide a variety of benefits including filtering runoff and taking up nutrients, trapping bacteria, moderating water temperature, preventing erosion and loss of land, providing flood control and helping to moderate streamflow, and providing food and habitat for both aquatic and terrestrial wildlife. Counties and municipalities should adopt ordinances that require buffers along streams whether in urban or rural areas. To obtain a free copy of DWQ's *Buffers for Clean Water* brochure, call (919) 733-5083, ext. 558.

12.2.5 Protecting Headwaters

Many streams in a given river basin are only small trickles or seeps of water that emerge from the ground. A larger stream is formed at the confluence of these trickles (Figure 17). 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. These streams account for approximately 80 percent of the stream network and provide many valuable services for quality and quantity of water delivered downstream (Meyer et al., September 2003). However, degradation of headwater streams can (and does) impact the larger stream or river and should be protected.

There are three types of headwater streams: ephemeral (flow only after precipitation events), intermittent (flow during wet seasons), and perennial (flow year-round). All types of headwater streams provide benefits to larger streams and rivers. Headwater streams control flooding, recharge groundwater, maintain water quality, reduce downstream sedimentation, recycle nutrients, and create habitat for plants and animals (Meyer et al., September 2003).
In smaller headwater streams, fish communities are not well developed and benthic macroinvertebrates dominate aquatic life. Benthic macroinvertebrates are often thought of as "fish food" and, in mid-sized streams and rivers, they are critical to a healthy fish community.

However, these insects, both in larval and adult stages, are also food for small mammals, such as river otter and raccoons, birds and amphibians (Erman, 1996). Benthic macroinvertebrates in

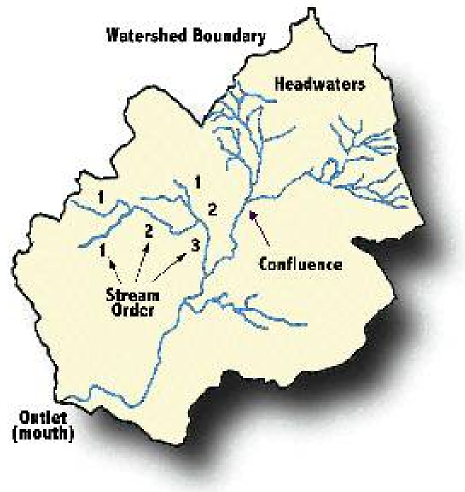


Figure 17 - Diagram of Headwater Streams within a Watershed Boundary

headwater streams also perform the important function of breaking down coarse organic matter, such as leaves and twigs, and releasing fine organic matter. In larger rivers, where coarse organic matter is not as abundant, this fine organic matter is a primary food source for benthic macroinvertebrates and other organisms in the system (CALFED, 1999). When the benthic macroinvertebrate community is changed or extinguished in an area, even temporarily, as occurs during land use changes, it can have repercussions in many parts of both the terrestrial and aquatic food web.

Headwater streams also provide a source of insects for repopulating downstream waters where benthic macroinvertebrate communities have been eliminated due to human alterations and pollution. Adult insects have short life spans and generally live in the riparian areas surrounding the streams from which they emerge (Erman, 1996). Because there is little upstream or stream-to-stream migration of benthic macroinvertebrates, once headwater populations are eliminated, there is little hope for restoring a functioning aquatic community. In addition to macroinvertebrates, these streams support diverse populations of plants and animals that face similar problems if streams are disturbed. Headwater streams are able to provide these important ecosystem services due to their unique locations, distinctive flow patterns, and small drainage areas.

Because of the small size of headwater streams, they are often overlooked during land use activities that impact water quality. All landowners can participate in the protection of headwaters by keeping small tributaries in mind when making land use management decisions on the areas they control. This includes activities such as retaining vegetated stream buffers, minimizing stream channel alterations, and excluding cattle from streams. Local rural and urban planning initiatives should also consider impacts to headwater streams when land is being developed. For a more detailed description of watershed hydrology and watershed management, refer to EPA's Watershed Academy website at http://www.epa.gov/OWOW/watershed/wacademy/acad2000/watershedmgt/principle1.html.

12.2.6 Reduce Impacts of Future Development

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

Areas adjacent to the high growth areas of the basin are at risk of having Impaired biological communities. These biological communities are important to maintaining the ecological integrity in the Roanoke River basin. These streams will be important as sources of benthic macroinvertebrates and fishes for reestablishment of biological communities in nearby streams that are recovering from past impacts or are being restored.

To prevent further impairment to aquatic life in streams in developing watersheds local governments should:

1. identify waters that are threatened by development;
2. protect existing riparian habitat along streams;
3. implement stormwater BMPs during and after development;
4. develop land use plans that minimize disturbance in sensitive areas of watersheds;
5. minimize impervious surfaces including roads and parking lots; and
6. develop public outreach programs to educate citizens about stormwater runoff.

Action should be taken at the local level to plan for new development in urban and rural areas.

For more detailed information regarding recommendations for new development found in the text box (right), refer to EPA's website at www.epa.gov/owow/watershed/wacademy/acad2000/protection, the Center for Watershed Protection website at www.cwp.org, and the Low Impact Development Center website at www.lowimpactdevelopment.org. Additional public education is also needed in the Roanoke River basin in order for citizens to understand the value of urban planning and stormwater management. DWQ recently developed a booklet that discusses actions individuals can take to reduce stormwater runoff and improve stormwater quality entitled *Improving Water Quality In Your Own Backyard*. To obtain a free copy, call (919) 733-5083, ext. 558. For an example of local community planning, visit the website at http://www.charmeck.org/Home.htm.

Planning Recommendations for New Development

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

Chapter 13
Water Quality Stressors

13.1 Stressor and Sources Identification

13.1.1 Introduction - Stressors

Water quality stressors are identified when impacts have been noted to biological (fish and benthic) communities or water quality standards have been violated. Stressors apply to one or more use support categories and may be identified for Impaired, as well as Supporting but impacted/noted waters. In many cases, identifying stressors is challenging because direct measurements of the stressor may be difficult or prohibitively expensive. DWQ staff use field observations from sample sites, special studies and data from ambient monitoring stations as well as information from other agencies and the public to identify potential water quality stressors. It is important to identify stressors and potential sources of stressors so that the limited resources of water quality programs can be targeted to address the water quality problems. Specific aquatic life stressors are defined in Section 13.2 and 13.3.

Most stressors to the biological community are composed of a complex grouping of many different stressors that individually may not degrade water quality or aquatic habitat, but together can severely degrade aquatic life. Sources of stressors are most often associated with land use in a watershed, as well as the quality and quantity of any treated wastewater that may be entering a stream. During naturally severe conditions such as droughts or floods, any individual stressor or group of stressors may have more severe impacts to aquatic life than during normal climatic conditions. The most common source of stressors is from altered watershed hydrology.

Stressors to recreation use include pathogenic indicators such as fecal coliform bacteria, *escheria coli* (*E. coli*) and *enterococci*. In the fish consumption category, mercury is typically the noted stressor. However, other substance may also result in the issuance of a fish consumption advisory or advice by the NC Division of Health and Human Services (NCDHHS) such as dioxin and selenium.

13.1.2 Introduction - Stressor Sources

As discussed above, sources of stressors most often come from a watershed where the hydrology is altered enough to allow the stressor to be easily delivered to a stream during a rain event along with unnaturally large amounts of water. DWQ identifies the source of a stressor as specifically as possible depending on the amount of information available in a watershed. Most often the source is based on the predominant land use in a watershed. Stressors sources identified in the Roanoke River basin during this assessment period include urban or impervious surface areas, residential and commercial development, road building, agriculture, and forestry/timber harvesting. Point source discharges are also considered a water quality stressor source.

13.1.3 Overview of Stressors Identified in the Roanoke River Basin

The stressors noted below are summarized from all waters and for all use support categories. Figure 18 identifies stressors noted for Impaired waters in the Roanoke River basin during the most recent assessment period. The stressors noted in these figures may not be the sole reason for an Impaired use support rating. Stressors that are listed due to standards violations may require TMDL development for waters where these stressors are identified (dissolved oxygen, turbidity, and fecal coliform bacteria). All waters in the basin are Impaired on an evaluated basis in the fish consumption category where mercury is the stressor of concern (not depicted in the graphs; 2,204 freshwater stream miles, 37,543 freshwater acres, and 1,467 saltwater acres). Figures 19 and 20 identify stressors noted for Impacted waters in the Roanoke River basin during the most recent assessment period (1999 to 2004). The stressors noted in these figures did not necessarily result in an Impaired use support rating. However, these could lead to future Impairment if corrective action is not taken. For specific discussions of stressors to Impaired or Impacted waters refer to the subbasin chapters 1 through 10. Stressor definitions and impacts are discussed in the remainder of this chapter.

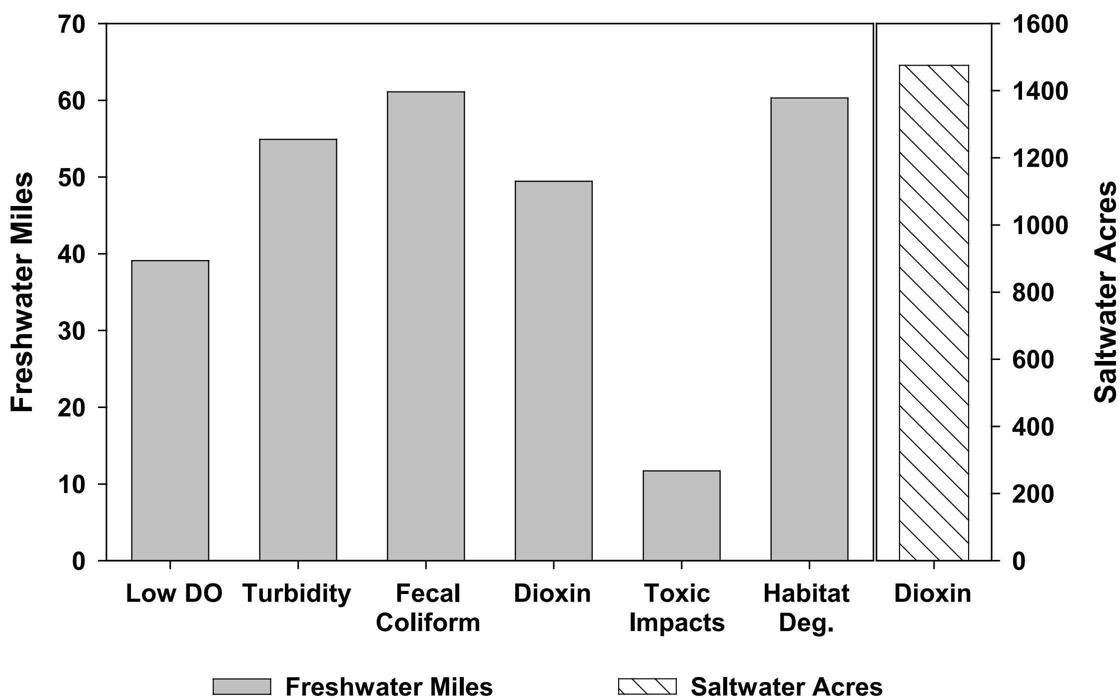


Figure 18 - Noted Stressors to Impaired Freshwater Streams Miles and Saltwater Acres in the Roanoke River Basin.

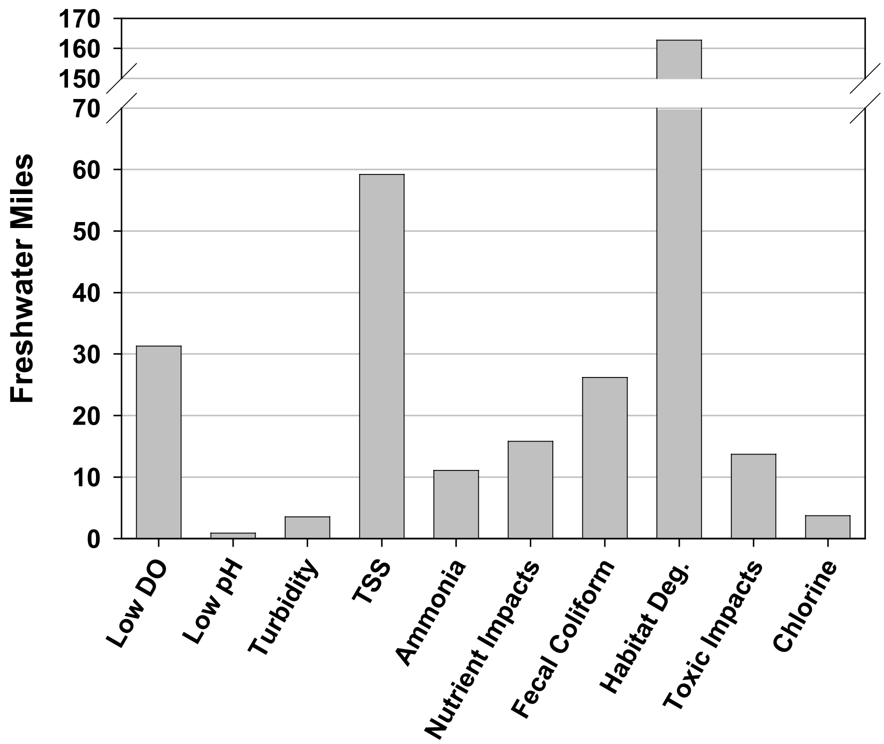


Figure 19 - Noted Stressors to Impacted Freshwater Streams/Rivers in the Roanoke River Basin

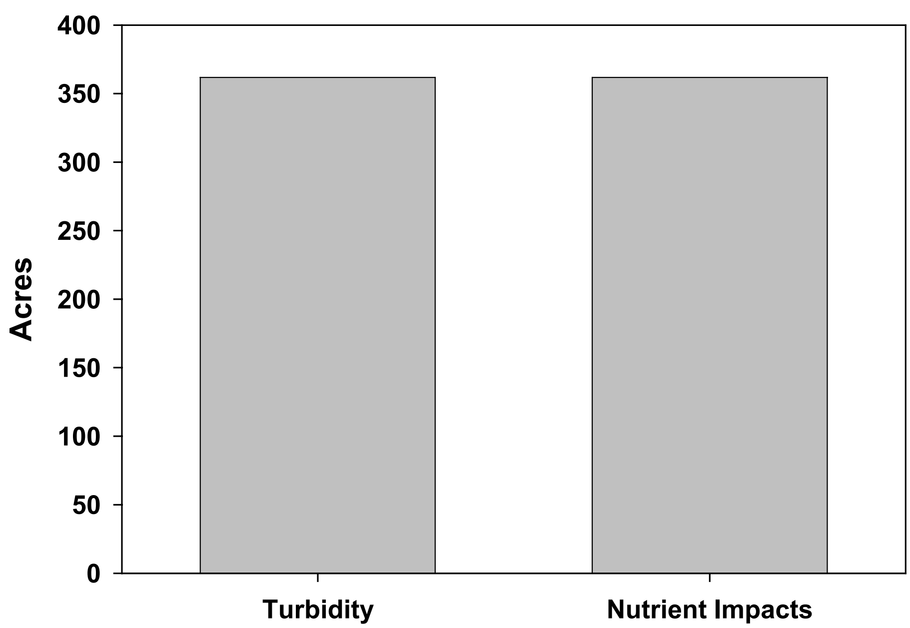


Figure 20 - Noted Stressors to Impacted Freshwater Acres in the Roanoke River Basin

13.1.4 Overview of Stressors Sources Identified in the Roanoke River Basin

The sources noted below are summarized for all waters and for all use support categories. Figure 21 and 22 identify sources of stressors noted for waters in the Roanoke River Basin during the most recent assessment period. Refer to the subbasin chapters (Chapters 1 – 10) for a complete listing and discussion of sources by stream.

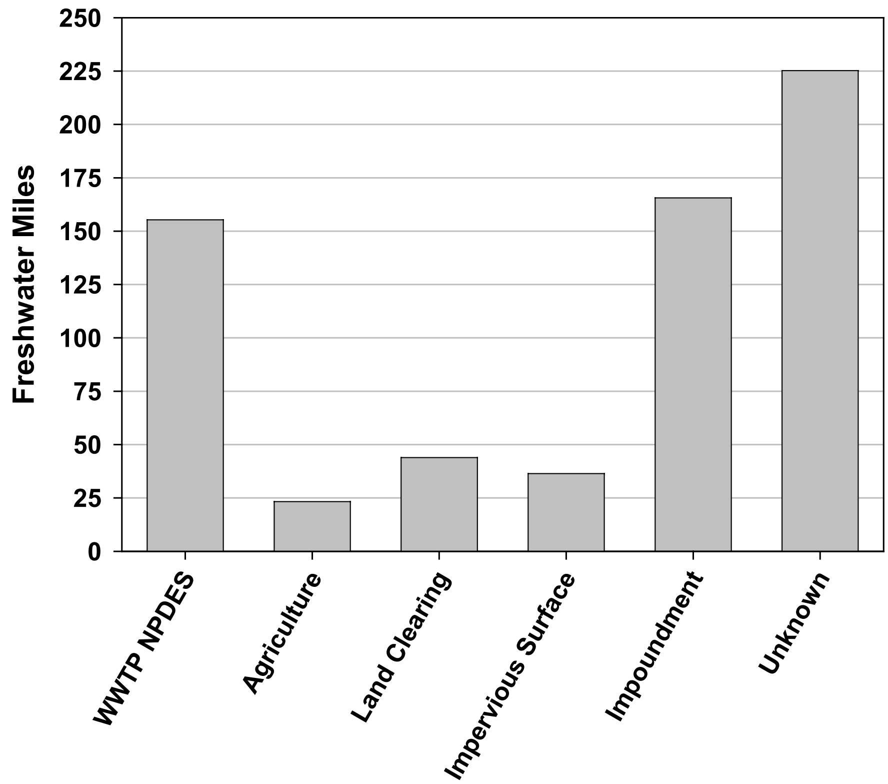


Figure 21 - Sources of Stressors Identified in the Roanoke River Basin (Freshwater Stream Miles)

Wastewater treatment plants (WWTPs) were noted as a potential source to many of the freshwater stream miles (155) and saltwater acres (1,476) in the Roanoke River basin. WWTPs are just one of many sources that can contribute excess nutrients that may increase the potential for algal blooms and cause exceedances of the chlorophyll *a* standard. This can include all discharges upstream of the area of Impairment or noted impacts. Most of these impacts were localized and based on permit violations. Better treatment technology and permit compliance has greatly decreased the number of stream miles locally impacted by WWTPs.

Agriculture was noted as a potential source of water quality stressors when field observations and watershed studies noted agriculture as the predominant land cover. In the Roanoke River basin, the majority of agricultural land is cultivated crop. Impacts to streams from agricultural activities can include excessive nutrient loading, pesticide and herbicide contamination, bacterial contamination, and sedimentation. Agriculture was noted as a source of stressors in 23 stream miles. Agriculture impacts and programs are discussed in more detail in Chapter 16.

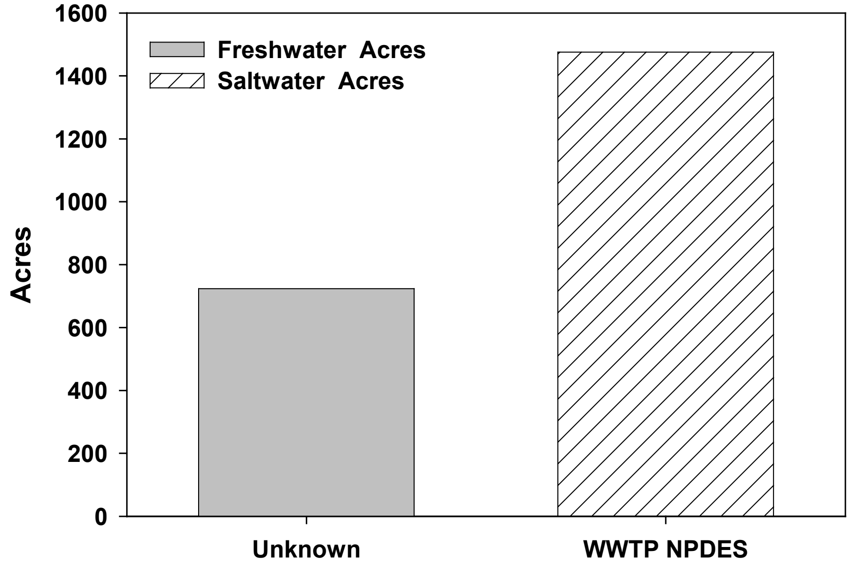


Figure 22 - Sources of Stressors Identified in the Roanoke River Basin (Fresh and Saltwater Acres)

Land clearing activities for residential and commercial development, for road/highway construction as well as for timber harvest/clear cutting were noted as potential sources of water quality stressors to 44 stream miles. Streams where land clearing is a noted source are likely to be more heavily impacted in the future by increased development and impervious surfaces. Impervious surface accounted for an additional 37 stream miles with noted impacts in the Roanoke River basin. Refer to Chapter 12 for more information related to population growth and land cover changes and its potential impacts on water quality.

In the Roanoke River basin there are 11 major impoundments. These are used as water supply reservoirs as well as for flood control and hydropower production. Impacts to water quality can also be magnified by the presence of a reservoir. Dams significantly slow the flow of water and create conditions not present in riverine systems. These conditions increase nutrient availability and give algae more time to grow. In theory, a reservoir may suffer the symptoms of excessive nutrient and sediment inputs, while a river receiving the same level of pollutants may not. The way in which these reservoirs/lakes are managed influence the quality of the water in the basin. For example, the amount of water released into the lower Roanoke River influences the extensive floodplain. As water is released from the floodplain back into the Roanoke River mainstem it carries low dissolved oxygen water as well as a high BOD material. This can result in dissolved oxygen sags, which impacts the water quality and aquatic health (i.e., fish kills) in the river.

Stressor sources could not be identified for 225 stream miles in the Roanoke River basin. These stream segments may be in areas where sources could not be identified during field observations, but the streams had noted impacts (e.g., habitat degradation). DWQ and the local agencies will work to identify potential sources for these stream segments during the next basinwide cycle.

13.2 Aquatic Life Stressors - Habitat Degradation

13.2.1 Introduction and Overview

Instream habitat degradation is identified as a notable reduction in habitat diversity or a negative change in habitat. This term may include sedimentation, lack of organic (woody and leaf) habitats and channelization. These stressors to aquatic insect and fish communities can be caused by many different land use activities and less often by discharges of treated wastewater. In the Roanoke River basin, 60 stream miles are Impaired where at least one form of habitat degradation has been identified as the stressor. There is an additional 163 stream miles where habitat degradation is a noted impact to water quality. Many of the stressors discussed below are either directly caused by or are a symptom of altered watershed hydrology. The altered hydrology increases both sources of stressors and delivery of stressors to receiving waters. Refer to the subbasin chapters (Chapters 1-10) for more information on the types of habitat degradation noted at sample locations and in watershed studies.

> *Some Best Management Practices*
>
> **Agriculture**
> - No till or conservation tillage practices
> - Strip cropping and contour farming
> - Leaving natural buffer areas around small streams and rivers
>
> **Construction**
> - Using phased grading/seeding plans
> - Limiting time of exposure
> - Planting temporary ground cover
> - Using sediment basins and traps
>
> **Forestry**
> - Controlling runoff from logging roads
> - Replanting vegetation on disturbed areas
> - Leaving natural buffer areas around small streams and rivers
> - Avoid stream crossings during forest operations

Good instream habitat is necessary for aquatic life to survive and reproduce. Streams that typically show signs of habitat degradation are in watersheds that have a large amount of land-disturbing activities (construction, mining, timber harvest and agricultural activities) or a large percentage of impervious surface area. A watershed in which most of the riparian vegetation has been removed from streams or channelization has occurred also exhibits instream habitat degradation. Streams that receive a discharge quantity that is much greater than the natural flow in the stream often have degraded habitat as well. All of these activities result in altered watershed hydrology.

Quantifying amounts of habitat degradation is difficult in most cases. To assess instream habitat degradation in most streams would require extensive technical and monetary resources and even more resources to restore the stream. Although DWQ and other agencies are starting to address this issue, local efforts are needed to prevent further instream habitat degradation and to restore streams that have been Impaired by activities that cause habitat degradation. As point sources become less of a source of water quality impairment, nonpoint sources that pollute water and cause habitat degradation need to be addressed to further improve water quality in North Carolina's streams and rivers.

13.2.2 Sedimentation

Sedimentation is a natural process that is important to the maintenance of diverse aquatic habitats. Overloading of sediment in the form of sand, silt and clay particles fills pools and covers or embeds riffles that are vital aquatic insect and fish habitats. A diversity of these habitats is important for maintenance of biological integrity. Suspended sediment can decrease primary productivity (i.e., photosynthesis) by shading sunlight from aquatic plants, affecting the overall productivity of a stream system. Suspended sediment also has several effects on various fish species including avoidance and redistribution, reduced feeding efficiency, and therefore, reduced growth by some species, respiratory problems, reduced tolerance to diseases and toxicants, and increased physiological stress (Roell, 1999). Sediment filling rivers, streams and reservoirs also decreases their storage volume and increases the frequency of floods (NCDENR-DLR, 1998). Suspended sediment also increases the cost of treating municipal drinking water. Sediment overloading to many streams has reduced biological diversity to the point of the stream being Impaired for aquatic life.

Sediment is the earthen material that is dislodged and transported from its original location by the erosive forces of wind, water or ice. The redeposition of the sediment is sedimentation. The grading and tilling of surfaces for construction of roads and buildings, crop production, livestock grazing and timber harvesting contribute to accelerated erosion rates by loosening the soils thereby allowing more soil than usual to become detached and transported by wind or water.

Streambank erosion, caused by very high stormwater flows after rain events, is another source of sediment overloading. Watersheds with large amounts of impervious surfaces transport water to streams very rapidly and at higher volumes than occurs in watersheds with little impervious surfaces. In many urban areas, stormwater is delivered directly by storm sewers. This high volume and velocity of water after rain events undercuts streambanks causing bank failure and large amounts of sediment to be deposited directly into the stream. Many urban streams are adversely impacted by sediment overloading from the watershed as well as from the streambanks.

Sedimentation can be controlled during most land-disturbing activities by using appropriate BMPs. Substantial amounts of erosion can be prevented by planning to minimize the amount and time that land is exposed during land-disturbing activities and by minimizing impervious surface area and direct stormwater outlets to streams. Refer to chapter 14 for more information on programs designed to reduce sedimentation.

Land Clearing Activities

Erosion and sedimentation can be controlled during most land-disturbing activities by using appropriate BMPs. In fact, substantial amounts of erosion can be prevented by planning to minimize the (1) amount and (2) time the land is exposed. DWQ’s role in sediment control is to work cooperatively with those agencies that administer sediment control programs in order to maximize the effectiveness of the programs and to protect water quality. Where programs are not effective, as evidenced by a violation of instream water quality standards, and where DWQ can identify a source, then appropriate enforcement action can be taken. Generally, this entails requiring the landowner or responsible party to install acceptable BMPs.

As a result of new stormwater rules enacted by EPA in 1999, construction or land development activities that disturb one acre or more are required to obtain a NPDES stormwater permit. An erosion and sediment control plan must also be developed and approved for these sites under the state's Sedimentation Pollution Control Act (SPCA) administered by the NC Division of Land Resources. Site disturbances of less than one acre are required to use BMPs, but an approved plan is not required.

Forestry operations in North Carolina are subject to regulation under the Sedimentation Pollution Control Act of 1973 (G.S. Chapter 113A, Article 4 referred to as "SPCA"). However, forestry operations may be exempted from the permit requirements in the SPCA, if the operations meet compliance standards outlined in the *Forest Practices Guidelines Related to Water Quality* (15A NCAC 1I .0101-.0209, referred to as "FPGs") and General Statutes regarding stream obstruction (G.S. 77-13 and G.S. 77-14). More information on forestry in the Roanoke River basin is available in Chapter 17 and on the Water Quality Section of the Division of Forest Resources (DFR) website at http://www.dfr.state.nc.us.

For agricultural activities that are not subject to the SPCA, sediment controls are carried out on a voluntary basis through programs administered by several different agencies (see Appendix VIII for further information).

Stronger Rules for Sediment Control

The Division of Land Resources (DLR) has the primary responsibility for assuring that erosion is minimized and sedimentation is reduced during construction activities. In November 2005, the NC Sedimentation Control Commission adopted significant changes for strengthening the Erosion and Sedimentation Control Program (NCDENR-DLR, November 2005) as follows:

- allows state and local erosion and sediment control programs to require a pre-construction conference when one is deemed necessary;
- surfaces must be non-erosive and stable within 15 working days or 90 calendar days after completion of the activity;
- graded slopes must be vegetated or otherwise stabilized within 21 calendar days of completion of a phase of grading;
- provides that no person may initiate a land-disturbing activity until notifying the agency that issued the plan approval of the date the activity will begin; and
- allows assessment penalties for significant violations upon initial issuance of a Notice of Violation (NOV).

Additionally, during its 1999 session, the NC General Assembly passed House Bill 1098 to strengthen the Sediment Pollution Control Act of 1973 (SPCA). The bill made the following changes to the Act (NCDENR-DLR, July-September 1999):

- increases the maximum civil penalty for violating the SPCA from $500 to $5000 per day;
- provides that a person may be assessed a civil penalty from the date a violation is detected if the deadline stated in the Notice of Violation is not met;
- provides that approval of an erosion control plan is conditioned on compliance with federal and state water quality laws, regulations and rules;

- provides that any erosion control plan that involves using ditches for the purpose of dewatering or lowering the water table must be forwarded to the Director of DWQ;
- amends the General Statutes governing licensing of general contractors to provide that the State Licensing Board for General Contractors shall test applicants' knowledge of requirements of the SPCA and rules adopted pursuant to the Act; and
- removes a cap on the percentage of administrative costs that may be recovered through plan review fees.

For information on North Carolina's Erosion and Sedimentation Control Program or to report erosion and sedimentation problems, visit the new website at http://www.dlr.enr.state.nc.us/ or you may call the NC Division of Land Resources, Land Quality Section at (919) 733-4574.

Recent Review of Sediment Control Research

Two of the most commonly used sediment control devices are silt fences and sediment basins. In 2005, DLR revised the requirements for these and other BMP's to make them more efficient at trapping and containing sediment on site. These revisions are based upon research done by NC State University, NC Department of Transportation, and other professional engineers.

Currently, sediment basins are designed to have a minimum volume of 1,800 cubic feet per acre of drainage area and a surface area of 325 square feet per cfs of Q_{10} peak flow. Sediment basins are designed to temporarily pool runoff water to allow sediment to settle before the water is discharged. Unfortunately, they are usually not very efficient due to high turbulence, which takes the runoff quickly to the outlet with little interaction with most of the basin. Per the 2005 revisions, three baffles are now required for a basin of this size. Baffles improve the rate of sediment retention by distributing the flow and reducing turbulence, allowing the baffles to capture soil particles 50 percent smaller than those captured without the use of baffles. Baffles also lower the chances of short-circuiting. To further improve sediment retention, the use of a skimmer attached at the bottom of a riser pipe is suggested. Skimmers are a dewatering mechanism that pulls water from the top of the water column. After the runoff has passed through the baffles, the sediment has had time to drop to the bottom of the water column. Therefore, the overflow water at the top will have the least amount of sediment particles.

Sediment fences are also used very frequently and are inefficient at capturing sediment before it leaves the site. This BMP is overused and, in most cases, is installed improperly. For these reasons DLR has revised the requirements to make it more efficient. For better support, the use of steel posts in the place of wooden posts is now required. The fence should be anchored by placing 12 inches of washed stone on the toe of the fence that should be facing uphill. Another method to anchor the fence is to slice the fabric into the ground. This method uses specially designed equipment to insert the fabric into a cut sliced in the ground with a disc. By slicing the fabric into the ground, excavating a trench can be avoided. Sediment fences require that installation is done properly and regular maintenance is scheduled.

Other new technologies such as applications of flocculants, rolled erosion control products, hardware cloth and gravel inlet protection, rock pipe inlet protection, and rock doughnut inlet protection are specified in the *North Carolina Erosion and Sediment Control Planning and Design Manual*, which can be found at http://dlr.enr.state.nc.us/pages/manualsandvideos.html. These technologies can significantly increase efficiency of trapping sediment on land disturbing sites. Research funded by the Sedimentation Control Commission (SCC) and the NC Department of Transportation (NCDOT) at NCSU demonstrated that turbidity levels could approach the current turbidity standard of 50 NTU (for waters not classified Tr) in runoff if these devices are used. However, the most important factor in reducing sedimentation is timely cover of cleared land with mulch matting or netting that are adequately tacked. It has been conclusively proven that use of ground cover (temporary or permanent) dramatically reduces erosion rates.

13.2.3 Loss of Riparian Vegetation and Organic Aquatic Microhabitats

During the 2004 basinwide sampling, DWQ biologists reported degradation of aquatic communities at numerous sites throughout the Roanoke River basin in association with narrow or nonexistent zones of native riparian vegetation. Riparian vegetation loss was common in rural and residential areas as well as in urban areas. The loss of riparian vegetation and subsequent reduction of organic aquatic habitats is caused by removal of riparian areas most commonly by land clearing for development, field agriculture, and pastureland as well as forestry and by grazing animals. Instream organic habitat removal has also been caused by de-snagging activities.

Removing trees, shrubs and other vegetation to plant grass or place rock (also known as riprap) along the bank of a river or stream degrades water quality. Removing riparian vegetation eliminates habitat for aquatic macroinvertebrates that are food for trout and other fish. Rocks or concrete lining a bank absorb the sun’s heat and warm the water. Some fish require cooler water temperatures as well as the higher levels of dissolved oxygen cooler water provides. Trees, shrubs and other native vegetation cool the water by shading it. Straightening a stream, clearing streambank vegetation, and lining the banks with grass or rock severely impact the habitat that aquatic insects and fish need to survive.

Establishing, conserving and managing streamside vegetation (riparian buffer) is one of the most economical and efficient BMPs. Forested buffers in particular provide a variety of benefits including filtering runoff and taking up nutrients, moderating water temperature, preventing erosion and loss of land, providing flood control and helping to moderate streamflow, and providing food and habitat for both aquatic and terrestrial wildlife. To obtain a free copy of DWQ’s *Buffers for Clean Water* brochure, call (919) 733-5083, ext. 558.

Organic microhabitat (leafpacks, sticks and large wood) and edge habitat (root banks and undercut banks) play very important roles in a stream ecosystem. Organic matter in the form of leaves, sticks and other materials serve as the base of the food web for small streams. Additionally, these microhabitats serve as special niches for different species of benthic macroinvertebrates, providing food and/or habitat. For example, many stoneflies are found almost exclusively in leafpacks and on small sticks. Some beetle species prefer edge habitat, such as undercut banks. If these microhabitat types are not present, there is no place for these specialized macroinvertebrates to live and feed. The absence of these microhabitats in some streams in the Roanoke River basin is directly related to the absence of riparian vegetation. Organic microhabitats are critical to headwater streams, the health of which is linked to the health of the entire downstream watershed.

13.2.4 Channelization

Channelization refers to the physical alteration of naturally occurring stream and riverbeds. Channelization is caused by mechanical straightening of channels or by hydraulic overloading during rain events. Often streams in urban areas become channelized as part of the development process in essence using the stream channels as stormwater conveyances. Although increased flooding, bank erosion and channel instability often occur in downstream areas after channelization has occurred, flood control, reduced erosion, increased usable land area, greater navigability and more efficient drainage are frequently cited as the objectives of channelization projects (McGarvey, 1996).

Typical Channel Modifications

- Removal of any obstructions, natural or artificial, that inhibit a stream's capacity to convey water (clearing and snagging).
- Widening, deepening or straightening of the channel to maximize conveyance of water.
- Lining the bed or banks with rock or other resistant materials.

Channelization reduces the sinuosity of streams greatly increasing the velocity of water flowing down these streams. Direct or immediate biological effects of channelization include injury and mortality of benthic macroinvertebrates, fish, shellfish/mussels and other wildlife populations, as well as habitat loss. Indirect biological effects include changes in benthic macroinvertebrate, fish and wildlife community structures, favoring species that are more tolerant of or better adapted to the altered habitat (McGarvey, 1996).

Restoration or recovery of channelized streams may occur through processes, both naturally and artificially induced. In general, streams that have not been excessively stressed by the channelization process can be expected to return to their original forms. However, streams that have been extensively altered may establish a new, artificial equilibrium (especially when the channelized streambed has been hardened). In such cases, the stream may enter a vicious cycle of erosion and continuous entrenchment. Once the benefits of a channelization project become outweighed by the costs, both in money and environmental integrity, channel restoration efforts are likely to be taken (McGarvey, 1996).

Channelization of streams within the continental United States is extensive and promises to become even more so as urban development continues. Overall estimates of lost or altered riparian habitats within US streams are as high as 70 percent. Unfortunately, the dynamic nature of stream ecosystems makes it difficult (if not impossible) to quantitatively predict the effects of channelization (McGarvey, 1996). Channelization has occurred historically in parts of the Roanoke River basin and continues to occur in some watersheds, especially in small headwater streams.

13.2.5 Recommendations for Reducing Habitat Degradation

In March 2002, the Environmental Management Commission (EMC) sent a letter to the Sedimentation Control Commission (SCC) outlining seven recommendations for improving erosion and sedimentation control, based on a comprehensive performance review of the turbidity standard conducted in 2001 by DWQ staff. Specifically, the recommendations are that the EMC and SCC:

1. evaluate, in consultation with the Attorney General's Office, whether statutory authority is adequate to mandate temporary ground cover over a percentage of the uncovered area at a construction site within a specific time after the initial disturbance of the area. If it is found that statutory authority does not exist, then the EMC and SCC should prepare resolutions for the General Assembly supporting new legislation to this effect;

2. prepare resolutions supporting new legislation to increase the maximum penalty allowed in the Sedimentation Pollution Control Act from $5,000 to $25,000 for the initial response to a noncompliant site;

3. jointly support a review of the existing Erosion and Sediment Control Planning and Design Manual by DLR. This review should include, but not be limited to, a redesign of the minimum specifications for sedimentation basins;

4. evaluate, in consultation with the Attorney General's Office, whether the statutory authority is adequate for effective use of the "Stop Work Order" tool and, if found not to be adequate, to prepare resolutions for the General Assembly supporting new legislation that will enable staff to more effectively use the "Stop Work Order" tool;

5. support increased research into and experimentation with the use of polyacrylamides (PAMs) and other innovative soil stabilization and turbidity reduction techniques;

6. jointly support and encourage the awarding of significant monetary penalties for all activities found to be in violation of their Stormwater Construction General Permit, their Erosion and Sediment Control Plan, or the turbidity standard; and

7. hold those individuals who cause serious degradation of the environment through excessive turbidity and sedimentation ultimately responsible for restoration of the area.

DWQ will continue to work cooperatively with DLR and local programs that administer sediment control in order to maximize the effectiveness of the programs and to take appropriate enforcement action when necessary to protect or restore water quality. However, more voluntary implementation of BMPs is needed for activities that are not subject to these rules in order to substantially reduce the amount of widespread sedimentation present in the Roanoke River basin. Additionally, more public education is needed basinwide to educate landowners about the value of riparian vegetation along small tributaries and the impacts of sedimentation to aquatic life.

Funding is available through numerous federal and state programs for landowners to restore and/or protect riparian buffer zones along fields or pastures, develop alternative watering sources for livestock, and fence animals out of streams (refer to Chapters 11 and 16). EPA's *Catalog of Federal Funding Sources for Watershed Protection* (Document 841-B-99-003) outlines some of these and other programs aimed at protecting water quality. A copy may be obtained by calling the National Center for Environmental Publications and Information at (800) 490-9198 or by visiting the website at http://www.epa.gov/OWOW/watershed/wacademy/fund.html. Local contacts for various state and local agencies are listed in Appendix VIII.

13.3 Aquatic Life Stressors – Water Quality Standard Violations

13.3.1 Introduction and Overview

In addition to the habitat stressors discussed in the previous section, the stressors discussed below are identified by water quality standards. These are usually direct measures of water quality parameters from ambient water quality monitoring stations. The water quality standards are designed to protect aquatic life. As with habitat degradation, altered watershed hydrology greatly increases the sources of these stressors as well as delivery of the stressors to the receiving waters. The following are water quality standards that were identified for waters with noted impacts. Refer to the subbasin chapters (Chapter 1 – 10) for more information on the affected waters.

13.3.2 Low Dissolved Oxygen

Maintaining an adequate amount of dissolved oxygen (DO) is critical to the survival of aquatic life and to the general health of surface waters. A number of factors influence DO concentrations including water temperature, depth and turbulence. Additionally, in the Roanoke River basin, a large floodplain drainage system and flow management from upstream impoundments also influences DO. Oxygen-consuming wastes such as decomposing organic matter and some chemicals can reduce DO levels in surface water through biological activity and chemical reactions. NPDES permits for wastewater discharges set limits on certain parameters in order to control the effects that oxygen depletion can have in receiving waters.

Waters are Impaired for aquatic life when greater than 10 percent of samples collected exceed the state DO standard and at least 10 samples were collected. The DO water quality standard for Class C waters is not less than a daily average of 5 mg/l with a minimum instantaneous value of not less than 4 mg/l. Swamp waters (supplemental Class Sw) may have lower values if caused by natural conditions. In the Roanoke River basin during this assessment period, there were 39 stream miles that are Impaired where low DO is a stressor. There were also over 30 freshwater stream miles where low DO is a stressor for waters with noted impacts, although many of these streams are in swampy areas where low DO levels are likely from natural sources.

13.3.3 Turbidity

The major sources of elevated turbidity are from agriculture and land clearing activities as well as from urban stormwater. These sources also add other pollutants beside suspended particulates. Waters are Impaired for aquatic life when greater than 10 percent of samples collected exceed the state turbidity standard and at least 10 samples were collected. The turbidity water quality standard for Class C waters are not to exceed 50 Nephelometric Turbidity Units (NTU). However, trout waters (Tr) are not to exceed 10 NTUs. In the Roanoke River basin during this assessment period, there were 55 stream miles Impaired where turbidity is a stressor; of these 11.6 were trout stream miles. There were also 4 freshwater stream miles and 362 freshwater acres that are impacted where turbidity is a stressor.

13.3.4 Toxic Impacts

Toxic impacts are noted as a stressor during biological monitoring or when identified from NPDES compliance reports. Waters are not impaired due to toxic impacts, but toxic impacts can be noted as a potential stressor on the system, which can ultimately result in impairment. During the most recent assessment period, toxic impacts were noted on 25.5 stream miles. Of these, 9.2 miles of the Dan River and 4.5 miles of Marlowe Creek are noted as having toxic impacts due to WWTP whole effluent toxicity (WET) test failures in the last two years of the assessment period (Chapter 1 and 5). Toxic impacts were also noted as a stressor for 11.8 miles of the Little Island Creek due to the watershed being encompassed by a defunct Tungsten mine (Chapter 6).

13.3.5 Other Aquatic Life Stressors

Several noted stressors to aquatic life are identified from WWTP NPDES compliance reports. Waters are not Impaired due to permit violations, however these violation can be noted as a potential stressor on the system. In the Roanoke River basin during this assessment period, there were 59, 11, 4, and 1 stream mile impacted where Total Suspended Solids (TSS), ammonia, chlorine and pH respectively were the noted stressors.

13.4 Recreation Stressor

13.4.1 Fecal Coliform Bacteria

Water quality standards for fecal coliform bacteria are intended to ensure safe use of waters for recreation (refer to Administrative Code Section 15A NCAC 2B .0200). The North Carolina fecal coliform standard for freshwater is 200 colonies/100ml based on the geometric mean of at least five consecutive samples taken during a 30-day period and not to exceed 400 colonies/100ml in more than 20 percent of the samples during the same period. In the Roanoke River basin, there were 43.3 stream miles where this standard was exceeded. These waters are Impaired for recreation. An additional 8 stream miles exceeded the fecal coliform bacteria screening criteria. These waters were not intensively sampled to assess the standard as described above, but had either a geometric mean above 200 colonies/100ml and/or 20 percent of samples exceeded 400 colonies/100ml over the five-year assessment period. These waters are discussed in the subbasin chapters. A total of 230.6 stream miles were monitored for recreation, of these only 111 stream miles are class B waters.

As stated above, there were 43 stream miles Impaired due to fecal coliform bacteria standard violations. There were an additional 18 Impaired stream miles that were noted as having fecal coliform bacteria as a noted stressor and another 26 stream miles for waters with noted impacts. These come from ambient data as well as from WWTP NPDES compliance reports.

A number of factors beyond the control of any state regulatory agency contribute to elevated levels of disease-causing bacteria. Therefore, the state does not encourage swimming in surface waters. To assure that waters are safe for swimming indicates a need to test waters for pathogenic bacteria. Although fecal coliform standards have been used to indicate the microbiological quality of surface waters for swimming for more than 50 years, the value of this indicator is often questioned. Evidence collected during the past several decades suggests that the coliform group may not adequately indicate the presence of pathogenic viruses or parasites in water.

Fecal coliform bacteria live in the digestive tract of warm-blooded animals (humans as well as other mammals) and are excreted in their waste. Fecal coliform bacteria generally do not pose a danger to most people or animals. However, where fecal coliform are present, disease-causing bacteria may also be present and water that is polluted by human or animal waste can harbor other pathogens that may threaten human health.

The presence of disease-causing bacteria tends to affect humans more than aquatic creatures. High levels of fecal coliform bacteria can indicate high levels of sewage or animal wastes that could make water unsafe for human contact (swimming). Fecal coliform bacteria and other potential pathogens associated with waste from warm-blooded animals are not harmful to fish and aquatic insects. However, high levels of fecal coliform bacteria may indicate contamination that increases the risk of contact with harmful pathogens in surface waters. Pathogens associated with fecal coliform bacteria can cause diarrhea, dysentery, cholera and typhoid fever in humans. Some pathogens can also cause infection in open wounds.

Sources of Fecal Coliform in Surface Waters

- Urban stormwater
- Wild animals and domestic pets
- Improperly designed or managed animal waste facilities
- Livestock with direct access to streams
- Improperly treated discharges of domestic wastewater, including leaking or failing septic systems and straight pipes

Under favorable conditions, fecal coliform bacteria can survive in bottom sediments for an extended period (Howell et al., 1996; Sherer et al., 1992; Schillinger and Gannon, 1985). Therefore, concentrations of bacteria measured in the water column can reflect both recent inputs as well as the resuspension of older inputs.

Reducing fecal coliform bacteria in wastewater requires a disinfection process, which typically involves the use of chlorine and other disinfectants. Although these materials may kill the fecal coliform bacteria and other pathogenic disease-causing bacteria, they also kill bacteria essential to the proper balance of the aquatic environment, and thereby, endanger the survival of species dependent on those bacteria.

The detection and identification of specific pathogenic bacteria, viruses and parasites such as *Giardia*, *Cryptosporidium* and *Shigella* are expensive, and results are generally difficult to reproduce quantitatively. Also, to ensure the water is safe for swimming would require a whole suite of tests for many organisms, as the presence/absence of one organism would not document the presence/absence of another. This type of testing program is not possible due to resource constraints.

13.5 Fish Consumption Stressors

The presence and accumulation of mercury in North Carolina's aquatic environment are similar to contamination observed throughout the country. Mercury has a complex life in the environment, moving from the atmosphere to soil, to surface water, and eventually, to biological organisms. Mercury circulates in the environment as a result of natural and human (anthropogenic) activities. A dominant pathway for mercury in the environment is through the atmosphere. Mercury emitted from industrial and municipal stacks into the ambient air can circulate around 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 fish levels

Fish is part of a healthy diet and an excellent source of protein and other essential nutrients. However, nearly all fish and shellfish contain trace levels of mercury. The risks from mercury in fish depend on the amount of fish eaten and the levels of mercury in the fish. In March 2003, the Food and Drug Administration (FDA) and the Environmental Protection Agency (EPA) issued a joint consumer advisory for mercury in fish and shellfish. The advice is for women who might become pregnant, women who are pregnant, nursing mothers, and young children. Aside from being issued jointly by two federal agencies, this advisory is important because it emphasizes positive benefits of eating fish and gives examples of commonly eaten fish that are low in mercury. In the past, the FDA issued an advisory on consumption of commercially caught fish, while the EPA issued advice on recreationally caught fish.

By following these three recommendations for selecting and eating fish, women and young children will receive the benefits of eating fish and shellfish and be confident that they have reduced their exposure to the harmful effects of mercury. These recommendations are:

- **Do not eat shark, swordfish, king mackerel, or tilefish**. They contain high levels of mercury.

- Eat up to 12 ounces (two average meals) a week of a variety of fish and shellfish that are lower in mercury. Five of the most commonly eaten fish that are low in mercury are shrimp, canned light tuna, salmon, pollock, and catfish. Another commonly eaten fish, albacore ("white") tuna, has more mercury than canned light tuna. So, when choosing your two meals of fish, you may eat up to 6 ounces (one average meal) of albacore per week.

- Check local advisories about the safety of fish caught by family and friends in your local lakes, rivers, and coastal areas. If no advice is available, eat up to 6 ounces (one average meal) per week of fish you catch from local waters. Don't consume any other fish during that week.

For more detailed information, visit EPA's website at http://www.epa.gov/waterscience/fish/ or visit the FDA at http://www.cfsan.fda.gov/seafood1.html. The FDA's food information toll-free phone number is 1-888-SAFEFOOD.

The NC Department of Health and Human Services (NCDHHS) also issues fish consumption advisories and advice for those fish species and areas at risk for contaminants. NCDHHS notifies people to either limit consumption or avoid eating certain kinds of fish. While most freshwater fish in North Carolina contain very low levels of mercury and are safe to eat, several species have been found to have higher levels. More information regarding use support assessment methodology related to fish consumption advisories and advice can be found in Appendix X.

Due to high levels of mercury in seventeen saltwater and five freshwater fish species, the NCDHHS offers the following health advice (updated March 31, 2006).

Women of childbearing age (15 to 44 years), pregnant women, nursing women, and children under 15:

- **Do not eat** the following ocean fish: almaco jack, banded rudderfish, canned white tuna (albacore tuna), cobia, crevalle jack, greater amberjack, south Atlantic grouper (gag, scamp, red, and snowy), king mackerel, ladyfish, little tunny, marlin, orange roughy, shark, Spanish mackerel, swordfish, tilefish, or tuna (fresh or frozen).
- **Do not eat** the following freshwater fish: bowfin (blackfish), catfish (caught wild), chain pickerel (jack fish), or warmouth caught in North Carolina waters south and east of Interstate 85.
- **Do not eat** largemouth bass caught in North Carolina waters (statewide).
- Eat up to two meals per week of other fish. A meal is 6 ounces of cooked fish for adults or 2 ounces of cooked fish for children under 15.

All other people:

- Eat no more than one meal (6 ounces) per week of ocean and/or freshwater fish listed above. These fish are often high in mercury.
- Eat up to four meals per week of other fish. A meal is 6 ounces of cooked fish for adults or 2 ounces of cooked fish for children under 15.

For more information and detailed listing of site-specific advisories, visit the NCDHHS website at http://www.schs.state.nc.us/epi/fish/current.html or call (919) 733-3816.

Chapter 14
Wastewater and Stormwater Programs

14.1 NPDES Wastewater Discharge Permit Summary

The primary pollutants associated with point source discharges are:

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

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

Types of Wastewater Discharges

Major Facilities: Wastewater Treatment Plants with flows ≥1 MGD (million gallons per day); and some industrial facilities (depending on flow and potential impacts to public health and water quality).

Minor Facilities: Facilities not defined as Major.

100% Domestic Waste: Facilities that only treat domestic-type waste (from toilets, sinks, washers).

Municipal Facilities: Public facilities that serve a municipality. Can treat waste from homes and industries.

Nonmunicipal Facilities: Non-public facilities that provide treatment for domestic, industrial or commercial wastewater. This category includes wastewater from industrial processes such as textiles, mining, seafood processing, glass-making and power generation, and other facilities such as schools, subdivisions, nursing homes, groundwater remediation projects, water treatment plants and non-process industrial wastewater.

Currently, there are 77 permitted wastewater discharges in the Roanoke River basin. Table 14 provides summary information (by type and subbasin) about the discharges. Various types of dischargers listed in the table are described in the inset box. Facilities are mapped in each subbasin chapter. For a complete listing of permitted facilities in the basin, refer to Appendix VI.

The majority of NPDES permitted wastewater flow in the Roanoke River basin is from minor municipal wastewater treatment plants (WWTP). Nonmunicipal discharges also contribute substantial wastewater flow into the Roanoke River basin. Facilities, large or small, where recent data show problems with a discharge are discussed in each subbasin chapter.

Table 14 - Summary of NPDES Dischargers and Permitted Flows for the Roanoke River Basin (as of 04/21/05)

	Roanoke River Subbasin										
Facility Categories	**01**	**02**	**03**	**04**	**05**	**06**	**07**	**08**	**09**	**10**	**Total**
Total Facilities	21	10	11	4	7	3	10	0	8	3	77
Total Permitted Flow (MGD)	1.29	5.37	20.26	0.66	26.02	6.00	41.69	0.0	85.98	1.30	188.57
Major Discharges	1	1	4	0	3	1	3	0	2	1	16
Total Permitted Flow (MGD)	0.0	4.5	19.2	0.0	26.02	6.0	37.54	0.0	84.5	1.15	178.91
Minor Discharges	20	9	7	4	4	2	7	0	6	2	61
Total Permitted Flow (MGD)	1.29	0.87	1.06	0.66	0.01	0.0036	4.15	0.0	1.48	0.15	9.67
100% Domestic Waste	14	3	4	1	1	1	2	0	0	0	26
Total Permitted Flow (MGD)	0.63	0.07	0.05	0.02	0.01	0.0036	0.13	0.0	0.0	0.0	0.91
Municipal Facilities	2	2	2	2	1	1	4	0	4	2	20
Total Permitted Flow (MGD)	0.6	5.28	14.5	0.63	5.0	6.0	9.77	0.0	3.03	1.3	46.11
Nonmunicipal Facilities	19	8	9	2	6	2	6	0	4	1	57
Total Permitted Flow (MGD)	0.69	0.10	5.76	0.03	21.02	0.0036	31.93	0.0	82.95	0.0	142.48

14.2 DWQ Stormwater Programs

There are several different stormwater programs administered by DWQ and local jurisdictions. One or more of these programs affects many communities in the Roanoke River basin. The goal of the DWQ stormwater discharge programs is to prevent pollution from entering the waters of the state via stormwater runoff. These programs try to accomplish this goal by controlling the source(s) of pollutants. These programs include NPDES Phase I and II, HQW/ORW stormwater requirements, and requirements associated with the Water Supply Watershed Program. Local governments that are or may be affected by these programs are presented in Table 15.

14.2.1 NPDES Phase I

Phase I of the EPA stormwater program started with Amendments to the Clean Water Act (CWA) in 1990. Phase I required NPDES permit coverage to address stormwater runoff from medium and large stormwater sewer systems serving populations of 100,000 or more. There are no NPDES Phase I stormwater permits issued to communities in the basin.

Phase I also had requirements for eleven categories of industrial sources to be covered under stormwater permits. Industrial activities which require permitting are defined in ten categories ranging from sawmills and landfills to manufacturing plants and hazardous waste treatment, storage or disposal facilities. Construction sites disturbing greater than five acres were also required to obtain an NPDES stormwater permit under Phase I of the EPA stormwater program. Excluding construction stormwater general permits, there are 106 general stormwater permits and 6 individual stormwater permits. Refer to the subbasin chapters for more information on stormwater programs and permits and a complete listing of individual permits in Appendix VI.

14.2.2 NPDES Phase II

The Phase II stormwater program is an extension of the Phase I program that expands permit coverage to include smaller municipalities below 100,000 populations. The local governments permitted under Phase II are required to develop and implement a comprehensive stormwater management program that includes six minimum measures.

1. Public education and outreach on stormwater impacts;
2. public involvement/participation;
3. illicit discharge detection and elimination;
4. construction site stormwater runoff control;
5. post-construction stormwater management for new development and redevelopment; and
6. pollution prevention/good housekeeping for municipal operations.

Construction sites greater than one acre will also be required to obtain an NPDES stormwater permit under Phase II of the EPA stormwater program in addition to erosion and sedimentation control approvals.

Those municipalities and counties required to obtain a NPDES stormwater permit under the Phase II rules are identified using 1990 US Census Designated Urban Areas and the results of the 2000 US Census. Based on federal census data, EPA identified 123 cities, including, and 33 counties in North Carolina that would be required to obtain permits for stormwater management.

The EPA delegated Phase II implementation to each state and then in 1999 the Division of Water Quality and the Environmental Management Commission (EMC) initiated a rulemaking process.

<u>Stormwater Management Rule Update:</u>

In 2002, the EMC adopted temporary stormwater rules and by 2003 had adopted permanent rules that were to become effective August 1, 2004. In early 2004, the Rules Review Commission (RRC) objected to the rules for failure to comply with the Administrative Procedures Act and lack of statutory authority. The EMC challenged the decision of the RRC in court (EMC v. RRC 04 CVS 3157). A Wake County Superior Court ruled in the EMC's favor and the RRC subsequently approved the EMC's rules. However, while the case was pending the legislature enacted a separate set of requirements in 2004 that were designed to replace the EMC rules.

These rules include NPDES stormwater rules covering owners and operators of storm sewer systems and State stormwater rules covering activities in urbanizing areas. The EMC amended the rules at their November 10, 2005 meeting to address objections raised by the RRC at their October 2005 meeting. The inconsistency between the legislative requirements and the EMC rules necessitated consideration of Senate Bill 1566 in the 2006 short session. The legislature approved Session Law 2006-246, Senate Bill 1566 in 2006.

Senate bill 1566 provides that development projects in Phase II municipalities and counties that cumulatively disturb one acre or more of land must comply with the post-construction stormwater standards set out in the bill. The bill sets out criteria whereby unincorporated areas of counties will be subject to Phase II requirements. Under these criteria 25 counties are fully covered, while 8 counties have portions that are subject to the stormwater requirements. The bill also provides a designation and petition process by which additional local governments and other entities may be required to obtain a stormwater management permit.

The bill sets out stormwater controls that are based on a project's level of density and its proximity to Shellfish Resource Waters. Shellfish Resource Waters are waters classified by the EMC as Class SA waters (shellfish growing waters) that contain an average concentration of 500 parts per million of natural chloride ion (saltwater).

The Water Quality Committee (WQC) met in November 2006 and directed DWQ Staff to return in January 2007 WQC meeting with proposed amendments to the State Stormwater Rules. These rules will extend the coastal post-construction stormwater controls in Session Law 2006-246 to all 20 Coastal Counties.

Low Density Projects

Development projects that are located within one-half mile of and draining to Shellfish Resource Waters are considered low density if they contain no more than 12 percent built-upon area. A project that is not located within one-half mile of Shellfish Resource Waters is a low density project if it contains no more than 24 percent built-upon area or no more than two dwelling units per acre. Low density projects must use vegetated conveyances to the maximum extent practicable to transport stormwater runoff from the project.

High Density Projects

Projects that are located within one-half mile of and draining to Shellfish Resource Waters are considered high density if they contain more than 12 percent built-upon area. A project that is not located within one-half mile of Shellfish Resource Waters is a high density project if it contains more than 24 percent built-upon area or more than two dwelling units per acre. High density projects must use structural stormwater management systems that will control and treat runoff from the first one inch of rain unless the project is in a coastal county, in which case the project must use structural stormwater management systems that will control and treat runoff from the first one and one-half inches of rain. In addition, projects that are located within one-half mile and draining to Shellfish Resource Waters must control and treat the difference in the stormwater runoff from the pre-development and post-development conditions for the one-year twenty-four hour storm as well as meet certain design standards.

Implementation

The bill provides an implementation schedule that requires regulated entities to apply for an NPDES stormwater management permit within 18 months of being notified that it is a regulated entity subject to the requirements of this act. A regulated entity must implement its post-construction program no later than 24 months from the date the permit is issued and fully implement its permitted program within five years of permit issuance. City of Jacksonville and Onslow County have both submitted applications for Phase II.

The bill authorizes the EMC to adopt Phase II stormwater management rules. If the EMC does adopt rules, the rules must be substantially identical to the provisions of this act and will be automatically subject to review by the General Assembly and not subject to review by the RRC. The bill became effective retroactively to July 1, 2006.

Major Post-Construction Stormwater Controls in SL 2006-246

	Shellfish Resource Waters* (SA Waters w/ > 500 ppm chlorides)	SA Designated Waters – Not Shellfish Resource Waters*	Coastal County – Not SA Designated Waters	Non – Coastal County
Low Density Threshold	12%	24%	24%	24%
Storm Design for High Density	Difference in pre and post-development for 1-yr, 24-hour storm**	Runoff from first 1.5 inches of rain	Runoff from first 1.5 inches of rain	Runoff from first 1 inch of rain
Setback	30 feet	30 feet	30 feet	30 feet
Other Controls	No new points of s/w discharge No increase in rate, volume, or capacity in existing conveyances Infiltration up to 1-yr, 24-hr storm Diffuse flow in excess of 1-yr, 24-hr storm	No new points of s/w discharge No increase in rate, volume, or capacity in existing conveyances Infiltration up to 1-yr, 24-hr storm Diffuse flow in excess of 1-yr, 24-hr storm		

*These controls apply within ½ mile and draining to these waters.
**Amount of Runoff that would need to be controlled in inches for the difference in pre- and post-development conditions for the 1-year, 24-hour storm.

For additional information on stormwater programs please go to http://h2o.enr.state.nc.us/su/

2006 Recommendations

DWQ recommends that the local governments that will be permitted under Phase II develop programs that go beyond the six minimum measures. Implementation of Phase II, as well as the other stormwater programs, should help to reduce future impacts to streams in the basin. Local governments, to the extent possible, should identify sites for preservation or restoration. DWQ and other NCDENR agencies will continue to provide information on funding sources and technical assistance to support local government stormwater programs.

14.2.3 State Stormwater Program

The State Stormwater Management Program was established in the late 1980s under the authority of the North Carolina Environmental Management Commission (EMC) and North Carolina General Statute 143-214.7. This program, codified in 15A NCAC 2H .1000, affects development activities that require either an Erosion and Sediment Control Plan (for disturbances of one or more acres) or a CAMA major permit within one of the 20 coastal counties and/or development draining to Outstanding Resource Waters (ORW) or High Quality Waters (HQW).

The State Stormwater Management Program requires new developments to protect these sensitive waters by maintaining a low density of impervious surfaces, maintaining vegetative setbacks, and transporting runoff through vegetative conveyances. Low-density development thresholds vary from 12-30 percent built-upon area (impervious surface) depending on the classification of the receiving stream. If low-density design criteria cannot be met, then high-density development requires the installation of structural best management practices (BMPs) to collect and treat stormwater runoff from the project. High density BMPs must control the runoff from the 1 or 1.5-inch storm event (depending on the receiving stream classification) and remove 85 percent or 90 percent of the total suspended solids.

Current Status
Table 15 shows the communities in the Roanoke River basin where permits may be required under the state stormwater management program. All development in the three coastal counties requiring an Erosion and Sediment Control Plan (for disturbances of one or more acres) or requiring a CAMA major permit must obtain a stormwater permit.

2006 Recommendations
DWQ will continue implementing the state stormwater program with the other NCDENR agencies and local governments. Local governments should develop local land use plans that minimize impervious surfaces in sensitive areas. Communities should integrate state stormwater program requirements, to the extent possible, with other stormwater programs in order to be more efficient and gain the most water quality benefits for protection of public health and aquatic life.

14.3 Water Supply Watershed Stormwater Rules

Current Status
The purpose of the Water Supply Watershed Protection Program is to provide a proactive drinking water supply protection program for communities. Local governments administer the program based on state minimum requirements. There are restrictions on wastewater discharges, development, landfills and residual application sites to control the impacts of point and nonpoint sources of pollution. The program attempts to minimize the impacts of stormwater runoff by utilizing low-density development or stormwater treatment in high-density areas.

All communities in the Roanoke River basin in water supply watersheds have EMC approved water supply watershed protection ordinances.

2006 Recommendations
DWQ recommends continued implementation of local water supply protection ordinances to ensure safe and economical treatment of drinking water. Communities should also integrate water supply protection ordinances with other stormwater programs, to the extent possible, in order to be more efficient and gain the most water quality benefits for both drinking water and aquatic life.

Table 15 - Communities in the Roanoke River Basin Subject to Stormwater Requirements

Local Government	NPDES Phase I and Phase II	State Stormwater Program	Water Supply Watershed Stormwater Requirements
Municipalities			
Askewville		X	
Aulander			
Danbury		X	
Eden	Likely in the Future		X
Garysburg			
Gaston			X
Halifax			
Hamilton			
Hassell			
Henderson			
Hobgood			X
Jackson			
Jamesville			X
Kelford		X	
Kernersville	Phase II		X
Lewiston Woodville			
Littleton			
Macon			
Madison			X
Mayodan			X
Middleburg			
Milton			
Norlina			
Oak City			
Plymouth		X	
Reidsville	Likely in the Future		X
Rich Square			
Roanoke Rapids	Likely in the Future		X
Roxobel		X	
Roxboro			X
Rural Hall	Phase II		X
Scotland Neck			
Stokesdale			X
Stoneville			X

Stovall			
Walkertown	**Phase II, has applied for a waiver from permit requirements**		**X**
Walnut Cove		**X**	
Weldon			
Wentworth			
Williamston			
Windsor		**X**	
Yanceyville			**X**
Counties			
Beaufort		**A coastal county**	
Bertie		**A coastal county**	
Caswell			**X**
Forsyth	**Phase II, in Process**		X
Granville			**X**
Guilford	**Phase II, in Process**		**X**
Halifax			**X**
Martin			**X**
Northampton			**X**
Orange	**Phase II**		**X**
Person			**X**
Rockingham			**X**
Stokes	**Phase II**	**X**	**X**
Surry			**X**
Vance			**X**
Warren			
Washington		**A coastal county**	

Chapter 15
TMDLs in the Roanoke River Basin

15.1 Introduction to TMDLs

A TMDL or Total Maximum Daily Load is a calculation of the maximum amount of a pollutant that a waterbody can receive and still meet water quality standards, and an allocation of that amount to the pollutant sources. A TMDL is the sum of the allowable loads of a single pollutant from all contributing point and nonpoint sources. The calculation must include a margin of safety to ensure that the waterbody can be used for the purposes the state had designated. The calculation must also account for seasonal variation and critical conditions in water quality.

For each water quality limited segment Impaired by a pollutant and identified in the 303(d) list, a TMDL must be developed. A TMDL includes a water quality assessment that provides the scientific foundation for an implementation plan. An implementation plan outlines the steps necessary to reduce pollutant loads in a certain body of water to restore and maintain human uses or aquatic life. For more information on TMDLs and the 303(d) listing process, refer to Appendix VII or visit the TMDL website at http://h2o.enr.state.nc.us/tmdl/.

15.2 Approved TMDLs in the Roanoke River Basin

The Dan River (subbasin 03-02-03) TMDL for turbidity was completed and approved by EPA on January 11, 2005. A dioxin TMDL for Welch Creek/Roanoke River (subbasin 03-02-09) was approved in 1996. The Roanoke River (subbasin 03-02-08) TMDL for dissolved oxygen consuming wastes was approved in 1996. The Cashie River (subbasin 03-02-10) *draft* TMDL for Mercury completed the public input process and was submitted to USEPA in 2005 for finalization.

15.3 Scheduled TMDLs in the Roanoke River Basin

EPA guidance provides a timeline for TMDL development of 8 to 13 years. Thus, the elapsed time between 303(d) listing and TMDL development should not exceed 8 to 13 years. If the pace of TMDL development does not comply with this schedule, EPA may elect to develop TMDLs in order to meet this timeline. Waterbodies that were listed in 1998 should have TMDLs developed by 2006 to 2011.

15.4 TMDL Implementation Efforts

Point source (i.e., wastewater) implementation plans are included in TMDLs per EPA guidance. Thus, any point source discharging to an Impaired water will receive an explicit allocation within the TMDL. In some cases, the allocation may be equal to existing permit limits; thus, no action is needed by the wastewater permittee. In other cases, the allocation may be associated with a reduction in loading. Where applicable, the point source allocation may include provisions for bubble permits and point-to-point trading.

Nonpoint source implementation plans are not included in TMDLs, nor are they required by federal law. Nonpoint source implementation plans can be developed by DWQ, other agencies within DENR, COGs or local government offices. The Environmental Management Commission (EMC), the rule-making agency, provides oversight on nonpoint source programs and adopts rules to implement strategies that protect water quality.

EPA has provided guidance regarding TMDLs and NPDES stormwater permits. As a result, selected NPDES stormwater permits may contain additional language when subject to a TMDL. Per EPA, MS4s identified in TMDLs as contributors to impairment may be required to develop a management plan that includes additional monitoring and BMP installation associated with pollutants of concern.

15.5 Impaired Waters – 303(d) listing

Waters identified as Impaired during this assessment period will be updated in the 2008 303(d) list. These waters will be considered Impaired upon EMC approval of this basin plan, scheduled for September 2006. TMDLs will be scheduled as appropriate depending upon the location of the waterbody and the identified problem parameters.

Chapter 16
Agriculture and Water Quality

16.1 Animal Operations

In 1992, the Environmental Management Commission (EMC) adopted a rule modification (15A NCAC 2H.0217) establishing procedures for managing and reusing animal wastes from intensive livestock operations. The rule applies to new, expanding or existing feedlots with animal waste management systems designed to serve animal populations of at least the following size: 100 head of cattle, 75 horses, 250 swine, 1,000 sheep or 30,000 birds (chickens and turkeys) with a liquid waste system.

Key Animal Operation Legislation (1995-2003)

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

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

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

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

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

2000 Attorney General Easley reached a landmark agreement with Smithfield Foods, Inc. to phase out hog lagoons and implement new technologies that will substantially reduce pollutants from hog farms. The agreement commits Smithfield to phase out all anaerobic lagoon systems on 276 company-owned farms. Legislation will be required to phase out the remaining systems statewide within a 5-year period (State of Environment Report 2000).

2001 House Bill 1216 extended (again) the moratorium on new construction or expansion of swine farms.

Table 16 and Figure 23 summarize, by subbasin, the number of registered livestock operations, total number of animals, number of facilities, and total steady state live weight (SSLW) as of January 2005. These numbers reflect only operations required by law to be registered, and therefore, do not represent the total number of animals in each subbasin.

Table 16 - Registered Animal Operations in the Roanoke River Basin (as of 01/28/05)

Subbasin	Cattle			Poultry			Swine		
	No. of Facilities	No. of Animals	Total Steady State Live Weight*	No. of Facilities	No. of Animals	Total Steady State Live Weight*	No. of Facilities	No. of Animals	Total Steady State Live Weight*
03-02-01	2	365	511,000	0	0	0	1	800	417,600
03-02-02	0	0	0	0	0	0	1	1,205	521,765
03-02-03	0	0	0	0	0	0	1	1,800	243,000
03-02-04	2	400	560,000	0	0	0	0	0	0
03-02-05	1	200	280,000	0	0	0	4	500	708,500
03-02-06	0	0	0	0	0	0	2	2,506	1,940,810
03-02-07	3	700	980,000	0	0	0	4	5,750	2,349,250
03-02-08	4	1,205	1,192,000	1	60,000	240,000	11	31,575	6,692,065
03-02-09	0	0	0	0	0	0	6	14,488	2,252,480
03-02-10	0	0	0	0	0	0	3	6,360	2,426,080
Totals	**12**	**2,870**	**3,523,000**	**1**	**60,000**	**240,000**	**33**	**64,984**	**17,551,550**

* Steady State Live Weight (SSLW) is in pounds, after a conversion factor has been applied to the number of swine, cattle or poultry on a farm. Conversion factors come from the US Department of Agriculture, Natural Resource Conservation Service guidelines. Since the amount of waste produced varies by hog size, this is the best way to compare the sizes of the farms.

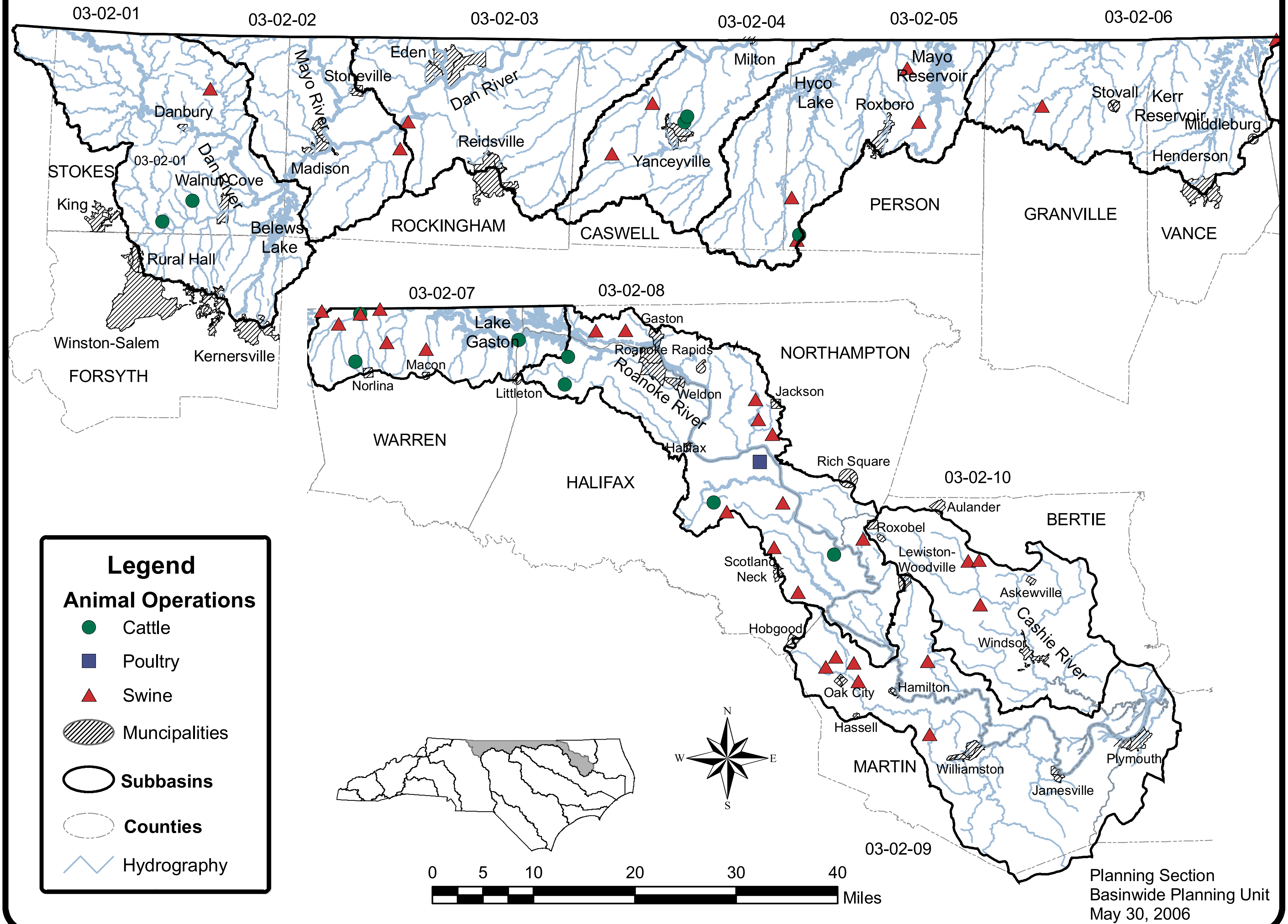
16.2 Impacted Streams in Agricultural Areas

In the Roanoke River basin, the majority of agricultural land is cultivated crop. Impacts to streams from agricultural activities can include excessive nutrient loading, pesticide and herbicide contamination, bacterial contamination, and sedimentation.

Based on the most recent information from the USDA Natural Resources Conservation Service (NRCS) National Resources Inventory (NRI), agricultural land use in the Roanoke River basin has decreased. Cultivated cropland decreased by 20.4 percent (9,700 acres) and uncultivated crop increased by 89.5 percent (22,200 acres), respectively. Pasture use decreased by 21.5 percent (2,400 acres). This same data also shows that urban and built-up areas increased by 136.1 percent (74,700 acres) (USDA-NRCS, 2001). Refer to Appendix III for more information related to land use changes in the Roanoke River basin.

2006 Recommendations
DWQ will identify streams where agricultural land use may be impacting water quality and aquatic habitat. Local Soil and Water Conservation District (SWCD) and NRCS staff should investigate these streams to assess agricultural impacts and recommend best management

Figure 23 Anima l Operations in the Roanoke River Basin



practices (BMPs) to reduce the impacts. DWQ recommends that funding and technical support for agricultural BMPs continue and increase. Refer to Appendix VIII for agricultural nonpoint source agency contact information.

16.3 Agricultural Best Management Practices Funding Opportunities

16.3.1 USDA – NRCS Environmental Quality Incentives Program (EQIP)

The USDA – Environmental Quality Improvement Program (EQIP) provides technical, educational and financial assistance to eligible farmers to address soil, water and related natural resource concerns on their lands in an environmentally beneficial and cost-effective manner. The program provides assistance to farmers in complying with federal and state environmental laws and encourages environmental enhancement. The purposes of the program are achieved through the implementation of a conservation plan that includes structural, vegetative and land management practices on eligible land. Two to ten-year contracts are made with eligible producers. Cost share payments may be made to implement one or more eligible structural or vegetative practices, such as animal waste management facilities, composters, filter strips, livestock exclusion and permanent wildlife habitat. Incentive payments can be made to implement one or more land management practices, such as nutrient management, pest management, grazing land management and long-term conservation tillage.

Sixty percent of the funding available for this program is targeted at natural resource concerns relating to livestock production. The program is carried out at the county level with base funding levels made available to each county. In North Carolina, EQIP was funded at approximately $14.0 million for 2005.

NRCS district contacts for the Roanoke River basin are provided in Appendix VIII or visit the website at http://www.nrcs.usda.gov/programs/eqip/ for more information.

16.3.2 NC Agriculture Cost Share Program

The NC Agricultural Cost Share Program (NCACSP) was established in 1984 to help reduce agricultural nonpoint runoff into the state's waters. The program helps owners and renters of established agricultural operations improve their on-farm management by using best management practices. These BMPs include vegetative, structural or management systems that can improve the efficiency of farming operations while reducing the potential for surface and groundwater pollution. The NCACSP is implemented by the Division of Soil and Water (DSWC), which divides the approved BMPs into five main purposes or categories.

- *Erosion Reduction/Nutrient Loss Reduction in Fields*
  Erosion/nutrient management measures include planned systems for reducing soil erosion and nutrient runoff from cropland into streams to improve water quality. Practices include: critical area planting, cropland conversion, water diversion, long-term no-till, pastureland conversion, sod-based rotation, strip cropping, terraces, and Christmas tree conservation cover.

- *Sediment/Nutrient Delivery Reduction from Fields*
  Sediment/nutrient management measures include planned systems that prevent sediment and nutrient runoff from fields into streams. Practices include: field borders, filter strips, grassed waterways, nutrient management strategies, riparian buffers, water control structures, streambank stabilization, and road repair/stabilization.

- *Stream Protection from Animals*
  Stream protection management measures are planned systems for protecting streams and streambanks. Such measures eliminate livestock access to streams by providing an alternate watering source away from the stream itself. Other benefits include reduced soil erosion, sedimentation, pathogen contamination, and pollution from dissolved, particulate, and sediment-attached substances. Practices include: heavy use area protection, livestock exclusion (e.g., fencing), spring development, stream crossings, trough or watering tanks, wells, and livestock feeding areas.

- *Proper Animal Waste Management*
  A waste management system is a planned system in which all necessary components are installed for managed liquid and solid waste to prevent or minimize degradation of soil and water resources. Practices include: animal waste lagoon closures, constructed wetlands, controlled livestock lounging area, dry manure stacks, heavy use area protection, insect and odor control, stormwater management, waste storage ponds/lagoons, compost, and waste application system.

- *Agricultural Chemical (agrichemical) Pollution Prevention*
  Agrichemical pollution prevention measures involve a planned system to prevent chemical runoff to streams for water quality improvement. Practices include: agrichemical handling facilities and fertigation/chemigation back flow prevention systems.

The NCACSP 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 BMP is completed, inspected and certified to be installed according to NCACSP standards. The annual statewide budget for BMP cost sharing is approximately $5.2 million, and another $2.1 million is provided for technical assistance for local soil and water conservation district staff. From September 1, 2000 to August 31, 2004, $3,0396,686 was implemented for projects in the Roanoke River basin. Table 17 summaries the cost and total BMPs implemented (i.e., acres, units, and linear feet) throughout the Roanoke River basin.

County Soil and Water Conservation District (SWCD) contacts for the Roanoke River basin are included in Appendix VIII. BMP definitions and DSWC contact information can be found online at www.enr.state.nc.us/DSWC/pages/agcostshareprogram.html.

Table 17 – NC Agriculture Cost Share Programs Contributions, BMPs Implemented and Potential Loadings Saved within the Roanoke River Basin

Purpose of BMP									
	Erosion Reduction[1]		**Sediment Reduction[2]**		**Stream Protection[3]**		**Animal Waste[4]**		**Total Cost ($)**
	Total	**Cost ($)**	**Total**	**Cost ($)**	**Total**	**Cost ($)**	**Total**	**Cost ($)**	
Subbasin 03-02-01	165.74 acres	48,319	5.51 acres	11,805	372 units 15,785 ft.	73,942 11,958	2 unit	18,905	164,929
Subbasin 03-02-02	405.9 acres 2,445 ft.	69,521 2,459	19.93 acres	28,916	377 units 16,105 ft.	81,347 12,650	4 units	31,613	226,506
Subbasin 03-02-03	448.36 acres 1,938 ft.	49,035 2,107	25.86 acres 1 unit	33,017 955	10 units 18,785 ft.	21,515 11,746			118,375
Subbasin 03-02-04	770.66 acres 10,913 ft.	93,275 11,050	37.67 acres	50,489	7 units 943 ft.	13,688 637			169,139
Subbasin 03-02-05	263.62 acres 18,493 ft.	32,997 19,523	101.19 acres 4 units	148,482 3,849	2 units 12,742 ft.	3,728 13,315	2 units	9,082	230,976
Subbasin 03-02-06	2852.46 acres 49,462 ft.	301,314 48,771	251.44 acres 5 units	313,996 4,804	403 units 50,136 ft.	132,687 39,402	6 units	40,695	881,669
Subbasin 03-02-07	629.02 acres 8,320.3 ft.	91,126 7,710	34.89 acres	35,497	6 units	10,609			144,942
Subbasin 03-02-08	1978.68 acres 17,343 ft.	226,707 15,498	104.2 acres 2 units	128,146 1,465	26 units	34,738	5 units 1 ton	60,139 6,000	472,693
Subbasin 03-02-09	1053.18 acres 0.5 ft.	71,023 1,120	78.55 acres	155,916			19 units 1 gallon 5 tons	203,025 6,000 24,000	461,084
Subbasin 03-02-10	676.6 acres	32,607	37 acres	43,219			13 units 3 tons	111,547 12,000	199,373

1 Erosion Reduction/Nutrient Loss Reduction in Field
2 Sediment/Nutrient Delivery Reduction from Field
3 Stream Protection from Animals
4 Proper Animal Waste Management

Total Benefits					
Subbasin	**Soil Saved (tons)**	**(N)itrogen Saved (lb.)**	**(P)hosph-orous Saved (lb.)**	**Waste-N Saved (lb.)**	**Waste-P Saved (lb.)**
03-02-01	4,871	8,849	1,610	61,457	38,571
03-02-02	9,045	22,325	2,363	75,907	47,530
03-02-03	7,638	33,382	1,449	193	188
03-02-04	8,600	92,650	1,607		
03-02-05	9,783	82,887	1,588	40,316	21,358
03-02-06	47,300	301,830	15,276	116,628	69,112
03-02-07	28,599	22,038	9,026		
03-02-08	32,523	94,312	39,321	115,570	97,500
03-02-09	11,457	54,711	25,015	266,082	101,934
03-02-10	2,259	20,545	2,355	128,256	72,086

16.3.3 Agricultural Sediment Initiative

In 2000, the NC Association of Soil and Water Conservation Districts and the NC Soil and Water Conservation Commission initiated an effort to assess stream channels and watersheds of streams on the state's 2000 303(d) list due to sediment where agriculture was included as a potential source. The primary objective of the Agricultural Sediment Initiative was to evaluate 303(d) listed waters in order to assess the severity of sedimentation associated with agricultural activities within the watershed and to develop local strategies for addressing sedimentation. The initiative involved 47 Impaired stream segments in 34 counties and 11 river basins.

Within the Roanoke River Basin, Smith Creek in subbasin 03-02-07 (Chapter 7) was targeted through this initiative. The Division of Soil and Water Conservation and the Warren Soil and Water Conservation District have obtained two section 319 grants, totaling $178,803 to fund best management practices and water quality education efforts in this watershed.

16.3.4 Conservation Security Program

The Conservation Security Program (CSP) is a voluntary conservation program that identifies and rewards farmers who are meeting the highest standards of conservation and environmental management on their operations. In addition, CSP creates powerful incentives for other producers to meet those same standards of conservation performance. CSP is administered by USDA's Natural Resources Conservation Service (NRCS). The Lower Roanoke watershed was selected as a CSP watershed in 2005, which includes Northampton, Bertie, Halifax, Washington and Martin counties. Approximately 701 farms in this watershed are eligible to join the program. For more information on the CSP program visit the NRCS website at: http://www.nrcs.usda.gov/programs/csp/2005_CSP_WS/.

Chapter 17
Forestry in the Roanoke River Basin

17.1 Forestland Ownership

Approximately 80 percent of timberland in the Roanoke River basin is privately-owned by individual landowners (Figure 24). This ownership estimate comes from the most recent data published by the USDA-Forest Service (*Forest Statistics for North Carolina, 2002.* Brown, Mark J. Southern Research Station Resource Bulletin SRS-88. January 2004).

It is estimated that forest industry owns nearly 10 percent of the timberland in the basin, while the remaining 10 percent is divided among other corporate ownership and public ownership. While there are no State Forests, Educational State Forests, or National Forest lands within the basin, there are large tracts of timberlands dedicated as State or National wildlife refuges and gamelands.

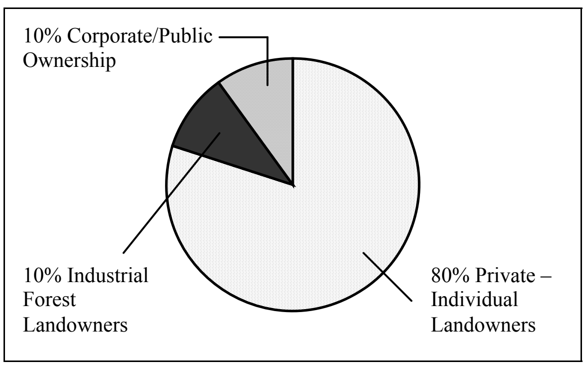


Figure 24 - Ownership of Forestland in the Roanoke River Basin

17.2 Forestry Water Quality Regulations in North Carolina

17.2.1 Forest Practices Guidelines for Water Quality (FPGs)

Forestry operations in North Carolina are subject to regulation under the Sedimentation Pollution Control Act (SPCA) of 1973 (reference NCGS Ch.113A Art.4). However, forestry operations may be exempted from the permit and plan requirements of the SPCA, if the operations meet the compliance standards outlined in the *Forest Practices Guidelines Related to Water Quality* (referred to as “FPGs”, reference 15A NCAC 1I .0101 - .0209) and N.C. General Statutes regarding stream obstruction (G.S.77-13 & G.S.77-14).

The FPGs are nine standards that are, in essence, codified performance-based practices that are required on forestry-related, site-disturbing activities. While the specific use of Best

Management Practices (BMPs) is voluntary, measures must be taken to comply with the standards defined in the FPGs.

The North Carolina Division of Forest Resources (DFR) is delegated the authority to monitor and evaluate forestry operations for compliance with these aforementioned laws and/or rules. In addition, the DFR works to resolve identified FPG compliance questions brought to its attention through citizen complaints. Violations of the FPG performance standards that cannot be resolved by the DFR are referred to the appropriate State agency for enforcement action.

During the period September 1, 1999 through August 31, 2004 the Division of Forest Resources conducted 1,697 FPG inspections of forestry-related activities in the Roanoke River basin; 93 percent of the sites inspected were in compliance.

17.2.2 Other Forestry Related Water Quality Regulations

In addition to the State regulations noted above, DFR monitors the implementation of the following Federal rules relating to water quality and forestry operations:
- the Section 404 Dredge and Fill exemption under the Clean Water Act;
- the US Army Corps of Engineers 15 mandatory BMPs related to road construction in wetlands; and
- the US Army Corps of Engineers mandatory BMPs for mechanical site preparation activities for the establishment of pine plantations in the southeast.

17.2.3 Water Quality Foresters

Water Quality Foresters conduct FPG inspections, survey BMP implementation, develop pre-harvest plans, and provide training opportunities for landowners, loggers, and the public regarding water quality issues related to forestry. They also participate in DFR-supported aerial reconnaissance flights to help locate potential water quality problems, as schedules and aircraft availability allows.

The DFR has an assigned Water Quality Forester in each of its Districts that cover the entire Roanoke River basin. The four foresters are based in the DFR's Lexington, Hillsborough, Rocky Mount, and Elizabeth City District Offices. The Lexington and Elizabeth City positions were added in 2005 as a result of new appropriations.

The DFR currently has a Water Quality Forester located in ten of its thirteen Districts across the State. Assistant District Foresters or Service Foresters handle water quality issues in the remaining Districts, along with other forest management and fire control responsibilities. See Appendix VIII for contact names and telephone numbers.

17.2.4 Forestry Best Management Practices

While using BMPs for forestry operations are voluntary in North Carolina, their usage is strongly encouraged in order to efficiently and effectively protect our water resources. It is interesting to note that while the state laws do not require using BMPs, several forestry and timber companies require BMPs to be used when timber is harvested to supply their manufacturing mills. This requirement is typically a component of the forest certification program(s) adopted by the forest products company.

The *North Carolina Forestry Best Management Practices Manual* describes recommended techniques that can be used to help comply with the State's forestry laws and help protect water quality. This manual is currently undergoing its first revision since adoption in 1989. This revision, led by the DENR-appointed Technical Advisory Committee (TAC) has undertaken over three years' of effort.

BMP Surveys

From March 2000 through March 2003, the DFR conducted a statewide BMP Implementation Survey to evaluate Forestry BMPs on active harvest operations for forest management purposes.

This survey evaluated 34 sites in the basin, which amounts to six percent (6 percent) of the total number of surveys conducted. The BMP implementation rate was 90 percent, placing these sites within the upper quartile from across the state during this survey.

The problems most often cited from the survey results across the state relate to stream crossings, skid trails, and site rehabilitation. This BMP survey, and additional periodic surveys to be conducted, will serve as a basis for focused efforts in the forestry community to address water quality concerns through better and more effective BMP implementation and training.

Bridgemat Loan Project

To help address some of these issues, the DFR has been providing bridgemats on loan out to loggers for establishing temporary stream crossings during harvest activities. Temporary bridges are usually the best solution for stream or ditch crossings, instead of culverts, hard-surfaced 'fords', or pole-timber crossings. Bridgemats have been available for use in the middle portion of the Roanoke River basin for three years.

Additional mats are being purchased by DFR for the lower Roanoke basin, to be based in Martin and Bertie counties. Bridgemats have been funded through US-EPA Section 319 Grants and from the Albemarle-Pamilco National Estuary Program (APNEP). More information about using bridgemats, and the above noted BMP survey, is available on the 'Water Quality' section of the DFR's website *http://www.dfr.state.nc.us./.*

Hurricane Isabel

In September 2003, Hurricane Isabel damaged several thousand acres of timberland across the lower Roanoke basin and elsewhere, with an estimated 186,000 acres impacted in Bertie County alone, which accounts for over one-quarter of all Isabel timber damage.

A short period of widespread salvage logging operations occurred after the storm in an effort to salvage damaged timber. The DFR sent foresters from outside the region to the impacted area to perform the additional FPG inspections warranted by this increased level of timber harvesting activities.

17.3 Forest Resources

17.3.1 Forest Products Industry

The economic value of the forest industry is evident across the Roanoke River basin. Twenty-eight (28) different businesses in the basin are considered "Primary Processors" of forest products raw material, which represents twelve percent (12 percent) of the total number of primary processors located in the state.

Two of the five pulp & paper mills that operate in North Carolina are located within the Roanoke basin. Other examples of primary processors in the basin include sawmills, pallet mills, and engineered lumber mills.

These forest product manufacturing facilities are foundations of the economy across the basin and its surrounding counties by providing not only direct employment, but also ancillary employment from service sectors, forestry occupations, and manufacturing support industries.

In addition to their employment value, all primary processors in North Carolina pay an assessment to the state, which is then combined with legislative appropriations, to fund the "Forest Development Program - FDP", which provides cost-shared reforestation assistance for forest landowners.

17.3.2 Forest Management

Some of the best-quality hardwood sawtimber in the eastern United States grows within the lower sections of the Roanoke River, which has been an important source of renewable timber resources for over two centuries.

In order to provide the raw materials used by the forest industry, the management of working forests is a vital component of the basin's landscape. This is evident from DFR records that indicate at least 54,000 acres of land were established or regenerated with forest trees across the basin from September 1, 1999 through August 31, 2004. Almost 70 percent of these reforested acres were partially funded through the FDP.

During this same time period the DFR provided over 2,600 individual forest management plans for forest landowners that encompassed nearly 154,000 acres in the basin.

17.3.3 Urban and Community Forestry

While the Roanoke River basin in North Carolina is relatively rural when compared to other river basins in the state, there are still opportunities for smaller communities to undertake Urban & Community Forestry projects that provide value for its citizens.

Two such towns, Eden and Yanceyville, are recognized as a "Tree City USA" by DFR's Urban & Community Forestry Program. Since 2001, seven Urban & Community Forestry Program Grants have been awarded to various groups in the basin, amounting to over $53,000 in project funding.

Urban forestry grant projects may include tree inventories, ornamental and streetscape tree planting, or the development of educational and training resources. Urban forestry, and an associated field known as Agroforestry are becoming increasingly important components in reducing NPS runoff by integrating 'working green space' into urbanized areas.

17.3.4 Forestry Accomplishments

Since the previous basinwide plan was produced, the DFR accomplished the following tasks in an ongoing effort to improve compliance with forest regulations and, in turn, minimize nonpoint source (NPS) pollution from forestry activities:

1. provided bridgemats for loaning to loggers for the first time across the western and central portions of the Roanoke River, and are purchasing additional bridgemats for the lower Roanoke section;
2. established a Forestry NPS Unit that develops and oversees projects throughout the state that involves protection, restoration and education on forestry NPS issues;
3. revised and produced 10,000 copies of a pocket field guide outlining the requirements of the FPGs and suggested BMPs to implement;
4. created and published 15,000 copies of a new informational brochure for landowners entitled "Call Before You Cut" promoting pre-harvest planning to insure water quality issues are addressed prior to undertaking timber harvesting; and
5. continued to assist with workshops in cooperation with the N.C. Forestry Association's "ProLogger" logger training program. As of 2005, this program requires at least 6 credit hours of continuing education every 3 years focused exclusively on water quality topics.

DFR continues its efforts to protect water quality through various protection, restoration, and education projects statewide. This includes monitoring studies, stream restoration, in-woods exhibits, and integration of NPS topics through the DFR's network of Educational State Forests as well as other public venues. One notable example included the first-ever "Forestry Festival" hosted in part by the DFR at Plymouth, NC in May 2005.

Progress reports and summaries are posted in the 'Water Quality' section of the DFR's Web site http://www.dfr.state.nc.us/ as they are completed.

Chapter 18
Water Resources

18.1 River Basin Hydrologic Units

Under the federal system, the Roanoke River basin is made up of hydrologic areas referred to as cataloging units (USGS 8-digit hydrologic units). The Roanoke River basin is made up of five whole cataloging units: Dan River (NC portion), County Line Creek and Hyco Reservoir, Kerr Reservoir and Tributaries, Lake Gaston and Smith Creek and Cashie River and Roanoke River. Cataloging units are further divided into smaller watershed units (14-digit hydrologic units or local watersheds) that are used for smaller scale planning like that done by NCEEP. There are 123 local watershed units in the basin. Table 18 compares the three systems. A map identifying the hydrologic units and subbasins can be found in Appendix I.

Table 18 - Hydrologic Subdivisions in the Roanoke River Basin

Watershed Name and Major Tributaries	DWQ Subbasin 6-Digit Codes	USGS 8-Digit Hydrologic Units	USGS 14-Digit Hydrologic Units Local Watersheds*
Dan River (NC Portion) Town Fork Creek, Snow Creek, Wolf Island Creek, Big Beaver Island, Belews Lake, Mayo River, Smith River	03-02-01 03-02-02 03-02-03	03010103	170010, 170020, 170030, 180010, 170050, 170040, 180020, 190010, 180030, 190020, 180050, 180040, 210100, 210150, 210200, 220020, 220010, 220030, 220050, 220040, 230010, 230020, 250030, 230040,
Country Line Creek and Hyco Reservoir Hogans Creek, Country Line Creek, Hyco Creek, Marlowe Creek, Hyco River, Mayo Reservoir	03-02-03 03-02-04 03-02-05 03-02-06	03010104	021010, 021020, 021030, 021040, 021050, 021060, 021070, 021080, 032010, 032020, 032030, 040040, 061010, 061020, 061030, 061040, 061050, 061060, 061070, 061080, 061090, 062010, 062020, 063010, 065010
Kerr Reservoir and Tributaries Grassy Creek, Island Creek, Nutbush Creek	03-02-06	03010102	161010, 161020, 161030, 161040, 170010, 170020, 170030, 170040, 180010
Lake Gaston and Smith Creek Sixpound Creek, Deep Creek, Roanoke Rapids Lake	03-02-07 03-02-08	03010106	031010, 041010, 041020, 041030, 041040, 041050, 041060, 041070, 041080, 041090, 041100
Cashie River and Roanoke River Roquist Creek, Conoho Creek, Hardison Mill Creek, Quankey Creek, Conconnara Swamp, Connaritsa Swamp, Kehukee Swamp	03-02-08 03-02-09 03-02-10	03010107	080010, 080020, 080040, 080030, 070010, 070030, 070020, 080050, 090020, 070040, 110010, 090010, 090030, 160010, 160011, 160020, 100020, 110020, 100010, 160012, 160050, 160030, 130010, 160040, 160070, 110030, 120010, 160060, 120020, 160071, 160090, 130020, 160110, 160080, 120050, 160130, 120040, 160115, 160120, 160081, 120030, 170020, 130030, 120070, 130040, 150020, 170010, 120060, 140050, 150030, 140040, 150010, 140020, 140030, 140010

* Numbers from the 8-digit and 14-digit column make the full 14-digit HU.

18.2 Minimum Streamflow

One of the purposes of the Dam Safety Law is to ensure maintenance of minimum streamflows below dams. Conditions may be placed on dam operations specifying mandatory minimum releases in order to maintain adequate quantity and quality of water in the length of a stream affected by an impoundment. The Division of Water Resources, in conjunction with the Wildlife Resources Commission (WRC), recommends conditions relating to release of flows to satisfy minimum instream flow requirements. The Division of Land Resources (DLR) issues the permits. The Federal Energy Regulatory Commission (FERC) licenses all dams associated with hydropower.

Hydroelectric Dams
There are three operational dams in the Roanoke River basin, which are all located on the Roanoke River (subbasin 03-02-07, 03-02-08). Information on these three dams is presented below. In addition, there are two dam projects that are under development both of which are located on the Mayo River (subbasin 03-02-02).

J.H. Kerr Dam is owned and operated by the U.S Army Corp of Engineers and covers 48,900 acres at an elevation of 300 feet. John H. Kerr project is authorized for recreation, flood control, hydroelectric power generation, fish and wildlife, and water supply. John H. Kerr is not regulated for low flow augmentation since the Federal Energy Regulatory Commission (FERC) assigned that requirement to the two Virginia Power Company projects located downstream. Kerr Reservoir extends into Mecklenburg, Charlotte and Halifax counties in Virginia and Granville, Vance and Warren counties in North Carolina.

Gaston and Roanoke Rapids Dam is owned and operated by Dominion North Carolina Power. These projects are regulated by FERC and have minimum flow requirements per FERC license number P-2009. The life of the license is forty years and was issued on March 31, 2004 and re-issued as ‘revised’ on March 4, 2005. Several license requirements are listed in the articles below:

Article 407. *Roanoke River Bypassed Reach Flows*.
Notwithstanding, the minimum flow in the bypass shall not be less than 325 cfs.

Article 409. *Roanoke Rapids Flow Operating Restrictions*.
From December 1 through January 15, the licensee shall maintain a minimum flow of 2,000 cubic feet per second (cfs) if the U.S. Army Corps of Engineers’ (Corps) weekly flow declaration for the Kerr dam is less than 6,000 cfs, or the daily mean of the weekly declaration (as defined in Settlement Agreement Article GP2), whichever is less. Notwithstanding, the licensee shall only release flows less than 2000 cfs pursuant to the provisions of article 405 of this license and settlement agreement article FL2, Section 4.2. If the Corps’ weekly flow declaration for the Kerr dam is equal to, or greater than, 6,000 cfs, the licensee shall maintain a minimum flow of 2,500 cfs.

From January 16 through the end of February, the licensee shall maintain a minimum flow of 2,500 cfs if the Corps’ weekly flow declaration for the Kerr dam is less than 6,000 cfs, or the daily mean of the weekly declaration (as defined in Settlement Agreement Article GP2), whichever is less. Notwithstanding, the licensee shall only release flows less than 2000 cfs pursuant to the provisions of article 405 of this license and settlement agreement article FL2, Section 4.2. If the Corps' weekly flow declaration for the Kerr dam is equal to, or greater than, 6,000 cfs, the licensee shall maintain a minimum flow of 3,000 cfs.

From March 1 through March 31, the licensee shall be afforded up to five days with which to operate in a peaking mode, provided that peaking operations occur only subject to all of the following conditions: (1) for no more than three consecutive days; (2) for no more than three days in any 7-day period; (3) during no more than two weeks during the month of March; (4) for no more than two days from March 25 through March 31; and (5) provided further that the Corps' weekly declaration flow is greater than 3,500 cfs. During peaking operations, the licensee shall maintain a minimum flow of 3,500 cfs, and maintain an 8,500-cfs flow for 1 hour as flows are increased from the minimum flow to the generation flow and decreased from the generation flow to the minimum flow. At all other times, the licensee shall maintain a continuous flow equal to the daily mean of the Corps' weekly declaration flow for Kerr Dam (as defined in Settlement Agreement Article GP2).

From April 1 through June 15, the licensee shall maintain, at all times, a continuous minimum flow equal to the Corps' weekly declaration flow for the Kerr dam (as defined in Settlement Agreement Article GP2), and no change in weekly flow shall exceed 5,000 cfs per hour.

From June 16 through November 30, the licensee shall maintain the following minimum flows:
Time Period Discharge (cfs)
June 16 – June 30 2,800
July 1 – September 15 2,000
September 16 – November 15 1,500
November 16 – November 30 2,000

Under drought conditions, as determined by the Corps', the licensee shall maintain, between January 1 and August 31, a minimum flow of 2,000 cfs; and between September 1 and November 30, a minimum flow of 1,500 cfs; and between December 1 and December 31, a minimum flow of 2,000 cfs.

For complete license, go to Federal Energy Regulatory Commission (FERC) e-Library, Advanced Search Page at: http://elibrary.ferc.gov/idmws/search/fercadvsearch.asp and enter "20050304-3070" in "Accession Number" field.

18.3 Interbasin Transfers

In addition to water withdrawals (discussed above), water users in North Carolina are also required to register surface water transfers with the Division of Water Resources (DWR) if the amount is 100,000 gallons per day or more. In addition, persons wishing to transfer two million gallons per day (MGD) or more, or increase an existing transfer by 25 percent or more, must first obtain a certificate from the Environmental Management Commission (G.S. 143-215.22I). The river basin boundaries that apply to these requirements are designated on a map entitled *Major River Basins and Sub-Basins in North Carolina*, on file in the Office of the Secretary of State. These boundaries differ from the 17 major river basins delineated by DWQ.

In determining whether a certificate should be issued, the state must determine that the overall benefits of a transfer outweigh the potential impacts. Factors used to determine whether a certificate should be issued include:

- the necessity, reasonableness and beneficial effects of the transfer;
- the detrimental effects on the source and receiving basins, including effects on water supply needs, wastewater assimilation, water quality, fish and wildlife habitat, hydroelectric power generation, navigation and recreation;
- the cumulative effect of existing transfers or water uses in the source basin;
- reasonable alternatives to the proposed transfer; and
- any other facts and circumstances necessary to evaluate the transfer request.

A provision of the interbasin transfer law requires that an environmental assessment or environmental impact statement be prepared in accordance with the State Environmental Policy Act as supporting documentation for a transfer petition.

In the Roanoke River basin, the Kerr Lake Regional Water System (KLRWS) is a public water system serving portions of Vance, Granville, Franklin and Warren counties. The System serves three bulk customers—the City of Henderson, City of Oxford, and Warren County—which currently supply water to the Town of Kittrell, Town of Norlina, Town of Warrenton, Town of Middleburg, Franklin County and the City of Louisburg.

In June 2003, KLRWS submitted an Environmental Assessment (EA) to the North Carolina Department of Environment and Natural Resources (NCDENR) for the Kerr Lake Water System Expansion to increase their existing water treatment plant capacity from 10 MGD to 20 MGD. This EA was granted a Finding of No Significant Impact (FONSI) on June 19, 2003. The treatment plant has been approved for a higher filter rating, allowing the plant to operate under special circumstances at 15 MGD or potentially operate at 25 MGD after plant expansion.

A meeting was held at NCDENRs office in Raleigh, NC on February 24, 2004 to review and prepare the scoping document for the KLRWS Interbasin Transfer petition. The compilation of key environmental issues and relevant agency comments at this meeting revealed greater clarity as to the requirements for this petition. Since the magnitude of the impacts from this proposed project is uncertain at this time, an Environmental Assessment (EA) was chosen as the initial document format. If, however, the EA concludes that the environmental impacts will be significant and cannot be fully mitigated, an EIS will be prepared. A determination that an EIS is required may be made at any time during the EA review process.

For more information on interbasin transfers, visit the website at http://www.ncwater.org or call DWR at (919) 733-4064.

18.4 Water Quality Issues Related to Drought

Water quality problems associated with rainfall events usually involve degradation of aquatic habitats because the high flows may carry increased loadings of substances like metals, oils, herbicides, pesticides, sand, clay, organic material, bacteria and nutrients. These substances can be toxic to aquatic life (fish and insects) or may result in oxygen depletion or sedimentation.

During drought conditions, these pollutants become more concentrated in streams due to reduced flow. Summer months are generally the most critical months for water quality. Dissolved oxygen is naturally lower due to higher temperatures, algae grow more due to longer periods of sunlight, and streamflows are reduced. In a long-term drought, these problems can be greatly exacerbated, and the potential for water quality problems to become catastrophic is increased. This section discusses water quality problems that can be expected during low flow conditions.

The frequency of acute impacts due to nonpoint source pollution (runoff) is actually minimized during drought conditions. However, when rain events do occur, pollutants that have been collecting on the land surface are quickly delivered to streams. When streamflows are well below normal, this polluted runoff becomes a larger percentage of the water flowing in the stream. Point sources may also have water quality impacts during drought conditions even though permit limits are being met. Facilities that discharge wastewater have permit limits that are based on the historic low flow conditions that may not be as extreme as future droughts. During droughts these wastewater discharges make up a larger percentage of the water flowing in streams than normal and might contribute to lowered dissolved oxygen concentrations and increased levels of other pollutants.

As streamflows decrease, there is less habitat available for aquatic insects and fish, particularly around lake shorelines. There is also less water available for irrigation and for water supplies. The dry conditions and increased removal of water for these uses further increases strain on the resource. With less habitat, naturally lower dissolved oxygen levels and higher water temperatures, the potential for large kills of fish and aquatic insects is very high. These conditions may stress the fish to the point where they become more susceptible to disease and where stresses that normally would not harm them result in mortality.

These decreased flow conditions create linger retention times and allow algae to take full advantage of the nutrients present resulting in algal blooms. During the daylight hours, algae greatly increase the amount dissolved oxygen in the water, but at night algal respiration and die off can cause dissolved oxygen levels to drop low enough to cause fish kills. Besides increasing the frequency of fish kills, algae blooms can also cause difficulty in water treatment resulting in taste and odor problems in finished drinking water.

18.5 Source Water Assessment of Public Water Supplies

18.5.1 Introduction

The Federal Safe Drinking Water Act (SDWA) Amendments of 1996 emphasize pollution prevention as an important strategy for the protection of ground and surface water resources. This new focus promotes the prevention of drinking water contamination as a cost-effective means to provide reliable, long-term and safe drinking water sources for public water supply (PWS) systems. In order to determine the susceptibility of public water supply sources to contamination, the amendments also required that all states establish a Source Water Assessment Program (SWAP). Specifically, Section 1453 of the SDWA Amendments require that states develop and implement a SWAP to:

- delineate source water assessment areas;

- inventory potential contaminants in these areas; and
- determine the susceptibility of each public water supply to contamination.

In North Carolina, the agency responsible for the SWAP is the Public Water Supply (PWS) Section of the DENR Division of Environmental Health (DEH). The PWS Section received approval from the EPA for their SWAP Plan in November 1999. The SWAP Plan, entitled *North Carolina's Source Water Assessment Program Plan*, fully describes the methods and procedures used to delineate and assess the susceptibility of more than 9,000 wells and approximately 207 surface water intakes. To review the SWAP Plan, visit the PWS website at http://www.deh.enr.state.nc.us/pws/index.htm.

18.5.2 Delineation of Source Water Assessment Areas

The SWAP Plan builds upon existing protection programs for ground and surface water resources. These include the state's Wellhead Protection Program and the Water Supply Watershed Protection Program.

Wellhead Protection (WHP) Program
North Carolinians withdraw more than 88 million gallons of groundwater per day from more than 9,000 water supply wells across the state. In 1986, Congress passed Amendments to the SDWA requiring states to develop wellhead protection programs that reduce the threat to the quality of groundwater used for drinking water by identifying and managing recharge areas to specific wells or wellfields.

Defining a wellhead protection area (WHPA) is one of the most critical components of wellhead protection. A WHPA is defined as "the surface and subsurface area surrounding a water well or wellfield, supplying a public water system, through which contaminants are reasonably likely to move toward and reach such water well or wellfield." The SWAP uses the methods described in the state's approved WHP Program to delineate source water assessment areas for all public water supply wells. More information related to North Carolina's WHP Program can be found at http://www.deh.enr.state.nc.us/pws/swap.

Water Supply Watershed Protection (WSWP) Program
DWQ is responsible for managing the standards and classifications of all water supply watersheds. In 1992, the WSWP Rules were adopted by the EMC and require all local governments that have land use jurisdiction within water supply watersheds adopt and implement water supply watershed protection ordinances, maps and management plans. SWAP uses the established water supply watershed boundaries and methods established by the WSWP program as a basis to delineate source water assessment areas for all public water surface water intakes. Additional information regarding the WSWP Program can be found at http://h2o.enr.state.nc.us/wswp/index.html.

18.5.3 Susceptibility Determination – North Carolina's Overall Approach

The SWAP Plan contains a detailed description of the methods used to assess the susceptibility of each PWS intake in North Carolina. The following is a brief summary of the susceptibility determination approach.

Overall Susceptibility Rating
The overall susceptibility determination rates the potential for a drinking water source to become contaminated. The overall susceptibility rating for each PWS intake is based on two key components: a contaminant rating and an inherent vulnerability rating. For a PWS to be determined "susceptible", a potential contaminant source must be present and the existing conditions of the PWS intake location must be such that a water supply could become contaminated. The determination of susceptibility for each PWS intake is based on combining the results of the inherent vulnerability rating and the contaminant rating for each intake. Once combined, a PWS is given a susceptibility rating of higher, moderate or lower (H, M or L).

Inherent Vulnerability Rating
Inherent vulnerability refers to the physical characteristics and existing conditions of the watershed or aquifer. The inherent vulnerability rating of groundwater intakes is determined based on an evaluation of aquifer characteristics, unsaturated zone characteristics and well integrity and construction characteristics. The inherent vulnerability rating of surface water intakes is determined based on an evaluation of the watershed classification (WSWP Rules), intake location, raw water quality data (e.g., turbidity and total coliform) and watershed characteristics (e.g., average annual precipitation, land slope, land use, land cover, groundwater contribution).

Contaminant Rating
The contaminant rating is based on an evaluation of the density of potential contaminant sources (PCSs), their relative risk potential to cause contamination, and their proximity to the water supply intake within the delineated assessment area.

Inventory of Potential Contaminant Sources (PCSs)
In order to inventory PCSs, the SWAP conducted a review of relevant, available sources of existing data at federal, state and local levels. The SWAP selected sixteen statewide databases that were attainable and contained usable geographic information related to PCSs.

18.5.4 Source Water Protection

The PWS Section believes that the information from the source water assessments will become the basis for future initiatives and priorities for public drinking water source water protection (SWP) activities. The PWS Section encourages all PWS system owners to implement efforts to manage identified sources of contamination and to reduce or eliminate the potential threat to drinking water supplies through locally implemented programs

To encourage and support local SWP, the state offers PWS system owners assistance with local SWP as well as materials such as:

- fact sheets outlining sources of funding and other resources for local SWP efforts;
- success stories describing local SWP efforts in North Carolina; and
- guidance about how to incorporate SWAP and SWP information in Consumer Confidence Reports (CCRs).

Information related to SWP can be found at http://www.deh.enr.state.nc.us/pws/swap.

18.5.5 Public Water Supply Susceptibility Determinations in the Roanoke River Basin

In April 2004, the PWS Section completed source water assessments for all drinking water sources and generated reports for the PWS systems using these sources. A second round of assessments were completed in April 2005. The results of the assessments can be viewed in two different ways, either through the interactive ArcIMS mapping tool or compiled in a written report for each PWS system. To access the ArcIMS mapping tool, simply click on the "NC SWAP Info" icon on the PWS web page (http://www.deh.enr.state.nc.us/pws/swap). To view a report, select the PWS System of interest by clicking on the "SWAP Reports" icon.

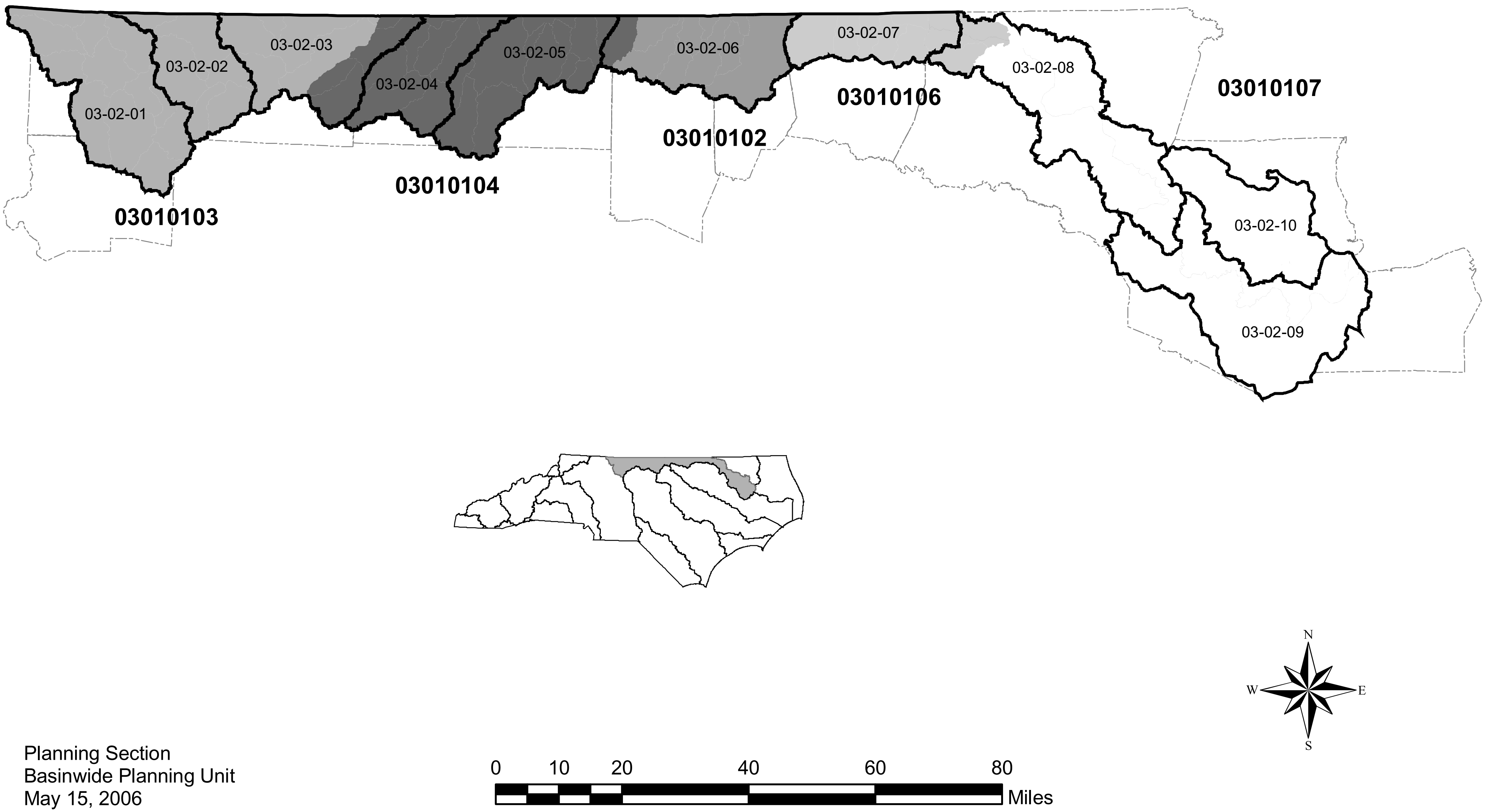
In the Roanoke River Basin, 456 public water supply sources were identified. Thirteen are surface water sources and 443 are groundwater sources. Of the 443 groundwater sources, 15 have a Higher susceptibility rating, 403 have a Moderate susceptibility rating and 25 have a Lower susceptibility rating. Table 19 identifies the thirteen surface water sources and the overall susceptibility rating. It is important to note that a susceptibility rating of Higher does not imply poor water quality. Susceptibility is an indication of a water supply's potential to become contaminated by the identified PCSs within the assessment area.

Table 19 - SWAP Results for Surface Water Sources in the Roanoke River Basin

PWS ID Number	Inherent Vulnerability Rating	Contaminant Rating	Overall Susceptibility Rating	Name of Surface Water Source	Public Water Supply Name
0217010	M	L	M	Fullers Creek	Town of Yanceyville
0217010	M	L	M	Farmer Lake	Town of Yanceyville
0273010	M	L	M	Lake Roxboro	City of Roxboro
0273409	M	L	M	Hyco Lake	Roxboro Steam Plant
0273427	M	L	M	Mayo Lake	CP&L-Mayo Elec Gen Plant
0273010	M	L	M	City Lake	City of Roxboro
0279010	H	H	H	Dan River	Town of Eden
0279025	H	L	M	Mayo River	Town of Mayodan
0279030	H	M	H	Dan River	Town of Madison
0291010	M	L	M	Kerr Lake	Henderson-Kerr Lake Regional Water
0442010	M	L	M	Roanoke Rapids Lake	Roanoke Rapids Sanitary District
0442010	H	L	M	Roanoke River	Roanoke Rapids Sanitary District
0442020	H	L	M	Roanoke River	Weldon Water System

H – higher; M – moderate; L – lower.

Figure 25 8-Digit Hydrologic Units in the Roanoke River Basin



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Chapter 19
Natural Resources

19.1 Ecological Significance of the Roanoke River Basin

The Roanoke River basin is ecologically significant and diverse in numerous ways, and contains habitat for over 140 rare plant and animal species. The character of the basin is somewhat montane as it enters North Carolina, where some natural communities are often associated with mountains, including Canada Hemlock Forest, Rich Cove Forest, Low Elevation Rocky Summit, Spray Cliff and Carolina Hemlock Bluff. The Roanoke then flows about 100 miles through the Piedmont and the Coastal Plain. In the Piedmont, it provides habitat for a number of rare fish and mussels, as well as small-anthered bittercress (*Cardamine micranthera*), a species only known to Stokes County and adjacent Hentry County, Virginia. This endemic plant requires small or intermittent streams and seepage areas and is found in the wet soil and rocks along small stream banks, and in hardwood forest with intact forest cover. This species had been presumed extinct however it was rediscovered in 1985, nearly 30 years after it had last been seen. The Coastal Plain section of the Roanoke River contains high-quality examples of wetland communities such as Coastal Plain Bottomland Hardwoods and Cypress-Gum Swamps. Some of these natural communities are extensive, and the large blocks of habitat are excellent for wildlife. Finally, the Roanoke River is the major contributor of freshwater to Albemarle Sound.

19.2 Rare Aquatic and Wetland-Dwelling Animal Species

Table 20 lists the rare fish, mollusks, insects, amphibians, and reptiles found throughout the Roanoke River basin. For information on any of the species listed in Table 20, visit the NC Natural Heritage Program (NHP) website at www.ncnhp.org.

Rare Species Listing Criteria

E =	Endangered (those species in danger of becoming extinct)
T =	Threatened (considered likely to become endangered within the foreseeable future)
SR =	Significantly Rare (those whose numbers are small and whose populations need monitoring)
SC =	Species of Special Concern
FSC =	Federal Species of Concern (those under consideration for listing under the Federal Endangered Species Act)
T(S/A) =	Threatened due to similarity of appearance
EX =	Extirpated
(PSC) =	Proposed Species of Concern (This is a proposed status, not yet adopted by Wildlife Resource Commission)

Table 20 - Rare aquatic animal species in the Roanoke River Basin (Source: NC Natural Heritage Program, July 2005)

Scientific Name	Major Group	Common Name	State Status	Federal Status
Lasmigona subviridis	Mollusk	Green floater	E	FSC
Ligumia nasuta	Mollusk	Eastern pondmussel	T	
Strophitus undulatus	Mollusk	Creeper	T	
Alasmidonta undulata	Mollusk	Triangle floater	T	
Leptodea ochracea	Mollusk	Tidewater mucket	T	
Pleurobema collina	Mollusk	James spinymussel	SR	E
Fusconaia masoni	Mollusk	Atlantic pigtoe	E	FSC
Lampsilis radiata	Mollusk	Eastern lampmussel	T	
Anodonta implicata	Mollusk	Alewife floater	T	
Elliptio roanokensis	Mollusk	Roanoke slabshell	T	
Alasmidonta varicosa	Mollusk	Brook floater	E	FSC
Orconectes virginiensis	Crustacean	Chowanoke crayfish	SC	FSC
Etheostoma collis pop. 2	Fish	Carolina darter - Eastern Piedmont population	SC	FSC
Etheostoma podostemone	Fish	Riverweed darter	SC	
Acipenser brevirostrum	Fish	Shortnose sturgeon	E	E
Noturus gilberti	Fish	Orangefin madtom	E	FSC
Hypentelium roanokense	Fish	Roanoke hog sucker	SR	
Exoglossum maxillingua	Fish	Cutlips minnow	E (PSC)	
Cottus caeruleomentum	Fish	Blue ridge sculpin	SR (PSC)	
Thoburnia hamiltoni	Fish	Rustyside sucker	E	FSC
Scartomyzon ariommus	Fish	Bigeye jumprock	T	
Diplectrona metaqui	Insect	A diplectronan caddisfly	SR	
Micrasema sprulesi	Insect	A caddisfly	SR	
Ceraclea mentiea	Insect	A caddisfly	SR	
Ephemerella berneri	Insect	A mayfly	SR	
Ceraclea cancellata	Insect	A caddisfly	SR	
Hemidactylium scutatum	Amphibian	Four-toed salamander	SC	
Ambystoma talpoideum	Amphibian	Mole salamander	SC	
Glyptemys muhlenbergii	Reptile	Bog turtle	T	T(S/A)

19.3 Significant Natural Heritage Areas in the Roanoke River Basin

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

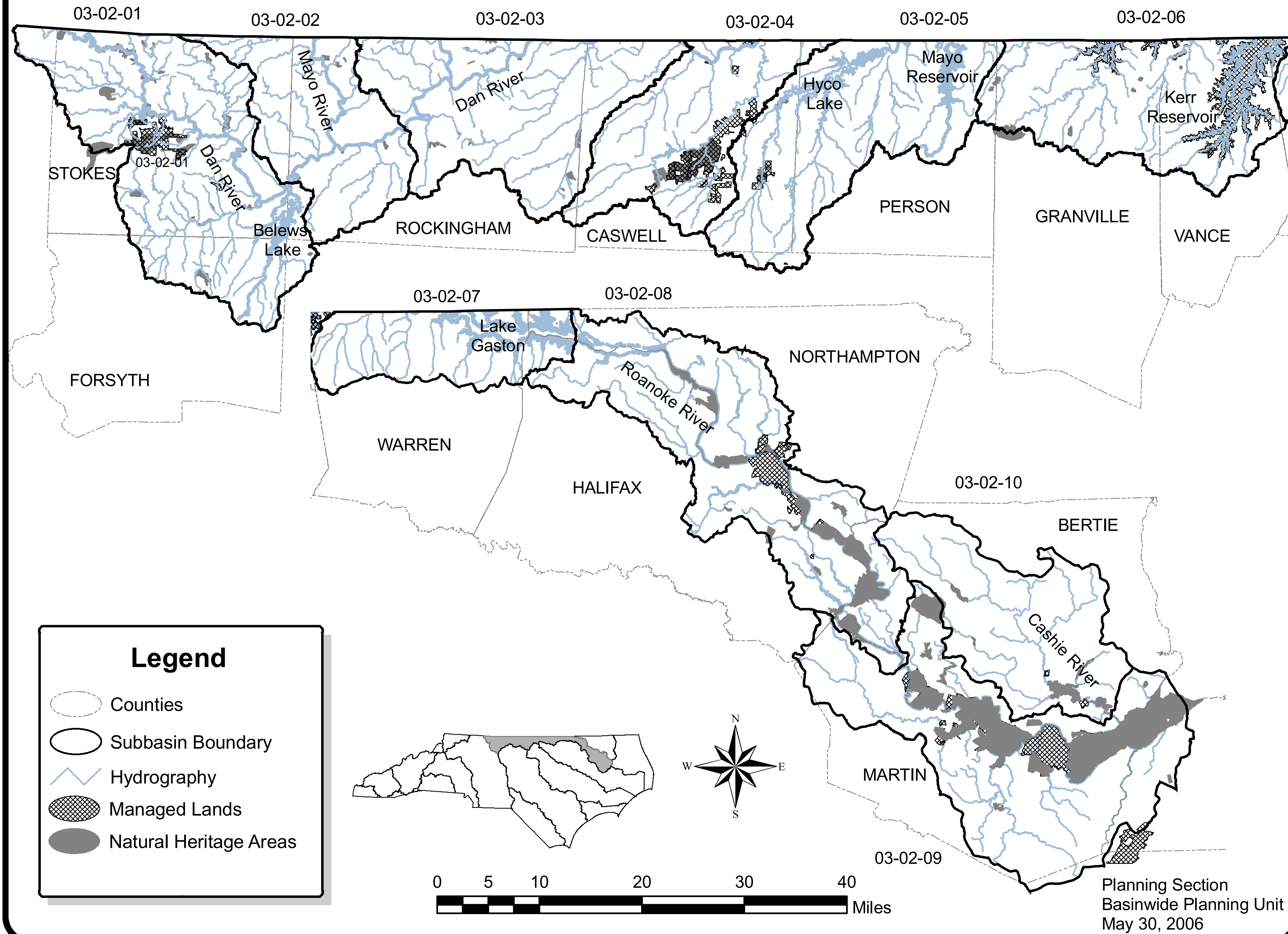
Figure 26 is a map of the Significant Natural Heritage Areas of the Roanoke River Basin. Sites that directly contribute to the maintenance of water quality in the Roanoke River basin are highlighted on the map and in the following text. The Natural Heritage Program has identified over 145 individual natural areas in the Roanoke River Basin. Because of this large number a some of the more important are discussed below:

Hanging Rock State Park is situated among the Sauratown Mountains, an isolated group of low mountains. The most prominent feature of the park is its series of steep, quartzite-capped ridges dissected by Cascades and Indian Creeks. Among the several rare plant species in the park are Greenland sandwort (*Minuartia groenlandica*), Bradley's spleenwort (*Asplenium bradleyi*), and a substantial population of bear oak (*Quercus ilicifolia*) on xeric slopes of Cooks Wall and Moores Knob.

Several important aquatic habitats are located in the Roanoke River Basin. Many of these are discussed below, but two of the more notable are the Dan River in Stokes County and the Mayo River. The Dan River Aquatic Habitat (Stokes County) is considered of national significance. As the Dan and Little Dan Rivers flow from Virginia, the waters maintain several fish species found nowhere else in North Carolina. The rarest of these fish is orangefin madtom, found in North Carolina only in these two waterways. This section of the river also contains populations of the federally endangered James River spinymussel. Other rare species that the Stokes County stretch of the Dan River provides habitat for include rare fish (Blue Ridge sculpin, cutlips minnow, Roanoke hog sucker, rustyside sucker, bigeye jumprock, and riverweed darter), mussels (James spinymussel, green floater, notched rainbow), and one rare plant, the Federally Endangered small-anthered bittercress. The Mayo River Aquatic Habitat is also nationally significant, and contains one of the best populations in the nation of James River spinymussel. Other rare species known from the Mayo include green floater, notched rainbow, riverweed darter, Roanoke hog sucker, bigeye jumprock, and three insects: *Ceraclea mentiea* (a caddisfly), *Ephemerella berneri* (a mayfly), *Micrasema sprulesi* (a caddisfly).

Jessups Mill/Georges Mill Corridor (Dan River) is a large, forested area of slopes along the Dan River, with examples of Mesic Mixed Hardwood Forest, Dry-Mesic Oak--Hickory Forest, Piedmont/Coastal Plain Heath Bluff, Rocky Bar and Shore, and Sand and Mud Bar communities. Four intermittent tributaries support populations of small-anthered bittercress, one of which is the largest known in the state. The site surrounds a portion of the nationally significant Dan River Aquatic Habitat (Stokes Section).

Figure 26 Roanoke River Basin Managed Lands and Significant Heritage Areas



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The Caswell Game Land protects much of the one of the most extensive and high quality tracts of mature Piedmont second-growth upland hardwood forest in the state. Oak and hickory dominate the upper slopes. Also found here are beech slopes, successional pine stands, narrow zones of alluvial hardwoods. Flowing through part of the game lands is Country Line Creek, a significant aquatic habitat discussed below.

The Nationally Significant Goshen Gabbro Forest contains many rare plant species, one of which is the Federally Endangered smooth coneflower (*Echinacea laevigata*). Yet most significant are the high quality examples of rare natural communities, including an outstanding Basic Oak--Hickory Forest, plus Xeric Hardpan Forest, and Upland Depression Swamp Forest. In addition, these high quality and rare communities are adjacent to each other in a 3-square-mile continuous block of forest. Thus, the site should provide important breeding and feeding habitat for amphibians that lay eggs in the pools and wander overland for the remainder of the year. The topography is flatter than typical Piedmont topography, due to the gabbro, which underlies the site. This rock is also associated with many of the rare plants and natural communities, through its influence on soil chemistry.

The lower Roanoke River floodplain contains perhaps some of the best remaining brownwater river floodplain communities known in the southeastern United States. The floodplain extends along about 130 miles along the lower Roanoke River and varies in width from three to five miles. In 1990, the US Fish & Wildlife Service and the NC Wildlife Resources Commission began acquiring property within the floodplain. Together, the Roanoke River National Wildlife Refuge and the Roanoke River Wetlands Game Land now protect over 32,000 acres. In addition, The Nature Conservancy, a private conservation group, has a cooperative agreement to manage and protect about 21,000 acres of land within the floodplain owned by Georgia-Pacific.

The privately-owned Occoneechee Neck Floodplain Forest, contains some of the best remaining examples of mature floodplain forest along the upper Roanoke River valley. Particularly notable are the 10-15 pairs of nesting cerulean warblers, a disjunct breeding population over 200 km from the nearest mountain population. This area also contains several large beaver ponds, some of the oldest in the Roanoke floodplain, and excellent examples of this community type.

Camassia Slopes is nationally significant for outstanding cluster of elements, including one of the best examples of a Basic Mesic Forest (Alluvial Terrace Slope Variant) in the State. It also contains one of only two wild hyacinth (*Camassia scilloides*) populations in the state – a species disjunct from midwestern slopes and prairies. These disjunct species are probable remnants from the Pleistocene glaciation period. Part of the natural area is a Dedicated Nature Preserve belonging to The Nature Conservancy, with the remaining portion on Odum Correctional Institution land.

Partly within the Roanoke River Wetland Game Land, the Buzzard Point/Ventosa Plantation natural area is a large expanse of river floodplain with some of the best examples of the typical bottomland and swamp communities in the Roanoke system, including levee forests, backswamps, alluvial flats, sloughs, low and high ridges, and beaver ponds. Diverse, abundant wildlife includes breeding populations of Mississippi kite, cerulean warbler, black vulture, and red-shouldered hawk, as well as wild turkeys, turkey vultures, wood ducks, and other more common game and nongame species.

Part of the Roanoke River National Wildlife Refuge, Broadneck Swamp contains one of best mature natural levee forest communities in the Roanoke floodplain. A rare disjunct population of Virginia bluebells (*Mertensia virginica*) is located on the levee. The natural area also contains the largest swamp forest in the upper and middle portions of the floodplain of the Roanoke River. The swamp supports the second largest inland heron rookery in North Carolina, and provides important nesting and wintering habitat for ducks.

Conoho Neck Swamp is located along the lower reaches of Conoho Creek within the floodplain of the Roanoke River, and is protected as part of the Roanoke River Wetland Game Land. It is a classic example of a "backswamp," a swamp formed by the natural levees along the main channel of the river, which act as berms or dams, impeding drainage and holding water in the backswamps during the winter and spring months. The deeply flooded cypress-gum swamp forest is the dominant natural community on this site and is influenced by both the blackwater Conoho Creek and brownwater Roanoke River. Also found here is a fine example of a “yazoo” tributary, formed when a tributary is deflected by the levee bordering the main river and is forced to run parallel to the main trunk river for some distance.

Devil’s Gut, a Nature Conservancy preserve, contains some of the best examples of old-growth alluvial forest communities in North Carolina. Located in the lower floodplain of the Roanoke River, it contains diverse alluvial features: filled river channels, point bars, and natural levees. Long, narrow sand or loamy ridges with levee forests of laurel oak, swamp chestnut oak, willow oak, and water oak alternate with parallel bands of bald cypress-water tupelo sloughs, forming a ridge and swale topography. On slightly higher terraces along Devil's Gut, an alluvial hardwood community containing green ash, sycamore, and silver maple. An old-growth (up to 160-year-old trees) loblolly pine/American beech community located on higher slopes in the southeastern section of this site support the only known stand of American beech in the North Carolina coastal Plain.

Jamesville Island is a large, contiguous Cypress--Gum Swamp Forest located on a bend in the lower Roanoke River floodplain. The site contains the largest expanse of contiguous cypress-water tupelo swamp forest in the Roanoke River floodplain and likely in North Carolina. It also supports extensive river frontage and several distributary streams, cypress-gum flats, and tidally influenced blackwater stream/bayou natural communities. The site is considered of national significance, as one of the most extensive and mature Brownwater Subtype Cypress--Gum Swamps in the nation. A portion of the natural area is within the Roanoke River National Wildlife Refuge, and another portion is protected by The Nature Conservancy.

Roanoke River Delta Islands contains a series of islands and distributary channels at river mouth. An extensive tract of mature bald cypress-water tupelo-Carolina water ash swamp forest is second in size only to the nearby Broad Creek Neck. It supports a high diversity of wildlife, including bear refuge, waterfowl, and nesting neo-tropical songbirds. It also protects important aquatic habitat for a diversity of fish. Much of the natural area is within the Roanoke River National Wildlife Refuge.

A large example of the rare Nonriverine Swamp Forest natural community is found in the Roanoke River basin at a site known as Roquist Pocosin. The canopy is mature to old, with trees averaging 17 inches in diameter and trees 24-30 inches in diameter are common. Much of this area has been degraded by logging. On the north side is a small but very mature and excellent quality Nonriverine Wet Hardwood Forest, dominated by swamp chestnut oak, cherrybark oak, and laurel oak. This natural community is also globally rare, and many of the other known examples have been degraded. The NC Ecosystem Enhancement Program has acquired much of the natural area as mitigation.

19.4 Significant Aquatic Habitats in the Roanoke River Basin

The NHP also collaborates with other agencies and organizations to identify Significant Aquatic Habitats in North Carolina. These habitat areas often include stream segments or other bodies of water that contain significant natural resources, such as a high diversity of rare aquatic animal species. The impact from lands adjacent to and upstream of these stream reaches determines their water quality and the viability of their aquatic species. The identification of a natural area conveys no protection; these lands are the responsibility of the landowner. Significant Aquatic Habitats in the Roanoke River basin are described below and are shown on Figure 26.

Mayo River Aquatic Habitat is ranked nationally significant. See page 171.

Lower Roanoke River Aquatic Habitat is state significant, and provides habitat for rare species such as alewife floater, Tidewater mucket, Chowanoke crayfish, and the rare caddisfly, *Ceraclea cancellata*.

Dan River (Rockingham) Aquatic Habitat is considered of state significance and provides habitat for several species, including three rare fish (Roanoke hog sucker, bigeye jumprock, and riverweed darter), as well as one mussel, the green floater.

Country Line Creek Aquatic Habitat is regionally significant as habitat for several mussels, including triangle floater, Atlantic pigtoe, and creeper, as well as the riverweed darter.

Middle Roanoke River Aquatic Habitat is regionally significant and contains populations of the rare species such as Roanoke slabshell and Chowanoke crayfish.

Cascade Creek/Indian Creek (Hanging Rock) Aquatic Habitat is regionally significant, and incorporates limited segments of Cascade Creek, Indian Creek and other significant tributaries in the vicinity of Hanging Rock State Park. A rare diplectronan caddisfly (*Diplectrona metaqui*) is known from these waters.

Dan River (Stokes) Aquatic Habitat is ranked nationally significant. See above for description.

Little Dan River Aquatic Habitat is considered regionally significant. This south-flowing river provides habitat for at least four rare species of fishes in North Carolina -- rustyside sucker, orangefin madtom, riverweed darter, and Blue Ridge sculpin.

Roanoke River Fall Zone Aquatic Habitat is state significant and contains an assemblage of seven rare mollusk species, including triangle floater, Alewife floater, Roanoke slabshell, Atlantic pigtoe, Eastern lampmussl, green Floater, and Tidewater mucket.

Aarons Creek Aquatic Habitat is regionally significant, and provides habitat for four rare mussels: brook floater, Atlantic pigtoe, creeper, and notched rainbow**.**

There are a number of Upland, Riparian and Wetland Significant Natural Heritage Areas not listed here that contribute to Roanoke River Water Quality. Please contact the NC Natural Heritage Program (NHP) to obtain information about these natural areas, or visit the NHP website at www.ncnhp.org.

19.5 Public Conservation Lands

Figure 26 also shows the land protected by public ownership in the Roanoke River basin. A number of significant natural areas, including some already mentioned, are located on public land (Hanging Rock State Park, Caswell Game Lands, Roanoke River Wetlands Game Land, Roanoke River National Wildlife Refuge). North Carolina State University's Sertoma 4-H Education Center is also in the Roanoke River basin, and a portion of it is the Moores Spring Dedicated Nature Preserve. These public lands are ecologically significant and provide water quality protection. Also on the map are some preserves or conservation easements held by private conservation organizations, many of which provide these same benefits, such as The Nature Conservancy's Camassia Slopes, Larkspur Ridge, and Roanoke River Preserves, and the Piedmont Land Conservancy's Dan River preserve near Hanging Rock State Park.

Some of the other lands noted on the map are important but not necessarily protected. Caledonia Correctional Institution and Odum Correctional Institution are large facilities (almost 9,000 acres combined) with about 13 miles of frontage on the Roanoke River. Portions of these facilities also provide important habitat for plants and animals, and qualify for Dedication as State Nature Preserves. There are numerous other conservation opportunities for partners to look at in the Roanoke River basin.

The contribution of private organizations to conservation in the Roanoke River basin has been irreplaceable. Although only partially shown on the map, these organizations have achieved significant protection in the Roanoke River basin. As noted, The Nature Conservancy owns and manages a number of Nationally Significant natural areas, and the Piedmont Land Conservancy and other local land trusts have also been working to protect the landscape of the Roanoke River basin from further fragmentation, benefiting wildlife and water quality. One of the more exciting projects involving a public private partnership is the Piedmont Land Conservancy's work with the Division of Park and Recreation's new Mayo River State Park. The Nature Conservancy works in a similar manner with the NC Wildlife Resources Commission on Roanoke River Wetlands Game Land. Using innovative tools such as conservation easements, these organizations work with private landowners as well, in a number of ways to protect important natural areas and water quality, as well as the "open space" of agricultural lands. The work that they do is helping to improve the quality of life for residents of the Roanoke River basin.

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Chapter 20
Water Quality Initiatives

20.1 The Importance of Local Initiatives

As the Basinwide Planning Program completes its third cycle of plan development, there are many efforts being undertaken at the local level to improve water quality. Information about local efforts particular to a watershed or subbasin is included in Chapters 1-10. DWQ encourages local agencies and organizations to learn about and become active in their watersheds.

An important benefit of local initiatives is that local people make decisions that affect change in their own communities. There are a variety of limitations local initiatives can overcome including: state government budgets, staff resources, lack of regulations for nonpoint sources, the rule-making process, and many others.

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

The collaboration of these local efforts is key to water quality improvements. There are good examples of local agencies and groups using these cooperative strategies throughout the state. The following local organizations and agencies (Table 21) are highlighted to share their efforts towards water quality improvement. Specific projects are described in the subbasin chapters (Chapters 1–10).

DWQ applauds the foresight and proactive response to potential water quality problems acted upon by these local efforts. Federal and state government agencies are interested in assisting local governments and citizen groups in developing their water quality management programs. The distribution of several grantors is discussed in the following sections.

Table 21 - Local Water Quality Initiatives

Roanoke River Basin Association
Office Location: Henderson, North Carolina

A non government organization consisting of private citizens, other non government environmental organizations and citizens groups that have a specific interest in the ecological, social and economic well being and integrity of the entire Roanoke River Basin. The mission of RRBA is to work with local, state and federal agencies, regional leaders, and the community to foster desirable economic, social and ecological conditions in the region. RRBA is especially concerned about issues relating to the inter-basin transfer of water between watersheds. For more information, contact:

Harrel B. Johnson Executive Director	Phone: (252) 257-3050 Email: hjohnson@rrba.org	http://www.rrba.org/

Current and Continuing Projects:

- Participation in the Virginia Roanoke River Basin Advisory Committee.
- Participation in the USACOE Kerr 216 study.
- Participating in the current American Electric Power relicensing study at Smith Mountain Lake in Va.
- Participating in The Stakeholders Board for the control of nuisance aquatic plants in Lake Gaston.
- Supporter of the Citizens opposed to the Off site landing field in Washington Co. NC

The Nature Conservancy
Office Locations: Arlington, Virginia (Home Office); Durham, North Carolina (NC Chapter Office); Roanoke Rapids, NC (Roanoke River Project Office)

The Nature Conservancy is a leading international, nonprofit organization dedicated to the following mission: to preserve the plants, animals and natural communities that represent the diversity of life on Earth by protecting the lands and waters they need to survive. Founded in 1951, The Nature Conservancy works in all 50 United States and 27 countries, and working with public and private partners, has protected more than 117 million acres of land and 5,000 miles of river around the world. The Nature Conservancy has about 1 million members and supporters, including more than 1,500 dedicated volunteers. The Nature Conservancy has 3,200 employees, 720 of whom are scientists. The Nature Conservancy has had a Lower Roanoke River Conservation Project since 1981.

The Nature Conservancy envisions that the Lower Roanoke River will be managed so that conservation of natural resources and native ecosystems, recreation, flood control, economic development, and hydropower production are balanced in ecologically and economically sustainable ways.

For more information on the Roanoke River project of The Nature Conservancy, contact:

Sam Pearsall Roanoke River Project Director and NC Science Director	Phone: (919) 403-8558 Email: sampearsall@tnc.org	http://nature.org

Current and continuing projects on the Roanoke River:

- Comprehensive conservation planning for the entire river valley below Roanoke Rapids Dam.
- Land protection and conservation – working closely with US Fish and Wildlife Service, NC Wildlife Resources Commission, and many other partners, by late 2005 we have helped to protect about 61,000 acres in the floodplain.
- Participation in the development of the settlement and final license for Dominion Resources at Lake Gaston and Roanoke Rapids and continuing active participation in the Cooperative Management Team for adaptive management of river flows.
- Active participation in the USACE Section 216 Study, with the goal of establishing modified flows to better support downstream ecosystems while stabilizing lake levels upstream.
- Support for the development of the Roanoke River paddle trail and other support for the development of ecotourism in the project area.

Piedmont Land Conservancy
Office Location: Greensboro, North Carolina

Piedmont Land Conservancy is a non-profit, grassroots land trust in nine North Carolina Counties: Alamance, Caswell, Forsyth, Guilford, Randolph, Rockingham, Stokes, Surry, and Yadkin. Their mission is to protect natural and scenic lands, farms, and open space in piedmont North Carolina to enrich the quality of life for our communities and for future generations. PLC serves as the only local land trust serving the Piedmont Triad region of North Carolina. PLC has protected more than 11,000 acres of land including farmland, parks, forestland, wetlands, rivers, gardens, greenways, and historical areas that provide multiple benefits such as wildlife habitat, water quality protection, recreational areas, and outdoor education to the current generation as well as future generations.

For more information contact:

Charles Brummitt	Phone: (336) 691-0088
Executive Director	email: info@piedmontland.org
	http:// www.piedmontland.org

Dan River Basin Association (DRBA)
Office Location: Madison, North Carolina and Martinsville, Virginia

A nonprofit association dedicated to maintaining and improving the water quality of the Dan River and its watershed in both North Carolina and Virginia. DRBA focuses on river access, citizen watershed awareness and river recreation. DRBA conducts a variety of voluntary initiatives including educational programs, riparian greenways, river history, StreamWatch monitoring, river clean-up work sessions, and guided outings. DRBA is funded by contributions from members, grants and donations. DRBA is guided by a Board of directors with representatives from across the watershed, local agencies as well as many volunteers from a variety of backgrounds and expertise. DRBA and its partner organizations have collaborated on several successful grant applications, providing funding for programs, a museum exhibit, a working recreation of an 18th century river bateau and for watershed projects in the fifteen counties of the Dan River Basin. DRBA has just received a major grant to hire a Program Director for activities in Virginia. We hope to be hiring staff to work on the North Carolina portion of the watershed soon. For more information, contact:

Ken Bridle	Office Phone: (336) 591-5882	www.danriver.org
DRBA Stewardship Chair	Cell Phone: (336) 207-5348	
	Email: bridle@mindspring.com	

Current and Continuing Projects:

- Our core belief is that citizens will protect the water resources what they understand and value. To foster this understanding we organize an outing on or around the river the first Saturday of each month. These activities are free and available to all interested.
- Educational activities related to watershed awareness and water quality. We regularly have a display and information at several local festivals and participated in the establishment of a River Festival in Eden, NC.
- We publish a monthly newsletter and distribute newspaper inserts and press releases related to the Dan River watershed and water quality issues throughout the watershed.
- We are actively working to integrate the parts of the watershed that occur across state lines. This boundary is an important regulatory, administrative and psychological barrier that divides the basin.
- We work with partner organizations to conserve riparian land, develop river walks, a historical river exhibit and canoe access sites.
- We were instrumental in the establishment of the new Mayo River State Park and conducted the land use study that guides the acquisition of land for this new park.
- DRBA is the designated StreamWatch coordinator for the basin and is actively recruiting and training StreamWatch volunteers to monitor their local waters.

20.2 Federal Initiatives

20.2.1 Clean Water Act – Section 319 Program

Section 319 of the Clean Water Act provides grant money for nonpoint source demonstration and restoration projects. Approximately $1 million is available annually through base funding for demonstration and education projects across the state. An additional $2 million is available annually through incremental funding for restoration projects on impaired waters. All projects must provide non-federal matching funds of at least 40 percent of the project's total costs. Project proposals are reviewed and selected by the North Carolina Nonpoint Source Workgroup, made up of state and federal agencies involved in regulation or research associated with nonpoint source pollution. Information on the North Carolina Section 319 Grant Program application process is available online at http://h2o.enr.state.nc.us/nps/application_process.htm.

There is one current project in the Roanoke River basin that has been funded through the Section 319 Program between 1999 and 2004. The project, 'Watershed Quality Improvement and Restoration Demonstration', is located in Warren County. This project was funded in fiscal year 1999 to the NC Division of Soil and Water Conservation for funding BMPs that will reduce sediment delivery to impaired waters. The BMPs are also designed to improve stream bank stability and prevent the off-site movement of pesticides, phosphorus, nitrogen, and fecal coliform.

Descriptions of projects and general Section 319 Program information are available at http://h2o.enr.state.nc.us/nps/Section_319_Grant_Program.htm.

20.2.2 National Estuary Program

Congress established the National Estuary Program and the Albemarle and Pamlico Sounds as an "Estuary of National Significance" in 1987. Section 320 of the Clean Water Act directs EPA to develop plans for attaining or maintaining water quality in the estuaries of national importance. This includes protection of public water supplies and the protection and propagation of a balanced, indigenous population of shellfish, fish, and wildlife, and allows recreational activities, in and on water, requires that control of point and nonpoint sources of pollution to supplement existing controls of pollution.

Today, Albemarle-Pamlico National Estuary Program (APNEP) is implementing a Comprehensive Conservation and Management Plan (CCMP) that was developed by numerous stakeholders to meet the goals of Section 320. The CCMP was ratified by the NC Governor and accepted by the US EPA in 1994. Additional information is available online at http://www.apnep.org

20.2.3 National Wildlife Refuge System

The Roanoke River National Wildlife Refuge (Refuge) is one of more than 540 National Wildlife Refuges found in the United States and its territories. The Refuge was established August 10, 1989 to protect and enhance wooded wetlands consisting of bottomland hardwoods and swamps with high waterfowl value along the Roanoke River. Administered by the U.S. Fish and Wildlife Service, management emphasis is placed on federal trust species such as migratory birds, migratory fish and federally listed endangered and threatened species and their habitats. Presently, the Refuge consists of 20,978 acres. Refuge lands are located in Bertie County and begin in the vicinity of Hamilton, NC and extend to the mouth of the river in five separate tracts of land.

The Refuge staff has been involved with projects and activities designed to protect, conserve and restore the integrity of the plant, fish and wildlife communities found within the coastal plain reach of the Roanoke River Basin. Some of the studies and monitoring activities being carried out on refuge lands include: annual avian point surveys, monitoring wood duck productivity via wood duck boxes, wood duck banding, water quality monitoring, forest regeneration studies, forest health studies, Swainson's warbler productivity study and when warranted anadromous fish surveys.

A fifteen year Comprehensive Conservation Plan and Environmental Impact Statement has been completed for the Refuge and can be found online at: http://www.fws.gov/southeast/planning/FinalDocs.htm. The plan outlines management programs and activities for the Refuge for the next fifteen years.

20.3 State Initiatives

20.3.1 Coastal Habitat Protection Plan

Recognizing the need to both protect habitat and prevent over fishing, the North Carolina General Assembly passed the Fisheries Reform Act in 1997. The law contains the directive to protect and enhance habitats supporting coastal fisheries. The law requires cooperation among three rule-making commissions: Environmental Management Commission (EMC), Coastal Resources Commission (CRC), and Marine Fisheries Commission (MFC). Because the commissions must work together to develop, adopt, and implement plans to protect and restore fisheries habitats, the Coastal Habitat Protection Plan (CHPP) was developed by the Division of Marine Fisheries and adopted in early 2005. The Coastal Habitat Protection Plan was developed to:

1. document the ecological role and function of aquatic habitats for coastal fisheries;
2. provide status and trends information on the quality and quantity of coastal fish habitat.
3. describe and document threats to coastal fish habitat, including threats from both human activities and natural events;
4. describe the current rules concerning each habitat;
5. identify management needs; and
6. develop options for management action using the above information.

For more information regarding the CHPPs document visit:
http://www.ncfisheries.net/habitat/index.html

20.3.2 North Carolina Ecosystem Enhancement Program

The North Carolina Ecosystem Enhancement Program (NCEEP) is a nonregulatory program responsible for implementing wetland and stream restoration projects as part of a statewide effort to provide more ecologically effective compensatory mitigation. The focus of the program is to restore, enhance and protect key watershed functions in the 17 river basins across the state through the implementation of wetlands, streams and riparian buffer projects within selected local watersheds *in advance of permitted impacts*. These vital watershed functions include water quality protection, floodwater conveyance & storage, fisheries & wildlife habitat, and recreational opportunities. The NCEEP is not a grant program. Instead, the program funds local mitigation projects directly through its various in-lieu fee receipts.

Through the development of ***River Basin Restoration Priorities*** (formerly called Watershed Restoration Plans), the NCEEP identifies local watersheds (14-digit Hydrologic Units) with the greatest need & opportunity for watershed mitigation projects. The *RBRP*s are developed, in part, using information compiled in DWQ's Basinwide Water Quality Plans and Basinwide Assessment Reports. Additional local resource data and locations of existing or planned watershed projects are considered in the selection of "Targeted Local Watersheds", which are identified and mapped within the *RBRP*s. ***Targeted Local Watersheds*** represent those areas within a given river basin where NCEEP resources can be most efficiently focused for maximum benefit to local watershed functions. The NCEEP *River Basin Restoration Priorities* are periodically updated and presented on the NCEEP website: http://www.nceep.net.

The NCEEP can perform restoration projects cooperatively with other state or federal programs or environmental groups. For example, the NCEEP's efforts can complement projects funded through the Section 319 Program. Integrating wetlands or riparian area restoration components with Section 319-funded or proposed projects will often improve the overall water quality, hydrologic and habitat benefits of the project.

The NCEEP is also working to develop comprehensive **Local Watershed Plans**, often within Targeted Local Watersheds identified in the *River Basin Restoration Priorities*. Through the Local Watershed Planning process, EEP conducts comprehensive watershed assessments to identify causes and sources of major functional problems in local watersheds, and then coordinates with local resource professionals and local governments to identify & implement watershed projects and management strategies designed to address these problems. NCEEP Local Watershed Plans identify and prioritize wetland areas, stream reaches, riparian buffer areas and best management practices that will provide water quality improvement, habitat protection and other environmental benefits to the local watershed. There are currently no active local watershed planning efforts in the Roanoke River basin.

EEP has also acquired several preservation tracts and is in the process implementing four restoration projects in the Roanoke basin. A substantial amount of wetland and stream preservation was obtained through EEP's High Quality Preservation initiative that took place during the program's transition period.

For more information about the NCEEP and its Watershed Restoration Plans, visit the NCEEP website at http://www.nceep.net/.

20.3.3 Clean Water Management Trust Fund

The CWMTF 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 Roanoke River basin, 22 projects have been funded for a total of $13,553,100 (Table 22) for 1997A-2005A. For more information on the CWMTF or these grants, call (252) 830-3222 or visit the website at www.cwmtf.net.

Table 22 - Projects in the Roanoke River Basin Funded by the Clean Water Management Trust Fund (as of August 2005)

Project Number	Application Name	Proposed Project Description	Amount Funded	CWMTF Region	Subbasin
1997B-515	Stovall- Wastewater Collection System and Land Application	Construct wastewater collection & treatment system, will consist of pressure sewer collection system with spray irrigation treatment plant.	$800,000	Eastern Piedmont/Central Coastal Plain	03-02-06
1998A-501	Stoneville- WWTP Elimination and Regionalization/Mayo River	Install pumping station to reroute wastewater from Town of Stoneville's WWTP to Town of Mayodan's facility. Decommission Stoneville WWTP.	$643,000	Western Piedmont	03-02-02
1998B-009	Piedmont Land Conservancy- Acq/ Dan River Bends	Acquire through fee simple 393 ac along Dan River; includes additional permanent easements along 1.8 miles of the Dan River.	$642,000	Western Piedmont	03-02-01
1998B-704	Plymouth- Constructed Wetlands/ Roanoke River	Construct 2 stormwater wetlands to treat runoff from 57 ac of heavily developed land. Develop urban greenway and berm/buffer system along 1200 ft on the Water Front Alley which would vary from 50 to 100 ft. Berm to route runoff to wetlands.	$835,000	Eastern Piedmont/Central Coastal Plain	03-02-09
2000A-011	NC Wildlife Resources Commission - Pollocks Ferry Acq/ Roanoke R	Acquire through fee simple 2,588 ac along the Roanoke River and Conocannara Swamp; acquire 1136 acres of riparian buffers.	$1,650,000	Eastern Piedmont/Central Coastal Plain	03-02-08
2000B-016	Piedmont Land Conservancy- Dan River Acq	Acquire 18.8 ac tract under conservation easement and reforest.	$75,100	Western Piedmont	03-02-01
2000B-409	Roanoke Rs- Restoration Design & Restoration/Roanoke River Tributary	Design/construct natural channel stream restoration project along 1,400 feet of Lions Watch Ck.	$617,000	Eastern Piedmont/Central Coastal Plain	03-02-08

2000B-601	Askewville- Sewage Collection System Construction	Design/construct sewer collection system for 120 units (failing septic systems of straight pipes). Convey collected wastewater to Windsor's permitted WWTP.	$705,000	Eastern Piedmont/Central Coastal Plain	03-02-10
2000M-002	Piedmont Land Conservancy- Moretz Acq Minigrant	Minigrant for preacquisition costs for 18.8 acres.	$25,000	Western Piedmont	03-02-01
2001A-512	Roxboro- Infiltration and Inflow & Sewer Line Upgrade	Replace 6,700 LF of gravity sewer to eliminate infiltration/ inflow along Marlowe Creek and develop/adopt ordinance(s) to nonpoint source pollution, and buffer protection.	$708,000	Eastern Piedmont/Central Coastal Plain	03-02-05
2001B-037	NC Wildlife Resources Commission - Acquisition/ Johnson Tract/ Caswell Gamelands/ South Country Line Creek	Acquire through fee simple 71 acres along South Country Creek.	$57,000	Eastern Piedmont/Central Coastal Plain	03-02-04
2001B-703	Gaston - Stormwater Design/ Lee Creek	Provide funds to design settling ponds and covered drain culverts to reduce erosion and stormwater runoff into Lee Creek.	$20,000	Eastern Piedmont/Central Coastal Plain	03-02-08
2002A-801	Concerned Citizens of Tillery - Landowner Outreach/ Roanoke R.	Conduct a planning project to identify appropriate lands for protection along Conconnara Swamp.	$42,000	Eastern Piedmont/Central Coastal Plain	03-02-08
2002B-803	Piedmont Land Conservancy- Planning/Upper Dan R.	Establish sediment monitoring stations on 30 sites in portions of the Dan River drainage; protect 285 riparian areas along tribs through donated easements. Develop a watershed plan.	$160,000	Western Piedmont	03-02-01
2003A-604	NCSU - Septic Tanks/ Sertoma 4-H Center, Vade Mecum Creek	Design, permit and construct on-site wastewater treatment and disposal system to replace failing system. Includes donated easement on 142 riparian acres.	$232,000	Western Piedmont	03-02-01
2003M-003	Piedmont Land Conservancy- Minigrant - Len's Knob	Minigrant to pay for transactional costs for fee simple of 2240 acres in Surry County on the Upper Mitchell River.	$25,000	Western Piedmont	03-02-01
2004B-042	NC Widlife Resources Commission-Acq/ Cashie River Tracts	Protect through fee simple 1,475 floodplain acres along the Cashie River.	$440,000	Eastern Piedmont/Central Coastal Plain	03-02-10

Table 22 continued

2004B-044	NC Wildlife Resources Commission-Acq/ Hodges/Barker Tract, Country Line Creek	Protect through fee simple 255 acres along Country Line Creek. CWMTF funds to purchase the riparian 95 acres.	$193,000	Eastern Piedmont/Central Coastal Plain	03-02-04
2004B-507	Halifax, Town of - WW/ Regionalization, Collection Rehabilitation, Quankey Creek	Decommission Town's WWTP and eliminate 50,000 gpd discharge to Quankey Creek. Waste routed to Town of Weldon's WWTP. Project includes replacement or repair of 18,609 LF of collection lines and rehabilitation of a pump station.	$2,297,000	Eastern Piedmont/Central Coastal Plain	03-02-08
2004B-512	Littleton, Town of - WW/ Collection System and Pump Station Rehabilitation, Little Stonehouse Creek	Rehabilitate Littleton's existing wastewater collection system (34,000 LF), replace 1,500 LF, repair 118 manholes, and construct 2 new pump stations. Will reduce contamination of Little Stone House Creek, Lake Gaston, Butterwood Br and Little Fishing Ck.	$2,738,000	Eastern Piedmont/Central Coastal Plain	03-02-07
2005A-004	Fishing Creek SWC District - Acq/ Iles Farm, Roanoke Rapids Lake	Protect through working forest easement a 183-acre dairy farm on tributaries to Roanoke Rapids Lake. CWMTF funds to purchase easement on 71 riparian acres. The USDA Farmland and Ranchland Preservation Program to provide matching funds.	$208,000	Eastern Piedmont/Central Coastal Plain	03-02-07
2005A-027	Piedmont Land Conservancy - Acq/ Berry Tract, Hyco Lake	Protect 321 acres, including 168 riparian acres, along Hyco Lake and tributaries through purchase of a conservation easement.	$441,000	Eastern Piedmont/Central Coastal Plain	03-02-05

Notes:

(1) The total funded amount excludes funded projects that were subsequently withdrawn by the applicant.

(2) Two regional and statewide projects were funded in areas that include the Roanoke Basin. These projects include riparian corridor planning and implementation activities and a freshwater mussel relocation program..

20.3.4 NC Construction Grants and Loans Programs

The NC Construction Grants and Loans Section provides grants and loans to local government agencies for the construction, upgrades and expansion of wastewater collection and treatment systems. As a financial resource, the section administers five major programs that assist local governments. Of these, two are federally funded programs administered by the state, the Clean Water State Revolving Fund (SRF) Program and the State and Tribal Assistance Grants (STAG). The STAG is a direct congressional appropriations for a specific "special needs" project within NC. The High Unit Cost Grant (SRG) Program, the State Emergency Loan (SEL) Program and the State Revolving Loan (SRL) Program are state funded programs, with the later two being below market revolving loan money. In the Roanoke River basin, 9 applicants received a total of $29,478,672 in grants and loans from these programs (Table 23).

As a technical resource, the Construction Grants and Loan Section, in conjunction with the Environmental Protection Agency, has initiated the Municipal Compliance Initiative Program. It is a free technical assistance program to identify wastewater treatment facilities that are declining but not yet out of compliance. A team of engineers, operations experts and managers from the section work with local officials to analyze the facility's design and operation. For more information, visit the website at http://www.nccgl.net/. You may also call (919)-715-6212 or email Bobby.Blowe@ncmail.net.

Table 23 - NC Construction Grants and Loans Programs disseminated within the Roanoke River Basin

Program	Applicant	Project #	Offer Date	Project Description	Loan/Grant Offered ($)
SRF[1]	Henderson	CS370410-04	6/19/92	WWTP improvements, including phosphorus removal	2,500,000
SRF[1]	Williamston	CS370435-04	8/5/99	Upgrade and expansion to 2.4 MGD	7,000,000
SRF[1]	Mayodan	CS370466-04	11/19/02	Mayodan expansion 3.0 to 4.5 MGD, Regional facility for Madison and Stoneville	5,500,000
SRF[1]	Plymouth	CS370500-04	5/6/98	WWTP upgrades	1,968,500
SRF[1]	Rockingham County	CS370793-01	10/20/98	Construction of gravity sewer, force mains and pumping stations	4,302,532
SRF[1]	Stokes County	CS370813-01	8/3/94	New package WWTP and collection system	1,200,000
STAG[2]	Henderson	XP-97440302	5/18/04	Sewer extension to the Mills River area	2,884,700
SEL[3]	Roxboro	E-SEL-T-00-0033	5/23/01	Sewer rehabilitation	400,000
SRL[4]	Rich Square	E-SRL-T-95-0030	1/18/96	WWTP improvements	500,000
SRG[5]	Granville County	E-SRG-T-00-0103	3/6/02	New Sewer to Stovall	223,000
SRG[5]	Rich Square	E-SRG-T-02-0126	4/14/04	Sewer rehabilitation and spray irrigation system	2,999,940

1 - SRF – Clean Water State Revolving Fund (SRF) Program
2 - STAG – State and Tribal Assistance Grants
3 - SEL – State Emergency Loan Program
4 - SRL – State Revolving Loan Program
5 - SRG – High Unit Cost Grant Program

20.3.5 Clean Water Bonds – NC Rural Center

Outdated wastewater collection systems, some more than 70 years old, allow millions of gallons of untreated or partially treated wastewater to spill into the state's rivers and streams. The NC Rural Economic Development Center, Inc. (Rural Center) has taken the lead role in designing public policy initiatives to assist rural communities in developing and expanding local water and sewer infrastructure. The Rural Center is a private, nonprofit organization. The Rural Center's mission is to develop sound, economic strategies that improve the quality of life in North Carolina, while focusing on people with low to moderate incomes and communities with limited resources.

To support local economic development and ensure a reliable supply of clean water, the Rural Center administers three Water and Sewer Grant Programs to help rural communities develop water and sewer systems. The *Supplemental Grants Program* allows local governments and qualified nonprofit corporations to improve local water and sewer systems by addressing critical needs for public health, environmental protection and/or economic development. The maximum grant amount is $400,000 and must be used to match other project funds. The *Capacity Building Grants Program* provides funding for local governments to undertake planning efforts to support strategic investment in water and sewer facilities. Projects typically include preliminary engineering reports, master water/sewer plans, capital improvement plans, feasibility studies, and rate studies. The maximum grant amount is $400,000. The *Unsewered Communities Grants Program* funds the planning and construction of new central, publicly owned sewer systems. This grant is designed to cover 90 percent of the total cost of a project, not to exceed $3 million. Qualifying communities for this program must not be served by an existing wastewater collection or treatment system. For each grant program, priority is given to projects from economically distressed counties of the state as determined by the NC Department of Commerce (www.nccommerce.com).

The water and sewer grants listed above are made possible through appropriations from the NC General Assembly and through proceeds from the Clean Water Bonds. In 1998, North Carolina voters approved an $800 million clean water bond referendum that provided $330 million to state grants to help local governments repair and improve water supply systems and wastewater collection and treatment. The grants also address water conservation and water reuse projects. Another $300 million was made available as clean water loans.

Since the program's beginning, the Rural Center has awarded nearly 500 communities and counties more than $64 million to plan, install, expand, and improve their water and sewer systems. As a result, these communities have served new residential and business customers, created and preserved thousands of jobs, and leveraged millions of dollars in other water and sewer funds. Table 24 lists the grants that were awarded in the Roanoke River Basin between 1999 and 2005. For more information on the Water and Sewer Grants administered by the Rural Center visit www.ncruralcenter.org/grants/water.htm.

20.3.6 Virginia Roanoke River Basin Advisory Committee (VRRBAC) and the Roanoke River Basin Bi-State Commission

The Virginia Roanoke River Basin Advisory Committee (VRRBAC) was established in the executive branch of state government as an advisory committee to the Virginia delegation to the Roanoke River Basin Bi-State Commission. The Roanoke River Basin Bi-State Commission was established and composed of members from the Commonwealth of Virginia and the State of North Carolina. The purpose of the Commission in short is to safeguard the Roanoke River Basin's natural resources for the citizens of the Roanoke River Basin. This duty includes providing guidance, making recommendations, identifying problems, disseminating information, and promoting communication, coordination, and education among stakeholders. NC has passed similar legislation. The advisory committees of both States assist the Roanoke River Basin Bi-State Commission fulfilling its responsibility.

Table 24 - Clean Water Bonds Awarded in the Roanoke River Basin

County	Recipient	Grant Amount	Grant Type	Year Awarded
Halifax	Roanoke Rapids Sanitary Dis.	$40,000	Capacity	August 2004
Rockingham	City of Eden	$40,000	Capacity	February 2004
Bertie	Town of Kelford	$31,000	Capacity	August 2002
Halifax	Town of Halifax	$40,000	Capacity	August 2002
Rockingham	City of Eden	$40,000	Capacity	August 2002
Martin	Town of Williamston	$40,000	Capacity	March 2002
Rockingham	City of Eden	$40,000	Capacity	March 2002
Bertie	Town of Windsor	$40,000	Capacity	August 2001
Caswell	Town of Yanceyville	$21,000	Capacity	August 2001
Rockingham	Town of Stoneville	$40,000	Capacity	August 2001
Washington	Town of Plymouth	$40,000	Capacity	February 2001
Bertie	Town of Askewville	$36,400	Capacity	December 1999
Rockingham	Town of Mayodan	$20,000	Capacity	December 1999
Bertie	Town of Windsor	$400,000	Supplemental	February 2004
Halifax	Town of Weldon	$400,000	Supplemental	February 2004
Granville	Town of Stovall	$400,000	Supplemental	June 2003
Martin	Town of Jamesville	$200,000	Supplemental	August 2001
Rockingham	Town of Madison	$400,000	Supplemental	August 2001
Washington	Town of Plymouth	$400,000	Supplemental	February 2001
Martin	Hamilton	$198,560	Supplemental	August 2000
Halifax	Roanoke Rapids	$150,000	Supplemental	April 2000
Caswell	Yanceyville	$200,000	Supplemental	February 2000
Rockingham	Mayodan	$200,000	Supplemental	February 2000
Bertie	Town of Windsor	$185,396	Supplemental	December 1999
Halifax	Town of Halifax	$64,135	Supplemental	December 1999
Bertie	Askewville	$2,739,500	Unsewered	August 2000
Caswell	Milton	$1,307,000	Unsewered	August 2000

A goal of VRRBAC is to open channels of communication. The Committee meets throughout the Roanoke basin in an effort to be available to all basin constituents. It is important that dialogue take place, which is representative of all areas of the basin. There must be rural and urban cooperation on water issues. Speakers representing various groups, State Agencies, Local Governments, different geographic areas, and interests have addressed VRRBAC. Localities and State entities have provided meeting facilities for the meetings. Such participation demonstrates that VRRBAC has strong partnerships in the region, which helps in carrying out the work of the Committee. Broad public support of policy and regional consensus is the best way to bring about positive change associated with environmental and related health issues. Better efficiency of protection efforts will result as all partners, public, private, federal, state, and local officials, can share and leverage resources. Such coordination and consensus building in the entire basin on watershed management issues is essential to sound watershed decision making and management. Sub-committees have been given direction to promote such an effort using broad-based input consolidated from as many interested parties as possible.

The sub-committees formed are Agriculture and Forestry, Lake Interests, Municipal Interests and Permit Holders, River Interests, and Water. The sub-committees are to prepare position papers on important issues and bring them back to the full Committee for adoption. An effort is being made to bring the most knowledgeable people possible to the table, where the work must take place. The objective is to obtain membership that will represent stakeholders throughout the basin and maintain a geographical and urban/rural balance.

Since the inaugural meeting of VRRBAC certain characteristics and issues of the basin have become evident. The importance of natural resources to the economic vitality of the Basin is apparent. People reside in and come to the Roanoke River Basin area to pursue various interests including vacation, lifestyle, esthetics, boating, fishing, etc. These activities and personal values help drive the economic engine of the local and regional area. In addition, agriculture is vital to the region's lifestyle and economy. Clean water and ample flow and supply are recognized as essential to existing beneficial uses and future economic development. There are interrelationships within the basin involving flow, as events in one section of the basin can impact other parts. Environmental, ecosystem, human health, power generation, aquatic life, and economic needs of the basin must be balanced. The generally good water quality of the Roanoke basin is valued and must be preserved. Issues and topics which are crucial to the well-being of the basin people include 1.) inter-basin transfer of water, 2.) water withdrawals, 3.) regulation of flow and storage, 4.) invasive species, 5.) recreation and fishing, 6.) water quality and 7.) lake vitality.

VRRBAC has adopted several positions regarding the Basin's natural resources. It supports the implementation of BMPs and other strategies such as Low Impact Development (LID) and Nutrient Management Plans to correct pollution problems. VRRBAC favored the development of a Virginia State-wide Water Policy, but only one that mandated local stakeholder input and was against the inter-basin transfer of water that is detrimental to the people of the basin. VRRBAC is opposed to any new water withdrawal until such time that the real and potential needs for the foreseeable future are determined. For more information please see the VRRBAC website. http://www.deq.virginia.gov/vrrbac/

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Appendix I

Population and Growth Trends
in the
Roanoke River Basin

Population and Growth Trends

Below are three different ways of presenting population data for the Roanoke River basin. Population data presented by county allow for analysis of projected growth trends in the basin based on Office of State Planning information (April and May 2001). Data presented by municipality summarizes information on past growth of large urban areas in the basin. The data presented by subbasin allow for 2000 population data to be presented by subbasin. While the three different sets of information cannot be directly compared, general conclusions are apparent by looking at the information. Counties with the highest expected growth are associated with the largest municipal areas and the most densely populated subbasins in the basin.

County Population and Growth Trends

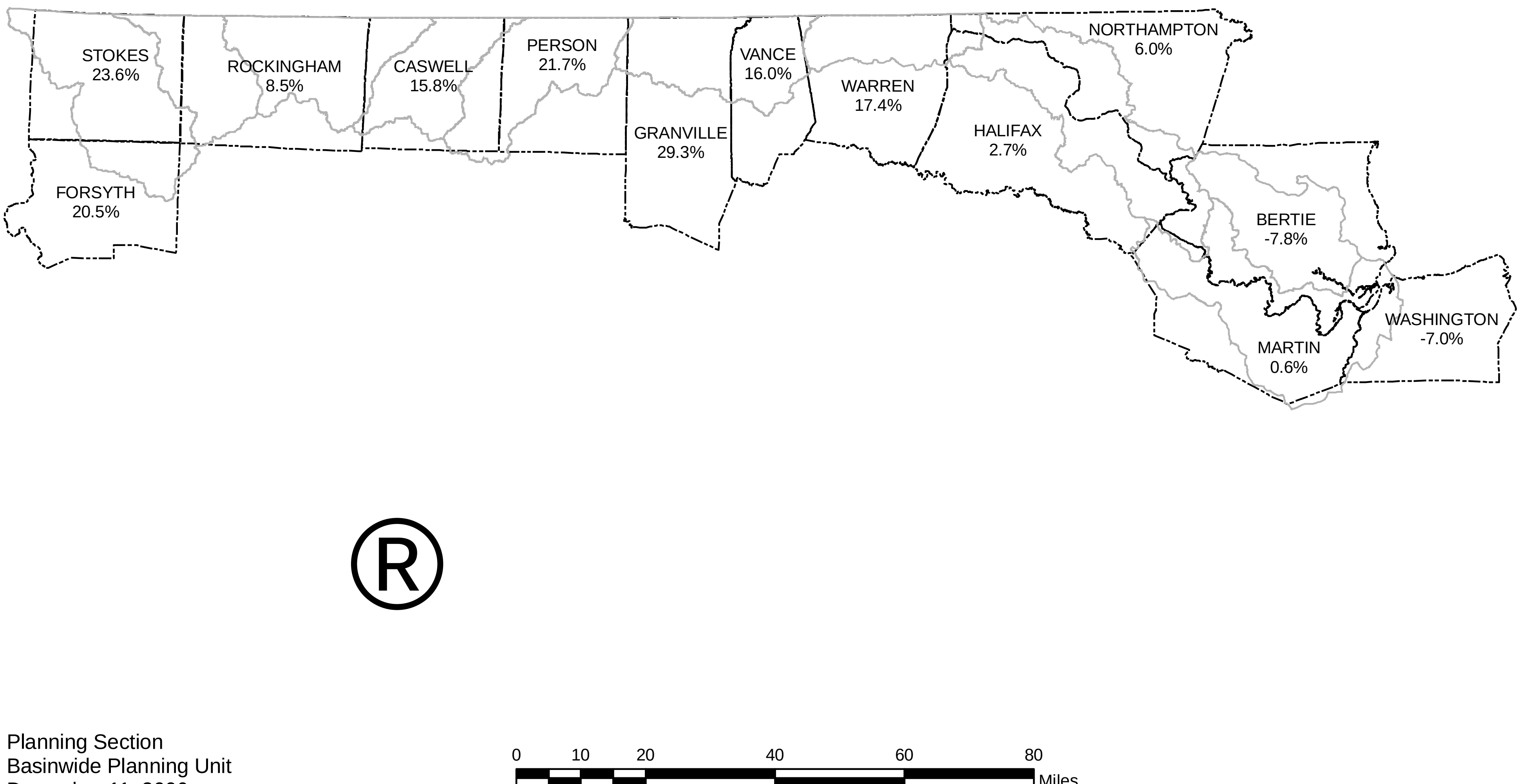
The following Table and map show the projected population for 2020 and the change in growth between 1990 and 2020 for counties that are wholly or partly contained within the basin. Since river basin boundaries do not coincide with county boundaries, these numbers are not directly applicable to the Roanoke River basin. This information is intended to present an estimate of expected population growth in counties that have some land area in the Roanoke River basin. For more information on past, current and projected population estimates, contact the Office of State Planning at (919) 733-4131 or visit their website at http://demog.state.nc.us/.

County	Percent of County in Basin ♦	1990 Population	2000 Population	Estimated % Growth 1990-2000	Estimated Population 2020	Estimated % Growth 2000-2020
Bertie	70	20,388	19,773	-3.1	18,347	-7.8
Caswell	90	20,662	23,501	12.1	27,918	15.8
Forsyth	21	265,855	306,067	13.1	385,079	20.5
Granville	33	38,341	48,498	20.9	68,600	29.3
Halifax	40	55,516	57,370	3.2	58,988	2.7
Martin	75	25,078	25,593	2.0	25,736	0.6
Northampton	35	21,004	22,086	4.9	23,507	6.0
Orange	2	93,662	118,227	20.8	166,971	29.2
Person	60	30,180	35,623	15.3	45,510	21.7
Rockingham	81	86,064	91,928	6.4	100,414	8.5
Stokes	85	37,224	44,711	16.7	58,515	23.6
Surry	3	61,704	71,219	13.4	88,596	19.6
Vance	52	38,892	42,954	9.5	51,151	16.0
Warren	38	17,265	19,972	13.6	24,183	17.4
Washington	13	13,997	13,723	-2.0	12,823	-7.0
Subtotals		825,832	941,245	12.3	1,156,338	18.6

♦ Source: North Carolina Center for Geographic Information and Analysis (CGIA), 1997.

Note: The numbers reported reflect county population; however, these counties are not entirely within the basin. The intent is to demonstrate growth for counties located wholly or partially within the basin.

Projected Population Growth (2000-2020) by County for the Roanoke River Basin in North Carolina



Planning Section
Basinwide Planning Unit
December 11, 2006

Municipal Population and Growth Trends

The Table below presents population data from Office of State Planning for municipalities with populations greater than 2,000 persons, located wholly or partly within the basin. These data represent 17 of the 42 municipalities in the basin.

Municipality	County	1980 Population	1990 Population	2000 Population	Percent Change (1980-90)	Percent Change (1990-2000)
Eden	Rockingham	15,672	15,238	15,908	-2.8	4.4
Henderson ●	Vance	13,522	15,655	16,095	15.8	2.8
Kernersville ●	Forsyth, Guilford	5,875	10,899	17,126	85.5	57.1
Madison	Rockingham	2,806	2,371	2,262	-15.5	-4.6
Mayodan	Rockingham	2,627	2,471	2,417	-5.9	-2.2
Plymouth	Washington	4,571	4,328	4,107	-5.3	-5.1
Reidsville ●	Rockingham	12,492	12,183	14,485	-2.5	18.9
Roanoke Rapids	Halifax	14,702	15,722	16,957	6.9	7.9
Roxboro ●	Person	7,532	7,332	8,696	-2.7	18.6
Rural Hall ●	Forsyth	1,336	1,652	2,464	23.7	49.2
Scotland Neck ●	Halifax	2,834	2,575	2,362	-9.1	-8.3
Stokesdale ●	Guilford	1,973	2,134	3,267	8.2	53.1
Walkertown ●	Forsyth	1,321	1,200	4,009	-9.2	234.1
Wentworth	Rockingham	----	1,989	2,779	----	39.7
Williamston	Martin	6,159	5,503	5,843	-10.7	6.2
Windsor	Bertie	2,126	2,209	2,283	3.9	3.3
Yanceyville	Caswell	1,869	1,973	2,091	5.6	6.0

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

Basin Population and Population Density

Information on population density at a watershed scale is useful in determining what streams are likely to have the most impacts as a result of population growth. This information is also useful in identifying stream segments that have good opportunities for preservation or restoration. This information is presented to estimate population and population density by each subbasin and for the entire basin. It is assumed that county populations are distributed evenly throughout each county; therefore, subbasins that are within counties with large urban areas may overestimate the actual population in that portion of the basin. The overall population of the basin based on 2000 Census data is 344,638 with approximately 98 persons/square mile. Population density estimated by subbasin is presented in the following map.

Appendix II

Local Governments and Planning Jurisdictions in the Roanoke River Basin

The Roanoke River basin encompasses all or portions of 15 counties and 42 municipalities. The following Table provides a listing of these local governments, along with the regional planning jurisdiction (Council of Governments). There are 17 municipalities located in more than one major river basin.

County	Region	Municipalities
Bertie	Q	Askewville, Aulander *, Kelford, Lewiston Woodville, Roxobel, Windsor
Caswell	G	Milton, Yanceyville
Forsyth	I	Kernersville * ♦, Rural Hall *, Walkertown *
Granville	K	Stovall
Guilford	G	Kernersville * ♦, Stokesdale *
Halifax	L	Halifax, Hobgood *, Littleton *, Roanoke Rapids, Scotland Neck *, Weldon
Martin	Q	Hamilton, Hassell, Jamesville, Oak City, Williamston
Northampton	L	Garysburg, Gaston *, Jackson *, Rich Square *
Orange	J	None
Person	K	Roxboro *
Rockingham	G	Eden, Madison, Mayodan, Reidsville *, Stoneville, Wentworth
Stokes	I	Danbury, Walnut Cove
Surry	I	None
Vance	K	Henderson *, Middleburg *
Warren	K	Macon *, Norlina *
Washington	R	Plymouth

G Piedmont Triad COG

I Northwest Piedmont COG

J Triangle J COG

K Kerr-Tar Regional COG

L Upper Coastal Plain COG

Q Mid-East Commission

R Albemarle Commission

* Located in more than one major river basin.

♦ Located in more than one county.

Note: Counties adjacent to and sharing a border with a river basin are not included as part of that basin if only a trace amount of the county (<2 percent) is located in that basin, unless a municipality is located in that county. (Note: Guilford County is only included because of the municipality, Kernersville.)

Appendix III

Land Cover
in the
Roanoke River Basin

Land Cover

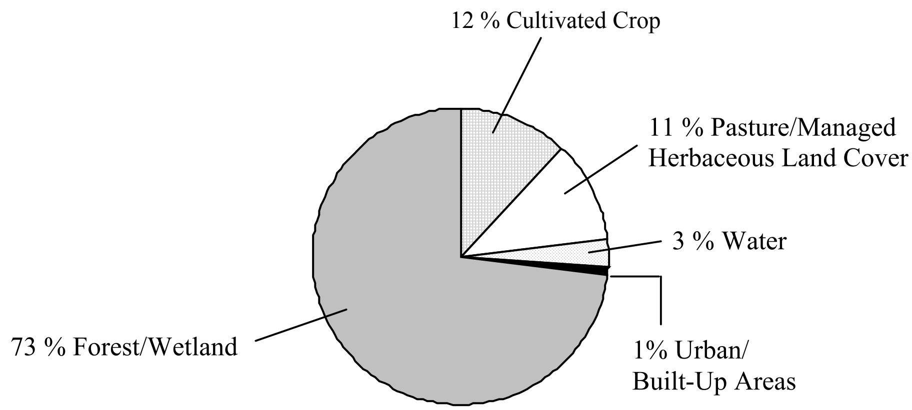
Land cover can be an important way to evaluate the effects of land use changes on water quality. Unfortunately, the tools and database to do this on a watershed scale are not yet available. The information below describes two different ways of presenting land cover in the Roanoke River basin.

Land cover information from the North Carolina Center for Geographic Information and Analysis (CGIA) is useful in providing a snapshot of land cover in the basin from 1993 to 1995. This information is also available in a GIS format so it can be manipulated to present amounts of the different land covers by subbasin or at the watershed scale. Land cover information from the National Resources Inventory (NRI) published by the Natural Resource Conservation Service (NRCS) is presented only at a larger scale (8-digit hydrologic unit), but the collection methods allow for between year comparisons. The two datasets cannot be compared to evaluate land cover data. This information is presented to provide a picture of the different land covers and some idea of change in land cover over time. In the future, it is hoped that land cover information like the GIS formatted dataset will be developed to make more meaningful assessments of the effects of land use changes on water quality. This dataset would also be useful in providing reliable and small-scale information on land cover changes that can be used in water quality monitoring, modeling and restoration efforts.

Center for Geographic Information and Analysis (CGIA) Land Cover

The North Carolina Corporate Geographic Database contains land cover information for the Roanoke River basin based on satellite imagery from 1993-1995. 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 the Table below. The following chart provides an illustration of the relative amount of land area that falls into each major cover type for the Roanoke River basin.

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



Percentages within Major Land Cover Categories in the Roanoke River Basin

National Resources Inventory (NRI) Land Cover Trends

Land cover information in this section is from the most current NRI, as developed by the NRCS (USDA-NRCS, June 2001). The NRI is a statistically based longitudinal survey that has been designed and implemented to assess conditions and trends of soil, water and related resources on the Nation's nonfederal rural lands. The NRI provides results that are nationally and temporally consistent for four points in time -- 1982, 1987, 1992 and 1997.

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

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

The following table summarizes acreage and percentage of land cover from the 1997 NRI for the major watersheds within the basin, as defined by the USGS 8-digit hydrologic units, and compares the coverages to 1982 land cover. Definitions of the different land cover types are also presented.

LAND COVER	MAJOR WATERSHED AREAS										1997 TOTALS		1982 TOTALS		% change since 1982
	Upper Dan River		Lower Dan River		Middle Roanoke River		Roanoke Rapids River		Lower Roanoke River						
	Acres (1000s)	%	Acres (1000s)	%	Acres (1000s)	%	Acres (1000s)	%	Acres (1000s)	%	Acres (1000s)	% of TOTAL	Acres (1000s)	% of TOTAL	
Cult. Crop	81.6	14.7	58.1	12.2	22.1	11.3	21.0	13.1	198.2	24.3	381.0	17.3	478.7	21.6	-20.4
Uncult. Crop	29.3	5.3	10.1	2.1	2.1	1.1	5.5	3.4	0.0	0.0	47.0	2.1	24.8	1.1	89.5
Pasture	28.5	5.1	27.8	5.8	15.0	7.7	4.9	3.1	11.6	1.4	87.8	4.0	111.8	5.0	-21.5
Forest	318.5	57.2	329.8	69.3	110.9	56.7	90.6	56.4	520.3	63.8	1370.1	62.1	1377.4	62.1	-0.5
Urban & Built-Up	55.0	9.9	18.6	3.9	8.2	4.2	14.4	9.0	33.4	4.1	129.6	5.9	54.9	2.5	136.1
Federal	0.0	0.0	0.0	0.0	14.0	7.2	0.0	0.0	6.2	0.8	20.2	0.9	14.8	0.7	36.5
Other	43.9	7.9	31.4	6.6	23.4	12.0	24.2	15.1	46.3	5.7	169.2	7.7	154.2	7.0	9.7
Totals	556.8	100.0	475.8	100.0	195.7	100.0	160.6	100.0	816.0	100.0	2204.9	100.0	2216.6	100.0	
% of Total Basin		25.3		21.6		8.9		7.3		37.0		100.0			
SUBBASINS	03-02-01 03-02-02 03-02-03		03-02-03 03-02-04 03-02-05 03-02-06		03-02-06		03-02-07 03-02-08		03-02-08 03-02-09 03-02-10						
8-Digit Hydraulic Units	03010103		03010104		03010102		03010106		03010107						

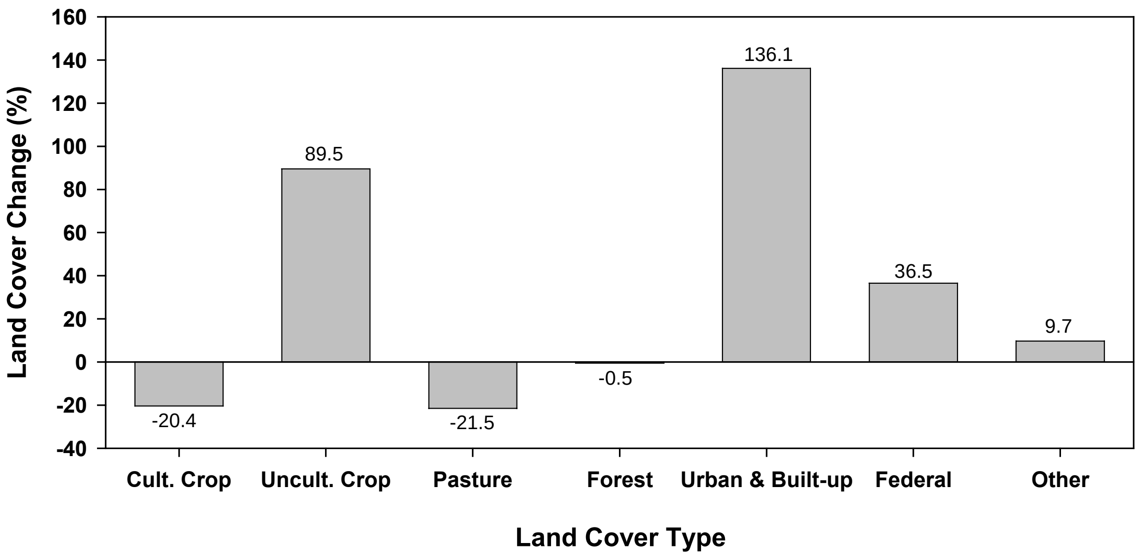
* = Watershed areas as defined by the 8-Digit Hydraulic Units do not necessarily coincide with subbasin titles used by DWQ.

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

Type	Description
Cultivated Cropland	Harvestable crops including row crops, small-grain and hay crops, nursery and orchard crops, and other specialty crops.
Uncultivated Cropland	Summer fallow or other cropland not planted.
Pastureland	Includes land that has a vegetative cover of grasses, legumes and/or forbs, regardless of whether or not it is being grazed by livestock.
Forestland	At least 10 percent stocked (a canopy cover of leaves and branches of 25 percent or greater) by single-stemmed trees of any size which will be at least 4 meters at maturity, and land bearing evidence of natural regeneration of tree cover. The minimum area for classification of forestland is 1 acre, and the area must be at least 1,000 feet wide.
Urban and Built-up Areas	Includes airports, playgrounds with permanent structures, cemeteries, public administration sites, commercial sites, railroad yards, construction sites, residences, golf courses, sanitary landfills, industrial sites, sewage treatment plants, institutional sites, water control structure spillways and parking lots. Includes highways, railroads and other transportation facilities if surrounded by other urban and built-up areas. Tracts of less than 10 acres that are completely surrounded by urban and built-up lands.
Other	*Rural Transportation*: Consists of all highways, roads, railroads and associated rights-of-way outside urban and built-up areas; private roads to farmsteads; logging roads; and other private roads (but not field lanes). *Small Water Areas*: Waterbodies less than 40 acres; streams less than 0.5 mile wide. *Census Water*: Large waterbodies consisting of lakes and estuaries greater than 40 acres and rivers greater than 0.5 mile in width. *Minor Land*: Lands that do not fall into one of the other categories.

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

Data from 1982 are also provided for a comparison of change over 15 years. During this period, urban and built-up land cover increased by 74,700 acres. Uncultivated croplands increased by 22,200 acres while cultivated cropland decreased by 97,700 acres. Forest and pastureland cover significantly decreased by 7,000 and 24,000 acres, respectively. Most land cover change is accounted for in the Lower Roanoke River hydrologic unit that includes rapidly growing areas in Warren County. Below is a graph that presents changes in land cover between 1982 and 1997.



Source: USDA-NRCS, NRI, updated June 2001

Appendix IV

DWQ Water Quality Monitoring Programs in the Roanoke River Basin

DWQ Water Quality Monitoring Programs in the Roanoke River Basin

Staff in the Environmental Sciences Branch (ESB) and Regional Offices of DWQ collect a variety of biological, chemical and physical data. The following discussion contains a brief introduction to each program, followed by a summary of water quality data in Roanoke 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 Roanoke 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.

> ***Roanoke River Basin include:***
>
> - Benthic Macroinvertebrates
> - Fish Assessments
> - Aquatic Toxicity Monitoring
> - Lake Assessment
> - Ambient Monitoring System

Benthic Macroinvertebrate Monitoring

Benthic macroinvertebrates, or benthos, are organisms that live in and on the bottom substrates of rivers and streams. These organisms are primarily aquatic insect larvae. The use of benthos data has proven to be a reliable monitoring tool, as benthic macroinvertebrates are sensitive to subtle changes in water quality. Since macroinvertebrates have life cycles of six months to over one year, the effects of short-term pollution (such as a spill) will generally not be overcome until the following generation appears. The benthic community also integrates the effects of a wide array of potential pollutant mixtures.

Criteria have been developed to assign a bioclassification to each benthic sample based on the number of different species present in the pollution intolerant groups of Ephemeroptera (Mayflies), Plecoptera (Stoneflies) and Trichoptera (Caddisflies), commonly referred to as EPTs. A Biotic Index (BI) value gives an indication of overall community pollution tolerance. Different benthic macroinvertebrate criteria have been developed for different ecoregions (mountains, piedmont, coastal plain and swamp) within North Carolina and bioclassifications fall into five categories (except for swam streams): Excellent, Good, Good-Fair, Fair and Poor.

The Biological Assessment Unit defines "swamp streams" as those streams that are within the coastal plain ecoregion and that normally have no visible flow during a part of the year. This low flow period usually occurs during the summer, but flowing water should be present in swamp streams during the winter. Sampling during winter, high flow periods provides the best opportunity for detecting differences in communities from what is natural, and only winter (February to early March) benthos data can be used when evaluating swamp streams. The swamp stream must have visible flow in this winter period, with flow comparable to a coastal plain stream that would have acceptable flow for sampling in summer. Swamp stream bioclassifications fall into three categories: Natural, Moderate and Severe.

<u>Overview of Benthic Macroinvertebrate Data</u>

Based on benthic macroinvertebrate data, water quality in the Roanoke River basin is Good near the headwaters (subbasins 01-04), while in the lower reaches (subbasins 05-10) overall water quality is generally Good-Fair. Benthic macroinvertebrate basinwide samples resulted in the following bioclassifications: Excellent-1, Good-9, Good-Fair-6, Fair-3, Natural-11, and

Moderate-6. Comparisons of benthos data from 1999 to 2004 between repeat sites reveal that Dan River at NC 704 improved from Good to Excellent, North Double Creek and Country Line Creek improved from Good-Fair to Good, Marlowes Creek improved from Fair to Good-Fair, while two swamp sites (Hoggard Mill and Conoconnara Swamp) declined from Natural to Moderate. All remaining sites maintained the same bioclassification from 1999 to 2004. Overall, water quality in this basin has improved slightly since 1999, based on benthos data.

The following table lists the bioclassifications (by subbasin) for all benthos sites in the Roanoke River basin. Benthos sampling may slightly overestimate the proportion of Fair, Poor and Severe stress sites, as DWQ special studies often have the greatest sampling intensity (number of sites/stream) in areas where it is believed that water quality problems exist.

Benthic macroinvertebrate basinwide monitoring data collected in the Roanoke River basin, 1999-2004. Current basin sites are in bold.

Subbasin/ Waterbody	Location	County	Index No.	Date	ST	EPT	BI	EPT BI	BioClass
30201									
Dan R	NC 704	Stokes	22-(1)	7/7/04	91	45	3.89	3.42	Excellent
		Stokes	22-(1)	8/23/99	85	41	4.20	3.31	Good
		Stokes	22-(1)	8/16/99	74	32	4.16	3.19	Good
Dan R	SR 1695	Stokes	22-(8)	7/7/04	87	43	4.80	4.07	Good
		Stokes	22-(8)	8/23/99	72	37	4.58	3.96	Good
N Double Cr	SR 1504	Stokes	22-10	6/28/04	31	31	--	3.42	Good
		Stokes	22-10	8/23/99	25	25	--	3.95	Good-Fair
Snow Cr	SR 1673	Stokes	22-20	7/7/04	31	31	--	4.33	Good
		Stokes	22-20	9/13/00	29	29	--	4.10	Good
		Stokes	22-20	8/23/99	18	18	--	4.37	Fair
Town Fork Cr	SR 1998	Stokes	22-25	5/18/04	87	35	4.84	3.86	Good-Fair
Town Fork Cr	SR 1961	Stokes	22-25	5/25/04	67	26	5.10	4.69	Good-Fair
Town Fork Cr	SR 1917	Stokes	22-25	5/25/04	80	35	5.30	4.84	Good
Brushy Fk	SR 1998	Stokes	22-25-1	5/18/04	86	37	5.10	4.06	Good-Fair
30202									
Mayo R	SR 1358	Rockingham	22-30-(1)	7/8/04	77	33	4.71	4.13	Good
		Rockingham	22-30-(1)	8/23/99	70	32	4.26	3.44	Good
Mayo R	SR 2177	Rockingham	22-30-(10)	8/24/99	52	21	5.23	4.26	Good-Fair
30203									
Rock House Cr	SR 2127	Rockingham	22-34-(2)	4/12/01	81	23	5.00	3.80	Good-Fair
Smith R	NC 14	Rockingham	22-40-(3)	9/13/99	51	18	5.24	3.68	Fair
30204									
Dan R	NC 57	Caswell	22-(39)	8/24/99	66	32	5.42	4.52	Good
Country Line Cr	SR 1129	Caswell	22-56-(1)	7/1/04	24	24	--	4.89	Good
Country Line Cr	NC 57	Caswell	22-56-(3.7)	7/1/04	24	24	--	4.82	Good
30205									
Marlowes Cr	SR 1351	Person	22-58-12-6	6/30/04	66	14	6.67	5.87	Fair
Marlowes Cr	SR 1322	Person	22-58-12-6	6/30/04	56	13	6.43	5.93	Good-Fair
		Person	22-58-12-6	8/25/99	53	9	6.34	5.74	Fair
30206									
Grassy Cr	SR 1436	Granville	23-2-(1)	6/30/04	13	13	--	5.05	Not Rated
Mountain Cr	SR 1300	Granville	23-2-3	7/2/04	13	13	--	5.40	Not Rated
Island Cr	SR 1445	Granville	23-4	6/29/04	17	17	--	5.48	Good-Fair
		Granville	23-4	8/24/94	17	17	--	5.11	Good-Fair
Nutbush Cr	NC 39	Vance	23-8-(1)	6/29/04	70	12	7.34	6.84	Fair
Nutbush	SR 1317	Vance	23-8-(1)	6/29/04	63	9	7.00	6.70	Fair
		Vance	23-8-(1)	8/25/99	41	8	6.73	6.76	Fair
30207									
Smith Cr	SR 1217	Warren	23-10	4/26/04	69	18	6.29	5.09	Fair
Smith Cr	SR 1208	Warren	23-10	4/26/04	87	22	6.03	4.87	Good-Fair
Smith Cr	US 1	Warren	23-10	4/26/04	50	10	6.43	5.13	Fair
Smith Cr	US 1	Warren	23-10	7/16/99	59	12	6.56	5.52	Fair
Newmans Cr	SR 1218	Warren	23-10-2	4/27/04	76	15	6.30	5.32	Fair
Sixpound Cr	SR 1306	Warren	23-13	6/29/04	62	15	6.43	5.44	Good-Fair
		Warren	23-13	7/16/99	54	14	5.50	5.05	Good-Fair

Subbasin/ Waterbody	Location	County	Index No.	Date	ST	EPT	BI	EPT BI	BioClass
30208									
Deep Cr	US 158	Halifax	23-24(1)	2/23/04	62	23	5.28	4.10	Natural
				7/15/99	58	11	6.41	5.17	Not Rated
Chockoyotte Cr	Country Club Rd	Halifax	23-29	2/23/04	52	11	6.72	5.40	Moderate
Quankey Cr	NC 903	Halifax	23-30	2/23/04	53	17	5.82	4.05	Natural
				2/16/99	40	9	6.66	5.93	Natural
Quankey Cr	NC 561	Halifax	23-30	9/1/99		9		5.51	Fair
L Quankey Cr	NC 903	Halifax	23-30-1	2/23/04	46	17	5.65	4.49	Moderate
Oconeechee Cr	SR 1126	Northhampto n	23-31	2/16/99	22	4	6.48	6.88	Natural
Conoconnara Swp	NC 561	Halifax	23-33	2/24/04	30	3	7.22	7.26	Moderate
				2/16/99	31	5	6.45	6.81	Natural
Kehukee Swp	SR 1804	Halifax	23-42	2/24/04	46	7	7.03	5.89	Moderate
				9/2/99	6	6	6.19	6.19	Not Rated
				2/11/99	59	8	7.11	6.64	Moderate
30209									
Conoho Cr	NC 11/42	Martin	23-49	2/4/04	31	4	7.64	7.10	Moderate
Conoho Cr	NC 125/903	Martin	23-49	2/1/99	29	3	7.29	7.58	
Conoho Cr	SR 1417	Martin	23-49	2/4/04	38	6	6.68	5.40	Natural
				2/1/99	39	5	6.27	4.80	
Hardison Mill Cr	SR 1528	Martin	23-50-3	2/4/04	36	2	7.49	5.20	Moderate
				2/1/99	27	3	7.29	7.67	Moderate
30210									
Cashie R	SR 1219, be WWTP	Bertie	24-2-(1)	2/23/04	29	3	7.47	7.03	Moderate
		Bertie	24-2-(1)	2/11/99	41	6	7.51	7.24	Natural
Cashie R	SR 1257	Bertie	24-2-(1)	2/24/04	35	7	6.51	4.90	Natural
	SR 1257	Bertie	24-2-(1)	2/15/99	34	7	6.80	6.09	Natural
Hoggard Mill Cr	SR 1301	Bertie	24-2-6	2/23/04	30	3	7.13	5.65	Moderate
		Bertie	24-2-6	2/15/99	46	7	6.81	6.38	Natural
Roquist Swp	US 13/17	Bertie	24-2-8	2/24/04	38	4	7.01	6.46	Natural
	US 13/17	Bertie	24-2-8	2/11/99	31	4	6.99	5.50	Natural
Wading Place Cr	NC 308	Bertie	24-2-8	3/8/99	35	3	7.31	7.45	Moderate

Assessing Benthic Macroinvertebrate Communities in Small Streams

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

DWQ will use this monitoring information to identify potential impacts to these waters even though a use support rating is not assigned. DWQ will continue to develop criteria to assess water quality in small streams.

Fish Assessments

Historical studies of fish communities in the Roanoke River basin were conducted primarily by the North Carolina Wildlife Resources Commission (NCWRC) in the 1960s and late 1970s. Several streams were sampled by DWQ during the last basinwide planning cycle (1994). Twenty-three of the 30 sites sampled in 2004 had not been sampled previously. Scores are assigned to these samples using the North Carolina Index of Biotic Integrity (NCIBI). 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.

Overview of Fish Community Data

In 2004, fish community assessments were performed at 30 sites in the basin, 29 in the Piedmont and 1 in the Coastal Plain. Chockoyotte Creek was not rated because metrics and criteria have yet to be developed for Coastal Plain streams. The Piedmont NCIBI ratings ranged from Poor to Excellent with the scores ranging from 22 to 54. The two streams rated Excellent were Archies and Peters Creeks. Based upon the fish community ratings, degraded streams (bioclassifications of Fair or Poor) included North Hyco, Little Island, Nutbush, and Smith Creeks. Fish community sampling resulted in the following bioclassifications: Excellent-2, Good-18, Good-Fair-5, Fair-2, and Poor-2. The following table lists the most recent ratings since 1990, by subbasin, for all fish community sites.

Fish community data collected from the Roanoke River basin, 1990 - 2004. Current basinwide sites are in bold font.

Subbasin/Waterbody	Location	County	Index No.	Date	NCIBI Score	NCIBI Rating
030201						
Dan R	SR 1416	Stokes	22-(1)	04/19/04	52	Good
Archies Cr	SR 1415	Stokes	22-2	04/19/04	54	Excellent
Elk Cr	SR 1433	Stokes	22-5	04/20/04	44	Good-Fair
Peters Cr	SR 1497	Stokes	22-6	04/21/04	54	Excellent
Big Cr	SR 1471	Stokes	22-9	04/20/04	48	Good
N Double Cr	SR 1504	Stokes	22-10	04/20/04	42	Good-Fair
S Double Cr	SR 1483	Stokes	22-11	04/20/04	46	Good
Snow Cr	SR 1652	Stokes	22-20	04/21/04	46	Good
Town Fork Cr	SR 1955	Stokes	22-25	04/21/04	48	Good
030202						
Big Beaver Island Cr	US 311	Rockingham	22-29	04/22/04	52	Good
Pawpaw Cr	SR 1360	Rockingham	22-30-6-(1)	04/22/04	44	Good-Fair
				08/03/90	48	Good
Hogans Cr	NC 704	Rockingham	22-31	04/22/04	48	Good
Jacobs Cr	NC 704	Rockingham	22-32-(0.5)	04/22/04	50	Good
030203						
Rock House Cr	SR 2127	Rockingham	22-34-(2)	04/23/04	48	Good
Matrimony Cr	NC 770	Rockingham	22-38	04/23/04	52	Good
Wolf Island Cr	SR 1767	Rockingham	22-48	04/23/04	50	Good
Wolf Island Cr	NC 700	Caswell	22-48	10/05/94	54	Excellent
Hogans Cr	SR 1330	Caswell	22-50	05/25/04	52	Good
Jones Cr	SR 2571	Rockingham	22-50-3	06/08/04	48	Good
030204						
Moon Cr	SR 1511	Caswell	22-51	04/30/04	46	Good
				09/07/94	44	Good-Fair
Rattlesnake Cr	SR 1523	Caswell	22-52	05/25/04	48	Good
Cane Cr	SR 1527	Caswell	22-54	05/25/04	46	Good
				10/05/94	46	Good
Country Line Cr	NC 57	Caswell	22-56-(3.7)	09/07/94	48	Good
030205						
N Hyco Cr	US 158	Caswell	22-58-1	04/30/04	30	Poor
S Hyco Cr	US 158	Person	22-58-4-(3)	04/30/04	52	Good
Marlowe Cr	SR 1322	Person	22-58-12-9	04/28/04	42	Good-Fair
				09/07/94	40	Good-Fair
030206						
Aarons Cr	SR 1400	Granville	22-59	04/28/04	46	Good
Grassy Cr	SR 1300	Granville	23-2-(1)	06/09/99	46	Good
Grassy Cr	SR 1436	Granville	23-2-(1)	06/02/94	50	Good
Johnson Cr	SR 1440	Granville	23-2-7-(1)	04/28/04	44	Good-Fair
Island Cr	SR 1445	Granville	23-4	06/09/99	54	Excellent
				06/02/94	50	Good
Little Island Cr	SR 1348	Vance	23-4-3	04/29/04	30	Poor

Subbasin/Waterbody	Location	County	Index No.	Date	NCIBI Score	NCIBI Rating
Nutbush Cr	SR 1317	Vance	23-8-(1)	04/29/04	38	Fair
				10/04/94	44	Good-Fair
030207						
Smith Cr	US 1	Warren	23-10	04/29/04	38	Fair
				05/12/94	42	Good-Fair
Sixpound Cr	SR 1306	Warren	23-13	05/12/94	42	Good-Fair
030208						
Deep Cr	US 158	Halifax	23-24-(1)	05/26/04	46	Good
				09/21/94	50	Good
Chockoyotte Cr	US 158	Halifax	23-29	05/26/04	---	Not Rated
Quankey Cr	SR 1619	Halifax	23-30	09/21/94	38	Fair
Conoconnara Swp	NC 561	Halifax	23-33	09/21/94	---	Not Rated
Kehukee Swp	SR 1804	Halifax	23-42	10/27/94	---	Not Rated
030210						
Cashie R	SR 1257	Bertie	24-2-(1)	10/26/94	---	Not Rated

In 2004, 61 different species were collected during NC DWQ's fish community monitoring program. The most commonly collected species were the bluehead chub and the redbreast sunfish (collected at 28 of the 30 sites). The most abundant species was the bluehead chub, which constituted almost one-quarter of all the fish collected. It was also the numerically dominant species at 15 of the 30 sites.

Overview of Fish Tissue Sampling

The Division conducted fish tissue surveys at four stations within the Roanoke Basin from 1999 to 2004. These surveys were conducted as part of the mercury contaminant assessments in the eastern part of the state and during statewide pesticide and PCB assessments.

Tissue samples collected during the period contained PCB and organic contaminants at undetectable levels or at levels less than the US EPA, US FDA, and State of North Carolina criteria.

Elevated mercury concentrations were, however, measured in fish samples collected from the Cashie River near Windsor (Subbasin 03-02-10). Elevated levels were most often detected in largemouth bass, a species at the top of the food chain and most often associated with mercury bioaccumulation in North Carolina. Largemouth bass, yellow perch and redear sunfish (10 of 23 samples) collected from the Cashie River contained mercury concentrations exceeding the state criteria of 0.4 ppm. Presently, there are no site-specific consumption advisories for mercury contaminated fish in the Roanoke River basin; however, an advice for the consumption of shark, Swordfish, Tilefish, King mackerel, Spanish mackerel, Albacore tuna, Largemouth bass, Bowfin/Blackfish, and Chain pickerel/Jack fish east of Interstate 85 was issued by NCDHHS in 2002. For more information on NCDHHS consumption advice and advisories in North Carolina, refer to http://www.epi.state.nc.us/epi/fish/current.html.

There is a NCDHHS site specific fish consumption advisory due to dioxin contamination in the Roanoke River from Williamston to the mouth including Welch Creek and the western part of Albemarle Sound (Chapter 8). Dioxin concentrations, however, have been declining since 1994. Annual monitoring by the mill has indicated that dioxin concentrations in most fish species are gradually decreasing since the mill initiated dioxin reduction and management programs in the early 1990s. In October 2001 NCDHHS lifted gamefish from the advisory after consecutive sampling years showed dioxin levels in gamefish dropped below the NC criteria of 4 pg/g. The advisory remains in place for catfish and carp species.

Roanoke River Basin Fish Kills

DWQ has systematically tracked reported fish kill events across the state since 1996. From September 1,1999 to August 31,2004, DWQ field investigators reported 3 fish kill events in the Roanoke River basin.

The two largest fish kills in this basin occurred after hurricane Isabel in 2003. The fish kills occurred due to low dissolved oxygen levels in the river as a result from an influx of low DO swamp water and organic matter flowing into the mainstem of the river following the hurricane. The following table lists the details of the Roanoke River Basin fish kills. For more information on fish kills in North Carolina, refer to http://www.esb.enr.state.nc.us/Fishkill/fishkillmain.htm

Detailed Fish Kill Information for the Roanoke River Basin from September 1, 1999-August 31, 2004.

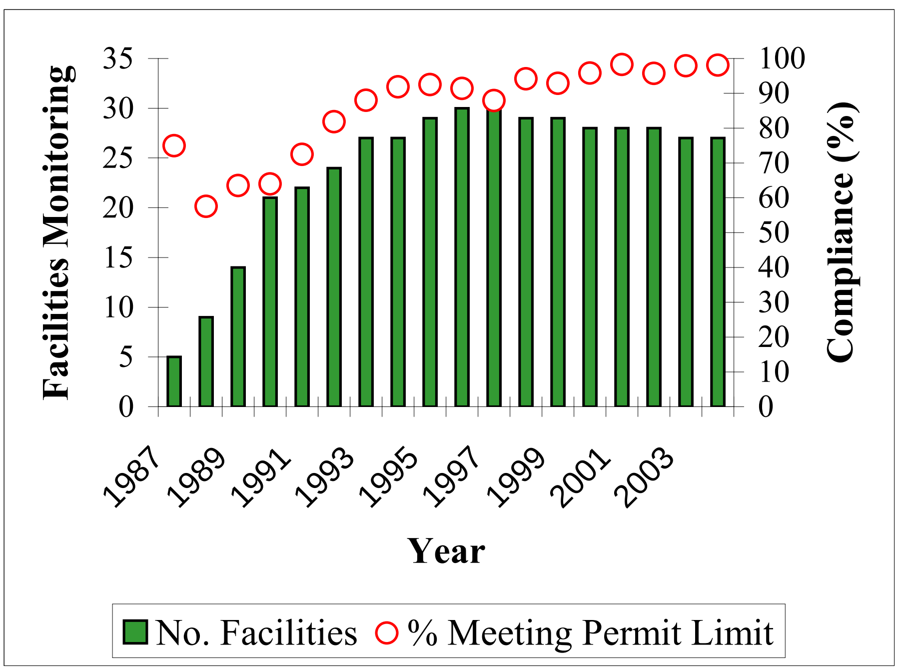
Date	County	Waterbody	Location	Kill #	Kill Area	Duration	Cause	Mortality	Fish species	Comments
Subbasin 03-02-09										
9/23/03	Martin	Roanoke River	Jamesesville, Plymouth	WA03021	18 miles	2 days	Low DO	93,500 Juvenile fish are not reflected in totals.	Catfish, Sunfish, Suckers, Shad, Largemouth bass, Eels, Minnows, Flounder, Perch, Striped bass	Kill resulted from the flushing of swamp water into the river following Hurricane Isabel, and the subsequent drop in DO levels. Kill zone stretched from Devils Gut above Jamesville to the river mouth. All DO readings were < 0.5 mg/L. Fish were seen at the surface gasping for air.
Subbasin 03-02-10										
9/25/03	Bertie	Cashie River	Windsor	WA03022	17.7 miles	4 days	Low DO	22,243	Sunfish, Catfish, Crappie, Minnows	Kill caused by low DO levels resulting from an influx of swamp water and organic matter following Hurricane Isabel. Dead fish found from Windsor to the mouth of the river. All DO readings were < 0.5 mg/L.
Subbasin 03-02-05										
3/29/04	Person	Mayo Creek	Below Reservoir Spillway	RA04001	1 mile	1 day	Unknown	60	Carp, Bluehead chub	Observed ~60 dead carp in various stages of decay within 500 meters of the spillway. About 50% of the live carp in the area had sores on top of their head and body. Many carp and Bluehead chub were very lethargic and unresponsive.

Aquatic Toxicity Monitoring

Acute and/or chronic toxicity tests are used to determine toxicity of discharges to sensitive aquatic species (usually fathead minnows or the water flea, *Ceriodaphnia dubia*). Results of these tests have been shown by several researchers to be predictive of discharge effects on receiving stream populations. Many facilities are required to monitor whole effluent toxicity (WET) by their NPDES permit or by administrative letter. Other facilities may also be tested by DWQ's Aquatic Toxicology Unit (ATU). Per Section 106 of the Clean Water Act, the ATU is required to test at least 10 percent of the major discharging facilities over the course of the federal fiscal year (FFY). However, it is ATU's target to test 20 percent of the major dischargers in the FFY. This means that each major facility would get evaluated over the course of their five-year permit. There are no requirements or targets for minor dischargers.

The ATU maintains a compliance summary for all facilities required to perform tests and provides monthly updates of this information to regional offices and DWQ administration. Ambient toxicity tests can be used to evaluate stream water quality relative to other stream sites and/or a point source discharge.

Thirty NPDES permits in the Roanoke River basin currently require WET testing. Twenty-seven permits have a WET limit; the other three facilities permits specify monitoring but do not have a limit. Across the state, the number of facilities required to perform WET has increased steadily since 1987, the first year that WET limits were written into permits in North Carolina. Consequently, compliance rates have also risen. Since 1998, the compliance rate has stabilized at approximately 90-95 percent. The following graph summaries WET monitoring compliance in the Roanoke River basin from 1987 to 2004. Facilities with toxicity problems during the most recent two-year review period are discussed in subbasin chapters.



NPDES facility whole effluent toxicity compliance in the Roanoke River basin, 1987-2004. The compliance values were calculated by determining whether facilities with WET limits were meeting their ultimate permit limits during the given time period, regardless of any SOCs in force.

Ambient Monitoring System

The Ambient Monitoring System (AMS) is a network of stream, lake and estuarine stations strategically located for the collections of physical and chemical water quality data. North Carolina currently has 365 water chemistry monitoring stations statewide, including 22 stations in the Roanoke River basin. Between 23 and 32 parameters are collected monthly at each station. These locations were chosen to characterize the effects of point source dischargers and nonpoint sources such as agriculture, animal operations, and urbanization within watersheds. The locations of these stations are listed in the following table and shown on individual subbasin maps. Notable ambient water quality parameters are discussed in the subbasin chapters. Refer to *2005Roanoke River Basinwide Assessment Report* at http://www.esb.enr.state.nc.us/bar.html for more detailed analysis of ambient water quality monitoring data.

Ambient Monitoring Stations in the Roanoke River Basin by Subbasin, 1999-2004.

Subbasin	Station	Location	Class	County
01				
	N0150000	Dan River at NC 704 near Francisco	C Tr	Stokes
02				
	N1400000	Mayo River at SR 1358 near Price	WS-V	Rockingham
03				
	N2300000	Dan River at SR 2150 near Wentworth	WS-IV	Rockingham
	N2430000[1]	Smith River at SR 1714 near Eden	WS-IV	Rockingham
	N2450000[2]	Smith River at NC 14 at Eden	WS-IV	Rockingham
	N3000000	Dan River at SR 1761 near Mayfield	C	Rockingham
04				
	N3500000	Dan River at NC 57 at VA Line at Milton	C	Caswell
05				
	N4110000[3]	Hyco Creek at US 158 near Leasburg	C	Caswell
	N4250000	Hyco River Below Afterbay Dam near Mcghees Mill	C	Person
	N4400000[4]	Marlowe Creek at SR 1322 near Woodsdale	C	Person
	N4510000	Hyco River at US 501 near Denniston VA	III NT	Halifax
	N4590000	Mayo Creek at SR 1501 near Bethel Hill	C	Person
06				
	N5000000	Nutbush Creek at SR 1317 near Henderson	C	Vance
07				
	N6400000	Smith Creek at US 1 near Paschall	C	Warren
08				
	N7300000	Roanoke River at NC 48 at Roanoke Rapids	WS-IV CA	Halifax
	N8200000	Roanoke River at US 258 near Scotland Neck	C	Halifax
	N8300000	Roanoke River at NC 11 near Lewiston	C	Martin
09				
	N8550000	Roanoke River at US 13 And US 17 at Williamston	C	Martin
	N9250000	Roanoke River 1.3 Mi Ups Welch Creek near Plymouth	C Sw	Martin
	N9600000	Roanoke River at NC 45 at Sans Souci	C Sw	Bertie
	N9700000	Albemarle Sound at Batchelor Bay near Black Walnut	B Sw	Bertie
10				
	N8950000	Cashie River at SR 1219 near Lewiston	C Sw	Bertie

[1]Sample collection at station N2430000 began on 7/24/00.
[2]Sample collection at station N2450000 ceased on 6/21/00.
[3]Sample collection at station N4110000 ceased on 6/21/00.
[4]Sample collection at station N4400000 was temporarily suspended on 10/7/03.

Lakes Assessment Program

Eleven Roanoke River Basin lakes were sampled in June through September of 2004. Generally, lake conditions were similar to previous years. Farmer Lake and Lake Roxboro had elevated chlorophyll *a* and dissolved oxygen concentrations; however, all other parameters were normal. While blue-green algae dominated the phytoplankton assemblages in Farmer Lake, Lake Roxboro had a diverse assemblage including species that may cause taste and odor problems in drinking water. Lakes with noted water quality impacts are discussed in the appropriate subbasin chapters. See the table below for a list of the lakes and their characteristic information.

Lakes Assessment – Roanoke River Basin

Subbasin		030201					030204	030205				030206	030207		030208
Lakes Ambient Program Name		Hanging Rock Lake	Kernersville Reservoir	Belews Lake			Farmer Lake	Lake Roxboro	Roxboro City Lake (Lake Isaac Walton)	Mayo Reservoir	Hyco Lake	Kerr Reservoir	Lake Gaston		Roanoke Rapids Lake
Trophic Status (NC TSI)		Oligotrophic	Eutrophic	Oligotrophic			Eutrophic	Eutrophic	Eutrophic	Mesotrophic	Mesotrophic	Mesotrophic	Mesotrophic		Oligotrophic
Mean Depth (meters)		1	5	15			5.5	6	3.5	9	6.1	10.7	6		5
Volume ($10^6 m^3$)		0.003	0.4	228			6.5	11	0.3	105	99	448	512		96
Watershed Area (mi^2)		0.8	3.5	46.3			48.3	23.9	196.1	51.4	188	7610.8	8293.4		8294.2
Assessment Unit Name		Cascade Creek	Belews Cr (Kernersville Reservoir)	Belews Cr. (including Belews Lake below elev. 725) & West Belews Cr. (W. Belews Cr. Arm of Belews Lake below elevation 725)			County Line Creek (Farmer Lake)	South Hyco Creek (Lake Roxboro)	Storys Creek [Roxboro City Lake (Lake Issac Walton)]	Mayo Cr (Maho Cr) (Mayo Res)	Hyco R., including Hyco Lake below elevation 410)	Nutbush Creek Arm of John H. Kerr Reservoir (below normal pool elevation 300 ft MSL…)	Roanoke River (Lake Gaston below normal full power pool elevation 200 MSL)		Roanoke River (Lake Gaston below normal ….)
Classification		B	WS IV	C	WS-IV	WS-IV	WS- II, HQW	WS-II, B, HQW	WS-II, HWQ	WS-V	WS-V, B	B	WS-V, B	WS-IV, B	W- IV, B, CA
Assessment Unit		22-12-(2)	22-27-(1.5)	22-27-(7)	22-27-9-(4)	22-27-(7.5)	22-56-(3.5)	22-58-4-(1.4)	22-58-12-(1.5)	22-58-15-(0.5)	22-58-(0.5)	23-8-(2)	23-(12)	23-(20.2)	23-(22.5)
Stations in Assessment Unit		ROA003A	ROA0092A	ROA009J	ROA009G	ROA009E, 009H	ROA027J, 027L, 027G	ROA0303DA, 0303DC, 0303DE	ROA031C, 031E, 031H	ROA0343A, 0342A, 0341A	ROA030C, 030E, 030F, 030G	ROA037A, 037E, 037I, 0371J	ROA038A, 039	ROA039B	ROA039C, 039D, O39E
		NL1	NL2	NL6	NL4	NL3, NL5	NL7-NL9	NL11-NL13	NL17-NL19	NL20-NL22	NL10, NL14-NL16	NL23-NL26	NL27-NL28	NL29	NL30-NL32
Number of Sampling Trips		12	8	11	11	11	12	11	4	3	3	6	5	5	3
Water Quality Standards															
Chlorophyll *a*	>40 ug/L	NCE	NCE	NCE	NCE	NCE	NCE	NCE	NCE	NCE	NCE	NCE	NCE	NCE	NCE
Dissolved Oxygen	<4.0 mg/L	NCE	NCE	NCE	NCE	NCE	NCE	NCE	NCE	NCE	NCE	NCE	NCE	NCE	NCE
pH	<6 s.u. or > 9 s.u.	NCE	NCE	NCE	NCE	NCE	NCE	NCE	NCE	NCE	NCE	NCE	NCE	NCE	NCE
Turbidity	>25 mg/L	NCE	NCE	NCE	NCE	NCE	**E (9%)**	NCE	NCE	NCE	NCE	NCE	NCE	NCE	NCE
Temperature	>32°C Lower Piedmont & Coastal Plain	NCE	NCE	NCE	NCE	NCE	NCE	NCE	NCE	NCE	**E (33%)**	NCE	NCE	NCE	NCE
Metals (excluding copper, iron & zinc)	15A NCAC 2B .0211	ND	NCE	ND	ND	ND	NCE	NCE	NCE	NCE	ND	ND	NCE	NCE	ND
Other Data															
% Saturation DO	>120%	N	N	N	N	**Y (9%)**	**Y (8%)**	**Y (9%)**	N	N	N	N	N	N	N
Algae	Documented blooms during 2 or more sampling events in 1 year with historic blooms	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Fish	Kills related to eutrophication	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Chemically/Biologically Treated	For algal or macrophyte control - either chemicals or biologically by fish, etc.	N	N	N	N	N	N	N	N	N	N	N	**Y**	**Y**	N
Macrophytes	Limiting access to public ramps, docks, swimming areas; reducing access by fish and other aquatic life to habitat	N	N	N	N	N	N	N	N	N	N	N	**Y**	**Y**	**Y**
Sediments	Clogging intakes – dredging program necessary; Frequent public/agency complaints - visual	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Rating:		**S**	**NR**	**S**	**S**	**S**	**NR**	**S**	**NR**	**NR**	**NR**	**NR**	**NR**	**NR**	**NR**

RATING KEY: S = Supporting; R = Not Rated; I = Impaired

KEY Water Quality Standards: NCE = No Criteria Exceeded; E = Criteria exceeded in less than 10% of the measurements **OR** criteria exceeded but number of sampling trips less than 10; CE = Criteria Exceeded – parameter is problematic, highly productive, or exceeds the standard in >10% of samples; ND = No Data – samples not taken for this parameter.

KEY Other Data: N = Indicates that the parameter is within the target or has not occurred per available information; Y = Exceeds target or has occurred; ND = No Data – samples not taken for this parameter

Appendix V

Other Water Quality Data
in the
Roanoke River Basin

Other Water Quality Research

North Carolina actively solicits "existing and readily available" data and information for each basin as part of the basinwide planning process. Data meeting DWQ quality assurance objectives are used in making use support determinations. Data and information indicating possible water quality problems are investigated further. Both quantitative and qualitative information are accepted during the solicitation period.

> ***DWQ data solicitation includes the following:***
>
> - Information, letters and photographs regarding the uses of surface waters for boating, drinking water, swimming, aesthetics and fishing.
> - Raw data submitted electronically and accompanied by documentation of quality assurance methods used to collect and analyze the samples. Maps showing sampling locations must also be included.
> - Summary reports and memos, including distribution statistics and accompanied by documentation of quality assurance methods used to collect and analyze the data.
>
> *Contact information must accompany all data and information submitted.*

High levels of confidence must be present in order for outside quantitative information to carry the same weight as information collected from within DWQ. This is particularly the case when considering waters for the Impaired categories in the Integrated Report (303(d) list). Methodology for soliciting and evaluating outside data is presented in *North Carolina's 2002 Integrated Report* http://h2o.enr.state.nc.us/tmdl/Docs_303/2002/2002%20Integrated%20Rept.pdf (Appendix I). The next data solicitation period for the Roanoke River Basin is planned for fall 2008.

Any data submitted to DWQ from other water sampling programs conducted in the Roanoke River basin have been reviewed. Data that meet quality and accessibility requirements were considered for use support assessments and the 303(d) list. These data are also used by DWQ to adjust the location of biological and chemical monitoring sites.

In particular, DWQ use data collected by the U.S. Geological Survey (USGS) at five sites in the lower Roanoke River. USGS used a continuous monitoring (15-minute intervals) in situ multiparameter water-quality sensor connected to a data logger to collected specific conductance, pH, water temperature, and DO concentration. DWQ also used NC Department of Health and Human Services fish consumption advisories and advice. For more information regarding fish consumption advisories, call (919) 707-5900 or visit the NC DHHS Division of Public Health website at http://www.schs.state.nc.us/epi/fish/current.html. These data were used by DWQ to assign use support ratings.

Subbasin	Station Number	AU Number	Sampling Location	Data Source
03-02-08	NA23	23-(26)a	Roanoke River at Halifax, NC	USGS
03-02-08	NA24	23-(26)b1	Roanoke River at Oak City, NC	USGS
03-02-09	NA25	23-(26)b2	Roanoke River at SR1100 near Grabtown, NC	USGS
03-02-09	NA27	23-(26)b3	Roanoke River at Jamesville, NC	USGS
03-02-09	NA26	23-(53)	Roanoke River at NC 45 near Westover, NC	USGS

Appendix VI

NPDES Discharges and Individual Stormwater Permits in the Roanoke River Basin

Permit	Owner	Facility	County	Region	Type	Class	MGD	Sub-basin	Receiving Stream
NC0003492	R J Reynolds Tobacco Company	R J Reynolds Tobacco Co - Brook Cove	Stokes	Winston-Salem	Industrial Process & Commercial	Minor	0.02	03-02-01	Voss Creek (Sandy Branch)
NC0003441	JPS Elastomerics Corp	JPS Elastomerics Corp-Caro Plt	Stokes	Winston-Salem	Industrial Process & Commercial	Minor	0.015	03-02-01	Little Dan River
NC0024406	Duke Energy Corporation	Belews Creek Steam Station	Stokes	Winston-Salem	Industrial Process & Commercial	Major	not limited	03-02-01	West Belews Creek (Little Belews Creek)
NC0025526	Town of Walnut Cove	Walnut Cove WWTP	Stokes	Winston-Salem	Municipal, < 1MGD	Minor	0.5	03-02-01	Town Fork Creek
NC0028746	Aqua North Carolina, Inc	Briarwood Subdivision WWTP	Stokes	Winston-Salem	100% Domestic < 1MGD	Minor	0.05	03-02-01	Brushy Fork Creek
NC0029777	Stokes County	Stokes Correctional Center WWTP	Stokes	Winston-Salem	100% Domestic < 1MGD	Minor	0.0132	03-02-01	Flat Shoals Creek
NC0035173	KobeWieland Copper Products LLC	Kobewireland Copper Products Incorporated	Stokes	Winston-Salem	Industrial Process & Commercial	Minor	0.025	03-02-01	DAN RIVER
NC0037311	Pierce Management Group	Creekside Manor Rest Home	Forsyth	Winston-Salem	100% Domestic < 1MGD	Minor	0.01	03-02-01	Belews Creek (including Belews Lake below elevation 725) (1)
NC0043290	Town of Danbury	Danbury WTP	Stokes	Winston-Salem	Water Treatment Plant	Minor	not limited	03-02-01	Scott Creek (Steadmans Creek)
NC0044954	Stokes County Schools	South Stokes High School	Stokes	Winston-Salem	100% Domestic < 1MGD	Minor	0.0173	03-02-01	Little Neatman Creek
NC0044962	Stokes County Schools	North Stokes High School	Stokes	Winston-Salem	100% Domestic < 1MGD	Minor	0.0115	03-02-01	DAN RIVER
NC0056791	Horizons Residential Care Ctr	Horizons Residential Care Ctr	Forsyth	Winston-Salem	100% Domestic < 1MGD	Minor	0.015	03-02-01	Buffalo Creek
NC0057720	John Henry Spainhour	Twin Lakes Mobile Home Park	Stokes	Winston-Salem	100% Domestic < 1MGD	Minor	0.04	03-02-01	Timmons Creek
NC0060461	Carolina Water Service, Incorporated of N.C.	Abington WWTP	Forsyth	Winston-Salem	100% Domestic < 1MGD	Minor	0.2	03-02-01	Belews Creek (including Belews Lake below elevation 725) (1)
NC0067091	Aqua North Carolina, Inc	Mikkola Downs Subdivision WWTP	Forsyth	Winston-Salem	100% Domestic < 1MGD	Minor	0.072	03-02-01	East Belews Creek
NC0075027	Cains Way Homeowners Association	Cains Way Mobile Home Park	Forsyth	Winston-Salem	100% Domestic < 1MGD	Minor	0.0432	03-02-01	Ader Creek
NC0078115	Aqua North Carolina, Inc	Greystone Subdivision WWTP	Forsyth	Winston-Salem	100% Domestic < 1MGD	Minor	0.032	03-02-01	Belews Creek
NC0079049	R H Johnson Construction Company	R.H. Johnson Construction WWTP	Forsyth	Winston-Salem	100% Domestic < 1MGD	Minor	0.06	03-02-01	Rough Fork
NC0082384	Stokes County	Danbury WWTP	Stokes	Winston-Salem	Municipal, < 1MGD	Minor	0.1	03-02-01	DAN RIVER
NC0083933	Heater Utilities Inc	Salem Quarters WWTP	Forsyth	Winston-Salem	100% Domestic < 1MGD	Minor	0.06	03-02-01	Belews Creek
NC0087980	Stokes County Schools	Pine Hall Elementary School WWTP	Stokes	Winston-Salem	100% Domestic < 1MGD	Minor	0.004	03-02-01	Eurins Creek
NC0037001	Rockingham County Board of Education	Bethany Elementary School	Rockingham	Winston-Salem	100% Domestic < 1MGD	Minor	0.0037	03-02-02	Huffines Mill Creek
NC0086665	Dynegy, Inc. / Rockingham Power LLC	Rockingham Power Combustion Turbine Facility	Rockingham	Winston-Salem	Industrial Process & Commercial	Minor	not limited	03-02-02	Jacobs Creek

Permit	Owner	Facility	County	Region	Type	Class	MGD	Sub-basin	Receiving Stream
NC0021075	Town of Madison	Madison WWTP	Rockingham	Winston-Salem	Municipal, < 1MGD	Minor	0.775	03-02-02	DAN RIVER
NC0021873	Town of Mayodan	Mayodan WWTP	Rockingham	Winston-Salem	Municipal, Large	Major	4.5	03-02-02	Mayo River
NC0044750	Britthaven Of Madison	Britthaven Of Madison	Rockingham	Winston-Salem	Industrial Process & Commercial	Minor	0.025	03-02-02	Hogans Creek
NC0046302	Town of Mayodan	Mayodan WTP	Rockingham	Winston-Salem	Water Treatment Plant	Minor	not limited	03-02-02	Mayo River
NC0060542	Gold Hill Mobile Home Park	Gold Hill Mobile Home Park	Rockingham	Winston-Salem	100% Domestic < 1MGD	Minor	0.0176	03-02-02	Hogans Creek
NC0085022	Michael R Hodgin	220 Mobile Home Park	Rockingham	Winston-Salem	Water Treatment Plant	Minor	not limited	03-02-02	Hogans Creek
NC0085626	Town of Madison	Madison WTP	Rockingham	Winston-Salem	Water Treatment Plant	Minor	not limited	03-02-02	Big Beaver Island Creek
NC0059251	Lee Simaan	Quail Acres Mobile Home Park	Rockingham	Winston-Salem	100% Domestic < 1MGD	Minor	0.05	03-02-02	Hogans Creek
NC0002828	Diakon Molding Inc	Diakon Molding	Rockingham	Winston-Salem	Industrial Process & Commercial	Minor	0.005	03-02-03	Lick Fork Creek
NC0001643	Hollingsworth GP	Pillowtex/Hollingsworth GP	Rockingham	Winston-Salem	Industrial Process & Commercial	Major	0.5	03-02-03	DAN RIVER
NC0003468	Duke Energy Corporation	Dan River Steam Station	Rockingham	Winston-Salem	Industrial Process & Commercial	Major	not limited	03-02-03	DAN RIVER (NC portion)
NC0025071	City of Eden	Mebane Bridge WWTP	Rockingham	Winston-Salem	Municipal, Large	Major	13.5	03-02-03	DAN RIVER
NC0025151	City of Eden	Dry Creek WWTP	Rockingham	Winston-Salem	Municipal, < 1MGD	Minor	1.0	03-02-03	DAN RIVER
NC0027987	Vulcan Construction Materials LP	Stoneville Quarry	Rockingham	Winston-Salem	Industrial Process & Commercial	Minor	not limited	03-02-03	Buffalo Creek
NC0029980	Miller Breweries East Inc	Miller Breweries East Inc.	Rockingham	Winston-Salem	Industrial Process & Commercial	Major	5.2	03-02-03	DAN RIVER
NC0060623	Sterling A Weaver	Stone Highway Mobile Home Park	Rockingham	Winston-Salem	100% Domestic < 1MGD	Minor	0.015	03-02-03	Buffalo Creek
NC0077135	Curl Modular Homes	Hidden Valley WWTP	Rockingham	Winston-Salem	100% Domestic < 1MGD	Minor	0.022	03-02-03	Lick Fork Creek
NC0078271	Betsy Jeff Penn 4H Education	Betsy Jeff Penn 4H Education	Rockingham	Winston-Salem	100% Domestic < 1MGD	Minor	0.0084	03-02-03	Carroll Creek (Lake Hazel)
NC0085189	Virginia H Doyle	Jose's Restaurant-Sand Filter	Rockingham	Winston-Salem	100% Domestic < 1MGD	Minor	0.005	03-02-03	Buffalo Creek
NC0007323	Town of Yanceyville	Yanceyville WTP	Caswell	Winston-Salem	Water Treatment Plant	Minor	0.015	03-02-04	Fullers Creek
NC0030180	NC Department of Correction	Blanch Youth Center WWTP	Caswell	Winston-Salem	100% Domestic < 1MGD	Minor	0.018	03-02-04	Country Line Creek
NC0040011	Town of Yanceyville	Yanceyville WWTP	Caswell	Winston-Salem	Municipal, < 1MGD	Minor	0.6	03-02-04	Country Line Creek
NC0087645	Town of Milton	Milton WWTP	Caswell	Winston-Salem	Municipal, < 1MGD	Minor	0.025	03-02-04	Country Line Creek
Permit	Owner	Facility	County	Region	Type	Class	MGD	Sub-basin	Receiving Stream

NC0038377	Progress Energy Carolinas, Inc.	Mayo Steam Electric Plant	Person	Raleigh	Industrial Process & Commercial	Major	21.0	03-02-05	Mayo Creek (Maho Creek)
NC0003042	City of Roxboro	Roxboro WTP	Person	Raleigh	Water Treatment Plant	Minor	not limited	03-02-05	Marlowe Creek
NC0003425	Progress Energy Carolinas, Inc.	Roxboro Steam Electric Power Plant	Person	Raleigh	Industrial Process & Commercial	Major	0.015	03-02-05	South Hyco Creek (Lake Roxboro)
NC0036536	Person County Schools	Woodland Elementary School	Person	Raleigh	100% Domestic < 1MGD	Minor	0.006	03-02-05	South Hyco Creek
NC0086983	Caswell County Schools	South Elementary WTP	Caswell	Winston-Salem	Water Treatment Plant	Minor	not limited	03-02-05	Hyco Creek (North Hyco Creek)
NC0021024	City of Roxboro	City of Roxboro WWTP	Person	Raleigh	Municipal, Large	Major	5.0	03-02-05	Marlowe Creek
NC0065081	Cogentrix Energy Inc	Roxboro Cogen plant	Person	Raleigh	Industrial Process & Commercial	Minor	not limited	03-02-05	Mitchell Creek
NC0020559	City of Henderson	Henderson WRF	Vance	Raleigh	Municipal, Large	Major	6.0	03-02-06	Nutbush Creek (Including Nutbush Creek Arm of John H. Kerr Reservoir below normal pool elevation)
NC0035491	Vance County Schools	E.O. Young, Jr. Elementary School	Vance	Raleigh	100% Domestic < 1MGD	Minor	0.0036	03-02-06	Mill Creek (Including Mill Creek Arm of John H. Kerr Reservoir below normal pool elevation)
NC0083101	City of Henderson	Kerr Lake Regional WTP	Vance	Raleigh	Water Treatment Plant	Minor	not limited	03-02-06	Anderson Swamp Creek (Including Anderson Swamp Creek Arm of John H. Kerr Reservoir below normal pool elevation)
NC0000752	International Paper Company	Roanoke Rapids Mill	Halifax	Raleigh	Industrial Process & Commercial	Major	28.0	03-02-08	ROANOKE RIVER
NC0024201	Roanoke Rapids Sanitary District	Roanoke Rapids WWTP	Halifax	Raleigh	Municipal, Large	Major	8.34	03-02-08	Chockoytte Creek
NC0025437	Town of Rich Square	Rich Square WWTP	Northampton	Raleigh	Municipal, < 1MGD	Minor	0.15	03-02-08	Bridgers Creek
NC0027626	NC Department of Correction	Caledonia WWTP	Halifax	Raleigh	Industrial Process & Commercial	Minor	0.8	03-02-08	ROANOKE RIVER
NC0027642	NC Department of Correction	Odom Correctional Institute WWTP	Northampton	Raleigh	100% Domestic < 1MGD	Minor	0.12	03-02-08	ROANOKE RIVER
NC0038636	Halifax County Schools	Bakers Elementary School WWTP	Halifax	Raleigh	100% Domestic < 1MGD	Minor	0.0073	03-02-08	Kehukee Swamp (White Millpond)
NC0066192	Town of Halifax	Halifax WWTP	Halifax	Raleigh	Municipal, < 1MGD	Minor	0.075	03-02-08	Quankey Creek
NC0025721	Town of Weldon	Weldon WWTP	Halifax	Raleigh	Municipal, Large	Major	1.2	03-02-08	ROANOKE RIVER
NC0028835	Perdue Farms Inc	Lewiston MIll	Bertie	Washington	Industrial Process & Commercial	Minor	3.0	03-02-08	ROANOKE RIVER
NC0079014	Panda Rosemary L P	Panda Rosemary L P	Halifax	Raleigh	Industrial Process & Commercial	Minor	not limited	03-02-08	Chockoytte Creek

Permit	Owner	Facility	County	Region	Type	Class	MGD	Sub-basin	Receiving Stream
NC0000680	Weyerhaeuser Company	Plymouth Mill	Martin	Washington	Industrial Process & Commercial	Major	82.5	03-02-09	ROANOKE RIVER
NC0002313	Town of Plymouth	Plymouth WTP	Washington	Washington	Water Treatment Plant	Minor	not limited	03-02-09	Conaby Creek
NC0020028	Town of Plymouth	Plymouth WWTP	Washington	Washington	Municipal, < 1MGD	Minor	0.8	03-02-09	ROANOKE RIVER
NC0020044	Town of Williamston	Williamston WWTP	Martin	Washington	Municipal, Large	Major	2.0	03-02-09	ROANOKE RIVER
NC0023710	McMurray Fabrics Jamesville Inc	McMurray Fabrics Jamesville Inc	Martin	Washington	Industrial Process & Commercial	Minor	0.45	03-02-09	ROANOKE RIVER
NC0035858	Town of Jamesville	Jamesville WWTP	Martin	Washington	Municipal, < 1MGD	Minor	0.15	03-02-09	ROANOKE RIVER
NC0044776	Town of Hamilton	Hamilton WWTP	Martin	Washington	Municipal, < 1MGD	Minor	0.08	03-02-09	ROANOKE RIVER
NC0068187	United Organics Corporation	United Organics Corporation	Martin	Washington	Industrial Process & Commercial	Minor	not limited	03-02-09	ROANOKE RIVER
NC0023116	Town of Lewiston-Woodville	Lewiston-Woodville WWTP	Bertie	Washington	Municipal, < 1MGD	Minor	0.15	03-02-10	Cashie River
NC0026751	Town of Windsor	Windsor WWTP	Bertie	Washington	Municipal, Large	Major	1.15	03-02-10	Cashie River
NC0086215	Williford Logging Inc	Williford Logging	Bertie	Washington	Industrial Process & Commercial	Minor	not limited	03-02-10	Cashie River

NPDES Individual Stormwater Permits in the Roanoke River Basin (as of May 10, 2005)

Permit #	Facility Name	Receiving Stream	Subbasin	County
NCS000106	Roanoke Rapids Mill	Roanoke River	03-02-08	Halifax
NCS000197	Rosemary Power Station	Roanoke River	03-02-08	Halifax
NCS000229	Roanoke Valley Energy Facility	Roanoke River	03-02-08	Halifax
NCS000289	Shenandoah Wood Preservers In	Kehukee Swamp (White Millpond)	03-02-08	Halifax
NCS000325	Myers Industries-Patch Rubber	Roanoke River	03-02-08	Halifax
NCS000189	Weyerhaeuser/ Martin	Roanoke River	03-02-09	Martin

Appendix VII

303(d) Listing
and
Reporting Methodology

Integrated 305(b) and 303(d) Report Summary

The *North Carolina Water Quality Assessment and Impaired Waters List* is an integrated report that includes both the 305(b) and 303(d) reports of previous years. The *305(b) Report* is compiled biennially to update the assessment of water quality in North Carolina and to meet the Section 305(b) reporting requirement of the Clean Water Act. The 305(b) reports present how well waters support designated uses (e.g., swimming, aquatic life support, water supply), as well as likely causes (e.g., sediment, nutrients) and potential sources of impairment. The term "Use Support" refers to the process mandated by 305(b). The *303(d) List* is a comprehensive public accounting of all Impaired waterbodies that is derived from the 305(b) Report/Use Support. An Impaired waterbody is one that does not meet water quality uses, such as water supply, fishing or propagation of aquatic life. Best professional judgment along with numeric and narrative standards criteria and anti-degradation requirements defined in 40 CFR 131 is considered when evaluating the ability of a waterbody to serve its uses.

Section 303(d) of the federal Clean Water Act (CWA) which Congress enacted in 1972 required States, Territories and authorized Tribes to identify and establish a priority ranking for waterbodies for which technology-based effluent limitations required by Section 301 are not stringent enough to attain and maintain applicable water quality standards, establish total maximum daily loads (TMDLs) for the pollutants causing impairment in those waterbodies, and submit, from time to time, the list of Impaired waterbodies and TMDLs to the US Environmental Protection Agency (EPA). Current federal rules require states to submit 303(d) lists biennially, by April 1st of every even numbered year. EPA is required to approve or disapprove the state-developed 303(d) list within 30 days. For each water quality limited segment Impaired by a pollutant and identified in the 303(d) list, a Total Maximum Daily Load (TMDL) must be developed. TMDLs are not required for waters Impaired by pollution. Here, pollution is defined by the EPA as, “man-made or man-induced alteration of the chemical, physical, biological, and radiological integrity of the water,” and is related to water control structures (e.g., dams).

The Integrated Report includes descriptions of monitoring programs, the use support methodology, and the Impaired waters list. New guidance from EPA places all waterbody assessment units into one unique assessment category (EPA, 2001b). Although EPA specifies five unique assessment categories, North Carolina elects to use seven categories. Each category is described in detail below:

Category 1: Attaining the water quality standard and no use is threatened. This category consists of those waterbody assessment units where all applicable use support categories are rated " Supporting". Data and information are available to support a determination that the water quality standards are attained and no use is threatened. Future monitoring data will be used to determine if the water quality standard continues to be attained.

Category 2: Attaining some of the designated uses; no use is threatened; and insufficient or no data and information are available to determine if the remaining uses are attained or threatened. This category consists of those waterbody assessment units where at least one of the applicable use support categories are rated " Supporting" and the other use support categories are rated "Not Rated" or “No Data”. Also included in this category are waters where at least one of the applicable use support categories, except Fish Consumption, are rated "Supporting"; the remaining applicable use support categories, except Fish Consumption, are rated "Not Rated"; and the Fish Consumption category is rated "Impaired-Evaluated". Data and information are available to support a determination that some, but not all, uses are attained. Attainment status of the remaining uses is unknown because there are insufficient or no data or information. Future monitoring data will be used to determine if the uses previously found to be in attainment remain in attainment, and to determine the attainment status of those uses for which data and information were previously insufficient to make a determination.

Category 3: Insufficient or no data and information to determine if any designated use is attained. This category consists of those waterbody assessment units where all applicable use support categories, except Fish Consumption, are rated "Not Rated", and the Fish Consumption category is rated "Impaired-Evaluated". Measured data or information to support an attainment determination for any use are not available. Supplementary data and information, or future monitoring, will be required to assess the attainment status.

Category 4: Impaired or threatened for one or more designated uses but does not require the development of a TMDL. This category contains three distinct sub-categories:

Category 4a: TMDL has been completed. This category consists of those waterbody assessment units for which EPA has approved or established a TMDL and water quality standards have not yet been achieved. Monitoring data will be considered before moving an assessment unit from Category 4a to Categories 1 or 2.

Category 4b: Other pollution control requirements are reasonably expected to result in the attainment of the water quality standard in the near future. This category consists of those waterbody assessment units for which TMDLs will not be attempted because other required regulatory controls (e.g., NPDES permit limits, Stormwater Program rules, etc.) are expected to attain water quality standards within a reasonable amount of time. Future monitoring will be used to verify that the water quality standard is attained as expected.

Category 4c: Impairment is not caused by a pollutant. This category consists of assessment units that are Impaired by pollution, not by a pollutant. EPA defines pollution as "The man-made or man-induced alteration of the chemical, physical, biological and radiological integrity of the water." EPA staff have verbally stated that this category is intended to be used for impairments related to water control structures (e.g., dams). Future monitoring will be used to confirm that there continues to be an absence of pollutant-caused impairment and to support water quality management actions necessary to address the cause(s) of the impairment.

Category 5: Impaired for one or more designated uses by a pollutant(s) and requires a TMDL. This category consists of those waterbody assessment units that are Impaired by a pollutant and the proper technical conditions exist to develop TMDLs. As defined by the EPA, the term pollutant means "dredged spoil, solid waste, incinerator residue, sewage, garbage, sewage sludge, munitions, chemical wastes, biological materials, radioactive materials, heat, wrecked or discarded equipment, rock, sand, cellar dirt and industrial, municipal, and agricultural waste discharged into the water." When more than one pollutant is associated with the impairment of a single waterbody assessment unit in this category, the assessment unit will remain in Category 5 until TMDLs for all listed pollutants have been completed and approved by the EPA.

Category 6: Impaired based on biological data. This category consists of waterbody assessment units historically referred to as "Biologically Impaired" waterbodies; these assessment units have no identified cause(s) of impairment although aquatic life impacts have been documented. The waterbody assessment unit will remain in Category 6 until TMDLs have been completed and approved by the EPA.

Category 7: Impaired, but the proper technical conditions do not yet exist to develop a TMDL. As described in the Federal Register, "proper technical conditions" refer to the availability of the analytical methods, modeling techniques and data base necessary to develop a technically defensible TMDL. These elements will vary in their level of sophistication depending on the nature of the pollutant and characteristics of the segment in question" (43 FR 60662, December 28, 1978). These are assessment units that would otherwise be in Category 5 of the integrated list. As previously noted, EPA has recognized that in some specific situations the data, analyses or models are not available to establish a TMDL. North Carolina seeks EPA technical guidance in developing technically defensible TMDLs for these waters. Open water and ocean hydrology fecal coliform Impaired shellfishing waters are included in this category.

For this integrated list, Categories 1 and 2 are considered fully supporting any assessed uses. This portion of the integrated list is extensive (thousands of segments); thus, a printed copy is not provided. A table of waters on Categories 1 through 3 is available for downloading on the DWQ website (http://h2o.enr.state.nc.us/tmdl/General_303d.htm). **Categories 5, 6 and 7 constitute the 2004 North Carolina 303(d) List for the State of North Carolina**.

Delisting Waters

In general, waters will move from Categories 5, 6 or 7 when data show that uses are fully supported or when a TMDL has been approved by EPA. In some cases, mistakes have been discovered in the original listing decision and the mistakes are being corrected. Waters appearing on the previously approved Impaired waters list will be moved to Categories 1, 2, 3 or 4 under the following circumstances:

- an updated 305(b) use support rating of Supporting, as described in the basinwide management plans;

- applicable water quality standards are being met (i.e., no longer Impaired for a given pollutant) as described in either basinwide management plans or in technical memoranda;
- the basis for putting the water on the list is determined to be invalid (i.e., was mistakenly identified as Impaired in accordance with 40 CFR 130.7(b)(6)(iv) and/or National Clarifying Guidance for State and Territory 1998 Section 303(d) Listing Decisions. Robert Wayland, III, Director. Office of Wetlands, Oceans and Watersheds. Aug 27, 1997);
- a water quality variance has been issued for a specific standard (e.g., chloride);
- removal of fish consumption advisories or modification of fish eating advice;
- typographic listing mistakes (i.e., the wrong water was identified); and
- EPA has approved a TMDL.

Scheduling TMDLs

Category 5 waters, those for which a TMDL is needed, are at many different stages on the path to an approved TMDL. Some require additional data collection to adequately define the problem in TMDL terms. Some require more outreach to increase stakeholder involvement. Others need to have a technical strategy budgeted, funded and scheduled. Some are ready for EPA submittal.

North Carolina has prioritized TMDL development for waters Impaired due to bacteria or turbidity. The approach of prioritizing TMDL development based on pollutant has been successfully used in other states. Limited resources are used more effectively with a focus on a particular pollutant. Waters Impaired by other pollutants (i.e., not bacteria) are not excluded from the schedule. However, the majority of waters prioritized for the next few years are associated with bacterial contamination. Compliance with TMDL development schedules provided in the Integrated Report depends upon DWQ and EPA resources.

North Carolina uses biological data to place the majority of waterbody assessment units on the 303(d) list. Additional consideration and data collection are necessary if the establishment of a TMDL for waters on Category 6 is to be expected. It is important to understand that the identification of waters in Category 6 does not mean that they are low priority waters. The assessment of these waters is a high priority for the State of North Carolina. However, it may take significant resources and time to determine the environmental stressors and potentially a cause of impairment. Assigning waters to Category 6 is a declaration of the need for more data and time to adequately define the problems and whether pollution, pollutants or a combination affects waters.

According to EPA guidance (EPA 2004), prioritization of waterbody assessment units for TMDLs need not be reflected in a “high, medium or low” manner. Instead, prioritization can be reflected in the TMDL development schedule. Generally, North Carolina attempts to develop TMDLs within 10 years of the original pollutant listing. Other information for each assessment unit is also utilized to determine the priority in the TMDL development schedule. This information includes the following:

- year listed. Assessment units that have been on the 303(d) list for the longest period of time will receive priority for TMDL development and/or stressor studies;

- reason for listing. (Applicable to Category 5 AUs only) AUs with an impairment due to a standard violation will be prioritized based on which standard was violated. Standard violations due to bacteria or turbidity currently receive priority for TMDL development;
- classification (AUs classified for primary recreation (Class B), water supply (Class WS-I through WS-V), trout (Tr), high quality waters (HQW), and outstanding resource waters (ORW) will continue to receive a higher priority for TMDL development and/or stressor studies; and
- basinwide Planning Schedule (Applicable to Category 6 AUs only). The basinwide schedule is utilized to establish priority for stressor studies.)

Revising TMDLs

Current federal regulations do not specify when TMDLs should be revised. However, there are several circumstances under which it would seem prudent to revisit existing TMDLs. The TMDL analysis of targets and allocations is based upon the existing water quality standards, hydrology, water quality data (chemical and biological), and existing, active NPDES wastewater discharges. Conditions related to any of these factors could be used to justify a TMDL revision. Specific conditions that the Division will consider prior to revising an existing, approved TMDL include the following:

- a TMDL has been fully implemented and the water quality standards continue to be violated. If a TMDL has been implemented and water quality data indicate no improvement or a decline in overall water quality, the basis for the TMDL reduction or the allocation may need to be revised;
- a change of a water quality standard (e.g., fecal coliform to Echerichia coli). The Division will prioritize review of existing TMDLs and data to determine if a revision to TMDLs will be required;
- the addition or removal of hydraulic structures to a waterbody (e.g., dams). Substantial changes to waterbody hydrology and hydraulics have the potential to change many aspects of target setting, including the water quality standard upon which the TMDL was developed, the water quality data, and the water quality modeling; and
- incorrect assumptions were used to derive the TMDL allocations. This would include errors in calculations and omission of a permitted discharge.

Should a TMDL be revised due to needed changes in TMDL targets, the entire TMDL would be revised. This includes the TMDL target, source assessment, and load and wasteload allocations. However, the Division may elect to revise only specific portions of the TMDL. For example, changes may be justifiable to the load and wasteload allocation portions of a TMDL due to incorrect calculations or inequities. In these cases, revisions to the TMDL allocations would not necessarily include a revision of TMDL targets.

Appendix VIII

Roanoke River Basin Nonpoint Source Program Description 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. http://www.nrcs.usda.gov/

Area 2 Conservationist	Jacquie Simon	704-637-8077	530 West Innes Street, Salisbury, NC 28144
Area 3 Conservationist	William Harrell	919-751-0976	208 Mallory Street, Goldsboro, NC 27534

County	Contact Person	Phone	Address
Alamance	Rick Bailey	336-228-1753	209 N. Graham-Hopedale Road, Burlington NC 27217
Beaufort	Rodney Woolard	252-946-4989	155C Airport Road, Washington, NC 27889
Bertie	Paula Ashley	252-794-5305	106 Dundee Street, PO Box 566, Windsor, NC 27983
Caswell	Warren Mincey	336-694-4581	Main Street, PO Box 96, Yanceyville, NC 27379
Forsyth	Randy Blackwood	336-767-0720	1450 Fairchild Road, Winston-Salem, NC 27105
Granville	Diana Lewis	919-693-4603	146 Main Street, PO Box 10, Oxford, NC 27565
Guilford	Gary Cox	336-375-5401	3309 Burlington Road, Greensboro, NC 27405
Halifax	Wayne Short	252-583-3481	359 Ferrell Lane, PO Box 8, Halifax, NC 27839
Martin	Rupert Hasty	252-792-4350	104 Kehukee Park Road, Williamston, NC 27892
Northampton	Tony Short	252-534-2591	John W. Faison Building, PO Box 218, Jackson, NC 27845
Orange	Brent Bogue	919-644-1079	306D Revere Road, PO Box 8181, Hillsborough, NC 27278
Person	Jim Huey	336-597-2973	304 S Morgan Street, Roxboro, NC 27573
Rockingham	Harvey Campbell	336-342-0460	525 NC 65, Suite 100, Reidsville, NC 27320
Stokes	Dede DeBruhl	336-593-2846	501 N Main Street, PO Box 98, Danbury, NC 27016
Surry	Richard Everhart	336-386-8751	220 Cooper Street, PO Box 218, Dobson, NC 27017
Vance	Diana Lewis	252-438-5727	305 Young Street, Henderson, NC 27536
Warren	Robert Brown	252-257-3836	820 Highway 158 Business West, Warrenton, NC 27589
Washington	Rufus Croom	252-793-4561	128 East Water Street, Plymouth, NC 27962

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. http://www.enr.state.nc.us/DSWC/

County	Phone	Address
Alamance	336-228-1753	209 N. Graham-Hopedale Road, Burlington NC 27217
Beaufort	252-946-4989	155C Airport Road, Washington, NC 27889
Bertie	252-794-5305	106 Dundee Street, PO Box 566, Windsor, NC 27983
Caswell	336-694-4581	Main Street, PO Box 96, Yanceyville, NC 27379
Edgecombe	252-823-8187	201 Andrew Street, Tarboro, NC 27886
Forsyth	336-767-0720	1450 Fairchild Road, Winston-Salem, NC 27105
Granville	919-693-4603	146 Main Street, PO Box 10, Oxford, NC 27565
Guilford	336-375-5401	3309 Burlington Road, Greensboro, NC 27405
Halifax (Fishing Creek)	252-583-3481	359 Ferrell Lane, PO Box 8, Halifax, NC 27839
Martin	252-792-4350	104 Kehukee Park Road, Williamston, NC 27892

Agriculture (continued)

County	Phone	Address
Northampton	252-534-2591	John W. Faison Building, PO Box 218, Jackson, NC 27845
Orange	919-732-8181	306D Revere Road, PO Box 8181, Hillsborough, NC 27278
Person	336-597-2973	304 S Morgan Street, Roxboro, NC 27573
Rockingham	336-342-0460	525 NC 65, Suite 100, Reidsville, NC 27320
Stokes	336-593-2846	501 N Main Street, PO Box 98, Danbury, NC 27016
Surry	336-386-8751	220 Cooper Street, PO Box 218, Dobson, NC 27017
Vance	252-438-5727	305 Young Street, Henderson, NC 27536
Warren	252-257-1753	820 Highway 158 Business West, Warrenton, NC 27589
Washington	252-793-4561	128 East Water Street, Plymouth, NC 27962

Division of Soil and Water Conservation:

State agency that administers the *Agricultural Cost Share Program for Nonpoint Source Pollution Control* (ACSP). Allocates ACSP funds to the Soil and Water Conservation Districts, and provides administrative and technical assistance related to soil science and engineering. Distributes Wetlands Inventory maps for a small fee. http://www.enr.state.nc.us/DSWC/

Central Office – ACSP	Teresa Furr	919-715-6101	1614 Mail Service Center, Raleigh, NC 27604
Central Office - NPS	David Williams	919-715-6103	1614 Mail Service Center, Raleigh, NC 27604
Raleigh Region*	Steve Bennett	919-791-4200	1628 Mail Service Center, Raleigh, NC 27699
Washington Region*	David Cash	252-946-6481	919 Washington Mall, Washington, NC 27889
Winston-Salem Region*	Michelle Lovejoy	336-771-5000	585 Waughtown Street, Winston-Salem, NC 27107

NCDA Regional Agronomists:

The NC Department of Agriculture technical specialists: certify waste management plans for animal operations; provide certification training for swine waste applicators; track, monitor, and account for use of nutrients on agricultural lands; operate the state *Pesticide Disposal Program,* and enforce the state pesticide handling and application laws with farmers.
http://www.ncagr.com/agronomi/index.htm

Central Office	J. Kent Messick	919-733-2655	4300b Reedy Creek Rd., Raleigh, NC 27607
Region 1	Wayne Nixon	252-426-7210	
Region 2	Kent Yarborough	252-793-4118	207 Research Station Rd., Plymonth, NC 27962
Region 6	Charles Mitchell	919-562-7700	1040 Mail Service Center Raleigh, NC 27699
Region 8	Robin Watson	336-570-6850	1709 Fairview St., Burlington, NC 27215

Education

NC Cooperative Extension Service:

Provides practical, research-based information and programs to help individuals, families, farms, businesses and communities. Extension service wedsite: http://www.ces.ncsu.edu/index.php?page=home

County	Contact Person	Phone	Address
Alamance	Rett Davis	336-570-6740	209-C N Graham-Hopedale Rd., Burlington, NC 27217
Beaufort	Ann Darkow	252-946-0111, Ext.23	155-A Airport Rd., Washington, NC 27889
Bertie	Richard Rhodes	252-794-5317, Ext.6171	106 Dundee St., Windsor, NC 27983
Caswell	Joey Knight	336-694-4158	126 Court Square, Agriculture Building, Yanceyville, NC 27379
Forsyth	Mark Tucker	336-767-8213	1450 Fairchild Rd., Winston-Salem, NC 27105
Granville	Johnsie Cunningham	919-603-1350	208 Wall St., Oxford, NC 27565
Guilford	Margaret Farrow	336-375-5876	3309 Burlington Rd., Greensboro, NC 27405
Halifax	Zoann Parker	252-583-5161	359 Ferrell Lane, Halifax, NC 27839
Martin	J.B. Coltrain	252-792-1621	205 E Main St., Williamston, NC 27892
Northampton	Rose Massey	252-534-2711	9495 NC 305 Hwy, Jackson, NC 27845
Orange	Fletcher Barber	919-245-2051	306-E Revere Rd., Hillsborough, NC 27278

Education (continued)

County	Contact Person	Phone	Address
Person	Derek Day	336-599-1195	304 S Morgan St., Room 123, Roxboro, NC 27573
Rockingham	Scott Shoulars	336-342-8230	525 NC Hwy 65, Suite 200, Reidsville, NC 27320-8861
Stokes	Jack Loudermilk	336-679-2061	700 N Main St., Danbury, NC 27016-0460
Surry	Brenda Rose	336-401-8025	210 N Main St., Dobson, NC 27017
Vance	Harold Thompson	252-438-8188, Ext. 20	305 Young St., Henderson, NC 27536
Warren	Peter Hight	252-257-3640	158 Rafters Lane, Warrenton, NC 27589
Washington	Frank Winslow	252-793-2163	128 E Water St., Plymouth, NC 27962

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. DFR website: http://www.dfr.state.nc.us/

Central Office	Bill Swartley - Forest Hydrologist & NPS Unit Leader	919-733-2162 ext. 206	1616 Mail Service Center, Raleigh NC 27699-1616
	Sean Brogan - Water Quality & Wetlands Staff Forester	919-553-6178 ext. 230	2411 Old US 70 West, Clayton, NC 27520
District Water Quality Foresters			
District 5 Counties – Edgecome, Franklin, Greene, Halifax, Nash, Northampton, Warren, Wayne, Wilson			
District 5	Gail Bledsoe	252-442-1626	737 Smokey Road, Rocky Mount, NC 27804-2002
District 7 Counties – Bertie, Camden, Chowan, Currituck, Gates, Hertford, Martin, Pasquotank, Perquimans			
District 7	Doug Wassum	252-331-4781	861 Berea Church Road, Elizabeth City NC 27909-7303
District 10 Counties – Davidson, Davie, Forsyth, Guilford, Randolph, Rockingham, Rowan, Stokes, Surry, Yadkin			
District 10	Keith Money	336 956-2111	304 Old Hargrave Road, Lexington NC 27295-7594
District 11 Counties – Alamance, Caswell, Durham, Granville, Orange, Person, Vance, Wake			
District 11	Jen Johnson	919-732-8105	3314 NC Hwy 86 South, Hillsborough NC 27278-8711

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. Website: http://www.dlr.enr.state.nc.us/

Central Office	Mel Nevils	919-733-4574	512 North Salisbury Street, Raleigh NC 27626
Central Office - Sedimentation	Gray Hauser	919-733-4574	512 North Salisbury Street, Raleigh NC 27626
Central Office -Mining	Floyd Williams	919-733-4574	512 North Salisbury Street, Raleigh NC 27626
Raleigh Region*	John Holley	919-791-4200	3800 Barrett Dr., Raleigh, NC 27609
Washington Region*	Pat McClain	252-946-6481	943 Washington Square Mall, Washington, NC 27889
Winston-Salem Region*	Matthew Gantt	336-771-5000	585 Waughtown St., Winston-Salem, NC 27107

Local Erosion and Sedimentation Control Ordinances:

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

Guilford County	Earl Davis	336-641-3803	PO Box 3427,Greensboro, NC 27402
City of Henderson	Frank Frazier	252-431-6026	PO Box 1434, Henderson, NC 27536
Orange County	Reynolds Ivins	919-254-2586	PO Box 8181, Hillsborough, NC 27278
Winston-Salem / Forsyth County	Jeff Kopf	336-727-2388	100 E. First St., Suite 328, Winston-Salem, NC 27101

General Water Quality

DENR DWQ Planning Section:

Coordinate the numerous nonpoint source programs carried out by many agencies; coordinate the Neuse River and Tar-Pamlico River Nutrient Sensitive Waters Strategies; administer the Section 319 grants program statewide; model water quality; prepares basinwide water quality assessment plans and conduct water quality classifications and standards activities.

DWQ Planning website: http://h2o.enr.state.nc.us/pb/index.html

Planning Section Chief	Alan Clark	919-733-5083 x570	1617 Mail Service Center, Raleigh NC 27699
Basinwide Planning	Darlene Kucken	919-733-5083 x354	1617 Mail Service Center, Raleigh NC 27699
NPS Planning	Rich Gannon	919-733-5083 x356	1617 Mail Service Center, Raleigh NC 27699
Modeling/TMDL	Michelle Woolfolk	919-733-5083 x505	1617 Mail Service Center, Raleigh NC 27699
Classifications & Standards	Jeff Manning	919-733-5083 x557	1617 Mail Service Center, Raleigh NC 27699
Groundwater Planning	Carl Bailey	919-733-5083 x522	1617 Mail Service Center, Raleigh NC 27699

DENR DWQ Surface Water Protection Section:

Conduct permitting and compliance in accordance with the federal National Pollution Discharge Elimination System (NPDES); Regulate sewage collection systems; control and document discharge of wastewater; oversight of the wetlands 401 certification program; nonpoint source compliance; and stormwater permitting. DWQ Surface Water Protection Website: **http://h2o.enr.state.nc.us/swps/**

Point Source	Dave Goodrich	919-733-5083 x517	1617 Mail Service Center, Raleigh NC 27699
NPDES (Western)	Susan Wilson	919-733-5083 x510	1617 Mail Service Center, Raleigh NC 27699
NPDES (Eastern)	Gil Vinzani	919-733-5083 x540	1617 Mail Service Center, Raleigh NC 27699
PERCS Supervisor	Jeff Poupart	919-733-5083 x527	1617 Mail Service Center, Raleigh NC 27699
Wetlands & Stormwater	Tom Reeder	919-733-5083	1650 Mail Service Center, Raleigh NC 27699
Program & Policy Development	John Dortey	919-733-9646	1650 Mail Service Center, Raleigh NC 27699
Transportation Permitting	John Hennessy	919-733-5694	1650 Mail Service Center, Raleigh NC 27699
401 Oversight/Express Permitting	Cynthia Karoly	919-733-9721	1650 Mail Service Center, Raleigh NC 27699
NPS Compliance	Stephen Smith	919-733-5083	1650 Mail Service Center, Raleigh NC 27699
Stormwater Permitting	Tilman Bennett	919-733-5083	1650 Mail Service Center, Raleigh NC 27699

DENR DWQ Aquifer Protection Section:

Oversight of animal waste systems; characterizes the state's groundwater aquifers; investigates contamination cases; prevents and investigates groundwater contamination; conducts remediation permitting; oversees nondischarge wastewater treatment and recycle systems. DWQ Aquifer Protection Website: http://h2o.enr.state.nc.us/aps/

Animal Operations	Paul Sherman	919-715-6697	1636 Mail Service Center, Raleigh NC 27699
Groundwater Protection	Debra Watts	919-715-6699	1636 Mail Service Center, Raleigh NC 27699
Groundwater Investigation	Tim Hill		1636 Mail Service Center, Raleigh NC 27699
Land Application	Kim Colson	919-715-6165	1636 Mail Service Center, Raleigh NC 27699

DWQ Regional Offices:

Conduct permitting and enforcement field work on point sources, stormwater, wetlands and animal operations; conduct enforcement on water quality violations of any kind; and perform ambient water quality monitoring.

http://www.enr.state.nc.us/html/regionaloffices.html

Raleigh Region*	919-791-4200	3800 Barrett Dr., Raleigh, NC 27609
Washington Region*	252-946-6481	943 Washington Square Mall, Washington, NC 27889
Winston-Salem Region*	336-771-5000	585 Waughtown St., Winston-Salem, NC 27107

General Water Quality (continued)

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. http://www.ncwildlife.org/

Central Office	Wildlife Management	919-707-0050	1722 Mail Service Center, Raleigh, NC 27699

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.

Raleigh Field Office	Jean Manuele	919-876-8441	6508 Falls of the Neuse Rd., Suite 120, Raleigh, NC 27615
Washington Office	David Lekson	252-975-1616	PO Box 1000, Washington, NC 27889
Wilmington Office	Keith Harris	910-251-4511	69 Darlington Ave., Wilmington, NC 27889

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. http://wastenot.enr.state.nc.us/

Central Office	Brad Atkinson	919-733-0692	401 Oberlin Road, Suite 150, Raleigh NC 27605
Raleigh Region*	Robert Davies	919-791-4200	3800 Barrett Dr., Raleigh, NC 27609
Washington Region*	James Scott Bullock	252-946-6481	943 Washington Square Mall, Washington, NC 27889
Winston-Salem Region*	Brent Rockett	336-771-5090	585 Waughtown St., Winston-Salem, NC 27107

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. http://www.deh.enr.state.nc.us/

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	Andy Adams	919-715-3274	2728 Capital Boulevard, Raleigh NC 27604
Raleigh Region*		919-791-4200	3800 Barrett Dr., Raleigh, NC 27609
Washington Region*	Bob Uebler	252-946-6481	943 Washington Square Mall, Washington, NC 27889
Winston-Salem Region*	Kevin Neal	336-462-0052	585 Waughtown St., Winston-Salem, NC 27107

County	Primary Contact	Phone	Address
Bertie	Jerry Parks	(252) 338-4490	PO Box 189, Elizabeth City, NC 27907-0189
Caldwell	Denise Michaud	(828) 426-8579	1966-B Morganton Blvd., SW, Lenoir, NC 28645
Forsyth	Time Monroe	(336) 703-3225	799 Highland Ave., PO Box 686, Winston-Salem, NC 27102
Granville/Vance	W. Rodwell Drake, Jr. MD	(919) 693-2688	101 Hunt Dr., PO Box 367, Oxford, NC 27565
Halifax	Lynda Smith	(252) 583-6651	19 Dobbs St., PO Box 10, Halifax, NC 27839
Martin/Tyrrell	Keith Patton	1-888-388-9208	210 West Liberty St, Williamston, NC 27892

On-Site Wastewater Treatment (Continued)			
County	**Primary Contact**	**Phone**	**Address**
Washington	Keith Patton	1-888-388-9208	198 NC Hwy 45 North, Plymouth, NC 27962
Northampton	Sue Gay	(252) 534-5841	9495 NC 305 HWY, PO Box 635, Jackson, NC 27845
Person	Janet Clayton	(336) 597-1790	355-A South Madison Blvd, Roxboro, NC 27573
Rockingham	Glenn Martin	(336) 342-8180	PO Box 204, Wentworth, NC 27375
Stokes	Don Moore	(336) 593-2403	1009 N. Main St., PO Box 187, Danbury, NC 27016
Warren	Kaye Hall Interim	(252) 257-1538	544 West Ridgeway St., Warrenton, NC 27589

*** DENR Raleigh Region Office covers the following counties:** Chatham, Durham, Edgecombe, Franklin, Granville, Halifax, Johnston, Lee, Nash, Northampton, Orange, Person, Vance, Wake, Warren and Wilson.

*** DENR Washington Region Office covers the following counties:** Beaufort, Bertie, Camden, Chowan, Craven, Currituck, Dare, Gates, Greene, Hertford, Hyde, Jones, Lenoir, Martin, Pamlico, Pasquotank, Perquimans, Pitt, Tyrrell, Washington and Wayne.

*** DENR Winston-Salem Region Office covers the following counties:** Alamance, Alleghany, Ashe, Caswell, Davidson, Davie, Forsyth, Guilford, Randolph, Rockingham, Stokes, Surry, Watauga, Wilkes and Yadkin.

Appendix IX

Use Support Methodology

Introduction to Use Support

All surface waters of the state are assigned a classification appropriate to the best-intended uses of that water. Waters are assessed to determine how well they are meeting the classified or best-intended uses. The assessment results in a use support rating for the use categories that apply to that water.

Use Support Categories

Beginning in 2000 with the *Roanoke River Basinwide Water Quality Plan*, DWQ assesses ecosystem health and human health risk through the use of five use support categories: aquatic life, recreation, fish consumption, water supply, and shellfish harvesting. These categories are tied to the uses associated with the primary classifications applied to NC rivers and streams. Waters are Supporting if data and information used to assign a use support rating meet the criteria for that use category. If these criteria are not met, then the waters are Impaired. Waters with inconclusive data and information are Not Rated. Waters where no data or information are available to make an assessment are No Data. The table below specifies which use support categories apply to which primary classifications.

A single body of water may have more than one use support rating corresponding to one or more of the use support categories, as shown in the following table. For many waters, a use support category will not be applicable (N/A) to the classification of that water (e.g., shellfish harvesting is only applied to Class SA waters). A full description of the classifications is available in the DWQ document titled: *Classifications and Water Quality Standards Applicable to Surface Waters of North Carolina* (15A NCAC 2b .0100 and .0200). Information can also be found within each basin plan and at http://h2o.enr.state.nc.us/csu/.

Use Support Categories

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

Assessment Period

Data and information are used to assess water quality and assign use support ratings using a five-year data window that ends on August 31 of the year of basinwide biological sampling. For example, if biological data are collected in a basin in 2004, then the five-year data window for use support assessments would be September 1, 1999 to August 31, 2004. There are occasionally some exceptions to this data window, especially when follow up monitoring is needed to make decisions on samples collected in the last year of the assessment period.

Data and information for assessing water quality and assigning use support ratings for lakes uses a data window of October 1 to September 30. Any data collected by DWQ during the five-year data window that ends on September 30 of the year of biological sampling will be used to develop a Weight-of-Evidence approach to lakes assessment. Refer to page 16 of this appendix for more information.

Assessment Units

DWQ identifies waters by index numbers and assessment unit numbers (AU). The AU is used to track defined stream segments or waterbodies in the water quality assessment database, for the 303(d) Impaired waters list, and in the various tables in basin plans and other water quality documents. The AU is a subset of the DWQ index number (classification identification number). A letter attached to the end of the AU indicates that the AU is smaller than the DWQ index segment. No letter indicates that the AU and the DWQ index segment are the same.

Interpretation of Data and Information

It is important to understand the associated limitations and degree of uncertainty when interpreting use support ratings. Although these use support methods are based on data analysis and other information, some best professional judgment is applied during these assessments. Use support ratings are intended to provide an assessment of water quality using a five-year data window, to describe how well surface waters support their classified uses, and to document the potential stressors contributing to water quality degradation and the sources of these contributions.

Use support methods continue to improve over time, and the information and technology used to make use support determinations also continue to become more accurate and comprehensive. These improvements sometimes make it difficult to make generalizations comparing water quality between basin plans. However, technology and methods improvements result in more scientifically sound use support assessments.

Assessment Methodology

Introduction

Many types of data and information are used to determine use support ratings and to identify stressors and sources of water quality degradation. All existing data pertaining to a stream segment for each applicable use support category are entered into a use support database. Assessments and data entries may include use support ratings for each of the five use support categories, basis of assessment, stressors and potential sources, biological, chemical/physical (ambient monitoring), and lakes assessment data, fish consumption advisories from the NC Department of Health and Human Services, swimming advisories and shellfish sanitation growing area classifications from the NC Division of Environmental Health, and available land cover and land use information. The following describes the data and methodologies used to conduct use support assessments. These methods will continue to be refined as additional information and technology become available.

Basis of Assessment

Assessments are made on an overall basis of either monitored (M) or evaluated (E), depending on the level of information available. A monitored rating is based on the most recent five-year data window and site-specific data and is therefore treated with more confidence than an evaluated rating. Evaluated ratings are used when there are no site-specific data.

Rating Basis	**Use Support Category**	**Assessment Applicability***
S/M	AL	Biological community data or ambient water quality parameters do not exceed criteria in AU during assessment period. Biological and ambient data are independently applied.
S/M	REC	Ambient fecal coliform bacteria levels do not exceed criteria in AU or AU with DEH sites is posted with advisories for 61 days or less during assessment period.
S/M	SH	AU is a DEH Approved shellfish growing area.
I/M	AL	Biological community data or ambient water quality parameters exceed criteria in AU during assessment period. Biological and ambient data are independently applied.
I/M	REC	Ambient fecal coliform bacteria levels exceeds criteria in AU or AU with DEH sites is posted with advisories for more than 61 days during assessment period.
I/M	FC	DHHS has established a site-specific advisory for fish consumption and fish tissue data are available.
I/M	SH	AU is a DEH Conditionally-Approved, Prohibited or Restricted shellfish growing area.
NR/M	AL	Biological community is Not Rated or inconclusive, or ambient water quality parameters are inconclusive or there are less than 10 samples in AU during assessment period. Biological and ambient data are independently applied.
NR/M	REC	Ambient fecal bacteria parameter exceeds annual screening criteria, but does not exceed assessment criteria of five samples in 30 days in AU during assessment period.
NR/M	FC	AU does not have site-specific advisory and is not under a mercury advice or drains to areas within a mercury advice; fish tissue data available.
S/E	AL	AU is a tributary to a S/M AU and land use is similar between AUs.
S/E	WS	AU is classified as WS, and DEH report notes no significant closures at time of assessment.
I/E	FC	AU is in basin under a mercury advice or drains to areas within a mercury advice. AU has a site-specific advisory and there is no fish tissue data available.
NR/E	AL	AU is tributary to I/M AU, or AU is in watershed with intensive and changing land use, or other information suggests negative water quality impacts to AU. Discharger in AU has noncompliance permit violations or has failed three or more WET tests during the last two years of the assessment period.
NR/E	REC	Discharger has noncompliance permit violations of fecal bacteria parameter during last two years of assessment period.
NR/E	FC	AU does not have site-specific advisory and is not under a mercury advice or drains to areas within a mercury advice, or has no fish tissue data.
ND	AL, REC, SH	No data available in AU during assessment period.

Note:	S/M = Supporting/Monitored	I/M = Impaired/Monitored	NR/M = Not Rated/Monitored
	S/E = Supporting/Evaluated	I/E = Impaired/Evaluated	NR/E = Not Rated/Evaluated
	ND = No Data		
	AL = Aquatic Life	REC = Recreation	FC = Fish Consumption
	SH = Shellfish Harvesting	WS = Water Supply	
	AU = Assessment Unit	WET = Whole Effluent Toxicity	
	DEH = Division of Environmental Health		
	DHHS = Department of Health and Human Services		
	* = for lakes assessments, see page 16		

Supporting ratings are extrapolated up tributaries from monitored streams when there are no problematic dischargers with permit violations or changes in land use/cover. Supporting ratings may also be applied to unmonitored tributaries where there is little land disturbance (e.g., national forests and wildlife refuges, wilderness areas or state natural areas). Problem stressors or sources are not generally applied to unmonitored tributaries. Impaired ratings are not extrapolated to unmonitored tributaries.

Stressors

Biological and ambient samplings are useful tools to assess water quality. However, biological sampling does not typically identify the causes of impairment, and ambient sampling does not always link water quality standards to a biological response. Linking the causes of impairment and the biological response are a complex process (USEPA, 2000) that begins with an evaluation of physical, chemical or biological entities that can induce an adverse biological response. These entities are referred to as stressors. A stressor may have a measurable impact to aquatic health. Not all streams will have a primary stressor or cause of impairment. A single stressor may not be sufficient to cause impairment, but the accumulation of several stressors may result in impairment. In either case, impairment is likely to continue if the stressor or the various cumulative stressors are not addressed. Use support assessments evaluate the available information related to potential stressors impacting water quality.

A stressor identification process may be initiated after a stream appears on the 303(d) list in order to address streams that are Impaired based on biological data. Intensive studies are required to summarize and evaluate potential stressors to determine if there is evidence that a particular stressor plays a substantial role in causing the biological impacts. Intensive studies consider lines of evidence that include benthic macroinvertebrate and fish community data, habitat and riparian area assessment, chemistry and toxicity data, and information on watershed history, current watershed activities and land uses, and pollutant sources. These studies result in decisions regarding the probable stressors contributing to or causing impairment. The intensity of a stressor study may be limited due to a lack of resources. In these cases, it may still be appropriate to include stressors in use support assessments, but to also note where additional information is needed in order to evaluate other stressors.

Where an ambient parameter is identified as a potential concern, the parameter is noted in the DWQ database and use support summary table. Where habitat degradation is identified as a stressor, DWQ and others attempt to identify the type of habitat degradation (e.g., sedimentation, loss of woody habitat, loss of pools or riffles, channelization, lack of riparian vegetation, streambed scour and bank erosion).

Aquatic Life Category

The aquatic life category is an ecosystem approach to assessing the biological integrity of all surface waters of the state. The biological community data and ambient water quality data are used in making assessments in this category. These represent the most important monitoring data for making water quality assessments in the aquatic life category. Evaluation information such as compliance and whole effluent toxicity information from NPDES dischargers, land cover, and other more anecdotal information are also used to identify potential problems and to refine assessments based on the monitoring data. The following is a description of each monitoring data type and the criteria used in assigning use support ratings. Criteria used to evaluate the other information and assign use support ratings are also described. Refer to page 14 for lakes and reservoir assessment methods as applied in the aquatic life category.

Biological Data

Benthic macroinvertebrate (aquatic insects) community and fish community samples are the best way to assess the biological integrity of most waterbodies. Unfortunately, these community measures cannot be applied to every stream size and are further limited by geographic region. These community measures are designed to detect current water quality and water quality changes that may be occurring in the watershed. However, they are only directly applied to the assessment unit where the sample was collected.

Where recent data for both benthic macroinvertebrates and fish communities are available, both are assessed for use support ratings. When the data from multiple biological data types are gathered, each data type is assessed independently. Biological monitoring is typically assessed independent of ambient monitoring data and either may be used to assign a use support rating for an assessment unit.

Benthic Macroinvertebrate Criteria

Criteria have been developed to assign bioclassifications to most benthic macroinvertebrate samples based on the number of taxa present in the pollution intolerant aquatic insect groups of *Ephemeroptera, Plecoptera* and *Trichoptera* (EPTs); and the Biotic Index (BI), which summarizes tolerance data for all taxa in each sample. Because these data represent water quality conditions with a high degree of confidence, use support ratings using these data are considered monitored.

If a Fair macroinvertebrate bioclassification is obtained under conditions (such as drought or flood conditions, recent spills, etc.) that may not represent normal conditions or is borderline Fair (almost Good-Fair), a second sample should be taken within 12-24 months to validate the Fair bioclassification. Such sites will be Not Rated until the second sample is obtained.

Use support ratings are assigned to assessment units using benthic macroinvertebrate bioclassifications as follows.

Waterbody Sample Type or Criteria	Benthic Bioclassification	Use Support Rating
Mountain, piedmont, coastal A[3]	Excellent	Supporting
Mountain, piedmont, coastal A[3]	Good	Supporting
Swamp[1]	Natural	Supporting
Mountain, piedmont, coastal A	Good-Fair	Supporting
Smaller than criteria but Good-Fair[2]	Not Impaired	Supporting
Swamp[1]	Moderate Stress	Supporting
Mountain, piedmont, coastal A[3]	Fair	Impaired
Swamp[1]	Severe Stress	Impaired
Mountain, piedmont, coastal A[3]	Poor	Impaired
Criteria not appropriate to assign bioclassification	Not Rated	Not Rated

1 Swamp streams for benthos sampling are defined as streams in the coastal plain that have no visible flow for a part of the year, but do have flow during the February to early March benthic index period.

1 This designation may be used for flowing waters that are too small to be assigned a bioclassification (less than three square miles drainage area), but have a Good-Fair or higher bioclassification using the standard qualitative and EPT criteria.

2 Coastal A streams are those located in the coastal plain that have flow year round and are wadeable.

Fish Community Criteria

The North Carolina Index of Biotic Integrity (NCIBI) is a method for assessing a stream's biological integrity by examining the structure and health of its fish community. The NCIBI incorporates information about species richness and composition, indicator species, trophic function, abundance and condition, and reproductive function. Because these data represent water quality conditions with a high degree of confidence, use support ratings using these data are considered monitored. Use support ratings are assigned to assessment units using the NCIBI bioclassifications as follows:

NCIBI	Use Support Rating
Excellent	Supporting
Good	Supporting
Good-Fair	Supporting
Fair	Impaired
Poor	Impaired

The NCIBI was recently revised (NCDENR, 2001), and the bioclassifications and criteria have also been recalibrated against regional reference site data (NCDENR, 2000a, 2000b and 2001a). NCIBI criteria are applicable only to wadeable streams in the following river basins: Broad, Catawba, Savannah, Yadkin-Pee Dee, Cape Fear, Neuse, Roanoke, Tar-Pamlico, French Broad, Hiwassee, Little Tennessee, New and Watauga. Additionally, the NCIBI criteria are only applicable to streams in the piedmont portion of the Cape Fear, Neuse, Roanoke and Tar-Pamlico River basins. The definition of "piedmont" for these four river basins is based upon a map of North Carolina watersheds (Fels, 1997). Specifically:

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

NCIBI criteria have not been developed for:

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

Ambient Water Quality Monitoring Criteria

Chemical/physical water quality data are collected through the DWQ Ambient Monitoring Program statewide and NPDES discharger coalitions in some basins. All samples collected (usually monthly) during the five-year assessment period are used to assign a use support rating. Ambient water quality data are not direct measures of biological integrity, but the chemical/physical parameters collected can provide an indication of conditions that may be impacting aquatic life. Because these data represent water quality conditions with a high degree of confidence, use support ratings assigned using these data are considered monitored. Where both ambient data and biological data are available, each data type is assessed independently.

The parameters used to assess water quality in the aquatic life category include dissolved oxygen, pH, chlorophyll *a* and turbidity. Criteria for assigning use support ratings to assessment units with ambient water quality data of a minimum of ten samples are as follows:

Ratings Criteria	Rating
Numerical standard exceeded in ≤10% of samples	Supporting
Numerical standard exceeded in >10% of samples	Impaired
Less than 10 samples collected	Not Rated
DO and pH standard exceeded in swamp streams	Not Rated

Some standards are written with more specific criteria than others and these specific criteria are used to assess use support. For example, the DO standard for Class C waters is a daily average of 5 mg/l and an instantaneous value of 4 mg/l. Because DWQ does not collect daily DO levels at the ambient stations, the instantaneous value is used for assessment criteria. In areas with continous monitoring, the daily average of 5 mg/l will also be assessed. In addition, pH has a standard of not less than 6 and not greater than 9; each level is assessed. To assess the fecal coliform bacteria standard, five samples must be collected within a 30 day period (see Recreation Category for more information).

Multiple Monitoring Sites

There are assessment units with more than one type of monitoring data. When the data from multiple biological data types are gathered, each data type is assessed independently. Biological monitoring is typically assessed independent of ambient monitoring data and either may be used to assign a use support rating for an assessment unit. Monitoring data are always used over the evaluation information; however, evaluation information can be used to lengthen or shorten monitored assessment units and to assign use support ratings on an evaluated basis to non-monitored assessment units.

NPDES Wastewater Whole Effluent Toxicity (WET) Information

Whole Effluent Toxicity (WET) tests are required for all major NPDES discharge permit holders, as well as those minor NPDES dischargers with complex effluent (defined as not being of 100 percent domestic waste). WET tests are evaluated to determine if the discharge could be having negative water quality impacts. If a stream with a WET test facility has not been sampled for instream chronic toxicity, biological community data or has no ambient water quality data, and that facility has failed three or more WET tests in the last two years of the assessment period, the assessment unit is Not Rated. Because this information is not a direct measure of water quality and the confidence is not as high as for monitoring data, this use support rating is considered evaluated rather than monitored. Problems associated with WET test failures are addressed through NPDES permits.

NPDES Discharger Daily Monitoring Report (DMR) Information

NPDES effluent data monthly averages of water quality parameters are screened for the last two years of the assessment period. If facilities exceed the effluent limits by 20 percent for two or more months during two consecutive quarters, or have chronic exceedances of permit limits for four or more months during two consecutive quarters, then the assessment unit is Not Rated if no biological or ambient monitoring data are available. Because discharger effluent data is not a direct measure of water quality and data confidence is not as high as for stream monitoring data, the assessment units are considered evaluated rather than monitored. If biological or ambient data are available, that data will be used to develop a use support rating for appropriate stream segments.

Fish Consumption Category

The fish consumption category is a human health approach to assess whether humans can safely consume fish from a waterbody. This category is applied to all waters of the state. The use support rating is assigned using fish consumption advisories or advice as issued by the NC Department of Health and Human Services (DHHS). The fish consumption category is different from other categories in that assessments are based on the existence of a DHHS fish consumption advice or advisory at the time of use support assessment. The advice and advisories are based on DHHS epidemiological studies and on DWQ fish tissue data. DWQ fish tissue data are used to inform DHHS of potential fish tissue toxicity. DHHS is responsible for proclaiming a fish tissue advisory or advice for any waterbody. Fish tissue monitoring data are not used directly for assigning a use support rating in this category.

If a site-specific fish consumption advisory is posted at the time of assessment, the water is Impaired on either a monitored or evaluated basis dependent upon the availability of monitoring data. The DHHS has developed statewide fish consumption advice for certain fish species shown to have elevated levels of mercury in their tissue. All waters of the state are therefore Impaired/Evaluated in the fish consumption category.

Recreation Category

This human health related category evaluates waters for the support of primary recreation activities such as swimming, water-skiing, skin diving, and similar uses involving human body contact with water where such activities take place in an organized manner or on a frequent basis. Waters of the state designated for these uses are classified as Class B, SB and SA. This category also evaluates waters used for secondary recreation activities such as wading, boating, and other uses not involving human body contact with water, and activities involving human body contact with water where such activities take place on an infrequent, unorganized or incidental basis. These waters are classified as Class C, SC and WS.

The use support ratings applied to this category are currently based on the state's fecal coliform bacteria water quality standard where ambient monitoring data are available or on the duration of local or state health agencies posted swimming advisories. Use support ratings for the recreation category may be based on other bacteriological indicators and standards in the future.

DWQ conducts monthly ambient water quality monitoring that includes fecal coliform bacteria testing. The Division of Environmental Health (DEH) tests coastal recreation waters (beaches) for bacteria levels to assess the relative safety of these waters for swimming. If an area has elevated bacteria levels, health officials will advise that people not swim in the area by posting a swimming advisory and by notifying the local media and county health department.

The North Carolina fecal coliform bacteria standard for freshwater is: 1) not to exceed the geometric mean of 200 colonies per 100 ml of at least five samples over a 30-day period; and 2) not to exceed 400 colonies per 100 ml in more than 20 percent of the samples during the same period. The AU being assessed for the five-year data window is Supporting in the recreation category if neither number (1) nor (2) of the standard are exceeded. The AU being assessed is Impaired in the recreation category if either number (1) or (2) is exceeded. Waters without sufficient fecal coliform bacteria data (five samples within 30 days) are Not Rated, and waters with no data are noted as having No Data.

Assessing the water quality standard requires significant sampling efforts beyond the monthly ambient monitoring sampling and must include at least five samples over a 30-day period. Decades of monitoring have demonstrated that bacteria concentrations may fluctuate widely in surface waters over a period of time. Thus, multiple samples over a 30-day period are needed to evaluate waters against the North Carolina water quality standard for recreational use support.

Waters classified as Class SA, SB and B are targeted for this intensive sampling effort due to the greater potential for human body contact.

Waters with beach monitoring sites will be Impaired if the area is posted with an advisory for greater than 61 days of the assessment period. Waters with beach monitoring sites with advisories posted less than 61 days will be Supporting. Other information can be used to Not Rate unmonitored waters.

DWQ Ambient Monitoring Fecal Coliform Bacteria Screening Criteria
As with other information sources, all available information and data are evaluated for the recreation category using the assessment period. However, DWQ conducts an annual screening of DWQ ambient fecal coliform bacteria data to assess the need for additional monitoring or immediate action by local or state health agencies to protect public health.

Each March, DWQ staff will review bacteria data collections from ambient monitoring stations statewide for the previous sampling year. Locations with annual geometric means greater than 200 colonies per 100 ml, or when more than 20 percent of the samples are greater than 400 colonies per 100 ml, are identified for potential follow-up monitoring conducted five times within 30 days as specified by the state fecal coliform bacteria standard. If bacteria concentrations exceed either portion of the state standard, the data are sent to DEH and the local county health director to determine the need for posting swimming advisories. DWQ regional offices will also be notified.

Due to limited resources and the higher risk to human health, Class B, SB and SA waters will be given monitoring priority for an additional five times within 30 days sampling. Follow-up water quality sampling for Class C waters will be performed as resources permit. Any waters on the 303(d) list of Impaired waters for fecal coliform will receive a low priority for additional monitoring because these waters will be further assessed for TMDL development.

DWQ attempts to determine if there are any swimming areas monitored by state, county or local health departments or by DEH. Each January, DEH, county or local health departments are asked to list those waters which were posted with swimming advisories in the previous year.

Shellfish Harvesting Use Support
The shellfish harvesting use support category is a human health approach to assess whether shellfish can be commercially harvested and is therefore applied only to Class SA waters. The following data sources are used to assign use support ratings for shellfish waters.

Division of Environmental Health (DEH) Shellfish Sanitation Surveys
DEH is required to classify all shellfish growing areas as to their suitability for shellfish harvesting. Estuarine waters are delineated according to DEH shellfish management areas (e.g., Outer Banks, Area H-5) which include Class SA, SB and SC waters. DEH samples growing areas regularly and reevaluates the areas by conducting shellfish sanitation shoreline surveys every three years to determine if their classification is still applicable. DEH classifications may be changed after the most recent sanitary survey. Classifications are based on DEH bacteria sampling, locations of pollution sources, and the availability of the shellfish resource. Growing waters are classified as follows.

DEH Classification	DEH Criteria
Approved (APP)	**Fecal Coliform Standard for Systematic Random Sampling:** The median fecal coliform Most Probable Number (MPN) or the geometric mean MPN of the water shall not exceed 14 per 100 milliliters (ml), and the estimated 90th percentile shall not exceed an MPN of 43 MPN per 100 ml for a 5-tube decimal dilution test. **Fecal Coliform Standard for Adverse Pollution Conditions Sampling:** The median fecal coliform or geometric mean MPN of the water shall not exceed 14 per 100 ml, and not more than 10 percent of the samples shall exceed 43 MPN per 100 ml for a 5-tube decimal dilution test.
Conditionally Approved-Open (CAO)	Sanitary Survey indicates an area can meet approved area criteria for a reasonable period of time, and the pollutant event is known and predictable and can be managed by a plan. These areas tend to be open more frequently than closed.
Conditionally Approved-Closed (CAC)	Sanitary Survey indicates an area can meet approved area criteria for a reasonable period of time, and the pollutant event is known and predictable and can be managed by a plan. These areas tend to be closed more frequently than open.
Restricted (RES)	Sanitary Survey indicates limited degree of pollution, and the area is not contaminated to the extent that consumption of shellfish could be hazardous after controlled depuration or relaying.
Prohibited (PRO)	No Sanitary Survey; point source discharges; marinas; data do not meet criteria for Approved, Conditionally Approved or Restricted Classification.

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

DWQ use support ratings may be assigned to separate segments within DEH management areas. In assessing use support, the DEH classifications and management strategies are only applicable to DWQ Class SA (shellfish harvesting) waters. It is important to note that DEH classifies all actual and potential growing areas (which includes all saltwater and brackish water areas) for their suitability for shellfish harvesting. This will result in a difference of acreage between DEH areas classified as CAC, PRO and RES, and DWQ waters rated as Impaired. For example, if DEH classifies a 20-acre area CAC, but only 10 acres are Class SA, only those 10 acres of Class SA waters are rated as Impaired.

The DEH "Closed" polygon coverage includes CAC, RES and PRO classifications, and it is not currently possible to separate out the PRO from the RES areas. Therefore, these areas are a combined polygon coverage, and DWQ rates these waters as Impaired.

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

DWQ and DEH are developing the database and expertise necessary to assess shellfish harvesting frequency of closures. In the interim, DWQ has been identifying the frequency of closures in Class SA waters using an interim methodology (see below) based on existing databases and GIS shapefiles. There will be changes in reported acreages in future assessments using the permanent methods and tools that result from this project.

Past Interim Frequency of Closure-Based Assessment Methodology

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

Percent of Time Closed within Basin Data Window	DEH Growing Area Classification	DWQ Use Support Rating
N/A	Approved*	Supporting
Closed ≤10% of data window	Portion of CAO closed ≤10% of data window	Supporting
Closed >10% of the data window	Portion of CAO closed >10% of data window	Impaired
N/A	CAC and PRO/RES**	Impaired

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

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

For CAO areas, DWQ worked with DEH to determine the number of days and acreages that CAO Class SA waters were closed to shellfish harvesting during the assessment period. For each growing area with CAO Class SA waters, DEH and DWQ defined subareas within the CAO area that were opened and closed at the same time. The number of days these CAO areas were closed was determined using DEH proclamation summary sheets and the original proclamations.

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

Current Assessment Methodology

Use support assessment is now conducted such that only the DEH classification will be used to assign a use support rating. By definition, CAO areas are areas that DEH has determined do not, or likely do not, meet water quality standards and these areas will be rated Impaired, along with CAC and PRO/RES areas. Only APP areas will be rated Supporting.

Growing areas that have been reclassified by DEH during the assessment period from a lower classification to APP will be rated Supporting. Areas that are reclassified from APP to any other classification during the assessment period will be rated Impaired.

Over the next few years, DWQ, DEH, Division of Coastal Management (DCM) and Division of Marine Fisheries (DMF) will be engaged in developing a database with georeferenced (GIS) shellfish harvesting areas. The new database and GIS tools will be valuable for the above agencies to continue to work together to better serve the public. Using the new database with georeferenced areas and monitoring sites, DEH will be able to report the number of days each area was closed excluding closures related to large or named storms.

Water Supply Use Support

This human health related use support category is used to assess all Class WS waters for the ability of water suppliers to provide potable drinking water. Water quality standards established for drinking water apply to water delivered to consumers after it has been treated to remove potential contaminants that may pose risks to human health. Ambient standards established by states under the Clean Water Act are not intended to ensure that water is drinkable without treatment. Modern water treatment technologies are required to purify raw water to meet drinking water standards as established by the North Carolina Division of Environmental Health.

Water supply use support is assessed by DWQ using information from the seven DEH regional water treatment plant consultant staff. Each January, the DEH staff consultants are asked to submit a spreadsheet listing closures and water intake switch-overs for all water treatment plants in their region. This spreadsheet describes the length and time of the event, contact information, and the reason for the closure or switch.

The spreadsheets are reviewed by DWQ staff to determine if any closures/switches were due to water quality concerns. Those closures/switches due to water quantity problems and reservoir turnovers are not considered for use support. The frequency and duration of closures/switches due to water quality concerns are considered when assessing use support. Using these criteria, North Carolina's surface water supplies are currently rated Supporting on an Evaluated basis. Specific criteria for rating waters Impaired are to be determined on a case-by-case basis.

Use of Outside Data

DWQ actively solicits outside data and information in the year before biological sampling in a particular basin. The solicitation allows approximately 90 days for data to be submitted. Data from sources outside DWQ are screened for data quality and quantity. If data are of sufficient quality and quantity, they may be incorporated into use support assessments. A minimum of ten samples for more than a one-year period is needed to be considered for use support assessments.

The way the solicited data are used depends on the degree of quality assurance and quality control of the collection and analysis of the data as detailed in the 303(d) report and shown in the table below. Level 1 data can be use with the same confidence as DWQ data to determine use support ratings. Level 2 or Level 3 data may be used to help identify causes of pollution and stressors. They may also be used to limit the extrapolation of use support ratings up or down a stream segment from a DWQ monitoring location. Where outside data indicate a potential problem, DWQ evaluates the existing DWQ biological and ambient monitoring site locations for adjustment as appropriate.

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

Lakes and Reservoir Use Assessment

Like streams, lakes are classified for a variety of uses. All lakes monitored as part of North Carolina's Ambient Lakes Monitoring Program carry the Class C (aquatic life) classification, and most are classified Class B and SB (recreation) and WS-I through WS-V (water supply). The surface water quality numeric standard specifically associated with recreation is fecal coliform. For water supplies, there are 29 numeric standards based on consumption of water and fish. Narrative standards for Class B and Class WS waters include aesthetics such as no odors and no untreated wastes. There are other numeric standards that also apply to lakes for the protection of aquatic life and human health. These standards also apply to all other waters of the state and are listed under the Class C rules. One of the major problems associated with lakes and reservoirs is increasing eutrophication related to nutrient inputs. Several water quality parameters help to describe the level of eutrophication.

For nutrient enrichment, one of the main causes of impacts to lakes and reservoirs, a more holistic or weight of evidence approach is necessary since nutrient impacts are not always reflected by the parameters sampled. For instance, some lakes have taste and odor problems associated with particular algal species, yet these lakes do not have chlorophyll *a* concentrations above 40 µg/l frequently enough to impair them based on the standard. In addition, each reservoir possesses unique traits (watershed area, volume, depth, retention time, etc.) that dramatically influence its water quality, but that cannot be evaluated through standards comparisons. In such waterbodies, aquatic life may be Impaired even though a particular indicator is below the standard. Where exceedances of surface water quality standards are not sufficient to evaluate a lake or reservoir, the weight of evidence approach can take into consideration indicators and parameters not in the standards to allow a more sound and robust determination of water quality.

The weight of evidence approach uses the following sources of information to determine the eutrophication (nutrient enrichment) level as a means of assessing lake use support in the aquatic life category:

- Quantitative water quality parameters - dissolved oxygen, chlorophyll *a*, pH, etc.
- Algal bloom reports

- Fish kill reports
- Hydrologic and hydraulic characteristics – watershed size, lake volume, retention time, volume loss, etc.
- Third party reports – citizens, water treatment plant operators, state agencies, etc.
    - Taste and odor
    - Sheens
    - Odd colors
    - Other aesthetic and safety considerations

In implementing the weight of evidence approach for eutrophication, more consideration is given to parameters that have water quality standards (see table). Each parameter is assessed for percent exceedance of the state standard. Parameters with sufficient (ten or more observations), quality-assured observations are compared to surface water quality standards. When standards are exceeded in more than 10 percent of the assessment period, portions or all of the waterbody are rated Impaired.

However, in many cases, the standards based approach is incapable of characterizing the overall health of a reservoir. The eutrophication-related parameters and water quality indicators without numeric standards are reviewed based on interpretation of the narrative standards in 15A NCAC 2B .0211(2) and (3).

A modification to lake use assessment is the evaluation and rating of a lake or reservoir by assessment units (AUs). Each lake or reservoir may have one or more AU based on the classification segments (DWQ index numbers). Each sampling date is considered one sample. Multiple sampling locations within one AU are considered one sample. A minimum of ten samples is needed to assess use support for any AU. Each AU with documented problems (sufficient data, ambient data above standards, and supporting public data) will be rated as Impaired while the other portions are rated as Supporting or Not Rated. The following table lists the information considered during a lake/reservoir use assessment, as well as the criteria used to evaluate that information.

Lake/Reservoir Weight of Evidence Use Assessment for Aquatic Life Category	
Assessment Type	**Criteria**
EUTROPHICATION	
Water Quality Standards (a minimum of 10 samples is required for use support assessment)	
Chl *a*	Above standard in >10% of samples.
DO	Below or above standard in >10% of samples.
pH	Below or above standard in >10% of samples.
Turbidity	Above standard in >10% of samples.
% Total Dissolved Gases	Above standard in >10% of samples.
Temperature	Minor and infrequent excursions of temperature standards due to anthropogenic activity. No impairment of species evident.
Metals (excluding copper, iron and zinc)	Above standard in >10% of samples.
Other Data	
% Saturation DO	>10% of samples above >120%
Algae	Blooms during 2 or more sampling events in 1 year with historic blooms.
Fish	Kills related to eutrophication.
Chemically/ Biologically Treated	For algal or macrophyte control - either chemicals or biologically by fish, etc.
Aesthetics Complaints	Documented sheens, discoloration, etc. - written complaint and follow-up by a state agency.
Trophic Status Index (TSI)	Increase of 2 trophic levels from one 5-year period to next.
Historic DWQ Data	Conclusions from other reports and previous use support assessments.
AGPT	Algal Growth Potential Test ≥5 mg/L
Macrophytes	Limiting access to public ramps, docks, swimming areas; reducing access by fish and other aquatic life to habitat; clogging intakes.
Taste and Odor	Public complaints; Potential based on algal spp
Sediments	Clogging intakes - dredging program necessary.

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Appendix X

Glossary

Glossary

7Q10	The annual minimum 7-day consecutive low flow, which on average will be exceeded in 9 out of 10 years.
ACOE	United States Army Corps of Engineers.
B (Class B)	Class B Water Quality Classification. This classification denotes freshwaters protected for primary recreation and other uses suitable for Class C. Primary recreational activities include frequent and/or organized swimming and other human contact such as skin diving and water skiing.
basin	The watershed of a major river system. There are 17 major river basins in North Carolina.
benthic macroinvertebrates	Aquatic organisms, visible to the naked eye (macro) and lacking a backbone (invertebrate), that live in or on the bottom of rivers and streams (benthic). Examples include, but are not limited to, aquatic insect larvae, mollusks and various types of worms. Some of these organisms, especially aquatic insect larvae, are used to assess water quality. See EPT index and bioclassification for more information.
benthos	A term for bottom-dwelling aquatic organisms.
best management practices	Techniques that are determined to be currently effective, practical means of preventing or reducing pollutants from point and nonpoint sources, in order to protect water quality. BMPs include, but are not limited to: structural and nonstructural controls, operation and maintenance procedures, and other practices. Often, BMPs are applied as system of practices and not just one at a time.
bioclassification	A rating of water quality based on the outcome of benthic macroinvertebrate sampling of a stream. There are five levels: Poor, Fair, Good-Fair, Good and Excellent.
BMPs	See *best management practices*.
BOD	Biochemical Oxygen Demand. A measure of the amount of oxygen consumed by the decomposition of biological matter or chemical reactions in the water column. Most NPDES discharge permits include a limit on the amount of BOD that may be discharged.
C (Class C)	Class C Water Quality Classification. This classification denotes freshwaters protected for secondary recreation, fishing, wildlife, fish and aquatic life propagation and survival, and others uses.
channelization	The physical alteration of streams and rivers by widening, deepening or straightening of the channel, large-scale removal of natural obstructions, and/or lining the bed or banks with rock or other resistant materials.
chlorophyll *a*	A chemical constituent in plants that gives them their green color. High levels of chlorophyll *a* in a waterbody, most often in a pond, lake or estuary, usually indicate a large amount of algae resulting from nutrient over enrichment 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).
conductivity	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.

DEH	Division of Environmental Health
DENR	Department of Environment and Natural Resources.
DHHS	Department of Health and Human Services.
DO	Dissolved oxygen.
drainage area	An alternate name for a watershed.
DWQ	North Carolina Division of Water Quality, an agency of DENR.
dystrophic	Naturally acidic (low pH), "black-water" lakes which are rich in organic matter. Dystrophic lakes usually have low productivity because most fish and aquatic plants are stressed by low pH water. In North Carolina, dystrophic lakes are scattered throughout the Coastal Plain and Sandhills regions and are often located in marshy areas or overlying peat deposits. NCTSI scores are not appropriate for evaluating dystrophic lakes.
EEP	Ecosystem Enhancement Program (EEP)
effluent	The treated liquid discharged from a wastewater treatment plant.
EMC	Environmental Management Commission.
EPA	United States Environmental Protection Agency.
EPT Index	This index is used to judge water quality based on the abundance and variety of three orders of pollution sensitive aquatic insect larvae: Ephemeroptera (mayflies), Plecoptera (stoneflies) and Trichoptera (caddisflies).
eutrophic	Elevated biological productivity related to an abundance of available nutrients. Eutrophic lakes may be so productive that the potential for water quality problems such as algal blooms, nuisance aquatic plant growth and fish kills may occur.
eutrophication	The process of physical, chemical or biological changes in a lake associated with nutrient, organic matter and silt enrichment of a waterbody. The corresponding excessive algal growth can deplete dissolved oxygen and threaten certain forms of aquatic life, cause unsightly scums on the water surface and result in taste and odor problems.
fall line	A geologic landscape feature that defines the line between the piedmont and coastal plain regions. It is most evident as the last set of small rapids or rock outcroppings that occur on rivers flowing from the piedmont to the coast.
FDA	Unites States Food and Drug Administration.
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 is not meeting the designated use criteria.
impervious	Incapable of being penetrated by water; non-porous.
lbs	Pounds. To change pounds to kilograms multiply by 0.4536.
loading	Mass rate of addition of pollutants to a waterbody (e.g., kg/yr)
macroinvertebrates	Animals large enough to be seen by the naked eye (macro) and lacking backbones (invertebrate).
macrophyte	An aquatic plant large enough to be seen by the naked eye.
mesotrophic	Moderate biological productivity related to intermediate concentrations of available nutrients. Mesotrophic lakes show little, if any, signs of water quality degradation while supporting a good diversity of aquatic life.
MGD	Million gallons per day.
mg/l	Milligrams per liter (approximately 0.00013 oz/gal).
NCIBI	North Carolina Index of Biotic Integrity. A measure of the community health of a population of fish in a given waterbody.
NH_3-N	Ammonia nitrogen.
nonpoint source	A source of water pollution generally associated with rainfall runoff or snowmelt. The quality and rate of runoff of NPS pollution is strongly dependent on the type of land cover and land use from which the rainfall runoff flows. For example, rainfall runoff from forested lands will generally contain much less pollution and runoff more slowly than runoff from urban lands.
NOV	Notices of Violation. An NOV serve to alert the permittee of permit infractions and request that whatever caused the violation be corrected immediately. Many times these will not include a fine. Depending upon the severity of the violation, the permittee may receive a Notice of Violation and Assessment of a Civil Penalty, which will include a fine.
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.
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.
PCBs	Polychlorinated Biphenyls. PCBs are man-made chemicals that persist in the environment. There are a number of adverse health effect associated with exposure to PCBs.
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.
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).
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.
SWCD	Soil and Water Conservation District
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.
USGS	United States Geological Survey
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.
WTP	Water treatment plant.
WWTP	Wastewater treatment plant.