BROAD RIVER BASINWIDE
WATER QUALITY MANAGEMENT PLAN

July, 1998

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This document was approved and endorsed by the NC Environmental Management Commission on July 9, 1998 to be used as a guide by the NC Division of Water Quality in carrying out its Water Quality Program duties and responsibilities in the Broad River Basin.

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FOREWORD

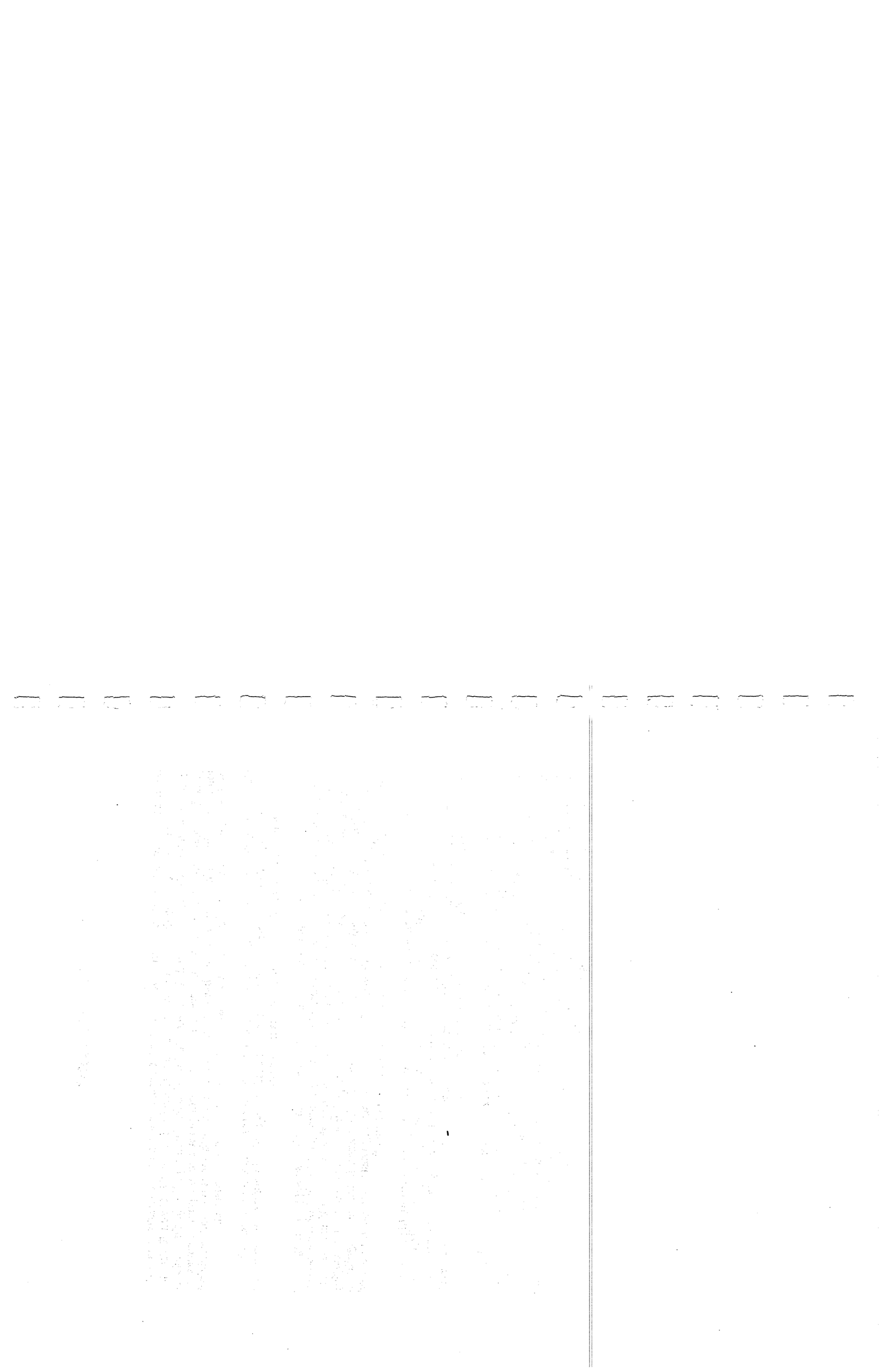
The Broad River is formed in the mountains of North Carolina and flows southeasterly into the Piedmont region before entering South Carolina. Major tributaries include the Green River, the First Broad River, the Second Broad River and Buffalo Creek. Water quality in the basin is generally good, but there are areas that are impacted by both point and nonpoint sources of pollution. The surface waters of the basin receive waste from both industrial and municipal discharges, as well as runoff from land use activities such as agriculture and construction.

The waters of the Broad River basin are an important resource for residents and visitors. They are used as a source of drinking water and for various recreational activities in addition to providing the benefit of assimilation of municipal and industrial wastes.

Of the 1,472 miles of freshwater streams and rivers in the Broad basin, use support ratings were determined for 96% or 1,416 miles of water. Only three (3) percent (or 49 miles) of these waters are considered impaired (partially supporting or not supporting their uses). Of the impaired waters, almost all of them are affected by nonpoint source pollution to some extent, and roughly 40% are impacted by industrial and/or municipal effluent. Sedimentation is the most significant water quality problem in the basin. Others include oxygen-consuming wastes and color in treated wastewater effluent, and fecal coliform bacteria in nonpoint source runoff.

There are two major management challenges in the Broad basin: to protect existing high levels of water quality, and to take actions to improve those waters that have impaired quality. These tasks are beyond the capabilities of any one agency or group. State and federal government regulatory programs will play an important part, but much of the responsibility will be at the local level. Those who live, work and recreate in the basin have the most at stake.

This document provides a summary of the causes and sources of water pollution in the basin, a summary of water quality rules and statutes that apply to water quality protection, and recommended measures to protect and enhance the quality of the surface waters and aquatic resources. The Broad River Basinwide Water Quality Management Plan will be used as a guide by the NC Division of Water Quality in carrying out its water quality program responsibilities in the basin. Beyond that, it is hoped that the plan will provide a framework for cooperative efforts between the stakeholders in the basin to work toward a common goal of protecting the basin's water resources while accommodating reasonable economic growth.



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EXECUTIVE SUMMARY

NORTH CAROLINA'S BASINWIDE APPROACH TO WATER QUALITY MANAGEMENT - PURPOSE OF BROAD RIVER BASIN PLAN

Basinwide management is a watershed-based approach to water quality protection. While this plan is being prepared by the North Carolina Division of Water Quality (DWQ), implementation of the plan and protection of water quality involve the efforts of all stakeholders in the basin. The *Broad River Basinwide Water Quality Management Plan* (Broad Plan) is the seventeenth in a series of basinwide water quality management plans that are being prepared by DWQ for all seventeen of the state's major river basins by the year 1998. The plan will be used as a guide by DWQ in carrying out its water quality program duties and responsibilities in the Broad River Basin.

A basinwide plan is prepared for each basin in order to communicate to policy makers, the regulated community and the general public the state's rationale, approaches and recommended long-term water quality management strategies for each basin. The draft plans are circulated for public review and comment and are presented at public meetings in each basin. The plan for a given basin is completed and approved prior to the scheduled date for basinwide wastewater discharge permit renewals in that basin. The plans are then re-evaluated and updated at five-year intervals.

The Broad Plan is due for completion in July of 1998 and will be updated in the year 2003. Basinwide NPDES permitting is scheduled to commence in November of 1998.

BASINWIDE GOALS

The primary goals of DWQ's basinwide program are to 1) identify and restore full use to impaired waters, 2) identify and protect highly valued resource waters, and 3) manage problem pollutants throughout the basin to protect water quality standards while accommodating reasonable economic growth. In addition, DWQ is applying this approach to each of the major river basins in the state as a means of better identifying water quality problems; developing appropriate management strategies; maintaining and protecting water quality and aquatic habitat; assuring equitable distribution of waste assimilative capacity for dischargers; and improving public awareness and involvement in management of the state's surface waters.

PUBLIC WORKSHOPS

Broad River Basinwide Planning Workshops were conducted on June 2 and 3, 1997 in Spindale, Lake Lure and Shelby, North Carolina. There were a total of 90 registered participants representing local government, business and industry, farmers and landowners, state and federal government, academic institutions and citizen organizations. The purpose of the workshops was to familiarize stakeholders in the basin with DWQ's basinwide approach and to solicit their input about what they see as the major water quality issues in the basin. The workshops were co-sponsored by the North Carolina Cooperative Extension Service (CES), the North Carolina League of Municipalities and DWQ. A summary of the comments received at these workshops is provided in Chapter 6 of the plan. DWQ examined the comments received at the workshop and grouped them into six broad categories: sedimentation, color, education, enforcement, management of nonpoint source pollution and the need for fair, equitable, common-sense regulations.

BROAD BASIN OVERVIEW

The Broad River Basin encompasses a 1,506 square mile watershed drained by 1,472 miles of streams and rivers. The headwaters of the Broad and its major tributaries are located within the mountain physiographic region and flow towards the foothills before entering the piedmont southeast and east of Lake Lure. Figure 1 provides a general map of the North Carolina portion of the basin, including major hydrology, municipalities and county boundaries.

The three major tributaries into the Broad River before it enters South Carolina are the Green River, the Second Broad River, and the First Broad River. Several areas in the basin are classified for water supply use and approximately 30% of the streams are supplementally classified as trout waters to protect for the propagation and maintenance of that fishery.

The basin encompasses all of Cleveland, Polk and Rutherford counties, as well as portions of Buncombe, Henderson, Lincoln and Gaston counties. There are 29 municipalities in the basin including Lake Lure, Rutherfordton, Spindale, Forest City, Shelby and Kings Mountain.

The Broad River basin has an estimated population of 169,001 people based on 1990 census data. The entire basin has experienced moderate population growth between 1970 and 1990, with higher levels of growth occurring in the extreme eastern and western portions of the basin. In the eastern part of the basin in the Kings Mountain area, the population increase may be related to the high growth of the Charlotte area. In the western part of the basin, which is characteristically more mountainous, increases may be related to second home development or settlement of retirees.

Over 60% of the land in the Broad River basin is covered in forests. Based on data from the USDA Natural Resources Conservation Service, the most significant land cover change between 1982 and 1992, was a 71% increase in the amount of urban land. In 1992, approximately 20% of the land in the basin was covered by cultivated or uncultivated crop or pastureland.

Agriculture is an important industry in the basin. According to the NC Department of Agriculture (1996), revenues are higher for crop production than for livestock production for the counties that are either wholly or partly in the basin. Crops grown include, but are not limited to, sorghum, barley, oats, corn, soybeans, wheat and hay. There are eleven registered livestock operations within the basin, including cattle, poultry and swine.

The Broad River Basin is home to 97 rare animal and plant species. Two aquatic animals that are listed as Threatened by the State of North Carolina are the Bog Turtle and the Squawfoot (a mussel). There are five Natural Heritage Program Priority Areas in the basin. These are: the Rollins/South Mountains Natural Area; Hickorynut Gorge; Green River Headwaters and Gorge; the Tryon Region and Pacolet River Gorge; and Pinnacle Mountain.

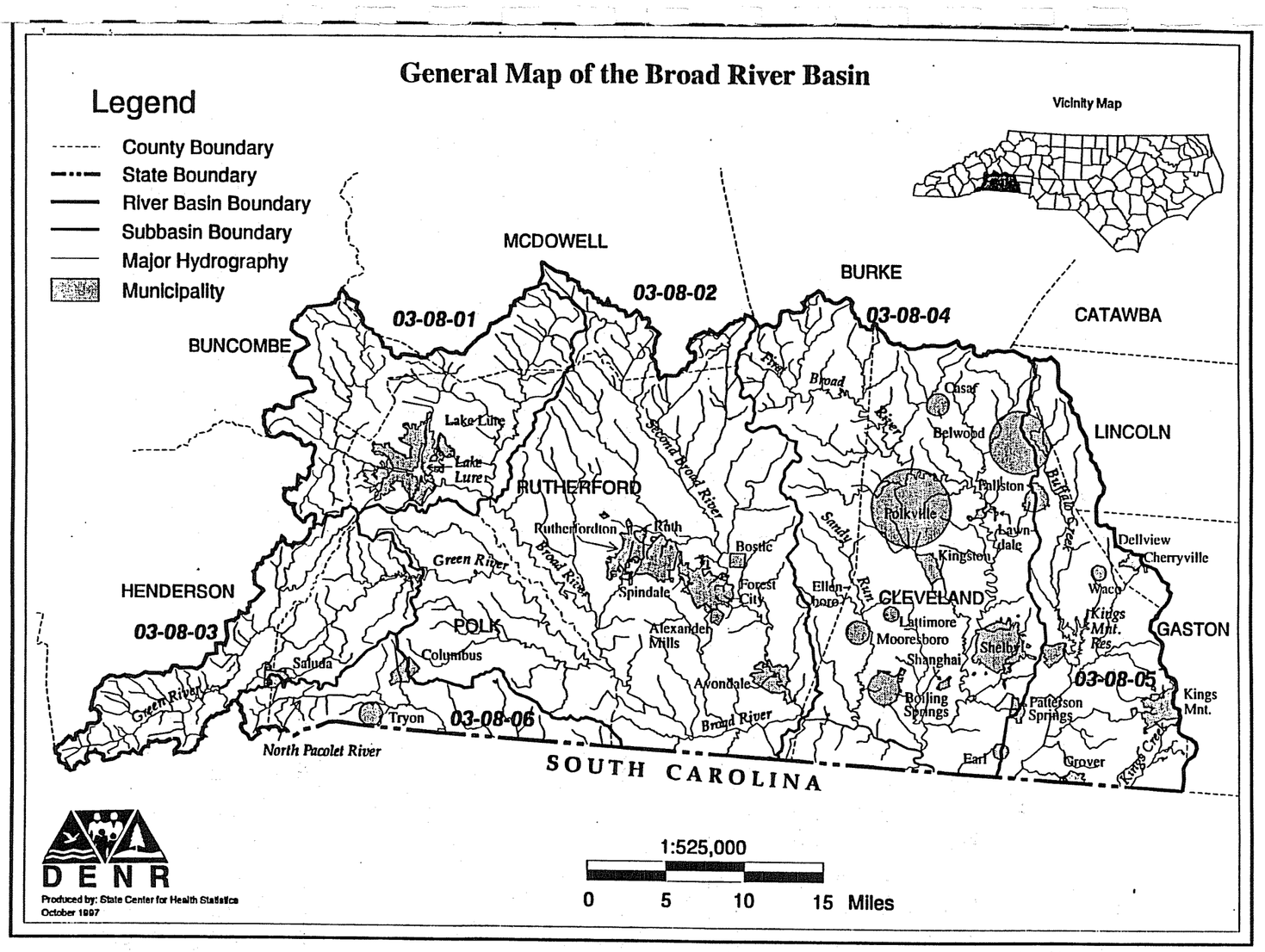


Figure 1. General Map of the Broad River Basin

ASSESSMENT OF WATER QUALITY IN THE BROAD RIVER BASIN

An assessment of water quality data collected by DWQ and others reveals that the Broad River basin has generally good water quality. There are areas, however, that are impaired and in need of attention. Below is a summary of some key monitoring data that reflect water quality in the basin. A more detailed presentation of this information can be found in Chapter 4.

Summary of Biological Indicators

Benthic Macroinvertebrates - Benthic macroinvertebrates (or benthos) are primarily bottom-dwelling aquatic insect larvae such as species of stoneflies, mayflies and caddisflies. Measurements of the number, types and diversity of these organisms at strategic sampling sites is an important means of assessing water quality. Since 1983, 108 benthic macroinvertebrate samples have been collected at 69 different locations within the Broad River basin. Of these 108 samples, an Excellent bioclassification was found for 6%, 34% were Good, 37% were Good-Fair, 17% were Fair and 6% were Poor. More Recently, in 1995, 33 sites were sampled which give an indication of present water quality of mainstem and major tributary sites. Of these sites, 9% were Excellent, 46% were Good, 33% were Good-Fair, 12% were Fair and none were Poor.

Fish Community Evaluations - In 1995, six sites in the Broad River basin were sampled and rated using the North Carolina Index of Biotic Integrity (NCIBI). This index provides an assessment of the overall health of the fish community. The NCIBI ratings at these six sites were: Good-Excellent (1 site), Good (4 sites), and Fair-Good (1 site).

Fish Tissue Analyses - Fish tissue samples were collected at 8 sites within the Broad River basin between 1988 and 1996 and were analyzed for metals contaminants. All fish tissue samples collected throughout the Broad River basin during this time contained levels of metals contaminants below federal Environmental Protection Agency (EPA) and Food and Drug Administration (FDA) criteria. There are no fish consumption advisories posted for the basin.

Lakes Studies - Five lakes in the Broad River basin have been sampled as part of the Lakes Assessment Program. These are Lake Lure in subbasin 01, Lake Adger and Lake Summit in subbasin 03, and Lake Montonia and Kings Mountain Reservoir (also known as Moss Lake) in subbasin 030805. All of these lakes were sampled most recently by DWQ in 1995 except for Lake Montonia, which was sampled in 1996. They all have been assigned the trophic status classification of oligotrophic based on the North Carolina Trophic State Index (NCTSI).

Use-Support Ratings

Another important method for assessing surface water quality is to determine whether the quality is sufficient to support the uses for which the waterbody has been classified by the state. All surface waters in the state have been assigned a classification. These classifications are discussed in Chapter 2, Chapter 5 and Appendix I. The word *uses* refers to activities such as swimming, fishing and water supply. All water quality data for a particular stream segment have been assessed to determine the overall *use support* rating; that is, whether the waters are *fully supporting*, *partially supporting* or *not supporting* their uses. A fourth rating, *fully supporting but threatened,* applies where all uses are currently being supported but water quality conditions are marginal. Streams referred to as *impaired* are those rated as either partially supporting or not supporting their uses. Use support ratings in the Broad River basin, described more fully in Chapter 4, are summarized below.

Of the 1,472 miles of freshwater streams and rivers in the Broad basin (based on measurements made from USGS topographic maps), use support ratings were determined for 96% or 1,416 miles of water. The relative breakdown of percentages for the use support categories is as follows:

SUPPORTING 93%
- Fully supporting (67%)
- Fully supporting but threatened (26%)

IMPAIRED.....3%
- Partially supporting (3%)
- Not supporting (0%)

NOT EVALUATED:.....4%

These use support values are different from the values in the 1994-1995 305(b) Report. The total waters supporting their uses appear to have increased, while those that are impaired appear to have decreased. While the water quality may have improved since the 1992-1993 305(b) report, the changes in values are due to revisions in the methodology for assigning use support (this is discussed in section 4.6.5 of Chapter 4).

MAJOR WATER QUALITY ISSUES AND RECOMMENDATIONS

Several water quality issues emerge as being of particular importance in light of factors such as the degree of water quality degradation, the value of the resources being impacted and the number of users potentially affected. Those issues considered most significant on a basinwide scale are presented below. Chapter 6 of the Broad Plan provides recommendations for many other issues including managing inputs of fecal coliform bacteria and oxygen consuming wastes, in addition to specific recommendation for the impaired waters in the basin. The issues presented here are the larger issues of most concern to the Broad basin.

A. RECOMMENDATIONS FOR SPECIFIC, IMPAIRED WATERBODIES

Table 1 provides a description of the four waters in the basin that have been determined to be impaired based on recent monitoring data. These waters, as well as other waters that are considered impaired based on older data, are described in more detail in Chapter 6.

B. ADDRESSING IMPACTS FROM WASTEWATER TREATMENT PLANTS

Although much progress has been made in the treatment of wastewater over the past 20 years, three of the four streams in the basin that are impaired based on recent water quality sampling are impacted by point source discharges. In most of the cases, actions have been or will be taken in the forseeable future to mitigate these impacts. However, it will be important during this basinwide planning cycle for DWQ to continue to work with the wastewater discharges of concern to make appropriate improvements to protect water quality. In addition, in the Broad River basin's larger river systems (i.e. the First Broad River and Second Broad River) there are issues related to assimilative capacity and wasteload allocation that need to be addressed. These rivers receive waste from a number of both industrial and domestic wastewater treatment facilities and are also influenced by water withdrawals from water treatment systems. Finally, an important wastewater related issue affecting the Broad River basin is the issue of color.

Recommendations

Table 1 presents specific recommendations for impaired waters in the basin, including those that are impacted by point sources. In addition, DWQ intends to develop calibrated water quality models for the First and Second Broad Rivers during this basinwide cycle to

ensure that permitted effluent limitations will protect water quality. Specific recommendations and comments regarding facilities discharging to these rivers are made in Chapter 6 (Section 6.4) of the Broad River Basinwide Water Quality Management Plan. Section 6.6.2 provides recommendations on color reduction. The current approach to address this issue statewide is to encourage facilities with color in their effluent to voluntarily take action to reduce that color. The Division of Pollution Prevention and Environmental Assistance is available to help facilities develop plans to achieve this goal.

Table 1 Recommended Management Strategies for Monitored Impaired Waters in the Broad River Basin*

Waterbody (subbasin)	Use Support Rating	Probable Source of Impairment	Recommended Management Strategy	Chapter 6 Reference Section
Walnut Creek (030802)	PS	nonpoint source(s) (possibly agricultural runoff)	The landuse in the immediate vicinity of the monitoring location is primarily fallow agricultural fields. DWQ should work with the local agricultural agencies to help farmers in this watershed ensure that appropriate measures are taken to minimize runoff into surface waters from agricultural activities (resources permitting**).	6.4.2
Catheys Creek (030802)	PS	point source (Spindale) and nonpoint source(s) (possibly agricultural runoff)	DWQ will continue to work with point sources to ensure protection of the surface waters through compliance with effluent limits. DWQ should also work with local experts to assess NPS contributions to impairment (resources permitting**).	6.4.2
Beaverdam Creek (030804)	PS	point sources (four small discharges) and nonpoint sources (erosion, sand dredging)	DWQ will require that four discharges upstream of the monitoring site conduct instream monitoring to determine to what extent they are contributing to impairment. DWQ should also work with local experts to assess NPS contributions to impairment as well as the impact of the dredging project (resources permitting**).	6.4.4
Lick Branch (030805)	PS	point source (New Minnette Textiles)	DWQ will monitor the stream for progress since improvements were made to point source situation in late 1995.	6.4.5

** Based on monitored data collected between 1992 and 1996.*
*** Only limited progress towards developing and implementing nonpoint source strategies for these impaired waters can be expected without additional resources.*

C. CONTROLLING SEDIMENTATION

Erosion, and resulting sedimentation, are prevalent throughout the basin. Workshop participants (Section 6.2.3) and Nonpoint Source Team members (Section 6.2.2) have expressed that a priority issue for the basin is sedimentation control. Many waters in the basin are thought to be impacted or impaired, at least in part, by sedimentation (Table 4.17 in Chapter 4). The sources of sedimentation are discussed in detail in Chapter 3. Programs to address erosion and sedimentation are discussed in Chapter 5 and Appendix VI. Some of the actions being taken at the local level are discussed in Chapter 5, Section

5.6. General management strategies for controlling sedimentation are presented in Section 6.6.1 of Chapter 6.

Recommendations
Chapter 6 includes recommendations for controlling sedimentation from a variety of land disturbing activities including road and home construction, agriculture and forestry. Tools include use of appropriate best management practices, better enforcement of sediment control regulations, promotion of local sediment control programs and improved education.

D. GROWTH MANAGEMENT

Based on data from the USDA Natural Resources Conservation Service, the most significant landcover change between 1982 and 1992, was a 71% increase in the amount of urban land. Proactive planning efforts at the local level are needed to assure that development is done in a manner that maintains the good water quality that plays a role in attracting people to the area. These planning efforts will need to find a balance between water quality protection, natural resource management and economic growth. Growth management requires planning for the needs of future population increases as well as maintaining a strong tourism base. These actions are critical to water quality management and the quality of life for the residents of the basin.

Recommendations
It is recommended that local governments in the Broad River basin, particularly those in the eastern and western sections, take steps to plan for growth that protects water quality; however, limited progress can be expected without additional resources and technical assistance. The recommendations in Section 6.6.4 for urban stormwater control contain ideas that can help alleviate the impacts resulting from growth.

E. ADDRESSING NONPOINT SOURCE IMPAIRED WATERS

Although point sources of pollution continue to impact water quality in the basin, pollution from nonpoint sources is identified as a significant contributor to some impairment including areas that are identified as supporting their uses but threatened. Ninety-five percent of the 48 miles of waters that are impaired are thought to be impacted, at least in part, by nonpoint sources of pollution. It is recognized that in some cases the information that DWQ has concerning nonpoint source contributions from land uses such as agriculture are dated and general. Accomplishments in managing runoff from agriculture and animal operations that have occurred during the last five years or so (such as Conservation Management Plans in compliance with the Farm Bill, or improved management of waste from animal operations in compliance with new regulations) are not reflected in this information. The reason for this is that the implementation of these programs is just beginning to occur or has occurred subsequent to water quality monitoring. However, agriculture remains prominent in the landscape of the river basin and it will be important to work toward further gains in this area in order to protect water quality.

In addressing nonpoint sources of pollution it is important to acknowledge agency resource constraints. The task of confirming and clearly identifying exact sources, developing management strategies, implementing best management practices and monitoring for water quality improvements is clearly beyond the current resources of DWQ, other agencies involved in managing nonpoint sources and local governments. Only limited progress can be expected unless substantial resources are put toward solving nonpoint source problems. Therefore this basinwide plan lacks specific strategies to address nonpoint source pollution.

Recommendations
As one means of addressing this problem with available resources, DWQ has formed a voluntary nonpoint source team (NPS Team) for the basin. Working with the NPS Team (a knowledgeable team of local professionals and stakeholders) is an avenue for developing NPS priorities as well as targeting and coordinating existing resources within a basin. The NPS Team for the Broad River basin has received funding through the federal NPS program (Section 319) to take action to reduce sedimentation above Lake Lure. The team members participate voluntarily on the team within their existing resource constraints. Limited progress can be expected in restoring impaired waters through the team without additional resources. The NPS team is further discussed in Chapters 6 and 7.

FUTURE INITIATIVES IN THE BROAD RIVER BASIN AND STATEWIDE

There are a number of initiatives that will be occurring in the basin over the next several years. Some are highlighted here. Chapter 7 provides a more thorough characterization of these initiatives.

- Development Of Field-Calibrated Models
  DWQ will be pursuing the development of a more sophisticated model for the larger rivers of the basin, especially the Second Broad River, to better predict point source impacts to surface waters. This model will be used to apply appropriate wastewater treatment effluent limits to dischargers to protect water quality.

- Investigation Into Long-Term Impacts Of Chip Mills
  In response to citizens' increasing concerns regarding the growing chip mill industry, Governor Hunt directed the NC Department of Environment and Natural Resources (NC DENR) to conduct an environmental and economic study of wood chip production in the state. These are facilities that produce wood chips for use in the production of paper products. One of the big concerns about these facilities is their potential to increase the amount of timber harvesting, especially clearcutting. For several months, NC DENR staff have been gathering information needed to identify issues that should be examined in the study. In October of 1997, public meetings were held across North Carolina to receive general public input into this process. Attendance was good and many ideas regarding the scope and nature of the forthcoming study were received.

- Efforts to Improve NC's Sedimentation and Erosion Control Program
  Recently, there has been an initiative in the Division of Land Resources to address sediment and turbidity water quality problems across the state. The Sedimentation and Erosion Control Commission has recognized the need to evaluate the implementation of the existing programs. A Technical Advisory Committee was established, along with three subcommittees, to perform the evaluation and develop recommendations. The committee and subcommittees met for several months during the fall of 1997 and presented a list of recommendations to the Commission in November. The Commission supported the recommendations and instructed the staff to implement the ones which can be implemented without rule or statute changes and have established a schedule to implement the others. It is believed that the changes initiated will result in program implementation improvements and reduction in sediment losses to our streams.

- The North Carolina Wetlands Restoration Program
  The North Carolina Wetlands Restoration Program (NCWRP) was established by the General Assembly in 1996. The purpose of the NCWRP is to protect and improve water quality, flood prevention, fisheries, wildlife and plant habitats, and recreational opportunities through the protection and restoration of wetlands and riparian areas. The

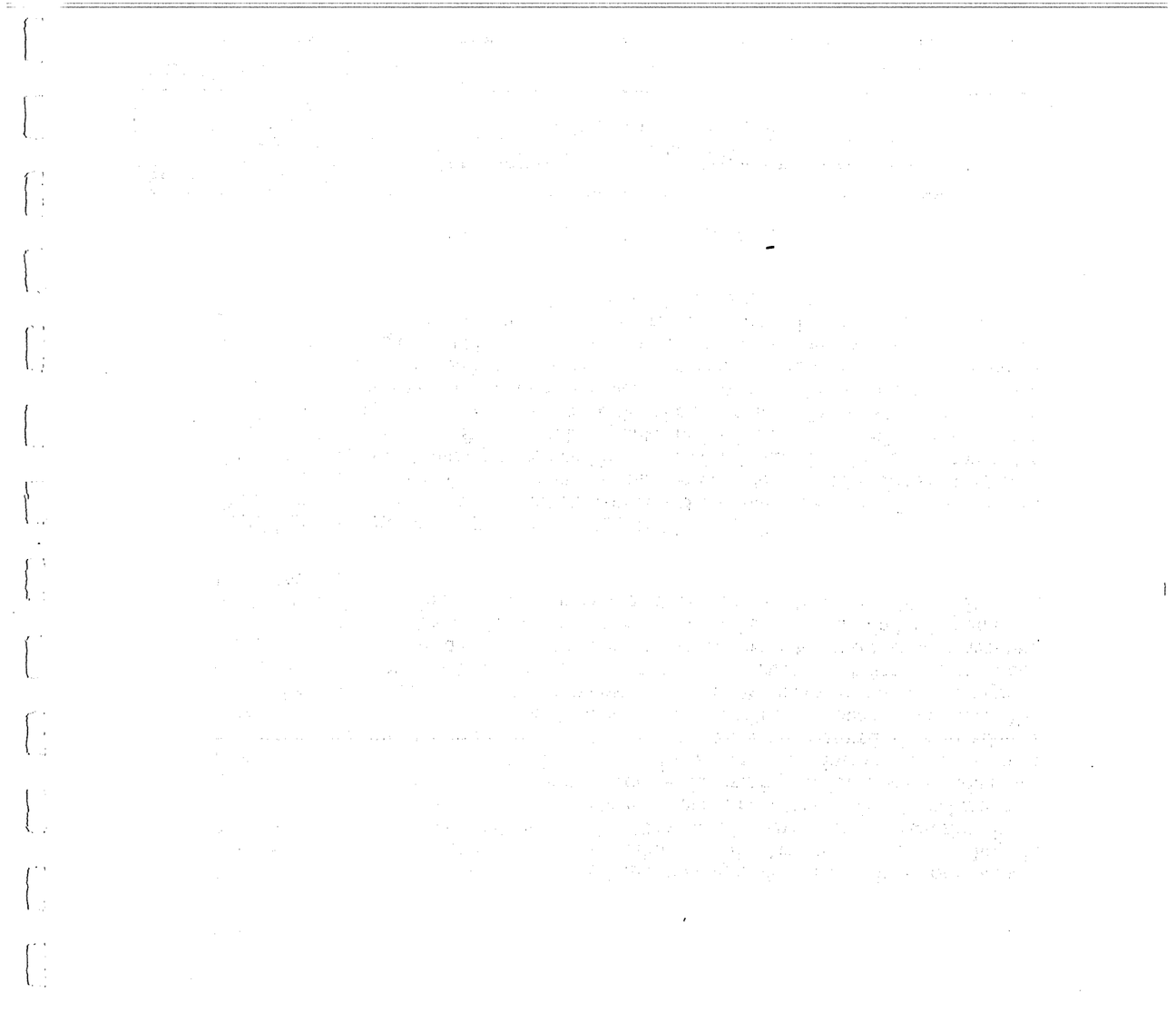
NCWRP will accomplish this purpose by implementing projects that will restore wetland and riparian area functions and values throughout North Carolina. Beginning July 1, 1997, comprehensive Basinwide Restoration Plans will be developed for each river basin in conjunction with the Basinwide Water Quality Management Plans. GIS-based mapping methodologies will be used to assess the status of the existing wetlands and riparian area resources within each basin and to identify degraded wetlands and riparian areas. Potential restoration sites will be prioritized based on the ability of the restored sites to address problems that have been identified in the Basinwide Water Quality Management Plans. The restoration plans will provide the framework for the Wetlands Restoration Program, therefore it is essential that the public, local governments, state and federal agencies and others be involved in the development of these plans. Requests for information concerning the NCWRP and the Basinwide Restoration Plans should be sent to the following address: NC Wetlands Restoration Program, Division of Water Quality, P.O. Box 29535, Raleigh, NC 27626-0535.

- Consideration of Reclassification of Waters to HQW or ORW

  Table 2 presents a list of waters in the Broad River Basin that, based on DWQ monitoring, received an Excellent biological rating and may be considered eligible for High Quality Waters (HQW) or Outstanding Resource Waters (ORW) designation. DWQ has completed a study of the upper Green River intends to pursue reclassification to B HQW in the future. In addition, DWQ has been requested to consider Lake Montonia for HQW reclassification, and studies are underway to determine whether or not it qualifies for this change. The two other areas in the table have been shown to have excellent water quality, and could possibly qualify for the HQW or ORW classification if a request were received by DWQ. The HQW, ORW and WS classifications generally require more stringent point and nonpoint source pollution controls than do basic water quality classifications such as C.

Table 2 Potential HQW/ORW Waters for the Broad River Basin

Subbasin	Waterbodies
030801	Broad River (upstream of Lake Lure) and Cove Creek
030803	upper Green River (from source to Rock Creek - not including tributaries, and Rock Creek and tributaries)
030804	North Fork First Broad River
030805	Lake Montonia



CHAPTER 1

INTRODUCTION

1.1 PURPOSE OF THIS DOCUMENT

The purpose of this Basinwide Water Quality Management Plan is to report to citizens, policy makers and the regulated community on:

- the current status of surface water quality in the basin,
- major water quality concerns and issues,
- projected trends in development and water quality,
- the long-range water quality goals for the basin, and
- recommended point and nonpoint source management options.

In addition, DWQ staff will use the plan as a guide in carrying out their water quality programs in the basin over the next five years. To that end, this Plan presents strategies for management of both point and nonpoint sources of pollution. The Division of Water Quality (previously Division of Environmental Management) is preparing a basinwide water quality management plan for each of the state's 17 major river basins, as shown in Figure 1.1.

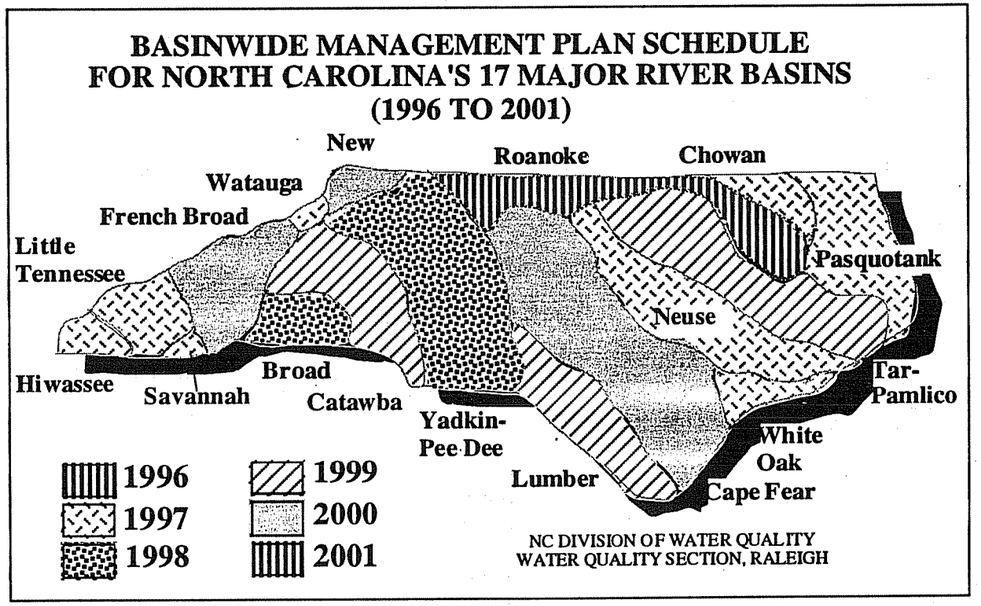


Figure 1.1 Basinwide Management Plan Schedule (1996 to 2001)

1.2 GUIDE TO USE OF THIS DOCUMENT

CHAPTER 1: Introduction - This chapter provides a non-technical description of the purpose of this plan, the basinwide water quality management approach and how this approach will be administered. The description of the basinwide management approach is based primarily on a 54-page framework document entitled *North Carolina's Basinwide Approach to Water Quality Management: Program Description - Final Report/August 1991* (Creager and Baker, 1991).

CHAPTER 2: General Basin Description- Some of the specific topics covered in this chapter include:

- an overview of the major features such as location, population, physiography, etc.
- hydrology of the basin and its subbasins
- a summary of land cover within the basin based on results of a 1982 and 1992 Nationwide Resources Inventory (NRI) conducted by the US Department of Agriculture Natural Resources Conservation Service.
- population growth trends and densities by subbasin using 1970, '80 and '90 census data.
- major water uses in the basin and DWQ's program of water quality classifications and standards.

CHAPTER 3: Causes of Impairment and Sources of Water Pollution - Chapter 3 describes both point and nonpoint sources of pollution. It also describes a number of important causes of water quality impacts including sediment, biochemical oxygen demand (BOD), toxic substances, nutrients, color, fecal coliform bacteria and others. Pollutant loading in the basin and general water quality problem areas are discussed.

CHAPTER 4: Water Quality and Use Support Ratings - Chapter 4 describes the various types of water quality monitoring conducted by DWQ, summarizes water quality in each of the subbasins in the basin and presents a summary of use support ratings for those surface waters that have been monitored or evaluated.

CHAPTER 5: Water Quality Programs and Program Initiatives in the Basin - Chapter 5 summarizes the existing point and nonpoint source control programs available to address water quality problems. These programs are management tools available for addressing the priority water quality concerns and issues that are identified in Chapter 6. Chapter 5 also describes the concept of Total Maximum Daily Loads (TMDLs). TMDLs represent management strategies aimed at controlling point and nonpoint source pollutants. This chapter also describes various program initiatives being implemented in the basin to address water quality problems.

CHAPTER 6: Major Water Quality Concerns and Recommended Management Strategies - Water quality issues identified in Chapters 2, 3 and 4 are evaluated and prioritized based on use-support ratings, degree of impairment, and the sensitivity of the aquatic resources being affected. Recommended management strategies, or TMDLs, are presented that describe how the available water quality management tools and strategies described in Chapter 5 will be applied in the basin. This includes generalized wasteload allocations for dischargers and recommended programs and best management practices for controlling nonpoint sources.

CHAPTER 7: Future Initiatives - Chapter 7 presents future initiatives for protecting or improving water quality in the basin. These may include both programatic initiatives such as improving permit compliance, or basin-specific initiatives such as developing strategies for restoring impaired waters.

1.3 NORTH CAROLINA'S BASINWIDE MANAGEMENT APPROACH

Introduction - Basinwide water quality management is a watershed-based management approach being implemented by DWQ which features basinwide permitting, integrating existing point and nonpoint source control programs, and preparing basinwide management plans. DWQ is applying this approach to each of the seventeen major river basins in the state as a means of better identifying water quality problems, developing appropriate management strategies, maintaining and protecting water quality and aquatic habitat, and assuring equitable distribution of waste assimilative capacity for dischargers.

After conducting public workshops to identify areas of concern and major issues, a basinwide management plan is prepared for each basin. The plans are circulated for public review and are presented at public meetings in each river basin. The management plan for a given basin is completed and approved preceding the scheduled date for basinwide discharge permit renewals in that basin. The plans are then evaluated, based on followup water quality monitoring, and updated at five year intervals.

DWQ began formulating the idea of basinwide management in the late 1980s, established a basin permitting schedule in 1990, began basinwide monitoring activities in 1990, and published a basinwide program description in August 1991. Basinwide management entails coordinating and integrating, by major river basin, DWQ's water quality program activities. These activities, which are discussed further in Section 1.4, include permitting, monitoring, modeling, nonpoint source assessments, and planning.

Water Quality Program Benefits - Several benefits of basinwide planning and management to North Carolina's Water quality program include:

- ***Improved program efficiency.*** By reducing the area of the state covered each year, monitoring, modeling, and permitting efforts can be focused. As a result, *efficiency increases* can be achieved for a given level of funding and resource allocation.
- ***Increased effectiveness.*** The basinwide approach is in consonance with basic ecological watershed management principles, leading to *more effective* water quality assessment and management. Linkages between aquatic and terrestrial systems are addressed (e.g., contributions from nonpoint sources). All inputs to aquatic systems and potential interactive, synergistic and cumulative effects are considered.
- ***Better consistency and equitability*** . By clearly defining the program's long-term goals and approaches, basinwide plans will encourage *consistent* decision-making on permits and water quality improvement strategies. Consistency and greater attention to long-range planning will promote a *more equitable* distribution of assimilative capacity, explicitly addressing the trade-offs among pollutant sources and allowances for economic growth.
- ***Increased public awareness of the state's water quality protection programs.*** The basinwide plans are an educational tool for increasing public awareness of water quality issues within the basin.
- ***Basinwide management promotes integration of point and nonpoint source pollution assessment and controls.*** Once waste loadings from both point and nonpoint sources are established, management strategies can be developed to prevent overloading of the receiving waters and to allow for a reasonable margin of safety to ensure compliance with water quality standards.

Basinwide Planning Schedule - The following table presents the overall basin schedule for all 17 major river basins in the state. Included are the dates for permit reissuance and the dates by which management plans are to be completed for each basin.

Table 1.1. Basinwide Permitting and Planning Schedule for North Carolina's 17 Major River Basins.

Basin	Begin NPDES Permit Issuance	*Final Plan Receives EMC Approval	Public Mtgs. and Draft out For Review	EMC/WQC Approval For Public Meetings	Inhouse Draft due for Staff Review	DWQ Biological Data Collection
Neuse	4/1993	**2/1993**	11/1992	9/1992	7/1992	Summer 91
Lumber	11/1994	**6/1994**	2/1994	11/1993	7/1993	Summer 91
Tar-Pamlico	1/1995	**12/1994**	9/1994	7/1994	5/1994	Summer 92
Catawba	4/1995	**2/1995**	11/1994	9/1994	7/1994	Summer 92
Fr. Broad	8/1995	**5/1995**	2/1995	12/1994	10/1994	Summer 92
New	11/1995	**7/1995**	6/1995	4/1995	3/1994	Summer 93
Cape Fear	1/1996	**9/1995**	6/1995	5/1995	4/1995	Summer 93
Roanoke	1/1997	**9/1996**	4/1996	2/1996	9/1995	Summer 94
White Oak	6/1997	**2/1997**	9/1996	7/1996	4/1996	Summer 94
Savannah	8/1997	**5/1997**	2/1997	12/1996	6/1996	Summer 94
Watauga	9/1997	**4/1997**	12/1997	10/1996	6/1996	Summer 94
Little Tenn.	10/1997	**5/1997**	2/1997	12/1996	7/1996	Summer 94
Hiwassee	12/1997	**5/1997**	2/1997	12/1996	7/1996	Summer 94
Chowan	1/1998	**9/1997**	6/1997	3/1997	11/1996	Summer 95
Pasquotank	2/1998	**9/1997**	6/1997	3/1997	11/1996	Summer 95
Neuse	4/1998	7/1998	4/1998	2/1998	12/1997	Summer 95
Yadkin	7/1998	5/1998	2/1998	12/1997	10/1997	Summer 96
Broad	11/1998	7/1998	3/1998	2/1998	11/1997	Summer 95
Lumber	11/1999	5/1999	2/1999	12/1998	8/1998	Summer 96
Tar-Pamlico	1/2000	5/1999	2/1999	12/1998	5/1998	Summer 97
Catawba	4/2000	10/1999	6/1999	4/1999	12/1998	Summer 97
Fr. Broad	8/2000	2/2000	10/1999	7/1999	3/1999	Summer 97
New	11/2000	5/2000	2/2000	12/1999	8/1999	Summer 98
Cape Fear	1/2001	7/2000	2/2000	12/1999	8/1999	Summer 98
Roanoke	1/2002	7/2001	2/2001	12/2000	8/2000	Summer 99

* Dates in bold print denote plans approved by the EMC

The number of plans to be developed each year varies from one to six and is based on the total number of permits to be issued each year. For example, the Cape Fear basin, the state's largest, has about as many dischargers as all six of the small basins in 1997. This has been done in order to balance the permit processing workload from year to year. In years where more than one basin is scheduled to be evaluated, an effort has been made to group at least some of the basins geographically in order to minimize travel time and cost for field studies and public meetings.

Plans to be updated every five years - The earliest basin plans will likely not achieve all of the long-term objectives for basinwide management outlined above. However, plans are updated every 5 years. Updated plans will incorporate additional data and new assessment tools (e.g., basinwide water quality modeling) and management strategies (e.g., for reducing nonpoint source contributions) as they become available.

Basinwide Plan Preparation, Review and Public Involvement - Preparation of an individual basinwide management plan is a five year process which is broken down into four phases as described below.

Year	Activity
Year 1 to 3	Water Quality Data Collection/Identification of Goals and Issues: Year 1 entails identifying sampling needs and canvassing for information. It also entails coordinating with other agencies, the academic community and local interest groups to begin establishing goals and objectives and identifying and prioritizing problems and issues. Biomonitoring, fish community and tissue analyses, special studies and other water quality sampling activities are conducted in Years 2 and 3 by DWQ's Environmental Sciences Branch (ESB). These studies provide information for assessing water quality status and trends throughout the basin and provide data for computer modeling.
Year 3 to 4	Data Assessment and Model Preparation: Modeling priorities are identified early in this phase and are refined through assessment of water quality data from the ESB. Data from special studies are then used by DWQ's Technical Support Branch (TSB) to prepare models for estimating potential impacts of waste loading from point and nonpoint sources using the TMDL approach. Preliminary water quality control strategies are developed based on modeling, with input from local governments, the regulated community and citizen groups during this period.
Year 4	Preparation of Draft Basinwide Plan: The draft plan, which is prepared by DWQ's Planning Branch, is due for completion by the end of year 4. It is based on support documents prepared by DWQ's Environmental Sciences Branch (water quality data) and the Technical Support Branch (modeling data and recommended pollution control strategies). Preliminary findings are presented at informal meetings through the year with local governments and interested groups, and comments are incorporated into the draft.
Year 5	Public Review and Approval of Plan: At the beginning of year 5, the draft plan, after approval of the Environmental Management Commission (EMC), is circulated for review and public meetings are held. Revisions are made to the document, based on public comments, and the final document is submitted to the EMC for approval midway through year 5. Basinwide permitting begins at the end of year 5.

Implementation - The implementation of basinwide planning and management will occur in phases. Permitting activities and associated routine support activities (field sampling, modeling, wasteload allocation calculations, etc.) have already been rescheduled by major river basin. All National Pollutant Discharge Elimination System (NPDES) permit renewals within a basin occur within a prescribed time period after completion of the final basin plan, and will be repeated at five year intervals.

Nonpoint source management proposals will be implemented by several different avenues. The Water Quality Section is setting up nonpoint source (NPS) teams for each basin. These teams are made up of representatives of nonpoint source agencies, resource agencies, and special interest groups. The NPS teams are responsible for prioritizing specific watersheds for follow-up investigations, educational efforts, and best management practice (BMP) implementation. Funding for BMP implementation will be sought from sources such as existing cost-share monies or from federal Section 319 grants. In addition to projects in specific watersheds, the NPS team will develop programmatic action plans for each category of nonpoint source pollution. The action plans detail voluntary actions that agencies and groups have committed to complete to protect and improve water quality in the basin. Many of the action plan items involve increased educational efforts or enforcement of existing programs.

1.4 BASINWIDE RESPONSIBILITIES WITHIN THE DWQ WATER QUALITY SECTION

The Division of Water Quality is the lead state agency for the regulation and protection of the state's surface waters. The Division is comprised of four sections: Water Quality, Groundwater, Construction Grants and Loans, and the Water Quality Laboratory.

The primary responsibilities of the Division of Water Quality are to maintain or restore an aquatic environment to sufficient quality to protect the existing and best intended uses of North Carolina's surface waters and to ensure compliance with state and federal water quality standards. The Division receives both state and federal allocations as well as funding through permit fee collections. Policy guidance is provided by the Environmental Management Commission. The major areas of responsibility are water quality monitoring, permitting, planning, modeling (wasteload allocations) and compliance oversight.

The Central office is divided into five branches, each branch is subdivided into units (Figure 1.2). The Planning Branch is responsible for developing surface water quality standards and classifications, nonpoint source program planning, administering the basinwide management program, modeling nonpoint pollution sources, developing use support ratings and supporting related GIS capabilities. It also coordinates the development of TMDLs and wasteload allocations for dischargers, provides primary computer modeling support, and coordinates EPA water quality planning grants and the implementation of the Comprehensive Conservation and Management Plan (CCMP) that resulted from the Albemarle-Pamlico Estuarine Study (APES).

The Regional Program Management Coordination Branch is responsible for providing increased communication and coordination of the water quality program. The responsibilities include the water supply watershed protection program, State Environmental Policy Act coordination for the Section, the operator training and certification program, emergency response, the development and administration of the enterprise wide database management system, and coordination and program management activities between the central and seven regional offices. The Environmental Technologies Unit is responsible for providing better access to data managed by the Water Quality Section so as to facilitate information exchange and analysis with the public as well as internal users. The Technical Assistance and Certification Unit rates the complexity of operation of wastewater treatment plants, provides training and operator certification commensurate with the plant operating needs, and provides technical assistance as requested by wastewater treatment systems. The Local Government Assistance Unit assists local governments in meeting the requirements of the water supply watershed protection program, managing the collection system permitting program, coordinating water quality state environmental policy act responsibilities and managing the EPA 205(j) grants program. The Branch also has the responsibility of ensuring program coordination through the seven Regional Offices.

The Environmental Sciences Branch is responsible for all biological and special study chemical water quality monitoring, discharger coalition water quality monitoring, and evaluations including benthic macroinvertebrate monitoring (biomonitoring), fish tissue, and fish communities studies. The Branch is also responsible for effluent toxicity testing and evaluations, biological laboratory certification, algal and aquatic macrophyte analyses, long term biochemical and sediment oxygen demand, and lakes assessments. The Branch interacts heavily in 305(b) use-support assessments and in water quality standards review and development. The Neuse River Rapid Response Team is coordinated through the Environmental Sciences Branch. The Branch is in the process of developing simplified public access to water quality information via the World Wide Web.

The Point Source Branch is responsible for permitting, compliance and enforcement of wastewater discharges into our state's surface waters. Permitting and enforcement programs include the municipal industrial pretreatment program, state and federal stormwater programs, and the National

Pollutant Discharge Elimination System (NPDES) program. Modeling is conducted to determine the receiving stream's ability to assimilate the discharge and protect the streams uses and surface water standards.

The Non-discharge Branch is responsible for permitting, compliance and enforcement of wastewater discharges that are **not** directly into our state's surface waters. Examples of these include spray irrigation systems, sludge applications, reuse systems, groundwater remediation projects and large-scale animal production operations. This branch also handles the section's activities related to wetlands including 401 certifications, wetland policy and mitigation, and DOT and dredging project reviews.

The seven Regional Offices carry out activities such as wetland reviews, compliance evaluations, permit reviews and facility inspections for both discharging and nondischarging systems, ambient water quality monitoring, state environmental policy act reviews, stream reclassification reviews, pretreatment program support and operator training and certification assistance. In addition, they respond to water quality emergencies such as oil spills and fish kills, investigate complaints and provide information to the public. Figure 1.3 shows the location of the regional offices and the counties that they serve.

REFERENCES CITED: CHAPTER 1

Creager, C.S., and J. P. Baker, 1991, North Carolina's Basinwide Approach to Water Quality Management: Program Description, DWQ Water Quality Section, Raleigh, NC.

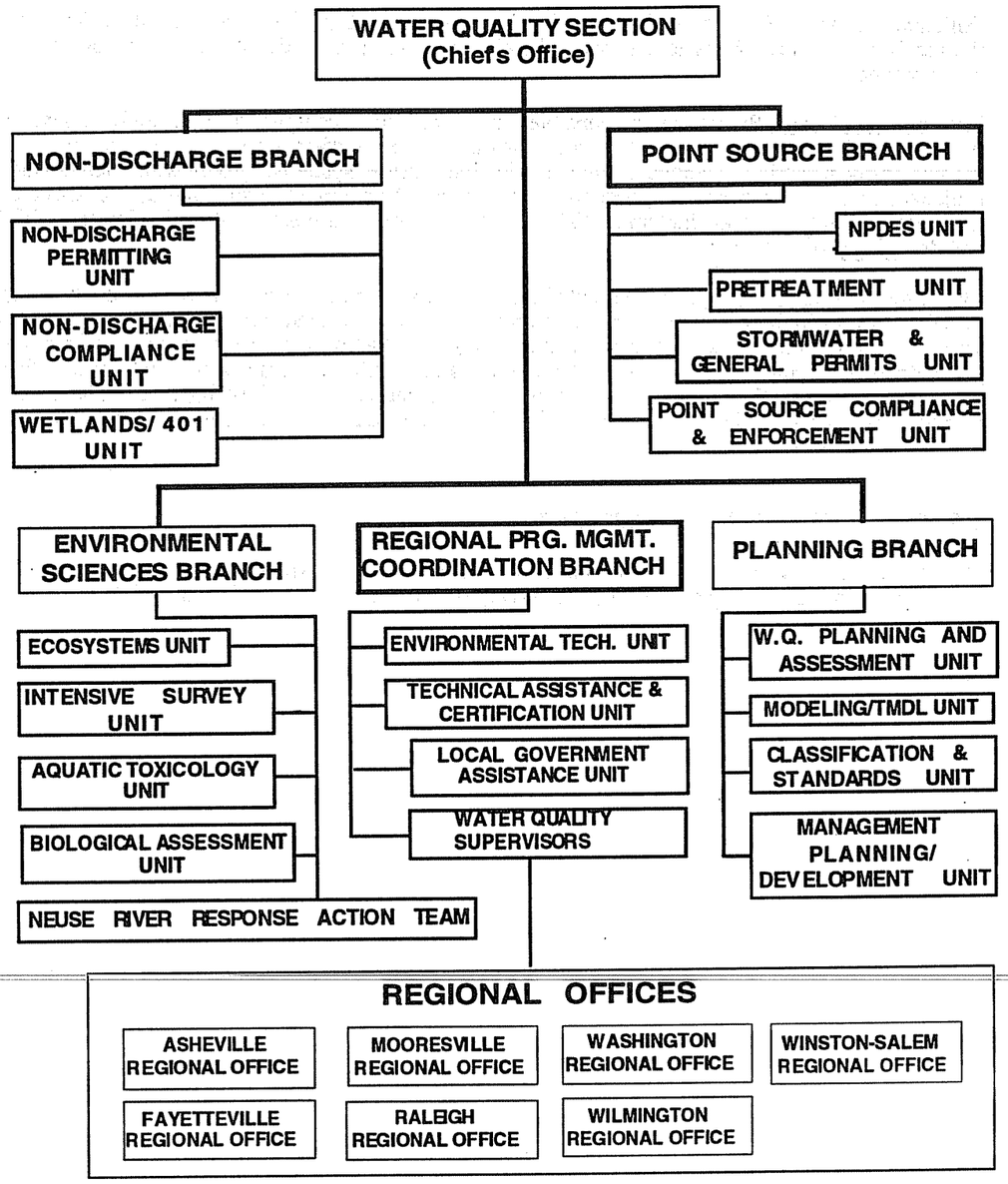
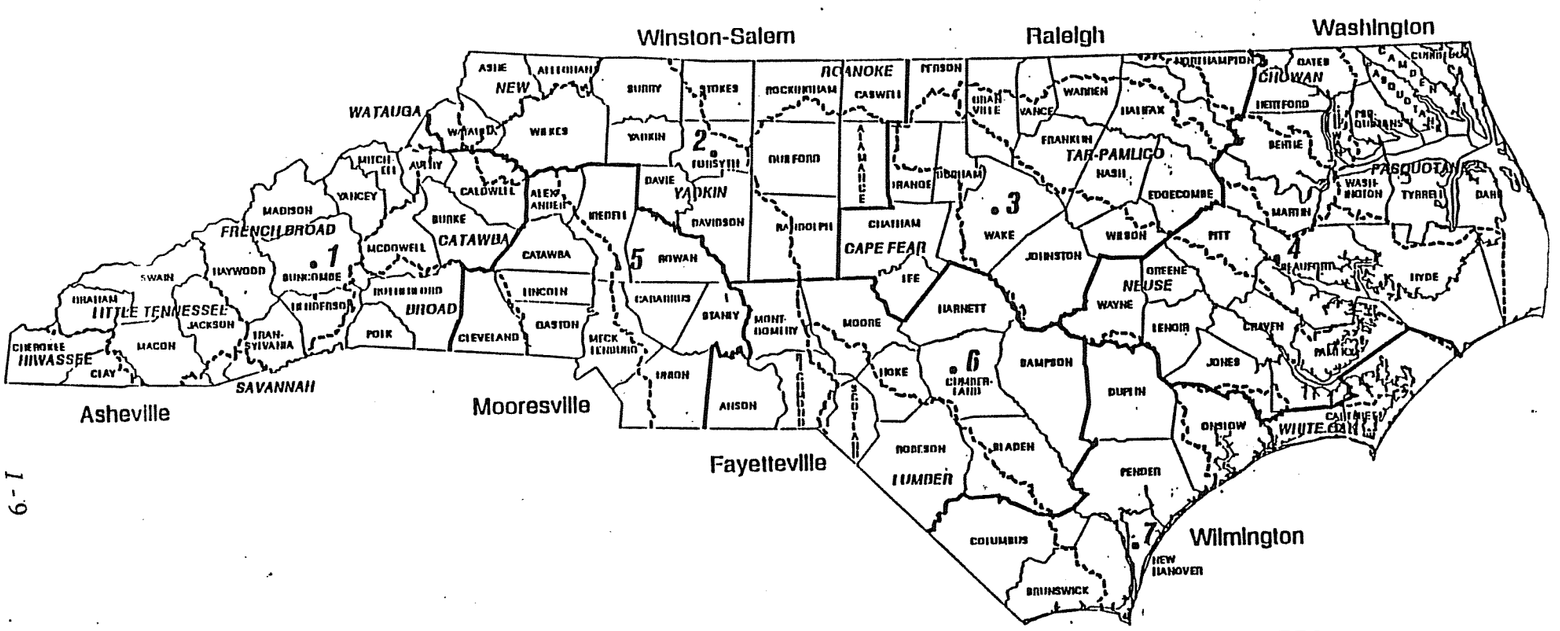


Figure 1.2 Organizational Structure of the DWQ Water Quality Section

N.C. Department of Environment and Natural Resources
Central & Regional Offices (with river basins)



1 - ARO
Mr. Roy Davis
Regional Supervisor
59 Woodfin Place
Asheville, NC 28801
(704) 251-6208
Fax (704) 251-6452

2 - WSRO
Mr. Larry Coble
Regional Suppervisor
585 Waughtown Street
Winston-Salem, NC 27107
(919) 771-4600
Fax (919) 771-4631

3 - Central Office
DENR, DWQ
Water Quality Section
P.O. Box 29535
Raleigh, NC 27626-0535
(919) 733-5083
Fax (919) 733-9919

3 - RRO
Mr. Ken Schuster
Regional Supervisor
3800 Barrett Drive
Raleigh, NC 27609
(919) 571-4700
Fax (919) 571-4718

4 - WaRO
Mr. Jim Mulligan
Regional Supervisor
1424 Carolina Avenue
Washington, NC 27889
(919) 946-6481
Fax (919) 975-3716

5 - MRO
Mr. Keith Overcash
Regional Supervisor
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Fax (704) 663-6040

6 - FRO
Mr. Tommy Stevens
Regional Supervisor
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Fayetteville, NC 28301
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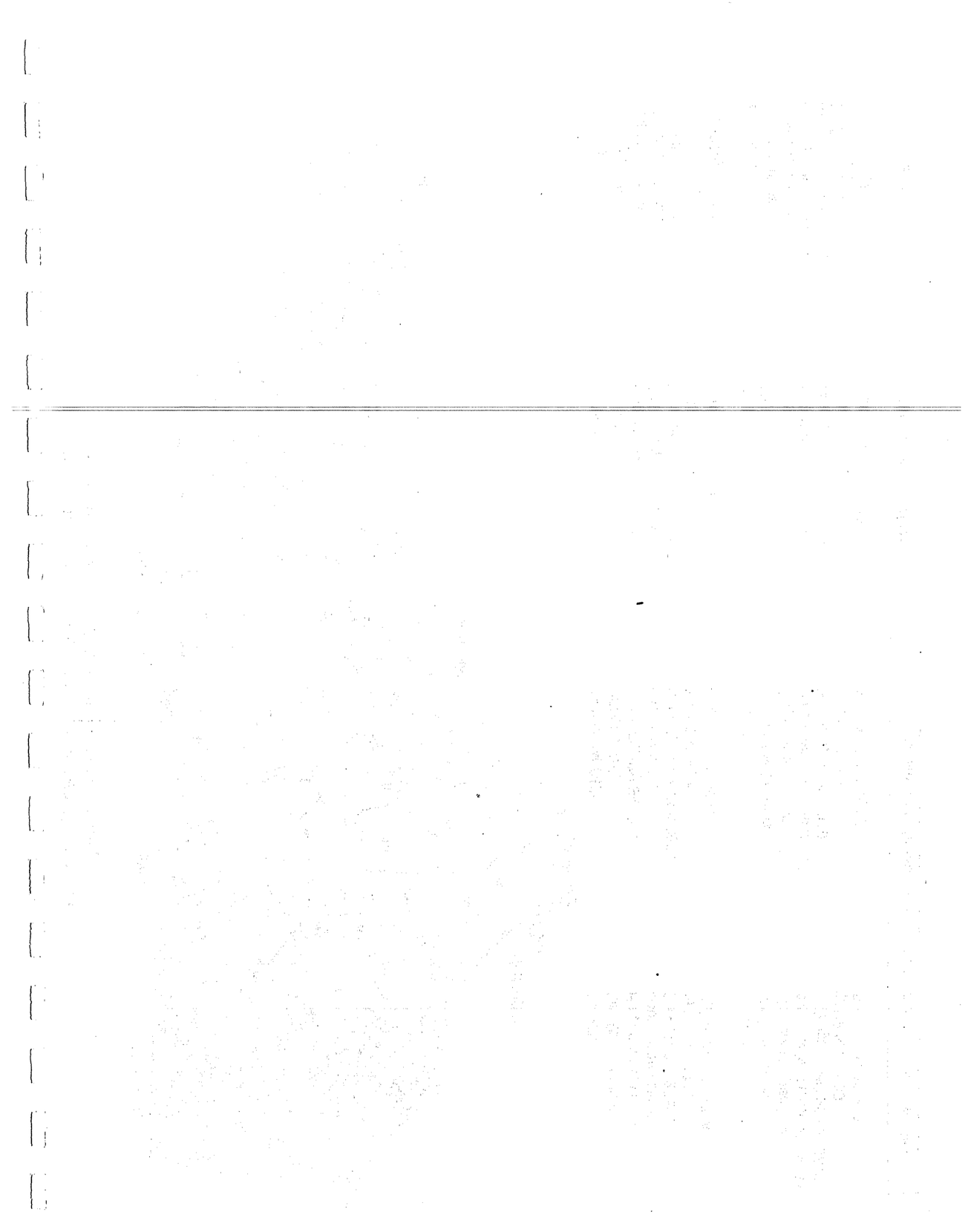
Fax (910) 486-0707

7 - WIRO
Mr. Rick Shiver
Regional Supervisor
127 Cardinal Drive Extension
Wilmigton, NC 28405-3845
(910) 395-3900
Fax (910) 350-2004

Figure 1.3 Location of Division of Water Quality Regional Offices

— — — River Basin Boundaries ——— Regional Office Boundaries



CHAPTER 2

GENERAL BASIN DESCRIPTION

2.1 BROAD BASIN OVERVIEW

The Broad River Basin encompasses a 1,506 square mile watershed drained by 1,472 miles of streams and rivers. The headwaters of the Broad and its major tributaries are located within the mountain and flow towards the foothills before entering the piedmont ecoregion southeast and east of Lake Lure. Figure 2.1 provides a general map of the North Carolina portion of the basin, including major hydrology, municipalities and county boundaries.

The three major tributaries to the Broad River are the Green River, the Second Broad River, and the First Broad River. These rivers flow into the Broad River before it enters South Carolina on its way to the Atlantic Ocean. There are five lakes in the basin, all of which are man-made. Several areas in the basin are classified for water supply use and approximately 30% of the streams are supplementally classified as trout waters to protect for the propagation and maintenance of that fishery.

The basin encompasses all of Cleveland, Polk and Rutherford counties, as well as portions of Buncombe, Henderson and Gaston counties. There are 29 municipalities in the basin including Lake Lure, Rutherfordton, Spindale, Forest City, Shelby and Kings Mountain.

The Broad River basin has an estimated population of 169,001 people based on 1990 census data. The entire basin has experienced moderate population growth between 1970 and 1990, with higher levels of growth occurring in the extreme eastern and western portions of the basin. In the eastern part of the basin in the Kings Mountain area, the population increase may be related to the high growth of the Charlotte area. In the western part of the basin, which is characteristically more mountainous, increases may be related to second home development or settlement of retirees.

Over 60% of the land in the Broad River basin is covered in forests. Based on data from the USDA Natural Resources Conservation Service, the most significant landcover change between 1982 and 1992, was a 71% increase in the amount of urban land. In 1992, approximately 20% of the land in the basin was covered by cultivated or uncultivated crop or pastureland.

Agriculture is an important industry in the basin. According to the NC Department of Agriculture (1996), revenues are higher for crop production than for livestock production for the counties that are either wholly or partly in the basin. Crops grown include, but are not limited to, sorghum, barley, oats, corn, soybeans, wheat and hay. There are twelve registered livestock operations within the basin, including cattle, poultry and swine.

The Broad River Basin is home to 97 rare animal and plant species. Two aquatic animals that are listed as Threatened by the State of North Carolina are the Bog Turtle and the Squawfoot (a mussel). There are five Natural Heritage Program Priority Areas in the basin. These are: the Rollins/South Mountains Natural Area; Hickorynut Gorge; Green River Headwaters and Gorge; the Tryon Region and Pacolet River Gorge; and Pinnacle Mountain.

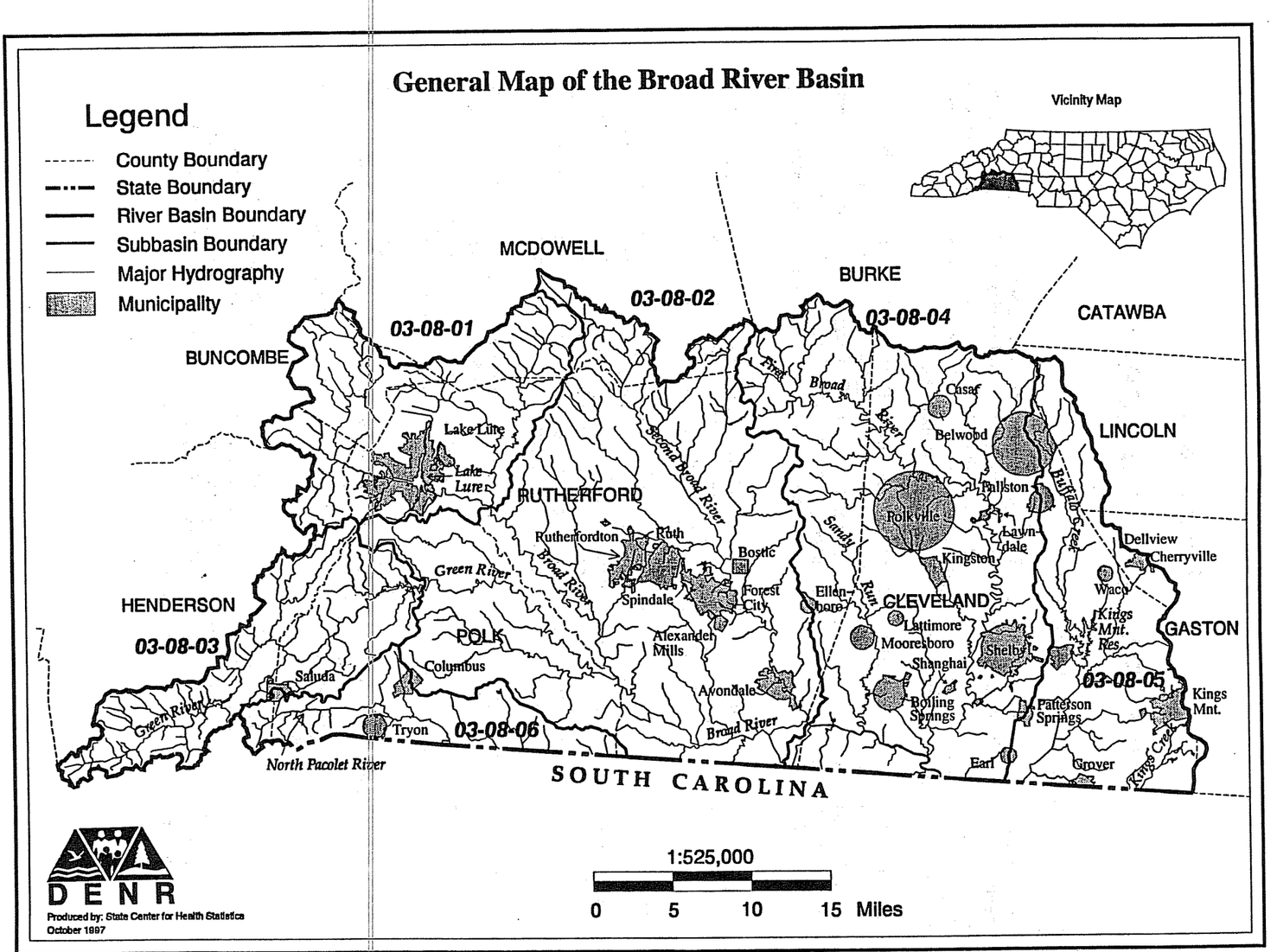


Figure 2.1 General Map of the Broad River Basin in North Carolina

2.2 COMPARISON OF STATE AND FEDERAL HYDROLOGIC AREAS IN THE BROAD BASIN

Most federal government agencies, including the US Geological Survey and the US Natural Resources Conservation Service (NRCS) use a system of defining watersheds that is different from that used by the Division of Water Quality (DWQ) and many other state agencies in North Carolina. Under this approach, a nationally uniform hydrologic unit system was developed in 1974 by the US Geological Survey's Office of Water Data Coordination (USDA, NRCS, Nov. 1995). This system divides the country into 21 regions, 222 sub-regions, 352 accounting units and 2,149 cataloging units based on surface hydrologic features. Under the federal system, the North Carolina portion of the Broad basin is made up of one hydrologic area referred to as a cataloging unit. Each cataloging unit is defined by an 8-digit number, and for the North Carolina portion of the Broad basin (or the 'Upper Broad') that number is 03050105. By contrast, DWQ has a two-tiered system in which the state is subdivided into 17 river basins, and each basin is subdivided into subbasins. The Broad River basin is subdivided by DWQ into 6 subbasins. Table 2.1, below, compares the two systems. Maps of each subbasin are included in Chapter 4.

Table 2.1 Hydrologic Divisions in the Broad River Basin

Watershed Name and Major Tributaries	Federal Cataloging Unit. 8-digit Hydrologic Units	DWQ Subbasin 6-digit codes Figure 2.1
Upper Broad River and Lake Lure	03050105	030801
Second Broad River and tribs. + middle portion of Broad River	"	030802
Upper Green River	"	030803
First Broad River and tribs. + lower portion of Broad River in NC	"	030804
Buffalo Creek and tribs.	"	030805
North Pacolet River and tribs.	"	030806

These comparisons are presented to aid in the interpretation of land cover data summaries in Section 2.4. That section presents land cover information developed by the US NRCS which is summarized for the 8-digit cataloging unit in the basin.

2.3 LOCAL GOVERNMENT AND PLANNING JURISDICTIONS

The Broad basin encompasses all or parts of Buncombe, Cleveland, Gaston, Henderson, Lincoln, McDowell, Polk and Rutherford counties and 29 municipalities as presented in Table 2.2. Also included in the table are abbreviations for the Lead Regional Organizations (Council of Governments) and Districts of the North Carolina League of Municipalities.

Table 2.2 Local Governments and Local Planning Units within the Broad River Basin

County	% of county in basin *	Lead Regional Organization	NC League of Munic. Dist.	Municipality
Buncombe	5%	Region B	XII	
Cleveland	100%	Region C	XI	Belwood Boiling Springs Casar Earl Fallston Grover Kingstown Kings Mountain Lattimore Lawndale Mooresboro Patterson Springs Polkville Shelby # Waco
Gaston	1%	Region F	XI	Cherryville Kings Mountain
Henderson	30%	Region B	XII	
Lincoln	2%	Region F	XI	
McDowell	4%	Region C	XI	
Polk	100%	Region C	XII	Columbus # Saluda Tryon
Rutherford	100%	Region C	XI	Alexander Mills Bostic Chimney Rock Village Ellenboro Forest City
				Lake Lure Ruth Rutherfordton # Spindale

* percentages are approximate # - denotes county seat
Region B = Land of the Sky Regional Council
Region C = Isothermal Planning & Economic Development Commission
Region F = Centralina Council of Governments

2.4 LAND COVER, POPULATION AND GROWTH TRENDS

2.4.1 General Land Cover

Land cover information in this section is derived from the US Department of Agriculture (USDA), Natural Resources Conservation Service's (NRCS) National Resources Inventory (NRI) of 1992

and 1982 (USDA, 1994). The NRI is a multi-resource national inventory based on soils and other resource data collected at scientifically selected random sample sites. According to the NRCS 1992 NRI Instructions booklet, the 1982 NRI was the most comprehensive study of our nation's natural resources ever conducted. The inventory is considered accurate to the 8-digit cataloging unit scale established by the US Geological Survey (NRCS, 1993). A 1992 update of these data was recently released.

Table 2.3 summarizes acreage and percentage of land cover from the 1992 and 1982 NRI for the basin. Land cover identified by the NRI as occurring in the Broad River basin include cultivated cropland, uncultivated cropland, pastureland, forest land, urban and built-up lands, and other. Table 2.4 provides a detailed description of each land use type identified.

Land cover in the basin, as presented in Table 2.3, is dominated by forest which in 1992 accounted for 61% of the total area. Between 1982 and 1992, the most significant change was seen in the urban/built-up category with a 71% increase. During that same time period the amount of cultivated cropland decreased by 52%, uncultivated cropland increased by 26% and the 'other' category, which includes rural transportation, water areas and federal lands, increased by 43%.

Table 2.3 Estimated Acreage by Broad Land Use for the Broad River Basin in 1992 and 1982. (Source: USDA, NRCS, 1994)

1992 NRI

	Upper Broad 03050105		% Change from '82 - '92
LAND COVER	Acres (1000s)	%	
Cult. Crop	52.5	5	-52%
Uncult. Crop	18.8	2	+26%
Pasture	129.0	13	+9%
Forest	592.9	61	-3%
Urban/Built-up	85.8	9	+71%
Other	87.3	9	+43%
Totals	966.3	99.0	
DWQ Subbasins	03-08-01 thru 03-08-06		

1982 NRI

	Upper Broad 03050105	
LAND COVER	Acres (1000s)	%
Cult. Crop	108.8	11
Uncult. Crop	14.9	2
Pasture	118.2	12
Forest	613.1	63
Urban/Built-up	50.1	5
Other	61.2	6
Totals	966.3	99.0

Table 2.4 Description of Land Cover Types (1992 NRI - USDA NRCS)

Land Cover Type (No.)	Land Cover Description
1) Cultivated Cropland	Land used for the production of adapted crops for harvest, including row crops, small-grain crops, hay crops, nursery crops, orchard crops, and other specialty crops. The land may be used continuously for these crops or they may be grown in rotation with grasses and legumes.
2) Uncultivated Cropland	Summer fallow, aquaculture in crop rotation, or other cropland not planted (may include cropland in USDA set-aside or similar short-term program).
3) Pastureland	Land used primarily for production of introduced or native forage plants for livestock grazing. This category includes land that has a vegetative cover of grasses, legumes, and /or forbs, regardless of whether or not it is being grazed by livestock.
4) Forest Land	Land at least 10 percent stocked 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 and not currently developed for non-forest use. Ten percent stocked, when viewed from a vertical direction, is a canopy cover of leaves and branches of 25 percent or greater. The minimum area for classification of forest land is 1 acre, and the area must be at least 1,000 feet wide.
5) Urban and Built-up Land	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. Highways, railroads, and other transportation facilities are considered part of this category if surrounded by other urban and built-up areas. Tracts of less than 10 acres that do not meet this category's definitions (e.g., small parks or water bodies) but are completely surrounded by urban and built-up lands are placed in this category.
6) Other:	This category includes rural transportation, water areas and federal lands. 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). Water consists of small water bodies (water bodies less than 40 acres in size and streams less than one-half mile wide) and census water (large water bodies consisting of lakes and estuaries greater than 40 acres and rivers greater than one-half mile in width).

2.4.2 Population and Growth Trends in the Basin

The Broad River basin has an estimated population of 169,00 people based on 1990 census data. Table 2.5 presents census data for 1970, 1980, and 1990 for each of the subbasins. It also includes land and water areas and population densities (persons/square mile of land area) by subbasin. Figure 2.2 shows the percent population growth by subbasin. The entire basin has experienced moderate population growth between 1970 and 1990, with higher levels of growth occurring in the extreme eastern and western portions of the basin. In the eastern part of the basin in the Kings Mountain area, the population increase may be related to the high growth of the Charlotte area, whereas in the western part of the basin, which is characteristically more mountainous, increases may be related to second home development or settlement of retirees.

Of the three counties that are located entirely within the Broad River basin, Polk and Rutherford counties are expected to grow by 21% and 12%, respectively, by the year 2020 (NC Department of Administration). Of the municipalities in the basin, the most significant population changes between 1990 and 1995 were seen in Shelby (+8%), and Lake Lure (+13%) (Office of State Planning, 1996).

Figure 2.3 demonstrates population density by census block group for the Broad basin. The majority of the basin is rural, but there are pockets of more densely populated areas. These pockets are centered around Rutherfordton, Forest City, Shelby, and Kings Mountain. The eastern portion of the basin in Cleveland County is generally more densely populated than other areas.

In using these data, it should be noted that the population figures are estimates because the census block group boundaries do not generally coincide with subbasin boundaries. The census data are collected within boundaries such as counties and municipalities. By contrast, the subbasin lines are drawn along natural drainage divides separating watersheds. Therefore, where a census block group straddles a subbasin line, an estimate has to be made on the percentage of the population that is located in the subbasin. This is done by simply determining the percentage of the census block group area located in the subbasin and then taking that same percentage of the total census block group population and assigning it the subbasin. Use of this method necessitates assuming that population density is evenly distributed throughout a census block group, which is not always the case. However, the level of error associated with this method is not expected to be significant for the purposes of this document. It is also important to note that the census block groups may change for each census so comparisons between years must be considered approximate.

2.5 AGRICULTURAL ACTIVITIES IN THE BROAD RIVER BASIN

Agriculture is a very important industry in the Broad River basin. Based on a 1996 report from the North Carolina Department of Agriculture, there are a total of 3,359 farms in counties that overlap the Broad River Basin (see Table 2.6). These farms comprise a total of 432,603 acres with the overall average farm size for all of the counties being 118 acres. In 1993, cash receipts for agricultural products in these counties, including both livestock and crop production, totaled $340,991,000. The following sections focus more specifically on livestock operations and crop production in the Broad basin.

Table 2.5 Broad River Basin Subbasin Population (1970, 1980 and 1990) and Land Area Summaries

SUBBASIN	POPULATION (Number of Persons)			POPULATION CHANGE (%)			POPULATION DENSITY (Persons/Square Mile)			LAND AND WATER AREAS			
										Total Land and Water Area		Water Area	Land Area
	1970	1980	1990	1970-80	1980-90	1970-90	1970	1980	1990	(Acres)	(Sq. Miles)	(Sq. Miles)	(Sq. Miles)
03-08-01	4,640	7,449	5,659	60	-24	21	25	40	31	117,552	183.675	1.195	182.48
03-08-02	47,197	54,704	57,440	15	5	21	92	106	112	328,415	513.148	1.086	512.062
03-08-03	4,793	6,476	8,186	35	26	70	35	47	60	87,495	136.711	0.583	136.128
03-08-04	50,495	55,847	56,063	10	0	11	118	131	131	272,892	426.394	1.27	425.124
03-08-05	26,861	34,317	34,047	27	0	26	150	192	191	115,613	180.645	2.733	177.912
03-08-06	6,454	6,755	7,606	4	12	17	88	92	104	46,608	72.825	0.174	72.651
Totals	140,440	165,548	169,001	18	2	20	93	110	112	968,575	1,513.4	7.041	1,506

Note: Population, land area and water area were derived from 1970, 1980 and 1990 census data.

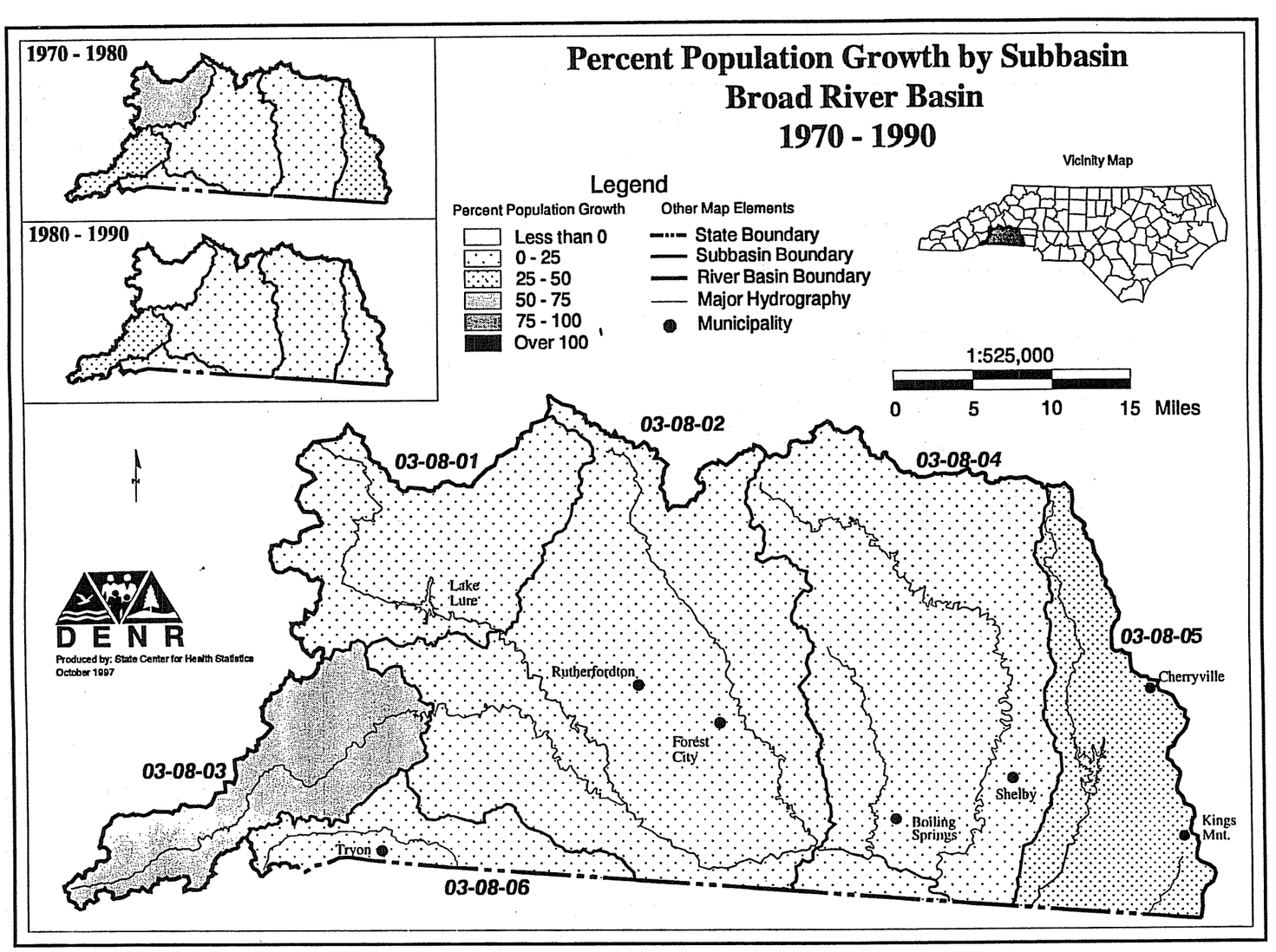


Figure 2.2 Percent Population Growth by Subbasin

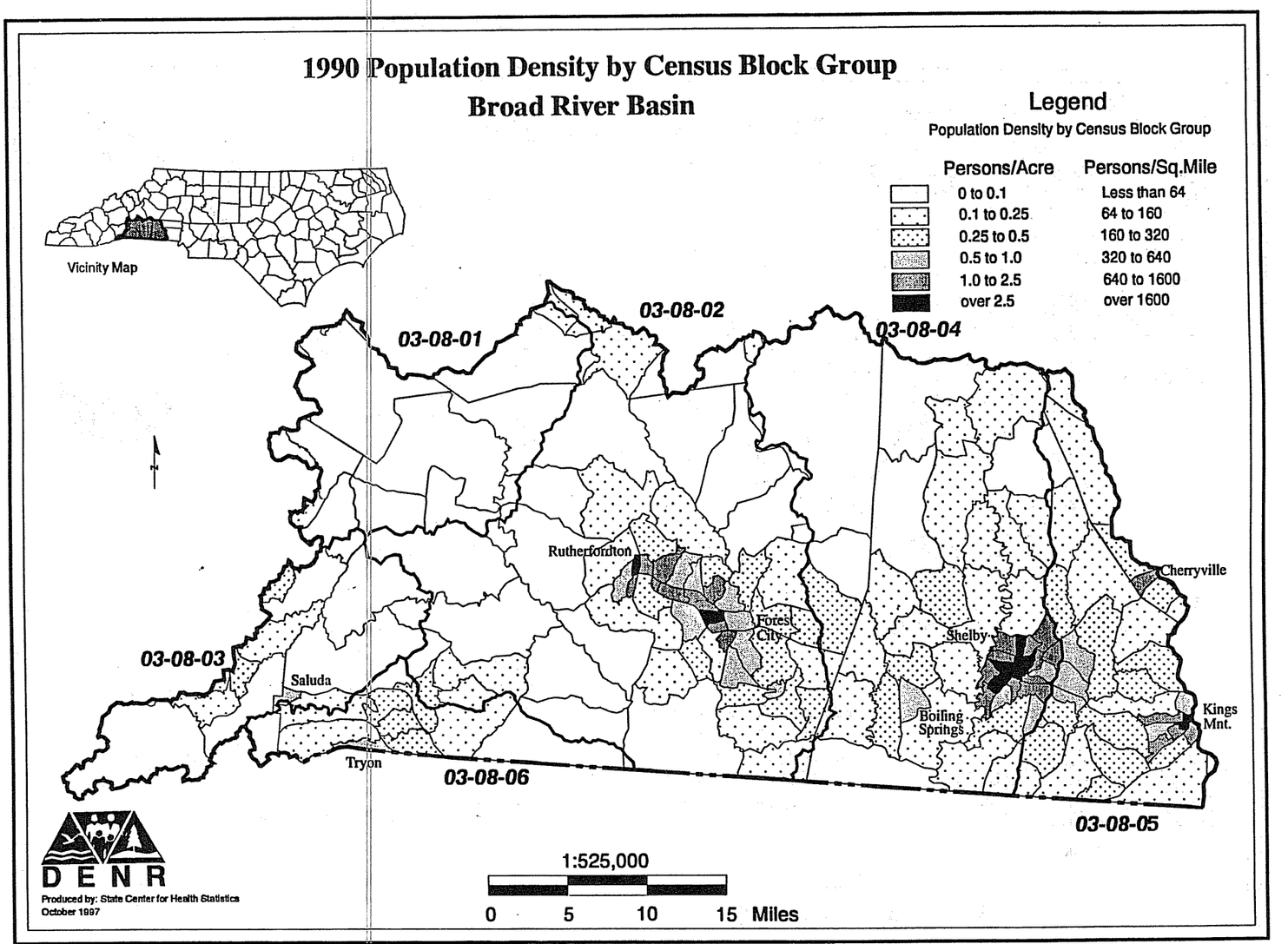


Figure 2.3 1990 Population Density by Census Block Group for the Broad River Basin

Table 2.6 Summary of 1993 Agricultural Statistics for Counties in the Broad River Basin (Source: NC Department of Agriculture, 1996)

County (% in Basin)	Number of Farms	Acres of Land in Farms	Avg. Size of Farm (Acres)	Revenue from Crops	Revenue from Livestock	Total Cash Receipts
Buncombe (5%)	1,097	93,584	85	$80,778,000	$14,314,000	$95,471,000
Cleveland (100%)	714	93,970	132	$9,889,000	$21,801,000	$33,253,000
Gaston (1%)	293	34,717	118	$4,362,000	$7,982,000	$12,663,000
Henderson (30%)	511	52,281	102	$115,715,000	$13,662,000	$129,807,000
Lincoln (2%)	425	58,384	137	$5,014,000	$15,350,000	$20,990,000
McDowell (4%)	194	21,218	109	$25,445,000	$2,720,000	$28,199,000
Polk (100%)	161	23,140	144	$5,247,000	$3,320,000	$8,908,000
Rutherford (100%)	464	55,309	119	$6,128,000	$5,234,000	$11,700,000
TOTALS	3,859	432,603	118	$252,578,000	$84,383,000	$340,991,000

2.5.1 Livestock Operations

In 1992, the Environmental Management Commission adopted a rule modification (15A NCAC 2H .0217) to establish procedures for managing and reusing animal wastes from intensive livestock operations (See section 5.3.1 for additional information on rule requirements). The rule applies to new, expanding or existing feedlots with animal waste management systems designed to serve more than or equal to the following animal populations: 100 head of cattle, 75 horses, 250 swine, 1,000 sheep or 30,000 birds (chickens and turkeys) with a liquid waste system. The deadline for submittal of registrations to DWQ for existing facilities was December 31, 1993.

In the Broad River basin, there are a total of 11 registered livestock operations. Three of these are certified, meaning they have approved waste management plans (the remainder must have approved plans in place before the end of 1997). Table 2.7 provides more information related to these operations, including numbers of animals for cattle, poultry and swine. There are no registered livestock operations in subbasins 03 and 06. The majority of registered livestock operations in the basin are cattle, although there is one poultry operation and one swine operation. Locations of registered animal operations in the Broad basin are illustrated in Figure 2.4. This map is intended to provide a general idea of locations of registered operations in the basin.

Table 2.7 Registered Animal Operations in the Broad River Basin

Subbasin	Cattle - Total Animals	Cattle - Total Operations	Poultry - Total Animals	Poultry - Total Operations	Swine - Total Animals	Swine - Total Operations	Total Animals in Basin	Total Operations in Basin
030801	150	1	0	0	0	0	150	1
030802	620	4	25,000	1	0	0	25,620	5
030804	620	3	0	0	500	1	21,120	4
030805	400	1	0	0	0	0	400	1
TOTAL	1,790	9	25,000	1	500	1	47,290	11

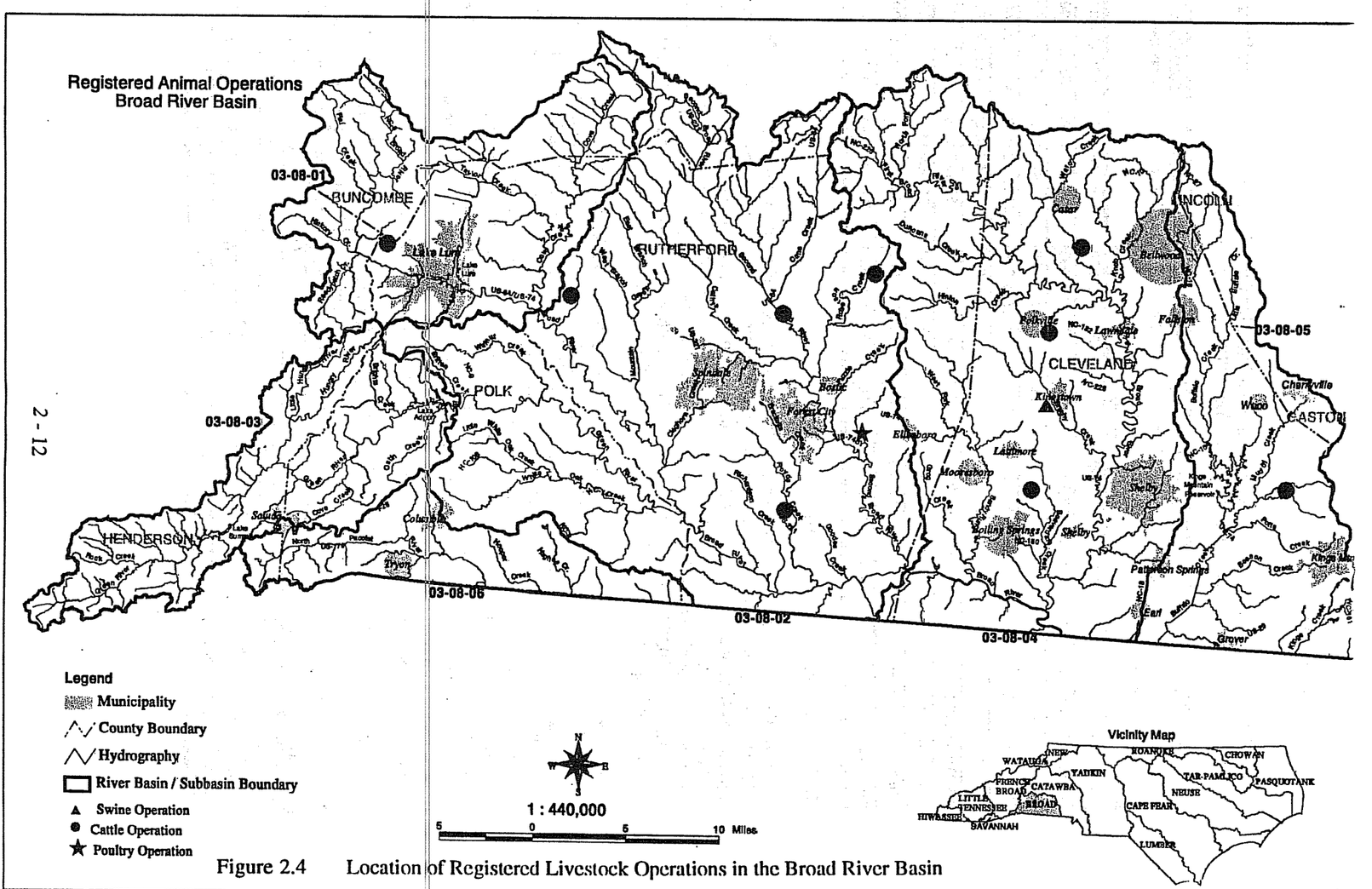


Figure 2.4 Location of Registered Livestock Operations in the Broad River Basin

2.5.2 Crop Production

According to the NC Department of Agriculture (1996), there are a variety of crops grown in the Broad River basin (based on data from counties that overlap that basin). As was indicated in Table 2.6, the amount of money in the basin made on crops was approximately 3 times as much as was made on livestock production. A variety of crops are grown in the basin, but some of the more common ones include sorghum, barley, oats, corn, soybeans, wheat and hay.

2.6 NATURAL RESOURCES IN THE BROAD RIVER BASIN

2.6.1 Wetlands

Wetlands can be very important in watershed planning because they perform a variety of services beneficial to society. These systems are able to process sediments, nutrients, and other pollutants, provide wildlife habitat, store organic matter and provide other means to protect habitat as well as downstream and on-site water quality. Each of the actions that a wetland performs, regardless of human recognition of that action, is called a function. When these actions are declared important to society as a whole, they are called values. Some wetland values are ubiquitous to most wetland types, such as wildlife habitat. However, wetland values are ultimately tied to specific wetlands because they depend on site specific factors such as landscape position, size, soil type, and land use.

DWQ has regulated wetland fill activities since the mid-1980's under provisions of Section 401 of the federal Clean Water Act. Under this section, the state regulated wetlands fill activities through the issuance of 401 water quality certifications. In 1989, the EMC passed a rule directing DWQ to review wetland fill using a review sequence of avoidance, minimization and mitigation of wetland fill.

After extensive public review and debate, the NC Environmental Management Commission (EMC) passed rules to restructure its regulation of wetlands through the 401 Water Quality Certification Program on March 14, 1996. These rules became effective October 1, 1996. These rules do not reflect a new regulatory program, but instead, helped better define the state's regulatory approach to the 401 process. The 1996 rules also consider wetland values - whether or not the wetland is providing significant uses or if the activity would remove or degrade uses. The rules also specify mitigation ratios, locations and types to make the mitigation process more predictable for the regulated community. The general approach adopted in the rules has been used by DWQ for five years. DWQ's emphasis has been and continues to be on water quality and the essential role that wetlands play in maintaining water quality.

Tables 2.8 and 2.9 show wetland impacts by subbasin as well by wetland type. Most of the fill activities in the basin occurred in subbasin 05 which is in the eastern part of the basin and has the highest population density in the basin. Bottomland hardwood forests were the type of wetland that received the most impact.

Table 2.8 Wetland fill activities (in acres) in the Broad River Basin from 1994 to 1996

Subbasin	1994	1995*	1996*	Total
030801	0	0.02	0	0.02
030802	0	0.60	0	0.6
030803	0	0.09	0	0.09
030804	0.08	0.02	0	0.10
030805	0	0	1.36	1.36
030806	0.4	0	0	0.40
Total Acres	0.48	0.73	1.36	2.57
No. of Projects	2	9	2	13

** Note: The 1995 and 1996 databases have not been checked for errors.*

Table 2.9 Fill activities (in acres) in the Broad River Basin by wetland type from 1994 to 1996

Wetland Type	1994	1995*	1996*	Total
Bottomland Hardwood	0.08	0.73	0.68	1.49
Freshwater Marsh	0.40	0	0	0.40
Headwater Forest	0	0	0.68	0.68
Total	0.48	0.73	1.36	2.57

** Note: The 1995 and 1996 databases have not been checked for errors.*

Wetland Communities in the Broad River Basin

Wetlands in the Broad River basin exist across a range of landscapes, from river channels to isolated hillsides. One type of wetland found in or adjacent to rivers and streams is known as Rocky Bar and Shore. These wetlands are actually rock outcrops and gravel bars which are too rocky, too wet, or too severely flooded to support large trees. Shrubs and herbs such as alder, buttonbush, willow, dogwood, cane, waterwillow, jewelweed, and various sedges dominate the vegetation. High-quality examples of Rocky Bar and Shore occur along the Broad River and the Green River.

Montane Alluvial Forest wetlands are found in floodplains. These forested wetland communities are dominated by trees such as hemlock, sycamore, white oak, and tulip poplar, with ironwood, witch hazel, and black willow underneath. High-quality examples, which are very rare in North Carolina, occur along the Broad River, Green River, and Little Sugarloaf Creek.

At the edges of floodplains in the Broad River basin can be found wetland communities known as Low Elevation Seeps. These are often very small wetlands located at the bases of slopes; they are partially shaded by canopies of trees rooted in adjacent communities. Low Elevation Seeps seem to be very important foraging and breeding habitats for amphibians such as salamanders and frogs.

Similar to Low Elevation Seeps are wetlands called Hillside Seepage Bogs. These wetland communities are fed by groundwater seepage and typically have trees at the edges of the wet, open interior. Hillside Seepage Bogs, which are very rare in North Carolina, are characterized by well-developed *Sphagnum* moss mats and typical bog plant species.

A unique wetland community called Spray Cliff occurs in the Broad River basin in association with waterfalls. Spray Cliff communities are constantly wet from the spray of waterfalls, and the plants -- mostly mosses, liverworts, algae, and vascular herbs -- that grow on patches of soil along the rock faces are adapted to moist environments more typical of the tropics. Spray Cliffs support many endemic bryophytes and rare plant species.

Bottomland hardwood and headwater wetlands perform valuable water quality functions including flood water storage, nutrient and sediment retention and nutrient transformation. However, their effectiveness is diminished if the stream waters can no longer inundate adjacent floodplains or if nutrient loads exceed the assimilative capacity of the wetland. As these wetlands are lost upstream, the potential for erosion, flooding, sedimentation, algal blooms, and fish kills increase downstream. Those wetlands adjacent to intermittent streams are especially important in filtering nonpoint pollution from agricultural and urban runoff.

2.6.2 Rare Aquatic and Wetland Species

The Broad River Basin is home to 97 rare animal and plant species. Of this total, aquatic or wetland environments directly support four rare animal species and sixteen rare plant species. Table 2.10 lists the rare aquatic and wetland-dwelling animals found in the Broad River basin. Figure 2.5 shows the general location of where these animals are found.

Table 2.10 Rare Aquatic and Wetland-dwelling Animal Species in the Broad River Basin (Source: NC Natural Heritage Program)

MAJOR TAXON	COMMON NAME	SCIENTIFIC NAME	LISTING STATUS: STATE	FEDERAL
Reptile	Bog Turtle	*Clemmys muhlenbergii*	T	FSC/ PT(S/A)
Fish	Santee Chub - Piedmont population	*Cyprinella zanema* pop. 1	SR	
Mollusk	Squawfoot	*Strophitus undulatus*	T	
Butterfly	Baltimore	*Euphydryas phaeton*	SR	

Abbreviations: E = Endangered; T = Threatened; PT (S/A) = Proposed Threatened due to Similarity of Appearance; FSC = Federal Species of Concern; SR = Significantly Rare.

Endangered species are those species in danger of becoming extinct. Threatened species are likely to become endangered within the foreseeable future. Federal Species of Concern are species for which further biological research and field study are needed before they are considered candidates for listing as threatened or endangered species. Significantly Rare species are those whose numbers in the state are small and whose populations need monitoring.

Bog Turtle (*Clemmys muhlenbergii*) State Threatened, Federal Species of Concern and Proposed Threatened due to Similarity of Appearance

The bog turtle is recognized by the bright orange patches on the side of its head. As its name suggests, the bog turtle makes its home in sphagnum moss bogs, marshy meadows, and wet pastures. Burrowing into soft mud, this small and secretive turtle can remain buried for considerable periods of time. In the Broad River basin, bog turtles are found in areas known as Hillside Seepage Bogs and Wet Pastures.

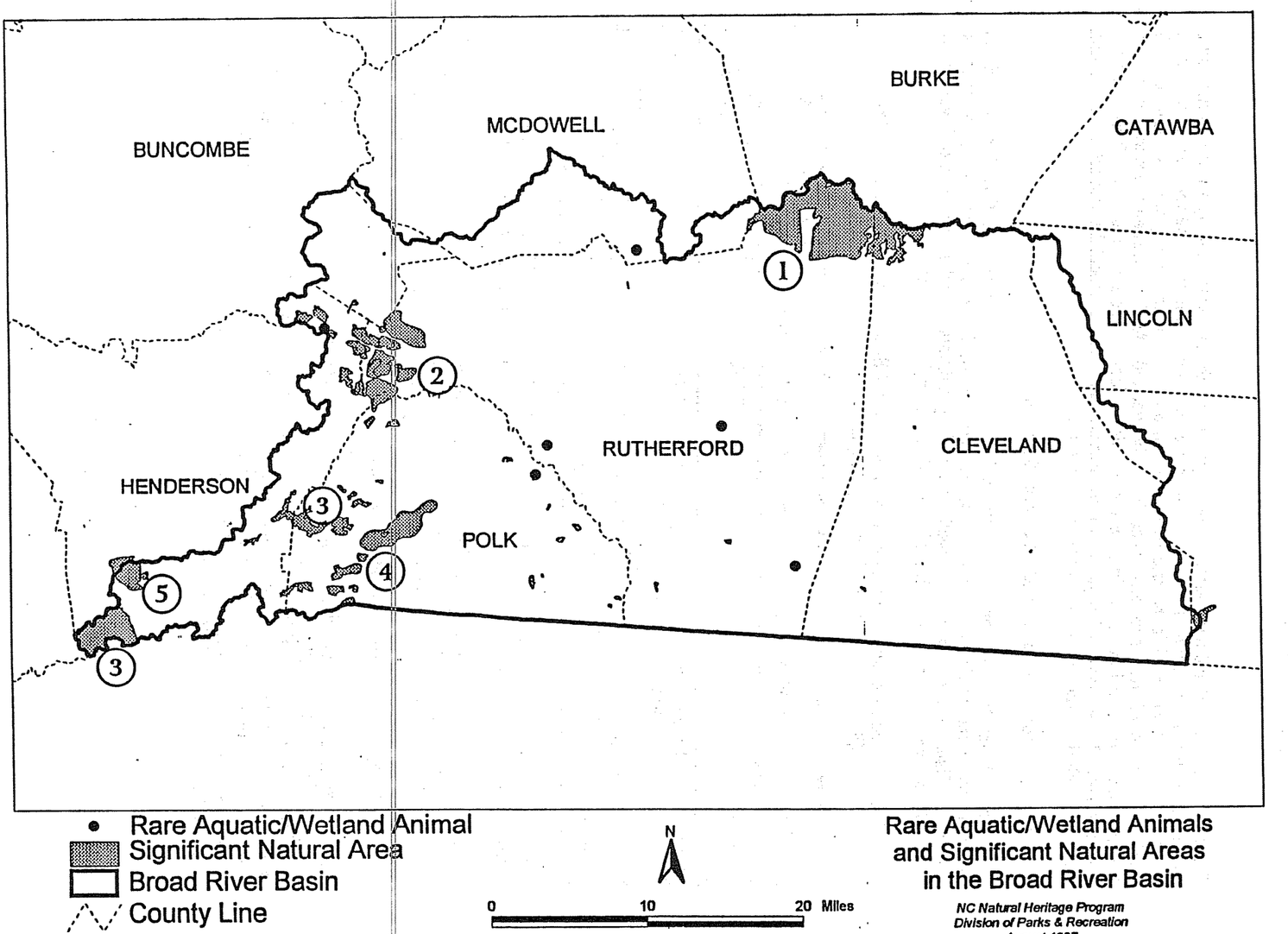


Figure 2.5 : Broad

Santee Chub - Piedmont population (*Cyprinella zanema* pop. 1) State Significantly Rare
This species is endemic to portions of North and South Carolina. The North Carolina population is actually composed of two distinct entities, a Piedmont population in the Broad and Catawba River drainages and a separate population in the Coastal Plain. The Piedmont population usually inhabits streams of moderately fast velocity over pebbles and gravel.

Squawfoot (*Strophitus undulatus*) State Threatened
The squawfoot is found throughout both the Atlantic and the Mississippi drainages. On the Atlantic slope it is known from the Savannah River in South Carolina to the St. Lawrence River in Canada. It is present in most of the Piedmont drainages in North Carolina. Although a very wide-ranging species, the squawfoot has become quite rare in many areas where it was once considered extremely common during the last century.

Baltimore (*Euphydryas phaeton*) State Significantly Rare
The baltimore, a black checkerspot butterfly whose wings have several rows of cream-colored spots fringed by red-orange crescents, lives in the mountains and foothills of North Carolina. It usually inhabits bogs and wet meadows where the caterpillar food plants, primarily turtleheads (*Chelone* spp.), are found.

2.6.3 Natural Heritage Priority Areas

The North Carolina Natural Heritage Program (NHP) compiles a list of Significant Natural Heritage Areas as required by the Nature Preserve Act (NCGS Chapter 113-A-164 of Article 9A). The list is based on the program's inventory of natural diversity in the state (DENR 1997). Natural areas are evaluated on the basis of the occurrences of rare plant and animal species, rare or high-quality natural communities, and geologic features. The global and statewide rarity of these elements and the quality of their occurrence at a site relative to other occurrences 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 2.5 shows the Significant Natural Heritage Areas (SNHA) in the Broad River basin. Sites that directly contribute to the maintenance of water quality in the Broad basin are highlighted below. The numbers correspond to the numbers on the map. More complete information on Significant Natural Heritage Areas may be obtained from the Natural Heritage Program.

1. Rollins/South Mountains Natural Area
Of national ecological significance, the 17,000-acre Rollins/South Mountains Natural Area contains an impressive array of high-quality natural communities, rare animal populations, and three Federally-listed and twenty State-listed rare plants. This intact forested area, tucked into the northeast corner of Rutherford County and stretching into Cleveland and McDowell counties, shelters the watershed (the headwaters of the First Broad River) that supplies drinking water to the town of Shelby. The Rollins/South Mountains Natural Area is enhanced by its proximity to other protected natural areas, including South Mountains State Park, and Morganton, Broughton, and Deaf School Watersheds. State funding from the Natural Heritage Trust and the North Carolina Clean Water Management Trust Fund has laid the foundation for the eventual acquisition of the Rollins/South Mountains Natural Area by the N.C. Wildlife Resources Commission. In addition to protecting the water supply for the town of Shelby, the Rollins/South Mountains Natural Area will serve as recreation lands and gamelands for the citizens of North Carolina.

2. Hickorynut Gorge
Located near Asheville on the edge of the Blue Ridge Escarpment, Hickorynut Gorge is an area of exceptional ecological significance. Its variety of high-quality natural communities and abundance of rare plants and animals is due in part to the area's geology; geologic faults, caves, mafic rock,

sheer cliffs, peaks, hoodoos, waterfalls, and granitic domes characterize the landscape around the Gorge as it drops 1800 feet from the mountains to the Piedmont. The Hickorynut Gorge area is composed of a number of individual sites that have been identified as having special ecological significance in themselves, and several of the most crucial Significant Natural Heritage Areas are listed below:

- Rumbling Bald and Shumont Mountain
- World's Edge/Sugarloaf Mountain (part Registered Natural Heritage Area)
- Broad River Natural Area
- Bald Mountain/Rainbow Falls
- Bat Cave (part Registered Natural Heritage Area)
- Cane Creek Mountain
- Chimney Rock Natural Area (part Registered Natural Heritage Area)
- Cloven Cliffs/The Pinnacles
- Little Bearwallow Mountain

3. Green River Headwaters and Gorge

The Green River Headwaters and Gorge is composed of two sets of Significant Natural Heritage Areas, those in the headwaters of the Green River, and those downstream in the Narrows of the gorge. The assemblages of plants, animals, and natural communities along the Green River are among the highest quality occurrences in North Carolina. The headwaters are buffered by intact, good quality forest communities which help to protect the integrity of the Green River. Additionally, the 4000-acre headwaters area is valuable for its landscape role connecting an adjacent natural area in South Carolina (Mountain Bridge) to Stone Mountain and Pinnacle Mountain to the north. At the Narrows, the gorge is 1000 feet deep, and the ravines and coves support floristically rich communities. The following Significant Natural Heritage Areas constitute the highest quality sites along the Green River and should be considered for preservation both for water quality and ecosystem functions:

- Cove Creek/Bradley Falls Natural Area (Dedicated Nature Preserve)
- Green River Gorge (Dedicated Nature Preserve)
- Green River Headwaters
- Laurel Branch Creek Gorge/Ravines and Slope
- Lower Hungry River Gorge

4. Tryon Region and Pacolet River Gorge

A collection of Significant Natural Heritage Areas in south-central Polk County is noted for the natural communities and rare plants associated with the high-pH amphibolite and granitic-gneissic geologic substrate of the region. Well-developed rich forests on slopes of Tryon Peak and unique cliff communities are interspersed with caves, streams, ridges and valleys. Dominated by White Oak Mountain, the Tryon Region encompasses several high-quality natural areas, several of which are listed below:

- White Oak Mountain/Tryon Peak
- Tryon Reservoir/Twin Lakes/Big Fall Creek Natural Area
- Cedar Cliff/Warrior Mountains (part Registered Natural Heritage Area)
- Melrose Mountain
- Pearsons Falls Glen/Pacolet River Bluffs (part Registered Natural Heritage Area)

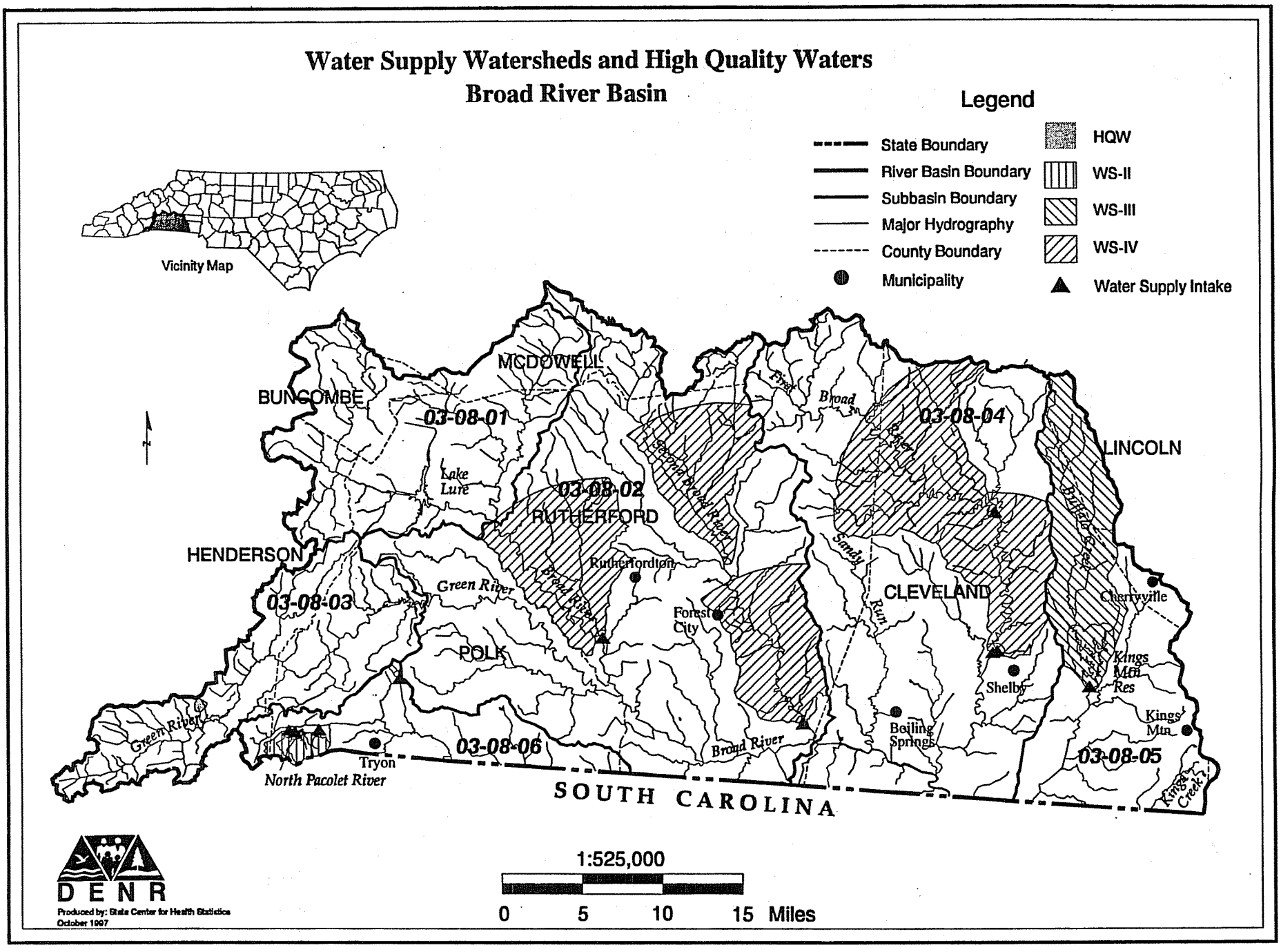


Figure 2.6 Water Supply Watersheds and High Quality Waters in the Broad River Basin

In general, the Protected Area boundary for each of these water supplies will be reduced in size. However, the proposal allowed local governments the option to: reduce the Protected Area size where water supply watershed ordinances are required; keep their current area of implementation; or as previously allowed, increase the area of water supply protection implementation within the local government's jurisdiction within the WS-IV run-of-the-river water supply watershed.

Table 2.13 Local Governments in the Broad River Basin with Jurisdiction in a Water Supply Watershed

Water Supply	Classi-fication	Local Government	User	% of Watershed Covered by Local Government	% of Local Government Jurisdiction in Watershed
Buffalo Creek	WS-III	Cleveland Co.	Kings Mountain	60	9
Buffalo Creek	WS-III	Bellwood	Kings Mountain	6	31
Buffalo Creek	WS-III	Fallston	Kings Mountain	2	57
Buffalo Creek	WS-III	Waco	Kings Mountain	1	57
Buffalo Creek	WS-III	Gaston Co.	Kings Mountain	2	0
Buffalo Creek	WS-III	Lincoln Co.	Kings Mountain	30	6
First Broad R.	WS-IV	Cleveland Co.	Shelby	93	9
First Broad R.	WS-IV	Fallston	Shelby	2	43
First Broad R.	WS-IV	Lawndale	Shelby	2	100
First Broad R.	WS-IV	Shelby	Shelby	3	15
First Br.-CCSD	WS-IV	Cleveland Co.	Shelby/Cl. Co.	75	12
First Br.-CCSD	WS-IV	Casar	Shelby/Cl. Co.	2	69
First Br.-CCSD	WS-IV	Polkville	Shelby/Cl. Co.	2	93
First Br.-CCSD	WS-IV	Rutherford Co	Shelby/Cl. Co.	21	3
Colt Creek	WS-II	Henderson Co	Tryon	11	0
Colt Creek	WS-II	Polk Co.	Tryon	89	1
Big Fall Creek	WS-II	Polk Co.	Tryon	100	1
Fork Creek	WS-II	Polk Co.	Tryon	100	1
Horse Creek	WS-III	Polk Co.	not used	100	0
Broad River	WS-IV	Rutherford Co	Rutherfordton	100	11
Broad River	WS-IV	Rutherfordton	Rutherfordton	0	4
Second Br. R.	WS-IV	Rutherford Co	Cone Mill Corp.	90	8
Second Br. R.	WS-IV	Alexander Mills	Cone Mill Corp.	1	56
Second Br. R.	WS-IV	Bostic	Cone Mill Corp.	2	99
Second Br. R.	WS-IV	Ellenboro	Cone Mill Corp.	1	46
Second Br. R.	WS-IV	Forest City	Cone Mill Corp.	6	50
Second Br. R.	WS-IV	Rutherford Co	Forest City	100	8

CCSD = Cleveland County Sanitary District

Table 2.14 Water Supplies that have been proposed for a revised Protected Area

Water Supply	Current Size of Protected Area (acres)	Size of Proposed Protected Area (acres)	Difference Between Current and Prop. (acres)
Broad River	38,590	16,440	22,150
Second Br. R. (Forest City)	29,015	20,935	8,080
Second Br. R. (Cone Mills)	31,453	13,246	18,207
First Broad River (Cl. Co. Sanitary District)	48,327	18,706	29,621

2.8 WATER USE IN THE BROAD RIVER BASIN

2.8.1 State Water Supply Plan Database

The Division of Water Resources is compiling a State Water Supply Plan (SWSP) database that contains information from Local Water Supply Plans pursuant to GS 143-355 (l) and (m). As of September 1997, 15 of an expected 16 systems that are in the Broad River basin are represented in the Sate Water Supply Plan database. The following summary of current and future population and water use is based on these 15 water systems.

Table 2.15 presents the 1992 and projected service population for these systems through the year 2020. Based on this table it may be expected that the population serviced by these systems will increase by 63% percent over the next few decades. Rutherfordton and Spindale are not listed because they receive their water from Duke Power. Duke Power has not yet provided information for this database, but will be doing so in 1998.

Table 2.15 1992 and Projected Service Populations for Water Suppliers in the Broad River Basin that have provided information to the NC Division of Water Resources. (SOURCE: SWSP Database, Division of Water Resources, DENR, Not Published)

System Name	Pop. 1992	Pop. 2000	Pop. 2010	Pop. 2020
Boiling Springs	2,744	3,300	3,600	3,900
Cleveland County	20,541	45,000	50,000	55,000
Fallston	572	600	620	630
Grover	700	735	772	810
Kings Mountain	9,700	9,991	10,412	10,716
Lawndale	648	597	592	581
Shelby	19,200	21,800	24,300	26,700
Columbus	1,623	1,733	1,834	1,892
Saluda	565	678	717	758
Tryon	5,400	5,830	6,170	6,436
Alexander Mills	331	341	351	361
Bostic	362	370	380	390
Forest City	9,436	9,948	10,293	10,550
Lake Lure	675	717	741	760
Sandy Mush	3,047	3,203	3,314	3,397
TOTAL	75,544	104,843	114,096	122,881

Based on the information submitted, total average daily use is 19 million gallons per day (MGD). Approximately 31% of the total amount of water supplied goes to residences, while 54% is used for industrial and commercial purposes (the remainder is unaccounted for).

As Figure 2.7 illustrates, overall projected water use is expected to increase modestly in the next two decades approaching a high of 30 MGD. The forecast between 1992 and 2020 is for a 55% increase in water use.

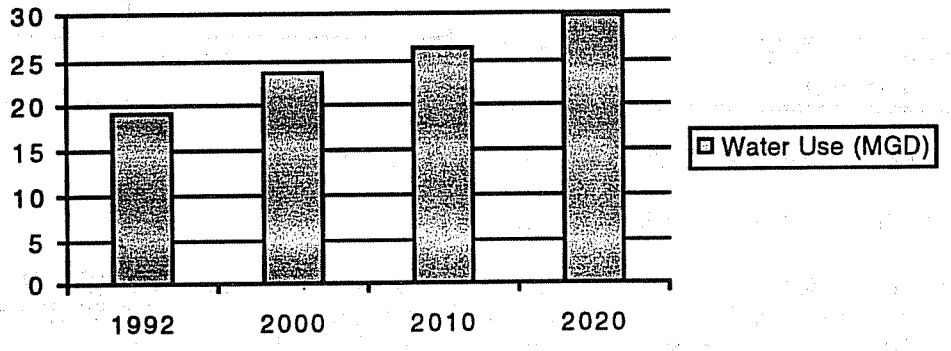


Figure 2.7 Total Projected Water Use in MGD for Water Suppliers in the Broad River Basin. (Source: SWSP Database, Division of Water Resources, Not Published.)

2.8.2 US Geological Survey Water Use Information

The US Geological Survey (USGS) maintains a water use database that characterizes whether the source of the water is surface or ground water. This information indicates that 85% of the population in the Broad basin is served by surface water, while 15% receive water from groundwater sources.

2.8.3 Water Withdrawal and Interbasin Transfer Registration

In 1991, the General Assembly passed G.S. 143-215.22H requiring all persons withdrawing a total of one million gallons per day or more to register that withdrawal with the Division of Water Resources. The law also mandates that interbasin transfers of one million gallons per day or more in any given day (G.S. 143-215.22G) be registered. The law was amended in 1993 to include groundwater, to add a penalty for non-compliance, to add required information, and to exempt water systems with approved local water supply plans. All new withdrawals must be registered within six months of the initial withdrawal and all withdrawals must be updated at least every five years. The law states that any person who withdraws one million gallon per day or more must register and as a result, many water suppliers with multiple facilities were required to register all of their facilities because the sum of the withdrawals equaled one million gallon per day or more. In addition to being registered, interbasin transfers of two million gallons per day or more must also obtain a certificate from the Environmental Management Commission under G.S. 143-215.22I.

The term "interbasin transfer" is sued to define transfers of surface water between any of the 38 defined river subbasin boundaries. The river basin boundaries that apply to these requirements are designated on a map entitled "Major River Basins and Sub-basins in North Carolina", which was

filed in the Office of the Secretary of State on April 16, 1991. Figure 2.8 illustrates the portion of this map that includes the Broad River basin and includes the location of the two registered interbasin transfers that are associated with the Broad River basin. As indicated on the map, there is one transfer from the French Broad basin into the Broad basin (0.103 MGD) and one transfer from the Broad basin into the Catawba River basin (0.683 MGD). Overall, these transfers result in a net export of 0.580 MGD out of the Broad River basin. The flows are based on 1992 Local Water Supply Plans and registered withdrawal/transfer information. Some additional transfers may occur from undocumented consumptive losses (i.e. septic, lawn irrigation) for public water systems having service areas in more that one sub-basin.

2.9 MINIMUM STREAMFLOW REQUIREMENTS

DWR, working with the Wildlife Resources Commission (WRC), provides minimum flow recommendations for dams to maintain downstream aquatic habitat. These requirements are then included in a project's dam safety permit issued by the Division of Land Resources. The authority for requiring a minimum release is included in the Dam Safety Law (G.S. 143-215.31(b)). Minimum flows for maintaining stream classification and water quality standards are based on water quality rules developed by DWQ. The rules for determining minimum flows to maintain aquatic habitat also include provision for existing water supply reservoirs which list several factors which must be considered in re-evaluating a minimum releases. The rules also limit the impact of any new minimum flow on an existing water supply reservoir's safe yield to no more than ten percent reduction.

DWR's Water Resources Planning Section (WRPS) is conducting a number of instream flow studies in the Broad River Basin. The WRPS operates under the rules applied to the Dam Safety Law that require dams to release minimum stream flows to adequately maintain aquatic habitat (G.S. 143-215.24.0500). Studies in the Broad River basin are described below.

First Broad River

In 1994, the Division of Water Resources performed Instream Flow Incremental Methodology (IFIM) studies at three sites on the First Broad to evaluate impacts on aquatic habitat of expansions of the existing intakes for the Cleveland County Sanitary District (CCSD) and the City of Shelby. These intakes are located at drainage areas of 145 and 226 mi2, respectively. The study results were also used to evaluate a dam proposal farther upstream. Investigation into the possible development of a portion the First Broad River drainage into a reservoir for water supply purposes is still in the early stages.

Cleveland County Sanitary District

The Cleveland County Sanitary District (CCSD) is planning for the expansion of their 6.0 million gallon per day (mgd) water treatment plant. The CCSD has proposed construction of a 10 mgd raw water pump station on land between the confluence of First Broad and Knob Creek. The proposed facility would pump from First Broad and Knob Creek. The drainage area at the proposed site is 181 mi2. The CCSD also has considered a dam upstream of their current intake to provide on-stream storage.

City of Shelby

In 1991, the Division of Water Resources participated in a habitat study with the consultant for the City of Shelby regarding the expansion of the City's withdrawal capacity on the First Broad from 10 mgd to 18 mgd. A minimum flow of 25 cfs passing the intake was required to protect aquatic habitat downstream. The Division of Water Resources calculated a "with project" 7Q10 and provided this to the Division of Environmental Management (now the Division of Water Quality) to use in evaluating assimilative capacity for the City's wastewater treatment plant downstream (memo to Trevor Clements dated November 2, 1992).

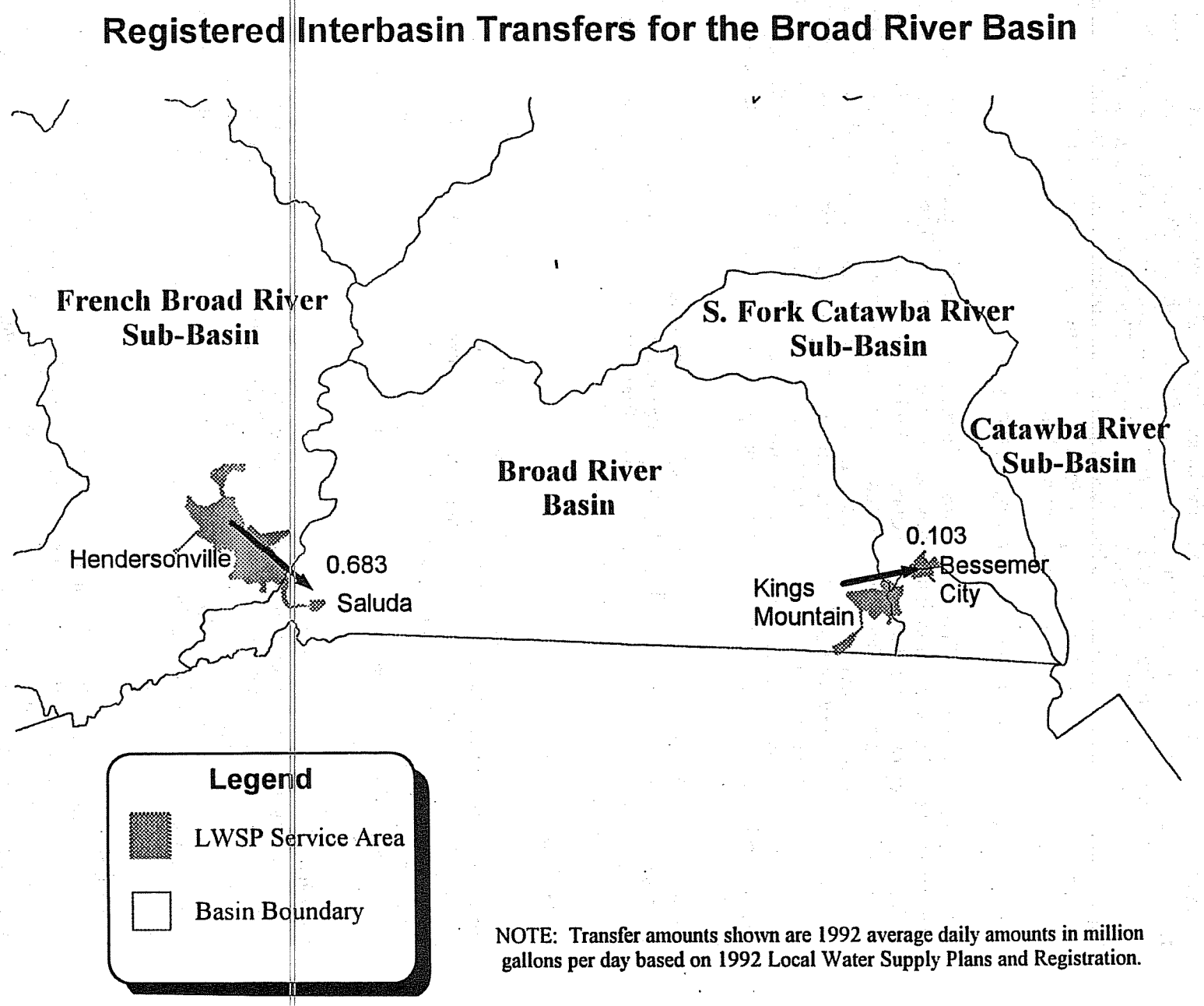


Figure 2.8 Registered Interbasin Transfers for the Broad River Basin

Hydropower
Northbrook Carolina Hydro L.L.C. operates the Stice Shoals hydropower facility on the First road upstream of the confluence with Shoal Creek. The Federal Energy Regulatory Commission (FERC) found Stice Shoals to be non-jurisdictional to FERC oversight. Stice Shoals has no minimum flow requirement.

Second Broad River

Forest City
The Town of Forest City has proposed a dam for on-stream storage on Roberson Creek, a tributary of the Second Broad, at the confluence with Heaveners Creek. The Division of Water Resources is doing a field study to determine the minimum flow requirement for the proposed structure.

Hydropower
Two hydropower facilities are currently in operation on the Second Broad. Cliffside is located in the Town of Cliffside and has no minimum flow requirement. The FERC has not pursued licensing on the Cliffside project. The U.S. Geological Survey is considering removing the gage on Second Broad downstream of the Cliffside dam because sediment discharge from the Cliffside dam has buried the gage intake under 6 feet of sediment. Upstream of the Cliffside dam is the Caroleen project. Caroleen is located in the Town of Caroleen and operates in a run-of-the-river mode, i.e. instantaneous outflow equals instantaneous inflow.

Broad River

Hydropower
The Town of Lake Lure owns and operates a hydropower facility at the dam for Lake Lure. The project has no minimum flow requirement attached to its dam safety permit. A flow of 6.6 cfs, the 7Q10, is required at the Town's wastewater treatment plant located downstream of the dam.

Northbrook Carolina L.L.C. operates the Gaston Shoals hydropower facility near the confluence with Mikes Creek in South Carolina. The impoundment for the project reaches into North Carolina.

Green River

Hydropower
Northbrook Carolina Hydro L.L.C. operates the Turner Shoals hydropower facility at the dam for Lake Adger. The FERC found Turner Shoals to be non-jurisdictional to FERC oversight. Turner Shoals has no minimum flow requirement.

Duke Power operates the Tuxedo hydropower facility at the dam for Lake Summit. The FERC found Tuxedo to be non-jurisdictional to FERC oversight. Tuxedo has no minimum flow requirement.

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CHAPTER 3

CAUSES OF IMPAIRMENT AND SOURCES OF WATER POLLUTION

3.1 INTRODUCTION

A number of substances cause pollution and water quality impairment. *Sources* of these substances are divided into two categories called *point* sources and *nonpoint* sources. Point sources are typically piped discharges from wastewater treatment plants and large urban and industrial stormwater systems. Nonpoint sources can include stormwater runoff from smaller urban areas, forestry, mining, agricultural lands, rural residential development, and others. Section 3.2 identifies and describes the major causes of impairment in the basin. Sections 3.3 and 3.4 describe point and nonpoint source pollution in the basin.

3.2 CAUSES OF IMPAIRMENT

Causes of impairment refer to the substances which enter surface waters from point and nonpoint sources and result in water quality degradation and impairment. The general causes of water quality impairment are shown in Table 3.1. Each of these causes of impairment is discussed in the following sections.

Table 3.1 Causes of Impairment and Sources of Water Pollution

Cause of Impairment	Source Index PS	Source Index NPS	Description
Sediment		++	Mostly nonpoint source activities including: construction and mining sites, disturbed land areas, streambank erosion, cultivated farmland, removal of vegetative buffers along streams
Color	++		Generally associated with industrial wastewater or municipal plants that receive certain industrial wastes, especially textile manufacturers that dye fabrics and pulp and paper mills.
Toxic and Synthetic Substances	+	+	Pesticide applications, disinfectants (chlorine), automobile fluids, accidental spills, illegal dumping, urban stormwater runoff, leaky automobiles
Oxygen-Consuming Wastes	++	+	Wastewater effluent, organic matter, leaking sewers and septic tanks, animal waste which result in low d.o.
Fecal Coliform Bacteria	+	++	Failing septic tanks and leaking sewers, animal waste, runoff from livestock operations, wildlife, improperly disinfected wastewater effluent
Nutrients	++	++	Fertilizer (on agricultural, residential, commercial and recreational lawns), animal wastes, leaky sewers and septic tanks, atmospheric deposition, municipal wastewater which can cause algal blooms

++ = significant or primary source; blank = little or no contribution
+ = limited source that may be locally significant
PS = Point Source (see Section 3.3)
NPS = Nonpoint Source (see Section 3.4)

3.2.1 Sedimentation and Erosion

Sedimentation is a major source of water quality impairment in the Broad River basin. The processes of erosion and sedimentation are described below. This section concludes with sedimentation trends in the Broad River basin.

Introduction

Erosion is a natural process by which soil and rock material is worn away by rain, wind, and ice. Natural erosion occurs on a geologic time scale, but the process can be greatly accelerated when human activities alter the landscape. The sediment produced by erosion generally winds up in the surface waters.

Some of the activities that increase sediment loads to waterbodies include: construction activities, unpaved private access roads, state road construction, golf courses, uncontrolled urban runoff, mining, timber harvesting, agriculture, and livestock operations.

Some of the adverse impacts of sediment include:

- Streambank erosion: Streams with high sediment load have a much greater potential to scour the streambank. Also, as the streambed fills in with sediment, the stream will widen to carry the flow. Streambank erosion causes the loss of valuable property.
- Damaged aquatic communities: Sediment damages aquatic life by destroying stream habitat, clogging gills, and reducing water clarity.
- Polluted water: Sediment often carries other pollutants with it, including nutrients, bacteria, and toxic/synthetic chemicals. This pollution can also threaten public health if drinking water sources and fish tissue become contaminated.
- Increased costs for treating drinking water: Sediment-filled waters require costly filtration to make them suitable for drinking. Water supply reservoirs lose storage capacity when they become filled with sediment, necessitating expensive dredging efforts.

Recommendations aimed at addressing sedimentation are listed in Chapter 6. Programs and best management practices aimed at addressing sedimentation are briefly described in Chapter 5 and Appendix V and VI.

North Carolina does not have a numeric water quality standard for suspended sediment. However all point source dischargers must at a minimum meet federal effluent guidelines (e.g. 30 mg/l for domestic dischargers) for total suspended solids (TSS). The biological oxygen demand (BOD) limits required for most point sources usually necessitate a degree of treatment that assures the removal of solids to a level below federal requirements. A TSS limit of 10 mg/l is required for discharges to those High Quality Waters (HQW) which are trout waters or primary nursery areas, and a limit of 20 mg/l is required for discharges to other HQWs.

North Carolina has adopted a numerical instream turbidity standard as follows:

- 50 Nephelometric Turbidity Units (NTU) in streams not designated as trout waters;
- 25 NTU in lakes and reservoirs not designated as trout waters;
- 10 NTU in trout waters.

Land disturbing activities are considered to be in compliance with the standard if approved best management practices have been implemented.

Effects of Sedimentation on Water Quality and Aquatic Habitats

Sedimentation is often divided into two categories: *suspended load* and *bed load*. Suspended load is composed of small particles that remain in suspension in the water. Bed load is composed of larger particles that slide or roll along the stream bottom. Suspension of load types depends on water velocity and stream characteristics. Biologists are primarily concerned with the *concentration* of the suspended sediments and the *degree of sedimentation* on the streambed (Waters 1995).

The concentration of suspended sediments affects the availability of light for photosynthesis, as well as the ability of aquatic animals to see their prey. Several researchers have reported reduced feeding and growth rates by fish in waters with high suspended solids. In some cases it was noted that young fish left those stream segments with turbid conditions. Suspended sediments can clog the gills of fish and reduce their respiratory abilities. These forms of stress may reduce the tolerance level of fish to disease, toxicants and chronic turbid conditions. Suspended solids are reported as Total Suspended Solids or as Turbidity. They are measured in parts per million or milligrams per liter (Waters 1995).

The degree of sedimentation affects both the habitat of aquatic macroinvertebrates and the quality and amount of fish spawning and rearing habitat. Degree of sedimentation can be estimated by observing the amount of streambed covered, the depth of sedimentation, and the percent saturation of interstitial space or embeddedness. Eggs and fry in interstitial spaces may be suffocated by the sediments thereby reducing reproductive success (Waters 1995). Effects of sedimentation on macroinvertebrates can be seen in alterations in population density, diversity, and community structure (Lenat et al. 1979).

The findings of academic research have noted the potential impact of sedimentation on fisheries, in particular on wild trout populations. Inorganic sediments can affect trout productivity in three ways: direct effects - impairment of respiration, feeding habits, and migration patterns; reduced egg hatching and emergence due to decreased water velocity and dissolved oxygen; and, trophic effects - reduction in prey (macroinvertebrates). As fine suspended solids increase in the waters, the dissolved oxygen, permeability, and apparent velocity decrease.

The impact of sedimentation on fish populations depends on both concentration and degree of sedimentation, but impact severity can also be affected by the duration (or dose) of sedimentation. Suspended sediments may occur at high concentrations for short periods of time, or at low concentrations for extended periods of time. The greatest impacts to fish populations will be seen at high concentrations for extended time periods. The use of a dose-response matrix in combination with field investigations can help predict the impact of suspended sediments on various life stages of fish populations (Newcombe 1996).

Sedimentation impacts streams in several other ways. Eroded sediments may gradually fill lakes and navigable waters and may increase drinking water treatment costs. Sediment also serves as a carrier for other pollutants including nutrients (especially phosphorus), toxic metals, pesticides, and road salts.

Sedimentation Processes

Sedimentation involves two stages: the movement of eroded material from its original site to a stream channel and movement through the channel network. During both of these stages, sediment movement is discontinuous, driven by the episodic nature of storm events. While some sediment may move directly from field or construction site to a stream and then to the watershed outlet during the course of a single storm, most sediment does not move in this manner. Rather, a particle of eroded material is generally remobilized and redeposited by a number of storms as it works its way through the watershed. Depending upon storm characteristics and antecedent soil

conditions, one storm in a given basin may result in the delivery of only a small percentage of eroded material to a stream, while another event may remobilize large quantities of previously eroded material.

The proportion of eroded material reaching a given point on a river or stream is often referred to as the sediment delivery ratio (SDR) (Novotny and Chester, 1989; Walling, 1983). SDRs calculated for the Carolinas and Georgia (Roehl, 1962) indicate that only about 10% of the material eroded from moderate sized drainages (100 square km) leaves those watersheds on an annual basis. For extremely small basins (1 square km) the SDR is about 50%. While specific estimates vary, researchers have repeatedly found that the delivery ratio declines as basin size increases. Sediment storage occurs in all watersheds, but especially in larger ones. This stored material can, if not stabilized, serve as a source of sediment for a long time after the original erosion occurs. However, over a period of years or even decades a large percentage of eroded material may never reach the lower portions of a watershed.

The sediment load carried by a stream thus reflects both past and present land use activities. Load measurements alone, however, tell us little about the source of the sediment or the amount of ongoing erosion. Under many conditions, the amount of sediment carried by a stream will increase as erosion in the watershed increases and decrease as watershed erosion declines (referred to as a "supply limited" stream). However a stream has only a finite capacity for transporting sediment. Once the supply of sediment exceeds the capacity of a stream to carry it, any additional sediment reaching the stream will be deposited in channels and on floodplains rather than carried out of the watershed (referred to as "transport limited"). These stored deposits can be remobilized into the stream years or decades later if the rate of upland erosion declines to levels below the transport capacity.

Measuring Sediment Loads

Suspended sediment is a very useful indicator of active erosion in a particular basin. Suspended sediment concentrations are very sensitive to landscape disturbance, and its conceptual simplicity as a measurement tool gives it broad appeal. The primary problem with using suspended sediment as a monitoring tool is its inherent variability. Representative samples are difficult to obtain, and suspended sediment samples vary tremendously over time. Suspended sediment concentrations in a river vary dramatically with streamflow. Sampling during high flows is critical for the accurate estimation of suspended sediment loads. Significant differences in suspended sediment concentrations can also occur with depth. In particular, concentrations are often lower near the surface since fine material is generally distributed throughout the water column, while coarser particles remain closer to the stream bed.

Most sampling schemes take individual or composite samples at regular time intervals (e.g. daily). Since high flows are relatively rare, a sampling system based on equal time intervals will result in a large number of samples at relatively low flows, when suspended sediment concentrations are low, and very few samples at high flows, which is when most of the suspended sediment transport takes place. This is both inefficient and results in a high level of uncertainty with regard to the total sediment load. For a clear picture of sediment dynamics in a particular watershed, sediment sampling programs should be carefully designed using staged, point integrated, or depth integrated samplers to include measurements at relatively high flows. The accurate characterization of suspended sediment concentrations thus requires the use of depth-integrating samplers and other methods that maximize the likelihood that the sample taken represents average conditions in the water column (Edwards and Glysson, 1988).

Because of these sampling requirements, few studies have attempted to estimate suspended sediment loads in North Carolina. Total suspended solids (TSS) is measured at the Division of Water Quality's ambient monitoring stations. The TSS parameter is similar to suspended

sediment, but is based on a grab sample rather than depth-integrated sampling. Moreover, since ambient data are collected on a regularly scheduled basis (usually monthly), high flows are undersampled at most sites. TSS data can be useful for confirming the cause of high turbidity levels and to support the targeting of nonpoint source programs, but they are likely to yield substantial underestimates if used to calculate sediment loads.

Sediment and Streamflow

Peak flows have important effects on stream channel morphology and bed load particle size. Higher flows move larger particles. Peak flows are also important in determining the stability of large woody debris in the stream and the rate of bank erosion. Increased bank erosion and channel migration affects the riparian vegetation and can increase the amount of active sediment in the stream channel.

The vast majority of the sediment transport occurs during peak flows, as sediment transport capacity increases exponentially with discharge. The ability of a stream to transport the incoming sediment will help determine whether there is deposition or erosion within the stream channel. The relationship between sediment load and sediment transport capacity affects habitat types, channel morphology and bed load particle size. Increased size of peak flows due to urbanization have been shown to cause rapid channel erosion and severe decline in fish habitat quality.

In developing areas, the erosive forces brought by increased flood flows must be addressed at the source—increased runoff—for instream restoration efforts to be successful. Recent studies underscore the importance of overall watershed imperviousness in determining water and habitat quality. Increased impervious cover in a watershed has many direct impacts on streams in the watershed. Streams broaden or deepen to accommodate larger flushes of water, specialized habitats such as pool and riffle structures and overhanging vegetation are lost, instream water quality declines, stream temperatures rise and stream biodiversity of aquatic insect and fish populations. Each of these impacts has been shown to increase with higher levels of watershed imperviousness.

A change in the size of peak flows can also have important consequences for human life and property. Structures such as bridges, dams, and levees are designed according to a presumed distribution of peak flows. If the size of the peak flows is increased, this could reduce the factor of safety and lead to more frequent and severe damage.

Sediment and Streambank Erosion

Streambank erosion can contribute sediment loads to a stream. Streambank erosion can result from clearing instream obstacles or streamside vegetation, livestock trampling stream banks, or higher than normal floods resulting from increased impervious surfaces. The bank material, vegetation type, and vegetation density affect the stability and form of the streambanks. Change in any one of these factors is likely to be reflected in the size and shape of the stream channel, including the banks.

Streambank stability refers to the inclination of the stream bank to change in form or location over time. Streambank stability can be an important indicator of watershed condition and can directly affect several designated uses of streams. A higher incidence of bank instability can be initiated by natural events that disrupt the quasi-equilibrium of the stream, or by human disturbance. Unstable banks contribute sediment to the stream channel by slumps and surface erosion. Because all the material from an eroding streambank is delivered directly to the stream channel, the adverse impact of bank instability can be much greater than the adverse effects of a comparable area of eroding hillslope.

Even in undisturbed streams some streambank instability usually occurs. In valleys with a defined floodplain there is often lateral migration through bank erosion and point bar accretion. In V-shaped valleys there is less opportunity for lateral migration and bank instability may stem from the input and eventual removal of obstructions resulting from fallen trees, landslides, or debris flows.

Although in some cases the erosion of one bank will be matched by deposition on the opposite bank, streambank erosion caused by human activities generally increases stream width. The corresponding increase in stream surface area allows more direct solar radiation to reach the stream surface and this will raise maximum summer water temperatures. In most cases an eroding streambank will provide little or no cover for fish.

Actively eroding streambanks also support little or no riparian vegetation, and the loss of this vegetation adversely affects a wide range of wildlife species and increases the long-term input of organic matter into the aquatic ecosystem. Both the increase in summer water temperatures and the loss of fish cover along an eroding stream bank will be exacerbated by the reduction in riparian cover.

Historic practices of disturbing the stream channel and removing large woody debris have been shown to increase the amount of fine sediment in the steam channel. Removal of, or a reduction in, the riparian vegetation is another mechanism by which management activities can increase the amount of fine sediments. Grazing often exacerbates the effect of reducing the vegetative cover by simultaneously trampling the vegetation, compacting the soil, and trampling the streambanks. The use of structural techniques such as: bank sloping, use of tree roots for stabilization, buffer strips, and fencing cattle out of streams can greatly reduce streambank erosion. Average annual soil loss has been shown to be decreased by 40% after cattle were fenced away from streams. This decrease resulted in nearly a 60% reduction in average sediment concentration during stormflow events (Owens, et al 1996). Stormwater management measures for urban development areas can also lessen the potential for streambank erosion.

Stream Modification

Natural streams around the world have certain physical characteristics in common, regardless of location and geologic conditions. One of the most important of these characteristics is known as bankfull stage. The bankfull stage corresponds to the flow at which channel maintenance is most effective, that is, the discharge that results in the average size and shape of channels.

Almost all natural streams have a bankfull discharge with a recurrence interval of 1-1.5 years. In other words, natural stream channels do not form with the capacity to carry a 50 year, 25 year, or even 2 year storm without overflow. Natural channels on average can carry the flow from an annual storm without overflow. In streams that have not been channelized or manipulated by human activities, streamflows larger than a typical annual event are generally carried in both the channel and a floodplain.

Humans have modified many natural streams by increasing the capacity of the stream channel to carry high flows, sometimes to carry even the flow from a 50 or 100 year storm. Such modifications are conceived in the name of flood control and are often used to justify development of floodplains for human occupancy and other activities which constrict or encroach upon the floodplain.

Most engineering channel designs give a great deal of attention to conveyance of floodwaters. Very few channel designs include close attention to sediment conveyance. Given that the equilibrium channel size tends toward a bankfull discharge with a 1-1.5 year recurrence interval, larger stream channels will naturally initiate disequilibrium erosional processes. For example, a channel that has been straightened and enlarged to carry a 50 year storm, will begin building a

smaller channel, point bars, floodplains, meanders, etc. as a result of the natural physical behavior of sediment and the frequency distribution of streamflows. As a result, we have created streams which are unstable; they lose their equilibrium shape and slope and erode, degrade, and aggrade rapidly. Such unstable channel conditions can ultimately lead to degraded water quality as result of excessive sediment loads.

Sedimentation Trends in the Southern Piedmont

Most of the Broad River basin is located in a region of the state designated by the U.S. Department of Agriculture as the southern piedmont. The extreme western portion of the basin in located in the Blue Ridge Mountains Region.

In the 19th and early 20th centuries, erosion increased dramatically in the southern piedmont due to the agricultural practices of the time and the large proportion of the land planted in row crops (Trimble, 1994). Erosion then began a sharp decline beginning around 1920 as some farmland was taken out of production and the implementation of various conservation practices was initiated. By 1967 levels of erosive land use in the southeastern piedmont were only 1/5 to 1/3 of their peak levels (Trimble, 1974). USDA data show that row cropped acreage accounted for about 45% of the North Carolina piedmont in 1937, but declined to about 18% by 1990 (Richter et al, 1995).

Urban impacts on numerous streams increased during this century, due both to the input of sediment eroded from upland areas and to streambank erosion caused by the increase in impervious surfaces and the resulting increase in storm runoff. Nonetheless, most large piedmont basins are experiencing less erosion today than earlier in this century.

By 1970 the suspended sediment discharges of large rivers in the southeast had declined to one third to one half their 1910 levels (Meade and Parker, 1985; Meade and Trimble, 1974). Yet given the decline in agricultural erosion and the amount of material trapped by impoundments, suspended sediment loads are not nearly as low as one might expect. Many scientists have concluded that sediment stored in river channels and floodplains is contributing to the present load (Meade et al, 1990; Meade, 1982; Meade and Trimble, 1974; Jacobson and Coleman, 1986; Phillips, 1991). This material was deposited on floodplains and in channels during periods of high erosion when sediment supply to the channel network exceeded transport capacity. Evidence from the Maryland piedmont (Jacobson and Coleman, 1986), for example, indicates that high yields can persist after active erosion has declined as streams rework floodplain material deposited during previous decades and build a new floodplain at a lower elevation.

It is likely that many large rivers in the southern piedmont are presently moving some amount of stored sediments, deposited earlier during times of intensively erosive agricultural land use, through their channel networks. When erosion declines, stored sediment is first removed from tributary streams and later from larger rivers (Meade et al, 1990; Trimble, 1983). It is thus reasonable to expect that a further reduction in upland erosion in many small rural basins will result in lower sediment yields for those watersheds. How quickly control efforts in small watersheds will result in lower sediment yields in the larger rivers to which they drain is a more difficult question.

Statistics compiled by the US Department of Agriculture, Natural Resource Conservation Service (formerly known as the Soil Conservation Service) indicate a statewide decline in erosion from 1982 to 1992 (USDA, NRCS, 1992) as shown in Table 3.2.

Table 3.2 Overall Erosion Trends in North Carolina

	1982	1987	1992
Area (1,000 acres)	33,708.2	33,708.2	33,708.2
Gross Erosion (1,000 tons/yr)	46,039.5	43,264.6	36,512.9
Erosion Rate (Tons/Yr/Ac)	1.1	1.4	1.3

The most widely used tool to evaluate erosion at the landscape level is the Universal Soil Loss Equation (USLE). The NRCS statistics also indicate a statewide reduction per acre on cropland erosion using the Universal Soil Loss Equation (Table 3.3). Although tons/acre/year is a standard unit of measurement for erosion, it does not reflect the high spatial and temporal variability of erosion. Sediment impacts do not generally originate from a county wide "average" area; the majority of sediment comes from localized high impact areas. It is very easy to average out a sediment impact over a whole watershed or county or state area and thereby give the impression that the problem is less significant than it actually is in the immediate area. It makes much more sense from a management perspective to reduce sediment from 40 tons/acre to 2 tons/acres in a high impact area than to reduce erosion from cropland from 6.5 to 6.3 tons/acre. This points to the need for targeted management efforts coupled with a monitoring strategy which effectively measures sediment transport under both average and extreme conditions.

Table 3.3 USLE Erosion on Cultivated Cropland in North Carolina

	1982	1987	1992
Cropland Area (1,000 acres)	6,318.7	5956.8	5538.0
Gross Erosion (1,000 tons/yr)	40,921.4	37475.3	30,908.3
Erosion Rate (Tons/Yr/Ac)	6.5	6.3	5.6

While there is an overall 10-year downward trend statewide in the erosion rate on agricultural lands, the erosion rate per acre and the 10-year trends vary by region as shown in Table 3.4. The greatest improvement in erosion control is seen in the Southern Piedmont and Sand Hills with a small uptrend in the tidewater area and a significant increase in the mountains. In the mountain region, it is noted that while the 10-year trend is up, the five-year trend from 1987 to 1992 was down. The reasons for the dramatic changes in the mountain basin erosion rates are not fully known.

Table 3.4 North Carolina Erosion on Major Land Resource Areas (MLRA)

	1982	1987	1992
Blue Ridge Mountains	12.7	20.8	18.3
Southern Piedmont	12.3	12.0	10.5
Carolina and Georgia Sand Hills	6.0	5.6	5.1
Southern Coastal Plain	3.9	3.9	4.0
Atlantic Coast Flatwoods	3.2	3.1	3.2
Tidewater Area	1.4	1.5	1.6

Sedimentation Trends in the Broad River Basin

Sedimentation is a significant cause of water quality impairment in the Broad River Basin. Walnut Creek, Catheys Creek and Lick Branch are all streams that are considered impaired partly due to sedimentation based on recent data. In addition, although it is not considered impaired, Lake Lure

was significantly impacted by sedimentation before and during the flood that occurred in September of 1996. The Town of Lake Lure spent $1,232,000 to dredge 235,000 cubic yards of sediment out of the lake. The dredging operation had already been planned prior to the flood due to a build-up of sediment. The following discussion presents some sediment information that is specific to the Broad River basin in North Carolina. Suggested management strategies for reducing sedimentation are presented in Chapter 6.

The only comprehensive study of suspended sediment loading in North Carolina, conducted by the USGS (Simmons, 1993), involved the assessment of sedimentation at 152 sites statewide during the 1970-79 period. Selected data are shown in Table 3.5. The comparison is limited to unimpounded rivers (the Haw and Neuse were not yet impounded at the time this study was conducted.)

Table 3.5 Major North Carolina Rivers: Mean Annual Suspended Sediment Yield at Selected Stations, 1970-79.

Station	Drainage Area (square miles)	County	Tons per Square Mile
Haw River at Haw River	606	Alamance	260
Neuse River near Falls	772	Wake	180
Yadkin River at Elkin	869	Yadkin	350
Broad River near Boiling Springs	**875**	**Cleveland**	**390**
Dan River near Wentworth	1,053	Rockingham	440
Neuse River near Clayton	1,150	Johnston	190
Haw River near Bynum	1,277	Chatham	140
Rocky River near Norwood	1,372	Stanley	200

Source: Simmons CE, 1993

The Broad River mainstem near Boiling Springs (which is a lower site for the river in North Carolina and includes all major drainages except the First Broad River) carried a relatively high sediment load compared to other piedmont rivers. Simmons notes that rivers flowing from one physiographic province to another (such as the Broad which flows from the mountains to the piedmont) tend to retain the sediment transport characteristics of the province of origin. Table 3.6 summarizes data for all Broad sites included in the USGS study.

Table 3.6 Broad River Basin: Mean Annual Suspended Sediment Yield, 1970-79

STATION	Drainage Area (Sq Mi)	County	Tons/ Sq Mile
Cove Creek near Lake Lure	79	Rutherford	380
Second Broad River at Cliffside	220	Rutherford	230
Broad River near Boiling Springs	875	Cleveland	390
First Broad River near Casar	60.5	Cleveland	250
Sugar Branch near Boiling Springs	1.4	Cleveland	550

Source: Simmons CE, 1993

All stations transported relatively large amounts of sediment in 1970-79. Sugar Branch, the smallest watershed represented, carried the most amount of sediment. This result could be the reflection of even a small, poorly managed land-disturbing activity.

One of the defining characteristics of suspended sediment transport is that most of the load is transported during a relatively small number of storm events (Meade et. al., 1990). Transport characteristics for the Broad River at Cliffside reflect this (Simmons, 1993). Data between 1970 and 1979 indicate that at this site, half of the sediment load for the entire year was carried during approximately one and a half days.

3.2.2 Oxygen-Consuming Wastes

Oxygen-consuming wastes, or Biochemical Oxygen Demand (BOD), include decomposing organic matter or chemicals that reduce dissolved oxygen in the water column through chemical reactions or biological activity. Maintaining a sufficient level of dissolved oxygen in the water is critical to most forms of aquatic life, especially trout.

A number of factors affect dissolved oxygen concentrations. Higher dissolved oxygen is produced by *turbulent actions*, such as waves, rapids and waterfalls, which mix air and water. *Lower water temperature* also generally allows for retention of higher dissolved oxygen concentrations. Therefore, the cool swift-flowing streams of the mountains are generally high in dissolved oxygen. Lower dissolved oxygen levels tend to occur more naturally in warm, slow-moving waters. In some cases, dissolved oxygen levels may naturally decrease in the warmer months below the state standard. In addition, high inputs of effluent from wastewater treatment plants during low flow conditions may significantly decrease dissolved oxygen from natural conditions. In general, the lowest dissolved oxygen concentrations occur during the warmest summer months and particularly during low flow periods. *Water depth* is also a factor. In deep slow-moving waters, such as reservoirs or estuaries, dissolved oxygen concentrations may be very high near the surface due to wind action and plant (algae) photosynthesis but may be entirely depleted (anoxic) at the bottom.

Sources of dissolved oxygen depletion may include wastewater treatment plant effluent, the decomposition of organic matter (such as leaves, dead plants and animals) and organic waste matter that is deposited, washed or discharged into the water. Sewage from human and household wastes is high in organic waste matter, as is waste from trout farms. Bacterial decomposition can rapidly deplete dissolved oxygen levels unless these wastes are adequately treated at a wastewater treatment plant. In addition, some chemicals may react with and bind up dissolved oxygen. Industrial discharges with oxygen consuming wasteflow may be resilient instream and continue to use oxygen for a long distance downstream.

Oxygen-Consuming Wastes in the Broad River Basin

Dissolved oxygen levels in waters of the Broad River basin are generally good. There are some streams, however, that are affected by discharges from wastewater treatment plants. The Second Broad River, in particular, receives effluent from a number of discharges. Recommendations for specific areas are presented in Chapter 6.

Point Source Wasteflow and BOD changes from 1987 to 1996

Wasteflow and BOD data from the discharge monitoring reports (DMR) for 1987 and 1996 were evaluated for point source inputs to the basin. Average daily loads for BOD were multiplied by 365 and added together for all discharges to determine the total annual point source load for BOD. Although the wasteflow increased, there was a 23% decrease in estimated BOD loading to streams from 719,659 pounds per year to 551,109 pounds per year (Figure 3.1). The permitted wasteflow increased by 129 % from 10,000 million gallons per year in 1987 to 22,994 million gallons per year in 1996. The increases in wasteflow to the system are due to the addition of new dischargers and existing facilities expanding their wasteflow. The largest increase in the ten-year period

occurred in subbasin 030802 (includes Forest City, Spindale, and Burlington - J.C. Cowan plant) where the total wasteflow more than tripled and six new dischargers were added.

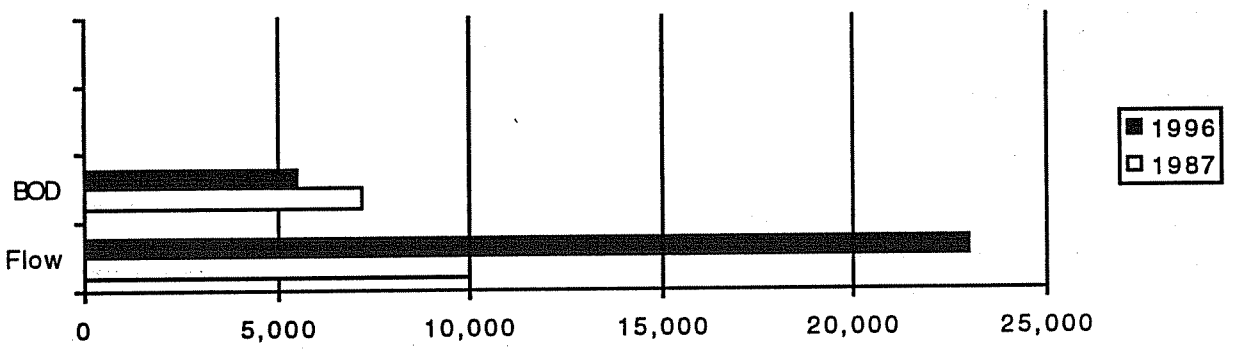

Figure 3.1 Comparison of Annual BOD Loading (in hundreds of pounds) and Annual Wasteflow (in million of gallons per year) from Point Sources in 1987 and 1996

3.2.3 Color

Color in wastewater is generally associated with industrial wastewater or with municipal plants that receive certain industrial wastes, especially from textile manufacturers that dye fabrics and pulp and paper mills. For colored wastes, 15A NCAC 2B .02113(f) states that the point sources shall discharge only such amounts that will not render the waters injurious to public health, secondary recreation, aquatic life and wildlife, or adversely affect the palatability of fish, aesthetic quality or impair the waters for any designated uses. NPDES permit requirements regarding color are included on a case-by-case basis since no numeric standard exists for color, and because a discharger may have high-color values but no visual impact instream due to dilution or the particular color of the effluent. Chapter 6 discusses ongoing efforts to study color and to develop a realistic approach to addressing this problem.

Color in the Broad River Basin

In the Broad basin, discharges with a high degree of color come primarily from certain industrial facilities and from municipal dischargers receiving highly colored industrial effluent. Participants in the basinwide planning workshops conducted in the Broad basin in June of 1997 indicated that color was an important concern for them. Some of the specific concerns that participants associated with color were general aesthetic impacts and water supply treatment. While colored effluent can be discharged by a number of industries, textile firms constitute the most significant source of color in the Broad basin.

3.2.4 Toxic Substances

Regulation 15A NCAC 2B. 0202(36) defines a toxicant as "any substance or combination of substances ... which after discharge and upon exposure, ingestion, inhalation, or assimilation into any organism, either directly from the environment or indirectly by ingestion through food chains, has the potential to cause death, disease, behavioral abnormalities, cancer, genetic mutations, physiological malfunctions (including malfunctions or suppression in reproduction or growth) or physical deformities in such organisms or their offspring or other adverse health effects". Toxic substances frequently encountered in water quality management include chlorine, ammonia, organics (hydrocarbons and pesticides) heavy metals and pH. These materials are toxic to different organisms in varying amounts. The effects may be evident immediately, or may only be manifested after long-term exposure or accumulation in living tissue.

North Carolina has adopted standards and *action levels* for several toxic substances. These are contained in 15A NCAC 2B .0200. Usually limits are not assigned for parameters which have action levels unless 1) monitoring indicates that the parameter may be causing toxicity or, 2) federal guidelines exist for a given discharger for an action level substance. This process of determining action levels exists because these toxic substances are generally not bioaccumulative and have variable toxicity to aquatic life because of chemical form, solubility, stream characteristics and/or associated waste characteristics. Water quality based limits may also be assigned to a given NPDES permit if data indicate that a substance is present for which there is a federal criterion but no water quality standard.

Whole effluent toxicity (WET) testing is required on a quarterly basis for major NPDES dischargers and any discharge containing complex (industrial) wastewater. This test shows whether the effluent from a treatment plant is toxic, but it does not identify the specific cause of toxicity. If the effluent is found to be toxic, further testing is done to determine the specific cause. This follow-up testing is called a toxicity reduction evaluation (TRE). WET testing is discussed in Chapter 4 and Appendix II. Other testing, or monitoring, done to detect aquatic toxicity problems include fish tissue analyses, chemical water quality sampling and assessment of fish community and bottom-dwelling organisms such as aquatic insect larvae. These monitoring programs are discussed in Chapter 4.

Each of the parameters below can be toxic if sufficient in quantity or concentration.

pH

Changes in pH to surface waters are primarily through point source discharges. However, changes can also occur with the introduction of substances in the form of spills to a waterbody. As the pH of a water decreases, metals are more bioavailable within the water column and are therefore more toxic to the aquatic organisms. As the pH increases, metals are precipitated out of the water column and less toxic to aquatic organisms. If a surface water has had chronic introductions of metals and the pH gradually or dramatically decreases, the metals in the substrate will become more soluble and be readily available in the water column. While lower pH values may not be toxic to the aquatic organisms, the lower values can have chronic effects on the community structure of macroinvertebrates, fish, and phytoplankton. Macroinvertebrates will show a shift from intolerant species to tolerant species and have less community diversity.

The NC standard for pH in surface fresh waters is 6.0 to 9.0. Trout reproduction is adversely affected in waters with pH values below 5.5.

Metals

Municipal and industrial dischargers and urban runoff are the main sources of metals contamination in surface water. North Carolina has stream standards for many heavy metals; the most common metals in municipal NPDES permits are cadmium, chromium, copper, nickel, lead, mercury, silver and zinc. Standards are listed in Appendix I. Each of these, with the exception of silver, is also monitored through the ambient network along with aluminum and arsenic. Point source discharges of metals are controlled through the NPDES permit process. Municipalities with significant industrial users discharging wastes to their treatment facilities limit the heavy metals from these industries through a *pretreatment program.* Source reduction and wastewater recycling at WWTPs also reduces the amount of metals being discharged to a stream. Nonpoint sources of pollution from urban runoff are controlled through best management practices, stormwater control programs, and sedimentation and erosion control plans.

Chlorine

Chlorine is commonly used as a disinfectant at NPDES discharge facilities which have a domestic (i.e., human) component. These discharges are a major source of chlorine in the State's surface waters. Chlorine dissipates fairly rapidly once it enters the water, but it can have significant toxic

effects on sensitive aquatic life such as trout and mussels. North Carolina has adopted a freshwater standard for trout waters of 17 ug/l (micrograms per liter). For all other waters an action level of 17 ug/l is applied to protect against chronic toxicity. It is recommended that new and expanding discharges provide dechlorination or alternate disinfection of wastewater. A total residual chlorine limit is assigned based on the freshwater action level of 17 ug/l or a maximum concentration of 28 ug/l for protection against acute effects in the mixing zone. Federal guidelines for residual chlorine of 8 ug/l for chronic effects and 13 ug/l for acute effects are used in saltwaters. In 1993, letters were sent to existing facilities with chlorine monitoring requirements. These letters encouraged permittees to examine their effluent chlorine levels and noted that limits may be implemented in the future. At this time, the State requires chlorine limits for all trout waters and any new or expanding facilities using chlorine for disinfection.

Ammonia (NH_3)

Point source dischargers are one of the major sources of ammonia. In addition, decaying organisms which may come from nonpoint source runoff and bacterial decomposition of animal waste products also contribute to the level of ammonia in a waterbody. At this time, there is no numeric standard for ammonia in North Carolina. However, DWQ has agreed to address ammonia toxicity through an interim set of instream criteria of 1.0 mg/l in the summer (April - October) and 1.8 mg/l in the winter (November - March). Currently, limits will be given no less than 2 mg/l in summer and 4 mg/l in winter, unless dissolved oxygen problems or modeling analysis dictate stricter limits. These interim criteria are under review, and the State may adopt a standard in the future.

Toxic substances in the Broad River Basin

Twenty-two facilities in the Broad River basin are required to monitor the toxicity of their effluent. These include industries and municipal wastewater treatment facilities. Two facilities are currently out of compliance (as of the approval date of this basin plan) with their toxicity limit and are operating under Special Order by Consent (SOC). These are the Spindale wastewater treatment plant and PPG-Shelby.

3.2.5 Fecal Coliform Bacteria

Fecal coliform bacteria are typically associated with the intestinal tract of warm-blooded animals. Common sources of fecal coliform bacteria include leaking or failing septic systems, leaking sewer lines or pump station overflows, runoff from livestock operations, wildlife and pets, as well as improperly disinfected wastewater effluent.

Fecal coliform bacteria are widely used as indicators of the potential presence of waterborne pathogenic organisms (which cause such diseases as typhoid fever, dysentery, and cholera). Fecal coliform bacteria in treatment plant effluent are controlled through disinfection methods including chlorinating, ozonation or ultraviolet light radiation.

Due to the low number of animal operations and limited development in the basin, the chances of bacterial contamination in streams is relatively low. However, failing septic systems, straight piping of waste waters to streams and animal operations without appropriate best management practices can cause elevated bacterial levels in any stream.

Fecal Coliform Bacteria in the Broad River Basin

Ambient monitoring indicates that the lower reaches of the First Broad River, Sugar Branch and Buffalo Creek have elevated levels of fecal coliform. Thus, these waters have been given use support ratings of fully supporting but threatened. It is believed that nonpoint sources of pollution are the main contributor to the elevated coliform concentrations. Additional discussion of these issues can be found in Chapter 4 and Chapter 6.

3.2.6 Nutrients

The term *nutrients* in this document refers to the two major plant nutrients, phosphorus and nitrogen. These are common components of fertilizers, animal and human wastes, vegetation, trout farms and some industrial processes.

Nutrients in surface waters come from both point and nonpoint sources. Nutrients are beneficial to aquatic life in small amounts. However, when conditions are favorable, excessive nutrients can stimulate the occurrence of algal blooms and excessive plant growth in slow-moving waters such as ponds, lakes, reservoirs and estuaries.

Algal blooms, through respiration and decomposition, can deplete the water column of dissolved oxygen and can contribute to serious water quality problems. In addition to problems with low dissolved oxygen, blooms can be aesthetically undesirable, result in an unbalanced food web, impair recreational use, impede fishing and pose difficulties for water treatment in water supply reservoirs. Excessive growth of larger plants, or macrophytes, such as milfoil, alligator weed and *Hydrilla*, can also be problematic by limiting recreation.

Dissolved oxygen depletion from nutrient overenrichment and algal growth fluctuates seasonally and even over the course of a day. In the presence of sunlight, oxygen is produced by algae and other plants through the process of photosynthesis. At night, however, photosynthesis and dissolved oxygen production slow down and oxygen is consumed by algae through respiration. During the summer months, this daily cycle of daytime oxygen production and night time depletion often results in the supersaturation of surface waters by oxygen during sunny days and low dissolved oxygen concentrations during late night and early morning hours. Supersaturation refers to dissolved oxygen levels greater than the saturation value for a given temperature and atmospheric pressure. Excessive dissolved gas levels can be lethal to fish populations, causing gas bubbles in the circulatory system and inhibiting the flow of blood. Additionally, algae may settle to the bottom of a waterbody and contribute to sediment oxygen demand as they decompose through bacterial action. This decomposition lowers dissolved oxygen concentrations in the bottom waters of lakes and other bodies of water.

Lake Eutrophication

Bodies of water which are nutrient rich and which support high levels of algal or macrophyte growth are often referred to as eutrophic. Eutrophication is a natural process which occurs as lakes and reservoirs gradually accumulate nutrients and sediments. As lakes age, they generally become more nutrient rich and biologically productive. Nutrients, soil or organic matter added by human activities can greatly accelerate this process. This is sometimes referred to as cultural eutrophication. As a group, reservoirs tend to have higher inflows and nutrient and sediment loads than natural lakes and are thus more likely to be eutrophic. In North Carolina this is especially true of piedmont reservoirs.

The classical lake succession sequence (Figure 3.2) is usually depicted as a unidirectional progression corresponding to a gradual increase in lake productivity from oligotrophy to hypereutrophy. The trophic states are:

- **Oligotrophic** - Nutrient-poor and low biological productivity. More typical of cold-water lakes.
- **Mesotrophic** - Intermediate nutrient availability and biological productivity.
- **Eutrophic** - Nutrient-rich and highly productive.
- **Hypereutrophic** - Extreme productivity characterized by algal blooms or dense macrophyte populations (or both) frequently having a high level of sedimentation.

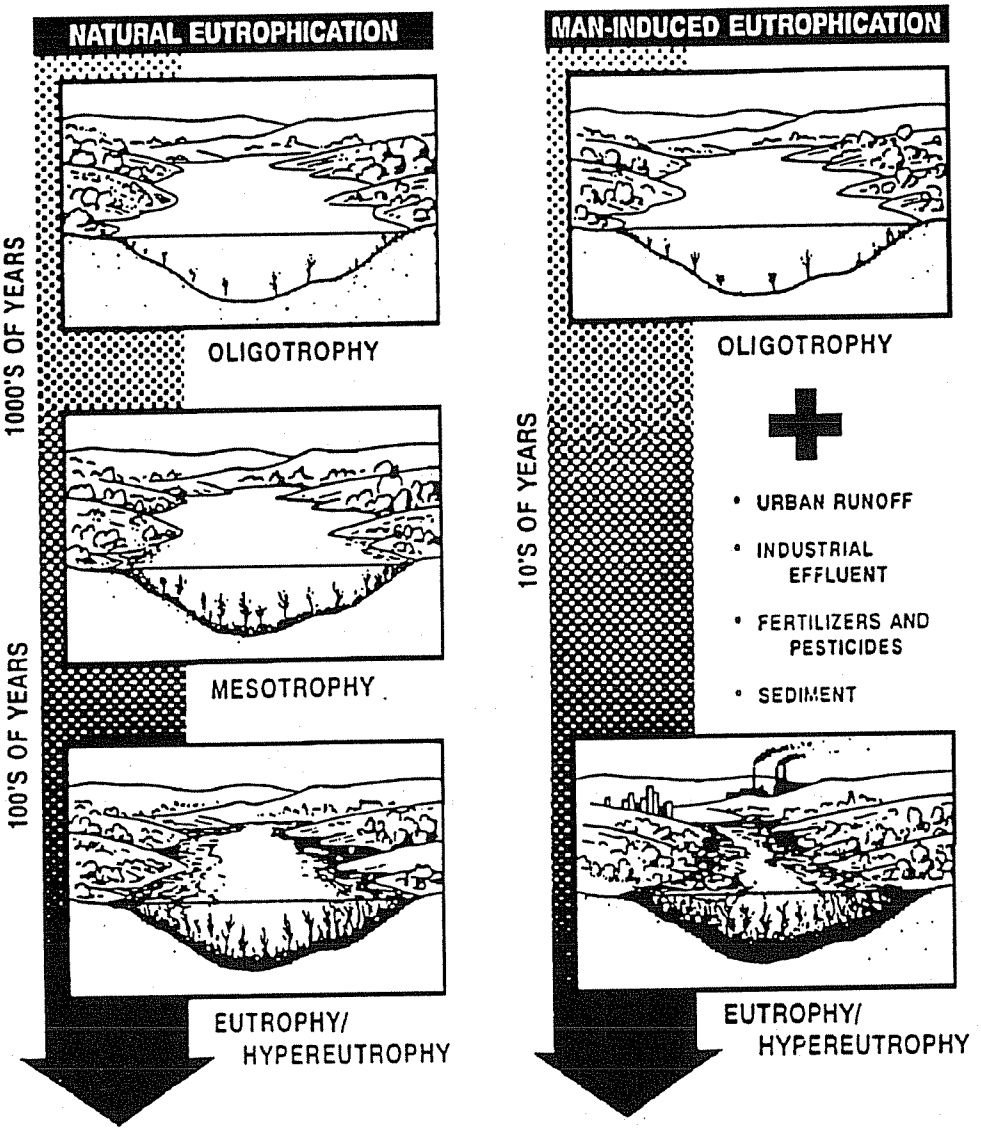

Figure 3.2 Natural versus Man-Induced Eutrophication

However, there is evidence that changes in lake trophic status is not necessarily gradual or unidirectional. If watersheds remain relatively undisturbed, lakes can retain the same trophic status for many thousands of years. Rapid changes in lake nutrient status and productivity are often a result of human-induced disturbances to the watershed rather than gradual enrichment and filling of the lake basin through natural means.

Eutrophic conditions--that is, high levels of nutrients and algal productivity--can but do not necessarily interfere with the uses of a waterbody. Some lakes and reservoirs can support substantial algal growth without significant interference with recreational activity or risk to aquatic organisms. Free-flowing streams with relatively undisturbed watersheds tend to have low nutrient levels. Increased nutrient inputs can affect aquatic life in streams, for example by supporting increased growth of benthic algae which in turn support a fish community that differs somewhat from what would otherwise be expected. Nutrient loading can cause some degradation of water quality in free-flowing piedmont streams, but does not generally result in water quality impairment.

North Carolina has a chlorophyll *a* standard of 40 ug/l (micrograms per liter) for lakes, reservoirs and slow moving waters not designated as trout waters, and 15 ug/l for trout waters. Chlorophyll *a* is a constituent of most algae and is a widely used indicator of algal biomass. Total dissolved gas levels in excess of 110% of saturation are also a violation of standards.

Agricultural and urban runoff, wastewater treatment plants, as well as atmospheric deposition are the main sources of nutrients reaching North Carolinas water bodies. Nutrients in nonpoint source runoff come mostly from fertilizer and animal wastes. Nutrients in point source discharges are from human wastes, food residues, some cleaning agents and industrial processes.

Nutrient Loading

Effective January 1, 1988 the General Assembly limited the quantity of phosphates in household laundry detergents to 0.5%. A statewide study of 23 municipal wastewater plants found that this phosphate detergent "ban" significantly reduced the amount of phosphorus entering wastewater treatment plants and resulted in an average reduction of 33% in the mass phosphorus load discharged from these facilities (NCDEM, 1991). An analysis of several sites in the state found reductions in ambient phosphorus levels downstream of major WWTPs (NCDEM, 1991).

It is important to distinguish between the nutrient loading to streams in a watershed (the 'end of pipe' or 'edge of field' loads) and the nutrients reaching a particular lake or estuary (the delivered load). Nutrients entering surface waters may be delayed for some time before reaching a downstream lake and may exist in a different chemical form by the time they arrive. For example, dissolved orthophosphorus from fertilizer or discharged wastewater may adsorb to suspended sediments once it enters a stream. Since sediment transport is episodic, occurring primarily during storms, the sediment-attached phosphorus may take weeks or months to reach a lake or estuary where it may potentially contribute to algal growth. In some cases--such as the loss of nitrogen to the atmosphere via denitrification--nutrients can leave the aquatic system entirely. It is the delivered load that influences algal growth, but these nutrient 'fate and transport' issues can sometimes be significant.

Phosphorus is usually the limiting nutrient in most freshwaters. Nutrient limitation can vary seasonally, however, and nitrogen can be limiting in situations where significant amounts of phosphorus have been added by human activity. Since algae use nitrogen and phosphorus in more or less fixed amounts, the ratio of nitrogen to phosphorus in a lake (the N:P ratio) is commonly used to evaluate which major nutrient is likely to be limiting. Algal growth potential tests are another method used to assess nutrient limitation. Algal growth potential tests (AGPT) are conducted by adding sufficient quantities of N or P to a water sample and observing the response of a test alga under controlled conditions.

Nutrients in the Broad River Basin

Although nutrient enrichment is not currently contributing to the impairment of any waters in the Broad River basin, symptoms of enrichment have been noted in the North Pacolet River, Second Broad River, Catheys Creek and Beaverdam Creek during biological sampling (especially in fish community structure sampling). Kings Mountain Reservoir, in particular, is considered borderline between oligotrophic and mesotrophic and could potentially develop symptoms of nutrient enrichment in the future. It is important to be aware of the potential for problems to develop in order to prevent them.

3.3 POINT SOURCES OF POLLUTION

3.3.1 Defining Point Sources

Point source refers to a discharge that enter surface waters through a pipe, ditch or other well-defined point of discharge. The term applies to wastewater and stormwater discharges from a variety of sources. Wastewater point source discharges include municipal (city and county) and industrial wastewater treatment plants and small domestic wastewater treatment systems that may serve schools, commercial offices, residential subdivisions and individual homes. Stormwater point source discharges include stormwater collection systems for municipalities which serve populations greater than 100,000 and stormwater discharges associated with certain industrial activities as defined in the Code of Federal Regulations [40 CFR 122.26(a)(14)]. The primary pollutants associated with point source discharges are oxygen-demanding wastes, nutrients, sediment, color, and toxic substances including chlorine, ammonia and metals.

Point source dischargers in North Carolina must apply for and obtain a National Pollutant Discharge Elimination System (NPDES) permit from the state. Discharge permits are issued under the NPDES program which is delegated to North Carolina by the EPA. See Chapter 5, Water Quality Programs and Program Initiatives in the Basin, for a description of the NPDES program and permitting strategies. Definitions and examples of the various categories can be found in Table 3.7.

3.3.2 Wastewater Point Source Discharges in the Broad River Basin

There are 85 permitted NPDES wastewater dischargers in the Broad River basin. There are 61 dischargers covered under individual permits and 24 dischargers covered under general permits. The locations of the permitted facilities are shown in Figure 3.3. Table 3.8 lists the major dischargers (≥1.0 MGD) as shown on the map with number designations. Table 3.9 provides a summary of total and average discharge for each category of permitted facility.

3.3.3 Stormwater Point Source Discharges in the Broad River Basin

Excluding construction general permits, there are 89 general permits and 2 individual stormwater permits issued within the river basin. Activities covered under the general stormwater permits include: construction; mining/borrow pits; metal waste recycling and manufacture of metal products and equipment; manufacture of timber products; apparel, printing, paper, leather, and rubber products manufacturing; food, tobacco, cleaning preparations, perfumes, cosmetics, and drug manufacturing and public warehouse storage; manufacture of stone, clay, glass, and concrete products; vehicle maintenance, transportation, and postal service activities, public warehousing and petroleum bulk stations and terminals; used automobile parts and scrap yards; non-metal waste scrap and recycling; ready mixed concrete production; manufacture of asphalt paving mixtures and blocks; production of textile mill products; and furniture and fixture manufacturing. The two facilities covered under individual permits are a polyester filament yarn manufacturing facility and a facility which produces lithium chemicals and castings of lithium material.

The primary source of concern from industrial facilities is the contamination of stormwater from contact with exposed materials. In addition, poor housekeeping can lead to significant contributions of sediment and other pollutants which have a detrimental effect on the water quality in receiving streams.

There are currently no municipalities in the Broad River basin that are subject to NPDES stormwater permitting.

Table 3.7 Definitions of Categories of NPDES Permits

CATEGORY	DEFINITION	EXAMPLES
Major vs. Minor discharges (NC00 Facilities)	For publicly owned treatment works, any facility discharging ≥1 MGD is defined as a Major discharge. For industrial facilities, the EPA provides evaluation criteria including daily discharge, toxic pollutant potential, public health impact and water quality factors. Any facilities which do not meet the criteria for Major status are defined as Minor discharges.	NC0020664 - Town of Spindale (6 mgd) NC0004685 - PPG Industries (1.3 mgd)
General Permits (NCG Permit Facilities)	Permits for dischargers in categories which all have similar discharges, operations and monitoring, and limits. Generally minor effluent on receiving stream individually.	Most stormwater permits. Non-contact cooling water, many groundwater remediation treatment systems, sand dredging operations, seafood packing, fish farms and single family residences
100% Domestic	A system which treats wastewater containing household-type wastes (bathrooms, sinks, washers, etc.).	Housing subdivision WWTPs, schools, mobile home parks.
Municipal	A system which serves a municipality of any size.	NC0025984 - Town of Forest City (4.95 mgd)
Process Industrial	Water used in an industrial process which must be treated prior to discharge.	NC0006025 - Burlington Industries (2.5 mgd)
Nonprocess Industrial	Wastewater which requires no treatment prior to discharging[1].	
Stormwater Facilities	Discharges of runoff from rainfall or snow melt. NPDES permits are required for "stormwater discharges associated with industrial activity" and from municipal stormwater systems for towns over 100,000 in population.	"Stormwater discharges associated with industrial activity" include most types of manufacturing plants. Landfills, mines, junkyards, steam electric plants, transportation terminals and any construction activity which disturbs 5 acres or more during construction.

1. Non-contact cooling water may contain biocides; however, the biocides must be approved by the DWQ Aquatic Toxicology Unit. The approval process predicts that the chemicals involved have no detrimental effect on the stream when discharged with the non-contact cooling water.

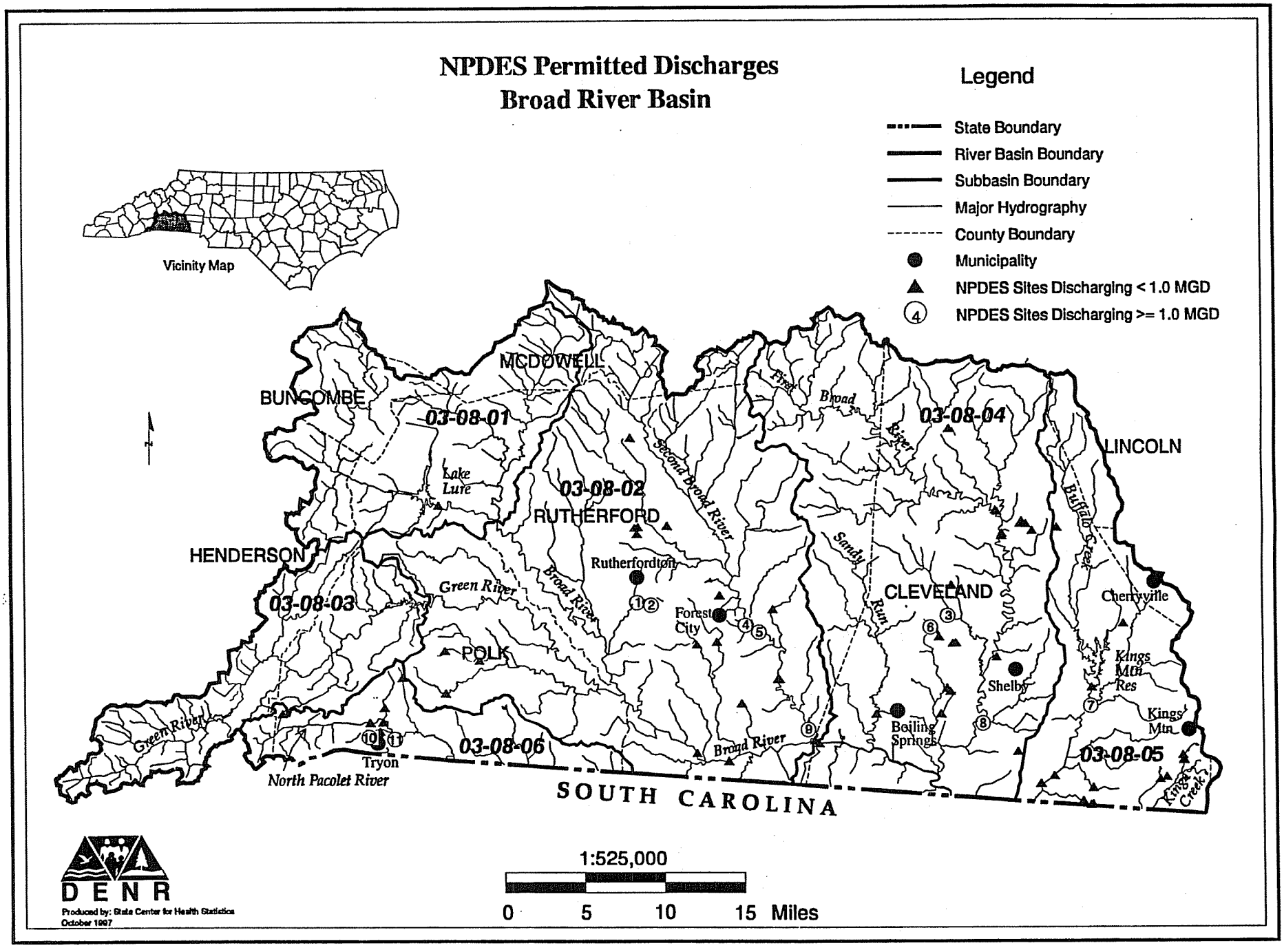

Figure 3.3 Map of NPDES Wastewater Permittees in the Broad River Basin

Table 3.8 Major dischargers in the Broad River Basin (numbers correspond to numbers in Figure 3.3)

Map No.	Facility	County	Permit No.	Design Flow (MGD)	Receiving Stream
1	Spindale WWTP	Rutherford	NC0020664	6.0	Hollands Creek
2	Rutherfordton WWTP	Rutherford	NC0025909	1.0	Cleghorn Creek
3	PPG Industries (pipe 1)	Cleveland	NC0004685	1.3	Overflow Branch
4	Forest City WWTP	Rutherford	NC0025984	4.95	Second Broad River
5	Burlington Industries	Rutherford	NC0006025	2.5	Second Broad River
6	PPG Industries (pipe 2)	Cleveland	NC0004685	1.3	Overflow Branch
7	Kings Mountain WWTP	Cleveland	NC0020737	6.0	Buffalo Creek
8	Shelby WWTP	Cleveland	NC0024538	6.0	First Broad River
9	Cone Mills Corporation	Rutherford	NC0004405	1.75	Second Broad River
10	Tryon WWTP (pipe 2)	Polk	NC0021601	1.5	Unnamed Trib. to Pacolet River
11	Tryon WWTP (pipe 1)	Polk	NC0021601	1.5	Vaughn Creek

Table 3.9 Summary of NPDES Dischargers and Permitted and Actual Flows for the Broad River Basin

FACILITY CATEGORIES	SUBBASIN						
	01	02	03	04	05	06	TOTAL
Total Facilities	3	31	5	24	14	8	85
NC00 Facilities	1	23	2	17	11	7	61
NCG Facilities	2	8	3	7	3	1	24
Total Permitted Flow (MGD)	1.00	18.45	0.03	8.50	7.79	2.08	37.84
***Major Discharges**	0	8	0	3	4	2	17
Total Permitted Flow (MGD)	0.00	17.29	0.00	8.08	7.63	1.95	34.95
***Minor Discharges**	1	15	2	14	7	5	44
Total Permitted Flow (MGD)	1.00	1.16	0.03	0.42	0.16	0.13	2.90
100% Domestic Wastewater	1	9	2	8	5	4	29
Total Permitted Flow (MGD)	1.00	0.11	0.03	0.39	6.14	0.13	7.80
Municipal Facilities	1	5	0	2	2	2	12
Total Permitted Flow (MGD)	1.00	12.95	0.00	6.30	6.10	1.60	27.95
Major Process Industrial	0	5	0	2	3	1	11
Total Permitted Flow (MGD)	0.00	5.34	0.00	2.08	1.63	0.45	9.50
Minor Process Industrial	0	4	1	2	1	1	9
Total Permitted Flow (MGD)	0.00	0.82	0.02	0.02	0.00	0.00	0.86
Nonprocess Industrial	0	9	1	11	5	3	29
Total Permitted Flow (MGD)	0.00	0.00	0.01	0.10	0.06	0.03	0.20

*** NC00 / Individual permit facilities**

3.4 NONPOINT SOURCES OF POLLUTION

Nonpoint source (NPS) pollution refers to runoff that enters surface waters through stormwater, snowmelt or atmospheric deposition (e.g., acid rain). There are many types of land use activities that are a source of nonpoint source pollution including land development, construction, mining operations, crop production, animal feeding lots, failing septic systems, landfills, roads and parking lots. As noted earlier, stormwater from large urban areas (>100,000 people) and from certain industrial sites is considered a point source since NPDES permits are required for piped discharges of stormwater from these areas. However, a discussion of urban runoff will be included in this section.

Sediment and nutrients are major pollution-causing substances associated with nonpoint source pollution. Others include fecal coliform bacteria, heavy metals, oil and grease, and any other substance that may be washed off the ground or removed from the atmosphere and carried into surface waters. Unlike point source pollution, nonpoint pollution sources are diffuse in nature and occur at random time intervals depending on rainfall events. The majority of water quality problems, including stream impairment, in the basin are from nonpoint source pollution. Below is a brief description of major categories of nonpoint sources of pollution in the Broad River basin.

3.4.1 Agriculture

There are a number of activities associated with agriculture that can serve as sources of water pollution. Land clearing and plowing make soils susceptible to erosion, which can then cause stream sedimentation. Pesticides and fertilizers (including chemical fertilizers and animal wastes) can be washed from fields, orchards, or improperly designed storage or disposal sites. Construction of drainage ditches on poorly drained soils enhances the movement of stormwater into surface waters. Concentrated animal feed lot operations or dairy farms without adequate waste management systems or fencing to keep animals away from streams can be a significant source of oxygen consuming wastes, fecal coliform bacteria, sediment and nutrients. Untreated discharge from a large animal operation has a nutrient load comparable to the discharge from a secondary waste treatment plant serving a small town.

Sediment production and transport has historically been greatest from row crops and cultivated fields (Waters, 1995; Lenat et al. 1979). However, with the gradual reduction of cultivated cropland acreage, implementation of the 1985 and 1990 Farm Bills and wider spread use by farmers of BMPs such as no-till farming, contour plowing, terracing, conservation tillage and grassed waterways, trends in sediment loss from cropland have been downward. Other recommended BMPs aimed at continuing to reduce sedimentation from agricultural land include maintaining a vegetated buffer between fields and streams, and fencing cattle and dairy cows from streams to protect streambanks from trampling and protect streamside vegetation. The use of these and other best management practices (BMPs) to reduce erosion can mitigate the impacts of sedimentation (Lenat, 1984). This is evidenced in the USDA, NRCS data in Table 3.3 which show a decline in cropland erosion rates on a per acre basis.

In reference to nutrient loading from animal operations, researchers from NC State University (Barker and Zublena, 1995) did a comparison between the amount of nutrients generated through manure and the amount of nutrients (nitrogen, phosphate, zinc and copper) needed for crop and forage production for each county in the state. These nutrient data were reported in "Livestock Manure Nutrient Assessment in North Carolina". The report was initiated to: 1) geographically depict where livestock are located and identify high livestock production density area around support facilities such as feed mills, hatcheries, processing plants, etc.; 2) assess current generation of manure by county; 3) determine the amount of nutrients from manure which can be recovered and made available to agronomic crops; 4) determine the quantity of nutrients required for non-legume agronomic crops and forages in each county; and 5) calculate the percent of

agronomic crop and forage nutrients which can be supplied by animal manure. A percentage greater than 100 means that there are more nutrients generated in manure than can be used by the crops and forage grown in that county. Plant recoverable manure nutrients are those that remain from the time the animal voids the manure until the time it is transported to the field for spreading (in other words, the nutrients that can be recovered or taken up and used by the plants). During this period, much of the nutrients can be lost through drying or dilution, surface runoff, volatilization or microbial digestion. Since different manure management systems either conserve or sacrifice varying amounts of nutrients, an estimate was made of the percentage of farms using specific systems. These percentages were applied to the manure characteristics appropriate for the specific method which gave the remaining nutrients after storage and treatment losses.

For the three counties that have most of their area in the Broad River Basin (Cleveland, Polk and Rutherford), most of the data result in low percentages (between 4% and 30%) for all nutrients. However, in Cleveland County, figures for zinc and copper were 274% and 574%, respectively. This means that for those parameters in that county, there are many more nutrients generated in manure than can be used by the crops and forage grown. It should be noted that this figure does not take into account commercial fertilizer applications in the counties. Alternatives to cropland application need to be considered in this area, such as application on forest land or transportation/distribution of the collectable manure to counties that have capacity and could use this nutrient source in lieu of commercial fertilizers.

Chapter 5 discusses agricultural nonpoint source control programs and general management strategies for controlling agriculture related sedimentation. A list of BMPs for addressing agricultural runoff is presented in Appendix V.

3.4.2 Urban/Residential Stormwater

It is commonly known that urban streams are often polluted streams (Mulholland and Lenat, 1992). As a rule, runoff from urbanized areas is more localized, but can often be more severe, than agricultural runoff. Any type of land-disturbing activity such as land clearing or excavation can result in soil loss and cause sedimentation of the waters in the watershed. The rate and volume of runoff in urban areas is much greater than in undeveloped areas due both to the high concentration of impervious surface areas and to storm drainage systems that rapidly transport stormwater to nearby surface waters. This increase in volume and rate of runoff can result in streambank erosion and sedimentation in surface waters. Some potential impacts of stormwater runoff include:

- Polluted water: Numerous pollutants may be present in urban stormwater, including sediment, nutrients, bacteria, oxygen demanding substances, oil and grease, trace metals, road salt, and toxic/synthetic chemicals. These pollutants can impair aquatic life, reduce recreational value and threaten public health if drinking water sources and fish tissue become contaminated.
- Flooding: Flooding damages public and private property, including infrastructure. It can also threaten public safety.
- Eroded streambanks: Sediment clogs waterways and fills lakes and reservoirs. It can also smother the plants and animals in waterbodies and destroy the habitat necessary for reproduction of fish and aquatic animals. The erosion of streambanks causes loss of valuable property as stream width grows.
- Increased Flow Variability: High flows caused by runoff from impervious surfaces can increase erosion and alter the aquatic habitat and fauna.
- Economic impacts: The economy can be impacted from a loss of recreation-related business and an increase in drinking water treatment costs.

There is abundant information on the effects of urban runoff on macroinvertebrates (Lenat and Eagleson, 1981; Crawford and Lenat, 1989). Stream organisms are affected not only by water quality, but also by the character of the physical habitat. One component of stream habitat is flow

regime. Most fish and macroinvertebrates in streams require flowing water and may be adversely affected by either extreme high or low flow. Development within a catchment may affect streamflow by increasing flow variability and/or altering base streamflow.

Natural streams with forested watersheds and vegetated riparian zones experience relatively little overland runoff. Much of the rainfall percolates through the soil and enters the groundwater. Therefore, natural streamflow is primarily the result of groundwater inputs. Both urban development and agricultural land use may include structures intended to prevent flooding by routing water directly to streams. This is especially true for urban landscapes where large amounts of impervious surfaces promote overland flow at the expense of groundwater recharge. The immediate result is high streamflow following rainfall, which can scour the stream bottom. Scouring is the physical movement of bedload, which disrupts the stream biology and habitat. The long-term result of increased overland flow is to accentuate summer low flows, due to the reduction of groundwater storage. Many streams in developed areas may stop flowing during summer months. This type of stress may severely limit the diversity of the aquatic fauna.

In addition, many streams are used as a source of irrigation water and this practice can reduce streamflow. The use of nearby well water might also reduce streamflow. In streams which normally experience low summer flows (especially in the Slate Belt region), water withdrawals for irrigation (or other uses) might be sufficient to convert a permanent stream into an intermittent stream. The lack of flowing water in the summer months can severely reduce the diversity of the aquatic fauna. This problem has not been investigated in North Carolina and further research is needed.

Storm drainage systems, including curb and guttered roadways, also allow pollutants to reach surface waters quickly and with little or no filtering. Pollutants include lawn care products such as pesticides and fertilizers; automobile-related pollutants such as fuel, lubricants, abraded tires and brake linings; lawn and household wastes (often dumped in storm sewers); road salts, and fecal coliform bacteria (from animals and failing septic systems). The diversity of these pollutants makes it very challenging to attribute water quality degradation to any one pollutant.

Replacement of natural vegetation with pavement, removal of streamside buffers and managed lawns reduce the ability of the watershed to filter pollutants before they enter the stream. The chronic introduction of these pollutants and increased flow and velocity into a stream results in degraded waters. Many urban streams are rated as biologically poor.

Urban Stormwater Impacts in the Broad River Basin

The population density map presented in Chapter 2 is an indicator of where urban development and potential urban stream impacts are likely to occur. Between 1982 and 1992, the most significant land use change in the basin was seen in the urban/built-up category with a 71% increase. Although population growth in the basin has been and is projected to be moderate, it will be important to properly manage the growth that will likely occur in the larger municipal areas. Hickory Creek, which runs through the City of Shelby, has been identified as having impaired water quality in part due to runoff from urban areas. Management strategies for addressing urban runoff are presented in Chapter 6. A list of BMPs for addressing urban runoff is presented in Appendix V.

Management strategies for addressing urban runoff are presented in Chapter 6, Section 6.6. A list of BMPs for addressing urban runoff is presented in Appendix V.

3.4.3 Construction

Construction activities that entail excavation, grading or filling (such as road construction or land clearing for development) can produce significant sedimentation if not properly controlled.

Sedimentation from developing urban areas can be a major source of pollution due to the cumulative number of acres disturbed in a basin.

As a pollution source, construction activities are typically temporary, but the impacts can be severe and long lasting (see discussion in Section 3.2.1). Construction activities tend to be concentrated in the more rapidly developing areas of the basin. However, construction is throughout the basin.

Construction-related sedimentation is addressed through the Sedimentation Pollution Control Act (see Chapter 5 and Appendix VI). Construction activities are thought to be associated with the impairment of Hickory Creek (subbasin 030804) and Buffalo Creek (subbasin 030805). In addition, construction can contribute to sedimentation which is the most prevalent problem in the basin. Recommended management strategies for construction activities can be found in Chapter 6, Section 6.6. A list of BMPs for controlling erosion and sedimentation is presented in Appendix V.

3.4.4 Timber Harvesting

Forested areas are an ideal land cover for water quality protection. They stabilize the soil, filter rainfall runoff and produce minimal loadings of organic matter to waterways. In addition, forested stream buffers can filter impurities from runoff from adjoining nonforested areas.

Improper forest management practices can adversely impact water quality in a number of ways. Without proper BMPs, harvesting operations can change the hydrology of an area and significantly increase the rate and flow of stormwater runoff. This results in both downstream flooding and stream bank erosion. Clearcutting, when compared to selective cutting, can cause a much higher rate of erosion (Waters 1995). Some experts have concluded that sedimentation from timber harvesting is more related to roads and skid trails than it is to the method of harvest (Stone, et. al., 1978).

Careless harvesting and road and stream crossing construction can transport sediment to downstream waters. Streams with sedimentation may require many years to restore. Removing riparian vegetation along stream banks can cause water temperature to rise, destabilize the shoreline and minimize or eliminate the runoff protection benefits of the buffer. Sedimentation due to forestry practices is most often associated with the construction and use of logging roads, particularly when roads are built near streams (Waters 1995). Density and length of logging roads can be major factors in the amount of sedimentation produced.

Timber harvesting is an important industry in the Broad River basin and is sometimes done at the onset of clearing for site development and agricultural activities. However, it is critical that all efforts be made to minimize sediment loss and runoff so as to protect other natural resources in this basin. These resources include fish spawning areas and habitat, recreational uses and aesthetics. This is especially important in light of a trend toward increased logging in North Carolina and in the southeast United States, in general.

Timber Harvest in the Broad River Basin

A recent concern related to timber harvesting that is receiving attention in the Broad River basin, as well as statewide, is chip mills. These are facilities that produce wood chips for use in the production of paper products. One of the big concerns about these facilities is their potential to increase the amount of timber harvesting, especially clearcutting, in their vicinity. In response to North Carolina citizens' increasing concerns regarding this industry, Governor Hunt directed the NC Department of Environment and Natural Resources (NC DENR) to conduct an environmental and economic study of wood chip production in the state. For several months, NC DENR staff have been gathering information needed to identify issues that should be examined in the study.

In October of 1997, three public meetings were held across North Carolina to receive general public input into this process. DENR received a large number of comments from state and federal agencies, individuals, businesses and groups. More than 100 persons presented oral comments at the pubic meetings and more than 200 written were also received by DENR. Comments received overwhelmingly supported the Governor's decision to conduct an environmental and economic study of this sector, with few, if any, commentors recommending that the study not be pursued. There also appeared to be general agreement that the study should be conducted in an informed, objective and unbiased manner, with frequent opportunities for public review and comment during the study process itself. Attendance was good and many ideas regarding the scope and nature of the forthcoming study were received.

An ongoing effort to manage timber harvesting in the Broad River basin such that it does not have a negative impact on water quality is being undertaken by the NC Division of Forest Resources (DFR). DFR is implementing various measures for protecting water quality statewide. These measures began with the creation of voluntary *Forest Practices Guidelies Related to Water Quality* (FPGs). These measures were voluntarily applied best management practices, which had no enforcement power by any agency. In 1989, the Sedimentation Pollution Control Act (SPCA) was amended to require compliance with nine performance standards in order to remain exempt from the SPCA's permitting requirements. These nine standards are the FPGs whose compliance is accomplished through the use of BMPs. The *Forestry Best Management Practices Manual* was published in September, 1989 to guide forestry operations in protecting water quality. The manual and the FPGs are available from any DFR office at no charge.

FPG/BMP inspections are carried out continuously by DFR field personnel in the course of their normal duties. Examinations of 3,779 sites in fiscal year 1996-97 revealed an initial compliance rate of 94.7%. Two systematic surveys by a DFR staff hydrologist in 1995 and 1996 examined 196 and 223 sites respectively. Compliance with FPGs and BMPs was found to be 92% and 95% for the two years, respectively. A summary of activities and past accomplishments in the Broad River basin is reported in Chapter 5.

Chapter 5 describes several programs that are aimed at either encouraging or requiring utilization of forest best management practices at the state and federal level. A list of FPGs is presented in Appendix V.

3.4.5 Onsite Wastewater Disposal

Septic systems receive wastewater from a household or business. The septic tank removes some wastes, but the soil drainfield provides further absorption and treatment. Septic tanks can be a safe and effective method for treating wastewater if they are sized, sited, and maintained properly. However, if the tank or drainfield malfunction or are improperly placed, constructed or maintained, nearby wells and surface waters may become contaminated.

Some of the potential problems from malfunctioning septic system include:

- Polluted groundwater: Pollutants in sewage include bacteria, nutrients, toxic substances, and oxygen-consuming wastes. Nearby wells can become contaminated by septic tanks.
- Polluted surface water: Often, groundwater carries the pollutants mentioned above into surface waters, where they can cause serious harm to aquatic ecosystems. Septic tanks can also leak into surface waters both through or over the soil.
- Risks to human health: Septic system malfunctions can endanger human health when they contaminate nearby wells, drinking water supplies, and fishing and swimming areas.

Pollutants associated with onsite wastewater disposal may also be discharged directly to surface waters through *straight pipes* (i.e., direct pipe connections between the septic system and surface

waters). These types of discharges, if unable to be eliminated, must be permitted under the NPDES program and be capable of meeting effluent limitations specified to protect the receiving stream water quality, including disinfection.

Onsite wastewater disposal is most prevalent in rural portions of the basin and at the fringes of urban areas. Data from the 1990 census indicates that in Polk, Rutherford and Cleveland counties combined, approximately 65% of the total number of housing units are on septic systems. Fecal coliform bacteria contamination from failing septic systems is of particular concern in waters used for swimming, tubing, water supply and other related activities. Regulatory programs and BMPs pertaining to onsite wastewater disposal are presented in Appendix V.

3.4.6 Solid Waste Disposal

Solid wastes may include household wastes, commercial or industrial wastes, refuse or demolition waste, infectious wastes or hazardous wastes. Improper disposal of these types of wastes can serve as a source of a wide array of pollutants. The major water quality concern associated with modern solid waste facilities is controlling the leachate and stabilizing the soils used for covering many disposal facilities. Properly designed, constructed and operated facilities should not significantly effect water quality.

Groundwater and surface water monitoring is required at all permitted Municipal Solid Waste Sites (MSW) and all Construction and Demolition landfills. Monitoring efforts have been required since July 1989. All MSW landfills must have a liner system in place by January 1, 1998. All existing unlined landfills must close at this same time.

Solid Waste Disposal in the Broad River Basin

During the public workshops conducted in the Broad River basin, concerns about the water quality impacts of a landfill near Kings Mountain Reservoir (Moss Lake) were expressed. Monitoring groundwaters and surface waters has been conducted around this site. No water quality violations have been detected through the surface water monitoring program, but monitoring will continue. In compliance with the requirements described above, the unlined portion of this site is being closed and a new area that has been lined will begin to be used.

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CHAPTER 4

WATER QUALITY AND USE SUPPORT RATINGS IN THE BROAD RIVER BASIN

4.1 INTRODUCTION

This chapter provides a detailed overview of water quality and use support ratings in the Broad River Basin. It is divided into two major parts and five sections.

Water Quality Monitoring and Assessment

- **Section 4.2** describes six water quality monitoring programs conducted by the Environmental Sciences Branch of the Division of Water Quality's (DWQ's) Water Quality Section as well as other programs local to the basin (Section 4.2.2). Basinwide data summaries are presented for several of the DWQ programs.
- **Section 4.3** presents a summary of the ambient monitoring data for the basin.
- **Section 4.4** presents a narrative summary of water quality findings for each of the subbasins in the basin. This summary is based on the DWQ monitoring programs described in Section 4.2 Also included are watershed maps which show the locations of monitoring sites.

Use-Support Ratings

- **Section 4.5** introduces the concept of use-support ratings and describes how they are derived. Using this approach, water quality for specific surface waters in the basin is assigned one of the following four use-support ratings: fully supporting uses, fully supporting but threatened, partially supporting or not supporting uses.
- **Section 4.6** presents the use support ratings for many streams in the Broad basin through a series of tables and figures. Included is a color-coded use support map of the basin (Figure 4.20).

4.2 WATER QUALITY MONITORING PROGRAMS

4.2.1 DWQ Programs

DWQ's monitoring program integrates biological, chemical, and physical data assessment to provide information for basinwide planning. Below is a list of the six major monitoring programs, each of which is briefly described in the following text and Appendix II.

- Benthic macroinvertebrate monitoring,
- Fish population and tissue monitoring,
- Lakes assessment (including phytoplankton monitoring),
- Aquatic toxicity monitoring,
- Special studies and chemical/physical water quality investigations, and
- Ambient water quality monitoring (covering the period 1991-1995).

Benthic Macroinvertebrate Monitoring

Benthic macroinvertebrates, or benthos, are organisms that live in and on the bottom of rivers, streams and estuaries. The benthic organisms collected most often in freshwater monitoring are aquatic insect larvae. The use of benthos data has proven to be a reliable water quality assessment tool (especially in freshwaters), as these organisms are relatively immobile and sensitive to subtle changes in water quality. Since many organisms in a community have life cycles of six months to one year, the effects of short term pollution (such as an oil or chemical spill) will generally not be overcome until the following generation appears. The benthic community also responds to, and shows the effects of, a wide array of potential pollutant mixtures.

For freshwater streams and rivers, criteria have been developed to assign five bioclassifications ranging from Poor to Excellent to each benthic sample. The bioclassifications include Excellent, Good, Good- Fair, Fair and Poor. The bioclassifications are based on the number of different kinds of species (taxa) present in three groups of pollution-intolerant insect larvae: Ephemeroptera (mayflies), Plecoptera (stoneflies) and Trichoptera (caddisflies). These three groups are used to develop EPT ratings. Likewise, ratings can be assigned with a Biotic Index (Appendix II). This index summarizes tolerance data for all taxa in each collection. The two rankings are given equal weight in final site classification. Higher taxa richness values (i.e. a greater number of different kinds of species) are associated with better water quality. These bioclassifications primarily reflect the influence of chemical pollutants. The major physical pollutant, sediment, is inadequately assessed by a taxa richness analysis alone. Different classification criteria have been developed for different ecoregions (mountains, piedmont and coastal plain) within North Carolina.

Benthic Macroinvertebrate Sampling in the Broad Basin

Since 1983, 108 benthic macroinvertebrate samples have been collected at 69 different locations within the Broad River basin. Of these 108 samples, an Excellent bioclassification was found for 6%, 34% were Good, 37% were Good-Fair, 17% were Fair and 6% were Poor. In 1995, during basinwide assessment, 33 sites were sampled which give a better indication of present water quality of mainstem and major tributary sites. Of these sites, 9% were Excellent, 46% were Good, 33% were Good-Fair, 12% were Fair and none were Poor. The results of benthic macroinvertebrate sampling for all sites in the Broad River Basin are presented in the individual subbasin discussion in sections 4.4.1 - 4.4.6.

Fisheries Monitoring

To the public, the condition of the fishery is one of the most meaningful indicators of ecological integrity. Fish occupy the upper levels of the aquatic food web and are both directly and indirectly affected by chemical and physical changes in the environment. Water quality conditions that significantly affect lower levels of the food web will affect the abundance, species composition, and condition of the fish population. Two types of fisheries monitoring are conducted by DWQ and described briefly below. The first, called Fish Community Structure, involves assessing the overall health of the fish community. The second, called Fish Tissue Analysis, involves analyzing fish tissues to determine whether they are accumulating metals or organic chemicals. This information is useful as an indicator of water quality and is also used to determine whether human consumption of these fish poses a potential health risk.

Fish Community Structure

As noted above, fish community structure involves assessing the overall health of the fish community as a means of assessing the quality of the ecosystem in which the fish reside. Fish community structure is assessed using a method called the North Carolina Index of Biotic Integrity (NCIBI). This method, which is a modification of Karr's IBI (1981), was developed as

a method for assessing a stream's biological integrity by examining the structure and health of its fish community. The index, (which is described in more detail in Appendix II), incorporates information about species richness and composition, trophic composition, fish abundance and fish condition. At this time there is no NC Index of Biotic Integrity developed for fish communities in lakes.

The NCIBI summarizes the effects of all classes of factors influencing aquatic faunal communities (water quality, energy source, habitat quality, flow regime, and biotic interactions). While any change in a fish community can be caused by many factors, certain aspects of the community are generally more responsive to specific influences. Species composition measurements reflect habitat quality effects. Information on trophic composition reflects the effect of biotic interactions and energy supply. Fish abundance and condition information indicates additional water quality effects. It should be noted, however, that these responses may overlap. For example, a change in fish abundance may be due to decreased energy supply or a decline in habitat quality, not necessarily a change in water quality.

Fish Community Structure in the Broad Basin

In 1995, six sites in subbasins 030801, -02, -04, and -06 were sampled and evaluated using the North Carolina Index of Biotic Integrity. The NCIBI Scores at these six sites ranged from 46 to 54 and the NCIBI ratings were: Good-Excellent (1 site), Good (4 sites), and Fair-Good (1 site). These data are presented below.

Table 4.1 Fish Community Structure Collections in the Broad River Basin, 1995.

Site	Road	County	Subbasin	Drainage Area (mi^2)	Date	NC IBI Score	NC IBI Rating[1]
Cove Creek	SR 1381	Rutherford	01	42.6	6/19/95	52	G
Green River	SR 1302	Polk	02	245.0	6/19/95	52	G
N.Fk. First Broad River	SR 1728	Rutherford	04	14.2	6/20/95	54	G-E
First Broad R.	SR 1530	Cleveland	04	60.5	6/20/95	50	G
Beaverdam Cr.	NC 150	Cleveland	04	16.9	6/20/95	50	G
N. Pacolet R.	SR 1501	Polk	06	49.3	6/19/95	46	F-G

[1] The NCIBI Ratings shown are: G-E = Good-Excellent, G = Good, and F-G = Fair-Good.

Fish Tissue Analysis

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

In evaluating fish tissue analysis results, several different types of criteria are used. Human health concerns related to fish consumption are screened by comparing results with federal Food

and Drug Administration (FDA) *action levels* and U.S. Environmental Protection Agency (EPA) recommended *screening values* for contaminants.

The FDA levels were developed to protect humans from the chronic effects of toxic substances consumed in foodstuffs and thus employ a "safe level" approach to fish tissue consumption. A list of fish tissue parameters accompanied by their FDA criteria are presented in Appendix II. At present, the FDA has only developed metals action level criteria for mercury (1.0 ppm). Individual parameters which appear to be of potential human health concern are evaluated by the N.C. Division of Epidemiology by request of DWQ.

Fish Tissue Analyses in the Broad Basin

Fish tissue samples were collected at 8 sites within the Broad River basin between 1988 and 1996 and were analyzed for metals contaminants. The 1996 sample collections were part of a special study to assess mercury contamination in the North Pacolet River near the Town of Tryon WWTP. All fish tissue samples collected throughout the Broad River basin between 1988 and 1996 contained levels of metals contaminants below EPA and FDA criteria. Mercury results from the North Pacolet River were also well below these limits.

Lakes Assessment Program (including Phytoplankton)

Lakes are valued for the multiple benefits they provide to the public, including recreational boating, fishing, drinking water, and aesthetic enjoyment. The North Carolina Lakes Assessment Program seeks to protect these waters through monitoring, pollution prevention and control, and restoration activities. Assessments have been made at all publicly accessible lakes, at lakes which supply domestic drinking water, and lakes (public or private) where water quality problems have been observed.

One way to evaluate the health of a lake is to examine the growth of phytoplankton. Phytoplankton are microscopic algae found in the water column of lakes, rivers, streams, and estuaries. Phytoplankton populations respond to the availability of nutrients (phosphorus and nitrogen) and other environmental factors such as light, temperature, pH, salinity, water velocity, and grazing by organisms in higher trophic levels. Phytoplankton may be useful as indicators of nutrient overenrichment (see following paragraph on trophic status) and are often collected with water quality samples from lakes. Prolific growths of phytoplankton sometimes result in "blooms" in which one or more species of algae may discolor the water or form visible mats on top of the water. These blooms, which are often due to high concentrations of nutrients, may be unsightly and deleterious to water quality, causing fish kills, anoxia, or taste and odor problems. An Algal Bloom Program was initiated in 1984 to document suspected algal blooms with species identification, quantitative biovolume, and density estimates. Usually, an algal sample with a biovolume larger than 5000 mm^3/m^3, density greater than 10,000 units/ml, or chlorophyll *a* concentration approaching or exceeding 40 µg/l (the North Carolina state standard) constitutes a bloom. Bloom samples may be collected as a result of complaint investigations, fish kills, or during routine monitoring if a bloom is suspected.

The Algal Growth Potential Test (AGPT) measures the potential of a lake to support algal growth and to determine whether algal growth is limited by nitrogen, by phosphorus, or co-limited by both nutrients. When a waterbody supports algal growth at bloom levels without additional increases in nitrogen and/or phosphorus, the system may be subject to frequent nuisance algal blooms. The test exposes a standard alga, Selenastrum capricornutum, to the test water (this constitutes the control). Additional test samples are enriched with nitrogen or phosphorus. When one of these nutrients is added to a water sample which is growth limiting to that nutrient, the resulting mean standing crop (MSC) will generally reflect the level of added nutrient. In some cases, the bioavailable nitrogen and phosphorus in a sample may approach

their optimum ratio for growth of the test alga and the addition of nutrients may not clearly identify the limiting nutrient. A waterbody may be protected from nuisance algal blooms if an AGPT value is consistently less than or equal to 5 mg/l.

Another measure of water quality in lakes is the North Carolina Trophic State Index (NCTSI). This is a numerical index used to evaluate the trophic status of lakes, and it can be used to determine whether the designated uses of a lake have been threatened or impaired by pollution. Trophic status is a relative measure of nutrient enrichment and productivity. The NCTSI score is based on total phosphorus, total organic nitrogen, secchi depth (water clarity indicator) and chlorophyll *a*. Based on this index, a lake is assigned one of five trophic status classifications: Oligotrophic, Mesotrophic, Eutrophic, Hypereutrophic and Dystrophic. Oligotrophic lakes are those that have the lowest levels of enrichment and generally have good clarity and no problems with algal blooms. At the other end of the spectrum are eutrophic and hypereutrophic lakes which have a lot of plant productivity which can cause nuisance problems and have little clarity in the water column. Dystrophic lakes are acidic blackwater lakes scattered throughout the coastal plain. Their NCTSI scores are highly skewed because of their natural discoloration. Further details of the NCTSI can be found in Appendix II.

Lakes Studies in the Broad River Basin

Five lakes in the Broad River basin have been sampled as part of the Lakes Assessment Program. These lakes are presented below by subbasin.

SUBBASIN 030801	SUBBASIN 030803	SUBBASIN 030805
Lake Lure	Lake Summit	Lake Montonia
	Lake Adger	Kings Mountain Reservoir

All of the lakes sampled have been assigned the trophic status classification of oligotrophic based on the NCTSI score. Each lake is individually discussed in the appropriate subbasin section with a focus on the most recent available data. Kings Mountain Reservoir was monitored intensively during the growing seasons of 1991 through 1993 as part of the reference lake program to determine if this lake was representative of a minimally impacted lake in the region of the state in which it is located. All of the lakes in this basin were sampled most recently by DWQ in 1995 except for Lake Montonia, which was most recently sampled in 1996.

Three lakes have been sampled for the potential of supporting algal growth with the Algal Growth Potential Test (AGPT) in the Broad River Basin. These are Lake Lure, Kings Mountain Reservoir and Lake Montonia. The AGPT results are described in each of the appropriate subbasin discussions.

Aquatic Toxicity Monitoring

Acute and/or chronic toxicity tests are used to determine toxicity of certain wastewater treatment discharges to sensitive aquatic species (usually fathead minnows or the water flea, *Ceriodaphnia dubia*). Types of discharges sampled include wastewater treatment plants that receive waste from industrial users and industrial facilities (i.e. textiles, metal finishers) that discharge effluent from their process operations. Results of these tests have been shown by several researchers to be predictive of discharge effects on receiving stream populations. The Aquatic Toxicology Unit maintains a compliance summary for all facilities required to perform tests and provides a monthly update of this information to regional offices and DWQ administration. Ambient toxicity tests can be used to evaluate stream water quality relative to other stream sites and/or a point source discharge.

Aquatic Toxicity Monitoring in the Broad Basin
There are twenty-two facilities in the Broad River Basin that are required to monitor the toxicity of their effluent. These facilities are listed in Appendix II.

Special Studies and Chemical/Physical Characterizations

Water quality simulation models are often used for the purpose of determining wasteload allocations. These models must accurately predict water body responses to different waste loads so that appropriate effluent limits can be included as requirements in National Pollutant Discharge Elimination System (NPDES) permits. Where large financial expenditures or the protection of water quality is at risk, models should be calibrated and verified with actual in-stream data. Because sufficient historical data are often lacking, intensive water quality surveys are required to provide the field data necessary to accomplish model calibration and verification. Intensive water quality surveys are performed on water bodies below existing or proposed wastewater dischargers and usually consist of a time-of-travel dye study, flow measurements, physical and chemical samples, long-term biochemical oxygen demand (BOD_{lt}) analysis, water body channel geometry, and effluent characterization analysis.

Special Studies and Chemical/Physical Characterizations in the Broad River Basin
In recent years, there have been no studies in the Broad basin as described above.

Ambient Monitoring System

The Ambient Monitoring System (AMS) is a network of stream, lake, and estuarine stations strategically located for the collection of physical and chemical water quality data or water quality parameters. Sampling stations are sited under one or more of the following monitoring designations:

Fixed Monitoring Stations	Rotating Monitoring Stations
Point source	Basinwide Information
Nonpoint source	HQW & ORW
Baseline Water Supply	

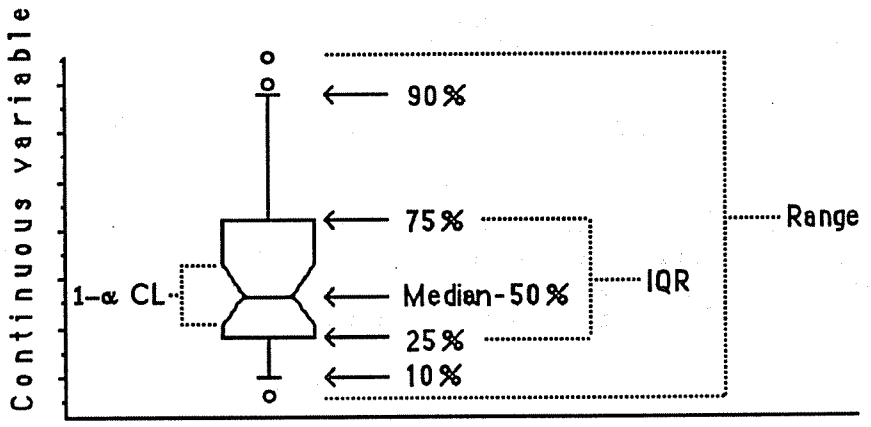
Parametric coverage is tiered by the waterbody's assigned surface water quality classification and corresponding water quality standards. Under this arrangement, core parameters are based on Class C waters with additional parameters added based on other classifications. Table 4.2 presents the parameters monitored for the classifications assigned to waters in the Broad River Basin. The next section (4.3) summarizes the results of ambient monitoring done in the Broad basin.

Table 4.2 Ambient Monitoring System Freshwater Parametric Coverage Pertinent to the Broad River Basin.

Class C and Class B Waters (minimum monthly coverage for all stream stations) ***Field Parameters:*** dissolved oxygen, pH, conductivity, temperature ***Nutrients***: total phosphorus, ammonia, total Kjeldahl nitrogen, nitrate+nitrite ***Physical Measurements:*** total suspended solids, turbidity, hardness ***Bacterial:*** fecal coliforms (Membrane Filter method) ***Metals:*** aluminum (no present water quality standard), arsenic, cadmium, chromium, copper*, iron, lead, mercury, nickel, silver*, zinc*
Trout Waters No changes or additions
Water Supply Chloride, total coliforms, manganese, total dissolved solids
PLUS any additional parameters of concern for individual station locations. *Action level water quality standard.

Ambient water quality data are often summarized using box and whisker plots (for example see Figure 4.4). Figure 4.1 provides an explanation of how to interpret the plots.

Box and whisker plot are useful for the visual comparison of single variable data sets. After the data have been ordered from low to high, the 10th, 25th, 50th, 75th, and 90th percentiles are calculated for plot construction. Box and whisker plots display the following important information: 1) the interquartile range (IQR) which measures the distribution and variability of the bulk of the data (located between the 25th and 75th percentiles), 2) the desired confidence interval (1- CL) for measuring the statistical significance of the median (50th percentile), 3) indication of skew from comparing the symmetry of the box above and below the median, 4) the range of the data from the lowest to highest values, and 5) the extreme values below the 10th percentile and above the 90th percentile (depicted as dots).



Visual comparison of confidence level notches about the medians of two or more box plots can be used to roughly perform hypothesis testing. If the box plots represent data from samples assumed to be independent, then overlapping notches indicate no significant difference in the samples at a prescribed level of confidence. Formal tests should subsequently be performed to verify preliminary conclusions based on visual inspection of the plots.

Figure 4.1 Interpreting Box and Whisker Plots

4.2.2 Local Water Quality Monitoring Programs

Environmental Quality Institute - University of North Carolina in Asheville: Volunteer Water Information Network (VWIN)

The Volunteer Water Information Network (VWIN) is a partnership of groups and individuals dedicated to preserving water quality in western North Carolina (Maas, et. al., 1996). Local environmental organizations provide administrative support, while the UNC Environmental Quality Institute provides technical assistance in the form of laboratory analysis of water samples, statistical analyses of water quality results, and written interpretation of the data. Volunteers collect samples once a month from designated sites in the region. The partnership has 130 sites in seven counties in western North Carolina. The programs for Buncombe County, Henderson County, Polk County and Lake Lure all have sites within the Broad River Basin. Table 4.3 provides further information on these programs. Locations of the sites that are in the Broad basin are illustrated in Figure 4.2. Results of the sampling efforts are presented in the individual subbasin characterizations in section 4.4.

Table 4.3 VWIN Sampling Sites in the Broad River Basin

VWIN Group	Map Symbol	Number of Sites in Basin	General Results
Buncombe County	b	1	This site in the headwaters of the Broad River exhibited good water quality.
Lake Lure	l	10	The first year of sampling in this program revealed areas where sedimentation is a problem and showed that the lake slowly recovered from the effects of the September 1996 flood.
Henderson County	h	4	Results indicate that the Green River has high water quality but that there are increasing levels of tubididty.
Polk County	p	10	The summary report for Polk County sampling sites indicates that sedimentation is the most commonly occurring problem observed.

4.3 SUMMARY OF AMBIENT MONITORING DATA FOR THE BROAD RIVER BASIN

The AMS stations for the basin are listed in Table 4.4. North Carolina has 9 stations in the Broad River Basin. Two stations are located on the mainstem of the Broad River, two are on the Second Broad River, and two are on the First Broad River. The remainder of the stations are on Cove Creek, Sugar Branch and Buffalo Creek. The locations of these stations are illustrated in Figure 4.3.

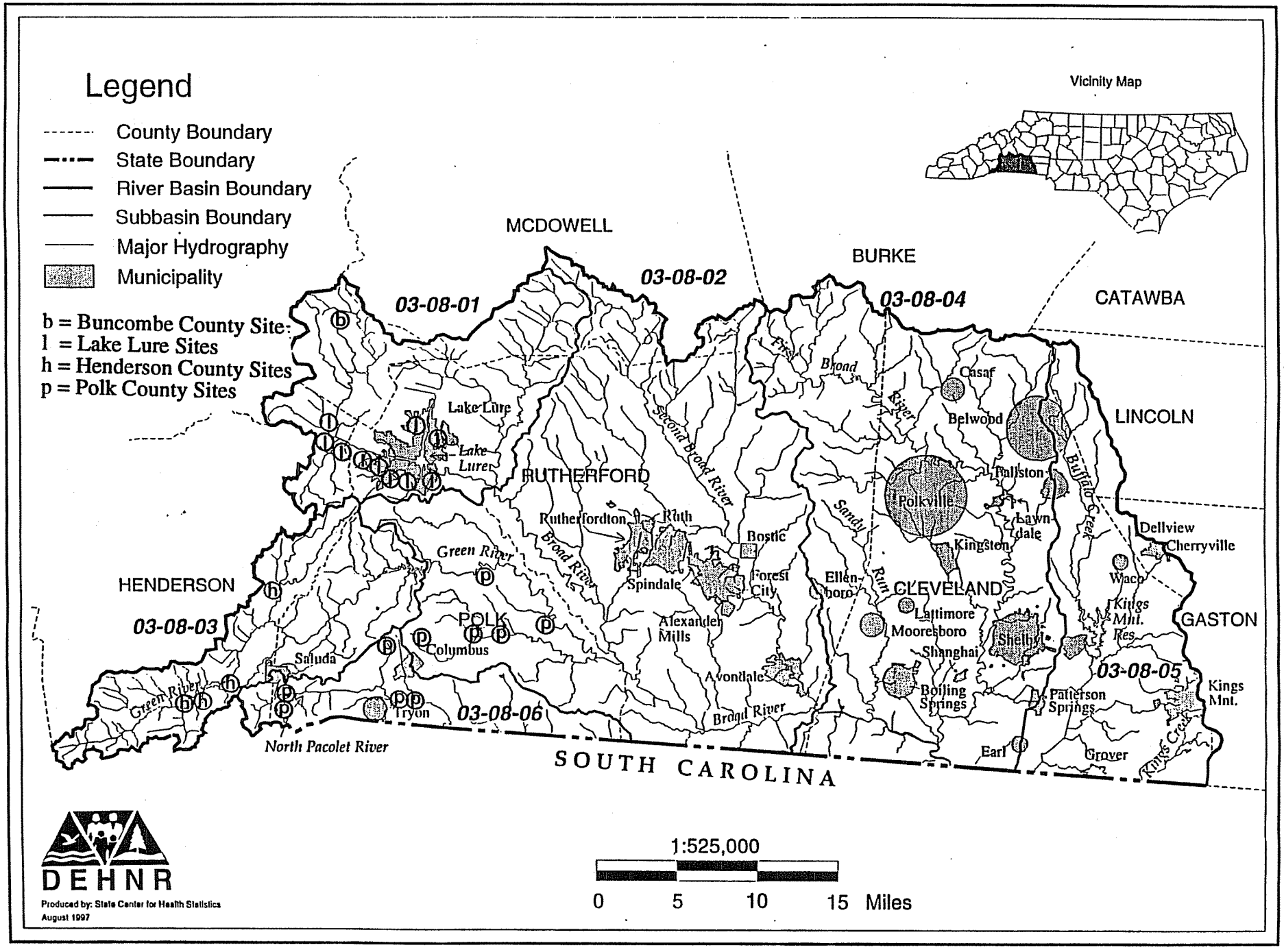


Figure 4.2 Location of Citizen Monitoring Program Sampling Sites in the Broad

Table 4.4 Ambient Monitoring System Stations Within the Broad Basin.

Primary No	STORET No	Station Name	Subbasin
02149000	A1510000	COVE CREEK AT US 64 AND US 74 NEAR LAKE LURE NC	030801
0214906350	A1520000	BROAD RIVER AT SR 1181 NEAR ROCK SPRINGS NC	030801
02150495	A2700000	SECOND BROAD RIVER AT SR 1538 NEAR LOGAN NC	030802
02151000	A4400000	SECOND BROAD RIVER AT CLIFFSIDE NC	030802
02151500	A4700000	BROAD RIVER AT NC 150 NEAR BOILING SPRINGS	030804
02152100	A4800000	FIRST BROAD RIVER NEAR CASAR NC	030804
02152596	A6400000	FIRST BROAD RIVER NEAR EARL NC	030804
02152610	A6450000	SUGAR BRANCH AT NC 150 NEAR BOILING SPRINGS NC	030804
02153456	A8600000	BUFFALO CREEK NEAR GROVER NC	030805

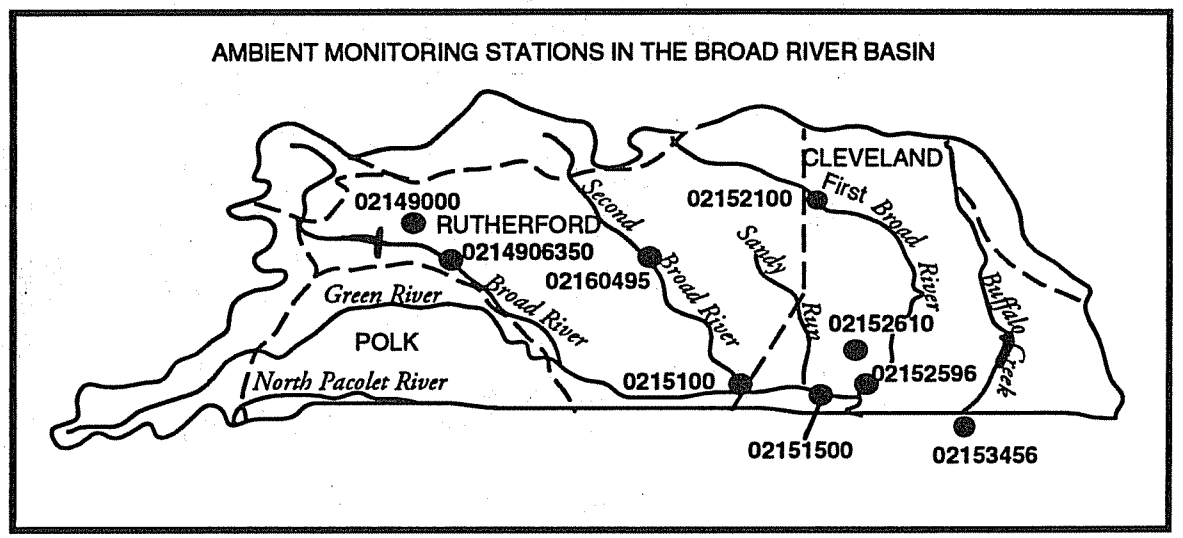


Figure 4.3. Location of Ambient Monitoring Stations in the Broad River Basin

Table 4.5 summarizes by parameter data collected at ambient stations in the Broad Basin where there are one or more excursions (or deviation) from the numerical water quality criteria. Each station includes the following information:

- parameter that exceeds the criterion
- total number of samples
- number of samples with less than the detection level recorded
- the number of samples for that parameter that represented an excursion from a water quality criterion

It should be noted that there are limitations to ambient water quality data. Because of the limited sampling frequency, the water quality sample may not be taken during a significant water quality event. It also should be noted that the criteria are presented as numerical and represent instantaneous measurements. The actual standard may include a narrative, such as turbidity, and, as in some metals criteria, may be based on extended exposure at or above the criteria to expect chronic toxicity of the most sensitive species of organism. Therefore the table is useful for relative comparisons between locations and screening areas where frequent excursions of individual or multiple parameters suggest waters that might be targeted for more detailed evaluations and/or specific management strategies. A more thorough evaluation can include review of temporal and spatial trends, association of concentrations to flow, degree of excursion

from the criterion, or use of other analytical methods. Table 4.6 shows totals from Table 4.5 as total samples, total excursions and percent excursions of total samples for each ambient station.

Table 4.5 Summary of Ambient Monitoring System Station Data Excursions from the NC Water Quality Criteria by Parameter. January 1990 to December 1994.

Station Number	Station Name	Parameter/Criterion	Samples All	<Det	Excur
02149000	COVE CREEK AT US 64 AND US 74 NEAR LAKE LURE	Turbidity (NTU)(50)	38	0	5
0214906350	BROAD RIVER AT SR 1181 NEAR ROCK SPRINGS NC	Turbidity (NTU)(50)	24	0	1
02150495	SECOND BROAD RIVER AT SR 1538 NEAR LOGAN NC	Turbidity (NTU)(50)	27	0	2
02151000	SECOND BROAD RIVER AT CLIFFSIDE NC	Turbidity (NTU)(50)	39	0	4
02151500	BROAD RIVER AT NC 150 NEAR BOILING SPRINGS	Turbidity (NTU)(50)	24	0	2
02152596	FIRST BROAD RIVER NEAR EARL NC	Turbidity (NTU)(50)	37	0	3
02152610	SUGAR BRANCH AT NC 150 NR BOILING SPRINGS NC	Turbidity (NTU)(50)	37	0	2
02153456	BUFFALO CREEK NEAR GROVER NC	Turbidity (NTU)(50)	36	0	3
02152100	FIRST BROAD RIVER NEAR CASAR NC	Total Residue (mg/l)(500)	37	0	1
02150495	SECOND BROAD RIVER AT SR 1538 NEAR LOGAN NC	Mercury (µg/l)(0.012)	25	24	1
02152610	SUGAR BRANCH AT NC 150 NR BOILING SPRINGS NC	Mercury (µg/l)(0.012)	37	35	2
0214906350	BROAD RIVER AT SR 1181 NEAR ROCK SPRINGS NC	Manganese (µg/l)(50)	16	0	6
02150495	SECOND BROAD RIVER AT SR 1538 NEAR LOGAN NC	Manganese (µg/l)(50)	16	1	9
02152100	FIRST BROAD RIVER NEAR CASAR NC	Manganese (µg/l)(50)	30	10	1

Table 4.6 Summary of Ambient Monitoring System Station Data Excursions from the NC Water Quality Criteria by Total Samples. January 1992 to December 1996.

Station Number	Station Name	Water Quality Class	Samples Total	Excursions	%Excursions
02149000	COVE CREEK AT US 64 AND US 74 NEAR LAKE LURE NC	C	364	8	2.2
0214906350	BROAD RIVER AT SR 1181 NEAR ROCK SPRINGS NC	WSIV	298	9	3.0
02150495	SECOND BROAD RIVER AT SR 1538 NEAR LOGAN NC	WSIV	326	16	4.9
02151000	SECOND BROAD RIVER AT CLIFFSIDE NC	C	403	8	2.0
02151500	BROAD RIVER AT NC 150 NEAR BOILING SPRINGS	C	237	8	3.4
02152100	FIRST BROAD RIVER NEAR CASAR NC	WSIV	510	5	1.0
02152596	FIRST BROAD RIVER NEAR EARL NC	C	396	19	4.8
02152610	SUGAR BRANCH AT NC 150 NR BOILING SPRINGS NC	C	396	22	5.6
02153456	BUFFALO CREEK NEAR GROVER NC	C	385	12	3.1

As Tables 4.5 and 4.6 indicate, there have been some, although infrequent, excursions from water quality standards. Sampling results are generally within acceptable ranges, including those for dissolved oxygen and pH (acidity). Data in Table 4.5 show excursions of the manganese criterion at all three water supply sites in the basin. The three sites with the most excursions (with the highest number being only 5.6%) are First Broad River at Earl, Second Broad River near Logan and Sugar Branch. It is particularly interesting to note the number of stations with excursions from the turbidity standard. In fact, there are excursions against the turbidity criterion for every site in the basin except the First Broad River at Casar. Turbidity is an indicator of sedimentation. Figure 4.4 illustrates the distribution of turbidity data for each ambient station in the basin.

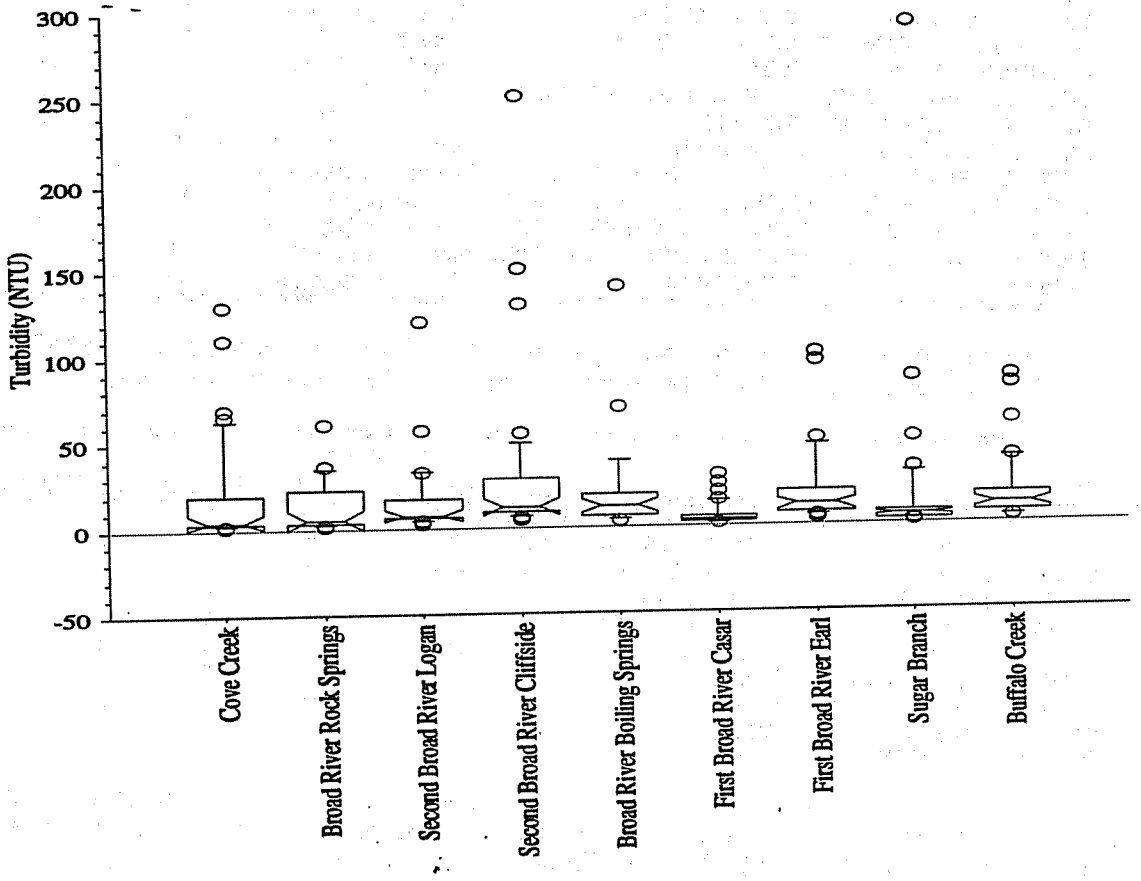


Figure 4.4 Turbidity distribution from ambient monitoring system sites in the Broad River Basin; 1992 - 1996.

Fecal coliform bacteria behave differently than most other water quality parameters, and these differences must be considered when using them to evaluate water quality. Available information was reviewed to identify potentially impaired waters and locate potential sources of pollutants in order that targeting efforts and appropriate management strategies can be developed. As sampled in the ambient monitoring system, fecal coliform bacteria are most useful as a screening tool to estimate the cumulative inputs from multiple sources, but in some instances can be used to locate a single large source of bacteria.

The Broad River Basin has three sites reporting a geometric mean of greater than 200/100ml. Table 4.7 provides a sumary of the results of fecal coliform sampling conducted between 1992 and 1996. The distribution of the fecal coliforms from the mainstem stations is shown in Figure 4.5. This shows the sites with high fecal numbers mainly in lower reaches of the basin at First Broad River at Earl, Sugar Branch and Buffalo Creek. However, the Buffalo Creek site had only nine samples taken throughout the reporting period.

Table 4.7 Fecal Coliform summary data for the Broad River Basin. 1992 to 1996.

Site	Total Samples	Geometric Mean	Samples >200/100ml	Percent >200/100ml	First Sample	Last Sample
COVE CREEK AT US 64 AND US 74 NEAR LAKE LURE	34	10.4	3	8.8	3/3/93	12/10/96
BROAD RIVER AT SR 1181 NEAR ROCK SPRINGS NC	24	12.0	2	8.3	1/24/95	12/10/96
SECOND BROAD RIVER AT SR 1538 NEAR LOGAN NC	27	45.3	4	14.8	10/19/94	12/10/96
SECOND BROAD RIVER AT CLIFFSIDE NC	33	47.5	4	12.1	9/2/93	12/10/96
BROAD RIVER AT NC 150 NEAR BOILING SPRINGS	23	89.4	6	26.1	10/26/94	11/20/96
FIRST BROAD RIVER NEAR CASAR NC	28	44.3	3	10.7	5/5/92	11/20/96
FIRST BROAD RIVER NEAR EARL NC	27	208.3	16	59.3	5/5/92	11/20/96
SUGAR BRANCH AT NC 150 NR BOILING SPRINGS NC	27	260.2	18	66.7	5/5/92	11/20/96
BUFFALO CREEK NEAR GROVER NC	27	203.8	9	33.3	5/5/92	11/20/96

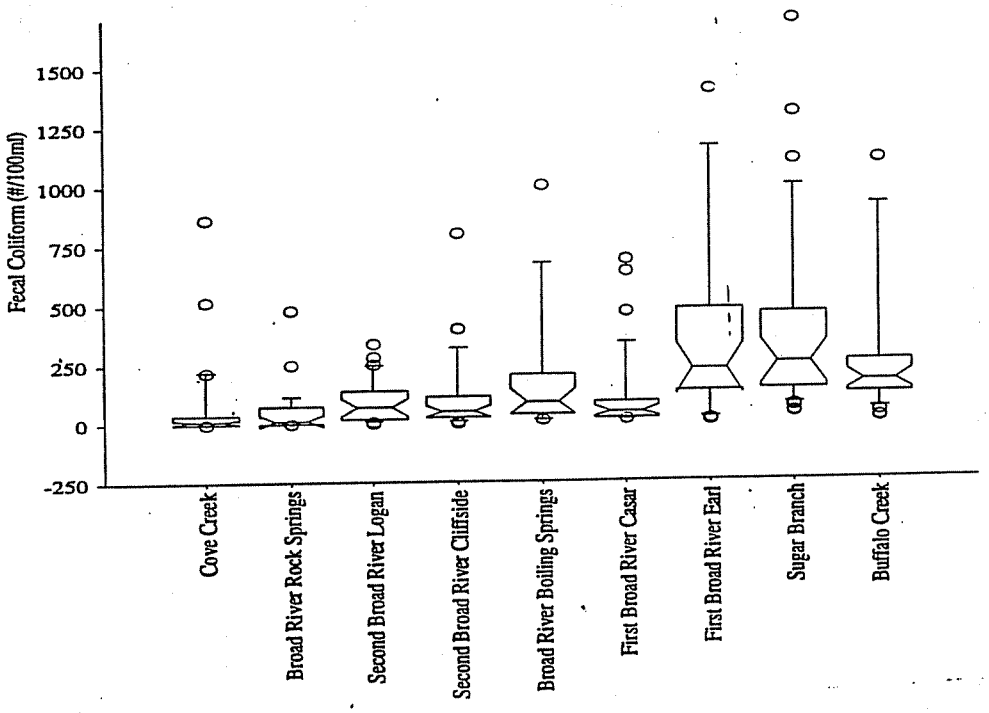


Figure 4.5 Fecal coliform distribution from ambient monitoring system sites in the Broad River Basin; 1992 - 1996.

4.4 NARRATIVE WATER QUALITY SUMMARIES BY SUBBASIN

4.4.1 Subbasin 01 - Upper Broad River basin, including Lake Lure and Cove Creek

Description

This subbasin is in the mountain ecoregion and contains Lake Lure, the uppermost reaches of the Broad River upstream of Lake Lure, and all of its tributaries, and approximately 5 river miles of the tailwater reach of the Broad River below Lake Lure. Figure 4.6 provides a map of the subbasin, including the location of sampling sites. Land use within the Lake Lure watershed is predominantly forested with some urban and agricultural uses. Cove Creek is the only large tributary to the Broad River in this subbasin, below Lake Lure. Most of the waters in this subbasin are currently classified as C Trout and are protected for natural trout propagation and survival of stocked trout. Portions of the Broad River corridor are becoming more developed, which may lead to water quality problems.

Overview of Water Quality

Rivers and streams in this subbasin have generally good water quality with very few violations of chemical water quality standards. Both the Broad River above Lake Lure and a downstream site on Cove Creek received Excellent bioclassifications in 1995 (Table 4.8). The Cove Creek site was given a Good NCIBI rating. Good to Excellent bioclassifications have been recorded during most benthic macroinvertebrate surveys since 1983. A Fair bioclassification was assigned to the Broad River below Lake Lure at US 64/74 in 1984. The regulated nature of the Broad River at this point may be partially responsible for the lower bioclassification.

Lake Lure is a large impoundment located in the mountains of Rutherford County, adjacent to the Town of Lake Lure. Lake Lure has alternated between mesotrophic and oligotrophic from 1981 to 1995 and is currently considered oligotrophic. Fish tissue samples were collected at Lake Lure in 1995 and results showed metals concentrations below levels of concern. There are 14 VWIN monitoring sites in and around the lake. The lake is discussed in detail later in this section.

The VWIN program described earlier in this chapter has one monitoring site on the upper Broad River in Buncombe County. Results of the volunteer sampling indicate that the upper Broad River has high water quality as compared to 48 other sampling sites in the county (Maas, et. al., 1997a).

Benthic Macroinvertebrates

Two locations were sampled for benthic macroinvertebrates in this subbasin during the 1995 basinwide investigations (Table 4.8). Both sites were selected to determine water quality conditions from previously unassessed reaches of the upper Broad River and Cove Creek. Benthic macroinvertebrate samples have been collected from 4 locations in this subbasin since 1983.

Table 4.8 Basin Assessment Sites in Broad Subbasin 030801, 1995, Taxa Richness Values and Bioclassifications.

Site #	Creek	Date	County	Road	S/SEPT	Rating
B-1	Broad R	950710	Buncombe	SR 2802	82/43	Excellent
B-3	Cove Cr	950710	Rutherford	SR 1381	-/37	Excellent

Note: Map # refers to number on subbasin map

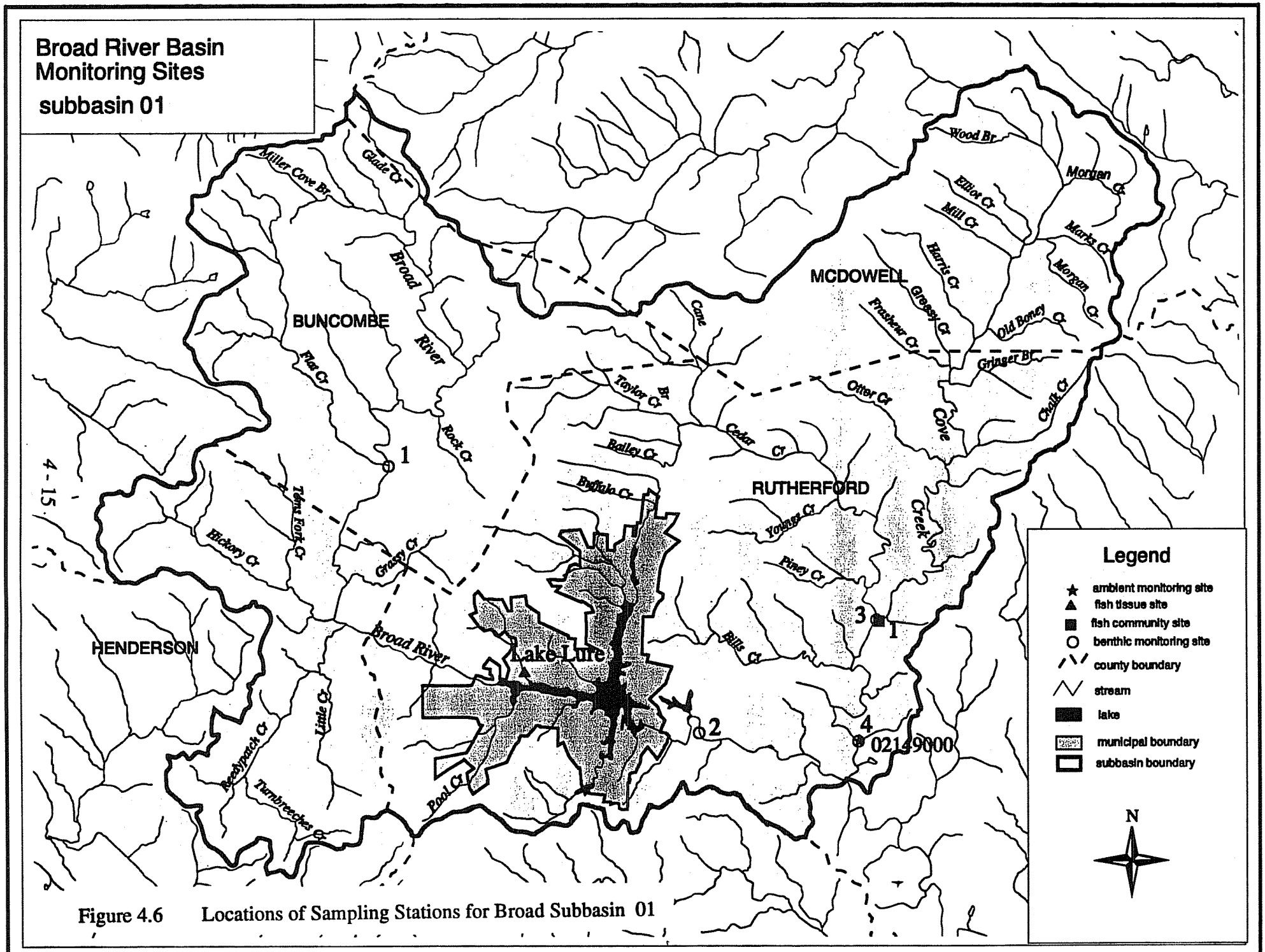


Figure 4.6 Locations of Sampling Stations for Broad Subbasin 01

The Broad River at SR 2802 in Buncombe County was selected to represent water quality conditions in the Broad River above Lake Lure. This is a previously unassessed reach of the Broad River. An Excellent bioclassification was given to this location (EPT taxa richness = 43). The catchment above this location appears to be forested or in small private farms. The Broad River at this point has a substrate dominated by boulder and rubble and received a very high NC habitat score (81). The catchment below this location becomes more developed, particularly along the river corridor near the communities of Bat Cave and Chimney Rock. Additional investigations could be conducted on the Broad River upstream of Lake Lure to assess the effects of development along the river corridor. In 1984, a benthic macroinvertebrate sample was collected at the Broad River near US 64/74 below the dam at Lake Lure. This reach was given a Fair bioclassification. These results may reflect the effects of flow regulation on the benthos in this reach of the Broad River.

An Excellent bioclassification also was given to Cove Creek at SR 1381. Despite the Excellent bioclassification, this site had a very sandy substrate, possibly reflecting the effects of nonpoint source runoff. Benthic macroinvertebrate data have been collected from Cove Creek during earlier investigations (Good bioclassification), however, the US 64/74 location is near the confluence with the Broad River and may receive more nonpoint source runoff.

Fish Community Structure and Fish Tissue

Only one site, Cove Creek, was sampled for fish community structure in this subbasin during 1995 (Table 4.9). Cove Creek was considered a smallmouth bass-cool water stream by Messer, et al. (1965).

Table 4.9 Basin Fish Community Assessment Sites in the Broad River Subbasin 030801, North Carolina Index of Biotic Integrity (NCIBI) Score, and Rating, 1995.

Site	Waterbody	Location	County	Drainage Area (mi^2)	Date	NCIBI Score	NCIBI Rating
F-1	Cove Cr	SR 1381	Rutherford	42.6	6/19/95	52	Good

The fish community found in Cove Creek was assessed a Good ecological health rating. Middle range scores were received for the number of species of darters and sunfish collected and for the percentage abundances of omnivores and insectivores. All other metrics were scored as a 5 which represents conditions which would be expected for undisturbed streams. The most abundant species collected was the fieryblack shiner. Sportfish collected included redbreast sunfish and smallmouth bass.

Lakes Assessment - Lake Lure

Lake Lure is a large impoundment located in the mountains of southwestern North Carolina (Rutherford County), adjacent to the Town of Lake Lure, which owns the lake. Figure 4.7 provides a schematic diagram of the lake, showing locations of sampling sites. The shoreline has been developed with houses and vacation lodges. This lake has a maximum depth of 164 feet (50 meters). Major tributaries to the lake are the Broad River, Buffalo Creek, and Cane Creek. Land use within the watershed is predominantly forested with some urban and agricultural uses. A small municipal golf course is located to the southeast of the lake and a larger golf course resort complex (Fairfield Mountains) with two 18 hole golf courses is located to the north, adjacent to the Buffalo Creek arm. Development is continuing along the lakeshore and, to a lesser extent, along the tributaries to the lake. A new development is planned within a 1,000 acre parcel located to the north of Fairfield Mountains and to the east of the Lake Lure dam (Albert Moore, District Conservationist, NRCD District Office, Rutherford County).

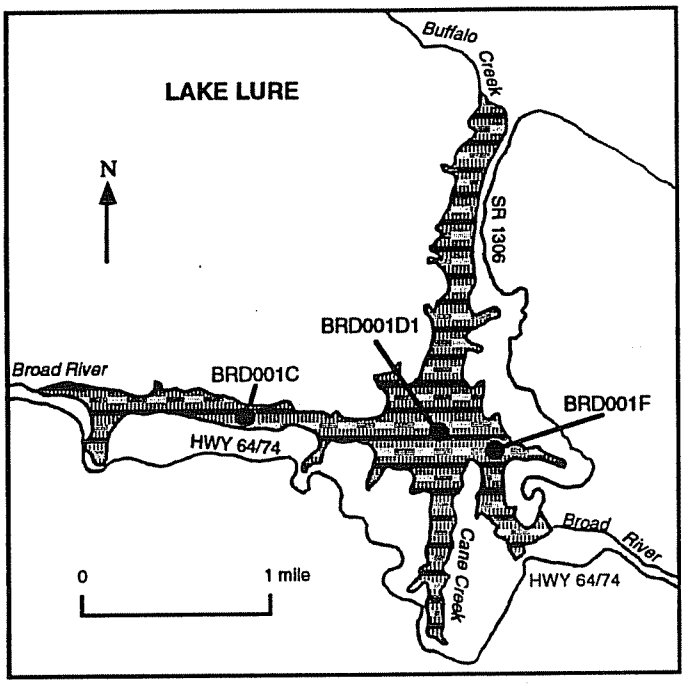


Figure 4.7 Lake Lure, Subbasin 01 of the Broad River Basin

Lake Lure was sampled on July 31, 1995. Thermal stratification was noted at all three stations. Field notes stated that the water had a greenish appearance at station BRD001C and the chlorophyll *a* value was higher at this station (11 µg/l) than at the other two stations (6 µg/l and 5 µg/l). All of these values are well within the state standard of 40 µg/l. The Secchi reading was also noticeably lower at BRD001C (1.3 meters) than at BRD001D1 (2.4 meters) and BRD001F (2.2 meters). Station BRD001C is shallower (six meters) than stations BRD001D1 and BRD001F (19.5 meters and 14.5 meters respectively). The NCTSI score in 1995 (-2.9) indicated that the lake was oligotrophic on the day it was sampled.

Lake Lure was previously sampled by DWQ in 1981, 1982, 1983, 1985 and 1989. In 1983, surface pH was less than the state water quality lower limit of 6.0 s.u. Nutrient and chlorophyll *a* values remained consistent and metals were less than the applicable state water quality standards except for copper (50 µg/l) and mercury (0.5 µg/l) which were detected in 1981. These values were greater than the applicable state water quality standards for these metals. From 1981 to 1989, the NCTSI score for Lake Lure fluctuated between oligotrophic and mesotrophic.

Historical data collected at Lake Lure from 1981 to 1995 for the four constituents of the NCTSI (total phosphorus, total organic nitrogen, Secchi depth and chlorophyll *a*) are summarized (Figure 4.8). Total phosphorus concentrations were highest at the upstream sampling site located in the Broad River arm of the lake (BRD001C), decreasing downstream to the sampling site nearest the dam (BRD001F). The lowest mean and median values for total organic nitrogen were observed at the mid-lake sampling site (BRD001D1) and the highest values for total organic nitrogen were observed in the upstream lake sampling site (BRD001C).

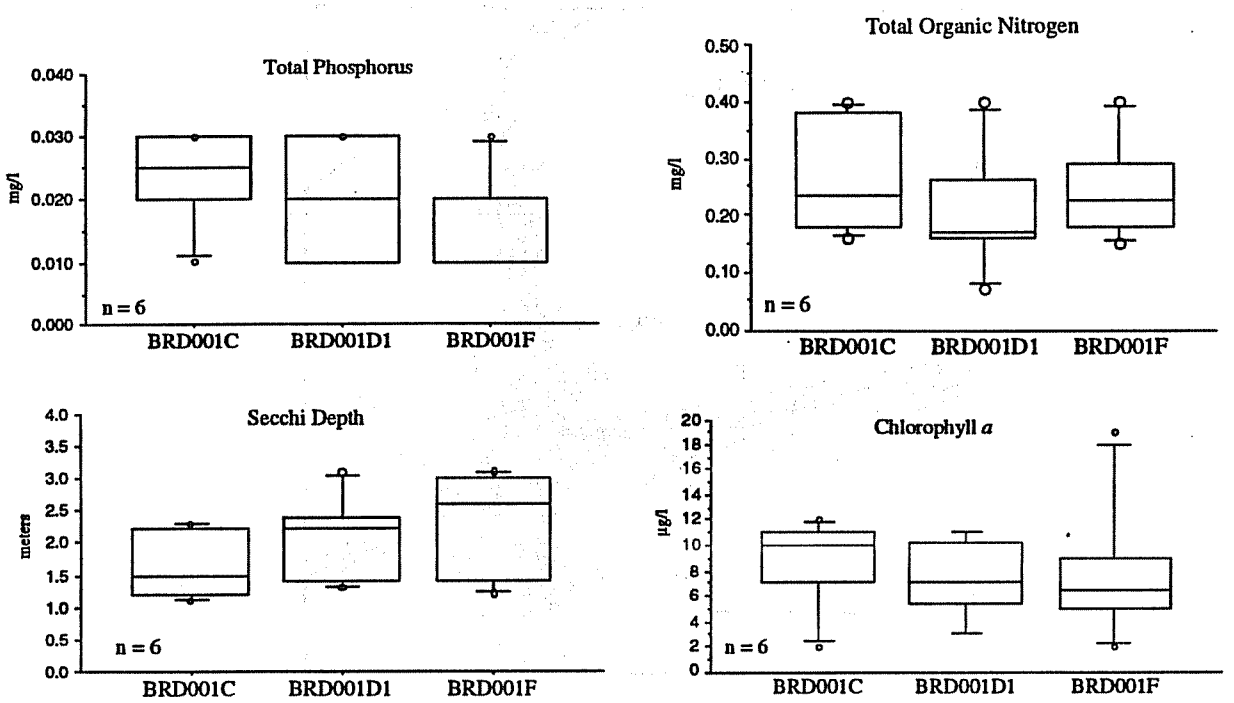


Figure 4.8 Lake Lure NCTSI Data Analysis from Lake Sampling Events, 1981 through 1995.

From 1981 to 1995, Secchi depth values were lower at the upstream sampling site, increasing in depth further downstream. Lakewide mean Secchi depth for this time period was 2.0 meters. Chlorophyll *a* values demonstrated the same upstream to downstream trend observed with total phosphorus. The upstream lake sampling site had the highest value for chlorophyll *a* observed in the lake from 1981 to 1995 (19 µg/l in 1989).

In July of 1996, the Town of Lake Lure began monitoring the lake as part of the VWIN program described earlier in this chapter. The first report of this effort was released in August of 1997 (Maas, et. al., 1997c). There are 14 VWIN monitoring sites in and around the lake. Results of the first year of monitoring revealed that two streams feeding the lake (a stream that runs through a public golf course and Cane Creek) exhibited problems with sedimentation and nutrient loading. These values were due to the complete draining of a small lake at the headwaters of the creek. Accumulated sediment is making its way into the Cane Creek arm of the lake (Robert Washburn, Town of Lake Lure, Lake Lure Committee, pers. com.). Results also revealed that the lake slowly recovered from high turbidity levels caused by the September, 1996 flood (see next paragraph). Depletion of dissolved oxygen levels in bottom waters due to stratification was also recorded. Continued monitoring will provide further information on the quality of the lake and the waters that feed it.

On September 4, 1996, more than 11 inches of rain fell in the Broad River basin in the vicinity of Bat Cave and Lake Lure. The flood water significantly raised the level of the Broad River, resulting in a flood that was believed to be the worst in the area in 80 years. Extensive bank erosion occurred on the Broad River above Lake Lure and on its tributaries. The Lake Lure Town Council approved bids in January 1997 for a dredging project in the western end of the lake (Broad River arm) to remove accumulated sediment. The project, which had been planned prior to the September 1996 flood, was initiated in February of 1997 and completed the following April at a cost of $1,232,000. An estimated 232,000 cubic yards of sediment were removed.

Lake Lure supports a sport fishery consisting of sunfish, crappie, largemouth bass and trout (Fish, 1968). In 1986, a survey was conducted to investigate the rainbow trout fishery in Lake Lure. This study was conducted to address angler concerns of the declining rainbow trout fishery in the lake. The three year study discovered that suitable habitat for trout (i.e., water temperature and dissolved oxygen) had declined since the 1950's (Goudreau and Brown, 1988). The Town of Lake Lure finances the stocking of the lake with trout and bass.

4.4.2 Subbasin 02 - Middle portion of the Broad River, including Walnut Creek, Mountain Creek, the lower Green River and the Second Broad River

Description

This subbasin includes the middle portion of the Broad River watershed (approximately 35 river miles from below the dam at Lake Lure to the confluence of the Second Broad River near the Cleveland/Rutherford County line,) the entire Second Broad River drainage, and the lower drainage of the Green River. These streams are found within the piedmont ecoregion and contain the urban areas of Rutherfordton, Spindale, and Forest City. Other significant tributary catchments of the Broad River include Mountain, Cleghorn, and Floyd Creeks. Large tributary systems of the Second Broad River include Catheys Creek and Robinson Creek. The Broad River, from the confluence of Cove Creek to the town of Rutherfordton, is currently classified as WS-IV and the Second Broad River from its headwaters to 0.5 miles above the Cone Mills water supply intake is currently classified as WS-IV or WS-V. Sedimentation is a major habitat quality problem in the subbasin and is responsible for habitat degradation in many catchments. Many of the streams have a shifting sand bottom. Eight permitted discharges have design flows of $\geq$ 0.5 MGD, of which 5 discharge within the Second Broad River catchment (Spindale WWTP, Burlington Industries, Forest City WTP and WWTP, and Cone Mills Corporation). Figure 4.9 provides a map showing the major hydrological features and the location of DWQ's sampling sites in this subbasin.

Overview of Water Quality

Water quality, based on benthic macroinvertebrate information, generally ranges from Good to Good/Fair in this subbasin (Table 4.10). During the 1995 basin assessment, the Broad River water quality was Good at two sites, but Good-Fair at a site in between. Good water quality was also found at Mountain Creek, the Green River, White Oak Creek and an upstream site on the Second Broad River. Cleghorn Creek, Robinson Creek, and a downstream site on the Second Broad River had Good-Fair bioclassifications. Fair water quality was found for Walnut Creek and Catheys Creek below the Spindale WWTP. Poor bioclassifications have been recorded only prior to 1987. Water quality deterioration is associated with large point source dischargers in the Rutherfordton-Spindale area and nonpoint source runoff in other areas of the subbasin.

A fish community sample from the Green River in 1995 also noted Good water quality. Fisheries samples were collected in 1994 during a special study of the Second Broad River. Fair-Good NCIBI ratings were found at Catheys Creek and a middle site on the Second Broad River. Upstream and downstream sites on the Second Broad had Good NCIBI ratings. Combining fisheries and benthos data, the 1994 study concluded that the overall water quality of the Second Broad River was Good-Fair, and that the major problem was sedimentation.

Benthos sampling above and below the Columbus WWTP discharge in the White Oak Creek watershed has shown improvement in water quality between 1986 and 1995. Water quality below the discharge improved from Poor to Good-Fair. This change is attributed to improved wastewater treatment and a reduction in the percent of industrial contributors.

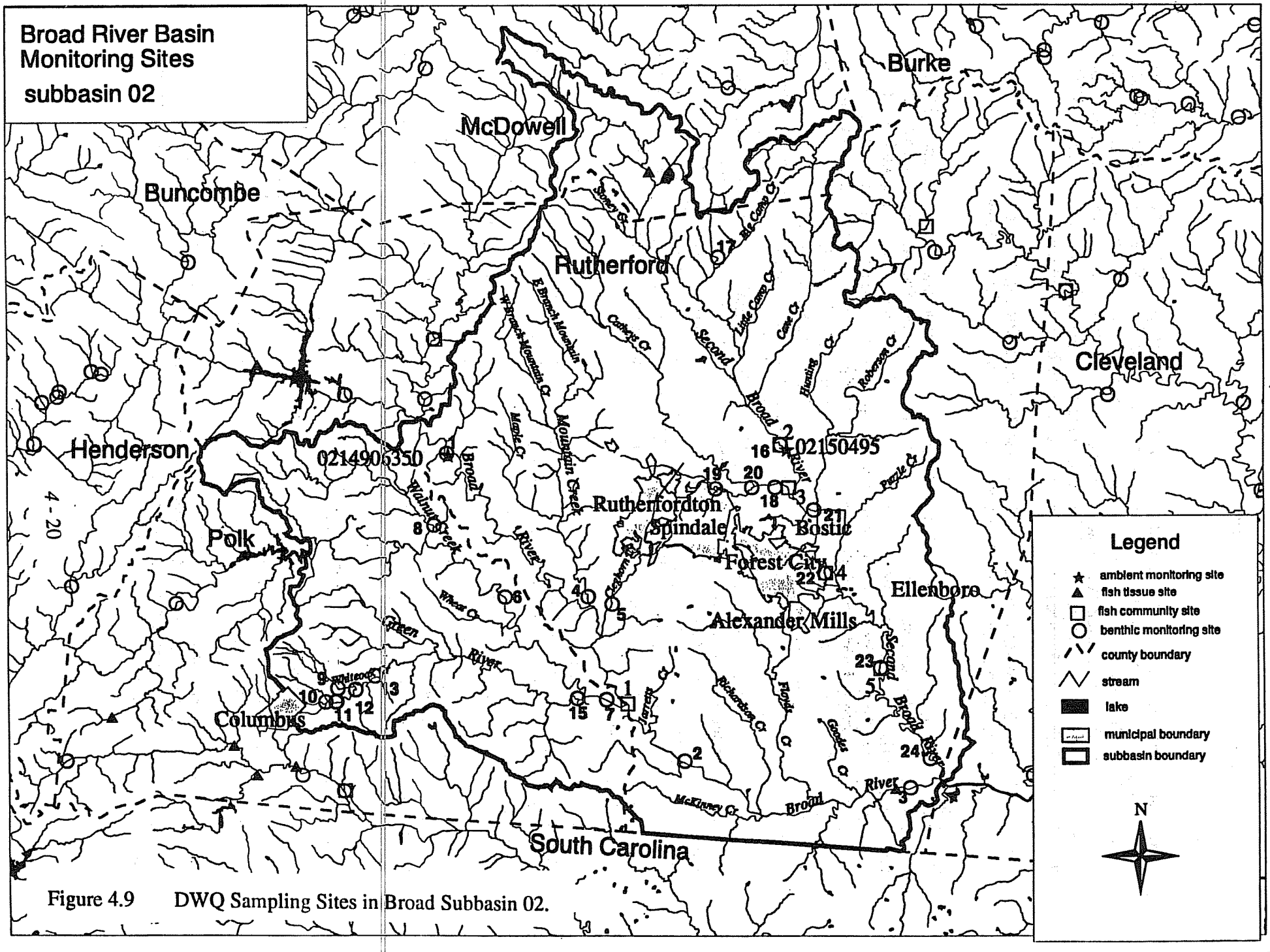


Figure 4.9 DWQ Sampling Sites in Broad Subbasin 02.

Good or Good-Fair bioclassifications have been consistently recorded from the ambient monitoring location on the Broad River at Cliffside. This site is the most downstream monitoring location in the subbasin and denotes water quality conditions prior to flowing into South Carolina. However, the gradient of the Broad River is less in the lower reaches below the ambient monitoring location. The reduction in gradient may account for sediment accumulation in the lower reaches of the river.

There are five VWIN (Polk County) monitoring sites in subbasin 02. Of all of the Polk County monitoring sites, the White Oak Creek watershed shows some of the highest turbidity and suspended solids levels (Maas, et. al., 1997b). This is likely due to agricultural or urban sources. Levels for these parameters were highest in the last year, possibly indicating a worsening situation.

Benthic Macroinvertebrates

Twelve locations were sampled for benthic macroinvertebrates in this subbasin during the 1995 basinwide investigation (Table 4.10). Six of these locations were at previously unassessed tributary sites (4) or unassessed reaches of the Broad River (2). Benthic macroinvertebrate samples have been collected from 24 locations in 030802 since 1983, including three special studies and five long-term monitoring locations. Results from earlier studies are contained in the Broad River Basin Basinwide Assessment Report (NCDENR, 1997).

Table 4.10 Benthic Macroinvertebrate Data, Broad Subbasin 02, 1995.

Site #	Creek	Date	County	Road	S/SEPT	Rating
B-1	Broad R	950712	Rutherford	SR 1181	56/28	Good
B-2	Broad R	950712	Rutherford	SR 1106	52/23	Good-Fair
B-3	Broad R	950920	Rutherford	US 221	58/29	Good
B-4	Mountain Cr	950712	Rutherford	SR 1149	-/28	Good
B-5	Cleghorn Cr	950712	Rutherford	SR 1149	49/17	Good-Fair
B-7	Green R	950711	Polk	SR 1302	52/27	Good
B-8	Walnut Cr	950711	Polk	SR 1315	-/14	Fair
B-11	White Oak Cr	950711	Polk	SR 1352	63/36	Good
B-16	Second Broad R	950713	Rutherford	SR 1538	51/26	Good
B-18	Catheys Cr	950713	Rutherford	SR 1549	-/18	Fair
B-21	Robinson Cr	950713	Rutherford	SR 1561	-/26	Good-Fair
B-24	Second Broad R	950713	Rutherford	SR 1973	42/20	Good-Fair

Note: Map # refers to number on subbasin map.

Benthic macroinvertebrate samples were collected from three mainstem Broad River locations during the 1995 basinwide sampling. Samples were collected from two previously unassessed reaches (SR 1181 and SR 1106) and at the ambient monitoring location at US 221 near Cliffside. These data suggest Good and Good/Fair bioclassifications. Despite the slightly lower EPT taxa richness value at the SR 1106 location (and a lower bioclassification) the benthic fauna at all three locations were very similar. EPT abundance values were also very low at each of these three locations (range from 73-88). In addition, very low chironomid abundances were recorded, suggesting the effects of scour. Low NC habitat scores for the Broad River sites suggest impacts to instream habitat.

Benthic macroinvertebrate samples were collected from two small, unassessed tributary catchments of the Broad River. Mountain Creek was selected as a typical tributary of the Broad River. This stream at SR 1149 is approximately 12 meters wide and has a very sandy substrate. Cleghorn Creek was chosen to assess the potential impacts of the Rutherfordton WWTP. The stream is 6-7 meters wide and also has a very sandy substrate. The field team noted that bank erosion was very severe which may account for some of the habitat deterioration. The Rutherfordton WWTP has a design flow of 1.0 MGD and an instream waste concentration of

48% under 7Q10 flow conditions. Rutherfordton is expanding the WWTP to a 3.0 MGD activated sludge discharge, which will be located below the confluence of Stonecutter and Cleghorn creeks. Mountain bioclassification criteria were used to assign Good and Good/Fair bioclassifications to Mountain and Cleghorn Creeks, respectively.

The only site surveyed on the Green River during the 1995 basinwide network was at SR 1302, which is a long-term monitoring location and will be discussed in that section (below). Two tributary streams of the Green River were sampled in 1995: Walnut Creek and White Oak Creek. Walnut Creek was selected as a typical tributary catchment in this subbasin and the survey at White Oak Creek was conducted to follow-up an earlier investigation of the Columbus WWTP. Walnut Creek at SR 1315 is near the confluence with the Green River. Only 14 EPT taxa were collected at this location and the EPT abundance also was very low (49). This site also received a low NC habitat score (63). The field team noted unstable banks with breaks in the riparian zone and a heavily embedded substrate. The landuse in the immediate vicinity of the monitoring location is primarily fallow agricultural fields. Walnut Creek received a Fair bioclassification.

Two collection sites were chosen on the Second Broad River to bracket several point source discharges in the Rutherfordton/Spindale metropolitan area. The Second Broad River at SR 1538 was selected as a reference site during an intensive investigation of the entire Second Broad River in June, 1994. This site also was sampled during the 1995 basinwide network. Both surveys resulted in Good bioclassifications using mountain bioclassification criteria. This reach of the Second Broad River has a very sandy substrate and is susceptible to the effects of scour during spate events. Despite the Good bioclassifications during both surveys, there was a large difference in EPT taxa richness numbers (26 vs. 33). These differences are particularly evident in the Ephemeroptera (10 in 1995 compared to 17 in 1994). Mayfly taxa that were either abundant or common during the 1994 survey but absent during the 1995 survey include *Baetis pluto*, *Caenis*, *Centroptilum*, *Heptagenia*, *H. marginalis*, and *Tricorythodes*. Interestingly, more Plecoptera were collected in 1995 during the July survey. *Pteronarcys dorsata* and *Tallaperla* were abundant and common, respectively in 1995, but not collected during the 1994 survey.

The Catheys Creek location was selected to follow-up information collected during a special investigation. The substrate at this location is dominated by sand and silt and the water during the 1995 survey was discolored due to the Spindale effluent. This site was initially chosen as a recovery site during an intensive investigation of the Spindale WWTP in 1988. It also was part of an intensive investigation of the entire Second Broad River basin in June 1994 and sampled in 1995 as part of the basinwide network. The bioclassification has been borderline between Good/Fair or Fair using mountain classification criteria during all three surveys. These bioclassifications reflect the impacts of the Spindale WWTP.

Robinson Creek was selected as an unassessed tributary in this subbasin. This is a small (6 meter wide) tributary of the Second Broad River with a sand and gravel dominated substrate. A Good/Fair bioclassification was assigned to Robinson Creek based on an EPT taxa richness value of 26. A Good/Fair bioclassification using mountain classification criteria is supported by a moderate EPT abundance value (104).

Long Term Benthos Locations

In subbasin 02 there are six locations that have been analyzed over a number of years to detect trends in water quality. These are described in detail below.

Broad River at US 221 near Cliffside

The Broad River at Cliffside is a very large river (approximately 50 meters wide) and has a sandy substrate. Benthic macroinvertebrate samples have been collected from this location on 7 different occasions. These data have given either a Good or Good-Fair bioclassification to this reach of the Broad River. Mountain bioclassification criteria are used at this location, however,

this site has some characteristics of a piedmont system. EPT taxa richness values have varied from a low of 17 in 1983, to a high of 29 in 1984 and 1995 (Table 4.11). The EPT abundance values also have varied considerably (56-137). Many invertebrate taxa were collected from this location for the first time during the 1995 survey: *Neoephemera purpurea*, *Eccoptura xanthenes*, *Chimarra*, and *Amnicola*. However, there were few differences in dominant taxa between surveys suggesting that there has been little change in the fauna at this location. Antecedent flow conditions are a likely factor at least partially responsible for the composition of the benthic fauna at this site.

Table 4.11 Benthic Macroinvertebrate Sampling Results from the Broad River at US 221 near Cliffside - 1983 through 1995.

Date	Total S	EPT S	EPT N	BI(BIEPT)	Bioclass	Flow
20 Sept 95	58	29	73	4.75(3.94)	Good	High
25 July 89	56	22	56	5.25(4.59)	Good-Fair	High
21 July 87	65	26	126	4.87(4.04)	Good-Fair	Normal
22 July 86	70	27	137	5.30(4.12)	Good-Fair	Low
04 Sept 85	48	21	63	4.92(3.81)	Good-Fair	Normal
30 Aug 84	66	29	117	4.46(3.55)	Good	Normal
11 Aug 83	44	17	56	5.13(4.33)	Good-Fair	Normal

Green River at SR 1302

This is the most downstream monitoring location on the Green River, prior to the confluence with the Broad River. This location is downstream of the dam at Lake Adger, therefore flow regimes are regulated. Benthic macroinvertebrate samples have been collected from this location on three different occasions. These collections have consistently suggested Good bioclassifications. However, EPT taxa richness and abundance values were much lower during the 1995 investigation compared to either the 1989 or 1987 surveys (Table 4.12). Many benthic invertebrate taxa were either reduced in abundance or not collected at all during the 1995 survey. These taxa include Baetis intercalaris, B. pluto, Hexagenia, Paragnetina fumosa, and many Chironomidae. The lower taxa richness and abundance values seen during the 1995 investigation may be partially related to high antecedent flow conditions resulting in scour of substrate material.

Table 4.12 Benthic Macroinvertebrate Sampling Results from the Green River at SR 1302 - 1987 through 1995.

Date	Total S	EPT S	EPT N	BI(BIEPT)	Bioclass	Flow
11 July 95	52	27	93	4.32(3.98)	Good	High
26 July 89	83	35	131	4.67(4.02)	Good	High
21 July 87	74	33	149	4.70(4.06)	Good	Normal

White Oak Creek at SR 1352

Benthic macroinvertebrate samples have been collected from this location on White Oak Creek on three occasions. An initial survey was conducted in 1986 as part of a toxicological evaluation of the Columbus WWTP. The Columbus WWTP discharges to a UT of White Oak Creek approximately 10 river miles upstream of this location. In May of 1995, a sample was collected as part of an investigation of dischargers across the state. The July 1995 survey was part of the basinwide network. Good bioclassifications were assigned to this site during the two full scale collections done in 1995 (Table 4.13). A Good/Fair bioclassification was given to this site in 1986. The May and October collections have been seasonally corrected for this comparison. Seasonal differences in the population structure of the benthic fauna are evident in these data.

While these differences complicate trend analyses, there does not appear to be a change in the overall biological integrity between investigations.

Table 4.13 Benthic Macroinvertebrate Sampling Results from White Oak Creek at SR 1352 - 1986 through 1995.

Date	Total S	EPT S	EPT N	BI(BIEPT)	Bioclass	Flow
11 July 95	63	36	106	4.41(3.89)	Good	High
15 May 95	84	38	131	4.54(3.00)	Good	High
29 Oct 86	-	24	92	-(3.87)	Good/Fair	Normal

Second Broad River at SR 1538

The Second Broad River at SR 1538 was selected as a reference site during an intensive investigation of the entire Second Broad River (B-950215) in June, 1994. This site also was sampled during the 1995 basinwide network. Both surveys resulted in Good bioclassifications using mountain bioclassification criteria (Table 4.14). This reach of the Second Broad River has a very sandy substrate and is susceptible to the effects of scour during spate events. Despite the Good bioclassifications during both surveys, there was a large difference in EPT taxa richness numbers (26 vs 33). These differences are particularly evident in the Ephemeroptera (10 in 1995 compared to 17 in 1994). Mayfly taxa that were either abundant or common during the 1994 survey but absent during the 1995 survey include *Baetis pluto*, *Caenis*, *Centroptilum*, *Heptagenia*, *H. marginalis*, and *Tricorythodes*. Interestingly, more Plecoptera were collected in 1995 during the July survey. *Pteronarcys dorsata* and *Tallaperla* were abundant and common, respectively in 1995, but not collected during the 1994 survey.

Table 4.14 Benthic Macroinvertebrate Sampling Results from Second Broad River at SR 1538 - 1994 through 1995.

Date	Total S	EPT S	EPT N	BI(BIEPT)	Bioclass	Flow
13 July 95	51	26	122	4.35(3.57)	Good	High
23 June 94	68	33	140	4.50(3.85)	Good	High

Catheys Creek at SR 1549

Catheys Creek at SR 1549 is near the confluence with the Second Broad River. The substrate at this location is dominated by sand and silt and the water during the 1995 survey was discolored due to the Spindale effluent. This site was initially chosen as a recovery site during an intensive investigation of the Spindale WWTP in 1988 (B-880516). It also was part of an intensive investigation of the entire Second Broad River basin in June 1994 (B-950215) and sampled in 1995 as part of the basinwide network. The bioclassification has been borderline between Good/Fair or Fair using mountain classification criteria during all three surveys (Table 4.15). These bioclassifications reflect the impacts of the Spindale WWTP. The EPT taxa richness value was slightly higher in 1995, but still resulted in a Fair bioclassification. In addition, there was a curious lack of several taxa in 1995 that were common or abundant in 1994. These EPT taxa are *Perlesta placida*, *Cheumatopsyche*, *Lype diversa*, and *Oecetis persimilis*.

Table 4.15 Benthic Macroinvertebrate Sampling Results from Catheys Creek at SR 1549 - 1988 through 1995.

Date	Total S	EPT S	EPT N	BI(BIEPT)	Bioclass	Flow
13 July 95	-	18	64	-(3.94)	Fair	High
27 June 94	49	17	98	5.17(3.57)	Good/Fair	High
23 Mar 88	-	15	70	-(3.98)	Fair	Normal

Second Broad River near SR 1973 near Cliffside

Benthic macroinvertebrate samples have been collected from the Second Broad River near Cliffside on six occasions (Table 4.16). This site is located below US 221A and the Cone Mills cooling water reservoir. Samples have been collected from this location during summer surveys in 1983, 1985, 1987, 1989, 1991 and 1995. In June, 1994, an intensive investigation was conducted on the Second Broad River, however, benthic macroinvertebrate samples were not collected at this location due to high flows (B-950215). The field team reported that the substrate at this location during the 1995 investigation was completely dominated by recently deposited, shifting sand (95%). The increase in sand as the dominant substrate material in 1995 is a result of a breech of the cooling water lake at the Cone Mills facility. Benthic macroinvertebrate surveys have found Good/Fair or Fair bioclassifications at this location using mountain classification criteria, with the exception of data from 1983, when a Poor bioclassification was assigned. The Poor or Fair collections are characterized by low EPT taxa richness values (9-17) and a low abundance of Plecoptera. Organic loading problems were apparent only in 1983, when tubificid oligochaetes were abundant. The 1995 collection resulted in a Good/Fair bioclassification. The Good/Fair bioclassification from this site in 1995 is very surprising considering the dominance of recently deposited sand. Apparently, the bank habitats support enough structure, above the benthic habitats that were buried in sand, to maintain the macroinvertebrate community. Taxa richness numbers were lower, during the 1995 survey when compared to the 1991 survey, within the Trichoptera (5 vs 12) and Mollusca (0 vs. 4) groups. *Hydropsyche betteni* and *Corbicula fluminea*, which had been either common or abundant during all previous investigations, were not collected during the 1995 survey. Many Trichoptera that were collected during the 1991 investigation that are considered 'top of the rock' species were not collected in 1995 (*Glossosoma*, *Hydroptila*, *Lepidostoma*, *Micrasema wataga*, and *Protoptila*). Based on these comparisons, it appears that some changes in the benthos community had taken place due to the recently deposited sand, but that these changes had not seriously affected the overall bioclassification of this reach of the Second Broad River.

Table 4.16 Benthic Macroinvertebrate Sampling Results from Second Broad River near SR 1973 near Cliffside - 1983 through 1995.

Date	Total S	EPT S	EPT N	BI(BIEPT)	Bioclass	Flow
13 July 95	42	20	95	5.43(4.70)	Good/Fair	High
08 July 91	59	25	120	5.21(4.39)	Good/Fair	Normal
25 July 89	60	17	70	6.11(5.18)	Fair	High
21 July 87	65	25	104	5.60(4.42)	Good/Fair	Normal
04 Sept 85	44	15	45	5.99(4.77)	Fair	Normal
11 Aug 83	26	9	13	7.83(4.24)	Poor	Normal

Fish Community Structure and Fish Tissue

Five sites within subbasin 02 of the Broad Basin have been sampled for fish community structure in 1994 and 1995. Results of these samples are presented in Table 4.17.

Table 4.17 Fish Community Assessment Sites in the Broad River Subbasin 030802, North Carolina Index of Biotic Integrity (NCIBI) Score, and Rating, 1994 and 1995.

Site	Waterbody	Location	County	Drainage Area (mi^2)	Date	NCIBI Score	NCIBI Rating
F-1	Green R	SR 1302	Polk	245	6/19/95	52	Good
F-2	Second Broad R	SR 1538	Rutherford	86.2	6/20/94	50	Good
F-3	Catheys Cr	SR 1549	Rutherford	44.0	6/20/94	46	Fair-Good
F-4	Second Broad R	US 74	Rutherford	168	6/20/94	46	Fair-Good
F-5	Second Broad R	US 221A	Rutherford	199	6/20/94	52	Good

The Green River at SR 1302 is a sand and gravel bottom stream whose flow is controlled by the upstream Lake Adger discharge. This site was rated only as Good because of 1) lower than expected scores for the number of taxa which were collected for a stream with a drainage area of 245 mi^2, 2) only two species of sunfish were collected, and 3) only one piscivore (or 0.2% of all fish) was collected. The most abundant species were the fieryblack shiner and the seagreen darter. Sportfish collected included redbreast sunfish, bluegill, and largemouth bass.

The Second Broad River at SR 2538 is located above Forest City and has a predominantly sand bottom. This site was rated as Good, but there were fewer than expected number of species of darters and sunfish collected and the trophic structure was slightly skewed towards more omnivores and less insectivores and piscivores than expected. These types of deviations from the expected are usually indicators of instream habitat impairment and nutrient enrichment. The most abundant species collected was the omnivorous bluehead chub. Sportfish collected included the redbreast sunfish, bluegill, and largemouth bass.

The monitoring site at Catheys Creek at SR 1549 was below the Spindale WWTP and had a shifting sand substrate. The fish community was rated as Fair-Good. The lower than expected scores for the trophic metrics, darter and sunfish diversity metrics, and the total fish abundance metric were indicative of habitat (sedimentation) and nutrient enrichment. Only 119 fish were collected, the fewest of any of the four sites monitored in 1994. The most abundant species collected was the bluehead chub. Sportfish collected included redbreast sunfish, bluegill, and smallmouth and largemouth bass.

The second site on the Second Broad River (at US 74) has a drainage area that is approximately twice the size of the upstream monitoring site. At US 74, this site was downstream from Catheys Creek and adjacent to Forest City. In 1964, the Second Broad River at US 74 was heavily silted by sand dredging operations and also received treated waste effluent from Forest City. The fishery resource was considered poor and in a 300 foot section of stream which was sampled, only 55 fish representing 5 species were collected (Messer, et al. 1965). Thirty years later, improvements in the fish community were evident as the community was rated Fair-Good with 163 fish collected representing 13 species. Nutrient enrichment and habitat impairment were still evident by the skewed trophic structure and the low diversity of intolerant species, darters, and minnow species. The most abundant species collected were the redbreast sunfish and the Santee chub.

The lowermost site monitored on the Second Broad River was located near Caroleen at US 221A; it was rated as Good. The river at this site has a rocky substrate. Sedimentation is reduced at the site because an upstream mill dam serves as an efficient sand and sediment trap. The rockier substrate contributed to a more diverse and abundant fish community. More species of fish (23) were collected at this site than at the other three sites monitored within the Second Broad River watershed. A diverse assemblage of 11 species of minnows (including the intolerant greenfin shiner, whitefin shiner, spottail shiner, and highback chub) and 5 species of

sunfish were collected at this site. However, with a skewed trophic structure due to the abundance of omnivores and with only one species of darter being collected, there were signs of longterm habitat deterioration and elevated nutrient levels. The most abundant species collected was the bluehead chub. Six species of sportfish were represented at this site: redbreast, green, and redear sunfishes, warmouth, bluegill, and largemouth bass.

The most recent fish tissue samples taken in this subbasin were in 1988 at the Second Broad River below Mt. Vein Church near the McDowell/Rutherford County line. These were analyzed for mercury and showed concentrations below levels of concern.

4.4.3 Subbasin 03 - Green River drainage above Lake Adger

Description

Subbasin 030803 contains the headwater reaches of the Green River and streams within this subbasin are in the mountain ecoregion. This section of the Green River has been dammed at two locations to form Lake Summit and Lake Adger. The Hungry River is the only large tributary catchment. Figure 4.10 shows the major hydrology in this subbasin along with the location of DWQ sampling sites.

Most of the high-gradient tributary systems are currently classified as C Trout. Rainbow, brown, and brook trout have been collected from streams in this subbasin (Menhinick, 1991) suggesting that many of these streams are capable of supporting reproducing trout populations. Apple orchards are a significant land use in upper reaches of many tributary catchments including the Hungry River. Lower reaches of many catchments are farmed, and residential development is found throughout the watershed. Sedimentation is the dominant problem in the subbasin, as the subbasin only has a few small permitted dischargers. Sources of nonpoint runoff include agriculture (primarily apple orchards), and residential development. Recent acquisition by the Wildlife Resources Commission of the Green River Game Land between Lake Summit and Lake Adger on the Green and Hungry rivers will provide an important buffer in this area. The Green River Preserve on the headwaters of the Green River serve a similar function.

Overview of Water Quality

During an Outstanding Resources Water study in 1993, Excellent bioclassifications were assigned to the upper reaches of the Green River above Lake Summit and to Rock Creek, a tributary of the Green River. Other Green River sites, above Lake Summit in 1993 and below the lake in 1995, had Good bioclassifications. Good/Fair bioclassifications have been found from low elevation tributaries of Lake Summit (Joe and Freeman Creeks) in 1989 and the Hungry River in 1995.

Lake Summit is a reservoir used to produce hydroelectric power and owned by Duke Power. The dam was built and the lake filled in 1920. The watershed is mostly forested with some small farms. Lake Summit is used extensively for recreational purposes (fishing, swimming, boating) and supports a sport fishery consisting of sunfish, catfish, crappie and largemouth bass. The results of an ORW survey in 1989 indicated that Lake Summit and its watershed had good water quality and were valuable waters of the state. However, neither excellent water quality or outstanding resource value were identified. The lake is considered oligotrophic.

Lake Adger is another impoundment located below Lake Summit, and is used to generate hydroelectric power. Fishing and boating are common on the reservoir, and the lake supports a sport fishery consisting of sunfish, crappie, catfish, carp, largemouth bass and trout. This lake is also oligotrophic. Fish tissue samples were collected at Lake Adger in 1995 and analyzed for metals contaminants. Results indicated metals concentrations below levels of concern.

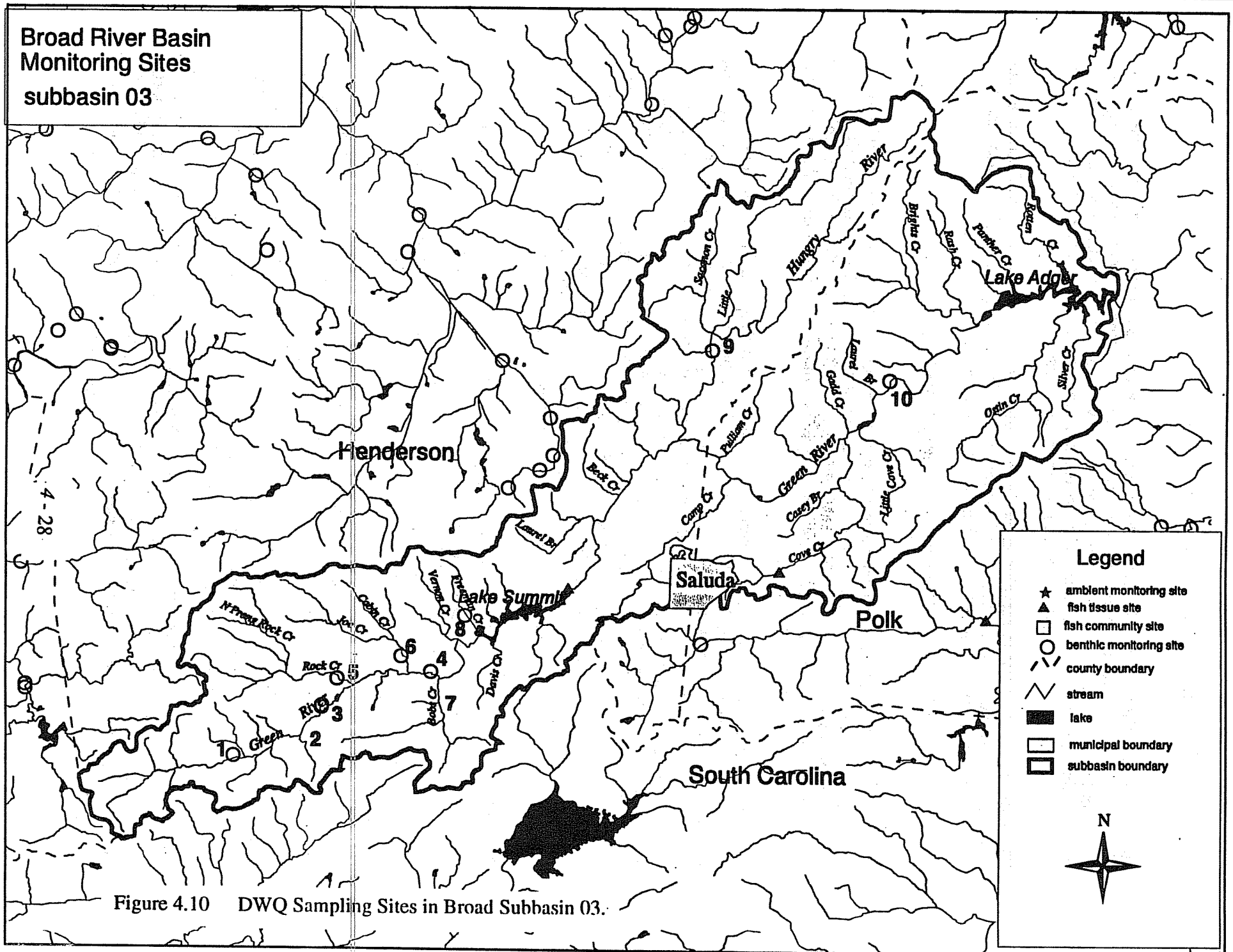


Figure 4.10 DWQ Sampling Sites in Broad Subbasin 03.

Henderson County has four VWIN monitoring sites in the upper Green River watershed. Results indicate that this area has high water quality, although there appears to be increasing turbidity, suspended solids and nitrogen (Maas, et.al., 1996).

Benthic Macroinvertebrates

Benthic macroinvertebrate samples were collected from two locations as part of the 1995 basinwide monitoring network (Table 4.18). Benthic macroinvertebrate samples have been collected from 10 locations in 030803 since 1983, including one special study.

Table 4.18 Basin Assessment Sites in Broad Subbasin 030803, 1995, Taxa Richness Values and Bioclassifications.

Site #	Creek	Date	County	Road	S/SEPT	Rating
B-9	Hungry R	950710	Henderson	SR 1799	-/25	Good-Fair
B-10	Green R	950710	Polk	SR 1151	54/25	Good

Note: Map # refers to number on subbasin map.

Two benthic macroinvertebrate samples were collected from previously unassessed locations during the 1995 basinwide network in this subbasin: the Green River at SR 1151 and the Hungry River at SR 1799. The Green River location was selected to determine water quality of the Green River below Lake Summit but above Lake Adger. A Good bioclassification was given to this location. This site was given a high NC Habitat score (76) but breaks in the riparian zone were common and SR 1151 (which is a dirt road) runs parallel to the river. Despite the regulated nature of this reach of the Green River, EPT abundance was low (79) suggesting that scour during high flow events affected the benthos. The substrate at this monitoring location was very sandy (60%).

Benthic macroinvertebrates also were collected from the Hungry River. The collection site at SR 1799 received an NC Habitat score of 71 and had a substrate dominated by sand and gravel (65%). The benthic fauna was dominated by intolerant taxa including Epeorus rubidus, Baetis pluto, Serratella serrata, and Dolophilodes. Apple orchards are common in the catchment; however, runoff from these orchard areas do not appear to seriously affect the benthos.

Two ORW/HQW investigations were conducted in the upper Green River catchment in 1989 and 1993 (Table 4.19). Results of the initial investigation in 1989 were inconclusive, therefore, a follow-up investigation was conducted in 1993. More intensive collection methods were used at many of the mainstem collection locations during the follow-up survey. The results of the 1993 survey indicated that two sites on the upper Green River and Rock Creek were Excellent and were eligible for HQW classification. Results of this investigation also noted low pH values at all locations. Values were below the 6.0 water quality standard for C trout streams. However, widespread occurrence of low pH readings at many ORW sites in the North Carolina mountains suggests that low pH values should not exclude the Green River from consideration for HQW classification. Following these studies, a separate request for reclassification to B Tr was received by the Planning Branch. As of 1997, sampling for the B reclassification still needed to be completed, after which the two requests would be brought forward together to the EMC.

Table 4.19 Benthic Macroinvertebrate Special Studies, Broad River Subbasin 030803, 1989-1995.

Site #	Creek	Date	Study	County	Road	S/SEPT	Rating
B-1	Green River	931027	Green River ORW	Henderson	SR 1106	78/42	Exc
		890118	Green River ORW	Henderson	SR 1106	-/40	Good
B-2	Green River	890118	Green River ORW	Henderson	nr SR 1106	87/42	Good
B-3	Green River	931027	Green River ORW	Henderson	SR 1104	103/51	Exc
B-4	Green River	931027	Green River ORW	Henderson	SR 1103	94/39	Good
B-5	Rock Creek	931028	Green River ORW	Henderson	SR 1106	-/37	Exc
		890119	Green River ORW	Henderson	SR 1106	-/32	Good
B-6	Joe Creek	890119	Green River ORW	Henderson	SR 1106	-/28	G/F
B-7	Bobs Creek	890119	Green River ORW	Henderson	SR 1103	-/35	Good
B-8	Freeman Creek	890118	Green River ORW	Henderson	SR 1115	-/20	G/F

Note: Map # refers to number on subbasin map.

Fish Tissue

Fish tissue samples were collected at Lake Summit and Lake Adger in 1995 and analyzed for metals contaminants. Results indicated metals concentrations below levels of concern.

Lakes Assessment

Lake Summit

Lake Summit is a reservoir located in the mountains of southwestern North Carolina. The lake, used to produce hydroelectric power, is owned by Duke Power. The dam was built and the lake filled in 1920. Lake Summit has an average retention time of 75 days. The major tributary to the lake is the Green River. Figure 4.11 provides a general map of the lake. The watershed is mostly forested with some small farms. Many single family homes are located around the shore of the lake. In 1994, the area around the lake was zoned residential from a distance that extends out approximately 1,000 feet from the shore (Matt Mattison, Henderson County Planning Director, pers. com.). Lake Summit is used extensively for recreational purposes (fishing, swimming, boating, etc.) and supports a sport fishery consisting of sunfish, catfish, crappie and largemouth bass (Fish, 1968). The Town of Tuxedo is located along the northwestern shore of the lake and US Highway 25 runs northeast to southwest through the western portion of the watershed. A number of summer camps are located in the watershed and these contribute significantly to the increase in the summer population (Robert Carter, District Conservationist, NRCD District Office, Henderson County, pers. com.) Two of these camps are located near the lake and use septic tanks systems for their wastewater disposal (Matt Mattison, Planning Director, Henderson County, pers com.)

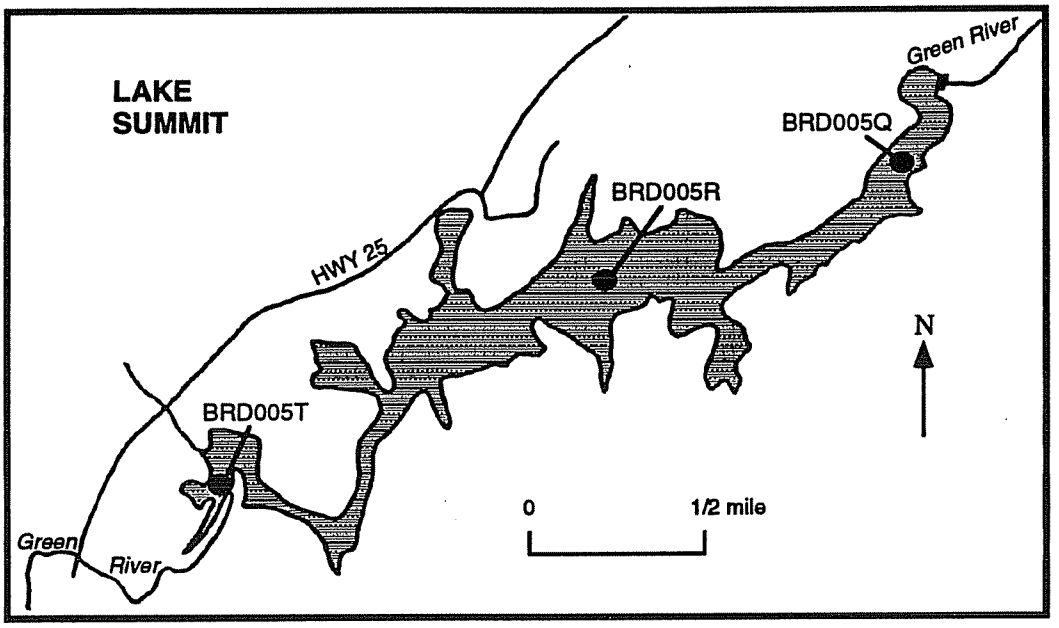


Figure 4.11 General Map of Lake Summit, Broad Subbasin 03

Lake Summit was most recently sampled by DWQ on July 31, 1995 as part of the ambient lakes monitoring program. The lake was stratified at the two deeper sampling stations while the upstream, shallower station (BRD005T) was mixed. The NCTSI was -4.0 in 1995 which indicated that Lake Summit was oligotrophic on the day it was sampled. The low nutrient values and chlorophyll *a* concentrations throughout the lake supported this trophic status classification.

Previously sampled in 1989 by DWQ (NC DEM, 1989), Lake Summit's mean surface dissolved oxygen was slightly elevated. The surface pH value at the upstream sampling site (BRD005T) was at the state water quality lower limit of 6.0 s.u. Nutrient and chlorophyll *a* values were similar to those observed in 1995. Cryptomonas ovata , a motile, unicellular alga commonly found throughout North Carolina, dominated phytoplankton biovolume estimates throughout the lake. In 1989, Lake Summit had a NCTSI score of -2.8, indicating that the lake was oligotrophic on the day it was sampled.

Lake Adger

Lake Adger is an impoundment located in the mountains of southwestern North Carolina. Currently owned by Northbrook Hydro, this reservoir is used to generate hydroelectric power. Fishing and boating are common on the reservoir. The lake supports a sport fishery consisting of sunfish, crappie, catfish, carp, largemouth bass and trout (Fish, 1968). The dam was built in 1925 and has a maximum depth of 72 feet (22 meters) and a mean depth of 26 feet (eight meters). The average retention time is 21 days. The major tributary to the lake is the Green River and smaller tributaries include Panther and Rotten Creeks to the north and Ostin and Silver Creeks to the south. Figure 4.12 provides a general map of the lake. A residential development is located in the southern Lake Adger watershed, west of Ostin Creek. Most of the watershed is primarily forested woodlands with some croplands and single family homes.

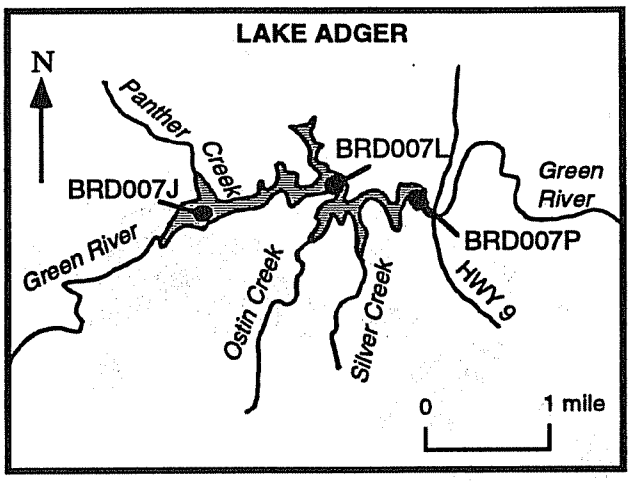


Figure 4.12 General map of Lake Adger, Broad subbasin 03

Lake Adger was sampled on July 31, 1995. Sampling was conducted immediately following a rainfall event, however, physical and chemical parameters did not reflect a significant increase in turbidity or nutrient loading as compared with data collected in 1989. Physical measurements indicated stratified conditions at the two deeper sampling stations while the more shallow station (BRD007J) was mixed. The NCTSI score in 1995 was -4.0, indicating that Lake Adger was oligotrophic on the day it was sampled. Lake Adger was previously sampled by DWQ in 1989. Surface dissolved oxygen was slightly elevated, however, surface pH was close to neutral. Total phosphorus was higher in 1989 as compared with values observed in 1995. This was also true for the nitrite plus nitrate value. In 1989, Lake Adger was determined to be oligotrophic (NCTSI score = -2.7).

As of 1996, there were no public complaints or comments regarding the water quality of Lake Adger. In the past, a sand pumping operation located upstream of the lake had produced complaints regarding sedimentation of the lake. However, this facility has not been in operation for several months in 1997 (Stuart Walker, District Technician, NRCS District Office, Polk County, pers. com.) Lake Adger, which had been previously owned by Duke Power Company, was sold in December 1996 to Northbrook Hydro, and the land surrounding the lake which had belonged to Champion has been sold to Lake Adger Developers, Inc. The 3,250 acre parcel is planned for future development into a private, low density residential and equestrian community. (Mark Maxwell, Planning and Community Development Director, Polk County, pers. com.).

4.4.4 Subbasin 04 - First Broad River and lower portion of Broad River in NC

Description

Subbasin 04 contains the First Broad River and its tributaries. Figure 4.13 provides a map of this subbasin showing DWQ's sampling sites. This geographic area is a transitional zone between ecoregions, with some streams exhibiting mountain characteristics, while other streams are more piedmont in nature. Land use is mainly a mixture of agriculture and forest. The town of Shelby is the largest urban area. The Shelby WWTP (6.0 MGD) is one of three NPDES permitted dischargers in the subbasin with a permitted flow of 0.5 MGD or greater. The other major dischargers are Cleveland Mills (0.78 MGD) and PPG Industries (1.3 MGD).

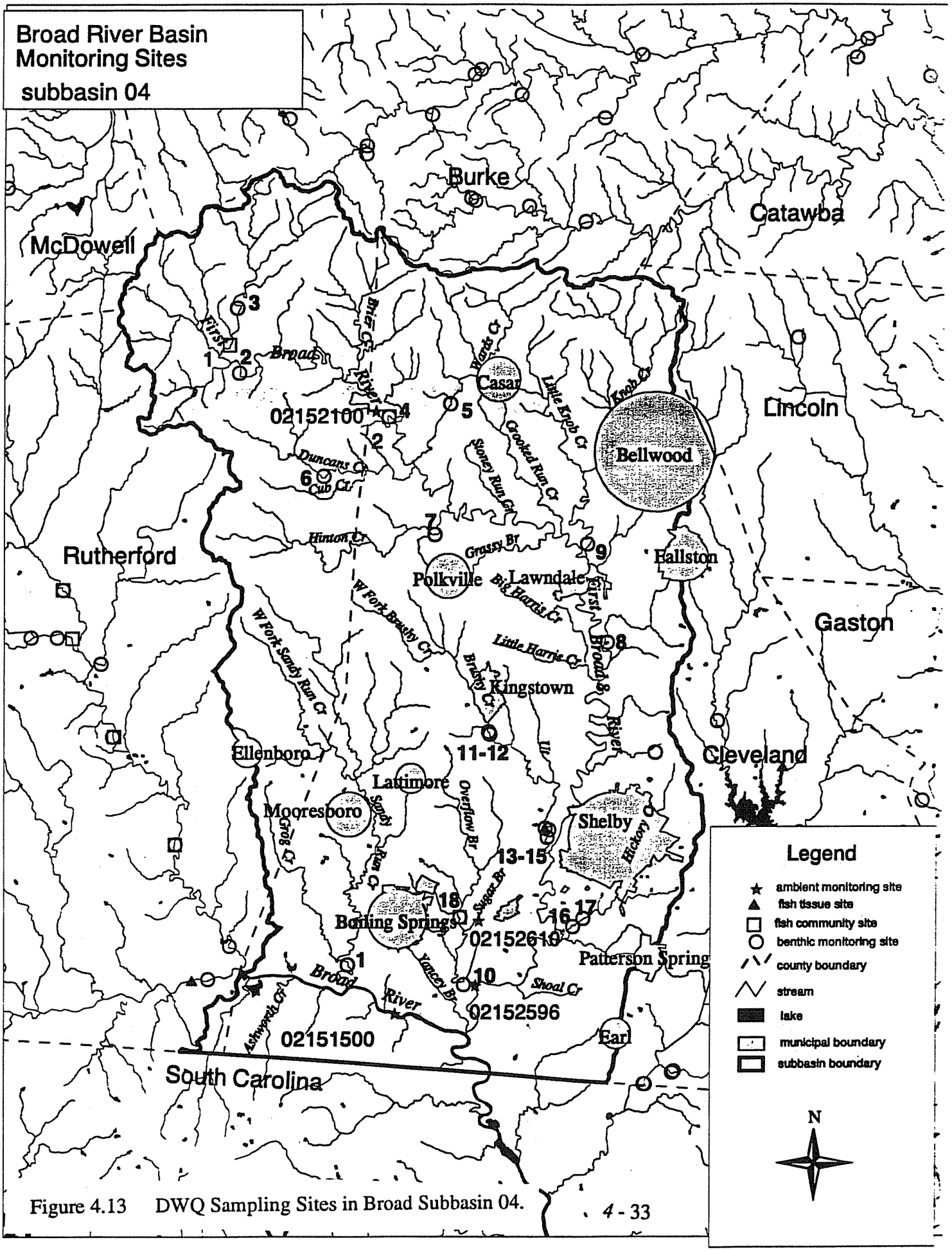


Figure 4.13 DWQ Sampling Sites in Broad Subbasin 04.

Overview of Water Quality

Recent macroinvertebrate data indicated Good water quality in the First Broad River in the area near Casar with a slight decrease to Good-Fair near Earl. These ratings have been found consistently since 1983. Excellent water quality was documented in the North Fork First Broad River, a headwater tributary to the First Broad in 1995. Other tributary streams with Good water quality include Duncans Creek, and Knob Creek, while Sandy Run Creek and Hinton Creek had Good-Fair bioclassifications. The only recent data indicating Fair water quality were from Beaverdam Creek below some small dischargers. Brushy Creek was sampled above and below PPG Industries in 1995 and Good water quality was found at both sites.

Fish community sampling in 1995 found similar water quality as the benthos data for sites on the North Fork First Broad River and the First Broad River, but had a Good NCIBI rating for Beaverdam Creek.

Benthic Macroinvertebrates

Benthic macroinvertebrate samples were taken from nine sites in this subbasin during the 1995 basinwide assessment. Results of these surveys are presented in Table 4.20.

Table 4.20 Basin Assessment Sites in Broad Subbasin 030804, 1995, Taxa Richness Values and Bioclassifications.

Site #	Creek	Date	County	Road	S/SEPT	Rating
B-1	Sandy Run Cr	950711	Cleveland	SR 1195	61/28	Good-Fair
B-3	N Fk F Broad R	950710	Rutherford	SR 1728	84/40	Excellent
B-4	First Broad R	950710	Cleveland	SR 1530	93/40	Good
B-6	Duncans Cr	950710	Cleveland	SR 1749	-/28	Good
B-7	Hinton Cr	950710	Cleveland	NC 226	-/22	Good-Fair
B-8	First Broad R	950711	Cleveland	SR 1809	72/30	Good
B-9	Knob Cr	950711	Cleveland	SR 1004	76/32	Good
B-10	First Broad R	950712	Cleveland	SR 1140	51/19	Good-Fair
B-18	Beaverdam Cr	950711	Cleveland	NC 150	57/20	Fair

Note: Map # refers to number on subbasin map.

Sandy Run Creek is potentially affected by nonpoint runoff from logging, agricultural activities, and the Boiling Springs WWTP (0.3 MGD) discharge. The site was chosen to evaluate this combination of possible problems. Sandy Run Creek at the sampling location was approximately 18 meters wide with a predominantly boulder and rubble substrate. The area around the site was mostly forested with a few clear cut areas and small pastures. Although this stream has both mountain and piedmont characteristics, it was rated using mountain criteria. The Good-Fair bioclassification assigned to this site suggested that the point and nonpoint source inputs to the stream were having some impacts to the stream fauna.

Duncans Creek was sampled as a possible HQW stream because it flows through a relatively undeveloped area. At the collection site, the stream was seven meters wide. Boulder and rubble were present, but sand composed the highest percentage (40%) of the substrate. Heavy bank erosion was noted along the sampling area. The site was located in an area that was half wooded and half fields and pastures. Duncans Creek was assigned a Good bioclassification with 28 EPT taxa collected (the lowest number of taxa included in the Good range). Of the 12 Trichoptera taxa collected, all but three were rare. Duncans Creek is not suitable for HQW classification because it did not receive a bioclassification of Excellent.

Hinton Creek is located just south of Duncans Creek and has similar land uses in its catchment. Hinton Creek also was sampled as a potential HQW stream. Severely eroded unstable banks were observed at the collection site. An estimated 60% of the substrate was sand with only a trace of boulder and rubble. The stream was approximately 8 meters wide at the site. Hinton

Creek received a Good-Fair bioclassification. The stream fauna at the collection site appeared to be affected by the high degree of sedimentation in the stream and agricultural runoff. Hinton Creek also did not qualify for HQW classification.

The First Broad River at SR 1809 was sampled because there was no prior macroinvertebrate data from this section of the river, and because the site is below the Cleveland Mills discharge (0.78 MGD). The river at this location was estimated to be 24 meters wide with sand as the dominant substrate component. Land use around the site was typical for the area: a combination of wooded and clear cut areas with pastures and fields. This site was assigned a Good bioclassification. This rating suggested that the Cleveland Mills discharge and any nonpoint runoff reaching the First Broad River, were having little impact on its macroinvertebrate community at this location.

Benthic macroinvertebrates were collected from Knob Creek because of the lack of data from the catchment. The stream had a mostly sand substrate and was approximately 11 meters wide at the sampling location. The site was surrounded by wooded sections and clear cuts, with a few fields and some pasture areas. Knob Creek received a Good bioclassification at this site.

Prior to the basinwide survey, no macroinvertebrate data had been collected from Beaverdam Creek. Water quality in the stream is potentially affected by several small dischargers and nonpoint runoff in the catchment. The stream was eight meters wide with severely eroded banks and a shifting sand bottom at the collection site. A sand dredging operation was adjacent to the site. The site was given a Fair bioclassification. Effluent from the discharging facilities, nonpoint runoff, and habitat degradation probably all contributed to the low rating.

Long Term Benthos Sites

In subbasin 04 there are three locations that have been analyzed over a number of years to detect trends in water quality. These are described in detail below.

North Fork First Broad River at SR 1728

The North Fork First Broad River is a montane stream with over half of its substrate composed of boulder and rubble. The stream is approximately 10 meters wide and the area around the site is primarily forested. The bioclassification at the site changed from Good in 1989 to Excellent in 1995 (Table 4.21). Although the bioclassification changed, there was no real change in water quality at the site, as the 35 EPT taxa collected in 1989 was only one taxa short of meeting the criteria for an Excellent rating. The 1995 BI of 3.54 was the lowest value ever recorded in this subbasin.

Table 4.21 Benthic Macroinvertebrate Sampling Results from North Fork First Broad River at SR 1728 - 1989 through 1995.

Date	Total S	EPT S	EPT N	BI(BIEPT)	Bioclass	Flow
10 July 95	84	40	208	3.54(2.98)	Excellent	Normal
24 July 89	-	35	169	-(3.21)	Good	Normal

First Broad River at SR 1530 near Casar

The river at this sampling location was rated using mountain criteria. The substrate is mostly boulder and rubble and the stream was estimated to be 15 meters wide. The land around the site is primarily wooded. This site has been sampled five times since 1986 and has been assigned a Good bioclassification each time (Table 4.22). Biotic Index values have shown a slight but constant improvement for the period of record.

Table 4.22 Benthic Macroinvertebrate Sampling Results from First Broad River at SR 1530 near Casar - 1986 through 1995.

Date	Total S	EPT S	EPT N	BI(BIEPT)	Bioclass	Flow
10 July 95	93	40	152	4.11(3.42)	Good	Normal
28 Oct 93	-	35	125	-(3.35)	Good	Low
24 July 89	92	37	140	4.21(3.62)	Good	Normal
27 July 88	97	43	204	4.40(3.61)	Good	Low
22 July 86	91	37	147	4.73(3.71)	Good	Low

First Broad River at SR 1140 near Earl

The First Broad River at this location is a low gradient, sand bottom stream with an estimated width of 27 meters. Land use in the area is mixed with only 25 percent wooded. This site has received a Good-Fair bioclassification every year that it has been sampled with the exception of 1985 when low total and EPT taxa richness values and high BI value were documented (Table 4.23). These changes in the macroinvertebrate community were probably due to increased nonpoint source runoff to the stream and scour. The stream flows in this area were estimated to be over 200 percent of normal for a 30 day period prior to the time the sample was collected. Although the EPT taxa richness in 1995 was the second lowest recorded from the site, it was offset by the BI which was the best recorded at the site.

Table 4.23 Benthic Macroinvertebrate Sampling Results from First Broad River at SR 1140 near Earl - 1983 through 1995.

Date	Total S	EPT S	EPT N	BI(BIEPT)	Bioclass	Flow
12 July 95	51	19	80	5.37(4.47)	Good-Fair	Normal
25 July 89	73	23	95	5.63(4.50)	Good-Fair	Normal
21 July 87	69	26	116	5.64(4.01)	Good-Fair	Normal
05 Sept 85	44	12	29	6.77(5.21)	Fair	High
11 Aug 83	57	21	93	5.93(4.60)	Good-Fair	Normal

Fish Community Structure

In 1995, sampling was conducted at one site on the upper First Broad River, a site on North Fork First Broad River in the upper part of the watershed, and a site on Beaverdam Creek in the lower part of the watershed (Table 4.24). The North Fork First Broad River site and the First Broad River site is located in the mountain ecoregion, whereas Beaverdam Creek is located in the piedmont.

Table 4.24 Basin Fish Community Assessment Sites in the Broad River Subbasin 030804, North Carolina Index of Biotic Integrity (NCIBI) Score, and Rating, 1995.

Site	Waterbody	Location	County	Drainage Area (mi^2)	Date	NCIBI Score	NCIBI Rating
F-1	N Fk First Broad R	SR 1728	Rutherford	14.2	6/20/95	54	Good-Excellent
F-2	First Broad R	SR 1530	Cleveland	60.5	6/20/95	50	Good
F-3	Beaverdam Cr	NC 150	Cleveland	16.9	6/20/95	50	Good

Note: Map # refers to number on subbasin map.

The North Fork First Broad River is trout waters and was rated as Good-Excellent. Middle range scores were received for the number of species of darters, sunfish, and intolerant species collected. All other metrics were scored as a 5 which represents conditions which would be

expected for an undisturbed stream. The most abundant species collected was the rosyside dace; sportfish were represented by rainbow trout and smallmouth bass. No sunfish were collected, although redbreast sunfish were collected by Messer, et al. (1965) at this site.

In 1965, the First Broad River at SR 1530 was described as fast moving with deep pools and abundant cover and shade (Messer, et al. 1965). The lack of game fish populations was attributed to frequent flooding during periods of moderate rainfall (Messer, et al. 1965). In 1995, the fish community was rated as Good. Despite abundant cover, only one species of sunfish, the redbreast sunfish, was collected. The trophic structure was also skewed with fewer than expected percentage of piscivores and a greater than expected percentage of omnivores collected as contrasted to an undisturbed site. The fieryblack shiner and the bluehead chub were the most abundant species collected. The sportfish were represented by the redbreast sunfish and the smallmouth bass.

Messer, et al. (1965) described Beaverdam Creek at NC 150 as a swift, turbid, sandy-bottom stream with very little suitable habitat for game fish. Of the eight species collected in 1964, the dominant species was the bluehead chub (77% or 754 out of the 957 of the fish collected). Only one species of sunfish was collected-the redbreast sunfish; and only seven of them were collected.

In 1995, Beaverdam Creek was rated as Good with 488 fish collected (the most collected from any of the six sites monitored in 1995). Of the 18 species collected, the dominant species was the bluehead chub. The redbreast sunfish was still the only species of sunfish in this fish community. However, 4 species of suckers, 9 species of minnows, 3 species of darters, and 5 intolerant species were present. A skewed trophic structure (an abundance of omnivores and an absence of piscivores) and a low diversity of sunfish documented the continued presence of a certain amount of habitat degradation (e.g., nutrient enrichment) at this site.

4.4.5 Subbasin 05 - Buffalo Creek

Description

Subbasin 05 consists of Buffalo Creek and its tributaries. Land use is primarily a combination of agriculture and forest. Kings Mountain is the largest town in the subbasin. The major NPDES permitted dischargers and their receiving streams are the Kings Mountain WWTP (6.0 MGD) into Buffalo Creek; New Minette Textiles (0.6 MGD) into Lick Branch; and Hoechst-Celanese Corporation (0.8 MGD) into Buffalo Creek. Although a few streams in the northern portion of the subbasin exhibit some montane characteristics, this subbasin is considered to be in the piedmont ecoregion. Figure 4.14 provides a map of the subbasin along with locations of DWQ sampling sites.

Overview of Water Quality

Macroinvertebrate data collected during the basinwide survey in 1995 indicated Good water quality at two sites on Buffalo Creek and for Muddy Fork. The downstream site on Buffalo Creek is below the Kings Mountain WWTP, and water quality has improved there from Fair and Good-Fair ratings found between 1983 and 1988. Beason Creek and Kings Creek had Good-Fair bioclassification, while Lick Branch below Minette Textiles had Fair water quality. This last site was also Fair in 1986, but was Poor in 1983.

Kings Mountain Reservoir (also known as Moss Lake) is a water supply for the City of Kings Mountain. Major inflows to the lake include Buffalo Creek and White Oak Creek. The drainage area is characterized by rolling hills and rural land use. The NCTSI score of -2.2 indicates borderline oligotrophic/mesotrophic conditions. To determine the lake's suitability as a reference lake, Kings Mountain Reservoir was monitored by DWQ from 1991 through 1993, three times each year for a total of nine sampling events. Data collected in 1991 and 1992 indicated the

Duke has morphometry data for Moss Lake

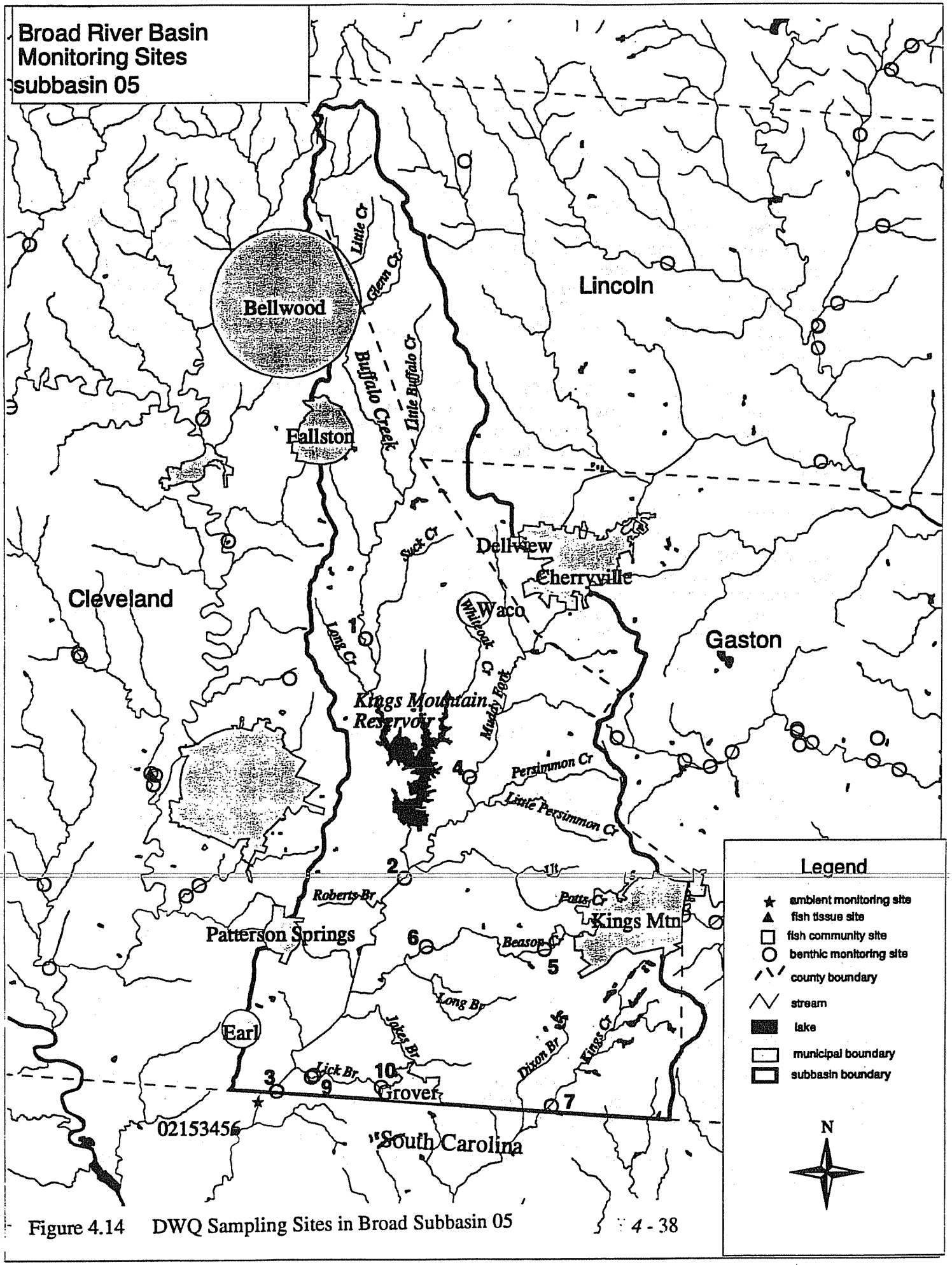


Figure 4.14 DWQ Sampling Sites in Broad Subbasin 05

presence of an algal bloom as well as elevated surface dissolved oxygen and pH. Because of symptoms of nutrient enrichment, Kings Mountain Reservoir is not suitable as a reference lake. Complaints about low numbers of fish in Kings Mountain Reservoir were confirmed during sampling efforts in 1995 to evaluate metals in fish collected from the lake. While few fish were collected, those that were analyzed showed no levels of metals above EPA or FDA human health criteria limits.

Lake Montonia is a small, man-made lake built in the 1920's. Two spring-fed ephemeral, unnamed tributaries flow into the lake. Over the six months that Lake Montonia was sampled in 1996 following a request for reclassification from B to B-HQW, the lake has been consistently oligotrophic. Mean lake nutrient values, and chlorophyll *a* concentrations were relatively similar from month to month.

Benthic Macroinvertebrates

Six sites in subbasin 05 were sampled for benthic macroinvertebrates in 1995. Results are presented in Table 4.25.

Table 4.25 Basin Assessment Sites in Broad Subbasin 030805, 1995, Taxa Richness Values and Bioclassifications.

Site #	Creek	Date	County	Road	S/SEPT	Rating
B-1	Buffalo Cr	950711	Cleveland	SR 1908	67/29	Good
B-3	Buffalo Cr	950712	Cleveland	NC 198	56/24	Good
B-4	Muddy Fk	950713	Cleveland	SR 2012	74/23	Good
B-6	Beason Cr	950712	Cleveland	SR 2246	60/19	Good-Fair
B-9	Lick Br	950712	Cleveland	SR 2227	48/6	Fair
B-10	Kings Cr	950713	Cleveland	SR 2286	57/19	Good-Fair

Note: Map # refers to number on subbasin map.

Buffalo Creek at SR 1908 was sampled because there was no prior macroinvertebrate data from the upper part of the catchment. The stream in this area has both mountain and piedmont characteristics, but was rated using piedmont criteria. The stream was 12 meters wide at the site with roughly half of the substrate consisting of boulder and rubble. One half of the area around the site was forested, the other half a mixture of pasture and fields. Buffalo Creek was assigned a Good bioclassification at this site.

Macroinvertebrates were collected from Kings Creek because no prior data had been collected from the catchment. Kings Creek at SR 2286 is approximately six meters wide and has a sand and gravel substrate. Unstable banks and severe erosion were noted along areas where fields and pastures came close to the stream. Kings Creek was assigned a Good-Fair bioclassification. This rating suggested that the combination of nonpoint runoff and effluent from the few small dischargers in the drainage was having some effect on the Kings Creek fauna.

Long Term Benthos Sites

In subbasin 05 there are four locations that have been analyzed over a number of years to detect trends in water quality. These are described in detail below.

Buffalo Creek at NC 198

The stream at the sampling location is approximately 20 meters wide and has a sand bottom. The area around the site is mostly wooded. The site is located below the Kings Mountain WWTP outfall as well as some small dischargers. The Good bioclassification in 1995 was the best recorded at this site (Table 4.26). The 1995 EPT taxa richness and EPT abundance values were both highs for this site, and the 1995 Biotic Index value was also the best observed here. These metrics suggest improvement in water quality at this site. However, water quality at the

site appears to be dependent upon flow, with the higher bioclassifications recorded during periods of higher flow. This pattern indicates that the permitted dischargers above this location have a greater effect on water quality at the site than does nonpoint runoff.

Table 4.26 Benthic Macroinvertebrate Sampling Results from Buffalo Creek at NC 198 - 1983 through 1995.

Date	Total S	EPT S	EPT N	BI(BIEPT)	Bioclass	Flow
12 July 95	56	24	117	5.15(4.58)	Good	Normal
27 July 88	80	14	69	6.56(5.70)	Fair	Low
06 Aug 84	55	18	84	6.06(5.24)	Good-Fair	High
14 Nov 83	59	15	50	6.86(5.33)	Fair	Low

Muddy Fork at SR 2012

The land use around the Muddy Fork site was a mixture that included mainly pasture and forest. The stream itself had a mixed substrate and was approximately 10 meters wide. The bioclassification in 1995 improved to Good from Good-Fair in 1990 and 1983 (Table 4.27). This was due to both an increase in the number of EPT taxa collected and a decrease in the Biotic Index. The EPT abundance was also the highest documented from this site. Improvement in all of these metrics does suggest an improvement in water quality for Muddy Fork at this location.

Table 4.27 Benthic Macroinvertebrate Sampling Results from Muddy Fork at SR 2012 - 1983 through 1995.

Date	Total S	EPT S	EPT N	BI(BIEPT)	Bioclass	Flow
13 July 95	74	23	106	5.49(4.95)	Good	Normal
13 Sept 90	74	17	90	5.92(5.21)	Good-Fair	Normal
14 Nov 83	75	18	91	6.03(4.30)	Good-Fair	Low

Beason Creek at SR 2246

Beason Creek at the sampling location was a sand bottom stream with eroding unstable banks. Stream width at the site was estimated to be four meters. Most of the land around the site was either pasture or areas that had been clear cut. The bioclassification for this site has been Good-Fair for both years it has been sampled. The slight increase in EPT taxa richness and decrease in Biotic Index in 1995 versus 1987 were not enough to change the rating (Table 4.28).

Table 4.28 Benthic Macroinvertebrate Sampling Results from Beason Creek at SR 2246 - 1987 through 1995.

Date	Total S	EPT S	EPT N	BI(BIEPT)	Bioclass	Flow
12 July 95	60	19	101	5.42(5.07)	Good-Fair	Normal
10 June 87	69	17	113	6.06(5.29)	Good-Fair	Normal

Lick Branch at SR 2227

This stream was approximately four meters wide at the collection site, and had a sand and gravel substrate. The site was located in a forested area. This site on Lick Branch is located below the current Minette Textiles discharge (IWC = 78%). Although there has been improvement in the Biotic Index since 1983, the Fair bioclassification in 1995 indicated that the effluent from the mill was still impacting the stream fauna (Table 4.29).

Table 4.29 Benthic Macroinvertebrate Sampling Results from Lick Branch at SR 2227 - 1983 through 1995.

Date	Total S	EPT S	EPT N	BI(BIEPT)	Bioclass	Flow
12 July 95	48	6	24	6.04(6.29)	Fair	Normal
17 Mar 86	51	13	60	6.60(5.26)	Fair	Low
15 Nov 83	37	6	10	7.44(6.00)	Poor	Low

Fish Tissue

Fish tissue samples were collected at Kings Mt. Reservoir in 1995. All metals results were below FDA and EPA criteria.

Lakes Assessment

Kings Mountain Reservoir

Kings Mountain Reservoir (also known as Moss Lake) is a water supply for the City of Kings Mountain. The impoundment, built in 1963, has a maximum depth of 79 feet (24 meters). Major inflows to the lake include Buffalo Creek and White Oak Creek. Figure 4.15 provides a general map of the lake. The drainage area is characterized by rolling hills and rural land use. Access to the lake is strictly controlled by a special set of regulations for the many recreational users of the lake which have been adopted to assure safety as well as to protect water quality.

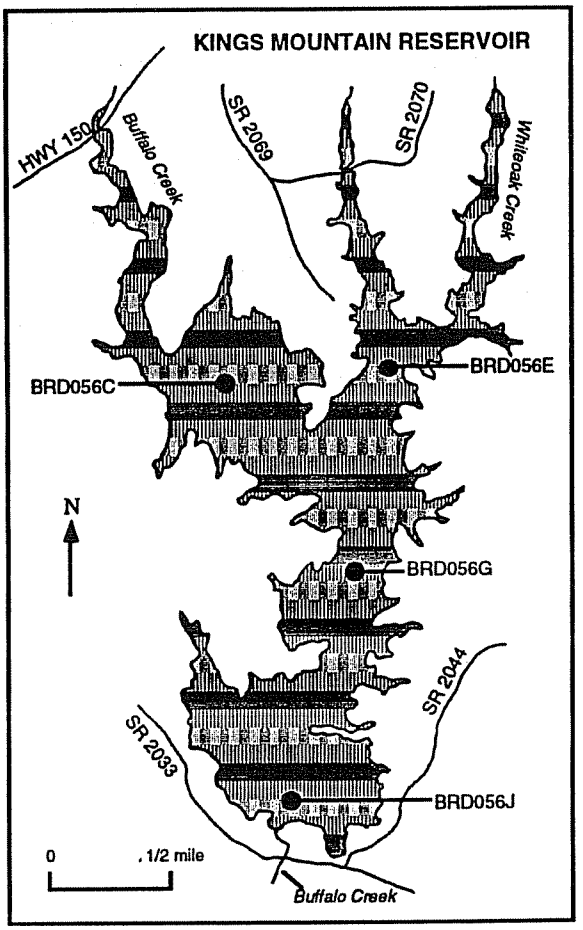


Figure 4.15 General map of Kings Mountain Reservoir (Moss Lake), Broad Subbasin 05

Kings Mountain Reservoir was sampled on August 3, 1995. The lake was stratified with hypoxic conditions at a depth of approximately six meters. The NCTSI score of -2.2 indicates borderline oligotrophic/mesotrophic conditions. Kings Mountain Reservoir supported all of its designated uses in 1995.

Kings Mountain Reservoir was one of sixteen lakes selected, statewide, as representative of a minimally impacted lake by which other lakes in the same region will be compared. To determine the lake's suitability as a reference lake, Kings Mountain Reservoir was monitored by DWQ from 1991 through 1993, three times each year for a total of nine sampling events. Data collected in 1991 and 1992 indicated the presence of an algal bloom as well as elevated surface dissolved oxygen and pH. In 1993, the Mean Standing Crop for an AGPT test was 4.67 mg/l,. Because of these symptoms of nutrient enrichment, a recommendation was made to remove Kings Mountain Reservoir as a reference lake. In 1989, this reservoir was also sampled by DWQ as part of the ambient lakes monitoring program. Water quality values in that year were consistent with those observed in 1991 through 1993.

Historical data collected at Kings Mountain Reservoir from 1989 to 1995 for the four constituents of the NCTSI (total phosphorus, total organic nitrogen, Secchi depth and chlorophyll *a*) are summarized using box and whisker plots by Figure 4.16. The highest value for total phosphorus was 0.04 mg/l which was recorded for the sampling site near the dam (BRD056J) in July, 1993. Mean total phosphorus values were the same for all four lake sampling sites and median values were higher for the first two upstream sites (BRD056C and BRD056E), and lower at the two remaining sites (BRD056G and BRD056J). The lowest mean and median values for total organic nitrogen were observed at the Buffalo Creek arm sampling site (BRD056C) while the highest values were observed at the sampling site near the dam (BRD056J).

Figure 4.16 also shows that Secchi depth was lowest at the two upstream lake sampling sites and was greatest at the site near the dam. The lowest Secchi depth measurements from 1989 to 1995 were recorded at the Buffalo Creek arm sampling site (0.6 meter) and the Whiteoak Creek arm (0.7 meter). The greatest Secchi depth measurement (2.3 meters) was observed at the mid-lake and near dam sampling sites. Both mean and median chlorophyll *a* values for the individual lake sampling sites were not greater than 10 µg/l. The lowest value (2 µg/l) was recorded at each of the four sampling sites, and the highest value (23 µg/l) was observed at the mid-lake (June, 1991) and near dam sampling sites (June 1992).

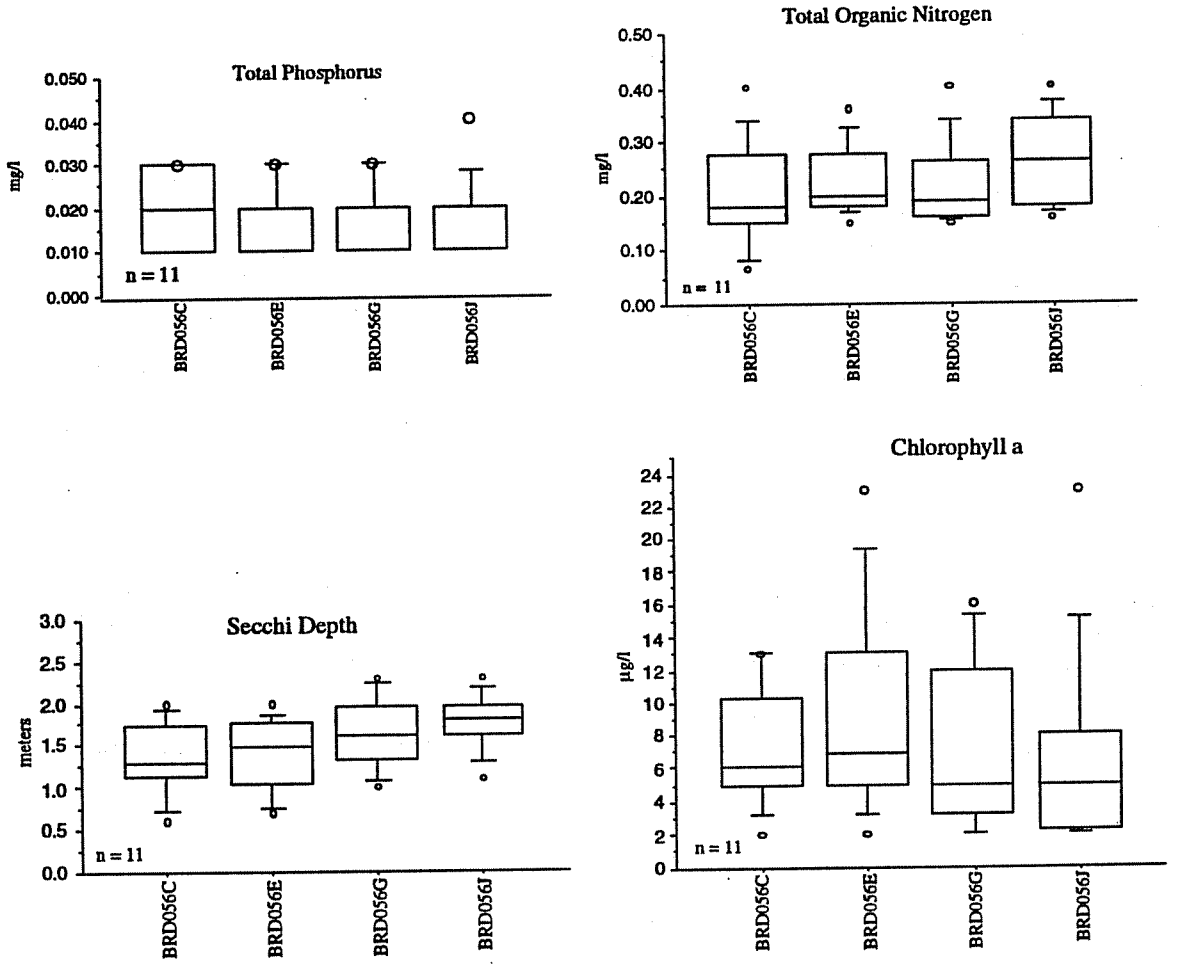


Figure 4.16 Kings Mountain Reservoir NCTSI Data Analysis from Lake Sampling Events, 1989 through 1995.

Phytoplankton populations in 1989 were dominated by blue-greens, cryptophytes, and diatoms. Lyngbya species A, a small filamentous blue-green alga, dominated density at all sampling stations. At the sampling site in the Buffalo Creek arm (BRD056C) Lyngbya species A also dominated biovolume estimates. This alga is commonly found in reservoirs and lakes throughout North Carolina and usually dominates biovolume in enriched systems.

Complaints during the early 1990's regarding the lack of fish by anglers led to an investigation which confirmed a low number of fish in the lake related to an absence of structures which would provide necessary habitats. A recommendation was made to provide artificial structures by submerging used Christmas trees into the lake to improve fishing (Chris Goudreau, Fishery Biologist, NRCD, pers. com.). The low number of fish in Kings Mountain Reservoir was confirmed during sampling efforts on September 21, 1995 to evaluate metals in fish collected from the lake. While few fish were collected, those that were analyzed showed no levels of metals above EPA or FDA human health criteria limits.

The water treatment facility at Kings Mountain Reservoir (Moss Reservoir) had received a few complaints from the public regarding problems with taste and odor (Junior Hinson, Operator, Moss Lake WTP, pers. com.). This was often the result of lake turnover rather than algal

blooms. When turnover occurs, the lake reportedly becomes muddy and some problems are encountered at the water treatment facility with increased turbidity, iron and manganese in the processed water. Plant personnel had received no reports of recent fish kills in the lake.

There is heavy residential development along the lakeshore and some new development is occurring in the upstream area of the watershed (Junior Hinson, Operator, Moss Reservoir WTP, pers. com.). There have been some reports of problems with malfunctioning septic tanks of homes in the watershed draining to the lake (Marty Allen, Environmental Supervisor, Cleveland County Environmental Heath Department, pers. com.). The soil types in this area are not good for septic tanks and many of the home sites are small in size. This problem has been especially prevalent in the Woodbridge subdivision. Following rain events, the lake becomes muddy (Marty Allen, Environmental Supervisor, Cleveland County Environmental Heath Department, pers. com.). Increased development along the lakeshore and within the watershed has resulted in observations of both domestic trash such as paper and drink bottles, along with debris from construction sites in the lake (Jerry Earl, President, Northshores Condominium Association, pers. com.).

Lake Montonia

Lake Montonia is a small, man-made lake built in the 1920's. Two spring-fed ephemeral, unnamed tributaries flow into the lake. The tributaries are located to the east and southeast of the lake. Figure 4.17 provides a general map of the lake. The drainage area of the lake is primarily forested with 65 private homes located immediately around the lake. Approximately 25 of these homes have year round residents with the remaining homes used primarily during the summer months. Septic tanks are used for waste disposal. Most of the homes have yards that have been left in natural conditions. Portions of Crowder's Mountain State Park and Kings Pinnacle are located within the watershed. No permitted dischargers are located in the watershed.

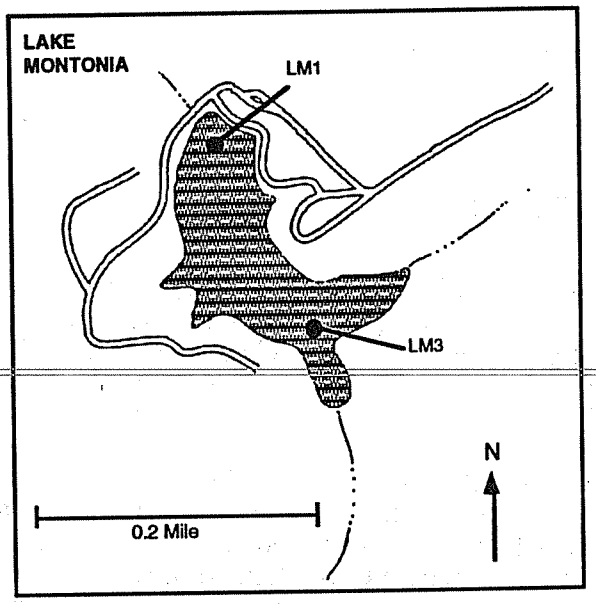


Figure 4.17 General Map of Lake Montonia, Broad subbasin 05

The Lake Montonia Board, a group of citizens concerned about the water quality of Lake Montonia, requested that the lake and its two unnamed tributaries be reclassified from their current classification of B to B HQW (High Quality Waters). The Board has requested this reclassification for the purpose of protecting the watershed of Lake Montonia from increased developmental pressures.

In response to this request, Lake Montonia was sampled six times in 1996, once in April as part of a presurvey visit, and five times from June through September. Surface dissolved oxygen was highest in April and surface water temperatures were lowest. In June, surface pH at the upstream sampling site (LM3) was at the lower limit of the state water quality standard for pH. Total phosphorus values were lowest in September and ammonia values were lowest in April.

Data collected at Lake Montonia during 1996 for the four constituents of the NCTSI (total phosphorus, total organic nitrogen, Secchi depth and chlorophyll *a*) are summarized using box and whisker plots by Figure 4.18. The highest value for total phosphorus observed at both sampling sites was 0.03 mg/l and the lowest was 0.01 mg/l and the highest total organic nitrogen value (0.30 mg/l) was observed at the sampling site near the dam (LM1).

Median Secchi depth was higher at the sampling site near the dam and lower at the upstream sampling site. The lowest and highest Secchi depths for Lake Montonia in 1996 (1.8 and 4.1 meters, respectively) were observed at the upstream lake sampling site (LM3). Chlorophyll *a* values were lowest at the upstream sampling site (LM3) and higher at the sampling site near the dam (LM1). The highest chlorophyll *a* value was observed at the dam sampling site (15 µg/l) and the lowest value was observed at the upstream lake sampling site (4 µg/l).

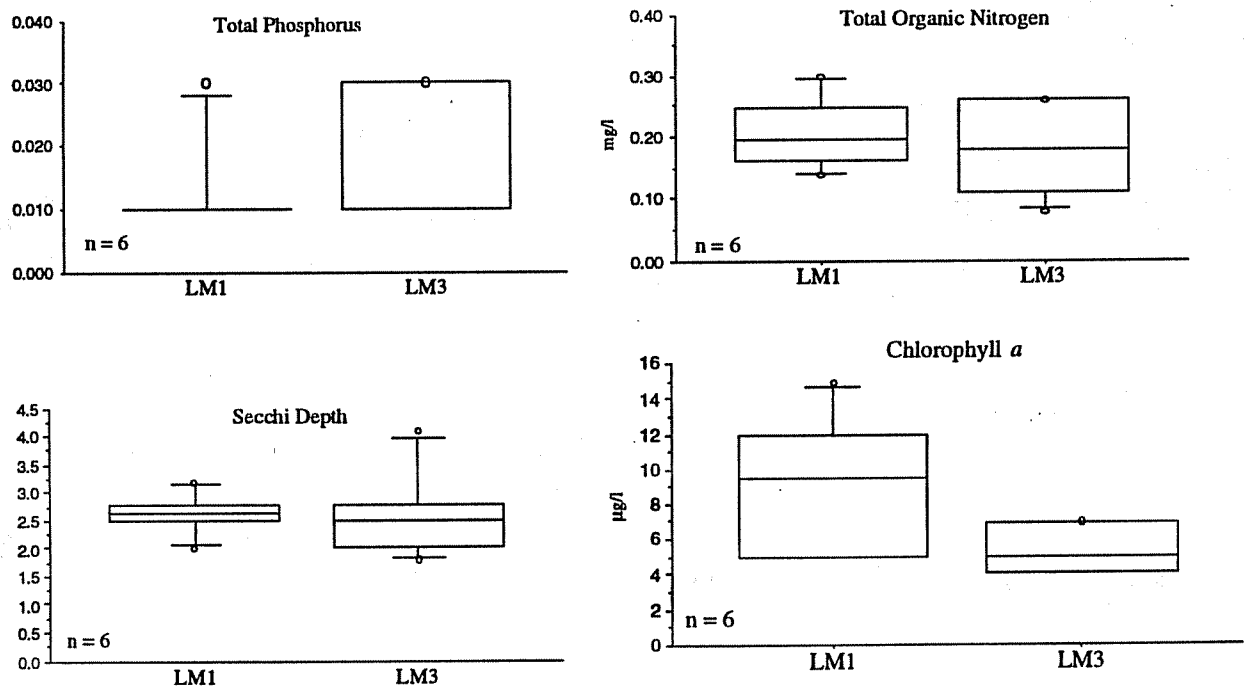


Figure 4.18 Lake Montonia NCTSI Data Analysis from Lake Sampling Events in 1996.

Over the six months that Lake Montonia was sampled in 1996, the lake has been consistently oligotrophic. Mean lake nutrient values, and chlorophyll *a* concentrations were relatively similar from month to month and Secchi depths from June through September were also similar. The mean Secchi depth in April was the greatest recorded for the lake in 1996, while the mean Secchi depth on June 13th was the lowest.
Parrot feather (Myriophyllum brasiliense) was observed in Lake Montonia in 1996, particularly in the upper end of the lake. Ornamental pink water lilies grow along three quarters of the lower lakeshore. The water lilies were observed later during the sampling season and did not present a problem for swimming and boating activities. Lake drawdowns, hand harvesting and

applications of herbicides have been used by the lake residents to control aquatic macrophytes in the lake (John Still, pers. com.).

In the past five years, there have been no reports of fish kills or algal blooms on Lake Montonia (John Still, home owner, Lake Montonia, pers. com.). There have also been no complaints of illness from swimmers who use the lake (Marty Allen, Environmental Supervisor, Cleveland County Environmental Heath Department, pers. com.). Some clear-cutting had occurred within the watershed and future residential development is planned in these areas. The lake home owners association, in an effort to protect the water quality of Lake Montonia, has purchased a parcel of land directly on the lake near the upstream tributaries to be left undeveloped (John Still, home owner, Lake Montonia, pers. com.).

4.4.6 Subbasin 06 - NC Portion of the North Pacolet River

Description

Broad River subbasin 030806 contains the North Carolina section of the North Pacolet River which flows into the Broad River in South Carolina. Streams within this subbasin are in the mountain ecoregion. This is a very small subbasin containing approximately 10 river miles of the North Pacolet River and many small tributaries. The upper reaches of the North Pacolet River are currently classified as C Trout, although there have been few collection records of trout in this reach (Menhinick, 1991). The lower reaches are classified as C. Tryon is the only urban area in the subbasin. Figure 4.19 provides a map of this subbasin.

Overview of Water Quality

Very little water quality information has been collected in this subbasin. Benthic macroinvertebrates have been collected from three locations on the North Pacolet River. Good and Good/Fair bioclassifications have been assigned to these locations. The North Pacolet River near the North Carolina/South Carolina state line is a very sandy stream (80%) suggesting that sedimentation is a significant water quality problem. Fish community structure sampling of the lower North Pacolet River also had a Fair-Good NCIBI rating. This was attributed to prolonged sedimentation and erosion and nutrient enrichment.

The Tryon WWTP which discharges to Vaughn Creek is the largest discharger in the subbasin. Concerns about mercury in this effluent led to a survey of fish tissue at three sites in the North Pacolet River and Vaughn Creek in 1996. Metals levels of concern were not found at any of the sites.

There are several Polk County VWIN monitoring sites in the Pacolet watershed. Results show high levels of suspended solids and turbidity (Maas, et. al., 1997b). Also, consistently elevated levels of nutrients appear to indicate point source pollution from the Saluda wastewater treatment plant.

Benthic Macroinvertebrates

Two locations were sampled for benthic macroinvertebrates during the 1995 basinwide investigations (Table 4.30). These two locations were on previously unassessed reaches of the North Pacolet River above and below the town of Tryon.

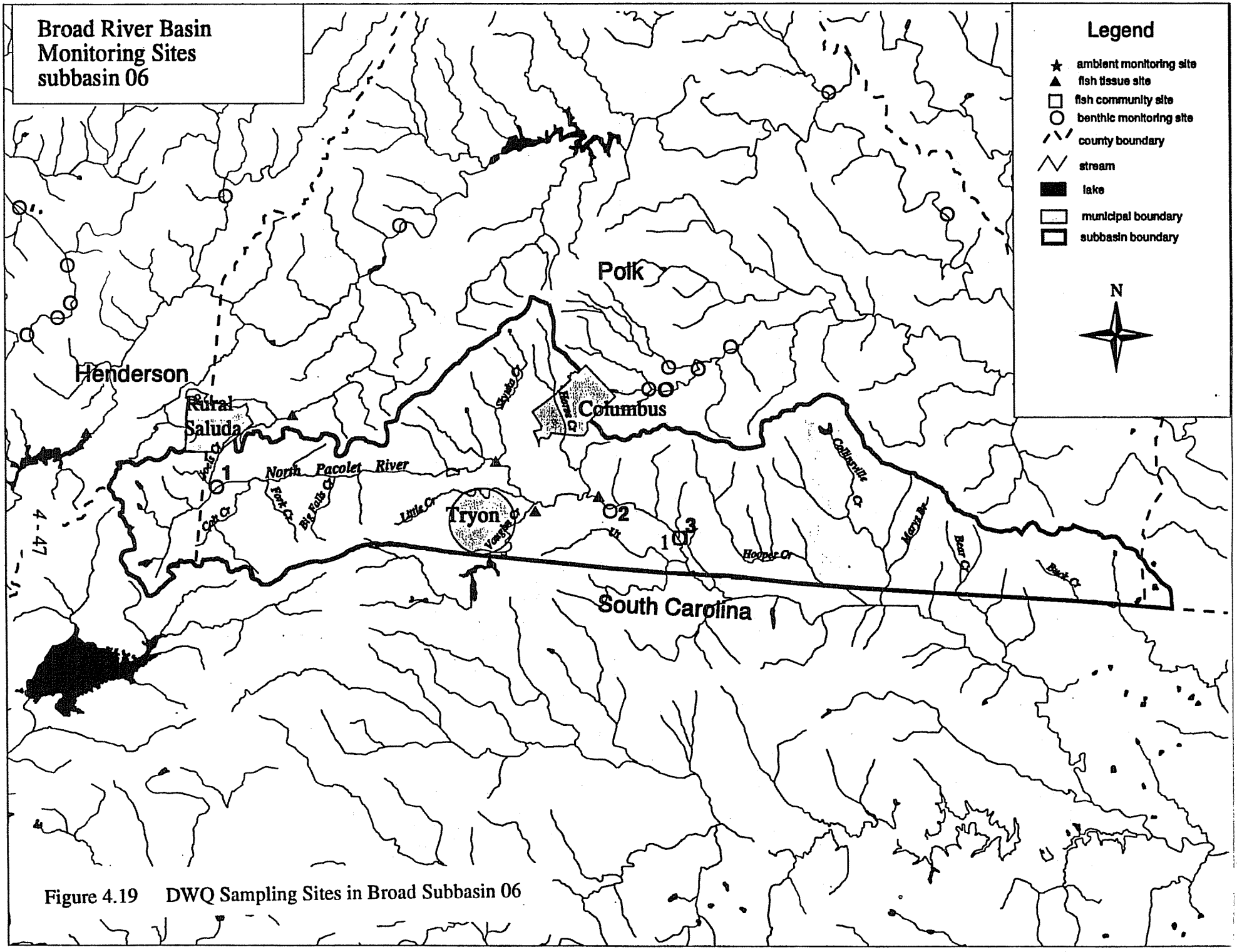


Figure 4.19 DWQ Sampling Sites in Broad Subbasin 06

Table 4.30 Basin Assessment Sites in Broad Subbasin 030806, 1995, Taxa Richness Values and Bioclassifications.

Site #	Creek	Date	County	Road	S/SEPT	Rating
B-1	N Pacolet R	950711	Polk	SR 1179	68/31	Good
B-3	N Pacolet R	950711	Polk	SR 1501	51/18	Good-Fair

Note: Map # refers to number on subbasin map.

The two sites selected on the North Pacolet River bracket the town of Tryon and the Tryon WWTP. A Good bioclassification was given to the upstream location. This location was given a NC habitat score of 59. This score, which is based on a 100 point scale, indicates that landuse and riparian zone perturbations have reduced habitat quality. This location had an urban setting, the bank vegetation was dominated by kudzu, the riparian zone was small, and breaks in the riparian zone were noted. The benthic macroinvertebrate fauna was dominated by facultative taxa including Pseudocloeon, Baetis intercalaris, Perlesta placida, and Cheumatopsyche. However, some intolerant taxa also were collected: Epeorus rubidus, Tallaperla, and Glossosoma.

The downstream site was located at SR 1501 near the North Carolina/South Carolina state line. The habitat score was very similar to the upstream location (58). The substrate was very sandy (80%) and the field team noted severe bank erosion, very infrequent sandy riffles, and a riparian zone with common breaks. The site was given a Good/Fair bioclassification. EPT abundance was significantly reduced compared to the upstream location (51 at SR 1501 compared to 134 at SR 1799). Additionally, the EPT taxa richness and biotic index values also suggest that water quality has declined between these two locations. The intolerant taxa recorded from the upstream location were not collected at the downstream location. The North Pacolet River immediately below the downstream monitoring location at SR 1501 has been channelized and the riparian zone completely removed.

Fish Community Structure and Fish Tissue

Only one site, the North Pacolet River, a tributary to the Pacolet River in South Carolina, was sampled for fish community structure in this subbasin during 1995 (see subbasin map for location). Based on the results, the lower part of the North Pacolet River at SR 1501 was rated only as Fair-Good. Similar to many of the fish communities within the Broad River basin which were sampled in 1994 and 1995, the fish community at this site had a skewed trophic structure (due to dominance by the omnivorous bluehead chub and a scarcity of piscivores), and a low diversity of sunfish and darters. These deviations from the expected fish community have resulted from prolonged sedimentation and erosion which has lead to the loss of pool and riffle habitats and nutrient enrichment-characteristic of many streams within the entire Broad River basin.

Fish tissue samples were collected at 3 sites within the Broad subbasin 06 in December 1996. Fish from all stations contained mercury levels well below FDA and EPA criteria.

4.5 USE-SUPPORT: DEFINITIONS AND METHODOLOGY

4.5.1 Introduction to Use Support

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

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

Streams rated as either partially supporting or nonsupporting are considered *impaired.* A waterbody is fully supporting but threatened (ST) for a particular designated use when it fully supports that use now, but may not in the future unless pollution prevention or control action is taken. Although threatened waters are currently supporting uses, they are treated as a separate category from waters fully supporting uses. Streams which had no data to determine their use support were listed as non-evaluated (NE).

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

4.5.2 Interpretation of Data

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

Interpretation of the use support ratings compiled by DWQ should be done with caution. The methodology used to determine the ratings must be understood, as should the purpose for which the ratings were generated. The intent of this use-support assessment was to gain an overall picture of the water quality, how well these waters support the uses for which they were classified, and the relative contribution made by different categories of pollution within the basin. In order to comply with guidance received from EPA to identify likely sources of pollution for all impaired stream mileage, DWQ used the data mentioned above.

The data are not intended to provide precise conclusions about pollutant budgets for specific watersheds. Since the assessment methodology is geared toward general conclusions, it is important not to manipulate the data to support policy decisions beyond the accuracy of these data. For example, according to this report, nonpoint source pollution is the greatest source of

water quality degradation. However, this does not mean that there should be no point source control measures. All categories of point and nonpoint source pollution have the potential to cause significant water quality degradation if proper controls and practices are not utilized.

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

4.5.3 Assessment Methodology - Freshwater Bodies

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

Biological Data

Benthic Macroinvertebrate Bioclassification

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

Bioclassification	Rating
Excellent	Supporting
Good	Supporting
Good-Fair	Support Threatened
Fair	Partially Supporting
Poor	Not Supporting

Fish Community Structure

The North Carolina Index of Biotic Integrity (NCIBI) is a method for assessing a stream's biological integrity by examining the structure and health of its fish community. The index incorporates information about species richness and composition, trophic composition, fish abundance and fish condition. Use support ratings are assigned to each category of the NCIBI as follows:

NCIBI	Rating
Excellent	Supporting
Good-Excellent	Supporting
Good	Supporting
Fair-Good	Support Threatened
Fair	Partially Supporting
Poor-Fair	Partially Supporting
Poor	Not Supporting
Very Poor - Poor	Not Supporting
Very Poor	Not Supporting

Phytoplankton and Algal Bloom Data
Prolific growths of phytoplankton, often due to high concentrations of nutrients, sometimes result in "blooms" in which one or more species of alga may discolor the water or form visible mats on top of the water. Blooms may be unsightly and deleterious to water quality, causing fish kills, anoxia, or taste and odor problems. An algal sample with a biovolume larger than 5,000 mm3/m3, density greater than 10,000 units/ml, or chlorophyll *a* concentration approaching or exceeding 40 micrograms per liter (the NC state standard) constitutes a bloom. A waterbody is rated ST if the biovolume, density and chlorophyll a concentrations are approaching bloom concentrations. If an algal bloom occurs, the waterbody is rated PS.

Chemical/Physical Data

Chemical/physical water quality data are collected through the Ambient Monitoring System as discussed in section 4.3. The data are downloaded from STORET to a desktop computer for analysis. Total number of samples and percent exceedences of the NC state standards are used for use support ratings. Percent exceedences correspond to use support ratings as follows:

Standards Violation	Rating
Criteria exceeded < 10%	Fully Supporting
Criteria exceeded 11-25%	Partially Supporting
Criteria exceeded >25%	Not Supporting

It is important to note that some waters may exhibit characteristics outside the appropriate standards due to natural conditions. These natural conditions do not constitute a violation of water quality standards.

Lakes Program Data

As discussed earlier in Chapter 4, assessments have been made for all publicly accessible lakes, lakes which supply domestic drinking water, and lakes where water quality problems have been observed.

Sources and Cause Data

In addition to the above data, existing information was entered for potential sources of pollution (point and nonpoint). It is important to note that not all impaired streams will have a potential source and/or cause listed for them. Staff and resources do not currently exist to collect this level of information. Much of this information is obtained through the cooperation of other agencies (federal, state and local), organizations, and citizens.

Point Source Data

Whole Effluent Toxicity Data
Many facilities are required to monitor whole effluent toxicity by their NPDES permit or by administrative letter. Streams that receive a discharge from a facility that have failed its whole effluent toxicity test may be rated ST (unless water quality data indicated otherwise), and have that facility listed as a potential source of impairment.

Daily Monitoring Reports
Streams which received a discharge from a facility significantly out of compliance with permit limits may be rated ST (unless water quality data indicate otherwise), and have that facility listed as a Point Source potential source of impairment.

Nonpoint Source Data

Information related to nonpoint source pollution (i.e., agricultural, urban and construction) was obtained from monitoring staff, other agencies (federal, state and local), 1988 nonpoint source workshops, land-use reviews, and workshops held at the beginning of each basin cycle.

Problem Parameters

Causes of use support impairment (problem parameters) such as sedimentation and low dissolved oxygen, were also identified for specific stream segments. For ambient water quality stations, those parameters which exceeded the water quality standard > 10% of the time for the review period were listed as a problem parameter. For segments without ambient stations, information from reports, other agencies, and monitoring staff were used if it was available.

Monitored vs. Evaluated

Assessments were made on either monitored (M) or evaluated (E) basis depending on the level of information that was used. Streams are rated on a monitored basis if the data are less than five years old. Streams are rated on an evaluated basis under the following conditions:

> If the only existing data for a stream are more than five years old, they are used to rate the stream on an evaluated basis.
>
> If a stream is a tributary to a monitored (segment of a) stream rated fully supporting (S) or support threatened (ST), the tributary will receive the same rating on an evaluated basis. If a stream is a tributary to a monitored (segment of a) stream rated partially supporting (PS) or not supporting (NS), the stream is considered not evaluated (NE).

4.5.4 Assigning Use Support Ratings

At the beginning of each assessment, all data are reviewed by subbasin with the monitoring staff, and data are adjusted where necessary based on best professional judgment. Discrepancies between data sources are resolved during this phase of the process. For example, a stream may be sampled for both benthos and fish community structure, and the bioclassification may differ from the NCIBI (i.e. the bioclassification may be S while the NCIBI may be PS). To resolve this, the final rating may defer to one of the samples (resulting in S or PS), or, it may be a compromise between both of the samples (resulting in ST).

After reviewing the existing data, ratings are assigned to the streams. If one data source exists for the stream, the rating is assigned based on the translation of the data value as discussed above. If more than one source of data exists for a stream, the rating is assigned according to the following hierarchy:

> Benthic Bioclassification / Fish Community Structure
> Chemical/Physical Data
> Monitored Data > 5 years old
> Compliance / Toxicity Data

This is only a general guideline for assigning use support ratings and not meant to be restrictive. Each segment is reviewed individually and the resulting rating may vary from this process based on best professional judgment which takes into consideration site specific conditions.

After assigning ratings to streams with existing data, streams with no existing data were assessed. Streams that were direct or indirect tributaries to streams rated S or ST received the

same rating (with an evaluated basis) if they had no known significant impacts, based on a review of the watershed characteristics and discharge information. Streams that were direct or indirect tributaries to streams rated PS or NS, or that had no data were assigned a Not Evaluated (NE) rating.

4.5.5 Revisions to Methodology Since 1995 - 95 305(b) Report

Methodology for determining use support has been revised. In the 1994-1995 305(b) Report, evaluated information from older reports and workshops were included in the use support process. Streams rated using this information were considered to be rated on an evaluated basis. In the current use support process, this older, evaluated information has been discarded, and streams are now rated using only monitored information (including current and older monitoring data). Streams are rated on a monitored basis if the data are less than five years old. Streams are rated on an evaluated basis under the following conditions:

If the only existing data for a stream are more than five years old, they are used to rate the stream on an evaluated basis.

> If a stream is a tributary to a monitored segment of a stream rated fully supporting (S) or fully supporting but threatened (ST), the tributary will receive the same rating on an evaluated basis. If a stream is a tributary to a monitored segment rated partially supporting (PS) or not supporting (NS), the stream is considered not evaluated (NE).

These changes resulted in a reduction in streams rated on an evaluated basis.

The basinwide process allows for concentrating more resources on individual basins during the monitoring phase. Therefore, more streams were monitored, and more information was available to use in the use support process.

4.6 USE SUPPORT RATINGS FOR THE BROAD RIVER BASIN

Use Support ratings for all monitored and evaluated surface waters in the basin are presented on color-coded map in Figure 4.20. The following sections describe the assignment of ratings to both the fresh and salt waters in the basin.

4.6.1 Freshwater Streams and Rivers

Of the 1,472 miles of freshwater streams and rivers in the Broad basin, use support ratings were determined for 96% or 1,416 miles of water. The relative breakdown of percentages for the use support categories is as follows:

SUPPORTING 93%
- Fully supporting (67%)
- Fully supporting but threatened (26%)

IMPAIRED.....3%
- Partially supporting (3%)
- Not supporting (0%)

NOT EVALUATED: 4%

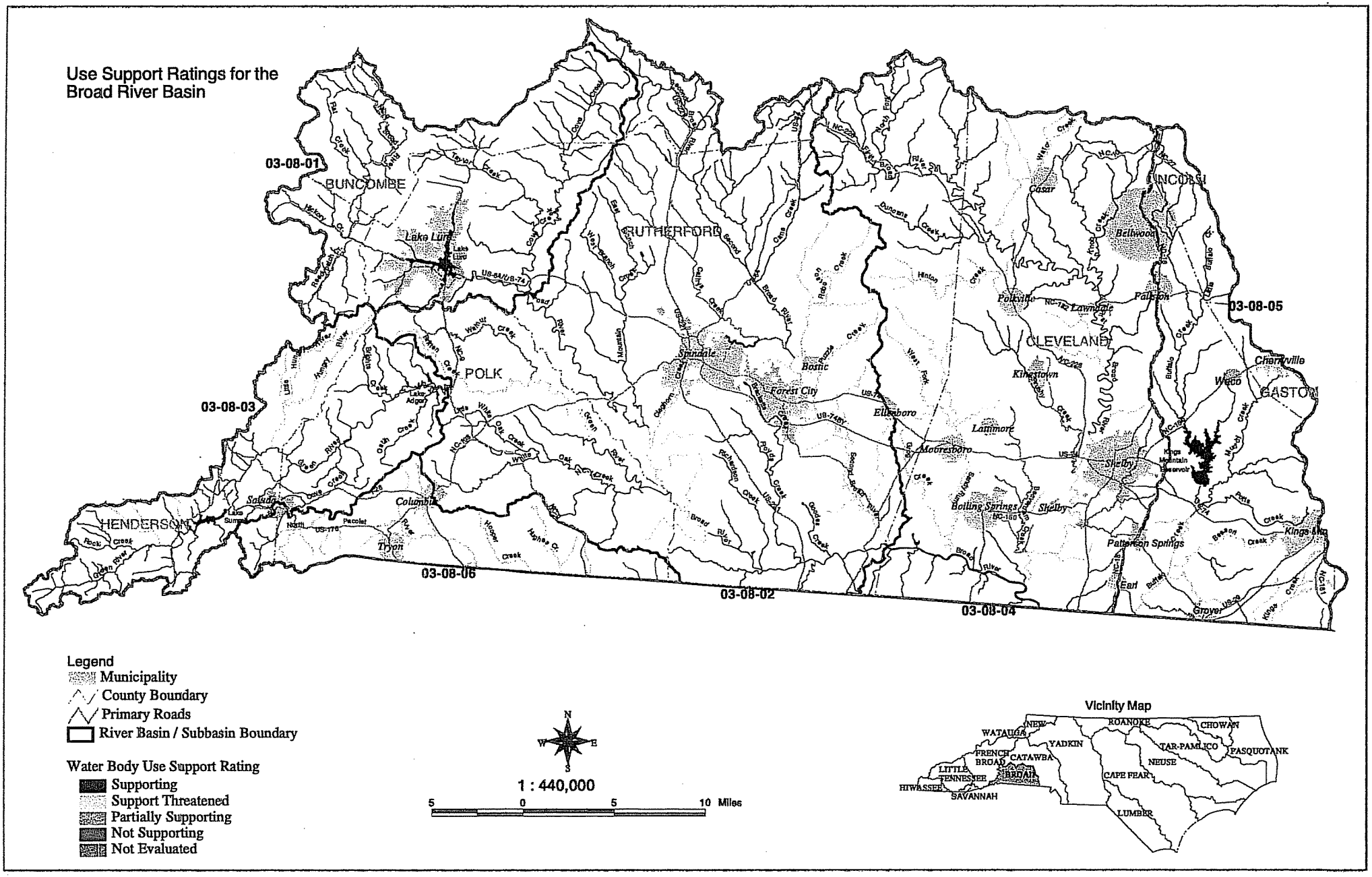


Figure 4.20 Use Support Map of the Broad River Basin

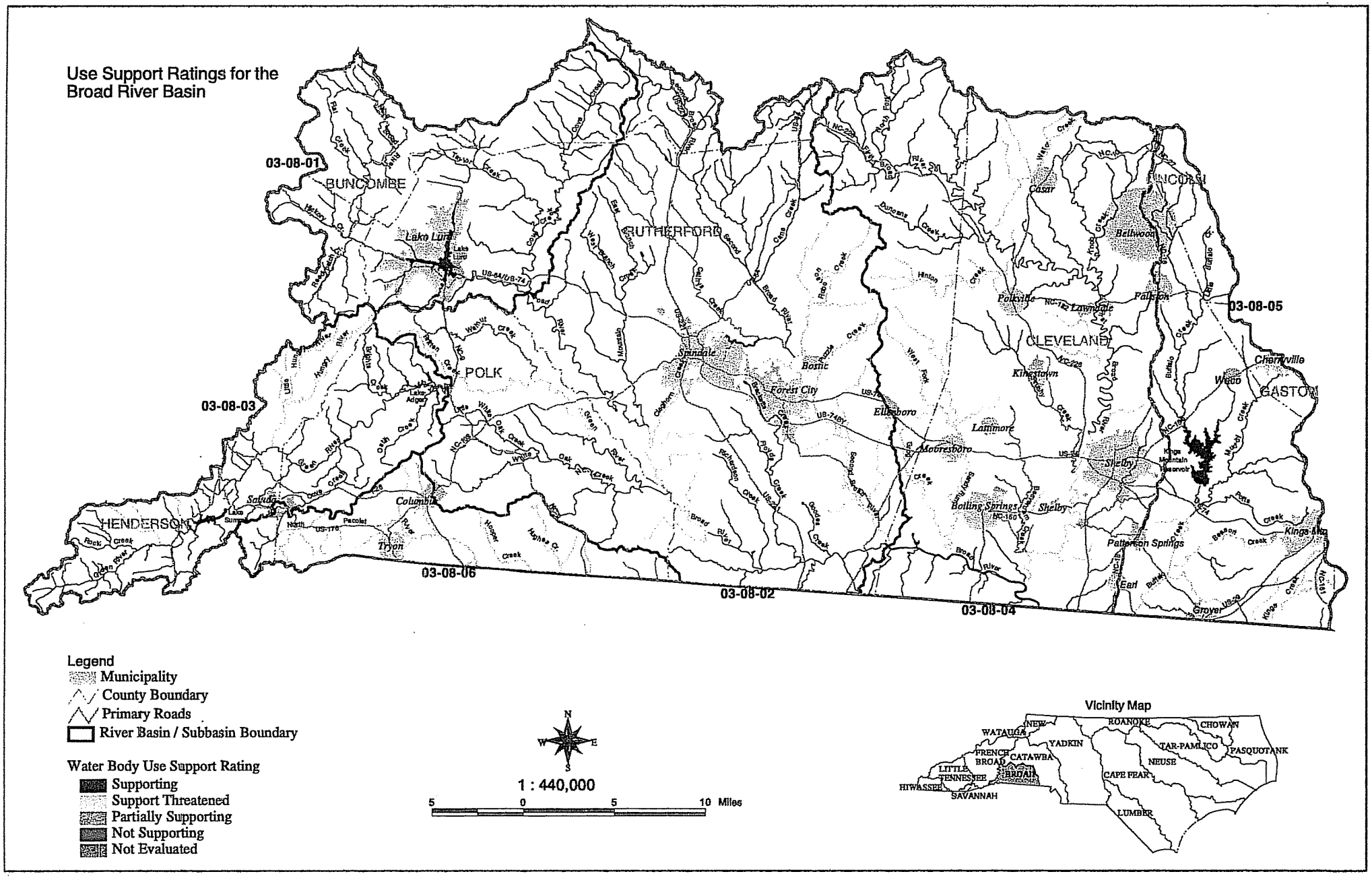


Figure 4.20 Use Support Map of the Broad River Basin

These use support values are different from the values in the 1992-1993 305(b) Report. The total waters supporting their uses appear to have increased, while those that are impaired appear to have decreased. While the water quality may have improved since the 1992-1993 305(b) report, the changes in values may also be due to revisions in the methodology for assigning use support (discussed earlier in section 4.5.5).

Table 4.32 (2 pages) provides information on streams and stream segments that were monitored as well as those evaluated based on data greater than five years old. Streams with data that were collected during the time period of 1992 through 1996 are considered to be monitored. This includes bioclassification and collection data for benthic macroinvertebrate samples, fish community structure samples, ambient monitoring station information, problem parameters such as sediment, potential sources of pollution (point or nonpoint), and the overall use support rating. All remaining streams in the basin were rated on an evaluated basis, or, if no data exists, were considered not evaluated. Table 4.31 presents the overall use support determinations by subbasin.

Table 4.31 Summary of Use Support Status for Freshwater Streams (miles) by Subbasin; 1992 - 1996

Subbasin	S	ST	PS	NS	NE	Total Miles
030801	·205.4	0	0	0	0	205.4
030802	273.3	133.9	12.1	2.5	30.1	451.9
030803	137.3	33.4	0	0	0	170.7
030804	259.7	124.8	29.1	0	21.4	435.0
030805	98.2	42.6	4.8	0	1.3	146.9
030806	6.3	53	0	0	2.9	62.2
TOTAL	980.2	387.7	46.0	2.5	55.7	1472.1
PERCENT	67	26	3	<1	4	

Impaired Freshwater Streams

In determining sources of pollution for impaired waters, observation from field staff, information from the 1988 nonpoint source workshops, and discharger daily monitoring reports were used. This does not provide a complete explanation for all potential sources of pollution in the basin. Recently, multi-agency teams have been assigned to address nonpoint source pollution in each of the river basins. As the different agencies work together within these teams, they will eventually provide more complete information on the nonpoint sources affecting the impaired waters. This section provides a summary of the impaired waters in the Broad basin, including DWQ's best information as to the cause.

In subbasin 030802, 14.6 stream miles are considered impaired. Walnut Creek is partially supporting due to sedimentation problems, possibly from agricultural activities. Field personnel noted that the banks of the creek are unstable and eroding. Catheys Creek is impaired (PS) due to both point and nonpoint sources of pollution. The Spindale wastewater treatment plant is affecting this creek in addition to nonpoint sources of pollution, (possibly agricultural activities).

In subbasin 030804, 29.1 stream miles were rated partially supporting. Beaverdam Creek is rated as partially supporting based on monitored data and the causes are likely agricultural runoff and the cumulative impact of several small wastewater treatment plants. Hickory Creek and the lower portion of Brushy Creek are both rated as partially supporting but it is based on data that are greater than five years old. Both are thought to be impacted by nonpoint source pollution from agriculture, and Hickory Creek, which runs through the City of Shelby, is also thought to be impacted by runoff from construction activities and urban areas.

Table 4.32 Use Support Status for Streams and Rivers in the Broad Basin

Name of Stream	Station Number	Station Location	Class	Index #	Subbasin	Miles	Chem Rating 91-95	Benthic Bioclassification 91	92	93	94	Fish Comm. 95	91-95	Proble Param	Overall Use Support Rating	Basis	Potential Sources (P,NP)
BROAD RIVER		Broad R SR 2802, Buncombe	C Tr	9-(1)	30801	18.6						Excellent		Sed	S	M	NP
BROAD RIVER (Lake Lure		Lakes - S	B Tr	9-(17)	30801	0									S	M-lakes	
BROAD RIVER			C	9-(22)	30801	15.9									S	M	
Cove Creek			C Tr	9-23-(1)	30801	4.3									S	M	
Cove Creek	02149000	Cove Creek SR 1381 & near L. Lure, U.S. Hwys. 64/74	C	9-23-(9)	30801	13.4	PS					Excellen	Good		S	M	
BROAD RIVER	02149635(	Broad R SR 1181, Rutherford	WS-IV	9-(23.5)	30802	14.5	S					Good			S	M	
BROAD RIVER			WS-IV CA	9-(24.5)	30802	0.5									S	M	NP
Mountain Creek		Mountain Cr SR 1149, Rutherford	WS-IV	9-25-(0.5)	30802	12.5						Good			S	M	
BROAD RIVER		Broad R SR 1106, Rutherford	C	9-(25.5)a	30802	8.4						Good-Fair			ST	M	NP
Cleghorn Creek		Cleghorn Cr SR 1149, Rutherford	C	9-26	30802	7.5						Good-Fair		Sed	ST	M	
Green River		Green River at SR 1331, Polk Co.	C	9-29-(33)b	30802	11.8				Good-Fair					ST	ED	NP
Green River		Green River at SR 1302, Polk Co.	C	9-29-(33)c	30802	10						Good			S	M	NP
Walnut Creek		Walnut Cr SR 1315, Polk	C	9-29-44	30802	8.3						Fair		Sed	PS	M	NP
Whiteoak Creek		Whiteoak Cr SR SR 1352, Polk	C	9-29-46	30802	16.3						Good			S	M	NP
Second Broad River	02150495	Second Broad River SR 1538, Rutherford	WS-IV	9-41-(10.5)	30802	11.2	S				Good	Good	Good	Sed	S	M	NP
Gap Branch		Gap Branch at SR 1512, Rutherford Co.	WS-V	9-41-11-1-(0.3)	30802	1.1									S	ED	
Second Broad River			WS-IV CA	9-41-12-(12.3)	30802	0.5								Sed	S	M	NP
Second Broad River			WS-V	9-41-12-(12.7)	30802	1								Sed	S	M	NP
Catheys Creek		Catheys CrSR 1549, Rutherford	C	9-41-13-(6)	30802	3.8					Good-	Fair		Sed	PS	M	NP,P
Hollands Creek		Hollands Creek at SR 1547, Rutherford Co.	WS-V	9-41-13-7-(1)	30802	4									ST	ED	
Hollands Creek		Hollands Creek at SR 1549, Rutherford Co.	C	9-41-13-7-(3)	30802	2.5									NS	ED	P
Roberson Creek		Roberson Cr. SR 1561, Rutherford	WS-V	9-41-14	30802	11.7						Good-Fair		Sed	ST	M	
Second Broad River		Second Broad River US 74 & US 221A Rutherford	WS-IV	9-41-(14.5)	30802	16.1						Good-Fair		Sed	ST	M	NP
Second Broad River			WS-IV CA	9-41-(24.3)	30802	0.5								Sed	ST	M	NP
Second Broad River	02151000	Second Broad River SR 1973, Rutherford	C	9-41-(24.7)	30802	2.1	S	Good-Fair				Good-Fair		Sed	ST	M	NP
Green River		Green River at 1106 nr 1106, SR 1104 SR 1103, Hend	C Tr	9-29-(1)	30803	11.2				Excellent/Good					S	M	
Rock Creek		Rock Creek at SR 1106, Henderson Co.	C Tr	9-29-12	30803	5				Excellent					S	M	
Joe Creek		Joe Creek at SR 1106, Henderson Co.	C Tr	9-29-14-(3)	30803	1.6									ST	ED	
Bobs Creek		Bobs Creek at SR 1103, Henderson Co.	C Tr	9-29-15	30803	3.6									S	ED	
Freeman Creek		Freeman Creek at SR 1115, Henderson Co.	C Tr	9-29-18	30803	2.2									ST	ED	
Hungry River		Hungry River SR 1799, Henderson	C Tr	9-29-30	30803	12.2						Good-Fair		Sed	ST	M	NP
Green River		Green River at SR 1151, Polk Co.	C	9-29-(33)a	30803	8.1						Good			S	M	NP
BROAD RIVER	02151500	Broad R, US 221, nr Cliffsld, amb at Hwy 150 Rutherfo	C	9-(25.5)b	30804	21.9	S					Good			S	M	NP
Sandy Run Creek		Sandy Run Cr, SR 1195, Cleveland Co	C	9-46	30804	17.9						Good-Fair		Sed	ST	M	NP
First Broad River		First Broad River SR 1726, Rutherford	WS-V Tr	9-50-(1)	30804	13.2									S	ED	
North Fork First Broad		North Fork First Broad River SR 1728, Rutherford	C Tr	9-50-4	30804	7.4						Excellen	Good-Exc		S	M	
First Broad River	02152100	First Broad River SR 1530 nr Casar, Cleveland	WS-IV Tr	9-50-(7.5)	30804	4.1	S			Good		Good			S	M	
First Broad River			WS-IV	9-50-(11)	30804	12.6									S	M	NP
Wards Creek			WS-IV	9-50-12	30804	9.7								Sed	ST	ED	NP
Duncans Creek		Duncans Cr SR 1749, Rutherford	WS-IV	9-50-13-(1.5)	30804	5.8						Good			S	M	
Hinton Creek		Hinton Cr NC 226, Cleveland	WS-IV	9-50-15-(1.5)	30804	10.1						Good-Fair		Sed	ST	M	NP
First Broad River			WS-IV CA	9-50-(18.5)	30804	0.8									S	M	

Table 4.32 Use Support Status for Streams and Rivers in the Broad Basin (continued)

Name of Stream	Station Number	Station Location	Class	Index #	Subbasin	Miles	Chem Rating 91-95	Benthic Bioclassification 91	92	93	94	95	Fish Comm. 91-95	Proble Param	Overall Use Support Rating	Basis	Potential Sources (P,NP)
First Broad River		First Broad River SR 1809 Cleveland	WS-IV	9-50-(18.7)	30804	14.5						Good			S	M	
Knob Creek (Big Knob			C	9-50-19-(0.5)	30804	4.2								Sed	S	M	NP
Knob Creek (Big Knob		Knob Creek SR 1004, Cleveland	WS-IV	9-50-19-(4)	30804	9.3						Good		Sed	S	M	NP
First Broad River		First Broad River SR 1809 Cleveland	WS-IV CA	9-50-(26.5)	30804	0.8									ST	M	
First Broad River	02152596	First Broad River SR 1140 near Earl, Cleveland	C	9-50-(28)	30804	13.4	ST					Good-Fair		Fecal	ST	M	NP
Brushy Creek		Brushy Cr, ab SR 1323 and at SR 1323, Cleveland	C	9-50-29a	30804	6.6						Good			S	M	NP
Brushy Creek		Brushy Cr, be US 74 Cleveland	C	9-50-29b	30804	8.4									PS	ED	NP
Hickory Creek		Hickory Cr SR 1110 & be NC 18, Cleveland	C	9-50-30	30804	9.8									PS	ED	NP
Beaverdam Creek		Beaverdam Cr Nc 150, Cleveland	C	9-50-32	30804	10.9						Fair	Good		PS	M	NP,P
Sugar Branch	02152610	Sugar Branch near Boiling Springs, NC Hwy. 150	C	9-50-32-3	30804	2.7	ST							Fecal	ST	M	NP
Buffalo Creek		Buffalo Cr SR 1908, Cleveland	WS-III	9-53-(1)	30805	20.8						Good			S	M	NP
Buffalo Creek (Kings Mountain Res)		Lakes - S	WS-III CA	9-53-(2.9)	30805	6									S	M-Lakes	NP
Buffalo Creek		Buffalo Creek at NC 74, Cleveland Co.	C	9-53-(5)a	30805	1.6									PS	ED	NP
Buffalo Creek	02153456	Buffalo Creek at NC 198 Cleveland Co.	C	9-53-(5)b	30805	7.9	ST					Good			ST	M	NP
Muddy Fork		Muddy Fork SR 2012 Cleveland Co.	C	9-53-6	30805	13.8						Good			S	M	NP
Beason Creek		Beason Cr SR 2252, 2246, Cleveland	C	9-53-8	30805	10.2						Good-Fair		Sed	ST	M	NP
Long Branch		Long Br Battlewood Rd	C	9-53-8-1	30805	5.6									S	ED	NP
Lick Branch		Lick Cr SR 2229 & sss7, Cleveland	C	9-53-11	30805	3.2						Fair		Sed	PS	M	NP,P
Kings Creek		Kings Cr SR 2286, Cleveland	C	9-54	30805	5.3						Good-Fair		Sed	ST	M	NP
North Pacolet River		North Pacolet River SR 1179, Polk	C Tr	9-55-1-(1)a	30806	2.9						Good			S	M	NP
North Pacolet River		North Pacolet River SR 1517, Polk	C Tr	9-55-1-(1)b	30806	7.4									ST	ED	NP
Fork Creek			WS-II Tr	9-55-1-6-(1)	30806	0.7								Sed	ST	M	NP
Fork Creek			WS-II Tr CA	9-55-1-6-(2)	30806	0.6								Sed	ST	M	NP
Fork Creek			C Tr	9-55-1-6-(3)	30806	0.3								Sed	ST	M	NP
North Pacolet River		North Pacolet R SR 1501, Polk	C	9-55-1-(10)	30806	7.2						Good-Fa	Fair-Goo	Sed	ST	M	NP

KEY:
Class = DWQ Surface Water Classification
Sed = Sedimentation
S = Supporting
ST = Support - Threatened
PS = Partially Supporting
NS = Not Supporting
M = Monitored
ED = Evaluated based on data > 5 years old
P = Point Source
NP = Nonpoint Source

In subbasin 030805, 4.8 miles are consider partially supporting. Buffalo Creek is rated as impaired based on data that are greater than five years old. Impairment is thought to be caused by runoff from agriculture, construction and land disposal. Lick Branch is considered impaired based on monitored data. The wastewater discharge from New Minnette Textiles is apparantly causing impairment.

4.6.2 Lakes

There are five significant lakes in the Broad River basin that have been monitored by DWQ. These are: Lake Lure (subbasin 01); Lake Adger and Lake Summit (subbasin 03); and Kings Mountain Reservoir (Moss Lake) and Lake Montonia (subbasin 05). All lakes in the basin were sampled most recently in 1995, except for Lake Montonia which was sampled in 1996. Results of the most recent sampling indicate that all lakes are oligotrophic and are fully supporting their uses.

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CHAPTER 5

EXISTING WATER QUALITY PROGRAMS AND PROGRAM INITIATIVES IN THE BASIN

5.1 INTRODUCTION

This chapter summarizes the point and nonpoint source control programs available for addressing water quality problems in the Broad River Basin and a number of important initiatives being implemented by federal, state, local and private interests. **Section 5.2** summarizes the state and federal legislative authorities developed to protect water quality. **Section 5.3** presents the water quality standards and classifications program. **Sections 5.4 and 5.5**, respectively, present existing point and nonpoint source pollution control programs. A more complete description of these programs can be found in Appendix VI. Application of these programs to specific water quality problems and water bodies is presented in Chapter 6. **Section 5.6** presents water quality program initiatives that have been implemented within the basin. **Section 5.7** discusses integration of point and nonpoint source control management strategies and introduces the concept of *total maximum daily loads* (TMDLs). **Section 5.8** provides information on potential sources of funding for both point and nonpoint water quality protection programs.

5.2 STATE AND FEDERAL LEGISLATIVE AUTHORITIES FOR NORTH CAROLINA'S WATER QUALITY PROGRAM

Authorities for some of the programs and responsibilities carried out by the Water Quality Section are derived from a number of federal and state legislative mandates outlined below. The major federal authorities (Section 5.2.1) for the state's water quality program are found in sections of the Clean Water Act (CWA). State authorities listed in Section 5.2.2 are from state statutes.

5.2.1 Federal Authorities for NC's Water Quality Program

- **The Clean Water Act Section 301** - Prohibits the discharge of pollutants into surface waters unless permitted by EPA.
- **The Clean Water Act Section 303(c)** - States are responsible for reviewing, establishing and revising water quality standards for all surface waters.
- **The Clean Water Act Section 303(d)** - Each state shall identify those waters within its boundaries for which the effluent limits required by section 301(b)(1) A and B are not stringent enough to protect any water quality standards applicable to such waters.
- **The Clean Water Act Section 305(b)** - Each state is required to submit a biennial report to the EPA describing the status of surface waters in that state.
- **The Clean Water Act Section 319** - Each state is required to develop and implement a nonpoint source pollution management program.
- **The Clean Water Act Section 402** - Establishes the National Pollutant Discharge Elimination System (NPDES) permitting program. Allows for delegation of permitting authority to qualifying states (includes North Carolina).
- **The Clean Water Act Section 404/401** - Section 404 regulates the discharge of fill materials into navigable waters and adjoining wetlands unless permitted by the US Army Corps of Engineers. Section 401 requires the Corps to receive a state Water Quality Certification prior to issuance of a 404 permit.

5.2.2 State Authorities for NC's Water Quality Program

- **G.S. 143-214.1** - Directs and empowers the NC Environmental Management Commission (EMC) to develop a water quality standards and classifications program.
  G.S. 143-214.2 - Prohibits the discharge of certain wastes to surface waters of the state without a permit.
- **G.S. 143-214.5** - Provides for establishment of the state Water Supply Watershed Protection Program.
- **G.S. 143-214.7** - Directs the EMC to establish a Stormwater Runoff Program.
- **G.S. 143-215** - Authorizes and directs the EMC to establish effluent standards and limitations.
- **G.S. 143-215.1** - Outlines methods for control of sources of water pollution (NPDES and nondischarge permits, statutory notice requirements, public hearing requirements, appeals, etc.).
- **G.S. 143-215.2** - Empowers the EMC to issue *special orders* to any person whom it finds responsible for causing or contributing to any pollution of the waters of the state within the area for which standards have been established.
- **G.S. 143-215.3** - Outlines additional powers of the EMC including provisions for adopting rules, charging permit fees, delegating authority, investigating fish kills and investigating violations of rules, standards or limitations adopted by the EMC.
- **G.S. 143-215.6A, 143-215.6B and 143-215.6C** - Includes enforcement provisions for violations of various rules, classifications, standards, limitations, provisions or management practices established pursuant to G.S. 143-214.1, 143-214.2, 143-214.5, 143-215, 143-215.1, 143-215.2. Section 6A describes enforcement procedures for civil penalties. Section 6B outlines enforcement procedures for criminal penalties. Section 6C outlines provisions for injunctive relief.
- **G.S. 143-215.74, 75A, 74B, 74C, 74D and 74E** - Refers to animal waste management and agriculture cost share.
- **G.S. 143-215.75** - Outlines the state's Oil Pollution and Hazardous Substances Control Program.
- **G.S. 143-215, 10A - 215.10G** - Requires permits and controls for animal waste systems.
- **G.S. 143-214.8 - 214.13** - Establishes a Wetland Restoration Program.
- **G.S. 143-15.3B, 113-145.1-145.7** - Establishes a Clean Water Management Trust Fund.

5.3 Surface Water Classifications and Water Quality Standards

~~Program Overview~~

North Carolina has established a water quality classification and standards program pursuant to G.S. 143-214.1. Classifications and standards are developed pursuant to 15A NCAC 2B. 0100 - Procedures for Assignment of Water Quality Standards. Waters were classified for their "best usage" in North Carolina beginning in the early 1950's, with classification and water quality standards for all the state's river basins adopted by 1963. The effort to accomplish this included identification of waterbodies (which included all named waterbodies on USGS 7.5 minute topographic maps), studies of river basins to document sources of pollution and appropriate best uses and formal adoption of standards/classifications following public hearings.

The Water Quality Standards program in North Carolina has evolved over time and has been modified to be consistent with the Federal Clean Water Act and its amendments. Water quality classifications and standards have also been modified to promote protection of surface water supply watersheds, high quality waters and the protection of unique and special pristine waters

with outstanding resource values. Classifications and standards are applied to provide protection of uses from both point and nonpoint source pollution.

Statewide Classifications

A full description of the state's primary and supplemental classifications including, for each classification, the best usage, key numeric standards, stormwater controls and other requirements as appropriate, are available in the document titled: Classifications and Water Quality Standards Applicable to Surface Waters of North Carolina (derived from 15A NCAC 2B .0200). A summary of these classifications follows.

Primary Classifications

Under this system, all surface waters in the state are assigned a *primary* classification that is appropriate to the best uses of that water body (e.g., aquatic life support and swimming). Primary freshwater classifications include the following: *C*, *B* and *WS* (Water Supply) *I* through *WS-V*. The WS freshwater classifications may also include a critical area (CA) designation. The critical area is the area in close proximity to a water supply intake and/or the shoreline of the reservoir. Primary saltwater classifications include *SC*, *SB* and *SA*. SC and SB are saltwater counterparts to the freshwater C and B classifications. SA is a classification assigned to waters used for shellfish harvesting. SA, WS-I and WS-II are also, by definition, considered to be High Quality Waters, as discussed below.

Supplemental Classifications

In addition to primary classifications, surface waters may be assigned a supplemental classification. The supplemental classifications include *HQW* (High Quality Waters), *ORW* (Outstanding Resource Waters), *NSW* (Nutrient Sensitive Waters), *Tr* (Trout Waters) *FWS* (Future Water Supply) and *Sw* (Swamp Waters). Most of these have been developed in order to afford special protection to sensitive or highly valued resource waters. Therefore, while all surface waters are assigned a primary classification, they may also have one or more supplemental classifications. For example, a typical freshwater stream in the mountains might have a C Tr classification where C is the primary classification followed by the Tr supplemental classification.

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 water body to support the uses associated with each classification. Some of the standards, particularly for HQW and ORW waters, outline protective management strategies aimed at controlling point and nonpoint source pollution. These strategies are discussed briefly below. The standards for C and SC waters establish the basic protection level for all state surface waters. With the exception of Sw, all of the other primary and supplemental classifications have more stringent standards than for C and SC and therefore require higher levels of protection.

High Quality Waters

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.

In an effort to protect waters that possess such characteristics, surface waters in the following categories qualify for classification as High Quality Waters or HQW:

1) waters rated as Excellent based on chemical and biological sampling (Division of Water Quality (DWQ) assigns water quality ratings to North Carolina's surface waters based on biological and chemical data);
2) streams designated by the Wildlife Resources Commission as native and special native trout waters or primary nursery areas;
3) waters designated as primary nursery areas by the Division of Marine Fisheries; and
4) critical habitat areas designated by the Wildlife Resources Commission or the Department of Agriculture. Waters classified by the Division of Water Quality as WS-I, WS-II and SA are HQW by definition, but these waters are not specifically assigned the HQW classification because the standards for WS-I, WS-II and SA waters are at least as stringent as those for waters classified as HQW.

Special HQW protection management strategies are presented in 15A NCAC 2B.0201(d), and implemented through 15A NCAC 2B .0224. Copies of these rules can be found in Appendix I. These measures are intended to prevent degradation of water quality below present levels from both point and nonpoint sources. HQW requirements for new wastewater discharge facilities and facilities which expand beyond their currently permitted loadings address oxygen-consuming wastes, total suspended solids, disinfection, emergency requirements, volume, nutrients (in nutrient sensitive waters) and toxic substances.

For nonpoint source pollution, development activities which require an Erosion and Sedimentation Control Plan in accordance with rules established by the NC Sedimentation Control Commission or local erosion and sedimentation control program approved in accordance with 15A NCAC 4B . 0218, and which drain to and are within one mile of HQWs will be required to control runoff from the development using either a low density or high density option described in 15A NCAC 2H. 1006. In addition, the Division of Land Quality requires more stringent sedimentation controls for land disturbing projects within one mile and draining to HQWs.

Outstanding Resource Waters

A small percentage of North Carolina's surface waters have excellent water quality (rated based on biological and chemical sampling) and an associated outstanding resource. The Outstanding Resource Waters rule defines outstanding resource values as:

1) outstanding fishery resource;
2) a high level of water-based recreation;
3) a special designation such as National Wild and Scenic River or a National Wildlife Refuge;
4) being within a state or national park or forest; or
5) having special ecological or scientific significance.

The requirements for ORW waters are more stringent than those for HQWs. Special protection measures that apply to North Carolina ORWs are set forth in 15A NCAC 2B .0225. At a minimum, no new discharges or expansions are permitted, and stormwater controls for most new development 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.

5.4 NORTH CAROLINA'S POINT SOURCE CONTROL PROGRAM

North Carolina does not allow point source discharges without a permit. Discharge permits are issued under the authority of North Carolina General Statute (NCGS) 143.215.1 and the National Pollutant Discharge Elimination System (NPDES) program. The NPDES program was delegated

to North Carolina from the US Environmental Protection Agency. These permits serve as both state and federal permits. North Carolina has a comprehensive NPDES program which includes the permitting of both wastewater and stormwater discharges. Refer to Appendix VI for a full program description.

NPDES permits are issued in two categories; individual or general. Individual permits are issued to a specific facility, contain site specific requirements, and incorporate recommendations from the basinwide water quality management plan. Individual NPDES permits are typically issued for a five year cycle with all permits in a river basin expiring at the same time. This permitting strategy allows for comprehensive review of individual dischargers within the basin and implementation of recommendations contained in the basinwide water quality management plan. New discharge permits issued during an interim period are given a shorter permit cycle so that expiration coincides with the basin cycle. Individual permits in the Broad River basin are scheduled for expiration and renewal in February and March of 1998.

General permits are developed for specific types of industries. Each general permit contains requirements that are appropriate for a typical facility within a specific industrial classification. Facilities that are considered atypical or have a history of water quality problems are required to obtain an individual permit. Because general permits are specific to a type of industrial activity and are issued statewide they do not contain basin specific measures. A general permit is typically issued for a five year cycle, which expires statewide on the same date. All general permits have a permit number that begins with "NCG".

5.4.1 NPDES Permits for Wastewater Discharges

Under the NPDES wastewater permitting program, each NPDES discharger is assigned either *major* or *minor* status. For municipalities, all dischargers with a flow of greater than 1 million gallons per day (MGD) are classified as major.

All new wastewater discharge permit applications must include an engineering proposal which includes a description of the origin, type, and flow of wastewater, a summary of waste treatment and disposal options, and a narrative description of the proposed treatment works and why the proposed system and point of discharge were selected. The summary must contain sufficient detail to assure that the most environmentally sound alternative was selected from the reasonably cost effective options. An assessment report describing the impact on waters in the area must be submitted for all applications of new discharges in excess of 500,000 gallons per day or 10 million gallons per day of cooling water or any other proposed discharge of 1 million gallons per day or more.

Under the NPDES program, wastewater treatment systems must be operated by a certified operator. Training and certification of operators is conducted by the DWQ. It is the goal of the program to provide competent and conscientious professionals that will protect both the environment and public health.

The amount or loading of specific pollutants that are allowed to be discharged into surface waters are defined in the NPDES permit and are called *effluent limits*. Point source discharges generally have the most impact on a stream during low flow conditions when the percentage of treated effluent within the stream is greatest. Effluent limits are generally set to protect the stream during these low flow conditions. The standard low flow used for determining point source impacts is called the *7Q10*. This is the lowest flow which occurs over seven consecutive days and which has an average recurrence of once in ten years. Computer modeling may be used to determine the fate and transport of pollutants, reduction goals for contaminants, and to derive effluent limits for NPDES permits. A wasteload allocation is performed to ensure the effluent limits are set at levels that can be safely assimilated by the receiving stream.

Most dischargers are required to periodically sample their treated effluent. This process is called self-monitoring. Larger and more complex dischargers are also required to sample both upstream and downstream of the discharge point. NPDES facilities are required to monitor for all pollutants for which they have permit limits as well as other pollutants which may be present in their wastewater. Sampling results are submitted to DWQ each month for compliance evaluations. If limits are not being met, various legal actions may be taken against the discharger to ensure future compliance.

All domestic wastewater dischargers are required to monitor flow, dissolved oxygen, temperature, fecal coliform, BOD, ammonia, and chlorine (if they use it as a disinfectant). In addition, wastewater treatment facilities with industrial sources may have to monitor for chemical specific toxicants and/or whole effluent toxicity, and all dischargers with design flows greater than 50,000 gallons per day (GPD) monitor for total phosphorus and total nitrogen. Minimum NPDES wastewater monitoring requirements are provided in 15A NCAC 2B .0500.

Other methods of collecting point source information include effluent sampling by DWQ during inspections and special studies. The regional offices may collect data at a given facility if they believe there may be an operational problem or as a routine compliance check. DWQ may collect effluent data during intensive surveys of segments of streams. Extensive discharger data have been collected during on-site toxicity tests.

A pretreatment program is aimed at protecting municipal wastewater treatment plants and the environment from the adverse impacts that may occur when hazardous or toxic wastes are discharged into a public system. This program requires that businesses and other entities that use or produce toxic wastes pretreat their wastes prior to discharging into a public wastewater system.

5.4.2 NPDES Permits for Stormwater Discharges

As currently defined by the NPDES program, stormwater point source discharges originate from two distinct sources; municipalities and selected industrial facilities. Subject municipalities are defined as those incorporated areas that encompass a population of 100,000 or more. Subject industrial activities are those where stormwater discharges directly related to manufacturing, processing or raw materials storage areas occur. A complete definition of "stormwater discharge associated with industrial activity" including a comprehensive listing of subject industries can be found in 40 CFR 122.26. The types of industrial activities that are subject to stormwater permitting are typically defined by Standard Industrial Classification (SIC) codes. SIC codes have been developed by the federal Office of Management and Budget to define industries in accordance with the composition and structure of the economy.

There are currently 19 general stormwater permits available for specific types of industrial activities across the state. As previously explained, the general permits define stormwater controls and monitoring for a typical facility within a specific industrial classification. General stormwater permits incorporate requirements determined to be appropriate based upon an analysis of available analytical monitoring data, input from industry and associations, site visits, and review of federal and other documents providing guidance on specific types of industries, pollutants, and stormwater discharges.

The North Carolina Department of Transportation (DOT) is subject to the NPDES stormwater permitting program. The permit, when issued, will cover stormwater runoff from DOT's non-administrative activities throughout the state including the state roadway network, construction, vehicle maintenance, and materials storage facilities. The draft permit is currently scheduled to be sent to public notice in 1998.

Stormwater permits may specify monitoring and reporting requirements for both quantitative and qualitative assessment of the stormwater discharge as well as operational inspections of the entire facility. The specific pollutant parameters for which sampling must be performed are based upon the types of materials used and produced in the manufacturing processes and the potential for contamination of the stormwater runoff at a typical facility.

All NPDES stormwater permits require the development and implementation of a Stormwater Pollution Prevention Plan (SPPP). The SPPP requires the permitted facility to develop a comprehensive stormwater management plan. This plan is the basis for evaluating the pollution potential of the site and implementing best management practices (BMPs) to reduce pollutants in runoff from the site.

All stormwater permits specify qualitative monitoring of each stormwater outfall for the purposes of evaluating the effectiveness of the Stormwater Pollution Prevention Plan and assessing new sources of stormwater pollution. Qualitative monitoring parameters include color, odor, clarity, floating and suspended solids, foam, oil sheen, and other obvious indicators of stormwater pollution.

Stormwater permits may provide for the use of cut-off concentrations in order to minimize the required analytical monitoring for facilities which are not significant contributors to stormwater pollution. These cut-off concentrations are not intended to be effluent limits (as used in wastewater permitting), but provide guidelines for determining which facilities are major contributors to stormwater pollution and need further monitoring. The arithmetic mean of all monitoring data collected during the term of the permit must be calculated for each parameter and compared to the permitted cut-off concentration. If the mean is below the cut-off concentration, then the facility may discontinue analytical monitoring for that parameter until the final year of the permit unless changes occur at the facility. This approach prevents facilities from using the cut-off concentrations as target concentrations for evaluating the effectiveness of the Stormwater Pollution Prevention Plan while also ensuring that problem facilities continue to collect analytical data on their discharges.

5.5 NONPOINT SOURCE CONTROL PROGRAMS

Nonpoint source pollution occurs when rainfall or snowmelt runs off the ground or impervious surfaces like buildings and roads and drains into waterways. Some of the most common nonpoint source pollutants and their causes are presented in Chapter 3.

The two approaches that are used to address nonpoint source pollution are prevention and engineered controls. Some of the methods of pollution prevention include optimum site planning, use of natural drainage systems rather than curb and gutter, nutrient management plans, public/farmer education, storm drain stenciling, and hazardous waste collection sites. It is generally more cost-effective to prevent and minimize pollution than to build engineered controls. For example, developers who are subject to stormwater requirements often choose to build low density developments rather than bearing the expense of building engineered BMPs. Engineered BMPs also have on-going expenses associated with long-term operation and maintenance.

Engineered BMPs generally work by capturing, retaining, and treating runoff before it leaves an area. Some commonly used types of BMPs include stormwater wetlands, wet detention ponds, water control structures, bioretention areas, and infiltration basins. Often higher levels of pollutant removal can be achieved by using a combination of different control systems. The main advantage of engineered controls is that they can treat runoff from high density developments.

The current trend is toward a more comprehensive "systems approach" to managing nonpoint source pollution. This involves using an integrated system of preventive and control practices to accomplish nonpoint pollution reduction goals. This approach emphasizes site planning, protecting important natural areas such as wetlands and riparian areas, and finding the most cost-effective engineered controls for high density areas. Programs which are currently using the systems approach include the animal waste regulations and the regulations for coastal stormwater management and water supply watersheds. In general, the goals of the nonpoint source management program include the following:

- Continue to build and improve existing programs,
- Develop new programs to control nonpoint pollution sources that are not addressed by existing programs,
- Continue to target geographic areas and waterbodies for protection,
- Integrate the NPS Program with other state programs and management studies (e.g., Albemarle-Pamlico Estuarine Study), and
- Monitor the effectiveness of BMPs and management strategies, both for surface and groundwater quality.

Table 5.1 lists a number of federal and state programs that address nonpoint source pollution. These programs are listed by category based on the type of activity. A complete program description can be found in Appendix VI for nonpoint source control programs. Refer to Table 5.2 for a brief description of each program and the contact persons within the basin for each program.

Table 5.1 List of Nonpoint Source Programs

PROGRAM	LOCAL	STATE	FEDERAL
AGRICULTURE:			
Agriculture Cost Share Program	SWCD	SWCC, DSWC	
N.C. Pesticide Law of 1971		NCDA	
Pesticide Disposal Program		NCDA	
Animal Waste Management	SWCD	DWQ,DSWC, CES	NRCS
Laboratory Testing Services		NCDA	
Watershed Protection (PL-566)			NRCS
1985 ,1990 and 1995 Farm Bills			USDA
- Conservation Reserve Program			
- Conservation Compliance			
- Sodbuster			
- Swampbuster			
- Conservation Easement			
- Wetland Reserve			
- Water Quality Incentive Program			
URBAN			
Coastal Stormwater Program		DWQ	
ORW, HQW, NSW Management Strategies		DWQ	
Water Supply Watershed Protection Program	city, county	DWQ	
Stormwater Control Program	city, county	DWQ	EPA
CONSTRUCTION			
Sedimentation and Erosion Control	ordinance	DLR, DOT	
Coastal Area Management Act	ordinance	DCM	
Coastal Stormwater Program		DWQ	
ON-SITE WASTEWATER DISPOSAL			
Sanitary Sewage Systems Program	county	DEH	
SOLID WASTE DISPOSAL			
Resource Conservation and Recovery Act			EPA
Solid Waste Management Act of 1989	city, county	DSWM	
FORESTRY			
Forest Practice Guidelines		DFR	
National Forest Management Act			USFS
Forest Stewardship Program		DFR	
MINING			
Mining Act of 1971			DLR
HYDROLOGIC MODIFICATION			
Clean Water Act (Section 404)		DCM, DWQ	COE
Rivers and Harbors Act of 1899			COE
Dam Safety Permit		DLR	
WETLANDS:			
Wetlands Restoration Program		DWQ	
Clean Water Act (Sections 401 and 404)		DWQ	COE
Wetland Reserve Program			USDA

COE: US Army Corps of Engineers
DCM: Division of Coastal Management
NCDA: NC Department of Agriculture
DWQ: Division of Water Quality
DLR: Division of Land Resources
NRCS: Natural Resources Conservation Service
DFR: Division of Forest Resource
DOT: Department of Transportation
SWCC: Soil and Water Cons. Commission
DSW: Division of Soil and Water
DSWM: Division of Solid Waste Mgt.
SWCD:Soil and Water Conservation District
USDA: US Department of Agriculture
USFS: US Forest Service

Table 5.2 Broad River Basin Nonpoint Source Contacts

Agriculture

USDA Natural Resources Conservation Service:

Formerly the Soil Conservation Service; provides technical specialist for certifying waste management plans; certified trainers for swine applicators training sessions works with landowners on private lands to conserve natural resources helping farmers and ranchers develop conservation systems uniquely suited to their land and individual ways of doing business; provides assistance to rural and urban communities to reduce erosion, conserve and protect water, and solve other resource problems; conducts site evaluations and soil surveys; administers the Wetlands Reserve Program; offers planning assistance for local landowners for installing best management practices; offers technical assistance for the determination of wetlands on agricultural lands.

Buncombe County	Loring McIntyre	704-251-4906	31 College Pl Bldg B Asheville NC 28801
Cleveland County	P. Benjamin Robinson	704-482-1906	124-1 South Post Rd Shelby NC 28152
*Gaston County	Garland E. Still	704-922-4181	1303 Cherryville Hwy Dallas NC 28034
Henderson County	Robert V. Carter	704-697-4949	Federal Bdg Rm 100 Hendersonville NC 28792
Lincoln County	Elton Barber	704-736-8501	Citizens Center Lincolnton NC 28092
McDowell County	Albert Moore	704-652-7121	15 N. Garden St. Marion NC 28752
Polk County	Marilyn M. Stowell	704-894-8550	P. O. Box 236 Columbus NC 28722
Rutherford County	Albert Moore	704-287-4817	Federal Bldg Rm 121 Rutherfordton NC 28139

Soil & Water Conservation Districts:

The local Soil and Water Conservation District Boards function under the administration of the North Carolina Soil and Water Conservation Commission (SWCC). The districts are responsible for administer the Agricultural Cost Share Program, identifying treatment areas, allocating resources, signing contractual agreements with landowners, providing technical assistance for the planning and implementation of BMPs and generally encouraging the use of appropriate BMPs to protect water quality.

Buncombe County	Robert M. Swicegood	704-252-1668	10 Round Oak Rd Asheville NC 28801
Cleveland County	Samuel A. Jenkins	704-434-6634	3213 Cliffside Rd Mooresboro NC 28114
*Gaston County	William N. Craig	704-867-6712	315 Union-New Hope Rd Gastonia NC 28056
Henderson County	Joe Lee Heffner	704-891-7531	80 School House Rd Horse Shoe NC 28742
Lincoln County	Blair Goodson	704-428-8300	3123 Buffalo Shoals Rd Maiden NC 28650
McDowell County	C. A. Buckner	704-652-2695	220 Tyler Heights Marion NC 28752
Polk County	Hubert McEntyre	704-863-2528	Rte 2 Box 22 Tryon NC 28782
Rutherford County	W. Henry Edwards	704-245-9752	Rte 1, Box 718 Rutherfordton NC 28139

Division of Soil and Water Conservation:

Provides administrative and technical assistance to the Soil & Water Conservation Districts in areas pertaining to soil science and engineering; distributes Wetlands Inventory maps for a small fee. Administers the Agriculture Cost Share Program (ACSP).

Central Office	Donna Moffitt (ACSP)	919-715-6108	512 N. Salisbury St. Raleigh NC 27626
Area 1	Dave Ferguson	704-251-6452	59 Woodfin Pl Asheville NC 28801

NCDA Regional Agronomists:

Provides technical specialists for certifying waste management plans. Provides certified trainers for animal waste applicators training sessions. Tracks, monitors, and accounts for use of nutrients on agricultural lands. Identifies and evaluates the use of nutrient management plans.

Central Office	Tom Ellis	919-733-7125	Box 27647 Raleigh, NC 27611
Regional Office	Lynn Howard	704-728-4675	604 Pine Mountain Rd Hudson NC 28638

Education

NC Cooperative Extension Service:

Provides practical, research-based information and programs to help individuals, families, farms, businesses and communities.

Buncombe County	Kenneth R. Reeves	704-255-5522	P. O. Box 7667 Asheville NC 28802
Cleveland County	Greg B. Traywick	704-482-4365	130-1 S Post Rd Shelby NC 28904
*Gaston County	Martha Burris	704-922-0301	P. O. Box 476 Dallas NC 28034
Henderson County	Joy S. Staton	704-697-4891	740 Glover St Hendersonville NC 28792
Lincoln County	Kevin D. Starr	704-736-8452	115 W. Main St Lincolnton NC 28092
McDowell County	Daniel B. Smith	704-652-7121	10 E. Court St Marion NC 28752
Polk County	John H. Vining	704-894-8218	P. O. Box 187 Columbus NC 28722
Rutherford County	Darrel L. Conley	704-287-6010	P.O. Box 272 Rutherfordton NC 28139

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.

Central Office	Moreland Gueth	919-733-2162, x255	P.O. Box 29581 Raleigh, NC 27626-0581
Central Office	Mickey Henson	919-733-2162, x206	same as above
Asheville Office	Keith Jenkins	828-667-5211	220 Sardis Road, Asheville, NC 28806
Mt. Holly	Howard Williams	704-827-7576	1933 Mountain Island Hwy., Mt. Holly, NC 28120

General Water Quality

DWQ Water Quality Section:

Control of water pollution from point sources such as municipal and industrial wastewater discharges, and from nonpoint sources that originate from agricultural drainage, urban runoff, land clearing, construction, mining, forestry, septic tanks and land application of waste; issues permits for both discharging and on-site wastewater treatment systems, conducts compliance inspections, operates an ambient water quality monitoring program, and performs a wide variety of special studies on activities affecting water quality; administers the 319 projects statewide.

Central Office	Beth McGee	919-733-5083	P.O. Box 29535 Raleigh NC 27626
Asheville Region	Forrest Westall	704-251-6208	59 Woodfin Pl Asheville NC 28801
Mooresville Region	Rex Gleason	704-663-1699	919 N Main St Mooresville NC 28115

Wildlife Resources Commission:

To manage, restore, develop, cultivate, conserve, protect, and regulate the wildlife resources of the State, and to administer the laws relating to game, game and freshwater fishes, and other wildlife resources enacted by the General Assembly to the end that there may be provided a sound, constructive, comprehensive, continuing, and economical game, game fish, and wildlife program.

Central Office	Frank McBride	919-528-9886	P.O. Box 118 Northside, NC 27564

Table 5.2 Broad River Basin Nonpoint Source Contacts, continued

General Water Quality

U.S. Army Corps of Engineers:

Responsible for: investigating, developing and maintaining the nation's water and related environmental resources; constructing and operating projects for navigation, flood control, major drainage, shore and beach restoration and protection; hydropower development; water supply; water quality control, fish and wildlife conservation and enhancement, and outdoor recreation; responding to emergency relief activities directed by other federal agencies; and administering laws for the protection and preservation of navigable waters, emergency flood control and shore protection. Responsible for wetlands and 404 Federal Permits.

Wilmington District	W.C. Long II	910-251-4745	P.O. Box 1890, Wilmington, NC 28402-1890

DWQ Groundwater Section:

Groundwater classifications and standards, enforcement of groundwater quality protection standards and cleanup requirements, review of permits for wastes discharged to groundwater, issuance of well construction permits, underground injection control, administration of the underground storage tank (UST) program (including the UST Trust Funds), well head protection program development, and ambient groundwater monitoring.

Central Office	Carl Bailey	919-733-3221	P.O. Box 29578 Raleigh, NC 27626-0578
Asheville Region	Don Link	704-251-6208	59 Woodfin Pl Asheville NC 28801
Mooresville Region	Barbara Christian	704-663-1699	919 N Main St Mooresville NC 28115

Construction/Mining

DENR Division of Land Resources:

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

Central Office	Mel Nevills	919-733-4574	512 N. Salisbury St. Raleigh NC 27626
Asheville Region	Richard Phillips	704-251-6208	59 Woodfin Pl Asheville NC 28801
Mooresville Region	Zahid Khan	704-663-1699	919 N Main St Mooresville NC 28115

Solid Waste

DEH Solid Waste Management:

Management of solid waste in a way that protects public health and the environment. The District includes three sections and one program -- Hazardous Waste, Solid Waste, Superfund, and the Resident Inspectors program.

Central Office	Dexter Matthews	919-733-0692	401 Oberlin Rd Ste 150 Raleigh NC 27605
Asheville Region	Albert Hetzell	704-251-6208	59 Woodfin Pl Asheville NC 28801
Mooresville Region	Richard Doby	704-663-1699	919 N Main St Mooresville NC 28115

Table 5.2 Broad River Basin Nonpoint Source Contacts, continued

On-Site Wastewater Treatment

Division of Environmental Health and County Health Departments:

Safeguards life, promotes human health, and protects the environment through the practice of modern environmental health science, the use of technology, rules, public education, and above all, dedication to the public trust.
Services include:

- Training of and delegation of authority to local environmental health specialists concerning on-site wastewater
- Engineering review of plans and specifications for wastewater systems 3,000 gallons or larger and industrial process wastewater systems designed to discharge below the ground surface
- Technical assistance to local health departments, other state agencies, and industry on soil suitability and other site considerations for on-site wastewater systems.

DEH Central Office	Steve Steinbeck	919-715-3273	2728 Capital Blvd. Raleigh, NC 27604
Buncombe County	Ken Castelloe	704-255-5691	35 Woodfin St Asheville NC 28801
Cleveland County	Marty Allen	704-484-5130	315 Grover St Shelby NC 28150
*Gaston County	Scott Wilson	704-853-5200	991 W Hudson Blvd Gastonia NC 28052
Henderson County	Robert Smith	704-692-4228	1347 Spartanburg Hwy Hendersonville NC 28792
Lincoln County	David Buckner	704-736-8426	302 N Academy St Lincolnton NC 28092
McDowell County	Frederick Matthews	704-287-6100	221 Callahan Koon Rd Spindale NC 28160
Polk County	Frederick Matthews	704-287-6100	221 Callahan Koon Rd Spindale NC 28160
Rutherford County	Frederick Matthews	704-287-6100	221 Callahan Koon Rd Spindale NC 28160

Note: *Less than 5% of Gaston County is in the Broad River Basin.

- DENR Asheville Region consists of the following counties: Cherokee, Graham , Swain, Haywood, Madison, Yancey, Mitchell, Avery, Caldwell, Burke, McDowell, Buncombe, Jackson, Macon, Clay, Transylvania, Henderson, Polk, and Rutherford.
- DENR Mooresville Region consists of the following counties: Cleveland, Alexander, Catawba, Lincoln, Gaston, Iredell, Mecklenburg, Union, Stanly, Cabarrus, and Rowan.

North Carolina NPS Management Program

This Nonpoint Source Management Program fulfills the requirements of the Water Quality Act of 1987 by identifying statewide NPS programs, listing BMPs used to reduce pollution loadings, and outlining an action plan to implement the Program. These Program components have been considered for the following categories of NPS pollution: agriculture, urban, construction, on-site wastewater disposal, solid waste disposal, forestry, mining, and hydrologic modification. Programs and plans are also developed for wetlands, groundwater, and other NPS related efforts, such as educational initiatives. Tasks to be undertaken in the next four years are developed by NPS agencies statewide. More specific NPS action plans and targeted watersheds are developed and listed in each of the Basinwide Water Quality Management Plans.

Clean Water Act Section 319(h) grant monies are made available to the states on an annual basis by EPA for implementation of BMPs. NPS agencies, local governments, and universities submit proposals to DWQ each year for use of these funds in various projects. Projects that have been funded in the past include BMP demonstrations, watershed water quality monitoring and improvement projects, data management, educational activities, modeling, stream restoration efforts, riparian buffer establishment, and streambank restoration.

Use Restoration Waters Program
The North Carolina Division of Water Quality is currently developing the Use Restoration Waters (URW) program to restore surface waters to their designated uses. If adopted, this program would allow the state to work with local governments, businesses, and residents to develop management strategies appropriate for the area. In order to be effective, the URW program would include a mix of mandatory and voluntary programs. The URW program would attempt to develop cooperative relationships among agencies so that overlapping efforts can be consolidated and targeted to restore designated water body uses.

5.6 PROGRAM INITIATIVES IN THE BROAD RIVER BASIN

Through the development of this plan, efforts were made to identify efforts that have been undertaken within the basin to protect water quality. The following discussion focuses on program initiatives that have been implemented or are underway within the Broad River basin. These initiatives demonstrate a tremendous effort to protect surface waters in the basin. There may be other initiatives underway in the basin of which we are not yet aware. Table 5.3 presents a summary of the agency or organizations that have program initiatives in the basin.

Table 5.3 Program Initiatives in the Broad River Basin

Level of Agency	Name of Agency	Type of Initiative
Federal	US Department of Agriculture - National Resource Conservation Service	Various Projects
State	NC Soil and Water Conservation District	Various Projects
State	NC Division of Environmental Health	Various Projects
State	NC Department of Agriculture	Various Projects
State	Cooperative Extension Service	Various Projects
State	NC Division of Land Resources	Sedimentation Pollution Control Act
Local Govt. and Citizen Groups	Mountain Valleys Resource, Conservation and Development Council	Various Projects
Local Govt. and Citizen Groups	Rutherford County	Various Projects

5.6.1 Federal Initiatives

US Department of Agriculture, Natural Resource Conservation Service (NRCS):

- Assist farmers in obtaining Agriculture Cost Share funds for no-till farming practices.
- Organizes Environmental Field Days at local schools.
- Administers Second Broad Flood Control Program.
- Conducts Environmental Quality Incentives Program (EQIP) sign up.

5.6.2 State Agency Initiatives

Cooperative Extension Service:

- Conducts ongoing IPM, integrated pest management, programs for farmers to reduce pesticide and fertilizer use, promotes good stewardship of agricultural chemicals.
- Conducts no-till program which started in 1979 with small grains and cotton. (75-80% of the crops in Cleveland County are currently in no-till).
- Informs producers of environmentally beneficial farming practices, especially no-till.
- Conducts on-the-farm demonstrations of chemical usage.
- Investigating the application of municipal sludge on farm fields in Rutherford County.
- Researching alternative forestry road design in Rutherford County.
- Promoting community beautification and stream clean up.
- Rutherford CES conducts Solid Waste Environmental Energy Panel (SWEEP), a program which educates adults and youth (4th and 5th) graders about recycling.

NC Department of Agriculture:

- Provides soil testing service to farmers. This ensures that productivity is maximized while reducing indiscriminate nutrient applications.
- Conducts a fertilizer and lime quality control program to make site and crop specific application recommendations.
- Provides nematode eradication advice to farmers. The strategies include crop rotation, resistant crop varieties and the use of nematicides. Nematodes have been found in area apple orchards.
- Promotes no-till cotton.
- Provides plant tissue analysis service (cotton, mostly) to farmers. This service provides the opportunity for farmers to monitor the nutritional status of growing crops. This provides farmers with the necessary information to select and apply only those nutrients that are needed.

Eight regional agronomists statewide provide on-site assistance to help growers implement management recommendations in a cost-effective and environmentally sound manner.

NC Division of Environmental Health:

- Conducts annual onsite sewage conference to update engineers and state agents (environmental health specialists in health departments) on latest technology to abate pollution from septic tank systems.
- Reviews two health department septic tank programs per year for quality assurance.
- Provides an annual 3 day Advanced Soils or Advanced Septic Tank Systems Course to health department agents.

NC Division of Land Quality:

The NC Division of Land Resources (DLR) is responsible for administering the Sedimentation Pollution Control Act of 1973 (SPCA). Since the inception of the SPCA, the Sedimentation control Commission has funded extensive workshops and educational programs aimed at children throughout the state. During fiscal year 1996, the DLR conducted workshops and symposiums, funded research and intern programs, reprinted manuals and developed video modules and

produced newsletters on a budget of over $270,000 for the entire state. The DLR has the following materials available.

- Erosion and Sediment Control Field Manual
- Erosion and Sediment Control Practices: Video Modules
- Erosion and Sediment Control "Inspector's Guide"
- Erosion and Sediment Control Planning and Design Manual
- "Erosion Patrol" Package for Grade 3

The DLR is also implementing various measures for protecting water quality statewide. These measures include:

- Coordinating the targeting and tracking of BMPs implementation in the basin.
- Conducting two workshops for public, regulated community and local governments on sediment reductions achievable through the requirements of the Sedimentation and Erosion Control Act.
- Enforceing existing sediment related rules and evaluate need for additional mandatory measures.

NC Division of Soil and Water Conservation (DSWC):

- The NC Division of Soil and Water Conservation administers the *NC Agriculture Cost Share Program for Nonpoint Source Pollution Control (NCACSP)*. This program provides incentives to farmers to install best management practices (BMPs) by offering to pay up to 75% of the average cost of approved BMPs. The NC Agriculture Cost Share Program funding totals for the Broad River basin from 1985 through 1995 is $391,254. Farmers in the basin have spent up to $130,418 in matching funds for cost share money. The cost share figures include a wide array of BMPs including conservation tillage, sod based rotation, diversions, critical area planting, crop conversion to grass, trees, spring development, stock trails, land application of waste, livestock exclusion, waste management.

Soil and Water Conservation Districts (SWCD):

- Administers ACSP (particularly animal waste BMPs, cropland conversion, livestock watering with fencing).
- Conducts education programs like a poster contest for school-age children and conservation field days for 5th graders.
- Implements Sandy Run Creek management plan (Rutherford and Cleveland Cos) for the past 20 years;
- Implements Second Broad flood control program for the past 15 to 20 years; Recognition of local farmers for practicing conservation.

NC Forest Service:

The North Carolina Division of Forest Resources (DFR) is implementing various measures for protecting water quality statewide. These measures began with the creation of voluntary *Forest Practices Guidelies Related to Water Quality* (FPGs). These measures were voluntarily applied best management practices, which had no enforcement power by any agency. In 1989, the Sedimentation Pollution Control Act (SPCA) was amended to require compliance with nine performance standards in order to remain exempt from the SPCA's permitting requirements. These nine standards are the FPGs whose compliance is accomplished through the use of BMPs. The *Forestry Best Management Practices Manual* was published in September, 1989 to guide forestry operations in protecting water quality. The manual and the FPGs are available from any

DFR office at no charge. Additional measures by the DFR include logger training in water quality/FPG issues through the ProLogger Program, which is a joint effort by the DFR, NC Forestry Association and the Cooperative Extension Service to provide training to loggers on Forest Management and the Environment, Safety and Business. Statewide as of 2-24-98, there have been 2002 graduates from the program. During the course of providing forest management advice to landowners, work to inform and educate them on proper harvesting techniques and water quality protection methods needed for their specific tract.

- Conducts Pro Logger Program: voluntary effort started three years ago; seeks to educate loggers about forestry BMPs, proper forestry techniques (especially road construction), safety, and adminstration. Special recognition is given to loggers that complete the program.
- Educate land owners about proper harvesting and forestry development on an as needed basis.
- Paricipates on basin Nonpoint Source Teams

5.6.3 Local Government and Citizen Initiatives

Mountain Valleys Resource Conservation and Development Council (RC&D)

- Coordinates program activities in eight mountain counties.

Lake Advisory Committee

- Developing a lake management plan that addresses the sedimentation from development around Lake Lure.

Volunteer Water Initiative Network (VWIN)

- Conducts water quality monitoring in Polk County, Henderson County, Buncombe County, and around Lake Lure. Within these programs, there are a total of 25 sampling sites in the Broad River basin.

NC Farm Bureau

- Promotes no-till farming. Rutherford County owns two no-till drills, mostly for forage, wheat, oak, and soybean crops. The program started 20 years ago with the purchase of the first drill; the second drill was purchased 2 years ago. In the past 2 years, 1000 acres has been worked in no-till with the 2nd drill.

5.7 Integrating Point And Nonpoint Source Pollution Control Strategies

Integrating point and nonpoint source pollution controls and determining the amount and location of the remaining assimilative capacity in a basin are key long-term objectives of basinwide management. The information is used for a number of purposes including: determining if and where new or expanded municipal or industrial wastewater treatment facilities can be allowed; setting the recommended treatment level at these facilities; and identifying where point and nonpoint source pollution controls must be implemented to restore assimilative capacity and maintain water quality standards.

Total Maximum Daily Loads

The U.S. Environmental Protection Agency (USEPA) has developed the means to help accomplish these objectives. The approach, called *total maximum daily loads (TMDL)*, uses the concept of

determining the total waste (pollutant) loading from point and nonpoint sources that a waterbody (such as a stream, lake or estuary) can assimilate while still maintaining its designated uses. USEPA requires the TMDL approach pursuant to Section 303(d) of the Clean Water Act.

Under the TMDL approach, waterbodies that do not meet water quality standards are identified. States establish priorities for action, and then determine reductions in pollutant loads or other actions needed to meet water quality goals. The approach is flexible and promotes a watershed approach driven by local needs and States' priorities. The overall goal in establishing a TMDL is to establish the management actions on point and nonpoint sources of pollution necessary for a waterbody to meet water quality standards.

As DWQ improves its abilities to quantify and predict the impacts of point and nonpoint source pollution, the basinwide approach will make more innovative management strategies possible.

Other Possible Strategies

- *Agency banking* refers to the concept of holding assimilative capacity in reserve by DWQ for future growth and development in the basin.
- *Pollution trading* involves trading of waste loading and stream assimilative capacity among permitted dischargers, or between point and nonpoint sources, adding flexibility to the permitting system and using the free market system as an aid to identifying the most cost effective solution to water quality protection. Nutrient trading is currently being done in the Tar-Pamlico River basin and is being considered for the Neuse River basin.
- *Industrial recruitment mapping* involves providing specific recommendations on the types of industry and land development best suited to the basin's long-term water quality goals and an individual basin's ability to assimilate a particular type or quantity of discharge or nonpoint source pollutants.
- *Consolidation of wastewater discharges*, also referred to as regionalization, entails combining several dischargers into one facility. Local authorities, regulated industries, landowners, and other interested parties are encouraged to provide ideas to develop these strategies. By accommodating, to the degree possible, local needs and preferences, the probability of the plan's long-term success will be increased.

5.8 POTENTIAL SOURCES OF FUNDING FOR WATER QUALITY PROJECTS

There are numerous sources of funding for all types of water quality projects. The sources of funding include federal and state agencies, nonprofits, and private funding. Funds may be loans, cost-shares, or grants that require a match. Section 319(h) grants are discussed in some detail in Section 5.8.1. Other funding sources are listed in Section 5.8.2.

If a local government, environmental group, university researcher, or other individual or agency wants to find funding to address a local water quality problem, it is well worth the time to prepare a thorough but concise proposal and submit it to applicable funding agencies. The list of goals for Section 319(h) proposals can be used as a guideline for other funding agencies. Even if a project is not funded, persistence may be beneficial when funding agencies observe several consecutive proposals from the same group.

5.8.1 Section 319 Grants

Clean Water Act Section 319(h) grant monies are made available to the states on an annual basis by EPA. Agencies in the state that deal with NPS problems submit proposals to DWQ each year for use of these funds in various projects. Projects that have been funded in the past include BMP

demonstrations, watershed water quality improvement projects, data management, educational activities, modeling, stream restoration efforts, riparian buffer establishment, and others. DWQ established a Workgroup process in 1995 for prioritizing and selecting projects from the pool of cost-share proposals and includes this list in its annual application to EPA. The Workgroup consists of representatives from the state and federal agencies that deal with NPS issues, including agricultural, silvicultural, on-site wastewater, mining, solid waste and resource protection.

DWQ staff first reviews proposals for minimum 319 eligibility criteria such as:

- Does it support the state NPS Management Program milestones?
- Does the project address targeted, high priority watersheds (See Table 5.4)?
- Is there sufficient nonfederal cost-share match available (40% of project costs)?
- Is the project period adequate?
- Are measurable outputs identified?
- Is monitoring required? Is there a QA/QC plan for monitoring?
- If GIS is used, is it compatible with those of the state?
- Is there a commitment for educational activities and a final report?

Workgroup members separately review and rank each proposal which meets the minimum Section 319 eligibility criteria. In their review, members consider such factors as: technical soundness; likelihood of achieving water quality results; degree of balance lent to the statewide NPS Program in terms of project type; and competence/reliability of contracting agency. They then convene to discuss individual projects' merits, to pool all rankings and to arrive at final rankings for the projects. The Workgroup seeks a balance between geographic regions of the state and types of projects. All proposals that rank above the funding target are included in the annual grant application to EPA, with DWQ reserving the right to make final changes to the list. Actual funding depends on approval from EPA and yearly Congressional appropriations.

While it is preferable that 319(h) proposals address high or medium priority watersheds, it is not a requirement. However, the Workgroup has agreed to reserve approximately 40% of the competitive funds for the FY99 grant for porjects in impaired waters.

All proposals that rank above the annual funding target are included in the grant application to EPA, with DWQ reserving the right to make final changes to the list. Obtaining the funding depends on approval from EPA and yearly Congressional appropriations. To obtain more information about applying for section 319(h) grants, contact:

Linda Hargrove, DWQ - Planning Branch
P.O. Box 29535, Raleigh, NC 27626-0535
(919) 733-5083 ext. 352

Table 5.4 Nonpoint Source (NPS) 319 Priority Ratings for Non-Coastal Waters

High priority waters

- monitored waters that have an overall use support rating of non-supporting,
- monitored waters that have a use support rating of partially supporting but have a high predicted loading for one or more pollutants,
- highly valued resource waters as documented by special studies
  - High Quality Waters
  - Outstanding Resource Waters
  - Water Supply I, Water Supply II, Critical areas of WS-II, WS-III or WS-IV

Medium priority waters

- monitored waters that have an overall use support rating of partially supporting,

Low priority waters:

- All other waters not considered high or medium priority

5.8.2 Wetlands Restoration Program

The North Carolina Wetlands Restoration Program (NCWRP) is responsible for implementing wetland and stream restoration projects on a basinwide scale throughout the state (See Appendix VI for more details). The focus of the program is to enhance water quality, flood prevention, fisheries, wildlife habitat and recreational opportunities. The NCWRP is not a grant program. However, it can compliment grant programs like the Section 319 program by taking on restoration projects identified through Section 319 grant applications. Alternatively, studies funded by Section 319 to identify suitable stream or wetland restoration sites can then be implemented by the NCWRP. The NCWRP can also directly fund other stream or wetland restoration sites identified by Nonpoint Source Teams or other means, provided those sites are located within a priority subbasin, as determined by the NCWRP. Finally, the NCWRP can perform restoration projects cooperatively with other state or federal programs, or with environmental groups. For more information on the NCWRP, contact Ron Ferrell at (919) 733-5083, ext. 358.

5.8.3 Other Sources of Funding

Besides Section 319(h) funding, there are numerous sources of funding for all types of water quality projects. The sources of funding include federal and state agencies, nonprofit, and private funding. Funds may be loans, cost-shares, or grants.

If a local government, environmental group, university researcher, or other individual or agency wants to find funding to address a local water quality problem, it is well worth the time to prepare a thorough but concise proposal and submit it to applicable funding agencies. The list of goals for Section 319(h) proposals can be used as a guideline for other funding agencies. Even if a project is not funded, persistence may be beneficial when funding agencies observe several consecutive proposals from the same group.

Tables 5.5 and Appendix VI provide summaries of the agencies that are potential sources of funds for point sources of pollution. Table 5.6 and Appendix VI provide summaries of the agencies that are potential funding sources for nonpoint sources of pollution.

In addition to these sources, the Clean Water Management Trust Fund will be another source of funding for both point and nonpoint sources of pollution. The 1996 General Assembly earmarked 6.5% annually of the year end General Fund credit balance to help finance projects that address water pollution problems and focus on upgrading surface waters, eliminating pollution and protecting and preserving unpolluted surface waters. Contact the Executive Director, Dave McNaught, at (919) 830-3222 and refer to Appendix VI for more details on this program.

Table 5.5 Funding Agencies for Assistance With Point Sources

Source	Agency and Name of Funding Source
Federal	U.S. Rural Utilities Service: Water and Wastewater Loan and Grant Program Rural Business and Cooperative Service: Rural Business Enterprise Grants U.S. Economic Development Administration: Public Works and Development Facilities Grant Program
State	NC Division of Water Quality: Construction Grants and Loans Program NC Division of Community Assistance: Small Cities Community Development Block Grant NC Commerce Finance Center: Industrial Development Fund
Private	Rural Economic Development Center, Inc.: Supplemental and Capacity Grants Program

Table 5.6 Funding Agencies for Assistance with Nonpoint Sources

Type of Assistance	Agency and Name of Funding Source
Agriculture	NC Agriculture Cost Share Program for NPS Pollution Control (NCACSP) Environmental Quality Incentives Program (EQIP) Conservation Reserve Program (CRP) Wetland Reserve Program (WRP) Small Watershed Program, PL-566 Conservation Easement Soil and Water Conservation Loan Program
Education	GTE Foundation Toyota TAPESTRY Grants National Environmental Education and Training Foundation (NEETF)
Water Quality Planning	Section 205(j) Water Quality Planning Grants
Stream Restoration	NC Division of Water Resources Stream Repair Funding
Forestry	Forestry Stewardship Incentive Program Forestry Incentives Program
Land Conservation	National Wetland Priority Conservation Plan NC Conservation Tax Credit Program Federal Wild and Scenic Rivers Program Emergency Wetlands Resources Act of 1986

CHAPTER 6

MAJOR BASINWIDE WATER QUALITY CONCERNS AND RECOMMENDED MANAGEMENT STRATEGIES

6.1 INTRODUCTION

Major concerns for water quality in the Broad River basin include addressing impacts from wastewater treatment plants, controlling sedimentation, addressing nonpoint source impaired waters, assuring balanced growth and maintaining current high levels of water quality.

Relative to other basins in North Carolina, few waters in the Broad River basin (only 3 percent of the total number of stream miles) are considered impaired. The challenge during the next five years will be to maintain the quality of waters where data indicates that conditions are good, and to take strides to improve the quality of waters that are exhibiting degradation.

The long range mission of basinwide management is to provide a means of addressing the complex problem of planning for increased development and economic growth while protecting and/or restoring the quality and intended uses of the Broad River basin's surface waters. Sediment and other priority issues are discussed in Section 6.2, below. In striving towards its mission, DWQ's highest priority near-term goals are as follows:

- **To identify and restore impaired waters in the basin.** Section 6.3 discusses impaired and threatened waters and how these waters are prioritized for restoration and protection. Priority Issues and Recommended Management Strategies are presented for each subbasin in Section 6.4.
- **To identify and protect high value resource waters and biological communities of special importance.** Section 6.5 discusses management strategies for protecting important biological communities in the basin.
- **To manage the causes and sources of pollution so as to ensure the protection of those waters currently supporting their uses while allowing for reasonable economic growth.** Major water quality issues addressed under this topic in Section 6.6 include, management strategies for controlling sedimentation, nonpoint source pollution from agriculture, urban and industrial stormwater control, fecal coliform bacteria, toxic substances and oxygen-consuming wastes.

6.2 MAJOR WATER QUALITY CONCERNS AND PRIORITY ISSUES

6.2.1 Addressing Impacts From Wastewater Treatment Plants

Although much progress has been made in the treatment of wastewater over the past 20 years, three of the four streams in the basin that are impaired based on recent water quality sampling are impacted by point source discharges. In most of the cases, actions have been or will be taken in the foreseeable future to mitigate these impacts. However, it will be important during this basinwide planning cycle for DWQ to continue to work with the wastewater discharges of concern to make appropriate improvements to protect water quality.

6.2.2 Controlling Erosion and Sedimentation

Erosion, and the resulting sedimentation, are prevalent throughout the basin. Of the 48 miles of streams that are considered impaired, 15 are impacted by sediment. In addition, there are approximately 112 miles of streams that are considered threatened because of impacts from sediment. Workshop participants (Section 6.2.3) and Nonpoint Source Team members (Section 6.2.2) have expressed that an important priority issue for the basin is sedimentation. Many waters in the basin are thought to be impacted or impaired, at least in part, by sedimentation (Table 4.17 in Chapter 4). The sources of sedimentation are discussed in detail in Chapter 3, programs to address erosion and sedimentation are discussed in Chapter 5 and Appendix VI, some of the actions being taken at the local level are discussed in Chapter 5, Section 5.6. General management strategies for controlling sedimentation are presented in Section 6.5.

6.2.3 Addressing Nonpoint Source Impaired Waters

Pollution from nonpoint sources is identified as the major contributor to water quality impairment in the Broad River Basin. Ninety-five percent of the 48 miles of waters that are impaired are thought to be impacted, at least in part, by nonpoint sources of pollution. It is recognized that in some cases the information that DWQ has concerning nonpoint source contributions from land uses such as agriculture are dated and general. Accomplishments in managing runoff from agriculture and animal operations that have occurred during the last five years or so (such as Conservation Management Plans in compliance with the Farm Bill, or improved management of waste from animal operations in compliance with new regulations) are not reflected in this information. The reason for this is that the implementation of these programs is just beginning to occur or has occurred subsequent to the purview of water quality assessments available. However, agriculture remains prominent in the landscape of the river basin and it will be important to work toward further gains in this area in order to protect water quality.

In addressing nonpoint sources of pollution, it is important to acknowledge agency and local government resource constraints to taking actions to tackle these problems. The task of confirming and clearly identifying exact sources, developing management strategies, implementing best management practices and monitoring for water quality improvements is clearly beyond the current resources of DWQ, other agencies involved in managing nonpoint sources and local governments. Only limited progress can be expected unless substantial resources are put toward solving nonpoint source problems. Therefore, due to the lack of resources, this basinwide plan lacks specific strategies to address nonpoint source pollution.

As one means of addressing this problem, DWQ has formed a voluntary nonpoint source team for the basin. Working with the NPS Team (a knowledgeable team of local professionals and stakeholders) is an avenue for identifying NPS priorities as well as targeting and coordinating existing resources within a basin. The NPS Team for the Broad River Basin is currently working to develop a project proposal for funding through the federal NPS program (Section 319). The team members participate voluntarily within their existing resource constraints. Limited progress can be expected in restoring impaired waters through the team without additional resources.

The Broad River NPS Team is one of a number of teams that DWQ has begun setting up in each of the state's 17 major river basins. These teams have representatives from agriculture, urban stormwater, construction, mining, on-site wastewater disposal, forestry, solid waste, wetlands, groundwater, natural resource agencies, local governments, special interest groups and citizens. Team members are asked to 1) provide descriptions of current NPS management activities within a basin, 2) conduct assessments of NPS controls in targeted watersheds, 3) prioritize impaired waters for development and implementation (including funding) of restoration strategies and 4) prioritize NPS issues for remedial action. Each team is asked to develop five year action plans to reflect these priorities.

The Broad NPS Team has identified team goals for abating nonpoint source pollution in the river basin as well as the conditions needed to reach those goals. A summary of the results is presented in Table 6.1 below. DWQ will continue to work with the Team to refine these goals and incorporate them into a plan of action; however, limited progress is expected on restoring impaired waters without additional resources.

Table 6.1 Goals and Needs Identified by the Broad NPS Team

Category	Goal	Need
Recreation	Expand recreation use of local parks and natural areas, particularly around Green River and the Rocky Broad	More public access to recreational areas along rivers and streams
Public Education	Produce brochures to educate the public about public access to recreational areas around local rivers and streams	Non-threatening, repetitive public education
Sedimentation and erosion from development	Promote the adoption of sediment erosion control ordinances	A minimum standard for development (for human protection, sanitation, density, conservation easement, etc.).
General Public Involvement	Generate more environmental stewardship	An 'everyone is affected' attitude

6.2.4 Growth Management

Based on data from the USDA Natural Resources Conservation Service, the most significant land cover change between 1982 and 1992 was a 71% increase in the amount of urban land. In addition, census data from 1970 to 1990 indicates that the population of subbasin 03 (the upper Green River area) increased by 70% and the population of subbasin 05 (Buffalo Creek) increased by 26%. As the Charlotte area continues to grow and as people from a variety of areas continue to pursue second home development in the North Carolina mountains, the pressures of growth will continue in this region. Proactive planning efforts at the local level are needed to assure that development is done in a manner that preserves the quality of the basin's surface waters, and important resource for residents. These planning efforts will need to find a balance between water quality protection, natural resource management and economic growth. Growth management requires planning for the needs of future population increases as well as maintaining a strong tourism base. These actions are critical to water quality management and the quality of life for the residents of the basin. The recommendations in section 6.6.4 for urban stormwater control contain ideas that can help alleviate the impacts from growth.

6.2.5 Priority Issues and Recommended Actions Identified by Workshop Participants

Broad River Basinwide Planning Workshops were conducted on June 2 and 3 in Spindale, Lake Lure and Shelby, North Carolina. There were a total of 90 registered participants representing the following interests:

23 City and County Government
21 Business and Industry
17 Farmers and Landowners
17 State and Federal Government
7 Citizen Organizations
3 Academic Institutions
2 Cooperative Extension Service

Workshop participants divided into small discussion groups to address the question: "What are the priority water quality issues in the Broad River Basin?" Each participant was then given five votes to apply to those issues that they believed to be the most important on the list they generated. The following general categories were distilled from the information generated in the subgroups.

* *sedimentation* - identification of sources (agriculture, forestry, development), the need for regulation and education, and stream erosion
* *color* - color standards for industry, cost of treatment (problem in water supplies)
* *education* - public education and awareness on water quality issues, regulation, methods to avoid nonpoint source pollution
* *enforcement* - better enforcement needed for existing regulations, more staff needed
* *management of nonpoint source pollution*
* *the need for fair, equitable, common-sense regulations* - better enforcement of regulations is wanted, but participants stressed the need for fair, equitable, common-sense regulations that were effective but not overly costly

These categories and associated specific comments are presented in more detail in Table 6.2 along with reference to sections of this basinwide management plan where applicable. While each identified issue may not be directly responded to in the plan, an effort has been made to consider these issues within the framework of the basinwide approach. Where there has been some discussion about the category or specific comments within the plan, the table provides this reference.

Table 6.2. Priority Water Quality Issues Identified by Workshop Participants and Reference Sections in the Broad River Basinwide Water Quality Management Plan

General Category	Specific Comments	Reference Section
Sedimentation	Siltation from forestry operations, clear-cutting; DOT projects; Unpaved roads; Soil disturbance from new development; Disturbance from dredging; Bank erosion	3.2.1, 6.6.1
Color	Need for a standard; Effect on recreational uses of waters; Effect on water supply	3.2.3, 6.6.2
Education	About erosion control and sedimentation; For: golf course owners, politicians, homeowners, and others	6.6, Appendices V and VI
Enforcement	Need proper monitoring of point sources; Public notification about sedimentation and erosion control violations; Consistent application of sedimentation and erosion control laws; Need better enforcement of existing standards	5.6.2, 7.3.1
General Nonpoint Source Pollution	Growth; Urban runoff; Loss of buffers (filter land); Runoff from junkyards; Control of petroleum products, waste oil from nonpoint sources; Septic system concerns; Fertilizer runoff from lawns; Straight pipes; Trash and litter control needed	3.4, 3.4.6, 5.5
Common-sense and fair regulations	Need reasonable effluent standards for municipalities; Need to compensate the regulated community; Need reasonable regulations for livestock and agriculture; Make decisions based on science, not emotions; Don't unfairly regulate point sources when nonpoint sources are the problem	5.7
Natural resource preservation	Wildlife; Recreation and aesthetic values; Fisheries; Water supplies; Concern about secondary impacts of chip mills	7.2.2, 3.4.4, 2.6
Specific areas of concern	Second Broad River (sedimentation and point source pollution); Landfill near Moss Lake (need to continue close monitoring); Rutherford County needs county-wide sewage treatment; Spindale wastewater treatment plant does not accept septic tank waste because it contains mercury	6.4.2, 7.3.6

6.3 IDENTIFICATION AND RESTORATION OF IMPAIRED WATERS

6.3.1 What Are the Impaired Waters?

Impaired waters are those waters identified in Chapter 4 as partially supporting or not supporting their designated uses. Table 6.3 presents partially supporting (impaired) waterbodies in the Broad River basin based on monitored data. The table includes the probable source of impairment, a summary of the recommended management strategy and the section in Chapter 6 that discusses the issue in more detail. Table 6.4 is essentially the same, except these are waters that are considered impaired based on evaluated data. Waters that are impaired based on 'monitored' information have been assessed using recent data, while the evaluated information is older (> 5 years) and may not reflect current conditions. But, since it is the best information that is currently available, water

quality conditions may still be depressed and these areas warrant attention. Chapter 4 provides a detailed explanation of use support ratings.

As mentioned in section 6.2.2, it is recognized the information that DWQ has regarding probable sources of impairment from nonpoint source contributions are imperfect. Tables 6.3 and 6.4 indicate that most of the waters are impaired due to some type of nonpoint source pollution. It is important to acknowledge that these represent the best information available at this time. It is understood that this information may not reflect significant management accomplishments that have been made in recent years. For example, in the agricultural sector, farmers have made important advances in managing runoff from crops and animal operations (through the implementation Conservation Management Plans in compliance with the Farm Bill, or improved management of waste from animal operations in compliance with new regulations). These advances may be reflected in the results of water quality sampling, but, where impairment still exists (as reflected in the following tables), staff rely on available information to identify a probable source of the problem. The NPS Team may be able to help update this information.

Table 6.3 Recommended Management Strategies for *Monitored Impaired Waters in the Broad River Basin

Waterbody (subbasin)	Use Support Rating	Probable Source of Impairment	Recommended Management Strategy	Chapter 6 Reference Section
Walnut Creek (030802)	PS	nonpoint source(s) (possibly agricultural runoff)	The landuse in the immediate vicinity of the monitoring location is primarily fallow agricultural fields. DWQ should work with the local agricultural agencies to help farmers in this watershed ensure that appropriate measures are taken to minimize runoff into surface waters from agricultural activities (resources permitting**).	6.4.2
Catheys Creek (030802)	PS	point source (Spindale) and nonpoint source(s) (possibly agricultural runoff)	DWQ will continue to work with point sources to ensure protection of the surface waters through compliance with effluent limits. DWQ should also work with local experts to assess NPS contributions to impairment (resources permitting**).	6.4.2
Beaverdam Creek (030804)	PS	point sources (four small discharges) and nonpoint sources (erosion, sand dredging)	DWQ will require that four discharges upstream of the monitoring site conduct instream monitoring to determine to what extent they are contributing to impairment. DWQ should also work with local experts to assess NPS contributions to impairment as well as the impact of the dredging project (resources permitting**).	6.4.4
Lick Branch (030805)	PS	point source (New Minnette Textiles)	DWQ will monitor the stream for progress since improvements were made to point source situation in late 1995.	6.4.5

** Based on monitored data collected between 1992 and 1996.*
*** Only limited progress towards developing and implementing nonpoint source strategies for these impaired waters can be expected without additional resources.*

Table 6.4 Recommended Management Strategies for Impaired Waters in the Broad River Basin Based Evaluated Information

Waterbody (subbasin)	Use Support Rating	Probable Source of Impairment	Recommended Management Strategy	Chapter 6 Reference Section
Hollands Creek (030802)	NS	point source(s)	Spindale should continue to pursue its efforts to move its outfall from Hollands Creek to Catheys Creek.	6.4.2
Brushy Creek (lower portion) (030804)	PS	point sources and nonpoint sources	Resources permitting, DWQ will update the water quality information at the lower end of the creek during the next basinwide cycle to more clearly determine whether the stream is still impaired and, if so, what are the causes and sources of the impairment.	6.4.4
Hickory Creek (030804)	PS	point source and nonpoint sources	DWQ will conduct follow-up monitoring, resources permitting, to determine current status of water quality since the removal of an effluent source from the stream. Contributions from nonpoint sources (particularly urban) should also be investigated.	6.4.4
Buffalo Creek (030805)	PS	point source and nonpoint sources	DWQ will conduct follow-up monitoring, resources permitting, to determine current status of water quality in this section of the creek. This effort should include the identification of activities influencing water quality.	6.4.5

6.3.2 What are the "Threatened Waters"?

Some waters in the basin have notable water quality problems but the impact of the problem is not severe enough to cause the stream to be considered impaired under the state use-support designation described in Chapter 4. These waters are rated Support-Threatened. Twenty-six percent of the surface waters in the Broad River basin are Support-Threatened (see Table 4.17 and Figure 4.20). The identification of Support-Threatened waters can be used to determine the sources and causes of degradation and to determine if management strategies can be used to reduce or eliminate the causes of pollution before impairment occurs.

6.3.3 How are Waters Prioritized for Restoration or Protection?

There are several different ways that waters are prioritized for restoration and protection depending upon the purpose of the prioritization. The three primary methods strategies for prioritization of waters based on water quality concerns are described below.

Priority Waters for Nonpoint Source (NPS) Management Strategies

DWQ has developed criteria to help NPS Teams to prioritize NPS-impaired waterbodies for management actions. This prioritization process will help the Teams as well as other agencies and groups allocate financial, technical and educational assistance to NPS efforts. These prioritization criteria are discussed in Appendix IV in the discussion of NPS Teams and can be summarized as follows:

- highly valued resource waters in need of restoration or protection from NPS pollution, and
- waters with impaired water quality as a result of NPS pollution.

Waters prioritized for action should have a high likelihood for successful restoration or protection.

The Broad River basin NPS Team has also worked to identify specific criteria that they consider important in targeting their efforts. The criteria developed by the Broad River NPS Team is as follows:

- Water quality impairment
- Recreational value
- Community concern/'buy-in'
- Use as a demonstration to others
- Presence of existing programs or initiatives
- Long-term risk of losing creek/stream to development, erosion, etc.
- Measurable improvement (to water quality, public education, etc).
- The existence of local resources (technical assistance, for instance)
- Basin-wide benefit
- Lasting effect on water quality

Waters that meet the above criteria will form a list of potential candidates for targeting by the NPS team. The team will be working with the list of impaired waterbodies presented in Tables 6.3 and 6.4 in conjunction with the criteria presented to determine where their efforts should be targeted.

Section 303(d) of the Clean Water Act (CWA)

States are required to develop a list of waters not meeting water quality standards or which have impaired uses (Partially Supporting or Not Supporting) under Section 303(d) of the Clean Water Act. Waters may be excluded from the list if existing control strategies are expected to achieve the standards or uses. Management strategies may be both point or nonpoint programs. Waterbodies which are listed must be prioritized and a management strategy or Total Maximum Daily Load (TMDL) must be developed.

Use support ratings for the 303(d) list are based on monitoring data collected in the last five years. Further information on the 303(d) program and a complete list of 303(d) waters in the Broad River basin can be found in Appendix VII. The list includes use support ratings, major causes and sources of impairment, descriptions of potential sources of pollution and the stream priority rating.

6.4 PRIORITY ISSUES AND RECOMMENDED MANAGEMENT STRATEGIES BY SUBBASIN

6.4.1 Subbasin 030801 - Upper Broad River basin (including Lake Lure and Cove Creek)

Rivers and streams in this subbasin have generally good water quality with very few violations of chemical water quality standards. Both the Broad River above Lake Lure and a downstream site on Cove Creek received Excellent bioclassifications in 1995. All monitored waters in this subbasin are considered to be fully supporting their uses.

Issues and Recommended Management Strategies

Although water quality in this subbasin is considered high, there is evidence that sedimentation is an issue. Problems with sedimentation in Lake Lure have led the town to spend $1,232,000 to dredge the lake. Information provided in Chapter 3 of this basin plan indicate that sedimentation rates throughout the Broad River basin, including the Cove Creek area, are relatively high.

Recommendations:
Measures to address sedimentation in this subbasin are needed. One of the goals identified by the NPS Team (Table 6.1) is the promotion of the adoption of local erosion control ordinances. Workshop participants identified the need for local education about erosion control and sedimentation. Local citizens and governments should consider pursuing such efforts.

In addition, because water quality in this subbasin is generally high, it is important to take actions to maintain these high levels. Some areas may qualify for a more protective surface water classification such as High Quality Waters. This is discussed in more detail in section 6.5.

6.4.2 Subbasin 030802 - Middle portion of the Broad River, including Walnut Creek, Mountain Creek, the lower Green River and the Second Broad River

This subbasin includes an approximately 35-mile portion of the Broad River watershed (from about 5 miles below the dam at Lake Lure to the confluence of the Second Broad River near the Cleveland/Rutherford County line), the entire Second Broad River drainage, and the lower drainage of the Green River. Other significant tributary catchments of the Broad River include Mountain, Cleghorn, and Floyd Creeks. Large tributary systems of the Second Broad River include Catheys Creek and Robinson Creek. Water quality, based on benthic macroinvertebrate information, generally ranges from Good to Good/Fair in this subbasin, although some streams are considered impaired. Problem areas are specifically addressed below.

Issues and Recommended Management Strategies

Walnut Creek
Walnut Creek, a tributary to the Green River, was sampled in 1995 as part of the Broad basinwide assessment. This site received a low bioclassification (Fair) and a low habitat score. Based on these results, this stream has received a use support rating of Partially Supporting. The field team noted unstable banks with breaks in the riparian zone and a heavily embedded substrate. The landuse in the immediate vicinity of the monitoring location is primarily fallow agricultural fields.

Recommendation:
There is a need in this watershed to more clearly identify the source (or sources) of impairment in order to determine what measures can be taken to improve water quality. DWQ should work with the local agricultural agencies to help farmers in this watershed ensure that appropriate measures are taken to minimize runoff into surface waters from agricultural activities (resources permitting). In addition, it is recommended that the NPS Team consider this area as a possible target of their efforts, resources permitting.

Catheys Creek and Hollands Creek
Catheys Creek has been given a use support rating of Partially Supporting based on three benthic macroinvertebrate surveys conducted between 1988 and 1995. The bioclassification has been borderline between Good/Fair or Fair using mountain classification criteria during all three surveys. The creek is impacted by the Spindale wastewater treatment plant. Based on nonpoint source workshops held in 1988, it was also indicated that the stream was receiving nonpoint source runoff from agricultural areas. Hollands Creek (which flows into Catheys Creek) is rated as Not Supporting based on data that is greater than five years old, but it is the receiving stream for the Spindale wastewater treatment plant.

The Spindale WWTP currently discharges 6.0 MGD of domestic and industrial wastewater into Hollands Creek. Historic macroinvertebrate data collected by DWQ determined this creek was not supporting its designated uses due to point source inputs. The Spindale WWTP with an instream waste concentration of 73% has had problems passing its whole effluent toxicity test. In order to maintain compliance with its NPDES permit limitations and to relieve stress on the receiving stream, Spindale has elected to relocate its outfall to Catheys Creek, a larger receiving stream

approximately 1 mile from its existing discharge point. In Catheys Creek, Spindale's effluent will be 32% of the streamflow and should be able to pass its toxicity test. Hollands Creek should begin recovery once the Spindale outfall is relocated.

In addition to relocation of the outfall, plant improvements will be made including the addition of a dissolved flotation unit and replacement of weirs and baffles in the final clarifiers. These improvements will enhance the operation of the plant and reduce the cost of sludge disposal. DWQ recommends that Spindale continue toxicity reduction evaluation efforts and seek cooperation from industrial contributors in order to obtain and maintain compliance with toxicity limits in Cathey's Creek.

Recommendation:
It is recommended that Spindale continue to pursue its efforts improve its wastewater treatment and to relocate its treatment plant outfall to Catheys Creek. This should relieve conditions on Hollands Creek and DWQ will monitor impacts on Catheys Creek. In addition, DWQ should work with local experts to assess NPS contributions to impairment and it is recommended that the NPS Team consider the Catheys Creek watershed as a possible target of their efforts, resources permitting.

Second Broad River
The relocation of the Spindale discharge into Catheys Creek could cause some water quality problems in the Second Broad River because of interaction with existing municipal and industrial dischargers located downstream. Major downstream dischargers include Forest City WWTP (4.95 MGD), Burlington – J.C. Cowan Plant (2.5 MGD), and Cone Mills (1.75 MGD).

The Forest City WTP has a water withdrawal of 8 MGD on the Second Broad River approximately 0.1 mile above the confluence of Catheys Creek. Historically, the streamflow inputs in the water quality models developed on the Second Broad River did not account for the water withdrawal of 8 MGD by the Forest City Water Treatment Plant (WTP). The 7Q10 low flow inputs to the model for this segment of the river were equal to 32 cfs. Updated information from the Division of Water Resources indicated that the 7Q10 on the Second Broad River above Cathey's Creek should be revised to 13 cfs based on the withdrawal. This revision is a 59% reduction in the flow input. New modeling results predicted that the assimilative capacity in the Second Broad River just below the Burlington - J.C. Cowan plant was nearly depleted (approaching the water quality standard of 5.0 mg/l) under 7Q10 conditions. Increased water withdrawal from the Forest City WTP due to future expansion will further modify the 7Q10 of the Second Broad River below the WTP. Previously developed effluent limits have been assigned to major dischargers to the river based on a much higher streamflow.

Recommendation
Modeling results indicate wasteflow interaction between the Spindale and Forest City plants results in predicted instream dissolved oxygen (DO) violations. The Division has determined that for the protection of the Second Broad River, equivalent limits should be assigned to the Forest City and Spindale WWTPs. New effluent limits have been developed for Forest City and Spindale that have accounted for the water plant withdrawals of 8 MGD and a proposed expansion to 12 MGD. In addition, based on these modeling results, the other facility affected is the industrial discharge of Burlington-J.C. Cowan. Preliminary model results indicated that in order to protect for predicted DO contravention; the J.C. Cowan plant will have to be held at its existing BOD5 loading for any future expansions.

Upon initiation of increased water withdrawal from the Second Broad River resulting from the expansion of the Forest City Water Treatment Plant, the NPDES permits for Spindale and the Forest City WWTP may be modified to incorporate more stringent effluent limitations for the oxygen consuming constituents, BOD5 and NH3 as N, to protect the downstream dissolved oxygen standard. Other permitted parameters may also be modified if necessary. If there is

documentation of instream water quality standard violations as a result of the decrease in the 7Q10 flow in the Second Broad River; effluent limits for Spindale, Forest City and Burlington – J.C. Cowan will have to be modified. Any plant expansions of these three dischargers will also result in the modification of permit limits.

In order to gain a better picture of the system, DWQ has developed a study plan for the Second Broad River to collect data to calibrate a QUAL2E model. Data was scheduled to be collected in 1996, however flow conditions and extreme weather, especially Hurricane Fran, did not allow for completion of the field studies. The study and a QUAL2E model will be completed by the next Broad basin plan, if resources allow it. The model results will be helpful in developing adequate wasteload allocations for the Second Broad River dischargers.

Another issue to be addressed in the Second Broad River is color. Citizen complaints about the aesthetics of the receiving stream due to dischargers' colored effluent have always been a topic of concern within DWQ. There has been some reduction of color inputs into the Second Broad River. In 1995, Cone Mills voluntarily implemented color removal by polymers through a flocculation and filtration system. Site visits by DWQ staff to the plant have shown marked improvement in the quality of the effluent. The Division's management strategy will include informational seminars in 1998 to provide technical assistance to dischargers for the removal of color. It is recommended that facilities voluntarily remove or reduce color so that numerical standards and effluent limits will not have to be assigned.

6.4.3 Subbasin 030803 - Green River drainage above Lake Adger

Subbasin 030803 contains the headwater reaches of the Green River and streams within this subbasin are in the mountain physiographic region. This section of the Green River has been dammed at two locations to form Lake Summit and Lake Adger. The Hungry River is the only large tributary catchment.

Issues

Water quality in this subbasin is generally high. All waters are fully supporting their uses although the Hungry River, which is supporting its uses, is considered threatened due to sedimentation problems.

The upper Green River watershed has been determined to qualify for classification as High Quality Waters as well as Class B (primary recreation). DWQ intends to pursue the reclassification of the upper portion of the river, but due to the lengthy nature of the rule-making process, it is not clear when this will occur. This action, if successful, will help to preserve the high quality nature of these waters. The HQW classification is described in more detail in section 6.5.

6.4.4 Subbasin 030804 - First Broad River and lower portion of Broad River in NC

Subbasin 04 contains the First Broad River and its tributaries, as well as the lowest portion of the mainstem of the Broad River before it enters South Carolina. This geographic area is a transitional zone between ecoregions, with some streams exhibiting mountain characteristics, while other streams are more piedmont in nature. Recent macroinvertebrate data indicated Good water quality in the First Broad River in the area near Casar with a slight decrease to Good-Fair near Earl. Excellent water quality was documented in the North Fork First Broad River, a headwater tributary to the First Broad in 1995. Many tributary streams have Good or Good-Fair water quality. The only recent data indicating Fair water quality was from Beaverdam Creek below some small dischargers. Some streams are considered impaired. Problem areas are specifically addressed below.

Issues and Recommended Management Strategies

Beaverdam Creek

Beaverdam Creek has been assigned a use support rating of Partially Supporting based on benthic macroinvertebrate sampling conducted in 1995. The site was given a Fair bioclassification. Water quality in the stream is potentially affected by several small dischargers and nonpoint runoff in the catchment. The stream was eight meters wide with severely eroded banks and a shifting sand bottom at the collection site. A sand dredging operation was adjacent to the site. Effluent from the discharging facilities, nonpoint runoff, and habitat degradation probably all contributed to the low rating.

There are four small ($\leq$ 0.020 MGD) dischargers located in the range of 2 - 5 miles upstream of Beaverdam Creek at Highway 150. Jefferson Smurfit Corporation (also know as Container Corp.), Specialty Lighting and Crest High School all discharge to an unnamed tributary to Beaverdam Creek (also known as East Fork Beaverdam Creek). Crest Junior High School is a direct discharger to Beaverdam Creek about 0.1 mile upstream of the aforementioned unnamed tributary to Beaverdam Creek. Modeling results predict that the dissolved oxygen standard will be protected downstream of these dischargers. In mid-1994 and once in April 1995, Jefferson Smurfit was having problems meeting its whole effluent toxicity test. However since May 1995, the facility has passed all toxicity tests.

Benthic macroinvertebrate data collected in 1995 rated Beaverdam Creek as "fair". Based on this information, Beaverdam Creek had an overall rating as partially supporting its designated use and is listed on the 303(d) impaired streams list. Potential causes for this rating are from point and nonpoint sources.

Recommendation

DWQ will require that the four discharges mentioned above conduct instream monitoring to determine if and to what extent these facilities are contributing to the impairment of Beaverdam Creek further downstream. In addition, DWQ, resources permitting, will work with local professionals and stakeholders to assess possible contributions to the impairment from nonpoint sources.

Brushy Creek

A sampling site at the lower end of Brushy Creek was given a Fair biological rating in 1985 and 1988. Comments provided at a nonpoint source workshop in 1988 attributed the impairment, at least in part, to runoff from agricultural areas, however at the time, point sources were also thought to be contributing to impairment. Although a site further upstream was sampled in 1995 and was found to have a Good rating, the lower site was not updated. As a result, it is unclear whether the lower section of the creek is still impaired.

Recommendation

Resources permitting, DWQ will update the water quality information at the lower end of the creek during the next basinwide cycle to more clearly determine whether the stream is still impaired and, if so, what are the causes and sources of the impairment.

First Broad River

The City of Shelby WWTP, PPG Industries, and Ora Mills discharge to the First Broad River watershed. In 1990, Shelby relocated its discharge to the mainstem of the First Broad River from Hickory Creek. The portion of Hickory Creek that Shelby had been discharging to was rated as "poor" (based on 1987 data) and therefore considered impaired. (The First Broad River which is currently receiving their waste is not considered impaired.) In 1993, Shelby requested speculative limits for expansion to 8.5 MGD. PPG Industries discharge 1.3 MGD to Brushy Creek, a tributary of the First Broad River upstream of Shelby. Brushy Creek below PPG has been rated fair in the past. The Shelby WTP withdraws 12 MGD from the First Broad River above Brushy

Creek. This withdrawal was not accounted for in previous models. A calibrated model will allow better wasteload allocations and provide a modeling tool for basinwide management.

Recommendation
In order to gain a better picture of the system, DWQ has developed study plan for the First Broad River to collect data to calibrate a QUAL2E model. Data collection was scheduled in 1996 however flow conditions and extreme weather, especially Hurricane Fran, did not allow for completion of the field studies. If resources and weather conditions allow it, the study and model will be completed before the next Broad River Basin plan update.

Hickory Creek
Hickory Creek is rated as Partially Supporting based on sampling done in 1987 to determine whether or not the Shelby wastewater treatment plant had an impact on the stream. The data indicated that the wastewater treatment plant, in addition to nonpoint source pollution, was having an impact on the stream. Since this sampling event, the City of Shelby has moved its discharge to the First Broad River.

Recommendation
Follow-up monitoring is needed to determine what effect removal of the plant has had, and whether urban runoff is causing impairment in the stream. Improvements to the City of Shelby's wastewater treatment plant, which included the removal of the discharge point on Hickory Creek, have likely lead to an improvement in water quality at this site. However, it is unclear to what extent this is the case due to the potential influence of nonpoint sources of pollution. The NPS team may also consider this area for targeting of their efforts if resources are available, but as a lower priority than streams in the basin that are impaired based on monitored information. DWQ will update the water quality information in the creek during the next basinwide cycle, resources permitting.

Potential HQW/ORW Classification of North Fork First Broad
The North Fork First Broad River received an Excellent bioclassification in 1995, and the fish community had a Good-Excellent NCIBI in same year. If petitioned, a follow-up survey could be conducted to determine if the stream and its tributaries qualify to be reclassified to HQW or ORW (see section 6.5).

6.4.5 Subbasin 030805 - Buffalo Creek

Subbasin 05 consists of Buffalo Creek and its tributaries. Although a few streams in the northern portion of the subbasin exhibit some montane characteristics, this subbasin is considered to be in the piedmont ecoregion. The subbasin includes two lakes - Kings Mountain Reservoir (Moss Lake) and Lake Montonia. Water quality in this subbasin ranges from Fair to Good. Impaired waters are addressed specifically below.

Issues and Recommended Management Strategies

Lick Branch
This site on Lick Branch is located below the New Minnette Textiles discharge. Although there has been improvement in the Biotic Index since 1983, the Fair bioclassification in 1995 indicated that the effluent from the mill was still impacting the stream fauna.

New Minnette Mills (NC0004235), a textile plant that produces woven bedspreads and blankets, currently discharges 0.262 MGD of wastewater into Lick Branch. Due to the small size of the receiving stream, New Minnette's discharge yields an instream waste concentration of 78%. The discharge has had long-term problems with compliance of its whole effluent toxicity test.

Until late 1995, the New Minnette plant also discharged wastewater from another textile mill, Grover Industries. In 1994, Grover Industries had initially requested an individual outfall into Lick Branch, however DWQ denied this request based on the poor biological condition of the stream. In 1995, Grover Industries opted for another alternative and constructed an outfall into the much larger Buffalo Creek, approximately three miles downstream. Although, it is preferred that toxicity problems be solved though reduction evaluation studies, the discharge site into Buffalo Creek was approved because of large dilution and capacity of stream to assimilate the wastewater. New Minnette's toxicity testing results have improved since Grover Industries removed its discharge. Grover Industries is also consistently passing its toxicity limits for its discharge to Buffalo Creek. The option of New Minnette relocating their outfall to Buffalo Creek has also been considered by the facility, however with improvements in the toxicity results, it is unknown whether this option will still be exercised.

Recommendation
It is recommended that conditions in the stream continue to be monitored to determine whether the removal of the waste from Grover Industries is sufficient to protect instream water quality.

Buffalo Creek
A small portion of Buffalo has been assigned a use support rating of Partially Supporting below Kings Mountain Reservoir based on data that is greater than five years old. Possible contributors to impairment include point sources and general nonpoint sources based on nonpoint source workshops conducted in 1988.

Recommendation
DWQ should update the water quality information in this portion of the creek during the next basinwide cycle, resources permitting.

6.4.6 Subbasin 030806 - NC Portion of the North Pacolet River

Broad River subbasin 030806 contains the North Carolina section of the North Pacolet River which flows into the Broad River in South Carolina. Streams within this subbasin are in the mountain ecoregion. This is a very small subbasin containing approximately 10 river miles of the North Pacolet River and many small tributaries.

Issues and Recommended Management Strategies
Very little water quality information has been collected in this subbasin. Benthic macroinvertebrates have been collected from three locations on the North Pacolet River and they have been assigned Good and Good/Fair bioclassifications. The North Pacolet River near the North Carolina/South Carolina state line is a very sandy stream (80%) suggesting that sedimentation is a significant water quality problem. As a result, many waters in this subbasin are considered support-threatened.

Recommendation
Measures to address sedimentation in this subbasin are recommended. One of the goals identified by the NPS Team (Table 6.1) is the promotion of the adoption of local erosion control ordinances. Workshop participants identified the need for local education about erosion control and sedimentation. Local citizens and governments should consider pursuing such efforts.

6.5 IDENTIFICATION AND PROTECTION OF HIGHLY VALUED RESOURCE WATERS

6.5.1 Overview of High Quality and Outstanding Resource Waters as well as Special Classifications and Habitats

Waters considered to be biologically sensitive or of high resource value may be given protection through reclassification to HQW (high quality waters), ORW (outstanding resource waters), Tr (trout) or WS (water supply), or they may be protected through more stringent NPDES permit conditions. Waters eligible for reclassification to HQW or ORW may include wild trout waters, designated critical habitat for threatened or endangered species (as designated by the NC Wildlife Resources Commission), waters classified for domestic water supply purposes (WS I and II), or waters having Excellent water quality based on DWQ biological monitoring. Based on DWQ monitoring, a few waters received an Excellent biological rating and may be considered eligible for HQW or ORW (Table 6.5). As mentioned earlier in this chapter, DWQ has completed a study of the upper Green River intends to pursue reclassification to B HQW in the future. In addition, DWQ has been requested to consider Lake Montonia for HQW reclassification, and studies are underway to determine whether or not it qualifies for this change. The two other areas in the table have been shown to have excellent water quality, and could possibly qualify for the HQW or ORW classification if a request were received by DWQ. The HQW, ORW and WS classifications generally require more stringent point and nonpoint source pollution controls than do basic water quality classifications such as C. Refer to Chapter 2 for more information on classifications and standards.

Table 6.5 Potential HQW/ORW Waters for the Broad River Basin

Subbasin	Waterbodies
030801	Broad River (upstream of Lake Lure) and Cove Creek
030803	upper Green River (from source to Rock Creek - not including tributaries, and Rock Creek and tributaries)
030804	North Fork First Broad River
030805	Lake Montonia

According to the NC Natural Heritage Program, there are four rare aquatic and wetland-dwelling animals found in the Broad River. These species are given special protection status by the North Carolina Wildlife Resources Commission and/or the North Carolina State Endangered Species Act (G.S. 113-331 to 113-337). The species and the status of each can be found in Chapter 2.

Where waters are known to support state or federally listed endangered or threatened species or species of concern, consideration will be given during the NPDES permitting process to minimize impacts to habitat areas consistent with the requirements of the federal Endangered Species Act and North Carolina's endangered species statutes. Possible protection measures may include but are not limited to dechlorination or alternative disinfection, tertiary or advanced tertiary treatment, outfall relocation, and backup power provisions to minimize accidental plant spills. The need for special provisions will be determined on a case-by-case basis during review of individual permit applications and take into account the degree of impact and the costs of protection.

6.5.2 Strategies for Controlling Discharges to High Quality Waters (HQWs) and Outstanding Resource Waters (ORWs)

A. High Quality Waters (HQWs)

In the Broad River basin, two streams near Tuxedo are classified as high quality waters. In addition, as described above, there are some streams that either do qualify for or may qualify for

HQW classification in the future. For HQWs, a distinct set of management strategies applies to wastes discharged from a facility. New discharges and expanding discharges that have an increase in pollutant load to HQW streams are subject to the following management strategies adopted by DWQ pursuant to 15A NCAC 2B.0224 (1) and 15A NCAC 2B .0224 (1)(b)(vii):

- Discharges from new single family residences will be prohibited. Those that must discharge must install a septic tank, dual or recirculating sand filters, disinfection and step aeration. (15A NCAC 2B.0224 (1)(a)).

- All new or expanded wastewater discharges (except single family residences) will be required to meet effluent limitations for oxygen consuming wastes as follows: BOD_5 = 5 mg/l, NH_3-N = 2 mg/l, and DO = 6 mg/l. More stringent limitations will be set, if necessary, to ensure that the cumulative pollutant discharge of oxygen consuming wastes will not cause the DO of the receiving water to drop more that 0.5 mg/l below background levels, and in no case below the standard. Where background information is not readily available, evaluations will assume a percent saturation determined by staff to be generally applicable to that hydroenvironment. (15A NCAC 2B .0224 (1)(b)(i)).

- Emergency Requirements: Failsafe treatment designs will be employed (except single family residences), including stand-by power capability for entire treatment works, dual train design for all treatment components, or equivalent failsafe treatment designs. (15A NCAC 2B .0224 (1)(b)(iv).

- Volume: The total volume of treated wastewater for all discharges combined will not exceed 50 percent of the total instream flow under 7Q10 conditions. (15A NCAC 2B 0.224 (1)(b)(v)).

- Toxics: In cases where complex wastes (those containing or potentially containing toxicants) may be present in a discharge, a safety factor will be applied to any chemical or whole effluent toxicity allocation. The limit for a specific chemical constituent will be allocated at one half of the normal standard at design conditions. Whole effluent toxicity will be allocated to protect for chronic toxicity at an effluent concentration equal to twice that which is acceptable under design conditions. In all instances there may be no acute toxicity in an effluent concentration or 90 percent. Ammonia toxicity shall be evaluated according to EPA guidelines promulgated in "Ambient Water Quality Criteria for Ammonia - 1984"; EPA document number 440/5-85-001; NTIS number PB85-227114; July 29, 1985 (50 FR 30784).

- North Carolina does not have a numeric water quality standard for suspended solids. Discharges to high quality waters (HQW) must meet a total suspended solids (TSS) limit of 10 mg/l for trout waters and primary nursery areas and 20 mg/l for all other HQWs.

B. Outstanding Resource Waters (ORWs)

Currently, no waters in the Broad River basin have been designated as ORW. If any of the waters that have been shown to have excellent water quality also have an associated outstanding resource, they could qualify for this designation. No new discharges nor expansions of existing discharges directly to waters classified as ORW are permitted in accordance with 15 NCAC 2B .0225 (c)(1). Those existing discharges will be handled on a case-by-case basis following standard operating procedures.

6.6 GENERAL MANAGEMENT STRATEGIES FOR PROTECTING WATER QUALITY IN THE BASIN

6.6.1 Management Strategies for Controlling Sedimentation.

Sedimentation is widespread in the Broad River basin. Of the 48 miles of streams that are considered impaired, 15 are impacted by sediment. In addition, there are approximately 112 miles of streams that are considered threatened because of impacts from sediment. While sedimentation has caused widespread water quality degradation, serious impairment is apparent in relatively few streams. However, the designated uses of numerous waterbodies are threatened by sedimentation.

Since this basin is an increasingly popular areas for home, commercial and golf course construction, there is the potential for greater sediment loads to enter streams during land clearing and construction activities. After construction is complete, poorly designed roads, trails, and driveways may continue to erode into water bodies.

Sedimentation is a widespread nonpoint source-related water quality problem that results from land-disturbing activities. The most significant of these activities include agriculture and land development (e.g., highways, shopping centers, and residential subdivisions). For each of these major types of land-disturbing activities, there are programs being implemented by various government agencies at the state, federal and/or local level to minimize soil loss and protect water quality. Some of these programs are listed in Table 6.6 and are briefly described in Appendix VI.

Table 6.6 State and Federal Sediment Control-Related Programs

Agricultural Nonpoint Source (NPS) Control Programs	North Carolina Agriculture Cost Share Program NC Cooperative Extension Service and Agricultural Research Service Watershed Protection and Flood Prevention Program (PL 83-566) Food Security Act of 1985 (FSA) and the Food, Agriculture, Conservation and Trade Act of 1990 (FACTA). (Includes Conservation Reserve Program, Conservation Compliance, Sodbuster, Swampbuster, Conservation Easement, Wetland Reserve and Water Quality Incentive Program)
Construction, Urban and Developed Lands	Sediment Pollution Control Act Federal Urban Stormwater Discharge Program Water Supply Protection Program ORW and HQW Stream Classification
Forestry NPS Programs	Forest Practice Guidelines National Forest Management Act Forest Stewardship Program Forestry Best Management Practices Forest Management Program Services
Mining	The Mining Act of 1971
Wetlands Regulatory NPS Programs	Section 10 of the Rivers and Harbors Act of 1899 Section 404 of the Clean Water Act Section 401 of the Water Quality Certification (from CWA) North Carolina Dredge and Fill Act (1969)

Construction activities, private access roads, state road construction and agriculture are sources of sediment and are discussed below. Golf courses and urban stormwater are other potential sources of sediment that are discussed in separate sections.

Before action is taken to restore a stream channel and riparian area, it is essential to understand the cause and nature of the problem. For example, if a landowner notices that excess gravel is accumulating in the stream on their property, they should first investigate the causes on their property and, if necessary, throughout the watershed. Stabilizing a streambank can result in an expense of time and money which will have to be repeated until the underlying cause is addressed. It is important to understand that a streambank may erode for many different reasons and the cause is not always obvious. Underlying causes might be as simple as a lack of bank vegetation to hold the soil in place or as complex as changes in runoff caused by urban runoff, poor logging or farming practices or other activities in the watershed.

Also, watershed inventories should not focus solely upon problem areas. Without advance planning and protection, sensitive resources, highly productive resource or critical components of natural systems are easily degraded or lost through development or overuse. Riparian buffers, wetlands, floodplains, animal movement corridors and rare species should be identified and their protection incorporated into watershed planning and management efforts.

Proven Techniques for Controlling Sediment and Protecting Streams

The following techniques are proven to be effective at controlling sedimentation to streams, thereby protecting the water quality of streams.

- Avoid disturbance of streams and the riparian zone. Protect existing riparian forest buffers. Restore vegetation that has been cleared from the riparian zone.
- Use BMPs for erosion and sediment control. A wide variety of agricultural BMPs have proven effective for sediment control. These include conservation tillage/residue management, filter strips and field borders, and cover crops.
- Maintain natural channels or, if modification is unavoidable, design channels based on the stability and behavior of natural stream channels. Channel designs based on natural stability principles will be less susceptible to erosion, dissipate energy more effectively, remain more stable, and provide more habitat than traditional engineered channel designs.
- Maintain pre-development peak flows, flow velocities, and flow timing to the extent possible through the use of stormwater management techniques and appropriate BMPs.

The Use of Riparian Buffers to Protect Stream Quality and Integrity

A stream and its riparian area function as one. The condition of the riparian area and its vegetation play a central role in determining the integrity of stream channels and water quality. Although streamside vegetation of any kind is desirable, forests provide the greatest amount of benefit and highest potential for meeting both water quality and habitat restoration objectives. A sound scientific foundation exists to support the sediment reduction, nutrient reduction, and ecological values and functions of riparian forest buffers. The use of riparian buffers as a management tool should be promoted.

Riparian Forest Buffers are streamside ecosystems, managed for the protection of water quality through control of nonpoint source pollution and maintenance of the stream environment. Riparian Forest Buffer Systems are typically managed as three integrated streamside zones which are designed to intercept surface runoff and subsurface flow. They comprise an area of trees, usually accompanied by shrubs and other vegetation, that is adjacent to a body of water. The Riparian Forest Buffer is managed to:

- maintain the integrity of stream channels and shorelines,
- reduce the impact of upland sources of pollution by trapping, filtering, and converting sediments, nutrients, and other chemicals, and
- supply food, cover, and thermal protection to fish and other wildlife.

Construction Activities and Sedimentation

Construction activities can dramatically increase the sediment delivered to streams. Construction activities are controlled under the Sedimentation and Erosion Control Act administered by the NC Division of Land Resources (DLR). This act requires anyone disturbing more than one acre of land to submit a Sedimentation and Erosion Control Plan to DLR. One of the major requirements is that there are adequate erosion control measures to retain all sediment on a development site during the 25-year storm. Generally, a land owner must install acceptable Best Management Practices (BMPs) when the land is disturbed by construction or development activities. Management practices may include barriers, filters, or sediment traps to reduce the amount of sediment that leaves a site. Under this act, local governments may take responsibility for reviewing and enforcing the Sedimentation and Erosion Control Program within their jurisdiction; however, their program must be at least as stringent as DLR's.

In the Broad River basin, development pressure will increase. In order to match the pace of land disturbing activity, more staff hours will be needed within the DLR in order to effectively administer and fully enforce the provisions of the Act. At present, planning and inspection staff are stretched thinly across large geographic areas and a wide variety of projects. Careful planning prior to construction, perhaps the most important part of erosion control, may often be neglected due to lack of available staff time.

The responsibility for controlling sediment from construction activities falls on many shoulders. The parties with the greatest responsibility include: homeowners, developers/contractors, local governments, and the NC Division of Land Resources. Table 6.7 presents actions that will help to address sediment problems associated with construction activities. No sediment control measures are 100% effective so some level of sedimentation will occur with land-disturbing activities. Education and promotion of stewardship are keys to reducing sedimentation, along with judicious strengthening of regulations and enforcement.

References/Resources:

- The following can be ordered from the NC Division of Land Resources at P.O. Box 27687, Raleigh, NC 27611, (919)733-3833:
  1) *NC Erosion and Sediment Control "Planning and Design Manual"* ($55 for in-state, $75 for out-of-state)
  2) *NC Erosion and Sediment Control "Inspector's Guide"* ($20 for in-state or out-of-state)
  3) *NC Erosion and Sediment Control "Field Manual"* ($20 for in-state or out-of-state)
  4) *NC Erosion and Sediment Control "Video Modules"* ($15 for in-state, $50 for out-of-state)
- Asheville Regional Office of the Division of Land Resources at (704)251-6208.
- Mooresville Regional Office of the Division of Land Resources at (704)663-1699.

Table 6.7 Recommended Actions to Address Construction-Related Sediment Problems

Homeowners	Know and follow state and local erosion and sedimentation ordinances. Fit the development to existing site conditions. Follow natural contours and avoid flood plains and highly erodible soils to control erosion and sedimentation. Establish, maintain, and protect vegetation beside streams on your property. Buffers provide a filter for sediment and other pollutants. Carefully monitor the construction process. Ensure permanent vegetation is established and maintained on construction site ASAP. Continue to control sediment after construction is complete.
Developers/ Contractors	Fit the development to existing site conditions. Development that follows natural contours and avoids flood plains and highly erodible soils is much easier to control erosion and sedimentation. Minimize the extent and duration of exposure. Schedule construction according to weather and season. Try to pick dry times. Protect areas to be disturbed from stormwater runoff. Use dikes, diversions, and waterways to intercept runoff and divert it away from cut-and-fill slopes or other disturbed areas. To reduce erosion, install these measures before clearing and grading. Keep runoff velocities low. Convey stormwater away from steep slopes to stabilized outlets, preserving natural vegetation when possible. Inspect and maintain control structures during the construction process. If not properly maintained, some erosion control measures can cause more damage than they correct. Retain sediment onsite. Protect low points below disturbed areas. Build barriers to reduce sediment loss. When possible, construct sediment traps before other land disturbing activities. Stabilize disturbed areas as soon as possible after construction. Apply mulch and vegetation to land and line channels for protection. Consider future repairs and maintenance of these measures. Train equipment operators to execute erosion and sediment control practices.
Citizens	Report any serious sediment problems on construction sites. This would include bare soil that has not been stabilized within 30 days, brown or red runoff during a storm, or obviously malfunctioning erosion/sediment controls.
Local Govts. Without Delegated Sediment/ Erosion Control Programs	Educate citizens as to the importance of erosion and sediment control before they begin construction activities and ensure they understand their responsibilities under the State Sedimentation Pollution Control Act. Report any serious problems on construction sites. This would include bare soil that has not been stabilized within 30 days, brown or red runoff during a storm, or obviously malfunctioning erosion/sediment controls. If your resources allow, consider taking responsibility for sediment and erosion control in your jurisdiction. This will allow greater control over implementation and enforcement of the program. It will also offer the opportunity to require sediment control on developments disturbing under one acre. Maintain publicly-owned open space. Will prevent sediment loss from certain tracts of land.

Table 6.7 Recommended Actions to Address Construction-Related Sediment Problems (Cont'd)

Local Govts. With Delegated Sediment/ Erosion Control Programs	Educate citizens as to the importance of erosion and sediment control. Maintain publicly-owned open space. Will prevent sediment loss from certain tracts of land. Evaluate the effectiveness of current sediment control enforcement. Identify staff resource needs. When possible, coordinate efforts with other agencies such as the Dept. of Transportation, Div. of Forest Resources, and Soil and Water Conservation Districts.
NC Div. of Land Quality	Continue to promote effective implementation and maintenance of erosion and sediment control measures on construction sites. Research innovative new ways to control sediment on construction sites. Evaluate the effectiveness of current sediment control enforcement. Identify staff resource needs. When possible, coordinate efforts with other agencies such as the Dept. of Transportation, Div. of Forest Resources, and Soil and Water Conservation Districts. Encourage more delegated programs by local governments where resources allow, especially in rapidly developing areas.

Private Access Road Construction

Improperly designed, constructed, and maintained private access roads are a significant source of sediment in the mountains. Often, landowners do not realize the importance of building driveways for lasting service. Some landowners depend entirely on their contractor to design the road. Others try to design it themselves without consulting a reputable source. The consequences of not paying attention to an access road as it is designed and constructed can be serious. In addition to losing the road and potentially losing land and property, the washed-out road can damage water quality. Table 6.8 offers suggestions for addressing these issues.

Most of the responsibility for an access road rests on the landowner. However, local governments, citizens, and state/federal agencies can also make their contribution to solving this problem.

References/Resources:

- *Guidelines for Drainage Studies,* NCDOT Hydraulic Design Unit (1995). To obtain, call NCDOT at (919)250-4128.
- *Final Report: Timbered Branch Demonstration/BMP Effectiveness Monitoring Project* by Richard Burns, USDA Forest Service (1994). To obtain, call USDA at (704)257-4214.
- *The Laymen's Guide to Access Road Construction in the Southern Appalachian Mountains*, USDA-SCS, USDA-Forest Service, Tennessee Valley Authority; July 1985. Copies are available from NC DFR Central Office by calling (919) 733-2162, ext. 255.
- Asheville Regional Office of the Division of Land Resources, (704)251-6208.
- Mooresville Regional Office of the Division of Land Resources at (704)663-1699.

State Road Construction

Like any impervious surface, roadway systems have the potential to generate stormwater runoff problems. Various types of pollutants from the road surface can be carried to surface waters by rainfall. In addition, roadway construction, roadside vegetation management and roadway operation and maintenance activities can contribute to stormwater pollution problems.

The Division of Water Quality is currently working with the NC Department of Transportation (DOT) to finalize a stormwater management permit for DOT activities. This permit will address

pollution from stormwater runoff related to roadways, road construction, vegetation management, operation and maintenance and other related DOT activities throughout the state. The major permit

Table 6.8 Recommended Actions to Address Problems Associated with Private Access Roads

Homeowners	Know the state and local laws, ordinances and regulations about access road construction. Be prepared to pay the cost of constructing a good road that will last. The cost of constructing a road will vary greatly from site to site. The cost may increase due to steep or rocky land, low stability soils, or drainage needs. In the long run, it does not pay to skimp. Avoid steep grades. Sustained grades should not exceed 10% for gravel or crushed stone roads. Make sure the road has adequate drainage. Adequate drainage is necessary to control erosion. The following water sources must be considered: rainfall on the roadbed and cut/fill slopes, overland storm flows from the watershed above the road, and springs or streams intercepted by the road. Use drainage methods that protect water quality. These methods include capture areas to treat runoff and routing runoff parallel to streams. Avoid grading access road drainage ditches directly to streams. Inspect the road periodically. Check for ruts and dips in the road, the condition of the drainage outlets, and the general condition of the cut and fill slopes. Repair any problems immediately. Any problems with ruts, drainage outlets, bare areas, etc. should be repaired before a small problem turns into a large problem.
Contractors	Watch for signs of subsurface drainage problems before, during, and after construction. Some things to look for include: soils that are gray in color, areas with springs or seeps, low areas, and areas dominated by water-tolerant plants such as alders, black walnut, poplar, cattails, reeds, etc. Road and ground cover should be applied as soon as possible after construction.
Citizens	Report any serious problems with access roads. Some problems to look for include big ruts in the roadway, wash-outs, and clogged drainage outlets. You can report problems to your local government officials. If they are not able to help, contact the regional office of the NC Division of Land Resources.
Local Governments	Require properly designed and constructed roads as part of the building permit process. Institute ordinances requiring proper maintenance of private access roads.
State and Local Agencies	Provide citizens with information about how to properly construct private access roads. Investigate innovative new ways of constructing private access roads while protecting water quality.

requirements are the implementation of a comprehensive stormwater management program, monitoring programs to direct the stormwater program and annual reports to outline the effectiveness and direction of the program.

The initial emphasis of the stormwater programs will be on high volume roadway segments in sensitive water areas such as coastal areas and water supply watersheds. The stormwater management programs will try to locate and characterize pollutant problems and to develop and implement appropriate best management practices to protect surface waters.

DOT is responsible for its own sedimentation and erosion control program. DOT has a number of projects with effective sedimentation and erosion control in mountain areas. Table 6.9 presents recommended road construction measures.

Table 6.9 Recommended Sediment Control Measures for State Road Construction

NC Dept. of Transportation	Know the state and local laws, ordinances and regulations about construction. Implement high quality sediment and erosion control. This is extremely important in areas with steep slopes. Increase training for DOT staff to ensure that sedimentation and erosion control devices are properly sized and installed. It is also important to include specific instructions for sediment and erosion control and phasing on the plans so that contractors can understand their responsibility. Inspect sedimentation and erosion control devices frequently. This is particularly important when contractors are responsible for the work. Implement pre-, during, and post-construction water quality monitoring at selected sites. This is the only way to tell for sure if sediment and erosion controls are working effectively. Reduce the threshold of exposed area when roads are constructed on steep slopes.
Citizens and Local Governments	Contact the district DOT office if you observe sediment problems at a road construction site. Some things to watch out for include: bare soil that is not mulched and/or planted within 30 days, washed-out sediment basins and filter cloths, and soil disposal sites that are placed in or directly adjacent to creeks.

References/Resources: Dan Martin, District Office of DOT, (704)586-2141.

6.6.2 Management Strategies for Controlling Color

North Carolina regulations specify that colored wastes may be discharged only in such amounts "as will not render the receiving waters injurious to public health, secondary recreation, or to aquatic life and the wildlife or adversely affect the palatability of fish, aesthetic quality or impair the waters for any designated uses" [NCAC 15A 2B .0211 (3)(f)]. Colored discharges are generally not toxic. Potential toxicity is managed by the regulation of specific chemical constituents and by whole effluent toxicity (WET) testing. The primary issue in the regulation of color is the aesthetic quality of receiving waters and the implication of this aesthetic quality for the designated uses of those waters.

The practical application of the above regulation must take into account the various ways in which color manifests itself in the environment. Color in natural waters is rarely the result of one specific chemical. Rather, a mixture of many dissolved and suspended constituents contributes to color. The stream bed and sediments may also contribute to color. Because color is perceived differently by different people and in different light conditions, no general definition of color impairment can be specified by a simple set of criteria and enforcement of the current narrative color standard can be very subjective.

In the Broad basin, discharges with a high degree of color come primarily from certain industrial facilities and from municipal dischargers receiving highly colored industrial effluent. While colored effluent can be discharged by a number of industries, textile firms constitute the most significant source of color in the Broad basin.

Division staff have researched the implementation of a numeric standard, or a set of numeric water quality standards. The Division would prefer, however, that dischargers remove color on their own initiative. If such efforts are not successful, the Division may proceed with the development of a numeric color standard.

In order to address the problem of discolored waterbodies and to assist facilities that are attempting to reduce color in their effluent, the Division is developing a statewide voluntary program in

cooperation with the Division of Pollution Prevention and Environmental Assistance (DPPEA). The program will focus on reducing the discharge of colored wastewater from textile manufacturing and related industries, with a goal of reducing instream color to the point where color-related complaints for surface waters are nonexistent. The program will be based on building a cooperative network between facilities with highly colored effluent and a "mentor" group. The mentors will include color removal experts, textile industry associations, facilities that are already implementing color removal, and DENR staff members. Although color in its elf is not a toxicant, dischargers removing color from their effluent may receive the added benefit of reducing salts, BOD and metals. DWQ and DPPEA staff are currently involved in data collection and the evaluation of various color removal proposals. Statewide workshops and conferences will be held in early 1998 to publicize the effort and obtain feedback on the design of the program.

6.6.3 Management Strategies for Controlling Nonpoint Source Pollution from Agriculture

Agricultural nonpoint source (NPS) pollution is reported as the leading probable source of water quality impacts to surveyed rivers and lakes, and the third largest probable source of impairments to surveyed estuaries. And it is also a major contributor to ground water contamination and wetlands degradation. Agricultural activities that may cause NPS pollution include confined animal facilities, grazing, plowing, stream access, pesticide spraying, irrigation, fertilizing, planting and harvesting. The major agricultural NPS pollutants that result from these activities are sediment, nutrients, pathogens, pesticide, and salts. Agricultural activities also can damage habitat and stream channels. Agricultural impacts on surface and groundwater can be minimized by properly managing activities the can cause NPS pollution. Table 6.10 is a list of recommendations for state and federal agencies, and farmers.

Streambank Fencing and Alternative Livestock Water Supply

Streambanks trampled by livestock can be a significant source of sediment. Streambank fencing and livestock watering facilities outside the riparian zone can help maintain the vegetation necessary for stabilizing streambanks and preventing erosion. The water quality benefits of streambank fencing have been well documented. Fencing and exclusion can create vegetative buffer strips along streams that trap sediment and reduce pesticide and nutrient runoff before they enter the stream. Streambank fencing also provides food, cover, and nesting sites for upland and aquatic wildlife. Allowing natural vegetation to re-establish can not only provide better habitat within the stream but also create a corridor for wildlife movement and a connection with other habitat.

Livestock exclusion may also improve water quality by preventing manure deposition in the stream. For example, according to Penn State University, one cow produces approximately 5.4 billion fecal coliform bacteria per day. At this rate, unrestricted access of fifty cows to a stream for a 24 hour period could contaminate the equivalent of one day's untreated water supply for a city the size of Baltimore.

Table 6.10 Recommended Actions to Address NPS Pollution from Agriculture

State and Federal Agencies	Target funds to control agricultural NPS pollution. State and federal agencies should work with the Nonpoint Source Team to target funds toward the areas where they are most needed and would be most effective. Promote agricultural best management practices (BMPs). State and federal agencies should increase programs which provide cost-share, technical assistance, and economic incentives to implement agricultural BMPs. Generate more "on-the-ground" water quality improvement demonstration projects. These projects will help to generate enthusiasm for more cooperative effects between farmers and various agencies. Create education programs. These programs increase farmers awareness of water quality impact of agricultural NPS pollution. And the programs also provide farmers a set of tool to control agricultural NPS pollution. Topics can include environmentally sound BMPs for agriculture and numerous field days for local and regional interests.
Farmers	Participate in the NPS team process. The NPS team process will provide a good opportunity to influence state policy in basinwide planning. The NPS team will describe current water quality initiatives, identify priority NPS-impaired waterbodies and implement solutions addressing these waterbodies. Participate in North Carolina Agricultural Cost Share program. The North Agricultural Cost Share program provides technical assistance and cost sharing to landowners in implementing BMPs. Practice a number of cost effective agricultural BMPs through the basin.

Exclusion from the riparian area may also improve the health of livestock. Bacteria and other disease-causing organisms entering the stream can transmit diseases between and within livestock herds. Streambank fencing reduces contact with disease-causing organisms that thrive in these environments. For example, environmental mastitis is most commonly caused by coliform bacteria which enter teats as cows wade in streams. The first recommendation in any mastitis prevention program is to provide a clean, dry environment for the cows. Streambank fencing also reduces the risk of foot and leg injuries and can be part of an effective lameness prevention program.

Waste from Animal Operations

DWQ is currently pursuing a number of efforts to improve the management of waste generated from animal production operations. These efforts, which are being coordinated with the Soil and Water Conservation Districts, Natural Resources Conservation Service and the Division of Soil and Water Conservation, are both new and ongoing and will work toward the goal of eliminating the contribution of animal waste into North Carolina's surface waters. They include the implementation and enforcement of animal waste regulations and the training and certification of operators of animal waste systems. Detailed descriptions of these programs are provided in Appendix VI. DWQ will continue to implement these efforts, some of which were precipitated by a number of lagoon failures in coastal basins in 1995.

References/Resources:
Nonpoint Source Planning Group of the Division of Water Quality at (919)733-5083

6.6.4 Management Strategies For Urban and Industrial Stormwater Control

Industrial Stormwater

Within the Broad basin various types of industrial activities with point source discharges of stormwater are required to be permitted under the NPDES stormwater program. These include

facilities engaged in construction; mining/borrow pits; metal waste recycling and manufacture of metal products and equipment; manufacture of timber products; apparel, printing, paper, leather, and rubber products manufacturing; vehicle maintenance, transportation, and postal service activities, public warehousing and petroleum bulk stations and terminals; used automobile parts and scrap yards; ready mixed concrete production; manufacture of asphalt paving mixtures and blocks; production of textile mill products; ship and boat building/repairing and marinas.

Surface waters can be significantly impacted by stormwater runoff from industrial facilities, particularly those that store or transfer materials out of doors. The types of chemicals, industrial operations and various ancillary sources influence the pollution potential of each individual facility. As such, industrial facilities can reduce stormwater impacts by developing a comprehensive site-specific Stormwater Pollution Prevention Plan (SPPP or Plan) which is based on an accurate understanding of the pollution potential of the site. The Plan provides a flexible basis for developing site-specific measures to minimize and control the amounts of pollutants in stormwater runoff by implementing best management practices (BMPs). With respect to stormwater, the ultimate BMP is the elimination of exposure of any significant materials to rainfall or runoff.

Recommendations

Facilities subject to NPDES stormwater permitting are required to develop and implement a SPPP. The SPPP approach focuses on two major objectives: 1) to identify sources of pollution potentially affecting the quality of stormwater discharges from the facility; and 2) to describe and ensure that practices are implemented to minimize and control pollutants in stormwater discharges from the facility. The basic components of a SPPP include a site plan detailing the facility layout and locations of potential pollutant sources, a stormwater management plan describing materials management practices and feasibility of employing best management practices, a spill prevention and response plan, a preventive maintenance and housekeeping plan, annual employee training and semi-annual facility inspections. The facility SPPP must be periodically reviewed and updated to reflect changes at the facility.

In addition to the SPPP, all permitted facilities are required to perform qualitative monitoring. This monitoring requires the periodic visual inspection of each stormwater outfall. Inspections are performed for parameters including color, odor, clarity, floating and suspended solids, foam, oil sheen, and other obvious indicators of stormwater pollution. Facilities with significant stormwater pollution potential are also required to perform quantitative analytical monitoring.

Urban Stormwater Control

Urban stormwater runoff can be a significant contributor to water quality problems. In the Broad basin, urban development is spread thinly across the basin, with larger areas being in the eastern portion. As land is converted to impervious surfaces with construction of housing developments and commercial areas, careful attention to stormwater control will be more important. Stormwater problems are likely to be centered around the urban areas in the basin. There are no municipalities in the Broad River Basin required to obtain permits to manage stormwater runoff within their jurisdiction.

The best time to address urban stormwater impacts are when it is most effective and least costly to do so -- before development occurs. Numerous studies have demonstrated a serious decline in the health of receiving waters when 10 to 15 percent of a watershed is turned into impervious surfaces (Schueler 1995).

The entire community plays a role in controlling the quality and quantity of urban stormwater. Table 6.11 is a list of recommendations for local governments, citizens, businesses, developers, and state agencies.

Table 6.11 Recommendations for Urban Stormwater Control

Local governments	Create public education programs. These programs advise citizens about how to care for their homes, businesses, and neighborhoods while minimizing stormwater pollution. Topics that can be covered include environmentally sensitive methods of caring for lawns and vehicles. Support stream clean-up programs. Clean-up programs such as Big Sweep remove harmful debris from streams and instill a sense of pride that will protect the waterbody in the long-term. Create and enforce strict penalties for improper waste disposal. In addition, local governments should protect dumpsters by fencing around them and cleaning them regularly. Institute land use planning to protect water quality. Through planning, local governments can reduce flooding by limiting the total area of impervious surfaces and directing runoff into vegetated areas or stormwater control devices. In addition, planning can be used to protect surface waters by directing growth away from sensitive areas/waters such as floodplains, steep slopes, wetlands, high quality waters, and water supplies. Review local ordinances pertaining to parking and curb and gutter. Local ordinances often require larger parking lots than are needed. Parking lots should be designed to handle the average parking needs with overflow areas in grass. When possible, it is best to eliminate curbs and gutters to allow runoff to flow off the street or parking lot in sheet flow. Protect open spaces and streamside buffers in and around urban areas. This will preserve recreational areas and significant natural resources near the town or city. Attend stormwater workshops for local government officials. Various agencies like DWQ offer workshops on stormwater management or reference materials. For more information, contact the DWQ stormwater group at (919)733-5083. Map the storm sewer system. If local governments map the inlets, pipes, and outlets that make up their storm drain system, they will be well equipped to identify the source of any observed stormwater problems. Offer hazardous waste collection days.
Citizens	Participate in stream clean-up programs. Clean-up programs remove harmful debris from streams and instill a sense of pride that will protect the waterbody in the long-term. An annual Big Sweep event is held each year in September. Stream clean-up is a great service activity for groups such as Scouts, 4-H, Rotary Clubs, etc. Practice environmentally-friendly lawn care. Table 6.12 has a list of suggestions for keeping a green lawn while minimizing harm to the environment. When possible, use less-harmful substances in the home for cleaning or painting. Any time hazardous substances are used, there is a risk that they can enter the water by interfering with the proper functioning of septic tanks, leaking out of sanitary sewers, etc. When possible, use less hazardous substances such as latex instead of oil paint (see Table 6.13). Educate adults and children about how to protect water quality. Educational materials can be obtained from the NC Office of Environmental Education, (919)733-0711. Utilize hazardous waste collection centers for paints, petroleum products, and other chemicals. Never dispose of oil, yard wastes, or other materials in storm drain inlets or dump these materials on lands. Storm drains connect directly to nearby streams without any treatment of the water. Maintain and protect riparian buffers on private property. Buffers provide a critical right of way for streams during storms. When buffers contain the 100-year floodplain, they are an extremely cost-effective form of flood insurance. Buffers remove a wide array of pollutants, including sediment, nutrients, and toxic substances. They can also increase property value. Support your local government's land use planning initiatives.
Developers	Incorporate stormwater management in the planning of projects. Plan developments to reduce impervious areas (roads, driveways, and roofs). Do not build in environmentally sensitive areas such as floodplains and wetlands. (This is also a flood insurance policy.) Maintain natural drainageways and buffers along streams.

Table 6.11
Continued:

Businesses	Maintain and protect riparian buffers on commercial property. Buffers provide a critical right of way for streams during storms. When buffers contain the 100-year floodplain, they are an extremely cost-effective form of flood insurance. Buffers remove sediment, nutrients, and toxic substances. Cover and contain waste materials. This will prevent runoff from the disposal area from becoming contaminated and polluting the receiving water. Practice good housekeeping. A clean and litter-free facility will promote good water quality. Institute hazardous waste collection sites. Automobile service centers, hardware stores, and other pertinent businesses can institute hazardous waste collection sites for used oil, antifreeze, paint, and solvents.
State and Federal Agencies	Provide technical information about urban stormwater. State and federal agencies should strive to increase their communication with local governments, businesses, and citizens. Create and maintain stormwater wetlands along streams. Like buffers, stormwater wetlands treat stormwater and reduce flows. Stormwater wetlands must be designed and maintained properly to be effective.

Table 6.12 How to Take Care of Your Lawn and Car and Protect Water Quality

If you are caring for...	This is the environmentally-friendly practice.
your lawn	• Use only fertilizers that are needed, based on soil tests and plant needs. • Keep fertilizers off driveways and sidewalks. • Avoid using fertilizers within 75 feet of any waterbody. • If you use a lawn service, request natural rather than chemical management. • Plant hardy, native species that do not require chemical inputs. • Contact your Cooperative Extension Agent for more information.
your vehicle	• Maintain motor vehicles and repair leaks promptly. • Dispose of used motor oil and antifreeze in recycling centers. • Avoid gas tank overflows during refueling.

from S.C. Dept. of Health and Environmental Control, "Turning the Tide" (1995)

Table 6.13 Substitutions for Household Hazardous Substances

Instead of...	Try...
• Ammonia-based Cleaners	• Vinegar + Salt + Water
• Abrasive Cleaners	• Lemon Dipped in Borax or Salt + Baking Soda
• Furniture Polish	• Lemon Juice + Olive Oil
• Toilet Cleaner	• Baking Soda + Toilet Brush
• Oven Cleaner	• Liquid Soap + Borax + Warm Water
• Drain Cleaners	• Boiling Water + Baking Soda + Vinegar
• Upholstery Cleaners	• Dry Cornstarch
• Mothballs	• Cedar Chips or Lavender Flowers
• Window Cleaner	• White Vinegar + Water
• Oil-Based Paints and Stains	• Water-based Paints and Stains

from S.C. Dept. of Health and Environmental Control, "Turning the Tide" (1995)

References/Resources for Urban Stormwater:

- *Stormwater Management Guidance Manual*, 1993, Cooperative Extension Service
- *Stormwater Management in North Carolina: A Guide for Local Officials*, 1994, Land-of-Sky Regional Council, Asheville, NC (Eaker 1994)
- Stormwater Fact Sheets by Land-of-Sky Regional Council, 1994
  1. *Stormwater Problems and Impacts: Why all the Fuss?*
  2. *Stormwater Control Principles and Practices*
  3. *Stormwater Management Roles and Regulations*
  4. *Local Stormwater Program Elements and Funding Alternatives*
  5. *Municipal Pollution Prevention*
  6. *Managing Stormwater in Small Communities: How to Get Started*
  7. *Maintaining Wet Detention Ponds*
  8. *Plan Early for Stormwater in Your New Development*
  9. *How Citizens Can Help Control Stormwater Pollution*
- *Stormwater Best Management Practices*, 1995, NC Division of Environmental Management.
- Asheville Regional Office of DWQ, Stormwater Group: (704)251-6208.
- Mooresville Regional Office of DWQ, Stormwater Group at (704)663-1699

6.6.5 Management Strategies for Controlling Fecal Coliform Bacteria

Fecal coliform bacteria are typically associated with the intestinal tract of warm-blooded animals and are widely used as an indicator of the potential presence of disease-causing bacteria and viruses. They enter surface waters from a number of sources including failing onsite wastewater systems, broken sewer lines, improperly treated discharges of domestic wastewater, pump station overflows, straight piping and runoff carrying livestock and wildlife wastes.

In the Broad River basin, there are four sampling sites where fecal coliform bacteria standards have been exceeded in more than 25% of the samples taken by DWQ. These are:

- the Broad River near Boiling Springs (subbasin 04)
- the First Broad River near Earl (subbasin 04)
- Sugar Branch near Boiling Springs (subbasin 04)
- Buffalo Creek near Grover (subbasin 05)

Several general management strategies for addressing fecal coliform contamination include:

- Proper maintenance and annual inspections of onsite waste disposal systems such as septic tanks (see Table 6.14 for maintenance recommendations).
- Maintenance and repair of sanitary sewer lines by WWTP authorities.
- Maintenance and establishment of riparian vegetative buffers.
- Maintenance of natural drainage patterns to maximize filtration and minimize runoff.
- Elimination of direct illegal discharges of domestic waste (also known as "straight piping").
- Proper management of livestock to keep wastes from reaching surface waters.
- Encouragement of local health departments to routinely monitor waters known to be used for body contact recreation (e.g., swimming and tubing).

The 1996 General Assembly established a program designed to eliminate domestic sewage or wastewater discharges from both direct (straight pipe) and from overland flow of failing septic systems. The focus of the program contains three components:

1) the identification and elimination of domestic sewage discharges into streams proposed or currently used for public water supplies,
2) an amnesty period to end December 31, 1997 during which time violations for identification of domestic dischargers will not be incurred, and
3) a public education program about the amnesty period will be implemented. The majority of the funds allocated to this program are recurring funds.

Septic tanks are used widely throughout this basin, particularly since many citizens live outside of the service area of a regional wastewater treatment plant. Unfortunately, many citizens are not aware of how to care for their septic tanks. Some of the actions that homeowners, local governments, and state and federal agencies can take to reduce pollution from septic tanks are listed in Table 6.14.

Table 6.14 Recommended Actions for Proper Maintenance of Septic Tanks

Homeowners	Do not put harmful substances in your septic tank. These substances include: cooking grease, oils, fats, pesticides, paints, solvents, disinfectants, and other household chemicals. These substances can kill the microorganisms that help purify the groundwater and can themselves pollute groundwater. Know the location of your system and keep heavy vehicles and plant roots away from drain field pipes. These things can compact soils and inhibit the proper functioning of the system. Conserve water and stagger intensive uses. Some intensive water uses include showers, laundry, dishwasher, etc. Look for ways to reduce (e.g.., full loads) and to not use all at once. Have the septic system inspected annually and pumped out every three to five years. This is a small price to pay to ensure that your household has functioning wastewater treatment. Look for "greener grass over the septic tank." This could be a sign that the septic tank is failing. Divert overland runoff from your property away from the drainfield area. This will reduce the likelihood of saturating the soil and causing malfunctions.
County Health Departments	Require regular inspections of septic systems. Enforce severe penalties for uncorrected septic system malfunctions. Ensure that citizens understand how to maintain their septic tank when they first obtain property in the county.
NC Div. of Environmental Health	Provide leadership to county health offices. Encourage county health offices to require regular inspections. Provide public education materials.

References/Resources:

Please contact the local county heath department for more specific advice.

6.6.6 Management Strategies For Controlling Toxic Substances

Toxic substances, or toxicants, routinely regulated by DWQ include dioxin, metals, organics, chlorine, and ammonia, as described in Chapter 3.

North Carolina has adopted standards and *action levels* for several toxic substances. These are contained in 15A NCAC 2B .0200. Usually, limits are not assigned for parameters which have action levels, such as copper, unless monitoring indicates that the parameter may be causing

toxicity or federal guidelines exist for a given discharger for an action level substance. This process of determining action levels exists because these toxic substances are generally not bioaccumulative and have variable toxicity to aquatic life because of chemical form, solubility, stream characteristics and/or associated waste characteristics. Water quality-based limits may also be assigned to a given NPDES permit if data indicate that a substance is present for which there is a federal criterion but no state water quality standard.

Whole effluent toxicity (WET) testing is required on a quarterly basis for all major dischargers (≥1 MGD) and any discharger releasing complex (industrial) wastewater. There are 22 such dischargers in the Broad River Basin. This test shows whether the effluent from a treatment plant is toxic, but it does not identify the specific cause of toxicity. If the effluent is found to be toxic, further testing is done to determine the specific cause. This follow-up testing is called a *toxicity reduction evaluation* (TRE).

Metals

Municipal and industrial dischargers along with urban runoff, and possibly atmospheric deposition, are the main sources of metals contamination in surface water. North Carolina has stream standards for many heavy metals. The most common metals limited in municipal permits are cadmium, chromium, nickel, lead, mercury, silver and zinc. Each of these is monitored at the 21 ambient monitoring stations in the basin along with aluminum and arsenic. Point source discharges of metals are controlled through the NPDES permit process. Mass balance models (Appendix III) are employed to determine appropriate limits. Municipalities with significant industrial users discharging wastes to their treatment facilities limit the heavy metals coming to them from their industries through their *pretreatment program.* Source reduction and wastewater recycling at WWTPs also reduces the amount of metals being discharged to a stream. Nonpoint sources of pollution are controlled through best management practices.

Chlorine

Chlorine is commonly used as a disinfectant at NPDES discharge facilities which have a domestic (i.e., human) component. These discharges are a major source of chlorine in the State's surface waters. Chlorine dissipates fairly rapidly once it enters the water, but it can have significant toxic effects on sensitive aquatic life such as trout and mussels. North Carolina has adopted a freshwater standard for trout waters of 17 ug/l (micrograms per liter). For all other waters an action level of 17 ug/l is applied to protect against chronic toxicity. It is recommended that new and expanding discharges provide dechlorination or alternate disinfection of wastewater. A total residual chlorine limit is assigned based on the freshwater action level of 17 ug/l or a maximum concentration of 28 ug/l for protection against acute effects in the mixing zone. Federal guidelines for residual chlorine of 8 ug/l for chronic effects and 13 ug/l for acute effects are used in saltwaters. In 1993, letters were sent to existing facilities with chlorine monitoring requirements. These letters encouraged permittees to examine their effluent chlorine levels and noted that limits may be implemented in the future. At this time, the State requires chlorine limits for all trout waters and any new or expanding facilities using chlorine for disinfection.

Ammonia (NH_3)

Point source dischargers are one of the major sources of ammonia. In addition, decaying organisms which may come from nonpoint source runoff and bacterial decomposition of animal waste products also contribute to the level of ammonia in a waterbody. At this time, there is no numeric standard for ammonia in North Carolina. However, DWQ has agreed to address ammonia toxicity through an interim set of instream criteria of 1.0 mg/l in the summer (April - October) and 1.8 mg/l in the winter (November - March). Currently, limits will be given no less than 2 mg/l in summer and 4 mg/l in winter, unless dissolved oxygen problems or modeling analysis dictate stricter limits. These interim criteria are under review, and the State may adopt a standard in the future.

Assimilative Capacity

The assimilative capacity (that is, the amount of a substance a waterbody can assimilate under designated flow conditions) available for toxicants in the Broad basin varies from one waterbody to another. In streams, the 7Q10 is used as the flow condition for aquatic life based standards, while average flow is used for carcinogens. In larger streams where more dilution flow exists there is more assimilative capacity for toxics. In areas with little dilution, facilities will receive chemical specific limits which are close to the water quality standard. In estuarine waters assimilative capacity can be difficult to determine since it is generally dependent on tidal forces, wind-driven mixing and proximity to inlets and not primarily on freshwater discharge. Toxics from nonpoint sources typically enter a waterbody during storm events. All waters must be protected from both immediate acute impacts and longer term chronic effects.

Control Strategies

Chemical specific toxics limits and monitoring requirements for point source dischargers will be determined using the techniques discussed in the Modeling Unit's Standard Operating Procedures manual and discussed in Appendix III of this report. These methods utilize an EPA recommended approach which considers the maximum predicted effluent concentration and the amount of variation in effluent monitoring data. Whole effluent toxicity limits are assigned to all major dischargers and to any discharger of complex wastewater.

Nonpoint source strategies being implemented through the industrial NPDES stormwater program should also be helpful in reducing toxic substance loading to surface waters. Agricultural BMPs implemented to reduce nutrient and sediment loading from cropland are likely to result in lower pesticide inputs.

6.6.7 Management Strategies For Oxygen-Consuming Wastes

Maintenance of dissolved oxygen (DO) is critical to the survival of aquatic life and to the general health of surface waters. The daily average dissolved oxygen standard for most waters in the state, except for waters classified as trout and swamp waters, is 5.0 mg/l. In trout waters the standard is 6.0 mg/l. Approximately 30% of the surface waters in the Broad basin have been supplementally classified as trout waters.

Biochemical oxygen demand (BOD) and ammonia nitrogen (NH_3-N) associated with wastewater treatment plants are generally the types of oxygen-consuming wastes of greatest concern. During summertime conditions, when temperature is high and stream flow is low, point source BOD and NH_3-N have the greatest impact on instream dissolved oxygen concentrations. NPDES permits for wastewater facilities generally limit BOD_5 (or $CBOD_5$) and NH_3-N in point source discharge effluents to ensure protection of the DO standard during warm, low flow conditions. Under these conditions, nonpoint source pollution input, which typically occurs as a result of rainfall events, has a minor impact.

Where residual BOD is significant, management of nonpoint sources to reduce loading is recommended by implementation of best management practices. Additionally, constructed wetlands can be strategically engineered and positioned in the landscape to reduce the input of oxygen demanding wastes. Constructed wetland treatment systems can remove between 50% and 90% of the BOD_5 from primary effluent (Bastian and Benforado 1988).

BOD/DO models are used by DWQ to determine NPDES permit limits for oxygen-consuming wastes. The choice of model in free-flowing streams, North Carolina's desktop empirical model (Level B) or the field calibrated, QUAL2E model, is determined by the amount of data available for a given stream reach (Appendix III). Modeling is not conducted in some instances, such as for discharges into zero flow streams and HQW stream segments where NPDES permit limitations are determined by special procedures and regulations.

Discharges to Low Flow Streams

Many low flow streams exist across the state. In 1980 studies were performed on zero flow streams (7Q10 and 30Q2 = 0 cfs) to determine the effect of wastewater discharges to these waterbodies. The studies concluded that:

- steady-state models do not apply to zero flow streams, particularly those receiving waste from small discharges;
- the pool/riffle configuration of these small streams results in violations of the DO standard even when the wastewater is well treated;
- small streams receiving wastes from schools, mobile home parks, subdivisions, etc. flow through populated areas where children have easy access to the streams;
- noxious conditions were found in the low flow streams that were part of the study.

As a result of the study, regulations were developed that prohibit new or expanded discharges of oxygen-consuming wastes to zero flow streams. Existing facilities discharging to zero flow streams were evaluated for alternatives to discharge. Many facilities found alternatives to a surface water discharge and some facilities built new treatment plants to meet advanced tertiary limits for BOD_5 and NH_3-N. Facilities that currently discharge to a zero flow stream but which have not yet been evaluated will receive the following language in their NPDES permit:

> *Removal of the discharge will be required if a more environmentally sound and economically achievable alternative is available.* ***An engineering report evaluating alternatives to discharge is due 180 days prior to permit expiration along with the permit renewal application.*** *As part of the report, the cost of constructing a treatment facility to meet limits of 5 mg/l BOD_5, 2 mg/l NH_3-N, 6 mg/l dissolved oxygen and 17 ug/l chlorine must also be included if there are no alternatives to a surface water discharge. Upon review of the results of the engineering report, the Division may reopen and modify this NPDES permit to require removal of the discharge, modified treatment designs, and/or revised effluent limitations within a specified time schedule.*

This policy typically covers small discharges, i.e., schools, mobile home parks, rest homes, subdivisions, etc. which discharge to zero flow streams in headwater areas. While these discharges may not cause severe water quality problems in mainstem reaches of the Broad Basin they can cause localized problems in their low flow receiving streams.

The results of the 1980 study were extrapolated for facilities discharging to low flow streams with a 7Q10 = 0 and a 30Q2 > 0 since similar adverse impacts are expected in the receiving streams. Regulations were developed to set effluent limitations for new and expanded discharges of oxygen consuming waste at 5 mg/l BOD5, 2 mg/l NH3-N, and 6 mg/l DO, unless it is determined that these limitations will not protect water quality standards.

REFERENCES CITED: CHAPTER 6

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CHAPTER 7

FUTURE INITIATIVES

7.1 OVERVIEW OF BROAD RIVER BASINWIDE GOALS AND OBJECTIVES

Near-term objectives, or those achievable at least in part during the next five years, include coordinating with various agencies to implement the control strategies outlined in Chapter 6. These strategies are aimed at reducing point and nonpoint source loadings of nutrients and other pollutants. These steps are necessary to progress towards restoring impaired waters, protecting threatened waters from further degradation, protecting waters with a high resource value and maintaining the quality of other waters currently supporting their uses.

The long-term goal of basinwide management is to protect the water quality standards and uses of the basin's surface waters while accommodating reasonable economic growth.

Attainment of these goals and objectives will require determined, widespread public support; the combined cooperation of state, local and federal agencies, agriculture, forestry, industry and development interests; and considerable financial expenditure on the parts of all involved. However, with the needed support and cooperation, DWQ believes that these goals are attainable through the basinwide water quality management approach.

7.2 FUTURE ACTIVITIES IN THE BROAD RIVER BASIN

7.2.1 Development of Field-Calibrated Models

In the Broad River basin's larger river systems (i.e. the First Broad River and Second Broad River) there are issues related to assimilative capacity and wasteload allocation that need to be addressed. These rivers receive waste from a number of both industrial and domestic wastewater treatment facilities and are also influenced by water withdrawals from water treatment systems. DWQ will be pursuing the development of a more sophisticated model for these rivers to better predict point source impacts to dissolved oxygen concentrations in surface waters. This model will be used to apply appropriate wastewater treatment effluent limits for oxygen-consuming wastes to dischargers to protect instream water quality.

7.2.2 Investigation into Long-term Impacts of Chip Mills

In response to North Carolina citizens' increasing concerns regarding the growing chip mill industry, Governor Hunt directed the NC Department of Environment and Natural Resources (NC DENR) to conduct an environmental and economic study of wood chip production in the state. These are facilities that produce wood chips for use in the production of paper products. One of the big concerns about these facilities is their potential to increase the amount of timber harvesting, especially clearcutting, in their vicinity. For several months, NC DENR staff have been gathering information needed to identify issues that should be examined in the study. In October of 1997, public meetings were held across North Carolina to receive general public input into this process. Attendance was good and many ideas regarding the scope and nature of the forthcoming study were received.

7.2.3 Broad River Basin Nonpoint Source (NPS) Team

DWQ has begun establishing voluntary Nonpoint Source Teams in each of the state's 17 major river basins. The goals of these teams are to use local knowledge, expertise, and support to develop and implement management strategies that restore and protect priority NPS waterbodies in the basin in a targeted, coordinated, and ongoing manner. The team members participate voluntarily on the NPS team within their existing resource constraints. Only limited progress can be expected in restoring impaired waters through the team without additional resources. Key elements of these goals are the participation of local stakeholders, prioritization of NPS-affected waters and developing coordination among various agencies to more effectively manage problem nonpoint sources.

The teams provide descriptions of current NPS management activities within a basin, conduct assessments of NPS controls in targeted watersheds, prioritize impaired waters for development and implementation (including funding) of restoration strategies and NPS issues for remedial action. The team will develop five year action plans to reflect these priorities.

A portion of the annual Section 319 grant from EPA is set aside for the teams. Teams that have a basin plan approved in a given year will have a Section 319 allocation from that year's funding. The Teams must submit an acceptable proposal to the State 319 Workgroup to obtain the funding. This funding will enable teams to develop management activities on priority issues and watersheds.

In May of 1997, DWQ initiated a NPS Team in the Broad River Basin. The team has identified and ranked specific problem waters from a nonpoint source standpoint. The Team has received funding through the federal NPS program (Section 319) to take action to reduce sedimentation above Lake Lure.

7.3 PROGRAMMATIC INITIATIVES

7.3.1 Efforts to Improve NC's Sedimentation and Erosion Control Program

Recently, there has been an initiative in the Division of Land Resources to address sediment and turbidity water quality problems across the state. The Sedimentation and Erosion Control Commission has recognized the need to evaluate the implementation of the existing programs. A Technical Advisory Committee was established, along with three subcommittees, to perform the evaluation and develop recommendations. The committee and subcommittees met for several months during the fall of 1997 and presented a list of recommendations to the Commission in November. The Commission supported the recommendations and instructed the staff to implement the ones which can be implemented without rule or statute changes and have established a schedule to implement the others. It is believed that the changes initiated will result in program implementation improvements and reduction in sediment losses to our streams.

7.3.2 The North Carolina Wetlands Restoration Program

The North Carolina Wetlands Restoration Program (NCWRP) was established by the General Assembly in 1996. The purpose of the NCWRP is to protect and improve water quality, flood prevention, fisheries, wildlife and plant habitats, and recreational opportunities through the protection and restoration of wetlands and riparian areas. The NCWRP will accomplish this purpose by implementing projects that will restore wetland and riparian area functions and values throughout North Carolina.

Beginning July 1, 1997, comprehensive Basinwide Restoration Plans will be developed for each river basin in conjunction with the Basinwide Water Quality Management Plans. GIS-based mapping methodologies will be used to assess the status of the existing wetlands and riparian area

resources within each basin and to identify degraded wetlands and riparian areas. Potential restoration sites will be prioritized based on the ability of the restored sites to address problems that have been identified in the Basinwide Water Quality Management Plans. The restoration plans will provide the framework for the Wetlands Restoration Program, therefore it is essential that the public, local governments, state and federal agencies and others be involved in the development of these plans. Requests for information concerning the NCWRP and the Basinwide Restoration Plans should be sent to the following address: NC Wetlands Restoration Program, Division of Water Quality, P.O. Box 29535, Raleigh, NC 27626-0535.

7.3.3 NPDES Program Initiatives

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

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

Longer-term objectives will include refinement of overall management strategies after obtaining feedback on current management efforts during the next round of water quality monitoring. Long-term point source control efforts will stress reduction of wastes entering wastewater treatment plants, seeking more efficient and creative ways of recycling byproducts of the treatment process (including reuse of nonpotable treated wastewater), and keeping abreast of and recommending the most advanced wastewater treatment technologies.

7.3.4 Use of Discharger Self-Monitoring Data

DWQ will continue to make greater use of discharger self-monitoring data to augment the data it collects through the programs described in Chapter 4. Quality assurance, timing and consistency of data from plant to plant will be issues of importance. Also, a system will need to be developed to enter the data into a computerized database for later analysis.

7.3.5 Use Restoration Waters (URW) Strategy

Throughout North Carolina, there are waters with pollution problems that prevent them from supporting their designated uses. Designated uses include aquatic life support, swimming and commercial shellfish harvest. These waters are often very difficult to restore due to the multitude of nonpoint sources contributing pollutants to the waterbody. Point source dischargers may also be a source of the impairment.

To address waters that have a persistent loss (full or partial) of designated uses, the Division of Water Quality is developing a Use Restoration Waters (URW) Program. If approved, this program would include voluntary and regulatory management strategies to control the specific parameters of concern in selected impaired watersheds. These voluntary and mandatory management strategies could include:

- best management practices for nonpoint sources,
- source reduction strategies such as education and land use planning,
- ecosystem restoration,
- wastewater treatment requirements, and
- other waste treatment management requirements.

The restoration strategies developed under the URW program would include coordination with other agencies' programs and funding mechanisms to to create a holistic approach to address the array of pollution problems in the watersheds

7.3.6 Promotion of Non-Discharge Alternatives/Regionalization

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

7.3.7 Coordinating Basinwide Management With Other Programs

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

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

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

Research Triangle Institute performed a pilot study in the Tar-Pamlico River Basin in which high priority waterbodies for nonpoint source control programs were mapped. These maps were used by the various nonpoint source agencies for planning purposes. As resources become available, this tool may be developed for other basins.

7.3.9 Improved Monitoring and Assessment of Erosion Impacts

Sedimentation is perceived by the workshop participants and the Yadkin-Pee Dee River basin NPS Teams as one of the highest priorities in the basin. Many streams are impacted or impaired, at least in part, due to sedimentation. Erosion is evident throughout the basin. The fact that sedimentation is visible and aesthetically unpleasant helps make it a higher profile issue. The extent of sedimentation problems can be difficult to diagnose with the monitoring methods historically used by DWQ and many other state water quality agencies. Suspended solids sampling conducted on a scheduled monthly basis is likely to miss most of the high-flow periods during which the majority of sediment is transported. Benthic monitoring techniques may not always identify the effects of sedimentation, which can impact aquatic organisms by reducing and altering available habitat.

Some of the actions that DWQ and others will take towards improving monitoring and assessment of erosion impacts are:

- DWQ currently does not have adequate means of quantifying the effects of sedimentation on water quality. This points to the need for targeted management efforts coupled with a monitoring strategy which effectively measures sediment transport under both average and extreme conditions. DWQ will initiate discussion among staff and others to determine what, if any, programmatic changes can be made to gain better knowledge on sedimentation.
- Locally-based watershed improvement efforts represent an important mechanism for restoring streams and watersheds degraded by sedimentation. The Division is working with several such projects in the Yadkin-Pee Dee River basin and will continue to do so. Funding for such efforts can come from a number of sources, including the Agricultural Cost Share Program, Section 319 grants and the Clean Water Management Trust Fund. The Division's role in such projects can include assistance with problem identification and targeting, monitoring and other technical assistance.
- The Division recognizes the need to improve its targeting and monitoring capabilities in order to further the identification of sediment problems as well as to facilitate and support efforts to restore degraded areas. This includes enhancing our ability to measure and model erosion and sediment levels, to identify sediment source areas, and to recommend appropriate management practices. DWQ will initiate discussions among staff to determine how these issues can best be addressed given current resource constraints.
- DWQ is currently working with the Division of Land Resources, Division of Forest Resources and Division of Soil and Water Conservation to develop a Memorandum of Agreement for Turbidity. Turbidity is an indicator of sedimentation in a waterbody. The intent of the agreement is to establish a relationship between the agencies that better defines each agency's responsibility for activities related to turbidity. The turbidity standard is not being changed under this agreement.

APPENDIX I

Summary of North Carolina's Water Quality Classifications and Standards

Antidegradation Policy

High Quality Waters

Outstanding Resource Waters

SUMMARY OF NORTH CAROLINA'S WATER QUALITY CLASSIFICATIONS AND STANDARDS

PRIMARY CLASSIFICATIONS	BEST USAGE	DISCHARGE RESTRICTIONS[1]	STORMWATER MANAGEMENT	OTHER REQUIREMENTS[2]
Freshwater:				
C (standards apply to all freshwaters, unless pre-empted by more stringent standard for more protective classification)	Secondary recreation (including swimming on an unorganized or infrequent basis); wildlife; fish and other aquatic life propagation and survival; agriculture and any other usage, except for primary recreation, water supply or other food-related ruses	Domestic and industrial wastewater dischargers allowed	Stormwater Management Rules apply in the 20 coastal counties as described in 15A NCAC 2H .1000	
B	Primary recreation (swimming on an organized or frequent basis) and all uses specified for Class C (and not water supply or other food-related uses)	Same as for Class C; wastewater treatment reliability requirements (dual train design; backup power capability) may apply to protect swimming uses (15A NCAC 2H .0124)	Same as for Class C	
WS-I Water Supply	Water supplies in natural and undeveloped watersheds	No point source discharges	Not applicable since watershed is undeveloped	No landfills; residual or petroleum contaminated soils application not allowed in the watershed
WS-II Water Supply	Water supplies in predominantly undeveloped watersheds	Only general permit wastewater discharges allowed in watershed	Local land management program required as per 15A NCAC 2B .0214; 6% built upon area in Critical Area; 12% built upon area in the Balance of the Watershed; up to 24% built upon area in the Critical Area and 30% in the Balance of the Watershed allowed with engineered stormwater controls for the 1" storm[3]	Buffers required along perennial waters; no new landfills allowed in the Critical Area and no new discharging landfills outside of Critical Area; no new residual or petroleum contaminated soils application allowed in the Critical Area
WS-III Water Supply	Water supplies in low to moderately developed watersheds	General permits allowed throughout watershed; domestic and non-process industrial discharges allowed outside of the Critical Area	Local land management program required as per 15A NCAC 2B .0215; 12% built upon area in Critical Area; 24% built upon area outside of Critical Area; up to 30% in Critical Area and 50% built upon area outside Critical Area allowed with engineered stormwater controls for the 1" storm[3]	Buffers required along perennial waters; no new landfills allowed in the Critical Area and no new discharging landfills outside of the Critical Area; no new residual or petroleum contaminated soils application allowed in the Critical Area

SUMMARY OF NORTH CAROLINA'S WATER QUALITY CLASSIFICATIONS AND STANDARDS (continued)

PRIMARY CLASSIFICATIONS	BEST USAGE	DISCHARGE RESTRICTIONS[1]	STORMWATER MANAGEMENT	OTHER REQUIREMENTS[2]
WS-IV Water Supply	Water supplies in moderately to highly developed watersheds	General permits, domestic and industrial discharges allowed throughout watershed[4]	Local land management program required as per 15A NCAC 2B .0216: 24% built upon area in Critical Area and Protected Area [5,6]; up to 50% in Critical Area and 70% built upon area outside Critical Area with engineered stormwater controls for the 1" storm[3]	Buffers required along perennial waters; no new landfills allowed in the Critical Area; no new residual or petroleum contaminated soils application allowed in the Critical Area
WS-V Water Supply	Former or industrial use water supplies	No categorical restrictions on development or wastewater dischargers	Stormwater Management Rules apply in the 20 coastal counties as described in 15A NCAC 2H .1000	Instream water quality standards for water supply waters are applicable

NOTES: Please refer to 15A NCAC 2B .0101, .0104, .0202, .0211 and .0301 for more specific requirements for surface water supply protection.

1 Groundwater remediation discharges allowed when no alternative exists.

2 See attached tables: *Water Quality Standards for Freshwater Classes* and *Water Quality Standards for Saltwater Classes* for numeric standards associated with specific classes.

3 If the high density option is utilized engineered stormwater control systems must be designed for 85% TSS removal. Refer to Stormwater Management Rules (15 A NCAC 2H .1000) for specific design information.

4 New industrial process wastewater discharges in the Critical Area are allowed but must meet additional treatment requirements.

5 Applies to projects requiring an Erosion/Sedimentation Control Plan.

6 36% built-upon area is allowed for projects without a curb and gutter street system in the Protected Area.

- Critical area is 1/2 mile and draining to water supplies from normal pool elevation of reservoirs, or 1/2 mile and draining to a river intake.
- Protected Area is 5 miles and draining to water supplies from normal pool elevation of reservoirs, or 10 miles upstream of and draining to a river intake.
- Agricultural activities are subject to provisions of the Food Security Act of 1985 and the Food, Agriculture, Conservation and Trade Act of 1990. In WS-I watersheds and Critical Areas of WS-II, WS-III and WS-IV areas, agricultural activities must maintain a 10 foot vegetated buffer or equivalent control as determined by the Soil and Water Conservation Commission.
- Silviculture activities are subject to the provisions of the Forest Practices Guidelines Related to Water Quality (15A NCAC 1I .0101-.0209).
- The Department of Transportation must use BMPs as described in their document, "Best Management Practices for Protection of Surface Waters".

SUMMARY OF NORTH CAROLINA'S WATER QUALITY CLASSIFICATIONS AND STANDARDS (continued)

PRIMARY CLASSIFICATIONS	BEST USAGE	DISCHARGE RESTRICTIONS	STORMWATER MANAGEMENT	OTHER REQUIREMENTS
Saltwater:				
SC	Saltwaters protected for secondary recreation, aquatic life propagation and survival and other uses as described for Class C	Domestic and industrial wastewater discharges allowed	Stormwater Management Rules (15A NCAC 2H .1000) apply to all waters in the 20 coastal counties; low density option: 30% built upon area or structural stormwater controls with higher density, as specified	
SB	Saltwaters protected for primary recreation and all Class SC uses (similar to Class B)	Same as Class SC; wastewater treatment reliability requirements (dual train design; backup power capability) may apply to protect swimming uses (15A NCAC 2H .0124)	Same as for Class SC	
SA	Shellfishing and all Class SC and SB uses	No domestic discharges and only non-process industrial discharges such as seafood packing houses or cooling water discharges	Same as for Class SC except low density option is 25% built upon area	

Supplemental Classifications are added to the primary classifications as appropriate (Examples include Class C-NSW, Class SA-ORW, Class B-Trout, etc.) and impose additional requirements.

SUPPLEMENTAL CLASSIFICATIONS	BEST USAGE	DISCHARGE RESTRICTIONS	STORMWATER MANAGEMENT	OTHER REQUIREMENTS
HQW High Quality Waters	Waters rated as Excellent by DEM; Primary Nursery Areas; Native or Special Native Trout Waters; WS-I, WS-II and SA waters are HQW by definition	For new or expanded discharges advanced treatment requirements are: BOD_5=5 mg/l; NH_3-N= 2 mg/l; DO=6 mg/l	For projects requiring Erosion/ Sedimentation Control Plan and that are within 1 mile and draining to HQW waters: 12% built upon area or higher density with engineered structural controls allowed; WS-I, WS-II and 20 coastal counties exempt since stormwater control requirements already apply	Other treatment requirements may apply, dependent upon type of discharge and characteristics of receiving waters (see Antidegradation Policy: Rule 15A: NCAC 2B .0201)

SUMMARY OF NORTH CAROLINA'S WATER QUALITY CLASSIFICATIONS AND STANDARDS (continued)

SUPPLEMENTAL CLASSIFICATIONS	BEST USAGE	DISCHARGE RESTRICTIONS	STORMWATER MANAGEMENT	OTHER REQUIREMENTS
ORW Outstanding Resource Waters	Unique and special waters having exceptional water quality and being of an exceptional state or national ecological or recreational significance; must meet other conditions and have 1 or more of 5 outstanding resource value criteria as described in Rule 15A NCAC 2B .0225	Water quality must clearly maintain and protect uses, including outstanding resource values; management strategies must include at a minimum: no new or expanded discharges to freshwater ORWs; some discharges may be allowed in coastal areas	Same as for High Quality Waters for Freshwater ORWs; for Saltwater ORWs, development activities within a 575' buffer must comply with the low density option of the Stormwater Management Rules (generally 25% built upon area around SA waters and 30% around other waters)	Other management strategy components as described in 15A NCAC 2B .0225
TR Trout Waters	Protected for natural trout propagation and survival of stocked trout	Domestic and industrial wastewater discharges allowed with stricter treatment requirements		More protective standards for cadmium, total residual chlorine, chlorophyll-a, dissolved oxygen, turbidity and toluene to protect these sensitive species
NSW Nutrient Sensitive Waters	Waters needing additional nutrient management due to their being subject to excessive growth of microscopic and macroscopic vegetation	No increase of nutrients over background levels permitted; domestic and industrial wastewater discharges allowed	Nutrient management strategies developed on a case-by-case basis	Nutrient management strategies developed on a case-by-case basis
SW Swamp Waters	Waters with low velocities and other characteristics different from other waterbodies (generally, low pH, DO, high organic content)			pH as low as 4.3 and DO less than 5 mg/l allowed if due to natural conditions
FWS Future Water Supply	Waters designated for future water supply use	Discharge restrictions will be reflective of those of primary water supply classification	Stormwater management options will be reflective of those of primary water supply classification; not required until after FWS supplemental classification is removed	Requirements for landfill permits, NPDES wastewater discharges, land application of residuals and road construction activities in Critical Area and Balance of Watershed or Protected Area as appropriate (15A NCAC 2H .0101)

Water Quality Standards For Freshwater Classifications

August 2, 1995

Parameters (ug/l unless noted)	Standards for All Freshwater * Aquatic Life	Human Health[1]	Standards to Support Additional Uses: WS Classes[2]	Trout Waters	HQW	Swamp Waters
Arsenic	50		1000			
Barium		71.4	1.19			
Benzene		0.117	0.0068			
Beryllium	6.5			0.4		
Cadmium	2.0					
Carbon tetrachloride		4.42	0.254			
Chloride	230000 (AL)		250000			
Chlorinated benzenes			488 (N)			
Chlorine, total residual	17 (AL)			17		
Chlorophyll a, corrected	40 (N)			15 (N)		
Chromium, total	50					
Coliform, total (MFTCC/100ml)[3]			50 (N)[4]			
Coliform, fecal (MFFCC/100ml)[3]		200 (N)				
Copper, total	7 (AL)					
Cyanide	5.0					
Dioxin		0.000000014	0.000000013			
Dissolved gases	(N)					
Dissolved oxygen (mg/l)	5.0[5]			6.0		(N)[6]
Fluoride	1800					
Hardness, total (mg/l)			100			
Hexachlorobutadiene		49.7	0.445			
Iron (mg/l)	1000 (AL)					
Lead	25 (N)					
Manganese			200			
MBAS (Methylene-Blue-Active-Substances)	500					
Mercury	0.012					
Nickel	88		25			
Nitrate nitrogen			10			
Pesticides						
Aldrin	0.002	0.000136	0.000127			
Chlordane	0.004	0.000588	0.000575			
DDT	0.001	0.000591	0.000588			
Demeton	0.1					
Dieldrin	0.002	0.000144	0.000135			
Endosulfan	0.05					
Endrin	0.002					
Guthion	0.01					
Heptachlor	0.004	0.000214	0.000208			
Lindane	0.01					
Methoxychlor	0.03					
Mirex	0.001					
Parathion	0.013					
Toxaphene	0.0002					
2,4-D			100			
2,4,5-TP (Silvex)			10			(N)[6]
pH (units)	6.0-9.0					
Phenolic compounds		(N)	1.0 (N)			
Polychlorinated biphenyls[7]	0.001	0.000079				
Polynuclear aromatic hydrocarbons [8]		0.0311	0.0028			
Radioactive substances		(N)				
Selenium	5					
Silver	0.06 (AL)					
Solids, total dissolved (mg/l)			500			
Solids, total suspended (mg/l)					10 Tr, 20 other	
Solids, settleable	(N)					
Sulfates			250000			
Temperature	(N)					
Tetrachloroethane (1,1,2,2)		10.8	0.172			
Tetrachloroethylene			0.8			
Toluene	11			0.36		
Toxic substances	(N)				(N)	
Trialkyltin	0.008					
Trichloroethylene		92.4	3.08			
Turbidity (NTU)	50; 25 (N)			10 (N)		
Vinyl chloride		525	2.0			
Zinc	50 (AL)					

* These standards apply to all freshwater classifications. For the protection of WS and supplemental classifications, standards listed under Stancards to Support Additional Uses should be used unless standards for aquatic life or human health are listed and are more stringent.

(AL) Values represent action levels as specified in 2B .0211(4). WS Classes - Water Supply Classifications, same standards for all WS Classes.

(N) See 2B .0211(3) for narrative description of limits. HQW - High Quality Waters, standards for HQW areas only. Tr - Trout Waters.

1 Human health standards are based on consumption of fish only unless dermal contact studies available. See 2B .0208 for equation.

2 Water Supply standards are based on consumption of fish and water. See 2B .0208 for equation.

3 MFTCC/100ml means membrane filter total coliform count per 100 ml of sample. MFFCC/100ml means membrane filter fecal coliform count per 100 ml of sample.

4 Applies only to unfiltered water supplies.

5 An instantaneous reading may be as low as 4.0 mg/l, but the daily average must be 5.0 mg/l or more.

6 Designated swamp waters may have a dissolved oxygen less than 5.0 mg/l and a pH as low as 4.3, if due to natural conditions.

7 Applies to total PCBs present and includes PCB 1242, 1254, 1221, 1232, 1248, 1260, and 1016. See 2B .0208 & .0211.

8 Applies to total PAHs present and includes benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, dibenz(a,h)anthracene, and indeno(1,2,3-cd)pyrene. See 2B .0208, .0212, .0214, .0215, .0216, & .0218.

.0201 ANTIDEGRADATION POLICY

(a) It is the policy of the Environmental Management Commission to maintain, protect, and enhance water quality within the State of North Carolina. Pursuant to this policy, the requirements of 40 CFR 131.12 are hereby incorporated by reference including any subsequent amendments and editions. This material is available for inspection at the Department of Environment, Health, and Natural Resources, Division of Environmental Management, Water Quality Planning Branch, 512 North Salisbury Street, Raleigh, North Carolina. Copies may be obtained from the U.S. Government Printing Office, Superintendent of Documents, Washington, DC 20402-9325 at a cost of thirteen dollars ($13.00). These requirements will be implemented in North Carolina as set forth in Paragraphs (b), (c) and (d) of this Rule.

(b) Existing uses, as defined by Rule .0202 of this Section, and the water quality to protect such uses shall be protected by properly classifying surface waters and having standards sufficient to protect these uses. In cases where the Commission or its designee determines that an existing use is not included in the classification of waters, a project which will affect these waters will not be permitted unless the existing uses are protected.

(c) The Commission shall consider the present and anticipated usage of waters with quality higher than the standards, including any uses not specified by the assigned classification (such as outstanding national resource waters or waters of exceptional water quality) and will not allow degradation of the quality of waters with quality higher than the standards below the water quality necessary to maintain existing and anticipated uses of those waters. Waters with quality higher than the standards are defined by Rule .0202 of this Section. The following procedures will be implemented in order to meet these requirements:

(1) Each applicant for an NPDES permit or NPDES permit expansion to discharge treated waste will document an effort to consider non-discharge alternatives pursuant to 15A NCAC 2H .0105(c)(2).

(2) Public Notices for NPDES permits will list parameters that would be water quality limited and state whether or not the discharge will use the entire available load capacity of the receiving waters and may cause more stringent water quality based effluent limitations to be established for dischargers downstream.

(3) The Division may require supplemental documentation from the affected local government that a proposed project or parts of the project are necessary for important economic and social development.

(4) The Commission and Division will work with local governments on a voluntary basis to identify and develop appropriate management strategies or classifications for waters with unused pollutant loading capacity to accommodate future economic growth.

Waters with quality higher than the standards will be identified by the Division on a case-by-case basis through the NPDES permitting and waste load allocation processes (pursuant to the provisions of 15A NCAC 2H .0100). Dischargers affected by the requirements of Paragraphs (c)(1) through (c)(4) of this Rule and the public at large will be notified according to the provisions described herein, and all other appropriate provisions pursuant to 15A NCAC 2H .0109. If an applicant objects to the requirements to protect waters with quality higher than the standards and believes degradation is necessary to accommodate important social and economic development, the applicant can contest these requirements according to the provisions of General Statute 143-215.1(e) and 150B-23.

(d) The Commission shall consider the present and anticipated usage of High Quality Waters (HQW), including any uses not specified by the assigned classification (such as outstanding national resource waters or waters of exceptional water quality) and will not allow degradation of the quality of High Quality Waters below the water quality necessary to maintain existing and anticipated uses of those waters. High Quality Waters are a subset of waters with quality higher than the standards and are as described by 15A NCAC 2B .0101(e)(5). The procedures described in Rule .0224 of this Section will be implemented in order to meet the requirements of this part.

(e) Outstanding Resource Waters (ORW) are a special subset of High Quality Waters with unique and special characteristics as described in Rule .0225 of this Section. The water quality of waters classified as ORW shall be maintained such that existing uses, including the outstanding resource values of said Outstanding Resource Waters, will be maintained and protected.

History Note: *Authority G.S. 143-214.1; 143-215.1; 143-215.3(a)(1);*
Eff. February 1, 1976;
Amended Eff. October 1, 1995; February 1, 1993; April 1, 1991; August 1, 1990.

.0224 HIGH QUALITY WATERS

High Quality Waters (HQW) are a subset of waters with quality higher than the standards and are as described by 15A NCAC 2B .0101(e)(5). The following procedures shall be implemented in order to implement the requirements of Rule .0201(d) of this Section.

(1) New or expanded wastewater discharges in High Quality Waters shall comply with the following:

(a) Discharges from new single family residences shall be prohibited. Those existing subsurface systems for single family residences which fail and must discharge shall install a septic tank, dual or recirculating sand filters, disinfection and step aeration.

(b) All new NPDES wastewater discharges (except single family residences) shall be required to provide the treatment described below:

(i) Oxygen Consuming Wastes: Effluent limitations shall be as follows: BOD_5= 5 mg/l, NH_3-N = 2 mg/l and DO = 6 mg/l. More stringent limitations shall be set, if necessary, to ensure that the cumulative pollutant discharge of oxygen-consuming wastes shall not cause the DO of the receiving water to drop more than 0.5 mg/l below background levels, and in no case below the standard. Where background information is not readily available, evaluations shall assume a percent saturation determined by staff to be generally applicable to that hydroenvironment.

(ii) Total Suspended Solids: Discharges of total suspended solids (TSS) shall be limited to effluent concentrations of 10 mg/l for trout waters and PNA's, and to 20 mg/l for all other High Quality Waters.

(iii) Disinfection: Alternative methods to chlorination shall be required for discharges to trout streams, except that single family residences may use chlorination if other options are not economically feasible. Domestic discharges are prohibited to SA waters.

(iv) Emergency Requirements: Failsafe treatment designs shall be employed, including stand-by power capability for entire treatment works, dual train design for all treatment components, or equivalent failsafe treatment designs.

(v) Volume: The total volume of treated wastewater for all discharges combined shall not exceed 50 percent of the total instream flow under 7Q10 conditions.

(vi) Nutrients: Where nutrient overenrichment is projected to be a concern, appropriate effluent limitations shall be set for phosphorus or nitrogen, or both.

(vii) Toxic substances: In cases where complex wastes (those containing or potentially containing toxicants) may be present in a discharge, a safety factor shall be applied to any chemical or whole effluent toxicity allocation. The limit for a specific chemical constituent shall be allocated at one-half of the normal standard at design conditions. Whole effluent toxicity shall be allocated to protect for chronic toxicity at an effluent concentration equal to twice that which is acceptable under design conditions. In all instances there may be no acute toxicity in an effluent concentration of 90 percent. Ammonia toxicity shall be evaluated according to EPA guidelines promulgated in "Ambient Water Quality Criteria for Ammonia - 1984"; EPA document number 440/5-85-001; NTIS number PB85-227114; July 29, 1985 (50 FR 30784) or "Ambient Water Quality Criteria for Ammonia (Saltwater) - 1989"; EPA document number 440/5-88-004; NTIS number PB89-169825. This material related to ammonia toxicity is hereby incorporated by reference including any subsequent amendments and editions and is available for inspection at the Department of Environment, Health, and Natural Resources Library, 512 North Salisbury Street, Raleigh, North Carolina. Copies may be obtained from the National Technical Information Service, 5285 Port Royal Road, Springfield, Virginia 22161 at a cost of forty-seven dollars ($47.00).

(c) All expanded NPDES wastewater discharges in High Quality Waters shall be required to provide the treatment described in Sub-Item (1)(b) of this Rule, except for those existing discharges which expand with no increase in permitted pollutant loading.

(2) Development activities which require an Erosion and Sedimentation Control Plan in accordance with rules established by the NC Sedimentation Control Commission or local erosion and sedimentation control program approved in accordance with 15A NCAC 4B .0218, and which drain to and are within one mile of High Quality Waters (HQW) shall be required to follow the stormwater management rules as specified in 15A NCAC 2H .1000. Stormwater management requirements specific to HQW are described in 15A NCAC 2H .1006.

If an applicant objects to the requirements to protect high quality waters and believes degradation is necessary to accommodate important social and economic development, the applicant may contest these requirements according to the provisions of G.S. 143-215.1(e) and 150B-23.

History Note: *Authority G.S. 143-214.1; 143-215.1; 143-215.3(a)(1);*
Eff. October 1, 1995;

.0225 OUTSTANDING RESOURCE WATERS

(a) General. In addition to the existing classifications, the Commission may classify certain unique and special surface waters of the state as outstanding resource waters (ORW) upon finding that such waters are of exceptional state or national recreational or ecological significance and that the waters have exceptional water quality while meeting the following conditions:

(1) there are no significant impacts from pollution with the water quality rated as excellent based on physical, chemical or biological information;

(2) the characteristics which make these waters unique and special may not be protected by the assigned narrative and numerical water quality standards.

(b) Outstanding Resource Values. In order to be classified as ORW, a water body must exhibit one or more of the following values or uses to demonstrate it is of exceptional state or national recreational or ecological significance:

(1) there are outstanding fish (or commercially important aquatic species) habitat and fisheries;

(2) there is an unusually high level of water-based recreation or the potential for such recreation;

(3) the waters have already received some special designation such as a North Carolina or National Wild and Scenic River, Native or Special Native Trout Waters, National Wildlife Refuge, etc, which do not provide any water quality protection;

(4) the waters represent an important component of a state or national park or forest; or

(5) the waters are of special ecological or scientific significance such as habitat for rare or endangered species or as areas for research and education.

(c) Quality Standards for ORW.

(1) Freshwater: Water quality conditions shall clearly maintain and protect the outstanding resource values of waters classified ORW. Management strategies to protect resource values shall be developed on a site specific basis during the proceedings to classify waters as ORW. At a minimum, no new discharges or expansions of existing discharges shall be permitted, and stormwater controls for all new development activities requiring an Erosion and Sedimentation Control Plan in accordance with rules established by the NC Sedimentation Control Commission or an appropriate local erosion and sedimentation control program shall be required to follow the stormwater provisions as specified in 15A NCAC 2H .1000. Specific stormwater requirements for ORW areas are described in 15A NCAC 2H .1007.

(2) Saltwater: Water quality conditions shall clearly maintain and protect the outstanding resource values of waters classified ORW. Management strategies to protect resource values shall be developed on a site-specific basis during the proceedings to classify waters as ORW. At a minimum, new development shall comply with the stormwater provisions as specified in 15A NCAC 2H .1000. Specific stormwater management requirements for saltwater ORWs are described in 15A NCAC 2H .1007. New non-discharge permits shall meet reduced loading rates and increased buffer zones, to be determined on a case-by-case basis. No dredge or fill activities shall be allowed where significant shellfish or submerged aquatic vegetation bed resources occur, except for maintenance dredging, such as that required to maintain access to existing channels and facilities located within the designated areas or maintenance dredging for activities such as agriculture. A public hearing is mandatory for any proposed permits to discharge to waters classified as ORW.

Additional actions to protect resource values shall be considered on a site specific basis during the proceedings to classify waters as ORW and shall be specified in Paragraph (e) of this Rule. These actions may include anything within the powers of the commission. The commission shall also consider local actions which have been taken to protect a water body in determining the appropriate state protection options. Descriptions of boundaries of waters classified as ORW are included in Paragraph (e) of this Rule and in the Schedule of Classifications (15A NCAC 2B .0302 through .0317) as specified for the appropriate river basin and shall also be described on maps maintained by the Division of Environmental Management.

(d) Petition Process. Any person may petition the Commission to classify a surface water of the state as an ORW. The petition shall identify the exceptional resource value to be protected, address how the water body meets the general criteria in Paragraph (a) of this Rule, and the suggested actions to protect the resource values. The Commission may request additional supporting information from the petitioner. The Commission or its designee shall initiate public proceedings to classify waters as ORW or shall inform the petitioner that the waters do not meet the criteria for ORW with an explanation of the basis for this decision. The petition shall be sent to:

Director
DEHNR/Division of Environmental Management
P.O. Box 29535
Raleigh, North Carolina 27626-0535

The envelope containing the petition shall clearly bear the notation: RULE-MAKING PETITION FOR ORW CLASSIFICATION.

(e) Listing of Waters Classified ORW with Specific Actions. Waters classified as ORW with specific actions to protect exceptional resource values are listed as follows:

(1) Roosevelt Natural Area [White Oak River Basin, Index Nos. 20-36-9.5-(1) and 20-36-9.5-(2)] including all fresh and saline waters within the property boundaries of the natural area shall have only new development which complies with the low density option in the stormwater rules as specified in 15A NCAC 2H .1005(2)(a) within 575 feet of the Roosevelt Natural Area (if the development site naturally drains to the Roosevelt Natural Area).

(2) Chattooga River ORW Area (Little Tennessee River Basin and Savannah River Drainage Area): the following undesignated waterbodies that are tributary to ORW designated segments shall comply with Paragraph (c) of this Rule in order to protect the designated waters as per Rule .0203 of this Section. However, expansions of existing discharges to these segments shall be allowed if there is no increase in pollutant loading:

(A) North and South Fowler Creeks,
(B) Green and Norton Mill Creeks,
(C) Cane Creek,
(D) Ammons Branch,
(E) Glade Creek, and
(F) Associated tributaries.

(3) Henry Fork ORW Area (Catawba River Basin): the following undesignated waterbodies that are tributary to ORW designated segments shall comply with Paragraph (c) of this Rule in order to protect the designated waters as per Rule .0203 of this Section:

(A) Ivy Creek,
(B) Rock Creek, and
(C) Associated tributaries.

(4) South Fork New and New Rivers ORW Area [New River Basin (Index Nos. 10-1-33.5 and 10)]: the following management strategies, in addition to the discharge requirements specified in Subparagraph (c)(1) of this Rule, shall be applied to protect the designated ORW areas:

(A) Stormwater controls described in Subparagraph (c)(1) of this Rule shall apply within one mile and draining to the designated ORW areas;

(B) New or expanded NPDES permitted wastewater discharges located upstream of the designated ORW shall be permitted such that the following water quality standards are maintained in the ORW segment:

(i) the total volume of treated wastewater for all upstream discharges combined shall not exceed 50 percent of the total instream flow in the designated ORW under 7Q10 conditions;

(ii) a safety factor shall be applied to any chemical allocation such that the effluent limitation for a specific chemical constituent shall be the more stringent of either the limitation allocated under design conditions (pursuant to 15A NCAC 2B .0206) for the normal standard at the point of discharge, or the limitation allocated under design conditions for one-half the normal standard at the upstream border of the ORW segment;

(iii) a safety factor shall be applied to any discharge of complex wastewater (those containing or potentially containing toxicants) to protect for chronic toxicity in the ORW segment by setting the whole effluent toxicity limitation at the higher (more stringent) percentage effluent determined under design conditions (pursuant to 15A NCAC 2B .0206) for either the instream effluent concentration at the point of discharge or twice the effluent concentration calculated as if the discharge were at the upstream border of the ORW segment;

(C) New or expanded NPDES permitted wastewater discharges located upstream of the designated ORW shall comply with the following:

(i) Oxygen Consuming Wastes: Effluent limitations shall be as follows: BOD = 5 mg/l, and NH3-N = 2 mg/l;

(ii) Total Suspended Solids: Discharges of total suspended solids (TSS) shall be limited to effluent concentrations of 10 mg/l for trout waters and to 20 mg/l for all other waters;

(iii) Emergency Requirements: Failsafe treatment designs shall be employed, including stand-by power capability for entire treatment works, dual train design for all treatment components, or equivalent failsafe treatment designs;

(iv) Nutrients: Where nutrient overenrichment is projected to be a concern, appropriate effluent limitations shall be set for phosphorus or nitrogen, or both.

(5) Old Field Creek (New River Basin): the undesignated portion of Old Field Creek (from its source to Call Creek) shall comply with Paragraph (c) of this Rule in order to protect the designated waters as per Rule ..0203 of this Section.

(6) In the following designated waterbodies, no additional restrictions shall be placed on new or expanded marinas. The only new or expanded NPDES permitted discharges that shall be allowed shall be non-domestic, non-process industrial discharges. The Alligator River Area (Pasquotank River Basin) extending from the source of the Alligator River to the U.S. Highway 64 bridge including New Lake Fork, North West Fork Alligator River, Juniper Creek, Southwest Fork Alligator River, Scouts Bay, Gum Neck Creek, Georgia Bay, Winn Bay, Stumpy Creek Bay, Stumpy Creek, Swann Creek (Swann Creek Lake), Whipping Creek (Whipping Creek Lake), Grapevine Bay, Rattlesnake Bay, The Straits, The Frying Pan, Coopers Creek, Babbitt Bay, Goose Creek, Milltail Creek, Boat Bay, Sandy Ridge Gut (Sawyer Lake) and Second Creek, but excluding the Intracoastal Waterway (Pungo River-Alligator River Canal) and all other tributary streams and canals.

(7) In the following designated waterbodies, the only type of new or expanded marina that shall be allowed shall be those marinas located in upland basin areas, or those with less than 30 slips, having no boats over 21 feet in length and no boats with heads. The only new or expanded NPDES permitted discharges that shall be allowed shall be non-domestic, non-process industrial discharges.

(A) The Northeast Swanquarter Bay Area including all waters northeast of a line from a point at Lat. 35• 23• 51• and Long. 76• 21• 02• thence southeast along the Swanquarter National Wildlife Refuge hunting closure boundary (as defined by the 1935 Presidential Proclamation) to Drum Point.

(B) The Neuse-Southeast Pamlico Sound Area (Southeast Pamlico Sound Section of the Southeast Pamlico, Core and Back Sound Area); (Neuse River Basin) including all waters within an area defined by a line extending from the southern shore of Ocracoke Inlet northwest to the Tar-Pamlico River and Neuse River basin boundary, then southwest to Ship Point.

(C) The Core Sound Section of the Southeast Pamlico, Core and Back Sound Area (White Oak River Basin), including all waters of Core Sound and its tributaries, but excluding Nelson Bay, Little Port Branch and Atlantic Harbor at its mouth, and those tributaries of Jarrett Bay that are closed to shellfishing.

(D) The Western Bogue Sound Section of the Western Bogue Sound and Bear Island Area (White Oak River Basin) including all waters within an area defined by a line from Bogue Inlet to the mainland at SR 1117 to a line across Bogue Sound from the southwest side of Gales Creek to Rock Point, including Taylor Bay and the Intracoastal Waterway.

(E) The Stump Sound Area (Cape Fear River Basin) including all waters of Stump Sound and Alligator Bay from marker Number 17 to the western end of Permuda Island, but excluding Rogers Bay, the Kings Creek Restricted Area and Mill Creek.

(F) The Topsail Sound and Middle Sound Area (Cape Fear River Basin) including all estuarine waters from New Topsail Inlet to Mason Inlet, including the Intracoastal Waterway and Howe Creek, but excluding Pages Creek and Futch Creek.

(8) In the following designated waterbodies, no new or expanded NPDES permitted discharges and only new or expanded marinas with less than 30 slips, having no boats over 21 feet in length and no boats with heads shall be allowed.

(A) The Swanquarter Bay and Juniper Bay Area (Tar-Pamlico River Basin) including all waters within a line beginning at Juniper Bay Point and running south and then west below Great Island, then northwest to Shell Point and including Shell Bay, Swanquarter and Juniper Bays and their tributaries, but excluding all waters northeast of a line from a point at Lat. 35• 23• 51• and Long. 76• 21• 02• thence southeast along the Swanquarter National Wildlife Refuge hunting closure boundary (as defined by the 1935 Presidential Proclamation) to Drum Point and also excluding the Blowout Canal, Hydeland Canal, Juniper Canal and Quarter Canal.

(B) The Back Sound Section of the Southeast Pamlico, Core and Back Sound Area (White Oak River Basin) including that area of Back Sound extending from Core Sound west along Shackleford Banks, then north to the western most point of Middle Marshes and along the northwest shore of Middle Marshes (to include all of Middle Marshes), then west to Rush Point on Harker's Island, and along the southern shore of Harker's Island back to Core Sound.

(C) The Bear Island Section of the Western Bogue Sound and Bear Island Area (White Oak River Basin) including all waters within an area defined by a line from the western most point on Bear Island to the northeast mouth of Goose Creek on the mainland, east to the southwest mouth of Queen Creek, then south to green marker No. 49, then northeast to the northern most point on Huggins Island, then southeast along the shoreline of Huggins Island to the southeastern most point of Huggins Island, then south to the northeastern most point on Dudley Island, then southwest along the shoreline of Dudley Island to the eastern tip of Bear Island.

(D) The Masonboro Sound Area (Cape Fear River Basin) including all waters between the Barrier Islands and the mainland from Carolina Beach Inlet to Masonboro Inlet.

(9) Black and South Rivers ORW Area (Cape Fear River Basin) [Index Nos. 18-68-(0.5), 18-68-(3.5), 18-68-(11.5), 18-68-12-(0.5), 18-68-12-(11.5), and 18-68-2]: the following management strategies, in addition to the discharge requirements specified in Subparagraph (c)(1) of this Rule, shall be applied to protect the designated ORW areas:

(A) Stormwater controls described in Subparagraph (c)(1) of this Rule shall apply within one mile and draining to the designated ORW areas;

(B) New or expanded NPDES permitted wastewater discharges located one mile upstream of the stream segments designated ORW (upstream on the designated mainstem and upstream into direct tributaries to the designated mainstem) shall comply with the following discharge restrictions:

(i) Oxygen Consuming Wastes: Effluent limitations shall be as follows: BOD = 5 mg/l and NH3-N = 2 mg/l;

(ii) Total Suspended Solids: Discharges of total suspended solids (TSS) shall be limited to effluent concentrations of 20 mg/l;

(iii) Emergency Requirements: Failsafe treatment designs shall be employed, including stand-by power capability for entire treatment works, dual train design for all treatment components, or equivalent failsafe treatment designs;

(iv) Nutrients: Where nutrient overenrichment is projected to be a concern, appropriate effluent limitations shall be set for phosphorus or nitrogen, or both.

(v) Toxic substances: In cases where complex discharges (those containing or potentially containing toxicants) may be currently present in the discharge, a safety factor shall be applied to any chemical or whole effluent toxicity allocation. The limit for a specific chemical constituent shall be allocated at one-half of the normal standard at design conditions. Whole effluent toxicity shall be allocated to protect for chronic toxicity at an effluent concentration equal to twice that which is acceptable under flow design criteria (pursuant to 15A NCAC 2B .0206).

History Note: *Authority G.S. 143-214.1;*
Eff. October 1, 1995;
Amended Eff. April 1, 1996; January 1, 1996

APPENDIX II

DEM Water Quality Monitoring Programs:

- Benthic Macroinvertebrate Sampling
- Fisheries Studies
- Lakes Assessment
- Effluent Toxicity Testing

A - II.1 BENTHIC MACROINVERTEBRATES

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 many taxa in a community have life cycles of six months to 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 bioclassifications ranging from Poor to Excellent to each benthic sample based on the number of taxa present in the intolerant groups Ephemeroptera, Plecoptera and Trichoptera (EPT S). Likewise, ratings can be assigned with a North Carolina Biotic Index (BI). This index summarizes tolerance data for all taxa in each collection. The two rankings are given equal weight in final site classification for the qualitative (10 sample) method. An abbreviated (4 sample) EPT method uses just the EPT criteria. Higher taxa richness values are associated with better water quality. These bioclassifications primarily reflect the influence of chemical pollutants. The major physical pollutant, sediment, is not assessed as well by a taxa richness analysis. Different criteria have been developed for different ecoregions (mountains, piedmont and coastal) within North Carolina for freshwater flowing waterbodies. Details of benthos sampling, criteria, and data analysis can be found in the Biological Monitoring SOP Manual (NCDENR 1997).

Table 1. Classification Criteria by Ecoregion*

A. EPT taxa richness values

	10-sample Qualitative Samples			4-sample EPT Samples		
	Mountains	Piedmont	Coastal	Mountains	Piedmont	Coastal
Excellent	>41	>31	>27	>35	>27	>23
Good	32-41	24-31	21-27	28-35	21-27	18-23
Good-Fair	22-31	16-23	14-20	19-27	14-20	12-17
Fair	12-21	8-15	7-13	11-18	7-13	6-11
Poor	0-11	0-7	0-6	0-10	0-6	0-5

B. Biotic Index Values (Range = 0-10)

	Mountains	Piedmont	Coastal
Excellent	<4.05	<5.19	<5.47
Good	4.06-4.88	5.19-5.78	5.47-6.05
Good-Fair	4.89-5.74	5.79-6.48	6.06-6.72
Fair	5.75-7.00	6.49-7.48	6.73-7.73
Poor	>7.00	>7.48	>7.73

*These criteria apply to flowing water systems only. Biotic index criteria are only used for full-scale (10-sample) qualitative samples.

A - II.2 FISHERIES

Fish Communtiy Structure Assessment

The fish communities of the Broad River basin were sampled in 1995 using methods developed for the application of the North Carolina Index of Biotic Integrity (NCIBI). Details of sampling, metrics, and data analysis can be found in the Biological Monitoring SOP Manual (NCDENR 1997). At each sample site, a 200 meter section of stream was selected and measured. The fish in the delineated stretch of stream were then collected using two backpack electrofishing units. A seine also was used at the Green River site where riffles were abundant, to increase collecting

efficiency. After collection, all readily identifiable fish (usually sport fishes, catfishes, and suckers) were examined for sores, lesions, fin damage, and skeletal anomalies, measured (total length to the nearest 1 mm), and then released. Fish that could not be identified were preserved in 10% formalin and returned to the laboratory for identification, examination, and total length measurement. The resulting data were then analyzed with the NCIBI.

The NCIBI is a modification of the Index of Biotic Integrity initially proposed by Karr (1981) and Karr et al. (1986). The Index has been subsequently modified for applicability to wadeable streams in North Carolina. The IBI method was developed for assessing a stream's biological integrity by examining the structure and health of its fish community. The scores derived from this index are a measure of the ecological health of the waterbody and may not directly correlate to water quality. For example, a stream with excellent water quality, but with poor or fair fish habitat, would not be rated excellent with this index. However, a stream which rated excellent on the NCIBI should be expected to have excellent water quality. Currently, the NCIBI is not applicable to high elevation or small, coldwater trout streams, lakes, or estuaries.

The Index of Biological Integrity incorporates information about species richness and composition, trophic composition, fish abundance, and fish condition. The NCIBI summarizes the effects of all classes of factors influencing aquatic faunal communities (water quality, energy source, habitat quality, flow regime, and biotic interactions). While any change in a fish community can be caused by many factors, certain aspects of the community are generally more responsive to specific influences. Species composition measurements reflect habitat quality effects. Information on trophic composition reflects the effect of biotic interactions and energy supply. Fish abundance and condition information indicates additional water quality effects. It should be noted, however, that these responses may overlap. For example, a change in fish abundance may be due to decreased energy supply or a decline in habitat quality, not necessarily a change in water quality.

The assessment of biological integrity using the NCIBI is provided by the cumulative assessment of 12 parameters or metrics. The values provided by the metrics are converted into scores on a 1, 3, or 5 scale. A score of 5 represents conditions which would be expected for undisturbed streams in the specific river basin or ecoregion, while a score of 1 indicates that the conditions vary greatly from those expected in undisturbed streams of the region. Each metric is designed to contribute unique information to the overall assessment. The scores for all metrics are then summed to obtain the overall IBI score. Finally, the NCIBI score (an even number between 12 and 60) is then used to determine the ecological integrity class of the stream from which the sample was collected.

Table 2. Definitions of NCIBI Scores

NCIBI Scores	Integrity Class	Class Attributes[1]
58 or 60	Excellent	Comparable to the best situations without human disturbance. All regionally expected species for the habitat and stream size, including the most intolerant forms, are present along with a full array of size classes and a balanced trophic structure.
54 or 56	Good-Excellent	
48, 50, or 52	Good	Species richness somewhat below expectation, especially due to the loss of the most intolerant species; some species are present with less than optimal abundances or size distributions; and the trophic structure shows some signs of stress.
46	Fair-Good	
40, 42, or 44	Fair	Signs of additional deterioration include the loss of intolerant species, fewer species, and a highly skewed trophic structure.
36 or 38	Poor-Fair	
28, 30, 32, or 34	Poor	Dominated by omnivores, tolerant species, and habitat generalists; few top carnivores; growth rates and condition factors commonly depressed; and diseased fish often present.
24 or 26	Very Poor-Poor	
12, 14, 16, 18, 20, or 22	Very Poor	Few fish present, mostly introduced or tolerant species; and disease fin damage and other anomalies are regular.
----	No fish	Repeated sampling finds no fish.

[1] Over-lapping classes share attributes with classes greater than and less than the respective NCIBI score.

Fish TIssue

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

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

The FDA levels were developed to protect humans from the chronic effects of toxic substances consumed in foodstuffs and thus employ a "safe level" approach to fish tissue consumption. A list of fish tissue analytes accompanied by their FDA criteria are presented below (USFDA, 1980). At

present, the FDA has only developed metals criteria for mercury. Individual parameters which appear to be of potential human health concern are evaluated by the N.C. Division of Epidemiology by request of the Water Quality Section.

Table 3. Food and Drug Administration (FDA) Action Levels

Metals			
Mercury	1.0 ppm		
Organics			
Aldrin	0.3 ppm	p,p DDE	5.0 ppm
Dieldrin	0.3 ppm	o,p DDT	5.0 ppm
Endrin	0.3 ppm	p,p DDT	5.0 ppm
o,p DDD	5.0 ppm	PCB-1254	2.0 ppm
p,p DDD	5.0 ppm	cis-chlordane	0.3 ppm
o,p DDE	5.0 ppm	trans-chlordane	0.3 ppm

In the guidance document, Fish Sampling and Analysis: Volume 1 (USEPA, 1993), EPA has recommended screening values for target analytes which are formulated from a risk assessment procedure. These are the concentrations of analytes in edible fish tissue that are of potential public health concern. The DWQ compares fish tissue results with EPA screening values to evaluate the need for further intensive site specific monitoring. A list of target analytes and EPA recommended screening values for the general adult population is presented below.

The North Carolina State Health Director has adopted a selenium limit of 5 ppm for issuing fish consumption advisories. Total DDT includes the sum of all its isomers and metabolites (i.e. p,p DDT, o,p DDT, DDE, and DDD). Total chlordane includes the sum of cis-and trans- isomers as well as nonachlor and oxychlordane. Although the EPA has suggested a screening value of 7.0 x 10^{-7} ppm for dioxins, the State of North Carolina currently uses a value of 3.0 ppt (3 x 10^{-3}) in issuing fish consumption advisories.

Table 4. Environmental Protection Agency (EPA) Screening Values

Metals			
Cadmium	10.0 ppm		
Mercury	0.6 ppm		
Selenium	50.0 ppm		
Organics			
Chlorpyrifos	30.00 ppm	Heptachlor epoxide	0.01 ppm
Total chlordane	0.08 ppm	Hexachlorobenzene	0.07 ppm
Total DDT	0.30 ppm	Lindane	0.08 ppm
Dieldrin	0.007 ppm	Mirex	2.00 ppm
Dioxins	7.0×10^{-7} ppm	Total PCB's	0.01 ppm
Endosulfan (I and II)	20.00 ppm	Toxaphene	0.10 ppm
Endrin	3.00 ppm		

A - II.3 LAKES ASSESSMENT PROGRAM

Lakes are valued for the multiple benefits they provide to the public, including recreational boating, fishing, drinking water, and aesthetic enjoyment. The North Carolina Lakes Assessment Program seeks to protect these waters through monitoring and pollution prevention and control. Assessments have been made at publicly accessible lakes, at lakes which supply domestic drinking

water, and lakes (public or private) where water quality problems have been observed. Data are used to determine the trophic state of each lake, a relative measure of nutrient enrichment and productivity, and whether the designated uses of the lake have been threatened or impaired.

Numerical indices are often used to evaluate the trophic state of lakes. An index was developed specifically for North Carolina lakes as part of the state's original Clean Lakes Classification Survey. The North Carolina Trophic State Index (NCTSI) is based on total phosphorus (TP in mg/l), total organic nitrogen (TON in mg/l), Secchi depth (SD in inches), and chlorophyll *a* (CHL in µg/l). Lakewide means for these parameters are used to produce a NCTSI score for each lake, using the following equations:

$$TON_{Score} = \frac{Log(TON) + 0.45}{0.24} \times 0.90$$

$$TP_{Score} = \frac{Log(TP) + 1.55}{0.35} \times 0.92$$

$$SD_{Score} = \frac{Log(SD) - 1.73}{0.35} \times -0.82$$

$$CHL_{Score} = \frac{Log(CHL) - 1.00}{0.48} \times 0.83$$

$$NCTSI = TON_{Score} + TP_{Score} + SD_{Score} + CHL_{Score}$$

In general, NCTSI scores relate to trophic classifications as follows: less than -2.0 is oligotrophic, -2.0 to 0.0 is mesotrophic, 0.0 to 5.0 is eutrophic, and greater than 5.0 is hypereutrophic. When scores border between classes, best professional judgment is used to assign an appropriate classification. NCTSI scores may be skewed by highly colored water typical of dystrophic lakes.

Lakes are classified for their "best usage" and are subject to the state's water quality standards. Primary classifications are C (suited for aquatic life propagation/protection and secondary recreation such as wading), B (primary recreation, such as swimming, and all class C uses), and WS-I through WS-V(water supply source ranging from highest watershed protection level I to lowest watershed protection V, and all class C uses). Lakes with a CA designation represent water supplies with watersheds that are considered to be Critical Areas (i.e., an area within 1/2 mile and draining to water supplies from the normal pool elevation of reservoirs, or within 1/2 mile and draining to a river intake). Supplemental classifications in the Broad River basin may include Trout Waters (Tr) for waters that support the survival and propogation of trout and HQW (High Quality Waters which are rated excellent based on biological and physical/chemical characteristics). A complete listing of these water classifications and standards can be found in Title 15 North Carolina Administrative Code, Chapter 2B, Section .0100 and .0200.

Phytoplankton are microscopic algae found in the water column of lakes, rivers, streams, and estuaries. Phytoplankton populations respond to nutrient availability and other environmental factors such as light, temperature, pH, salinity, water velocity, and grazing by organisms in higher trophic levels. Phytoplankton may be useful as indicators of eutrophication and are often collected with ambient water quality samples from lakes. Prolific growths of phytoplankton, often due to

high concentrations of nutrients, sometimes result in "blooms" in which one or more species of algae may discolor the water or form visible mats on top of the water. Blooms may be unsightly and deleterious to water quality, causing fish kills, anoxia, or taste and odor problems. The Algal Bloom Program was initiated in 1984 to document suspected algal blooms with species identification, quantitative biovolume, and density estimates. Usually, an algal sample with a biovolume larger than 5000 mm^3/m^3, density greater than 10,000 units/ml, or chlorophyll *a* concentration approaching or exceeding 40 µg/l (the North Carolina state standard) constitutes a bloom. Bloom samples may be collected as a result of complaint investigations, fish kills, or during routine monitoring if a bloom is suspected.

Three lakes have been sampled for the potential of supporting algal growth with the Algal Growth Potential Test (AGPT) in the Broad River Basin. These are Lake Lure, Kings Mountain Reservoir and Lake Montonia. The results of the Algal Growth Potential Test are mentioned in each of the appropriate subbasin discussions in Chapter 4 of the main document. The objective of the Algal Growth Potential Test is assessment of a waterbody's potential for supporting algal biomass and to determine whether algal growth is limited by nitrogen, by phosphorus, or co-limited by both nutrients. When a waterbody supports algal growth at bloom levels without additional increases in nitrogen and/or phosphorus, the system may be subject to frequent nuisance algal blooms. The test exposes a standard alga, *Selenastrum capricornutum*, to the test water (this constitutes the control). Additional test samples are enriched with nitrogen or phosphorus. When one of these nutrients is added to a water sample which is growth limiting to that nutrient, the resulting mean standing crop (MSC) will generally reflect the level of added nutrient. In some cases, the bioavailable nitrogen and phosphorus in a sample may approach their optimum ratio for growth of the test alga and the addition of nutrients may not clearly identify the limiting nutrient. A waterbody may be protected from nuisance algal blooms if an AGPT value is consistently less than or equal to 5 mg/l.

Five lakes in the Broad River basin have been sampled as part of the Lakes Assessment Program. These lakes are presented below.

SUBBASIN 030801	SUBBASIN 030803	SUBBASIN 030805
Lake Lure	Lake Summit	Lake Montonia
	Lake Adger	Kings Mountain Reservoir

Each lake is individually discussed in the appropriate subbasin section with a focus on the most recent available data. The figure below shows the most recent NCTSI scores for the five lakes of the Broad River basin. Kings Mountain Reservoir was monitored intensively during the growing seasons of 1991 through 1993 as part of the reference lake program to determine if this lake was representative of a minimally impacted lake in the region of the state in which it is located. It was not found to represent a reference lake. All of the lakes in this basin were sampled most recently by DWQ in 1995 except for Lake Montonia, which was most recently sampled in 1996.

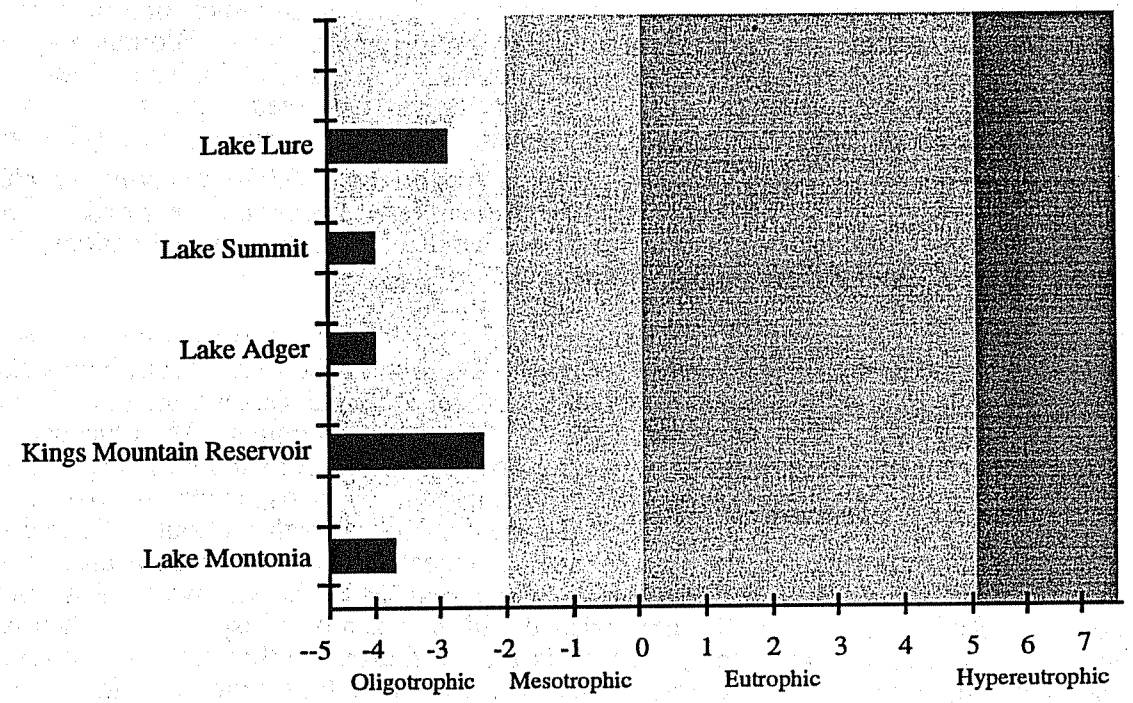

Figure 1. Broad Basin - TSI Scores (Last Assessment Date)

A-II.4 AQUATIC TOXICITY MONITORING

Acute and/or chronic toxicity tests are used to determine toxicity of discharges to sensitive aquatic species (usually fathead minnows or the water flea, *Ceriodaphnia dubia*). Results of these tests have been shown by several researchers to be predictive of discharge effects on receiving stream populations. Many facilities are required to monitor whole effluent toxicity by their NPDES permit or by administrative letter. Other facilities may be tested by DEM's Aquatic Toxicology Laboratory. The Aquatic Survey andToxicology Unit maintains a compliance summary for all facilities required to perform tests and provides a monthly update of this information to regional offices and DEM administration. Ambient toxicity tests can be used to evaluate stream water quality relative to other stream sites and/or a point source discharge. Facilities in the Broad River Basin required to monitor effluent toxicity are presented in the table below.

Table 5. Facilities in the Broad River Basin Monitoring Aquatic Toxicity

Subbasin 02

Facility	NPDES#	Receiving Stream	County	Flow(MGD)	IWC(%)
Alexander Mills WWTP	NC0020320/001	Brackett's Cr	Rutherford	0.200	11.0
Burlington Ind.-Cowan 001	NC0006025/001	Second Broad R	Rutherford	2.000	5.5
Columbus WWTP	NC0021369/001	UT White Oak Cr	Polk	0.800	37.1
Cone Mills- Cliffside	NC0004405/001	Second Broad R	Rutherford	1.750	4.2
Duke Power-Cliffside	NC0005088/002	Broad R	Rutherford	8.800	4.5
Forest City WWTP	NC0025984/001	Second Broad R	Rutherford	4.950	18.0
J. H. Mont. Mill/Spartan Mills	NC0080993/001	Broad R	Rutherford	0.175	0.1
New Cherokee/Harris Fin. Plant	NC0083275/001	Broad R	Rutherford	0.910	0.7
Rutherfordton WWTP	NC0025909/001	Cleghorn Cr	Rutherford	1.000	48.0
Spindale WWTP	NC0020664/001	Holland's Cr	Rutherford	6.000	73.0

Subbasin 04

Facility	NPDES#	Receiving Stream	County	Flow(MGD)	IWC(%)
Cleveland Co.- Burns HS	NC0066486/001	UT Maple Cr	Cleveland	0.017	100.0
Cleveland Mills/001	NC0004120/001	First Broad R	Cleveland	0.780	2.4
Jefferson Smurfit Corp.	NC0005061/001	EF Beaverdam Cr	Cleveland	0.010	11.0
PPG-Shelby -001	NC0004685/001	Overflow Br	Cleveland	1.300	33.0
Shelby WWTP	NC0024538/001	First Broad R	Cleveland	6.000	11.6

Subbasin 05

Facility	NPDES#	Receiving Stream	County	Flow(MGD)	IWC(%)
Cyprus Foote Mineral Co./001	NC0033570/001	Kings Cr	Cleveland	0.123	17.0
Grover Industries, Inc.	NC0083984/001	Buffaloe Cr	Cleveland	0.380	1.8
Hoechst-Celanese Corp.	NC0004952/001	Buffalo Cr	Cleveland	0.550	4.5
King's Mtn.-Pilot Cr. WWTP	NC0020737/001	Buffalo Cr	Cleveland	6.000	33.0
New Minette Textiles	NC0004235/001	Lick Br	Cleveland	0.450	77.7

Subbasin 06

Facility	NPDES#	Receiving Stream	County	Flow(MGD)	IWC(%)
Grover Industries, Inc.	NC0004391/001	N Pacolet R	Polk	0.450	6.1
Tryon WWTP	NC0021601/001	Vaughn Cr	Polk	1.500	37.0

NOTE: IWC = Instream Waste Concentration

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NCDENR, Division of Water Quality. 1997. Biological Monitoring SOP Manual.

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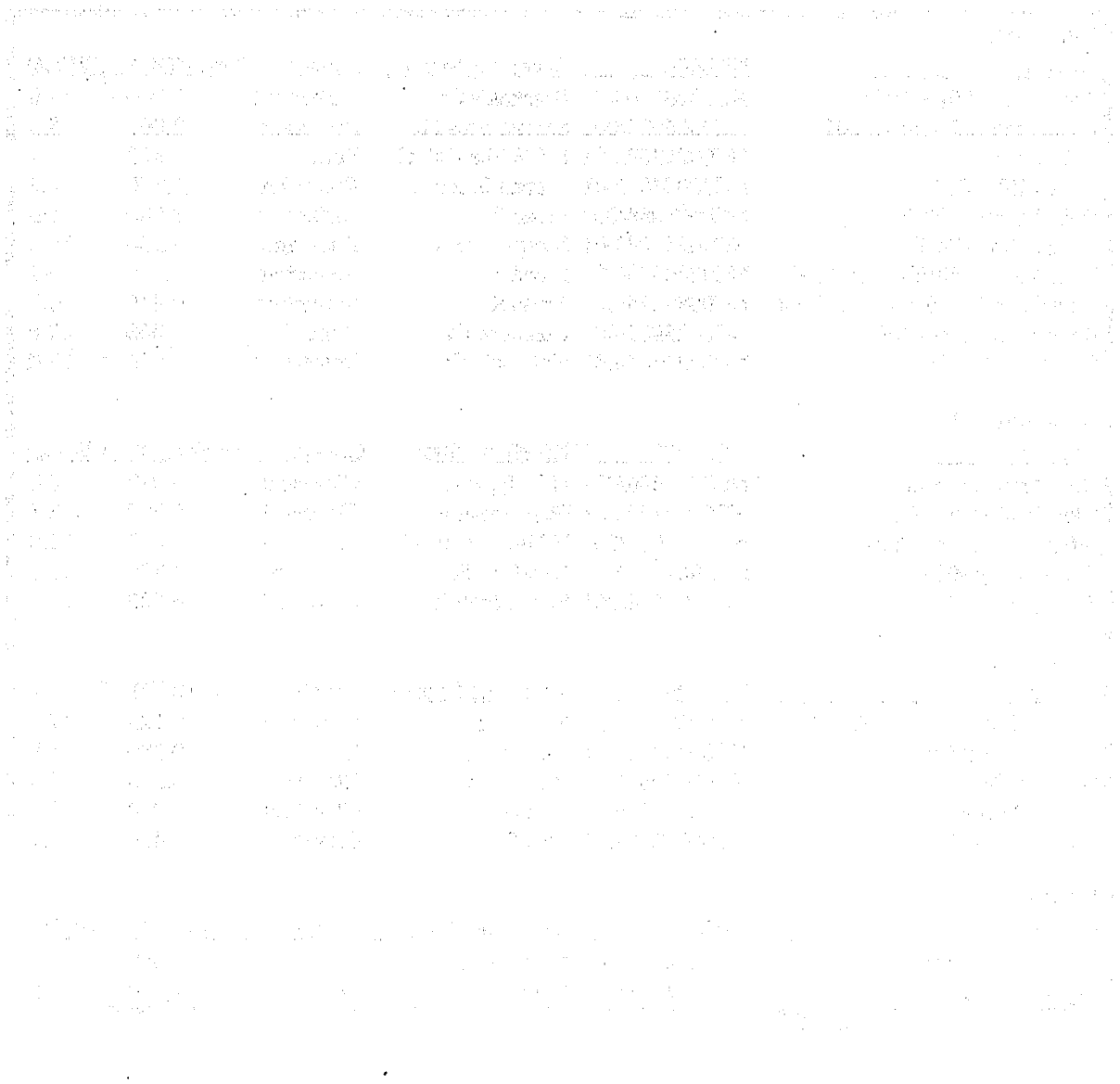


APPENDIX III

Modeling Information

Modeling Information

INTRODUCTION

In order to assess the impact of pollutants on surface water quality, the Division must often develop and apply water quality models. A water quality model is a simplified representation of the physical, chemical, and biological processes which occur in a water body. The type of model used is dependent on the purpose for which it is needed, the amount of information that is available or attainable for its development, and the degree of accuracy or reliability that is warranted. In most cases, the Division develops and applies a given model to predict the response of the system to a given set of inputs that reflect various management strategies. For example, water quality models such as QUAL2E or the Division's Level B model are used to predict what the instream dissolved oxygen concentration will be under various sets of NPDES wasteflows and discharge limits. The following sections briefly summarize the types of models used by the Division.

Oxygen-Consuming Waste Models

Several factors are considered when choosing an oxygen-consuming waste model including: the type of system (stream, lake, or estuary), whether one, two, or three dimensions are needed, the temporal resolution needed, and the type of data available. Many of the factors are related. For example, in streams, flow usually occurs in one direction and one can assume that a steady state model will result in adequate predictions. A steady state model is one in which the model inputs do not change over time. However, in open water estuaries, the tide and wind affect which way water moves, and they must often be represented by 2 or 3 dimensional models. In addition, the wind and tide can affect the model reaction rates, and therefore a dynamic model must be used rather than one which is steady state. The last factor, the amount of data available, dictates whether an empirical or calibrated model will be used. An empirical model is used when little water quality information is available for a given water body, and hydraulics and decay rates are estimated through the use of equations. For example, in North Carolina's empirical stream model (referred to as a Level B analysis) velocity is determined through a regression equation developed from North Carolina stream time-of-travel (TOT) studies which includes stream slope and flow estimates as independent variables. Stream slope can be measured from a topographic map, and flow is estimated at a given site by the U.S. Geological Survey. Therefore, the empirical model can be run without TOT information specific to a given stream since parameters are estimated through the use of information which can easily be obtained in the office environment. More information regarding the empirical dissolved oxygen model used by DEM can be found in the Instream Assessment Unit's Standard Operating Procedures Manual.

Field calibration of a BOD/DO model requires collection of a considerable amount of data. For example, in order to develop hydraulics equations specific to a given stream, TOT studies using rhodamine dye are recommended under at least two flow scenarios including one summer low flow period. In addition, during one summer low flow study, dissolved oxygen, temperature, long term BOD and nitrogen series data are collected. Sediment oxygen demand (SOD) data may also be collected. These data are then used to calibrate reaction rates specific to the stream. QUAL2E is the most commonly used calibrated DO/BOD model for streams in North Carolina. A copy of the model guidance can be obtained from EPA's Environmental Research Lab in Athens, Georgia, and further information on North Carolina's calibration procedures can be found in the Instream Assessment Unit's Standard Operating Procedures Manual.

Data collection for an estuary DO model is even more extensive. Since the system is multi-dimensional and not steady-state, many more data are needed. Dye is often injected into a system over a period of time, and the dye cloud is then followed for a period of time which may last for days. In addition, several tide gages may need to be set up. Due to the stratification which occurs

in an estuary, depth integrated data must also be collected. Calibrated estuary models which have been used by DEM include WASP and GAEST. WASP is also supported by EPA, and a user manual may be obtained from them. You should note that both GAEST is a one dimensional and is not applicable to many of North Carolina's estuaries.

Lakes are rarely modeled for BOD. Tributary arms of lakes are modeled as slow-moving streams if it is clearly indicated that the flow goes in one direction at all times. Depending on the system, a one, two, or three dimensional model may be used. If a one dimensional model is needed, the modeler may choose the Level B (if little or no data), or QUAL2E. In multidimensional lake systems, WASP will be used.

The calibrated model will be more accurate than the empirical model since it is based on data collected specifically for a given stream in the State. However, it is much more expensive to develop a calibrated model. Not only do a number of staff spend several days to weeks collecting field data (sometimes having to wait months for appropriate conditions), but it also takes the modeling staff several months to develop and document the calibrated model. An empirical model can be developed and applied in a matter of hours. Therefore, due to resource constraints, the majority of the BOD/DO models developed in North Carolina are empirical.

Eutrophication Models

Eutrophication models are used to develop management strategies to control trophic response of a system to nutrient inputs (usually total phosphorus (TP) or total nitrogen (TN)). Nutrient management strategies are typically needed in areas which are sensitive to nutrient inputs due to long residence times, warm temperature, and adequate light penetration. These characteristics are found in deep slow moving streams, ponds, lakes, and estuaries. Modeling and insitu research are used to relate nutrient loading to the trophic response to the system allowing the manager to establish nutrient targets. Models which may be used include the Southeastern Lakes Model (Reckhow, 1987), Walker's Bathtub Model (Walker, 1981), QUAL2E, and WASP.

Once the nutrient targets are known, watershed nutrient budgets are developed to evaluate the relative nutrient loadings from various point and nonpoint sources. Land use data are obtained for the basin, and export coefficients based on literature values are applied to each land use. An export coefficient is an estimate of how may pounds of nutrient will runoff from each acre of land in a given year.

Toxics Modeling

Toxics modeling is done to determine chemical specific limits which will protect to the "no chronic" level in a completely mixed stream. The standards developed for the State of North Carolina are based on chronic criteria. These chemical specific toxics limits are developed through the use of mass balance models:

$(Cup)(Qup) + (Cw)(Qw) = (Cd)(Qd)$ where

Cup = concentration upstream
Qup = flow upstream
Cw = concentration in wastewater (known being solved for in WLA)
Qw = wasteflow
Cd = concentration downstream (set = to standard or criteria)
Qd = flow downstream (= Qup + Qw)

When no data are available concerning the upstream concentration, it is assumed to be equal to zero. The upstream flow is the 7Q10 at the discharge point unless the parameter's standard is based on human health concerns, in which case the average flow is used.

REFERENCES CITED - MODELING APPENDIX

Reckhow, K. H., 1987. "A Cross-Sectional Analysis of Trophic State Relationships in Southeastern Lakes." Duke University School of Forestry and Environmental Studies, Durham, N.C.

Walker, W. W., Jr. 1981. "Empirical Methods for Predicting Eutrophication in Impoundments," Technical Report E-81-9, prepared by William W. Walker, Jr., Environmental Engineer, Concord, Mass., for the U.S. Army Engineer Waterways Experiment Station, CE, Vicksburg, Miss.

APPENDIX IV

LIST OF NPDES PERMITTED DISCHARGES IN THE BROAD RIVER BASIN

Broad River Basin - NPDES Permits Sorted by Subbasin

Permit	Facility	County	Issued	Expires	Basin	Qw
NC0025381	LAKE LURE, TOWN-WWTP	Rutherford	02/18/94	11/30/98	30801	0.995
					1	
NC0004405	CONE MILLS CORPORATION	Rutherford	02/25/94	11/30/98	30802	1.75
NC0004464	STONECUTTER MILLS CORP.	Polk	10/29/93	11/30/98	30802	0.015
NC0005088	DUKE POWER CO., CLIFFSIDE S.E.	Rutherford	04/24/95	11/30/98	30802	0
NC0005461	BROYHILL FURNITURE INDUSTRIES	Rutherford	11/30/93	11/30/98	30802	0.026
NC0006009	GALEY & LORD IND-CAROLEEN	Rutherford	07/05/94	11/30/98	30802	0.018
NC0006025	BURLINGTON IND.-JC COWAN PLANT	Rutherford		02/28/98	30802	2.5
NC0020320	ALEXANDER MILLS WWTP,TOWN OF	Rutherford	01/31/94	11/30/98	30802	0.2
NC0020664	SPINDALE, TOWN-WWTP	Rutherford	05/31/94	11/30/98	30802	6
NC0021369	COLUMBUS WWTP, TOWN OF	Polk	02/18/94	11/30/98	30802	0.8
NC0025909	RUTHERFORDTON, TOWN-WWTP	Rutherford	03/31/97	11/30/98	30802	1
NC0025984	FOREST CITY, TOWN-WWTP	Rutherford	03/24/95	11/30/98	30802	4.95
NC0030139	WHITE OAK MANOR - RUTHERFORDTO	Rutherford	01/31/94	11/30/98	30802	0.015
NC0032174	UNITED WORLD MISSION	Rutherford	07/29/94	11/30/98	30802	0.02
NC0033553	POLK CO SCH-POLK CENTRAL SCHL	Polk	01/14/94	11/30/98	30802	0.01
NC0034673	RUTHERFORD CO SCH-TRI-COMMUNIT	Rutherford	10/24/94	11/30/98	30802	0.007
NC0034690	RUTHERFORD CO.-CHASE HIGH SCH	Rutherford	11/01/93	11/30/98	30802	0.014
NC0073211	TANDEM PROP./EDGEWOOD NURSING	Rutherford	11/12/93	11/30/98	30802	0.018
NC0074306	FOREST CITY, TOWN-WTP	Rutherford		11/30/98	30802	0
NC0079448	FAIRHAVEN HOME	Rutherford	10/20/93	11/30/98	30802	0.01
NC0080993	SPARTAN MILLS	Rutherford	01/31/94	11/30/98	30802	0.175
NC0083275	DAN RIVER INCORPORATED	Rutherford	11/02/93	10/31/98	30802	0.91
NC0085294	PAVILLON INTL-BITTEN CRK/POLK	Polk	04/15/96	11/30/98	30802	0.005
NC0085405	LITTLE CUBBARD-WWTF/THOMAS PET	Rutherford	05/30/96	06/30/01	30802	0.0057
					23	
NC0004120	CLEVELAND MILLS COMPANY	Cleveland	08/19/93	07/31/98	30804	0.78
NC0004685	PPG INDUSTRIES-SHELBY	Cleveland	09/28/94	12/31/98	30804	1.3
NC0005061	JEFFERSON SMURFIT CORP-SHELBY	Cleveland	03/30/94	12/31/98	30804	0.01
NC0024538	SHELBY WWTP, CITY OF	Cleveland	01/31/94	12/31/98	30804	6
NC0027197	SHELBY WTP	Cleveland	04/27/94	12/31/98	30804	0
NC0030481	RAMSEUR WASHERETTE	Cleveland	12/16/93	12/31/98	30804	0.0056
NC0031062	YELTON HEALTH CENTER	Cleveland	10/29/93	10/31/98	30804	0.004
NC0042293	SPECIALITY LIGHTING, INC.	Cleveland	03/28/94	12/31/98	30804	0.01
NC0051918	UPPER CLEVELAND CO. SAN.DIST.	Cleveland	01/14/94	12/31/98	30804	0
NC0063797	WHISPERING PINES REST HOME	Cleveland	02/28/94	12/31/98	30804	0.0025
NC0066389	CLEVELAND CO. SCH-BURNS JR. HS	Cleveland	12/31/93	12/31/98	30804	0.02
NC0066397	CLEVELAND CO. SCH-CASAR ELEM	Cleveland	01/14/94	12/31/98	30804	0.0066
NC0066401	CLEVELAND CO. SCH-CREST HIGH	Cleveland	12/31/93	12/31/98	30804	0.0175
NC0066435	CLEVELAND CO. SCH-NO. 3 TWNSHP	Cleveland	12/31/93	12/31/98	30804	0.0075

Permits noted with *** have requested rescission

Broad River Basin - NPDES Permits Sorted by Subbasin

Permit	Facility	County	Issued	Expires	Basin	Qw
NC0066460	CLEVELAND CO. SCH-CREST JR. HS	Cleveland	12/16/93	12/31/98	30804	0.02
NC0066486	CLEVELAND CO. SCH-BURNS HIGH	Cleveland	07/29/94	12/31/98	30804	0.0175
NC0071943	BOILING SPRINGS, TOWN OF -WWTP	Cleveland	07/07/97	12/31/98	30804	0.3
					17	
NC0004235	NEW MINETTE TEXTILES-CLEVELAND	Cleveland		12/31/98	30805	0.45
NC0004952	HOECHST CELANESE-SHELBY	Cleveland		12/31/97	30805	0.8
NC0020737	KINGS MTN-PILOT CREEK WWTP	Cleveland	04/26/94	12/31/98	30805	6
NC0024821	NCDOT REST AREA ***	Cleveland	05/23/94	12/31/98	30805	0.032
NC0032867	ROADSIDE TRUCK PLAZA, INC.	Cleveland	02/28/94	12/31/98	30805	0.0195
NC0033570	CYPRUS FOOTE MINERAL CO.	Cleveland	01/31/94	12/31/98	30805	0
NC0065242	GROVER, TOWN OF - WWTP	Cleveland	01/28/94	12/31/98	30805	0.1
NC0066419	CLEVELAND CO. SCH-FALLSTON ES	Cleveland	12/16/93	12/31/98	30805	0.008
NC0066451	CLEVELAND CO. SCH-WASHINGTON	Cleveland	12/31/93	12/31/98	30805	0.0045
NC0079740	KINGS MOUNTAIN-T.J.ELLISON WTP	Cleveland	12/31/93	12/31/98	30805	0
NC0083984	GROVER INDUSTRIES,INC.	Cleveland	07/29/94	12/31/98	30805	0.38
					11	
NC0004391	GROVER IND-TRYON PLANT	Polk	02/25/94	12/31/98	30806	0.45
NC0021601	TRYON WWTP, TOWN OF	Polk	12/31/93	12/31/98	30806	1.5
NC0028975	SALUDA, CITY-PEARSON FALLS RD	Polk	02/28/94	12/31/98	30806	0.1
NC0034932	POLK COUNTY SCH. -TRYON MIDDLE	Polk	02/18/94	12/31/98	30806	0.005
NC0048305	CAROLINA YARN PROCESSORS, INC.	Polk	02/23/94	12/31/98	30806	0
NC0058581	THE BROW ASSOC.,INC./WHITE OAK	Polk	02/03/94	12/31/98	30806	0.015
NC0071005	LYNNBROOK ESTATES HOA	Polk	09/30/94	12/31/98	30806	0.009
					7	
					59	

Permits noted with *** have requested rescission

APPENDIX V

Lists of Best Management Practices (BMPs) For:

- Agriculture
- Urban Runoff
- Erosion and Sedimentation Control
- Onsite Wastewater Disposal
- Solid Waste Disposal
- Forestry
- Mining
- Hydrologic Modifications

BMPs FOR AGRICULTURE

Detailed Implementation Plan*
September 1996 (Revised)

Definition of Practices

(1) An agrichemical handling facility means a permanent structure that provides an environmentally safe means of mixing agrichemicals and filling tanks with agrichemicals for the application and storage of agrichemicals to prevent accidental degradation of surface and ground water.

(2) A conservation tillage system means any tillage and planting system in which at least (30) thirty percent of the soil surface is covered by plant residue to reduce soil erosion and improve the quality of surface water.

(3) A critical area planting means an area of highly erodible land which can not be stabilized by ordinary conservation treatment on which permanent perennial vegetative cover is established and protected to reduce soil erosion and sedimentation and to improve the quality of surface water.

(4) A cropland conversion practice means to establish and maintain a conservation cover of grasses, trees, or wildlife plantings on fields previously used for crop production to reduce soil erosion and sedimentation and to improve the quality of surface water.

(5) A diversion means a channel constructed across a slope with a supporting ridge on the lower side to control drainage by diverting excess water from an area to reduce soil erosion and sedimentation and to improve the quality of surface water.

(6) A field border means a strip of perennial vegetation established at the edge of the field that provides a stabilized outlet for row water to reduce erosion, sedimentation and nutrient pollution to improve the quality of surface water.

(7) A filter strip means an area of permanent perennial vegetation for removing sediment, organic matter, and other pollutants from runoff and waste water to reduce erosion, sedimentation and nutrient pollution to improve the quality of surface water.

(8) A grade stabilization structure means a structure (earth embankment, mechanical spillway, detention-type, etc.) used to control the grade and head cutting in natural or artificial channels to reduce erosion and sedimentation and to improve the quality of surface water.

(9) A grassed waterway means a natural or constructed channel that is shaped or graded to required dimensions and established in suitable vegetation for the stable conveyance of runoff to reduce erosion and sedimentation and to improve the quality of surface water.

(10) A heavy use protection area means an area used frequently and intensively by animals which must be stabilized by surfacing with suitable materials to reduce erosion, sedimentation and nutrient pollution to improve the quality of surface water.

(11) A livestock exclusion system means a system of permanent fencing (board, barbed, high tensile or electric wire) installed to exclude livestock from streams and critical areas not intended for grazing to reduce erosion, sedimentation and to improve the quality of surface water.

(12) A long term no-till practice means planting all crops for five consecutive years in at least 80 percent plant residue from preceding crops to reduce soil erosion and sedimentation and improve the quality of surface water.

(13) A pastureland conversion practice means establishing trees or perennial wildlife plantings on excessively eroding Class VII land being used for pasture that is too steep to mow or maintain with conventional equipment to reduce soil erosion and sedimentation and to improve the quality of surface water.

(14) A nutrient management practice means a definitive plan to manage the amount, form, placement, and timing of applications nutrients to minimize entry of nutrient to surface and groundwater and to improve water quality.

(15) A rock-lined outlet means a waterway having an erosionresistant lining of concrete, stone or other permanent material where an unlined or grassed waterways would be inadequate to provide safe disposal of runoff, reduce erosion and sedimentation and to improve the quality of surface water.

(16) A sediment basin means a basin constructed to trap and store waterborne sediment where physical conditions or land ownership preclude treatment of a sediment source by the installation of other erosion control measures to improve the quality of surface water.

(17) A sod-based rotation practice means an adapted sequence of crops and grasses established and maintained for a definite number of years which is designed to provide adequate organic residue for maintenance or improvement of soil filth to help reduce erosion and improve surface water quality.

(18) A stock trail or walkway means to provide a stable area used frequently and intensively for livestock movement by surfacing with suitable material to reduce erosion sedimentation and nutrient pollution to improve the quality of surface water.

(19) A stream protection system means a planned system for protecting streams and streambanks which eliminates the need for livestock to be in streams by providing an alternative watering source for livestock to reduce erosion and sedimentation and to improve the quality of surface water. System components may include:

(A) A spring development means improving springs and seeps by excavating, cleaning, capping or providing collection and storage facilities.

(B) A trough or tank means devices installed to provide drinking water for livestock at a stabilized location.

(C) A well means constructing a drilled, driven or dug well to supply water from an underground source.

(D) A windmill means erecting or constructing a mill operated by the wind's rotation of large vanes and is used as a source of power for pumping water.

(E) A stream crossing means a trail constructed across a stream to allow livestock to cross without disturbing the bottom or causing erosion on the banks.

(20) A stripcropping practice means to grow crops and sod in a systematic arrangement of alternating strips on the contour to reduce soil erosion and sedimentation and to improve the quality of surface water.

(21) A terrace means an earth embankment, a channel, or a combination ridge and channel constructed across the slope to reduce erosion, reduce sediment content in runoff water, and to improve the quality of surface water.

(22) A waste management system means a planned system in which all necessary components are installed for managing liquid and solid waste to prevent or minimize degradation of soil and water resources. System components may include:

(A) A waste storage pond means an impoundment made by excavation or earthfill for temporary storage of animal waste, waste water and polluted runoff.

(B) A drystack means a fabricated structure for temporary storage of animal waste.

(C) A composter/storage structure means a facility for the biological treatment, stabilization and environmentally safe storage of organic waste material (such as livestock and poultry manure and dead animal carcasses) to produce a material that can be recycled as a soil amendment and fertilizer substitute.

(D) A waste treatment lagoon means an impoundment made by excavation or earthfill for biological treatment and storage of animal waste.

(E) A waste application system means an environmentally safe system (such as solid set, dry hydrant, mobile irrigation equipment, etc.) for the conveyance and distribution of animal wastes from waste treatment and storage structures to agricultural field as part of an irrigation and nutrient management plan.

(F) A constructed wetlands for land application practice means an artificial wetland area into which liquid animal waste from a waste storage pond or lagoon is dispersed over time to lower the nutrient content of the liquid animal waste.

(G) A controlled livestock lounging area means a planned, stabilized and vegetated area in which livestock are kept for a short duration.

(H) A closure of abandoned waste treatment lagoons and waste storage ponds practice means the safe removal of existing waste and waste water and the application of this waste on land in an environmentally safe manner.

(I) A storm water management system means a system of collection and diversion practices (buttering, collection boxes, diversions, etc.) to prevent unpolluted storm water from flowing across concentrated waste area on animal operations.

(23) A water control structure means to provide control of surface and subsurface water through the use of permanent structures which increase infiltration and reduce runoff to improve the quality of surface and ground water.

(24) A waste utilization plan means a plan of using animal waste on land in an environmentally acceptable manner while maintaining or improving soil and plant resources to safeguard water resources.

(25) An insect control practice means an method of pest management used in an integrated pest management program to control target organisms and minimize contamination of soil, water, and air, and minimize impacts to non-target organisms through cultural, biological and physical practices including safe and prudent use of pesticides.

(26) A riparian buffer means an area adjacent to solid blue line streams as shown on 7.5 minute USGS maps where a permanent, long-lived vegetative cover (sod, shrubs, trees, or a combination of vegetation types) is established to reduce soil erosion, sedimentation, nutrient and pesticide pollution, and to improve the quality of surface water and shallow ground water.

(27) An odor control management system means a practice or combination of practices (planting windbreaks, precharging structures, incorporation of waste into soil, etc.) which manages or controls odors from confined animal operations, waste treatment and storage structures and waste applied to agricultural land.

*To be used in conjunction with the most recent version of the APA Rules for the North Carolina Agriculture Cost Share Program for Nonpoint Source Pollution Control and the NCACSP Manual.

Best Management Practices Eligible for Cost Share Payments

Best Management Practices eligible for cost sharing include the following practices and any approved District BMPs. District BMPs shall be reviewed by the Division for technical merit in achieving the goals of this program. Upon approval by the Division, the District BMPs will be eligible to receive cost share funding.

The minimum life expectancy of the BMPs is listed below. Practices designated by a District shall meet the life expectancy requirement established by the Division for that District BMP. The list of BMPs eligible for cost sharing may be revised by the Commission as deemed appropriate in order to meet program purpose and goals.

Practice	Minimum Life Expectancy (years)
Agrichemical Handling Facility	10
Conservation Tillage System	10
Critical Area Planting	10
Cropland Conversion	10
Diversion	10
Field Border	10
Filter Strip	10
Grade Stabilization Structure	10
Grassed Waterway	10
Heavy Use Area Protection	10
Insect Control	5
Livestock Exclusion	10
Long Term No-Till	5
Mobile Irrigation Equipment	10
Pastureland Conversion	10
Nutrient Reduction Management System	3
Rock-lined Waterway or Outlet	10
Sediment Control Structure	10
Sod-based Rotation	4 or 5
Stock Trail and Walkway	10
Stream Protection System	
Spring Development	10
Trough or Tank	10
Well	10
Windmills	10
Stream Crossing	10
Stripcropping	5
Riparian Buffer	10
Terrace	10

Best Management Practices Eligible for Cost Share Payments (continued)

Waste Management System	
Waste Storage Pond	10
Waste Storage Structure	10
Waste Treatment Lagoon	10
System for Land Application of Animal Waste	10
Wetlands Development for Land Application	10
Controlled Livestock Lounging Area	10
To-Be-Abandoned or Abandoned Confined	
Animal Operation (CAO)	5
Odor Control	1 to 10
Water Control Structure	10

Agricultural Best Management Practices

I. Crop and Pasture Lands

A. BMPs for Sediment Control
- Conservation Tillage System
- Critical Area Planting
- Cropland Conversion
- Diversion
- Field Border
- Filter Strip
- Grade Stabilization Structure
- Grassed Waterway
- Rock-lined Waterways or Outlets
- Sediment Control Structure
- Sod-based Rotation
- Stripcropping
- Terrace
- Water Control Structure
- Pastureland Conversion

B. BMPs for Nutrient Control
- Legumes in Rotation
- Soil Testing
- Liming
- Setting Realistic Crop Yield Goals (determines fertilization rates)
- Fertilizer Waste Application (method, rate, and timing)
- Sediment Control BMPs

C. BMPs for pesticide control
- Alternative Pesticides
- Optimize Pesticide Formulation, Amount, Placement Timing, Frequency
- Crop Rotation
- Resistant Crop Varieties
- Other Cultural or Biological Controls
- Optimize Crop Planting Time
- Plant Pest Quarantines

Proper Disposal of Obsolete Pesticides and Containers
Certification of Applicators
Sediment Control BMP's

II. Animal Production (esp. Confined Animal Operations)
BMPs for bacteria and nutrient control
Grade Stabilization Structures
Heavy Use Area Protection
Livestock Exclusion
Spring Development
Stock Trails and Walkways
Trough or Tank
Waste Management System
Waste Storage Pond
Waste Storage Structure
Waste Treatment Lagoon
Land Application of Waste
Water Control Structure

BMPs FOR URBAN STORMWATER

Structural Best Management Practices for urban runoff control are typically designed to reduce sediment, its attached pollutants, and nutrients. In addition, other BMPs protect the riparian ecosystem, provide streambank stabilization, provide shade to water bodies and reduce the likelihood of excessive water temperatures. Non-structural BMPs, such as a design manual or a public education program, encourage the comprehensive and effective implementation of structural BMPs. The table below contains a list of both structural and non-structural BMPs. This list is taken from the *Stormwater Management Guidance Manual*, published by DWQ's Water Quality Planning Branch in 1995. The *Manual* provides a detailed discussion of each of the BMPs, including its characteristics, pollutant-specific effectiveness, reliability, feasibility, costs, unknown use factors, design considerations, and references for further information.

STRUCTURAL BMPs
I. Wet Detention Basin
II. Constructed Wetlands
• Wet Retention Basin
• Dry Detention Basin
• Infiltration Basin
• Vegetative Practices
◊ Filter Strips
◊ Grassed Swales with Check Dams
• Sand Filter
• Oil and Grease Separator
• Rollover-Type Curbing
NON-STRUCTURAL BMPs
I. Preventive Measures
II. Pollutant Minimization
• Exposure Reduction (proper scheduling, etc. - see Manual)
• Landscaping and Lawn Maintenance Controls
• Animal Waste Collection
• Curb Elimination
• Parking Lot and Street Cleaning
• Road Salt Application Control
• Catch Basin Cleaning
III. Riparian area protection
IV Design Manual for Urban BMPs
V Public Education
VI. Identification and Enforcement of Illegal Discharges
VII. Land-Use Control
• Low-Density Development
• Comprehensive Site Planning
• Buffer Zone
• Sanitary Waste Management
VIII. Conservation Easement

Structural BMPs may affect groundwater quality in certain situations. Devices that recharge groundwater pose the risk of passing soluble pollutants into groundwater systems. It is not currently known whether pollutant concentrations in recharged groundwater areas pose a significant environmental or health risk. USGS is presently studying groundwater quality effects of urban BMPs. In addition, if funds are made available, DWQ may conduct a similar study in North Carolina.

BMPs FOR EROSION AND SEDIMENTATION CONTROL

Best Management Practices suggested pursuant to the NC Sedimentation Pollution Control Act of 1973 are selected on the basis of performance in providing protection from the maximum peak rate of runoff from a 10-year storm. This allows the developer/designer of the control measures, structures, or devices to determine and submit for approval the most economical and effective means of controlling erosion and preventing sedimentation damage. Practices are therefore reviewed for acceptability based upon the characteristics of each individual site and its erosion potential. Ideally, the erosion control plan will employ both practices and construction management techniques which will provide the most effective and reasonable means of controlling erosion while considering the uniqueness of each site. The following table provides a list of practices commonly used in sedimentation and erosion control plans across North Carolina.

Check Dam	Sand Fence (Wind Fence)
Construction Road Stabilization	Sediment Basin
Dust Control	Sediment Fence
Grade Stabilization Structure	Sod Drop Inlet Protection
Grass-lined Channels	Sodding
Grass Channels with Liner	Structural Streambank Stabilization
Land Grading	Subsurface Drain
Level Spreader	Surface Roughening
Mulching	Temporary Block & Gravel Inlet Protection
Outlet Stabilization Structure	Temporary Diversions
Paved Channels	Temporary Excavated Drop Inlet Protection Fabric Drop Inlet Protection
Paved Flume (Chutes)	Temporary Gravel Construction Entrance/Exit
Perimeter Dike	Temporary Sediment Trap
Permanent Diversions	Temporary Seeding
Permanent Seeding	Temporary Slope Drains
Permanent Stream Crossing	Temporary Stream Crossing
Right-Of-Way Diversions	Topsoiling
Riprap	Tree Preservation & Protection
Riprap-lined Channels	Trees, Shrubs, Vines & Ground Covers
Rock Dam	Vegetative Dune Stabilization
	Vegetative Streambank Stabilization

BMPs FOR ON-SITE WASTEWATER DISPOSAL

To protect public health and water quality, best management practices (BMPs) need to be implemented throughout the life cycle of an on-site wastewater disposal system. Life-cycle management problems can be addressed in three phases (Steinbeck, 1984). The first phase includes system siting, design, and installation. The second phase involves the operation of the system and phase three involves maintenance and repair when the system malfunctions or fails. As BMPs are applied in each life-cycle phase, the primary factor the success of the system is the participation of the local influencing health department and the cooperation of the developer, owner, design engineer, system operator, and the state. The table that follows gives a summary of the current life-cycle management practices and penalties utilized in North Carolina to implement the on-site sewage systems program (Steinbeck, 1984).

1. Application -- The developer or property owner meets with the staff of the local health department to review the project proposal and submits an application to the local health department that contains information regarding ownership, plat of property, site plan, type of facility, estimated sewage flow, and proposed method of sewage collection, treatment, and disposal.
2. Site Evaluation -- The local health department, with technical assistance from the state, evaluates the proposed sewage effluent disposal site for several factors, including slope, landscape position, soil morphology, soil drainage, soil depth, and space requirements. Next, the local health department will assign a site suitability classification, establish the design sewage flow, and the design loading rate for the soil disposal system.
3. Design Review --The applicant is required to submit plans and specifications for the sewage collection, treatment, and disposal system prepared by a professional engineer, for complex systems, or for systems exceeding 3,000 gal/day. Reviews are made by both state and local health departments. The designer must also include in the plans and specifications, installation procedures, phasing schedules, operation and maintenance procedures, monitoring requirements, and designate the responsible agents for operation and maintenance.
4. Legal Document Review -- For systems with multiple ownership or off-site disposal, the applicant must prepare and submit to state and local health departments for their legal review documents applicable to the project.
5. Improvement Permit -- Issued only after a successful review of the proposed project, including each of the items discussed above and allows construction to begin for the on-site sewage system. The improvement permit must be issued prior to other construction permits and allows only temporary electrical power to the site. This permit contains the necessary conditions for construction of the projects with the plans, specifications, and legal documentation appended to it.
6. Operation Permit -- Issued to the owner of the on-site sewage system by the local health department when it determines that all the requirements in the rules, plans and specifications are met; all conditions on the improvement permit are met; and the design engineer for the sewage collection, treatment, and disposal system certifies in writing to the local health department that the on-site system has been installed in accordance with the approved plans and specifications. The operation permit is also conditioned to establish performance requirements and may be issued for a specific period of time. It allows the on-site sewage system to be placed into use, prevents permanent electrical service to the project and prevents occupancy of the facilities until issued. The operation permit applies to systems larger than 480 gallons per day. A certificate of completion is required for conventional septic tank systems when the design sewage flow is less than 480 gal/day.

On-Site Wastewater Disposal BMPs (continued)

7.	Surveillance -- Once an on-site sewage system is placed into operation the local health department must make routine inspections at least annually for large systems to determine that the system is performing satisfactorily and not creating a public health nuisance or hazard. Additionally, required monitoring reports are routinely submitted to the local health department as required in the permits. The state provides technical assistance to the local health department and the system operator in assuring adequate performance. While annual inspections are required, frequent performance checks must be made by the local health department.
8.	Remedies -- When voluntary compliance with the performance requirements for the on-site system is unsuccessful, the General Statutes (1983) provide for the following remedies:
a)	Right of Entry -- Allows the state or local health department to enter the premises to determine compliance with the laws and rules and provides for an administrative search and inspection warrant when entry is denied.
b)	Injunction -- The state or local health department may institute an action for injunctive relief against the owner to bring the on-site sewage system into compliance.
c)	Order of Abatement -- The state or local health department is empowered to issue an order of abatement directing the owner to take any necessary action to bring the system into compliance. However, if the on-site system is determined to be creating an imminent health hazard, the state or local health department may, after previous unsuccessful attempts at correction, take the necessary action to correct the problem and recover any costs for abatement from the owner. This is the least frequently applied remedy.
d)	Administrative Penalties -- The state may impose administrative penalties up to $300 per day for violation of the laws, rules, or any permit condition for on-site sewage systems serving multi-family residences with a flow greater than 480 gal/day. A penalty of up to $50 per day can be assessed for malfunctioning systems where the flow is less than or equal to 480 gal/day.
e)	Suspension and Revocation of Permits -- The state may suspend or revoke a permit for violations of the laws, rules, or permit conditions upon a finding that a violation has occurred.
f)	Misdemeanor -- The owner who violates the sewage laws or rules shall be guilty of a misdemeanor and punishable by a fine or imprisonment as determined by the courts. This is the most frequently used remedy.

BMPs FOR SOLID WASTE MANAGEMENT

Best Management Practices for solid waste management address the water quality impacts of leachate migration and surface erosion. A list of BMPs for controlling solid waste impacts on water quality can be found in the table below.

The BMPs offer significant benefits for groundwater quality. Landfill liners will prohibit or greatly decrease the volume of leachate entering groundwater. In turn, leachate collection systems capture leachate for subsequent treatment rather than groundwater disposal. For even greater protection, groundwater and surface water monitoring should detect failures in the liner or collection system.

Reduce, Recover, and Recycle Solid Waste to Maximum Extent
Incineration with Energy Recovery
North Carolina Water Quality Monitoring Guidance Document for Solid Waste Facilities, 1987
Liners (Clay or Synthetic) for All New Landfills
Leachate Collection Systems
Erosion Control Plan
Operation and Maintenance Plan
Buffers Between Landfill and Streams, Property Lines and Dwellings
Groundwater Quality Monitoring
Surface Water Quality Monitoring
Public Education
Stormwater Runoff Control
Sedimentation Control

FOREST PRACTICE GUIDLINES RELATED TO WATER QUALITY

A. Performance Standards for Forestry Site Disturbing Activities in North Carolina

Forest Practices Guidelines Related to Water Quality (15A NCAC 1I.0101-.0209) have been adopted as published in the NCR, Volume 4, Issue 11, pages 601-604, and were effective January 1, 1990. These guidelines are summarized below.

Streamside Management Zone(SMZ)
• Must establish SMZ along natural, intermittent and perennial streams and water bodies. (Not required along man-made ditches and canals, although erosion protection is needed).
• Must have sufficient width and adequate ground cover to confine visible sediment (usually best to protect existing ground cover).
• Place roads, trails and decks outside of SMZ.
• Limited cutting(harvesting) is permitted within the SMZ.
Prohibition of Debris Entering Streams
• Prevent debris(logging slash, soil) of all types that can cause stream flow impediment or water quality degradation from entering intermittent and perennial streams and water bodies.
• Remove debris that accidentally enters streams.
Access Road and Skid Trail Stream Crossing
• Avoid crossing streams where possible.
• Avoid using stream channels as roads or trails.
• Construct crossings to minimize sediment entering streams.
• Protect stream banks and channels from damage.
• Provide water control devices and/or structures and, within 10 working days of initial disturbance provide ground cover sufficient to restrain accelerated erosion and prevent stream sedimentation.
Access Road Entrance
• Prevent soil and debris from being deposited on public highways which may result in stream sedimentation.
Keep Waste from Entering Streams, Water bodies and Groundwater
• Prevent oil, fuels, fertilizer and other chemical waste from entering streams, water bodies and groundwater.
Pesticide Application
• Application must follow labeling and N.C. Pesticides Board rules. Includes insecticides, fungicides, herbicides, and rodenticides.
Fertilizer Application
• Apply in a manner to prevent adverse impacts on water quality.
Stream Temperature
• Retain shade sufficient to prevent temperature fluctuations which result in a violation.
Rehabilitation of Project Site
• Within 30 working days after ceasing operations, provide sedimentation control measures to prevent water quality damage.
• Permanently stabilize SMZ areas and other areas that may directly contribute visible sediment to streams.

The Forestry Best Management Practices Manual was prepared to provide the means of meeting the above standards. The Manual is available from any DFR office at no charge.

B. BMPs for Forestry Operations in Wetlands

The Division of Forest Resources is in the process of developing BMPs for forested wetlands. Economic pressure to expand forestry activities in wetlands continues to increase. This expansion will require a sound strategy to protect these environmentally sensitive areas.

A Forested Wetlands BMP Committee was established in 1987. The members represented state and federal agencies, industry, education and conservation groups which have an interest or role in the fate of wetlands. In 1990, the *Best Management Practices for Forestry in the Wetlands of North Carolina* was published. The committee has been reconvened and is currently working to revise and update the wetland BMPs. This update will take into account the Corps of Engineer's and EPA's Application of Best Management Practices to Mechanical Site Preparation Activities for the Establishment of Pine Plantations in the Southeast. This EPA guidance restricts the areas that can be mechanically site prepared for planting in loblolly pine without a Section 404 permit.

In addition to the state's voluntary wetland BMPs, the Corps of Engineers has produced 15 mandatory BMPs for forest and farm road construction and maintenance in forested wetlands. These BMPs must be followed, or else a Section 404 permit is required for the road construction or maintenance. The 15 BMPs are listed below.

• Permanent roads (for forestry), temporary access roads (for forestry), and skid trails (for logging) in waters of the U.S. shall be held to the minimum feasible number, width, and total length consistent with silvicultural and local topographic and climatic conditions;
• All roads shall be located sufficiently far from streams or other water bodies (except for portions of such roads that must cross water bodies) to minimize discharges of dredged or fill material into waters of the U.S.;
• Road fill shall be bridged, culverted, or otherwise designed to prevent the restriction of expected flood flows;
• Fill shall be properly stabilized and maintained to prevent erosion during and following construction;
• Discharges of dredged or fill material into waters of the U.S. to construct road fills shall be made in a manner that minimizes encroachment of trucks, tractors, bulldozers, and other heavy equipment into waters of the U.S. (including adjacent wetlands that lie outside the lateral boundaries of the fill itself);
• In designing, constructing, an maintaining roads, vegetative disturbance in waters of the U.S. shall be kept to a minimum;
• Design, construction and maintenance of road crossings shall not disrupt the migration or other movement of those aquatic species inhabiting the water body;
• Borrow material shall be taken from upland sources whenever feasible;
• The discharge shall not take, or jeopardize the continued existence of, a threatened or endangered species as defined under the Endangered Species Act, or adversely modify or destroy the critical habitat of such species;
• Discharges into breeding and nesting areas for migratory waterfowl, spawning areas, and wetlands shall be avoided if practical alternatives exist;
• Discharge shall not be located in proximity to a public water supply intake;
• The discharge shall not occur in areas of concentrated shellfish production;
• Discharge shall not occur in a designated National Wild and Scenic River;
• Discharge shall be of suitable material free from toxic pollutants in toxic amounts; and
• All temporary fills shall be removed in their entirety and the area restored to its original elevation.

BMPs FOR MINING OPERATIONS

Significant environmental damage can and often times does occur during land-disturbing activities of mining operations, especially during the initial stages. The potential for such damage can be substantially reduced with the installation of BMPs. Once the mining has terminated, BMPs are used to reclaim or reasonably rehabilitate the site (for mined lands after June 11, 1971). The basic objective of the reclamation is to establish on a continuing basis the vegetative cover, soil stability, and water and safety conditions appropriate to the area. The BMPs are performance-oriented, allowing a mining permit applicant to design and propose the most economical and effective means of a) controlling erosion and preventing off-site sedimentation damage; b) preventing contamination of surface waters and groundwater; and, c) preventing any condition that will have unduly adverse effects on wildlife or freshwater, estuarine, or marine fisheries. BMP selection is site-specific and controlled in part by the pre- and post-mining land use(s). The acceptability of a BMP is therefore based upon the characteristics of the individual site and its potential for off-site damage.

The table which follows provides a list of BMPs used for activities associated with mining activities in North Carolina. This list is essentially the same as that provided for Sedimentation and Erosion Control, due to the similar nature of activities in both programs.

Check Dam	Sediment Basin
Construction Road Stabilization	Sediment Fence
Dust Control	Sod Drop Inlet Protection
Grade Stabilization Structure	Sodding
Grass-lined Channel	Structural Streambank Stabilization
Grass Channels with Liner	Subsurface Drain
Groundwater Monitoring Wells	Surface Roughening
Land Grading	Temporary Block and Gravel Inlet Protection
Level Spreader	Temporary Diversions
Mulching	Temporary Excavated Drop Inlet Protection
Outlet Stabilization Structure	Temporary Fabric Drop Inlet Protection
Paved Flume (Chutes)	Temporary Gravel Construction Entrance/Exit
Perimeter Dike	Temporary Sediment Trap
Permanent Diversions	Temporary Seeding
Permanent Seeding	Temporary Slope Drains
Permanent Stream Crossing	Temporary Stream Crossing
Right-of-Way Diversions	Topsoiling
Riprap	Tree Preservation and Protection
Riprap-lined Channels	Trees, Shrubs, Vines & Ground Covers
Rock Dam	Vegetative Dune Stabilization
Sand Fence (Wind Fence)	Vegetative Streambank Stabilization

BMPs FOR HYDROLOGIC MODIFICATION (related to mining operations)

BMPs for Discharges of Dredged or Fill Material (Adapted from 40 CFR 230 - Guidelines for Specification of Disposal Sites for Dredged or Fill Material)

1. Actions concerning the location of the discharge.
a) Minimize smothering of organisms;
b) Avoid disruption of periodic water inundation patterns;
c) Select a previously used disposal site;
d) Select a disposal site with substrate similar in composition to the material being disposed;
e) Minimize extent of any plume; and
f) Minimize or prevent creation of standing bodies of waters in areas of normally fluctuating water levels.
2. Actions concerning the material to be discharged.
a) Maintain physiochemical conditions and reduce potency and availability of pollutants;
b) Limit solid, liquid and gaseous components;
c) Add treatment substances; and
d) Utilize chemical flocculants in diked disposal areas.
3. Actions controlling the materials after discharge.
a) Reduce potential for erosion, slumping or leaching by
i) using containment levees, sediment basins and cover crops to reduce erosion; and
ii) using lined containment areas to reduce leaching.
b) Cap in-place contaminated material with clean material;
c) Prevent point and nonpoint sources of pollution; and
d) Time the discharge to minimize impact, especially during unusual high water flows, wind, wave and tidal actions.
4. Actions affecting the method of dispersion.
a) Maintain natural substrate contours and elevation;
b) Minimize undesirable obstruction to the water current or circulation pattern;
c) Confine suspended particulate/turbidity to a small area where settling can occur;
d) Mix, dilute and disperse the discharge;
e) Minimize water column turbidity;
f) Maintain light penetration for organisms; and
g) Set limitations on the amount of material to be discharged per unit of time or volume of receiving water.
5. Actions related to technology.
a) Use appropriate equipment and machinery, including protective devices;
b) Employ appropriate operation and maintenance of machinery, including training, staffing and working procedures;
c) Use machinery and techniques designed to reduce damage to wetlands, including devices that scatter rather than mound excavated materials, machines with specially designed wheels or tracks, and the use of mats under heavy machinery to reduce compaction and rutting; and
d) Design access roads and channel spanning structures to accommodate fluctuating water levels and circulation patterns.

BMPs for Hydrologic Modification (continued)

6. Actions affecting plant and animal populations.
a) Avoid changes in water current and circulation patterns;
b) Prevent or avoid creating habitat conducive to the development of undesirable predators or species;
c) Avoid sites having unique habitat or other value, including endangered or threatened species;
d) Institute habitat development and restoration;
e) Avoid spawning or migration seasons and other biologically critical time periods; and
f) Avoid destruction of remnant natural sites within areas already affected by development.
7. Actions affecting human use.
a) Prevent or minimize damage to the aesthetically pleasing features of an aquatic site, including water quality;
b) Avoid disposal sites valuable as natural aquatic areas;
c) Avoid seasons or periods when human recreational activity associated with the aquatic site is most important;
d) Avoid sites which will increase incompatible human activity or require frequent dredge or fill maintenance in remote fish and wildlife areas; and
e) Locate disposal site outside of the vicinity of a public water supply intake.

APPENDIX VI

Existing Point And Nonpoint Source Water Quality Programs

APPENDIX VI

EXISTING POINT AND NONPOINT SOURCE POLLUTION CONTROL PROGRAMS

NORTH CAROLINA'S POINT SOURCE CONTROL PROGRAMS

Discharge permits are issued under the authority of North Carolina General Statute (NCGS) 143.215.1 and the National Pollutant Discharge Elimination System (NPDES) program. NPDES permits establish effluent limitations on the maximum level of wastes or pollutants, that may be discharged into surface waters. North Carolina has a very comprehensive NPDES program that includes the following major components:

1. NPDES Permit Review and Processing,
2. Wasteload Allocation Modeling,
3. Compliance Monitoring and Enforcement,
4. Aquatic Toxicity Testing,
5. Pretreatment,
6. Operator Certification and Training and
7. Nondischarge and Regional Wastewater Treatment Alternatives.

Below is a brief summary of key components of North Carolina's NPDES program

NPDES Permit Review and Processing

In North Carolina, the issuance of discharge permits is coordinated with the basinwide planning process. Thus, DWQ issues all discharge permits within a given basin at approximately the same time. These permits are valid for five years. New discharge permits issued during an interim period between cycles will have a shorter expiration period in order to coincide with the next basin permitting cycle. Thus, DWQ can more effectively monitor and modify its permitting system consistently across the river basins.

DWQ will not process a permit application until the application is complete. The requirements for discharge permit application and processing are outlined in Administrative Code Section: 15A NCAC 2H .0100 - Wastewater Discharges to Surface Waters. Under this rule, all applications must include a feasibility analysis on alternative disposal options, such as spray irrigation, and justification for the selection of the discharge option.

Applications for new discharges greater than 500,000 gallons per day of wastewater, 10 million gallons per day (MGD) of cooling water, or 1 MGD of any other type of effluent must include an *assessment* report in addition to the normal permit application. The assessment is to provide sufficient information to describe the impact of the proposed action on the waters in the area. DWQ may also require an Environmental Impact Statement or Environmental Assessment, under the NC Environmental Policy Act for certain publicly funded projects.

DWQ staff establish waste limits for permit applications based on a wasteload allocation process (described in the following section). The staff review also includes a site inspection (for existing facilities up for renewal, the inspection may be conducted prior to submittal of a complete application). If DWQ finds the application acceptable, it will issue a public notice (called a Notice of Intent to Issue) in newspapers having wide circulation in the local area. The Notice of Intent includes all of the permit applications for a particular subbasin (or subbasins) that will be issued

within a given month. The public then has a 30-day period to comment on the proposed permit. If the public expresses sufficient interest in one or more of the applications, DWQ may hold a public hearing.

DWQ also sends copies of the Notice of Intent to a number of state and federal agencies for comment. For example, the Division of Environmental Health reviews the applications for their potential impact on surface water sources of drinking water. Once DWQ received and evaluates the comments, the Director of DWQ decides whether to issue or deny the permit. The final permit will include recommended waste limits and other special conditions that may be necessary to ensure protection of water quality standards.

Establishing Discharge Permit Effluent Limitations/Wasteload Allocations

Effluent limitations, also called waste limits, dictate the amounts of wastes (pollutants), that the permittee is allowed to discharge into surface waters under an NPDES permit. Before DWQ issues a discharge permit, it evaluates the projected impact of the discharge on the receiving waters. This determination, called a wasteload allocation (WLA), is usually based on a computer model which considers many factors, including the characteristics of the waste (e.g., flow and type) and the characteristics of the receiving waters (e.g., flow, waste assimilative capacity, channel configuration, rate of reaeration, water quality classification). DWQ determines permit limits using models called water quality-based limits. DWQ also bases some permit limits based on federal effluent guidelines established by the USEPA.

DWQ performs wasteload allocations by using various models, depending on the parameter (type of pollutant) of interest and the characteristics of the receiving waters. Model frameworks (discussed in more detail in Appendix IV) can range from simple mass balance analyses to 3-dimensional dynamic water quality models. Modeling fits into the basin plan by drawing on the current conditions within the basin and evaluating the effects of various management strategies. DWQ uses models for a number of objectives, including determining the fate and transport of pollutants, setting reduction goals for point and nonpoint sources, and to derive effluent limits for NPDES permits. For example, models can be used to predict concentrations of a parameter at a given site, such as instream DO or chlorophyll *a* in a lake.

Models can also be a tool for determining the level of pollutant reductions needed to protect instream standards. In addition, DWQ performs uncertainty analyses of water quality models to expand their predictive capabilities and increase confidence in results. Waste limits may vary from summer to winter for some parameters, such as nutrients and ammonia, with winter limits being somewhat less stringent than summer limits due to higher instream flows during the winter months.

When point sources are responsible for water quality problems, WLAs can yield appropriate permit limits that offer adequate water quality protection. Where a sole discharge is responsible for the water quality impacts, DWQ can perform a simple WLA without considering other discharges. In this case, DWQ will establish limits in accordance with the state's Standard Operating Procedures (SOP) for Wasteload Allocations manual. The SOP manual has been developed to support State and Federal regulations and guidelines and has been approved by the EPA.

A critical factor in determining the wasteload for an individual discharge is whether the receiving waters have a flow during 7Q10 or 30Q2 conditions. DWQ's policy prohibits new or expanded discharges into "no flow" streams that have a 7Q10 and a 30Q2 equal to zero. In addition, DWQ will look for ways to remove existing discharges on such streams unless it is determined that there are no reasonable alternatives. If it is not feasible to remove the discharge, then the facility will be

required to meet limits of 5 mg/l BOD_5 and 2 mg/l NH_3N in summer (and 10 mg/l BOD_5 and 4 mg/l NH_3N in winter).

When numerous discharges affect water quality, the Environmental Management Commission is required to consider the cumulative impacts of all of the permitted discharges to a water body (pursuant to NCGS 143-215.1(b)(2)). Such areas are identified and discussed in Chapter 6. Generally, these are areas where the SOP alone does not provide adequate guidance. Since the SOP addresses mostly single discharge or relatively simple interaction of multiple discharges, WLA procedures outside the realm of the SOP represent the larger, basinwide strategy that DWQ is implementing.

Compliance Monitoring and Enforcement

Most dischargers are required to periodically sample the treated effluent from their discharge pipes. Also, many larger and more complex dischargers are required to sample points in the receiving waters both up and downstream from the discharge point. This process is called self-monitoring and it is typically required five days a week for some parameters (Monday through Friday) for major facilities. The sampling results (contained in a daily monitoring report or DMR) are then submitted each month to DWQ for compliance evaluations.

If a plant does not meet its permitted limits, DWQ may take one or more of the following actions: issue a notice of violation, initiate enforcement action, place the facility on moratorium, and/or enter into a Special Order by Consent (SOC). An SOC is a legal commitment entered into by the state and the discharger that establishes a time schedule for bringing the wastewater treatment plant back into compliance. During this time period, interim waste limits may be assigned to the facility until the improvements can be made. These interim limits may be less stringent than those in the permit although they are still required to protect water quality in the receiving waters.

In addition to the DMR data, illegal or improperly treated discharges may be identified in other ways including through third party reports, routine DWQ site inspections, and water quality monitoring conducted by DWQ staff.

Aquatic Toxicity Testing

There are thousands of chemicals and compounds that can enter wastewater systems and potentially be discharged to surface waters. Treatment plants are unable to monitor each of these chemicals individually due to limited funds and time, and limits in the ability of current analytical techniques to detect some pollutants. Even if the existence and potential effects of every constituent of a wastewater were known, the combined effects of these constituents could not be predicted.

North Carolina uses an integrated approach to aquatic toxicity testing that includes monitoring specific chemicals, assessing resident aquatic populations, and analyzing whole effluent toxicity (WET). Whole effluent toxicity limits predict the impacts of toxicants by measuring those impacts in a laboratory setting. It is from this same foundation of aquatic toxicity laboratory tests that chemical specific limits and criteria are derived for the majority of chemical toxicants.

In February 1987, North Carolina implemented a policy to incorporate WET limits for all major and complex minor permits. As of June 1996, 567 permitted NPDES discharges were required to perform WET monitoring, and over 15,000 individual toxicity analyses had been performed for plants across the state. WET limits were developed to protect aquatic life from the discharge of substances in toxic amounts as prescribed by 15 NCAC 2B. 0208 (i.e. so as not to result in chronic toxicity at permitted discharge flow and 7Q10 receiving flow volumes). Since the

inception of the program, a change in WET limitations has been observed. Previously, DWQ had predicted that approximately 25% of the facilities tested to be acutely toxic instream; however, DWQ has lowered that prediction to ten percent.

Aquatic toxicity testing, like other complex analytical techniques, requires a great deal of quality assurance and control to achieve reliable results. In 1988, North Carolina initiated a program that requires all laboratories performing NPDES analyses in North Carolina to be certified by the state as a biological laboratory. As of June 1996, 22 commercial, municipal, and industrial laboratories had achieved this certification in either aquatic toxicity analyses and/or aquatic population survey. The NC Biological Laboratory Certification Program, much like WET permitting in North Carolina, is looked at as a national leader in its field.

Pretreatment Program

The goal of pretreatment program is to protect municipal treatment plants or publicly-owned treatment works (POTWs) as well as the environment from the discharge of hazardous or toxic wastes into a public sewage system. The pretreatment program regulates non-domestic (e.g., industrial) users of POTWs that discharge toxic wastes under the Domestic Sewage Exclusion of the Resource Conservation and Recovery Act (RCRA). In essence, the program requires that businesses and other entities that use or produce toxic wastes pretreat their wastes prior to discharging their wastewater into the sewage collection system of POTW. State-approved pretreatment programs are typically administered by local governments that operate POTWs.

Local pretreatment program address four areas of concern: (1) interference with POTW operations, (2) pass-through of pollutants to a receiving stream, (3) municipal sludge contamination, and (4) exposure of workers to chemical hazards. Interference refers to any problem with plant operation, including physical obstruction and inhibition of biological activity. DWQ and the local government develop local pretreatment limits by determining the maximum amount of each pollutant the plant can accept at the influent (or headworks) and still protect the receiving water, the POTW itself, and the POTW's sludge disposal options.

Operator Certification and Training Program

Water pollution control systems must be operated by individuals certified by the North Carolina Water Pollution Control System Operators Certification Commission (WPCSOCC). The level of training and certification that the operator must have is based on the type and complexity of the wastewater treatment system. These systems include: wastewater treatment plants, wastewater collection systems and "non-discharge" ground absorption systems, such as alternative on-site disposal technologies and spray irrigation facilities. The Commission currently certifies operators in four grades of wastewater treatment, four grades of collection system operation, subsurface operation, spray irrigation operation, animal waste management and a variety of specialized conditional exams for specific technologies (e.g. oil/water separators).

The Technical Assistance and Certification Group of the North Carolina Division of Water Quality provides staff support for the Commission and assists in organizing training for operators in cooperation with the North Carolina University System, the North Carolina Community College System and through the professional associations for operators and pollution control professionals. Specialty courses and seminars for operators are also offered by the North Carolina combined Section Of The Water Environment Association/American Water Works Association (WEA/AWWA).

Training and certification of operators is essential to the proper operation and maintenance of pollution control systems. Without proper operation and maintenance, even the most effectively designed treatment system will not function efficiently. The goal of the WPCSOCC is to train

competent and conscientious professionals that will provide the best wastewater treatment and thus protect the environment and public health.

Nondischarge and Regional Wastewater Treatment Alternatives

DWQ requires NPDES permit applicants to consider alternatives for disposal of wastewater effluent other than discharge to a stream. For some, there may be no other economically feasible alternatives. However, for others, particularly smaller dischargers, there are a number of potentially cost-effective and environmentally sound alternatives. There are several types of non-discharging wastewater treatment systems including spray irrigation, rapid infiltration, trickling systems and underground injection. Researchers in North Carolina are evaluating artificial wetlands as wastewater treatment systems. Permit requirements for nondischarging systems are listed in Administrative Code Section 15 NCAC 2H .0200 - Waste Not Discharged to Surface Waters.

Another alternative to a surface water discharge is to tie into an existing wastewater treatment system. Where possible, DWQ is encouraging smaller dischargers to connect to large established municipal systems. Regionalization, as this is called, has several advantages. Large municipal facilities, unlike smaller package-type plants, have a larger and better-trained staff, thereby reducing the potential for plant malfunctions. When malfunctions do occur in a large plant, they can be caught and remedied more quickly than in a small plant. Larger facilities provide a higher level of treatment more economically and more consistently than can smaller plants. Larger plants are monitored daily. Additionally, centralizing the discharges reduces the number of streams receiving effluent. As DWQ evaluates future permit expansion requests from regional facilities, it will look favorably upon plants that accept flows from smaller discharges.

Nondischarge permits are required for alternative methods of wastewater treatment. Nondischarge permits are also issued for the land application of residual solids (sludge) from wastewater treatment processes.

NONPOINT SOURCE CONTROL PROGRAMS

Agricultural Nonpoint Source (NPS) Control Programs

Agricultural BMPs have been developed largely to control the five major agriculturally-related causes of pollution: nutrients, sediment, pesticides, oxygen-demanding substances and bacteria. BMPs vary from site to site and are dependent upon a particular pollutant but include practices such as grassed waterways and vegetated buffers, nondischarging animal waste lagoons, integrated crop and pest management and soil testing. BMPs may be administered through one or more of the agricultural programs described below. Common agricultural BMPs are listed in Appendix VI.

- **North Carolina Agriculture Cost Share Program**
  In 1984, the North Carolina General Assembly budgeted approximately $2 million to assist landowners in 16 counties within the "Nutrient Sensitive Water" (NSW) watersheds including the Upper Neuse River (Falls Lake) and the New River in Onslow County to implement BMPs for agricultural and silvicultural activities. These funds were increased in May 1987 to include 17 additional coastal counties by the passage of a General Statute formally creating the *Agriculture Cost Share Program for Nonpoint Source Pollution Control (NCACSP)*. In 1989 the NCACSP became a statewide program. The NCACSP will pay a farmer 75 percent of the average cost of implementing approved BMPs and offer technical assistance to the landowners or users which would provide the greatest benefit for water quality protection. The primary purpose of this voluntary program is water quality protection.

The local Soil and Water Conservation District Boards under the administration of the North Carolina Soil and Water Conservation Commission (SWCC) are responsible for identifying treatment areas, allocating resources, signing contractual agreements with landowners, providing technical assistance for the planning and implementation of BMPs and generally encouraging the use of appropriate BMPs to protect water quality. The criteria for allocating funds to the District is "based on the identified level of agricultural related nonpoint source pollution problems and the respective District's BMP installation goals and available technical services as demonstrated in the Districts annual strategy plan" (NC Administrative Code, Title 15, Chapter 6, Section 6E). This local participation is crucial to the success of the program.

The DEHNR-Division of Soil and Water Conservation (DSWC) provides staff, administrative and technical support to the SWCC. The DSWC also coordinates the efforts of various associated Program committees and acts as the clearinghouse for District strategy plans, contracts, etc. A legislated Technical Review Committee meets quarterly "to review the progress of the Program" (G.S. 143-215.74B) and to make technical recommendations to the Commission.

Technical assistance for the implementation of approved BMPs is provided to the Districts through a 50:50 cost share provision for technical positions to be filled at the District level. The USDA-Natural Resources Conservation Service also provides technical assistance.

- **North Carolina Pesticide Law of 1971**
  In 1971 the General Assembly created and authorized the North Carolina Pesticide Board to regulate the use, application, sale, disposal and registration of pesticides for the protection of the health, safety, and welfare of the people and for the promotion of a healthy and safe environment. Some of the responsibilities of the Pesticide Board and the North Carolina Department of Agriculture include registering all pesticides prior to distribution and sale in North Carolina, sampling pesticides to insure that all products are up to guaranteed analysis and unadulterated by any other pesticide, sampling pesticides at time of application to insure that the applicator is following label instructions, and certifying the competency of applicators and dealers of restricted use pesticides.
  The Pesticide Section of the North Carolina Department of Agriculture conducts mandatory annual inspections of all aircraft used in pesticide application and conducts random inspections of ground application equipment and chemigation systems (application of pesticides through irrigation systems). These inspections are intended to encourage proper calibration and use of equipment in order to avoid excessive application rates and accidental spills from faulty systems. Stop use orders are issued for noncompliance with the regulations.

  Inspections are also required for bulk storage tanks prior to filling. All commercial pesticide storage facilities are required to have an approved Pre-fire Plan. In addition, each large commercial storage facility is required to develop and maintain an Emergency Contingency Plan. This plan describes the actions facility personnel shall take to respond to fires, explosions, spills, or any other sudden or gradual release of pesticides or pesticide contaminated materials to air, soil, or surface waters. The Contingency Plan is designed to minimize hazards to human health and the environment.

  Penalties are assessed to careless pesticide applicators. Enforcement of the law is based on where the pesticide is deposited rather than just where it is applied. For example, if a pesticide is found in a stream as a result of wind drift, the applicator is subject to legal action. The Raleigh Office staff of the NCDA Pesticide Section is comprised of 20 employees. There are 10 Inspectors who conduct field-level compliance monitoring and investigation services. The annual budget for pesticide control and analytical work is $1.4 million.

- **NCDA Pesticide Disposal Program**

  In 1976, the North Carolina Pesticide Board adopted regulations governing the disposal of pesticides. These regulations make it illegal in North Carolina to dispose of hazardous waste (which includes certain pesticides) in sanitary landfills. While households and farms which generate less than 220 pounds of hazardous waste and less than 2 pounds of acutely hazardous waste are exempt from federal disposal requirements, the regulations prohibiting the disposal of these wastes in sanitary landfills still applies to them. The option to use commercial hazardous waste disposal companies is too expensive and most companies will not pickup small quantities. As a result of this dilemma, the NCDA created the Pesticide Disposal Program in 1980 through appropriations from the General Assembly.

  The goal of the Program is to provide an available, affordable and environmentally acceptable mechanism in which any homeowner, farmer, or institution can dispose of unwanted or unusable pesticides. It is mandatory, however, that all pesticide products are labeled correctly before NCDA will pick them up. An EPA permitted hazardous waste treatment or disposal facility (TSD) requires proper identification before the products can be disposed.

  The Food and Drug Division of the North Carolina Department of Agriculture administers the Pesticide Disposal Program. The same staff used for enforcing the North Carolina Pesticide Law of 1971 are used in the Disposal Program.

- **Animal Waste Management**

  Regulations

  On December 10, 1992, the Environmental Management Commission adopted a rule modification (15A NCAC 2H .0217) to establish procedures for properly managing and reusing animal wastes from intensive livestock operations. The goal of the rule is for intensive animal operations to operate so that animal waste is not discharged to waters of the state. This means that if criteria are met and no waste is discharged to surface waters, then an individual permit from DWQ is not required. The rule applies to new, expanding or existing feedlots with animal waste management systems designed to serve more than or equal to the following animal populations: 100 head of cattle, 75 horses, 250 swine, 1,000 sheep or 30,000 birds with a liquid waste system. These operations are deemed permitted if a signed registration and an approved waste management plan certification are submitted to DWQ by the appropriate deadlines.

  The deadline for submittal of registrations to DWQ for existing facilities was December 31, 1993. Animal waste management plans for existing facilities must be certified by a technical specialist designated by the Soil and Water Conservation Commission and submitted to DWQ by December 31, 1997. The standards and specifications of the USDA Natural Resources Conservation Service are the minimum criteria used for plan approval by the local Soil and Water Conservation Districts.

  Operator Training and Certification

  The North Carolina General Assembly ratified Senate Bill 974 (NCGS 143-215.74C - E) on July 29, 1995, which requires that the Department of Environment, Health and Natural Resources, in cooperation with the Cooperative Extension Service, develop and administer a training and certification program for operators of swine facilities with more than 250 swine that land apply animal waste. The Department assigned the task of developing and administering this program to the Technical Assistance and Certification Group of the Water Quality Section. The purpose of this program is to reduce nonpoint source pollution associated with the operation of animal waste management systems. Animal waste management systems are defined as a combination of structural and non-structural practices that collect, treat, store, or apply animal waste to the land. All animal operations with 250 or more swine (Sus scrofa)

are required to designate an Operator in Charge who has primary responsibility for the operation of the animal waste management system. There are approximately 4,000 animal operations in the state that are required to designate an Operator in Charge.

A steering committee was established that includes representatives from the animal agriculture industry, environmental groups, North Carolina Department of Agriculture, Natural Resources Conservation Service, Division of Soil and Water Conservation, North Carolina Cooperative Extension Service and the Division of Environmental Management. The primary purpose of this committee was to develop the instructional manual and exam questions for the training and certification program. The manual has been completed and is being used in the training sessions that are primarily being conducted by the Cooperative Extensive Service in each county. Also involved in the training will be personnel from the NC Department of Agriculture, Natural Resources Conservation Service and pork producers. The training sessions for the operators began in April 1996. The examinations will be administered by the Technical Assistance and Certification Group in eighteen locations throughout the state beginning in May, 1996.

Persons who wish to be certified as operators of animal waste management systems must attend a minimum of six hours of training and demonstrate competence in the operation of animal waste management systems by passing an examination. The training and certification requirements must be completed once every five years. Participants in the training program will receive instruction in the following areas: 1) proper operation of animal waste management system components such as lagoons and irrigation systems; 2) waste utilization plans and proper waste, soil and tissue sampling techniques; 3) proper application of waste including calculation of application rates and calibration of equipment; and 4) consequences of improper management and environmental stewardship.

Inspection and Enforcement
Prior to July, 1995, DWQ's limited compliance resources were mostly directed toward getting existing facilities registered, insuring that new and existing facilities had approved waste management plans and responding to citizen complaints.

Following major lagoon dike breaks in late June and July, 1995, DWQ and the Department's natural resources divisions made a major commitment to inspecting all animal operations. As of December 1, 1995, over 4,000 operations were inspected.

These inspections have found a very high percentage of these facilities with problems. DWQ is currently working with these problem facilities to get them into compliance. These efforts include technical assistance, Notices of Violations, notification of loss of deemed permitted status and other appropriate enforcement actions. Approximately 1,800 out of the 3,922 reports entered in the Division's database indicate a compliance problem. As of May 13, 1996, approximately 200 facilities were found to have a discharge during an inspection.

As of May 13, 1996, 40 civil penalty cases were assessed and 8 court injunctions have been filed. Eighty-five facilities have lost their deemed permitted status and are required to obtain a certified waste management plan prior to the December 31, 1997 deadline.

Swine Farm Siting Act
The Swine Farm Siting Act, SB 1080, was adopted on July 11, 1995 to minimize adverse impacts on property adjoining concentrated animal operations. The Act specifies that a swine house or lagoon of a new farm sited on or after October 1, 1995 is required to be at least 1,500 feet from any occupied residence; at least 2,500 feet from any school, hospital, or church; and at least 100 feet from any property boundary. The Act restricts the application of lagoon effluent to land at least 50 feet from a residential property line and from any perennial stream or

river, excluding irrigation ditches and canals. If written permission is given by the property owner and recorded with the Register of Deeds, a swine house or lagoon may locate closer to a residence, school, hospital, church, or property boundary.

- **NC Cooperative Extension Service and Agricultural Research Service**
  Crop and animal production programs are administered under the research and education activities of the NC Agricultural Research Service (ARS) and the NC Cooperative Extension Service (CES). The research and education efforts are broad and include areas such as variety development, crop fertilizer requirements, soil testing, integrated pest management, animal housing, animal waste management, machinery development and irrigation. Guidelines for most agricultural enterprises have been developed and made available to farmers. A more intensified water quality emphasis is being incorporated in these areas and many other projects undertaken by ARS and CES. The local contact that county CES agents have with farmers and homeowners provides an excellent opportunity for dialogue and education in nonpoint source pollution control. This network of contacts can be used to inform people about BMPs and to provide some structure for a general NPS education program.

  The NC Agricultural Research Service and the NC Cooperative Extension Service conduct broad research and education efforts that include areas such as variety development, crop fertilizer requirements, soil testing, integrated pest management, animal housing, animal waste management, machinery development, and irrigation. County Cooperative Extension agents work closely with farmers and homeowners, providing an excellent opportunity for dialogue and education in nonpoint source pollution control. In addition, CES has begun assisting DWQ in holding a series of public workshops in each river basin prior to DWQ's preparation of the draft basin plan.

- **Soil, Plant Tissue, and Animal Waste Testing Program**
  These services provide farmers with information necessary to improve crop production efficiency, to manage the soil properly and to protect environmental quality. The Soil, Plant Tissue and Animal Waste Testing Program is administered by the Agronomic Division of the North Carolina Department of Agriculture. Water and wastewater from lagoons is also tested for irrigation and fertilizer use.

- **Watershed Protection and Flood Prevention Program (PL 83-566)**
  The purpose of the Watershed Protection and Flood Prevention Program is to provide technical and financial assistance in planning, designing, and installing improvement projects for protection and development of small watersheds. The Program is administered by the USDA-Natural Resources Conservation Service in cooperation with the NC Division of Soil and Water Conservation, the State Soil and Water Conservation Commission, the U.S. Forest Service, Soil and Water Conservation Districts, and other project sponsors.

  The emphasis of the Program over the past three decades has been to provide flood control. However, legislation has shifted emphasis of PL-566 land treatment projects so that a project proposal must demonstrate off-site water quality benefits in order to have any chance of funding.

- **Food Security Act of 1985 (FSA) and the Food, Agriculture, Conservation and Trade Act of 1990 (FACTA)**
  There are several provisions authorized by the federal Food Security Act of 1985 (FSA) and re-authorized by the Food, Agriculture, Conservation, and Trade Act of 1990 (FACTA) which offer excellent opportunities for the abatement of agricultural nonpoint source pollution. The FSA and FACTA make the goals of the USDA farm and conservation programs more consistent by encouraging the reduction of soil erosion and production of surplus commodities and the retention of wetlands. At the same time, the provisions can serve as tools to remove

from production those areas which critically degrade water quality by contributing to sedimentation. Important water quality-related provisions are known as the Conservation Reserve, Conservation Compliance, Sodbuster, Swampbuster, and Conservation Easement, Wetland Reserve, and Water Quality Incentive Program. These provisions are administered by the USDA.

Conservation Reserve Program

The Conservation Reserve Program (CRP) is administered by the USDA Agricultural Stabilization and Conservation Service (ASCS) and the USDA Natural Resources Conservation Service (NRCS). Other cooperating agencies include the NC CES, NC Division of Forest Resources and local Soil and Water Conservation Districts. The CRP was established to encourage removing highly erodible land from crop production and to promote planting long-term permanent grasses and tree cover. The ASCS will share up to half of the cost of establishing this protective cover. The intention of the program is to protect the long term ability of the US to produce food and fiber by reducing soil erosion, improving water quality and improving habitat for fish and wildlife. Additional objectives are to curb the production of surplus commodities and to provide farmers with income supports through rental payments over a 10 year contract period for land entered under the CRP.

Conservation Compliance

The Conservation Compliance provision of the FSA and FACTA discourages the production of crops on highly erodible cropland where the land is not carefully protected from erosion. Highly erodible land is defined as land where the potential erosion (erodibility index) is equal to eight times or greater than the rate at which the soil can maintain continued productivity. This rate is determined by the Natural Resources Conservation Service.

A farmer had until January 1, 1990 to develop and begin applying a conservation plan on highly erodible land. Plans were required to be operational by January 1, 1995. If a conservation plan is not developed and implemented, the farmer loses eligibility in price and income supports, crop insurance, FHA loans, Commodity Credit Corporation storage payments, farm storage facility loans, Conservation Reserve Program annual payments, and other programs under which USDA makes commodity-related payments. In other words, Conservation Compliance is an economic disincentive, quasi-regulatory program.

Sodbuster

The Sodbuster provision of the FSA and FACTA is aimed at discouraging the conversion of highly erodible land for agricultural production. It applies to highly erodible land that was not planted in annually tilled crops during the period 1981-85. As with the other provisions of the FSA, the Natural Resources Conservation Service determines if a field is highly erodible. If a highly erodible field is planted in an agricultural commodity without an approved conservation system, the landowner (or farmer) becomes ineligible for certain USDA program benefits.

Swampbuster

The purpose of Swampbuster is to discourage the conversion of wetlands to cropland use. Wetlands are defined as areas that have a predominance of hydric soils that are inundated or saturated by surface water or groundwater at a frequency or duration sufficient to support a prevalence of hydrophytic (water loving) vegetation. It is the responsibility of the Natural Resources Conservation Service to determine if an area is a wetland. Like the other provisions of the FSA and FACTA, a farmer will lose eligibility for certain USDA program benefits on all the land which is farmed if a wetland area is converted to cropland.

Conservation Easement

The Conservation Easement provision encourages producers whose FHA loans are in or near default to place their wetland, highly erodible land, and fragile land in conservation, recreation, or wildlife uses for periods of at least 50 years. The producer benefits by having the FHA loan

partially canceled. The environment benefits by reducing the level of soil disturbing activities and the threat of agricultural pollutants.

Wetland Reserve
FACTA established a voluntary program for farmers to grant the federal government a 30-year or perpetual easement to wetlands. Eligible land includes farmed or converted wetlands which could be restored to their highest wetland function and value. The goal is to enroll one million acres by the end of 1995.

Water Quality Incentive Program
FACTA established this cost sharing program to help farmers control pollution problems associated with agricultural activities. A producer could receive up to $3,500 in cost share assistance to implement approved BMPs. The goal is to enroll 10 million acres by 1995.

Nonpoint Source Programs for Urban and Developed Lands

- **Federal Urban Stormwater Discharge Program / NC NPDES Stormwater Program**
  In 1987, Congress passed the Water Quality Act Amendments to the Clean Water Act requiring the U.S. Environmental Protection Agency (EPA) to develop regulations on permit application requirements for stormwater discharges associated with industrial activities as well as those associated with large and medium municipal separate storm sewer systems (population greater than 100,000). These regulations became effective in December 1990.

  The goal of the stormwater discharge permitting regulations in North Carolina is to prevent stormwater runoff pollution by controlling the source(s) of pollutants. Defining the potential pollutant sources and establishing controls of the sources that will reduce and minimize pollutant availability will result in an improvement to the water quality of the receiving streams, consistent with the overall goal of the water quality program. Authority to administer these regulations has been delegated to the North Carolina Division of Water Quality (DWQ). The NPDES stormwater regulations require that facilities with stormwater point source discharges associated with industrial activity and municipalities defined as either large or medium municipal separate storm sewer systems be permitted.

  The municipal permitting requirements are designed to lead to the formation of site-specific stormwater management programs for a municipal area. Therefore, the permits issued to municipalities for their municipal separate storm sewer systems will be explicitly written for each individual municipality. Municipal permits of this type in North Carolina are currently required for Charlotte, Durham, Greensboro, Raleigh, Winston-Salem and Fayetteville/Cumberland County. The municipalities will develop and implement comprehensive stormwater quality management programs to reduce the discharge of pollutants in stormwater to the maximum extent practicable (MEP). MEP will be defined separately for each municipality required to be permitted. Industrial facilities discharging through a municipal separate storm sewer system are required to submit a permit application to the state and receive their own NPDES stormwater permit.

  Industrial activities which require permitting are defined in eleven categories in the federal regulations ranging from sawmills and landfills to phosphate manufacturing plants and hazardous waste treatment, storage or disposal facilities. The regulations cover point source discharges that are related to manufacturing, processing, or material storage areas at an industrial facility. Stormwater discharges associated with industrial activities are required to be covered by permits which contain technology based controls based on Best Available Technology (BAT)/Best Conventional Pollutant Control Technology (BCT) considerations or water quality controls, if necessary. Through monitoring and regulating stormwater discharge

quality, the goal of the NPDES stormwater program is to reduce the pollutant load in stormwater runoff.

The permitting requirements described here represent Phase I of the stormwater program. EPA and Congress are currently involved in studies to determine the scope of additional stormwater coverage under Phase II of the stormwater program. Further stormwater NPDES coverage could include additional industrial activities or additional municipal areas. If additional areas of coverage are added under the federal stormwater programs, DWQ will be responsible for the appropriate permitting of these areas within North Carolina.

- **Water Supply Watershed Protection Program**
  Approximately 50 percent of North Carolina's population depends on surface water supplies for drinking, commercial, and industrial uses. Water supplies have become more important in recent years because of increased demand for water, concern over potential contamination by toxic substances, and protection of human health. As a result, the General Assembly passed the Water Supply Watershed Protection Act of 1989 (NCGS 143-214.5). This Act requires all local governments that have land-use jurisdiction within surface water supply watersheds, or a portion thereof, to be responsible for implementation and enforcement of nonpoint source management requirements related to urban development, according to minimum standards adopted by the state. NPS control strategies are included in the rules for urban, agricultural, silvicultural, and Department of Transportation activities. The Water Supply Watershed Protection Rules were adopted by the Environmental Management Commission on February 13, 1992 and became effective on August 3, 1992. These rules were recently revised (effective August 1, 1995) to give local governments more flexibility in the implementation of water supply protection programs.

  The purpose of the Water Supply Watershed Protection Program is to encourage communities to work with the state to provide enhanced protection for their water supply from nonpoint pollution sources. There are five water supply classes that are defined according to existing land use and the amount and types of permitted wastewater discharges. (See Appendix I for a summary of the management requirements for the five water supply classifications.) By classifying a watershed as a water supply watershed, local governments with land use jurisdiction within the watershed will take steps to control nonpoint sources of pollution and thereby reduce the potential of pollutants contaminating drinking water supplies. In turn, the state limits the point source discharges that can locate within the watershed which reduces the potential of contamination of the water supply.

  This dual approach of state and local government action to preclude potential impacts from stormwater runoff and wastewater discharges is important since only a small fraction of the pollutants that enter water supplies from nonpoint sources have water quality standards. As more is learned about the types and effects of pollutants in our drinking waters, the state will be forced to adopt additional water quality standards. If these additional standards are imposed, one effect may be that water treatment facilities will be required to apply additional technology and possibly more expensive treatment facilities or operation to ensure safe drinking water. It is, therefore, very important for the state and local governments to consider alternative means of preventing nonpoint source pollution from entering drinking water supplies in the first place. The land-use requirements, including density controls, buffers along perennial streams and stormwater control requirements for high density developments are but a few ways to accomplish this.

  The Water Supply Protection Program is administered by staff in the Operations Branch of the DWQ. These staff coordinate with the Division of Community Assistance (NCDCA) which helps local governments develop land-use ordinances, the Division of Environmental Health, which certifies that a proposed water supply is suitable for drinking water, and DWQ staff in

NCDEHNR regional offices who are responsible for water quality sampling. Statewide, the compliance rate for submittals is 100%.

- **Coastal Stormwater Management**
  In November 1986, the EMC adopted rules which required new development in a limited zone (575 feet) around Class SA (shellfish) waters to control stormwater either by limiting density or completely controlling a 4.5 inch, 24-hour storm with the use of a stormwater treatment system. The regulations applied to development activities which required either a CAMA major permit or a Sediment/Erosion Control Plan (generally development disturbing more than one acre). The design storm, low density limits, and aerial coverage were all quite controversial and the adopted rules represented a compromise by all parties. A sunset provision was added to the rules to force the staff and Commission to reconsider the rules after a year. These rules expired December 31, 1987, but new stormwater regulations were adopted having an effective date of January 1, 1988. These regulations are administered by the DWQ. Approximately five man-years are allocated to implementing this program. Planning Branch staff are responsible for providing guidance and interpretation to promote consistent implementation of the rules. DWQ regional staff review and approve plans and enforce the requirements of the regulations.

  Perhaps the most important measure accomplished with the regulations has been the applicability of stormwater controls to development activities within the 20 CAMA coastal counties. Certainly the near-water impact of stormwater as addressed in the original rules is important, but the staff believed the cumulative impact of stormwater runoff throughout the coastal zone also needed to be addressed. Therefore, the expanded area of coverage helps provide better protection of both shellfish waters and coastal water quality in general.

  Other major items specified in the rules address the sizing of stormwater treatment systems. For developments adjacent to SA waters, infiltration systems must be able to retain 1.5 inches of rainfall, whereas development in other areas must control one inch of rainfall. Wet detention ponds are not allowed for stormwater control near SA waters and must be sized for 85 percent TSS removal in other areas. In addition, porous pavement is considered an innovative infiltration system (only five are allowed until they are proven to work) as evidence has not been provided regarding its effectiveness in coastal areas. A low density option of the new regulations applies a built-upon limit of 25 percent for SA areas and 30 percent for other coastal areas rather than a limit on effective impervious cover. Development exceeding these levels is required to have a engineered stormwater system as indicated.

  In summary, the regulations which have an expanded aerial coverage increases the annual number of projects affected from approximately 50 (original rules) to 500. This increase is coincident with a reduction in design storm that is comparable to requirements in other states. In addition, the low density option, retained from the original regulations, is encouraged as operation and maintenance concerns associated with stormwater controls are not applicable.

- **Coastal Nonpoint Pollution Control Programs**
  As part of the Coastal Zone Act Reauthorization Amendments of 1990, Congress enacted a new section 6217 entitled "Protecting Coastal Waters". This provision requires states with coastal zone management programs (which includes North Carolina) that have received Federal approval under section 306 of the Coastal Zone Management Act (CZMA) to develop and implement Coastal Nonpoint Pollution Control Programs. The coastal nonpoint programs will provide additional control for sources of nonpoint pollution that impair coastal water quality. Sources subject to the 6217 Coastal NPS Program include: agriculture, forestry operations, urban and developing areas, marinas, hydromodification projects, and wetlands and riparian areas.

Section 6217 requires coastal states to submit their coastal nonpoint control programs to the National Oceanic and Atmospheric Administration (NOAA) and the U.S. EPA for approval by July 1995. The programs are to be implemented by January, 1999. Failure to submit an approvable program by July 1995 will result in a state losing substantial portions of its Federal funding under section 306 of the CZMA and section 319 of the Clean Water Act. The coastal nonpoint program will be developed and administered jointly by the NC Division of Coastal Management and DWQ.

Summary of Changes Since 1989

- The N.C. DWQ has developed programs for the administration of NPDES stormwater permits for industries and municipalities.
- The N.C. DWQ has developed and issued eighteen general permits to cover a variety of facilities that discharge stormwater associated with industrial activity.
- Water Supply Protection Legislation was passed in N.C. which has resulted in the development and implementation of statewide water supply watershed protection requirements. This program is described in detail in the previous section.
- The stormwater management rules governing coastal areas, High Quality Waters and Outstanding Resource Waters have been modified. These rules were finalized and effective on September 1, 1995. These programs are described in more detail in the previous section.
- Educational Efforts: The N.C. DWQ has instituted a number of educational efforts related to stormwater management across the state. These efforts have included:

- Guidance Manuals:
1 *Stormwater Management Guidance Manual*
2 *Stormwater Management In North Carolina: A Guide For Local Officials*
- Fact Sheets on Stormwater Management
1 *Stormwater Problems and Impacts*
2 *Stormwater Control Principles and Practices*
3 *Stormwater Management Roles and Regulations*
4 *Local Stormwater Program Elements and Funding Alternatives*
- Statewide Stormwater Conference - (1994)
- Statewide Workshops on The Water Supply Protection Program (1994 & 95)
- Statewide Workshops on Stormwater Management (1995)

- **ORW and HQW Stream Classifications**
  Outstanding Resource Waters (ORW) and High Quality Waters (HQW) have management strategies that address handling of urban stormwater. Controls for urban stormwater, either through development density limitations or stormwater treatment systems, are required by DWQ. Other NPS management agencies are expected to place priority on protecting these waters as well. For example, the NC Department of Transportation and the NC Division of Land Resources require more stringent sediment control on construction sites in ORW and HQW areas.

- **CAMA Land Use Plans**
  The Coastal Area Management Act (CAMA), passed in 1974, requires the development of land use plans by each of the 20 coastal counties that fall within the coastal area. These plans must be consistent with state guidelines and address a wide range of issues, including resource protection and conservation, hazards mitigation, economic development and public participation. Land use plans must be updated every five years. 1995 revisions to the land use planning guidelines strengthened the connection between land use planning and surface water quality. Future land use plan updates must consider water quality use classifications, watershed planning and problems identified in basinwide plans. There are 91 jurisdictions that have prepared and adopted CAMA land use plans.

A land use plan is a "blueprint" used by local leaders to help guide the decisions that affect their community. Through land use planning, local jurisdictions can influence how growth will affect surface water quality by adopting policies supported by local ordinances, promoting better sedimentation and erosion control standards, stream buffers and lower levels of impervious surface cover. Although land use plans are required only in the state's coastal area, these land use planning tools for the protection of water quality are available to any jurisdiction which chooses to implement them.

Construction - Sedimentation and Erosion Control Nonpoint Source Program

In 1973, the North Carolina General Assembly enacted the Sedimentation Pollution Control Act (SPCA). The Act authorized the establishment of a sediment control program to prevent accelerated erosion and off-site sedimentation caused by land-disturbing activities other than agriculture, forestry, and mining. The Land Quality Section of the Division of Land Resources is responsible for administration and enforcement of the requirements of the Act under the authority of the NC Sedimentation Control Commission.

The sediment control program requires, prior to construction, the submission and approval of erosion control plans on all projects disturbing one or more acres. On-site inspections are conducted to determine compliance with the plan and to evaluate the effectiveness of the BMPs which are used. The intent is to offer permanent downstream protection for stream banks and channels from damages caused by increased runoff velocities. If voluntary compliance with the approved plan is not achieved and violations occur, the Land Quality Section will pursue enforcement through civil penalties and injunctive relief. House Bill 448, passed in 1991, authorized the issuance of stop-work orders for violations of the SPCA. This additional enforcement mechanism will help improve the overall performance of the program.

Sedimentation control rules are more stringent for areas draining to waters supplementally classified as Trout or High Quality Waters.

Local programs are reviewed annually for compliance with the requirements of the Sedimentation Pollution Control Act. The Land Quality Section also conducts educational programs directed toward state and local government officials in order to strengthen the local programs. Persons engaged in land-disturbing activities and interested citizen groups are included in the educational effort.

The Sedimentation Control Commission has delegated to the Division of Highways of the North Carolina Department of Transportation (DOT) the authority to approve erosion and sedimentation control plans for land-disturbing activity conducted by that agency or by other persons under highway contracts with that agency. The DOT sedimentation control program has been reviewed by the Division of Land Resources under the authority of the Sedimentation Control Commission. DOT uses more stringent sedimentation controls in areas adjacent to High Quality Waters and Outstanding Resource Waters. The NC Department of Environment, Health, and Natural Resources (NCDEHNR) has established a position to evaluate environmental aspects of DOT highway projects and programs. DOT, in cooperation with DWQ, has developed and adopted formal BMPs for protection of surface waters. These BMPs and other efforts are significant improvements in developing a proactive system at DOT toward environmental issues.

On-Site Wastewater Disposal - Sanitary Sewage Systems Nonpoint Source Program

Septic tank soil absorption systems are the most widely used method of on-site domestic wastewater disposal in North Carolina. More than 52 percent of all housing units in the state are served by septic tank systems or other systems besides public or community sewage systems. A

conventional septic system consists of a septic tank, a distribution box or equivalent branching lines, and a series of subsurface absorption lines consisting of tile or perforated pipes laid in a bed of gravel. All subsurface sanitary sewage systems are under the jurisdiction of the Commission for Health Services (CHS) of the Department of Environment, Health, and Natural Resources. The CHS establishes the rules for on-site sewage systems which are administered by the Division to Environmental Health. BMPs for onsite sewage systems are listed in Appendix VI.

According to GS 130A-335(e) and (f), the rules of the CHS and the rules of the local board of health shall address at least the following: sewage characteristics; design unit; design capacity; design volume; criteria for the design, installation, operation, maintenance, and performance of sanitary sewage collection, treatment, and disposal systems; soil morphology and drainage; topography and landscape position; depth to seasonally high water table, rock, and water impeding formations; proximity to water supply wells, shellfish waters, estuaries, marshes, wetlands, areas subject to frequent flooding, streams, lakes, swamps, and other bodies of surface or groundwaters; density of sanitary sewage collection, treatment, and disposal systems in a geographical area; requirements for issuance, suspension, and revocation of permits; and other factors which affect the effective operation in performance of sanitary sewage collection treatment and disposal systems.

The rules also must provide construction requirements, standards for operation, and ownership requirements for each classification of sanitary systems of sewage collection, treatment, and disposal in order to prevent, as far as reasonably possible, any contamination of the land, groundwater, and surface waters. There exists a strict permitting procedure which regulates site selection, system design, and installation of on-site sewage systems. Privately owned subsurface sewage discharging systems are governed by NCDEHNR through local county health departments. Authorized local sanitariums serve as agents of NCDEHNR and assist in implementing the state sewage rules. Local boards of health may adopt by reference the state rules and append to those rules more stringent laws and local criteria which they desire. These amendments, however, must be approved by the state. Only nine counties in the state currently operate under local rules. The 1983 amendments of the state public health laws eliminated the co-mingling of state rules with local rules except by state approval.

The Straight Pipe Elimination Amnesty Program was established in 1996 for the purpose of eliminating domestic sewage or wastewater discharges, from both straight pipes and overland flow of failing septic systems. The program contains three components: identification and elimination of domestic sewage discharges into streams currently or proposed to be used for public water supplies; an amnesty period to end on December 31, 1997 during which time violations of State rules and laws on domestic sewage and wastewater discharges identified as a result of this program will not result in legal consequences; and a public education effort on the program and the amnesty period.

Solid Waste Disposal NPS Programs

- **Federal Program**
  The major federal legislation in the area of solid waste management is the Resource Conservation and Recovery Act (RCRA) administered by the U.S. Environmental Protection Agency (EPA). RCRA deals almost entirely with hazardous waste management but it does require that states meet minimum standards for solid waste facilities. EPA does not have permitting authority over solid waste management facilities.

- **State Program**
  States are accorded a major role in solid waste management by RCRA. North Carolina now operates under revisions by the General Assembly to Chapter 130A of the General Statutes. The Division of Solid Waste Management (DSWM) in the Department of Environment Health

and Natural Resources is authorized as the single state agency for the management of solid waste. DSWM is responsible for the development of the state's solid waste management plan, has permitting authority over all solid waste management facility siting and operation, inspects permitted facilities, provides technical assistance, investigates complaints, responds to emergencies, monitors ground water quality at facilities, promotes the state's recycling effort, and closes non-conforming sites.

The Solid Waste Management Act of 1989 established the policies and goals of the state to recycle at least 25 percent of the total waste stream by January 1, 1993. This Act created a Solid Waste Management Trust Fund to promote waste reduction and fund research and demonstration projects to manage solid waste. In 1991, the Solid Waste Management Act of 1989 was amended to broaden the goal to reduce the solid waste stream by 40 percent through source reduction, reuse, recycling, and composting by June 30, 2001.

The state adopted solid waste management rules, effective February 1, 1991, requiring liner, leachate collection, and final cover systems at all new landfills, lateral expansions of existing landfills, and at all active landfills by January 1, 1998. Septage rules and regulations also have been adopted and are administered through a permit program.

- **Local Program**
  Solid waste collection and disposal has long been a municipal function. The operation of solid waste collection and disposal facilities is among the enterprises which municipalities are expressly authorized by statute to operate (G.S. 160A-311 through 160A-321). Municipalities are also authorized to regulate the disposal of solid waste within their corporate limits. Such regulations may specify the location and type of receptacles to be used for collection (G.S. 160A-192).

  Outside municipal limits, counties are authorized to operate solid waste collection and disposal facilities either as a function of county government or through establishment of a special service district (G.S. 153A-292 and 301). Since 1970, county governments have increasingly accepted responsibility for solid waste disposal activities and most disposal facilities in the state are now operated by counties or with county financial assistance.

Forestry NPS Programs

- **Forest Practice Guidelines Related to Water Quality**
  Prior to January 1, 1990, all forestry operations were exempt from the permitting requirements of the Sedimentation Pollution Control Act (SPCA). Effective January 1, the SPCA was amended to require all forestry operations to comply with nine performance standards in order to remain exempt from the permitting requirements of the SPCA. The nine performance standards are the *Forest Practice Guidelines related to Water Quality*. The FPGs, like the SPCA, are performance based. They require measures such as establishment of a streamside management zone along intermittent and perennial streams and waterbodies to restrain accelerated erosion and prevent visible sediment from entering intermittent and perennial streams and waterbodies.

  Use of Best Management Practices (BMPs) is encouraged to meet the FPG requirements. A *Forestry Best Management Practices Manual* and other publications are available to provide guidance in meeting the FPGs. DFR personnel work with landowners, timber buyers, and loggers when requested to help plan and prevent water quality problems. Under MOAs with the DLR, DWQ and NCDA, the DFR monitors compliance with the FPGs. If a potential violation is found, the DFR will attempt to get it corrected by the responsible party(ies) within a reasonable time frame. If it is not corrected, a referral of the project is made to the appropriate

- **National Forest Management Act (NFMA)**
  The National Forest Management Act was passed in 1976 and applies to all lands owned or administered by the National Forest System. The Act stipulates that land management plans be prepared which consider economic and environmental aspects of forest resources. The Act further states that timber will be harvested from National Forest lands only where soil, slope, or other watershed conditions will not be irreversibly damaged; and where protection is provided for streams, streambanks, shorelines, lakes, wetlands, and other bodies of water from detrimental changes in water temperatures, blockages of watercourses, and deposits of sediment, where harvests are likely to seriously and adversely affect water conditions or fish habitat.

- **Forest Stewardship Program**
  The Forest Stewardship Program was begun in 1991 by the US Forest Service, with the DFR as the lead agency in North Carolina. In cooperation with other natural resource agencies, the Forest Stewardship Program is intended to bring more forest land under management. Identifying four resource categories, (timber, fisheries and wildlife habitat improvement, recreation and aesthetics, and soil and water conservation), Forest Stewardship Plans are developed for landowners based on their individual goals and objectives. A landowner mush own at least 10 acres of woodland, and agree to manage it to improve at least three of the four resources while maintaining the fourth in at least the same condition. Primary cooperating agencies with the DFR are the NC WRC, USDA-NRCS, NC CES, and USDA-FSA.

Mining NPS Program

In 1971 the North Carolina General Assembly passed the Mining Act to ensure that the usefulness, productivity, and scenic values of all land and waters involved in mining will receive the greatest practical degree of protection and restoration. The Mining Commission is the rule-making body for the Act and has designated authority to administer and enforce the rules and regulations of the Act to the Mining Program within the Land Quality Section of the NCDEHNR Division of Land Resources.

The Mining program has four major areas of responsibility. First, the Program requires submission and approval of a mining permit application prior to initiating land disturbing activity if the mining operation is one (1) or more acres in surface area. The mining permit application must have a reclamation plan for these operations. Second, the Program conducts on-site inspections to determine compliance with the approved application and whether or not the plan is effective in protecting land and water quality. Third, the program pursues enforcement action through civil penalties, injunctive relief, and/or bond forfeiture to gain compliance when voluntary compliance is not achieved. Finally, the Mining Program conducts educational efforts for mine operators.

Wetlands Regulatory NPS Programs

There are numerous reasons for preserving wetlands, but of special interest within the context of basinwide planning is their role in protecting water quality. Because of their intrinsic characteristics and location within the landscape, wetlands function to protect water quality in a number of ways. These functions include the retention and removal of pollutants, stabilization of shorelines, and storage of flood waters.

Numerous authors have studied the effectiveness of riparian wetland forests for nutrient retention and transformation (Jones et al. 1976; Yates and Sheridan 1983; Brinson et al. 1984; Lowrance et al. 1984; Peterjohn and Correll 1984; Jacobs and Gilliam 1985; Budd et al. 1987; and Groffman et al. 1991). The location of riparian wetlands allows them the opportunity to receive nutrients from the surrounding landscape as well as through overbank flooding. In addition to the storage of

nutrients in wetland vegetation, the microbial and chemical processes within wetland soils may function to completely remove nutrients from the system.

Headwater riparian wetlands are extremely important and effective in terms of sediment and associated nutrient and toxicant retention and transformation. Since small streams comprise most of the total stream length within a watershed (Leopold 1974), these areas intercept the greatest proportion of eroded sediments and associated substances from uplands before these pollutant reach waters downstream. Novitzki (1978) found that approximately 80% of the sediments entering a stream were retained in headwater wetlands.

Wetlands adjacent to streams, rivers and lakes stabilize shorelines and help protect these bodies of water from erosive forces. This function is particularly important in urbanized watersheds where the prevalence of impervious surfaces contributes to greater peak storm flows. Wetland vegetation serves to dissipate erosive forces and anchors the shoreline in place preventing sediments and associated pollutants from entering waterways. Wetlands by their very nature of being "wet" are also vital for water storage. Those wetlands adjacent to surface waters, that have the opportunity to receive flood waters and surface runoff, are most important to water storage. Wetlands located in headwaters generally minimize peak flood waters in tributaries and main channels. Lakes and wetlands with restricted outlets hold back flood waters and attenuate flood peaks (Carter et al. 1978).

Several important state and federal wetland protection programs are described below. In addition to the following wetlands programs, provisions of the 1985 and 1990 Farm Bills, discussed in Section 5.3.1, should also help reduce wetlands impacts. Agriculture conversions should be reduced by the "swampbuster" provision of the 1985 Farm Bill, which encourages farmers not to convert wetlands for agriculture to prevent the loss of their USDA subsidies, loans, and price supports. Silviculture is exempted from the swampbuster provision and therefore, conversion of wetlands for intensive or managed forestry is not affected by this provision. A Wetland Reserve Program was established by the 1990 Farm Bill with the goal of allowing one million acres of prior-converted wetlands to revert back to wetlands by 1995.

- **Section 10 of the Rivers and Harbors Act of 1899**
  This act, administered by the US Army Corps of Engineers, provides the basis for regulating dredge and fill activities in navigable waters of the United States. Originally, this Act was administered to protect navigation and the navigation capacity of the nation's waters. In 1968, due to growing environmental concerns, the review of permit applications was changed to include factors other than navigation including fish and wildlife conservation, pollution, aesthetics, ecology, and general public interest. Activities which may be covered under the Act include dredging and filling, piers, dams, dikes, marinas, bulkheads, bank stabilization and others.

- **Section 404 of the Clean Water Act**
  The U.S. Army Corps of Engineers administers a national regulatory program under Section 404 of the Clean Water Act aimed at controlling the discharge of dredged or fill material into waters of the United States. Section 404 applies to the discharge of dredged or fill materials into waters of the United States including dredging. Waters of the United States refers to navigable waters, their tributaries, and adjacent wetlands. Activities covered under Section 404 include dams, dikes, marinas, bulkheads, utility and power transmission lines and bank stabilization. Although the 404 program does not fully protect wetlands, it is nonetheless the only existing federal tool for regulating wetland development statewide. State legislation has not been adopted to protect inland freshwater wetlands in North Carolina, as has been done for coastal wetlands, but the EMC in March of 1996 adopted rules which will formalize the wetlands protection measures associated with the 401 Water Quality Certification review process.

- **Section 401 Water Quality Certification (from CWA)**
  The Division of Water Quality is responsible for the issuance of 401 Water Quality Certifications. Section 401 of the federal Clean Water Act provides that no federal agency can issue any license or permit to conduct any activity that may result in a discharge to navigable waters unless the state in which the discharge may occur certifies that the discharge will not result in a violation of any state water quality or related standards. Thus, a 401 certification is required for, among other things, a discharge into surface waters or wetlands for projects that require a section 404 permit. A federal permit cannot be issued if a 401 certification is denied. Any conditions added to the 401 certification become conditions of the 404 permit. The 401 certification process is coordinated with the 404 and CAMA processes in the 20 counties of CAMA jurisdiction.

- **North Carolina Dredge and Fill Act (1969)**
  This act requires permits for "excavation or filling begun in any estuarine waters, tidelands, marshlands, or state-owned lake". This law is currently administered with North Carolina's Coastal Area Management Act (CAMA) (1974).

- **Wetlands Restoration Program/Funds**
  The North Carolina Wetlands Restoration Program (NCWRP) was established in 1996 as a nonregulatory program "...for the acquisition, maintenance, restoration, enhancement, and creation of wetland and riparian resources that contribute to the protection and improvement of water quality, flood prevention, fisheries, wildlife habitat, and recreational opportunities". The goals of the program include: the restoration of wetlands function and values; to provide a consistent and simplified approach to mitigation requirements associated with permits or Corps of Engineers authorizations; to streamline the permitting process; to increase the ecological effectiveness of mitigation efforts; to achieve a net increase in wetlands acres, functions and values for each major river basin; to promote a comprehensive approach to environmental protection.

  The NCWRP is developing Basinwide Restoration Plans for each of the seventeen river basins throughout North Carolina. Basinwide Restoration Plans are watershed-based strategies for identifying degraded and functioning wetland and riparian areas which, when restored or protected, could contribute significantly to the NCWRP's goals.

  The NCWRP has identified priority subbasins within each river basin. The sixty priority subbasins selected are distributed among all river basins according to the comparative size, water quality, overall ecological condition, and availability and distribution of good restoration sites within each river basin. Natural resource information for priority subbasins will be contained within the Basinwide Restoration Plans which will guide the NCWRP in targeting its wetlands and stream restoration.

  Priority subbasins were selected based in large part on water quality data from DWQ's Basinwide Water Quality Management Plans. These data will be available in GIS (geographic information systems) format and contained in the Basinwide Restoration Plans. Data will be detailed on the 14-digit hydrologic unit level. For each hydrologic unit, the percentage of non-supporting, partially supporting, and support-threatened stream miles will be reported. Some of the resource data layers that will be compiled and analyzed for each hydrologic unit in GIS format include: (1) shellfish closure areas, (2) water supply watersheds, (3) fin fish and shellfish nursery areas, and (4) groundwater recharge zones. This information, along with other natural resource data relating to Natural Heritage Program sites and land use, will be used to target specific potential restoration sites and to identify landowners whose properties could provide significant public benefits through NCWRP restoration efforts.

The water quality information found in the Basinwide Water Quality Management Plans will be used by NCWRP as a primary tool to prioritize restoration efforts. In turn, the restoration work resulting from the Basinwide Restoration Plans will serve as a tool for achieving the water quality and aquatic habitat protection and enhancement goals set forth in the Basinwide Water Quality Management Plans.

The NCWRP is not a grant program. However, it can complement grant programs like the Section 319 program by taking on actual restoration projects that are identified through Section 319 grant applications. Alternatively, studies funded by the Section 319 program to identify suitable stream or wetland restoration sites can then be implemented by the NCWRP. The NCWRP can also directly fund other stream or wetland restoration sites identified by Nonpoint Source Teams or other means, provided those sites are located within a priority subbasin, as determined by the NCWRP. Finally, the NCWRP can perform restoration projects cooperatively with other state or federal programs, or with environmental groups.

The NCWRP is focusing its stream and wetlands restoration work in sixty designated priority subbasins throughout North Carolina and is in the process of identifying prior converted wetlands, stream frontage and riparian buffers that, when restored, can provide significant functions and values on a watershed scale. Landowners who are willing to consider selling either property title or a permanent conservation easement (i.e., a legally binding agreement to allow restoration work and not to prohibit development) on suitable land are encouraged to contact the NCWRP. In turn, the NCWRP will determine the restoration potential of the land, whether it is located in a designated priority subbasin, and the basinwide ecological benefits of siting a restoration project there. If mutually acceptable to the NCWRP and the landowner, the latter may receive cash payments for land sales or tax breaks for conservation easements. The NCWRP will be responsible for the costs of wetlands or stream restoration and maintenance.

Hydrologic Modification

Hydrologic modification is defined as channelization, dredging, dam construction, flow regulation and modification, bridge construction, removal of riparian vegetation, streambank modification/destabilization, and dam collapse. By its very nature hydrologic modification is closely tied to wetland issues. It is not surprising then that the U.S. Army Corps of Engineers (Corps) is the agency most involved in issuing permits for land-disturbing activities in wetlands. These permits are issued through Section 404 and the Rivers and Harbors Act discussed above.

In addition to wetland issues, dam construction and the lack of low flow releases into streams can severely impact downstream aquatic resources. Dam construction, repair, modification, and removal are regulated by the NC Division of Land Resources under the Dam Safety Law of 1967. A dam safety permit is required for any dam which is 15 feet or greater in height (from top of dam to lowest point on downstream toe) and the impoundment capacity is 10-acre-feet or greater at the top of the dam. Low-flow release requirements to maintain adequate instream flows are established in permits where appropriate. Instream flows are recommended by the NC Division of Water Resources.

There are several other programs which can affect hydrologic modification. The Forest Practice Guidelines Related to Water Quality requires streamside management zones to be maintained during logging operations. The Water Supply Watershed Protection Program also has requirements to maintain buffers for certain activities. The Conservation Reserve Program encourages the establishment of vegetative filter strips (66-99 feet wide) for farming operations. A significant number of local governments have established greenway programs within urban settings in order to maintain and protect riparian areas.

Water Supply Legislation in North Carolina

- **Water Supply Planning Law**
  The Water Supply Planning law (G.S. 143-355 (l) and (m)) was adopted in 1989 and amended in 1993. It requires all local governments that supply or plan to supply water to prepare a local water supply plan. In their plans, local governments are to include present and projected population, industrial development and water use within the service area, present and future water supplies, an estimate of technical assistance needs and other information that may be required by the Department. All local plans are to be approved and submitted to DWR by January 1, 1995. Information in those local plans is to be included in a State Water Supply Plan. The State Plan will also investigate the extent to which the various local plans are compatible.

- **Registration of Water Withdrawals and Transfers Law**
  The Registration of Water Withdrawals and Transfers law (G.S. 143-215.22H) requires any person who withdraws or transfers 1 MGD or more of surface water or groundwater to register the average daily and maximum daily withdrawal or transfer with the Environmental Management Commission (EMC). The law also provides that if a local government has an approved local water supply plan on file with DWR, it does not have to register that withdrawal, thereby reducing duplication of effort by local governments that otherwise would be subject to both laws. In addition, the law includes a 5-year renewal requirement, which will ensure that the data is regularly updated.

- **Regulation of Surface Water Transfers Act**
  In 1993, the legislature adopted the Regulation of Surface Water Transfers Act (G.S. 143-215.22I et seq.). This law was designed to regulate large surface water transfers by requiring a certificate from the EMC and by repealing several other laws that had previously affected interbasin transfers. The law applies to anyone initiating a transfer of 2 MGD from one river basin to another and to anyone increasing an existing transfer by 25 percent or more if the total transfer is 2 MGD or more. Applicants for certificates must petition the EMC and include a description of the transfer facilities, the proposed water uses, water conservation measures to assure efficient use and any other information desired by the EMC. A certificate will be granted for the transfer if the Commission concludes that the overall benefits of the transfer outweigh its detriments. The Commission may grant the petition in whole or in part, or deny it, and it may require mitigation measures to minimize detrimental effects. The law also provides for a $10,000 civil penalty for violating various statutes.

- **Capacity Use Act**
  DWR administers the Capacity Use Act (G.S. 143-215.11 et seq.), which allows the EMC to establish a Capacity Use Area where it finds that the use of ground water, surface water or both requires coordination and limited regulation. If after an investigation and public hearings a Capacity Use Area is designated, the EMC may adopt regulations within the area, including issuance of permits for water users. In the near future, DWR plans to review the rules for implementation of the Capacity Use statute and develop a model of the aquifer system, in coordination with the Groundwater Section of DWQ, for Capacity Use Area 1, which was created to regulate surface water and ground water withdrawals in an area surrounding Texasgulf, Inc. in Aurora, N.C. A new ground water flow model will be used to simulate Capacity Use Area 1 as a basis for permitting withdrawals.

- **Dam Safety law**
  The Dam Safety law (G.S. 143-215.24) was amended in 1993, and rules are being developed for implementation of these amendments. Among the changes, the amendment defines "minimum stream flow" as a quantity and quality sufficient in the judgment of the Department of Environment, Health and Natural Resources (DEHNR) to meet and maintain stream

classifications and water quality standards established by DEHNR and to maintain aquatic habitat in the affected stream length.

The Dam Safety Law applies to dams that are 15 feet or more high or with impoundment capacity of 10 acre feet or more. The law requires that the EMC adopt rules specifying minimum stream flow in the length of the stream affected by a dam and sets specific parameters for minimum stream flow for dams operated by small power producers that divert water from 4,000 feet or less of a natural stream bed and return the water to the same stream.

Section 319 Nonpoint Source Management and Other Programs

- **Section 319**
  Clean Water Act Section 319(h) grant monies are made available to the states on an annual basis by EPA. Agencies in the state that deal with NPS problems submit proposals to DWQ each year for use of these funds in various projects. Projects that have been funded in the past include BMP demonstrations, watershed water quality improvement projects, data management, educational activities, modeling, stream restoration efforts, riparian buffer establishment, and others. North Carolina DWQ established a Workgroup process in 1995 for prioritizing and selecting projects from the pool of cost-share proposals for inclusion in its annual application to EPA. DWQ staff first reviews proposals for minimum 319 eligibility criteria such as:
  - support state Program milestones;
  - address targeted, high priority watersheds;
  - provide sufficient cost-share match (40% of project costs);
  - propose adequate time periods;
  - identify measurable outputs;
  - use compatible GIS products with those of the state; and
  - make commitment for educational activities and a final report.

  Workgroup members separately review and rank each proposal which meets the minimum 319 eligibility criteria. The Workgroup consists of representatives from the state and federal agencies that deal with NPS issues, including agricultural, silvicultural, on-site wastewater, mining, solid waste and resource protection. In their review, members consider such factors as: technical soundness; likelihood of achieving water quality results; degree of balance lent to the state Program in terms of project type; and competence/reliability of contracting agency. They then convene to discuss individual projects' merits, to pool all rankings and to arrive at final rankings for the projects. All proposals that rank above the funding target are included in the annual grant application to EPA, with DWQ reserving the right to make final changes to the list. Actual funding depends on approval from EPA and yearly Congressional appropriations.

- **Use Restoration Waters**
  The North Carolina Division of Water Quality is currently developing the Use Restoration Waters (URW) program to restore surface waters to their designated uses. If adopted, this program will allow the state to work with local governments, businesses, and residents to develop management strategies appropriate for the area. In order to be effective, the URW program will include a mix of mandatory and voluntary programs. The voluntary and mandatory programs will be coordinated on a site-specific basis by DWQ and a group of stakeholders who have an interest in the impaired water body and associated watershed. In addition, the URW program will attempt to develop cooperative relationships among these

mandatory programs will be coordinated on a site-specific basis by DWQ and a group of stakeholders who have an interest in the impaired water body and associated watershed. In addition, the URW program will attempt to develop cooperative relationships among these agencies so that overlapping efforts can be consolidated and targeted to restore designated water body uses.

The URW Program will apply to polluted surface waters where the following conditions apply:
- Biological, physical and/or chemical data indicate the specific sources of pollution.
- A use attainment study indicates that the sources of pollution are not transitory.
- It is possible to control the sources of pollution by implementing appropriate management strategies under the existing authority of the North Carolina Environmental Management Commission (EMC), other state commissions, and local agencies or voluntary actions implemented by citizens and other groups.

Based on current water quality data, there are approximately 4,300 miles of freshwater streams (or about 1.4 percent of total miles) and about 40,000 saltwater acres (or about 2 percent of total saltwater acres) that would be potential candidates for URW consideration.

The restoration strategies developed under the URW Program will be site-specific to the watershed of the nonsupporting or impaired water body. DWQ and the stakeholders will coordinate each URW strategy with other agencies' programs to create a holistic approach to address the array of pollution problems in the watershed.

- **The Nonpoint Source (NPS) Team Process**

Successfully managing NPS pollution requires not only a knowledge of science and technology, but also an understanding of the local resources and economy. Although there are some general management guidelines, there is no single technique for controlling NPS pollution. The most efficient and effective NPS solutions will be site-specific. Formulating NPS solutions often requires cooperation between different interested parties. Each group that contributes to the NPS problem must be part of the solution.

DWQ will coordinate the Broad NPS Team to include a wide variety of stakeholders interested in the basin. This team will take the lead in identifying NPS problems and implementing solutions. The NPS Team process is discussed below and in Chapter 7.

1. Coordinate the NPS Team.
DWQ's goal in forming the Broad NPS Team is to choose predominantly locally-based members that represent the federal, local, and state agencies, local governments, industries, and citizens' groups that have interests and responsibilities pertaining to NPS pollution. DWQ will consult local groups to determine which interests should be represented on the team.

Once the NPS Team is formed, DWQ and the team will work as partners to identify, prioritize, and address the NPS problems in the basin. DWQ will offer information from the state's water quality monitoring program and its staffs' knowledge of technical and financial resources. The NPS Team will describe current NPS initiatives, identify priority NPS-impaired waterbodies, and analyze NPS issues and needs. One of the most important missions of the DWQ-NPS Team partnership is to foster coordination and cooperation between the basin's diverse interest groups and agencies. The eventual goal of the NPS Team is to create and implement Action Plans that will address priority *NPS-impaired waterbodies* and *NPS issues* as part of the basinwide planning process. The implementation schedule will be determined as the plans are developed.

readers some of the potential resources for addressing their NPS problems (see Chapter 5). This effort will provide an opportunity for mutual education, understanding and coordination with other stakeholders. An important responsibility of the NPS Teams will be to assess whether existing initiatives and programs in the basin are successfully improving water quality.

3. Choosing the priority NPS-impaired waterbodies and NPS issues.
Since the NPS Team will not be able to address all of the *NPS-impaired waterbodies* and *NPS issues* in the basin, it will have to follow a system for prioritization. The NPS Team will use the following process to target NPS-impaired waterbodies and select NPS issues.

Selecting the Priority NPS-impaired Waterbodies

Within the guidelines described below, the NPS Team will select at least one NPS-impaired waterbody for which an Action Plan will be developed. More than one waterbody may be selected if time and resources allow. The goal of the Action Plan will be to restore the designated use of the selected waterbody using a comprehensive, site-specific, and coordinated approach. The Actions Plans will be a prime candidate for funding under the federal Section 319(h) program.

The NPS Team will use both primary and secondary criteria to select the *priority NPS-impaired waterbodies*. The primary criteria are (in order of importance):

- Highly-valued resource waters, such as High Quality Waters and Water Supplies I-IV, that have a demonstrated pollution problem.
- Monitored waters that have an overall use support rating of non-supporting.
- Monitored waters that have a use support rating of partially supporting but have a high predicted loading for one or more pollutants.
- Highly valued resource waters, such as High Quality Waters and Water Supplies I-IV, that are in need of protection.
- Monitored waters that have an overall use support rating of partially supporting.

DWQ will provide a list of waterbodies that meet the primary criteria to the NPS Team.

The secondary criteria for selecting the priority *NPS-impaired waterbodies* are:

- Waters that pose a potential threat to human health,
- Waters that are important for ecological reasons not reflected in their classification and use support ratings (such as endangered species, unique habitats, or significant biological resources),
- Waters that are highly eroded or have other evidence of serious erosion problems that are not reflected in the use support ratings,
- Waters that have experienced a recent, rapid decline in water quality, and
- Waters that have identifiable pollution sources and a high likelihood of successful restoration.

An NPS-impaired waterbody that meets the primary criteria as well as one or more of the secondary criteria listed above is a good candidate for prioritization by the NPS Team. However, the NPS Team may select a priority NPS-impaired waterbody that does not meet the primary criteria but meets *several* of the secondary criteria. This allows the team to select waters that DWQ did not monitor or waters for which the use support rating failed to describe the extent of the NPS problem.

Selecting the Priority NPS Issues

In order to address problems in the remaining NPS-impaired or threatened waterbodies (ones not prioritized for specific Action Plans), the follwing criteria will be used to target NPS issues throughout the basin:

- Issues that apply throughout a significant portion of the basin or address one or more impaired waters that were not selected as a *priority NPS-impaired waterbody,*
- Issues that have a clearly defined "problem" and "solution," and
- Issues that are within the team's ability to address through educational efforts, improved coordination between stakeholders, focused new initiatives, or involvement of additional stakeholders.

4. Determine what is needed to address the priority NPS-impaired waterbody and the NPS issues the team selects.

The NPS Team will decide which actions are likely to restore the priority NPS-impaired waterbodies and address the NPS issues. Some of the possible needs include:

- Public education. When water quality problems result from citizens' lack of knowledge about how their local actions affect water quality or from land use decisions, public education is a key component of the solution.
- Implementation of best management practices (BMPs). BMPs are structural or nonstructural management practices used to reduce nonpoint source inputs to receiving waterbodies in order to achieve water quality protection goals. Often higher levels of pollutant removal can be achieved by using a combination of different BMPs.
    * Structural BMPs generally work by capturing, retaining, and treating runoff before it leaves an area. Some examples of structural BMPs include constructed wetlands and wet detention ponds in urban settings and controlled drainage on agricultural lands. Structural BMPs require regular maintenance.
    * There are a variety of nonstructural BMPs. One nonstructural BMP is source reduction, which reduces the amount of pollutants that are introduced into the environment. Some types of source reduction are nutrient management plans for crop production and hazardous waste collection sites in urban areas. Another nonstructural BMP is maintaining natural drainageways to allow the vegetation and soil to cleanse runoff before it enters a waterbody.
- Ecosystem restoration and management. If a stream's ecosystem is badly damaged, removing pollutants alone will not always restore the water's uses. In cases like these, it will be necessary to restore the ecosystem through measures such as riparian revegetation and streambank stabilization.
- Local water quality planning. Development sites can be planned in order to reduce their risk of harming water quality. Some planning techniques include steering development towards less environmentally sensitive areas, using natural drainage systems rather than curb and gutter, and planning for development densities that allow for open space, greenways, and wildlife corridors.

5. Develop comprehensive Action Plans consisting of management strategies to address the priority NPS-impaired waterbody and the NPS issues.

The NPS Team members will work together to develop "Action Plans." These Action Plans will consist of a list of Action Items that form a coordinated, comprehensive effort to address each priority NPS-impaired waterbody and NPS issue. Each Action Item will include lead contacts, goals, and a schedule for completion and may utilize one or more of the following vehicles for implementation:

- Efforts by NPS Team members: The NPS Team members can make commitments to target their agency's/group's existing resources to address the priority NPS-impaired waterbody or NPS issues. Team members can also agree to share their expertise on a volunteer basis.
- Section 319: Clean Water Act Section 319(h) grant monies are made available to the states on an annual basis by EPA. Agencies in the state that deal with NPS problems submit proposals to DWQ each year for use of these funds in various projects. Projects that have been funded in the past include BMP demonstrations, watershed water quality improvement projects, data management, educational activities, modeling, stream restoration efforts, riparian buffer establishment, and others. Refer to Section 5.7 for a complete program description.
- Agriculture Cost Share Program: Provides a number of cost-share practices designed to solve soil, water, and related environmental problems in agricultural areas including forested buffer strips.
- Wetlands Restoration Program. A bill recently ratified by the NC General Assembly establishes a statewide Wetland Restoration Program that will provide a leadership role in targeting and consolidating all wetland and riparian area restoration initiatives in NC.
- Proposed Use Restoration Waters (URW) Program. DWQ is currently developing the URW program to restore surface waterbodies to their designated uses. If adopted, this program would allow the state to work with local governments, businesses, and residents to develop focused management strategies appropriate for the area. Those affected by the URW program will be requested to meet well-defined milestones and goals for water quality improvement. If these milestones are not met on a voluntary basis within an established schedule, mandatory controls may be considered by the Environmental Management Commission.
- Federal Initiatives: There are a number of federal programs and resources that may be available to address the Priority NPS-impaired waterbody and NPS issues. These include US Fish and Wildlife Service funds, the USDA-NRCS Wetland Reserve Program, and the Environmental Quality Initiative Program (EQIP) provisions of the Farm Bill.
- Other Programs: There are numerous other programs sponsored by private and state agencies that could be initiated to address the NPS Team's priority waterbodies and issues. Some of these programs include corporate funding for educational programs, the Small Watershed Program, and US Fish and Wildlife Grants. A complete list of funding sources for NPS pollution is listed in Appendix VIII.

6. Implement Action Plans.

Implementation is the most important part of the state's NPS program since it is the only way to restore the priority NPS-impaired waterbody and address NPS issues. Most, if not all, members of the NPS Team will be involved with the implementation of one or more of the Action Items. During the implementation phase, the NPS Team will continue to meet on a regular basis. The purpose of these meetings will be for the team to update each other on their progress toward completing the Action Items and provide a forum for continuing the coordination between team members. When some of the team members experience setbacks in implementing an Action Item, the rest of the team can advise and/or provide additional help so that the item can be completed successfully.

7. Monitor to evaluate the effectiveness of management strategies.

The NPS Team will identify where additional water quality monitoring sites may be needed to document the effectiveness of its Action Plans. DWQ and the NPS Team will cooperate to assure that pre- and post-monitoring is in place before a new program, initiative or BMP is implemented. In order to supplement DWQ's monitoring programs, the team may seek the involvement of citizens' groups. Any agencies that receive 319 grants will be required to conduct pre- and post-evaluations as a part of their project.

8. Consider additional management strategies if the voluntary approaches do not result in an improvement in water quality.

If the NPS Team's management strategies do not show progress in improving water quality according to the designated schedule, DWQ and the team will work together to identify the reason for the lack of progress. Some of the potential courses of action are:

- Reevaluate the source of impairment.
- Increase and/or redirect voluntary measures.
- Consider additional measures.

APPENDIX VII

List of 303(d) Waters in the Broad River Basin

APPENDIX VII

LIST OF 303(D) WATERS IN THE BROAD RIVER BASIN

What is the 303(d) list?

Section 303(d) of the Clean Water Act (CWA) requires states to develop a list of waters not meeting water quality standards or which have impaired uses. Waters may be excluded from the list if existing control strategies for point and nonpoint source pollution will achieve the standards or uses. Listed waters must be prioritized, and a management strategy or total maximum daily load (TMDL) must subsequently be developed for all listed waters. The 303(d) process is presented in Figure 1.

303(d) List Development

Generally, there are four steps to preparing North Carolina's 303(d) list. They are (1) gathering information about the quality of North Carolina's waters, (2) screening those waters to determine if any are impaired and should be listed, (3) determining if a total maximum daily load (TMDL) has been developed, and (4) prioritizing impaired waters for TMDL development. This document also indicates whether the Division of Water Quality (DWQ) intends to develop a TMDL as part of a Management Strategy (MS) to restore the waterbody to its intended use. The following subsections describe each of these steps in more detail.

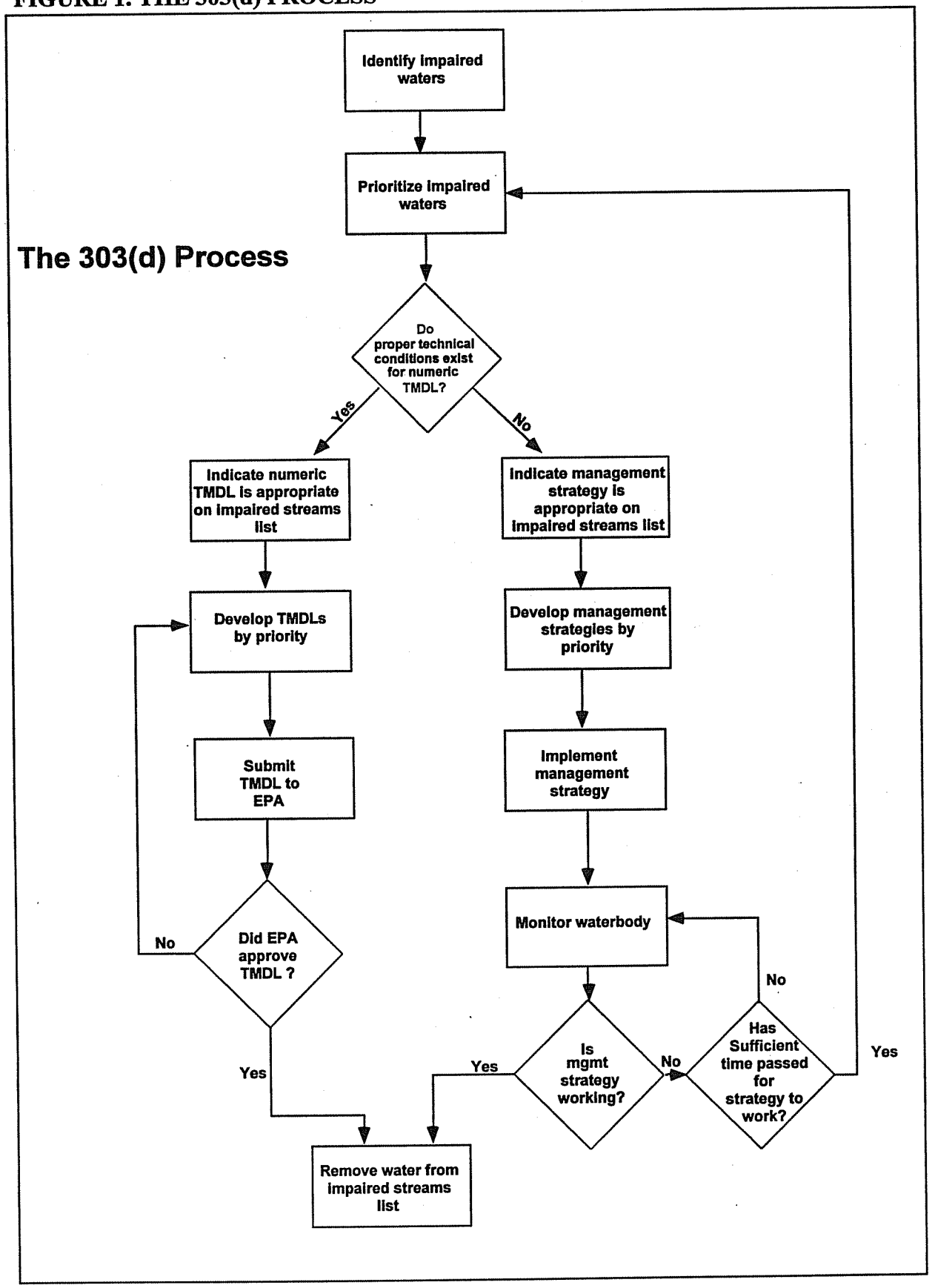
Sources of Information

For North Carolina, the primary sources of information are the basinwide management plans and accompanying assessment documents, which are prepared on a five-year cycle, and the 305(b) report, which is prepared biennially. Basinwide management plans include information concerning permitting, monitoring, modeling, and nonpoint source assessment by basin for each of the 17 major river basins within the state. Basinwide management allows the state to examine each river basin in detail and to determine the interaction between upstream and downstream point and nonpoint pollution sources. As such, more effective management strategies can be developed across the state.

The 305(b) report is used as a basis for developing the 303(d) list. Section 305(b) of the CWA requires states to report biennially to the U.S. Environmental Protection Agency (EPA) on the quality of waters in their state. In general, the report describes the quality of the state's surface waters, groundwaters, and wetlands, and existing programs to protect water quality. Information on use support, likely causes (e.g., sediment, nutrients, etc.) and sources (point sources, agriculture, etc.) of impairment are also presented.

Many types of information were used to make use support assessments and to determine causes and sources of use support impairment. Chemical, physical, and biological data collected by DWQ were the primary sources of information used to make use support assessments.

FIGURE 1. THE 303(d) PROCESS



North Carolina has an extensive ambient and biological monitoring network throughout the state. Benthic macroinvertebrate data, which indicate taxa richness and species diversity, are an important data source. North Carolina also collects fish tissue and fish community structure data, and phytoplankton bloom data that are used in the assessments. Shellfish closure data, fish kill data, reports, predictive modeling results, toxicity data, and self-monitoring data are considered when making final use support determinations.

Data from all readily available sources outside of DWQ are considered when evaluating use support. Many other agencies, universities, industries, point sources, and environmental groups collect data on North Carolina's surface waters. Published reports and data from ongoing studies that the DWQ has knowledge of are actively solicited during the assessment phase of the basin planning cycle. Data that are not collected and analyzed following procedures outlined by the Environmental Protection Agency (EPA) are used to quality assure other monitoring that may occur in the same water and identify areas to monitor in the future. The Division therefore uses all data.

Listing Criteria

Waters whose use support ratings were not supporting (NS), partially supporting (PS), and support threatened (ST) based on monitored information in the 305(b) report were considered as initial candidates for the 303(d) list. Although support threatened waters currently meet their intended uses, these waters were reviewed to determine if there were sufficient data to determine if they would become impaired in the next two years. The list was then compared to the 1996 303(d) list to determine if additional waters should be added that were included on that 303(d) list that are still considered as impaired based on evaluated information.

Fish consumption advisory information was then reviewed to determine if other waters should be added to the list. Fish consumption advisories are no longer considered when determining use support since the entire state was posted in June 1997 for the consumption of bowfin from mercury contamination. It should be noted that bowfin do not occur statewide; they are found primarily within the coastal plain. While fish consumption advisories do indicate impairment, DWQ did not want to mask other causes and sources of impairment by having the entire state or an entire basin listed as impaired due to advisories. However, DWQ believes that advisories on specific waters are cause to include the water on the 303(d) list, therefore, advisories other than statewide bowfin mercury contamination were considered when developing the state's 303(d) list.

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

parameters are on the 1998 303(d) list. Following is a summary of waters that were added to the Broad 303(d) list:

- Walnut Creek, Catheys Creek, and Beaverdam Creek were not included on the 1996 303(d) list. They have been added to the 1998 list based on updated use support information.

De-Listing Criteria

Waters included on the 1996 303(d) list were reviewed to determine if they may be removed from the list of impaired waters. If updated use support analyses indicated that the water was meeting its uses, the waterbody was dropped from the list. Other waters were dropped from the list if an approved TMDL is on file for the water and parameter listed.

Management strategies have been developed for a number of impaired waters. These waters remain on the list unless updated use support information indicated the water met its uses. In some cases, DWQ is confident that the management strategy will restore water quality, but it may take time to restore the water. For these waters, DWQ does not propose to do further modeling on the water, but the water will continue to be monitored to determine when it meets its uses. This approach is addressed further in the prioritization section of the document. A summary of waters that were removed from the 1996 303(d) list follows:

- The following waters are currently supporting their uses based on the latest techniques: Fall Creek, Green River, Little Hungry River, Pulliam Creek, Camp Creek, Cove Creek, Rixhaven Creek, Little Cove Creek, Hungry River, and North Pacolet River.
- The UT to Whiteoak Creek was not found in the 1997 use support information, but available data on Whiteoak Creek indicate the water meets its uses. The tributary was, therefore, dropped from the 303(d) list.
- Lick Branch was listed as two segments in previous 303(d) lists. These segments have been combined into one longer segment on the 1998 listing.
- Brushy Creek was formerly listed as one segment, but for this list was split into two segments. The most upstream segment has data that indicate improvement and was removed from the list. The downstream segment is still rated partially supporting and remains on the list. However, the downstream portion of Brushy Creek will be resampled since this rating is based on data more than 5 years old.

Assigning Priority

North Carolina is required to prioritize its 303(d) list in order to direct resources to those waters in greatest need of management. The Clean Water Act states that the degree of impairment (use support rating) and the uses to be made of the water (stream classification) are to be considered when developing the prioritization. In addition, DWQ reviews the degree of public interest and the probability of success when developing its prioritization schemes. Waters harboring endangered species are also given additional priority. A method to assign ratings to freshwaters

that have recent data indicating impairment has been devised based on these criteria. A summary of the prioritization scheme is included in Figure 2.

The prioritization process results in ratings of **high, medium, and low**. Generally, waters rated with the highest priority are classified for water supply, rated not supporting, and harbor an endangered species. Waters receiving a High priority are important natural resources for the state of North Carolina and generally serve significant human and ecological uses. High priority waters will likely be addressed first within their basin cycles.

EPA recently issued guidance that suggested states should develop TMDLs and management strategies on all of their impaired waters within the next eight to thirteen years. To meet this federal guidance, the DWQ is striving to address all waters on the 1998 303(d) list that have a priority of high, medium, or low within the next 10 years. Numeric TMDLs, if proper technical conditions exist, and management strategies will be developed for these waters. The DWQ is currently reviewing its resource needs in order to meet this aggressive schedule.

Other priorities have also been assigned to waters. A **Monitor** priority indicates that the waterbody is listed based on (1) data older than 5 years, (2) biological monitoring and no problem pollutant has been identified, or (3) biological monitoring that occurred in waters where we now have evidence that the biological criteria should not have been applied. These waters will be resampled before a restorative approach may be developed because more information is required about the cause of impairment. Further information on the monitoring approaches that have a Monitor priority is provided in the next section.

The final priority listed on the 303(d) list is **N/A** for not applicable. This priority was assigned to waters that DWQ believes will meet their uses based on the current management strategies. DWQ will not develop a new TMDL or management strategy for these waters unless data continue to indicate impairment and sufficient time has passed for the waterbody to respond to the management action. An example of this priority is a water impaired by a point source, and the pollutant causing the impairment has been completely removed from the point source.

Approaches to Restore Water Quality

EPA informed North Carolina at a TMDL workshop in January, that TMDLs must now be total, maximum, daily, and loads in order to be approved. Such a narrow definition of a TMDL severely limits states' abilities to develop numeric TMDLs. Given this narrow definition of a TMDL, North Carolina believes that TMDLs cannot be developed for waters impaired by sediment, turbidity, fecal coliform, and pH.

FIGURE 2. PRIORITY RANKING FOR FRESHWATERS

Each of the waters on the 303(d) list were ranked in order to prioritize DWQ's resources. The ranking is based on the classification, use support rating, presence of endangered species, degree of public interest, and the probability of success. This ranking can be represented by

Rank = Σ (classification, use support rating, endangered species, public interest, probability of success)

Where the following numeric rankings were applied to the various categories:

Classification:
- Water supply waters (WS-1, II, III, IV) = 2
- B = 1
- C = 0
- Supplemental classifications = +1
  - Tr (Trout fishing waters)
  - NSW (Nutrient sensitive waters)
  - HQW (High quality waters)
  - ORW (Outstanding resource waters)

Use Support Rating:
- NS = 1
- PS = 0

Endangered Species present:
- Federally endangered = 2
- Other endangered or threatened = 1
- None present = 0

Public interest expressed on particular water body:
- Yes = 1
- No = 0

Probability of success (subjective criteria depending upon problem parameters, type of sources of problem parameters, availability of technical tools to calculate numeric loads, NPS/319 priorities, etc.):
- Yes = 1
- No = 0

The sum of the individual category ranking is used to determine the priority for the impaired water body. If the overall rank is between 6 and 8, the water is prioritized as high. If the overall rank is between 3 and 5, the water body is prioritized medium, and overall ranks of below 3 are prioritized as low. Each category has equal weight in the determination of the overall ranking. For example, for Little Buffalo Creek in the Cape Fear River Basin, the overall ranking and priority of medium were determined as follows:

Category	Value	Comments	Rank
Classification	WS-IV	No supp classifications	2
Use support rating	NS	None	1
Public interest	No	None	0
Endangered species	Yes, federal	Cape Fear Shiner in subbasin 11	2
Prob of success	Sediment impaired, no standard, NPS sources	None	0
Total			5

DWQ believes that TMDLs are only one tool that can be used to prioritize and direct resources for the restoration of impaired waters. There are other tools that can be used. In the management strategy approach included on the 303(d) list, the state can work to identify the causes and sources of impairment and implement strategies to reduce those sources so that water quality can ultimately be restored. As part of the management strategy approach, North Carolina may be able to develop numeric targets such as percentage reductions or other metrics that do not meet EPA's current definition of an approvable TMDL. However, DWQ would like to have adequate data and a defensible modeling approach to minimize challenges of the numeric goals which can exhaust our limited resources. DWQ is reviewing its options to address these impaired waters, and staff are currently working together to develop a process to encourage local watershed management plans. This process could include a combination of voluntary and mandatory control strategies. We anticipate that we will receive stakeholder input on the process in mid to late 1998 after it is presented to and approved by the Department's administration. DWQ has confidence that this approach will be successful in restoring impaired waters. Management strategies developed with strong stakeholder input have been shown throughout the nation to be effective in restoring water quality.

For both the numeric TMDL approach and management strategies that include alternative numeric targets, DWQ needs to ensure that defensible targets are developed. In order to have technically defensible numeric targets, the proper technical conditions are needed. EPA's guidance published in the December 28, 1978 Federal Register defined proper technical conditions as having the analytical methods, modeling techniques, and database necessary to develop a technically defensible TMDL.

North Carolina and EPA are currently reviewing methods to develop numeric targets for fecal coliform and sediment. As better models and data become available, North Carolina will review its approach column to include more TMDLs if EPA revises its current definition of a TMDL. In the interim, DWQ will develop other numeric goals when data are available to support them.

The 303(d) list contains information on whether the Division plans to pursue a numeric **TMDL** as currently defined by EPA or whether it will pursue a management strategy (**MS**). Some waters must have more data collected on them to determine the causes and sources of pollution before a management strategy or TMDL can be devised. These include the waters that are biologically impaired waters where no problem parameter has been identified or waters listed based on data older than five years.

It will be difficult to develop TMDLs or management strategies on waters where we have no problem pollutant identified even if the data were collected recently. DWQ proposes to collect more biological and chemical data to determine the causes and sources of the impairment for waters included on the list based on recent biological data. The approach for these waters is problem parameter identification or **PPI**. Monitor appears in the Priority column, corresponding to PPI in the approach column. DWQ will develop TMDLs or management strategies for these waters within two basin planning cycles from when data indicating causes and sources of impairment are available. We will collect this information on as many waters as resources allow during the next basin planning cycle. DWQ is beginning to collect this information in the Cape

Fear Basin this summer. We should have more information on our ability to identify the causes and sources of biological impairment these waters later this year.

Waters that are listed based on data older than 5 years may in fact be meeting their uses. Since many changes can occur within a watershed in a five-year period, conclusive information about a waterbed's use support cannot be made with older data. North Carolina will resample as many of these waters that have only historical data as staffing and time permit for subsequent updates of the basin plans and 303(d) list. Waters listed based on older information are indicated by a **RES** in the Approach column of the lists to denote that they will be resampled.

A TMDL or management strategy will not be developed for waters listed based on old data or an inappropriate use of biological criteria until we have updated sampling information that indicates the water is impaired. This process will ensure that DWQ has sufficient current information to determine if the impairment exists and to help identify the source of the impairment. This will enable DWQ to focus its limited resources on watersheds that are in greatest need of management.

If guidance is issued in the future which indicates that mandatory controls are to be placed on point or nonpoint sources on the basis that it is included on a state's 303(d) list, these controls should not be applied to waters listed based on older information or biological criteria that are not applicable to the water. Mandatory controls applied to these waters simply on the basis of being included on the 303(d) list could result in high costs to the regulated community with little or no environmental benefit.

Targeted Waters for TMDL Initiation by April 2000

North Carolina's focus for the next ten years is to develop strategies to restore impaired waters with a high, medium or low priority to their intended uses. Therefore, DWQ will spend significant resources deciding the best approaches and strategies for restoring waters. Some waters are impaired due to problem parameters that are not necessarily conducive to a TMDL. In these cases, DWQ believes that resources are better utilized by developing a management strategy instead of attempting to develop a technically defensible TMDL

Additional Guidance on Using the 303(d) List

The column headings in the 303(d) list refer to the following:

Class - The information in this column indicates the classification assigned to the particular waterbody. Stream classifications are based on the existing and anticipated best usage of the stream as determined through studies and information obtained at public hearings. The stream classifications are described in 15 A NCAC 2B .0300, and are summarized in Appendix I.

Wtrbdy - The number in this column refers to the DWQ subbasin in which the waterbody is located. The NRCS 14 digit hydrologic units nest within the DWQ subbasins. On the lakes tables, this column is entitled subbasin.

Problem Parameter - These are the causes of impairment as identified in the 305(b) report. Where no cause is listed, the rating was based on biological data, and available chemical data showed no impairment. These biological data may include benthic and fish habitat and community structure. When a problem parameter is identified, the parameter listed exceeded the state's water quality standards for that substance or was identified by scientific personnel during field studies (e.g., sediment). This parameter is a potential cause of the impairment, but there may be other, unidentified causes contributing to the impairment as well. Problem parameters included in the 303(d) list are outlined below:

Chla – chlorophyll-a
Cl – chlorine
Cu – copper
DO – dissolved oxygen
Fecal – fecal coliform bacteria
Hg – mercury
NH3 – ammonia
Nutr – nutrients
Pb – lead
pH – pH
Sed – habitat impairment due to sediment
Tox – toxicity
Turb – turbidity
Aq. Weeds – aquatic weeds

Rating - This column lists the overall use support rating. These values may be NS (not supporting), PS (partially supporting), and NE (not evaluated). A rating of not evaluated is typically assigned to waters that were sampled using biocriteria that may not apply or there is no data available on the water. These waters appeared on earlier lists, and they continue to be listed, but no TMDL or management strategy will be developed until we have updated information that the water continues to be impaired. For waters listed solely on the basis of fish consumption advisories, the rating may also be supporting (S) or supporting but threatened (ST). The 305(b) report describes these use support ratings further. On the lake tables, the overall use support rating is found in the column entitled "Overall use". Ratings for specific uses are found in the columns entitled "Fish Consump", "Aq. Life and Secondary Impact", "Swimming", and "Drinking Water". However, all lakes in the Broad River basin are rated as supporting their uses, so a lakes table is not included in this appendix.

Major Sources (P,NP) - This column indicates whether point (P) or nonpoint (NP) sources are the probable major sources of impairment.

Subcategory - This column breaks the probable point and nonpoint sources down further. A list describing what each number means is provided in Table 1.

TABLE 1. SOURCE SUBCATEGORIES		
Category	***Subcategory***	***Description***
0		Point Sources
	01	Industrial
	02	Municipal
	03	Municipal pretreatment (indirect dischargers)
	04	Combined sewer overflows (end-of-pipe control)
	05	Storm sewers (end-of-pipe control)
	06	Schools
	08	Minor non-municipal
1		Nonpoint sources
10		Agriculture
	11	Non-irrigated crop production
	12	Irrigated crop production
	13	Specialty crop production (e.g., truck farming and orchard)
	14	Pasture land
	15	Range lots
	16	Feedlots – all types
	17	Aquaculture
	18	Animal holding/management areas
20		Silviculture
	21	Harvesting, reforestation, residue management
	22	Forest management
	23	Road construction/maintenance
30		Construction
	31	Highway/road/bridge
	32	Land development
40		Urban Runoff
	41	Storm sewers (source control)
	42	Combined sewers (source control)
	43	Surface runoff
	44	Finger canals
	45	Industrial
50		Resource Extraction/Exploration/Development
	51	Surface mining
	52	Subsurface mining
	53	Placer mining
	54	Dredge mining
	55	Petroleum activities

TABLE 1. SOURCE SUBCATEGORIES		
Category	***Subcategory***	***Description***
	56	Mill tailings
	57	Mine tailings
	58	Abandoned mines
60		Land Disposal (Runoff/Leachate from permitted areas)
	61	Sludge
	62	Wastewater
	63	Landfills
	64	Industrial land treatment
	65	On-site wastewater systems (septic tanks, etc.)
	66	Hazardous waste
70		Hydrologic/Habitat Modification
	71	Channelization
	72	Dredging, sand dipping
	73	Dam construction
	74	Flow regulation
	75	Bridge construction
	76	Removal of riparian vegetation
	77	Streambank modification/destabilization
	78	Collapsed dam
80		Other
	81	Atmospheric deposition
	82	Waste storage/storage tank leaks
	83	Highway maintenance and runoff
	84	Spills
	85	In-place contaminants
	86	Natural
	87	Marinas, harbors
	88	Airport
	89	Military activities (off-road)
90		Source Unknown
	91	General erosion (road erosion)

Approach – This column indicates the approach DWQ will take to restore the waterbody. If more than one approach is listed, one is a TMDL. TMDLs are typically developed for DO, nutrients, ammonia, and metals. Management strategies are typically done for pH, sediment, turbidity, and fecal coliform. Further information on each approach is provided below.

TMDL – A numeric TMDL as currently defined by EPA will be developed (e.g. is total, maximum, daily, load).

MS – Management Strategy – These waters are on the list based on data collected within the five years prior to when the use support assessment was completed. A problem pollutant has been identified, but North Carolina cannot develop a numeric TMDL as EPA currently defines it. A management strategy may contain the following elements: further characterization of the causes and sources of impairment, numeric water quality goals other than TMDLs, and best management practices to restore the water.

RES – This waterbody was identified as being impaired based on water quality data that were greater than 5 years old at the time the use support assessment was performed. This waterbody will be resampled prior to TMDL or management strategy development to ensure the impairment continues to exist. This will enable the Division to focus its limited resources on watersheds that are in greatest need of management.

PPI – Problem Parameters Identification - Available chemical data do not show any parameters in violation of the standard, but biological impairment have been noted within the five years prior to use support assessment. DWQ will resample these waters for chemical and biological data to attempt to determine the potential problem pollutants. TMDLs or management strategies will be developed within 2 basin cycles of problem parameter identification.

Priority – Priorities of high, medium and low were assigned for waters identified as being impaired based on data that were not greater than 5 years of age at the time the use support assessment was done and for which a problem pollutant has been identified. All waters assigned a priority of high, medium, or low will be addressed within the next two basin cycles. The basis of these priorities is further explained in Appendix II. Priorities of monitor and N/A have also been assigned. Further explanation on each of these is provided below:

High – Waters rated High are important resources for the state of North Carolina in terms of human and ecological uses. Typically they are classified as water supplies, harbor federally endangered species, and are rated as not supporting. These waters will be addressed first within their basin cycles.

Medium – Waters rated Medium may be classified for water supply or primary recreational use, may have state endangered or other threatened species, and may be rated as partially or not supporting.

Low – Waters rated Low generally are classified for aquatic life support and secondary recreation (i.e., Class C waters), and harbor no endangered or threatened species.

Monitor – The waterbody is included on the 303(d) list based on: (1) data that are greater than 5 years of age when use support assessment done (denoted by RES in approach column) or (2) biological data collected within 5 years of use support assessment but no problem pollutant has been identified (available chemical data show full use support – denoted by PPI in approach column), and (3) freshwater biological criteria applied to swamp waters. In general, waters given this priority based on recent biological data will be sampled prior to waters listed based on older information and are therefore higher priority than waters listed based on older information or swamp waters. All waters with this priority will be resampled as resources allow. Waters with this priority will not have management strategy or TMDL developed for it before updated sampling or analyses of the biological criteria are done which indicates that the water continues to be impaired and a problem pollutant has been identified. Once updated sampling is done and problem pollutants have been identified, these waters will be addressed by either a management strategy or TMDL within two basin planning cycles (10 years). This approach will enable DWQ to focus its limited resources on watersheds that are in greatest need of management.

N/A – DWQ believes that its current management strategy will address the water quality impairment, but it may take a number of years before standards are met. In this case, DWQ plans to continue monitoring the water to determine if improvements are occurring, but no new management strategy or TMDL will be developed unless sufficient time has passed for improvement to occur, and data indicate the water is still impaired.

The lakes column entitled "Troph Status" refers to the trophic status of the lake, a relative description of the biological productivity of the lake. The lake may be hypereutrophic, eutrophic, mesotrophic, or oligotrophic. Oligotrophic lakes are nutrient poor and biologically unproductive, mesotrophic lakes have intermediate nutrient availability and biological productivity, eutrophic lakes are nutrient rich and highly productive, and hypereutrophic lakes are extremely eutrophic. As previously stated, all lakes in the Broad River Basin are supporting their uses, thus a lakes table does not appear in this appendix.

1998 303(d) LIST FOR THE BROAD RIVER BASIN											
Name of Stream	Description	Class	Index #	Miles	Wtrbdy	Problem Parameter(s)	Overall Rating	Major Sources (P,NP)	Subcategory	Approach	Priority
Walnut Creek	From source to Green River	C	9-29-44	8.3	30802	Sed	PS	NP	10	MS	Low
Catheys Creek	From dam at old Duke Power Co.'s Raw	C	9-41-13-(6)	3.8	30802	Sed	PS	NP,P	03,10	MS	Low
Hollands Creek	From Duke Power Co. Aux Raw	C	9-41-13-7-(3)	2.5	30802		NS	P	03	RES	Monitor
Buffalo Creek	Dam at Kings Mtn Res to US 74	C	9-53-(5)a	1.6	30801		PS	NP	10,30,60	RES	Monitor
Brushy Creek	From SR 1323 Cleveland Co to First Broa	C	9-50-29b	8.4	30804		PS	NP	11	RES	Monitor
Beaverdam Creek	From source to First Broad River	C	9-50-32	10.9	30804		PS	NP,P	10,30	PPI	Monitor
Lick Branch	From source to Buffalo Cr	C	9-53-11	3.2	30805	Sed	PS	NP,P	10,01	MS	Low

Definitions for approach:

TMDL - Proper technical conditions exist to develop a TMDL for this water body/pollutant. Usual approach for nutrients, DO, and all metals.

MS - A management strategy will be developed for this water body/pollutant. Usual approach for sediment, fecal, pH, and turbidity.

RES -Resample. Water body remains on the 303(d) list even though data are more than five years old. Waters will be resampled to obtain updated use support information.

PPI - Problem Parameter Identification. Biologically impaired waters will be resampled for biological and chemical data to attempt to determine potential problem parameters.

SWMP - Swamp Waters. Swamp waters previously evaluated using freshwater criteria will continue to be monitored and will be re-evaluated when swamp criteria are available.

APPENDIX VIII

Glossary

7Q10- a value which represents the lowest average flow for a seven day period that will recur on a ten year frequency. This value is applicable at any point on a stream. 7Q10 flow (in cfs) is used to allocate the discharge of toxic substances to streams.

AGPT-Algal Growth Potential Test.

AMS-Ambient Monitoring System.

BI(BIEPT)-Biotic Index, Biotic Index for EPT groups. A summary measure of the tolerance values of organisms found in the sample, relative to their abundance. Sometimes noted as the NCBI or NCBIEPT.

Bioclass-Criteria have been developed to assign bioclassifications ranging from Poor to Excellent to each benthic sample based on the number of taxa present in the intolerant groups (EPT) and the Biotic Index value.

BMAN-Biological Monitoring Ambient Network.

BODlt-Biochemical Oxygen Demand, long term.

cfs-Cubic feet per second, generally the unit in which stream flow is measured.

CHLA-Chlorophyll A.

ChV-Chronic Value. Of a toxicity test, defined as the geometric mean of the Lowest Observed Effect Concentration and the No Observed Effect Concentration.

DEM-Division of Environmental Management (became the Division of Water Quality on July 1, 1996)

D.O.-Dissolved Oxygen.

Ecoregion: An area of relatively homogeneous environmental conditions, usually defined by elevation, geology, and soil type. Examples include mountains, piedmont, coastal plain, sandhills and slate belt.

EHNR-N.C. Dept. of Environment, Health, and Natural Resources.

EPT-The insect orders Ephemeroptera, Plecoptera, Trichoptera)-as a whole the most intolerant insects present in the benthic community

EPT N- The abundance of Ephemeroptera, Plecoptera, Trichoptera insects present, using values of 1 for Rare, 3 for Common and 10 for Abundant.

EPT S-Taxa richness of the insect orders Ephemeroptera, Plecoptera and Trichoptera. Higher taxa richness values are associated with better water quality.

HQW-High Quality Waters

IWC- Instream Waste Concentration. The percentage of a stream comprised of an effluent calculated using permitted flow of the effluent and 7Q10 of the receiving stream.

JOC-Judicial Order by Consent- An administrative order issued by an administrative law judge which in some way modifies limitations of an NPDES permit by consent of both parties which provides interim limitations and conditions.

LC50- The concentration of a toxicant or percentage dilution of an effluent that is predicted to be lethal to 50% of a test population of organisms.

LOEC-In a toxicity test, the Lowest Observed Effect Concentration.

MGD-Million Gallons per Day, generally the unit in which effluent discharge flow is measured.

MSD-Metropolitan Sewerage District.

NPDES-National Pollutant Discharge Elimination System.

NCIBI-North Carolina Index of Biotic Integrity-a summary measure of the effects of factors influencing the fish community

NCTSI-North Carolina Trophic State Index.

NOEC-In a toxicity test, the No Observed Effect Concentration.

NSW-Nutrient Sensitive Waters.

NTU-Nephelometric Turbidity Unit.

ORW-Outstanding Resource Water.

Parameter-Independent measure of water quality. For example: Dissolved Oxygen, Turbidity are 2 parameters.

Parametric Coverage-A listing of parameters measured and reported.

PF-Permitted flow, of an NPDES permit.
POTW-Publicly Owned Treatment Works.
Secchi- a standard measure of water transparency as determined by lowering of a black and white Secchi disk to the depth that the disk is no longer visible.
Total S-the number of different taxa present in a benthic macroinvertebrate sample
WTP-Water treatment plant
WWTP-Wastewater treatment plant