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

4.1 Overview

The 1997 Chowan River Basinwide Water Quality Management Plan included several recommendations to address water quality issues in the basin. Most of these recommendations were for specific stream segments and are discussed separately in the individual subbasin chapters in Section B. This chapter discusses water quality issues that relate to the entire Chowan River basin. Habitat degradation, including channelization and loss of riparian vegetation, is the main water quality issue in the basin.

4.2 Biological Monitoring Issues

DWQ strives to properly evaluate the health of biological communities throughout the state. Swamp stream systems, nonwadeable waters and coldwater fisheries have presented unique challenges. This section discusses some of these challenges. Refer to Appendix III for further information.

4.2.1 Draft Criteria for Assessing Benthic Macroinvertebrates in Swamp Streams

Extensive evaluation, conducted by DWQ, of swamp streams across eastern North Carolina suggests that different criteria must be used to assess the condition of water quality in these systems. Swamp streams are characterized by seasonally interrupted flows, lower dissolved oxygen and sometimes, lower pH. Sometimes they also have very complex braided channels and dark-colored water. Since 1995, benthic swamp sampling methods have been used at over 100 sites in the coastal plain of North Carolina, including more than 20 reference sites. In 2000, seven sites on swamp streams in the Chowan River basin were sampled by DWQ. Preliminary investigations indicate that there are at least five unique swamp ecoregions in the NC coastal plain, and each of these may require different biocriteria. The lowest "natural" diversity has been found in low-gradient streams (especially in the outer coastal plain) and in areas with poorly drained soils.

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

changes in a particular stream between dates or to evaluate effects of different land uses on water quality within a relatively uniform ecoregion.

4.2.2 Draft Criteria for Assessing Fish Communities

In the past, fish communities in some streams were sampled by DWQ, and scores were assigned using the North Carolina Index of Biotic Integrity (NCIBI). The NCIBI uses a cumulative assessment of twelve parameters or metrics. Each metric is designed to contribute unique information to the overall assessment. The scores for all metrics are then summed to obtain the overall NCIBI score.

However, during the late 1990s, application of the NCIBI was restricted to wadeable streams that can be sampled by a crew of 2-4 persons using backpack electrofishers and following the DWQ Standard Operating Procedures (NCDEHNR, 1997). Work began in 1998 to develop a fish community boat sampling method that could be used in nonwadeable coastal plain streams. Plans are to sample 10-15 reference sites with the boat method once it is finalized. As with the benthic in swamp streams, several years of reference site data will be needed before criteria can be developed with confidence to evaluate the biological integrity of large streams and rivers using the fish community.

4.3 Fish Consumption Advisories

The NC Department of Health and Human Services (NCDHHS) has developed guidelines to advise people to what fish are safe to eat. DWQ considers uses of waters with a consumption advisory for one or more species of fish to be impaired. Elevated methylmercury levels have been found in shark, swordfish, king mackerel, tilefish, largemouth bass, bowfin (or blackfish), and chain pickerel (or jack). As of April 2002, these fish are under an advisory.

4.3.1 Mercury Related Fish Consumption Advisories

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

The NC Department of Health and Human Services issues fish consumption advisories for those fish species which have median and/or average methylmercury levels at 0.4 mg/kg or greater. These fish include shark, swordfish, king mackerel, tilefish as well as largemouth bass, bowfin (or blackfish) and chain pickerel (or jack) caught in North Carolina waters south and east of Interstate 85. As a result of these advisories, DWQ considers all waters in the Chowan River

basin to be partially supporting the fish consumption use support category. Refer to Appendix III for more information regarding use support ratings and assessment methodology.

DWQ has sampled fish tissue from a variety of species at one location in the Chowan River basin. Fish samples were collected on the Chowan River near Gatesville during August 2000. The survey was conducted to obtain baseline metals data prior to operation of the Nucor steel mill near Tunis (Hertford County). Metals concentrations, except mercury, were non-detectable or at levels below current USEPA, USFDA and North Carolina criteria.

Specific Fish Consumption Advisories

Fish is an excellent source of protein and other nutrients. However, several varieties of saltwater and NC freshwater fish may contain high levels of mercury, which may pose a risk to human health. These guidelines will help you make healthy food choices.

Women of Childbearing Age (15-44 years), Pregnant Women, Nursing Women and Children under 15:

- **Do not eat** shark, swordfish, tilefish or king mackerel; or blackfish (bowfin), largemouth bass or jack fish (chain pickerel) caught in North Carolina waters south and east of Interstate 85. These fish are all high in mercury.
- **Eat up to two meals* per week of other fish.**

Other Women, Men and Children 15 years and older:

- **Eat no more than one meal* per week** of shark, swordfish, tilefish or king mackerel; or blackfish (bowfin), largemouth bass or jack fish (chain pickerel) caught in North Carolina waters south and east of Interstate 85. These fish are all high in mercury.
- **Eat up to four meals* per week of other fish.**

* A "meal" is 6 ounces of cooked fish for adults and children 15 years and older, and 2 ounces of cooked fish for younger children.

4.3.2 Dioxin Related Fish Consumption Advisories

Dioxin contamination is found worldwide, including a portion of the Albemarle Sound westward of Bull Bay and Harvey Point to the Roanoke River. Dioxin is typically generated through high temperature combustion processes, chemical bleaching of pulp, and through the production of chlorinated phenols and their derivatives. Dioxins can bioaccumulate in animal tissues, creating human health concerns such as reproductive impairment, carcinogencity and even death. Dioxin binds tightly with sediment, food particles and organic matter in the water column, thus, leaving only low concentrations dissolved in the water column.

Due to dioxin's bioaccumulation properties, the Department of Health and Human Services (NCDHHS) recommends that in fish advisory areas fish consumption should be limited to two meals per person per month. Children and pregnant or nursing women should not consume any

fish from the Albemarle Sound. Consumption of herring, shellfish and shad (including roe) is not considered a health risk.

Chowan River: The Chowan River from the Virginia border to Albemarle Sound was placed under a fish consumption advisory in 1990 for all species except herring and shad due to dioxin contamination from International Paper, formerly known as Union Camp, in Franklin, Virginia. Yearly monitoring by International Paper in North Carolina indicated that dioxin levels gradually decreased in fish from the Chowan River and Meherrin River after new bleaching technologies were instituted in 1990 to improve effluent quality.

In March 1998, the advisory was partially lifted, leaving carp and catfish as the only two species still considered unsafe to eat. The advisory was completely lifted in early 2000 after dioxin levels from all stations and species remained below the recommended level for two consecutive years (1998 and 1999) (Williams, 2000). The sampling of catfish species by International Paper is scheduled to continue through the year 2001 to verify the reduction in dioxin concentrations.

Specific Fish Consumption Advisories

Albemarle Sound: Dioxin has prompted an advisory since March 2001 in the Albemarle Sound from Bull Bay to Harvey Point, west to the mouth of the Roanoke River and north to the mouth of the Chowan River at the US Highway 17 Bridge. During the 1980s, officials recognized that dioxin, a carcinogenic by-product of the chlorine bleaching process, was accumulating in fish tissue. Weyerhaeuser Company, located at the mouth of Welch Creek in the Roanoke River basin, previously discharged directly to the creek. In 1988, Weyerhaeuser made improvements and relocated the discharge to the Roanoke River. Weyerhaeuser is required by DWQ to provide extensive monitoring in the Roanoke River from Williamston down the Roanoke and out into the Albemarle Sound as far as Bull Bay. Data recently collected by Weyerhaeuser Company indicate a decline in dioxin concentrations. In October 2001, the advisory was partially lifted for game fish. However, an advisory remains in place for bottom-dwelling fish such as carp and catfish.

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

4.3.3 2002 Recommendations

DWQ, in cooperation with Weyerhaeuser Company, will continue to monitor for dioxin contamination and will work closely with the Department of Health and Human Service's Division of Public Health to lift the advisory when there is no longer a risk to human health from consumption of fish.

DWQ Mercury Workgroup

DWQ is committed to characterizing methylmercury exposure levels and determining if NPDES sources need to be controlled. DWQ formed an internal Mercury Workgroup to improve communication from all programs which directly affect mercury issues (i.e., Pretreatment, Environmental Sciences, Basinwide and Estuary Planning, etc.). The workgroup meets as

needed to share information and determine next steps in addressing mercury issues associated with the aquatic environment.

Improved Ambient Sampling Techniques

DWQ aims to stay abreast of new technology and sampling techniques to ensure that water quality data are accurate, precise and of highest value. In 2000, DWQ started training water quality sampling staff on the new EPA Method 1631 technique. Current monitoring using a higher detection limit (EPA Method 245.1) has consistently yielded non-detected values, and DWQ aims to use the 1631 method to allow detection levels three orders of magnitude lower than EPA Method 245.1.

Regional Mercury Study

In an effort to better manage state waters that may have methylmercury issues, DWQ initiated a study through EPA 104(b)(3) funds. The study aims to provide information that may be used in water quality standard and TMDL development. The study goals include:

- determining levels of ambient mercury in the surface water system;
- estimating site-specific total mercury: methylmercury translators to evaluate water quality criteria;
- develop site-specific water to fish bioaccumulation factors; and
- determine levels of mercury in treatment plant effluent.

DWQ aims to complete this study in 2003, and results will be available to the public. For more information, contact the DWQ Planning Branch Modeling/TMDL Supervisor at (919) 733-5083.

DWQ will continue to host an internal workgroup to stay abreast of current mercury issues. The public has voiced concerns that DWQ should be working on the ecological components and consequences of mercury bioavailability to biota in these areas and the biogeochemical cycling and production of methylmercury from associated wetlands along these streams. Though the workgroup does not have a mandate to conduct research into mercury, the workgroup will better communicate its purpose and accomplishments to the public through periodic updates on the DWQ website.

DWQ will also provide interested members of the public with an overview of the new ambient monitoring sampling technique to gather feedback and insights on how DWQ can best accomplish its data collecting goals.

DWQ will continue to monitor concentrations of various contaminants in fish tissue across the state and will work to identify and reduce wastewater contributions of mercury to surface waters. The Division of Air Quality (DAQ) evaluates mercury levels in rainwater on a regular basis through the EPA Mercury Deposition Network. EPA continues to focus on nationwide mercury reductions from stack emissions and through pollution prevention efforts. Pollution prevention efforts are being investigated on a state and federal level to reduce mercury emissions.

4.4 Growth and Development and Stormwater Management

4.4.1 Introduction

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

Larger waters are impacted from the cumulative effect of freshwater runoff transporting bacteria and other contaminants farther out into the estuary. Urban runoff carries a wide variety of contaminants to streams including oil and grease from roads and parking lots, street litter, bacterial contaminates and pollutants from the atmosphere. Generally, there are a larger number of point source discharges in urban areas. Cumulative impacts from habitat alterations, point and nonpoint source pollution can cause severe impairment to urban streams. Runoff increases with increasing development (impervious surfaces). Research over the past 15 years consistently demonstrates a strong correlation between the imperviousness of a drainage basin and the health of its receiving waters (Arnold and Gibbons, 1996). Mallin et al. (2000) showed that with increasing impervious surfaces there is an increase in fecal coliform delivery to estuarine waters. Restoration strategies that address the source and transport of contaminants are more appropriate than developing complicated models, because of the complex hydrology of coastal waters and the life-cycle of fecal coliform bacteria.

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

Projected population growth over the next twenty years (2000-2020) for the Chowan River basin varies among subbasins (Table A-9). Winton is currently the fastest growing municipality in the basin with an increase in population of 20 percent from 1990 to 2000. Population in Edenton, Jackson, Severn and Woodland increased over the same 10-year period. However, the majority of municipalities in the basin experienced a net decrease in their population. As populations flux, so do developed areas. Some local governments in the Chowan River basin have prioritized water quality planning; however, proactive planning efforts at the local level are needed across the entire basin in order to assure that development is done in a manner that minimizes impacts to water quality. A lack of good environmental planning was identified by participants at the public workshops as a threat to water quality in the Chowan River basin.

4.4.2 Recommendations for Addressing Growth, Development and Stormwater Impacts

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

Land Use Planning Efforts

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

Planning Recommendations for New Development

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

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

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

The new coastal land use planning guidelines under consideration by the CRC stress the importance of healthy water. From the requirements of the pre-planning scoping process to the elements of local plans, the new guidelines will ask local governments to do more to protect water quality. One of the goals of the proposed guidelines is to maintain, protect and, where possible, enhance water quality in all coastal wetlands, rivers, streams and estuaries. That effort begins at the local level. The guidelines will require local governments to adopt policies to ensure that coastal water quality is improved or maintained. Chief among these policies are

those that prevent or control stormwater discharges as it is a leading cause of water quality problems along the coast. Local policies, such as impervious surface limits, vegetated riparian buffer creation and wetlands protection, can help lessen the negative impacts of stormwater runoff on coastal waters. The guidelines also will require local governments to develop policies and land use categories that protect open shellfish waters and restore closed or conditionally approved shellfish waters. The Coastal Resources Commission anticipates the revision and adoption of new land use planning rules to go into effect by August 2002.

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

- Development of a "how to" manual to assist local governments in developing high quality land use plans.
- Involvement of coastal local governments in state basinwide planning and seeking application of a land use planning requirement in all areas of coastal river basins are strongly encouraged.
- Strengthen the ties between basinwide planning for water quality and CAMA land use plans, especially focusing on participation in basinwide planning. The team also recommends that the CRC coordinate with the Environmental Management Commission to expand the role of local government and local land use plans in the basinwide water quality planning process. Three specific steps are recommended:
    - ► The database and strategies contained in the basinwide plans should be loosely tailored to the requirements for land use plans.
    - ► The EMC should incorporate local land use policies in basinwide plans.
    - ► Local governments should be encouraged by the CRC to participate in the scoping process for basinwide plans.
- Measures to encourage greater intergovernmental coordination in the development of land use plans.

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

For more information on the CAMA land use process, contact a DCM land use planner at (252) 808-2808 or visit the program on-line at http://dcm2.enr.state.us/.

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

Developing Coastal Habitat Protection Plans

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

North Carolina Coastal Nonpoint Source Program (Section 6217)

Section 6217 of the Federal 1990 Coastal Zone Act Reauthorization Amendments (CZARA) requires every state participating in the Coastal Zone Management Act program to develop a Coastal Nonpoint Pollution Control Program (CNPCP). The purpose of this requirement, as stated in the Act, is to "strengthen the links between federal and state coastal zone management and water quality management programs and to enhance state and local efforts to manage land use activities that degrade coastal waters and coastal habitats." To accomplish these goals, the federal agencies established 56 Management Measures that are to be used by each state to address the following nonpoint source pollution categories:

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

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

The core of the state's CNPSP will be increased through communication and coordination between DWQ and key state agencies that have regulatory responsibilities for controlling nonpoint sources of pollution. This increased dialogue will be facilitated in part by the state's CNPSP Coordinator and will allow for identification of gaps, duplications, inadequacies or inefficiency of existing programs and policies. Responsibilities of the state program coordinator will include participation in the NPS Workgroup to represent coastal water quality interests. The workgroup is involved with the continual refinement of the 319 Grant Program and development of North Carolina's 2001 NPS Management Program Update. The CNPSP Coordinator will also participate in the development and implementation of the basinwide management plans for the

coastal draining rivers; serve as a liaison between DWQ and DCM; and participate in the development of nonpoint source educational materials. For more information about this program, contact the Coastal Nonpoint Source Program Coordinator at (919) 733-5083 or visit http://h2o.enr.state.nc.us/nps/czara.htm.

Implementation of Coastal Resources Commission 30-Foot Buffer Rules

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

Stormwater Programs

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

DWQ administers a number of programs aimed at controlling stormwater runoff in the Chowan River basin. These include: 1) in the "coastal" counties as defined by the Coastal Area Management Act (CAMA); 2) NPDES stormwater permit requirements for industrial activities and municipalities; and 3) NPDES stormwater permit requirements for construction or land development activities on one acre of land or more. For more detailed information on current and proposed stormwater rules, refer to Section 2.7.

Recommendations for Local Governments, Community Groups and Chowan River Basin Citizens to Address Impacts

Because of limited resources and authority, the various state agencies listed above cannot completely address impacts to surface waters. Local governments, community groups and citizens often have more local knowledge and are directly affected by degraded water quality, and therefore, have a responsibility for protecting and restoring waters.

Local Governments

Local governments should consider water quality impacts in all aspects of government operations. Land use planning should discourage development in wetlands and areas draining to sensitive coastal areas. Land use plans should incorporate preservation and limited development of land adjacent to waters. Best management practices should be implemented during all land-disturbing activities to reduce runoff and delivery of contaminants to waters. Local governments should work together and with the NCDENR agencies to develop strategies for reducing sources and delivery of contaminants to waters.

Community Groups

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

Marina Operators

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

4.5 Effects of Hurricanes on Water Quality

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

In September 1999, Hurricane Floyd made landfall in North Carolina, only a few days after Hurricane/Tropical Storm Dennis made two passes across the eastern part of the state. Flooding in eastern North Carolina was higher and more extensive than any ever recorded. Many towns and homes were completely flooded, bridges and buildings were washed downstream, animal waste lagoons breached, and wastewater treatment plants were inundated. Floyd resulted in more fatalities than any hurricane since 1972 and thousands were left homeless (Bales, 2000). In terms of water quality impacts, DWQ scientists note that the Pasquotank River basin did not experience hurricane-related fish kills in recent years as compared with the more southern areas such as the Neuse River and Cape Fear River basins (NCDENR-DWQ, 1999).

4.5.1 Contaminants

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

4.5.2 De-Snagging

The Natural Resources Conservation Services' (NRCS) Emergency Watershed Protection (EWP) is responsible for emergency de-snagging (removal of piles of woody debris from stream and river channels) activities. The EWP program is intended to respond to watersheds impacted by natural disasters such as hurricanes, floods and fire. The purpose of the program is to restore watershed functions to predisaster conditions. Areas selected for debris removal are based on the amount and location of debris and the increased risk of flooding to improved property (including cropland), or public safety (primarily roads and bridges). Location maps and a description of all proposed work are sent to appropriate federal and state agencies for review and comment prior to contracting the work. The program's intent is to consider environmental concerns.

The activity of debris removal is of great interest to DWQ as the excessive removal of debris can impact the aquatic habitat and aquatic life within a stream reach. The decision to remove debris is made by considering topography, proximity of improved property subject to damage, location of culverts, bridges and other restrictions, comparison of costs and benefits, and potential environmental impacts. NRCS, along with other state and federal agencies, is in the process of developing guidelines for debris removal that will improve the decision-making process with regard to eligibility and damage thresholds, as well as improving the standards and specifications for removing woody debris in a manner that leaves enough to provide suitable habitat. Debris removal under EWP is not intended to remove all debris from stream channels, only that which causes or may cause an increased risk of flooding or streambank erosion.

Woody debris is the predominant habitat for benthic macroinvertebrates in larger, slower-moving coastal stream and wetland systems. Therefore, removal of these snags removes the habitat available for aquatic life. If care is not taken in properly removing woody debris, the streambanks and streambed can be altered as well as causing moderate to severe habitat degradation.

4.5.3 2002 Recommendations

DWQ is aware of the need to remove obstructions to water flow, including snags, near bridges or other structures in emergency situations because of safety concerns, to reduce economic loss in the event of natural disasters, and to reduce the risk of flooding. NRCS has recently adopted an Interagency Coordination and Implementation Plan for the EWP program that allows for a direct and ongoing role for several agencies to play in the implementation process. The method in which snags are removed, the amount of debris that is removed, and the sites selected should all be chosen following a thorough review by the various agencies responsible for the implementation of the EWP program. Local governments that receive additional funding for this type of activity should also implement the same management strategies as outlined in the EWP implementation plan to reduce impacts to water quality, aquatic habitat and aquatic life.

4.6 Wetland Loss

4.6.1 Introduction

Wetlands provide a variety of benefits to society and are very important in watershed planning because of the functions they perform. Wetlands provide important protection for flood prevention to protect property values; streambank stabilization to prevent erosion and downstream sedimentation; water purification and pollutant removal (especially for nitrogen and phosphorus); habitat for aquatic life and wildlife and endangered species protection. These values vary greatly with wetland type. Wetlands adjacent to intermittent and permanent streams are most important to protecting water quality in those streams, as well as downstream lakes and estuaries. However, wetlands located away from streams also have important water storage capacity and pollutant removal potential. Section A, Part 2.6 contains more specific information on the ecological significance of wetlands in the Chowan River basin.

4.6.2 Physical Impacts to Wetlands and Streams

DWQ has issued approvals for wetland filling activities since the mid-1980s; however, in 1989, the Environmental Management Commission directed DWQ to begin reviewing wetland fill and stream alteration activities using a review sequence of (1) avoidance, (2) minimization, and (3) mitigation of wetland impacts. Rules finalized in 1996 required wetland values, such as whether or not the wetland is providing significant uses or whether the filling activity would remove or degrade those uses, be considered. The rules also specify wetland and stream mitigation ratios and type and location of projects to make the mitigation process more predictable and manageable for the regulated community. DWQ's emphasis continues to be on water quality and the essential role that wetlands play in maintaining water quality. The issuance of a 401 Water Quality Certification by DWQ is required before the US Army Corps of Engineers can issue a Section 404 Permit authorizing the fill or alteration of wetlands and/or streams in North Carolina.

Despite efforts to protect and restore wetland and stream functions on the part of DWQ and many other agencies and organizations in North Carolina, there is still an annual net loss of wetlands and streams statewide. DWQ and Division of Land Resources (DLR) regulate construction activities near streams and wetlands. These regulatory programs ensure that construction projects cause minimal damage to these resources and that unavoidable impacts are addressed through mitigation projects. Restoration projects are also funded through the Wetland Restoration Program (WRP), Section 319 Program, Clean Water Management Trust Fund, and Division of Water Resources Grant Program that can help offset stream and wetland impacts (NCDENR-DWQ-WRP, 1998).

DWQ tracks wetland and stream losses that are authorized through the issuance of a 401 Water Quality Certification. In addition to the permitted wetland and stream impacts that are tracked by DWQ, an unknown amount of permanent wetland and stream losses also occurs. Projects that affect less than one-third of an acre of wetland or less than 150 linear feet of stream are not required to receive written confirmation from DWQ, and therefore, might not be reported. The magnitude of unauthorized impacts to wetlands and streams is not known.

In June 1998, a federal court declared that the US Army Corps of Engineers' Tulloch Rule, which prohibited the ditching and draining of wetlands, was illegal. As a result, during FY 1999-2000, approximately 9,220 acres of wetlands on about 80 sites (mostly in southeastern NC) were ditched and drained. This activity stopped in March 1999 when DWQ began to enforce its wetland standards. DWQ, EPA and DLR have spent an extensive amount of time visiting each of these sites to check for compliance with environmental rules. Most of these wetlands were slated to be restored by December 2000.

Over the past six years (1995-2000), DWQ issued permits for approximately 90.59 acres of wetland fill and alteration activities in the Chowan River basin (Table A-29). Two of the largest projects occurred in the Chowan River subbasin 03-01-04, which includes Rockyhock Creek to the Albemarle Sound and involved 47.32 acres of permitted wetland impacts. NC Department of Transportation (DOT) requested a permit for wetland impacts associated with the US-17 construction in Chowan and Bertie counties. The permit affected approximately 26.17 acres in 1996. DOT was also responsible for the 19.86 acres affected in 1997 due to US-17 bridge construction activities in Bertie County. Most of the projects that occur in this basin which are associated with wetland permits do not have wetland impacts. Instead, the projects have stream impacts. Table A-30 provides summary information on the amount of permitted wetland mitigation activities in the basin.

Table A-29 Permitted Wetland Impacts Activities (in Acres) by Subbasin and Year

Subbasin Number	1995	1996	1997	1998	1999	2000	Total
03-01-01	3.49	1.12	0.79	1.16	2.4	1.04	**10.0**
03-01-02	17.99	1.81	2.06	1.58	0.9	0.07	**24.41**
03-01-03	0.06	0.01	0.1	0.2	0.9	0	**1.27**
03-01-04	0.7	27.17	20.15	0.37	4.85	1.67	**54.91**
Total Acres	**22.24**	**30.11**	**23.1**	**3.31**	**9.05**	**2.78**	**90.59**

Table A-30 Permitted Wetland Mitigation Activities (in Acres) by Subbasin and Year

Subbasin Number	1995	1996	1997	1998	1999	2000	Total
03-01-01	0.0	0.0	0.0	0.0	9.43	0.0	**9.43**
03-01-02	6.6	0.0	0.0	0.0	0.0	0.0	**6.6**
03-01-03	0.0	0.0	0.0	0.0	0.0	0.0	**0.0**
03-01-04	0.0	124.14	59.36	0.0	4.0	0.0	**187.5**
Total Acres	**6.6**	**124.14**	**59.36**	**0.0**	**13.43**	**0.0**	**203.53**

Overall, there have been 113 more acres of wetlands permitted for mitigation than for impacts in the basin. However, there have been some net losses in wetlands by year and by basin.

Comparing the number of acres of wetland impacts to the number of acres of wetland mitigation activities, each year there has typically been more wetland acres mitigated than impacts permitted. The years 1995, 1998 and 2000 are exceptions.

4.6.3 2002 Recommendations

Through protecting wetlands, local decision-makers can reduce the likelihood of nonpoint source contamination of surface waters. DWQ recommends that local governments consider the value of wetlands and include protection of wetlands in land use plans. DWQ will provide funding source information upon request to local governments for opportunities to restore, enhance or create wetlands.

4.7 Chowan River Basin Wastewater Discharger Issues

4.7.1 Chowan River Nutrient Sensitive Waters (NSW) Strategy

1997 Recommendations

Nutrient enrichment in the Chowan River basin continues to be a primary water quality concern. Since the application of the Nutrient Sensitive Waters (NSW) management strategy, reductions in nutrient loads have been achieved and algal blooms have been less frequent and shorter in duration. As of 1990, installation of control measures for agricultural nonpoint sources through the Agricultural Cost Share Program had resulted in a six percent reduction in North Carolina's total phosphorus input (DEM, 1990). Also, many point source discharges in the basin have converted their facilities to land application operations, reducing nutrient loads to the surface waters. Overall, as of 1990, the nitrogen reduction goal of 20 percent had been accomplished and total phosphorus had been reduced by 29 precent (goal of 35 percent).

Major points of the 1990 management strategy include:

- Reduction in phosphorus inputs from point and nonpoint sources by 35-40 precent
  - *Point Sources*
    - Land application systems for municipal wastewater treatment plants
    - Phosphorus limits of 1 mg/l in the North Carolina portion of the basin
  - *Nonpoint Sources*
    - Target funds from the Agriculture Cost Share Program to the Chowan River basin
- Reduction of nitrogen inputs from all sources by 20 percent
  - *Point Sources*
    - Land application systems for municipal wastewater treatment plants
    - Nitrogen limits of 3 mg/l in the North Carolina portion of the basin
  - *Nonpoint Sources*
    - Target funds from the Agriculture Cost Share Program to the Chowan River basin

The 1997 plan recommends continuing the 1990 NSW management strategy.

Current Status

Over $1,942,634 of Agriculture Cost Share funding has been directed toward the basin over the last five years. DWQ and the Division of Soil and Water Conservation continue to collaborate on efforts to protect and restore water quality in the Chowan River basin due to agricultural impacts. DWQ does not have flow data for the Chowan River, limiting DWQ scientists' ability to conduct long-term records of "load". DWQ continues to measure concentrations and document response measures.

All municipal POTWs have switched to non-discharge systems for treatment of domestic wastewater, and are required to meet total nitrogen and total phosphorus limits for new and expanding private systems that discharge nutrient-bearing wastes.

4.7.2 Discharges of Oxygen-Consuming Waste to Swamp Waters

Most of the freshwater in the Chowan River basin is swampy with naturally low dissolved oxygen (DO), low pH, and low or zero flow during summer months. Wastewater discharges that discharge effluent with high biological oxygen demand have the potential to further reduce DO in these swampy streams. Models to evaluate the impact of discharges to swamp streams have not been developed.

4.7.3 2002 Recommendations

The Chowan River NSW recommendations from 1997 will remain in effect. DWQ continues to issue permits for point sources using the NSW management strategy that involves nitrogen and phosphorus limits and land application requirements. DWQ will conduct a 15-year status analysis on nutrient reduction efforts in the Chowan River basin. Anticipated date of availability is 2005. The DWQ modelers and NPDES permittees will review the information, reevaluate current permit limitations, and revise as necessary based on this analysis.

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

4.8 Priority Issues for the Next Five Years

4.8.1 Introduction

Clean water is crucial to the health, economic and ecological well-being of the state. Tourism, water supplies, recreation and a high quality of life for residents are dependent on the water resources within any given river basin. Water quality problems are varied and complex. Inevitably, water quality impairment is due to human activities within the watershed. Solving these problems and protecting the surface water quality of the basin in the face of continued growth and development will be a major challenge. Looking to the future, water quality in this basin will depend on the manner in which growth and development occur.

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

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

4.8.2 Strategies for Restoring and Protecting Impaired Waters

Impaired waters are those waters identified in Section A, Chapter 3 as partially supporting (PS) or not supporting (NS) their designated uses based on DWQ monitoring data. These waters are summarized by subbasin in Table A-28 and indicated on Figure A-14. The impaired waters are also discussed individually in the subbasin chapters in Section B.

These waters are impaired, at least in part, due to nonpoint sources (NPS) of pollution. The tasks of identifying nonpoint sources of pollution and developing management strategies for these impaired waters are very resource intensive. Accomplishing these tasks are overwhelming, given the current limited resources of DWQ, other agencies (e.g., Division of Land Resources, Division of Soil and Water Conservation, Cooperative Extension Service, etc.) and local governments. Therefore, only limited progress towards restoring NPS impaired waters can be expected during this five-year cycle unless substantial resources are put toward solving NPS problems. Due to these restraints, this plan has no NPS management strategies for streams with NPS problems.

DWQ plans to further evaluate the impaired waters in the Chowan River basin in conjunction with other NPS agencies. After evaluation, the agencies will develop management strategies for a portion of these impaired waters for the next Chowan River Basinwide Water Quality Plan, in accordance with the requirements of Section 303(d) (see Part 4.8.3 below).

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

For the next several years, addressing water quality impairment in waters that are on the state's 303(d) list will be a priority. The waters in the Chowan River basin that are on this list are presented in the individual subbasin descriptions in Section B. For information on listing requirements and approaches, refer to Appendix IV.

Section 303(d) of the federal Clean Water Act requires states to develop a 303(d) list of waters not meeting water quality standards or which have impaired uses. States are also required to develop Total Maximum Daily Loads (TMDLs) or management strategies for 303(d) listed waters to address impairment. In the last few years, the TMDL program has received a great deal of attention as the result of a number of lawsuits filed across the country against EPA. These lawsuits argue that TMDLs have not adequately been developed for specific impaired waters. As a result of these lawsuits, EPA issued a guidance memorandum in August 1997 that called for states to develop schedules for developing TMDLs for all waters on the 303(d) list. The schedules for TMDL development, according to this EPA memo, are to span 8-13 years.

There are approximately 2,387 impaired stream miles on the 303(d) list in NC. The rigorous and demanding task of developing TMDLs for each of these waters during an 8 to 13-year time frame will require the focus of much of the water quality program's resources. Therefore, it will be a priority for North Carolina's water quality programs over the next several years to develop TMDLs for 303(d) listed waters.