Section A - Chapter 4
Water Quality Issues Related to Multiple Watersheds in the Lumber River Basin

4.1 Introduction

This chapter reviews the status of specific recommendations made for multiple watersheds in the 1999 Lumber River Basinwide Water Quality Plan. Current status and future recommendations are provided for each recommendation. Some of these recommendations were pertinent to several watersheds or the basin as a whole, while others were specific to a particular stream or area within a subbasin. Status of the more specific recommendations is reported within the subbasin chapters in Section B. This chapter also discusses water quality problems that were commonly noted during the most recent use support assessment (1996-2001). Specific waters where these problems were observed are described in Section B. Current status and future recommendations are discussed for each water quality problem.

4.2 Biological Criteria for Assessment of Aquatic Life

DWQ strives to properly evaluate the health of aquatic biological communities throughout the state. Swamp stream systems, small streams and estuarine waters have presented unique challenges for benthic macroinvertebrate evaluation, while nonwadeable waters and trout streams have done the same for fish community evaluations. This section discusses some of these challenges. Refer to Appendix II for further information.

4.2.1 Assessing Benthic Macroinvertebrates in Swamp Streams

Current Status

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 often lower pH. They also may have very complex braided channels and dark-colored water. Since 1995, benthic macroinvertebrates swamp sampling methods have been used at over 100 sites in the coastal plain of North Carolina, including more than 20 reference sites. 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 a multi-metric system to refine biological criteria to assign bioclassifications to these streams (as is currently done for other streams and rivers across the state). However, validation of this swamp criteria was not finalized and approved during this Lumber River basinwide assessment (1996-2001) but will be used to assign bioclassifications in the next five-year period. DWQ was required to collect data for several years from swamp stream reference sites. Now, DWQ can properly 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 macroinvertebrate community.

2003 Recommendations
As of December 2002, DWQ has finalized and approved the biological swamp criteria. Assessment using the finalized swamp criteria will first be used in the Tar-Pamlico River basin. The next *Lumber River Basinwide Water Quality Plan* (2008) will contain use support on swamp streams from the finalized criteria.

4.2.2 Assessing Benthic Macroinvertebrate Communities in Small Streams

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

Presently, a designation of Not Impaired may be used for flowing waters that are too small to be assigned a bioclassification (less than 4 meters in width), but meet the criteria for a Good-Fair or higher bioclassification using the standard qualitative and EPT criteria. This designation will translate into a use support rating of Supporting. However, DWQ will use the monitoring information from small streams to identify potential impacts to small streams even in cases when a use support rating cannot be assigned. Gum Swamp, site B-3, in subbasin 03-07-51 (Section B, Chapter 2) is the only site in the basin which received a Not Impaired bioclassification.

2003 Recommendations
DWQ will use this monitoring information to identify potential impacts to these waters even though a use support rating is not assigned. DWQ will continue to develop criteria to assess water quality in small streams.

4.2.3 Assessing Fish Communities

Current Status
Fish communities in most wadeable streams can be sampled by a crew of 2-4 persons using backpack electrofishers and following the DWQ Standard Operating Procedures. The data are evaluated using the North Carolina Index of Biotic Integrity (NCIBI) (NCDENR-DWQ, 2001). The NCIBI uses a cumulative assessment of 12 parameters or metrics. Each metric is designed to contribute unique information to the overall assessment. The scores for all metrics are then summed to obtain the overall NCIBI score.

2003 Recommendations
In order to obtain data from nonwadeable coastal plain streams (that are difficult to evaluate using benthic macroinvertebrates), a fish community boat sampling method is being developed with the goal of expanding the geographic area that can be evaluated using fisheries data. This project may take many years to complete. DWQ will continue to use this monitoring

information to identify potential impacts to these waters even though a use support rating is not assigned.

4.3 Mercury Contamination and Fish Consumption

In April 2002, the NC Department of Health and Human Services (NCDHHS) developed new guidelines to advise people as to what fish are safe to eat. DWQ considers uses of waters with a consumption advice or 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), and these fish species fall under the NCDHHS guidelines.

4.3.1 Mercury-Related Fish Consumption Information

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 and advice for those fish species which have median and/or average methylmercury levels of 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) in North Carolina waters south and east of Interstate 85. As a result of this advice, DWQ considers all waters in the Lumber River basin to be Impaired for 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 one location on the Lumber River mainstem. Refer to subbasin chapter 03-07-51 for more information.

Fish Consumption Advice

Fish is an excellent source of protein and other nutrients. However, several varieties of 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. A "meal" is defined as six ounces of cooked fish for adults and children 15 years or older and two ounces of cooked fish for younger children.

Women of childbearing age (15-44 years), pregnant or 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 likely contain high concentrations of mercury.
- Eat up to two meals per week of other fish.

Men, other women, 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 likely contain high concentrations of mercury.
- Eat up to four meals per week of other fish.

For more information regarding fish consumption, 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.

4.3.2 2003 Recommendations

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.

NC Eastern Regional Mercury Study
In an effort to better manage state waters that may have methylmercury issues, DWQ initiated a study using grant funding from EPA Region IV. 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 April 2004, and results will be available to the public. For more information, contact the DWQ Planning Branch Modeling/TMDL Supervisor at (919) 733-5083.

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 Planning, etc.). The workgroup meets as needed to share

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

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.

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. Additionally, a significant historical source of atmospheric mercury deposition from the Holtrachem plant in Columbus County ceased operations in October 2000. The facility was a former chlor-alkali manufacturing plant that produced chlorine, sodium hydroxide, sodium hypochlorite and hydrochloric acid using the mercury cell process.

NPDES Mercury Requirement, Implementation of EPA Method 1631

NPDES permittees have worked with the state to reduce potential risks from this pollutant, including tasks associated with collecting and reporting more accurate data. The most commonly used laboratory analysis for total mercury (EPA Method 245.1) has a method detection level of 0.2 µg/l, while the current water quality standard is an order of magnitude lower at 0.012 µg/l. Thus, true compliance with the water quality standard could not be judged. A more recently approved laboratory method (EPA Method 1631) has a detection level below the water quality standard (0.0005 µg/l), which would allow the Division to assess potential water quality impacts from dischargers more accurately.

A total of 155 facilities statewide will be required to use EPA Method 1631 (or subsequent low level mercury methods approved by EPA in 40 CFR 136) when analyzing for total mercury beginning September 1, 2003. These facilities are subject to this new requirement because of either criteria: 1) the facility has a current total mercury limit in its NPDES permit that is <0.20 µg/l; or 2) the facility has limited instream dilution (i.e., the instream waste concentration (IWC) is >6 percent). This requirement complies with 15 A NCAC 2B.0505(e)(4), which requires that "test procedures must produce detection and reporting levels below the permit discharge requirements".

There are ten facilities in the Lumber River basin which are required to analyze for total mercury using EPA Method 1631. For more information on NPDES Mercury requirement, visit the NPDES permitting website at http://h2o.enr.state.nc.us/NPDES/NPDESweb.html or contact the DWQ Point Source Branch/NPDES Supervisor at (919) 733-5083.

Lumber River Basin Mercury TMDL Report

The Lumber River basin currently has several waters listed on the North Carolina 303(d) List for fish consumption advisories related to mercury (see Appendix V). 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. The 303(d) process requires that a Total Maximum Daily Load (TMDL) be developed for each of the listed waters, where technically feasible. A TMDL, titled *TMDL Study: Mercury Loads to Impaired Waters in the Lumber River Basin, North Carolina*, was developed by DWQ and approved by EPA in 2000. This TMDL describes sources and allowable Hg loads to surface waters.

Past fish consumption advisories for waters in the Lumber River basin have primarily been in the Lumber River and Waccamaw River watersheds. There are four aquatic point source dischargers in the Lumber River watershed and one in the Waccamaw River watershed that analyze effluent for mercury. However, these aquatic point sources are not believed to be the most significant source of mercury to surface waters in these watersheds. Rather, a significant portion of mercury sources is believed to be from atmospheric sources. Mercury emissions to the atmosphere have increased since the industrial revolution. Local deposition of mercury occurs near an atmospheric point source; however, much of the atmospheric mercury can travel across countries and continents.

During this basin cycle, NPDES permit limits will be issued to facilities that show a reasonable potential to exceed state water quality standards. Other facilities may be asked to monitor effluent for mercury if it is likely that mercury is present in the effluent. Current and future NPDES discharges in the Lumber River and Waccamaw River watershed will not be allowed to increase the total mercury already present in the system.

Even with restrictions on point sources, mercury levels in the Lumber River and Waccamaw River fish are not likely to change appreciably over the next several years. Thus, efforts should be made to educate the public in and around the Lumber River and Waccamaw River watersheds with regard to mercury pollution.

The State of North Carolina alone cannot eliminate the atmospheric deposition of mercury over surface waters. Actions for reducing atmospheric mercury will also be needed at the national and international levels. The Mercury Report to Congress (EPA, 1997) lists initiatives under the Clean Air Act that may reduce atmospheric mercury emissions from industrial sources. The most significant initiative is emission limits for municipal waste combustors and medical waste incinerators.

North Carolina, in conjunction with EPA, will need to assess the relative inputs of mercury from within and outside the state using a regional air quality model. Modeling results may indicate that a significant portion of the mercury load to the Lumber River and Waccamaw River watersheds is not due to local sources. In this case, assistance will be needed from EPA to address mercury emissions reductions across river basins and state boundaries.

4.4 Habitat Degradation

Instream habitat degradation is identified in the use support summary (Appendix III) where there is a notable reduction in habitat diversity or a negative change in habitat. This term includes sedimentation, bank erosion, channelization, lack of riparian vegetation, loss of pools or riffles, loss of woody habitat, and streambed scour. Good instream habitat is necessary for aquatic life to survive and reproduce. Streams that typically show signs of habitat degradation are in

watersheds that have a large amount of land-disturbing activities (construction, mining, timber harvest and agricultural activities) or a large percentage of impervious surfaces. A watershed in which most of the riparian vegetation has been removed from streams or channelization has occurred also exhibits instream habitat degradation. Streams that receive a discharge quantity that is much greater than the natural flow in the stream often have degraded habitat as well.

Some Best Management Practices

Agriculture

- Using no till or conservation tillage practices
- Fencing livestock out of streams and rivers
- Leaving natural buffer areas around small streams and rivers

Construction

- Using phased grading/seeding plans
- Limiting time of exposure
- Planting temporary ground cover
- Using sediment basins and traps

Forestry

- Controlling runoff from logging roads
- Replanting vegetation on disturbed areas
- Leaving natural buffer areas around small streams and rivers

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

4.4.1 Land Clearing Activities

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

As a result of new stormwater rules enacted by EPA in 1999, construction or land development activities that disturb one acre or more are required to obtain a NPDES stormwater permit (refer to page 69). An erosion and sediment control plan must also be developed and approved for these sites under the state's Sedimentation Pollution Control Act (SPCA) administered by the NC Division of Land Resources. Site disturbances of less than one acre are required to use BMPs, but a plan is not required.

Forestry operations in North Carolina are subject to regulation under the Sedimentation Pollution Control Act of 1973 (G.S. Chapter 113A, Article 4 referred to as "SPCA"). However, forestry operations may be exempted from the permit requirements in the SPCA, if the operations meet compliance standards outlined in the *Forest Practices Guidelines Related to Water Quality* (15A

NCAC 1I .0101-.0209, referred to as "FPGs") and General Statutes regarding stream obstruction (G.S. 77-13 and G.S. 77-14). Detailed information is available on the Water Quality Section of the DFR's website at http://www.dfr.state.nc.us.

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

4.4.2 Loss of Riparian Vegetation

During the 2001 basinwide sampling, DWQ biologists reported degradation of aquatic communities at several sites throughout the Lumber River basin in association with narrow or nonexistent zones of native riparian vegetation. Riparian vegetation loss was common in rural and residential areas as well as in urban areas (NCDENR-DWQ, June 2002).

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

Livestock grazing with unlimited access to the stream channel and banks can cause severe streambank erosion resulting in degraded water quality. Although they often make up a small percentage of grazing areas by surface area, riparian zones (vegetated stream corridors) are particularly attractive to cattle that prefer the cooler environment and lush vegetation found beside rivers and streams. This concentration of livestock can result in increased sedimentation of streams due to "hoof shear", trampling of bank vegetation, and entrenchment by the destabilized stream. Despite livestock's preference for frequent water access, farm veterinarians have reported that cows are healthier when stream access is limited (EPA, 1999).

Establishing, conserving and managing streamside vegetation (riparian buffer) is one of the most economical and efficient BMPs. Forested buffers in particular provide a variety of benefits including filtering runoff and taking up nutrients, moderating water temperature, preventing erosion and loss of land, providing flood control and helping to moderate streamflow, and providing food and habitat for both aquatic and terrestrial wildlife (NCDENR-DWQ, February 2002). To obtain a free copy of DWQ's *Buffers for Clean Water* brochure, call (919) 733-5083, ext. 558.

4.4.3 Loss of Instream Organic Microhabitats

Organic microhabitat (leafpacks, sticks and large wood) and edge habitat (root banks and undercut banks) play very important roles in a stream ecosystem. Organic matter in the form of leaves, sticks and other materials serve as the base of the food web for small streams. Additionally, these microhabitats serve as special niches for different species of benthic

macroinvertebrates, providing food and/or habitat. For example, many stoneflies are found almost exclusively in leafpacks and on small sticks. Some beetle species prefer edge habitat, such as undercut banks. If these microhabitat types are not present, there is no place for these specialized macroinvertebrates to live and feed. The absence of these microhabitats in some streams in the Lumber River basin is directly related to the absence of riparian vegetation (refer to Part 4.2.2 above). Organic microhabitats are critical to headwater streams, the health of which is linked to the health of the entire downstream watershed.

4.4.4 Channelization

Channelization refers to the physical alteration of naturally occurring stream and riverbeds. Typical modifications are described in the text box. Although increased flooding, bank erosion and channel instability often occur in downstream areas after channelization has occurred, flood control, reduced erosion, increased usable land area, greater navigability and more efficient drainage are frequently cited as the objectives of channelization projects (McGarvey, 1996).

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

Typical Channel Modifications

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

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

Channelization of streams within the continental United States is extensive and promises to become even more so as urban development continues. Overall estimates of lost or altered riparian habitats within US streams are as high as 70 percent. Unfortunately, the dynamic nature of stream ecosystems makes it difficult (if not impossible) to quantitatively predict the effects of channelization (McGarvey, 1996).

4.4.5 Recommendations for Reducing Habitat Degradation

In March 2002, the Environmental Management Commission (EMC) sent a letter to the Sedimentation Control Commission (SCC) expressing seven recommendations for improving erosion and sedimentation control, based on a comprehensive performance review of the

turbidity standard conducted in 2001 by DWQ staff. Specifically the recommendations are that the EMC and SCC:

1. Evaluate, in consultation with the Attorney General's Office, whether statutory authority is adequate to mandate temporary ground cover over a percentage of the uncovered area at a construction site within a specific time after the initial disturbance of the area. If it is found that statutory authority does not exist, then the EMC and SCC should prepare resolutions for the General Assembly supporting new legislation to this effect.
2. Prepare resolutions supporting new legislation to increase the maximum penalty allowed in the Sedimentation Pollution Control Act from $5,000 to $25,000 for the initial response to a noncompliant site.
3. Jointly support a review of the existing Erosion and Sediment Control Planning and Design Manual by DLR. This review should include, but not be limited to, a redesign of the minimum specifications for sedimentation basins.
4. Evaluate, in consultation with the Attorney General's Office, whether the statutory authority is adequate for effective use of the "Stop Work Order" tool and, if found not to be adequate, to prepare resolutions for the General Assembly supporting new legislation that will enable staff to more effectively use the "Stop Work Order" tool.
5. Support increased research into and experimentation with the use of polyacrylamides (PAMs) and other innovative soil stabilization and turbidity reduction techniques.
6. Jointly support and encourage the awarding of significant monetary penalties for all activities found to be in violation of their Stormwater Construction General Permit, their Erosion and Sediment Control Plan, or the turbidity standard.
7. Hold those individuals who cause serious degradation of the environment through excessive turbidity and sedimentation ultimately responsible for restoration of the area.

DWQ will continue to work cooperatively with DLR and local programs that administer sediment control in order to maximize the effectiveness of the programs and to take appropriate enforcement action when necessary to protect or restore water quality. However, more voluntary implementation of BMPs is needed for activities that are not subject to these rules in order to substantially reduce the amount of sedimentation.

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

4.5 Fecal Coliform

Fecal coliform bacteria live in the digestive tract of warm-blooded animals (humans as well as other mammals) and are excreted in their waste. Fecal coliform bacteria do not actually pose a

danger to people or animals. However, where fecal coliform are present, disease-causing bacteria may also be present and water that is polluted by human or animal waste can harbor other pathogens that may threaten human health.

The presence of disease-causing bacteria tends to affect humans more than aquatic creatures. High levels of fecal coliform bacteria can indicate high levels of sewage or animal wastes which could make water unsafe for human contact (swimming) or the harvesting and consumption of shellfish. Fecal coliform bacteria and other potential pathogens associated with waste from warm-blooded animals are not harmful to fish and aquatic insects. However, high levels of fecal coliform bacteria may indicate contamination that increases the risk of contact with harmful pathogens in surface waters. In the Lumber River basin, data from DWQ's ambient monitoring stations in subbasin 03-07-55 and 03-07-59 (Section B, Chapters 6 and 10) show high levels of fecal coliform bacteria. Many areas in the coastal region of the basin (subbasin 03-07-59) are Impaired because of shellfish harvesting area closures. There are also many waters that have high levels of fecal coliform bacteria associated mostly with stormwater runoff in urban areas. DWQ is currently developing TMDLs (see Appendix IV) for waters that are on the 303(d) list of Impaired waters.

Pathogens associated with fecal coliform bacteria can cause diarrhea, dysentery, cholera and typhoid fever in humans. Some pathogens can also cause infection in open wounds.

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

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

Water quality standards for fecal coliform bacteria are intended to ensure safe use of waters for recreation and shellfish harvesting (refer to Administrative Code Section 15A NCAC 2B .0200). The North Carolina fecal coliform standard for freshwater is 200 colonies/100ml based on the geometric mean of at least five consecutive samples taken during a 30-day period and not to exceed 400 colonies/100ml in more than 20 percent of the samples during the same period. The 200 colonies/100ml standard is intended to ensure that waters are safe for water contact through recreation.

The standard for Class SA waters (waters used for shellfishing) is a median or geometric mean fecal coliform Most Probable Number (MPN) not greater than 14 MPN/100ml. In addition, not more than 10 percent of the samples can be in excess of 43 MPN/100ml. Many areas closed to shellfish harvesting have median levels below 14 MPN/100ml, but fail to meet the second criteria due to periodic contamination that occurs after moderate to heavy rainfall events.

Sources of Fecal Coliform in Surface Waters

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

The North Carolina Division of Environmental Health (DEH) has subdivided all of the state's coastal waters into shellfish growing areas in which a sanitary survey is conducted every three years. Beginning in the summer of 1997, DEH began assessing fecal coliform levels in coastal recreation waters. These assessments provide a gauge of water quality along the North Carolina coast over the short and long-term.

If a certain area along the coast is found to have potential water quality problems related to stormwater pipes or high levels of indicator bacteria, health officials will post signs recommending that people not swim there or harvest shellfish from the area. The location will be listed on the DEH website at (http://www.deh.enr.state.nc.us/shellfish/), and local media and county health departments will be notified.

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

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

4.6 Water Quality Problems Resulting from Hurricanes

Current Status

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 programs' 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 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, are 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.

2003 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.

4.7 DWQ Stormwater Programs

There are many different stormwater programs administered by DWQ. One or more of these programs affects many communities in the Lumber River basin. The goal of the DWQ stormwater discharge permitting regulations and programs is to prevent pollution from entering the waters of the state via stormwater runoff. Those programs try to accomplish this goal by controlling the source(s) of pollutants. These programs include NPDES Phase I and II, coastal county stormwater requirements, HQW/ORW stormwater requirements, and requirements associated with the Water Supply Watershed Program. Local governments that are or may be affected by these programs are presented in Table A-26.

4.7.1 NPDES Phase I

Phase I of the EPA stormwater program started with Amendments to the Clean Water Act (CWA) in 1990. Phase I required NPDES permit coverage to address stormwater runoff from medium and large stormwater sewer systems serving populations of 100,000 or more people. Phase I also had requirements for ten categories of industrial sources to be covered under stormwater permits. Industrial activities which require permitting are defined in categories

ranging from sawmills and landfills to manufacturing plants and hazardous waste treatment, storage or disposal facilities. Construction sites disturbing greater than five acres are also required to obtain an NPDES stormwater permit under Phase I of the EPA stormwater program.

4.7.2 NPDES Phase II

Current Status

The Phase II stormwater program is an extension of the Phase I program that will include permit coverage for smaller municipalities and cover construction activities down to one acre. The local governments permitted under Phase II will be required to develop and implement a comprehensive stormwater management program that includes six minimum measures.

1) Public education and outreach on stormwater impacts.
2) Public involvement/participation.
3) Illicit discharge detection and elimination.
4) Construction site stormwater runoff control.
5) Post-construction stormwater management for new development and redevelopment.
6) Pollution prevention/good housekeeping for municipal operations.

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

Two counties (Table A-26) in the basin are automatically required (1990 and/or 2000 US Census designated Urbanized Areas) to obtain a NPDES stormwater permit under the Phase II rules if they own and operate a small MS4. The local governments designated based on the 1990 US Census, that own and operate a small MS4, are required to submit applications for NPDES stormwater permits by March 2003. Those designated based on the 2000 US Census have until May 2004 to submit applications. DWQ has developed criteria that will be used to determine whether other public entities should be required to obtain a NPDES permit and how the NPDES stormwater program will be implemented in North Carolina. The criteria are contained in temporary rule language (15A NCAC 2B .0126) that went into effect on November 1, 2002. DWQ is currently working on permanent state rules to implement the Phase II stormwater requirements. Also, the South Brunswick Water and Sewer Authority was issued a NPDES Phase II permit in 2001.

2003 Recommendations

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

Table A-26 Communities in the Lumber River with Stormwater Requirements

Local Government	NPDES		Coastal Stormwater Rules	State Stormwater Program*	Water Supply Watershed Stormwater Requirements
	Phase I	Phase II*			
Municipalities					
Aberdeen					
Boiling Spring Lakes					
Chadbourn					
Fairmont					
Laurinburg					
Lumberton				**X**	**X**
Maxton					
Oak Island		**X**			
Pembroke					**X**
Pinehurst					**X**
Raeford					
Red Springs					
Saint Pauls					
Southern Pines					
Tabor City					
Whiteville					
Counties					
Bladen					
Brunswick		**X**	**X**	**X**	
Columbus				**X**	
Hoke		**X**		**X**	**X**
Moore				**X**	**X**
Montgomery					**X**
Richmond				**X**	**X**
Robeson				**X**	**X**
Scotland				**X**	**X**

Note: More local governments may be designated based on designation criteria set forth in state rule 15A NCAC 2B .0126.

* Counties listed under State Stormwater Program do not pertain to the entire county, just those waters draining to HQWs and/or ORWs.

4.7.3 State Stormwater Program and Coastal Stormwater Rules

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

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

Table A-26 shows the one coastal county, Brunswick County, in the Lumber River basin where permits may be required under the stormwater management program and the coastal stormwater rules under CAMA or ORW stormwater rules. Several other counties are depicted in Table A-26 which may be required to obtain permits under the state stormwater rules where development activities drain to HQW or ORW waters. Note, however, this does not pertain to the entire county, just the waters in the county which drain to HQWs and/or ORWs. Also, all development requiring an Erosion and Sediment Control Plan (for disturbances of one or more acres) must obtain a stormwater permit.

2003 Recommendations
DWQ will continue implementing the state stormwater program with the other NCDENR agencies and local governments. Local governments should develop local land use plans that minimize impervious surfaces in sensitive areas. Communities should integrate state stormwater program requirements, to the extent possible, with other stormwater programs in order to be more efficient and gain the most water quality benefits for protection of public health and aquatic life.

4.7.4 Water Supply Watershed Stormwater Rules

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

All local governments in the Lumber River basin that have jurisdiction within a water supply watershed have an EMC approved water supply watershed protection ordinance. Refer to page 39 for more information on classified water supply waters and watersheds in the Lumber River basin. Table A-26 shows a listing of local governments that have approved water supply ordinances.

2003 Recommendations

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

4.8 Protection and Restoration of Streams in Urbanized and Developing Watersheds

4.8.1 Current Status

Urbanization often has greater hydrologic effects than any other land use, as native vegetation is replaced with impervious surfaces in the form of paved roads, buildings, parking lots, and residential homes and driveways. 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 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). Most of the impacts are in terms of habitat degradation (page 62), but runoff from developed and developing areas can also carry toxic pollutants and pathogens to surface waters (NCDENR-DWQ, November 2001). For these streams to support aquatic life, good water quality and aquatic habitat must be maintained.

Currently, in the Lumber River basin in subbasin 03-07-59, there are 3,606.9 estuarine acres (Class SA) that are Impaired due to the loss of shellfish harvesting where stormwater runoff is a contributing factor. These waters around the high growth areas of the basin are, and will increasingly be, impacted by urban stormwater runoff as land use changes from agriculture and forest uses to urban and suburban land uses.

4.8.2 2003 Recommendations

Maintain Riparian Buffers

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.

Removing trees, shrubs and other vegetation to plant grass or place rock (also known as riprap) along the bank of a river or stream degrades water quality. Removing riparian vegetation eliminates habitat for aquatic macroinvertebrates that are food for trout and other fish. Rocks lining a bank absorb the sun's heat and warm the water. Some fish require cooler water temperatures as well as the higher levels of dissolved oxygen cooler water provides. Trees, shrubs and other native vegetation cool the water by shading it. Straightening a stream, clearing streambank vegetation, and lining the banks with grass or rock severely impact the habitat that aquatic insects and fish need to survive (WNCT, 1999).

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

Protect Headwater Streams

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

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

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

Reduce Impacts of Future Development

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

Proactive planning efforts at the local level are needed to assure that development is done in a manner that minimizes impacts to water quality. These planning efforts must find a balance among 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.

Action should be taken at the local level to plan for new development in urban and rural areas. For more detailed information regarding recommendations for new development found in the text box (below), refer to EPA's website at www.epa.gov/owow/watershed/wacademy/acad2000/protection and the Center for Watershed Protection website at www.cwp.org. Additional public education is also needed in the Lumber River basin in order for citizens to understand the value of urban planning and stormwater management. DWQ recently developed a booklet that discusses actions individuals can take to reduce stormwater runoff and improve stormwater quality entitled *Improving Water Quality In Your Own Backyard*. To obtain a free copy, call (919) 733-5083, ext. 558.

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

1. Identify waters that are threatened by development.
2. Protect streams beyond existing buffer regulations.
3. Implement stormwater BMPs during and after development.
4. Develop land use plans that minimize disturbance in sensitive areas of watersheds.
5. Minimize impervious surfaces including roads and parking lots.
6. Develop public outreach programs to educate citizens about stormwater runoff.

Establish Long–Term Restoration Plans for Impaired Streams

Many streams in existing urban areas have been Impaired for a very long time. Because of the large amounts of established structures, it is generally considered to be too expensive to undertake a stream restoration project in many urban watersheds. These streams are important to ecosystem health, water quality in the basin, and to the quality of life in general. The following steps can be incorporated into a long-term redevelopment plan that will eventually provide opportunity for a stream restoration project.

Planning Recommendations for New Development

- Minimize number and width of residential streets.
- Minimize size of parking areas (angled parking and narrower slots).
- Place sidewalks on only one side of residential streets.
- Vegetate road right-of-ways, parking lot islands and highway dividers to increase infiltration.
- Plant and protect natural buffer zones along streams and tributaries.
- Minimize floodplain development.
- Protect and restore wetland/bog areas.

1. Maintain good water quality and aquatic habitat of nearby unimpacted watersheds. Streams in these watersheds will be needed to establish reference conditions and as a source of aquatic life for repopulating restored streams.
2. Identify urban watersheds and encourage community groups, local business and industry to become involved in the long-term planning, fund raising and eventual restoration projects.
3. Target streamside properties that can be purchased or put into easement as the existing structures are removed to provide space for restoration of riparian areas.
4. When streamside properties are redeveloped, structures and parking lots should be sited to provide as much space as possible for restoration of stream channels and riparian areas.

5. Minimize impervious surfaces during redevelopment with the goal of having less impervious surface than was previously on the site.
6. Install BMPs that can hold and treat stormwater runoff from the site during and after redevelopment.
7. When enough stream reach has restoration opportunity, proceed with restoration projects.
8. Proactive planning efforts through local land use plans, refer to Section C, Part 1.3.

Although this process may take many years before urban stream water quality and aquatic habitat are restored, the end product will be an important feature of urban areas.

4.9 Capacity Use Investigation

Current Status

A capacity use area investigation occurs at the request of the Environmental Management Commission (EMC) under the guidance of the Water Use Act of 1967 (G.S. 143-215.11). The EMC can request an investigation to determine whether rules for capacity use area designation and procedures for water use permitting should be written. Under G.S. 143-215.13(b) a capacity use area can be defined if the EMC finds that the combined uses of water have exceeded or threaten to exceed availability.

Of special concern in the Lumber River basin are the declining groundwater levels in the upper Cape Fear aquifer centered under the Smithfield Packing, Inc. plant in Bladen County and extending into Cumberland and Robeson counties. This aquifer supplies the bulk of the drinking and industrial groundwater needs in this region. Elizabethtown, Bladen County water districts, White Lake, Bladenboro and other small towns make use of this resource. Groundwater levels have declined to the top of the aquifer under Smithfield Packing plant; dewatering of the upper Cape Fear aquifer is already occurring or will occur in the near future. Also, these withdrawals may cause lateral or vertical saltwater encroachment.

2003 Recommendations

In the fall of 2002, the Environmental Management Commission (EMC) requested the Division of Water Resources (DWR) to submit a report entitled "Proposed Bladen County Capacity Use Investigation Scope of Work and Timeline for Completion" to the Water Allocation Committee (WAC). The DWR presented the report to the WAC on December 11, 2002. The WAC recommended that DWR perform a capacity use investigation and report on the results in 18 months. The EMC approved the recommendation of the WAC on December 12, 2002.

4.10 Impacted Streams in Agricultural Areas

Current Status

Impacts to streams from agricultural activities can include excessive nutrient loading, pesticide and herbicide contamination, bacterial contamination and sedimentation. In the coastal plain, many agricultural areas are ditched, thereby, increasing the delivery of the contaminants to surface waters.

There are stream miles that are being impacted in areas where agriculture is the predominant land use, and biologists have noted these impacts to streams related to nutrient loading and sedimentation. There has been a loss of approximately 41,000 acres of cultivated cropland in the Lumber River basin since 1982 (page 18). Much of this land has been converted into more intensive uses such as urban and suburban areas.

2003 Recommendations

DWQ will identify streams where agricultural land use may be impacting water quality and aquatic habitat. This information will be related to local Division of Soil and Water Conservation (DSWC) and NRCS staff to investigate the agricultural impacts in these watersheds and to recommend BMPs to reduce impacts. DWQ recommends that funding and technical support for agricultural BMPs be continued. Refer to Appendix VI for agricultural nonpoint source agency contact information.

4.11 Confined Animal Operations

Waste produced by confined animal operations in North Carolina is a valuable soil amendment and source of nitrogen, phosphorus and other crop nutrients, when applied to land in proper amounts (the traditional waste management approach). But, if not properly used or disposed, or if applied in amounts that exceed plant needs, animal waste can leach through soil to contaminate groundwater or can be transported by runoff to pollute rivers and streams.

DWQ recommends that the agricultural community work to implement best management practices and/or other alternatives to avoid excessive land application.

4.12 Addressing Waters on the State's 2002 Integrated 305(b) and 303(d) Report

Current Status

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 been developed by states or the EPA. 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.

In 2002, per EPA guidance, DWQ submitted required information on a format similar to that specified in the *2002 Integrated Water Quality Monitoring and Assessment Report* (EPA, 2001b). This integrated report is considered a hybrid report, incorporating elements of old and new EPA guidance on 305(b) and 303(d) reporting. EPA confirms this report satisfies Clean Water Act (CWA) requirements for both the 2002 Section 305(b) water quality report and the 2002 Section 303(d) priority ranking of Impaired waterbodies, commonly referred to as the Section 303(d) list.

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

2003 Recommendations

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 Lumber River basin that are on this list are presented in the individual subbasin descriptions in Section B and in Section A, Chapter 3, Table A-25. For information on listing requirements and approaches, refer to Appendix IV.

4.13 Golf Courses

There were 17,108 golf courses in the United States in 2000; and in that year, 524 new courses were built, 707 were under construction, and 1,049 were being planned (NGF, 2001). In North Carolina, 150,000 acres of new turf areas, including athletic fields, recreational areas, home lawns and golf courses, are developed each year and the rate of development continues to grow (NCCES, 1995). Without proper site design, construction practices and maintenance, all turf areas can serve as a source of sediment, nutrients and other contaminants that can impact water quality. Golf courses, because of their size, location and historical design practices, can cause significant impacts to small streams. In order to insure water quality protection, best management practices (BMPs) that maximize resources while minimizing risk to the environment should be implemented throughout the life of a golf course from design to construction to daily maintenance.

Proper site design works with the landscape. The design should designate environmentally sensitive areas throughout the course and strive to protect them with minimal disturbance. The design can prevent or minimize erosion and stormwater runoff by maintaining natural vegetated riparian areas near streams, wetlands and lake shorelines as much as possible. Good design also minimizes the development of gullies, avoids channelization (straightening) of streams, and prohibits the unnecessary disruption of streambanks and lake shorelines (NCCES, 1995).

During golf course construction, the exposed soils and steep slopes are highly susceptible to erosion thus sedimentation to any adjacent streams. North Carolina requires that an erosion and sediment control plan be submitted to the Land Quality Section, Division of Land Resources, 30 days prior to the start of clearing or grading for areas larger than one contiguous acre. In order to reduce erosion and sedimentation from the site, strategies to effectively control sediment by minimizing the loss of topsoil and protecting water resources should be implemented throughout the construction of the course (CRM, 1996). Establishing ground cover as soon as possible after soil disturbance is one very effective BMP to implement during construction activity (NCCES, 1995).

Maintenance of the golf course also has the potential to impact water quality through improper fertilization, mowing and irrigation. Fertilizer applications should be based on a soil test to determine the appropriate timing, level and type of fertilizer necessary for the type of grass on particular areas of the course. Fertilizers should also not be applied on the steep slopes near surface waters or directly to lakes, streams and drainage areas. It is a good practice to maintain a

buffer of low-maintenance grasses or natural vegetation between areas of the highly maintained portions of the golf course and surface waters (NCCES, 1995).

The appropriate level of irrigation for a golf course is vital to the health of the grasses and the preservation of water quality. Over-irrigating increases the potential for leaching fertilizers, pesticides and nutrients from the soil and increasing runoff. A properly designed irrigation system will apply a uniform level of water at the desired rate and time. The amount and frequency of watering should be based on the type of grass and soil and weather conditions (NCCES, 1995).

Golfers can also play a role in protecting water quality on the golf course. Players should respect designated environmentally sensitive areas within the course and recognize that golf courses are managed areas that complement the natural environment. Golfers should also support and encourage maintenance practices that protect and enhance the environment and encourage the development of environmental conservation plans for the course. In addition, golfers can choose to patronize courses that are designed, constructed and maintained with protection of natural resources in mind (CRM, 1996).