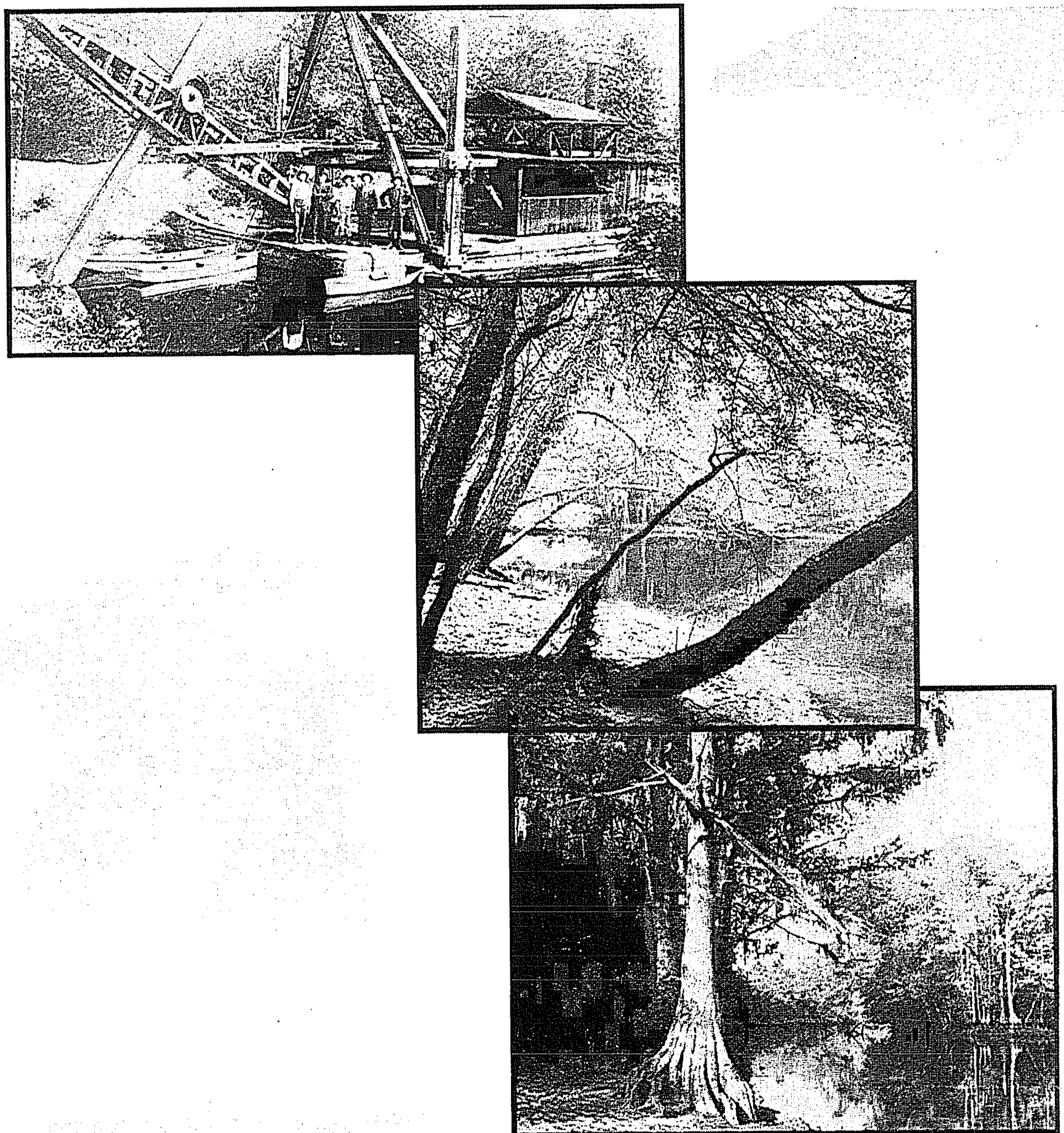
LUMBER RIVER BASINWIDE WATER QUALITY MANAGEMENT PLAN



North Carolina Department of Environment, Health, and Natural Resources
Division of Environmental Management • Water Quality Section May 1994

Michael F. Easley, Governor
William G. Ross Jr., Secretary
North Carolina Department of Environment and Natural Resources

Alan W. Klimek, P.E. Director
Division of Water Quality

November 1, 2002

Thank you for your interest in North Carolina's water quality issues. Enclosed is the basinwide water quality plan that you recently requested from the Division of Water Quality (DWQ).

The basinwide planning program aims to identify and restore full use to impaired waters, identify and protect highly valued resource waters, and protect the quality and intended uses of North Carolina's surface waters while allowing for sound economic planning and reasonable growth. North Carolina relies on the input and experience of its public to ensure that the water quality plans are effective. DWQ coordinates plan development; however, plan implementation and effectiveness entails the coordinated efforts and endorsement of many agencies, groups, local governments, and the general public. Your participation is essential for us to achieve our goals.

Our website (http://h2o.enr.state.nc.us/wqs/) provides detailed information on our program, other basin plans, current events, publications, and rules and regulations. Please visit us at this site.

DWQ appreciates your interest in water quality issues, and we hope to continue working with you into the future. Please contact the following basin planners if you have any further questions or ideas on specific basins at (919) 733-5083 (extensions for each planner are provided below).

Sincerely,

Darlene Kucken

Darlene Kucken
Basinwide Planning Program Coordinator

Basin Planners:

Callie Dobson (ext. 583)	Broad, Hiwassee, Little Tennessee, New, Savannah, Watauga and Yadkin-Pee Dee River Basins
Jennifer Everett (ext. 374)	Chowan, Lumber, Pasquotank and Roanoke River Basins
Darlene Kucken (ext. 354)	Catawba and French Broad River Basins
Cam McNutt (ext. 575)	Cape Fear, Neuse, Tar-Pamlico and White Oak River Basins

Enclosure

State of North Carolina
Department of Environment,
Health and Natural Resources
Division of Environmental Management

James B. Hunt, Jr., Governor
Jonathan B. Howes, Secretary
A. Preston Howard, Jr., P.E., Director

DEHNR

ADDENDUM TO LUMBER RIVER BASINWIDE WATER QUALITY MANAGEMENT PLAN

FISH CONSUMPTION ADVISORY ISSUED FOR THE ENTIRE LUMBER RIVER BASIN BASED ON FINDINGS OF ELEVATED LEVELS OF MERCURY IN FISH TISSUES

Elevated mercury levels in fish were first detected as part of routine fish tissue sampling by the North Carolina Division of Environmental Management (DEM) in May 1992. Additional sampling in June, October and December 1992, and April 1993 confirmed the elevated levels of mercury in largemouth bass. A fish consumption advisory was issued by the State Health Director in July 1993 for largemouth bass in Big Creek and the Waccamaw River. In November 1993, bowfin (also known as blackfish) were added to the consumption advisory because of elevated mercury levels. That advisory affected the entire Big Creek drainage, which flows into Lake Waccamaw and the Waccamaw River from where it flows out of Lake Waccamaw to the South Carolina border. It did not apply to Lake Waccamaw itself, where mean mercury levels in largemouth bass were below the federal Food and Drug Administration (FDA) action level of 1.0 part per million (ppm). The above advisories were included in the Lumber River Basinwide Water Quality Management Plan that was approved by the North Carolina Environmental Commission in May, 1994.

Additional sampling at 32 stations in the Lumber, Cape Fear and Yadkin River basins, found that 17 stations in the Lumber River basin had at least one species of fish with mean mercury levels approaching or exceeding the FDA action level of 1.0 ppm. These results neither identified a source for the mercury contamination, nor established a clear boundary for it; however, elevated levels of mercury in fish tissues are found in many other states including South Carolina. Based on the addtional sampling noted above, a fish consumption advisory was issued by the State Health Director for the *entire* Lumber River basin, including Lake Waccamaw, in October 1994. The advisory recommends that consumption of largemouth bass and bowfin be limited to no more than two meals per person per month. Children and women of childbearing age are advised not to eat any largemouth bass or bowfin taken from this area.

If there are any questions, please contact the Division's Fayetteville or Wilmington Regional Office or the Division's Basinwide Coordinator (phone numbers listed below).

DEM REGIONAL OFFICES

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LUMBER RIVER BASINWIDE WATER QUALITY MANAGEMENT PLAN

MAY 1994

Prepared by:

North Carolina
Division of Environmental Management
Water Quality Section
P.O. Box 29535
Raleigh, NC 27626-0535

(919) 733-5083

This plan was approved and endorsed by the North Carolina Environmental Management Commission on May 12, 1994 to be used as a guide by the North Carolina Division of Environmental Management, Water Quality Section, in carrying out its Water Quality Program duties and responsibilities in the Lumber River Basin

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Center and Bottom - Dr. Colin Osborne

EXECUTIVE SUMMARY

PURPOSE OF LUMBER BASINWIDE PLAN

The *Lumber River Basinwide Water Quality Management Plan* is the second of a series of basinwide water quality management plans that are being prepared by the North Carolina Division of Environmental (DEM) for all seventeen of the state's major river basins. The full schedule is presented in Chapter 1. The purpose of the Lumber Plan is to report to citizens, policy makers and the regulated community on:

- the current status of surface water quality in the basin;
- major water quality concerns and issues;
- projected trends in development and water quality;
- long-range water quality goals for the basin;
- point and nonpoint source pollution control programs and regulations;
- recommended waste limit strategies for discharges of nutrients, oxygen-demanding wastes and toxic substances; and
- followup monitoring to gauge the Division's performance in implementing the plan to meet established goals.

Basinwide plans will be updated at five-year intervals. The Lumber Basinwide Plan is to be updated in 1999. Basinwide NPDES permitting in the Lumber Basin occurs in November and December of 1994.

NORTH CAROLINA'S BASINWIDE APPROACH TO WATER QUALITY MANAGEMENT - BASINWIDE GOALS AND OBJECTIVES

Basinwide water quality management is a new watershed-based management approach being implemented by the North Carolina Division of Environmental Management (DEM) to improve the efficiency, effectiveness and consistency of the state's Water Quality Protection Program. Two key features include *basinwide discharge permitting* and preparation of a *basinwide management plan* for each of the seventeen major river basins in the state.

The primary goals of DEM's basinwide program are to: 1) identify and restore full use to impaired waters, 2) identify and protect highly valued resource waters, and 3) manage problem pollutants throughout the basin so as to protect water quality standards while accommodating population increases and economic growth. Near-term objectives, or those achievable at least in part during the next five years, include implementing management strategies to minimize increases in point and nonpoint source pollution loading and making measurable improvements towards addressing the major issues presented below. Longer-term objectives will include refining the recommended basinwide management strategies during the next round of water quality monitoring after obtaining feedback on current management efforts.

Near-term point source management efforts will include maintaining existing waste loads for oxygen-consuming wastes at most expanding wastewater treatment plants and possibly requiring more stringent limits on a case-by-case basis at some existing plants in areas where documented water quality problems exist; continuing efforts to improve compliance with permitted limits; improving pretreatment of industrial wastes to municipal wastewater treatment plants so as to reduce the toxicity in effluent wastes; increasing compliance surveillance of designated concentrated-animal feeding operations; requiring industrial facilities to develop and implement stormwater pollution prevention plans; and requiring multiple treatment trains at wastewater facilities as designated by rules adopted by the Environmental Management Commission.

Near-term nonpoint source management efforts will include working with appropriate nonpoint source agencies to target the implementation of best management practices (BMPs) to reduce sediment and nutrient runoff to the most sensitive surface water areas in the basin, as well as implementing DEM's water supply watershed protection, federal urban stormwater and state animal waste control rules.

Longer term point source control efforts will stress reduction of wastes entering wastewater treatment plants, seeking more efficient and creative ways of recycling byproducts of the treatment process (including recycling wastewater), and keeping abreast of and recommending the most advanced and cost-effective wastewater treatment technologies. In addition, DEM will be seeking a better understanding of the water quality and waste assimilative capacity of swamp waters so that more accurate long-range waste limit strategies can be provided to dischargers.

For nonpoint sources, long-term efforts will include more effective controls of urban runoff and continuing efforts to work with the agricultural, forestry and development communities to reduce nutrient, sediment and chemical runoff through expanded and improved best management practices (BMP). In addition, identification of the geographic extent of mercury in fish tissue and continued identification of numerous sources of fecal coliform bacteria and controls will be pursued.

LUMBER BASIN OVERVIEW

The Lumber River Basin lies along the North Carolina/South Carolina border at the southeast corner of the state stretching about 150 miles from the Atlantic Ocean coastline in Brunswick County to the Sandhills region in southern Moore and Montgomery Counties (Figure 1). The Lumber Basin is the home of Calabash seafood in Brunswick County; the vast Green Swamp and Lake Waccamaw in Columbus County; and world-renowned golf resorts in the vicinity of Southern Pines in southern Moore County. In addition, much of the mainstem of the Lumber River has been designated as a state Natural and Scenic River, one of just four in North Carolina.

There are 2,283 miles of freshwater streams in the basin, most of which are supplementally classified as swamp waters. There are also 4,800 acres of waters along the coast that are classified as salt waters, about 90% of which are classified as SA and 10% as SB. According to a 1982 study conducted by the U.S. Soil Conservation Service, 58% of the land area was forested, 32.9 percent was in agriculture (cultivated, uncultivated and pasture lands), 3.3 percent of the basin was classified as developed, 2.3 percent was open water, 4.5 percent was in rural transportation and the remaining 1.9 percent was unclassified.

The basin has a population of about 259,539 and encompasses an area of 3,343 square miles in all or part of 10 different counties including Brunswick, Columbus, Bladen, Robeson, Cumberland, Hoke, Scotland, Richmond, Moore and Montgomery. Municipalities with a population of 5,000 or more (1990 census data) include Lumberton, Laurinburg, Southern Pines, Pinehurst and Whiteville. Population growth for the basin as a whole from 1980 to 1990 is estimated to be 7.9 percent. This compares to a statewide population increase of 12.7 percent for the same period.

The Lumber River Basin is actually composed of four, separate, major drainage areas or *watersheds*, as they are referred to in this plan. The basin is also subdivided into ten subbasins for management purposes by DEM. The subbasins are identified by 6-digit subbasin code numbers ranging from 03-07-50 to 03-07-59.

- **Lumber River Watershed** (Subbasins 03-07-50 through 54) - This is the largest of the four watersheds in the basin and the one from which the overall basin draws its name. Major tributaries include Drowning Creek, Raft Swamp, Big Swamp and Ashpole Swamp. The Lumber River flows into the Little Pee Dee River in South Carolina.

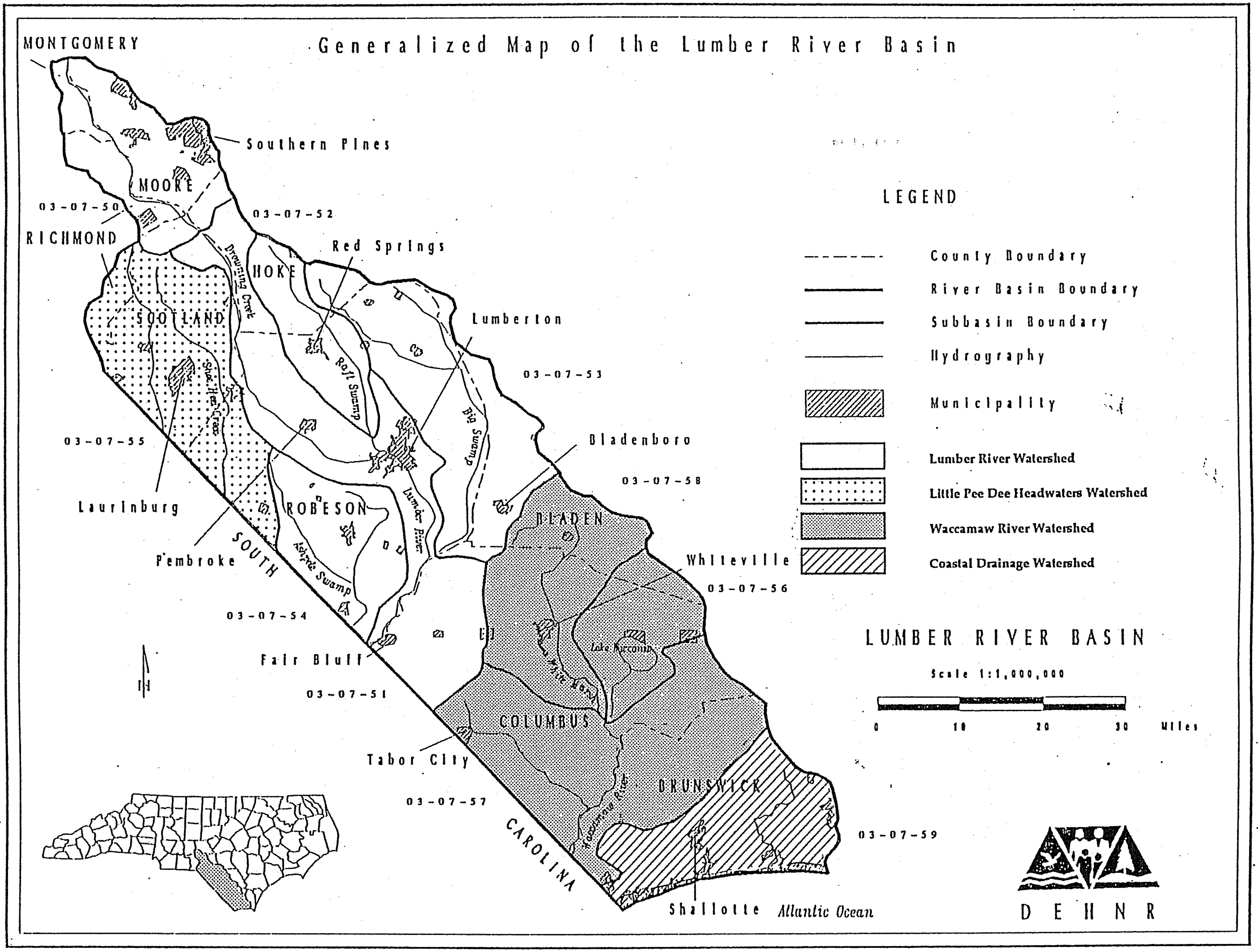

Figure 1 Map of the Lumber River Basin, Subbasins and Four Major Watersheds

- **Little Pee Dee Headwaters Watershed** (Subbasin 03-07-55) - This includes Shoe Heel and Gum Swamp Creeks as well as the City of Laurinburg. These streams flow into South Carolina and are major headwater tributaries of the Little Pee Dee River.
- **Waccamaw River Watershed** (Subbasins 03-07-56 to 58) - This watershed includes Lake Waccamaw, White Marsh Swamp and a portion of the Green Swamp. It flows southwestward into South Carolina joining the Great Pee Dee River downstream of the confluence of the Great Pee Dee and Little Pee Dee.
- **Coastal Area Watershed** (Subbasin 03-07-59) - This area includes that portion of the basin that flows to the Atlantic Ocean and includes the Shallotte and Lockwoods Folly Rivers.

Except for the coastal area watershed, all of these watersheds flow southwest into South Carolina and all drain either directly or indirectly into the Great Pee Dee River. The Great Pee Dee River, which also receives water from the entire Yadkin River Basin in central North Carolina, flows into the Atlantic Ocean near Georgetown, South Carolina.

WATER QUALITY IN THE LUMBER RIVER BASIN

Water quality is summarized below for each of the four major watersheds and their respective subbasins. Water quality monitoring program areas upon which the following summary is based include: benthic macroinvertebrate monitoring (primarily bottom-dwelling aquatic insect larvae), phytoplankton monitoring, aquatic toxicity monitoring, fish population and tissue monitoring, special chemical/physical water quality investigations, lake assessments, sediment oxygen demand monitoring, and ambient (chemical) water quality monitoring.

Lumber River Watershed (Subbasins 03-07-50 through 54)

The upper Lumber River watershed (subbasin 03-07-50) includes the headwaters of the Lumber River (Naked Creek and Drowning Creek) and is located entirely within the Sandhills ecoregion of the state. This region is characterized by swift-flowing sandy-substrate streams. These streams are generally of high water quality, which reflects both the sandy soil characteristics (which promote groundwater infiltration) and undisturbed watersheds. Naked Creek has been classified as Outstanding Resource Waters (ORW) and Drowning Creek has been classified as High Quality Waters (HQW) by the Environmental Management Commission.

Despite general high water quality in this subbasin, fish tissue analyses indicate elevated levels of mercury in several species of fish in three lakes associated with Aberdeen Creek. A March 1992 - April 1993 survey revealed elevated mercury levels in largemouth bass and yellow bullheads collected from Pit Links Lake, an impoundment located on a tributary Aberdeen Creek. Elevated mercury was also detected in bass from Watson Lake, which is an impoundment on Aberdeen Creek located upstream from the Pit Links tribuary. The mean for mercury in bass at this site was just under the FDA action level (1.0 mg/Kg). Several bass collected from Pages Lake, an impoundment on Aberdeen Creek located downstream from both Pit Links and Watson Lakes, showed mercury concentrations over 1.0 mg/Kg, but the mean concentration for bass in Pages Lake during this survey was 0.8 mg/Kg. Effective July 7, 1993, the State Health Director issued a fish consumption advisory for Pit Links, Pages and Watson Lakes recommending the consumption of largemouth bass be limited to two meals per month and that women of childbearing age and children avoid consumption. There are three superfund sites in close proximity to Pit Links and Pages Lakes. The *Fairway Six* site is located upstream from Pit Links Lake, and the *Twin Sites* and *Farm Chemical* sites are located not far from the west side of Pages Lakes. Despite the proximity of these sites to the lakes, their contribution to the elevated mercury levels in the lakes is not clear. Watson Lake, for example, is located a mile upstream from both of the other lakes and superfund sites, and yet it, too, had elevated mercury levels. These lakes continued to monitored.

Downstream of Drowning Creek, the Lumber River mainstem and its major tributaries (subbasin 03-07-51) have been intensively studied in relation to point source discharges; however, much less data is available for its smaller tributaries which are usually swamp-like and have very little flow. The upper Lumber River from its source, along the Hoke/Scotland County line, to US 301, just above Lumberton, has Excellent water quality, based on evaluation of benthic macroinvertebrates (mostly aquatic insects), and has been designated as High Quality Waters (HQW). Water quality ratings under past low flow conditions downstream of Lumberton are Fair or Poor. This appears to be resulting, at least in part, from a concentration of dischargers in the Lumberton area. The issue of water color from wastewater treatment plant dischargers in this section of the Lumber River has also been raised and efforts are being made to address it. Further downstream at Boardman, water quality recovery is occurring (Good ratings), and recovery appears to be complete by the time the river has reached Fair Bluff (Excellent rating). Water chemistry data reflects a similar pattern with high dissolved oxygen (DO) values in the upper Lumber River, lower values below Lumberton, and a subsequent rise of DO at Fair Bluff.

The Raft Swamp subbasin (03-07-52) and the Big Swamp subbasin (03-07-53), two major Lumber River tributaries in Hoke, Robeson and Bladen counties, have typical swamp-streams which exhibit very little visible current (under normal flow conditions) and tannin-colored water. Raft Swamp, Big Swamp and Big Marsh Swamp have Good-Fair water quality based on benthic macroinvertebrate data, while Gallberry Swamp was given a Good bioclassification.

The water quality and associated biological integrity of Ashpole Swamp (subbasin 03-07-54), a tributary of the Lumber River in Robeson County which flows directly into South Carolina, has been difficult to assess as evidenced by the indication of Good water quality in Ashpole Swamp based on the fisheries community, but only Fair water quality based evaluation of benthic organisms. Discharge from the Fairmont WWTP complicates evaluation of this swamp system, where low dissolved oxygen may occur naturally. Ambient water chemistry data from Ashpole Swamp has evidenced low dissolved oxygen values.

Little Pee Dee Headwaters Watershed (Subbasin 03-07-55)

This area includes the watersheds of Shoe Heel Creek and Gum Swamp, which are also within the Sandhills ecoregion and are characterized by streams with positive year round flow. These streams flow directly into South Carolina. Water quality has ranged from Excellent or Good in the lower sections of Shoeheel Creek and Gum Swamp (based on benthos data), to Good (above Laurinburg WWTP on Shoeheel Creek) or Good-Fair in upstream sections of these two streams. Fisheries data indicate Fair-Good water quality in Little Shoeheel Creek. Benthos data suggest a Good-Fair bioclassification for Leiths Creek. Lakes data have shown John's Pond, a private impoundment of Leiths Creek to be hypereutrophic. Maxton Pond, an old shallow millpond, is eutrophic and almost completely dominated by aquatic plants.

Waccamaw River Watershed (Subbasins 03-07-56 to 58)

Southeast of the Lumber River watershed is the Waccamaw River watershed, which also flows into the Great Pee Dee River in South Carolina. Small streams here tend to be ephemeral, with little or no flow during dry summer months. For this reason, most of the DEM sampling in this area has focused on Lake Waccamaw and the Waccamaw River. The shallow, clear waters and high water quality of Lake Waccamaw (third largest natural lake in the state) provide a unique habitat for a diverse aquatic community, including the federally endangered Waccamaw Silversides fish and two state-listed threatened mollusks, the Waccamaw Spike and the Savannah lilliput.

Water quality of the Waccamaw River ranges from Good-Fair just below the lake to Good and Excellent in the middle reaches, with a subsequent decline to Good and then Good-Fair near the South Carolina border, based on benthos data. Fish community analyses show a similar pattern in water quality. Water quality information is more difficult to assess on tributary streams, since most are non-flowing or slowly flowing swamp systems. Fisheries information indicated Good water quality for Grissett Swamp and Juniper Creek, and Fair-Good for Monie Swamp, and Fair for Toms Creek and Brown Marsh. Green Swamp and Juniper Creek constitute a unique area, but their fauna are quite different from the Waccamaw River due to very low pH levels.

Fish tissue analyses indicate elevated levels of mercury in several species of fish in the Waccamaw River watershed. Mean mercury concentrations exceeding the FDA action level of 1.0 mg/Kg have been detected in largemouth bass collected from 6 of 11 (54%) stations along the Waccamaw River drainage. Fish collected from Lake Waccamaw did not contain mean mercury above the FDA action level. Effective July 7, 1993 the State Health Director issued a fish consumption advisory for Big Creek and the Waccamaw River below Lake Waccamaw to the South Carolina Border recommending the consumption of largemouth bass be limited to two meals per month and that women of childbearing age and children avoid consumption. DEM is continuing evaluations in these areas to determine the extent of fish tissue contamination.

Coastal Area Watershed (Subbasin 03-07-59)

Finally, there are two rivers within the coastal plain ecoregion, the Lockwoods Folly and Shallotte Rivers, both of which are estuarine over a significant portion of their length, and flow directly into the Atlantic Ocean. Good or Good-Excellent water quality is suggested for the Lockwoods Folly River, Royal Oak Swamp and Cool Run using fish community data. However, closures of shellfishing waters due to elevated fecal coliform bacteria in the lower river are of concern. Benthos data also suggest a tentative Good rating for the Shallotte River. The intra-coastal waterway, the Lockwoods Folly River downstream from the mouth of Royal Oak Swamp and the Shallotte River downstream from Hwy 17 are all classified as SA waters, and are therefore, by definition, High Quality Waters.

WATER QUALITY USE-SUPPORT RATINGS / CAUSES AND SOURCES OF POLLUTION

Another important method for assessing surface water quality is to determine whether the quality is sufficient to support the uses for which the waterbody has been classified by the state. Uses, depending on the classification of the waters, refers to activities such as swimming, fishing, water supply and shellfishing. DEM has collected extensive chemical and biological water quality monitoring data throughout the Lumber basin as summarized above. All data for a particular water body have been assessed to determine its *use support* rating; that is whether the waters are *fully supporting*, *partially supporting* or *not supporting* their classified uses. A fourth rating, *support-threatened*, applies where all uses are currently being supported but that water quality conditions are marginal. Streams referred to as *impaired* are those rated as either partially supporting or not supporting. Use support ratings in the Lumber basin, described more fully in Chapter 4, are summarized below for freshwater streams, saltwaters (estuarine areas) and lakes.

Freshwater Streams and Rivers

Of the 2,283 miles of freshwater streams and rivers in the Lumber basin, use support ratings were determined for 87% or 1,987.4 miles with the following breakdown: 35% were rated fully supporting, 39% support-threatened, 10% partially supporting, 3% not supporting, and 13% nonevaluated. Waters rated as either partially supporting or not supporting their uses are considered *impaired*. In general, subbasins 50, 51, 52, 53, 55, 56, 58 and 59 had a majority of their streams which were either supporting or support-threatened. Subbasins 54 (Ashpole Swamp subbasin) and 57 (Lower Waccamaw River subbasin) had a larger percentage of streams which were partially supporting or not supporting.

Probable causes and sources of impairment were determined for about 65% of the impaired streams. Sediment was the most widespread cause of impairment, followed by metals (mercury in fish tissue) and low dissolved oxygen. Information on identifiable sources of impairment for stream miles rated partially or not supporting indicated that they were impaired by nonpoint rather than point sources. No source of impairment was identified for 107 miles of the impaired streams. Of this total, 17 miles were impaired based on *evaluated* information (evaluations from third party sources) and 90 miles, including 39.9 miles impacted by mercury (found in fish tissue), were based on monitored information (data collected by DEM). Agriculture was the most widespread nonpoint source, followed by hydrologic/habitat modification and urban activities. Subbasins 51 and 54 had the highest number of streams thought to be impaired by agriculture and subbasin 58 had the highest number attributed to urban activities (Pine Log Branch and Soules Swamp near Whiteville). Although no streams were identified as being "impaired" due to point sources, DEM has concerns regarding the impact of point source effluent on dissolved oxygen in swamp waters throughout the basin as discussed under the major issues section, below.

Salt (Estuarine) Waters

Use support determinations were made for all of the 4,800 acres of saltwater in the Lumber Basin. Fifty-five percent of the saltwaters were rated as fully supporting, and 45 percent were rated partially supporting. Fecal coliform bacteria was the only reported cause of impairment. Of the total 4800 acres of salt waters, 2152 were rated partially supporting. This rating was determined largely on the closure of shellfishing areas by the Division of Marine Fisheries as recommended by the NC Division of Environmental Health (DEH). DEH recommended closures based on finding consistently elevated levels of fecal coliform bacteria during their Shoreline Sanitation Surveys. DEM's ambient water quality stations located in coastal waters also indicated elevated levels of fecal coliforms and violations of additional criteria such as turbidity, copper, low dissolved oxygen, pH and temperature. Nonpoint source pollution is implicated as the primary source of impaired estuarine waters. Nonpoint sources include agriculture, urban runoff, septic tanks and marinas.

Lakes

Five lakes in the Lumber Basin, totaling 9256 acres, were monitored and assigned use support ratings. Of these five, one fully supported its use, two were support-threatened, and two were partially supporting. Lake Waccamaw fully supports its uses. It is a natural bay lake that is characterized by clear shallow water and low nutrient levels, and it supports several endangered species of fish and mollusks. Both Maxton Pond and Johns Pond are eutrophic and have elevated nutrient loading and infestations of aquatic plants. Lake Tabor's use support rating was recently changed from fully supporting to support-threatened because of a violation of the chlorophyll *a* standard and elevated nutrient levels. Pages Lake use support changed from fully supporting to partially supporting due to a fish consumption advisory. This advisory was based on the results of an analysis of fish tissue which indicated elevated levels of mercury as noted above.

PRIORITY WATER QUALITY CONCERNS AND RECOMMENDED MANAGEMENT STRATEGIES

Several water quality issues emerge as being of particular importance in light of factors such as the degree of water quality degradation, the value of the resources being impacted, the number of users affected or the sensitivity of the resources involved. Those issues considered most significant on a basinwide scale are presented below.

- <u>Lack of Assimilative Capacity for Oxygen-Consuming Wastes</u>
  Dissolved oxygen (DO) concentrations are naturally low throughout most of the Coastal Plain portion of Lumber River Basin due to swamp conditions (i.e., low flows, high

organic loadings, wide-ranging water temperatures, etc.). DEM is concerned with the additional stress placed upon these systems from discharges of oxygen-consuming wastes. As an example, there is a dissolved oxygen sag below Lumberton which approaches 3.0 mg/l which appears to be resulting, at least in part from a number of major dischargers located in the Lumberton area. Instream waste concentrations of treatment plant effluent are becoming dominant during low flow conditions. For most freshwater systems, DEM would use a computer model to help determine the waste assimilative capacity of the system and to then develop and recommend appropriate waste limits for dischargers. However, the model does not appear to be totally reliable in swamp systems. As a result, a permitting strategy has been developed based on best professional judgment taking into account a comprehensive review of available water quality data, stream conditions, water quality classifications, past permitting decisions and the need for accommodating future growth.

In light of these factors, DEM recommends a conservative management approach which limits further BOD waste loading (on a mass loading basis) to the river in order to maintain water quality standards and uses but which provides for expansion of existing facilities and permitting of new discharge facilities. Below are recommended BOD point source control strategies that are discussed more fully in Chapter 6.

Lumber River mainstem & tributaries (other than HQW classifications and zero flow streams) and including Big Shoe Heel Creek and Gum Swamp Creek Watersheds - Subbasins 03-07-50 through 03-07-55

1. Expansions: Increased flows allowed; waste loads to be maintained at existing permitted levels.

2. New Facilities: Facilities will receive limits of 15 mg/l BOD5 and 4 mg/l NH3-N. More stringent limits may be assigned on a case-by-case basis if deemed warranted for protection of water quality standards or maintaining existing uses.

Waccamaw River - Subbasins 03-07-56 through 03-07-58

1. Expansions: Increased flows allowed; waste loads to be maintained at existing permitted levels.

2. New Facilities: All facilities recommended to receive 5 mg/l BOD5 and 2 mg/l NH3N.

Coastal Area Watershed - Subbasin 03-07-59

Most waters in this subbasin are supplementally classified as HQW which carries with it point and nonpoint source control strategies and regulations. A portion of the Lockwoods Folly River is also subject to a water quality management plan approved by the Environmental Management Commission. New or expanding dischargers will be evaluated on a case-by-case basis.

o Swamp Water Quality Study

DEM will initiate studies to develop better tools to evaluate a swamp system's ability to assimilate waste flow. Since the large influx of flow from a pipe may also have a significant impact on these systems, DEM will also be investigating the potential for innovative outfall designs which will allow a slower/more evenly distributed release of effluent to the system. As noted above, this study has been necessitated by the uncertainty of existing predictive models to determine waste assimilative capacity of swamp waters.

- <u>Elevated Mercury Levels Found in Fish Tissues</u>
  As presented in the water quality summary, above, fish tissue analyses in lakes in the Aberdeen Creek area and in the Waccamaw River have revealed mean mercury concentrations exceeding the FDA action level of 1.0 mg/Kg. This, in turn, prompted the State Health Director to issue a fish consumption advisory, effective July 7, 1993, for these waters. The sources of mercury are not known at this time. Further studies are being done to better define the geographic scope of the problem areas.

- <u>Shellfish Water Closures due to fecal coliform bacteria</u>
  Forty-five percent (2152 acres) of the shellfish waters in the Lumber River Basin have been closed to harvesting by the NC Division of Marine Fisheries (DMF). These closures are based on the recommendations of the NC Division of Environmental Health's (DEH) Sanitation Branch which conducted shoreline sanitation surveys and found fecal coliform levels that exceeded safe levels for human consumption. Nonpoint source pollution associated with runoff from coastal development, agriculture, forest land, failing septic tanks and marinas is the primary source of impairment. Research is currently underway by Duke University's Marine Lab and DEH on the relationship of land-based activities to shellfish water closures along North Carolina's southern coastline. DEM recommends that interagency coordination be increased to develop a common understanding of the extent and nature of shellfish water closures, to identify existing weaknesses in shellfish water protection, and to outline a strategy of what would be required protect and reopen these waters, including the need for new rules or legislation. Staff will continue to evaluate the sources of bacterial contamination of shellfish waters and to develop necessary statutory and/or rule modifications to provide the necessary means to address such situations where standards are not being met nor uses being attained.

- <u>Sediment</u>
  Sediment is the most widespread cause of water quality use support impairment in the Lumber Basin, just as it is throughout the rest of the state. There are numerous programs administered by both state and federal agencies which have been developed to control sediment from agricultural land, construction sites, forestry operations and others (see Chapter 5). Without these programs, sediment-related water quality impacts would be expected to be much worse. However, despite the efforts of these programs, water quality degradation from sediment is still widespread. Therefore, DEM will continue to work with the agencies that administer these programs to find new or better ways of improving sedimentation control measures.

- <u>Identifying Sources of Impairment</u>
  There are approximately 107 miles of impaired freshwater streams in the basin for which no probable source of pollution has been identified. Future monitoring and assessment efforts will seek to identify the sources so that corrective actions can be recommended. Present source identification efforts for nonpoint sources have been hampered to some extent by lack of accurate land cover maps for the basin. The state Center for Geographic Information and Analysis (CGIA) is working on meeting this need. CGIA plans to have land cover maps and data available statewide in two to three years.

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CHAPTER 1

INTRODUCTION

1.1 PURPOSE OF THIS DOCUMENT

The purpose of the Lumber River Basinwide Water Quality Management Plan (Lumber River Plan) is to report to citizens, policy makers and the regulated community on

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

The Lumber River Plan presents recommended strategies for wastewater treatment plant waste limits and includes recommendations for reductions in nonpoint source loadings. Section 1.2 provides an overview of the plan format to assist in use and understanding of the document. The Lumber River Plan is the second in a series of basinwide water quality management plans that are being prepared by the Water Quality Section of the North Carolina Division of Environmental Management (DEM) under its new basinwide approach to water quality management. Plans will be prepared for all seventeen of the state's major river basins over the next five years as shown in Figure 1.1. An introduction to the basinwide management approach and a statewide basinwide permitting schedule are presented in section 1.3.

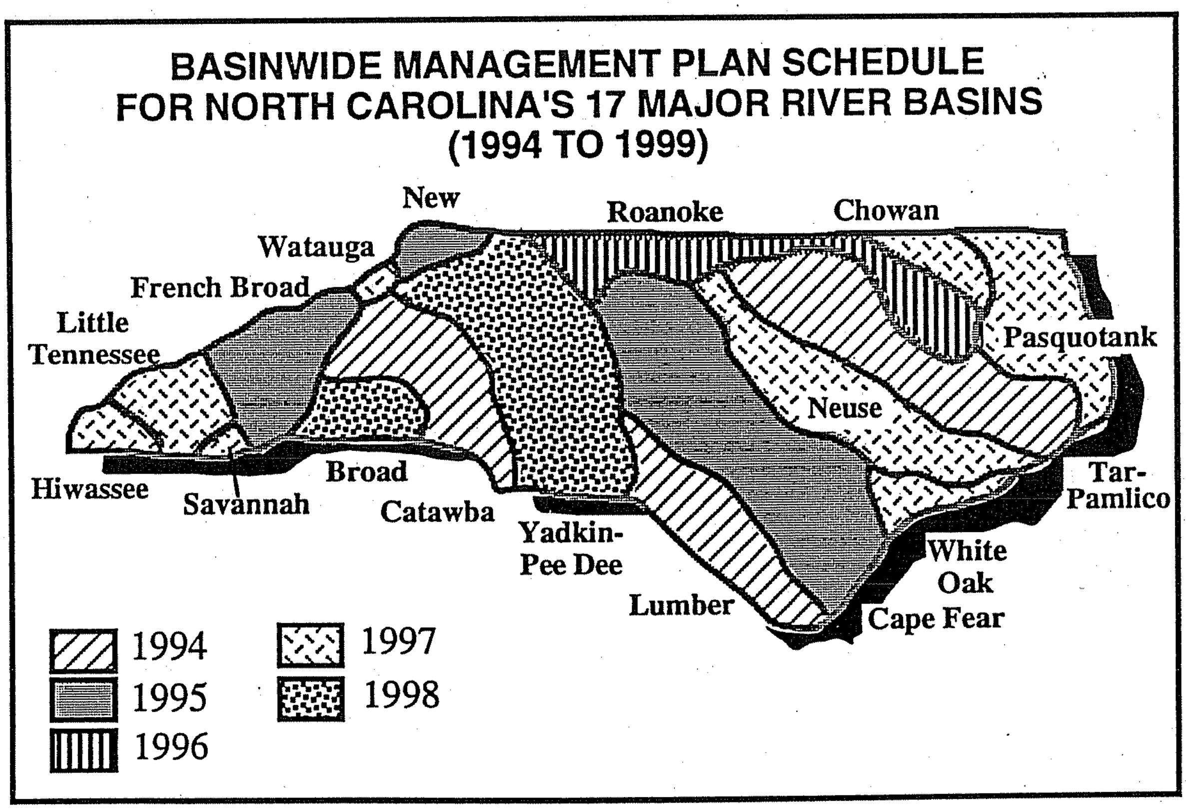

Figure 1.1 Basinwide Management Plan Schedule (1994 to 1999)

1.2 GUIDE TO USE OF THIS DOCUMENT

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

CHAPTER 2: General Basin Description - Physical features, population concentrations, land cover, animal operations and water uses in the Lumber River basin are summarized in seven sections. Section 2.1 provides an overview of the major features of the Lumber River basin such as location, rainfall, population, physiography and so on. Section 2.2 describes the hydrology of the basin and its four major watersheds. Section 2.3 presents a summary of land cover within the basin and its four major drainage areas based on information provided from the US Soil Conservation Service's 1982 National Resources Inventory. Section 2.4 describes population growth trends and densities by subbasin using 1970, 1980 and 1990 census data. The information is presented through a series of maps and tables. Section 2.5 discusses the Lumber River Natural and Scenic and plans by the Division of Parks and Recreation to obtain wetland along the river. Section 2.6 describes registered animal operation in the Lumber Basin. Section 2.7 discusses major water uses in the basin and introduces DEM's program of water quality classifications and standards.

CHAPTER 3: Causes and Sources of Water Pollution in the Lumber River Basin - Chapter 3 discusses the causes and probable sources of surface water degradation in the Lumber River basin. It describes both point and nonpoint sources of pollution as well as a number of important causes of water quality impacts including fecal coliform bacteria, sedimentation, biological oxygen demand (BOD), toxic substances, nutrients and others. It also discusses pollutant loading in the basin and generally discusses water quality problem areas.

CHAPTER 4: Water Quality Status in the Lumber River Basin - Data generated by DEM on water quality and biological communities are reviewed and interpreted in this chapter in order to assess current conditions and the status of surface waters within the Lumber River basin. Section 4.2 describes the various types of water quality monitoring conducted by DEM. Water information is summarized for each of the four major watersheds in the basin (and their respective subbasins) in sections 4.3 through 4.6. This information is then used to generate a summary of use support ratings for those surface waters that have been monitored or evaluated (sections 4.7 and 4.8).

CHAPTER 5: Existing Point and Nonpoint Source Pollution Control Programs - Chapter 5 summarizes the existing point and nonpoint source control programs available to address water quality problems. These programs represent the management tools available for addressing the priority water quality concerns and issues that are identified in Chapter 6. Chapter 5 also describes the concept of Total Maximum Daily Loads (TMDLs). TMDLs represent management strategies aimed at controlling point and nonpoint source pollutants on various water bodies within the basin.

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

1.3 NORTH CAROLINA'S BASINWIDE MANAGEMENT APPROACH

Introduction - Basinwide water quality management is a watershed-based management approach being implemented by DEM which features basinwide permitting, integrating of existing point and nonpoint source control programs, and preparing basinwide management plan reports.

DEM is applying this approach to each of the seventeen major river basins in the state as a means of better identifying water quality problems; developing appropriate management strategies; maintaining and protecting water quality and aquatic habitat; and assuring equitable distribution of waste assimilative capacity for dischargers. Other important benefits of the basinwide approach include improved efficiency, increased cost-effectiveness, better consistency and equitability, and improved public awareness and involvement in management of the state's surface waters.

A basinwide management plan document is prepared for each basin. The plans are circulated for public review and are presented at public meetings in each river basin. The management plan for a given basin is completed and approved preceding the scheduled date for basinwide permit renewals in that basin. The plans are then to be evaluated, based on followup water quality monitoring, and updated at five year intervals thereafter.

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

Water Quality Program Benefits - Several benefits of basinwide planning and management to North Carolina's Water Quality Program include: (1) *improved program efficiency,* (2) *increased effectiveness*, (3) better *consistency and equitability* and (4) *increased public awareness of the state's water quality protection programs*. First, by reducing the area of the state evaluated each year, monitoring, modeling and permitting efforts can be focused. As a result, *efficiency increases* and more can be achieved for a given level of funding and resource allocation. Second, the basinwide approach is in consonance with basic ecological principles of watershed management, leading to *more effective* water quality assessment and management. Linkages between aquatic and terrestrial systems are addressed (e.g., contributions from nonpoint sources) and all inputs to aquatic systems, and potential interactive, synergistic and cumulative effects, are considered. Third, the basinwide plans will provide a focus for management decisions. By clearly defining the program's long-term goals and approaches, these plans will encourage *consistent* decision-making on permits and water quality improvement strategies. Consistency, together with greater attention to long-range planning, in turn will promote a *more equitable* distribution of assimilative capacity, explicitly addressing the trade-offs among pollutant sources (point and nonpoint) and allowances for future growth.

Basinwide management will also facilitate integrating point and nonpoint source pollution assessment and controls. Once waste loadings from both point and nonpoint sources are established, management strategies can be developed to prevent overloading of the receiving waters and to allow for a reasonable margin of safety to ensure compliance with water quality standards.

Basinwide Planning Schedule - The following table presents the overall basin schedule for all 17 major river basins in the state. Included are the dates for permit reissuance the dates by which management plans are to be completed for each basin. Draft plans are due for completion a year in advance for public review.

Table 1.1 Basinwide Permitting and Planning Schedule for North Carolina's 17 Major River Basins (1993 through 1999).

Basin	Discharge Permits to be Issued	Target Date for Basin Plan Approval	Basin	Discharge Permits to be Issued	Target Date for Basin Plan Approval
Neuse	4/93	2/93 (approved)	**Roanoke**	1/97	7/96
			White Oak	6/97	1/97
Lumber	11/94	5/94 (approved)	**Savannah**	8/97	4/97
			Watauga	9/97	4/97
Tar Pamlico	1/95	12/94	**Little Tennessee**	10/97	5/97
Catawba	4/95	2/95	**Hiwassee**	12/97	5/97
French Broad	8/95	4/95			
New	11/95	6/95	**Chowan**	1/98	8/97
			Pasquotank	1/98	8/97
Cape Fear	1/96	8/95	**Neuse (2nd cycle)**	4/98	11/97
			Yadkin	7/98	1/98
			Broad	11/98	6/98

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

The earliest basin plans, such as the Neuse and Lumber, may not achieve all of the long-term objectives for basinwide management outlined above. However, subsequent updates of the plans, every 5 years, will incorporate additional data and new assessment tools (e.g., basinwide water quality modeling) and management strategies (e.g., for reducing nonpoint source contributions) as they become available.

Basinwide Plan Preparation, Review and Public Involvement - Preparation of an individual basinwide management plan is a five year process which is broken down into 15 steps in Figure 1.2 and is broadly described below.

Year	Activity
1 to 3	Water Quality Data Collection/Identification of Goals and Issues (steps 1 to 6): Year 1 entails identifying sampling needs and canvassing for information. It also entails coordinating with other agencies, the academic community and local interest groups to begin establishing goals and objectives and identifying and prioritizing problems and issues. Biomonitoring, fish community and tissue analyses, special studies and other water quality sampling activities are conducted in Years 2 and 3 by DEM's Environmental Sciences Branch (ESB) to provide information for assessing water quality status and trends throughout the basin and to provide data for computer modeling.
3 to 4	Data Assessment and Model Preparation (steps 7 to 9): Modeling priorities are identified early in this phase and are refined through assessment of water quality data from ESB. Data from special studies are then used by DEM's Technical

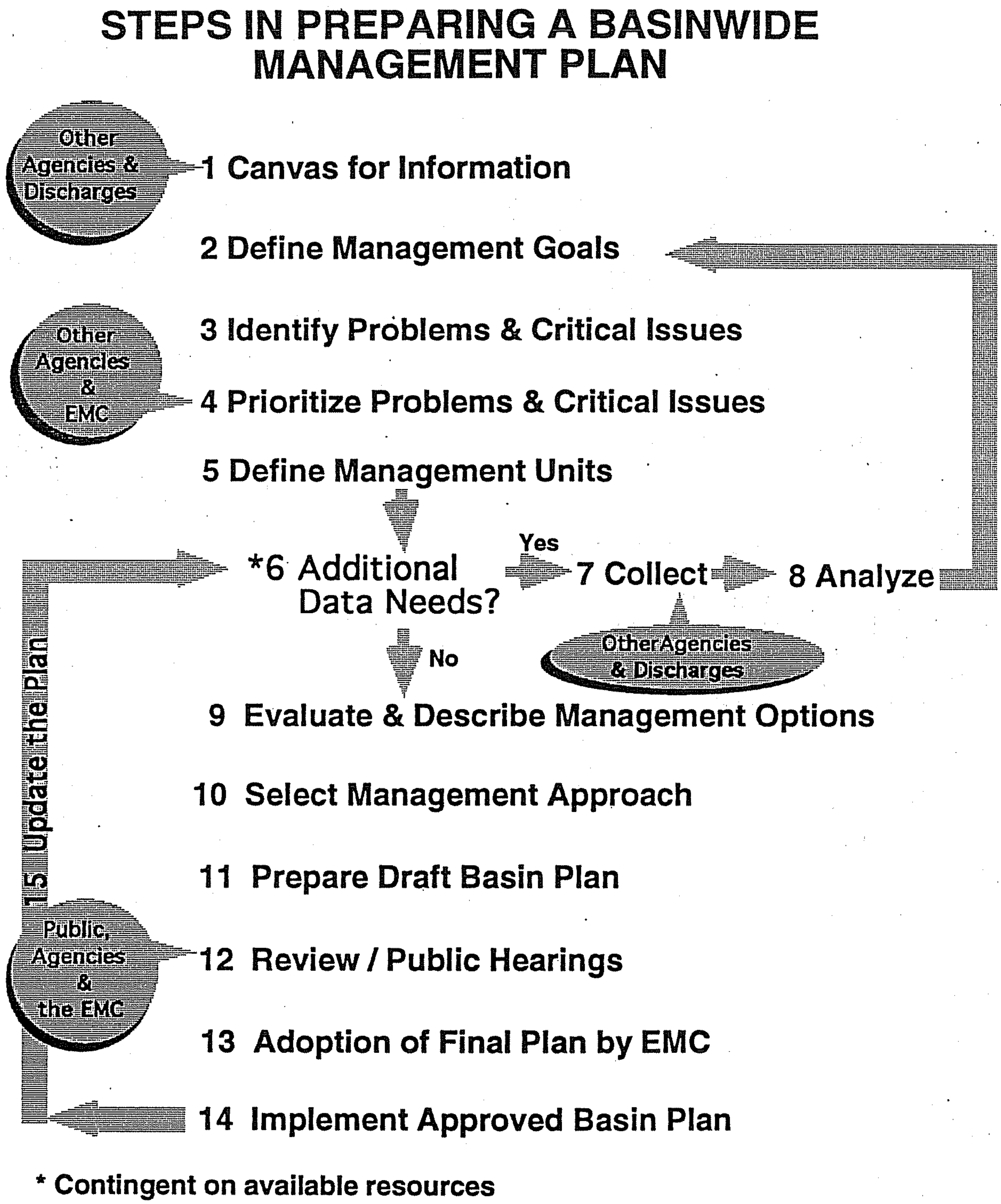

Figure 1.2 Major Steps and Information Transfers Involved in the Development of a Basinwide Management Plan.

Support Branch (TSB) to prepare models for estimating potential impacts of waste loading from point and nonpoint sources using the TMDL approach. Preliminary water quality control strategies are developed as the modeling results occurs with local governments, the regulated community and citizens groups during this period.

4 Preparation of Draft Basinwide Plan (Steps 9, 10 and 11): The draft plan, which is prepared by DEM's Planning Branch, is due for completion by the end of year 4. It is based on support documents prepared by ESB (water quality data) and TSB (modeling data and recommended pollution control strategies). Preliminary findings are presented at informal meetings through the year with local governments and interested groups, and comments are incorporated into the draft.

5 Public Review and Approval of Plan (Steps 12 thru 15): During the beginning of year 5, the draft plan, after approval of the Environmental Management Commission (EMC), is circulated for review, and public meetings are held. Revisions are made to the document, based on public comments, and the final document is submitted to the EMC for approval midway through year 5. Basinwide permitting begins at the end of the year 5. Step 15 involves updating of the plan during the next cycle five-year cycle.

Each basinwide management plan includes seven chapters: (1) An introduction describing the purpose and format of the plan, Water Quality Section responsibilities and enabling legislation; (2) a general basin description including land use, population trends, physiographic regions, and classifications and standards; (3) an overview of existing pollutant sources and loads within a basin and a more generic description of causes and sources of point and nonpoint source pollution for the lay person; (4) an assessment of the status of water quality and biological communities in the basin including use-support rating and 305(b) information; (5) a description of the TMDL approach and the state's NPDES and nonpoint source control programs; (6) priority water quality issues and recommended control strategies, including TMDLs; and (7) implementation, enforcement, and monitoring plans. This process is discussed in more detail in the basinwide program description document (Creager and Baker, 1991).

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

In large river basins, permits are to be issued by subbasin. Permitting in the Lumber River basin begins in November 1994 and ends in December, 1994 (Table 1.2).

TABLE 1.2. Subbasin NPDES Permit Schedule for Lumber Basin

Subbasin No.	Month/Year	Subbasin No.	Month/Year
03-07-50	November, 1994	**03-07-55**	December, 1994
03-07-51	November, 1994	**03-07-56**	December, 1994
03-07-52	December, 1994	**03-07-57**	December, 1994
03-07-53	December, 1994	**03-07-58**	December, 1994
03-07-54	December, 1994	**03-07-59**	December, 1994

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

1.4 BASINWIDE RESPONSIBILITIES WITHIN THE DEM WATER QUALITY SECTION

The Water Quality Section is the lead state agency for the regulation and protection of the state's surface waters. It is one of five sections located within the Division of Environmental Management. The other sections are Groundwater, Air Quality, Construction Grants and the Laboratory.

The primary responsibilities of the Water Quality Section are to maintain or restore an aquatic environment of sufficient quality to protect the existing and best intended uses of North Carolina's surface waters and to ensure compliance with state and federal water quality standards. The Section receives both state and federal allocations and also receives funding through permit fee receipts. Policy guidance is provided by the Environmental Management Commission. The Water Quality Section is comprised of over 200 staff members in the central and seven regional offices (Figure 1.3). The major areas of responsibility are water quality monitoring, permitting, planning, modeling (wasteload allocations) and enforcement.

The Central office is divided into four branches, with each branch being subdivided into two units. The Planning Branch is responsible for developing water quality standards and classifications, program planning and evaluation, and implementation of new water quality protection programs. The *Classifications and Stormwater Unit* handles surface water reclassifications, development of water quality standards, implementation of the water supply watershed program and development of the stormwater runoff program. The *Program Planning Unit* administers the nonpoint source and basinwide management programs, handles the 401 wetlands certification program, and coordinates EPA grants, state environmental policy act responsibilities and development of water quality rules and regulations.

The Operations Branch administers the pretreatment program as well as enforcement and compliance of the permits issued by the Technical Support Branch. The *Facility Assessment Unit* is responsible for permit enforcement, emergency response and the pretreatment program. The Operator Training and Certification Unit handles operator training and certification and facility classifications and ratings.

The Technical Support Branch is responsible for processing of discharge and nondischarge permits as well for preparing TMDLs and wasteload allocations for dischargers. The *Instream Assessment Unit* provides primary computer modeling support and is responsible for coordinating development of TMDLs and individual NPDES wasteload allocations. The *Permits and Engineering Unit* handles reviews and processing of permit applications for both discharging and nondischarging wastewater treatment systems.

The Environmental Sciences Branch is responsible for water quality monitoring, toxicity testing and biological laboratory certifications. The branch is divided into the Ecosystems Analysis Unit and the Aquatic Toxicology Unit. Major functions of the *Ecosystems Analysis Unit* include biological and chemical water quality monitoring and evaluation; evaluating reclassification requests; algal analyses; lakes assessments; fish tissue and fish communities studies; benthic macroinvertebrate community structure (biomonitoring); and special water quality studies including time of travel and biochemical and sediment oxygen demand. Major functions of the *Aquatic Toxicology Unit* include effluent toxicity testing, chemical toxicity evaluations, toxicity reduction evaluations (TRE), biological lab certification, biocide evaluations and related special studies.

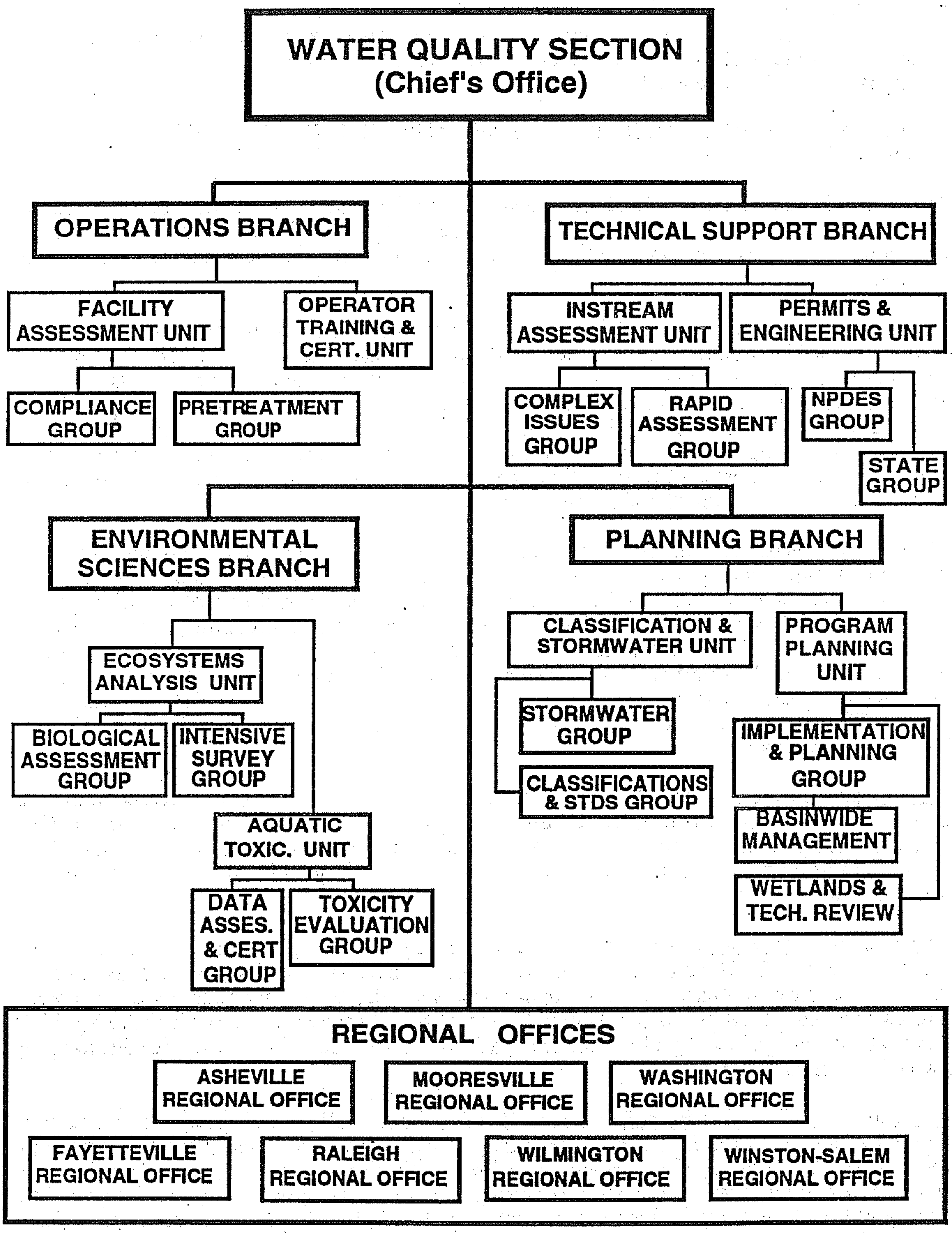

Figure 1.3 Organizational Structure of the DEM Water Quality Section

The seven Regional Offices provide support to the central office and carry out implementation activities. Activities include wetland reviews, compliance evaluations, permit reviews and facility inspections for both discharging and nondischarging systems, ambient water quality monitoring, state environmental policy act reviews, stream reclassification reviews, pretreatment program support and operator training and certification assistance. In addition, they respond to water quality emergencies such as oil spills and fish kills, investigate complaints and provide information to the public.

Although the basic structure and major responsibilities within the Water Quality Section will remain unchanged, implementation of a basinwide approach to water quality management will require some modification of and additions to the tasks currently conducted by each branch and the regional offices. The goal of basinwide planning is to increase the scope of management activities from a stream reach to the entire basin. Accomplishing this goal will require more complex water quality modeling, data interpretation, and data base management within the Water Quality Program. For example, more sophisticated methods of quantitatively estimating nonpoint source pollutant loads will need to be developed and applied. In addition, these quantitative estimates of nonpoint source loads will have to be integrated with information on point sources to determine the total loading to the system. Planning for future growth will require model projections of various potential future scenarios to properly allocate the remaining assimilative capacity and fairly distribute control requirements. Finally, the link between water quality data and model projections for the multiple stream reaches within a basin, and the overlay of other relevant types of information, such as land use, will require expanded use of geographic information systems (GIS) with coordination and support from this state's Center for Geographic Information Analysis (CGIA).

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

Authorities for some of the programs and responsibilities carried out by the Water Quality Section are derived from a number of federal and state legislative mandates outlined below.

1.5.1 Federal Authorities

The major federal authorities for the state's water quality program are found in various sections of the Federal Clean Water Act (CWA).

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

1.5.2 State Authorities

The following authorities are derived from North Carolina state statutes. Many of these statutes have been created in response to the federal legislation.

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

REFERENCES CITED: CHAPTER 1

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

CHAPTER 2

GENERAL BASIN CHARACTERISTICS AND WATER QUALITY CLASSIFICATIONS AND STANDARDS

2.1 LUMBER RIVER BASIN OVERVIEW

The Lumber River Basin lies along the North Carolina/South Carolina border at the southeast corner of the state stretching about 150 miles from the Atlantic Ocean coastline in Brunswick County to the Sandhills region and in southern Moore and Montgomery Counties (Figure 2.1). The Lumber Basin is the home of Calabash seafood in Brunswick County; the vast Green Swamp and Lake Waccamaw in Columbus County; and world-renowned golf resorts in the vicinity of Southern Pines in southern Moore County. In addition, much of the mainstem of the Lumber River has been designated as a state Natural and Scenic River, one of just four in North Carolina.

The basin has a population of about 259,539 and encompasses an area of 3,343 square miles in all or part of 10 different counties including: Brunswick, Columbus, Bladen, Robeson, Cumberland, Hoke, Scotland, Richmond, Moore and Montgomery. Municipalities with a population of 5,000 or more (1990 census data) include Lumberton, Laurinburg, Southern Pines, Pinehurst and Whiteville. Population growth for the basin as a whole from 1980 to 1990 is estimated to be 7.9 percent. This compares to a statewide population increase of 12.7 percent for the same period. Population and growth rates are discussed in more detail in section 2.4.

There are 2,247 miles of freshwater streams in the basin, most of which are supplementally classified as swamp waters. There are also 4,800 acres of waters along the coast that are classified as *salt* waters, approximately 90% of which are classified SA and the remainder SC. According to a 1982 study conducted by the United States Department of Agriculture (USDA) Soil Conservation Service (SCS), 58 percent of the land area was forested, 32.9 percent was in agriculture (cultivated, uncultivated and pasture lands) and 3.3 percent of basin was classified as developed.

Average rainfall in the Lumber basin ranges from a low of about 45 inches per year in the central portion to over 50 inches per year near the coast and towards the Sandhills. The average July temperature is a little over 80° F and the Coastal Plain portion of the basin has an evapotranspiration rate of greater than 42 inches per year. This is the highest in the state and constitutes over 70 percent of the average annual rainfall.

The Lumber basin is divided into two major physiographic regions: the Piedmont (Sandhills) and the Coastal Plain. The dividing line is located along a subtle escarpment called Coats Scarp which extends through central Hoke, Scotland and northern Cumberland Counties. The Piedmont is located northwest of this line and the Coastal Plain is located to the southeast (Figure 2.2). That portion of the Piedmont encompassed by the Lumber Basin is known as the Sandhills. The Sandhills are underlain by the Tuscaloosa geologic formation which is composed of light-colored sands and clays. It is overlain by well-drained sandy soils including the Lakeland and Wagram soil types. These soils have a high percolation rate which allows for ample recharge of natural groundwater reserves. This, in turn, benefits local streams which receive substantial flow from groundwater discharges that feed streams with high quality water during low rainfall periods. The water quality of streams in this region is generally good to excellent. Use of soils for wastewater treatment is somewhat limited by steep to moderate slopes and the low filtering capacity of the

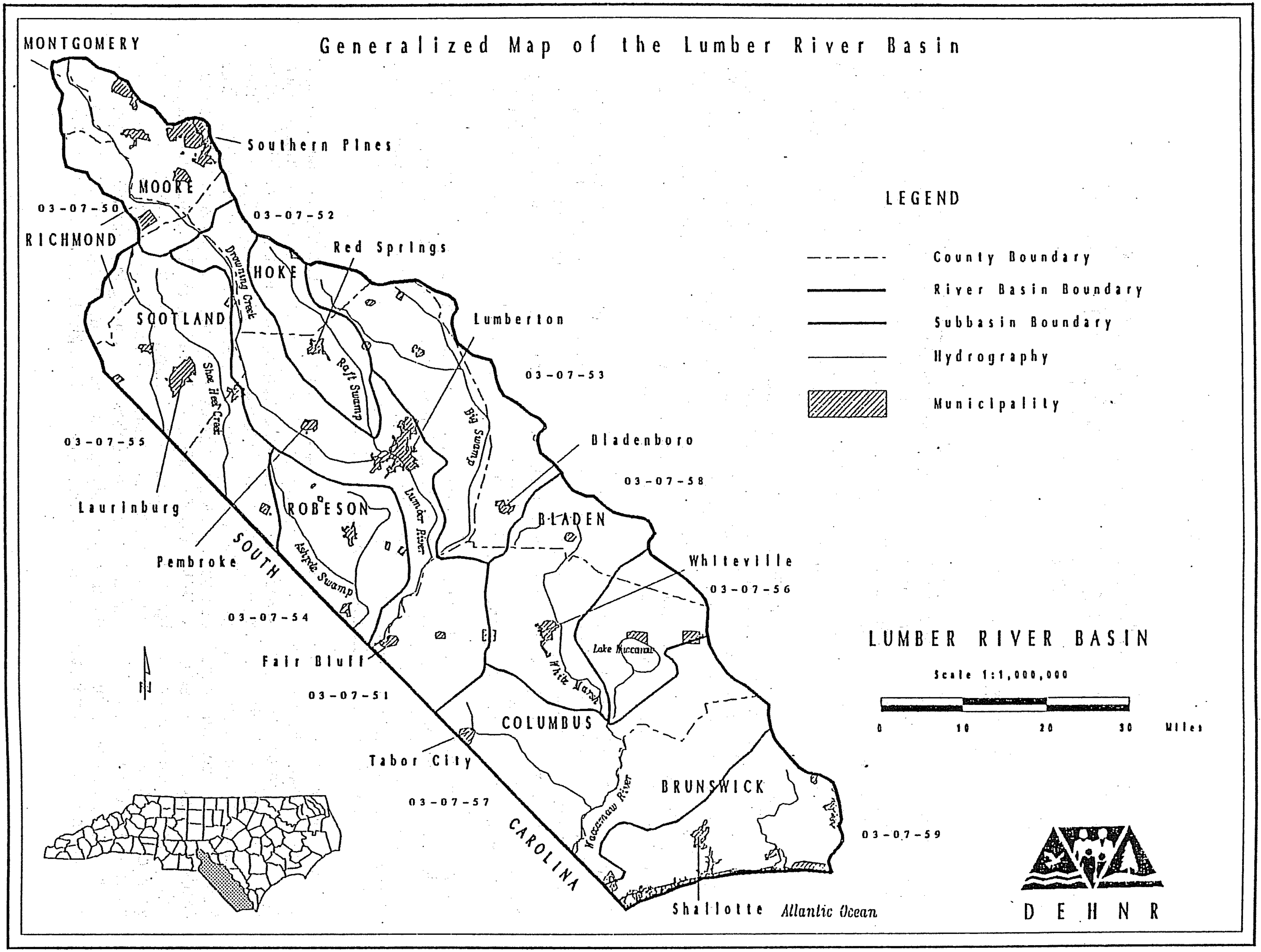

Figure 2.1 Generalized Map of the Lumber River Basin

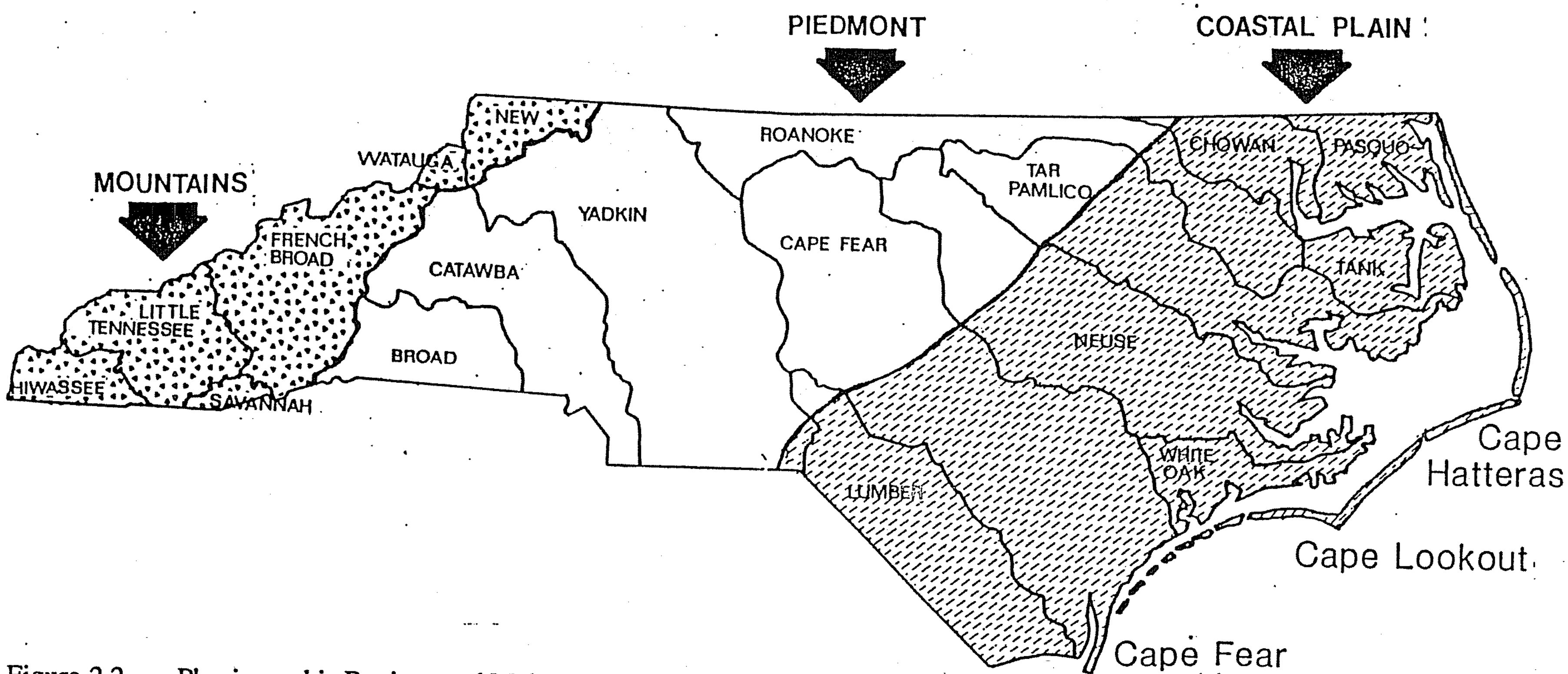

Figure 2.2 Physiographic Regions and Major River Basins of North Carolina

sandy soils. Care must taken in land development and use of these soils for wastewater treatment to prevent contamination of the underlying groundwater.

The Coastal Plain region is subdivided into two subregions called the Inner and Outer Coastal Plain. The divide occurs along Surry Scarp which runs southwest to northeast through Columbus County (west of Lake Waccamaw) and southern Bladen County. The inner Coastal Plain, which is underlain by the Black Creek geologic formation, extends southeast from the Sandhills to the Surry Scarp. It includes the Lumber River watershed and its tributaries (downstream from the Sandhills) as well as streams in eastern Scotland County that flow into South Carolina (such as Gum Swamp and Shoe Heel Creeks). The outer Coastal Plain extends southeastward from the Surry Scarp to the Atlantic Ocean and is underlain by the Pee Dee formation. It includes most the Waccamaw River drainage, Green Swamp, small coastal rivers and the estuarine area of the basin.

The Coastal Plain region, as a whole, is generally characterized by relatively flat low-lying terrain, sluggish "blackwater streams" that are bordered by swamps and bottomland forests, and poorly drained soils. Streams flowing through swampland areas are naturally tea-colored by tannic acid from decomposing plant material, hence the name "blackwater". The differences between the Inner and Outer Coastal Plain subregions are a matter of degree. The terrain is flatter in the outer Coastal Plain, elevations are lower, streams are bordered by wider wetland floodplains and soils are wetter, thereby posing limitations on a wider array of land uses. Roughly 75% of the land area in the outer Coastal Plain is forested. Predominant soil types include Pamlico, Bayboro, Leon, Muck-Peat and Swamp-Tidal marsh. Elevations are a little higher in the Inner Coastal Plain, and soils are more conducive to agriculture and other uses, although they still generally require drainage for farming, and most pose limitations for wastewater treatment. With the exception of the Norfolk and Orangeburg soils in southeastern Hoke, Scotland and southern Robeson Counties, most soils pose moderate to severe limitations for wastewater disposal because of high water tables, slow percolation rates and/or flooding. A good indicator of the extent of use limitations posed by saturated soil conditions is the percentage of hydric soils in a given area.

Table 2.1 presents the percentage of hydric soils for 8 of the 10 counties in the Lumber Basin. Those four counties comprising most of the coastal plain portion of the basin (Bladen, Brunswick, Columbus and Robeson) have, as a whole, over 50% of their land area classified as hydric soils based on USDA soil classifications. The water content of hydric soils is generally sufficient to support wetlands vegetation. In fact, the presence of hydric soils was used in a 1991 study (NC Department of Environment, Health and Natural Resources, 1991) to determine the extent of wetlands prior to European settlement. Today, despite drainage for agriculture and forestry, a large percentage of the land area in the lower Lumber Basin is still in wetlands. These wetlands serve important functions in providing habitat for wildlife, retaining flood waters, protecting water quality, and more. Wetlands values for water quality protection and related regulatory programs are presented in Section 5.3.8 in Chapter 5.

Table 2.1 Percentage of Land Surface in Hydric Soils by County in the Lumber Basin

County	Hydric Soils	County	Hydric Soils
Bladen	54.1%	Hoke	18%
Brunswick	58.3%	Richmond	17.6%
Columbus	57.7%	Robeson	47%
Cumberland	33.8%	Scotland	26.7%

The Coastal Plain is underlain by deep sands and limestone. Groundwater is abundant and is a major water supply source in the basin, especially southeast of Lumberton where there are few surface water intakes. In light of the abundance of groundwater, the flat terrain and the high evapotranspiration rate, there are relatively few surface water impoundments and most major streams are free-flowing. The eastern half of the basin does, however, have several natural lakes, the most prominent of which is Lake Waccamaw. These lakes are associated with Carolina Bays, intriguing natural landscape features of unknown origin found throughout the Coastal Plain of North Carolina and other southern Atlantic Coast states.

2.2 BASIN HYDROLOGY AND THE FOUR MAJOR WATERSHEDS

Despite its name, the Lumber River Basin is actually composed of four separate river systems or *watersheds*, as they will be referred to in this plan (Table 2.1). The largest of the four watersheds is the **Lumber River Watershed** from which the overall basin draws its name. The others include the **Waccamaw River Watershed**, the **Little Pee Dee Headwaters Watershed**, which includes Shoe Heel and Gum Swamp Creeks, and the **Coastal Area Watershed** which includes the Shallotte and Lockwoods Folly Rivers. All of these watersheds, except the coastal area watershed, flow southwest into South Carolina and are tributaries, directly or indirectly, of the Great Pee Dee River which flows into the Atlantic Ocean near Georgetown, SC (Figure 2.3). The Coastal Area Watershed flows to the Atlantic Ocean through several inlets.

The four watersheds correspond with *8-digit hydrologic units* under a watershed classification system used by the U.S. Water Resources Council and U.S. Geological Survey (USGS) (Figure 2.4). In addition, several of these watersheds are further subdivided for management purposes by DEM into subbasins denoted by 6-digit numbers (03-07-50 through 03-07 59) as shown in Figure 2.1 and presented in Table 2.2. The Lumber watershed has five subbasins, the Waccamaw has three, and the others have one. There are ten subbasin in all in the Lumber basin. Each of these four watersheds is discussed in more detail in sections 2.2.1 through 2.2.4, below.

Table 2.2 Hydrologic Divisions in the Lumber River Basin

Watershed Name and Major Tribs	USGS 8-digit Hydrologic Units (Figure 2.3)	DEM Subbasin 6-digit codes (Figure 2.1)
Lumber River and Tributaries	**03040203**	**03-07-50, 51,52, 53 and 54**
Naked Creek	"	03-07-50
Drowning Creek	"	"
Lumber River Mainstem	"	03-07-50 and 51
Raft Swamp	"	03-07-52
Big Swamp	"	03-07-53
Ashpole Swamp	"	03-07-54
Little Pee Dee River Headwaters	**03040204**	**03-07-55**
Shoe Heel Creek	"	"
Bridge Creek	"	"
Gum Swamp	"	"
Waccamaw River and Tributaries	**03040206**	**03-07-56, 57 and 58**
Lake Waccamaw and Waccamaw River down to White Marsh	"	03-07-56
Lower Waccamaw River below White Marsh confluence	"	03-07-57
White Marsh	"	03-07-58
Coastal Drainage	**03040207**	**03-07-59**
Lockwoods Folly River	"	"
Shallotte River	"	"
Calabash River	"	"

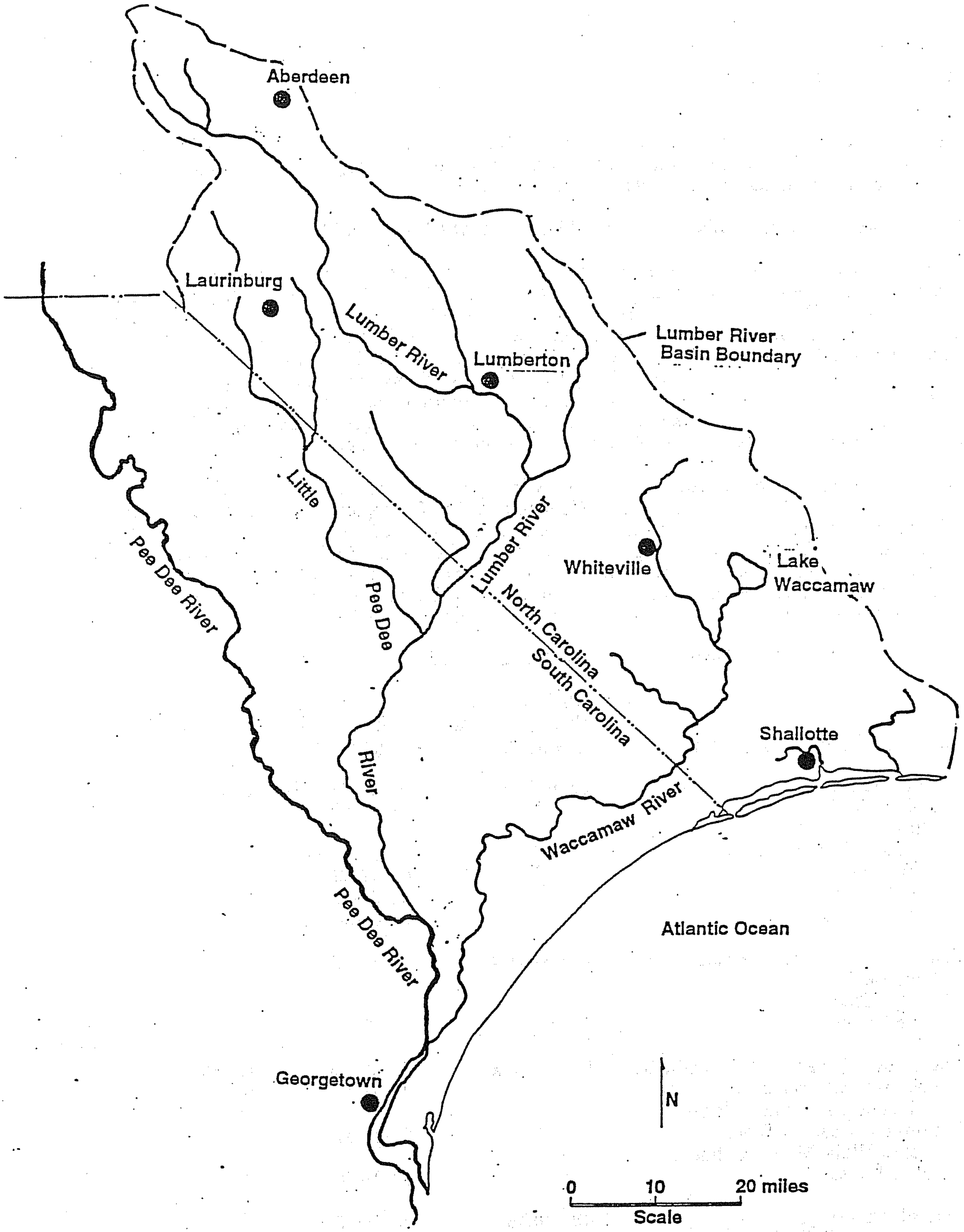

Figure 2.3 The Lumber Basin in North and South Carolina

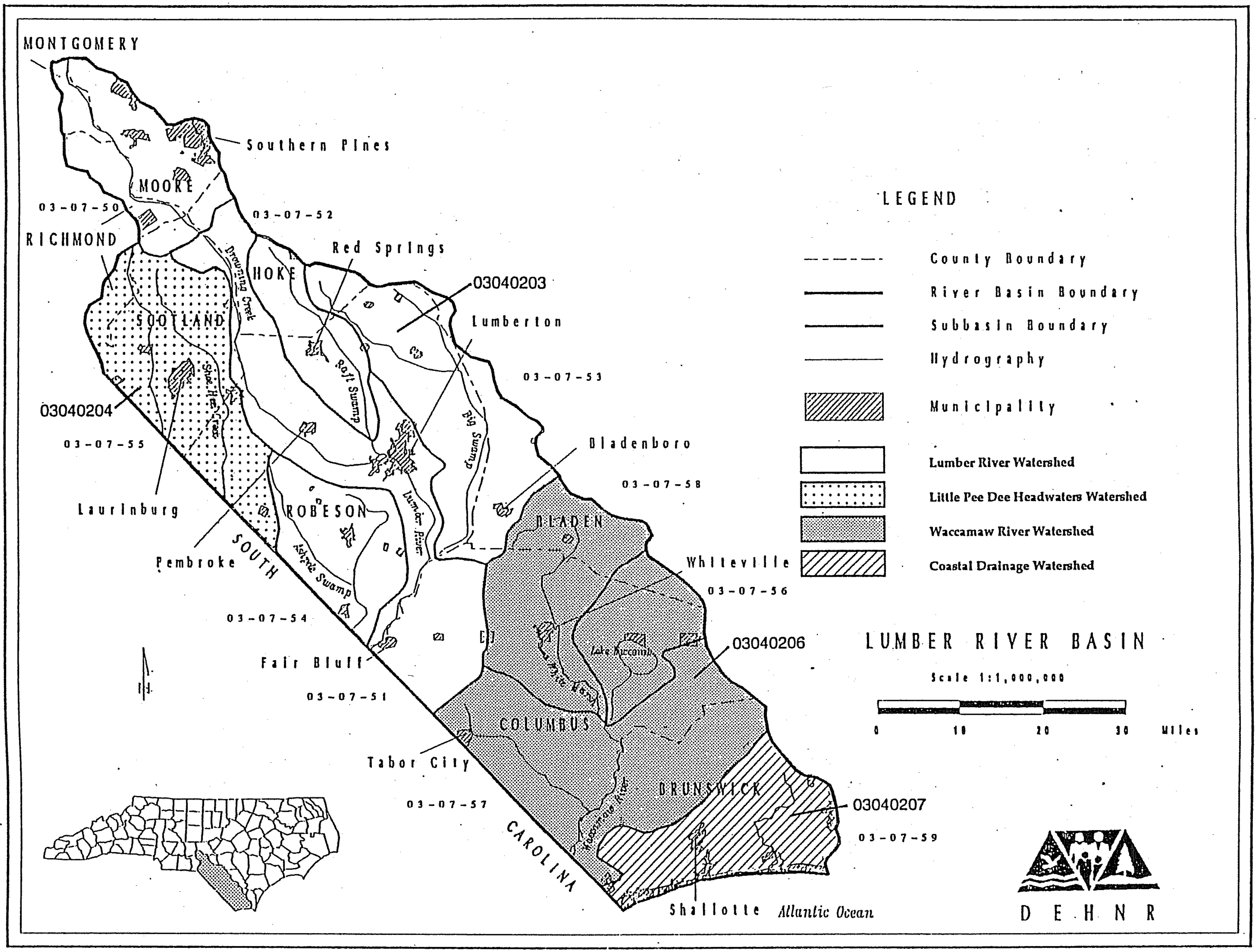

Figure 2.4 Watershed/8-digit SCS Hydrologic Unit Map of the Lumber River Basin

2.2.1 Lumber River Watershed

With a drainage area of 1,043,300 acres, the Lumber River watershed is the largest of the four watersheds in the overall Lumber River Basin. It is formed at the confluence of Buffalo Creek with Drowning Creek along the Scotland and Hoke County line near SR 1424. This point of origin generally coincides with the transitional boundary between the Sandhills and Coastal Plain regions. Other counties in the Lumber River watershed include Columbus, Robeson, Bladen, Cumberland, Moore, Montgomery and Richmond.

From its origin, the Lumber flows for approximately 115 miles past Maxton, Lumberton, and Fair Bluff before crossing into South Carolina where it joins the Little Pee Dee River. It has been designated as a state Natural and Scenic River from SR 1412 in Scotland County downstream to the South Carolina line (Kim Huband, Per. comm.). Principal tributaries of the Lumber River include Raft Swamp, Big Swamp and Ashpole Swamp. The Lumber River watershed is divided into five subbasins. Subbasin 03-07-50 includes most of Drowning Creek and its tributaries as well as most of the Sandhills portion of the basin. It features the only outstanding resource waters (ORW) in the basin, Naked Creek, and is generally characterized with high quality streams. Subbasin 03-07-52 includes the Raft Creek drainage area and the town of Red Springs. Subbasin 03-07-53 encompasses the Big Swamp drainage area. Subbasin 03-07-54 includes the Ashpole Swamp drainage area in North Carolina. Ashpole Swamp is a tributary of the Lumber but its confluence is in South Carolina. Subbasin 03-07-51 includes the entire Lumber River mainstem in North Carolina, its minor tributaries and the lower portion of Drowning Creek.

2.2.2 Little Pee Dee River Headwaters Watershed

The Little Pee Dee River headwaters watershed is approximately 255,100 acres in size and encompasses most of Scotland County, including the Town of Laurinburg. It also includes small portions of eastern Richmond and western Robeson Counties. Principal streams include Big Shoe Heel Creek, Bridge Creek and Gum Swamp Creek. These creeks flow southwest and join with other creeks in South Carolina to form the Little Pee Dee River.

2.2.3 Waccamaw River Watershed

The Waccamaw River watershed covers approximately 804,400 acres in Columbus, western Bladen and northern Brunswick Counties. It includes Lake Waccamaw and a large portion of Green Swamp, most of which has been converted from pocosin wetlands to pine plantations. Roughly 63 percent of the watershed is forested and 27 percent is in agriculture, mostly cropland. The Waccamaw River originates at Lake Waccamaw and flows southwest through forested wetlands into South Carolina, eventually joining with the Great Pee Dee River.

This watershed is subdivided into three subbasins. Subbasin 03-07-56 includes the drainage area for Lake Waccamaw and that portion of the Waccamaw River downstream of the lake but upstream of the confluence with White Marsh. Subbasin 03-07-58 includes the entire White Marsh drainage area upstream from the Waccamaw River. Subbasin 03-07-57 includes the drainage area for the lower Waccamaw River. Lake Waccamaw is an important natural resource serving as both a popular recreation and vacation area as well as home to several threatened or endangered species including a federally endangered fish, the Waccamaw Silversides (see Section 6.2.2) and two state-threatened mollusks, Savannah lilliput (*Toxolasma pullus*) and Waccamaw spike (*Ellipto waccamawensis*). These species are found in the lake as well as in Big Creek and its tributaries.

2.2.4 Coastal Area Watershed

This watershed covers a 131,400-acre area. It encompasses the southern half of Brunswick County west of Long Beach including Bolivia, the county seat. It is made up of several small stream systems which flow southward from Green Swamp to the ocean including the Lockwoods Folly River, Shallotte River and the Calabash River. The watershed is 78 percent forested, much of which is in pine plantations. The mainland is protected by a line of barrier islands separated by a series of inlets: Lockwoods Folly Inlet, Shallotte Inlet, Tubbs Inlet and Browns Inlet (in South Carolina). The islands support several popular vacation communities including Sunset Beach, Ocean Isle Beach and Holden Beach. Landward of the islands is a narrow estuary and the Intracoastal Waterway. Calabash (population 1,217) and Shallotte (population 1,073) are the largest municipalities in this watershed and are important commercial fishing ports. They are also experiencing explosive growth. From 1980 to 1990, population increased by 57 percent for Shallotte and 845 percent for Calabash.

2.3 LAND COVER

Land cover information in this section is derived from the federal Soil Conservation Service's (SCS) National Resources Inventory (NRI) of 1982. The SCS is an agency of the US Department of Agriculture (USDA). The NRI is a multi-resource national inventory based on soils and other resource data collected at scientifically selected random sample sites. According to the SCS 1992 NRI Instructions booklet (SCS, 1992), the 1982 NRI was the most comprehensive study of our nation's nonfederal natural resources ever conducted. It is considered accurate to the 8-digit hydrologic unit scale (SCS, 1993).

Land cover types identified by the NRI as occurring in the Lumber Basin include cultivated cropland, uncultivated cropland, pastureland, forest land, minor lands, urban and built-up land, rural transportation, small water areas and census waters. Table 2.3 summarizes acreages and percent cover of these land cover types for the basin as a whole and for the four major watershed areas (8-digit hydrologic units). Table 2.4 provides a description of each of these cover types.

Table 2.3 Land Cover in the Lumber River Basin by 8-Digit USGS Hydrologic Units (USDA, Soil Conservation Service - 1982 NRI)

	Lumber 03040203		**Little Pee Dee 03040204**		**Waccamaw 03040206**		**Coastal 03040207**			
LAND COVER	Acres (1000s)	%	Acres (1000s)	%	Acres (1000s)	%	Acres (1000s)	%	TOTAL ACRES (1000s)	% of TOTAL
Cult. Crop	374.8	35.9	41.2	16.2	215.6	26.8	17.4	13.2	649.0	29.0
Uncult. Crop	16.4	1.6	9.6	3.8	0.0	0.0	0.0	0.0	26.0	1.2
Pasture	20.4	2.0	15.6	6.1	2.1	0.3	0.0	0.0	38.1	1.7
Forest	519.4	49.8	164.7	64.6	508.6	63.2	103.3	78.6	1296.0	58.0
Minor Land	18.7	1.8	2.8	1.1	17.1	2.1	3.2	2.4	41.8	1.9
Urban/built-up	41.0	3.9	9.1	3.6	18.8	2.3	4.8	3.7	73.7	3.3
Rural Trans.	38.4	3.7	9.1	3.6	11.3	1.4	0.0	0.0	58.8	2.6
Sm. Water Areas	7.1	0.7	2.7	1.1	2.4	0.3	2.7	2.1	14.9	0.7
Census Water	7.1	0.7	0.3	0.1	28.5	3.5	*0.0	0.0	35.9	1.6
Totals	1043.3	100.0	255.1	100.0	804.4	100.0	131.4	100.0	2234.2	100.0
% of Total Basin		46.7		11.4		36.0		5.9		100.0

Land cover in the basin, as presented in Table 2.3, is dominated by forest land (58%) and agriculture (31.9%) which jointly comprise roughly 90% of the land/water surface area in the entire basin. There is little urban development (3.3% of basin) and open water (2.3% of basin). The remaining 4.5% of land cover is in rural transportation (2.6%) and minor lands (1.9%).

Table 2.4 Description of Land Cover Types (1982 NRI - USDA SCS)

Land Cover Type (No.)	Land Cover Description
1) Cultivated Cropland	Land used for the production of adapted crops for harvest, including row crops, small-grain crops, hay crops, nursery crops, orchard crops, and other specialty crops. The land may be used continuously for these crops or they may be grown in rotation with grasses and legumes.
2) Uncultivated Cropland	Summer fallow, aquaculture in crop rotation, or other cropland not planted (may include cropland in USDA set-aside or similar short-term program).
3) Pastureland	Land used primarily for production of introduced or native forage plants for livestock grazing. This category includes land that has a vegetative cover of grasses, legumes, and /or forbs, regardless of whether or not it is being grazed by livestock.
4) Forest Land	Land at least 10 percent stocked by single-stemmed trees of any size which will be at least 4 meters at maturity, and land bearing evidence of natural regeneration of tree cover and not currently developed for nonforest use. Ten percent stocked, when viewed from a vertical direction, is a canopy cover of leaves and branches of 25 percent or greater. The minimum area for classification of forest land is 1 acre, and the area must be at least 1,000 feet wide.
5) Minor Land	Lands not classified into one of the other categories.
6) Urban and Built-up Land	Includes airports, playgrounds with permanent structures, cemeteries, public administration sites, commercial sites railroad yards, construction sites, residences, golf courses, sanitary landfills, industrial sites, sewage treatment plants, institutional sites, water control structure spillways and parking lots. Highways, railroads, and other transportation facilities are considered part of this category if surrounded by other urban and built-up areas. Tracts of less than 10 acres that do not meet this categories definitions (e.g., small parks or water bodies) but are completely surrounded by urban and built-up lands are placed in this category.
7) Rural Transportation	Consists of all highways, roads, railroads, and associated rights-of-way outside Urban and Built-up areas; private roads to farmsteads, logging roads; and other private roads (but not field lanes).
8) Small Water Areas	Water bodies less than 40 acres in size and streams less than one-half mile wide.
9) Census Water	Large water bodies consisting of lakes and estuaries greater than 40 acres and rivers greater than one-half mile in width.

2.4 POPULATION AND GROWTH TRENDS IN THE BASIN

Population growth information is based on 1970, 1980 and 1990 census data. Information is summarized in Figures 2.5 and 2.6 and in Table 2.5. The overall population of the basin, based on 1990 census data, is estimated to be 259,539. Most of the population is concentrated in the upper basin (Figure 2.5). Figures 2.5 and 2.6, which are discussed in more detail below, are

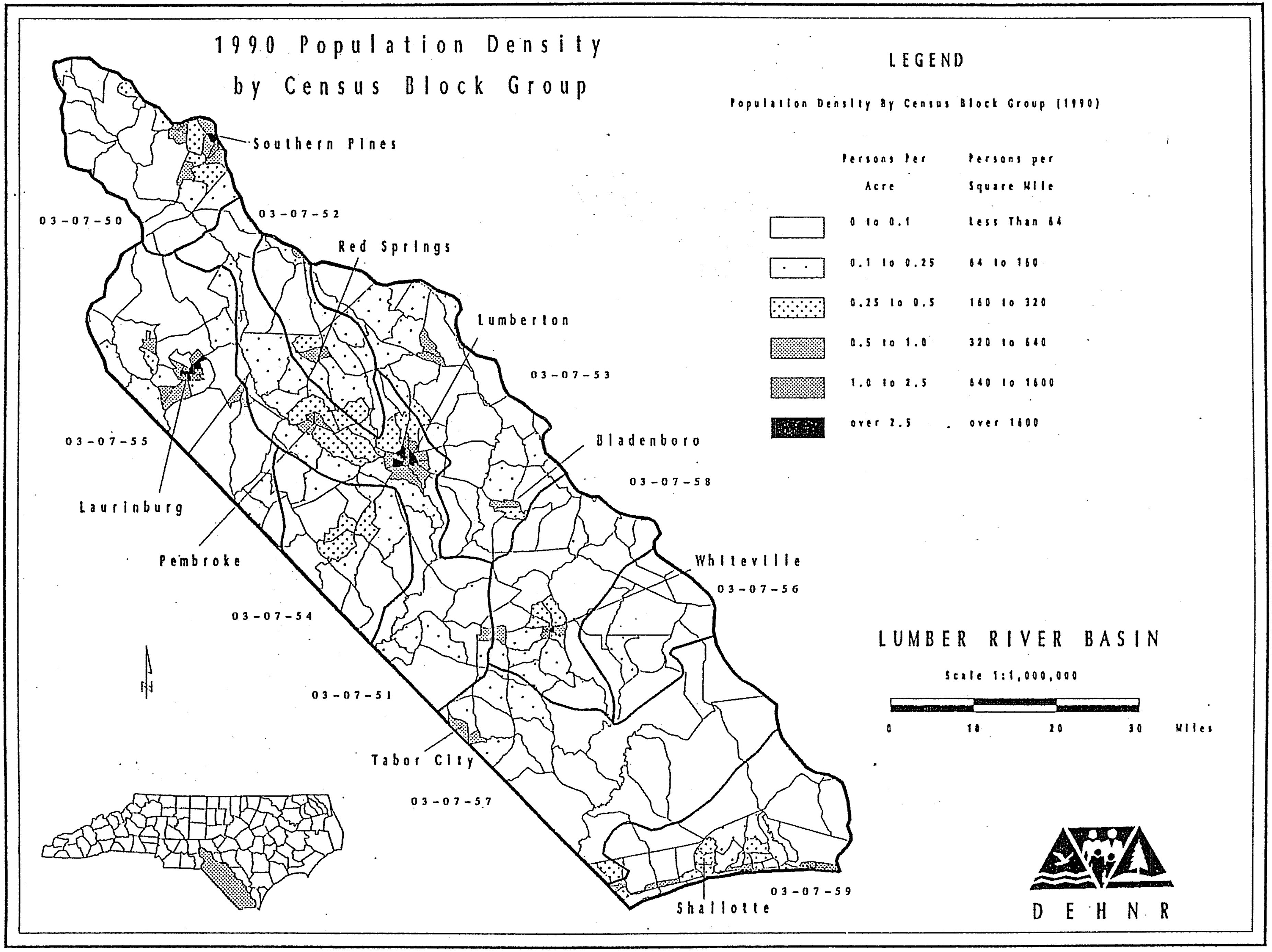

Figure 2.5 1990 Population Density by Census Block Group

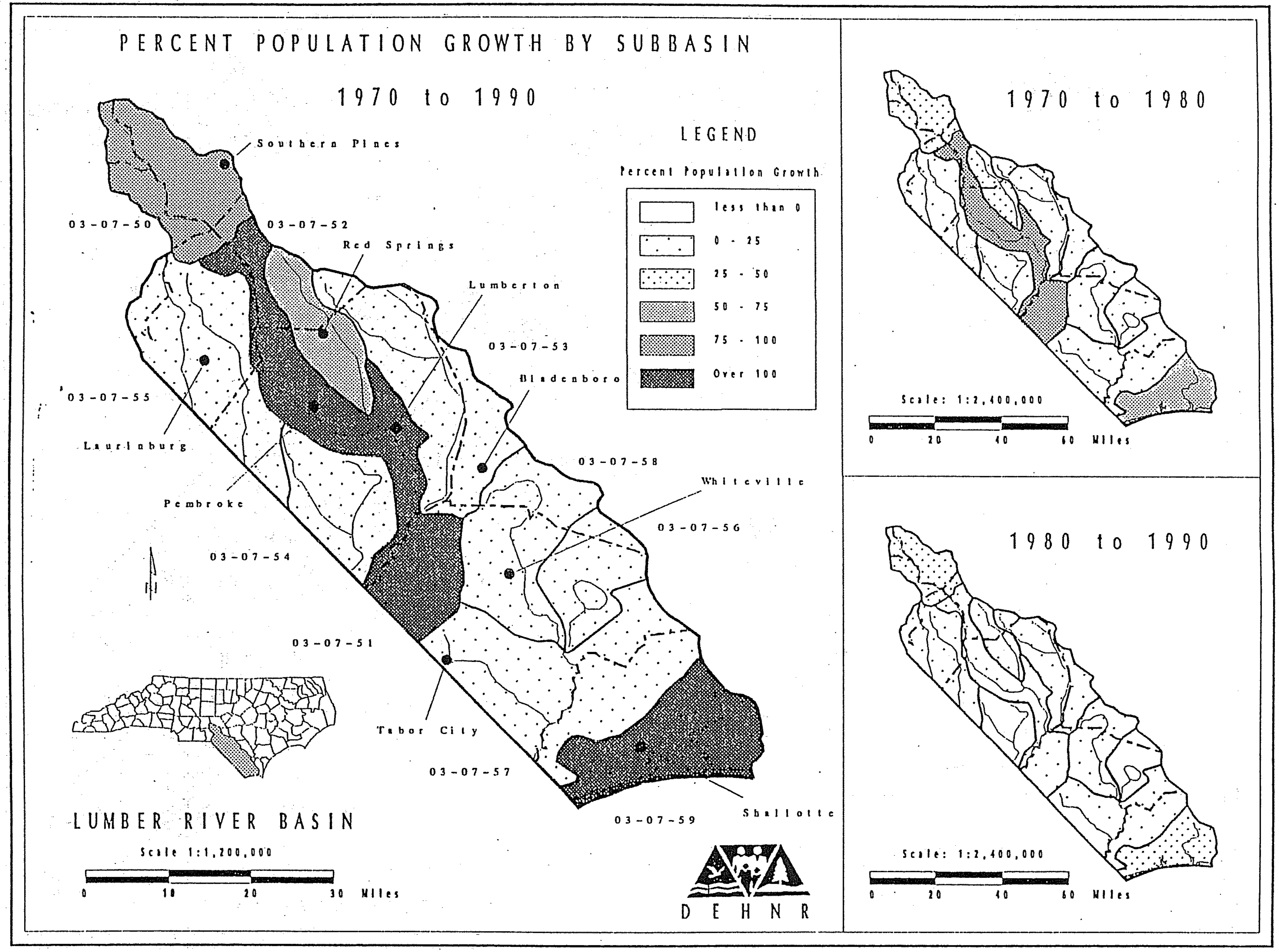

Figure 2.6 Percent Population Growth by Subbasin Between 1970 and 1990

Table 2.2 Lumber Subbasin Population (1970, 1980 and 1990) and Land Area Summaries

SUBBASIN	POPULATION (Number of Persons)			POPULATION DENSITY (Persons/Square Mile)			LAND AND WATER AREAS			
							Total Land and Water Area		Water Area	Land Area
	1970	1980	1990	1970	1980	1990	(Acres)	(Sq. Miles)	(Sq. Miles)	(Sq. Miles)
03-07-50	11,722	16,610	22,133	43	61	81	174,720	273	2	271
03-07-51	31,865	60,037	63,959	60	114	121	337,280	527	1	526
03-07-52	10,695	15,787	16,351	68	100	104	100,480	157	0	157
03-07-53	27,246	28,496	30,035	65	68	71	270,080	422	2	420
03-07-54	15,204	16,760	15,710	68	75	70	142,720	223	0	223
03-07-55	34,373	40,233	40,415	85	100	100	255,360	399	2	397
03-07-56	5,061	5,761	5,511	27	31	30	118,400	185	14	171
03-07-57	16,205	18,926	20,080	30	35	37	342,400	535	1	534
03-07-58	21,425	22,830	22,995	66	70	71	207,360	324	1	323
03-07-59	9,856	15,094	22,350	33	50	74	192,000	300	8	292
TOTALS	183,652	240,534	259,539	545	704	759	2,140,800	3,345	31	3,314

based on information contained in Table 2.5. This table presents census data for 1970, 1980 and 1990 for each of the subbasins. It also includes land areas and population densities (persons/square mile) by subbasin based on the *land area* (excludes open water) for each subbasin.

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

Figure 2.5 shows population densities by census block group based on 1990 census data. The population density categories are based on persons/acre. An average family unit size is close to 2.5 persons. Therefore, a density of 2.5 persons/acre (1600 persons/square mile) is very roughly equivalent to one house per acre. The lowest density category of less than 0.1 persons/acre is equivalent to less than 64 persons/square mile. Subbasin 51, encompassing Lumberton, Pembroke and Fair Bluff is the most densely populated with 121 persons per square mile. This compares with an overall basin density of 78 persons per square mile. The next highest subbasins, having a population density of greater than or equal to 100 persons per square mile, are 52 (Red Springs - 104 persons/square mile) and 55 (Laurinburg - 100 persons/square mile). The lowest population densities are found in subbasins 56 and 57 with respective densities of 30 and 37 persons/square mile.

Figure 2.6, which displays both twenty-year growth trends (1970 to 1990) and ten-year growth trends (1970 to 1980 and 1980 to 1990) for each subbasin, reveals two major growth areas. Subbasin 51 (Lumberton area) and subbasin 59 (coastal communities) saw their populations more than double over the 20-year period (1970 to 1990). Interestingly, however, most of this growth occurred in the ten-year interval from 1970 to 1980 (Figure 2.6 inset map). Over the past ten years, those areas with the highest population growth are subbasin 50 (Southern Pines area) and subbasin 59 (coastal communities) with growth rates in the 25 to 50% range.

2.5 Lumber River State Park - Natural Heritage Priority Areas

The North Carolina Division of Parks and Recreation, along with designating the Lumber River as a State Natural and Scenic River, has established a park along the river from SR 1412, in Scotland County, to the South Carolina State line (Ellis, 1994). The Division's Natural Heritage Program has identified eight areas along the river as Natural Heritage Priority Areas. These sites, all of which involve extensive tracts of swamp and wetlands, total 6,756 acres and have been designated by the Division as priorities for acquisition and protection as part of the Lumber River State Park. The emphasis of these acquisitions is to safeguard significant examples of the river's natural communities and rare species. Development at each of the sites is to be minimal. The park's master plan calls for these lands to be purchased in two phases. The master plan also calls for the purchase of additional lands that will connect these areas and form continuous corridors. The master plan calls for each of these connecting buffer corridors to extend for a minimum of 400 feet on each side of the river. The areas are depicted in Figure 2.7 and listed below in Table 2.6.

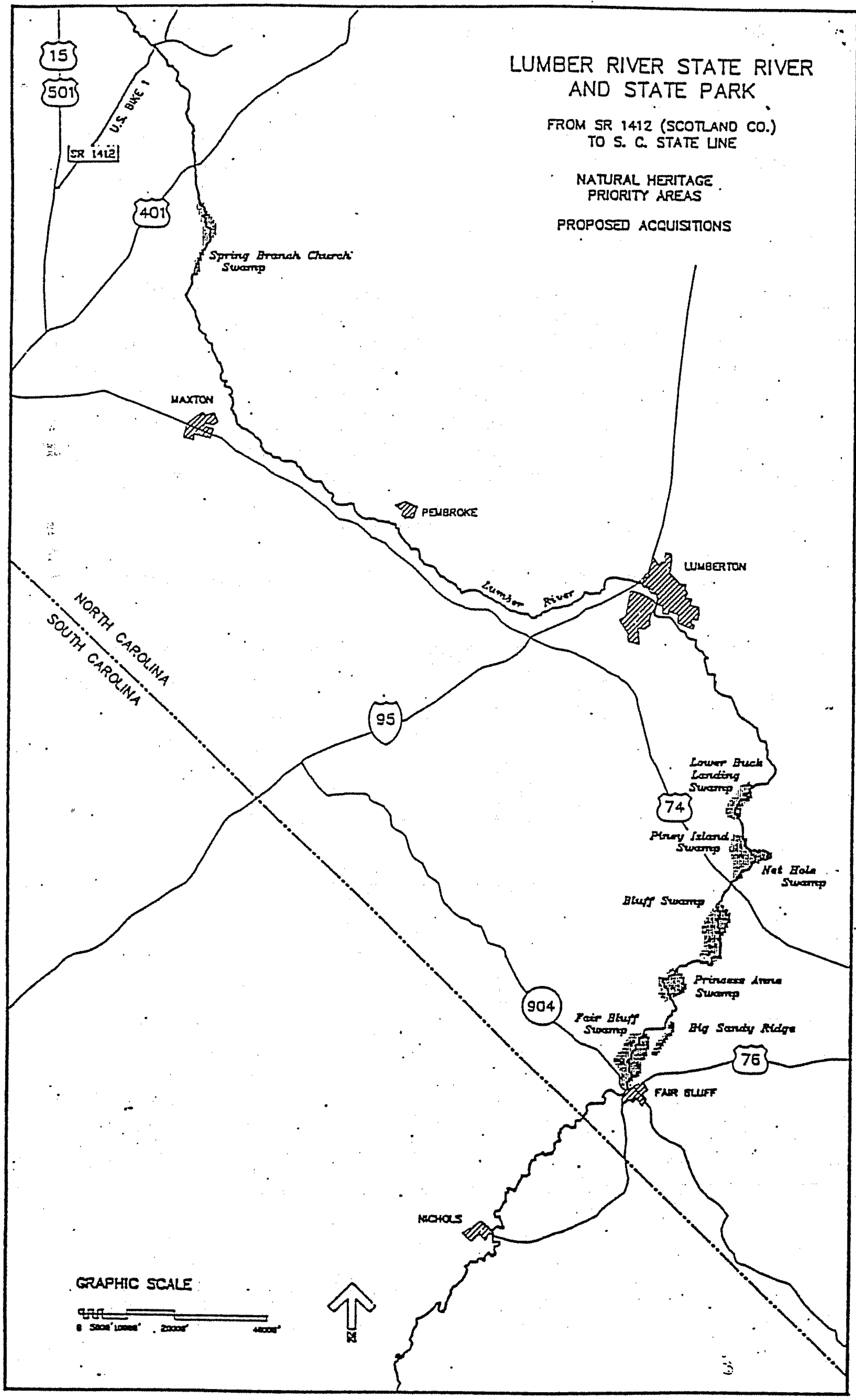

Figure 2.7 Lumber River State Park Natural Heritage Priority Area Acquisitions

Table 2.6 Natural Heritage Priority Acquisition Areas for Lumber River State Park

Phase I
1. Lower Buck Landing Swamp (531 acres)
2. Piney Island and Swamp (537 acres)
3. Net Hole Swamp (1570 acres)
4. Bluff Swamp (1268 acres)

Phase II
1. Spring Branch Church Swamp (616 acres)
2. Big Sandy Ridge (376 acres)
3. Fair Bluff Swamp (1178 acres)
4. Princess Ann Swamp (680 acres)

2.6 Registered Animal Operations

On December 10, 1992, the Environmental Management Commission adopted a rule modification (15A NCAC 2H .0217) to establish procedures for properly managing and reusing animal wastes from intensive livestock operations. The goal of the rule is for intensive animal operations to operate so that animal waste is not discharged to waters of the state. The rule applies to new, expanding or existing feedlots with animal waste management systems designed to serve more than or equal to the following animal populations: 100 head of cattle, 75 horses, 250 swine, 1,000 sheep or 30,000 birds with a liquid waste system. The deadline for submittal of registrations to DEM for existing facilities was December 31, 1993. The following tables summarize the number of registered operations and animals, by type, subbasin (Table 2.7) and county (Table 2.8) for those registrations received for the Lumber Basin through April 1994.

Table 2.7 Numbers of Registered Animal Operations and Animals by Type and Subbasin in the Lumber River Basin

TYPE OF OPERATION	SUBBASINS 50	51	52	53	54	55	56	57	58	59	TOTALS
CATTLE											
Operations		2		1				2			5
Animals		198		90				485			773
CHICKENS											
Operations				1		1					2
Animals				61,000		60,000					121,000
DAIRY											
Operations				1				1			2
Animals				700				360			1,060
POULTRY											
Operations					3	6			2		11
Animals					240,000	1,006,600			180,000		1,426,600
SWINE											
Operations	5	20	4	32	9	32	2	30	20	6	160
Animals	31,700	28,885	16,865	88,738	141,070	166,537	4,300	129,851	40,903	8,273	657,122
TOTALS											
Operations	5	22	4	35	12	39	2	33	22	6	180
Animals	31,700	29,083	16,865	150,528	381,070	1,233,137	4,300	130,696	220,903	8,273	2,206,555

Table 2.8 Numbers of Registered Animal Operations and Animals by Type and County in the Lumber River Basin

TYPE OF OPERATION	BLADE	BRUNS	COLUM	CUMBE	HOKE	MOORE	RICHM	ROBES	SCOTL	TOTALS
CATTLE										
Operations		1	1		3					5
Animals		125	360		288					773
CHICKENS										
Operations								2		2
Animals								121,000		121,000
DAIRY										
Operations			1					1		2
Animals			360					700		1,060
POULTRY										
Operations	2							4	5	11
Animals	180,000							360,000	886,600	1,426,600
SWINE										
Operations	20	12	48	1	8	4	1	47	19	160
Animals	65,441	23,468	146,948	969	16,125	27,300	4,400	277,895	94,576	657,122
TOTALS										
Operations	22	13	50	1	20	4	1	54	24	180
Animals	245,441	23,593	147,668	969	16,413	27,300	4,400	759,595	981,176	2,206,555

The numbers of animals are based on estimates provided by the operators of the average daily animal population at their facilities. It should be noted that only those poultry and chicken operations that utilize a wet waste management system are required to register, and these constitute only a small percentage of all poultry operations (chicken and turkeys). Most poultry operations utilize a dry litter waste management approach which is not subject to the registration requirement.

2.7 SURFACE WATER CLASSIFICATIONS AND WATER QUALITY STANDARDS

2.7.1 Program Overview

Clean water is critical to the health, economic well-being and the quality of life of those residing or working in the Lumber basin. Most water users throughout the basin rely on surface water for basic needs such as water supply and/or wastewater disposal. In addition, many businesses and residents of the Lumber Basin rely directly or indirectly on a healthy river and its tributaries for their source of living. Commercial fisherman, water-oriented real estate and building industries, and those businesses that serve the recreational needs of the basin such as fishing, boating and vacationing are just some examples. To these groups and the public they serve, it is important that the waters support viable fisheries and shellfish resources. In addition, full enjoyment of boating, swimming and residing along the water requires the waters to be relatively safe (low risk of contracting water-borne disease) and aesthetically desirable (free of objectionable colors, odors and smells). Yet maintaining clean water becomes increasingly difficult and more expensive as the population grows, as land develops and as competition for its resources heighten. In order to assure that water quality throughout the basin is maintained at levels that support the various uses presented above as well as aquatic life, North Carolina has established a water quality classification and standards program (15A NCAC 2B 0.200).

Waters were classified for their "best usage" in North Carolina beginning in the early 1950's, with classification and water quality standards for all the state's river basins adopted by 1963. The effort to accomplish this included identification of water bodies (which included all named water bodies on USGS 7.5 minute topographic maps), studies of river basins to document sources of pollution and appropriate best uses, and formal adoption of standards/classifications following public hearings.

The Water Quality Standards program in North Carolina has evolved over time and has been modified to be consistent with the Federal Clean Water Act and its amendments. Water quality classifications and standards have also been modified to promote protection of surface water supply watersheds, high quality waters and the protection of unique and special pristine waters with outstanding resource values. Classifications and standards have been broadly interpreted to provide protection of uses from both point and nonpoint source pollution. Stormwater rules to protect uses and standards of coastal water are an example of North Carolina's water quality authorities.

2.7.2 Statewide Classifications and Water Quality Standards

Appendix I summarizes the state's primary and supplemental classifications including, for each classification, the best usage, key numeric standards, stormwater controls and other requirements as appropriate.

Primary Classifications

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

Supplemental Classifications

In addition to primary classifications, surface waters may be assigned a supplemental classification. The supplemental classifications include *HQW* (High Quality Waters), *ORW* (Outstanding Resource Waters), *NSW* (Nutrient Sensitive Waters), *Tr* (Trout Waters) and *Sw* (Swamp Waters). Most of these have been developed in order to afford special protection to sensitive or highly valued resource waters. While all surface waters are assigned a primary classification, they may have one or more supplemental classifications. For example, most freshwater streams in the Lumber basin are classified C Sw. In this example, C is the primary classification followed by the Sw (swamp) supplemental classification. As another example, one segment of Lumber River near Lumberton is classified as WS-IV Sw HQW CA. I

Water Quality Standards

Each primary and supplemental classification is assigned a set of water quality *standards* that establish the level of water quality that must be maintained in the water body to support the uses associated with each classification. Some of the standards, particularly for HQW and ORW waters, outline protective management strategies aimed at controlling point and nonpoint source pollution. These strategies are summarized in Appendix I and are discussed briefly in section 2.7.3, below. Tables 1 and 2 in Appendix 1 summarize the state's freshwater and saltwater numeric standards. The standards for C and SC waters establish the basic protection level for all state surface waters. With the exception of Sw, all of the other primary and supplemental classifications have more stringent standards and provide for higher levels of protection. The Sw classification allows for a lower dissolved oxygen and pH standard than other waters due to naturally-occurring low dissolved oxygen and high pH conditions in swamp waters. Dissolved oxygen is discussed more fully in Chapter 3.

2.7.3 Surface Water Classifications in the Lumber Basin

The Lumber Basin has examples of all but four of the classifications and supplemental classifications presented above. The exceptions include trout waters (Tr), which are found only in the western half of the state, as well as WS-I, WS-III and NSW.

Most of the freshwater streams in the basin are classified as C Sw. Those freshwater streams not supplementally classified as Sw are confined primarily to the Sandhills portion of the basin and include: tributaries to Drowning Creek, tributaries to the Lumber River upstream from Pembroke, and the upper reaches of Gum Swamp Creek in Scotland County above Richmond Mill Pond.

There are few occurrences of B and SB waters throughout the basin. The two most prominent examples of B waters include Lake Waccamaw in Columbus County and Gum Swamp Creek in Scotland County.

Streams classified WS are also limited in number and extent. They include Drowning Creek and most of its tributaries in Moore, Richmond and Montgomery Counties, and the Lumber River and most of its tributaries between Lumberton and Pembroke in central Robeson County.

Most of the saltwaters in the basin are classified as SA, which by definition are also considered high quality waters (HQW).

High Quality Waters (HQW) in the Lumber Basin

High Quality Waters in the Lumber Basin (include the following (Figure 2.8):

- Lockwoods Folly River from the mouth of Royal Oak Swamp to Intra-coastal Waterway (based on SA water classification);
- Shallotte River from US 17 to Intra-coastal Waterway (based on SA water classification);
- Intra-coastal waterway from South Carolina to the Cape Fear Basin boundary (based on SA water classification);
- Lumber River mainstem from Drowning Creek to the Hwy 301 bypass at Lumberton; and
- Drowning Creek and most of its tributaries in Moore, Montgomery and Richmond Counties upstream from Aberdeen Creek (based on WS-II water classification).

Special HQW protection management strategies are presented in 15A NCAC 2B.0201(d), which is included in its entirety in Appendix I under Antidegradation Policy. These measures are intended to prevent degradation of water quality below present levels from both point and nonpoint sources. HQW requirements for new or expanded NPDES permitted facilities address oxygen-consuming wastes, total suspended solids, disinfection, emergency requirements, volume, nutrients (in nutrient sensitive waters) and toxic substances. For oxygen-consuming wastes, for example, effluent limitations for new or expanding facilities are as follows: BOD5 = 5 mg/l; NH3-N = 2 mg/l; DO = 6 mg/l (except for those expanding discharges which expand with no increase in permitted pollutant loading).

For nonpoint source pollution, development activities which require an Erosion and Sedimentation Control Plan in accordance with rules established by the NC Sedimentation Control Commission or local erosion and sedimentation control program approved in accordance with 15A NCAC 4B

.0218, and which drain to and are within one mile of high quality waters will be required to control runoff from the one-inch design storm using either a low density or high density option described in the rules.

Outstanding Resource Waters in the Lumber Basin

The only waters in the North Carolina portion of the Lumber Basin classified as outstanding resource waters (ORW) are Naked Creek and its tributaries in Richmond and Montgomery Counties (Figure 2.8). In addition, the Waccamaw River and Lake Waccamaw are also being considered for reclassification to ORW. It should also be noted that the Little Pee Dee River in South Carolina below it's confluence with the Lumber River (Figure 2.3) has been classified as Outstanding Resource Water by the State of South Carolina (SC Department of Health and Environmental Control, 1993).

Special protection measures that apply to North Carolina ORWs are set forth in 15A NCAC 2B .0216, most of which is included in Appendix I. At a minimum, no new discharges or expansions will be permitted, and stormwater controls for most new development will be required.

For the protection of South Carolina's waters, including the Little Pee Dee ORW, South Carolina water quality officials from the Department of Health and Environmental Control (SCDHEC) have recommended that the point source management strategies in North Carolina streams should maintain a level of water quality which supports the classification and standards of the waterbody into which they flow in South Carolina (Sherer 1994, letter) (SCDHEC, 1993). North Carolina is mindful of the need to protect South Carolina's waters and believes that the point source management strategies being recommended in Chapter 6 will serve to address this need.

Lockwoods Folly River Water Quality Management Plan

That portion of the Lockwoods Folly River downstream from a line between Genoes Point and Mullet Creek to the Intra-coastal waterway (Figure 2.8) is subject to a management plan adopted by the Environmental Management Commission under 15A NCAC 2B.0219. The plan, which is included in its entirety in Appendix I, states that new or expanded NPDES permits will be issued only for non-domestic, non-industrial process type discharges (such as non-industrial process cooling or seafood processing discharges), and that a public hearing is mandatory for any proposed (new or expanding) NPDES permit in this area.

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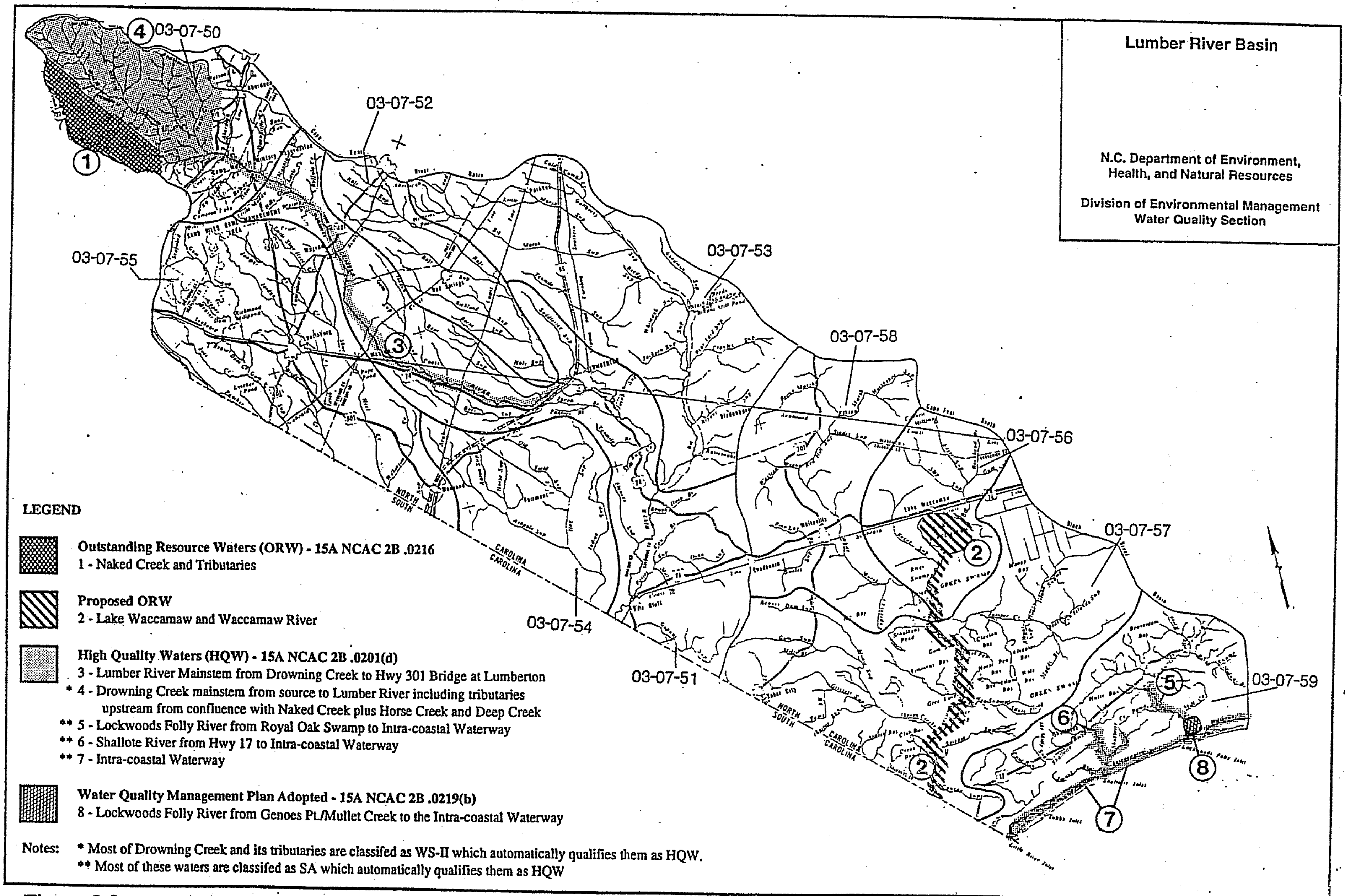


Figure 2.8 Existing and Proposed Outstanding Resource Waters (ORW) and High Quality Waters (HQW) in the Lumber River Basin

CHAPTER 3

CAUSES AND SOURCES OF WATER POLLUTION IN THE LUMBER RIVER BASIN

3.1 INTRODUCTION

The intent of this chapter is to provide the reader with a basic understanding of causes and sources of water pollution, in general, and to then briefly discuss how surface water quality is affected in the Lumber Basin. *Causes* of water pollution, including sediment, nutrients, bacteria, oxygen-demanding wastes, metals and organic chemicals, are described in **Section 3.2.** *Sources* of pollution, point sources and nonpoint sources, are described in **Sections 3.3 and 3.4**, respectively. Actual water quality assessment data are presented in Chapter 4, and specific pollution control strategies are presented in Chapter 6.

3.2 *CAUSES* OF WATER POLLUTION

The term *causes* of pollution refers to the substances which enter surface waters from point and nonpoint sources resulting in water quality degradation. The major causes of pollution in the Lumber Basin include *biochemical oxygen demand (BOD)*, *nutrients*, *toxics* (such as heavy metals, chlorine, ammonia and pesticides), *sediment*, *color*, and *fecal coliform bacteria*. Each of the following descriptions indicates whether the cause is point or nonpoint source-related (or a combination).

3.2.1 Oxygen-Consuming Wastes

Oxygen-consuming wastes are substances, such as decomposing organic matter, which can react with and remove dissolved oxygen from the water column. Maintaining a sufficient level of dissolved oxygen in the water is critical to most forms of aquatic life. Understanding oxygen-consuming wastes and their impact on water quality is enhanced by some basic knowledge of dissolved oxygen and the factors which affect its concentrations in the water.

The concentration of dissolved oxygen (DO) in a water body is one indicator of the general health of an aquatic ecosystem. A lack of sufficient DO in the water will threaten aquatic life. The United States Environmental Protection Agency (USEPA) states that 3.0 milligrams per liter (mg/l) is the threshold DO concentration needed for many species' survival (USEPA, 1986). Higher concentrations are needed to promote propagation and growth of a diversity of aquatic life in North Carolina's surface waters. North Carolina has adopted a water quality standard of 5.0 mg/l to protect the majority of its surface waters. Exceptions to this standard exist for waters supplementally classified as *trout waters* (not found in the Lumber Basin) and those supplementally classified as *swamp*. Trout waters have a DO standard of 6.0 mg/l due to the higher sensitivity of trout to low DO levels. Swamp waters, on the other hand, often have naturally low levels of DO, and aquatic life typically found in these waters is adapted to the lower DO levels. Therefore, the DO standard for swamp waters may be less than 5.0 mg/l if that lower level is the result of natural conditions. As indicated in Chapter 2, the vast majority of surface waters in the Lumber Basin are classified as swamp waters.

DO concentrations are affected by a number of factors. Higher DO is produced by turbulent actions which mix air and water such as waves, rapids and water falls. This process is referred to as reaeration. Aquatic plant life, including algae, can also produce DO, although, as will be discussed below under Nutrients, this effect may be temporary and may only occur near the surface. In addition, lower water temperature generally allows for retention of higher DO concentrations. Cool, rapid mountain streams often have naturally high DO levels of 8.0 mg/l or more. Sluggish swamp waters in the coastal plain portion of the state may have natural DO levels of 3.0 to 4.0 mg/l or less at times.

A major cause of DO depletion is bacteria which consume oxygen as they decompose organic matter such as leaves, dead plants and animals, and organic waste matter that may be washed or discharged into the water. Human and household wastes are high in organic waste matter, and bacterial decomposition can rapidly deplete DO levels unless these wastes are adequately treated at a wastewater treatment plant to remove much of the organic component. DO is also consumed by aquatic organisms such as fish and insect larvae. In addition, some chemicals may react with and bind up DO, and high water temperatures reduce the ability of water to retain DO. Therefore, in general, lowest DO concentrations usually occur during the warmest summer months and particularly during low flow periods. Low DO levels often occur in warm, slow-moving waters that receive a high input of effluent from wastewater treatment plants or that may have naturally high levels of organic matter (such as swamps). Water depth is also a factor. In deep slow moving waters such as lakes or estuaries, DO concentrations may be very high near the surface due to wind action and plant (algae) photosynthesis but may be entirely depleted (anoxic) at the bottom.

Biochemical oxygen demand, or BOD, is a technical term that describes the overall demand on DO from the various oxygen-depleting processes presented above. BOD can be further subdivided into two broad categories: *carbonaceous* biochemical oxygen demand (CBOD) and *nitrogenous* biochemical oxygen demand or NBOD (largely comprised of ammonia (NH_3)). CBOD accounts for the DO consumed by organic substances breaking down. NBOD refers to the bacterial conversion of ammonia to nitrite and nitrate which also uses dissolved oxygen.

A large portion of the organic material discharged into the water from a wastewater treatment plant is readily decomposed as the oxygen-consuming decay process may begin to occur within a matter of hours. As this decay process occurs in a moving water column, the actual area of impact may be several miles below the point of discharge. This area can be readily identified by a marked reduction in instream dissolved oxygen concentrations and is commonly referred to as the *sag zone*. Frequently, DO concentrations will gradually rise downstream of the sag zone as the amount of readily decomposed organic matter is reduced. However, a significant portion of the organic matter in wastewater treatment plant effluent may take days to decompose. A commonly used measure of BOD is called BOD_5 where the "5" stands for five days. BOD_5 is a standard waste limit in most discharge permits. A limit of 30 mg/l of BOD_5 is the highest concentration allowed by federal and state regulations for municipal and domestic wastewater treatment plants. However limits less than 30 mg/l and sometimes as low as 5 mg/l are becoming more common in order to maintain DO standards in the receiving waters. Carbonaceous biochemical oxygen demand (CBOD) and ammonia (NH_3) are the two most important types of oxygen-consuming wastes that are regulated by NCDEM under its permit program. Point source discharges are responsible for the majority of loading of these pollutants under critical low flow conditions.

Oxygen Consuming Wastes in the Lumber Basin

Point source-related oxygen-consuming wastes are a concern throughout most of the basin. DO is naturally stressed in swamp conditions due to low natural stream flow and high organic matter loadings. BOD waste assimilation is therefore naturally low. This is of particular concern in the Waccamaw and Coastal Area Watersheds (subbasins 03-07-56 through 59) which are characterized by shallow, very slow-moving streams. Another area of concern is the mainstem of the Lumber River below Lumberton. DO levels are low here due both to the swamp conditions and to the number and size of wastewater treatment facilities that discharge into and above this reach of the river. Recommended BOD management strategies are presented in section 6.3 of Chapter 6.

3.2.2 Nutrients

The term *nutrients* in this document refers to the elements phosphorus and nitrogen, two common components of plant fertilizers, animal wastes and wastewater treatment plant effluent. Nutrients in surface waters come from both point and nonpoint sources. While nutrients, alone, have little impact on water quality, and are generally beneficial to aquatic ecosystems in moderate amounts, an overabundance of nutrients under certain conditions can stimulate excessive plant growth, such as algae blooms, in quiet waters such as ponds, lakes, reservoirs and estuaries. Algae blooms can deplete the water column of dissolved oxygen and contribute to serious water quality problems through the processes of respiration and decomposition (described below). Nutrient overenrichment and the resultant problems with low DO is called *eutrophication*. In addition to problems with low DO, the blooms are aesthetically undesirable, impair recreational use and enjoyment of the affected waters, impede commercial fishing and pose difficulties in water treatment at water supply reservoirs.

Excessive growth of larger plants, or macrophytes, such as milfoil, alligator weed and Hydrilla, is also a problem. These plants, in overabundance, can reduce or eliminate swimming, boating and fishing in infested waters. In addition, the algae and larger plants can form floating layers of organic matter which can cause odor problems.

Agricultural runoff and municipal wastewater treatment plants are the two main sources of nutrients along with urban runoff and forestry. Nutrients in nonpoint source runoff come mostly from fertilizer and animal wastes. Nutrients in point source discharges are from human wastes, food residues and some cleaning agents. A statewide phosphorus detergent ban implemented in 1988 significantly reduced the amount of phosphorus reaching and being discharged into surface waters from wastewater treatment plants.

Nutrients in an aquatic system are necessary to support primary productivity by algae and other aquatic plants. Algae, also referred to as *phytoplankton*, are a basic component of the aquatic food web upon which fish and other aquatic organisms depend. However, human activities such as wastewater discharges and agriculture, often add nutrients to water bodies at an excessive rate.

DO depletion from nutrient overenrichment and algal blooms fluctuates seasonally and with the time of day. Oxygen is produced by algae and other plants in the presence of sunlight through a process called *photosynthesis*. At night, however, photosynthesis and DO production slow and DO is consumed by plants through the process of *respiration*. During the summer months, this daily cycle of daytime oxygen production and nighttime depletion often results in supersaturation of the surface water by oxygen during the afternoon hours on bright, sunny days, and low DO concentrations during the late night and early morning hours. In addition, decaying algae may settle to the bottom of the water body and contribute to a *sediment oxygen demand* (SOD) which may lower DO concentrations in the bottom waters of lakes, reservoirs, and estuaries.

At this time, North Carolina has no instream water quality standards for total phosphorus (TP) and total nitrogen (TN), but analyses are underway, and standards or instream criteria may be developed for these parameters in the future. Limits on the amount of phosphorus that may be discharged into surface waters are presented in Chapter 6. In addition, the State has a standard of 40 µg/l (micrograms per liter or parts per billion) for chlorophyll a. Chlorophyll a is a chemical constituent of algae (it gives it its green color). A chlorophyll a reading above the 40 µg/l standard is indicative of excessive algal growth and portends bloom conditions.

Nutrient Problems in the Lumber Basin

Nutrients are not a major concern throughout most the Lumber basin except in several ponds and lakes. Chapter 4 identifies four lakes as having nutrient-related problems including Pages Lake in subbasin 03-07-50 (see Section 4.4.2), Johns and Maxton Ponds in subbasin 03-07-55 (see

Section 4.5) and Lake Tabor in subbasin 03-07-57 (see Section 4.6.3). Use support information for these lakes is summarized in Table 4.9.

3.2.3 Toxic Substances

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

North Carolina has adopted standards and action levels for several toxic substances. These are contained in 15A NCAC 2B .0200. Usually, limits are not assigned for parameters which have action levels unless monitoring indicates that the parameter may be causing toxicity or federal guidelines exist for a given discharger for an action level substance. This process of determining action levels exists because these toxic substances are generally not bioaccumulative and have variable toxicity to aquatic life because of chemical form, solubility, stream characteristics and/or associated waste characteristics. Water quality based limits may also be assigned to a given NPDES permit if data indicate that a substance is present for which there is a federal criterion.

Whole effluent toxicity (WET) testing is required on a quarterly basis for major dischargers and any discharger containing complex (industrial) wastewater. This test shows whether the effluent from a treatment plant is toxic, but it does not identify the specific cause of toxicity. If the effluent is found to be toxic, further testing may be done to determine the specific cause. This followup testing is called a *toxicity reduction evaluation* (TRE). Any substance, including those below can be toxic in sufficient quantity.

Metals

Municipal and industrial dischargers along with urban runoff are the main sources of metals contamination in surface water. North Carolina has stream standards for many heavy metals, but the most common ones examined for in municipal permits are cadmium, chromium, copper, nickel, lead, mercury, silver, and zinc. Each of these metals (with the exception of silver) is also monitored through the ambient network along with aluminum and arsenic. Point source discharges of metals are controlled through the NPDES permit process. Mass balance models (Appendix II) are employed to determine appropriate limits. Municipalities with significant industrial users discharging wastes to their treatment facilities limit the heavy metals coming to them from their industries through their *pretreatment program.* Source reduction and wastewater recycling at WWTPs also reduces the amount of metals being discharged to a stream. Nonpoint sources of pollution are controlled through best management practices. The new urban stormwater program described in Chapter 5 should help the nonpoint source metals loading instream.

Chlorine

Chlorine is commonly used as a disinfectant at NPDES discharge facilities which have a domestic (i.e., human) waste component. These discharges are the main source of chlorine in the State's surface waters. Chlorine dissipates fairly rapidly once it enters the water, but its toxic effects can have a significant impact on sensitive aquatic life such as trout and mussels if the amount of wastewater discharged into a stream is high relative to the flow in the stream. At this time, action level standard of 17 μg/l exists for chlorine. All new and expanding dischargers are required to dechlorinate their effluent if chlorine is used for disinfection. In the future, chlorine limits may be assigned to all dischargers in the State that use chlorine for disinfection.

Ammonia (NH3)

Point source dischargers are one of the major sources of ammonia. In addition, decaying organisms which may come from nonpoint source runoff and bacterial decomposition of animal waste products also contribute to the level of ammonia in a waterbody. At this time, there is no standard for ammonia in North Carolina. However, DEM is reviewing EPA's ammonia criteria and may adopt an ammonia standard in the near future.

Toxicants Loading in the Lumber Basin

It is difficult to assess surface water concentrations of toxics on a basinwide scale since they often break down due to physical or chemical reactions, or a significant portion may be lost to the sediments through precipitation and settling. Toxics models which attempt to simulate these reactions are difficult and costly to develop. Due to the difficulty in developing mechanistic toxics models, DEM usually performs mass balance models to determine toxic wasteload allocations. Interaction among dischargers in close proximity is accounted for in the process. Nonpoint sources are accounted for in the background assumptions when stream specific information is available. However, in the majority of the calculations, a background concentration of zero is used, since available data usually are all less than analytical detection levels.

Ambient water column data indicate that there is not excessive toxic loading instream throughout most of the basin (see Chapter 4 for further information), however, 5 of 13 ambient water quality samples on the Lumber River at Maxton exceeded copper action levels. Also, fish tissue sampling has revealed mercury levels in fish above US Food and Drug Administration (FDA) criteria of 1.0 mg/Kg. These sites include Watson, Pit Links and Pages Lakes in subbasin 03-07-50; Drowning Creek at SR 1412 and Porter Creek at SR 1503 in subbasin 03-07-51; Ashpole Swamp at SR 2256 in subbasin 03-07-54; several locations on the Waccamaw River in subbasins 03-07-56 and 57 (see Sections 4.6.2 and 4.6.3); and White Marsh at US 74 in subbasin 03-07-58 have been found in fish in the Waccamaw River and in Pages Lake in subbasin 03-07-50. Evidence of toxic accumulation or other biological impacts is limited. Fish consumption advisories have been issued for the Waccamaw River and for the three impoundments in 03-07-50.

3.2.4 Sedimentation

Sediment is the most widespread cause of nonpoint source pollution in the state. It impacts streams in several ways. Eroded sediment may gradually fill lakes and navigable waters and may increase drinking water treatment cost. Sediment may clog the gills of fish, eliminate the available habitat of organisms which serve as food for fish, or even completely cover shellfish beds. Sediment also serves as a carrier for other pollutants including nutrients (especially phosphorus), toxic metals and pesticides. However, aside from a few industrial sources, stream sediment impacts are not usually a problem associated with point sources.

North Carolina does not have a numeric water quality standard for suspended solids, however all discharges must meet federal effluent guideline values at a minimum (e.g. 30 mg/l for domestic discharges). Also, most point source BOD limitations usually require treatment to a degree that removes sediments to a level below federal guidelines requirements. Discharges to high quality waters (HQW) must meet a total suspended solids (TSS) limit of 10 mg/l for trout waters and primary nursery areas and 20 mg/l for all other HQWs. In addition, the state has adopted a numerical instream turbidity standard expressed in Nephelometric Turbidity Units (NTU) for different types of waters. The turbidity standard for freshwater streams, other than trout waters, is 50 NTU. Trout waters are 10 NTU and lakes and tidal waters are 25 NTU. Nonpoint sources are considered to be in compliance with the standard if approved best management practices (BMPs) have been implemented.

Sedimentation in the Lumber Basin

Sediment is the most widespread cause of impairment to stream water quality and biological integrity in the basin. While much has been done to reduce sedimentation resulting from construction, agriculture and other land-disturbing activities, as discussed in Chapter 5, further improvements and/or more widespread application of sediment control measures in the Lumber Basin, and throughout the state, are needed.

3.2.5 Fecal Coliform Bacteria

Fecal coliform are bacteria typically associated with the intestinal tract of warm-blooded animals and are widely used as an indicator of the potential presence of pathogenic, or disease-causing, bacteria and viruses. They enter surface waters from improperly treated discharges of domestic wastewater and from nonpoint source runoff. Common nonpoint sources of fecal coliforms include leaking or failing septic systems, leaking sewer lines or pump station overflows, runoff from livestock operations and wildlife.

Fecal coliforms are used as indicators of waterborne pathogenic organisms (which cause such diseases as typhoid fever, dysentery, and cholera) because they are easier and less costly to detect than the actual pathogens. Fecal coliform water quality standards have been established in order to ensure safe use of waters for water supplies, recreation and shellfish harvesting. The current State standard for fecal coliforms is 200 MF/100 ml for all waters except SA waters. SA waters, which are classified for shellfish harvesting, have a standard of 14 MF/100 ml. The majority of domestic waste dischargers receive a limit of 200 MF /100 ml in their NPDES permit (14 /100 ml in SA waters). Bacteria in treatment plant effluent are controlled through disinfection methods including chlorination (sometimes followed by dechlorination), ozonation or ultraviolet light radiation.

Fecal Coliforms in the Lumber Basin

Fecal coliform pollution has been a problem in the coastal waters of the basin (subbasin 03-07-59). High fecal coliform levels in 1989 precluded the Lockwoods Folly River from being reclassified to ORW (outstanding resource waters) although the EMC later approved an ORW management plan for the river (Section 4.6). Also, of the 4,800 acres of salt water in the basin, 2,152 acres of shellfish waters have been closed for harvesting because of fecal coliform bacteria contamination (Section 4.8.2 and Table 4.7). The bacteria are from nonpoint sources including agriculture, urban runoff, septic tanks, forest land and marinas. A discussion on management of fecal coliform bacteria in shellfish waters is presented Section 6.6.

3.2.6 Color

Color in wastewater is generally associated with industrial wastewater or with municipal plants that receive certain industrial wastes, especially from textile manufacturers, that use dyes to color their fabrics, and from pulp mills. For colored wastes, 15A NCAC 2B .0211(b)3(F) states that the point sources shall discharge only such amounts as will not render the waters injurious to public health, secondary recreation, or aquatic life and wildlife or adversely affect the palatability of fish, aesthetic quality or impair the waters for any designated uses. NPDES permit requirements regarding color are included on a case by case basis since no numeric standard exists for color, and because a discharger may have high color values but no visual impact instream due to dilution or the particular color of the effluent. Color monitoring is included in an NPDES permit where it has been perceived to be a problem instream.

Color in the Lumber River Basin

The major color concern in the Lumber River Basin occurs in the mainstem below the West Point Pepperell-Wagram facility, a textile firm. As noted above, it is difficult to determine allowable color loading to the Lumber River because no numeric standard exists for color, different colors are perceived by the human eye at different concentrations, and different stream substrates also affect the visual impact. In order to assess West Point Pepperell-Wagram's allowable color loading to the Lumber River, the facility has been required to perform color monitoring of its effluent as well as color monitoring in the river upstream and downstream of the discharge outfall location. In addition, the facility has begun modeling work which DEM will evaluate to determine appropriate color limits to protect classified uses of downstream waters.

3.3 POINT SOURCES OF POLLUTION

3.3.1 Defining Point Sources of Pollution

Point sources refers to discharges that enter surface waters through a pipe, ditch or other well-defined points of discharge. The term most commonly refers to discharges associated with wastewater treatment plant facilities. These include *municipal* (city and county) and *industrial* wastewater treatment plants as well as small *domestic* discharging treatment systems that may serve schools, commercial offices, residential subdivisions and individual homes. In addition, discharges from *stormwater systems* at industrial sites and in large urban areas (such as Raleigh and Durham in the Neuse Basin but none in the Lumber Basin) are now considered point source discharges and will be regulated under new urban stormwater runoff regulations being required by U.S. Environmental Protection Agency (EPA). The urban stormwater runoff program is discussed in more detail in Chapter 5.

The primary substances and compounds associated with point source pollution are oxygen-demanding wastes, nutrients, and toxic substances including chlorine, ammonia and metals. Color, pathogens, pH, temperature, oil and grease are several other potential pollutants.

Point source discharges are not allowed in North Carolina without a permit from the state. Discharge permits are issued under the National Pollutant Discharge Elimination System (NPDES) program delegated to North Carolina from EPA. The amount or loading of specific pollutants that may be allowed to be discharged into a stream are defined in the NPDES permit and are called *effluent limits*. Under the NPDES permitting program, each NPDES discharger is assigned either *major* or *minor* status. Major facilities are large with greater flows and/or treat complex wastewaters (i.e., those receiving industrial wastewater). For municipalities, all dischargers with a flow of greater than 1 million gallons per day (MGD) are classified as major. Most point source discharges, other than urban and industrial stormwater discharges which are stormwater discharges, are continuous and do not occur only during storm events as do nonpoint sources. They generally have the most impact on a stream during low flow conditions when the percentage of stream flow composed of treated effluent is greatest. Permit limits are generally set to protect the stream during low flow conditions. The standard low flow used for determining point source impacts is called the *7Q10*. This is the lowest flow which occurs over seven consecutive days and which has an average recurrence of once in ten years.

Information is collected on NPDES permitted discharges in several ways. The major method of collection is facility self-monitoring data which are submitted monthly to DEM by each individual permittee. NPDES facilities are required to monitor for all pollutants for which they have limits as well as other pollutants which may be present in their wastewater. Domestic wastewater dischargers are generally required to monitor flow, dissolved oxygen, temperature, fecal coliform, BOD, ammonia, and chlorine (if used as a disinfectant). In addition, facilities with industrial sources may have to monitor for chemical specific toxicants and/or whole effluent toxicity (see Section 3.2.3); and all dischargers with design flows greater than 50,000 gallons per day (GPD) monitor for total phosphorus and total nitrogen. Minimum NPDES monitoring requirements are provided in 15A NCAC 2B .0500.

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

3.3.2 Point Sources in the Lumber River Basin

Listed below in Table 3.1 are some statistics on NPDES discharge facilities in the Lumber Basin. A map of the 12 major municipal and non-municipal facilities in the basin is shown in Figure 6.1 in Chapter 6.

Table 3.1 Summary of NPDES Discharge Permits in the Lumber Basin

Total number of NPDES discharge permits: 78

Nonprocess Permits: 32 permits (41%) Includes cooling waters, filter backwash waters, seafood packing & processing waters, mine dewatering, sand dredging, groundwater remediation discharges

Domestic Discharges: 15 permits (19%) Includes subdivisions, schools, and industrial establishments that have no industrial component to their discharge

Major Municipal Permits: 6 permits (7.6%)
Minor Municipal Permits: 13 permits (16.7%)

Major Process Industrial Permits: 6 permits (7.6%) Includes pulp and paper (1), textile (3), metal finishing (1), power plant (1)

Minor Industrial Permits: 6 permits (7.6%) Includes facilities that discharges from wet decking operations - spraying wood to maintain moisture (3), power plant (1), textile (1), poultry processor(1)

As part of the point source control program, DEM also encourages dischargers to evaluate nondischarge alternatives. This is difficult in the Lumber Basin because of the limited acreage of suitable soils (described in Chapter 2). However, some nondischarging systems have been permitted. The nondischarge permits outlined below are those issued for the beneficial reuse of wastewater (spray irrigation) and land application of residuals that are a byproduct of wastewater treatment. These systems do not discharge to surface waters of the state. Other nondischarge permits are also issued and are briefly summarized in Section 5.2.8 of Chapter 5, but do not pose the same potential for improper operation having an effect on the surface waters.

Total Land under application for residuals:	8500 acres
Total number of spray systems:	12

3.4 NONPOINT SOURCES OF POLLUTION

Nonpoint source (NPS) refers to runoff that enters surface waters through stormwater or snowmelt. There are many types of land use activities that can serve as sources of nonpoint source pollution including land development, construction, crop production, animal feeding lots, failing septic systems, landfills, roads and parking lots.

Sediment and nutrients are major pollution-causing substances associated with nonpoint source pollution. Others include pesticides, bacteria, heavy metals, oil and grease, and any other substance that may be washed off the ground or removed from the atmosphere and carried into surface waters. Unlike point source pollution, nonpoint pollution sources are diffuse in nature and occur at random intervals depending on rainfall events. Below is a brief description of major areas of nonpoint sources of interest.

3.4.1 Agriculture

There are a number of activities associated with agriculture that may serve as sources of water pollution. Land clearing and tillage may render soils susceptible to erosion which in turn can cause stream sedimentation. Pesticides and fertilizers (including chemical fertilizers and animal wastes) can be washed from fields or improperly designed storage or disposal sites. Animal waste management systems that are determined to have an adverse impact on water quality may be required to obtain an approved animal waste management plan or to apply for and receive either an individual nondischarge permit. An illegally discharging operation may be designated as a concentrated animal feeding operation (CAFO) and an NPDES discharge permit could be required. Thirteen CAFOs have been designated in the Lumber basin since March of 1984. Concentrated animal feeding operations can be a significant source of both BOD and nutrients. The untreated discharge from a large operation would be comparable to the nutrient load in the discharge from a secondary waste treatment plant serving a small town. Animal wastes can also be a source of bacterial contamination of surface waters. Construction of drainage ditches on poorly drained soils enhances the movement of stormwater into surface waters. Chapter 5 discusses agricultural nonpoint source control programs.

3.4.2 Urban

Runoff from urbanized areas, as a rule, is more predictable and generally more severe for some pollutants than agricultural runoff although far fewer stream miles are actually impacted. The rate and volume of runoff in urban areas is much greater due both to the high concentration of impervious surface areas and to storm drainage systems that rapidly transport stormwater to nearby surface waters. These drainage systems, including curb and guttered roadways, also allow urban pollutants to reach surface waters quickly and with little or no filtering. These pollutants include lawn care products such as pesticides and fertilizers; automobile-related pollutants such as fuel, lubricants, abraded tire and brake linings; lawn and household wastes (often dumped in storm sewers); and fecal coliform bacteria (from animals and failing septic systems). Many urban streams are rated as biologically poor.

3.4.3 Construction

Construction activities that entail excavation, grading or filling, such as road construction or land clearing for development, can produce large amounts of sediment if not properly controlled. As a pollution source, construction activities are temporary in nature but the impacts, discussed under sediment, below, can be long lasting. Construction activity tends to be concentrated in the more rapidly developing areas of the basin However, road construction is widespread and often involves stream crossings in remote or undeveloped areas of the basin.

3.4.4 Forestry

Forestry, a major industry in North Carolina, can impact water quality in number of ways. Ditching and draining of naturally forested low-lying lands in order to create pine or hardwood plantations can change the hydrology of an area and significantly increase the rate and flow of stormwater runoff. Clearing of trees through timber harvesting and construction of logging roads can produce sedimentation. Removing riparian vegetation along stream banks can cause water temperature to rise substantially, and improperly applied pesticides can result in toxicity problems. Timber harvesting occurs throughout the basin and is often done at the onset of clearing for site development. Commercial timber operations involving intensive management techniques such as ditching and draining are located in the lower portion of the basin. A prime example is the Green Swamp which has been largely ditched and converted from pocosin wetlands to a pine plantation. Localized hydrologic impacts can be expected downstream of these operations.

3.4.5 Mining

Mining is a common activity in the Piedmont and upper Coastal Plain regions and can produce high localized levels of stream sedimentation. Sediment may be washed from mining sites or it may enter streams from the wash water used to rinse some mined products. The most prevalent type of mining activity in the Lumber basin is for sand and gravel.

3.4.6 Onsite Wastewater Disposal

Septic tank soil absorption systems are the most widely used method of on-site domestic wastewater disposal in North Carolina. These systems can provide safe and adequate treatment of wastewater when properly designed, constructed and maintained. However, improperly placed, constructed or maintained septic systems can serve as a significant source of pathogenic bacteria and nutrients. These pollutants may enter surface waters both through or over the soil. They may also be discharged directly to surface waters through *straight pipes* (i.e., direct pipe connections between the septic system and surface waters). These types of discharges, if unable to be eliminated, must be permitted under the NPDES program and be capable of meeting effluent limitations specified to protect the receiving stream water quality.

Onsite wastewater disposal is most prevalent in rural portions of the basin and at the fringes of urban areas. Fecal coliform contamination from failing septic systems poses a problem in some coastal waters where it can result in closure of shellfish waters as is happening in the coastal waters of the Lumber basin. Nutrients from failing septic systems also contribute to eutrophication problems in some impoundments and coastal waters.

3.4.7 Solid Waste Disposal

Solid wastes may include household wastes, commercial or industrial wastes, refuse or demolition waste, infectious wastes or hazardous wastes. Improper disposal of these types of wastes can serve as a source of wide array of pollutants. The major water quality concern associated with modern solid waste facilities is controlling the leachate and stabilizing the soils used for covering many disposal facilities.

REFERENCES CITED - CHAPTER 3

Thomann, Robert V. and John A. Mueller, 1987, Principles of Surface Water Quality Modeling and Control, Harper & Row, Publishers, Inc., New York.

United States Environmental Protection Agency, 1986, Water Quality Criteria for Dissolved Oxygen, EPA 440/5-86-003, Washington DC.

CHAPTER 4

WATER QUALITY IN THE LUMBER RIVER BASIN

4.1 INTRODUCTION

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

Part One: *Detailed Watershed and Subbasin Summaries for the Lumber Basin* includes Sections 4.2 through 4.6 and presents a detailed summary of water quality monitoring and assessments for each of four major watersheds and the ten subbasins in the overall Lumber River Basin. It points out areas of water quality impairment and those areas where water quality is higher than the standards by using results of water quality surveys. A detailed listing of in-stream water quality standards exceedances is not provided within the context of these summaries. More specific data and descriptions of information covered by these summaries will be available in a separate document and under the NCDEM 305(b) reporting requirements. Please note that this information provides an assessment of instream conditions. Management actions to address some problems noted may already be in place, and are detailed in Chapter 6.

Part Two: *Use Support Assessment of the Lumber River Basin* includes Sections 4.7 and 4.8 and addresses the topic of use support in the Lumber Basin. Use support utilizes much of the data presented in Part One, along with other relevant data, to assess water quality using methods outlined in Section 4.7. The use support ratings for evaluated streams and subbasins are presented in Section 4.8 along with a use support map of the basin.

PART ONE: *Detailed Watershed and Subbasin Water Quality Summary*

This part represents a summary of work conducted by the Environmental Sciences Branch of the NCDEM Water Quality Section including consideration of information reported by researchers and other agencies within the Lumber River Basin. Program areas covered within this part, and described below in Section 4.2, include: benthic macroinvertebrate monitoring, phytoplankton monitoring, aquatic toxicity monitoring, fish population and tissue monitoring, special chemical/physical water quality investigations, lake assessments, sediment oxygen demand monitoring, and ambient water quality monitoring.

Water quality in each of the four major watersheds, and their respective subbasins are discussed in Sections 4.3 through 4.6. Each section first presents an assessment of ambient water quality monitoring data for the overall watershed. The ambient data is presented through the use of figures and maps. Then, water quality and biological data from each of the above-mentioned program areas is presented for the subbasins in each watershed.

4.2 TYPES OF WATER QUALITY MONITORING IN THE LUMBER BASIN

NCDEM's monitoring program integrates biological, chemical, and physical data assessment to provide information for basinwide planning. A more complete review of this information and data summaries is included in a separate support document entitled Lumber River Basinwide Assessment Report that was prepared by NCDEM's Environmental Sciences Branch.

4.2.1 Benthic Macroinvertebrate Sampling

Benthic macroinvertebrates, or *benthos*, are predominantly aquatic insect larvae that live in and on the bottom of rivers and streams. Stream sampling, or *biomonitoring*, of the number, type and diversity of these organisms can be used to assess water quality. Those benthos that are most intolerant of pollution, and used most commonly in evaluating water quality, fall into three taxonomic groups: Ephemeroptera (mayflies), Plecoptera (stoneflies) and Trichoptera (caddisflies). Water quality is rated from Poor to Excellent based on evaluation criteria presented in Appendix II.

4.2.2 Phytoplankton Sampling

Phytoplankton (free floating algae), are microscopic plants found in the water column of lakes, rivers, streams, and estuaries. Phytoplankton are especially useful as indicators of eutrophication (discussed under Nutrients in Chapter 3). Prolific growths of phytoplankton, often due to abundant nutrients, may result in surface "blooms" in which one or more species of algae may actually form a visible mat on top of the water. A statewide effort to document blooms associated with fish kills, discolored waters, taste and odor problems, or significant fluctuations in dissolved oxygen levels in surface waters was initiated in 1984. Identification and enumeration of phytoplankton is also an integral part of the ambient monitoring network in large rivers, estuaries and in special lake studies.

4.2.3 Aquatic Toxicity Monitoring (Whole Effluent Toxicity Testing)

Aquatic toxicity monitoring is used to determine the toxicity of treated effluent from a wastewater treatment facility. Under laboratory conditions, sensitive aquatic species (usually fathead minnows or the water flea, Ceriodaphnia dubia) are placed in a sample of the effluent that has been diluted to the same dilution ratio as occurs after the effluent is discharged to a receiving stream (e.g. if the effluent makes up 50% of the receiving stream's flow, then the sample will be diluted by 50%). Results of these tests have been shown by numerous researchers to be predictive of toxic discharge effects on aquatic life in receiving streams. NCDEM maintains a compliance summary for all facilities required to perform tests and provides a monthly update of this information to NCDEM regional offices and NCDEM administration. This program is discussed further in Chapter 5.

4.2.4 Fish Studies: Fish Community Structure and Tissue Analyses

These studies include *fish community structure* assessments, which are used as a measure of the ecological health of the water body as determined by resident fish populations, and *fish tissue analyses* which are primarily used in human health evaluations. In assessing fish community structure, fish are collected from the stream, and the number, type, size and general health of the fish are noted. This assessment results in assigning a biological integrity rating from Poor to Excellent based on criteria presented in Appendix II. Fish tissue analyses entail measuring concentrations of parameters of concern that are contained in fish tissue such as heavy metals, pesticides, and other organic compounds from contaminated water or from the food they eat. Fish tissue analyses can serve as an important early warning indicator of contaminated sediments and surface water. The findings of these analyses are used as indicators for human health concerns, fish and wildlife health concerns, and the presence of various chemicals in the ecosystem.

4.2.5 Intensive Surveys and Sediment Oxygen Demand (SOD)

Intensive water quality surveys are performed on water bodies below existing or proposed wastewater dischargers and usually consist of a time-of-travel dye study, stream flow measurements, physical and chemical samples, long-term biochemical oxygen demand (BOD_{lt})

analysis, water body channel geometry, and effluent characterization analysis. If oxygen depletion from sediments is suspected, *sediment oxygen demand (SOD)* studies may be performed along with intensive surveys. Intensive surveys and SOD's are performed where there is insufficient in-stream field data to calibrate and verify a water quality simulation model for a specific wastewater discharge location or on a larger scale for basin modeling. Water quality simulation models, described in Appendix III and discussed in Chapter 6, are often used for the purpose of determining the potential impact of a point source discharge on receiving waters and to determine appropriate effluent limits as requirements in National Pollutant Discharge Elimination System (NPDES) permits.

4.2.6 Lakes Assessment Program

A North Carolina Lakes Assessment Program has been implemented to protect lake waters through monitoring, pollution prevention and control. Assessments have been made at all publicly accessible lakes, at lakes which supply domestic drinking water, and lakes (public or private) where water quality problems have been observed. Data are used to determine each lake's *trophic status*. Trophic status is a relative measure of nutrient enrichment and productivity. Data are also used to evaluate whether the lake's uses have been threatened or impaired by pollution (see Appendix III for trophic status ratings). More detailed studies are conducted to evaluate loading and system response where specific management strategies are necessary to restore a lake to full use support status (Section 4.8.3).

4.2.7 Ambient Monitoring System

The Ambient Monitoring System (AMS) is a network of stream, lake, and estuarine water quality monitoring stations (about 380 statewide) strategically located for the collection of physical and chemical water quality data. The type of water quality data, or parameters, that are collected is determined by the waterbody's freshwater or saltwater classification and corresponding water quality standards. Table 4.1 summarizes the types of water quality data collection conducted at ambient stations. AMS data for the Lumber Basin are summarized for each watershed at the beginnings of Sections 4.3, 4.4, 4.5 and 4.6. The presentation of data involves the use of graphs that utilize box and whisker plots. Box and whisker plots are explained in Figure 4.1.

Table 4.1. Ambient Monitoring System Parameters

<u>C and SC WATERS</u> (minimum monthly coverage for all stream stations)
- dissolved oxygen, pH, conductivity, temperature,
- salinity (SC), secchi disk (where appropriate),
- total phosphorus, ammonia, total Kjeldahl nitrogen, nitrate+nitrite
- total suspended solids, turbidity, hardness, chlorides (SC),
- fecal coliforms, aluminum, arsenic, cadmium, chromium, copper, iron, lead, mercury, nickel, silver, zinc

<u>NUTRIENT-SENSITIVE WATERS</u>
- Chlorophyll <u>a</u> (where appropriate)

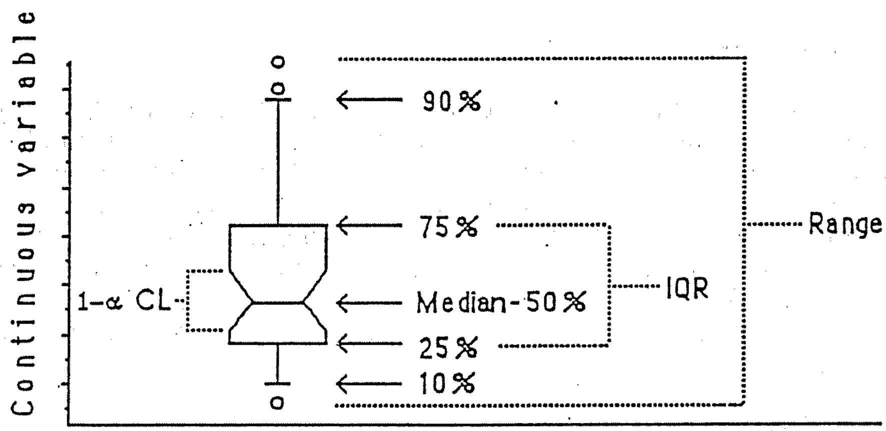
<u>WATER SUPPLY</u>
- Chlorides, total coliforms, manganese, total dissolved solids

<u>SA WATERS</u>
- Fecal coliforms (tube method where appropriate)

PLUS any additional parameters of concern for individual station locations

Box and Whisker Plots

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



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

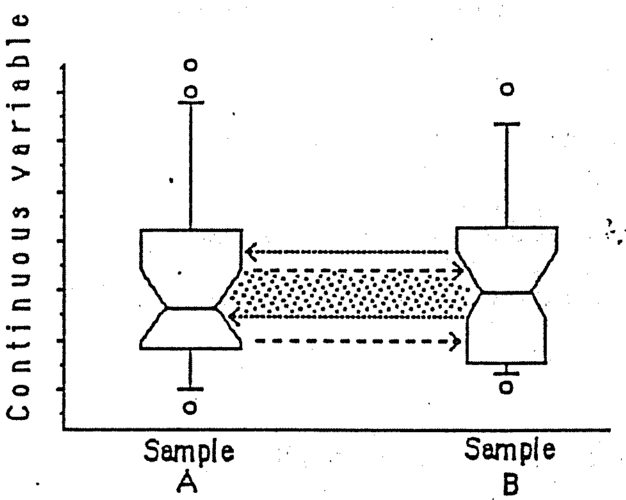


Figure 4.1 Explanation of Box and Whisker Plots

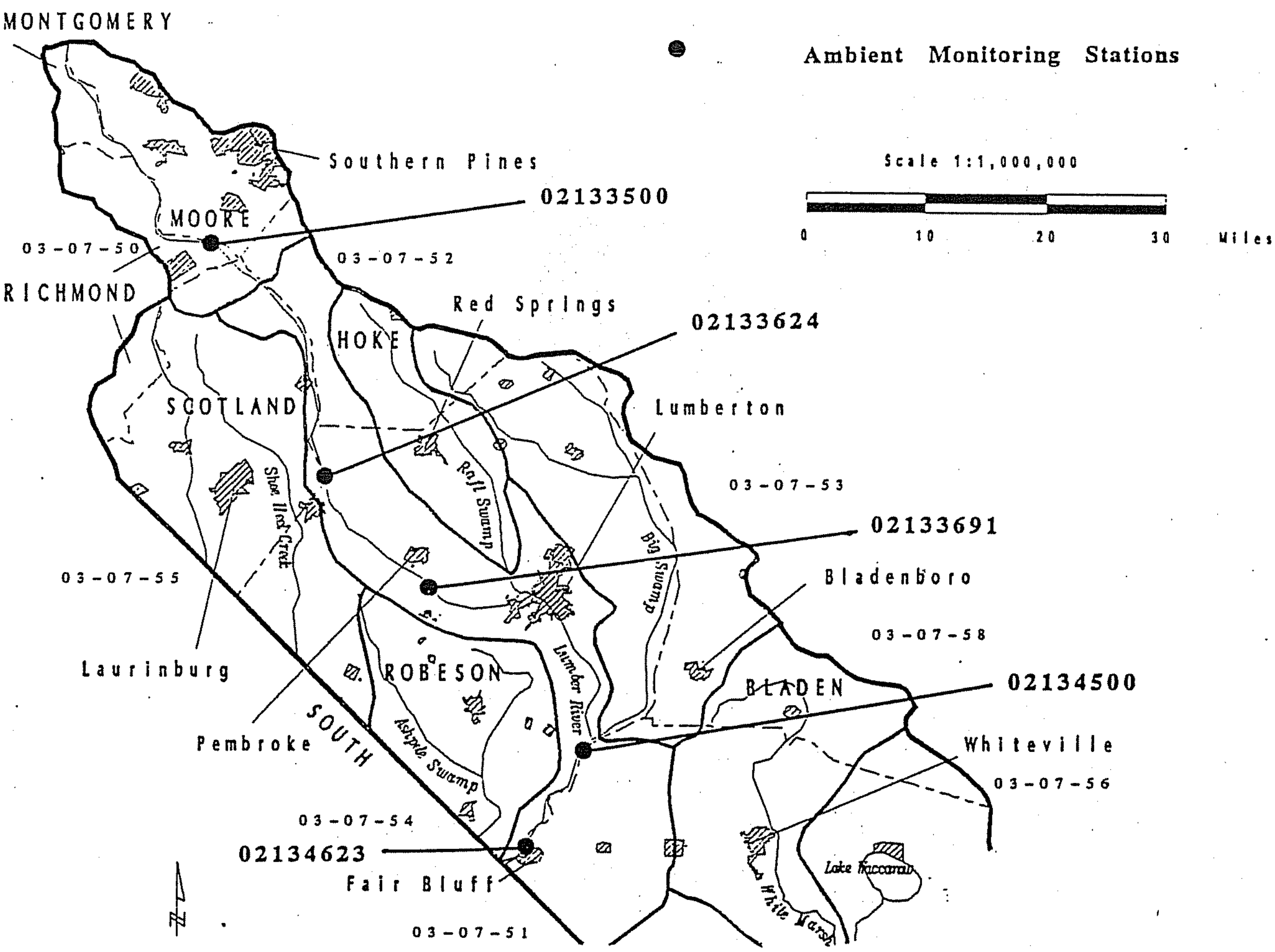
4.3 LUMBER RIVER WATERSHED

4.3.1 Ambient Monitoring System (AMS) Summary

Subbasins 03-07-50 through 03-07-55 make up the drainage of the Lumber River in North Carolina. At present, there are 10 AMS stations within these subbasins with five on the main stem of the river (Figure 4.2). There are no other stations on the Lumber River above the confluence with the Little Pee Dee River in South Carolina. All of these mainstem stations have recorded data for the five-year cycle from 1988 to 1992 and are listed below.

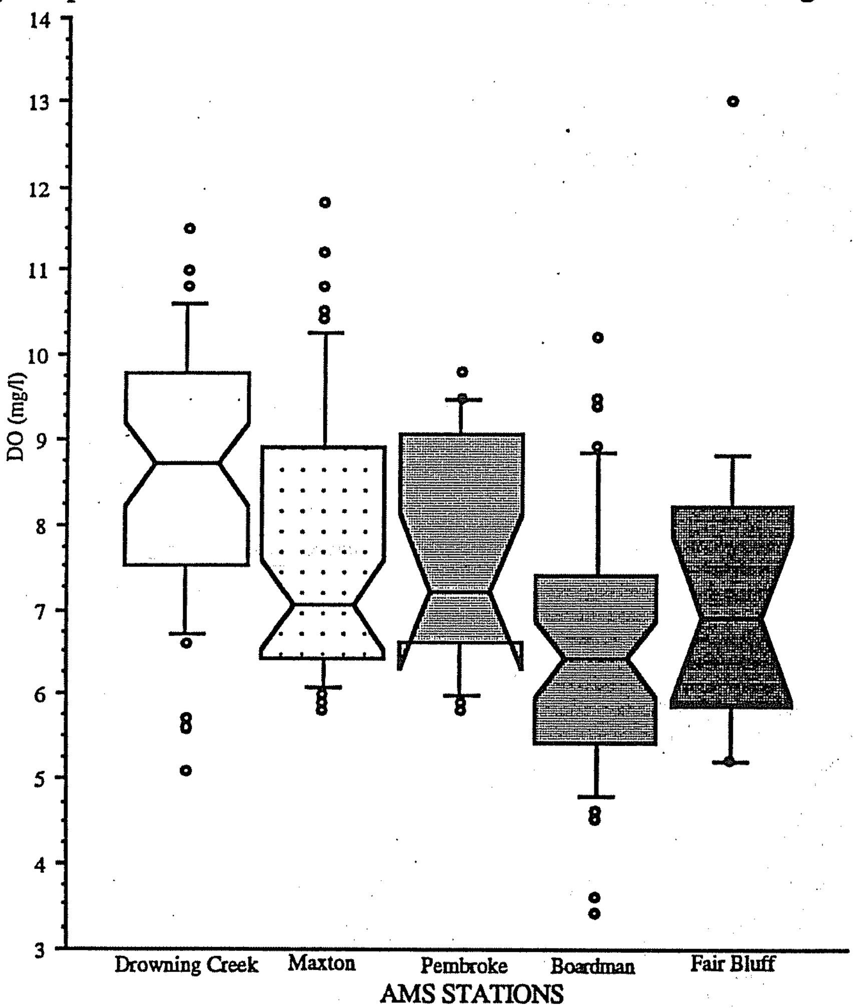
Primary Number	Location
02133500	Drowning Creek at US Hwy 1 near Hoffman, NC
02133624	Lumber River at NC Hwy 71 near Maxton, NC
02133691	Lumber River at NC SR 1003 near Pembroke, NC
02134500	Lumber River at US Hwy 74 at Boardman, NC
02134623	Lumber River at NC Hwy 904 at Fair Bluff, NC

Figure 4.2 AMS Stations on the Main Stem of the Lumber River



The mainstem stations on the Lumber River show a continual decrease in median dissolved oxygen to the Boardman station (Figure 4.3) at which seven samples below 5.0 mg/l were recorded during the period 1988 through 1992. DEM ambient stations above this one registered no samples below 5.0 mg/l. (Although instream self-monitoring data from dischargers in the Lumberton and

Pembroke areas have shown numerous samples below 5.0 mg/l. See section 6.3 for details.) The downward trend in dissolved oxygen appears to be attributable, at least in part, to point source discharges. There are dischargers just upstream of the stations at Maxton and Pembroke. The city of Lumberton is just upstream of the Boardman station and has several facilities discharging into the Lumber River. The river below Boardman separates into several channels and the subsequent slowing of the water could give the waste load time to be consumed. Just upstream of the Fair Bluff station the channels converge to a main channel. These two characteristics of the river above Fair Bluff, the slowing of water in multiple channels and increase in velocity with reconvergence just upstream of the station, could contribute to the recorded higher dissolved oxygen there.

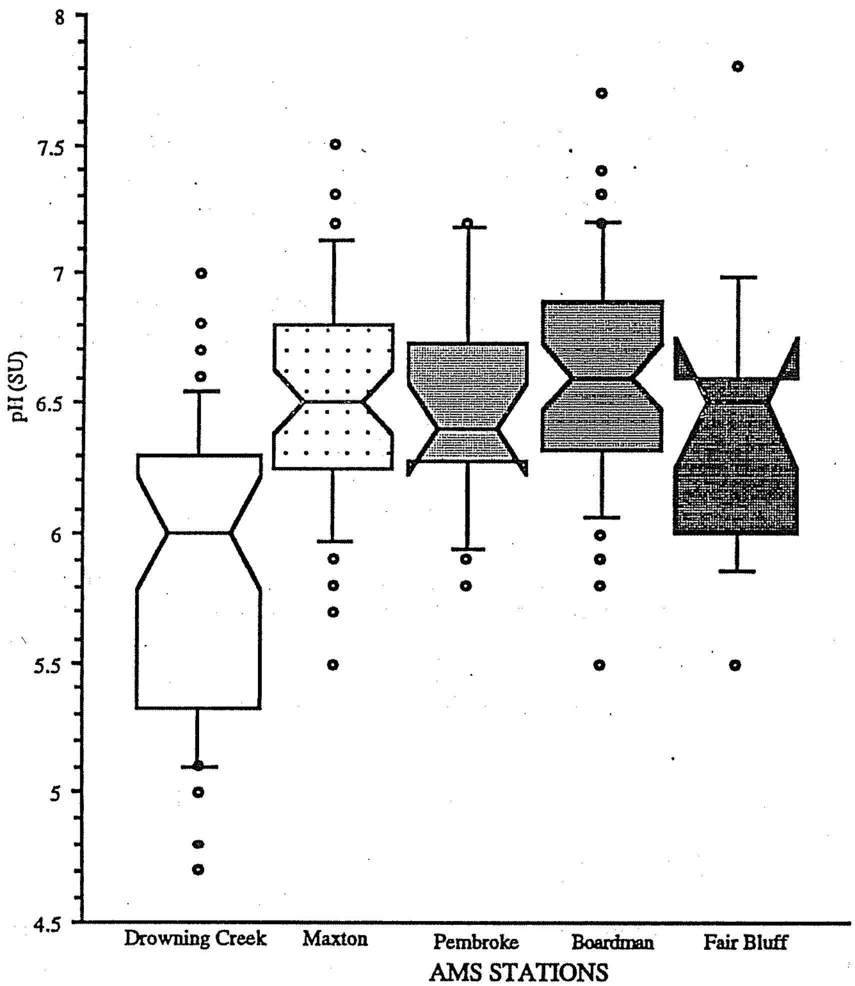


	Count	Minimum	Maximum	Range	Geom. Mean	Median	IQR*
DO, Total	186	3.400	13.000	9.600	7.405	7.200	2.600
Drowning Creek	51	5.100	11.500	6.400	8.474	8.700	2.275
Maxton	52	5.800	11.800	6.000	7.548	7.050	2.500
Pembroke	17	5.800	9.800	4.000	7.646	7.200	2.425
Boardman	51	3.400	10.200	6.800	6.361	6.400	1.975
Fair Bluff	15	5.200	13.000	7.800	7.077	6.900	2.375

*Interquartile Range-Spread of values containing the central 50% of the data(75th-25 percentiles)

Figure 4.3 Dissolved Oxygen Concentrations at AMS Stations on the Lumber River Mainstem 1988 to 1992 (Box and Whisker Plots)

Mainstem readings for pH show an increase from the Drowning Creek station to Maxton (Figure 4.4). The readings then change very little further downstream. Low pH readings from all stations were recorded. All the stations in this basin are in swamp-class waters. The natural presence of tannins and other organic decay products in swamp waters is usually accepted as cause of low pH. The Drowning Creek station is in headwaters of the Lumber River and is expected to have lower pH due to these natural chemicals. The main stem stations further downstream have much more altered drainage area and can be expected to have a higher pH.



	Count	Minimum	Maximum	Range	Geom. Mean	Median	IQR*
pH, Total	185	4.700	7.800	3.100	6.328	6.400	.700
Drowning Creek	51	4.700	7.000	2.300	5.838	6.000	.975
Maxton	52	5.500	7.500	2.000	6.506	6.500	.550
Pembroke	17	5.800	7.200	1.400	6.488	6.400	.450
Boardman	51	5.500	7.700	2.200	6.589	6.600	.575
Fair Bluff	14	5.500	7.800	2.300	6.414	6.500	.600

*Interquartile Range-Spread of values containing the central 50% of the data(75th-25 percentiles)

Figure 4.4 pH at AMS Stations on the Lumber River Mainstem, 1988 to 1992 (Box and whisker plots)

Metals show few samples that exceeded the water quality criteria. The exception being Lumber River at Maxton with five of 13 samples above detection above the Copper action level. The main stem stations showed a general trend toward higher conductivities beginning in 1990 through the final samples in 1992. Conductivity, while not a pollutant, per se, is an indicator of treated wastewater. Higher conductivity would be expected with increased effluent flows. The tributary stations have low dissolved oxygen and pH samples as with the main stem. No unusual trends in metal parameters were noted in the tributaries.

4.3.2 Lumber Subbasin 03-07-50 (Naked and Drowning Creeks)

The headwaters of the Lumber River are located entirely within the sandhills ecoregion. Swift-flowing sandy streams characterize this area. Streams in this area are generally of high water quality. Naked Creek has been designated Outstanding Resource Waters and Drowning Creek has been designated High Quality Waters. Only one lake, Pages Lake, has been monitored, and it was found to be eutrophic. The high water quality of subbasin 03-07-50 reflects both sandy soil characteristics (which promote groundwater infiltration) and undisturbed watersheds. The town of Aberdeen is in the northern portion of the basin.

BENTHIC MACROINVERTEBRATES Three locations were sampled for benthos in 1991. One site, Horse Creek, was sampled to assess nonpoint source impacts in this subbasin. There is sufficient information from several sites to analyze long-term changes in water quality.

Site #	Creek	Date	County	Road	S/SEPT	Rating
L50-3	Naked Cr	910909	Moore	SR1103	94/34	Excellent
L50-6	Drowning Cr	910909	Moore	SR1104	90/39	Excellent
L50-7	Horse Cr	910909	Moore	SR1102	EPT=26	Excellent

LONG TERM BENTHOS SITES Naked Creek has been sampled 13 times since 1983, although only two of these samples occurred during summer ambient collections. It has consistently yielded an Excellent bioclassification. Based on this excellent water quality and "special ecological or scientific significance", the creek has been reclassified to Outstanding Resource Waters. The ORW classification also was supported by the potential for excellent "water-based" recreation and by the inclusion of a part of the drainage area in the Sandhills Game Lands.

Drowning Creek near Hoffman has been sampled three times during the summer since 1985; all collections produced an Excellent bioclassification. The creek, from its confluence with Naked Creek to the Lumber River, is classified as High Quality Waters based on this information.

Two sites on Quewhiffle Creek below the Carolina Galvanizing discharge were sampled in 1984 and 1989. In 1986, the plant ceased discharging to the creek and began discharging to the Moore County Regional WWTP. Improvement was documented below the old discharge site; however, it still remains Fair. Further downstream, the station recovered to a Good bioclassification.

SPECIAL STUDIES The Drowning Creek drainage area was evaluated for HQW designation. The lower section of Drowning Creek, from its confluence with Naked Creek to the Lumber River, qualified for the designation.

Naked Creek was sampled to help with seasonality adjustments to EPT taxa richness. Several tributary sites also were sampled to examine EPT taxa richness versus stream size. This site also is being monitoring for long-term trends. Naked Creek and its tributaries are now classified as Outstanding Resource Waters.

EPT samples taken above and below the Moore County Regional WWTP suggested a slight decline in the abundance of the more intolerant species. Two sites were sampled below the

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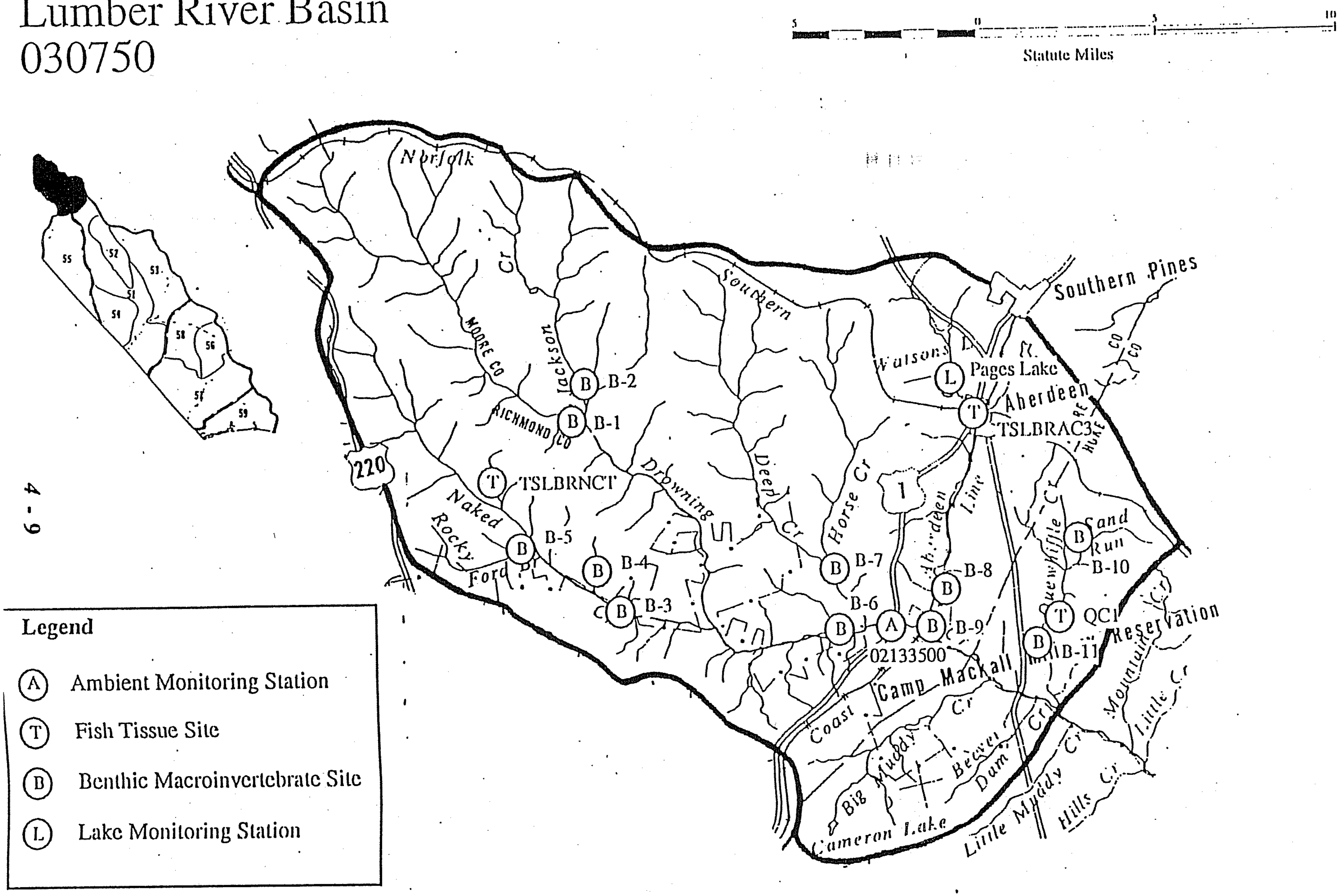

Figure 4.5 Water Quality Monitoring Stations in Subbasin 03-07-50

discharge of Carolina Galvanizing in 1984. This survey was repeated in 1989 after this industry ceased to discharge. Impact was noted right below the discharge area in both years, although taxa richness had improved in 1989. Lasting effects of the discharge and soil and groundwater contamination cannot be ruled out.

POTENTIAL HQW/ORW STREAMS Benthos data collected from Horse Creek in 1991 suggested an Excellent bioclassification. This stream is a major tributary to the HQW section of Drowning Creek, and also should be considered for an HQW classification.

FISH TISSUE SAMPLING Fish were collected and processed whole for metals analyses at Quewhiffle Creek at SR 1225 (1985), Aberdeen Creek at NC 5 in Aberdeen (1986), Naked Creek (1990) and Drowning Creek at SR 1225 (1993). With the exception of one fish at Drowning Creek, all results for metals analyses were lower than FDA recommended criteria. However, a fish consumption advisory for largemouth bass has been issued for Watson, Pit Links and Pages Lakes due to elevated mercury levels in fish tissues sampled in March through May of 1993.

LAKE ASSESSMENT PROGRAM Only Pages Lake in this subbasin has been monitored under the Lakes Assessment Program. Elevated nutrient concentrations have made Pages Lake eutrophic. Urban runoff from a developed watershed is probably the primary source of nutrients. Several pesticide burial sites in the Pages Lake watershed are under EPA investigation, including one site located near the western shore of the lake. The EPA study revealed many toxic compounds associated with the burial sites; however, only one was detected in Pages Lake. In a public statement dated June 9, 1989, EPA said that results from Pages Lake presented no significant health risk. However, later DEM fish tissue monitoring in Pages Lake and two lakes located upstream indicated elevated levels of mercury in largemouth bass. Accordingly, the North Carolina Director of Health issued a largemouth bass fish consumption advisory for Pages Lake, Pitt Lake and Watson Lake in July 1993.

When last sampled in 1991, the water appeared to have a greenish tint; indicative of a high rate of primary production. In addition, approximately 50% of the surface area contained submerged macrophytes. Identified species included: Brasenia schreberi, Nymphaea odorata, Myriophyllum heterophyllum , Najas sp. and Utricularia sp. Use support is considered threatened because aquatic life and primary contact (swimming and aesthetic enjoyment) could be impaired if eutrophic conditions are not brought under control.

4.3.3 Subbasin 03-07-51 (Lumber River Mainstem and Major Tributaries)

This subbasin includes the mainstem of the Lumber River and its minor tributaries. The tributary sites usually have very little flow and, therefore, have seldom been sampled. The Lumber River, however, has been intensively studied in relation to point source dischargers.

The Lumber River from its source to U.S. Highway 301 has been designated as High Quality Waters based on chemical and biological (benthos and fish community) data. Dischargers in the Laurinburg to Pembroke area have been shown to impact the Lumber River. This portion of the river recently was given Good bioclassifications based on benthos data, while prior samples have indicated Excellent water quality. Dischargers in the Lumberton area result in further degradation of the Lumber River and Fair or Poor benthos bioclassifications under low flow conditions. The issue of color problems in this section of the Lumber River has been raised and efforts are being made to resolve the issue. At Boardman, recovery is occurring (Good benthos rating), and appears to be complete by the time the river has reached Fair Bluff (Excellent benthos rating). Ambient chemistry data reflects a similar pattern with high DO values in upstream areas, lower values below Lumberton, and a subsequent rise at Fair Bluff. Results of sediment oxygen demand work are similar with the highest demand occurring above Boardman. Water quality of tributary streams has been difficult to assess because of their swampy character. Fish community

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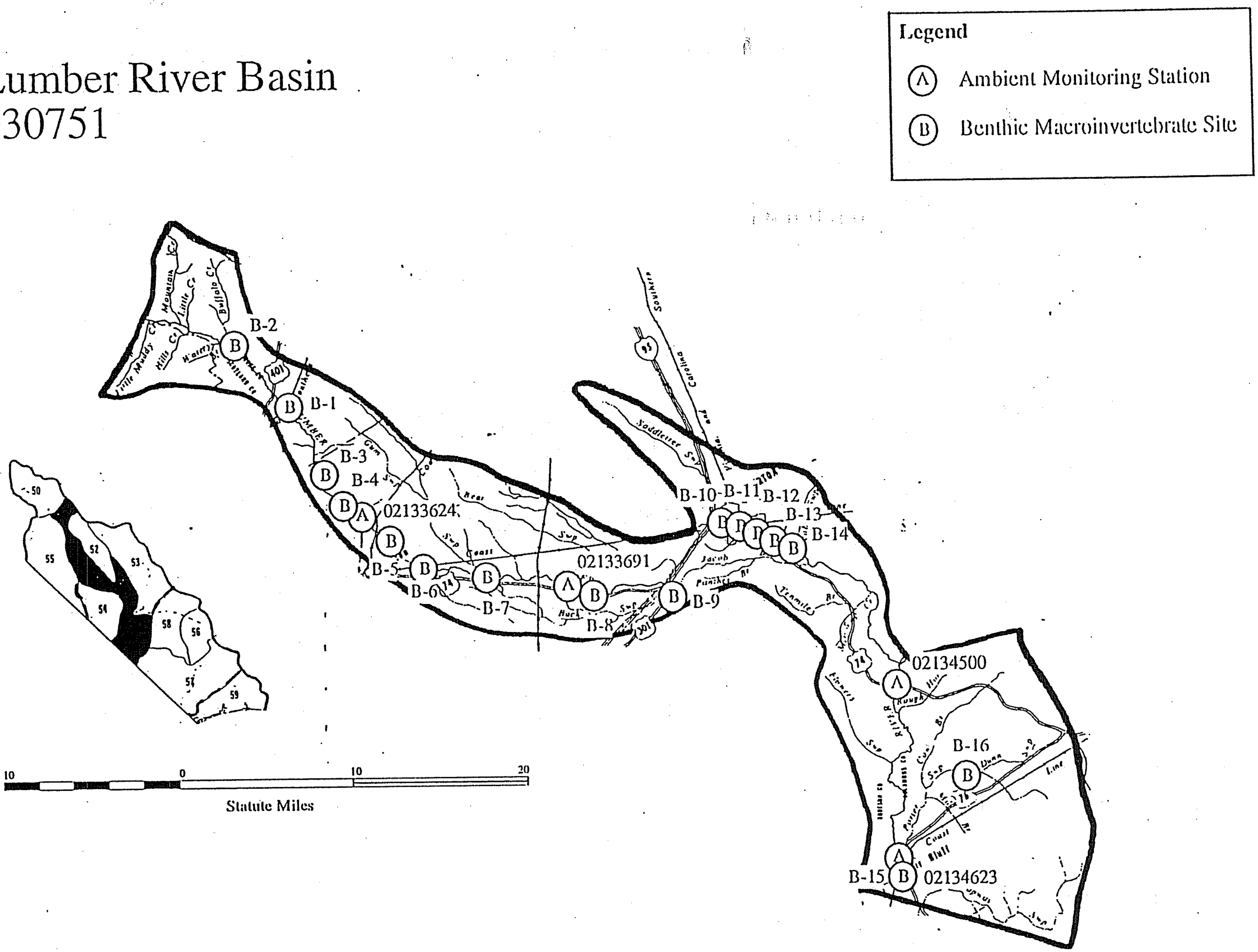

Figure 4.6a Water Quality Monitoring Stations in Subbasin 03-07-51 (Lumber River)

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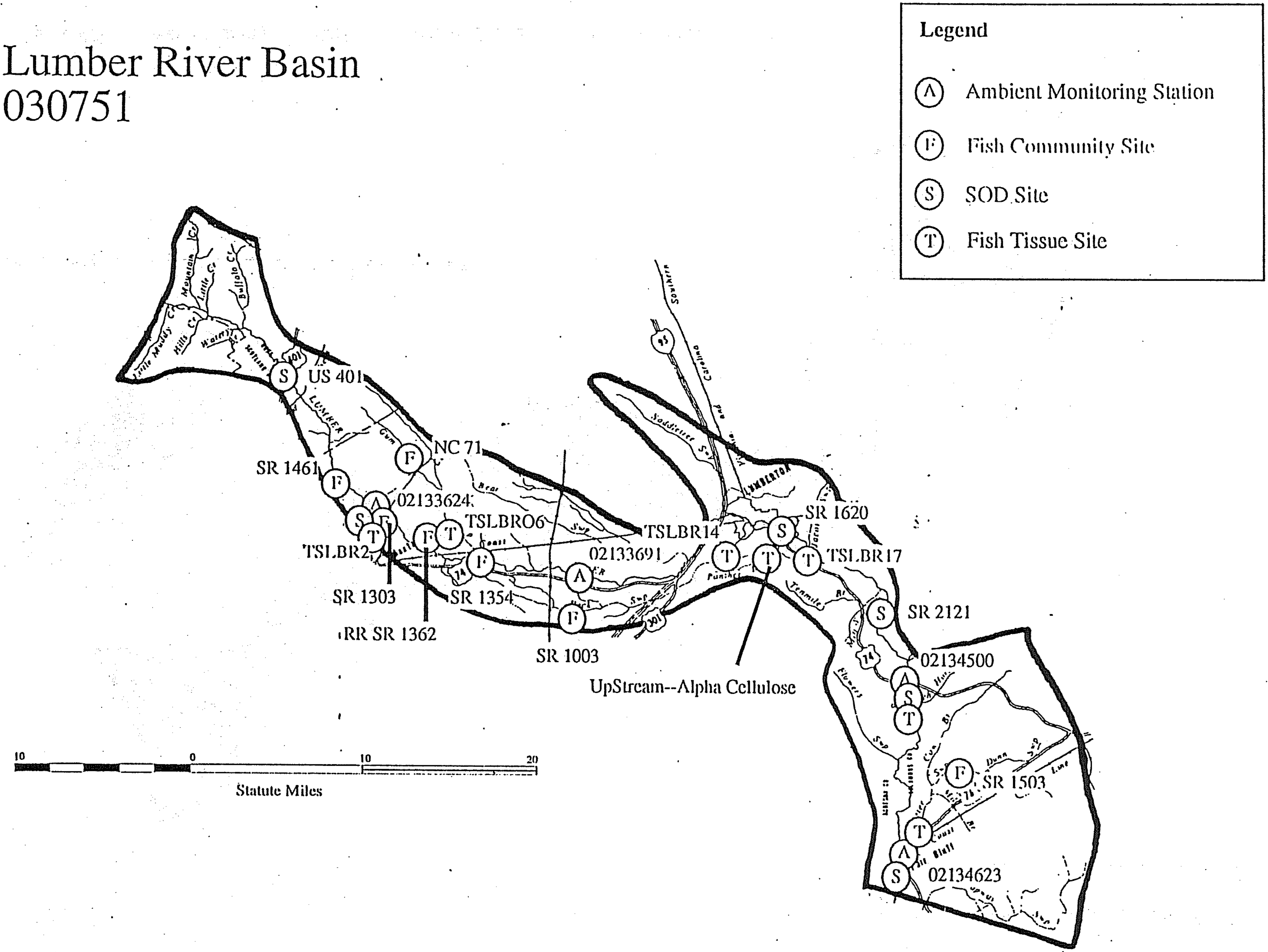


Figure 4.6b Water Quality Monitoring Stations in Subbasin 03-07-51 (Lumber River)

analyses of Back Swamp and Porter Swamp have indicated Good-Fair or Fair biotic index ratings while benthos data resulted in a similar bioclassification at Back Swamp, but a poor classification at Porter Swamp.

BENTHIC MACROINVERTEBRATE MONITORING Benthic macroinvertebrate samples were collected at the following nine sites in subbasin 03-07-51 in 1991.

Site #	Creek	Date	County	Road	S/SEPT	Rating
L51-1	Lumber R nr Wagram	910912	Scotland	SR 1404	83/30	Excellent
L51-4	Lumber R nr Maxton	910912	Robeson	NC 71	77/22	Good
L51-8	Lumber R nr Pembroke	910912	Robeson	SR 1003	86/30	Good
L51-9	Back Swp	910911	Robeson	US 301	- /15	G-F
L51-10	Lumber R above Lumb	910911	Robeson	SR 2289	84/29	Good
L51-13	Lumber R be WWTP	910910	Robeson	NC 72	67/27	Good
L51-14	Lumber R	910910	Robeson	NC 74	53/20	Good
L51-15	Lumber R	910910	Robeson	NC 904	69/23	Excellent
L51-16	Porter Swp	910911	Columbus	SR 1503	- /3	Poor

Several mainstem sites have been sampled for numerous years and can provide both an indication of present water quality, and how water quality has changed since 1983.

<u>Lumber River near Maxton at NC 71:</u> This site had shown some improvement in 1986 and 1988, when the classification was upgraded from Good to Excellent. However, the 1990 and 1991 collections indicated that this condition was not permanent. A white flocculent material was observed in the river during the August 1990 collections, which originated from the West Point Pepperell-Wagram discharge. This has since been eliminated through WWTP upgrades.
<u>Lumber River near Pembroke at SR 1003:</u> The EPT taxa richness values for this site have been fairly stable during all years of collection since 1983, and it retained an Excellent bioclassification through 1988. An increase in the Biotic Index in 1990 and 1991 pulled the bioclassification down to Good during these years.
<u>Lumber River near Boardman at NC 74:</u> The bioclassification has remained constant for each of the years it has been sampled. High flows in 1991 made sampling difficult and contributed to the decreased total taxa and EPT taxa richness values.
<u>Lumber River near Wagram:</u> This site has been sampled four times since 1985 and has been assigned an Excellent bioclassification each time.
<u>Lumber River at SR 2289 above Lumberton (LB51-10)</u>: This site has also been sampled four times since 1985 and consistently received a Good bioclassification.
<u>Lumber River below Lumberton WWTP, at SR 1620/NC 72 (LB51-14)</u>: This site is located downstream of the major Lumberton area dischargers. Water quality has improved from Fair in 1985 and Poor in 1986 to Good in 1991. These changes in bioclassifications reflect changes in flow in the 1991 data over the previous years' data.

SPECIAL STUDIES A number of special macroinvertebrate studies were conducted to determine the impact of several NPDES facilities on water quality and aquatic life. Based on data from all benthic macroinvertebrate special studies since 1983 the following conclusions were drawn:

- The Laurinburg - Maxton Airport was found not to have an impact on the Lumber River fauna. Ratings were Excellent at all three sampling sites in 1985.
- The study did not indicate any impact on the Lumber River fauna due to the Alpha Cellulose discharge. However, any possible impacts may been masked by upstream impacts. Ratings ranged from Fair to Good.
- The West Point Pepperell-Wagram discharge was found to have no impact on river fauna.

- A possible slight impact to the river fauna was indicated below the Laurinburg/Maxton area dischargers.

- Below Lumberton, the West Point Pepperell and Alpha Cellulose discharges showed a combined impact, with further impact by the Lumberton WWTP. Collections further downstream indicated some recovery.

POTENTIAL HQW/ORW STREAMS Based on DEM surveys, the Lumber River above Lumberton has been designated HQW. Recent DEM surveys have not indicated any other eligible streams in this subbasin. The Lumber River near Fairbluff received an Excellent bioclassification during the 1991 basin survey. However, this rating was borderline, and consideration of this stretch of river for HQW designation is further complicated by the upstream dischargers.

AQUATIC TOXICITY MONITORING: SELF-MONITORING Twelve facilities in this subbasin currently monitor effluent toxicity as per permit requirements. These facilities are:

Facility	NPDES #	Receiving Stream	County	Flow(MGD)	IWC(%)
Alpha Cellulose	NC0005321	Lumber River	Robeson	1.6	1.73
Cogentrix Leasing-003	NC0058301	Lumber River	Robeson	0.45	0.5
Converse Inc.	NC0005673	Holly Swamp	Robeson	0.075	100.0
DOC-McCain Hospital-001	NC0035904	UT Mountain Cr.	Hoke	0.1	50.83
DOC-McCain Hospital-003	NC0035904	UT Field Branch	Hoke	variable	
CP&L Weatherspoon-001	NC0005363	Lumber River	Robeson	variable	
West Pt Pepperell-Wagram	NC0005762	Lumber River	Scotland	4.5	6.17
Laurinburg-Maxton Airport	NC0044725	Lumber River	Scotland	1	1.37
Lumberton WWTP	NC0024571	Lumber River	Robeson	10	10.7
Pembroke WWTP	NC0027103	Lumber River	Robeson	1.33	1.8
Robeson Co. Schools	NC0034100	UT Flowers Swamp	Robeson	0.006	100.0
West Point Pepperell	NC0004618	Lumber River	Robeson	2.5	2.93

DOC-McCain Hospital-003 is an episodic cooling water discharge which has not had occasion to report any data as yet. Converse, Inc. ceased discharge from its 001 pipe in December 1992 and now discharges to the Lumberton WWTP. The facility continues to discharge groundwater remediation and cooling water for which general permits are being sought.

The DOC-McCain Hospital-001 was under a Special Order by Consent lasting until April, 1993. The facility has been performing toxicity reduction activities with the assistance of the NC DEM Toxicity Evaluation Group. The Pembroke WWTP is under a consent order lasting from 6/18/92 to 12/31/94 which relieves the facility from a toxicity limit. This plant is being upgraded and enlarged to a 1.33 MGD facility.

FISH COMMUNITY STRUCTURE Sampling was performed at 6 sites in this subbasin.

Stream	Location	Date	County	NCIBI Score	NCIBI Rating
Lumber River	SR-1461	870728	Scotland	54	Good-Excellent
Lumber River	SR-1303	861001	Robeson	56	Good-Excellent
Lumber River	SR-1362	860930	Robeson	58	Excellent
Lumber River	SR-1362	870728	Robeson	56	Good-Excellent
Lumber River	SR-1354	860930	Robeson	54	Good-Excellent
Gum Swamp	NC-71	910930	Robeson	44	Fair
Back Swamp	SR-1003	910724	Robeson	46	Fair-Good
Porter Swamp	SR-1503	920429	Robeson	46	Fair-Good

FISH TISSUE Fish tissue samples were collected and processed for metals at five sites within subbasin 03-07-51. All results were lower than FDA criteria except for two samples which exhibited mercury levels exceeding the FDA criteria of 1.0 mg/Kg. These included Drowning Creek at SR 1412 (July 1993) and Porter Swamp at SR 1503 (April 1992). The sampling sites were: Lumber River at the Lumberton WWTP (July 22,1986), Lumber River at the railroad near Maxton (September 30 1986), Lumber River at SR. 1303 (July 22, 1986), Lumber River at SR. 1620 below Lumberton (1986 and 1987) and Lumber River at US-74 at Boardman (August 14, 1980 and May 27, 1981)

SEDIMENT OXYGEN DEMAND SOD sampling was performed at six sites.

Station	Date	Avg. SOD Rate g/m2/day at 20°C	Avg. Amb. Temp. °C
Lumber R. at HWY401	052792	-1.0484	17.7
Lumber R. at Hwy 71	082891	-0.3390	23.5
Lumber R. at HWY 72	071791	-0.7631	24.8
Lumber R. at SR 2121	071891	-0.6671	24.8
Lumber R. at HWY 74	082192	-1.4789	20.2
Lumber R. at HWY 904	072491	-0.8000	29.6

4.3.4 Subbasin 03-07-52 (Raft Swamp)

This subbasin contains the entire Raft Swamp drainage area: a tributary of the Lumber River in Hoke and Robeson Counties. Raft Swamp and its tributaries are typical swamp-streams, having very little visible current (under normal flow conditions) and tannin-colored water. Some streams in this subbasin have flows that are restricted due to beaver dams. Greater flows were evident in other sections of Raft Swamp. Raft Swamp has Good-Fair water quality based on benthic macroinvertebrate data. Water chemistry data from an ambient station on Raft Swamp indicates a median DO value of 7.2 mg/l.

BENTHIC MACROINVERTEBRATE MONITORING Benthic macroinvertebrates were collected from a single location in subbasin 03-07-52 during basin assessment in the summer of 1991.

Site #	Creek	Date	County	Road	S/SEPT	Rating
L52-1	Raft Swamp	910911	Robeson	NC 211	-/16	G/F

SPECIAL STUDIES The following special benthic macroinvertebrate studies were performed:

Site #	Creek	Date	Study	County	Road	S/SEPT	Rating
L52-1	Raft Swamp	881229	Lumberton Landfill	Robeson	NC 211	75/24:	G-F
L52-2	Raft Swamp	881229	Lumberton Landfill	Robeson	SR 1526	87/30:	Good
L52-3	Burnt Swp	910609	Ag. Chemicals Inc	Robeson	ab RR bridge	41/4:	Fair?
L52-4	Burnt Swp	910609	Ag. Chemicals Inc	Robeson	SR 1515	44/5:	Fair?

Benthic macroinvertebrates were collected from two locations on Raft Swamp above and below the Lumberton landfill. Taxa richness was greater at the downstream location, indicating that there are no apparent effects of drainage from the landfill site.

Benthic macroinvertebrate samples were collected from two locations on Burnt Swamp, above and below Agricultural Chemical Inc. There was no indication that the facility was having any negative impact. However, this stream is very small and has little or no flow during much of the year. This natural stress will severely limit the diversity of the aquatic fauna.

Lumber River Basin
030752

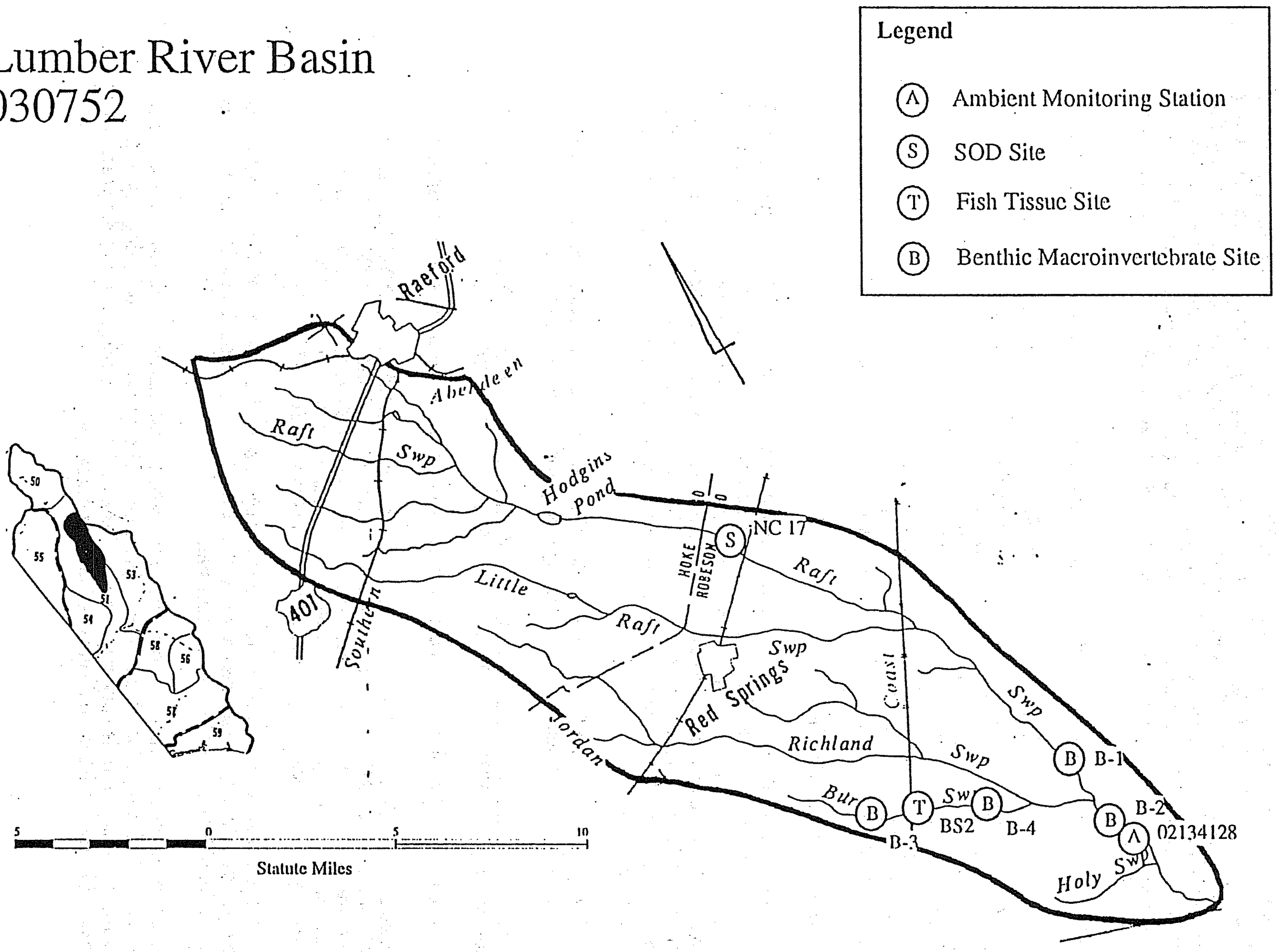


Figure 4.7 Water Quality Monitoring Sites in Subbasin 03-07-52

POTENTIAL HQW/ORW STREAMS None was found to qualify as either HQW or ORW.

PHYTOPLANKTON MONITORING One sample was evaluated from this subbasin (Bruce Pond, 1988). Although collected as a bloom sample, the data do not support bloom conditions.

AQUATIC TOXICITY MONITORING: SELF-MONITORING One facility in this subbasin currently monitors effluent toxicity as per a permit requirement. This facility is:

Facility	NPDES #	Receiving Stream	County	Flow(MGD)	IWC(%)
Red Springs WWTP	NC0025577	Little Raft Swamp	Robeson	2.5	98.0

FISH COMMUNITY ASSESSMENT None was made in this subbasin.

FISH TISSUE Burnt Swamp at SR. 1513 was sampled on August 13, 1985. All results for metals analyses were lower than FDA recommended criteria.

LAKES ASSESSMENT PROGRAM No lakes were assessed in this subbasin.

SEDIMENT OXYGEN DEMAND Sampling was performed at Raft Swamp at HWY 71 on May 5, 1992. An average SOD rate of -4.6124 g/m2/day at 20°C measured at an average ambient temperature of 15.2°C.

4.3.5 Subbasin 03-07-53 (Big Swamp)

This subbasin contains the entire Big Swamp drainage area: a tributary of the Lumber River in Hoke, Robeson and Bladen counties. Big Swamp and its tributaries are typical swamp-streams, with tannin-colored water and very low current speeds under normal flow conditions. Good (Gallberry Swamp) or Good-Fair (Big Swamp and Big Marsh Swamp) bioclassifications are indicated for the only streams sampled in this subbasin. One algal bloom was noted at Sealy Pond.

BENTHIC MACROINVERTEBRATE MONITORING Benthic macroinvertebrates were collected from four locations in this subbasin during 1991. No collections had been made prior to 1991.

Site #	Creek	Date	County	Road	S/SEPT	Rating
L53-1	Big Swamp abv Bladenboro	910923	Robeson	NC 211	60/13	G/F
L53-2	Big Swamp bel Bladenboro	910923	Robeson	SR 1002	61/15	G/F
L53-3	Gallberry Sw	910912	Robeson	NC 20	-/19	Good
L53-4	Big Marsh Sw	910912	Robeson	SR 1924	-/16	G/F

PHYTOPLANKTON MONITORING Only one phytoplankton sample was collected from subbasin 03-07-53 at Sealy Pond (1991). The high biovolume and density indicated bloom conditions. Chlorophyll *a* was not collected. The pond was sampled one month after the fish kill.

AQUATIC TOXICITY MONITORING: SELF-MONITORING Three facilities in this subbasin, listed below, currently monitor effluent toxicity as per permit requirements; at least one other will be recommended for a monitoring requirement in its next permit renewal.

Facility	NPDES #	Receiving Stream	County	Flow(MGD)	IWC(%)
Bladenboro WWTP	NC0026352	Bryant Swamp	Bladen	0.50	100.0
Croft Metals 001,003	NC0035530	Big Marsh Swamp	Robeson	0.095	48.7
Parkton WWTP	NC0026921	Dunn's Marsh	Robeson	0.2	100.0
Piedmont Poultry Proc., Inc.	NC0040185	Big Marsh Swamp	Robeson	No flow limit	N/A

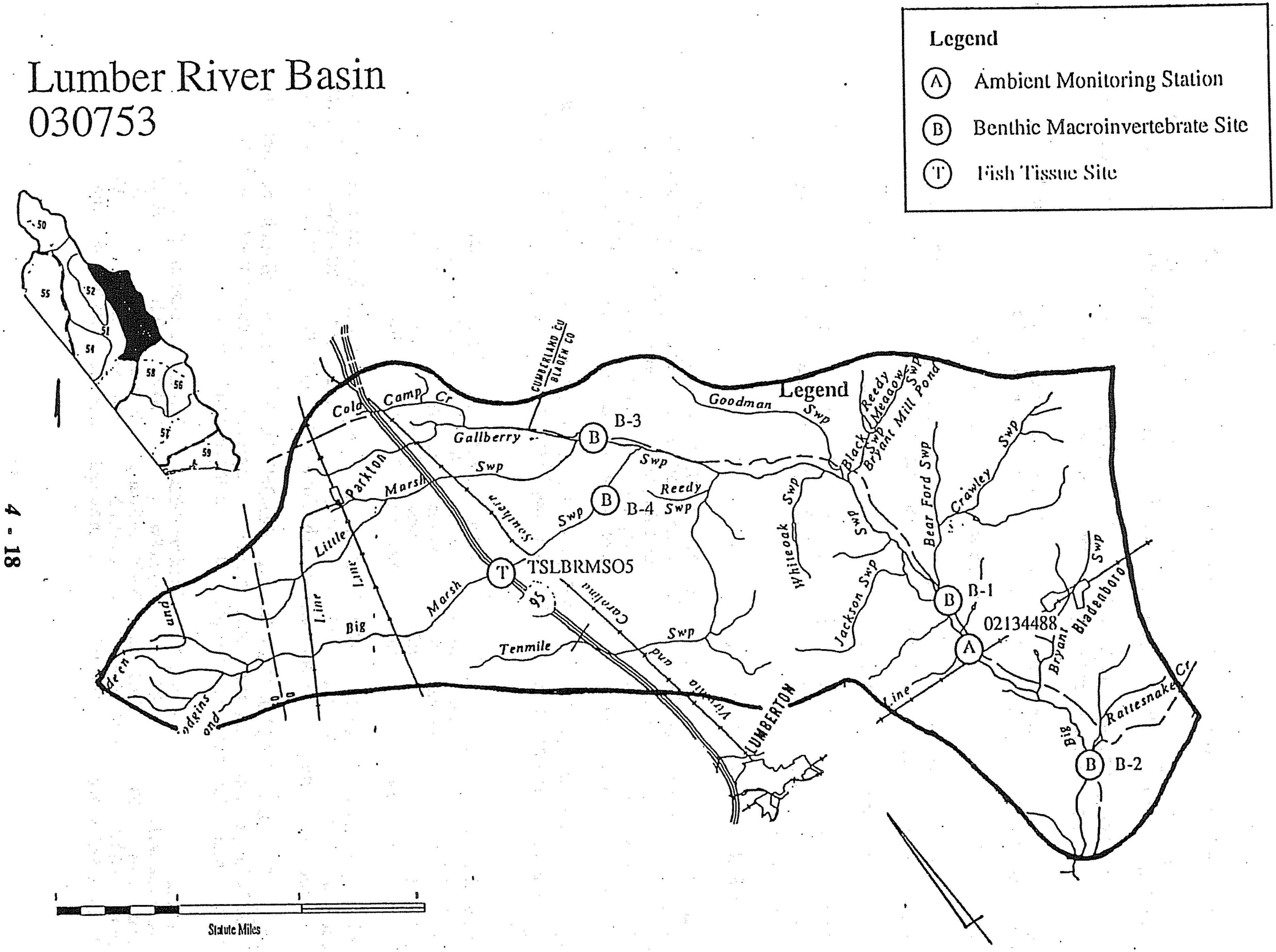


Figure 4.8 Water Quality Sampling Sites in Subbasin 03-07-53

Croft Metals has been under consent orders since 1989. The facility is currently performing toxicity reduction activities.

FISH TISSUE Fish tissue samples were collected and analyzed for metals at one site within the Lumber 53 subbasin. Big Marsh Swamp at St. Pauls was sampled on October 30, 1986. All results for metals analyses were lower than FDA recommended criteria.

4.3.6 Subbasin 03-07-54 (Ashpole Swamp in the Lumber River Watershed)

This small subbasin contains the Ashpole Swamp drainage area, a tributary of the Lumber River in Robeson County. Ashpole Swamp and its tributaries are typical swamp-streams, with little visible current under normal flow conditions and tannin-colored water. Water quality of these swamp streams is difficult to assess as evidenced by the indication of Good fish community in Ashpole Swamp, but only Fair water quality based on the benthos community. Discharge from the Fairmont WWTP complicates evaluation of this swamp system, where low dissolved oxygen may naturally occur. Ambient water chemistry data from Ashpole Swamp indicate a low median DO value of 4.3 mg/l.

BENTHIC MACROINVERTEBRATE MONITORING Benthic macroinvertebrates were collected from two locations in this subbasin during 1991.

Site #	Creek	Date	County	Road	S/SEPT	Rating
L54-1	Ashpole Swp	910911	Robeson	NC 41	-/8	Fair
L54-3	Hog Swamp	910911	Robeson	SR 2262	-/8	Fair

LONG TERM BENTHOS SITES Ashpole Swamp near Barnesville at SR 2258 is the only ambient benthic monitoring site in this subbasin, and there has been only one collection from this location. This location is fairly typical of streams/tributaries in this subbasin. The floodplains are extremely large, swamp systems; channels are often braided. Visible current, if present, is usually restricted to small areas. The benthic information from Ashpole Swamp is difficult to assess using the established criteria. A combination of swamp-like conditions and low flow might be expected to produce low dissolved oxygen concentrations during the summer months. The results from this location are complicated by the Fairmont WWTP which is located about 10 miles upstream from the ambient location. Chemical data from this site in 1985 and 1986 indicated that the dissolved oxygen values are usually $\leq$2.0 mg/l for 6 months and $\leq$1.0 mg/l for 3-4 months. The dominant taxa (Stictochironomus sp.), however, is not characteristic of sewage-affected streams.

POTENTIAL HQW/ORW STREAMS None were found to qualify as either HQW or ORW.

PHYTOPLANKTON MONITORING No samples were collected from this subbasin.

AQUATIC TOXICITY MONITORING: SELF-MONITORING The Fairmont WWTP currently monitors effluent toxicity as a permit requirement. The facility was under a chronic monitoring requirement from the effective date of its current permit until 9/1/92. The facility now has a chronic limit at 90%.

Facility	NPDES #	Receiving Stream	County	Flow(MGD)	IWC(%)
Fairmont WWTP	NC0021059	Pittman Mill Branch	Robeson	0.5	100.0

FISH COMMUNITY ASSESSMENT Fish community structure sampling was performed twice at one site in this subbasin.

Lumber River Basin
030754

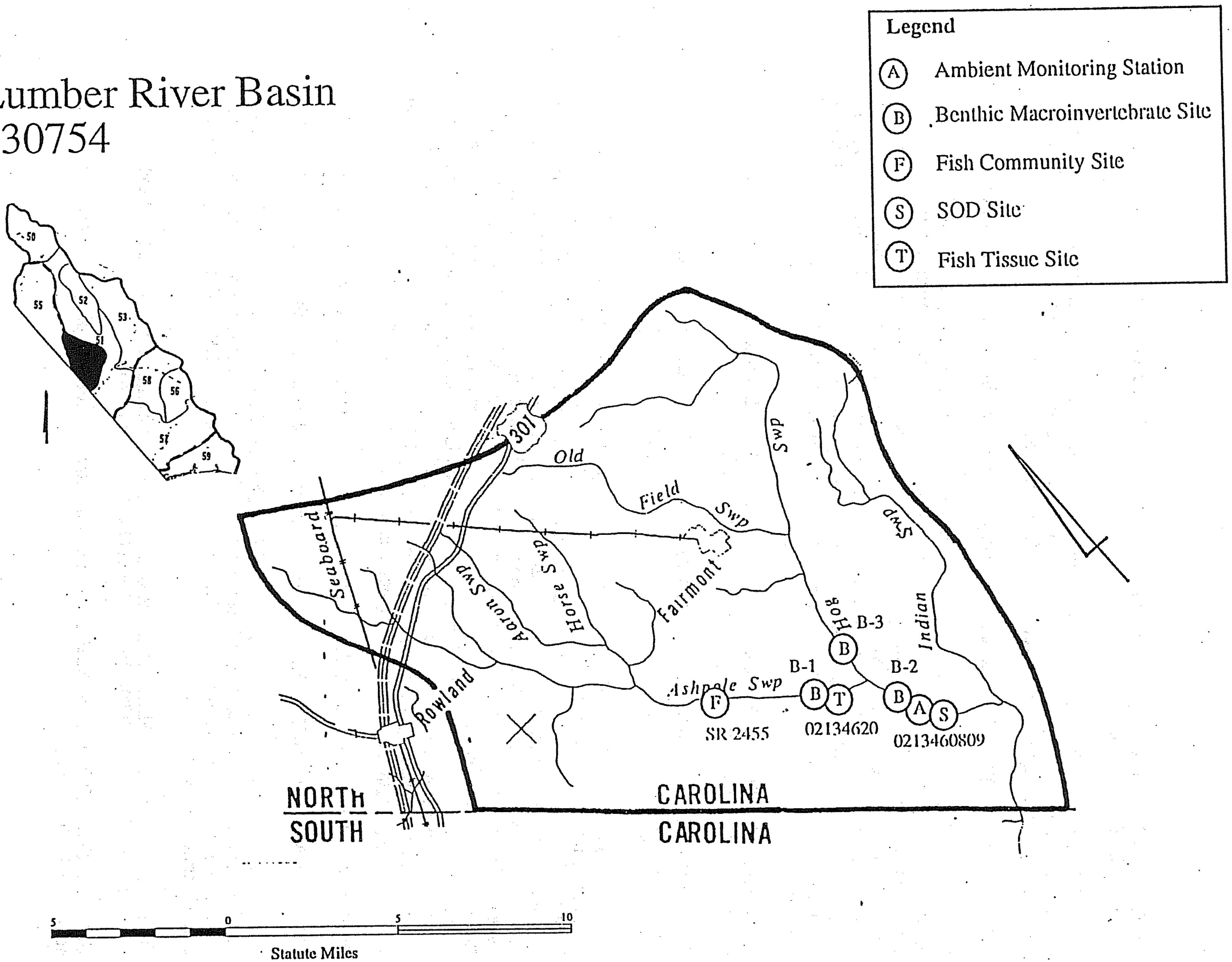


Figure 4.9 Water Quality Sampling Sites in Subbasin 03-07-54

Stream	Location	Date	County	NCIBI Score	NCIBI Rating
Ashpole Swamp	SR-2455	910725	Robeson	48	Good
Ashpole Swamp	SR-2455	921022	Robeson	50	Good

FISH TISSUE Fish tissue samples were collected analyzed for metals contaminants at Ashpole Swamp at SR 2256 Bridge on May 20,1992 and again as part of a follow up study on October 28,1992. Mercury concentrations of 0.22 ppm to 2.0 ppm were detected in tissue at this site. A mean mercury concentration of 0.78 ppm was calculated for whole fish samples with one sample containing 1.7 ppm mercury. Analysis of fillet samples resulted in a mean of 1.06 ppm mercury, which exceeds the FDA recommended action level of 1.0 ppm.

CHEMICAL/PHYSICAL CHARACTERIZATIONS A water quality survey was performed on July 9-11, 1984, on a 0.5 mile reach of Pitman Mill Branch and Old Field Swamp downstream of the Fairmont WWTP outfall. The consulting firm representing the town requested a wetlands discharge, so that the WWTP would receive less stringent effluent limits. This request was denied as a result of the study, because Pitman Mill Branch and old Field Swamp are channelized streams not swamps. Data collected: field parameters, nutrients, solids, chlorophyll, coliform BOD5, long-term BOD, flow measurements, and time-of-travel.

SEDIMENT OXYGEN DEMAND Sediment oxygen demand tests were conducted on the main channel of Ashpole Swamp at SR 2258 near Barnesville in Columbus County. Bottom sediment at the station consisted of fine sand and chambers were set at a depth of 4 to 5 feet. Average SOD rate for the station was -0.7749 gr/m^2/day at an average ambient water temperature of 29.6°C and -0.8410 when corrected to 20°C.

4.4 LITTLE PEE DEE HEADWATERS WATERSHED (Subbasin 03-07-55)

Most of this subbasin lies within the Sandhills ecoregion, characterized by streams with obvious year round flow. Laurinburg lies within this basin, and several permitted discharges are located in this area. The watersheds of Shoe Heel Creek and Gum Swamp make up most of the subbasin.

Water quality has ranged from Excellent or Good in the lower sections of Shoeheel Creek and Gum Swamp (based on benthos data), to Good (above Laurinburg WWTP on Shoeheel Creek) or Good-Fair in upstream sections of these two streams. Fisheries data indicate Fair-Good community health in Little Shoeheel Creek. Benthos data suggests a Good-Fair bioclassification for Leiths Creek. Lakes data have shown John's Pond, a private impoundment of Leiths Creek to be hypereutrophic. Maxton Pond, an old shallow millpond, is eutrophic and almost completely closed in with macrophytes. Phytoplankton data also indicated bloom conditions were found in Dunn's Pond. Nonpoint runoff may be contributing to much of the impact found in this subbasin.

BENTHIC MACROINVERTEBRATE MONITORING Four benthic macroinvertebrate samples were collected from this subbasin during 1991 as shown below. One ambient site is located in this subbasin. Several special studies also have been conducted here.

Site #	Creek	Date	County	Road	S/SEPT	Rating
L55-1	Gum Swamp Cr.	910909	Scotland	SR1323	EPT=12	G-F
L55-4	Gum Swamp Cr	910909	Scotland	15-401	EPT=25	Ex
L55-5	Leiths Cr	910910	Scotland	SR1610	EPT=12	G-F
L55-8	(Big) Shoeheel Cr	910910	Scotland	SR 1101	75/26	Good

Benthic macroinvertebrate data collected from Gum Swamp Creek above Richmond Mill Lake yielded a Good-Fair bioclassification, but a downstream site was rated as Excellent. Leiths Creek was originally rated Fair in the Assessment Document (NCDEHNR 1985), however, 1991 data suggested a Good-Fair bioclassification.

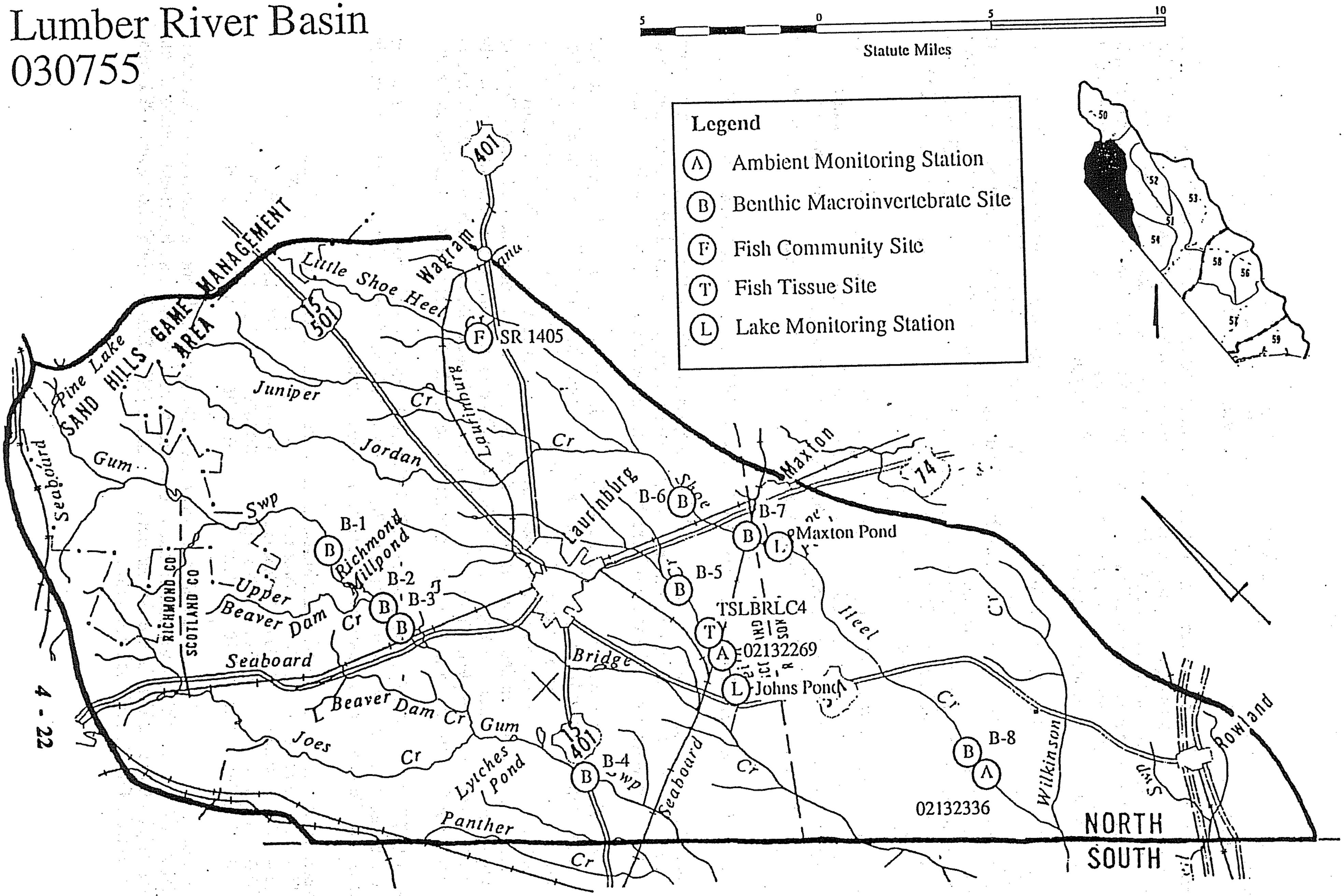


Figure 4.10 Water Quality Sampling Sites in Subbasin 03-07-55

LONG TERM BENTHOS SITES

(Big) Shoeheel Creek nr Rowland at SR 1101: Data from Big Shoeheel Creek suggested a slight improvement in water quality, Good in 1985 to Excellent in 1987 and 1990. However, the 1991 collection again produced a Good rating. In fact, as shown below, biotic index values generally have increased since 1985, suggesting a slight shift to more tolerant taxa. The changes may be more related to flow than to any long-term change in water quality: low flows produce an Excellent rating, while higher flows produce a Good rating.

A study conducted upstream of this station in September 1990 indicated an impact to Shoeheel Creek by the Laurinburg WWTP. Many intolerant taxa were collected above the plant, but were not collected below it. However, collections made one month earlier near Rowland included those intolerant taxa, indicating that the stream was recovering from upstream impacts.

SPECIAL BENTHIC MACROINVERTEBRATE STUDIES Based on evaluation of data from all special studies since 1983 the following conclusions are drawn:

- Comparisons of benthos in Gum Swamp Creek above and below the Fieldcrest Mills discharge indicated that the facility was having a slight impact on stream fauna. The presence of Richmond Mill Lake above the control site complicated the between-site comparison.
- Benthos samples collected above and below the Laurinburg WWTP suggested a moderate impact on the biota of Shoeheel Creek

POTENTIAL HQW/ORW STREAMS An EPT sample was collected from Gum Swamp Creek at US 15-401 and yielded an Excellent bioclassification. Many intolerant taxa were collected including the mayfly Stenonema lenati. Data collected several miles upstream produced Good-Fair ratings both above and below the discharge of Fieldcrest Mills, although some minor impact was noted below this industry. Since that time the flow from the mill has been substantially reduced from about 1.0 MGD to about 0.2 MGD. It is possible that some portion of Gum Swamp may now qualify as HQW.

PHYTOPLANKTON MONITORING One ambient sample, at John's Pond, and one bloom sample, at Dunn's Pond, were collected. The high concentration of chlorophyll *a* found in the ambient sample (John's Pond) indicates that an algal bloom was present. The high biovolume, density and chlorophyll *a* found in Dunn's Pond all indicate that an algal bloom was present. High nutrient concentrations also were present.

AQUATIC TOXICITY MONITORING: SELF-MONITORING Four facilities currently monitor effluent toxicity as per permit requirements; at least one other will be recommended for a monitoring requirement in its next permit renewal. Monitoring facilities include;

Facility	NPDES #	Receiving Stream	County	Flow(MGD)	IWC(%)
Fieldcrest Mills-Laurel Hill	NC0005479	Gum Swamp Cr.	Scotland	0.3	1.5
Laurinburg WWTP	NC0020656	Big Shoe Heel Cr.	Scotland	4.0	31.0
Springs Industries	NC0005754	Gum Swamp Cr.	Scotland	0.03	0.14
Toastmaster, Inc.	NC0005053	Leith Cr.	Scotland	0.015	100.0

Toastmaster, Inc. is not currently discharging and its NPDES permit has expired. The Fieldcrest Mills facility closed its carpet mill operations and is currently a domestic discharge with some possible minor industrial contribution.

FISH COMMUNITY STRUCTURE Sampling was performed at the following site.

Stream	Location	Date	County	NCIBI Score	NCIBI Rating
Little Shoeheel Cr	SR-1405	910930	Scotland	46	Fair-Good

FISH TISSUE Fish tissue samples were collected at one site within the Lumber 55 subbasin. Leith Creek at SR. 1619 was sampled on November 19, 1986. All results for metals analyses were lower than FDA recommended criteria.

LAKES ASSESSMENT PROGRAM

Lake	Date	NCTSI	TP	TON	CHLA	Classification	Use Support
Johns Pond	8807	5.4[H]	0.18	0.78	80.0	C-SW	Partial
Maxton Pond	9108	0.7[E]	0.11	0.46	1.0	C-SW	Threatened

Two lakes in subbasin 03-07-55 have been sampled. Johns Pond, an impoundment of Leith Creek, is a private lake characterized by tannic, shallow water with low dissolved oxygen (DO). Violation of the chlorophyll *a* standard and extremely high nutrient levels reflect the hypereutrophic condition of the lake. When last sampled, decaying clumps of organic matter were seen floating in the water. Use support is considered partial because aquatic life is affected by low DO levels.

Maxton Pond is an old shallow millpond with extremely high levels of total phosphorus and high levels of total organic nitrogen. Land uses upstream include agriculture, agricultural related industries and urban development in the town of Maxton. The eutrophic pond is almost completely closed in with macrophytes. Use support is considered threatened because swimming and aesthetic enjoyment of the lake is hampered by the dense vegetation.

4.5 WACCAMAW RIVER WATERSHED (Subbasins 03-07-56, 57 and 58)

4.5.1 Watershed Ambient Monitoring Assessment

Subbasins 03-07-56 through 03-07-58 make up the drainage of the Waccamaw River in North Carolina. At present, the AMS has four stations within these subbasins with three on the mainstem of the river (Figure 4.11). All of these mainstem stations have recorded data for the five-year cycle from 1988 to 1992 and are listed below.

Primary Number	Location
02108969	Lake Waccamaw at Dam Spillway near Lake Waccamaw, NC
02109500	Waccamaw River at NC Hwy 130 at Freeland, NC
02110500	Waccamaw River at SC Hwy 9 near Longs, SC

Data from these mainstem stations show a drop in the median dissolved oxygen from the dam spillway to the Longs, SC station (Figure 4.12). The higher dissolved oxygen recorded at Lake Waccamaw is probably due to aeration caused by the dam spillway. The median dissolved oxygen readings on the lower two stations are within the 95% confidence interval of the median and can be considered not different from each other. There are no significant point discharges near these stations.

Waccamaw River Main Stem

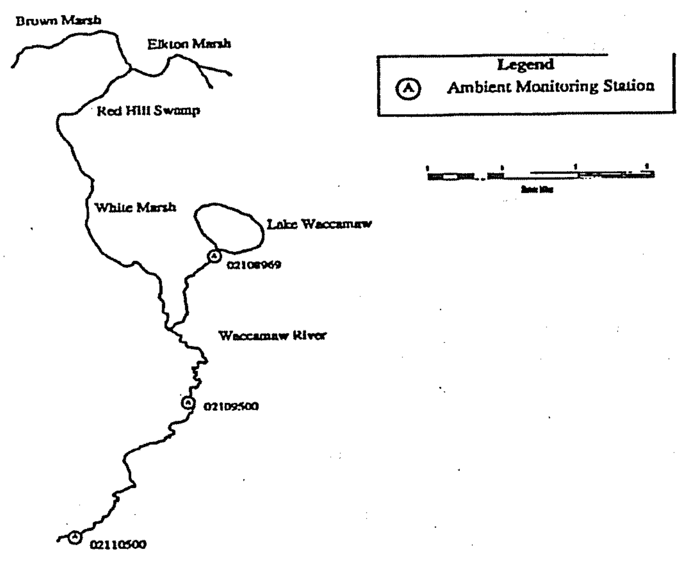
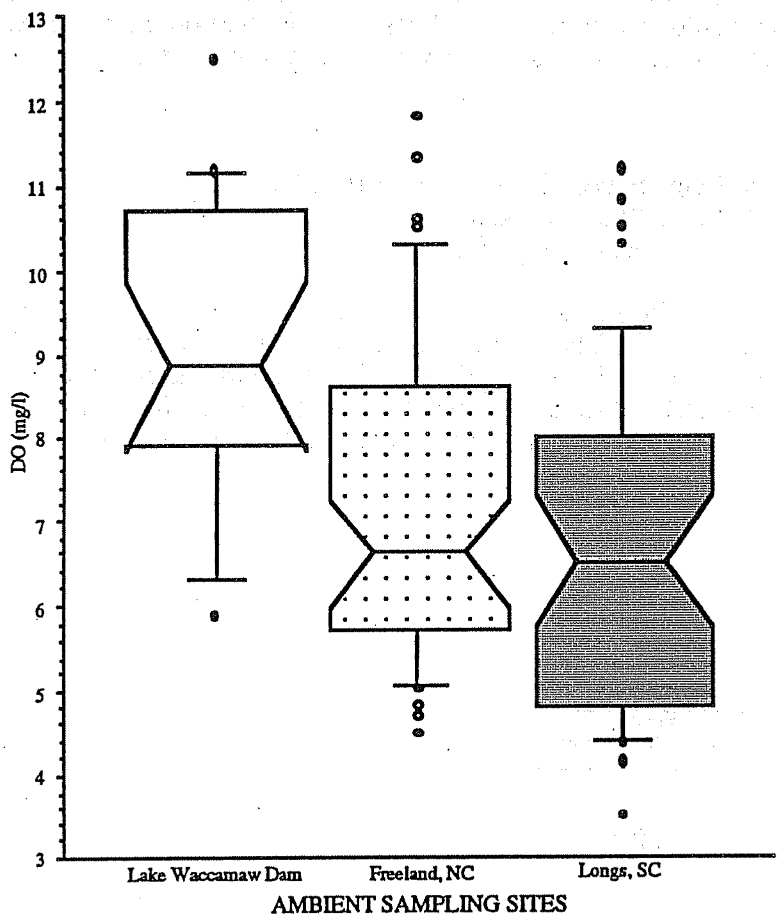


Figure 4.11 AMS Stations on the Main Stem of the Waccamaw River

The pH median (Figure 4.13) from main stem stations drops from the dam spillway to the Freeland station and again higher at the Longs, SC station. These stations are in swamp-class waters and the discussion of pH and swamp waters in the Lumber basin above is applicable here also.

None of the main stem stations have high metals samples and they show a general rise in conductivity samples over the five year period. There is one tributary station and the data shows generally the same trends as the main stem.



	Count	Minimum	Maximum	Range	Geom. Mean	Median	IQR*
DO, Total	115	3.500	12.500	9.000	6.962	7.000	3.15
Lake Waccamaw	18	5.900	12.500	6.600	8.732	8.850	2.8
Freeland	52	4.500	11.800	7.300	6.940	6.600	2.9
Longs, SC	45	3.500	11.200	7.700	6.382	6.500	3.2

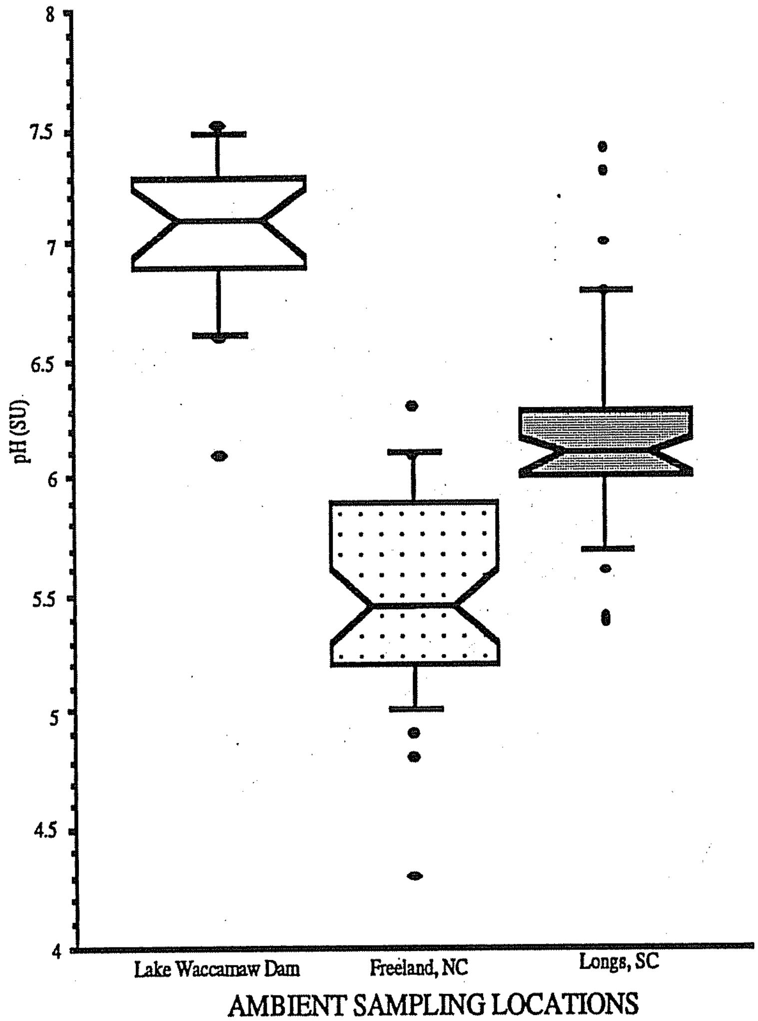
*Interquartile Range-Spread of values containing the central 50% of the data(75th-25 percentiles)

Figure 4.12 Dissolved Oxygen Concentrations at AMS Stations on the Waccamaw River Main Stem, 1988 to 1992 (Box and whisker plots)

4.5.2 Subbasin 03-07-56 (Lake Waccamaw and Upper Waccamaw River)

DESCRIPTION This subbasin is comprised of Lake Waccamaw, one of the Carolina Bay lakes, and its tributary Big Creek, the upper Waccamaw River, and Bogue Swamp. There is some residential development near Lake Waccamaw, but most of the land use is either forest or agriculture. Small streams tend to be ephemeral, with little or no flow during dry summer months. For this reason, most of the DEM sampling in this subbasin has focused on Lake Waccamaw and the Waccamaw River. DEM fish tissue surveys have revealed elevated mercury concentrations in largemouth bass and several other species throughout the Waccamaw Drainage above and below

Lake Waccamaw from Meares Millpond to the South Carolina border. The Division is preparing a report on these two water bodies, evaluating their suitability for ORW designation. Lake Waccamaw contains a high diversity of endemic fish and mollusks; it is the third largest natural lake in the state and is widely considered to be one of the most unique lakes in North Carolina.



	Count	Minimum	Maximum	Range	Geom. Mean	Median	IQR*
pH, Total	111	4.300	7.500	3.200	5.964	6.000	.800
Lake Waccamaw	17	6.100	7.500	1.400	7.062	7.100	.400
Freeland	50	4.300	6.300	2.000	5.485	5.450	.700
Longs, SC	44	5.380	7.400	2.020	6.145	6.100	.300

*Interquartile Range-Spread of values containing the central 50% of the data(75th-25 percentiles)

Figure 4.13 pH at AMS Stations on the Waccamaw River Main Stem, 1988 to 1992 (Box and whisker plots)

OVERVIEW OF WATER QUALITY The shallow, clear waters and high water quality of Lake Waccamaw provide a unique and sensitive habitat for a diverse aquatic community. Phytoplankton

Lumber River Basin
030756

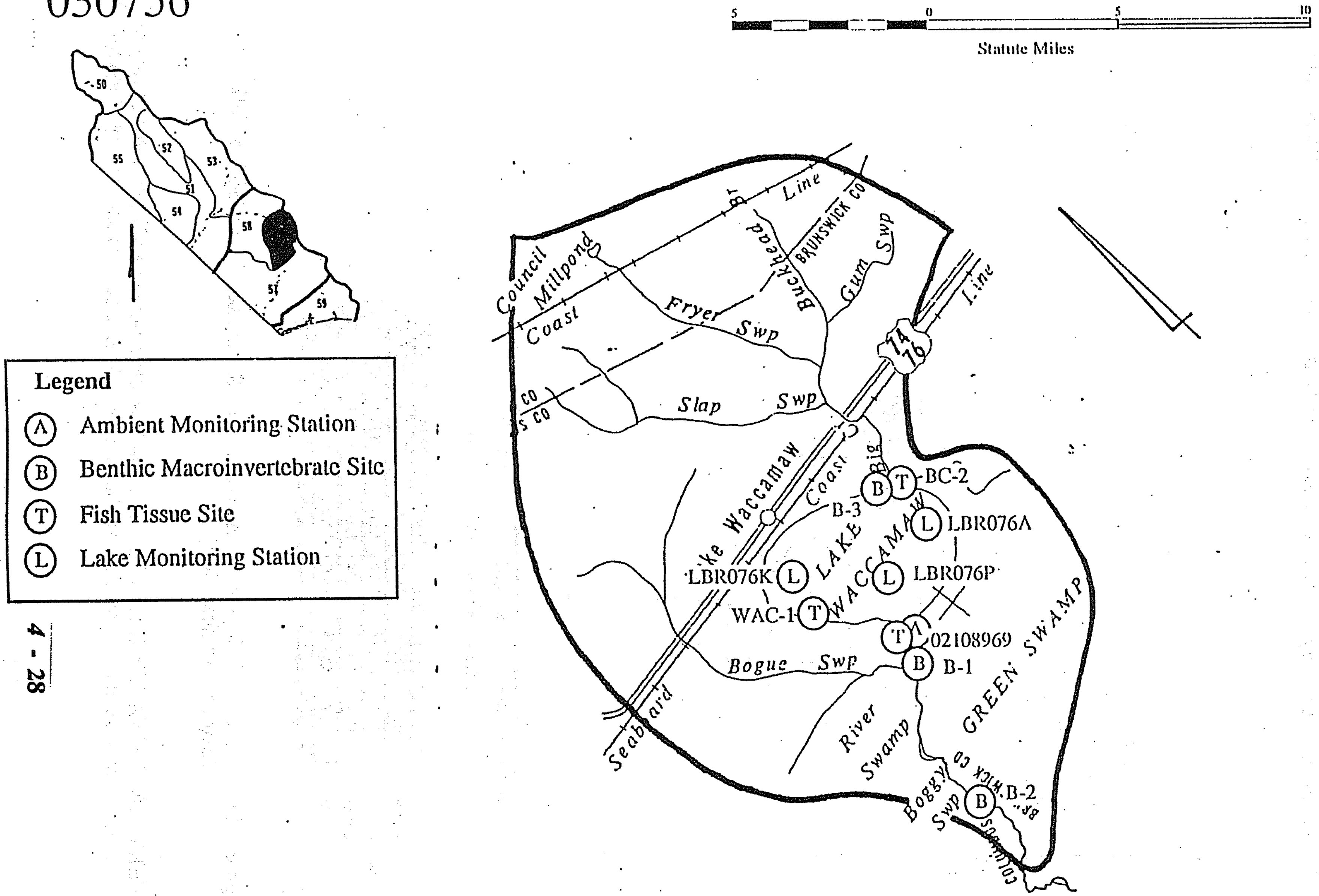


Figure 4.14 Water Quality Monitoring Sites in Subbasin 03-07-56

and chlorophyll *a* levels are very low in the lake, but were found to be very high in the two canals surrounding the northwestern and western shores of the lake. Fish tissue analyses indicated high mercury levels in fish from Big Creek. Benthos collections resulted in a Good-Fair bioclassification just below the lake with an improvement in water quality to Good at the lower end of this subbasin.

BENTHIC MACROINVERTEBRATE MONITORING Benthic macroinvertebrate samples were collected at three sites in subbasin 03-07-56 during 1991.

Site #	Creek	Date	Study	County	Road	S/SEPT	Rating
L56-1	Waccamaw R	910617	Waccamaw ORW	Columbus	Below Dam	56/13	G-F
L56-2	Waccamaw R	910617	Waccamaw ORW	Columbus	Crusoe Is.	82/27	Good
L56-3	Big Swamp	910617	Waccamaw ORW	Columbus	SR 1947	42/2	NR

No DEM macroinvertebrate samples had been collected in this subbasin prior to 1991, but Lake Waccamaw has been intensively sampled by other investigators. A survey of potential ORW sites indicated Good-Fair to Good water quality in this section of the Waccamaw River. Taxa richness was depressed below the dam. Most tributary sites were not flowing, including Bogue Swamp and the tributaries of Big Creek. Collections at Big Creek were only intended to check for rare invertebrates. This was a "reconnaissance" sample, taken in an atypical habitat, and was not intended to produce a bioclassification.

POTENTIAL HQW/ORW STREAMS The Division is preparing a report on potential ORW areas in the Waccamaw River basin. Many rare and intolerant species (fish, mollusks, aquatic insects) are known to occur in this area.

PHYTOPLANKTON MONITORING Three ambient and 15 special study samples were collected in or near Lake Waccamaw. The three ambient station samples were collected from Lake Waccamaw during July, 1990. No water quality problems were found. The remaining samples were collected as part of a special study to evaluate changes in water quality resulting from proposed improvements in water circulation in Cove Canal. The poorly circulating waters of Cove Canal contained an abundance of euglenophytes and *Anacystis cyanea,* a cyanophyte. Chlorophyll *a* values from Cove Canal ranged from 19 to 53 µg/l, much higher than the average of 2 µg/l from samples taken in Lake Waccamaw.

AQUATIC TOXICITY MONITORING: SELF-MONITORING No facilities in this subbasin have permit toxicity monitoring requirements. Lake Waccamaw WWTP has been recommended for a toxicity limit in its next permit renewal. Whole effluent toxicity testing has been required under an administrative letter requirement since September, 1991.

FISH TISSUE SAMPLING Based on fish tissue sampling, a fish consumption advisory for largemouth bass has been issued for Big Creek and the Waccamaw River below Lake Waccamaw due to elevated levels of mercury. Below is a summary of fish tissue sampling at six sites.

Meares Millpond was sampled in April 1993 for mercury. Three species were collected and processed as fillets for analysis. A mean mercury level of 1.05 mg/Kg was calculated for largemouth bass collected at this site. All other results were lower than FDA criteria.

Big Creek upstream from the 1947 bridge was sampled in December 1992 for mercury. All other metals results were lower than FDA criteria.

Big Creek near the mouth at Lake Waccamaw was sampled in June and October 1992 Five species were collected and processed as fillets for metals and mercury analyses. All samples were analyzed for metals contaminants. Mercury concentrations ranging from 0.07 mg/Kg to 3.4 mg/Kg were detected in tissue at this site. A mean mercury concentration of 1.0 mg/Kg was calculated for warmouth and a level of 1.51 mg/Kg was calculated for largemouth bass.

This exceeds the FDA action level for mercury of 1.0 mg/Kg. Results for all other metals analyses were lower than FDA criteria.

Lake Waccamaw near the Wildlife Boat Ramp was sampled for fish tissue mercury as part of a special study in October 1992. A mean mercury concentration of 0.32 mg/Kg was calculated for this site. One largemouth bass contained 1.4 mg/Kg of mercury which exceeds the 1.0 mg/Kg FDA action level.

Lake Waccamaw on the east edge was sampled in April 1993 for mercury. Two species were collected and processed as fillets for analysis. A mean mercury level of 0.79 mg/Kg was calculated for largemouth bass collected at this site.

Waccamaw River below the spillway at Lake Waccamaw was sampled in December 1992 for mercury. A mean mercury level of 1.27 mg/Kg was calculated for largemouth bass collected at this site.

LAKES ASSESSMENT PROGRAM Lake Waccamaw is the only lake in subbasin 56. Land use around the lake consists of private residences and a state park. It was sampled in 1991. The lake is characterized by clear shallow water and low nutrient levels. No problematic aquatic plants were observed when last sampled. Use support has remained full for the past 10 years. It is a heavily used recreation area that has been petitioned by the NC Division of Parks and Recreation's Natural Heritage Program for a supplemental classification of Outstanding Resource Waters.

4.5.3 Subbasin 03-07-57 (Lower Waccamaw River)

DESCRIPTION This subbasin is comprised of the lower Waccamaw River drainage area below the White Marsh confluence. Small streams tend to be ephemeral with little or no flow during dry summer months. For this reason, most of the DEM sampling in this subbasin has focused on the Waccamaw River. Green Swamp and Juniper Creek constitute a very unique area, but their fauna is quite different from the Waccamaw River due to very low pH levels.

SUMMARY Benthos data indicates Excellent water quality in the Waccamaw River at the head of this subbasin, with a decline to Good or Good-Fair at Freeland and Good-Fair near Pireway. Fish community analyses show a similar pattern in ecological health for the first two sites. Water quality information is more difficult to assess on tributary streams. Fish community information showed Good ratings for Grissett Swamp and Juniper Creek, and Fair-Good for Monie Swamp, and Fair for Toms Creek. However, fish consumption advisory for largemouth bass has been issued for the Waccamaw River below Lake Waccamaw to the South Carolina Border due to elevated levels of mercury found in fish tissue samples. Recent lakes data from Lake Tabor indicated a high chlorophyll *a* value and high nutrients, however a phytoplankton sample from the lake did not indicate bloom conditions, and prior data indicated no water quality problems.

BENTHIC MACROINVERTEBRATE MONITORING Benthic macroinvertebrate samples were collected at seven sites in subbasin 03-07-57 in 1991. Collections at upper Juniper Creek were only intended to check for rare invertebrates. Such "reconnaissance" samples were taken in atypical habitats, and were not intended to produce a bioclassification. (Report in review)

Benthic Macroinvertebrate Sampling Sites in subbasin 03-07-57

Site #	Creek	Date	Study	County	Road	S/SEPT	Rating
L57-1	Waccamaw R	910617	Waccamaw ORW	Columbus	SR 1928	78/27	Exc
L57-2	Waccamaw R	910617	Waccamaw ORW	Columbus	NC 130	93/27	Good
L57-3	Juniper Cr	910617	Waccamaw ORW	Brunswick	NC 211	30/3	NR
L57-4	Juniper Cr	910617	Waccamaw ORW	Columbus	SR 1928	50/10	NR
L57-5	Grissett Swamp	910911	Lumber basin survey	Columbus	SR 1173	EPT=5	Poor*
L57-6	Monie Swamp	910911	Lumber basin survey	Columbus	SR 1006	EPT=5	Poor*
L57-7	Waccamaw R	910910	Lumber basin survey	Columbus	NC 904	58/19	G-F

*Swamp streams, rating may be unreliable.

Lumber River Basin
030757

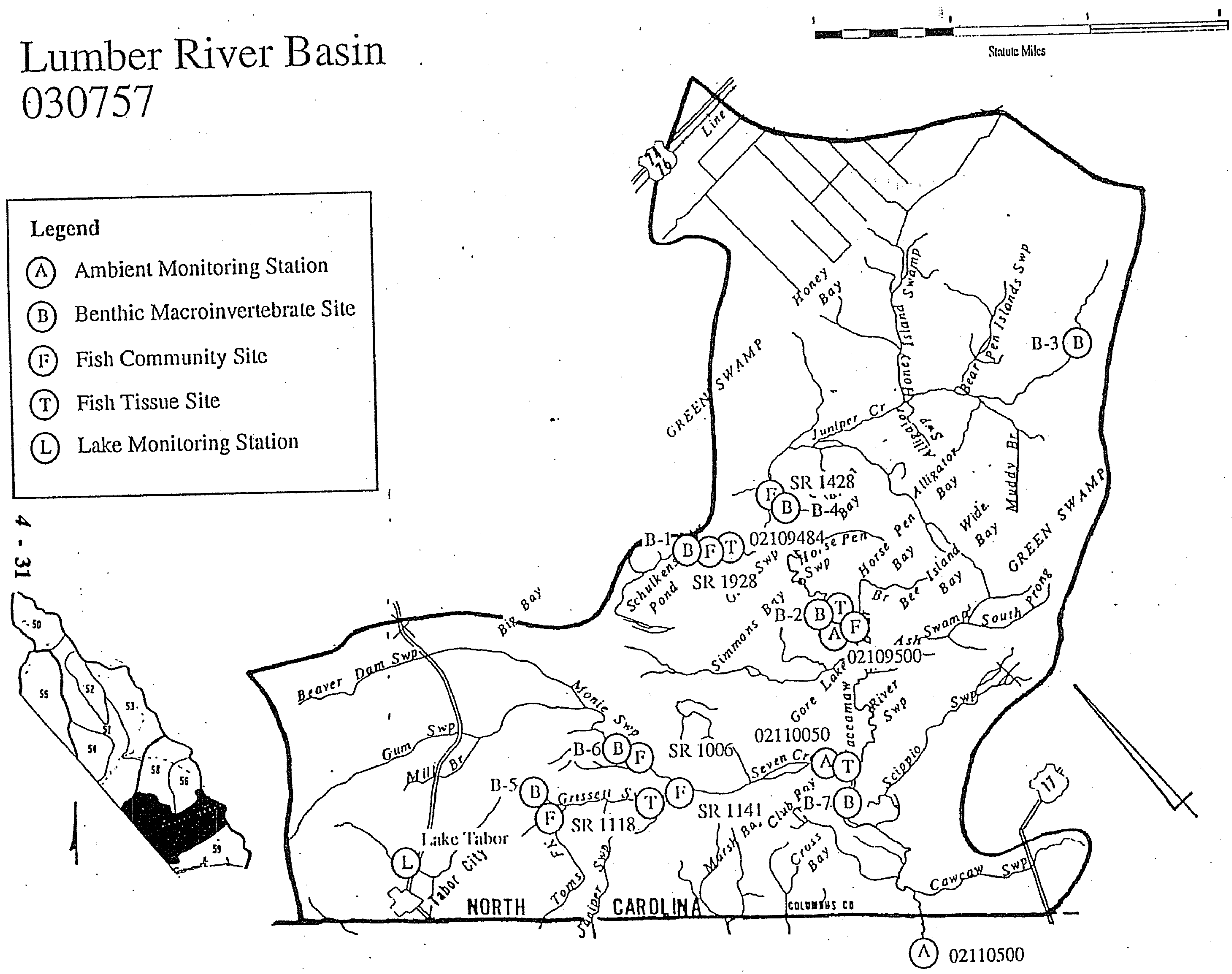


Figure 4.15 Water Quality Monitoring Sites in Subbasin 03-07-57

LONG TERM BENTHOS SITES The site on the Waccamaw River near Freeland at NC 130 has been sampled four times since 1984 and can provide not only an indication of present water quality, but also can show water quality trends over that time. Using flowing stream criteria it has received ratings of Good-Fair or Good. This site, however, has little visible flow and it might be more appropriate to assign higher bioclassifications using different criteria. It does not appear that there is any long-term change in water quality at this site. Between-year differences are probably related to the difficulty of sampling a habitat characterized by deep and slow-moving water.

POTENTIAL HQW/ORW STREAMS The Division is preparing a report on potential ORW areas in the Waccamaw River basin. Eligible areas appear to include the upper Waccamaw River. Juniper Creek also may be eligible for special designation, although the extremely low pH of this stream precludes a high diversity. Many rare and intolerant species (fish, mollusks, aquatic insects) are known to occur in these areas.

PHYTOPLANKTON MONITORING Only one ambient sample was taken from subbasin 03-07-57 at Lake Tabor. No water quality problems were present.

AQUATIC TOXICITY MONITORING: SELF-MONITORING Only the Tabor City WWTP facility (NPDES # NC0026000) in this subbasin currently monitors effluent toxicity as per a permit requirement. The facility discharges to Town Canal in Columbus County and has a permitted flow of 1.1 MGD.

FISH COMMUNITY STRUCTURE Sampling was performed at 6 sites in subbasin 03-07-57.

Stream	Location	Date	County	NCIBI Score	NCIBI Rating
Waccamaw R	SR-1928	920513	Columbus	60	Excellent
Juniper Creek	SR-1928	911211	Columbus	50	Good
Waccamaw R	NC-130	920530	Columbus	46	Fair-Good
Toms Fork	SR-1118	920429	Columbus	44	Fair
Grissett Swamp	SR-1141	920429	Columbus	52	Good
Monie Swamp	SR-1006	920429	Columbus	46	Fair-Good

FISH TISSUE SAMPLING Fish tissue samples were collected at four sites within this subbasin in 1992. A fish consumption advisory for largemouth bass has been issued for the Waccamaw River below Lake Waccamaw to the South Carolina Border due to elevated levels of mercury.

Waccamaw River at SR- 1928 was sampled in May 1992 for metals contaminants. One carp was collected and processed whole and four species were collected and processed as fillets. All results were lower than FDA criteria. One bass and a composite sample of four chain pickerel contained 0.78 mg/Kg mercury which approaches the FDA action level of 1.0 mg/Kg.
Waccamaw River at NC-130 was sampled in May 1992 and April 1993 for metal contaminants and mercury. Four species were collected and processed as fillets and one carp was collected and processed whole before analysis. Largemouth bass collected at the site contained a mean mercury level of 1.39 mg/Kg. All other results were lower than FDA criteria.
Grissett Swamp at SR 1141 was sampled in April 1992. One species was collected and analyzed for metals. All results were lower than FDA criteria.
Monte Swamp at SR 1106 was sampled in April 1992. Two species was collected and analyzed for metals. All results were lower than FDA criteria.

LAKES ASSESSMENT PROGRAM When last sampled in 1991, Lake Tabor was in violation of the chlorophyll *a* standard and had elevated nutrient levels. Contrary to this, only a small amount of vegetation was evident along the shoreline, and a small amount of algae and suspended sediment was visible. Use support was considered threatened (aquatic life and secondary contact) because of the chlorophyll *a* violation.

4.5.4 Subbasin 03-07-58 (White Marsh Swamp)

This watershed contains White Marsh Swamp and its tributaries and is within the coastal plain ecoregion. Most surface waters are tannin-colored, non-flowing or slowly flowing swamps. The primary land cover in this area is forestry. The only biological data from this subbasin is one fish community sample from Brown Marsh which indicated a Fair rating.

BENTHIC MACROINVERTEBRATE MONITORING Benthic macroinvertebrate samples have not been collected at any sites in subbasin 58 because no wadable, flowing water could be found.

AQUATIC TOXICITY MONITORING: SELF-MONITORING Two facilities in this subbasin currently monitor effluent toxicity as per a permit requirement. These include:

Facility	NPDES #	Receiving Stream	County	Flow(MGD)	IWC(%)
Whiteville WWTP-001	NC0021920	White Marsh Swamp	Columbus	2.5	45.19
Chadbourn WWTP	NC0021865	Soules Swamp	Columbus	0.5	83.76

FISH COMMUNITY STRUCTURE Sampling was performed at 1 site in this subbasin.

Stream	Location	Date	County	NCIBI Score	NCIBI Rating
Brown Marsh	SR-1760	920811	Bladen	41	Fair

FISH TISSUE SAMPLING Fish tissue samples were collected at two sites within the Lumber 58 subbasin. Inman Lake near Whiteville was sampled in April 1993. All results were lower than FDA criteria. White Marsh at US-74 was sampled in December 1992. One chain pickerel was collected and processed as a fillet for mercury analysis. The pickerel sample contained 1.9 mg/Kg mercury which exceeds the FDA action level of 1.0 mg/Kg..

4.6 COASTAL AREA WATERSHED (Subbasin 03-07-59)

This area is entirely within the coastal plain ecoregion. Most surface waters are tannin-colored, non-flowing or slowly flowing swamps. Streams in subbasin 59 flow into either the Lockwoods Folly River or the Shallotte River, both of which are estuarine over a significant portion of their length with direct access to the Atlantic Ocean. The primary land use is agriculture. Good or Good-Excellent fish community structure was found in the Lockwoods Folly River, Royal Oak Swamp and Cool Run using fish community data. Benthos data also suggests a tentative Good rating for the Shallotte River (possible estuarine influence).

4.6.1 Ambient Monitoring Information

Subbasin 03-07-59 is a coastal area containing the drainage areas of Lockwood Folly River, Shallotte River, and others. There are 13 stations within this subbasin, eight of which are on the Lockwood Folly river, one on Calabash Creek and four on the Intracoastal Waterway (ICW). Lockwood Folly stations are listed below.

Primary Number	Location
LBR097C	Lockwood Folly River at NC Hwy 211 at Supply, NC
LBR098	Lockwood Folly River at Varnum, NC
LBR098B	Lockwood Folly River at W Channel DS from Varnum, NC
LBR098D	Lockwood Folly River at Center DS from Varnum, NC
LBR098F	Lockwood Folly River at E Channel DS from Varnum, NC
LBR098H	Lockwood Folly River at W Channel NW of Sunset Harbor, NC
LBR098J	Lockwood Folly River at E Channel NW of Sunset Harbor, NC
LBR098L	Lockwood Folly River at West Channel Islands

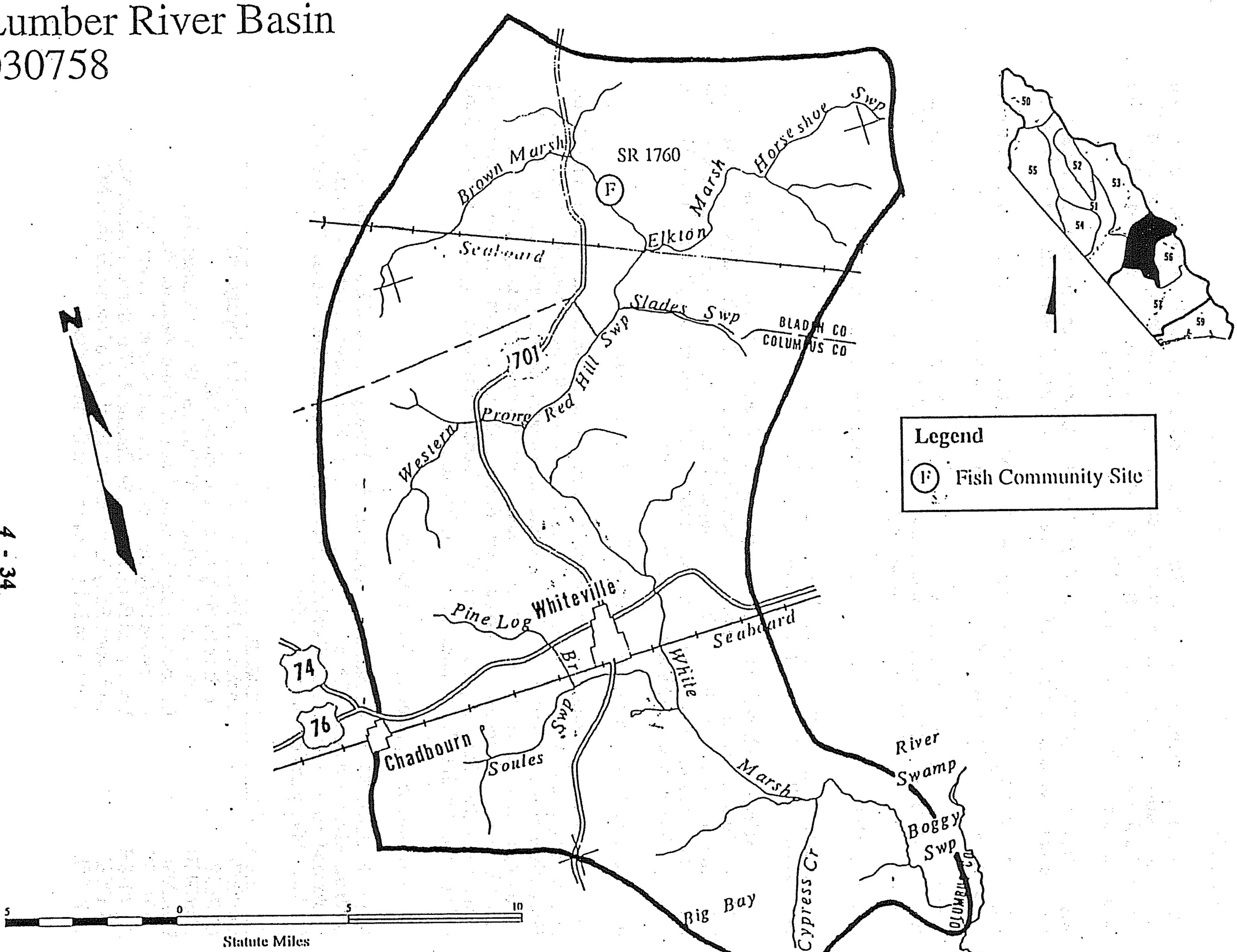
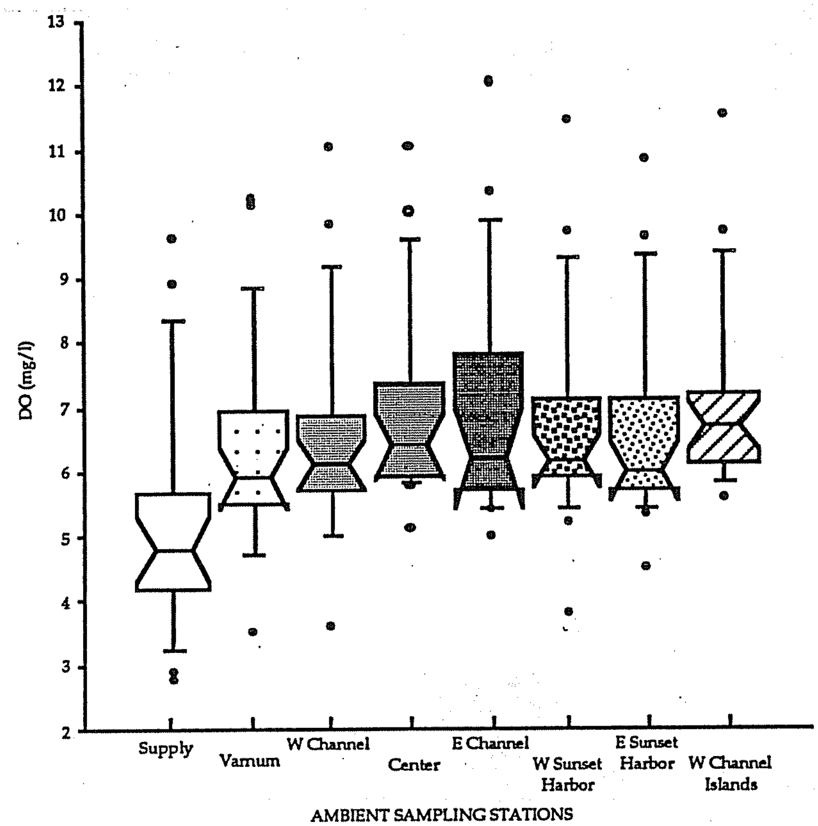


Figure 4.16 Water Quality Monitoring Sites in Subbasin 03-07-58



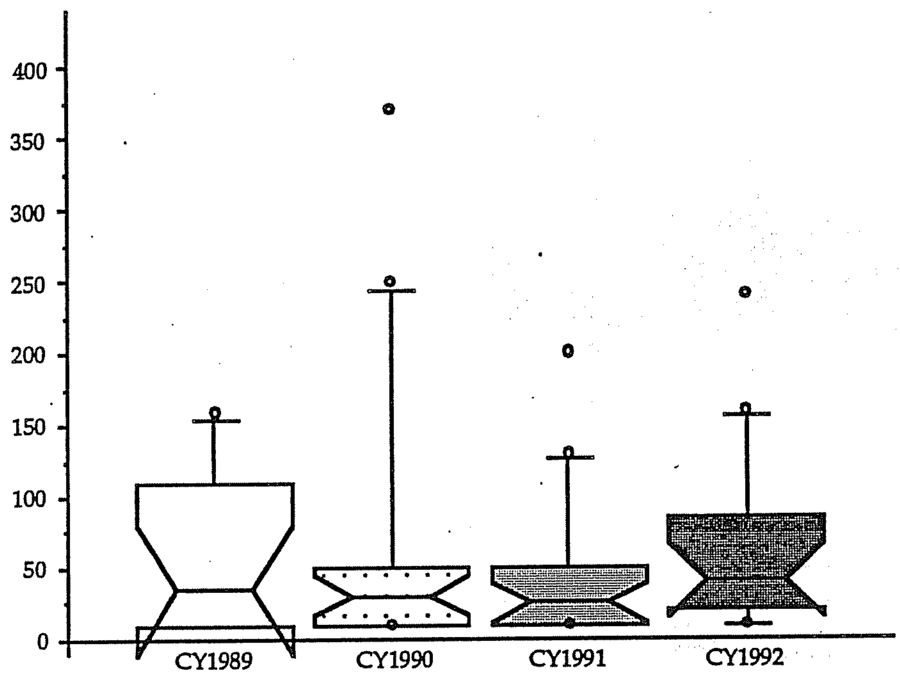
	Count	Minimum	Maximum	Range	Geom. Mean	Median	IQR*
DO, Total	172	2.800	12.000	9.200	6.348	6.100	1.4
Supply, NC	23	2.800	9.600	6.800	5.043	4.800	1.5
Varnum, NC	23	3.500	10.200	6.700	6.161	5.900	1.42
W Channel	23	3.600	11.000	7.400	6.387	6.100	1.17
Center	19	5.100	11.000	5.900	6.818	6.400	1.45
E Channel	18	5.000	12.000	7.000	6.765	6.200	2.1
W Sunset Harbor	22	3.800	11.400	7.600	6.564	6.150	1.2
E Sunset Harbor	22	4.500	10.800	6.300	6.520	6.000	1.4
West Channel Islands	22	5.600	11.500	5.900	6.960	6.700	1.1

*Interquartile Range-Spread of values containing the central 50% of the data(75th-25 percentiles)

Figure 4.17 Dissolved Oxygen Concentrations at AMS Stations in Coastal Waters of Lumber River Basin (Subbasin 03-07-59)

Dissolved oxygen distributions are shown in Figure 4.17 for the Lockwood Folly stations. The upstream station, Supply, NC, shows samples that are similar to the distributions in the swampy areas of the Lumber and Waccamaw Rivers. The dissolved oxygen median samples generally rise towards the mouth of the river. These stations show high readings in Copper and some high readings in Nickel and Chromium. Two stations near the mouth of the Lockwood Folly River (ICW at Sunset Harbor and ICW West of Lockwood Folly River) also show high Copper, Nickel and Chromium samples. Other ICW stations have no high metals readings.

The Water Quality Section of the Division of Environmental Management conducted a study in 1989 to investigate the Outstanding Resource Waters (ORW) in coastal North Carolina. The Lockwood Folly was not recommended for ORW status in the 1989 study because of high fecal coliform counts but an ORW management plan was approved by the EMC. Subsequent investigation in 1989 into the water quality of the river found that septic tanks and urban stormwater runoff were probably then major sources of contamination and, coupled with the impaired flushing of the inlet, this has led to the decline in water quality. Figure 4.18 shows the results of the fecal coliform counts at the lower river stations (all stations except Supply) by year. The fecal counts were lower after 1989 and remained low until 1992 when they returned to levels near the original levels in 1989.



	Count	Minimum	Maximum	Range	Geom. Mean	Median	IQR*
Fecal, Total	68	10.000	370.000	360.000	33.261	30.000	70.000
Fecal, CY1989	12	10.000	160.000	150.000	35.090	35.000	100.000
Fecal, CY1990	22	10.000	370.000	360.000	33.553	30.000	40.000
Fecal, CY1991	18	10.000	200.000	190.000	26.521	25.000	40.000
Fecal, CY1992	16	10.000	240.000	230.000	40.729	40.000	65.000

*Interquartile Range-Spread of values containing the central 50% of the data(75th-25 percentiles)

Figure 4.18 Fecal Coliform Concentrations in the Coastal Areas Watershed, 1988 to 1992 (Box and whisker plots)

4.6.2 Subbasin 03-07-59: Water Quality Summary

BENTHIC MACROINVERTEBRATE MONITORING Benthos were collected at two sites in this subbasin in 1991 at sites which had been sampled in the early 1980s. The purpose of these surveys was to see how water quality had changed since 1984.

<u>Lockwoods Folly River.</u> A sample collected in 1984 suggested Good/Fair water quality for the river. Sampling in 1991, however, found a distinctly estuarine character to the river, suggesting recent reduced flows in the river.
<u>Shallotte River.</u> A sample collected here during low-no flow conditions in 1983 suggested that a Good/Fair water quality rating was appropriate for the river. Sampling in 1991, under slightly higher flows, found increased taxa richness which suggested a Good bioclassification to be more appropriate.

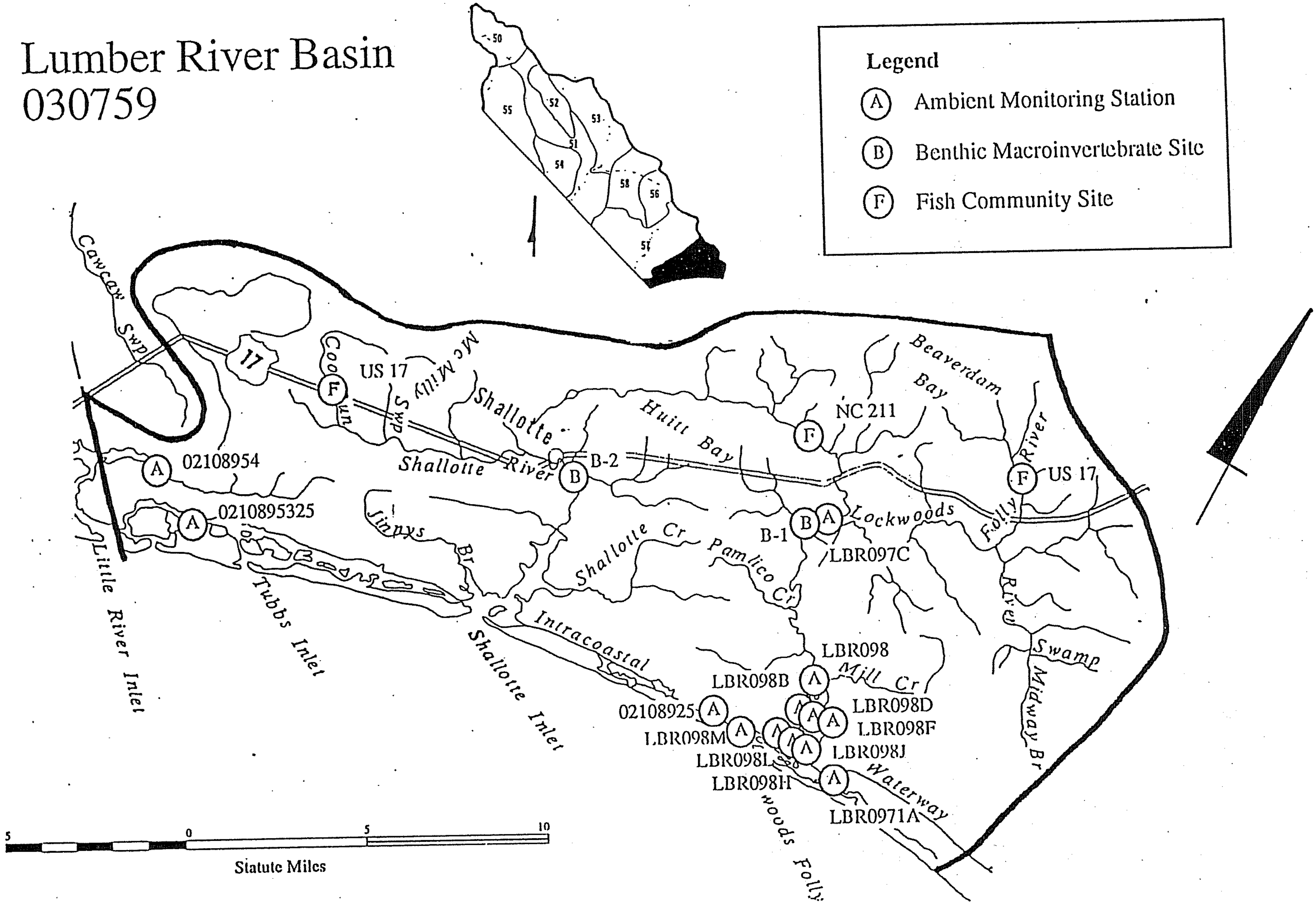


Figure 4.19 Water Quality Sampling Sites in Subbasin 03-07-59 (Coastal Waters)

POTENTIAL HQW/ORW STREAMS There are no additional areas within this subbasin that would qualify for High Quality Water or Outstanding Resource Water status.

PHYTOPLANKTON MONITORING Only one phytoplankton bloom sample was taken in subbasin 03-07-59. The high values for biovolume, density and chlorophyll *a* all exceeded the threshold values for bloom conditions. Nitrogen and phosphorus concentrations were high.

BLOOM LOCATION	DATE	BIOVOLUME (mm/m3)	DENSITY (units/ml)	CHLA (µg/l)	DOMINANT CLASS Biovolume, Density	Bloom (Yes, No) WQ Problem
Oxpen	91-08-12	10,160	26,550	290	EUG, EUG	Y,high nutrients

AQUATIC TOXICITY MONITORING: SELF-MONITORING None require monitoring.

FISH COMMUNITY STRUCTURE Sampling was performed at 3 sites in this subbasin.

Stream	Location	Date	County	NCIBI Score	NCIBI Rating
Lockwoods Folly	US-17	920428	Brunswick	48	Good
Royal Oak Swamp	NC-211	920428	Brunswick	54	Good-Excellent
Cool Run	US-17	920428	Brunswick	48	Good

FISH TISSUE STUDIES Fish tissue samples were collected at one site on Lockwoods Folly River in December, 1988. All results were lower than FDA criteria for metals and organics.

PART TWO: Use Support Assessment: Methodology and Assessment

4.7 USE-SUPPORT: DEFINITIONS AND METHODOLOGY

4.7.1 Introduction to Use Support

Determining the *use support* status of a waterbody, that is how well a waterbody supports its designated uses, is another important method of interpreting water quality data and assessing water quality. Use support assessments are presented in Section 4.8 using figures, tables and maps for freshwater streams, lakes and estuaries within the Lumber River Basin.

Surface waters (streams, lakes or estuaries) are rated as either *fully supporting* (S), *support-threatened* (ST), *partially supporting* (PS), or *nonsupporting* (NS). The terms refer to whether the classified uses of the water (such as water supply, aquatic life protection and swimming) are being fully supported, partially supported or are not supported. For instance, saltwaters classified for commercial shellfish harvesting (SA) would be rated as fully supporting if bacterial levels in the water were low enough to allow harvesting (<14 MPN). However, if fecal coliform bacteria levels were too high to allow shellfish to be harvested (>14 MPN), but not too high to prevent swimming, (<200 MPN), then the waters would be rated as partially supporting since they only support the swimming. If the waters were impacted to the point that even swimming was disallowed, the waters would be rated as nonsupporting. Streams rated as either partially supporting or nonsupporting are considered *impaired.* The support -threatened category for freshwater rivers and streams refers to those waters classified as good-fair based on water quality data, in contrast to excellent or good which are considered fully supporting. An overall support rating, however, does include both fully supporting and support -threatened waters. Streams which had no data to determine their use support were listed as nonevaluated (NE).

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

4.7.2 Interpretation of Data

The assessment of water quality presented below involved evaluation of available water quality data to determine a water body's use support rating. In addition, an effort was made to determine likely causes (e.g., sediment or nutrients) and sources (e.g., agriculture, urban runoff, point sources) of pollution for waters that did not support their designated uses (i.e. those found to be either partially or nonsupporting). These data consisted of biological and chemical ratings, reports of citizen complaints, responses to mailings requesting water quality information, land-use reviews of topographic maps, and best professional (see Data Analysis Methodology section for more details). By including best professional judgments (i.e., perceived water quality problems) in deciding the overall water quality ratings and the potential sources of pollution, a much broader, but less precise, picture of water quality conditions in the basin was developed.

Interpretation of these data compiled by DEM should be done cautiously. The methodology used to acquire the numbers must be understood, as does the purpose for which the numbers were generated. The intent of this use-support assessment was to gain an overall picture of the relative contribution made by different categories of pollution within the Lumber basin. In order to comply with guidance received from EPA to identify likely sources of pollution for all impaired stream mileage, DEM used the data mentioned above.

The data are not intended to provide precise conclusions about pollutant budgets for specific watersheds. Since the assessment methodology is geared toward general conclusions, it is important to not manipulate the data to support policy decisions beyond the accuracy of these data. For example, according to this report, nonpoint source pollution is thought to be the most widespread source of the impairment of water quality. In fact, for those impaired streams where a probable source of impairment has been identified in the Lumber Basin, all are nonpoint source related. However, this does not mean that there should be no point source control measures. As discussed in previous sections of this chapter, and in Chapter 6, many stream miles in the basin are impacted by point source dischargers, but the degree of impact has not resulted in a partial or nonsupport rating. What is clear from the plan is that all categories of point and nonpoint source pollution have the potential to cause significant water quality degradation if proper controls and practices are not utilized.

This threat to water quality from all types of activities heightens the need for point and nonpoint source pollution control. It is important to not neglect any source (or potential source) of pollution in developing appropriate management and control strategies. Data exist which document water quality problems from every major pollution category that has been considered in this report. Certainly, the potential for further problems remains high as long as the activity in question continues carelessly. Because of this potential, neglecting one pollution source in an overall control strategy can mask the benefits achieved from controlling all other sources.

4.7.3 Assessment Methodology - Freshwater Bodies

Many types of information were used to make use support assessments and to determine causes and sources of use support impairment. Chemical, physical and biological data as well as wastewater treatment plant self-monitoring data and toxicity data were the primary sources of information used to make use support assessments. Information was also obtained from other agencies, workshops, and pertinent reports.

The most recent water quality chemical data (January 1988 through December 1992) were interpreted for use support utilizing the STAND(ards) program available through the STORET system. The program determines water quality standard violations and computes percentages of the values in violation based on applicable North Carolina water quality standards. According to EPA guidance, use support determinations based on chemical data are to be made as follows:

Fully Supporting - for any one pollutant, criteria exceeded in ≤ 10% of the measurements,
Partially Supporting - for any one pollutant, criteria exceeded in 11- 25% of the measurements, and
Not Supporting - for any one pollutant, criteria exceeded in > 25% of the measurements.

The following parameters were evaluated in the STAND(ards) program: dissolved oxygen (surface values), temperature, pH, turbidity, fecal coliform bacteria, chlorophyll *a*, ammonia, arsenic, cadmium, chromium, copper, lead, nickel, mercury, zinc, chloride, fluoride and selenium.

Another valuable source of data used for the report was biological rankings from 1983 through 1992 as determined from benthic macroinvertebrate surveys discussed in Part One. The most recent report on these surveys (NCDEHNR, DEM 1991) is available from DEM's Environmental Sciences Branch. Data from North Carolina's Biological Monitoring Ambient Network (BMAN), in addition to special macrobenthic studies were ranked on a five point scale. This scale is based on taxa richness for the three pollution intolerant groups of Ephemeroptera, Plecoptera and Trichoptera (EPT).

Collected specimens are identified to the lowest possible taxonomic level. Total species (or taxa) richness values for the EPT groups are calculated and biological classifications assigned to each station (Excellent, Good, Good-fair, Fair or Poor). Higher species richness values are associated with better water quality. For ranking purposes, stations classified as "Poor" with regard to biological data are rated not supporting (NS) and stations classified as "Fair" are rated partially supporting (PS). Stations classified as "Good-Fair" are rated as support-threatened (ST) and those having a Good to Excellent biological classified are rated as supporting their designated uses (S).

Other types of DEM-collected data used to make use support assessments were toxicity data related to discharging facilities, fish tissue and fish community structure data and phytoplankton bloom information. In addition, fish consumption advisories and information from other agencies, workshops held in 1987 and pertinent reports were utilized. In general, stream segments which received a discharge from a facility significantly out of compliance with permit limits or failing their whole effluent toxicity test were rated as support-threatened, unless water quality data indicated otherwise. Streams which had a fish consumption advisory in place were rated as partially supporting. Assessments were made on either a monitored (M) or evaluated (E) basis. A *monitored* basis represents data which are less than five years old. An *evaluated* basis refers to the use of best professional judgment or data older than five years old. Overall ratings were determined for stream segments as follows:

1. Biological ratings generally were preferred over any other source of information since they are a direct measurement of aquatic life support.
2. Chemical ratings (when biological ratings were unavailable) were preferred over information from older reports or information from workshops.
3. Workshop "evaluations" or best professional judgments were preferred over information from older reports.
4. Information from older reports was used when no other information was available.

After overall ratings were assigned, probable sources of pollution (point or nonpoint) for partially supporting and nonsupporting streams were sought. Information on point sources, such as permit compliance records, was reviewed in order to identify major and minor dischargers potentially affecting streams. The Aquatic Toxicology Unit was also consulted to identify facilities known to have toxic effects based on chronic and acute bioassays. Information related to nonpoint source pollution (e.g., agricultural, urban and construction) was obtained from other agencies (federal, state and local), citizens, land-use reviews and best professional judgment.

Causes of use support impairment, such as sediment and low dissolved oxygen, were also identified for specific stream segments. For ambient water quality stations, those parameters which exceeded the water quality standard >10% of the time for the two year period (i.e., they indicated a PS or NS use support rating) were included as probable causes. For segments without ambient stations, information from reports, other agencies and best professional judgment were used. In general, facility self-monitoring data and facility aquatic toxicity data were not included in the cause or overall problem parameter column since these data may not reflect instream conditions occurring during the two-year reporting period because they are based on 7Q10 conditions.

Once all monitored and evaluated information was located on water basin maps, remaining "unassessed" streams and segments were evaluated to have the same use-support if they were a direct or indirect tributary to monitored or evaluated segments rated supporting and support-threatened. Partially and nonsupporting segments were not extended. U.S. Geological Survey (USGS) 7.5 minute topographic maps (1:26,000 scale) and orthophotoquads were used to determine probable sources for all impaired streams when other sources, such as WWTP compliance data, were insufficient.

4.8 USE SUPPORT RATINGS FOR THE LUMBER BASIN

4.8.1 Freshwater Streams and Rivers

Of the 2,282.7 miles of freshwater streams and rivers in the Lumber basin, use support ratings were determined for 87% or 1,987.4 miles with the following breakdown: 35% were rated fully supporting, 39% support-threatened, ten percent partially supporting, three percent not supporting, and 13% nonevaluated. Background information for all of the *monitored* stream segments including biologic, chemical and overall use support ratings is presented in Table 4.2. Information on *evaluated* stream segments is not included in the table. A map showing the use support ratings based on both the monitored and evaluated data is presented in Figure 4.20.

Table 4.3 and Figure 4.21 present the use support determinations by subbasin. In general, subbasins 50, 51, 52, 53, 55, 56, 58 and 59 had a majority of their streams which were either supporting or support-threatened. While subbasins 54 (Ashpole Swamp subbasin) and 57 (Lower Waccamaw River subbasin) had a larger percentage of streams which considered to be *impaired*, that is, streams that are rated as either partially supporting or not supporting. A total of 303, or 15%, of the stream miles in the basin are considered impaired.

Table 4.4 summarizes the probable sources and causes of impairment, by subbasin, for about 65%, or 195.8 miles, of the total 303 miles of impaired streams in the basin. Based on this information, all impaired stream segments for which a source of probable impairment was identified were impaired by nonpoint rather than point sources. Agriculture was the most widespread nonpoint source, followed by hydrologic/habitat modification and urban activities. Subbasins 51 and 54 had the highest number of streams thought to be impaired by agriculture and subbasin 58 had the highest number attributed to urban activities. Where the sources of impairment could not be identified, no mileage for that segment was entered into the table. Under causes of impairment (second table), sediment was the most widespread cause, followed by metals (mercury) and low dissolved oxygen.

In interpreting Table 4.4, when a stream segment had more than one source of impairment identified, the number of stream miles was listed under the appropriate column(s) in the table. For instance, if a 10-mile long stream segment was determined to be impaired as a result of both agricultural and urban nonpoint source pollution, then 10 miles would be entered under both the agricultural and urban columns. However, the nonpoint source column summarizes just the total number of miles for which a probable source of stream impairment has been identified. Therefore, for this example, the nonpoint source column would have ten miles entered since the agricultural and urban columns both applied to the same ten miles of stream. A similar situation occurs in Table 4.4 on the line for Subbasin 03-07-58. There are 18.7 miles under agriculture and 13.9 miles under urban, but only 18.7 total miles of stream are listed under the Nonpoint Source column, meaning that the impaired miles are overlapping. If, on the other hand, two separate 10-mile stream segments were identified and listed under the agriculture and urban columns, then the mileage under the Nonpoint Source column would be 20 miles. For example, in Table 4.4, on the line for Subbasin 03-07-51 we see that 35.4 miles were impaired by agriculture and 36.1 miles by hydrologic modification. Since the total number of miles impaired under the Nonpoint Source column is 61.5, it is evident that there was no overlap between impaired stream miles.

The last line of the table is intended to determine the percentage of impaired stream miles attributed to the various sources. This is derived by dividing the number of miles in each column by the total number of impaired stream miles (303 miles) and then multiplying by 100 to the get the percentage. While probable sources have been identified for 65 percent (195.8 miles) of the impaired streams, sources have not been identified for the remaining 35 percent (107.2).

4.8.2 Salt (Estuarine) Waters

Use support determinations were made for all of the 4,800 acres of saltwater in the Lumber Basin. Fifty-five percent of the saltwaters were rated as fully supporting, and 45 percent were rated partially supporting. Table 4.5 and Figure 4.22 present the use support determinations by Division of Environmental Health (DEH) area (Figure 4.23), and probable causes and sources of use support impairment are presented in Table 4.7.

Fecal coliform bacteria was the only reported cause of impairment. As indicated in Table 4.6 , 1,201 acres in DEH area A1, 230 acres in DEH area A2 and 721 acres in DEH area A3 were rated partially supporting. This was largely determined from closure of shellfishing areas due to elevated levels of bacteria as reported by DEH Shellfish Sanitation Surveys. Ambient stations located in Areas A1 and A3 also indicated elevated levels of bacteria and violations of additional criteria such as turbidity, copper, low dissolved oxygen, pH and temperature.

Nonpoint source pollution is reported to be the only pollution source of the impaired estuary waters. Waters were impacted primarily by multiple nonpoint sources including agriculture, urban runoff, septic tanks and marinas.

4.8.3 Lakes

Five lakes in the Lumber Basin, totaling 9256 acres, were monitored and assigned use support ratings (Table 4.7). Of these five, one fully supported its use, two were support-threatened, and two were partially supporting. Lake Waccamaw fully supports its uses. It is a natural bay lake that is characterized by clear shallow water and low nutrient levels, and it supports several endangered species of fish and mollusks. Both Maxton Pond and Johns Pond are eutrophic and have elevated nutrient loading and infestations of aquatic plants. Lake Tabor's use support rating was recently changed from fully supporting to support -threatened because of a violation of the chlorophyll *a* standard and elevated nutrient levels. Pages Lake use support rating changed from fully supporting to partially supporting due to a fish consumption advisory. This advisory was based on the results of an analysis of fish tissue which indicated elevated levels of mercury (section 4.3.2).

REFERENCES CITED - CHAPTER 4

NC Division of Environmental Management, 1993. Basinwide Assessment Report Document for the Lumber River Basin (Final Draft), Water Quality Section, Environmental Sciences Branch, Raleigh, NC

Table 4.2 Lumber River Basin Monitored Freshwater Segments (1988-1992) (1 of 2))

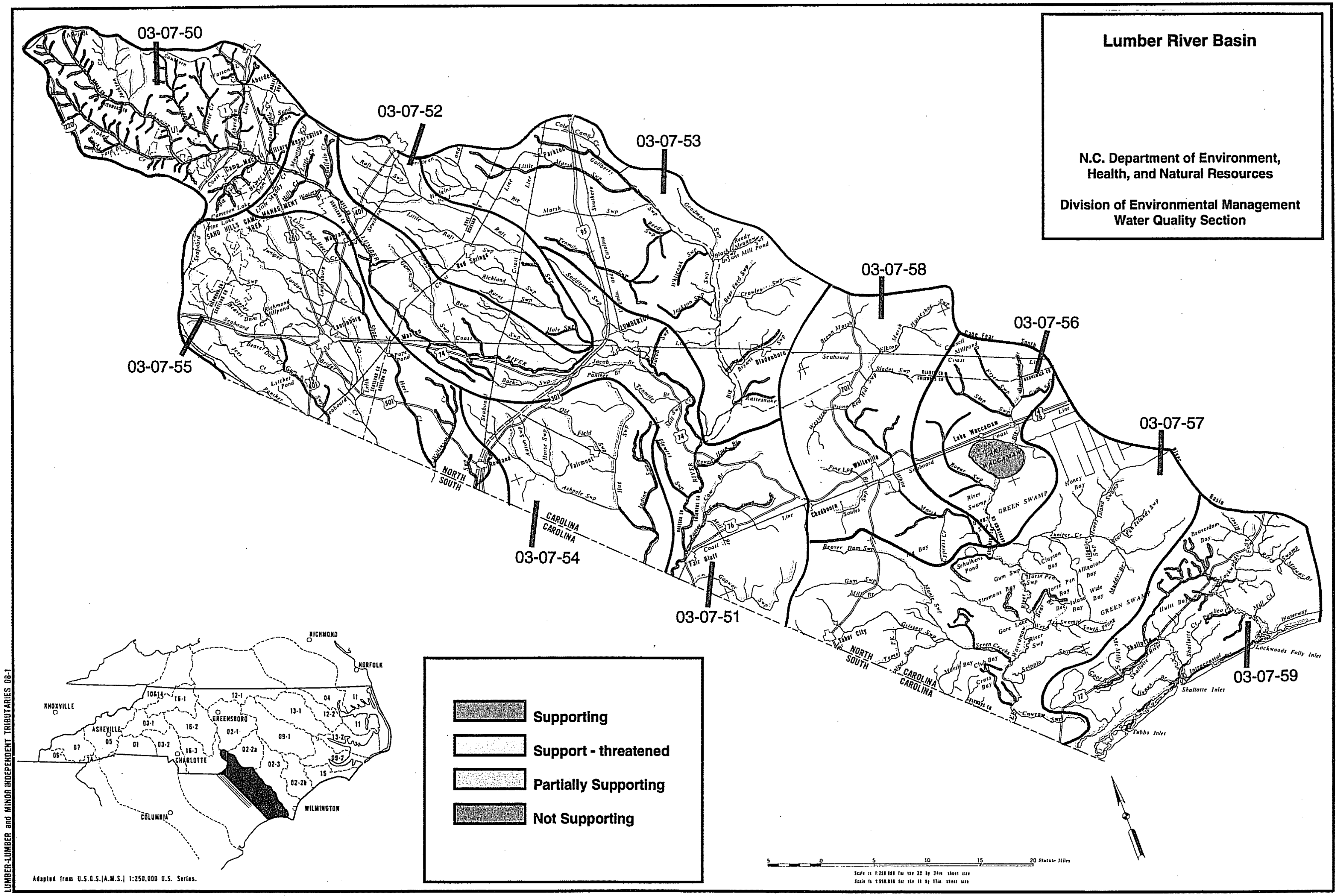
Station Number	Station Location	Classification	Index Number	Miles	Chem. Rat. 88-92	Biolog. Rating: Benthc s (/Fish) 88	89	90	91	92	Overall Rating Prob Para.	Use Sup.	Source
SUBBASIN 30750													
	Drowning Creek at SR 1124, Moore Co.	WS-II Sw	14-2-(1)	20.5			G					S	
	Jackson Creek at SR 1122, Moore Co.	WS-II	14-2-5	9.4			G/F					ST	
	Naked/UT Naked Cr nr SR1003, Rich. Co.	WS-II ORW	14-2-6	16.0			Ex	E/E	Ex			S	
	Rocky Ford Br, SR 1424 Rich. Co.	WS-II ORW	14-2-6-1	4.6				Ex				S	NP
	Drown. Cr nr Hoffman, SR1004, Rich. Co.	WS-II Sw	14-2-(6.5)	5.4		Ex	Ex		Ex			S	
		HQW											
	Horse Creek at SR 1102, Moore Co.	WS-II	14-2-10	10.2					Ex			S	
02133500	Drown. Cr., US 1, nr Hoffman, Rich. Co.	C Sw HQW	14-2-(10.5)	6.9	S							S	NP
	Quewhiffle Creek at SR 1214, Hoke Co.	C	14-2-14a	2.8			F					PS	
	Quewhiffle Creek at SR 1225, Hoke Co.	C	14-2-14b	3.0			G					S	
SUBBASIN 030751													
	Lumber R. nr Wagram, SR 1404, Scot. Co.	WS-IV Sw	14-(3)a	2.2					Ex			S	
		HQW											
02133624	Lumber R. nr Maxton, NC 71, Rob. Co.	C Sw HQW	14-(4.5)a	0.5	PS	Ex		G	G		Cu	S	
	Gum Swamp at NC HWY 71	C	14-5	13.0					/F			PS	
02133691	Lumb. R. nr Pembroke, SR 1003, Rob. Co.	WS-IV Sw	14-(7)a	20.0	S	Ex		G	G		Fecal	S	
		HQW											
	Back Swamp at US 301, Robeson Co.	WS-IV Sw	14-8-(2.5)	7.7					GF/			PS	NP
									GF				
	Lumber River at SR 2289, Robeson Co.	C Sw	14-(13)a	2.7					G			S	
	Lumb. R. @WWTP, Sr1620/NC72, Rob. Co	C Sw	14-(13)d	1.3					G			S	
02134500	Lumber R. NC 74, Robeson	C Sw	14-(13)e	16.6	S	G			G			S	NP
02134623	Lumber RiverNC 904, Robeson	C Sw	14-(13)f	18.4	PS				Ex		Fecal	S	
	Porter Swamp at SR 1503, Robeson Co.	C Sw	14-27	16.4					Pr	/FG	Sed	NS	NP
SUBBASIN 030752													
	Raft Creek at NC 211, Robeson Co.	C Sw	14-10-(1)	29.4		G/F			G/R			ST	
02134128	Raft Swamp at SR 1527, Robeson Co.	WS-IV Sw	14-10-(5.5)	11.5	S	G						S	
	Burnt Swamp ab RR, Robeson	WS-IV Sw	14-10-8-4	1.0				F				PS	
			-(0.5)a										
	Burnt Swamp SR 1515, Robeson	WS-IV Sw	14-10-8-4	3.3				F				PS	
			(0.5)b										

Table 4.2 Lumber River Basin Monitored Freshwater Segments (1988-1992) (2 of 2))

Station Number	Station Location	WQ Classification	Index Number	Miles	Chem Rat. 88-92	Biolog. Rating: Benthc s (/Fish) 88	89	90	91	92	Overall Rating Prob Para.	Use Sup.	Source
SUBBASIN 030753													
02134488	Big Swp nr Richardson, NC 211, Rob. Co.	C Sw	14-22a	15.4	S				G/F			ST	NP
	Big Swamp, SR 1002, Robeson Co.	C Sw	14-22b	9.5					G/F			ST	NP
	Gallberry Swamp at NC 20, Robeson Co.	C Sw	14-22-1	7.0					G/F			S	
	Big Marsh Swamp, SR 1924, Robeson	C Sw	14-22-2a	24.0					G/			ST	P
SUBBASIN 030754									F				
	Ashepole Swp, NC41, Rob. Co./fish-SR2455	C Sw	14-30a	18.8					F/G	F?G		PS	NP
0213460809	Ashepole Swamp at SR-2258, Robeson Co.	C Sw	14-30b	6.9	NS						DO	NS	NP
	Hog Swamp at SR 2262, Robeson Co.	C Sw	14-30-7	17.3					F			PS	
SUBBASIN 030755													
	Gum Swamp at SR 1323, Scotland Co.	B	14-32-(7)	7.4					G/F			ST	
	Gum Swp, SR1319, nr Fldcrst Mills, Scot. Co	C Sw	14-32-(10)	1.6				G/F				ST	
	Gum Swamp at US 15-401, Scotland Co.	B Sw	14-32-(12)	12.6					E			S	NP
02132269	Leith Creek, SR 1610/1609, Scotland Co.	C Sw	14-33	20.7	S				G/F		Sed	ST	NP
	Big Shoe Heel Creek at SR 1369, Scotland	C SW	14-34a	12.3				G				S	
	Shoe Heel Creek at SR 1612, Scotland Co.	C Sw	14-34b	2.3				G/F				ST	
02132336	Shoe Heel Cr nr Rowland, SR1101, Rob. Co	C Sw	14-34c	15.4	PS			E	G		Cd	S	
	Little Shoe Heel Creek at SR 1405	C Sw	14-34-3	7.6					/FG			PS	
SUBBASIN 030756													
02108969	Waccamaw River , below dam. Columbus	C Sw	15-(1)a	0.2	S				G/F			ST	
	Wacc. R. off SR1930, nr Crusoe Is., Col. Co	C Sw	15-(1)b	6.8					G			S	
SUBBASIN 030757													
	Waccamaw River at SR 1928, Columbus Co.	C Sw	15-(1)c	3.5					E	/E	Hg	PS	
02109500	Waccamaw River at NC 130, Columbus Co.	C Sw	15-(1)d	8.9	S			G/F	G	/FG	Hg	PS	
	Waccamaw River at NC 904 Columbus Co.	C Sw	15-(1)e	18.1					G/F		Hg	PS	
	Juniper Creek at SR 1928, Columbus Co.	C Sw	15-7b	13.4					Nr/G			ST	
02110050	Seven Creeks near Bug Hill, NC Hwy. 905	C Sw	15-17	4.6	S						Sed	S	
	Grissett Swp, SR1173, Col Co./fish->SR1141	C Sw	15-17-1-(5)	17.3					Pr?	/ G		ST	
	Toms Fork SR 1118	C Sw	15-17-1-10	6.2						/F		PS	
	Monie Swamp at 1006, Columbus Co.	C Sw	15-17-1-12	7.8					Pr?	/FG		PS	NP
02110500	Waccamaw River at SC 9 near Long, SC	B Sw	15-(18)	8.4	S						Hg	PS	
SUBBASIN 030758													
	Brown Marsh at SR 1760	C Sw	15-4-1-1	4.8						/F		PS	NP
SUBBASIN 030759													
	Lockwoods Folly at US 17	C Sw	15-25-1-(1)	10.0						/G		ST	NP
	Royal Oak Swamp at NC 211	C Sw	15-25-1-12	10.0						/GE		S	
	Cool Run at US 17	C Sw	15-25-2-3	4.1						/G		ST	

Biological Ratings: E - Excellent, G - Good, F - Fair, Pr - Poor, Nr - Not Rated (Note: Ratings without a "/" or to the left of a "/" are for Benthos. Ratings to the right of the "/" are fish community ratings. Two letters represents a combination of ratings. For example, FG = Fair-Good.)

Overall Ratings: Hg - mercury, Fecal - Fecal Coliform Bacteria, Sed - Sediment, Cd - Cadmium, S - Supporting
ST - Support threatened, PS - Partially Supporting, NS - Nonsupporting, P - Point Source
NP - Nonpoint Source


Lumber River Basin
N.C. Department of Environment, Health, and Natural Resources
Division of Environmental Management Water Quality Section
03-07-50
03-07-51
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03-07-55
03-07-56
03-07-57
03-07-58
03-07-59
Supporting
Support - threatened
Partially Supporting
Not Supporting
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Table 4.3 Use Support Ratings for Freshwater Streams by Subbasin

USE SUPPORT STATUS FOR FRESHWATER STREAMS (MILES) (1988-1992)						
Subbasin	S	ST	PS	NS	NE	Total Miles
03-07-50	137.9	14	2.8	0	0	154.7
03-07-51	191.8	86.5	52.1	24.4	66.3	421.1
03-07-52	29	101.2	4.3	0	0	134.5
03-07-53	113.7	145.8	15.5	8.7	16.5	300.2
03-07-54	15.8	19.6	46.2	6.9	48.2	136.7
03-07-55	102.3	174.9	16.4	0	12.4	306
03-07-56	113.5	0	30.10	3.7	0	147.3
03-07-57	27.7	162.4	52.2	12	81.7	336
03-07-58	38.8	90.6	18.7	0	49.9	198
03-07-59	36.3	82.6	0	9	20.3	148.2
TOTAL	806.8	877.6	238.3	64.7	295.3	2282.7
PERCENTAGE	35%	39%	10%	3%	13%	

Monitored:	576.3	713.1	102.1	41.4	1432.9
Evaluated:	230.5	164.5	136.2	23.30	554.5
Total Assessed:					1987.4

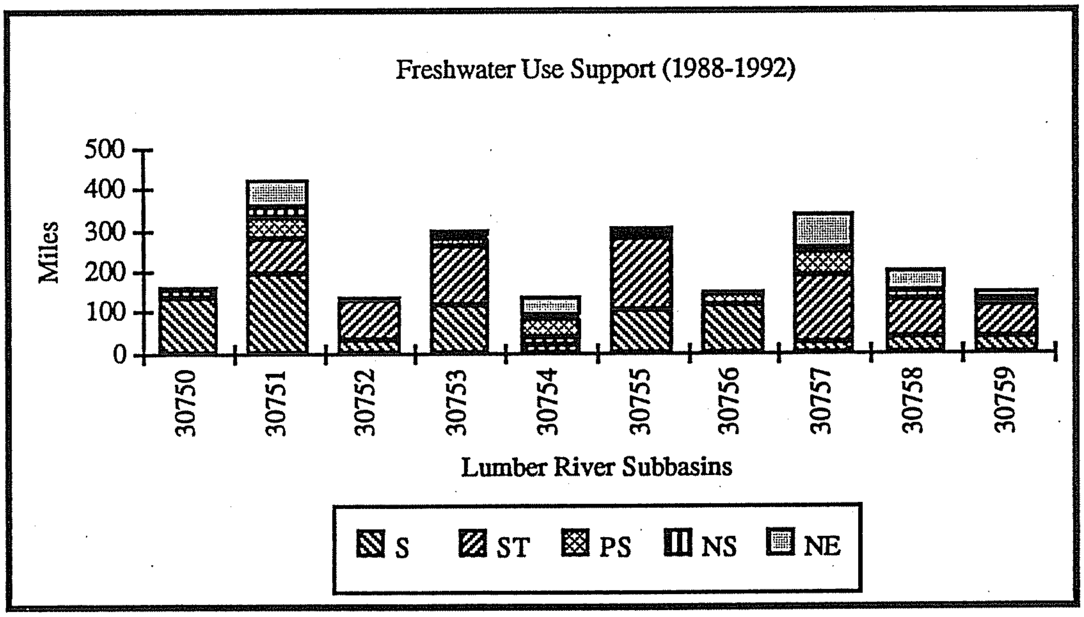


Figure 4.21 Bar Graph Showing Freshwater Use Support by Subbasin

Table 4.4 Sources and Causes of Use Support Impairment in Freshwaters

PROBABLE SOURCES OF USE SUPPORT IMPAIRMENT (MILES)						
			Breakdown of NPS Sources			
Subbasin	Point Sources	Non-Point Sources	NPS Agriculture	NPS Urban	NPS Hydro/ Mod	NPS Other/ Unknown
03-07-50	0	0	0	0	0	0
03-07-51	0	61.5	35.4	0	36.1	0
03-07-52	0	0	0	0	0	0
03-07-53	0	24.2	8.7	8.7	1.3	14.2
03-07-54	0	25.7	25.7	0	0	0
03-07-55	0	8.8	0	0	0	8.8
03-07-56	0	8.7	3.7	0	0	5
03-07-57	0	37.2	19	0	12.6	5.6
03-07-58	0	18.7	18.7	13.9	0	0
03-07-59	0	9	0	9	0	0
*Total Miles	0	195.8	111.2	31.6	50	33.6
** % of PS and NS	0	65%	37%	10%	17%	11%

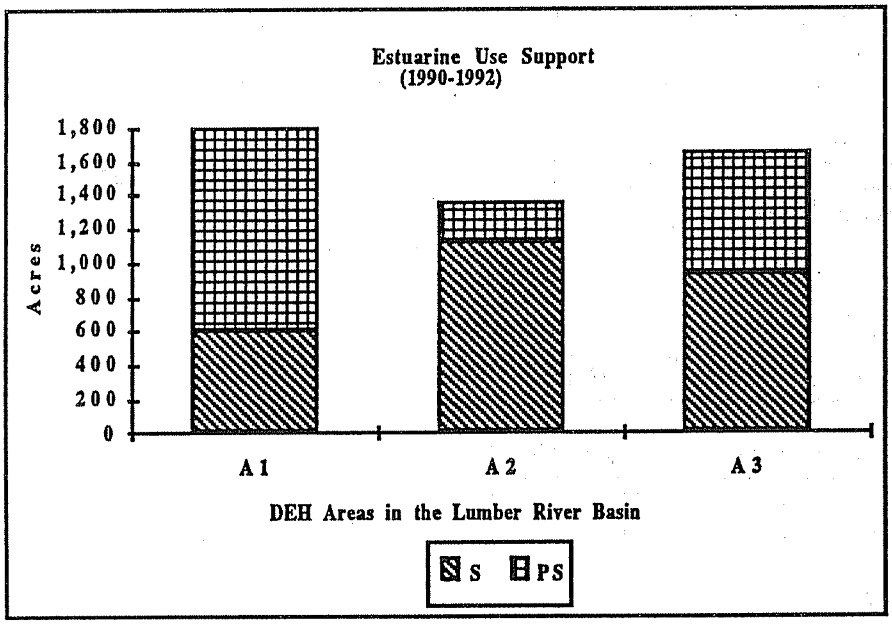
* **Total Miles** = miles of impaired streams where a probable source has been identified.
** **PS** = Partially supporting; NS = Not supporting; PS and NS = Impaired streams.
Total miles of impaired streams (PS+NS) from Table 4.3 = 303 miles

CAUSES OF USE SUPPORT IMPAIRMENT (MILES)			
Subbasin	Sediment	Metals	Low DO
03-07-50	0	0	0
03-07-51	36.8	0	0
03-07-52	0	0	0
03-07-53	22.9	0	0
03-07-54	10.1	0	6.9
03-07-55	8.8	0	0
03-07-56	0	12.0	0
03-07-57	28.8	38.9	0
03-07-58	0		0
03-07-59	9	0	0
Total Miles	116.4	50.9	6.9
% of PS and NS	38	17	2

Table 4.5 Lumber River Estuarine Waterbodies Use Support Status (Acres)

Lumber River Estuarine Waterbodies Use Support Status (Acres)						
			<----Overall Rating (Acres)---->			
Area Name	Total Acres	DEH Area	S	ST	PS	NS
Calabash	1,800	A1	599	0	1,201	0
Shallotte River	1,350	A2	1,120	0	230	0
Lockwoods Folly River	1,650	A3	929	0	721	0
TOTAL ACRES	4,800		2,648	0	2,152	0
PERCENTAGE			55	0	45	0

* *DEH Area* refers to shellfish water areas designated by the Division of Environmental Health (DEH). See Figure 4.23 for DEH shellfish area boundaries.



* *DEH Area* refers to shellfish water areas designated by the Division of Environmental Health (DEH). See Figure 4.23 for DEH shellfish area boundaries.

Figure 4.22 Bar Graph of Estuarine Use Support Status (1989-1991)

Table 4.6 Lumber River Estuarine Waterbodies Causes and Sources of Use Support Impairment

Lumber River Estuarine Waterbodies
Causes and Probable Sources of Use Support Impairment (1990-1992)
(PS and NS waterbodies only)

	DEH	Causes	Sources		
Area Name	Area	Fecal	Point	NPS	Source Descriptions
Calabash	A1	1,201	0	1,201	ag,urban runoff,septic tanks,marinas
Shallotte River	A2	230	0	230	ag,urban runoff,septic tanks,marinas
Lockwoods Folly River	A3	721	0	721	urban runoff, septic tanks, marinas
TOTAL ACRES		2,152	0	2152	
PERCENT OF PS+NS		100		100	

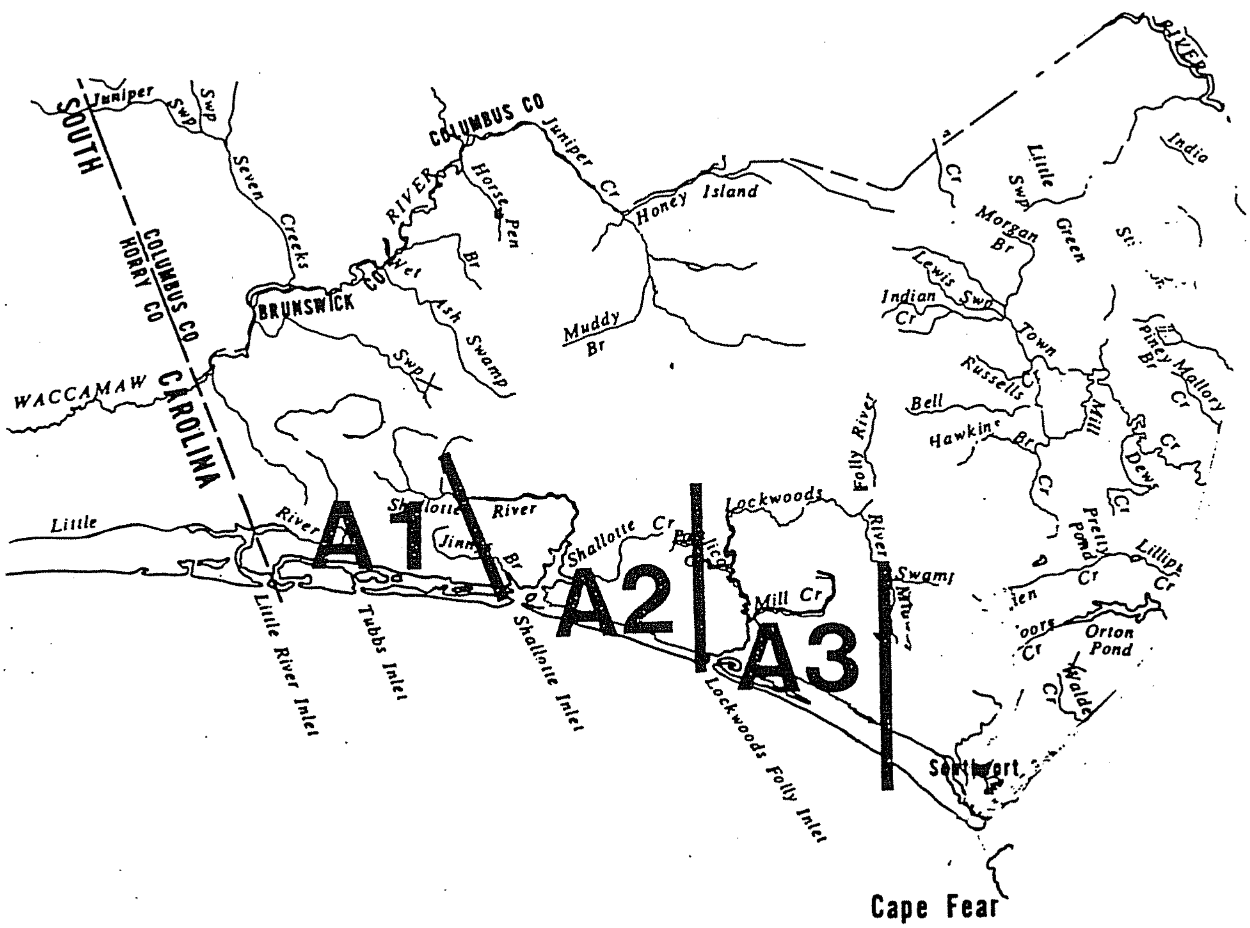


Figure 4.23 Division of Environmental Health (DEH) Shellfish Areas for the Lumber River

TABLE 4.7 Lakes Use Support Status and Causes and Sources of Impairment

LAKE NAME	INDEX NO.	SIZE (Acres)	CLASS	OVER-ALL USE STATUS	FISH CON-SUMP.	AQ. LIFE & SEC. CONT.	SWIM-MING	WATER SUPPLY	DRINK. TROPHIC STATUS	PROB. PARA-METERS	SOURCES
Sub. 30750											
PAGES LAKE	14-2-11-(5)	40	B	PS	PS	ST	FULL	n/a	EUTRO	Hg	UNKNOWN
Sub. 30755											
JOHNS POND	14-33	126	C-SW	PS	FULL	PART	n/a	n/a	HYPER	NOX AQ) PLANTS	NP
MAXTON PD	14-34-(5)	70	C-SW	ST	FULL	ST	n/a	n/a	EUTROC		
Sub. 30756											
LAKE WACC.	15-2	8950	B-SW	FULL	FULL	FULL	FULL	n/a	MESO		
Sub. 30757											
LAKE TABOR	15-17-1-(1)	70	B-SW	ST	FULL	ST	FULL	n/a	EUTRO		

CHAPTER 5

EXISTING POINT AND NONPOINT SOURCE POLLUTION CONTROL PROGRAMS

5.1 INTRODUCTION

This chapter summarizes the point and nonpoint source control programs available for addressing water quality problems in the Lumber River basin. **Sections 5.2 and 5.3**, respectively, describe existing point and nonpoint source pollution control programs. Application of these programs to specific water quality problems and water bodies is presented in Chapter 6. **Section 5.4** discusses integration of point and nonpoint source control management strategies and introduces the concept of *total maximum daily loads* (TMDLs). The development of TMDLs is hindered at this time in the Lumber River Basin by limitations of the applicability of available tools to model swamp water conditions found throughout the basin. DEM plans on intiating studies to address this issue (see section 6.1 in Chapter 6).

5.2 NORTH CAROLINA'S POINT SOURCE CONTROL PROGRAM

5.2.1 Introduction

Point source discharges, which are also described in Section 3.3 in Chapter 3, are not allowed in North Carolina without a permit from the state. Discharge permits are issued under the authority of North Carolina General Statute GS 143.215.1 and the National Pollution Discharge Elimination System (NPDES) program which was delegated to North Carolina from the USEPA. These NPDES discharge permits, issued by North Carolina, serve as both state and federal permits. NPDES permits contain effluent limitations which establish the maximum level of wastes, or pollutants, that may be discharged into surface waters. North Carolina has a very comprehensive NPDES program which includes permitting, enforcement, wasteload allocation modeling, pretreatment, aquatic toxicity testing, operator training and consideration of nondischarge alternatives. Below is a brief summary of key components of the state's NPDES program.

5.2.2 Review and Processing of NPDES Permits

Under the basinwide approach, all discharge permits within a given basin are set to expire and be renewed at about the same time. In the Lumber basin, for example, all of the existing permits will expire and be renewed in November and December of 1994. The permitting schedule for the Lumber Basin is presented in Chapter 1 by subbasin. Permits are issued with an effective life of not more than five years, thus basin plans are renewed at five-year intervals prior the next round of permitting. New discharge permits issued during an interim period between cycles will be given a shorter expiration period in order to coincide with the next basin permitting cycle.

DEM will not process a permit application until the application is complete. Rules outlining the discharge permit application and processing requirements are contained in Administrative Code Section: 15A NCAC 2H .0100 - Wastewater Discharges to Surface Waters. Under this rule, all applications must include a summary of waste treatment and disposal options that were considered, and why the proposed system and point of discharge were selected. The summary should have sufficient detail to assure that the most environmentally sound alternative was selected from the reasonably cost effective options.

Also, applications for new discharges which propose to discharge wastewater in excess of 500,000 gallons per day or 10 million gallons per day (MGD) of cooling water or any other proposed discharge of 1 MGD or greater to surface waters must include an *assessment* report in addition to the normal permit application. The assessment is to provide sufficient information to describe the impact of the proposed action on the waters in the area. An Environmental Impact Statement (EIS) or Environmental Assessment (EA), under the NC Environmental Policy Act (NCEPA)may also be required for certain publicly funded projects. If either an EA or EIS is needed, the NCEPA review process must be completed in order for a discharge permit application to be deemed complete.

Once an application is considered complete, a staff review is initiated and a wasteload allocation is performed in order to establish permitted waste limits (described in the following section). The staff review includes a site inspection (which may actually be conducted prior to submittal of complete application for existing facilities that are up for renewal). If the Division finds the application acceptable, then a public notice, called a Notice of Intent to Issue, is published in newspapers having wide circulation in the local area. The public is given a 30-day period in which to comment, and a public hearing may be held if there is sufficient interest. Under Basinwide Management, the Notice of Intent will include all of the permit applications for a particular subbasin (or subbasins) that will be issued within a given month. A public hearing would be scheduled for just those applications where sufficient interest is indicated. Copies of the Notice of Intent are also sent to a number of state and federal agencies for comment. For example, the Division of Environmental Health reviews the applications for their potential impact on surface water sources of drinking water. Once all comments are received and evaluated, a decision is made by the Director of DEM on whether to issue the permit. The final permit will include recommended waste limits and other special conditions which may be necessary to ensure protection of water quality standards.

5.2.3 Discharge Permit Effluent Limitations - Wasteload Allocations

As noted above, effluent limitations, or waste limits as they are sometimes called, dictate the amounts of wastes (pollutants), that are allowed to be discharged into surface waters under an NPDES permit. Where a discharge permit is required, an evaluation is conducted to determine the projected impact of the discharge on the receiving waters. This determination, called a wasteload allocation (WLA), is often based on computer modeling which considers such factors as the rate of waste flow, the type of waste to be discharged, and characteristics of the receiving waters (e.g. rate and quantity of flow, waste assimilative capacity, channel configuration, rate of reaeration, water quality classification, etc.). Permit limits that are determined by models are called water quality-based limits. Permits may also be based on federal effluent guidelines established by the USEPA.

Wasteload allocations are performed by DEM using models of varying scope and complexity, depending on the parameter (type of waste) of interest and the characteristics of the receiving waters. Model frameworks, which are discussed in more detail in Appendix III, can range from simple mass balance analyses to 3-dimensional dynamic water quality models. Modeling fits into the basin plan by drawing on the current conditions within the basin and evaluating the effects of various management strategies. In general terms, modeling can be used to determine the fate and transport of pollutants, reduction goals for point and nonpoint sources of environmental contaminants, and to derive effluent limits for NPDES permits. More specifically, models can be used to predict concentrations of a parameter at a given site, such as instream DO or chlorophyll a in a lake, and can be used as a tool to determine what is needed to protect instream standards. Uncertainty analysis of water quality models expand the predictive capabilities and the confidence in results, and can produce probabilities that an event would occur under a certain set of circumstances. Waste limits may vary from summer to winter for some parameters, such as nutrients and ammonia, with winter limits being somewhat less stringent than summer limits due to higher instream flows during the winter months.

It should be noted that where point sources are responsible for water quality problems, WLAs offer a solution by yielding appropriate permit limits that offer adequate water quality protection. Where a sole discharge is responsible for the water quality impacts, a simple WLA can be performed and no other discharges need be affected. If the issues are not complex, and a standard WLA analysis was performed, the management practice is to establish limits in accordance with DEM's Standard Operating Procedures (SOP) for Wasteload Allocations manual. The SOP manual has been developed to support State and Federal regulations and guidelines and has been approved by the EPA.

In considering a wasteload for an individual discharge facility, a critical factor is whether the receiving waters have a flow during 7Q10 or 30Q2 conditions. It is DEM's policy not to allow new or expanded discharges into "no flow" streams having a 7Q10 and 30Q2 equal to zero. In addition, existing facilities on such streams will be targeted for removal unless it is determined that there are no reasonable alternatives. If that is the case, then the facility will be required to meet limits of 5 mg/l BOD_5 and 2 mg/l NH_3N in summer (10 mg/l BOD_5 and 4 mg/l NH_3N in winter).

If the water quality issues involve numerous discharges, the Environmental Management Commission, pursuant to NCGS 143-215.1(b)(2), is required to consider the cumulative impacts of all permits in order to prevent violations of water quality standards. Such areas are identified and discussed in Chapter 6. Generally, these are areas where the SOP alone does not provide adequate guidance. Since the SOP addresses mostly single discharge or relatively simple interaction of multiple discharges, WLA procedures outside the realm of the SOP represent the larger, basinwide strategy that DEM is implementing.

5.2.4 Compliance Monitoring and Enforcement

Most dischargers are required to periodically sample the treated effluent from their discharge pipes. Also, many larger and more complex dischargers are required to sample points in the receiving waters both up and downstream from the discharge point. This process is called self-monitoring and it is typically required five days a week (Monday through Friday) for major facilities. The sampling results (contained in a daily monitoring report or DMR) are then submitted each month to DEM for compliance evaluations. If the limits are not being met, the state may issue a notice of violation, initiate enforcement action, place the facility on moratorium, and/or enter into a Special Order by Consent (SOC) to ensure compliance. An SOC is a legal commitment entered into by the state and the discharger that establishes a time schedule for bringing the wastewater treatment plant back into compliance. During this time period, interim waste limits may be assigned to the facility until the improvements can be made.

In addition to the DMR data, illegal or improperly treated discharges may be identified in other ways including through third party reports, routine DEM site inspections, and water quality monitoring conducted by DEM staff.

5.2.5 Aquatic Toxicity Testing

There are literally thousands of chemicals or compounds in use today which may enter wastewater systems and eventually be discharged to surface waters. Monitoring the concentration of each of these chemicals individually would be impossible due both to cost/time considerations as well as the inability of current analytical technique to detect many of them. Even if the existence and potential effects of every constituent of a wastewater were known, the combined effects of these constituents could not be predicted.

North Carolina utilizes an integrated approach to address this problem which relies on chemical specific monitoring, assessment of resident aquatic populations, and analysis of whole effluent toxicity (WET) to control the potential effects of these chemicals and their interactions. Whole effluent toxicity limits allow protection against predicted impacts of toxicants through measurement of those impacts in the laboratory. It is from this same foundation of aquatic toxicity laboratory tests that chemical specific limits and criteria are derived for the majority of chemical toxicants.

Whole effluent toxicity limitations were implemented by North Carolina in February, 1987 through a policy to incorporate these limits in all major and complex minor permits. As of August 1992, there were 530 permitted NPDES discharges in North Carolina required to perform whole effluent toxicity monitoring, and over 9,000 individual toxicity analyses had been performed across the state. These limitations are developed to protect aquatic life from the discharge of toxic substances in toxic amounts as prescribed by 15 NCAC 2B. 0208 (i.e. so as not to result in chronic toxicity at permitted discharge flow and 7Q10 receiving flow volumes). Since the inception of the aquatic toxicity program a shift in observed WET has been seen from a time when approximately 25% of the facilities tested would be predicted to have been acutely toxic instream to a point now where less than 10% would be considered chronically toxic.

Aquatic toxicity testing, no less than any other complex analytical technique, requires a great deal of quality assurance and quality control to achieve reliable results. In 1988, North Carolina adopted regulations that initiated a program which required all laboratories performing NPDES analyses in North Carolina to be certified by the state as a biological laboratory. As of August, 1992, 21 commercial, municipal, and industrial laboratories had achieved this certification in either aquatic toxicity analyses and/or aquatic population survey. The NC Biological Laboratory Certification Program, much like WET permitting in North Carolina, is looked at as a national leader in its field.

5.2.6 Pretreatment Program

The goal of the pretreatment program is to protect municipal wastewater treatment plants, or publicly-owned treatment works (POTWs), and the environment from the adverse impacts that may occur when hazardous or toxic wastes are discharged into a public sewage system. The pretreatment program is designed to achieve this protection primarily by regulating nondomestic (e.g. industrial) users of POTWs that discharge toxic wastes under the Domestic Sewage Exclusion of the Resource Conservation and Recovery Act (RCRA). In essence, the program requires that businesses and other entities that use or produce toxic wastes pretreat their wastes prior to discharging their wastewater into the sewage collection system of POTW. State-approved pretreatment programs are typically administered by local governments that operate POTWs.

There are four major areas of concern addressed through implementation of a local pretreatment program: 1) interference with POTW operations, 2) pass-through of pollutants to a receiving stream, 3) municipal sludge contamination, and 4) exposure of workers to chemical hazards. Interference may involve any aspect of plant operation from physical obstruction to inhibition of biological activity. The process for developing technically based local pretreatment limits involves determining the maximum amount of each pollutant that can be accepted at the influent, or headworks, of the POTW and still protect the receiving water, the POTW itself, and the POTW's sludge disposal options.

5.2.7 Operator Certification and Training Program

Water Pollution control systems must be operated by state-certified operators. These systems include: wastewater treatment plants, wastewater collection systems and "non-discharge" ground absorption systems, such as alternative on-site disposal technologies and spray irrigation facilities. Systems are classified based on system type and complexity and are required to have an appropriately trained and certified operator. The Certification Commission currently certifies operators in four grades of wastewater treatment, four grades of collection system operation, one grade of subsurface operation, and a variety of specialized conditional exams for other technologies. Training and certification programs are also being developed for land application of residuals and groundwater remediation.

Training is accomplished in cooperation with the state university and community college system as well as through the professional associations for operators and pollution control professionals. Specialty courses and seminars for operators are also offered by Operators' Associations and the NC Water Pollution Control Association/American Water Works Association (WPCA/AWWA).

Training and certification of operators is essential to the proper operation and maintenance of pollution control systems. Without proper operation and maintenance, even the most highly designed treatment system will not function efficiently. It is the goal of the Training and Certification Program to provide competent and conscientious professionals that will provide the best wastewater treatment and protect the environment and the public health.

5.2.8 Nondischarge and Regionalized Wastewater Treatment Alternatives

As discussed in section 5.2.2, discharge permit applicants are required to consider alternatives to wastewater treatment other than discharging into a stream. For some, there may be no other economically feasible alternatives. However, for others, particularly smaller dischargers, there are a number of potentially cost-effective and environmentally sound options. There are several types of non-discharging wastewater treatment systems including spray irrigation, rapid infiltration, trickling systems and underground injection. Artificial wetlands wastewater systems are also being evaluated in this state. Permit requirements for nondischarging systems are presented in Administrative Code Section 15 NCAC 2H .0200 - Waste Not Discharged to Surface Waters.

Another alternative to a surface water discharge is to tie into an existing wastewater treatment system. Where possible, DEM is encouraging smaller dischargers to connect to large established municipal systems. Regionalization, as this is called, has several advantages. First, large municipal facilities, unlike smaller package type plants, are manned most of the time thereby reducing the potential for plant malfunctions, and where malfunctions do occur, they can be caught and remedied more quickly. Second, these larger facilities can provide a higher level of treatment more economically and more consistently than can smaller plants. Third, the larger plants are monitored daily. And fourth, centralizing the discharges reduces the number of streams receiving effluent. In evaluating future permit expansion requests by regional facilities, DEM will take into consideration the amount of flow accepted by them from the smaller discharges.

In addition to the nondischarging wastewater treatment systems mentioned above, nondischarge permits are also issued for the land application of residual solids (sludge) from wastewater treatment processes. Section 3.3.2 in Chapter 3 lists the number of some of these systems in the Lumber Basin.

5.3 NONPOINT SOURCE CONTROL PROGRAMS

Land use control as well as technology-based best management practices (BMPs) are the two most widely used tools for controlling nonpoint source pollution and protecting designated uses of waterbodies. In developing areas, land use control through low density development has often been selected by municipalities as the preferred method of treatment for urban stormwater because it avoids potential problems with long-term BMP maintenance requirements. In situations where low density development is not feasible or where higher densities are preferred, stormwater control devices (BMPs) are available. These include, but are not limited to stormwater retention and wet detention ponds, vegetated buffer strips along streams, and designated infiltration areas.

Nonpoint source strategies for other categories of pollution (e.g., agriculture, construction, or mining) depend more on the installation of BMPs and waste reduction/management systems. The installation of these BMPs and management systems may be voluntary or required by a set of regulations, depending on the designated management agency. Examples of nonpoint source management approaches that combine land use controls and BMPs include the coastal stormwater regulations and the Water Supply Watershed Protection Program rules.

Once a management strategy is developed for each category of nonpoint source pollution, a schedule can be developed for implementing these strategies for specific geographic areas and waterbodies. It is important to emphasize that management strategies are developed for both highly valued resource waters where a potential for degradation exists and for areas already impacted by nonpoint source pollution.

Regulations or programs are in place which address most categories of nonpoint source pollution (Table 5.1). For example, discharges are not allowed into state waters without a discharge permit from DEM. This includes discharges from septic systems and animal operations. In addition, water quality standards apply to all categories of land-use activities. In the case of the turbidity standard, it is assumed that the standard will be met if proper BMPs are in place, as determined by the appropriate lead nonpoint source agency.

After acceptable BMPs are established and geographic areas or waterbodies are targeted for implementation, steps must then be taken to assure that the chosen management strategies and BMPs are protecting water quality. DEM utilizes both chemical and biological sampling procedures to test the effectiveness of BMPs. In general, the goals of the nonpoint source management program include the following:

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

North Carolina has a variety of statewide programs which are used in the Lumber River Basin and statewide to address nonpoint source pollution. Table 5.1 lists these programs by categories based on the type of activity. Below is a brief overview of existing nonpoint source control efforts for various categories of land use activities.

5.3.1 Agricultural Nonpoint Source (NPS) Control Programs

Agricultural BMPs have been developed largely to control the five major agriculturally-related causes of pollution: sediment, nutrients, pesticides, oxygen-demanding substances and bacteria. BMPs vary from site to site and are dependent upon a particular pollutant but include practices such as grassed waterways and vegetated buffers, nondischarging animal waste lagoons, integrated crop and pest management and soil testing. BMPs may be administered through one or more of the agricultural programs described below.

- **North Carolina Agriculture Cost Share Program**
  In 1984, the North Carolina General Assembly budgeted approximately $2 million to assist landowners in 16 counties within the "Nutrient Sensitive Water" (NSW) watersheds

Table 5.1 Examples of Nonpoint Source Programs

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

(ABBREVIATIONS: **COE**, US Army Corps of Engineers; **DCM**, Div. of Coastal Mgmt.; **DEM**, Div. of Environ. Mgmt.; **DLR**, Div. of Land Resources; **DFR**, Div. of Forest Resources; **DOT**, Dept. of Transportation; **DSW**, Division of Soil and Water; **DSWM**, Div. of Solid Waste Mgmt.; **NCDA**, NC Dept. of Agric.; **SCS**, Soil Conservation Service; **SWCC**, Soil and Water Conservation Commission; **SWCD**, Soil and Water Conserv. District; **USDA**, US Dept. of Agric.)

including the Upper Neuse River (Falls Lake) to implement BMPs for agricultural and silvicultural activities. These funds were increased in May 1987 to include 17 additional coastal counties by the passage of a General Statute formally creating the *Agriculture Cost Share Program for Nonpoint Source Pollution Control (NCACSP)*. In 1989 the NCACSP became a statewide program. The NCACSP will pay a farmer 75 percent of the average cost of implementing approved BMPs and offer technical assistance to the landowners or users which would provide the greatest benefit for water quality protection. The primary purpose of this voluntary program is water quality protection.

The local Soil and Water Conservation District Boards under the administration of the North Carolina Soil and Water Conservation Commission (SWCC) are responsible for identifying treatment areas, allocating resources, signing contractual agreements with landowners, providing technical assistance for the planning and implementation of BMPs and generally encouraging the use of appropriate BMPs to protect water quality. The criteria for allocating funds to the District is "based on the identified level of agricultural related nonpoint source pollution problems and the respective District's BMP installation goals and available technical services as demonstrated in the Districts annual strategy plan" (NC Administrative Code, Title 15, Chapter 6, Section 6E). This local participation is crucial to the success of the program.

The DEHNR-Division of Soil and Water Conservation (DSWC) provides staff, administrative and technical support to the SWCC. The DSWC also coordinates the efforts of various associated Program committees and acts as the clearinghouse for District strategy plans, contracts, etc.,. A legislated Technical Review Committee meets quarterly "to review the progress of the Program" (G.S. 143-215.74B) and to make technical recommendations to the Commission.

Technical assistance for the implementation of approved BMPs is provided to the Districts through a 50:50 cost share provision for technical positions to be filled at the District level. The USDA-Soil Conservation Service provides direct technical assistance for the planning and application of BMPs. The agency trains District personnel and others in the principles and technicalities of natural resource conservation. Its Technical Guides provide standards and specifications for District staff and are often incorporated into rules and regulations dealing with nonpoint source pollution control. The agency also provides vehicles and other equipment to the SWCDs.

The current annual statewide budget to cost share BMPs (75% - NCACSP / 25% landowner) with landowners is approximately $ 6.7 million. The budget to share the cost of providing technical assistance with Districts is approximately $ 1.3 million. Additional support for administration and staff is provided by local governments. In Lumber River Basin districts, approximately $1.48 million in BMP cost share dollars have been spent (see section 6.6 in Chapter 6). There is also federal assistance through ASCS for BMP implementation.

- **North Carolina Pesticide Law of 1971**
  In 1971 the General Assembly created and authorized the North Carolina Pesticide Board to regulate the use, application, sale, disposal and registration of pesticides for the protection of the health, safety, and welfare of the people and for the promotion of a healthy and safe environment. Some of the responsibilities of the Pesticide Board and the North Carolina Department of Agriculture include registering all pesticides prior to distribution and sale in N.C., sampling pesticides to insure that all products are up to guaranteed analysis and unadulterated by any other pesticide, sampling pesticides at time of application to insure that the applicator is following label instructions. certifying the competency of applicators and dealers of restricted use pesticides.

The Pesticide Section of the North Carolina Department of Agriculture conducts mandatory annual inspections of all aircraft used in pesticide application and conducts random inspections of ground application equipment and chemigation (application of pesticides through irrigation systems) systems. These inspections are intended to encourage proper calibration and use of equipment in order to avoid excessive application rates and accidental spills from faulty systems. Stop use orders are issued for noncompliance with the regulations.

Inspections are also required for bulk storage tanks prior to filling. All commercial pesticide storage facilities are required to have an approved Pre-fire Plan. In addition, each large commercial storage facility is required to develop and maintain an Emergency Contingency Plan. This plan describes the actions facility personnel shall take to respond to fires, explosions, spills, or any other sudden or gradual release of pesticides or pesticide contaminated materials to air, soil, or surface waters. The Contingency Plan is designed to minimize hazards to human health and the environment.

Penalties are assessed to careless pesticide applicators. Enforcement of the law is based on where the pesticide is deposited rather than just where it is applied. For example, if a pesticide is found in a stream as a result of wind drift, the applicator is subject to legal action. The Raleigh Office staff of the NCDA Pesticide Section is comprised of 20 employees. There are 10 Inspectors who conduct field-level compliance monitoring and investigation services. The annual budget for pesticide control and analytical work is $1.4 million.

- **NCDA Pesticide Disposal Program**

  In 1976, the North Carolina Pesticide Board adopted regulations governing the disposal of pesticides. These regulations make it illegal in North Carolina to dispose of hazardous waste (which includes certain pesticides) in sanitary landfills. While households and farms which generate less than 220 lbs of hazardous waste and less than 2 lbs of acutely hazardous waste are exempt from federal disposal requirements, the regulations prohibiting the disposal of these wastes in sanitary landfills still applies to them. The option to use commercial hazardous waste disposal companies is too expensive and most companies will not pickup small quantities. As a result of this dilemma, the NCDA created the Pesticide Disposal Program in 1980 through appropriations from the General Assembly.

  The goal of the Program is to provide an available, affordable and environmentally acceptable mechanism in which any homeowner, farmer, or institution can dispose of unwanted or unusable pesticides. It is mandatory, however, that all pesticide products are labeled correctly before NCDA will pick them up. An EPA permitted hazardous waste treatment or disposal facility (TSD) requires proper identification before the products can be disposed.

  The Food and Drug Division of the North Carolina Department of Agriculture administers the Pesticide Disposal Program. The same staff used for enforcing the North Carolina Pesticide Law of 1971 are used in the Disposal Program.

- **Animal Waste Management Regulations**

  On December 10, 1992, the Environmental Management Commission adopted a rule modification (15A NCAC 2H .0217) to establish procedures for properly managing and reusing animal wastes from intensive livestock operations. The goal of the rule is for intensive animal operations to operate so that animal waste is not discharged to waters of the state. This means that if criteria are met and no waste is discharged to surface waters, then an individual permit from DEM is not required. The rule applies to new, expanding or existing feedlots with animal waste management systems designed to serve more than or equal to the following animal populations: 100 head of cattle, 75 horses, 250 swine, 1,000 sheep or 30,000 birds with a liquid waste system. These operations are deemed permitted if a signed registration and an approved waste management plan certification are submitted to DEM by the appropriate deadlines. The deadline for submittal of registrations to DEM for existing facilities was December 31, 1993. Below is a summary of the number of registered operations and animals, by type, in the Lumber Basin through April 1994 (summarized from Table 2.7 in Chapter 2).

Type of Operation	No. of Operations	No. of Animals
Swine	160	657,122
Poultry	11	1,426,600
Chicken (w/ wet lagoons)	3	121,000
Dairy	2	1,060
Cattle	5	773

Facility plans for existing facilities must be submitted to and certified by the Division of Soil and Water Conservation by December 31, 1997. The standards and specifications of the USDA Soil Conservation Service will be the minimum criteria used for plan approval by the local Soil and Water Conservation Districts. Proposed rules more clearly defining the standards, specifications and approval of the certifications were presented by the Soil and Water Conservation Commission at public meetings in November 1993.

In the past, DEM inspected intensive animal operations mostly in response to third party complaints. However, with the passage of the above rules, the increasing numbers of these operations and their potential impact on water quality, DEM will be making more routine inspections to make sure that their waste management systems are adequate and are being operated properly. Animal waste management systems that are determined to have an adverse impact on water quality may be required to obtain an approved animal waste management plan or to apply for and receive either an individual nondischarge permit.

An illegally discharging operation may also be designated as a concentrated animal feeding operation (CAFO) and an NPDES discharge permit could be required. Thirteen CAFOs have been designated in the Basin since March of 1984.

- **NC Cooperative Extension Service and Agricultural Research Service**
  Crop and animal production programs are administered under the research and education activities of the N.C. Agricultural Research Service (ARS) and the N.C. Cooperative Extension Service (CES). The research and education efforts are broad and include areas such as variety development, crop fertilizer requirements, soil testing, integrated pest management, animal housing, animal waste management, machinery development and irrigation. Guidelines for most agricultural enterprises have been developed and made available to farmers. A more intensified water quality emphasis is being incorporated in these area and many other projects undertaken by ARS and CES. The local contact that county CES agents have with farmers and homeowners provides an excellent opportunity for dialogue and education in nonpoint source pollution control. This network of contacts can be used to inform people about BMPs and to provide some structure for a general NPS education program.

  The N.C. Agricultural Research Service and the N.C. Cooperative Extension Service conduct broad research and education efforts that include areas such as variety development, crop fertilizer requirements, soil testing, integrated pest management, animal housing, animal waste management, machinery development, and irrigation. County

Cooperative Extension agents work closely with farmers and homeowners, providing an excellent opportunity for dialogue and education in nonpoint source pollution control.

- **Soil, Plant Tissue, and Animal Waste Testing Program**
  These services provide farmers with information necessary to improve crop production efficiency, to manage the soil properly and to protect environmental quality. The Soil, Plant Tissue and Animal Waste Testing Program is administered by the Agronomic Division of the North Carolina Department of Agriculture. Water and wastewater from lagoons is also tested for irrigation and fertilizer use.

- **Watershed Protection and Flood Prevention Program (PL 83-566)**
  The purpose of the Watershed Protection and Flood Prevention Program under Public Law - 566 (PL-566) is to provide technical and financial assistance in planning, designing, and installing improvement projects for protection and development of small watersheds. The Program is administered by the USDA-Soil Conservation Service in cooperation with the N.C. Division of Soil and Water Conservation, the State Soil and Water Conservation Commission, the U.S. Forest Service, Soil and Water Conservation Districts, and other project sponsors.

  The emphasis of the Program over the past three decades has been to provide flood control and watershed protection. More recently, the focus of PL-566 projects has shifted to total water management to address both water quantity and quality issues Projects that address off-site water quality benefits have a much better chance of being funded. In the Lumber River Basin, there are a number of watershed protection projects underway with more in the planning stages.

  PL-566 also authorizes the SCS to conduct Cooperative River Basin Studies (CRBS) which are usually sponsored by other agencies or units of government. Typically, other federal and state water resource agencies participate in these studies. There are two CRBS's in progress which include the Lumber River Basin. The Eastern North Carolina CRBS will prioritize 11-digit hydrologic units for treatment based on a number of resource factors. The North Carolina CRBS will result in the delineation and digitization of 14-digit hydrologic units across the state.

- **Food Security Act of 1985 (FSA) and the Food, Agriculture, Conservation and Trade Act of 1990 (FACTA)**
  There are several provisions authorized by the federal Food Security Act of 1985 (FSA) and re-authorized by the Food, Agriculture, Conservation, and Trade Act of 1990 (FACTA) which offer excellent opportunities for the abatement of agricultural nonpoint source pollution. The FSA and FACTA make the goals of the USDA farm and conservation programs more consistent by encouraging the reduction of soil erosion and production of surplus commodities and the retention of wetlands. At the same time, the provisions can serve as tools to remove from production those areas which critically degrade water quality by contributing to sedimentation. Important water quality-related provisions are known as the Conservation Reserve, Conservation Compliance, Sodbuster, Swampbuster, and Conservation Easement, Wetland Reserve, and Water Quality Incentive Program. These provisions are administered by the USDA.

  <u>Conservation Reserve Program</u>
  The Conservation Reserve Program (CRP) is administered by the USDA Agricultural Stabilization and Conservation Service (ASCS) and the USDA Soil Conservation Service (SCS). Other cooperating agencies include the NC CES, NC Division of Forest Resources and local Soil and Water Conservation Districts. The CRP was established to encourage removing highly erodible land from crop production and to promote planting long-term

permanent grasses and tree cover. The ASCS will share up to half of the cost of establishing this protective cover. The intention of the program is to protect the long term ability of the US to produce food and fiber by reducing soil erosion, improving water quality and improving habitat for fish and wildlife. Additional objectives are to curb the production of surplus commodities and to provide farmers with income supports through rental payments over a 10 year contract period for land entered under the CRP.

Conservation Compliance

The Conservation Compliance provision of the FSA and FACTA discourages the production of crops on highly erodible cropland where the land is not carefully protected from erosion. Highly erodible land is defined as land where the potential erosion (erodibility index) is equal to eight times or greater than the rate at which the soil can maintain continued productivity. This rate is determined by the Soil Conservation Service.

A farmer had until January 1, 1990 to develop and begin applying a conservation plan on highly erodible land. The plan must be operational by January 1, 1995. If a conservation plan is not developed and implemented, the farmer loses eligibility in price and income supports, crop insurance, FHA loans, Commodity Credit Corporation storage payments, farm storage facility loans, Conservation Reserve Program annual payments, and other programs under which USDA makes commodity-related payments. In other words, Conservation Compliance is an economic disincentive, quasi-regulatory program.

Sodbuster

The Sodbuster provision of the FSA and FACTA is aimed at discouraging the conversion of highly erodible land for agricultural production. It applies to highly erodible land that was not planted in annually tilled crops during the period 1981-85. As with the other provisions of the FSA, the Soil Conservation Service determines if a field is highly erodible. If a highly erodible field is planted in an agricultural commodity without an approved conservation system, the landowner (or farmer) becomes ineligible for certain USDA program benefits.

Swampbuster

The purpose of Swampbuster is to discourage the conversion of wetlands to cropland use. Wetlands are defined as areas that have a predominance of hydric soils that are inundated or saturated by surface water or groundwater at a frequency or duration sufficient to support a prevalence of hydrophytic (water loving) vegetation. It is the responsibility of the Soil Conservation Service to determine if an area is a wetland. Like the other provisions of the FSA and FACTA, a farmer will lose eligibility for certain USDA program benefits on all the land which is farmed if a wetland area is converted to cropland.

Conservation Easement

The Conservation Easement provision encourages producers whose FHA loans are in or near default to place their wetland, highly erodible land, and fragile land in conservation, recreation, or wildlife uses for periods of at least 50 years. The producer benefits by having the FHA loan partially canceled. The environment benefits by reducing the level of soil disturbing activities and the threat of agricultural pollutants.

Wetland Reserve

FACTA established a voluntary program for farmers to grant the federal government a 30-year or perpetual easement to wetlands. Eligible land includes farmed or converted wetlands which could be restored to their highest wetland function and value. The goal is to enroll one million acres by the end of 1995.

Water Quality Incentive Program
FACTA established this cost sharing program to help farmers control pollution problems associated with agricultural activities. A producer could receive up to $3,500 in cost share assistance to implement approved BMPs. The goal is to enroll 10 million acres by 1995.

5.3.2 NPS Programs for Urban and Developed Lands

- **Federal Urban Stormwater Discharge Program / NC NPDES Stormwater Program**
  In 1987, Congress passed the Water Quality Act Amendments to the Clean Water Act requiring the U.S. Environmental Protection Agency (EPA) to develop regulations on permit application requirements for stormwater discharges associated with industrial activities as well as those associated with large and medium municipal separate storm sewer systems (population greater than 100,000). These regulations became effective in December 1990.

  The goal of the stormwater discharge permitting regulations in North Carolina is to prevent pollution of the stormwater runoff by controlling the source(s) of pollutants. Defining the potential pollutant sources and establishing controls of the sources that will reduce and minimize pollutant availability will result in an improvement to the water quality of the receiving streams, consistent with the overall goal of the water quality program.

  Authority to administer these regulations has been delegated to the North Carolina Division of Environmental Management (DEM). The NPDES stormwater regulations require that facilities with stormwater point source discharges associated with industrial activity and municipalities defined as either large or medium municipal separate storm sewer systems be permitted.

  The municipal permitting requirements are designed to lead to the formation of site-specific stormwater management programs for a municipal area Therefore, the permits issued to municipalities for their municipal separate storm sewer systems will be explicitly written for each individual municipality. Municipal permits of this type in North Carolina are currently required for Charlotte, Durham, Greensboro, Raleigh, Winston-Salem and Fayetteville/Cumberland County. The municipalities will develop and implement comprehensive stormwater quality management programs to reduce the discharge of pollutants in stormwater to the maximum extent practicable (MEP). MEP will be defined separately for each municipality required to be permitted. Industrial facilities discharging through a municipal separate storm sewer system are required to submit a permit application to the state and receive their own NPDES stormwater permit.

  Industrial activities which require permitting are defined in eleven categories in the federal regulations ranging from sawmills and landfills to phosphate manufacturing plants and hazardous waste treatment, storage or disposal facilities. The regulations cover point source discharges that are related to manufacturing, processing, or material storage areas at an industrial facility. Stormwater discharges associated with industrial activities are required to be covered by permits which contain technology based controls based on Best Available Technology (BAT)/Best Conventional Pollutant Control Technology (BCT) considerations or water quality controls, if necessary. Through monitoring and regulating stormwater discharge quality, the goal of the NPDES stormwater program is to reduce the pollutant load in stormwater runoff. In North Carolina, the stormwater regulations affect more than 16,000 industrial facilities. Of the 16,000, it is projected that six to ten thousand will require permitting.

The permitting requirements described here represent Phase I of the stormwater program. EPA and Congress are currently involved in studies to determine the scope of additional stormwater coverage under Phase II of the stormwater program. Further stormwater NPDES coverage could include additional industrial activities or additional municipal areas. If additional areas of coverage are added under the federal stormwater programs, DEM will be responsible for the appropriate permitting of these areas within North Carolina.

- **Water Supply Protection Program**

Approximately 50 percent of North Carolina's population depends on surface water supplies for drinking, commercial and industrial uses. Water supplies have become more important in recent years because of increased demand for water, concern over potential contamination by toxic substances, and protection of human health. As a result, the General Assembly passed the Water Supply Watershed Protection Act of 1989 (House Bill 156). This Act requires all local governments that have land-use jurisdiction within surface water supply watersheds, or a portion thereof, to be responsible for implementation and enforcement of nonpoint source management requirements related to urban development according to minimum standards adopted by the state. NPS control strategies are included in the rules for urban, agricultural, silvicultural, and Department of Transportation activities. The Water Supply Watershed Protection Rules were adopted by the Environmental Management Commission on February 13, 1992.

The purpose of the Water Supply Protection Program is to provide an opportunity for communities to work with the state to provide enhanced protection for their water supply from pollution sources. There are five water supply classes that are defined according to the amount and types of permitted point source discharges, as well as a requirement to control nonpoint sources of pollution. By classifying a watershed as a water supply watershed, a local government and adjacent jurisdictions within the watershed will take steps to control nonpoint sources of pollution at their sources and thereby reduce the potential of pollutants contaminating their drinking water supply. In turn, the state limits the point source discharges that can locate within the watershed and thereby reduces the potential of contamination of the water supply.

This dual approach of state and local government action to preclude potential impacts from stormwater runoff and wastewater discharges is important since only a small fraction of the possible pollutants have water quality standards. As more is learned about the types and effects of pollutants in our drinking waters, the state will proceed to adopt additional water quality standards. One of the effects this would have is that water treatment facilities will be required to remove these pollutants. This could require additional technology and possibly more expensive treatment facilities or operation to ensure safe drinking water. It is therefore very important for the state and local governments to consider the important alternative of preventing pollution from entering their drinking water supplies.

The General Assembly extended the deadline for completing reclassification of existing surface water supply waters to July 1, 1992 in House Bill 873. The bill also established a schedule for local governments' submittal of water supply protection ordinances as follows:

1) July 1, 1993 for municipalities with populations of 5,000 or more,
2) October 1, 1993 for municipalities with smaller populations, and
3) January 1, 1994 for counties.

The Water Supply Protection Program is administered by staff in the Planning Branch of the Water Quality Section in NCDEM. These staff coordinate with the Division of Community Assistance (NCDOC) who helps local governments develop land-use ordinances, the Division of Environmental Health, NCDEHNR who certifies that a proposed reclassification is suitable for a drinking water supply, and NCDEM staff in NCDEHNR regional offices who are responsible for water quality sampling in the proposed water supply. Implementation of the act and adoption of the rules has entailed developing a new set of water supply surface water classifications: WS-I to WS-V. Watersheds draining to waters classified WS carry some restrictions on point source discharges and on many land use activities including urban development, agriculture, forestry and highway sediment control. See Appendix I for a summary of land use and density controls for the five WS water quality classifications.

- **NC Coastal Stormwater Management Regulations**
  In November 1986, the EMC adopted rules which required new development in a limited zone (575 feet) around Class SA (shellfish) waters to control stormwater either by limiting density or completely controlling a 4.5 inch, 24-hour storm with the use of a stormwater treatment system. The regulations applied to development activities which required either a CAMA major permit or a Sediment/Erosion Control Plan (generally development disturbing more than one acre). The design storm, low density limits, and areal coverage were all quite controversial and the adopted rules represented a compromise by all parties. A sunset provision was added to the rules to force the staff and Commission to reconsider the rules after a year. These rules expired December 31, 1987, but new stormwater regulations were adopted having an effective date of January 1, 1988. These regulations are administered by the Water Quality Section in DEM. Approximately five man-years are allocated to implementing this program. Planning Branch staff are responsible for providing guidance and interpretation to promote consistent implementation of the rules. DEM regional staff review and approve plans and enforce the requirements of the regulations.

  Perhaps the most important measure accomplished with the regulations has been the applicability of stormwater controls to development activities within the 20 CAMA coastal counties. Certainly the near-water impact of stormwater as addressed in the original rules is important, but the staff believed the cumulative impact of stormwater runoff throughout the coastal zone also needed to be addressed. Therefore, the expanded area of coverage helps provide better protection of both shellfish waters and coastal water quality in general.

  Other major items specified in the rules address the sizing of stormwater treatment systems. For developments adjacent to SA waters, infiltration systems must be able to retain 1.5 inches of rainfall, whereas development in other areas must control one inch of rainfall. Wet detention ponds are not allowed for stormwater control near SA waters and must be sized for 85 percent TSS removal in other areas. In addition, porous pavement is considered an innovative infiltration system (only five are allowed until they are proven to work) as evidence has not been provided regarding its effectiveness in coastal areas. A low density option of the regulations applies a built-upon limit of 25 percent for SA areas and 30 percent for other coastal areas rather than a limit on effective impervious cover. Development exceeding these levels is required to have an engineered stormwater system.

  In summary, the regulations have an expanded areal coverage that increases the annual number of projects from approximately 50 (original rules) to 500. This increase coincides with a reduction in design storm that is comparable to requirements in other states. In addition, the low density option, retained from the original regulations, is encouraged as operation and maintenance concerns associated with stormwater controls are not applicable.

- **Coastal Nonpoint Pollution Control Programs**
  As part of the Coastal Zone Act Reauthorization Amendments (CZARA) of 1990, Congress enacted a new section 6217 entitled "Protecting Coastal Waters". This provision requires

states with coastal zone management programs (which includes North Carolina) that have received Federal approval under section 306 of the Coastal Zone Management Act (CZMA) to develop and implement Coastal Nonpoint Pollution Control Programs. The coastal nonpoint programs will provide additional control for sources of nonpoint pollution that impair coastal water quality. Sources subject to the 6217 Coastal NPS Program include: agriculture, forestry operations, urban and developing areas, marinas hydromodification projects, and wetlands and riparian areas.

Section 6217 requires coastal states to submit their coastal nonpoint control programs to the National Oceanic and Atmospheric Administration (NOAA) and the U.S. EPA for approval by July 1995. The programs are to be implemented by January, 1999. Failure to submit an approvable program by July 1995 will result in a state losing substantial portions of its Federal funding under section 306 of the CZMA and section 319 of the Clean Water Act. The coastal nonpoint program will be developed and administered jointly by the NC Division of Coastal Management and DEM.

- **ORW and HQW Stream Classifications**
  Outstanding Resource Waters (ORW) and High Quality Waters (HQW) have management strategies that address handling of urban stormwater. Controls for urban stormwater, either through development density limitations or stormwater treatment systems, are required by DEM. ORW and HQW surface water classifications are discussed in Chapter 2, and excerpts from the state's rules on classifications and water quality standards (15A NCAC 2B .0200) that pertain specifically to ORW and HQW waters are presented in Appendix I. Other NPS management agencies are expected to place priority on protecting these waters as well. For example, the NC Department of Transportation and the NC Division of Land Resources require more stringent sediment control on construction sites in ORW and HQW areas.

5.3.3 Construction - Sedimentation and Erosion Control NPS Program

In 1973, the North Carolina General Assembly enacted the Sedimentation Pollution Control Act. The Act authorized the establishment of a sediment control program to prevent accelerated erosion and off-site sedimentation caused by land-disturbing activities other than agriculture, forestry, and mining. The Land Quality Section of the Division of Land Resources is responsible for administration and enforcement of the requirements of the Act under the authority of the N.C. Sedimentation Control Commission.

The sediment control program requires, prior to construction, the submission and approval of erosion control plans on all projects disturbing one or more acres. On-site inspections are conducted to determine compliance with the plan and to evaluate the effectiveness of the BMPs which are used. The intent is to offer permanent downstream protection for stream banks and channels from damages caused by increased runoff velocities. If voluntary compliance to the approved plan is not achieved and violations occur, the Land Quality Section will pursue enforcement through civil penalties and injunctive relief. House Bill 448, passed in 1991, authorized the issuance of stop-work orders for violations of the SPCA. This additional enforcement mechanism will help improve the overall performance of the program.

There are a number of local municipal and county erosion and sedimentation control programs in the Lumber River Basin. These local programs are reviewed annually for compliance with the requirements of the Sedimentation Pollution Control Act. The Land Quality Section also conducts educational programs directed toward state and local government officials in order to strengthen the local programs. Persons engaged in land-disturbing activities and interested citizen groups are included in the educational effort.

The Sedimentation Control Commission has delegated to the Division of Highways of the North Carolina Department of Transportation (DOT) the authority to approve erosion and sedimentation control plans for land-disturbing activity conducted by that agency or by other persons under highway contracts with that agency. The DOT sedimentation control program has been reviewed by the Division of Land Resources under the authority of the Sedimentation Control Commission. DOT is required to incorporate more stringent sedimentation controls as specified in the High Quality Water rules. The N.C. Department of Environment, Health, and Natural Resources (NCDEHNR) has established a position to evaluate environmental aspects of DOT highway projects and programs. DOT, in cooperation with DEM, has developed and adopted formal BMPs for protection of surface waters. These BMPs and other efforts are significant improvements in developing a proactive system at DOT toward environmental issues.

Sedimentation control rules remain in effect for High Quality Waters (HQW). These rules require more stringent erosion control measures for projects draining to HQWs.

5.3.4 On-Site Wastewater Disposal - Sanitary Sewage Systems NPS Program

Septic tank soil absorption systems are the most widely used method of on-site domestic wastewater disposal in North Carolina. More than 52 percent of all housing units in the state are served by septic tank systems or other systems besides public or community sewage systems. A conventional septic system consists of a septic tank, a distribution box or equivalent branching lines, and a series of subsurface absorption lines consisting of tile or perforated pipes laid in a bed of gravel.

All subsurface sanitary sewage systems are under the jurisdiction of the Commission for Health Services (CHS) of the Department of Environment, Health, and Natural Resources. The CHS establishes the rules for on-site sewage systems which are administered by the Division to Environmental Health.

According to GS 130A-335(e) and (f), the rules of the CHS and the rules of the local board of health shall address at least the following: sewage characteristics; design unit; design capacity; design volume; criteria for the design, installation, operation, maintenance, and performance of sanitary sewage collection, treatment, and disposal systems; soil morphology and drainage; topography and landscape position; depth to seasonally high water table, rock, and water impeding formations; proximity to water supply wells, shellfish waters, estuaries, marshes, wetlands, areas subject to frequent flooding, streams, lakes, swamps, and other bodies of surface or groundwaters; density of sanitary sewage collection, treatment, and disposal systems in a geographical area; requirements for issuance, suspension, and revocation of permits; and other factors which affect the effective operation in performance of sanitary sewage collection treatment and disposal systems. The rules also must provide construction requirements, standards for operation, and ownership requirements for each classification of sanitary systems of sewage collection, treatment, and disposal in order to prevent, as far as reasonably possible, any contamination of the land, groundwater, and surface waters.

There exists a strict permitting procedure which regulates site selection, system design, and installation of on-site sewage systems. Privately owned subsurface sewage discharging systems are governed by NCDEHNR through local county health departments. Authorized local sanitarians serve as agents of NCDEHNR and assist in implementing the state sewage rules. Local boards of health may adopt by reference the state rules and append to those rules more stringent laws and local criteria which they desire. These amendments, however, must be approved by the state. Only nine counties in the state currently operate under local rules. The 1983 amendments of the state public health laws eliminated the co-mingling of state rules with local rules except by state approval.

5.3.5 Solid Waste Disposal NPS Programs

- **Federal Program**

  The major federal legislation in the area of solid waste management is the Resource Conservation and Recovery Act (RCRA) administered by the U.S. Environmental Protection Agency (EPA). RCRA deals almost entirely with hazardous waste management but it does require that states meet minimum standards for solid waste facilities. EPA does not have permitting authority over solid waste management facilities.

- **State Program**

  States are accorded a major role in solid waste management by RCRA. North Carolina now operates under revisions by the General Assembly to Chapter 130A of the General Statutes. The Division of Solid Waste Management (DSWM) in the Department of Environment Health and Natural Resources (NCDEHNR) is authorized as the single state agency for the management of solid waste. DSWM is responsible for the development of the state's solid waste management plan, has permitting authority over all solid waste management facility siting and operation, inspects permitted facilities, provides technical assistance, investigates complaints, responds to emergencies, monitors ground water quality at facilities, promotes the state's recycling effort, and closes non-conforming sites.

  The Solid Waste Management Act of 1989 established the policies and goals of the state to recycle at least 25 percent of the total waste stream by January 1, 1993. This Act created a Solid Waste Management Trust Fund to promote waste reduction and fund research and demonstration projects to manage solid waste. In 1991, the Solid Waste Management Act of 1989 was amended to broaden the goal to reduce the solid waste stream by 40 percent through source reduction, reuse, recycling, and composting by June 30, 2001.

  The state adopted solid waste management rules, effective February 1, 1991, requiring liner, leachate collection, and final cover systems at all new landfills, lateral expansions of existing landfills, and at all active landfills by January 1, 1998. Septage rules and regulations also have been adopted and are administered through a permit program.

- **Local Program**

  Solid waste collection and disposal has long been a municipal function. The operation of solid waste collection and disposal facilities is among the enterprises which municipalities are expressly authorized by statute to operate (G.S. 160A-311 through 160A-321). Municipalities are also authorized to regulate the disposal of solid waste within their corporate limits. Such regulations may specify the location and type of receptacles to be used for collection (G.S. 160A-192).

  Outside municipal limits, counties are authorized to operate solid waste collection and disposal facilities either as a function of county government or through establishment of a special service district (G.S. 153A-292 and 301). Since 1970, county governments have increasingly accepted responsibility for solid waste disposal activities and most disposal facilities in the state are now operated by counties or with county financial assistance.

5.3.6 Forestry NPS Programs

- **Forest Practice Guidelines Related to Water Quality**

  In 1989 the Sedimentation Pollution Control Act (SPCA) was amended to limit the forestry exemption to those operations that adhere to forest practice guidelines. The forestry amendment to the SPCA required the Division of Forest Resources to develop performance standards known as the Forest Practices Guidelines Related to Water Quality. Guidelines consist of nine performance standards for activities such as maintaining streamside management zones and applying fertilizer and pesticide applications. These Guidelines are used to determine if a forestry operation will fall under the jurisdiction of the Division of Land Resources which enforces the SPCA. The Guidelines were developed in October 1989 and were put into effect on January 1, 1990. A Memorandum of Agreement was also signed between the Division of Forest Resources and the Division of Land Resources to coordinate their respective activities in the sedimentation control program. DLR has also signed an MOA with DEM.

Site-disturbing forestry activities are being inspected by local DFR personnel as part of a training, mitigation, and monitoring program. Site inspections are conducted when a problem or potential problem is suspected to exist. Sites not brought into compliance within a reasonable time schedule are referred by DFR to DLR or DEM for appropriate enforcement action.

- **National Forest Management Act (NFMA)**
  The National Forest Management Act was passed in 1976 and applies to all lands owned or administered by the National Forest System. The Act stipulates that land management plans be prepared which consider economic and environmental aspects of forest resources. The Act further states that timber will be harvested from National Forest lands only where soil, slope, or other watershed conditions will not be irreversibly damaged; and where protection is provided for streams, streambanks, shorelines, lakes, wetlands, and other bodies of water from detrimental changes in water temperatures, blockages of watercourses, and deposits of sediment, where harvests are likely to seriously and adversely affect water conditions or fish habitat.

- **Forest Stewardship Program**
  The Division of Forest Resources initiated the Forest Stewardship Program in 1991 along with the cooperation and support of several other natural resource and conservation agencies. This program encourages landowners with ten or more acres of forestland to become involved and committed to the wise development, protection and use of all natural forest resources they own or control.

5.3.7 Mining NPS Program

In 1971, the General Assembly passed the Mining Act to ensure that the usefulness, productivity, and scenic values of all land and waters involved in mining will receive the greatest practical degree of protection and restoration. The Mining Commission is the rule-making body for the Act and has designated authority to administer and enforce the rules and regulations of the Act to the Mining Program within the Land Quality Section of the NCDEHNR Division of Land Resources.

The Mining program has four major areas of responsibility. First, the Program requires submission and approval of a mining permit application prior to initiating land disturbing activity if the mining operation is one (1) or more acres in surface area. The mining permit application must have a reclamation plan for these operations. Second, the Program conducts on-site inspections to determine compliance with the approved application and whether or not the plan is effective in protecting land and water quality. Third, the program pursues enforcement action through civil penalties, injunctive relief, and/or bond forfeiture to gain compliance when voluntary compliance is not achieved. Finally, the Mining Program conducts educational efforts for mine operators.

5.3.8 Wetlands Regulatory NPS Programs

There are numerous reasons for preserving wetlands, but of special interest within the context of basinwide planning is their role in protecting water quality. Because of their intrinsic characteristics and location within the landscape, wetlands function to protect water quality in a number of ways. These functions include the retention and removal of pollutants, stabilization of shorelines, and storage of flood waters. As indicated in Table 2.1 of Chapter 2, wetlands make up a significant portion of the land cover in the Lumber Basin and form wide borders along most of lower basins streams and estuaries.

Numerous authors have studied the effectiveness of riparian wetland forests for nutrient retention and transformation (Jones et al. 1976; Yates and Sheridan 1983; Brinson et al. 1984; Lowrance et al. 1984; Peterjohn and Correll 1984; Jacobs and Gilliam 1985; Budd et al. 1987; and Groffman et al. 1991). The location of riparian wetlands allows them the opportunity to receive nutrients from the surrounding landscape as well as through overbank flooding. In addition to the storage of nutrients in wetland vegetation, the microbial and chemical processes within wetland soils may function to completely remove nutrients from the system.

Headwater riparian wetlands are the most important wetland in terms of sediment and associated nutrient and toxicant retention. Since small stream comprise most of the total stream length within a watershed (Leopold 1974), these areas intercept the greatest proportion of eroded sediments and associated substances from uplands before these pollutant reach waters downstream. Novitzki (1978) found that approximately 80% of the sediments entering a stream were retained in headwater wetlands.

Wetlands adjacent to streams, rivers and lakes stabilize shorelines and help protect these bodies of water from erosive forces. This function is particularly important in urbanized watersheds where the prevalence of impervious surfaces contributes to greater peak storm flows. Wetland vegetation serves to dissipate erosive forces and anchors the shoreline in place preventing sediments and associated pollutants from entering waterways. Wetlands by their very nature of being "wet" are also vital for water storage. Those wetlands adjacent to surface waters, that have the opportunity to receive flood waters and surface runoff, are most important to water storage. Wetlands located in headwaters generally desynchronize peaks in tributaries and main channels, and lakes and wetlands with restricted outlets hold back flood waters and attenuate flood peaks (Carter et al. 1978).

Several important state and federal wetland protection programs are described below. In addition to the following wetlands programs, provisions of the 1985 and 1990 Farm Bills, discussed in Section 5.3.1, should also help reduce wetlands impacts. Agriculture conversions should be reduced by the "swampbuster" provision of the 1985 Farm Bill, which encourages farmers not to convert wetlands for agriculture in order not to lose their USDA subsidies, loans, and price supports. Silviculture is exempted from the swampbuster provision and therefore, conversion of wetlands for intensive or managed forestry will not receive the benefits of this incentive device. A Wetland Reserve Program was established by the 1990 Farm Bill with the goal of allowing one million acres of prior-converted wetlands to revert back to wetlands by 1995.

- **Section 10 of the Rivers and Harbors Act of 1899**
  This act, administered by the US Army Corps of Engineers, provides the basis for regulating dredge and fill activities in navigable waters of the United States. Originally, this Act was administered to protect navigation and the navigation capacity of the nation's waters. In 1968, due to growing environmental concerns, the review of permit applications was changed to include factors other than navigation including fish and wildlife conservation, pollution, aesthetics, ecology, and general public interest. Activities which may be covered under the Act include dredging and filling, piers, dams, dikes, marinas, bulkheads, bank stabilization and others.

- **Section 404 of the Clean Water Act**
  The U.S. Army Corps of Engineers administers a national regulatory program under Section 404 of the Clean Water Act aimed at controlling the discharge of dredged or fill

material into waters of the United States. Section 404 applies to just the discharge of dredged or fill materials into waters of the United States and does not apply to dredging activities. Waters of the United States refers to navigable waters, their tributaries, and adjacent wetlands. Activities covered under Section 404 include dams, dikes, marinas, bulkheads, utility and power transmission lines and bank stabilization. Although the 404 program does not fully protect wetlands, it is nonetheless the only federal tool at this time for regulating wetland development statewide. State legislation has not been adopted to protect inland freshwater wetlands in North Carolina, as has been done for coastal wetlands, but DEM is in the process of drafting rules which will formalize the wetlands protection measures associated with the 401 Water Quality Certification review process.

- **Section 401 Water Quality Certification (from CWA)**
  The Division of Environmental Management is responsible for the issuance of 401 Water Quality Certifications (as mandated under Section 401 of the Clean Water Act). A 401 certification is required for the discharge of pollutants into surface waters and wetlands for projects that require a section 404 federal permit. The 401 certification indicates that the discharged pollutant will not violate state water quality standards. A federal permit cannot be issued if a 401 certification is denied. The 401 certification process is coordinated with the 404 and CAMA processes in the 20 counties of CAMA jurisdiction.

- **North Carolina Coastal Area Management Act (CAMA) 0f 1974**
  This act is aimed at controlling development pressures in North Carolina's coastal region in order to preserve the region's economic, aesthetic and ecological values. The program, which applies to 20 coastal counties, is administered by the NC Division of Coastal Management under the oversight of the Coastal Resources Commission (CRC), a 15-member board. Part of the CRC's responsibility is the identification of Areas of Environmental Concern (AEC). These areas are regarded as sensitive and productive coastal lands and waters where uncontrolled development might cause irreversible loss of property, public health, and the natural environment. Four categories of AEC are defined: 1) the estuarine system, 2) the ocean system, 3) public fresh water supplies and 4) natural and cultural resource areas. AECs cover practically all coastal waters and three percent of the land in coastal counties.

  Under CAMA, permits are required for projects that may cause damage to Areas of Environmental Concern (AECs). A permit program was established to protect AECs based on standards that guide development. CAMA permits require an obligation to meet the CRC's development guidelines. Permits are revoked if these guidelines are not followed and fines can be levied if the development has harmed the state's coastal resources. A joint permitting process allows a CAMA-permitted project to simultaneously receive a Section 404 permit. The 401 certification process is coordinated with the 404 and CAMA processes in the 20 counties of CAMA jurisdiction. There is a joint application form, joint public notice, and a single place to apply for the required permits.

  Any proposed project requiring federal permits or authorization in the 20 coastal counties are reviewed by the Division of Coastal Management for consistency with the Coastal Management Program (as mandated by the U.S. Coastal Zone Management Act of 1972). Generally, major federal permits reviewed for consistency are Section 10 of the Rivers and Harbors Act, Section 404 of the Clean Water Act, and U.S. Coast Guard permits for bridge and causeway construction and modification over navigable waters.

- **North Carolina Dredge and Fill Act (1969)**
  This act requires permits for "excavation or filling begun in any estuarine waters, tidelands, marshlands, or state-owned lake". This law is currently administered with North Carolina's Coastal Area Management Act (CAMA) (1974).

5.3.9 Hydrologic Modification

Hydrologic modification is defined as channelization, dredging, dam construction, flow regulation and modification, bridge construction, removal of riparian vegetation, streambank modification/destabilization, and dam collapse. By its very nature hydrologic modification is closely tied to wetland issues. It is not surprising then that the U.S. Army Corps of Engineers (Corps) is the agency most involved in issuing permits for land-disturbing activities in wetlands. These permits are issued through Section 404 and the Rivers and Harbors Act discussed above.

In addition to wetland issues, dam construction and the lack of low flow releases into streams can severely impact downstream aquatic resources. Dam construction, repair, modification, and removal are regulated by the NC Division of Land Resources under the Dam Safety Law of 1967. A dam safety permit is required for any dam which is 15 feet or greater in height (from top of dam to lowest point on downstream toe) and the impoundment capacity is 10-acre-feet or greater at the top of the dam. Low-flow release requirements to maintain adequate instream flows are established in permits where appropriate. Instream flows are recommended by the NC Division of Water Resources.

There are several other programs which can affect hydrologic modification. The Forest Practice Guidelines Related to Water Quality requires streamside management zones to be maintained during logging operations. The Water Supply Watershed Protection Program also has requirements to maintain buffers for certain activities. The Conservation Reserve Program encourages the establishment of vegetative filter strips (66-99 feet wide) for farming operations. A significant number of local governments have established greenway programs within urban settings in order to maintain and protect riparian areas.

5.4 INTEGRATING POINT AND NONPOINT SOURCE POLLUTION CONTROLS STRATEGIES

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

The U.S. Environmental Protection Agency (USEPA) has developed a means to help accomplish these objectives called *total maximum daily loads (TMDL)*. The TMDL approach, which is being required by the United States Environmental Protection Agency (USEPA) pursuant to Section 303(d) of the Clean Water Act, is based on the concept of determining the total waste (pollutant) loading, from point and nonpoint sources, that a water body (such as a stream, lake or estuary) can assimilate while still maintaining its designated uses (Uses are discussed in Section 2.7).

A TMDL is a strategy for establishing water quality-based controls on point and nonpoint sources of a given pollutant identified as contributing to a waterbody's impairment. In the Lumber basin, biochemical oxygen demand (BOD) is the primary pollutant for which TMDLs are being developed. The TMDL can reflect quantifiable limits to be placed on specific pollution sources or it can be comprised of programmatic strategies (e.g., implementation of nonpoint source best management practices) established to reduce pollutant loadings, in general, throughout the targeted waterbody. The overall goal in establishing the TMDL is to set forth a course of management actions necessary for a waterbody to meet water quality standards.

It should be noted that a targeted water body does not necessarily refer to an entire basin. This is particularly true for the Lumber River Basin which is actually composed of four major watersheds. TMDLs for smaller streams may serve as important elements in a TMDL covering a larger portion of the basin. Nesting of TMDLs in this fashion constitutes a flexible yet comprehensive management approach that allows for specific strategies to be developed for smaller problem areas and yet offers the means to address the large scale problems as well.

As DEM's abilities to quantify and predict the impacts of point and nonpoint source pollution become more sophisticated, the basinwide approach will make more innovative management strategies possible. Possible strategies that might be considered in future Lumber Basinwide Plans or in the plans for basins that come up later in this first five-year cycle include agency banking, pollution trading among permitted dischargers, industrial recruitment mapping and consolidation of wastewater discharges.

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

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CHAPTER 6

BASINWIDE GOALS, MAJOR WATER QUALITY CONCERNS AND RECOMMENDED MANAGEMENT STRATEGIES FOR THE LUMBER BASIN

6.1 BASINWIDE MANAGEMENT GOALS

The long-range goal 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 Lumber Basin's surface waters. In striving towards the long-range goal stated above, NCDEM's highest priority near-term goals will be as follows:

- identify and restore the most serious water quality problems in the basin (**Section 6.2.1**)
- protect those waters known to be of the highest quality or supporting biological communities of special importance (**Section 6.2.2**)
- manage problem pollutants, particularly biological oxygen demand, in order to correct existing water quality problems and to ensure protection of those waters currently supporting their uses (**Sections 6.2.3, 6.3, 6.4, 6.5, 6.6 and 6.7**)

To assist in achieving these goals, DEM has identified a special need in the Lumber Basin of conducting a long-term study on swamp systems. The Coastal Plain portion of the Lumber River Basin consists of primarily swamp-like water bodies where the natural conditions, particularly dissolved oxygen concentrations, pH and temperature, may fluctuate greatly. Due to these fluctuations, the waste assimilative capacity of a swamp can vary significantly making it difficult to predict with existing computer modeling programs that work on freshwater systems that are more prevalent throughout the rest of the state. This in turn affects NCDEM's abilities to develop specific long-term TMDLs for major streams within the basin. As a result, NCDEM has identified a need to learn more about the water quality associated with natural swamp conditions. Further study and information gathered on swamps will allow a more definitive plan for long-term growth within this basin. For the purposes of this five-year plan, therefore, the point source-related pollution management strategies set forth in this document are directed at maintaining waste loadings at present levels to the extent possible. For expanding dischargers, this will generally mean allowing flow expansions but upgrading treatment in order to maintain present permitted loadings. For new facilities, advanced secondary or tertiary treatment will be recommended depending on factors such as the location and receiving stream flow of the proposed facility. For nonpoint sources (NPS), NPS-related water quality impacts will be identified, and NCDEM will work with the appropriate lead agencies to control these sources as appropriate.

6.2 MAJOR WATER QUALITY CONCERNS AND PRIORITY ISSUES

6.2.1 Identifying and Restoring Impaired Waters

Impaired waters are those rated in Chapter 4 as partially supporting or not supporting their designated uses based on either evaluated or monitored water quality data described in Section 4.7. A list of those impaired freshwater streams has been compiled in Table 6.1. The table includes the

Table 6.1 Management Strategies for Impaired Freshwater Streams in the Lumber River Basin

Subbasin	Name of Stream	Use Rating	Source	Planned Management Strategy
30750	Quewhiffle Creek	PS		Sw Study, IS, CEP
30751	Gum Swamp	PS		Sw Study, IS, CEP
	Back Swamp	PS	NP	Sw Study, IS, CEP
	Jacob Swamp	PS	NP	Sw Study, IS, CEP
	Porter Swamp	NS	NP	Sw Study, IS, CEP - concentrate on sediment control
	Dunn Swamp	NS	NP	Sw Study, IS, CEP
	Cow Branch	PS	NP	Sw Study, IS, CEP
	Mill Branch	PS	NP	Sw Study, IS, CEP
	Gapway Swamp	PS	NP	Sw Study, IS, CEP
30752	Burnt Swamp	PS		Sw Study, IS, CEP
30753	Buck Branch	PS	NP	Sw Study, IS, CEP
	Crawley Swamp	PS	NP	Sw Study, IS, CEP
	Bear Ford Swamp	PS	NP	Sw Study, IS, CEP
	Bryant Swamp	NS	NP	Sw Study, IS, CEP
30754	Ashpole Swamp	NS	NP	Sw Study, IS, CEP
	Ashpole Swp SR 2258	NS	NP (PS?)	Sw Study, Determine low DO source, CEP
	Hog Swamp	PS	NP (PS?)	Sw Study, Determine low DO source, CEP
	Old Field Swamp	PS		Sw Study, IS, CEP
30755	Little Shoe Heel Creek	PS		Sw Study, IS, CEP
	Jordan Creek	PS	NP	Sw Study, IS, CEP
30756	Buckhead Branch	NS	NP	Sw Study, IS, CEP
	Big Creek	PS	NP	Sw Study, IS, CEP
	Waccamaw River	PS		Sw Study, Fish tissue monitoring, investigate merc.
30757	Waccamaw River	PS		Sw Study, Fish tissue monitoring, investigate merc.
	Muddy Branch	PS	NP	Sw Study, IS, CEP
	Bear Branch	NS	NP	Sw Study, IS, CEP
	Gore Creek (Gore Lake)	NS	NP	Sw Study, IS, CEP
	Gore Branch	PS	NP	Sw Study, IS, CEP
	Toms Fork	PS		Sw Study, IS, CEP
	Monie Swamp	PS	NP	Sw Study,IS (Feedlots and non-irrigated crops?), CEP
	Cawcaw Swamp	PS	NP	Sw Study, IS, CEP
30758	Brown Marsh	PS	NP	Sw Study, Investigate urban runoff, CEP
	Soules Swamp	PS	NP	Sw Study, Investigate urban runoff, CEP
	Pine Log Branch	PS	NP	Sw Study, IS - urban runoff
30759	Shallotte River	NS	NP	HQW, CZARA, IS
	Salt Waters (SA)	PS	NP	Identify Fecal Coliform Sources, CZARA

DEFINITIONS	
PS	Partially Supporting classifed uses
NS	Not Supporting classifed uses
NP	Impairment attributed to Nonpoint Source pollution, though specific sources may not be known.
HQW	Strategy Under High Quality Water Regulation
IS	Investigate Sources - efforts between government agencies to identify sources
Sw Study	Future DEM study to more accurately determine natural vs impacted swamp conditions (Section 6.1)
CEP	Continue existing nonpoint source control programs (Chap. 5) many of which are in initial phases of development and have not reached full implementation and effectiveness (e.g. Farm bill)
CZARA	Coastal Zone Management Act Amendments require NP source control plans to be devised
DO	Dissolved oxygen - impaired reaches have recorded DO's below 3.0 mg/l

planned water quality management strategies for these waters. In all cases, impairment is either unknown or attributed to nonpoint sources.

Planned Management Strategies fall into two major categories. The first is continuation of ongoing programs that have not yet reached full effectiveness. For example, nonpoint source programs constitute an extremely important set of management strategies and many are in relatively early stages of implementation. These programs, described briefly in Chapter 5 are wide-ranging and are grouped under general nonpoint source categories such as urban development, construction, agriculture, forestry, mining, onsite wastewater treatment and wetlands protection. Agricultural programs such as the NC Agricultural Cost Share Program, which provides farmers with financial assistance to install best management practices (BMPs), and the Farm Bill (Food, Agriculture, Conservation and Trade Act of 1990), which among its provisions reduces government funding subsidies for farming on highly erodible land, are examples of potentially effective ongoing programs which should reduce water quality impacts of certain agricultural activities over the long run.

Another example is the Coastal Zone Act Reauthorization Amendments of 1990 (CZARA). In coastal counties including Brunswick County in the Lumber Basin, the federal government, as requrired by these amendments, is requiring the state to develop new coastal nonpoint pollution control programs. Such programs will take time to develop and will require action on the part of local governments, but their eventual implementation should help reduce nonpoint source pollution in these areas. It should be noted that the inland boundary of the CZARA has not yet been determined are could include subbasins and counties further inland than indicated in Table 6.1.

The second category of planned management strategies includes several other initiatives. Where water quality problems have been identified but the source(s) is not evident, investigation of the source(s) will be necessary before any specific actions can be outlined. Water quality monitoring will be an important component of this strategy. Below are discussions of several specific impaired stream segments.

Quewhiffle Creek has been listed as partially supporting its use. This creek is located in subbasin 03-07-50 and is a tributary to Drowning Creek. Since sampling began in 1984, Carolina Galvanizing has ceased its discharge, although the stream still remains in fair condition. Further improvements may occur as any residual effects from Carolina Galvanizing are gradually eliminated from the system. Future sampling and subsequent rating techniques may use other criteria being developed to give a more appropriate rating for swamp-like streams.

The results from sampling at the station (SR 1500) on Porter Swamp has indicated that the Swamp is not supporting its use. Porter Swamp is located in subbasin 030751 and drains into the Lumber River near the Town of Fair Bluff. A poor rating has been given to this stream segment with the causes being nonpoint and point sources. The West Columbus High School has been listed as the point source and this discharge has since been removed. Sampling in the future should evaluate for stream recovery.

Hog Swamp (located in subbasin 03-07-54) is rated as partially supporting its use. Hog Swamp feeds into Ashpole Swamp which has recorded low dissolved oxygen values (down to 1.0 mg/l). The causes of these low values are not obvious. The Fairmont WWTP discharge is located on Hog Swamp, but the dominant taxa in the samples are not characteristic of streams affected by sewage. The Fairmont WWTP discharges into this swamp but it is possible that the index used was not appropriate for swamp-like systems.

Monie Swamp is also located in Subbasin 03-07-57. This swamp has been given a Poor biologic rating from data collected in 1991. Nonpoint sources including non-irrigated crop production and feedlots were listed as causes. Further investigation is needed to look at the necessary reduction of these sources to the swamp.

In addition to the streams listed in Table 6.1 and discussed above, there may be other streams that are being impaired but where the degree of impairment is difficult to assess. This is because streams in the Coastal Plain portion of the Lumber River Basin, as noted in section 6.1, have unique qualities which set them apart from typical Piedmont or mountainous streams. Their characteristics are swamp-like, and normal conditions would seem to violate North Carolina water quality standards. A good example is the Lumber River mainstem downstream from Lumberton where DO concentrations approach 3 mg/l. This is considerably lower than the rest of the river's mainstem and is well below the state standard of 5 mg/l, but it is difficult to determine to what extent these low DO concentrations are natural or should be attributed to point source discharges of oxygen-demanding wastes located just upstream. This issue has prompted the need for a study of water quality in swamp waters. The need for management of point source discharges for low DO is noted in section 6.2.3 and is discussed more fully in section 6.3.1.

Grissett Swamp offers another example of the difficulty of assessing the ecological integrity of a swamp environment. Swamp waters are being assessed using techniques applied to Piedmont and mountain streams. Grissett Swamp received a Poor biological index rating in 1991, but that rating was discounted because of the low stream flow conditions in the swamp. In 1992, a Good fish community rating was determined. The stream received an overall use support rating of support-threatened (not impaired). The problems of applying the biotic index used in other fresh waters to swamp waters has been under review by DEM for the past two years. Once this study has been completed, use of a macrobenthic sampling index that has been fine-tuned to swamp conditions should provide more appropriate and useful information when evaluating swamps in the future.

6.2.2 Identification and Protection of High Resource Value or Biologically Sensitive Waters

Waters considered to be biologically sensitive or of high resource value may be afforded protection through reclassification to HQW (high quality waters), ORW (outstanding resource waters) or WS (water supply), or they may be protected through more stringent NPDES permit conditions. Waters eligible for reclassification to HQW or ORW (see Appendix I) may include those approved for commercial shellfish harvesting (SA), designated primary nursery areas, designated critical habitat for threatened or endangered species (as designated by the NC Wildlife Resources Commission), waters having excellent water quality or those used for domestic water supply purposes (WS I and II). The HQW, ORW and WS classifications generally require more stringent point and nonpoint source pollution controls than do basic water quality classifications such as C or SC. Special protection requirements for ORW, HQW and WS surface water classifications are discussed in Section 2.7 of Chapter 2, and excerpts from the state's rules on classifications and water quality standards (15A NCAC 2B .0200) that pertain to these waters are presented in Appendix I. A map of HQWs, ORWs and the Lockwoods Folly management area is presented in Figure 2.8 of Chapter 2.

Designated HQWs in the Lumber River Basin include the following streams: 1) Drowning Creek from its source to the Lumber River including tributaries upstream from the confluence with Naked Creek plus Horse Creek and Deep Creek; 2) the Lumber River mainstem from its origin in Scotland County to the Highway 301 bridge at Lumberton; 3) Lockwoods Folly River and its tributaries downsteam of Royal Oak Swamp; and 5) Shallotte River and most of the tributaries it drains downstream of Hwy 17 (subbasin 03-07-59) and the Intra-coastal waterway. In addition to the above designations, Horse Creek (a tributary to the HQW section of Drowning Creek) suggests an excellent bioclassification determined from benthos data collected in 1991. Benthic samples collected on Gum Swamp Creek (a tributary which joins Big Shoe Heel Creek and drains into the Little Pee Dee River - subbasin 03-07-55) also suggest an excellent classification for segments of this creek. These two creeks may be considered for a HQW classification. Lake Waccamaw and the Waccamaw River have been nominated for reclassfication to ORW. Results of studies are pending on those reclassifications.

In addition, where waters are known to support state or federally listed endangered or threatened species or species of concern, but where water quality is not Excellent and there is no state-designated critical habitat, consideration will be given during NPDES permitting to minimize impacts to these habitat areas consistent with the requirements of the federal Endangered Species Act and North Carolina's endangered species statutes. Of note is the fact that Lake Waccamaw, in its entirety, and Big Creek, from its mouth at Lake Waccamaw upstream approximately 0.4 mile to the state road 1947 bridge is a federally-designated critical habitat for the federally endangered Waccamaw Silverside (Menida extensa) The federal designation of critical habitat at this location is especially significant because there are only three such critical habitat designations for aquatic endangered species in North Carolina. This area also supports two state-threatened molluscs, the Savannah lilliput and Waccamaw spike. Possible point-source related protection measures may include effluent dechlorination or alternative disinfection, tertiary or advanced tertiary treatment, outfall relocation, backup power provisions to minimize accidental plant spills, and others. The need for special provisions will be determined on a case-by-case basis during review of individual permit applications and take into account the degree of impact and the costs of protection.

6.2.3 Managing Problem Pollutants to Maintain Water Quality Standards and Existing Uses

In addition to restoring impaired waters, protection of other waters which currently meet their standards and are considered supporting of their uses is a basic responsibility of the state's water quality program and a primary goal of basinwide management. Protecting standards and uses rests on DEM's ability to control the causes and sources of water pollution from point and nonpoint sources. Existing point and nonpoint source programs are outlined in Chapter 5. Oxygen-demanding wastes and sediment are the most widespread problem pollutants in the Lumber basin. Metals (primarily mercury), fecal coliform bacteria (in shellfish waters) and nutrients (in lakes and impoundments) are other important pollutants requiring management. Point-source oriented control strategies for oxygen-demanding wastes are further addressed in section 6.3. Nutrients are addressed in section 6.4 and toxic substances (including metals, ammonia and chlorine) are addressed in section 6.5. Sediment control is discussed in section 6.6.

The management strategies outlined below are the results of comprehensive evaluations of all previously summarized data. It is the intention of NCDEM that the following recommendations serve the public of North Carolina for long-term planning purposes. General nonpoint source management strategies are discussed thoroughly in Chapter 5. Point source controls are implemented through limiting wastewater parameters in NPDES permits.

6.3 RECOMMENDED MANAGEMENT STRATEGIES FOR OXYGEN DEMANDING WASTES

Oxygen demanding wastes were described in Chapter 3. BOD and ammonia nitrogen (NH3) are generally the types of oxygen-consuming wastes of greatest concern. Therefore, NPDES permits generally limit BOD5 (or CBOD5) and NH3 in point source discharge effluents to control the effects of oxygen depletion in receiving waters.

In most surface water systems throughout the State of NC, the lowest concentrations of dissolved oxygen usually occur during summertime conditions when temperature is high and streamflow is low. During these periods point source discharges have their greatest impact, while nonpoint input is generally low. Nonpoint loads are typically delivered at high flow during and after storm events, but may have residual effects on water quality through runoff and sediment oxygen demand. Modeling of oxygen-consuming wastes is typically performed under low flow scenarios, accounts for the residual effects of nonpoint sources and is used to establish appropriate NPDES permit limits. Where the residual BOD is significant, management of nonpoint sources to reduce loading is recommended by implementation of best management practices.

Eighty-five percent of the waters in the Lumber River Basin are classified as swamps. There are indications that swamp-like receiving waters have different characteristics than normal flowing Piedmont or mountainous streams. For example, swamps may have critical low dissolved oxygen conditions occurring at times other than during low flow periods as evidenced in Figure 6.5 (A through K). As discussed throughout this section, the critical period for swamps is yet to be determined. A more detailed narrative description of the strategies follows.

Table 6.2 below summarizes the management strategies for oxygen consuming wastes proposed for the Lumber River Basin. The strategies vary to some extent regional stream conditions and can be further fine-tuned on a case-by-case basis. This strategies are discussed in more detail in the following subsections for each watershed and subbasin.

Table 6.2. General Recommended Strategies for Expanding and Proposed Dischargers in the Lumber River Basin

Lumber River Mainstem & Tributaries (other than HQW classifications and zero flow streams) and including Big Shoe Heel Creek and Gum Swamp Creek Watersheds - SUBBASINS 03-07-50 through 03-07-55

1. Expansions:	Increased flows allowed; waste loads to be maintained at existing permitted levels (mass basis).
2. New Facilities:	Facilities will receive limits of 15 mg/l BOD5 and 4 mg/l NH3-N. More stringent limits may be assigned on a case-by-case basis if deemed warranted for protection of water quality standards or maintaining existing uses.

Waccamaw River Watershed - SUBBASINS 03-07-56 through 03-07-58

1. Expansions:	Increased flows allowed; waste loads to be maintained at existing permitted levels (mass basis).
2. New Facilities:	All facilities recommended to receive 5 mg/l BOD5 and 2 mg/l NH3N.

Coastal Area Watershed - SUBBASIN 03-07-59

In waters not subject to HQW management strategies and outside the Lockwoods Folly River Area from Genoes Point to the Intra-Coastal Waterway, waste limits for new or expanding discharges of oxygen-consuming waste will be determined on a case-by-case basis. Dischargers in HQW waters will receive limits in accordance with the Division's Antidegration Policy (15A NCAC 2B .0201). Dischargers in the Lockwoods Folly River Area must meet requirements set forth in 15A NCAC 2B .0219.

6.3.1 Lumber River Watershed (Subbasins 03-07-50 to 03-07-54)

The tributaries in the Lumber River Basin are mostly classified swamps. A Level-B analysis may not be an appropriate tool for evaluation of these systems since it also assumes a steady state, one-dimensional system. Again, critical conditions may not be related to flow. Inadequate flow and water quality data prevent us from checking the relationship between flow and dissolved oxygen in the tributaries. Given the inability to determine assimilative capacity with any degree of accuracy, DEM will initiate studies to develop a better tool to evaluate a swamp system's ability to assimilate waste flow. Since the large influx of flow from a pipe may have a larger impact on these systems than actual treatment levels, DEM will also be investigating the potential for innovative outfall designs which will allow a slower release of effluent to the system. Until these studies are completed, new discharges will not be permitted at limits greater than 15 mg/l BOD5 and 4 mg/l NH3-N (NH3-N may be lower if dilution is low). On occasion more stringent limits may be given if staff believe that adverse impacts will occur or if discharge is to HQW or zero flow stream. Existing facilities will receive existing limits unless they expand. Upon expansion they will receive existing loading (mass basis). The following subbasin summaries further describe point source discharges and areas which are designated HQW where this general strategy does not pertain.

Subbasin 03-07-51 (Lumber River Mainstem)

The Lumber River subbasin 030751 makes up the entire mainstem of the Lumber River. Except for three small discharges (one school, one Department of Corrections, and one municipality) all of the facilities in this basin with oxygen consuming wastes discharge directly to the Lumber River. Below, are listed in order from the upper most segment of the River to the end of the Lumber River in NC, the facilities that discharge to the Lumber River main stem (all of the listed facilities have oxygen consuming wastewater (BOD), but made up of different sources).

FACILITY	LOCATION
West Point Pepperell-Wagram	Lumber River
Laurinburg-Maxton Airport Commission	"
Pembroke WWTP	"
Deep Branch School	"
Alpha Cellulose Corporation	"
West Point Pepperell, Inc.	"
Lumberton WWTP	"

The above facilities, with the addition of the Fairbluff WWTP which discharges to a small UT just above the confluence of the River, were all included in an intensive modeling analysis for the Lumber River. Further discussion on the River strategy is discussed below. The additional facilities located in this subbasin are:

FACILITY	LOCATION
NCDOC McCain Hosp.	Unnamed tributary (UT) to Mountain Cr.
Orrum High School	UT Flowers Swamp
Town of Fairbluff	UT Lumber River

The Lumber River experiences low dissolved oxygen concentrations throughout its course from the West Point Pepperell-Wagram discharge location in Scotland County to the NC/SC border in Robeson County. As part of the evaluation of the River, intensive self-monitoring data have been gathered to help assess the origin of the oxygen consuming matter in the River.

Currently there are six major dischargers on the River. West Point Pepperell-Wagram, Laurinburg/Maxton Airport, and Pembroke all discharge above Lumberton proper; West Point Pepperell, Alpha Cellulose, and Lumberton WWTP discharge below Lumberton proper (Figure 6.1). The three facilities above Lumberton are scattered along the River but below Lumberton the three major facilities are very close together (within 1.5 miles).

Historical DO data (1975 to 1992) show no significant trend in DO concentration (Figure 6.3). Conductivity data since 1982 shows a steady increase over the last 10 years (Figures 6.4). While conductivity is dependent on flow, it exhibits no clear relationship to the dissolved oxygen sag.

Lumber River Basin

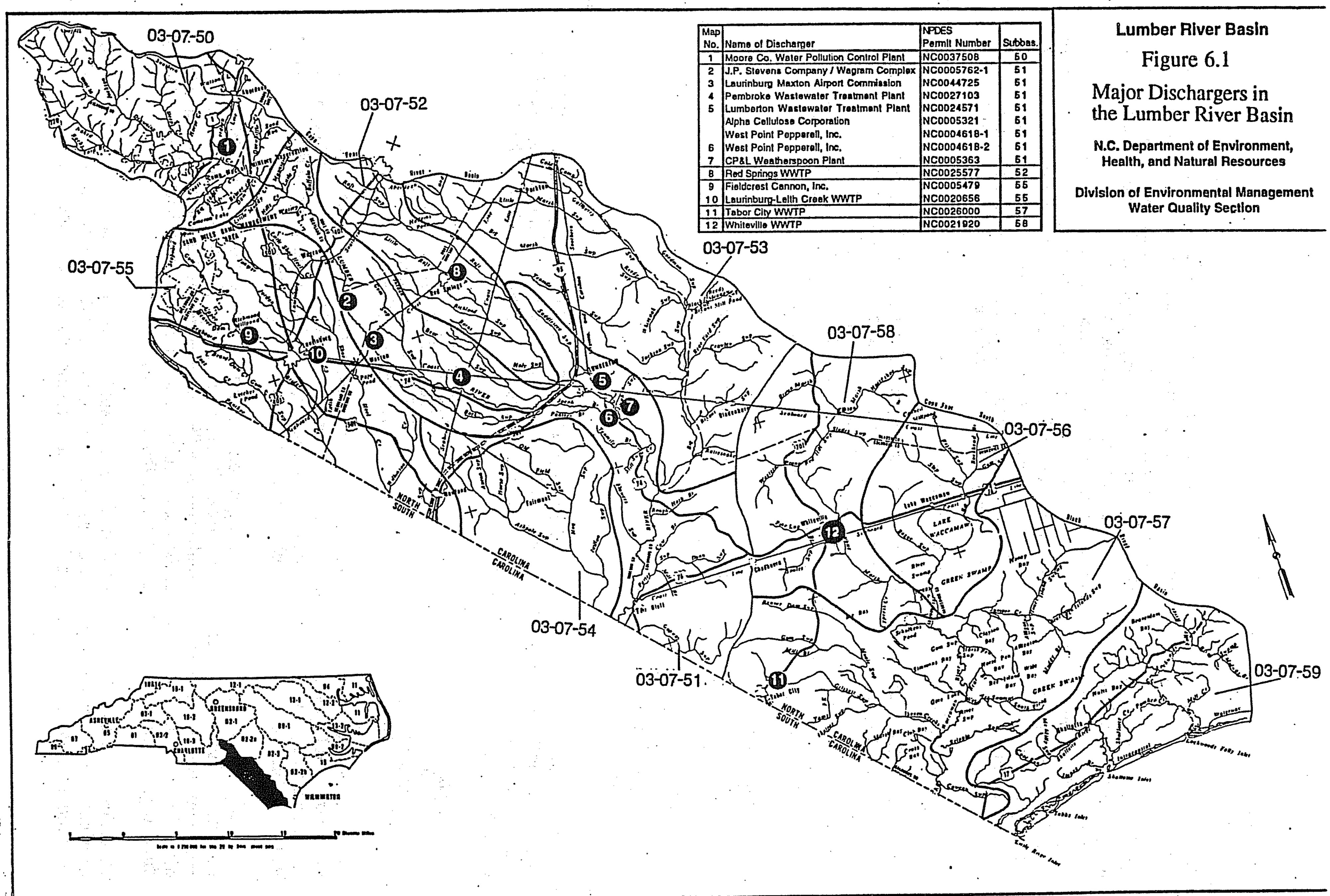
Figure 6.1

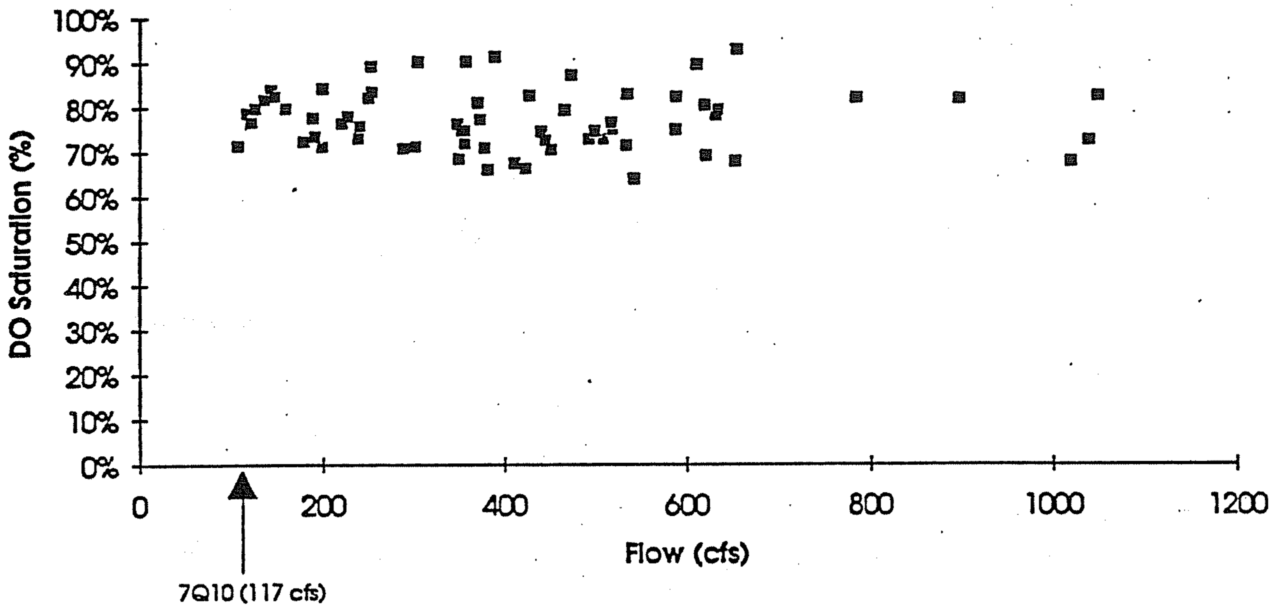
Major Dischargers in the Lumber River Basin

N.C. Department of Environment, Health, and Natural Resources

Division of Environmental Management Water Quality Section

Map No.	Name of Discharger	NPDES Permit Number	Subbas.
1	Moore Co. Water Pollution Control Plant	NC0037508	50
2	J.P. Stevens Company / Wagram Complex	NC0005762-1	51
3	Laurinburg Maxton Airport Commission	NC0044725	51
4	Pembroke Wastewater Treatment Plant	NC0027103	51
5	Lumberton Wastewater Treatment Plant	NC0024571	51
	Alpha Cellulose Corporation	NC0005321	51
	West Point Pepperell, Inc.	NC0004618-1	51
6	West Point Pepperell, Inc.	NC0004618-2	51
7	CP&L Weatherspoon Plant	NC0005363	51
8	Red Springs WWTP	NC0025577	52
9	Fieldcrest Cannon, Inc.	NC0005479	55
10	Laurinburg-Leith Creek WWTP	NC0020656	55
11	Tabor City WWTP	NC0026000	57
12	Whiteville WWTP	NC0021920	58





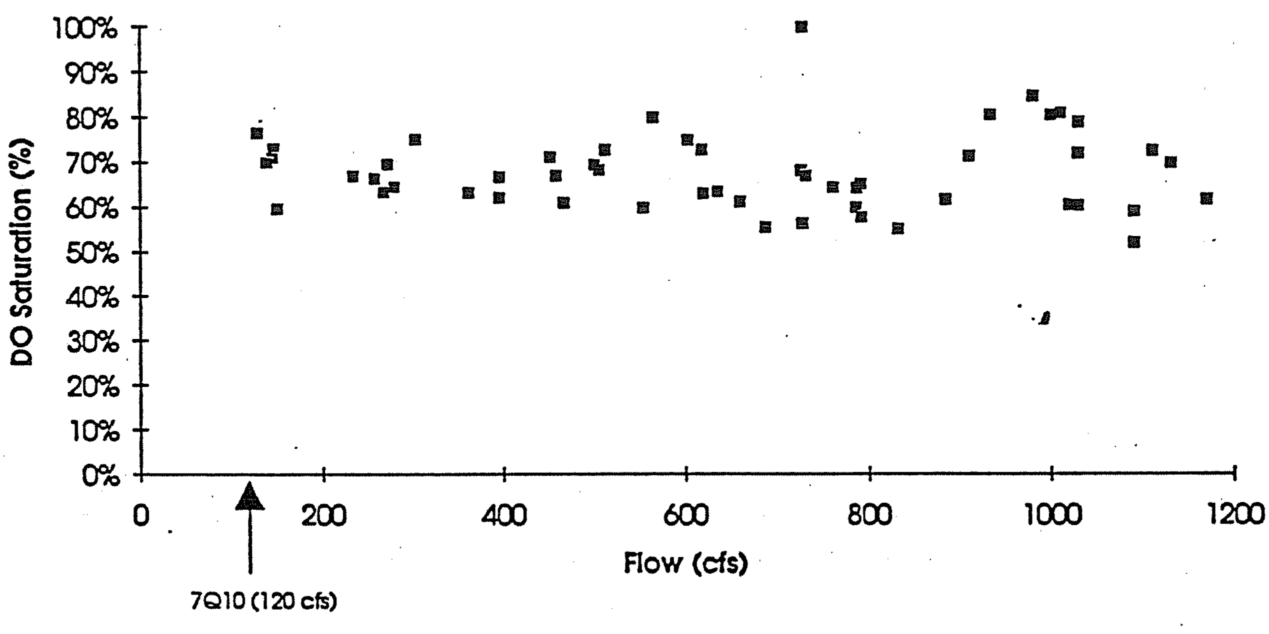
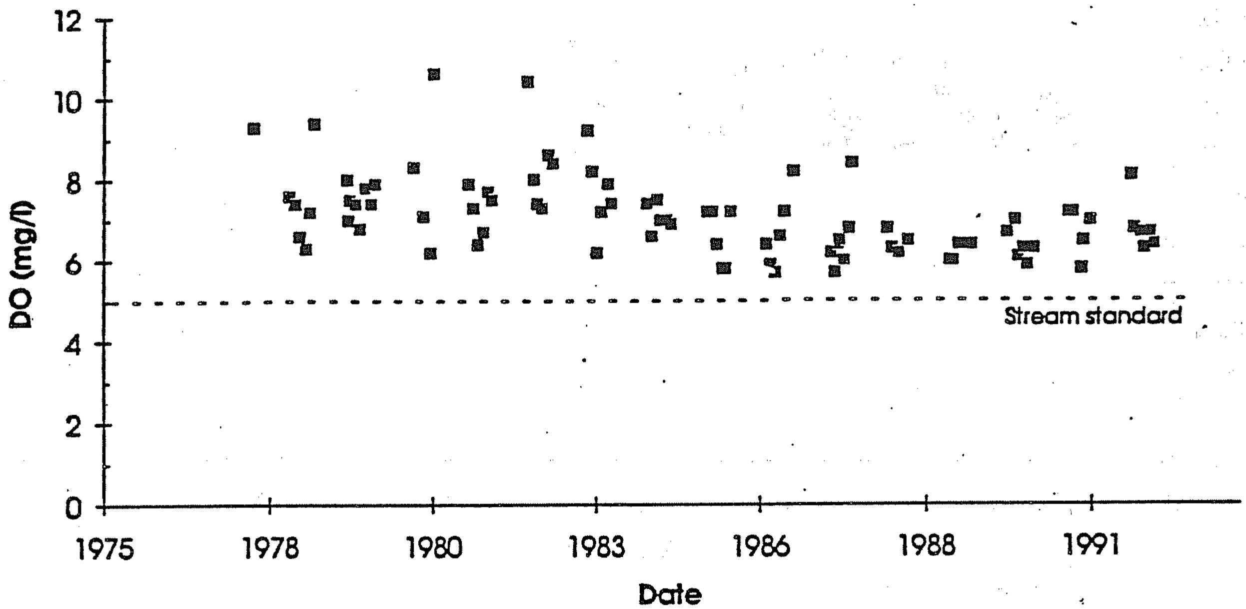


Figure 6.2 Dissolved Oxygen Saturation Versus Flow at Maxton and Boardman Ambient Monitoring Stations - 1987 to 1992 (Lumber River Mainstem)



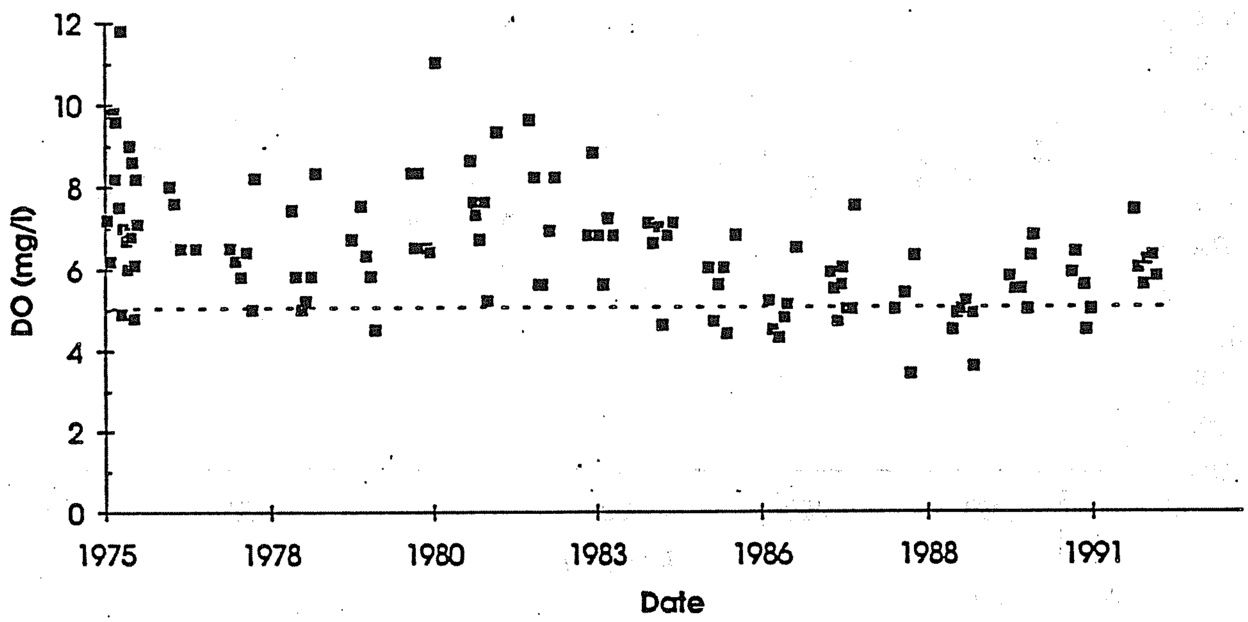
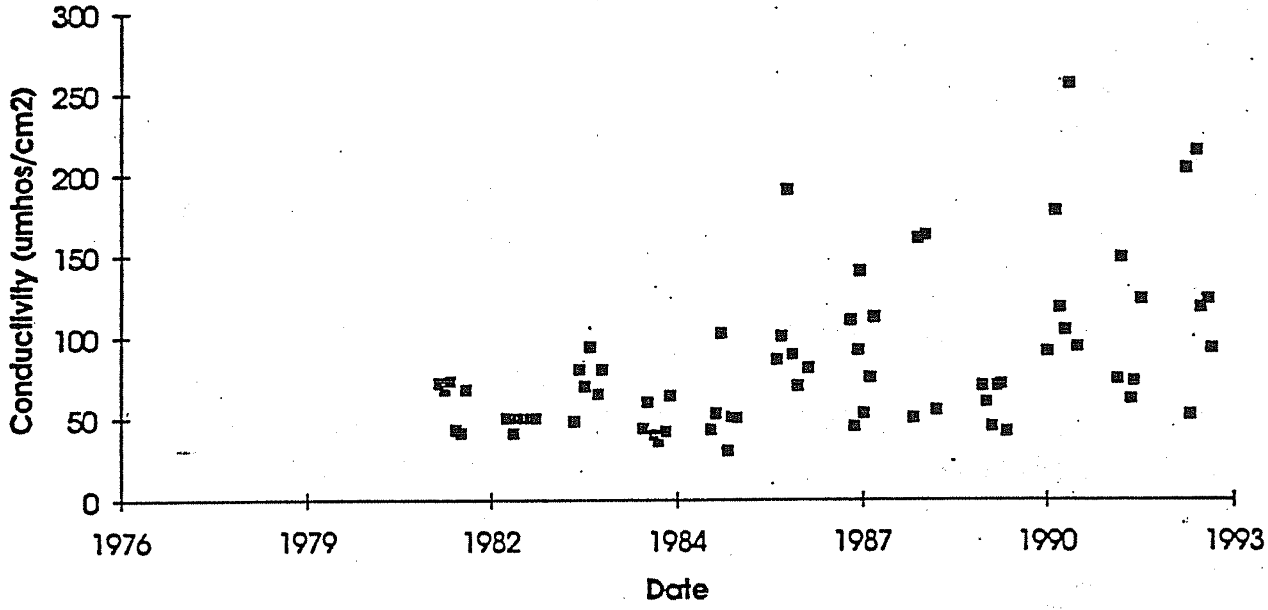


Figure 6.3 Summer Dissolved Oxygen at Maxton and Boardman - 1975 to 1992 (Lumber River Mainstem)



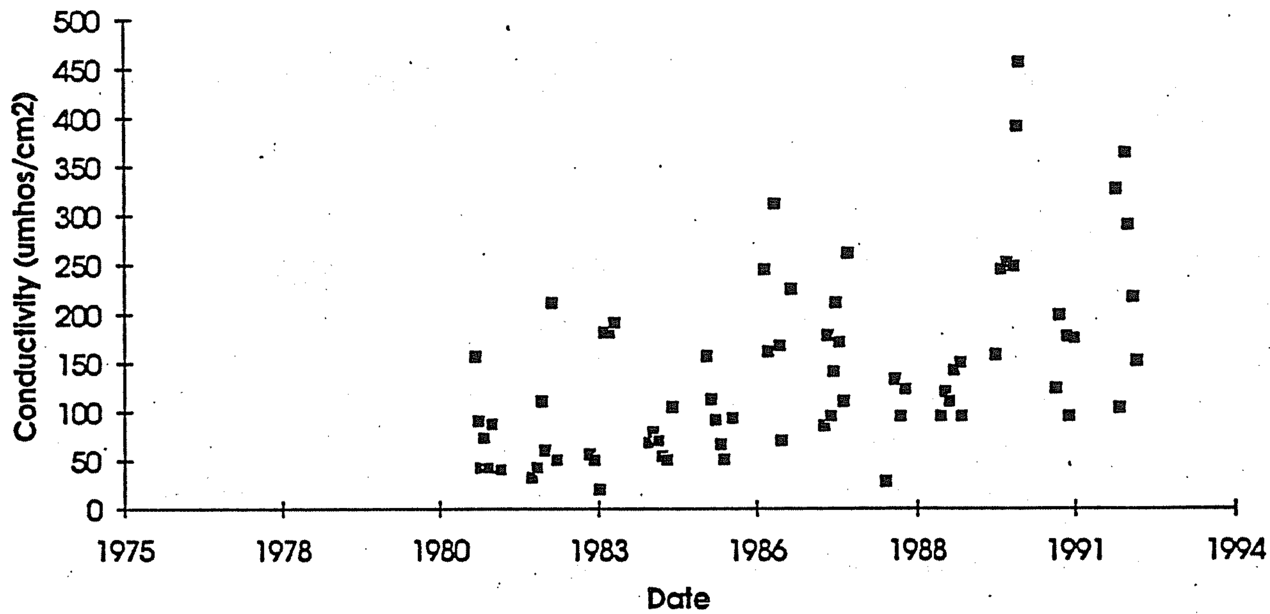
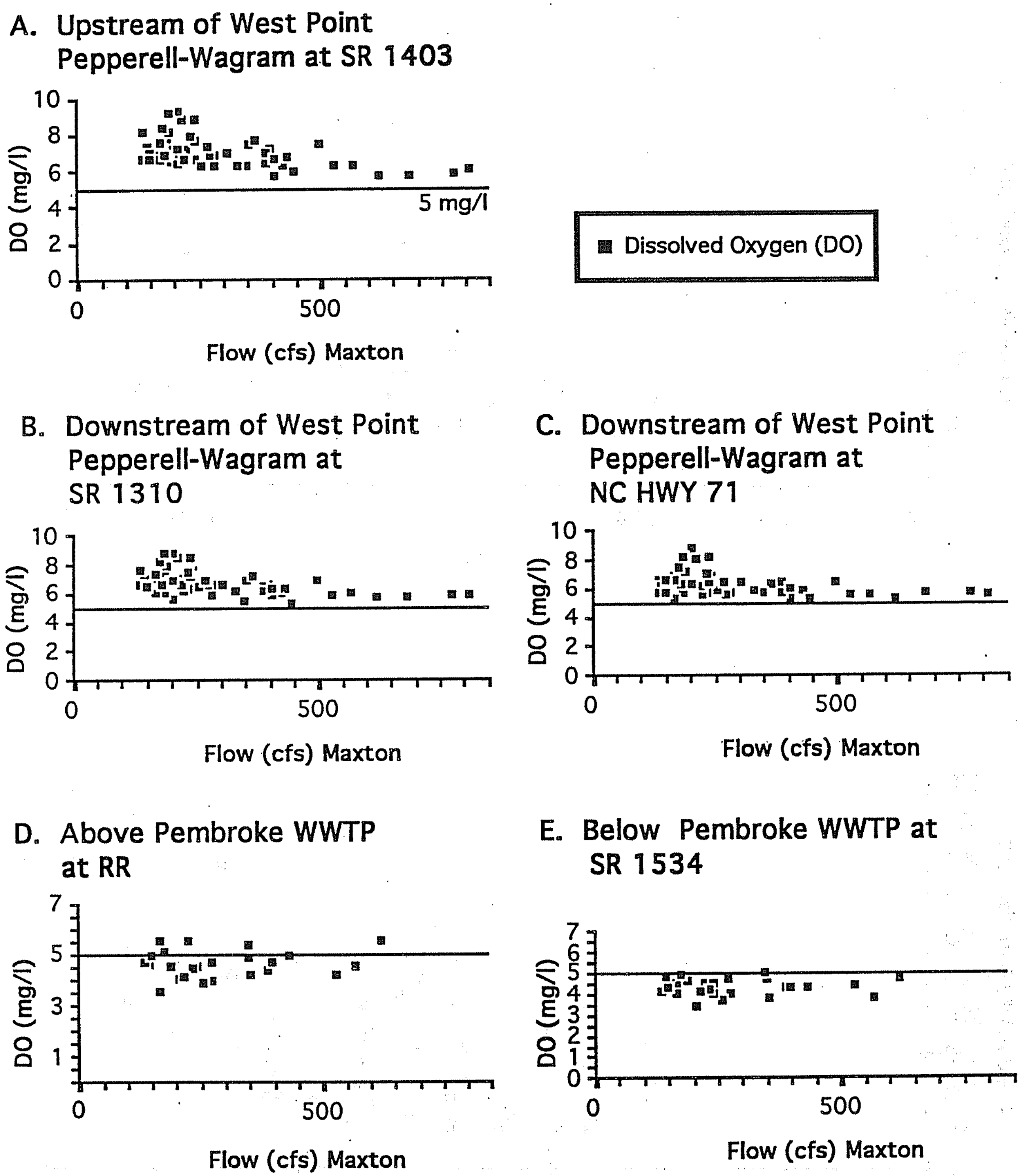


Figure 6.4 Summer Conductivity at Maxton and Boardman 1975 to 1992 (Lumber Mainstem)



Note: JP Stevens is now known as West Point Pepperell-Wagram

Figure 6.5 (A through E) - Lumber River Discharger Self-monitoring Data Summary for Dissolved Oxygen (versus Flows at Maxton) for May through October, 1991

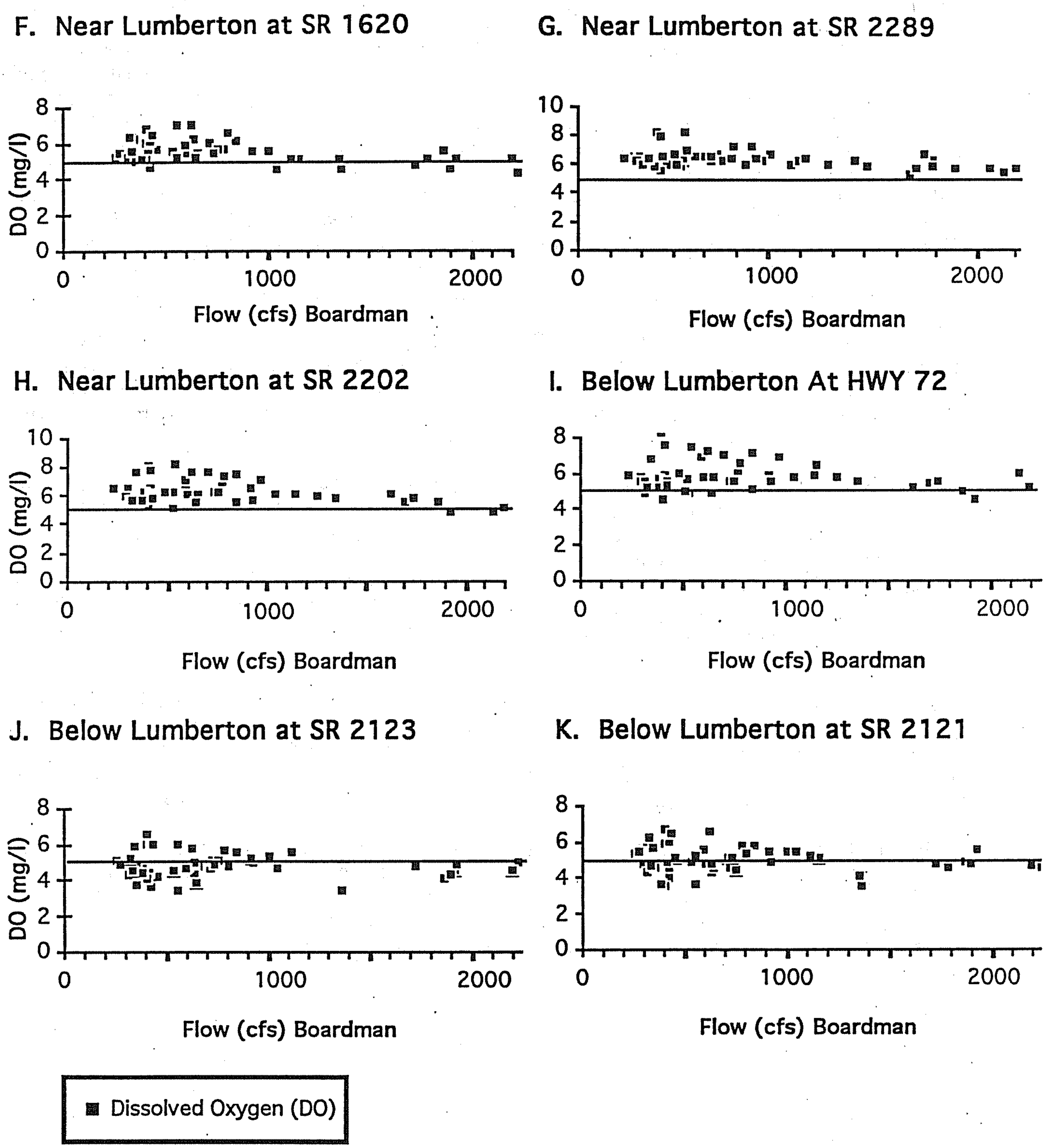


Figure 6.5 (F through K) - Lumber River Discharger Self-monitoring Data Summary for Dissolved Oxygen (versus Flows at Boardman) for May through October, 1991

A QUAL2E model was calibrated for approximately 90 miles of the Lumber River mainstem from the West Point Pepperell-Wagram outfall to the NC/SC border using data gathered from four separate intensive surveys. This model produced DO estimates consistent with the calibration data and predicted a DO sag below the acute value of 3.0 mg/l at 7Q10 conditions. Allocation model runs with existing and permitted conditions revealed that the River had previously been over-allocated. The applicability of the QUAL2E model for wasteload allocation is questionable, however, and under review. Ambient monitoring data (at Maxton and Boardman) and instream self-monitoring data from the Lumber River failed to show a significant relationship between flow and DO. The percent saturation for dissolved oxygen at both ambient stations revealed lower than normal levels (i.e. 90%) not only at low flow events, but at flows up to 10 times the 7Q10 value (Figure 6.2). In fact, instream self-monitoring data at several locations along the River show DOs as low as 3 mg/l at all flow conditions, both in the summer and winter, suggesting that point sources may not have as significant an effect on water quality as first suspected (Figure 6.5).

Based on the historical consistency of DO concentrations over a wide range of flow and temperature conditions, the swampy natural condition of the Lumber River, and the somewhat limited predictive power of the QUAL2E model in swamp waters, it cannot be conclusively determined to what extent point source discharges are impacting instream DO concentrations. Examples of the QUAL2E model's limitations in swamp water are presented below:

1) *QUAL2E is a steady state model.* It is possible and likely that low flow steady state conditions assumed in the model do not represent the critical period for DO in the river system. Dynamic processes such as flow fluctuations, BOD and sediment storage, scouring, and other natural phenomena greatly influence minimum DO values.
2) *QUAL2E is a one dimensional model.* It is possible that lateral (flood plain) processes are important in the Lumber River. An example of such a lateral process could be mixing of deoxygenated waters from the adjacent pools to the mainstem of the river during higher flow situations.

Given the discrepancy of the Lumber River steady-state one dimensional advective flow assumptions and natural swamp-like water quality conditions, it is difficult to base management decisions on the model alone. However, at current low flow conditions, due to the instream waste concentrations (IWC) alone, the discharges are undoubtedly contributing to the DO sag below Lumberton, which approaches 3 mg/l and shows very little room for error in allocations.

In light of these factors, DEM recommends a conservative management approach which limits further BOD waste loading to the river in order to maintain water quality standards and uses but which provides for some expansion of existing facilities and construction of new discharge facilities. Since facilities discharging to the upper Lumber River have a management strategy in place (HQW - see 15A NCAC 2B.0201(d)), DEM recommends that existing wastewater treatment facilities in the Lumber River mainstem below Lumberton receive limits as follows:

Existing Discharges with no expansion => Renew with Same Limits
Expanding Discharges => Recommend Equivalent Loading

Facilities affected by this interim strategy are: West Point Pepperell, Alpha Cellulose and the City of Lumberton. At present, the only request for proposed expansion is the City of Lumberton.

For new dischargers/expansions in the mainstem below Lumberton, the permitting strategy should be handled on a case-by-case basis, but DEM will not recommend limits less stringent than 15 mg/l BOD5 and 4 mg/l NH3-N for a new discharge in these waters. In addition, new discharges may receive more stringent limits based on interactions with surrounding discharges and/or the possibility of a proposed discharge locating to waters that have documented substandard dissolved oxygen values.

Subbasin 03-07-50 (Drowning/Naked Creeks - Upper Lumber Watershed)

This subbasin constitutes the headwaters of the Lumber River mainstem. Drowning Creek and its tributaries drain the entire subbasin. The following dischargers of oxygen-consuming wastes discharge into or close to the receiving waters classified HQW.

FACILITY	LOCATION
Samarkand Manor	Drowning Creek (uppermost headwaters)
Camp Mackall	Drowning Creek
Moore Co. WPC Plant	Aberdeen Creek
Lake Diamond	Deep Creek

The permitting strategy for HQW per NCAC 2B.0201(d)(1) is no increase in permitted loading to the stream. Most facilities in this subbasin will fall under this regulation. New domestic wastewater facilities discharging into HQW classified water will receive limits of 5 mg/l BOD5, 2 mg/l NH3-N, and 6 mg/l DO. No new toxicants will be introduced to waters classified HQW.

Subbasin 03-07-52 (Raft Swamp - Lumber River Watershed)

Raft Swamp is the main stream which drains the entire subbasin of 03-07-52. Two oxygen consuming discharges are located in this subbasin. The Converse discharge through pipe 001 recently began discharging to the Lumberton WWTP. Pipes 002 and 003 are cooling water discharges and remain in Holly Swamp. The characteristics of Little Raft Swamp and Raft Swamp which it feeds into are swamp-like (slow moving with low dissolved oxygen values). The self-monitoring instream data for Little Raft Swamp show extremely low dissolved oxygen (down to 2 mg/l) values above and below the discharge location. In addition, sediment oxygen demand tests were performed on Raft Swamp and revealed very high rates. The permitting strategy in Table 6.1 will apply to this subbasin.

FACILITY	LOCATION
Red Springs WWTP	Little Raft Swamp
Converse Inc.	Holly Swamp

Subbasin 03-07-53 (Big Swamp - Lumber River Watershed)

The Big Marsh Swamp mainstem and its tributaries make up this entire subbasin. Big Marsh Swamp has three dischargers located on its mainstem, but they are not considered interacting. Self monitoring instream data show these receiving waters to be typically swamp-like with low (below 5 mg/l) dissolved oxygen values above and below the discharge location. The permitting strategy in Table 6.1 will apply to this subbasin. The discharges in this subbasin are as follows:

FACILITY	LOCATION
Piedmont Poultry	Big Marsh Swamp
Croft Metals Inc.	Big Marsh Swamp
Saint Pauls WWTP	Big Marsh Swamp
Parkton WWTP	Dunn's Marsh
Bladenboro WWTP	Bryant Swamp
Littlefield High School	Abram Branch

Subbasin 03-07-54 (Ashpole Swamp - Lumber River Watershed)

There is one discharge in the Ashpole Swamp subbasin. The Fairmont WWTP discharge to Pittman Mill Branch goes directly to Old Field Swamp which feeds into Hog Swamp 1.5 miles downstream. Hog Swamp then feeds into Ashpole Swamp approximately 6 miles downstream. Water quality on Hog Swamp and Ashpole Swamp are rated Fair according to benthos data collected in 1991. The Town of Fairmont discharges 100 % domestic wastewater and is treating below the permitted secondary limitations. Since previous ambient data have indicated low dissolved oxygen levels in Ashpole Swamp, it may be beneficial to get self-monitoring instream data at this location. Current instream self-monitoring data instream standards are being maintained (on old Field Sw). The sediment oxygen demand on Ashpole Swamp is high according to data. The permitting strategy in Table 6.1 will apply to this subbasin. The Green Grove Elementary School which discharged to Old Field Swamp has recently gone to a subsurface system.

6.3.2 Little Pee Dee Rivers Watershed (Subbasin 03-07-55)

This subbasin makes up two separate drainage basins: Shoe Heel Creek and Gum Swamp. These two streams join and become the Little Pee Dee River in South Carolina. The facilities located in this subbasin with oxygen consuming wastes are listed below:

FACILITY	LOCATION
Carver Middle School	UT Lower Beaverdam
Spring Industries	Gum Swamp Creek
Fieldcrest Cannon	Gum Swamp Creek
Town of Rowland WWTP	Big Shoe Heel Creek
Maxton WWTP	Big Shoe Heel Creek
NCDOC Scotland Co.	Big Shoe Heel Creek
Laurinburg / Libby-Owen Ford	Big Shoe Heel Creek
Laurinburg-Leith Creek WWTP	Big Shoe Heel Creek
Butler Manufacturing Co.	Shoe Heel Creek

Gum Swamp Creek
Fieldcrest Cannon and Springfield Industries were modeled together using the modified Streeter Phelps (level-b) model. No significant impacts were determined in the analysis. The 7Q10 flow at the location of these discharges is relatively high and therefore the resulting dilution potential is correspondingly high. Current information indicates that Fieldcrest Cannon is shutting down its carpet manufacturing component and reducing its flow. Instream self-monitoring data from Fieldcrest Cannon indicate no instream violation of the DO standard. According to the benthic data collected by ESB, Gum Swamp Creek has the potential to qualify for HQW. If Gum Swamp becomes HQW, then no increase in permitted loading will be allowed for existing dischargers and new dischargers will be required to meet 5 mg/l BOD5, 2 mg/l NH3-N and 6 mg/l DO.

Big Shoe Heel Creek Drainage Area
A modified Streeter Phelps model was updated for the Shoe Heel Creek drainage basin. The model included the following domestic waste dischargers: NCDOC/Scotland Co., Butler Manufacturing, Laurinburg WWTP, Maxton WWTP and Rowland WWTP. Other discharges were not included because they were not considered significant or they were not considered to contribute biochemical oxygen demand. Based on design conditions, the model indicated that the dissolved oxygen standard of 5 mg/l may be violated. However, instream data taken by Laurinburg indicated that during low flow conditions, both up and downstream values sometimes dropped below 5 mg/l. This may be due to the natural conditions of the swampy area of Big Shoe Heel Creek. Further studies need to be performed to establish headwater conditions (above NCDOC) for the model as well as to determine natural conditions of swamp-type areas.

Benthos sites in the lower Big Shoe Heel drainage area indicate excellent to good ratings (ref. ESB). At the Laurinburg WWTP benthos data indicated an impact to Shoe Heel Creek.
Parts of Gum Swamp Creek and all of Big Shoe Heel Creek and the tributaries draining to them are classified swamps.

6.3.3 Waccamaw River Watershed (Subbasins 03-07-56 to 03-07-58)

These basins are made up of streams and rivers that are mostly swamp and have characteristics representing swamp-like systems. The dissolved oxygen concentrations collected from self-monitoring reports of instream data reflect low dissolved oxygen levels above and below discharges (below 1 mg/l in some cases). Existing facilities in some of these basins have been given limits less stringent than 15 mg/l BOD5 and 4 mg/l NH3-N based on previous analyses and recorded substandard DO values. A federally endangered species is also known to occur in the Waccamaw River drainage basin. Therefore, since this system appears to be stressed, new discharges to these subbasins will be required to meet limits of 5 mg/l BOD5 and 2 mg/l NH3-N. The following subbasin summaries further describe the receiving streams.

Subbasin 03-07-56 (Lake Waccamaw - Waccamaw River Watershed)

This subbasin includes Lake Waccamaw and the upper Waccamaw River, which drains the lake. Both the lake and river are being considered for the supplemental classification of ORW. This would affect future and expanding discharges in this subbasin. Specific strategies and limits may be modified if this additional classification is given. Endangered species occur in this subbasin, and special consideration to these waters should be afforded for that reason. However, specific strategies for this consideration are also pending. There are two discharges in this subbasin:

FACILITY	LOCATION
Council Tool Company	UT to Lake Waccamaw
Lake Waccamaw WWTP	UT to Bogue Swamp

Council Tool Company is an industrial discharger which has a general permit for the discharge of non-contact cooling waters. Lake Waccamaw WWTP is a municipality whose effluent is 100% domestic waste. The instream DO values above and below the Lake Waccamaw WWTP are less than 5 mg/l, although not atypical of a swamp stream. The Town of Lake Waccamaw is currently making improvements to its plant under a special order by consent, but it is not increasing its permitted flow. Any future expansions will be in consonance with stated policies.

Subbasin 03-07-57 (Lower Waccamaw River)

This drainage area delineates the lower Waccamaw River watershed excluding the White Marsh drainage area. There are five discharges in this subbasin: one municipality, one resort, and three schools. No clusters of discharges exist in this subbasin, and there would seem to be no chance of regionalization in the near future because of the somewhat isolated location of the non-municipal discharges.

Tabor City WWTP discharges to Town Canal which is a tributary to Grissett Swamp. Benthic macroinvertebrate data collected downstream from this discharge indicated poor water quality. However, it is unlikely that Tabor City is contributing to significant degradation to the water quality at this site given that these results are less reliable in swampy areas, and the diffusive nature of the receiving stream should buffer effects from this point source. Nevertheless, future WLA analyses for the Town of Tabor City should concentrate on toxicants in the discharge.

FACILITY	LOCATION
Tabor City WWTP	Town Canal
Williams Township School	UT to Gum Swamp
Nakina High School	UT to Big Cypress Swamp
Old Dock Elementary School	UT to Gum Swamp Run
Carolina Shores WWTP	UT to Persimmon Swamp

Subbasin 03-07-58 (White Marsh - Waccamaw River Watershed)

This subbasin delineates the White Marsh drainage area. Six of the seven discharges in 03-07-58 are clustered around the Whiteville-Chadbourn area. As a result there may be opportunities for regionalization in the future. The discharges to the White Marsh watershed are:

FACILITY	LOCATION
National Spinning Co., Inc.	UT to White Marsh
Whiteville WWTP	White Marsh
Chadbourn WWTP	Soules Swamp
Georgia Pacific	Juniper Creek
Clarkton WWTP	Brown Marsh Swamp
Intercontinental Branded Apparel	UT to White Marsh
Georgia Pacific	UT to White Marsh

Most of this subbasin is extremely swampy. Strategy for wasteload allocations may be changed as a result of an ongoing project studying discharges to swamps.

6.3.4 Coastal Area Watershed (Subbasin 03-07-59)

This subbasin drains into the Atlantic Ocean through four inlets. Upland areas are drained by Little River, Shallotte River and Lockwoods Folly River. Only one domestic discharge (Bolivia Elementary School) exists in the upper part of the subbasin. Most waters in 03-07-59 are classified SA and/or HQW as indicated in Chapter 2 (section 2.7). There are a number of discharges from mines and seafood houses. Most of these operate periodically and are covered by general permits because they are considered de minimus. The largest municipality in this subbasin is Shallotte which uses a spray field to dispose of its wastewater. Listed below are the dischargers in this subbasin.

FACILITY	LOCATION
Bolivia Elementary School	UT to Bolivia Branch
Captain Pete's Seafood	Intracoastal Waterway
Bellamy's Shrimp House	Intracoastal Waterway
Holden Beach Seafood	Intracoastal Waterway
J.B. Robinson Seafood	Lockwoods Folly River
Robinson & Thompson Seafood	Lockwoods Folly River
Holden Seafood	Shallotte River
Green's Oyster Company, Inc.	UT to Shallotte River
J.P. Russ & Son Mine	Little Saucepan Creek
NCDOT/Towles Pit	UT to Little Saucepan Creek
McQuaig Mine	UT to The Mill Pond
O'Neil Caison Pit	Doe Creek
Suggs Mine	UT to Little Doe Creek

For those parts of Lockwoods Folly and the Shallotte Rivers that are designated HQW, which includes all SA waters, the state's Antidegradation Policy (15A NCAC 2B.0201) will apply to all new or expanding discharges in those areas. In addition, that portion of Lockwoods Folly from between Genoes Point and Mullet Creek to the Intracoastal Waterway is subject to a management plan adopted by the Environmental Management Commission under 15A NCAC 2B.0219 which states that new or expanded NPDES permits will be issued only for non-domestic, non-industrial process type discharges (such as non-industrial process cooling or seafood processing discharges), and that a public hearing is mandatory for any proposed (new or expanding) NPDES permit in this area. New discharges of oxygen-consuming wastes outside the Lockwood Folly River Area and

HQW waters will be dealt with on a case-by-case basis. As implied above, the characteristics of this subbasin represent a sensitive ecosystem. Therefore, since an abundance of point-source discharges of oxygen-consuing wastes have not been evaluated in this subbasin, DEM will recommend that discharge permit applicants perform a special water quality study in the area where their proposed discharge is to be located.

6.4 MANAGEMENT STRATEGIES FOR NUTRIENTS

Control of nutrients is necessary to limit algal growth potential, to assure protection of the instream chlorophyll *a* standard, and to avoid the development of nuisance conditions in the state's waterways. Point source controls are typically NPDES permit limitations on total phosphorus (TP) and total nitrogen (TN). Nonpoint controls of nutrients generally include best management practices (BMPs) to control nutrient loading from areas such as agricultural land and urban areas.

6.4.1 Assimilative Capacity

The Lumber River basin does not have a large nutrient problem. There are not any nutrient sensitive streams but there are a few eutrophic ponds. The conditions of these ponds cannot be directly attributed to point source dischargers and are considered to be nonpoint source related.

6.4.2 Control Strategies

Subbasin 03-07-50 (Drowning/Naked Creek - Lumber River Watershed)

One lake has been sampled in this subbasin for chlorophyll *a* and that is Pages Lake. There are no point source discharges in or upstream of the lake. Therefore, the source of exceeded nutrients is thought to be urban runoff in the upper watershed in this basin. Implementation for controlling nutrients in Pages Lake should take place in conjunction with DEM's storm water regulations.

Subbasin 03-07-53 (Big Swamp - Lumber River Watershed)

One pond from this subbasin, Sealy Pond, was monitored for phytoplankton in July, 1991 since an algal bloom was noted. No point source discharge is attributed to the bloom and it is thought to be from agricultural runoff

Subbasin 03-07-55 (Little Pee Dee Headwaters Watershed)

Algal bloom conditions were found in three ponds sampled in this subbasin - John's Pond, Dunn's Pond, and Maxton Pond. John's Pond located on Leiths Creek was found to be hypereutrophic and Maxton Pond was found to be eutrophic. The Laurinburg WWTP is located upstream of Maxton Pond on Shoe Heel Creek, but it is unknown whether the discharge is contributing to the eutrophication. It is assumed that all three of these ponds are influenced by non-point sources and should undergo further monitoring and control by agencies controlling non-point sources.

Subbasin 03-07-56 (Lake Waccamaw - Waccamaw River Watershed)

The canals around the northern and western shores of Lake Waccamaw have been documented to have high concentrations of aquatic weeds, sediment and nutrients. Some of the problems were related to exfiltration of sewage from the Lake Waccamaw collection system. A ten-inch force main was replaced recently, but continuing problems with overflowing lift stations have been targeted for improvements through issuance of an SOC. Monitoring should continue to determine if water quality improves as a result of these improvements.

6.5 TOXIC SUBSTANCES

6.5.1 Assimilative Capacity

Toxic substances, or toxicants, routinely regulated by NCDEM include metals, organics, chlorine and ammonia. These are described in Chapter 3.

The assimilative capacity, that is the amount of wastewater the stream can assimilate under designated flow conditions (7Q10 for aquatic life based standards, average flow for carcinogens), available for toxicants in the Lumber Basin varies from stream to stream. In larger streams where there is more dilution flow, there is more assimilative capacity for toxic dischargers. In areas with little dilution, facilities will receive chemical specific limits which are close to the standard. Toxics from nonpoint sources typically enter a waterbody during storm events. The waters need to be protected from immediate acute effects and residual chronic effects. A review of the ambient station data in the Lumber River Basin indicates that there are no significant problems occurring for toxicants within any one subbasin. Most ambient stations where metals data is collected, show levels of copper, zinc and iron above detection and in some cases above the designated action level instream. Action levels are not limited in the effluent unless the facility has a federal guideline limit for the parameter or if the facility is failing toxicity and the cause is known to be the substance regulated by the action level.

6.5.2 Control Strategies

Point source dischargers will be allocated chemical specific toxic substance limits and monitoring requirements based on a mass balance technique discussed in the Instream Assessment Unit's Standard Operating Procedures manual and in Appendix III of this report. Whole effluent toxicity limits are also assigned to all major dischargers and any discharger of complex wastewater.

Nonpoint source strategies to be implemented through the industrial NPDES stormwater program should also be helpful in reducing toxic substance loading to surface waters. Industries are being required to control runoff from their sites and to cover stockpiles of toxic materials that could pose a threat to water quality.

Subbasin 03-07-51

Ambient data show that copper has exceeded the action level instream five times with 13 samples taken in the last five years at the Lumber River Maxton Station. This location is near the Laurinburg/Maxton Airport Commission, which has been in compliance with its toxicity limit although the DMR data show high levels of copper in the effluent.

Subbasin 03-07-56

Elevated levels of mercury have been found in fish tissue samples collected in this subbasin. Fish tissue samples were collected on Big Creek near the mouth of Lake Waccamaw and Lake Waccamaw near the Wildlife Boat Ramp. There is no known point source which could be contributing to these levels and past causes of this contamination are unknown. It is possible that the mercury is entering the waters in this area via atmospheric deposition.

6.6 MANAGEMENT STRATEGIES FOR CONTROLLING SEDIMENTATION

This section, unlike those that preceded it, is not intended to present sediment control strategies for targeted water bodies. The problem of sedimentation is too widespread and is caused by too many sources to take this approach. Rather, it is to describe ongoing sediment control program strategies, to summarize some achievements in sediment control, and to also stress the need to continue to develop and apply more effective and widespread sediment control measures.

Sedimentation refers to the deposition of sediment in surface waters. The causes, sources and water quality impacts of sedimentation are described in section 3.2.4 of Chapter 3. It is essentially a widespread nonpoint source-related water quality problem which results from land-disturbing activities. The most significant of these activities include agriculture, forestry, land development (e.g., highways, shopping centers, schools and residential subdivisions) and mining. For each of these major types of land-disturbing activities, there are programs being implemented by various government agencies at the state, federal and/or local level to minimize soil loss and protect water quality. These programs are listed in Table 6.3 and are briefly described in Chapter 5.

Table 6.3 State and Federal Sediment Control-related Programs (with Chapter 5 Section References in Parentheses)

- Agricultural Nonpoint Source (NPS) Control Programs (Section 5.3.1)
  - North Carolina Agriculture Cost Share Program
  - NC Cooperative Extension Service and Agricultural Research Service
  - Watershed Protection and Flood Prevention Program (PL 83-566)
  - Food Security Act of 1985 (FSA) and the Food, Agriculture, Conservation and Trade Act of 1990 (FACTA) (Includes Conservation Reserve Program, Conservation Compliance, Sodbuster, Swampbuster, Conservation Easement, Wetland Reserve and Water Quality Incentive Program)

- Construction, Urban and Developed Lands (Sections 5.3.2 and 5.3.3)
  - Sediment Pollution Control Act (Section 5.3.3)
  - Federal Urban Stormwater Discharge Program
  - Water Supply Protection Program
  - NC Coastal Stormwater Management Regulations
  - Coastal Nonpoint Pollution Control Programs
  - ORW and HQW Stream Classifications

- Forestry NPS Programs (Section 5.3.6)
  - Forest Practice Guidelines Related to Water Quality
  - National Forest Management Act (NFMA)
  - Forest Stewardship Program

- Mining Act (Section 5.3.7)

- Wetlands Regulatory NPS Programs (Section 5.3.8)
  The sediment trapping and soil stabilization properties of wetlands are particularly important to nonpoint source pollution control. Several important state and federal wetland protection programs are listed below.

  - Section 10 of the Rivers and Harbors Act of 1899
  - Section 404 of the Clean Water Act
  - North Carolina Coastal Area Management Act (CAMA) Of 1974
  - Section 401 Water Quality Certification (from CWA)
  - North Carolina Dredge and Fill Act (1969)

DEM's role in sediment control is to work cooperatively with those agencies that administer the sediment control programs in order to maximize the effectiveness of the programs and protect water quality. Where programs are not effective, as evidenced by violation of instream water quality standards (section 3.2.4), and where DEM can identify a source, then appropriate enforcement action can be taken. Generally, this would entail requiring the land owner or responsible party to install acceptable best management practices (BMPs). BMPs vary with the type of activity, but they are generally aimed at minimizing the area of land-disturbing activity and the amount of time the land remains unstabilized; setting up barriers, filters or sediment traps (such as temporary ponds or silt fences) to reduce the amount of sediment reaching surface waters; and recommending land management approaches that minimize soil loss, especially for agriculture.

Some control measures, principally for construction or land development activities of 1 acre or more, are required by law under the state's Sedimentation and Erosion Control Act administered by the NC Division of Land Resources. For activities not subject to the act such as agriculture, sediment controls are carried out on a voluntary basis through programs administered by several different agencies. The NC Agricultural Cost Share Program administered by the NC Division of

Soil and Water Conservation provides incentives to farmers to install BMPs by offering to pay up to 75% of the average cost of approved BMPs. The 1985 Food Security Act (FSA) administered by the US Department of Agriculture requires producers to comply with conservation plans developed by the Soil Conservation Service on highly erodible land (HEL) in order to participate in federal farm programs (Farmers Home Administration loans, subsidies, etc.).

Listed below in Table 6.4 are figures provided by the NC Division of Soil and Water Conservation (NC Agricultural Cost Share Program) and the US Soil Conservation Service (1985 and 1990 Farm Bill Programs) on the acres affected and tons of soil saved for their respective programs.

Table 6.4 Tons Saved and Acres Affected for two Agricultural Sediment Control Programs

Program (time period of data)		Acres Affected	Tons Saved	Total Contract Amount ($)
NC Agricultural Cost Share Program (10 years ±: 1984 to 9/94)		**40,965**	**104,727**	**$1,478,683**
Subbasin	03-07-50	2,863	2,761	87,177
	03-07-51	2,092	6,451	167,682
	03-07-52	646	933	14,975
	03-07-53	6,206	6,999	219,314
	03-07-54	4,248	8,927	57,506
	03-07-55	11,767	34,471	244,453
	03-07-56	229	240	48,645
	03-07-57	8,495	19,929	331,027
	03-07-58	2,124	6,224	135,380
	03-07-59	1,712	9,176	105,561
1985 and 1990 Farm Bills (9 months: 10-1-92 to 6-30-93)		**3144**	**16,553**	

The NC Cost Share Program totals are cumulative for an approximate 10-year period. The cost share figures include a wide array of BMPs including conservation tillage, terraces, diversions, critical area plan, sod-based rotation, crop conservation grass, crop conservation trees, filter strip, field border, grass waterway, water control structure and livestock exclusion.

The SCS Farm Bill Figures are for a 9-month period (October 1, 1992 to June 30, 1993). The SCS figures were compiled by county as opposed to subbasins or hydrologic units. The county totals were then multiplied by the percentage of the land area of that county that was located in the Lumber Basin. For Example, since roughly 50% of Brunswick County is located in the Lumber Basin, then 50% of the total acres affected and tons saved were used in compiling the basin total. The acreages and tons are composed almost exclusively of cropland acres treated.

It should be noted that these figures are not presented for comparative purposes between the programs. Rather, they are presented to demonstrate that there are tangible benefits being derived from these (and other) programs. To help put these numbers in some perspective, however, there are an estimated 713,100 acres of crop and pastureland in the Lumber Basin (based on 1982 SCS NRI data - section 2.3 in Chapter 2). The 10-year total of acres affected under the Cost Share Program would therefore constitute roughly 5% of the total. If figures were added in for programs administered by SCS, the Agricultural Stabilization and Conservation Service (ASCS) and others, the number of acres affected could increase substantially, but obtaining total figures is difficult. There is a need for a cooperative effort by all of these agencies to compile and assess the BMP data for all of these program in order to gain a more complete understanding of what is being accomplished regarding agricultural sediment controls and what still needs to be accomplished.

Further, despite the combined efforts of all of the above programs for construction, forestry, mining and agriculture, there were still 116 miles of streams in the Lumber Basin found to be impaired by sediment, thus pointing to the need for continued overall improvements in sediment control.

6.7 MANAGEMENT STRATEGIES FOR CONTROLLING FECAL COLIFORM BACTERIA IN SHELLFISH WATERS

As indicated in section 3.2.5, forty-five percent (2152 acres) of the shellfish waters in the Lumber River Basin have been closed to shellfish harvesting because of elevated concentrations of fecal coliform bacteria. Shellfish water closures are administered by the NC Division of Marine Fisheries (DMF) based on the recommendations of the NC Division of Environmental Health's (DEH) Shellfish Sanitation Branch.

DEM has identified nonpoint source pollution as the primary source of impairment with potential sources including stormwater runoff from coastal development, failing septic systems, marinas, agriculture and forestry drainage. A 1989 study of shellfish water closures in the Lockwoods Folly watershed tentatively identified stormwater and failing septic systems as the leading sources.

From a management standpoint, there are two objectives concerning shellfish (SA) waters. One is to protect open shellfish waters through preventing closure due to bacterial contamination. The second, and more difficult, is to reopen closed shellfish waters.

A good example of the difficulties faced in protecting or restoring shellfish waters is the Lockwoods Folly River. DEM conducted a study of the Lockwoods Folly River and prepared a report in 1989 which was aimed at addressing the closure of shellfish beds due to fecal coliform bacteria. As noted above, the report tentatively identified urban runoff and septic systems as the primary sources of bacterial contamination and recommended that the Environmental Management Commission (EMC) establish management strategies for a portion of the river consistent with requirements for outstanding resource waters. The EMC subsequently adopted a water quality management plan for a portion of the Lockwoods Folly River (15 NCAC 2B .0219) which placed restrictions on new discharges and development activities in the immediate proximity of the management area. However, the plan did not include specific provisions for controlling bacterial loadings from existing development and land use activities. In regard to existing sources, the study recommended that further studies be conducted, and if septic tanks and urban stormwater were confirmed to be the primary source of contamination, then it was recommended that county and state governments should consider establishing sanitary districts or similar wastewater management systems, in the lower portion of the basin, to dispose of wastewater presently being treated by septic tanks.

Since that time, water quality monitoring has continued to document violations of water quality standards for fecal coliform bacteria, but the sources have still not been positively identified. Also, it has been suggested that even if central sewage collections systems are provided to heavily developed areas with septic systems, that the bacteria contained in stormwater runoff from these densely developed areas may still be unacceptably high, thus requiring additional control measures of some type.

An important lesson from this example is that a major stumbling block in reopening closed shellfish waters has been in identifying the specific sources of bacterial pollution and then ensuring implementation of effective control measures. Because of the high costs of treatment (e.g. replacement of septic systems with centralized wastewater treatment systems or installation of BMPs in urban or agricultural areas), there has been a reluctance to require control measures without being able to document specific sources. However, documentation of sources requires expensive and time-consuming monitoring, and there is little money and insufficient staff time and resources available to pinpoint sources "beyond a shadow of a doubt". And third, even when a source has been identified, control of bacteria to meet shellfish water standards may be extremely difficult as in the case of runoff from densely developed areas.

Clearly, if the continued closure of shellfish waters is to be prevented, and the reopening of closed shellfish waters is to be accomplished, there needs to be a concerted effort by state, local and federal government agencies, cooperation of landowners and support by the state legislature to make it happen. Such an effort will require funding, staff time, public education, and probably new regulations aimed clearly at controlling fecal coliform bacteria in the area of shellfish waters. The basinwide planning process is not empowered with the authority to require these actions, however, it does offer the opportunity to draw attention to this issue and to set into motion actions that may lead to positive results.

There are two new efforts underway that may provide additional protection of shellfish waters. The first is a new coastal nonpoint pollution control program being developed by the NC Division of Coastal Management under requirements of the Coastal Zone Act Reauthorization Amendments (CZARA). It is unclear to what extent these rules would reduce bacterial loadings from existing land uses, particularly developed areas, however, they may be able to strengthen requirements aimed at controlling pollution from new development through more effective density controls and/or use of BMPs. These rules are in the process of being drafted and are to be completed in 1995. The second approach is the Governors Coastal Futures Initiative. This initiative is taking a close look at coastal problems, including the closure of shellfish waters.

Therefore, as a first step, DEM recommends that interagency coordination be increased to develop a common understanding of the extent and nature of shellfish water closures, to identify existing weaknesses in shellfish water protection, and to outline a strategy of what would be required protect and reopen these waters, including the need for new rules or legislation. Staff should continue to evaluate the sources of bacteria contamination of shellfish waters and to develop necessary statutory and/or rule modifications to provide the necessary means to address such situations where standards are not being met nor uses being attained.

APPENDIX 1

CONTENTS:

SUMMARY OF NORTH CAROLINA'S WATER QUALITY CLASSIFICATIONS AND STANDARDS

PRIMARY CLASSIFICATIONS	BEST USAGE	NUMERIC STANDARDS	STORMWATER CONTROLS	OTHER REQUIREMENTS
Freshwater:				
Class C (standards apply to all freshwaters, unless preempted by more stringent standard for more protective classification)	Secondary recreation (including swimming on an unorganized or infrequent basis); fish and other aquatic life propagation and survival; agriculture and other uses, except for primary recreation, water supply or other food - related uses	See attached Table 1.; WATER QUALITY STANDARDS FOR FRESHWATER CLASSES; standards listed under "Standards For All Freshwaters" column (aquatic life and human health sections) apply to Class C waters, unless preempted by more protective standard.	Stormwater Disposal Rules apply in the 20 coastal counties as described in 15A NCAC 2H .1000	
Class B	Primary recreation (swimming on an organized or frequent basis) and all uses specified for Class C (and not water supply or other food-related uses)	Same as for Class C	Same as for Class C	Wastewater treatment reliability requirements (dual train design; backup power capability) may apply to protect swimming uses (15A NCAC 2H .0124)
WS-I Water Supply <u>NOTE:</u> Revised water supply classifications and standards effective as of 8/3/92	Water supplies in natural and undeveloped watersheds	See Table 1. under "More Stringent Standards to Support Additional Uses": WS Classes heading; no point sources except groundwater remediation when no alternative exists	Not applicable since watershed is undeveloped	No landfills, sludge/residual or petroleum contaminated soils application allowed in watershed
WS-II Water supply	Water supplies in predominantly undeveloped watersheds	See Table 1. under "More Stringent Standards to Support Additional Uses": WS Classes heading; only general permit wastewater discharges allowed in watershed and groundwater remediation discharges allowed when no alternative exists	Local land management program required as per 15A NCAC 2B .0211(d): 2-acre lots or 6% built-upon area in critical area; 1-acre lots or 12% built-upon area outside of critical area; up to 64% in the critical area and 30% built upon area outside of the critical area allowed with engineered stormwater controls for the 1" storm[1]	Buffers required along perennial waters; no new landfills allowed in the critical area and no new discharging landfills outside of critical area; no new sludge/residual or petroleum contaminated soils application allowed in the critical area; hazardous material and spill/failure containment plan required; spill containment structures required for new industries in the critical area using, storing or manufacturing hazardous materials
WS-III Water Supply	Water supplies in low to moderately developed watersheds	See Table 1. under "More Stringent Standards to Support Additional Uses": WS Classes heading; general permits allowed throughout watershed, domestic and non-process industrial outside of the critical area, groundwater remediation discharges allowed when no alternative exists	Local land management program required as per 15A NCAC 2B .0211(e): 1-acre lots or 12% built-upon area in critical area; $\frac{1}{2}$-acre lots or 24% built-upon outside of critical area; up to 30% in critical area and 50% built-upon area outside critical area with engineered stormwater controls for the 1" storm[1]	Buffers required along perennial waters; no new landfills allowed in the critical area and no new discharging landfills outside of the critical area; no new sludge/residual or petroleum contaminated soils application allowed in the critical area; hazardous material and spill/failure containment plan required; spill containment structures required for new industries in the critical area using, storing or manufacturing hazardous materials

SUMMARY OF NORTH CAROLINA'S WATER QUALITY CLASSIFICATIONS AND STANDARDS (continued)

PRIMARY CLASSIFICATIONS	BEST USAGE	NUMERIC STANDARDS	STORMWATER CONTROLS	OTHER REQUIREMENTS
WS-IV Water Supply	Water supplies in moderately to highly developed watersheds	See Table 1. under "More Stringent Standards to Support Additional Uses": WS Classes heading; general permits, domestic and industrial discharges allowed throughout water supply [2]; groundwater remediation discharges allowed when no alternative exists	Local land management program required as per 15A NCAC 2B .0211(f): ½-acre lots or 24% built-upon area in critical area and protected area [3,4]; up to 50% in critical area and 70% built-upon area outside critical area with engineered stormwater controls for the 1" storm[1]	Buffers required along perennial waters; no new landfills allowed in the critical area; no new sludge/residual or petroleum contaminated soils application allowed in the critical area; hazardous material and spill/failure containment plan required
WS-V Water Supply	River segment	No categorical restrictions on development or wastewater dischargers. Instream water quality standards for water supply waters are applicable.		

NOTE: Please refer to 15A NCAC 2B .0101, .0104, .0202, .0211 and .0301 for more specific requirements for surface water supply protection.

1 If the high density development option is utilized, then wet detention basins are required and local governments will assume ultimate responsibility for the operation and maintenance of these engineered stormwater control structures.
2 New industrial process wastewater discharges in the critical area are allowed but must meet additional treatment requirements.
3 Applies to projects requiring an Erosion/Sedimentation Control Plan.
4 1/3 acre or 36% built-upon area is allowed for projects without a curb and gutter street system in the protected area.
- Critical area is ½ mile and draining to water supplies from normal pool elevation of reservoirs, or ½ mile and draining to a river intake.
- Protected area is 5 miles and draining to water supplies from normal pool elevation of reservoirs, or 10 miles upstream of and draining to a river intake.
- Agricultural activities are subject to provisions of the Food Security Act of 1985 and the Food, Agriculture, Conservation and Trade Act of 1990. In WS-I watersheds and critical areas of WS-II, WS-III and WS-IV areas, agricultural activities must maintain a 10 foot vegetated buffer or equivalent control, and animal operations >100 animal units must use BMPs as determined by the Soil and Water Conservation Commission.
- Silviculture activities are subject to the provisions of the Forest Practices Guidelines Related to Water Quality (15A NCAC 1I .0101-.0209).
- The Department of Transportation must use BMPs as described in their document, "Best Management Practices for Protection of Surface Waters".

PRIMARY CLASSIFICATIONS	BEST USAGE	NUMERIC STANDARDS	STORMWATER CONTROLS	OTHER REQUIREMENTS
Saltwater:				
Class SC	Saltwaters protected for secondary recreation, aquatic life propagation and survival and other uses as described for Class C	See attached Table 2.; WATER QUALITY STANDARDS FOR SALTWATER CLASSES; standards listed under "Standards For All Tidal Saltwaters" column (aquatic life and human health sections) apply to Class SC waters, unless preempted by more protective standard.	Stormwater Disposal Rules (15A NCAC 2H .1000) apply to all waters in the 20 coastal counties; low density option: 30% built-upon area or 1/3 acre lots, or structural stormwater controls with higher density, as specified	
Class SB	Saltwaters protected for primary recreation and all Class SC uses (similar to Class B)	Same as Class SC except no floating solids, settleable solids or sludge deposits attributable to sewage, industrial or other wastes	Same as Class SC	Reliability requirements same as for Class B
Class SA	Shellfishing and all Class SC and SB uses	Same as for Class SC, except fecal coliform = 14 colonies per 100 ml of water; all other waters = 200/100 ml fecal	Same as for Class SC, except low density option = 25% built-upon area	No domestic discharges and only nonprocess industrial discharges, such as seafood packing house or cooling water discharges

SUMMARY OF NORTH CAROLINA'S WATER QUALITY CLASSIFICATIONS AND STADARDS (continued)

Supplemental Classifications are added to the primary classifications as appropriate (Examples include Class C-NSW, Class SA-ORW, Class B-Trout, etc.) and impose additional requirements

SUPPLEMENTAL CLASSIFICATIONS	BEST USAGE	NUMERIC STANDARDS	STORMWATER CONTROLS	OTHER REQUIREMENTS
High Quality Waters (HQW) (categories: (1) waters rated as Excellent by DEM; (2) Primary Nursey Areas; (3) Native or Special Native Trout Waters; (4) Critical Habitat Areas; (5) WS-I and WS-II water supplies; (6) SA waters)	Waters with quality higher than the standards (EPA's Tier II waters; the minimum standards for Class C and SC define Tier I); see Standards and Stream Classifications Rules (15A NCAC 2B .0100) for detailed description (15A NCAC 2B .0101(e)(5))	For new or expanded discharges, advanced treatment requirements are: BOD_5=5 mg/l; NH_3-N= 2 mg/l; DO=6 mg/l	Projects requiring Erosion/ Sedimentation Control Plan and are within 1 mile and draining to HQW waters: 1-acre lots or 12% built-upon area, or higher density with engineered structural controls (wet detention ponds); WS-I, WS-II and 20 coastal counties exempt since stormwater control requirements already apply	Other treatment requirements may apply, dependent upon type of discharge and characteristics of receiving waters (see pp. 1 and 2 of Section .0200 Rules: 15A: NCAC 2B .0201(d) of Antidegradation Policy)
Outstanding Resource Waters (ORW)	Unique and special waters having exceptional water quality and being of exceptional state or national ecological or recreational significance; must meet other certain conditions and have 1 or more of 5 outstanding resource value criteria as described in Rule 2B .0216	Water quality must clearly maintain and protect uses, including outstanding resource values; management strategies must include at a minimum: no new or expanded discharges to freshwater ORWs; some discharges may be allowed in coastal areas	Same as for High Quality Waters for Freshwater ORWs; for Saltwater ORWs, development activities within a 575' buffer must comply with the low density option of Stormwater Disposal Rules (generally, 25% built-upon area around SA waters and 30% around other waters)	Other management strategy components as described in Rule .0216
Trout Waters (Tr)	Protected for natural trout propagation and survival of stocked trout;	More protective standards for cadmium, total residual chlorine, chlorophyll-a, dissolved oxygen, turbidity and toluene to protect these sensitive species (see Table 1. under "Trout" heading)		
Nutrient Sensitive Waters (NSW)	Waters needing additional nutrient management due to their being subject to excessive growth of microscopic or macroscopic vegetation	No increase of nutrients over background levels		Nutrient management strategies developed on a case-by-case basis
Swamp Waters (Sw)	Waters with low velocities and other characteristics different from other waterbodies (generally, low pH, DO, high organic content)	pH as low as 4.3 and DO less than 5 mg/l allowed if due to natural conditions		

CLASS92.TBL
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TABLE 1. WATER QUALITY STANDARDS FOR FRESHWATER CLASSES

Parameters	Standards For All Freshwater		More Stringent Standards To Support Additional Uses	
	Aquatic Life	Human Health	WS Classes	Trout
Arsenic (ug/l)	50			
Barium (mg/l)			1.0	
Benzene (ug/l)		71.4	1.19	
Beryllium (ng/l)		117	6.8	
Cadmium (ug/l)	2.0			0.4
Carbon tetrachloride (ug/l)		4.42	0.254	
Chloride (mg/l)	230 (AL)		250	
Chlorinated benzenes (ug/l)			488	
Chlorine, total residual (ug/l)	17 (AL)			17
Chlorophyll a, corrected (ug/l)	40 (N)			15 (N)
Chromium, total (ug/l)	50			
Coliform, total (MFTCC/100ml)			50 (N)(2)	
Coliform, fecal (MFTCC/100ml)		200 (N)		
Copper (ug/l)	7 (AL)			
Cyanide (ug/l)	5.0			
Dioxin (ng/l)		0.000014	0.000013	
Dissolved gases	(N)			
Dissolved oxygen (mg/l)	5.0 (Sw)(1)			6.0
Fluoride (mg/l)	1.8			
Hardness, total (mg/l)			100	
Hexachlorobutadiene (ug/l)		49.7	0.445	
Iron (mg/l)	1.0 (AL)			
Lead (ug/l)	25 (N)			
Manganese (ug/l)			200	
MBAS (ug/l) (Methylene-Blue-Active Substances)	500			
Mercury (ug/l)	0.012			
Nickel (ug/l)	88		25	
Nitrate nitrogen (mg/l)			10	
Pesticides				
Aldrin (ng/l)	2.0	0.136	0.127	
Chlordane (ng/l)	4.0	0.588	0.575	
DDT (ng/l)	1.0	0.591	0.588	
Demeton (ng/l)	100			
Dieldrin (ng/l)	2.0	0.144	0.135	
Endosulfan (ng/l)	50			
Endrin (ng/l)	2.0			
Guthion (ng/l)	10			
Heptachlor (ng/l)	4.0	0.214	0.208	
Lindane (ng/l)	10			
Methoxychlor (ng/l)	30			
Mirex (ng/l)	1.0			
Parathion (ng/l)	13			
Toxaphene (ng/l)	0.2			
2,4-D (ug/l)			100	
2,4,5-TP (Silvex) (ug/l)			10	
pH (units)	6.0-9.0 (Sw)			
Phenolic compounds (ug/l)		(N)	1.0 (N)	
Polychlorinated biphenyls (ng/l)	1.0	0.079		
Polynuclear aromatic hydrocarbons (ng/l)		31.1	2.8	
Radioactive substances		(N)		
Selenium (ug/l)	5			
Silver (ug/l)	0.06 (AL)			
Solids, total dissolved (mg/l)			500	
Solids, suspended	(N)			
Sulfates (mg/l)			250	
Temperature	(N)			
Tetrachloroethane (1,1,2,2) (ug/l)		10.8	0.172	
Tetrachloroethylene (ug/l)			0.8	
Toluene (ug/l)	11			0.36
Toxic Substances	(N)			
Trialkyltin (ug/l)	0.008			
Trichloroethylene (ug/l)		92.4	3.08	
Turbidity (NTU)	50; 25 (N)			10 (N)
Vinyl chloride (ug/l)		525	2	
Zinc (ug/l)	50 (AL)			

Note:
- (N) See 2B .0211 (b), (c), (d), or (e) for narrative description of limits.
- (AL) Values represent action levels as specified in .0211 (b)(4).
- (Sw) Designated swamp waters may have a pH as low as 4.3 and dissolved oxygen less than 5.0 mg/l if due to natural conditions.
- (1) An instantaneous reading may be as low as 4.0 ug/l but the daily average must be 5.0 ug/l or more.
- (2) Applies only to unfiltered water supplies.

TABLE 2. WATER QUALITY STANDARD FOR SALTWATER CLASSES

Parameters	Standards For All Tidal Saltwaters: Aquatic Life	Standards For All Tidal Saltwaters: Human Health	More Stringent Standards To Support Additional Uses: Class SA
Arsenic (ug/l)	50		
Benzene (ug/l)		71.4	
Beryllium (ng/l)		117	
Cadmium (ug/l)	5.0		
Carbon tetrachloride (ug/l)		4.42	
Chlorophyll a (ug/l)	40 (N)		
Chromium, total (ug/l)	20		
Coliform, fecal (MFFCC/100ml)		200 (N)	14 (N)
Copper (ug/l)	3 (AL)		
Cyanide (ug/l)	1.0		
Dioxin (ng/l)		0.000014	
Dissolved gases	(N)		
Dissolved oxygen (mg/l)	5.0 (1)		
Hexachlorobutadiene (ug/l)		49.7	
Lead (ug/l)	25 (N)		
Mercury (ug/l)	0.025		
Nickel (ug/l)	8.3		
Phenolic compounds		(N)	
Polychlorinated biphenyls (ng/l)	1.0	0.079	
Polynuclear aromatic hydrocarbons (ng/l)		31.1	
Pesticides (ng/l)			
Aldrin	3.0	0.136	
Chlordane	4.0	0.588	
DDT	1.0	0.591	
Demeton	100		
Dieldrin	2.0	0.144	
Endosulfan	9.0		
Endrin	2.0		
Guthion	10		
Heptachlor	4.0	0.214	
Lindane	4.0		
Methoxychlor	30		
Mirex	1.0		
Parathion	178		
Toxaphene	0.2		
pH (units)	6.8-8.5 (1)		
Radioactive substances		(N)	
Salinity	(N)		
Selenium (ug/l)	71		
Silver (ug/l)	0.1 (AL)		
Solids, suspended	(N)		
Temperature	(N)		
Tetrachloroethane (1,1,2,2) (ug/l)		10.8	
Toxic substances	(N)		
Trialkyltin (ug/l)	0.002		
Trichloroethylene (ug/l)		92.4	
Turbidity (NTU)	25 (N)		
Vinyl chloride (ug/l)		525	
Zinc (ug/l)	86 (AL)		

Note: (N) See 2B .0212 (b), (c), or (d) for narrative description of limits.
(AL) Values represent action levels as specified in .0212(b)(4).
(1) Designated swamp waters may have a pH as low as 4.3 and dissolved oxygen less than 5.0 mg/l if due to natural conditions.

HIGH QUALITY WATERS

Excerpt from Classifications and Water Quality Standards Applicable to Surface Waters of North Carolina 15 NCAC 2B .0200

.0201 ANTIDEGRADATION POLICY

(a) It is the policy of the Environmental Management Commission to maintain, protect, and enhance water quality within the State of North Carolina. Pursuant to this policy, the requirements of 40 CFR 131.12 are hereby incorporated by reference including any subsequent amendments and editions. This material is available for inspection at the Department of Environment, Health, and Natural Resources, Division of Environmental Management, Water Quality Planning Branch, 512 North Salisbury Street, Raleigh, North Carolina. Copies may be obtained from the U.S. Government Printing Office, Superintendent of Documents, Washington, DC 20402-9325 at a cost of thirteen dollars ($13.00). These requirements will be implemented in North Carolina as set forth in Paragraphs (b), (c) and (d) of this Rule.

(b) Existing uses, as defined by Rule .0202 of this Section, and the water quality to protect such uses shall be protected by properly classifying surface waters and having standards sufficient to protect these uses. In cases where the Commission or its designee determines that an existing use is not included in the classification of waters, a project which will affect these waters will not be permitted unless the existing uses are protected.

(c) The Commission shall consider the present and anticipated usage of waters with quality higher than the standards, including any uses not specified by the assigned classification (such as outstanding national resource waters or waters of exceptional water quality) and will not allow degradation of the quality of waters with quality higher than the standards below the water quality necessary to maintain existing and anticipated uses of those waters. Waters with quality higher than the standards are defined by Rule .0202 of this Section. The following procedures will be implemented in order to meet these requirements:

(1) Each applicant for an NPDES permit or NPDES permit expansion to discharge treated waste will document an effort to consider non-discharge alternatives pursuant to 15A NCAC 2H .0105(c)(2).

(2) Public Notices for NPDES permits will list parameters that would be water quality limited and state whether or not the discharge will use the entire available load capacity of the receiving waters and may cause more stringent water quality based effluent limitations to be established for dischargers downstream.

(3) The Division may require supplemental documentation from the affected local government that a proposed project or parts of the project are necessary for important economic and social development.

(4) The Commission and Division will work with local governments on a voluntary basis to identify and develop appropriate management strategies or classifications for waters with unused pollutant loading capacity to accommodate future economic growth.

Waters with quality higher than the standards will be identified by the Division on a case-by-case basis through the NPDES permitting and waste load allocation processes (pursuant to the provisions of 15A NCAC 2H .0100). Dischargers affected by the requirements of Paragraphs (c)(1) through (c)(4) of this Rule and the public at large will be notified according to the provisions described herein, and all other appropriate provisions pursuant to 15A NCAC 2H .0109. If an applicant objects to the requirements to protect waters with quality higher than the standards and believes degradation is necessary to accommodate important social and economic development, the applicant can contest these requirements according to the provisions of General Statute 143-215.1(e) and 150B-23.

(d) The Commission shall consider the present and anticipated usage of **High Quality Waters (HQW)**, including any uses not specified by the assigned classification (such as outstanding national resource waters or waters of exceptional water quality) and will not allow degradation of the quality of **High Quality Waters** below the water quality necessary to maintain existing and anticipated uses of those waters. **High Quality Waters** are a subset of waters with quality higher than the standards and are as described by 15A NCAC 2B .0101(e)(5). The following procedures will be implemented in order to meet the requirements of this part:

(1) New or expanded wastewater discharges in **High Quality Waters** will comply with the following:

(A) Discharges from new single family residences will be prohibited. Those that must discharge will install a septic tank, dual or recirculating sand filters, disinfection and step aeration.

(B) All new NPDES wastewater discharges (except single family residences) will be required to provide the treatment described below:

(i) Oxygen Consuming Wastes: Effluent limitations will be as follows: BOD_5= 5 mg/l, NH_3-N = 2 mg/l and DO = 6 mg/l. More stringent limitations will be set, if necessary, to ensure that the cumulative pollutant discharge of oxygen-consuming wastes will not cause the DO of the receiving water to drop more than 0.5 mg/l below background levels, and in no case below the standard. Where background information is not readily available, evaluations will assume a percent saturation determined by staff to be generally applicable to that hydroenvironment.

(ii) Total Suspended Solids: Discharges of total suspended solids (TSS) will be limited to effluent concentrations of 10 mg/l for trout waters and PNA's, and to 20 mg/l for all other **High Quality Waters.**

(iii) Disinfection: Alternative methods to chlorination will be required for discharges to trout streams, except that single family residences may use chlorination if other options are not economically feasible. Domestic discharges are prohibited to SA waters.

(iv) Emergency Requirements: Failsafe treatment designs will be employed, including stand-by power capability for entire treatment works, dual train design for all treatment components, or equivalent failsafe treatment designs.

(v) Volume: The total volume of treated wastewater for all discharges combined will not exceed 50 percent of the total instream flow under 7Q10 conditions.

(vi) Nutrients: Where nutrient overenrichment is projected to be a concern, appropriate effluent limitations will be set for phosphorus or nitrogen, or both.

(vii) Toxic substances: In cases where complex wastes (those containing or potentially containing toxicants) may be present in a discharge, a safety factor will be applied to any chemical or whole effluent toxicity allocation. The limit for a specific chemical constituent will be allocated at one-half of the normal standard at design conditions. Whole effluent toxicity will be allocated to protect for chronic toxicity at an effluent concentration equal to twice that which is acceptable under design conditions. In all instances there may be no acute toxicity in an effluent concentration of 90 percent as measured by the North Carolina "Pass/Fail Methodology for Determining Acute Toxicity in a Single Effluent Concentration". Ammonia toxicity will be evaluated according to EPA guidelines promulgated in the Ammonia Criteria Development Document (1986); EPA document number 440/5-85-001; NTIS number PB85-227114; July 29, 1985 (50 FR 30784).

(C) All expanded NPDES wastewater discharges in **High Quality Waters** will be required to provide the treatment described in part (1)(B) of this Rule, except for those existing discharges which expand with no increase in permitted pollutant loading.

(2) Development activities which require an Erosion and Sedimentation Control Plan in accordance with rules established by the NC Sedimentation Control Commission or local erosion and sedimentation control program approved in accordance with 15A NCAC 4B .0218, and which drain to and are within one mile of **High Quality Waters (HQW)** will be required to control runoff from the one inch design storm as follows:

(A) Low Density Option: Developments which limit single family developments to one acre lots and other type developments to 12 percent built-upon area, have no stormwater collection system as defined in 15A NCAC 2H .1002(13), and have built-upon areas at least 30 feet from surface waters will be deemed to comply with this requirement, unless it is determined that additional runoff control measures are required to protect the water quality of **High Quality Waters** necessary to maintain existing and anticipated uses of those waters, in which case more stringent stormwater runoff control measures may be required on a case-by-case basis. Activities conforming to the requirements described in 15A NCAC 2H .1003(a) [except for Subparagraphs (2) and (3) which apply only to waters within the 20 coastal counties as defined in 15A NCAC 2H .1002(9)] will also be deemed to comply with this requirement, except as provided in the preceding sentence.

(B) High Density Option: Higher density developments will be allowed if stormwater control systems utilizing wet detention ponds as described in 15A NCAC 2H .1003(i), (k) and (l) are installed, operated and maintained which control the runoff from all built-upon areas generated from one inch of rainfall, unless it is determined that additional runoff control measures are required to protect the water quality of **High Quality Waters** necessary to maintain existing and anticipated uses of those waters, in which case more stringent stormwater runoff control measures may be required on a case-by-case basis. The size of the control system must take into account the runoff from any pervious surfaces draining to the system.

(C) All waters classified WS-I or WS-II and all waters located in the 20 coastal counties as defined in Rule 15A NCAC 2H .1002(9) are excluded from this requirement since they already have requirements for nonpoint source controls.

If an applicant objects to the requirements to protect high quality waters and believes degradation is necessary to accommodate important social and economic development, the applicant can contest these requirements according to the provisions of G.S. 143-215.1(e) and 150B-23.

(e) Outstanding Resource Waters (ORW) are a special subset of **High Quality Waters** with unique and special characteristics as described in Rule .0216 of this Section. The water quality of waters classified as ORW shall be maintained such that existing uses, including the outstanding resource values of said Outstanding Resource Waters, will be maintained and protected.

OUTSTANDING RESOURCE WATERS

Excerpt from Classifications and Water Quality Standards Applicable to Surface Waters of North Carolina 15 NCAC 2B .0200

.0216 OUTSTANDING RESOURCE WATERS

(a) General. In addition to the existing classifications, the Commission may classify certain unique and special surface waters of the state as outstanding resource waters (ORW) upon finding that such waters are of exceptional state or national recreational or ecological significance and that the waters have exceptional water quality while meeting the following conditions:

(1) there are no significant impacts from pollution with the water quality rated as excellent based on physical, chemical or biological information;

(2) the characteristics which make these waters unique and special may not be protected by the assigned narrative and numerical water quality standards.

(b) Outstanding Resource Values. In order to be classified as ORW, a water body must exhibit one or more of the following values or uses to demonstrate it is of exceptional state or national recreational or ecological significance:

(1) there are outstanding fish (or commercially important aquatic species) habitat and fisheries;

(2) there is an unusually high level of water-based recreation or the potential for such recreation;

(3) the waters have already received some special designation such as a North Carolina or National Wild and Scenic River, Native or Special Native Trout Waters, National Wildlife Refuge, etc, which do not provide any water quality protection;

(4) the waters represent an important component of a state or national park or forest; or

(5) the waters are of special ecological or scientific significance such as habitat for rare or endangered species or as areas for research and education.

(c) Quality Standards for ORW.

(1) Freshwater: Water quality conditions shall clearly maintain and protect the outstanding resource values of waters classified ORW. Management strategies to protect resource values will be developed on a site specific basis during the proceedings to classify waters as ORW. At a minimum, no new discharges or expansions of existing discharges will be permitted, and stormwater controls for all new development activities requiring an Erosion and Sedimentation Control Plan in accordance with rules established by the NC Sedimentation Control Commission or an appropriate local erosion and sedimentation control program will be required to control stormwater runoff as follows:

(A) Low Density Option: Developments which limit single family developments to one acre lots and other type developments to 12 percent built-upon area, have no stormwater collection system as defined in 15A NCAC 2H .1002(13), and have built-upon areas at least 30 feet from surface water areas will be deemed to comply with this requirement, unless it is determined that additional runoff control measures are required to protect the water quality of Outstanding Resource Waters necessary to maintain existing and anticipated uses of those waters, in which case such additional stormwater runoff control measures may be required on a case-by-case basis.

(B) High Density Development: Higher density developments will be allowed if stormwater control systems utilizing wet detention ponds as described in 15A NCAC 2H .1003(i), (k) and (l) are installed, operated and maintained which control the runoff from all built-upon areas generated from one inch of rainfall, unless it is determined that additional runoff control measures are required to protect the water quality of Outstanding Resource Waters necessary to maintain existing and anticipated uses of those waters, in which case such additional stormwater runoff control measures may be required on a case-by-case basis. The size of the control system must take into account the runoff from any pervious surfaces draining to the system.

(2) Saltwater: Water quality conditions shall clearly maintain and protect the outstanding resource values of waters classified ORW. Management strategies to protect

resource values will be developed on a site-specific basis during the proceedings to classify waters as ORW. At a minimum, new development will comply with the low density options as specified in the Stormwater Runoff Disposal rules [15A NCAC 2H .1003 (a)(2)] within 575 feet of the mean high water line of the designated ORW area. New non-discharge permits will be required to meet reduced loading rates and increased buffer zones, to be determined on a case-by-case basis. No dredge or fill activities will be allowed where significant shellfish or submerged aquatic vegetation bed resources occur, except for maintenance dredging, such as that required to maintain access to existing channels and facilities located within the designated areas or maintenance dredging for activities such as agriculture. A public hearing is mandatory for any proposed permits to discharge to waters classified as ORW.

Additional actions to protect resource values will be considered on a site specific basis during the proceedings to classify waters as ORW and will be specified in Paragraph (e) of this Rule. These actions may include anything within the powers of the commission. The commission will also consider local actions which have been taken to protect a water body in determining the appropriate state protection options. Descriptions of boundaries of waters classified as ORW are included in Paragraph (e) of this Rule and in the Schedule of Classifications (15A NCAC 2B .0302 through .0317) as specified for the appropriate river basin and will also be described on maps maintained by the Division of Environmental Management.

(d) Petition Process. Any person may petition the Commission to classify a surface water of the state as an ORW. The petition shall identify the exceptional resource value to be protected, address how the water body meets the general criteria in Paragraph (a) of this Rule, and the suggested actions to protect the resource values. The Commission may request additional supporting information from the petitioner. The Commission or its designee will initiate public proceedings to classify waters as ORW or will inform the petitioner that the waters do not meet the criteria for ORW with an explanation of the basis for this decision. The petition shall be sent to:

Director
DEHNR/Division of Environmental Management
P.O. Box 29535
Raleigh, North Carolina 27626-0535

The envelope containing the petition shall clearly bear the notation: RULE-MAKING PETITION FOR ORW CLASSIFICATION.

LOCKWOODS FOLLY RIVER AREA
WATER QUALITY MANAGEMENT PLAN

Excerpt from Classifications and Water Quality Standards Applicable to Surface Waters of North Carolina
15 NCAC 2B .0200

.0219 WATER QUALITY MANAGEMENT PLANS

(a) In implementing the water quality standards to protect the existing uses [as defined by Rule .0202(16) of this Section] of the waters of the state or the water quality which supports those uses, the Commission shall develop water quality management plans on a priority basis to attain, maintain or enhance water quality throughout the state. Additional specific actions deemed necessary by the Commission to protect the water quality or the existing uses of the waters of the state will be specified in Paragraph (b) of this Rule. These actions may include anything within the powers of the Commission. The Commission may also consider local actions which have been taken to protect a waterbody in determining the appropriate protection options to be incorporated into the water quality management plan.

(b) All waters determined by the Commission to be protected by a water quality management plan are listed with specific actions as follows:

(1) The **Lockwoods Folly River Area** (Lumber River Basin), which includes all waters of the lower **Lockwoods Folly River** in an area extending north from the Intracoastal Waterway to a line extending from Genoes Point to Mullet Creek, will be protected by the specific actions described in Subparagraphs (A) through (E) of this Rule.

(A) New development activities within 575' of the mean high water line which require a Sedimentation Erosion Control Plan or a CAMA major development permit must comply with the low density option of the coastal Stormwater Runoff Disposal Rules [as specified in 15A NCAC 2H .1003(a)(2)].

(B) New or expanded NPDES permits will be issued only for non-domestic, non-industrial process type discharges (such as non-industrial process cooling or seafood processing discharges). A public hearing is mandatory for any proposed (new or expanded) NPDES permit to this protected area.

(C) New non-discharge permits will be required to meet reduced loading rates and increased buffer zones, to be determined on a case-by-case basis.

(D) New or expanded marinas must be located in upland basin areas.

(E) No dredge or fill activities will be allowed where significant shellfish or submerged aquatic vegetation bed resources occur, except for maintenance dredging, such as that required to maintain access to existing channels and facilities located within the protected area or maintenance dredging for activities such as agriculture.

History Note: Statutory Authority G.S. 143-214.1; 143-215.8A;
Eff. January 1, 1990

APPENDIX II

Sources and Types of Water Quality and Biological Data Collected by the NC Division of Environmental Management

APPENDIX II

SOURCES AND TYPES OF WATER QUALITY AND BIOLOGICAL DATA COLLECTED BY THE NC DIVISION OF ENVIRONMENTAL MANAGEMENT

The North Carolina Division of Environmental Management's Environmental Sciences Branch collects a variety of biological, chemical, and physical data that may be used in a myriad of ways within the basinwide planning process. In some areas there may be adequate data from several program areas to allow a fairly comprehensive analysis of ecological integrity, i.e., water quality. In other areas, data may be limited to one program area, such as only benthos data or only fisheries data, with little other information available. Such data may or may not be adequate to provide a definitive assessment of water quality, but can provide general indications of water quality.

The primary program areas from which data were drawn for this assessment of the Lumber River Basin are:

BENTHIC MACROINVERTEBRATES

Benthic macroinvertebrates, or benthos, are organisms, mostly aquatic insect larvae, that live in and on the bottom substrates of rivers and streams. The use of benthos data has proven to be a reliable monitoring tool as benthic macroinvertebrates are sensitive to subtle changes in water quality. Since many taxa in a community have life cycles of six months to one year, the effects of short term pollution (such as a spill) will generally not be overcome until the following generation appears. The benthic community also integrates the effects of a wide array of potential pollutant mixtures.

Criteria have been developed to assign bioclassifications ranging from Poor to Excellent to each benthic sample based on the number of taxa present in the intolerant groups Ephemeroptera, Plecoptera and Trichoptera (EPT S). Likewise, ratings can be assigned with a "biotic index". This index summarizes tolerance data for all taxa in each collection. The two rankings are given equal weight in final site classification. Higher taxa richness values are associated with better water quality. These bioclassifications primarily reflect the influence of chemical pollutants. The major physical pollutant, sediment, is poorly assessed by taxa richness. Different criteria have been developed for different ecoregions (Mountains, Piedmont and Coastal Plain) within North Carolina.

Classification Criteria by Ecoregion*:

A. EPT taxa richness values

	10-sample Qualitative Samples			4-sample EPT samples		
	Mountains	Piedmont	Coastal	Mountains	Piedmont	Coastal
Excellent	>41	>31	>27	>35	>27	>23
Good	32-41	24-31	21-27	28-35	21-27	18-23
Good-Fair	22-31	16-23	14-20	19-27	14-20	12-17
Fair	12-21	8-15	7-13	11-18	7-13	6-11
Poor	0-11	0-7	0-6	0-10	0-6	0-5

B. Biotic Index Values (Range = 0-5)

	Mountains	Piedmont/Coastal
Excellent	<2.18	<2.61
Good	2.19-2.58	2.61-2.93
Good-Fair	2.59-2.99	2.94-3.24
Fair	3.00-3.46	3.25-3.69
Poor	>3.46	>3.69

*These criteria apply to flowing water systems only. Biotic index criteria are only used for full-scale (10-sample) qualitative samples

PHYTOPLANKTON

Phytoplankton or algae are microscopic plants found in the water column of lakes, rivers, streams, and estuaries. Through photosynthesis, these tiny plants provide the base for the aquatic food web and, as such, can be a determining factor in overall aquatic production. Phytoplankton populations are dependent upon nutrient availability and other ecological factors such as light, temperature, pH, salinity, organic matter, grazing by higher trophic levels, and water velocity. Phytoplankton are especially useful as indicators of eutrophication.

Prolific growths of phytoplankton, often due to abundant nutrients, sometimes result in surface "blooms" in which one or more species of algae may actually form a visible mat on top of the water. Surface blooms may be unsightly and deleterious to water quality, causing fish kills, anoxia, or taste and odor problems. The algal bloom program was initiated in 1984 to document suspected algal blooms with actual biovolume and density estimates. Usually, an algal sample with a biovolume larger than 5,000 mm^3/m^3, density greater than 10,000 units/ml, or chlorophyll-a concentration approaching 40 ug/l (the North Carolina state standard) constitutes a bloom. Other components of the phytoplankton program include ambient monitoring, lake monitoring, and special studies.

AQUATIC TOXICITY MONITORING

Acute and/or chronic toxicity tests are used to determine toxicity of discharges to sensitive aquatic species (usually fathead minnows or the water flea, *Ceriodaphnia dubia*). Results of these tests have been shown by several researchers to be predictive of discharge effects on receiving stream populations. Many facilities are required to monitor whole effluent toxicity by their NPDES permit or by administrative letter. Other facilities may be tested by DEM's Aquatic Toxicology Laboratory. The Aquatic Toxicology Unit maintains a compliance summary for all facilities required to perform tests and provides a monthly update of this information to regional offices and DEM administration. Ambient toxicity tests can be used to evaluate stream water quality relative to other stream sites and/or a point source discharge.

FISHERIES

To the public, the condition of the fishery is one of the most meaningful indicators of water quality. Fish occupy the upper levels of the aquatic food web and are both directly and indirectly affected by chemical and physical changes in the environment. Water quality conditions that significantly affect lower levels of the food web will affect the abundance, species composition, and condition of the fish population.

FISH COMMUNITY ASSESSMENT

The amount of sedimentation, nutrients, and toxicants a stream receives, in conjunction with available habitat and basic water quality characteristics, will dictate the type of fish community that a stream can support. Therefore, by determining the structure of the fish community at a certain location, assumptions about fish community and water quality can be surmised. Fish have the following advantages in regard to their use in evaluating water quality and biotic integrity :

(1) Fish are integrators of community response to aquatic environmental quality conditions; they are the end product of most aquatic food webs, thus the total biomass of fishes is highly dependent on the gross primary and secondary productivity of lower organisms.

(2) They constitute a conspicuous part of the aquatic biota and are recognized by the public for their sport, commercial and endangered status, and represent the end product of protection for most water pollution abatement programs.

(3) They reproduce once per year and complete their entire life cycle in the aquatic environment which they inhabit.

(4) They have relatively high sensitivity to a variety of substances and physical conditions.

(5) There is an abundance of information concerning their life history, ecology, environmental requirements and distribution.

Criteria have been developed to assign fish biological integrity classes, ranging from poor to excellent, to each fish community sample. The method of assigning classifications is an Index of Biotic Integrity (IBI) that has been modified from Karr's Index of Biotic Integrity [1] for North Carolina. The North Carolina IBI is based on a number of component observations. The principal components of fish community evaluations include information about species richness and composition, trophic composition, and fish abundance and condition. The actual assessment of biological integrity using IBI is provided by the cumulative assessment of 12 parameters or metrics. The values provided by the metrics are converted into scores on a 1, 3, 5 scale. A score of 5 represents conditions expected for undisturbed streams in the area, while a score of 1 indicates that the conditions vary greatly from those expected in undisturbed streams of the region. The scores for each metric are summed to attain the overall IBI score with a maximum value of 60. Integrity classes and their respective score ranges are listed below.

Excellent	58-60
Good-Excellent	53-57
Good	48-52
Fair-Good	45-47
Fair	40-44
Poor-Fair	35-39
Poor	28-34
Very Poor - Poor	23-27
Very Poor	12-22
No Fish	<12

FISH TISSUE

Since fish spend their entire lives in the aquatic environment, they incorporate chemicals from this environment into their body tissues. Therefore, by analyzing fish tissue, determinations about what chemicals are in the water can be made. Contamination of aquatic resources, including freshwater, estuarine, and marine fish and shellfish species have been documented for heavy metals, pesticides, and other complex organic compounds. Once these contaminants reach surface waters, they may be available for bioaccumulation through aquatic food webs and may accumulate in fish and shellfish tissues. Thus fish tissue monitoring can serve as an important early warning indicator of contaminated sediments and surface water.

Fish tissue analysis results are used as indicators for human health concerns, fish and wildlife health concerns, and the presence and concentrations of various chemicals in the ecosystem. In evaluating fish tissue analysis results, several different types of criteria are used. Human health concerns related to fish consumption are screened by comparing results with Federal Food and Drug Administration (FDA) action levels. A list of fish tissue parameters accompanied by their FDA criteria are presented below. Individual parameters which appear to be of potential human health concern are evaluated by the N.C. Division of Epidemiology by request of the Water Quality Section. Fish tissue samples are also evaluated by comparing results to a number of least water quality impacted locations(reference sites).

Metals

	FDA		FDA
Cadmium	None	Chromium	None
Nickel	None	Lead	None
Copper	None	Arsenic	None
Mercury	1.0 ppm	Selenium	None

[1]Karr, J.R. K.D. Fausch, P.L. Angermeier, P.R. Yant, and I.J. Schlosser. 1986. Assessing biological integrity in running water: a method and its rationale. Illinois History Survey Special Publication No. 5.

Synthetic Organics

	FDA		FDA
Aldrin	0.3 ppm	o,p DDD	5.0 ppm
Dieldrin	0.3 ppm	p,p DDD	5.0 ppm
Endrin	0.3 ppm	o,p DDE	5.0 ppm
Methoxychlor	None	p,p DDE	5.0 ppm
Alpha BHC	None	o,p DDT	5.0 ppm
Gamma BHC	None	p,p DDT	5.0 ppm
PCB-1254	2.0 ppm	cis-chlordane	3.0 ppm
Endosulfan I	None	trans-chlordane	3.0 ppm
Endosulfan II	None	Hexachlorobenzene	None

CHEMICAL/PHYSICAL CHARACTERIZATIONS

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

LAKES ASSESSMENT PROGRAM

Lakes are valued for the multiple benefits they provide to the public, including recreational boating, fishing, drinking water, and aesthetic enjoyment. The North Carolina Lake Assessment Program seeks to protect these waters through monitoring, pollution prevention and control, and restoration activities. Assessments have been made at all publicly accessible lakes, at lakes which supply domestic drinking water, and lakes (public or private) where water quality problems have been observed. Data are used to determine each lake's trophic status-a relative measure of nutrient enrichment and productivity, and whether the lake's uses have been threatened or impaired by pollution.

Tables presented in each subbasin summarize data used to determine the trophic status and use support status of each lake. These determinations are based on information from the most recent summertime sampling (date listed). The most recent North Carolina Trophic State Index (NCTSI) value is shown, followed by the descriptive trophic state classification (O=oligotrophic, M=mesotrophic, E=eutrophic, H=hypereutrophic, D=dystrophic).

Numerical indices are often used to evaluate the trophic status of lakes. An index was developed specifically for North Carolina lakes as part of the state's original Clean Lakes Classification Survey (NRCD 1982). The North Carolina Trophic State Index (NCTSI) is based on total phosphorus (TP in mg/l), total organic nitrogen (TON in mg/l), Secchi depth (SD in inches), and chlorophyll-a (CHL in µg/l). Lakewide means for these parameters are manipulated to produce a NCTSI score for each lake, using the following equations:

$$\text{TON score} = \frac{\text{Log(TON)} + (0.45)}{0.24} \times 0.90$$

$$\text{TP score} = \frac{\text{Log(TP)} + (1.55)}{0.35} \times 0.92$$

$$\text{SD score} = \frac{\text{Log(SD)} - (1.73)}{0.35} \times -0.82$$

$$\text{CHL score} = \frac{\text{Log(CHL)} - (1.00)}{0.43} \times 0.83$$

$$\text{NCTSI} = \text{TON score} + \text{TP score} + \text{SD score} + \text{CHL score}$$

In general, NCTSI scores relate to trophic classifications as follows: less than -2.0 is oligotrophic; -2.0 to 0.0 is mesotrophic; 0.0 to 5.0 is eutrophic; and greater than 5.0 is hypereutrophic. When scores border between classes, best professional judgment is used to assign an appropriate classification. NCTSI scores are also skewed by the highly colored water typical of dystrophic lakes. These acidic, "black-water" lakes are scattered throughout the coastal plain, often located in swampy areas or overlying peat deposits.

The summary tables list lakewide averages of total phosphorus (TP in mg/l), total organic nitrogen (TON in mg/l), and chlorophyll *a* (CHLA in µg/l), followed by surface water classification . The final column indicates whether the designated uses of the lake are supported by current water quality: "Full" indicates all uses are supported; "Threatened" indicates all uses are currently supported, but one or more uses is threatened (i.e. could be impaired in the future unless pollution control actions are taken); "Partial" indicates one or more uses is partially supported and remaining uses are fully supported; "Not" indicates one or more uses is not supported. Causes of use impairment or threat are explained below each table.

SEDIMENT OXYGEN DEMAND

If oxygen depletion is suspected due to the characteristics of benthic sediments then sediment oxygen demand (SOD) studies may be performed. Each stream reach is divided into a series of model segments. The number of stream segments that must be evaluated with an intensive survey depends on the individual study and the spatial resolution desired. Intensive surveys and SOD evaluations are usually reported as a series of field data tables and summaries of laboratory analysis reports. Occasionally, for large surveys, complete reports with survey narratives and summaries are written.. For the purposes of this report, intensive surveys and SOD studies that have been performed within each subbasin will be listed in table format accompanied by a brief summary of surveys that have been performed within the last five years.

AMBIENT MONITORING SYSTEM

The Ambient Monitoring System (AMS) is a network of stream, lake, and estuarine water quality monitoring stations (about 350 statewide) strategically located for the collection of physical and chemical water quality data. Sampling stations are sited under one or more of the following monitoring designations:

Fixed Monitoring Stations	Rotating Monitoring Stations
Point source	Basinwide Information
Nonpoint source	HQ & OR Waters
Baseline	Water Supply

The type of water quality analyses, or parameters, that are performed is determined by the freshwater or saltwater waterbody classification and corresponding water quality standards. Under this arrangement, basic *core* parameters are based on Class C waters with additional parameters added when justified. Parametric coverage is organized by freshwater or saltwater designation as shown in Tables 1.1 and 1.2.

Water quality data collected at all AMS stations are evaluated for the period 1987-1991 since basinwide permitting is done in five year cycles. These data were downloaded from STORET to a desktop computer for analysis. Because the methodology for determining parametric coverage within the AMS program has recently been revised, some stations have little or no data for several parameters. However, for the purpose of standardization it was felt that data summaries for each station should include all parameters that will be sampled in the future. In addition, monthly sampling regimes are being initiated as each basin comes up for assessment.

TABLE A.I.1. Ambient Monitoring System Freshwater Designations.

<u>C WATERS (minimum monthly coverage for all stream stations)</u>

<u>Field Parameters</u>
dissolved oxygen, pH, conductivity, temperature, chlorine,
<u>Nutrients</u>
total phosphorus, ammonia, total Kjeldahl nitrogen, nitrate+nitrite
<u>Physical Measurements</u>
total suspended solids, turbidity, hardness
<u>Bacterial</u>
fecal coliforms (Millipore Filter method)
<u>Elements</u>
aluminum (No present water quality standard), arsenic, cadmium, chromium, copper*, iron*, lead, mercury, nickel, silver*, zinc*

<u>TROUT WATERS</u> - No changes or additions
<u>SWAMP WATERS</u> - No changes or additions
<u>WATER SUPPLY</u>
Chlorides, total coliforms, manganese, total dissolved solids
<u>NUTRIENT-SENSITIVE WATERS</u>
Chlorophyll <u>a</u> (where appropriate)

PLUS any additional parameters of concern for individual station locations
*Action level instead of water quality standard.

TABLE A.I.2 Ambient Monitoring System Saltwater Designations.

<u>SC WATERS (minimum monthly coverage for all stations)</u>

<u>Field Parameters</u>
dissolved oxygen, pH, conductivity, temperature, chlorine, salinity, secchi disk (where appropriate)
<u>Nutrients</u>
total phosphorus, ammonia, total Kjeldahl nitrogen, nitrate+nitrite
<u>Physical Measurements</u>
total suspended solids, turbidity, hardness, chlorides
<u>Bacterial</u>
fecal coliforms(Millipore Filter method)
<u>Elements</u>
aluminum(No present water quality standard), arsenic, cadmium, chromium, copper*, iron*, lead, mercury, nickel, silver*, zinc*

<u>SA WATERS</u>
Fecal coliforms (tube method where appropriate)
<u>SWAMP WATERS</u> - No changes or additions
<u>NUTRIENT-SENSITIVE WATERS</u>
Chlorophyll <u>a</u> (where appropriate)

PLUS any additional parameters of concern for individual station locations
*Action level instead of water quality standard.

APPENDIX III

Modeling Information

APPENDIX III

MODELING INFORMATION

INTRODUCTION

In order to assess the impact of pollutants on surface water quality, the Division must often develop and apply water quality models. A water quality model is a simplified representation of the physical, chemical, and biological processes which occur in a water body. The type of model used is dependent on the purpose for which it is needed, the amount of information that is available or attainable for its development, and the degree of accuracy or reliability that is warranted. In most cases, the Division develops and applies a given model to predict the response of the system to a given set of inputs that reflect various management strategies. For example, water quality models such as QUAL2E or the Division's Level B model are used to predict what the instream dissolved oxygen concentration will be under various sets of NPDES wasteflows and discharge limits. The following sections briefly summarize the types of models used by the Division.

Oxygen-Consuming Waste Models

Several factors are considered when choosing an oxygen-consuming waste model including: the type of system (stream, lake, or estuary), whether one, two, or three dimensions are needed, the temporal resolution needed, and the type of data available. Many of the factors are related. For example, in streams, flow usually occurs in one direction and one can assume that a steady state model will result in adequate predictions. A steady state model is one in which the model inputs do not change over time. However, in open water estuaries, the tide and wind affect which way water moves, and they must often be represented by 2 or 3 dimensional models. In addition, the wind and tide can affect the model reaction rates, and therefore a dynamic model must be used rather than one which is steady state. The last factor, the amount of data available, dictates whether an empirical or calibrated model will be used. An empirical model is used when little water quality information is available for a given water body, and hydraulics and decay rates are estimated through the use of equations. For example, in North Carolina's empirical stream model (referred to as a Level B analysis) velocity is determined through a regression equation developed from North Carolina stream time-of-travel (TOT) studies which includes stream slope and flow estimates as independent variables. Stream slope can be measured from a topographic map, and flow is estimated at a given site by the U.S. Geological Survey. Therefore, the empirical model can be run without TOT information specific to a given stream since parameters are estimated through the use of information which can easily be obtained in the office environment. More information regarding the empirical dissolved oxygen model used by DEM can be found in the Instream Assessment Unit's Standard Operating Procedures Manual.

Field calibration of a BOD/DO model requires collection of a considerable amount of data. For example, in order to develop hydraulics equations specific to a given stream, TOT studies using rhodamine dye are recommended under at least two flow scenarios including one summer low flow period. In addition, during one summer low flow study, dissolved oxygen, temperature, long term BOD and nitrogen series data are collected. Sediment oxygen demand (SOD) data may also be collected. These data are then used to calibrate reaction rates specific to the stream. QUAL2E is the most commonly used calibrated DO/BOD model for streams in North Carolina. A copy of the model guidance can be obtained from EPA's Environmental Research Lab in Athens, Georgia, and further information on North Carolina's calibration procedures can be found in the Instream Assessment Unit's Standard Operating Procedures Manual.

Data collection for an estuary DO model is even more extensive. Since the system is multi-dimensional and not steady-state, many more data are needed. Dye is often injected into a system over a period of time, and the dye cloud is then followed for a period of time which may last for days. In addition, several tide gages may need to be set up. Due to the stratification which occurs in an estuary, depth integrated data must also be collected. Calibrated estuary models which have been used by DEM include WASP, GAEST, and QUAL2E. WASP is also supported by EPA, and a user manual may be obtained from them. You should note that both GAEST and QUAL2E are one dimensional and are not applicable to many of North Carolina's estuaries.

Lakes are rarely modeled for BOD. Tributary arms of lakes are modeled as slow moving streams. Depending on the system, a one, two, or three dimensional model may be used. If a one dimensional model is needed, the modeler may choose the Level B (if little or no data), or QUAL2E. In multidimensional lake systems, WASP will be used.

The calibrated model will be more accurate than the empirical model since it is based on data collected specifically for a given stream in the State. However, it is much more expensive to develop a calibrated model. Not only do a number of staff spend several days to weeks collecting field data (sometimes having to wait months for appropriate conditions), but it also takes the modeling staff several months to develop and document the calibrated model. An empirical model can be developed and applied in a matter of hours. Therefore, due to resource constraints, the majority of the BOD/DO models developed in North Carolina are empirical.

Eutrophication Models

Eutrophication models are used to develop management strategies to control trophic response of a system to nutrient inputs (usually total phosphorus (TP) or total nitrogen (TN)). Nutrient management strategies are typically needed in areas which are sensitive to nutrient inputs due to long residence times, warm temperature, and adequate light penetration. These characteristics are found in deep slow moving streams, ponds, lakes, and estuaries. Modeling and insitu research are used to relate nutrient loading to the trophic response to the system allowing the manager to establish nutrient targets. Models which may be used include the Southeastern Lakes Model (Reckhow, 1987), Walker's Bathtub Model (Walker, 1981), QUAL2E, and WASP.

Once the nutrient targets are known, watershed nutrient budgets are developed to evaluate the relative nutrient loadings from various point and nonpoint sources. Land use data are obtained for the basin, and export coefficients based on literature values are applied to each land use. An export coefficient is an estimate of how may pounds of nutrient will runoff from each acre of land in a given year.

Toxics Modeling

Toxics modeling is done to determine chemical specific limits which will protect to the no chronic level in a completely mixed stream. The standards developed for the State of North Carolina are based on chronic criteria. These chemical specific toxics limits are developed through the use of mass balance models:

$$(Cup)(Qup) + (Cw)(Qw) = (Cd)(Qd) \text{ where}$$

Cup = concentration upstream
Qup = flow upstream
Cw = concentration in wastewater (unknown being solved for in WLA)
Qw = wasteflow
Cd = concentration downstream (set = to standard or criteria)
Qd = flow downstream (= Qup + Qw)

When no data are available concerning the upstream concentration, it is assumed to be equal to zero. The upstream flow is the 7Q10 at the discharge point unless the parameter's standard is based on human health concerns, in which case the average flow is used.

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