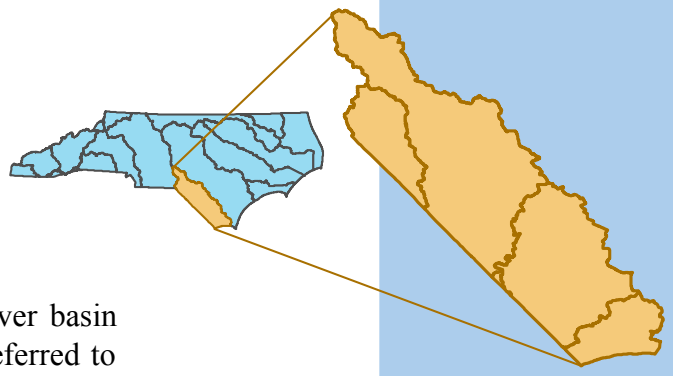
Chapter 1 Lumber Basin Overview

Part of Hydrologic Unit Code 030402



General Description

While this basin is actually part of the larger Pee Dee River basin (HUC 030402), for the purposes of this report it will be referred to as the Lumber River basin. This is because all convergence with the Pee Dee River occurs in South Carolina and this report pertains only the North Carolina portion of the Pee Dee River basin. All the rivers in this basin flow into South Carolina except for the Shallotte River and Lockwoods Folly River, which drain to the Atlantic Ocean. The Lumber River flows into the Little Pee Dee River about 10 miles after it crosses the state line. The Little Pee Dee River continues for several miles after this confluence eventually draining to the Pee Dee River. The Waccamaw River links to the Pee Dee River by forming a braided river system shortly before the two rivers discharge to Winyah Bay near Georgetown, SC (Figures 1-1 and 1-2).

The basin covers an area of approximately 3,329 square miles. It has approximately 2,222 miles of freshwater streams, 9,865 acres of freshwater lakes, and 4,680 acres of estuarine or saline waterbodies. In addition, there are 26 miles of coastline along the basin. Over 80 percent of all assessment units in the basin are supplementally classified as swamp waters and have different assessment standards than other waters. All assessment standards can be found in Appendix A Use Support Methodology.

The basin is made up of three main ecoregions: the sandhills, loam plains and Carolina flatwoods (Figure 1-3). The sandhills region is typically characterized by upland pine forest and wiregrass. Soils in the sandhills are well drained and provide a reliable source of groundwater recharge to the streams that run through the area. This is not the case in the loam plains and Carolina flatwoods regions where flow is often slow and ephemeral. This low flow contributes to the coastal plain being dominated by blackwater systems that often consist of braided streams, wide floodplains and pocosin wetlands. The water is usually absent of sediment but has a dark color due to tannins that are leached from organic matter. This tannic acid produces a pH that is naturally much lower than other river systems. Also these low flow streams and wetlands can have natural dissolved oxygen levels below the 5 mg/L freshwater standard.

A unique type of wetland known as Carolina bays can be found throughout much of the basin. Carolina bays are a type of isolated depressional wetland that range in size from a few acres to several hundred acres. They are found on the Atlantic Coastal Plain from

BASIN AT A GLANCE

COUNTIES

Bladen, Brunswick, Columbus, Hoke, Montgomery, Moore, Richmond, Robeson, Scotland

MUNICIPALITIES

Aberdeen, Bladenboro, Boardman, Boiling Spring Lakes, Bolivia, Bolton, Brunswick, Calabash, Candor, Carolina Shores, Cerro Gordo, Chadbourn, Clarkton, Dublin, East Laurinburg, Fair Bluff, Fairmont, Foxfire Village, Gibson, Hoffman, Holden Beach, Lake Waccamaw, Laurinburg, Lumber Bridge, Lumberton, Marietta, Maxton, McDonald, Norman, Oak Island, Ocean Isle Beach, Orrum, Parkton, Pembroke, Pinebluff, Pinehurst, Proctorville, Raeford, Raynham, Red Springs, Rennert, Rowland, Saint James, Saint Pauls, Shallotte, Southern Pines, Sunset Beach, Tabor City, Tar Heel, Varnamtown, Wagram, Whiteville

PERMITTED FACILITIES

NPDES Discharge	
Major:	12
Minor:	32
NPDES Nondischarge:	30
NPDES Stormwater	
General:	137
Individual:	5
State:	181
Animal Operations:	201

AQUATIC LIFE SUMMARY

Monitored:	652 Miles 10,763 Acres
Total Supporting:	557 Miles 10,146 Acres
Total Impaired:	31 Miles 18 Acres
Total Not Rated:	64 Miles 599 Acres

Figure 1-1: Entire Yadkin-Pee Dee River Basin in NC, SC, and VA

Figure 1-2: Lumber River Basin within the Pee Dee River Basin

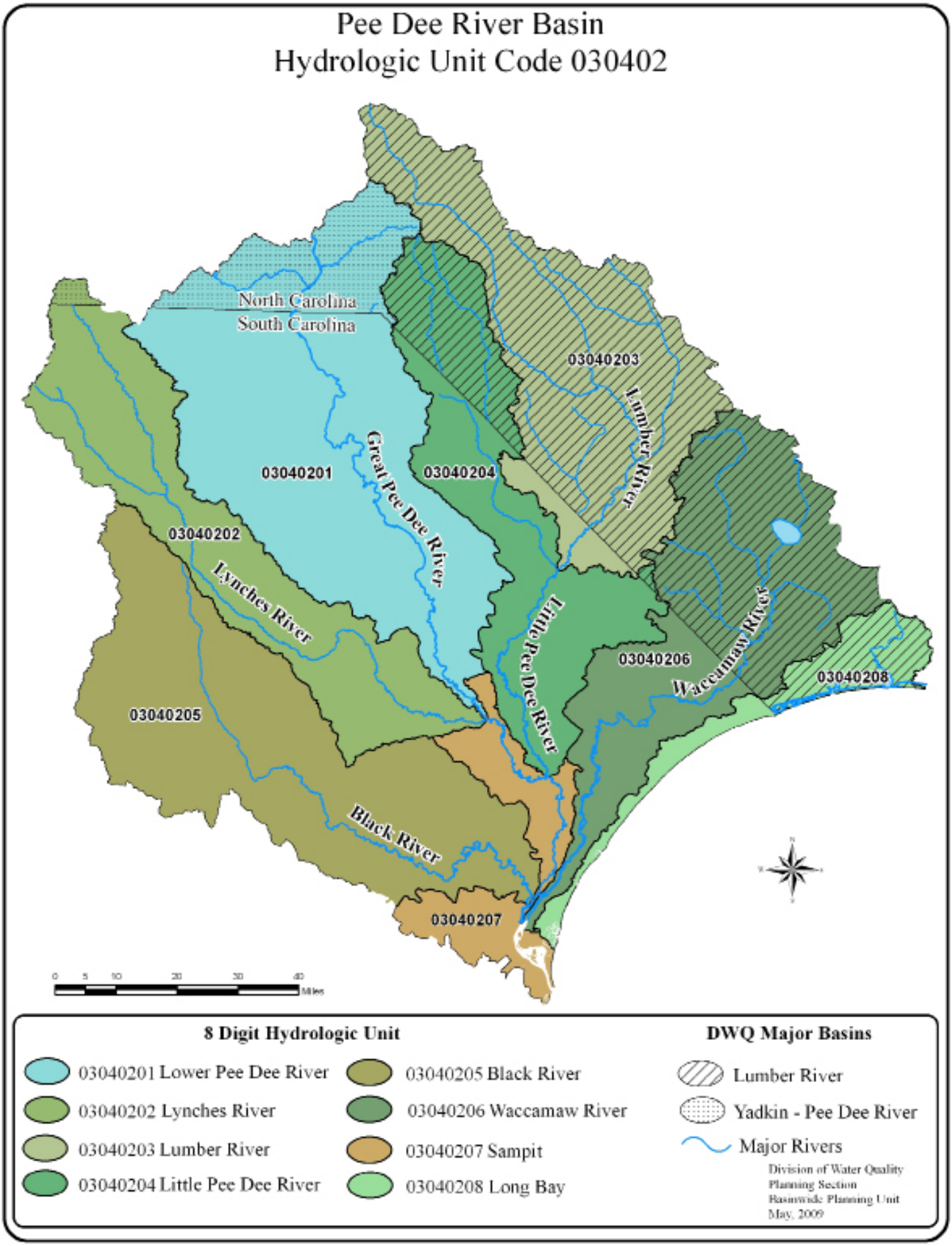
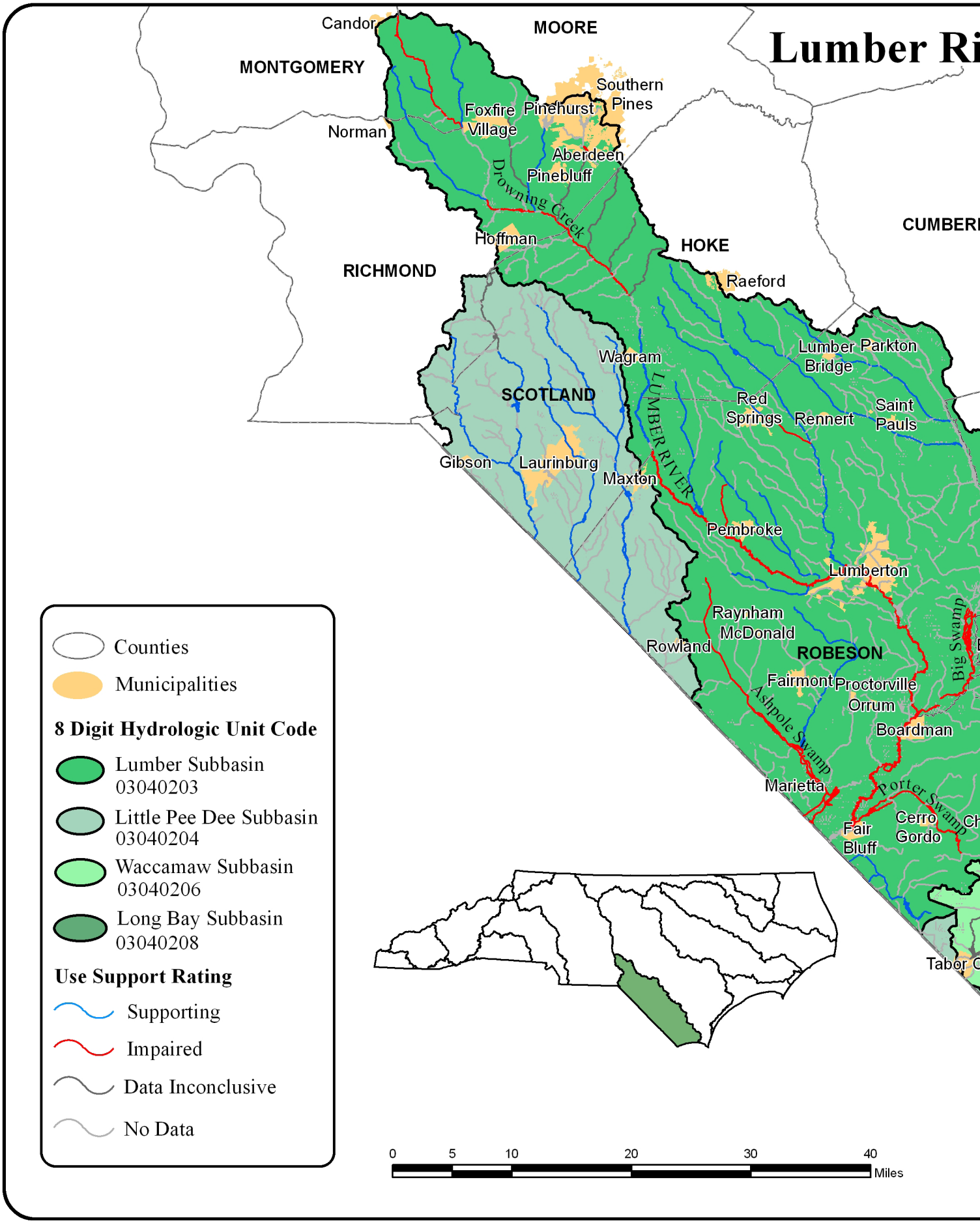
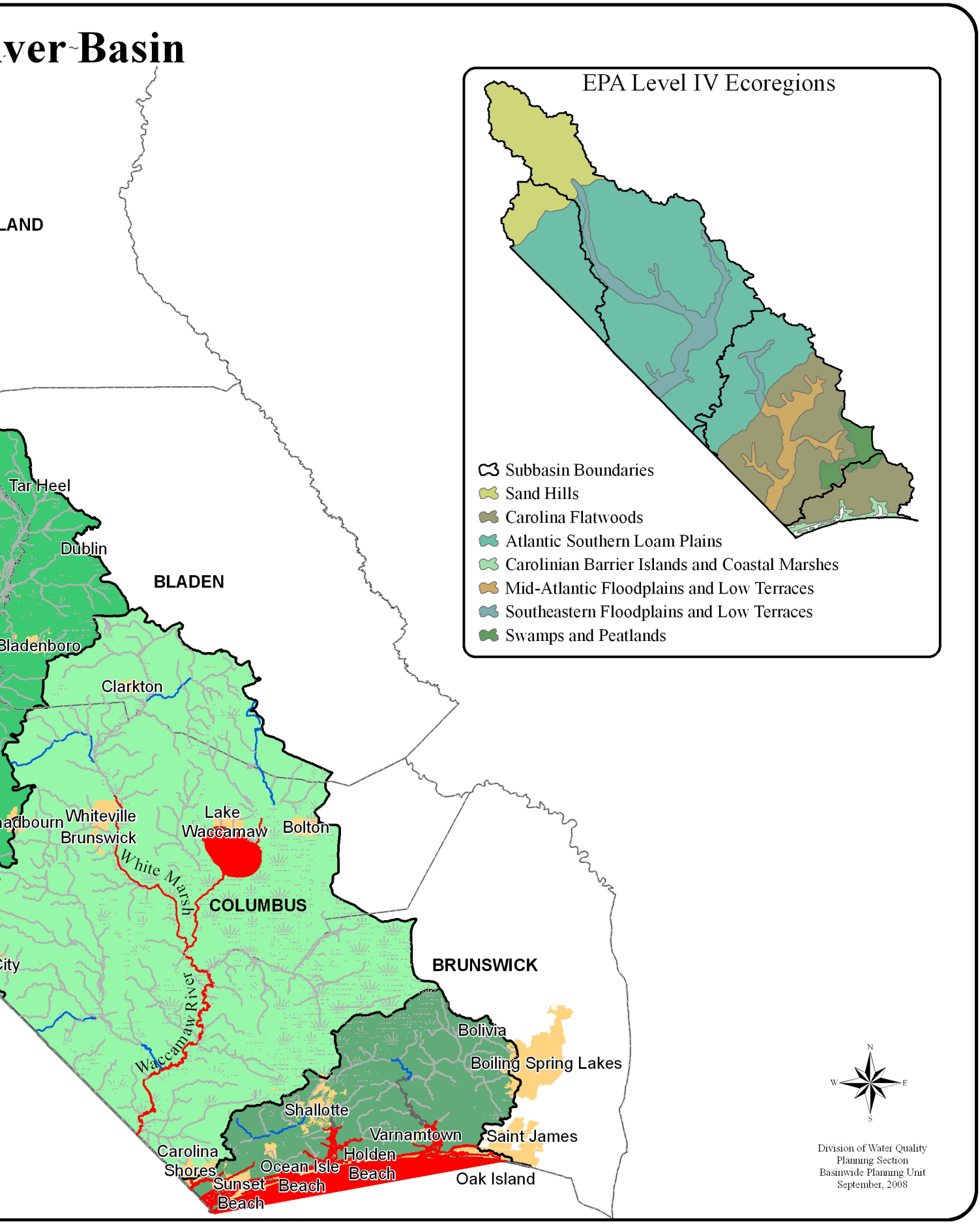


FIGURE 1-3: GENERAL MAP OF THE LUMBER BASIN WITH AN INSET OF ECOREGIONS




ver Basin
LAND
EPA Level IV Ecoregions
Subbasin Boundaries
Sand Hills
Carolina Flatwoods
Atlantic Southern Loam Plains
Carolinian Barrier Islands and Coastal Marshes
Mid-Atlantic Floodplains and Low Terraces
Southeastern Floodplains and Low Terraces
Swamps and Peatlands
Tar Heel
Dublin
BLADEN
Bladenboro
Clarkton
adbourn
Whiteville
Brunswick
Lake
Waccamaw
Bolton
White Marsh
COLUMBUS
ity
BRUNSWICK
Waccamaw River
Bolivia
Boiling Spring Lakes
Shallotte
Varnamtown
Saint James
Carolina
Shores
Ocean Isle
Beach
Holden
Beach
Sunset
Beach
Oak Island
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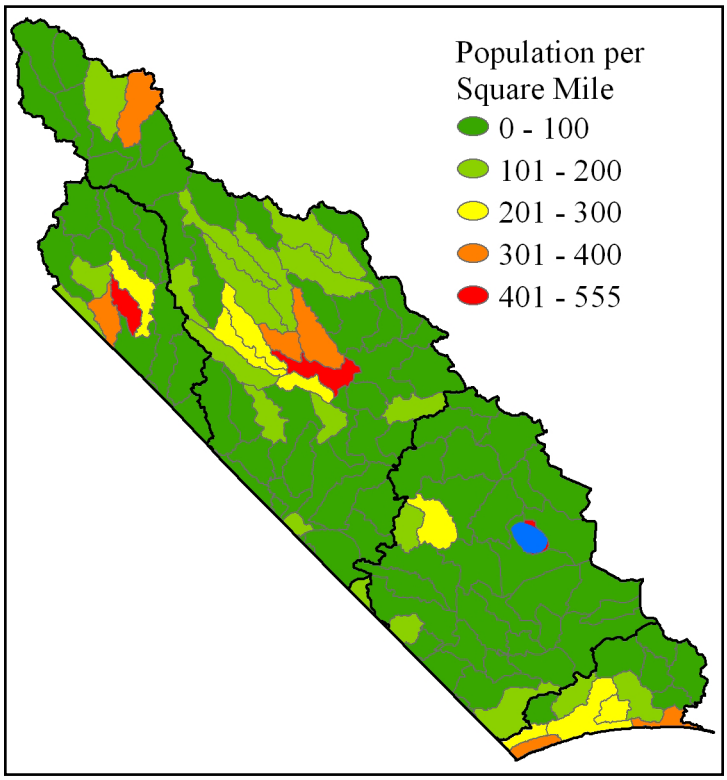
Division of Water Quality
Planning Section
Basinwide Planning Unit
September, 2008

northern Florida to southern New Jersey, but are most highly concentrated in southeastern North Carolina and northeastern South Carolina. These depressional wetlands are distinguished from other wetlands by their elliptical shape, orientation, and an eolian sand rim that is most pronounced along the southeastern shoreline. Many of these wetlands, especially the smaller ones, are ephemeral and provide an ideal habitat for amphibians. They have a very high degree of biodiversity due mainly to varying amounts of soil moisture from inundated in the center to increasingly drier at the edges. Since these wetlands are often isolated from interaction with other surface waters rare or endemic species can be found in and around many of them.

Population and Land Use

The estimated population for the basin is just over 315,000 people based on the 2000 census. The majority of the population growth is occurring in Brunswick, Hoke, and Moore counties. These areas are experiencing rapid growth while the rest of the basin is undergoing small, neutral, or even negative growth. Land use seems to mirror population, thus as areas become more populated there is a greater percentage of impervious surfaces. An increase in impervious surfaces leads to an increase in runoff which correlates to an increase in pollution and habitat degradation. Low impact development can offset some of these impacts and reduce the amount of stormwater that reaches surface waters. Figure 1-4 depicts the population density by subwatershed based on the 2000 census. The data in Figure 1-4 does not depict the seasonal increases in population along the Atlantic coast of Brunswick County nor the rapid growth that has occurred since 2000. A detailed summary of population and land use can be found in the Population and Land Cover chapter of this document.

Figure 1-4: Population Density by Subwatershed



Current Status

This report covers biological and ambient data that was collected between January 1, 2002 and December 31, 2006. However, other issues that have occurred after December 31, 2006 pertaining to water quality are also included. The majority of the problem areas in this basin can be found along the coast while the highest quality waters are located in the sandhills ecoregion, Waccamaw River Headwaters and portions of the Lumber River. Table 1-1 provides a summary of the use support ratings for all waterbodies that have been assigned an assessment unit number. It does not include all waterbodies in the basin. Table 1-4 at the end of this chapter lists all impaired waterbodies and the cause for the impairment.

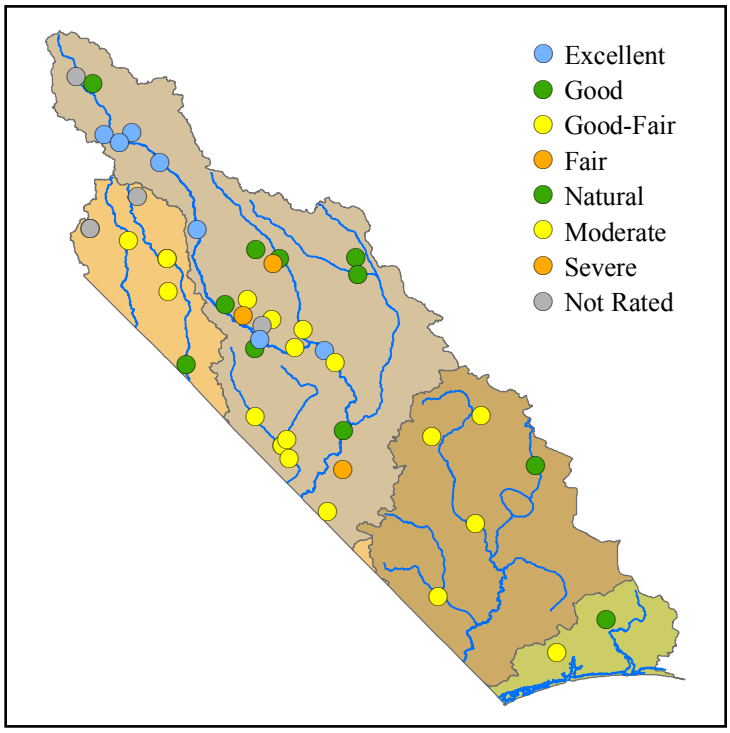
Table 1-1: Summary of Use Support in the Lumber River Basin

	Total (Miles/Acres)	Monitored (Miles/Acres)	Percent Monitored	Percent Impaired	Percent Supporting	Percent Not Rated
Freshwater Miles	2,221.2	693.0	31.2	12.0	16.9	2.2
Coastline Miles	25.6	25.6	100.0	100.0	0.0	0.0
Total Miles	2,246.8	719.0	32.0	13.0	16.7	2.2
Freshwater Acres	9,864.5	9,001.3	91.2	90.0	0.0	0.4
Saltwater Acres	4,848.4	4,692.5	96.8	94.2	0.0	2.5
Total Acres	14,712.9	13,693.8	93.1	92.1	0.0	1.1

Biological Sampling

The Biological Assessment Unit of the Environmental Sciences Section collects information on benthic macroinvertebrates, stream habitats, fish communities, and fish tissue data for the Division of Water Quality (DWQ). Forty-three locations were sampled for benthic macroinvertebrates and assessed for habitat during the 2002-2006 data window (Figure 1-5). Seven of these 43 sites received a lower rating than the previous report and one site's rating improved. Thirteen of the sites were sampled for the first time. Nine of those sites were sampled as part of DWQ requested special studies and four sites were sampled for an Ecosystem Enhancement Program local watershed plan. During the same period 13 fish community sites were observed but not rated, although it was noted that the fish communities appeared to be healthy. Most sites sampled for fish communities contained rare and pollution intolerant species; however, only the Lumber River subbasin and the Little Pee Dee subbasin were sampled. Refer to the ***Lumber River Basinwide Assessment Report*** for more information about benthic macroinvertebrate sampling sites.

Figure 1-5: Most recent Bioclassification Rating for Benthos Sample Taken between 2002-2006.



Ambient Sampling

The Division of Water Quality's Ambient Monitoring System (AMS) collected data from 30 monitoring sites between 2002 and 2006 to measure chemical and physical parameters. Stations are monitored for dissolved oxygen, pH, conductivity, turbidity, and fecal coliform bacteria. Nutrients were monitored at 14 of the sites. These sites are maintained permanently to gauge long term local trends in water quality. Six of the 30 sites were discontinued in July, 2002 and another one was discontinued in September, 2003. A new Random Ambient Monitoring System (RAMS) was started in January 2007, but sampling at the first RAMS site in the Lumber basin began in January of 2009. This program will create new temporary monitoring sites that will measure a wider range of parameters in order to obtain a broader understanding of water quality throughout the entire state. Two RAMS sites are scheduled for collection during the 2009-2010 cycle. Refer to the ***Lumber River Basinwide Assessment Report*** for more information about the ambient monitoring system.

Lakes Assessment

The Intensive Survey Unit of the Environmental Sciences Section tests and reports on the water quality of lakes and reservoirs. Three lakes were sampled during the data window: Pages Lake, Lake Tabor, and Lake Waccamaw. All three of these lakes are currently on the 303(d) list for mercury levels found in fish. Pages Lake has some minor problems with aquatic plant growth due to eutrophication that occurs in summer months but is drained in the winter for weed control. Lake Tabor, like Pages Lake, is man made and also has problems with aquatic plant growth. In July and August of 2006 samples from the lake exceeded the chlorophyll a standard of 40 ug/L. The source of the eutrophication in this lake is most likely from stormwater runoff considering 50 to 75 percent of the shoreline is developed. Lake Waccamaw, the only natural lake tested, was found to be in good condition with the exception of the mercury levels in the fish. However, it was noticed that the adjacent canal has problems with aquatic weed growth.

Water Quality Stressors and Sources

Figure 1-6 shows the stressors that have been identified for rivers and streams whose size is calculated linearly. Similar data is displayed in Figure 1-7 for waterbodies whose size is determined by area, such as lakes, wide coastal rivers and estuaries. Both graphs exclude mercury violations since all water bodies in the basin have been deemed impaired for mercury. Eight out of 14 freshwater ambient monitoring sites exceeded iron standards but these waterbodies were not impaired because iron levels are thought to be naturally high throughout the state.

Figure 1-6: Freshwater Stressors for Streams and Rivers Measured in Miles

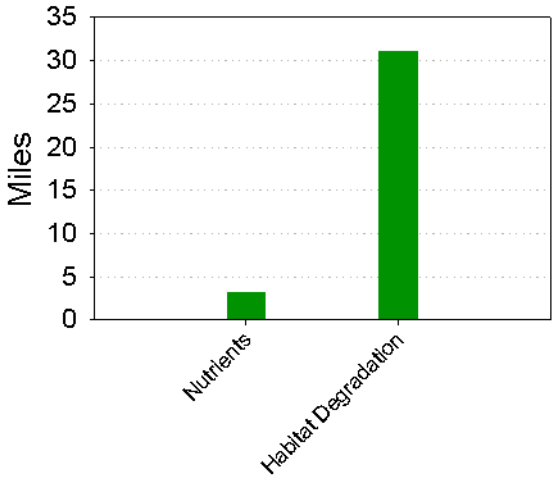
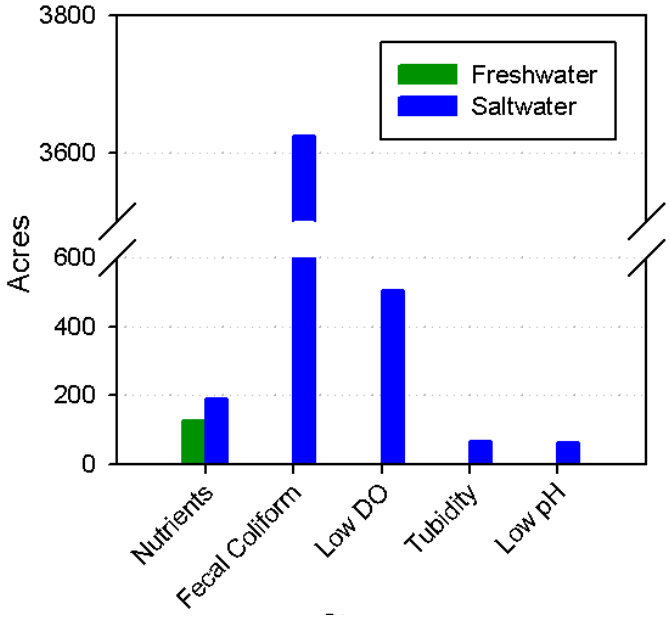


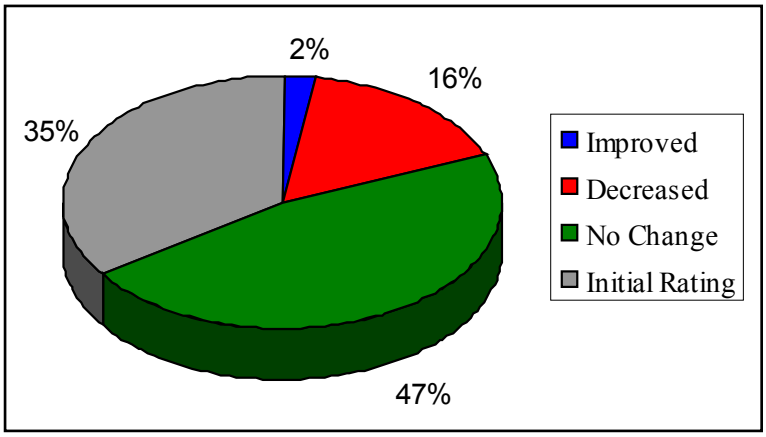
Figure 1-7: Stressors for Waterbodies Measured in Acres (Saltwater bodies and Freshwater Lakes)



Habitat Degradation

Channelization, bottom substrate composition, lack of pool variety, bank instability, lack of riparian buffers, and improper instream water chemistry are all examples of habitat degradation. These factors can lead to a decrease in the overall number and diversity of benthic species indicating a water quality problem. Approximately 31 miles of freshwater streams were reported to be suffering from at least one of the conditions listed above and resulted in a biological impairment. The benthos rating decreased for 16 percent of the benthic macroinvertebrate sites in the basin and three stream segments were impaired for aquatic life. This was the most prevalent cause for new freshwater impairments in the basin. Figure 1-8 illustrates the change in ratings at benthos sampling sites. See Appendix D for a list of biological sampling sites and ratings

Figure 1-8: Change in Benthic Sampling Site Ratings



Fecal Coliform

Fecal coliform bacteria is a widespread stressor in the basin. Figure 1-9 shows that while some samples throughout the basin contained high levels of fecal coliform bacteria, most exceedances occurred in the Long Bay subbasin where fecal coliform standards are lower because of shellfishing resources. Four of the 15 saltwater ambient sites tested exceeded fecal coliform standards. All waterbodies that are currently impaired for fecal coliform exist in the Long Bay subbasin. All Shellfishing waters (SA waters) in the basin are either permanently or periodically closed to shellfish harvesting. According to surveys conducted by the Division of Environmental Health for the

three shellfish growing areas in the basin the source of the fecal coliform is suspected to be from stormwater runoff and septic systems. New stormwater rules were implemented on October 1, 2008 by DWQ in the coastal counties and are described in Chapter 5 of the ***Supplemental Guide to Basinwide Planning***. This should limit fecal coliform loading from new development, but additional activities will be needed to restore the impaired waters.

Turbidity

Two ambient monitoring sites exceeded the saltwater turbidity standard of 25 NTU in at least 10 percent of the samples. Montgomery Slough was just over the 10 percent while Calabash River was in exceedance over 42 percent of the time. The shallow, tidal nature of Montgomery Slough and the Calabash River may contribute to the elevated turbidity. However, the municipalities of Calabash and Sunset Beach have experienced extremely fast growth and development over the assessment period which could be a contributing factor to existing turbidity problem in the river. The Calabash River watershed also has slightly steeper slopes than the surrounding area making it more susceptible to erosion.

Nutrients

Nitrogen and phosphorous over enrichment can result in algal blooms that deplete oxygen, kill fish, and create taste and odor problems in drinking water. Nutrient levels were analyzed at 15 ambient stations throughout the basin, as well as, at all the lake sampling sites. High levels of nutrients in Lake Tabor, Calabash River, and Montgomery Slough are suspected to be the result of increased stormwater runoff from existing and new developments. None of these waterbodies were impaired for Chlorophyll a due to an insufficient number of samples. The lower portions of the Waccamaw River has high levels of Total Kjeldahl Nitrogen (TKN) which may be from natural sources, such as decaying organic matter in adjacent swamps.

Figure 1-9: Percentage of Samples that Exceeded Fecal Coliform Standards from 2002-2006

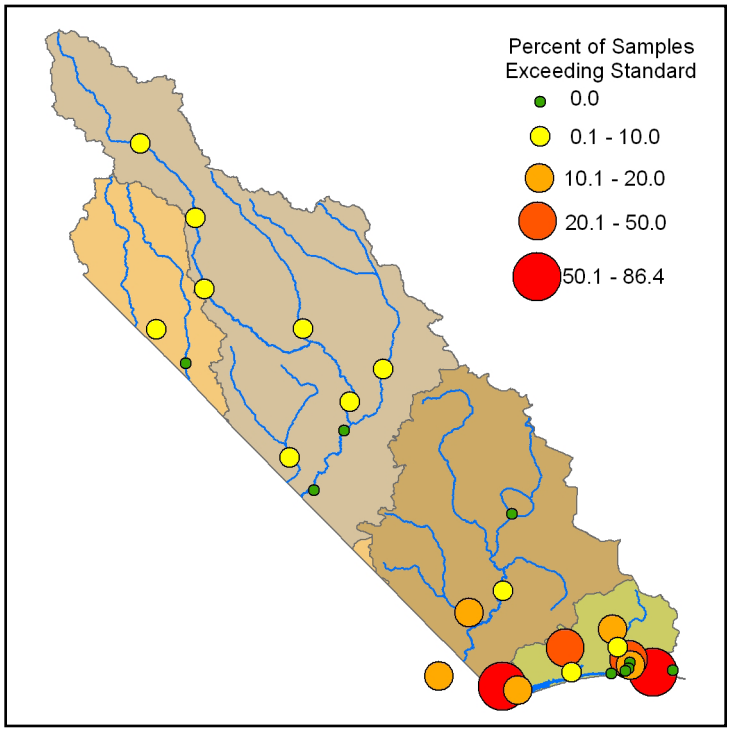
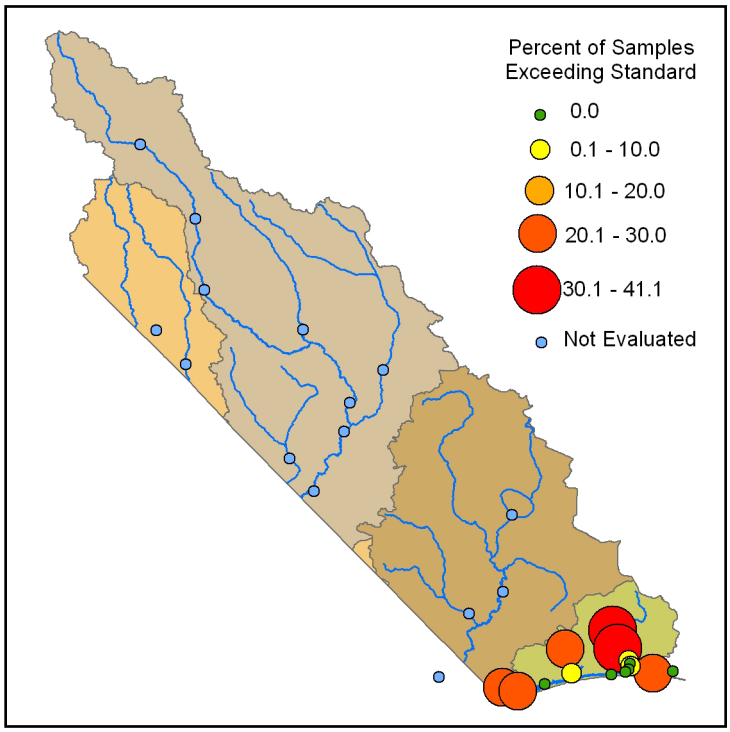


Figure 1-10: Percentage of Samples that Exceeded Dissolved oxygen Standards from 2002-2006



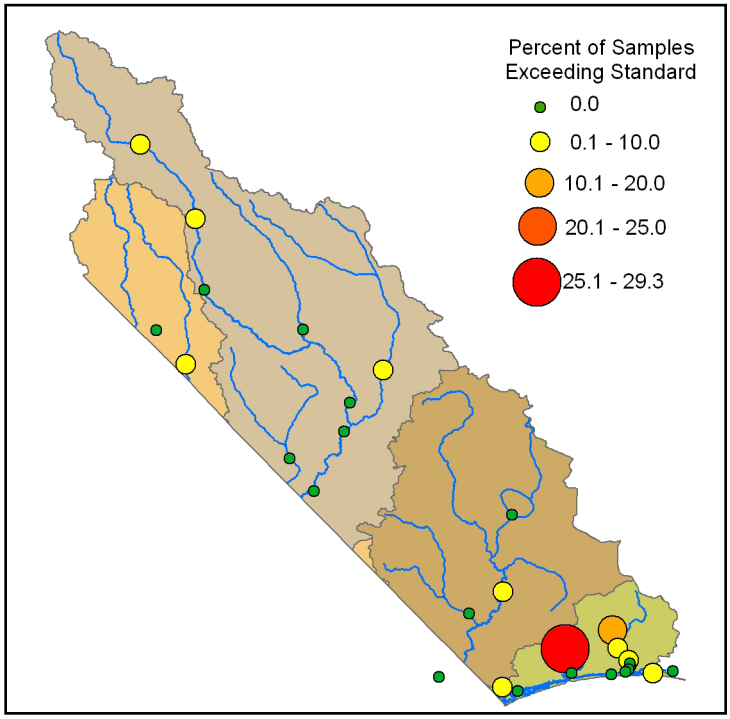
Dissolved Oxygen

Figure 1-10 shows the percentages of samples that exceeded the dissolved oxygen standards. The inland stations do not show any exceedances but this is because these streams are not evaluated for dissolved oxygen. Some of these sites are supplementally designated as Swamp Waters and therefore have a lower standard for dissolved oxygen because it is considered the natural condition of the water. The low dissolved oxygen levels along the coast are caused in some cases by poor flow prohibiting the water from mixing. In others cases it may be the result of interaction with tributaries that possess swamp characteristics.

Low pH

The standard freshwater range for pH is between 6 su and 9 su, but for waterbodies that are supplementally classified as Swamp Waters the pH can be as low as 4.3 su. The different standard for Swamp Waters is to avoid impairing waterbodies that have naturally low pH and are considered healthy at such levels. Only two river segments were less than the pH standards in at least 10 percent of the samples: a section of Lockwoods Folly River and a section of Shallotte River (Figure 1-11). These waterbodies were Not Rated for pH because of possible swamp water interactions.

Figure 1-11: Percentage of Samples Below the pH Standards From 2002-2006



Mercury

In 1994, a basinwide fish consumption advisory for mercury was enacted and in 1997 a statewide fish consumption advisory was issued due to mercury levels found throughout the state. Mercury levels in fish have been found at unsafe levels especially in larger fish due to bioaccumulation. The major source of the mercury has been determined to be atmospheric deposition. Only waterbodies where fish tissue samples have been taken were rated as impaired. A TMDL for mercury has been developed for most of the locations in the basin where fish tissue samples were found to have unsafe levels of mercury.

The conditions that exist in a black water system, such as the Lumber River basin, put them at an increased risk for accumulation of methylmercury. This is because high temperature, high organic content, low dissolved oxygen, and low pH provide the ideal conditions for the methylation of mercury.

See Appendix G for more information regarding mercury.

Copper

This is the first time copper has been assessed to determine use support. The Calabash River is the only waterbody in the Lumber basin that is impaired for copper. Possible sources include antifouling coatings on boats, brake dust, wood preservatives, pesticides, and algalcides.

NPDES Wastewater Discharge Permit Summary

The National Pollutant Discharge Elimination System (NPDES) program requires wastewater treatment facilities that discharge pollutants to obtain a permit. Over time many of the smaller treatment facilities have and continue to be merged with larger more sophisticated facilities. While the large facilities may be allowed to discharge more treated wastewater, the water quality standards for the effluent remain strict and in some cases become even more strict. In order to meet standards, many discharge facilities are now making the transition from discharge to non-discharge by dispersing treated effluent onto sprayfields. Table 1-2 list the permitted wastewater dischargers in the basin by several categories.

Aquatic Toxicology Monitoring

North Carolina's NPDES program requires large dischargers to perform whole effluent toxicity (WET) testing as part of its strategy in meeting the Clean Water Act requirements to control the discharge of toxic pollutants. Currently 25 NPDES discharge permits in the Lumber River Basin require WET monitoring. These facilities are rated on a pass/fail basis and in recent years compliance has remained at about 98 percent.

Table 1-2: Summary of NPDES Permitted Wastewater Dischargers in the Lumber Basin

Facility Category	03040203	03040204	03040206	03040208	Total
Total Facilities	22	9	11	2	44
Permitted Flow (MGD)	46.025	5.485	6.307	0.01	57.827
Grouped by Size					
Major	8	1	3	0	12
Permitted Flow (MGD)	42.09	4	5.1	0.0	51.19
Minor	14	8	8	2	32
Permitted Flow (MGD)	3.935	1.485	1.207	0.01	6.637
Grouped By Type					
100% Domestic	1	1	3	0	5
Permitted Flow (MGD)	0.2	0.018	0.5407	0.0	0.7587
Municipal	10	4	5	0	19
Permitted Flow (MGD)	35.71	4.917	5.74	0.0	46.367
Nonmunicipal	4	2	3	2	11
Permitted Flow (MGD)	9.56	0.3	0.03	0.01	9.9
Water Treatment	7	2	0	0	9
Permitted Flow (MGD)	0.555	0.25	0	0	0.805

Total Maximum Daily Loads

A Total Maximum Daily Load (TMDL) is a calculation of the maximum amount of a pollutant that a waterbody can receive and still meet water quality standards. This includes an allocation of that amount to the pollutant's sources and a margin of safety. A TMDL includes a detailed water quality assessment that can provide the scientific foundation for a restoration implementation plan. However, under the Federal Clean Water Act there is no requirement to develop an implementation plan. Therefore, a TMDL by itself can only identify controls to point sources; however, the allocation estimates are used for development of discharger permit limits. DWQ is supporting local development and implementation of management strategies to address nonpoint sources identified by TMDLs.

There has been one mercury TMDL completed for eleven different waterbodies throughout the Lumber and Waccamaw Watersheds. A statewide TMDL for mercury is being developed and will replace the existing TMDL. Another TMDL is currently under development for fecal coliform in the Lockwoods Folly River Watershed. For more information on TMDL's visit the ***Modeling and TMDL Unit's website.***

Supplemental Classifications

Some waterbodies in the basin have been supplementally classified as High Quality Waters (HQW) or Outstanding Resource Waters (ORW) because they either have excellent water quality or they are a significant resource to humans or wildlife. Figure 1-12 provides an overview of the areas affected by these supplemental classifications. A more detailed description of what constitutes an HQW or ORW and the increased protection required for such waterbodies can be found in Chapter 2 of the ***Supplemental Guide to Basinwide Planning***. Other supplemental designations in the Lumber River basin include the Swamp Water and Unique Wetland classifications. Swamp Waters have low flows and high organic content that produce naturally low pH and dissolved oxygen levels. Unique Wetlands are wetlands have exceptional state or national significance and are essential for conservation.

High Quality Water (HQW)

There are 171 freshwater miles and 4,668 saltwater acres of HQW classified waters in the basin. About 7.7 percent of all freshwater streams in the basin are classified as HQW. All streams in the watersheds of Jackson

Creek (030402030101), Headwaters Drowning Creek (030402030102), Big Branch-Upper Drowning Creek (030402030104), and Lower Drowning Creek (030402030201) are classified as HQW. Also the first 68.6 miles of the Lumber River are classified HQW. See Appendix B for the classification specific to each individual assessment unit.

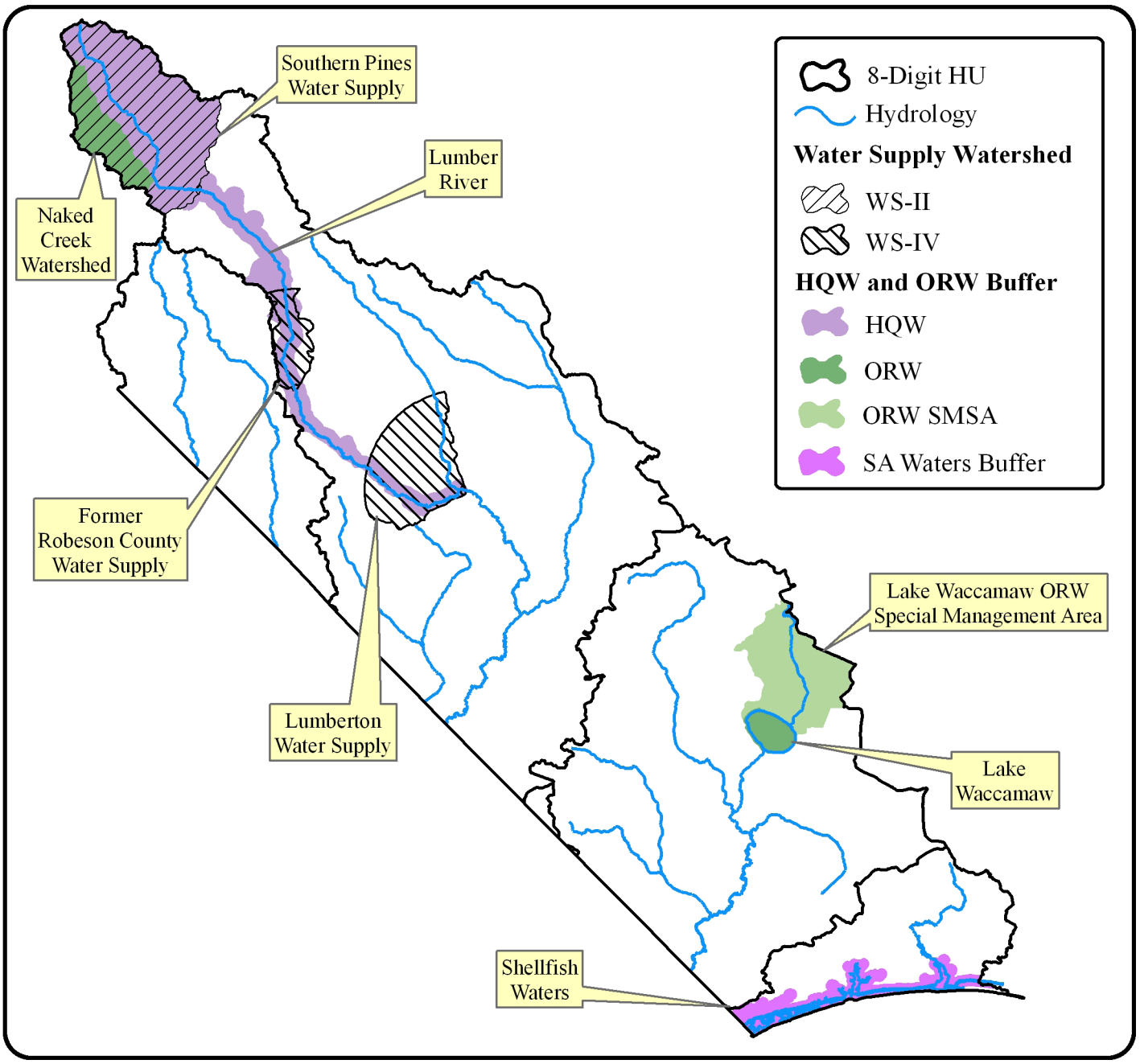
Outstanding Resource Water (ORW)

There are 43 miles and 8840 acres of ORW waters in the basin. All of the streams found within Naked Creek subwatershed (030402030103) and all of Lake Waccamaw (AU# 15-4) are classified as ORW.

ORW Special Management Strategy Area

All waters that drain to Lake Waccamaw are subject to the Lake Waccamaw Special Management Strategy. These waters have the same requirement as ORW waters because they are vital to protecting water quality in the lake [15 NCAC 02B.0225 (c) (10)]. This designation is denoted in Appendix B by a + symbol.

Figure 1-12: High Quality Waters and Outstanding Resources Waters in the Lumber Basin



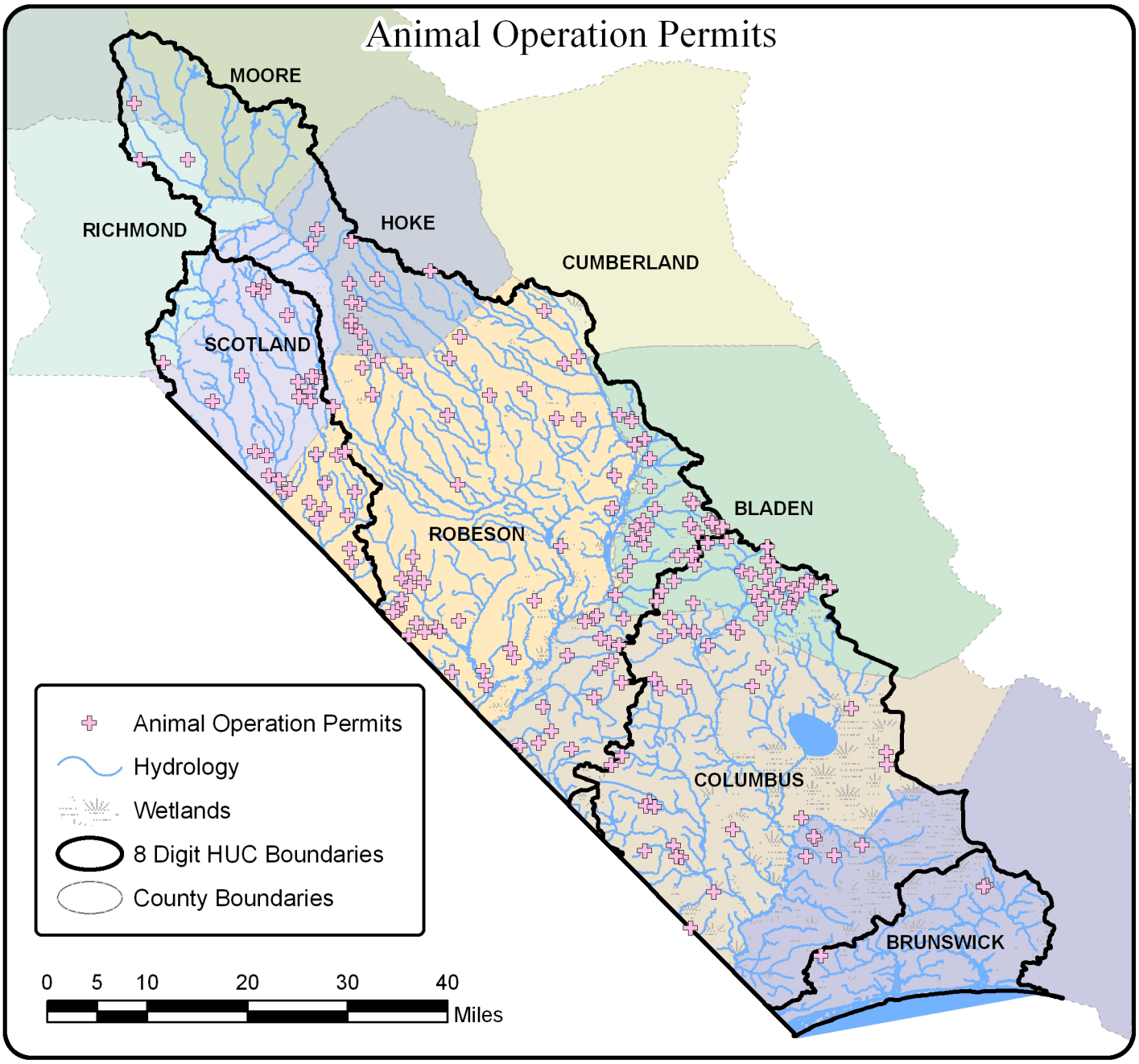
Animal Operations Summary

All animal operations permits in the basin are for swine. There are poultry and cattle operation in the basin but these facilities do not meet the criteria that requires a permit. Over 30 percent of all animal operation permits in the Lumber Basin are in Bladen County despite the fact that most of the county is outside of the basin. Table 1-3 lists the steady state live weight estimates for swine in the Lumber Basin and Figure 1-13 shows the location of permitted swine operations in the basin. There are incentives available through the North Carolina Division of Soil and Water Conservation for farmers that would like to improve their swine operations.

Table 1-3: Permitted Swine Operations in the Lumber Basin

8 Digit HUC	Number of Facilities	Number of Animals	Steady State Live Weight in Pounds
03040203	104	521,847	72,538,383
03040204	30	143,587	31,859,010
03040206	64	296,686	43,629,226
03040208	3	8,072	1,283,420

Figure 1-13: Animal Operation Permits Map



Recommendations

Reduce Impacts from Point Sources

Upgrade Wastewater Treatment Plants

Regionalization allows for waste from rural areas to come together and be treated at a high quality facility that may not be possible for many small communities otherwise. This may be accomplished through grants such as the CWMTF and loans such as the ones provide by the Construction Grants and Loans Section of DWQ. A recent example of regionalization in the area is the Fairmont Regional Wastewater Treatment Plant (WWTP) which allowed for other older and smaller plants to shut down. Another recent example is the West Brunswick WWTP which began connecting to areas that had previously been on septic systems. Upgrades to WWTPs that are in disrepair or use outdated technology can decrease pollution of surface waters.

Upgrade Animal Operations

The Division of Soil and Water Conservation initiated the Lagoon Conversion Program in 2007. This program provides cost sharing opportunities for swine farmer to upgrade their farms with more technologically advanced systems for managing waste produced by the animals. These innovative waste management systems would reduce discharge or seepage of hog waste to surface waters.

Reduce Impacts from Nonpoint Sources

Limit Impervious Surfaces and Improve Stormwater Management

Areas lacking stormwater regulations are encouraged to develop and implement stormwater management plans. As new construction occurs in the basin, developers are encouraged to design both commercial and residential properties using low impact techniques. The longer these area go without stormwater regulation the problems associated with stormwater runoff become greater and so does the cost of remedying the situation.

Protect and Establish Buffers

Since the last basinwide plan there have been many achievements in conserving lands that protect water quality and provide habitat. There remain many unprotected areas with nationally significant ecosystems and good water quality in need of conservation. The continued purchase of easements and preserves is encouraged especially in the Lumber River and Waccamaw River floodplains. The Boiling Springs Wetlands Complex in Brunswick County is under extreme pressure from development and may be severely impacted if not protected soon. Some common incentive programs for such projects include the Nonpoint Source 319(h) Grant Program, the Clean Water Management Trust Fund (CWMTF), and the North Carolina Agriculture Cost Share Program (NCACSP).

Research Needs

Turbidity and Copper Studies

Calabash River and Montgomery Slough are both impaired for turbidity. Some of the turbidity is believed to be related to the low, shallow, and tidal nature of these streams, although land disturbing activities can not be ruled out entirely. A study is needed to determine the cause of the turbidity impairments and what is required to restore water quality.

Boat maintenance activities, such as scraping, sanding, pressure washing, and painting is a source of copper that may be reaching surface waters. Brake dust can contain varying amount of copper and can reach surface waters through runoff or atmospheric deposition. Some pesticides and algaecides contain copper that may be contributing to the copper levels. A copper study is recommended for the Calabash River.

Fish Community Evaluation Criteria

Currently no criteria exist to quantitatively evaluate the health of fish communities in both the sandhills streams or the coastal plain streams of the basin. Developing criteria specific to these ecoregions will allow DWQ to

better evaluate fish community health and how it relates to water quality. Piedmont and mountain methodology applied to this area may lead to improper diagnosis of water quality. Development of such capability is listed as a research priority for the Lumber River Basin in the ***North Carolina Wildlife Action Plan*** created by the Wildlife Resources Commission.

Non-discharge Methods and Consequences
The practice of spreading sludge and partially treated wastewater onto fields is one approach that is increasingly being employed to meet standards. The sludge and effluent from wastewater treatment plants contains valuable nutrients, but may also contain toxic substances. Studies are needed to determine any environmental problems that may arise as this transition is being made and develop methods to prevent possible contamination of surface waters. GIS mapping of the sprayfields is needed so that better spatial analysis may be conducted.

Restore Impaired Waters

Aquatic Life Impairments
Little Raft Swamp, Mill Branch, and Porter Swamp are all impaired for ecological and biological integrity. Little Raft Swamp was impacted by the Red Springs WWTP, which has since been upgraded and continues to make further improvement to the facility and its operation in order to restore water quality. Both Mill Branch and Porter Swamp are in mostly agricultural watersheds, lack stream buffers, and have modified channels. These streams would benefit from habitat restoration. The Ecosystem Enhancement Program has designated both of these watershed as targeted local watersheds meaning that the program has determined that they exhibit a need for restoration or protection of wetlands, streams, and riparian buffers and will receive priority for EEP planning and project funds. The Division of Soil and Water Conservation are encouraged to direct funds to these watershed through the Agriculture Cost Share Program and the Conservation Reserve Enhancement Program.

A reduction of copper levels is needed in Calabash River to meet water quality standards. Education of individual boat owners about how to safely clean their boats is encouraged.

Shellfish Harvesting Impairments
While new coastal stormwater rules are now in effect to control bacteria loading for new development, additional actions are needed to help restore water quality. DWQ supports prioritizing funding to projects that plan to retrofit existing development with stormwater controls especially in watersheds that drain to shellfishing waters. The Division of Soil and Water Conservation offers grants through the Community Conservation Assistance Program for the instillation of best management practices that restore water quality in urban areas. These types of project could be done in towns like Shallotte and Calabash that need to reduce their impervious surface or put in place other protective measures. The Ecosystem Enhancement Program has identified areas for potential stormwater retrofitting projects in the Lockwoods Folly Watershed.

Fish Consumption Impairments
A decrease in mercury emissions is necessary to reduce mercury levels found in fish tissue samples. The main source of these emissions are from coal fired power plants. Since mercury can be transported over long distances, this is a global problem that requires state, federal, and international cooperation.

Table 1-4: Impaired Waterbodies in the Lumber River Basin

Assessment Unit Number	Hydrologic Unit Code	Name	Class	Parameter of Interest
14-(13)a	03040203	Lumber River	C;Sw	Mercury
14-(13)b	03040203	Lumber River	C;Sw	Mercury
14-(13)c	03040203	Lumber River	C;Sw	Mercury
14-(13)d	03040203	Lumber River	C;Sw	Mercury
14-(13)e	03040203	Lumber River	C;Sw	Mercury
14-(13)f	03040203	Lumber River	C;Sw	Mercury
14-(4.5)b	03040203	Lumber River	B;Sw;HQW	Mercury
14-(4.5)c	03040203	Lumber River	B;Sw;HQW	Mercury
14-(4.5)d	03040203	Lumber River	B;Sw;HQW	Mercury
14-(7)	03040203	Lumber River	WS-IV;B;Sw;HQW	Mercury
14-10-5b	03040203	Little Raft Swamp	C;Sw	Benthos
14-2-(1)a	03040203	Drowning Creek	WS-II;Sw;HQW	Mercury
14-2-(10.5)	03040203	Drowning Creek	C;Sw;HQW	Mercury
14-2-(6.5)	03040203	Drowning Creek	WS-II;Sw;HQW	Mercury
14-2-11-(5)	03040203	Aberdeen Creek [Pages Lake (Aberdeen Lake)]	B	Mercury
14-22a	03040203	Big Swamp	C;Sw	Mercury
14-22b	03040203	Big Swamp	C;Sw	Mercury
14-27	03040203	Porter Swamp	C;Sw	Benthos; Mercury
14-30a	03040203	Ashpole Swamp	C;Sw	Mercury
14-30b	03040203	Ashpole Swamp	C;Sw	Mercury
14-6	03040203	Mill Branch	C	Benthos
15-(1)a	03040206	Waccamaw River	C;Sw	Mercury
15-(1)b	03040206	Waccamaw River	C;Sw	Mercury
15-(1)c	03040206	Waccamaw River	C;Sw	Mercury
15-(1)d	03040206	Waccamaw River	C;Sw	Mercury
15-(1)e	03040206	Waccamaw River	C;Sw	Mercury
15-(18)	03040206	Waccamaw River	B;Sw	Mercury
15-2	03040206	Lake Waccamaw	B;Sw;ORW	Mercury
15-2-6	03040206	Big Creek	C;Sw;+	Mercury
15-4a	03040206	White Marsh	C;Sw	Mercury
15-4b	03040206	White Marsh	C;Sw	Mercury
15-25-1-(16)a	03040208	Lockwoods Folly River	SA;HQW:@	Shellfish Harvesting
15-25-1-(16)b	03040208	Lockwoods Folly River	SA;HQW:@	Shellfish Harvesting
15-25-1-(16)c	03040208	Lockwoods Folly River	SA;HQW:@	Shellfish Harvesting;
15-25-1-(16)d	03040208	Lockwoods Folly River	SA;HQW:@	Shellfish Harvesting
15-25-1-18-(2)	03040208	Mill Creek	SA;HQW	Shellfish Harvesting
15-25-1-19	03040208	Mullet Creek	SA;HQW;@	Shellfish Harvesting
15-25-1-20	03040208	Lockwoods Creek	SA;HQW;@	Shellfish Harvesting
15-25-1-21	03040208	Spring Creek	SA;HQW;@	Shellfish Harvesting

Assessment Unit Number	Hydrologic Unit Code	Name	Class	Parameter of Interest
15-25-10	03040208	The Big Narrows	SA;HQW	Shellfish Harvesting
15-25-11	03040208	Blane Creek	SA;HQW	Shellfish Harvesting
15-25-11-1	03040208	Fox Creek	SA;HQW	Shellfish Harvesting
15-25-11-2	03040208	Salt Boiler Creek	SA;HQW	Shellfish Harvesting
15-25-11-3	03040208	Bull Creek	SA;HQW	Shellfish Harvesting
15-25-12	03040208	Little River	SA;HQW	Shellfish Harvesting
15-25-12-1	03040208	Dead Backwater	SA;HQW	Shellfish Harvesting
15-25-12-1-1	03040208	East River	SA;HQW	Shellfish Harvesting
15-25-12-2	03040208	Bonaparte Creek	SA;HQW	Shellfish Harvesting
15-25-12-3	03040208	Clayton Creek	SA;HQW	Shellfish Harvesting
15-25-13	03040208	Calabash River	SA;HQW	Shellfish Harvesting, Turbidity; Copper
15-25-13-1	03040208	Hangman Branch	SA;HQW	Shellfish Harvesting
15-25-2-(10)a	03040208	Shallotte River	SA;HQW	Shellfish Harvesting
15-25-2-(10)b	03040208	Shallotte River	SA;HQW	Shellfish Harvesting
15-25-2-(10)c	03040208	Shallotte River	SA;HQW	Shellfish Harvesting
15-25-2-(10)d	03040208	Shallotte River	SA;HQW	Shellfish Harvesting
15-25-2-11-(2)	03040208	The Mill Pond	SA;HQW	Shellfish Harvesting
15-25-2-12-(2)	03040208	Sams Branch	SA;HQW	Shellfish Harvesting
15-25-2-14	03040208	The Swash	SA;HQW	Shellfish Harvesting
15-25-2-15-(3)	03040208	Shallotte Creek	SA;HQW	Shellfish Harvesting
15-25-2-16	03040208	Saucepan Creek	SA;HQW	Shellfish Harvesting
15-25-2-16-1-(2)	03040208	Jinnys Branch	SA;HQW	Shellfish Harvesting
15-25-2-16-4-(2)	03040208	Goose Creek	SA;HQW	Shellfish Harvesting
15-25-3	03040208	Big Gut Slough	SA;HQW	Shellfish Harvesting
15-25-4	03040208	Kilbart Slough	SA;HQW	Shellfish Harvesting
15-25-5	03040208	Gause Landing Creek	SA;HQW	Shellfish Harvesting
15-25-6	03040208	Eastern Channel	SA;HQW	Shellfish Harvesting
15-25-6-1	03040208	Clam Creek	SA;HQW	Shellfish Harvesting
15-25-7	03040208	Sols Creek	SA;HQW	Shellfish Harvesting
15-25-8	03040208	Still Creek	SA;HQW	Shellfish Harvesting
15-25-9	03040208	Jinks Creek	SA;HQW	Shellfish Harvesting
15-25-6-1	03040208	Cooter Creek	SA;HQW	Shellfish Harvesting
15-25d	03040208	Intracoastal Waterway	SA;HQW	Shellfish Harvesting
15-25f	03040208	Intracoastal Waterway	SA;HQW	Shellfish Harvesting
15-25g	03040208	Intracoastal Waterway	SA;HQW	Shellfish Harvesting
15-25i	03040208	Intracoastal Waterway	SA;HQW	Shellfish Harvesting
15-25j	03040208	Intracoastal Waterway	SA;HQW	Shellfish Harvesting
15-25k	03040208	Intracoastal Waterway	SA;HQW	Shellfish Harvesting
15-25l	03040208	Intracoastal Waterway	SA;HQW	Shellfish Harvesting
15-25m	03040208	Intracoastal Waterway	SA;HQW	Shellfish Harvesting

Assessment Unit Number	Hydrologic Unit Code	Name	Class	Parameter of Interest
15-25n	03040208	Intracoastal Waterway	SA;HQW	Shellfish Harvesting
15-25o	03040208	Intracoastal Waterway	SA;HQW	Shellfish Harvesting
15-25p	03040208	Intracoastal Waterway	SA;HQW	Shellfish Harvesting
15-25q	03040208	Intracoastal Waterway	SA;HQW	Shellfish Harvesting
15-25r	03040208	Intracoastal Waterway	SA;HQW	Shellfish Harvesting
15-25s	03040208	Intracoastal Waterway	SA;HQW	Shellfish Harvesting
15-25t	03040208	Intracoastal Waterway	SA;HQW	Shellfish Harvesting
15-25u	03040208	Intracoastal Waterway	SA;HQW	Shellfish Harvesting
15-25v	03040208	Montgomery Slough	SA;HQW	Shellfish Harvesting, Turbidity; Low DO
99-(1)	03040208	Atlantic Ocean	SB	Mercury

Note: Mercury impairments listed are the result of direct fish tissue samples. However, all waters statewide are impaired for mercury on an evaluated basis.