

North Carolina's Basinwide Approach to Water Quality Management

Basinwide water quality planning is a nonregulatory watershed-based approach to restoring and protecting the quality of North Carolina's surface waters. Basinwide water quality plans are prepared by the NC Division of Water Quality (DWQ) for each of the 17 major river basins in the state. Each basinwide plan is revised at five-year intervals. While these plans are prepared by the DWQ, the implementation and the protection of water quality entails coordinated efforts of many agencies, local governments and stakeholders in the state.

The goals of DWQ's basinwide program are to:

- Identify water quality problems and restore full use to impaired waters,
- Identify and protect high value resource waters, and
- Protect unimpaired waters while allowing for reasonable economic growth.

DWQ accomplishes these goals through the following objectives:

- Evaluate cumulative effects of pollution,
- Assure equitable distribution of waste assimilative capacity for dischargers,
- Regulate point and nonpoint source pollution where other approaches were unsuccessful,
- Improve public awareness and involvement, and
- Collaborate with other agencies to develop appropriate management strategies to protect and restore water quality. This includes providing agencies information related to financial and funding opportunities.

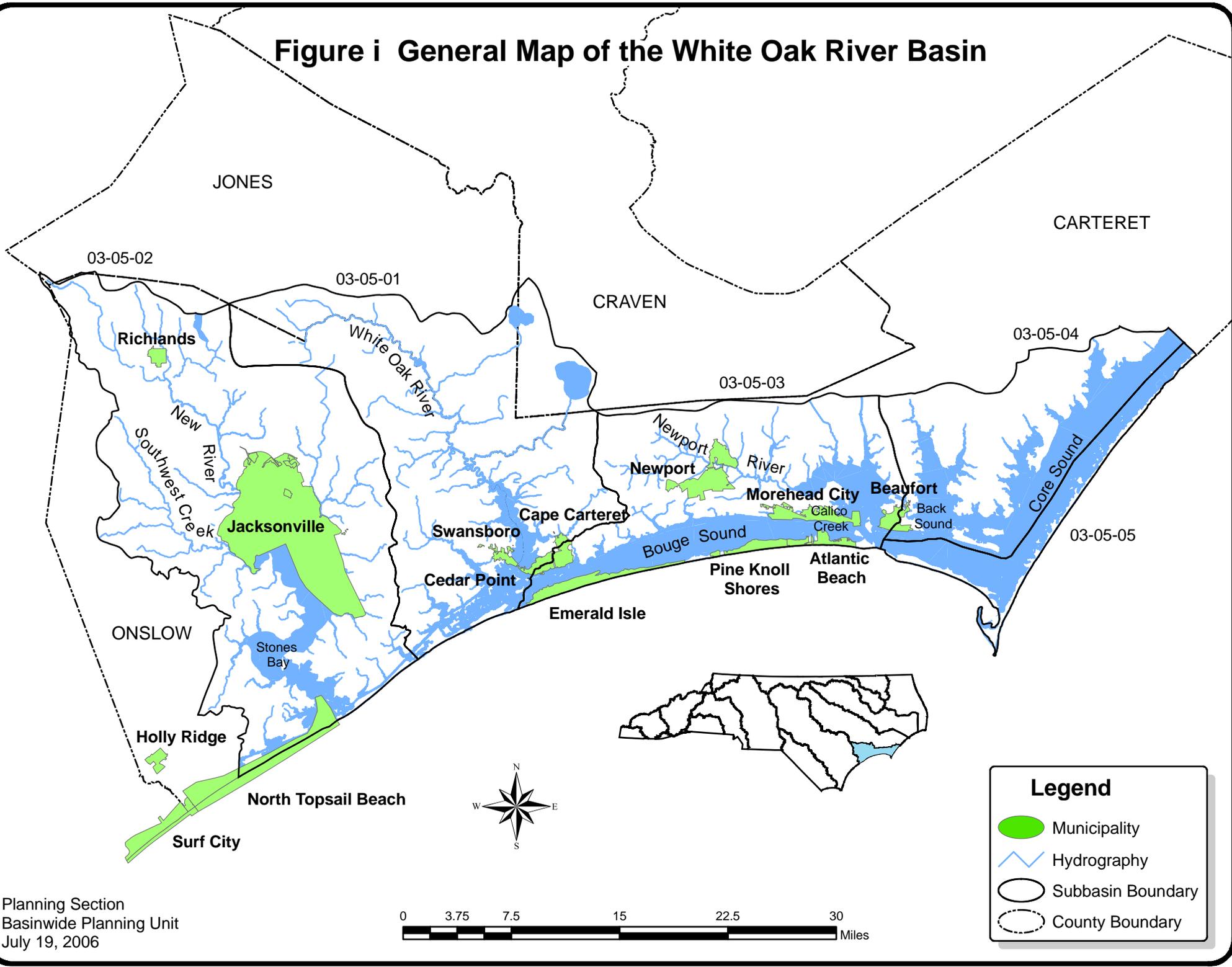
This document is the third edition of the *White Oak River Basinwide Water Quality Plan* updated on a five-year cycle. The first basinwide plan for the White Oak River basin was completed in 1997 and the second in 2001. The format of this plan was revised in response to comments received during the first planning cycle. DWQ replaced much of the general information in the first two plans with more detailed information specific to the White Oak River basin. For this plan, a greater emphasis was placed on identifying water quality concerns on the watershed level in order to facilitate protection and local restoration efforts. Refer to the Introduction for additional information on the Basinwide Planning Program.

White Oak River Basin Overview

The White Oak River basin lies entirely within the outer coastal plain (Figure *i*). The name of the basin is a bit of a misnomer in that it includes four separate river systems: the New River and its tributaries in the southwestern section; the White Oak River and its tributaries; the Newport River and its tributaries; and the North River in the eastern section. The basin also includes Bogue, Back and Core Sounds as well as significant portions of the Intracoastal Waterway.

Information presented in this basinwide water quality plan is based on information collected from September 1999 to November 2006 to describe water quality conditions and issues in each of the five subbasins. Specific water quality assessments were based on biological, chemical and

Figure i General Map of the White Oak River Basin



physical monitoring data collected between September 1999 and August 2004. A discussion of conditions reflecting whether specific surface waters support their best-intended use and maps of each subbasin are included in each subbasin chapter (Chapters 1 – 5). Each subbasin has a mix of freshwater and saltwater, high quality (Class HQW) and outstanding resource waters (Class ORW), recreational (Class B) and shellfish harvesting (Class SA) uses. Each subbasin has its own unique characteristics and water quality concerns. Below is a brief description of each subbasin and their water classifications.

Subbasin 03-05-01

The White Oak River watershed (subbasin 03-05-01), the basin’s namesake, is located east of the New River. The White Oak River and its tributaries primarily flow through Onslow and Carteret counties, with small portions flowing through Jones and Craven counties. The river flows past the western end of Bogue Sound and into the Atlantic Ocean at Bogue Inlet. It is the second largest watershed in the basin. Most of this area, including its two lakes (Catfish Lake and Great Lake), lies relatively undisturbed within the Croatan National Forest and Hoffman State Forest. There are 113 stream miles, 12,314 estuarine acres and eight miles of Atlantic coastline in this subbasin.

Population has increased in this subbasin, especially in and around Swansboro. There has been a noted loss in agricultural land as development expands inland. There are five individual NPDES wastewater discharge permits in this subbasin.

Surface water classifications and the amount of acreage or miles in subbasin 03-05-01 are listed in Table *i*. Of the monitored waters, 44 percent of freshwater and saltwater acres are Impaired for aquatic life, and 100 percent of saltwater miles and 63 percent of saltwater acres are Impaired for shellfish harvesting. Impaired waters on the 2004 303(d) list include 5.3 miles and 6,630.4 acres. Chapter 1 presents specific water quality information for each monitored waterbody in this subbasin.

Table *i* Subbasin 03-05-01 DWQ Classifications by Acres and Miles

DWQ Classification	Freshwater Acres	Freshwater Miles	Saltwater Acres	Saltwater Miles
C	949	106	--	--
C HQW	--	3	--	--
SC	--	--	328	--
SA HQW	--	--	8,462	4
SA ORW	--	--	2,570	--
Total	949	109	11,360	4

C/SC= Aquatic life propagation/protection and secondary recreation, SA= Shellfish waters, HQW= High Quality Waters, ORW= Outstanding Resource Waters

Subbasin 03-05-02

The New River watershed (subbasin 03-05-02) is the furthest west of the four major river systems in the basin. It is also the largest and most populated and includes the City of Jacksonville and the Camp Lejeune Marine Corps Base. The New River is a coastal blackwater river with a watershed entirely within Onslow County. Gum-cypress swamps characterize the watershed above Jacksonville with upland areas used primarily for agriculture and forestry activities. At Jacksonville, the river widens into a broad, slow-moving tidal embayment. It eventually discharges to the Atlantic Ocean through a narrow opening called New River Inlet. There are 204 stream miles, 22,840 estuarine acres and 15 miles of Atlantic coastline in this subbasin.

The City of Jacksonville and the Camp Lejeune Marine Corps Base comprise the majority of land in the lower watershed (that area below the US 17 bridge). This is the most densely populated area in the basin. There are 27 individual NPDES wastewater discharge permits in this subbasin.

Surface water classifications and the amount of acreage or miles in subbasin 03-05-02 are listed in Table *ii*. Of the monitored waters, 100 percent of saltwater miles and five percent of saltwater acres are Impaired for aquatic life; 24 percent of saltwater acres are Impaired for shellfish harvesting. Impaired waters on the 2004 303(d) list include 55.3 miles and 11,585.3 acres. Chapter 2 presents specific water quality information for each monitored waterbody in this subbasin.

Table *ii* Subbasin 03-05-02 DWQ Classifications by Acres and Miles

DWQ Classification	Freshwater Acres	Freshwater Miles	Saltwater Acres	Saltwater Miles
B NSW	36	--	--	--
C HQW NSW	595	--	--	--
C NSW	--	137	--	--
SA HQW	--	--	10,747	--
SA ORW	--	--	720	--
SB HQW NSW	--	--	49	--
SB NSW	--	--	364	4
SC	--	--	539	--
SC HQW	--	--	19	2
SC HQW NSW	--	--	1,363	15
SC NSW	--	--	8,409	45
Total	631	137	22,210	66

C/SC= Aquatic life propagation/protection and secondary recreation, **B/SB=** Primary recreation and Class C uses, **SA=** Shellfish waters, **HQW=** High Quality Waters, **ORW=** Outstanding Resource Waters, **NSW=** Nutrient Sensitive Waters

Subbasin 03-05-03

The Newport River watershed (subbasin 03-05-03) is located just east of the White Oak River. It flows into the eastern end of Bogue Sound before entering the Atlantic Ocean near Morehead City. There are 74 stream miles, 34,445 estuarine acres and 25 miles of Atlantic coastline in this subbasin.

With the exception of Newport, most of the development in this subbasin is along the coast. Morehead City, Newport and the communities along Bogue Banks experienced population increases, while Atlantic Beach and Beaufort population decreased between 1990 and 2000. There are eight individual NPDES wastewater discharge permits in this subbasin. Calico Creek, the receiving water for the Morehead City WWTP discharge, is rated as Impaired for both the aquatic life and recreation use support categories.

Surface water classifications and the amount of acreage or miles in subbasin 03-05-03 are listed in Table *iii*. Of the monitored waters, two percent of saltwater acres are Impaired for aquatic life, less than one percent of saltwater acres are Impaired for recreation, 100 percent of saltwater miles and 43 percent of saltwater acres are Impaired for shellfish harvesting. Impaired waters on the 2004 303(d) list include 17.7 miles and 7,462.5 acres. Chapter 3 presents specific water quality information for each monitored waterbody in the subbasin.

Table *iii* Subbasin 03-05-03 DWQ Classifications by Acres and Miles

DWQ Classification	Freshwater Acres	Freshwater Miles	Saltwater Acres	Saltwater Miles
C	--	69	--	--
SA HQW	--	--	22,631	5
SA ORW	--	--	11,236	--
SB	--	--	24	--
SC	--	--	414	--
SC HQW	--	--	140	--
Total	--	69	34,445	5

C/SC= Aquatic life propagation/protection and secondary recreation, SB= Primary recreation and Class C uses, SA= Shellfish waters, HQW= High Quality Waters, ORW= Outstanding Resource Waters

Subbasin 03-05-04

The North River watershed (subbasin 03-05-04) is located on the western side of Core Sound and is mostly rural. The headwaters of the North River, in Carteret County, flow directly into Back Sound near Harkers Island. Jarrett and Nelson Bays also drain inland areas in this subbasin. There are three stream miles and 39,749 estuarine acres in this subbasin.

Most of this subbasin is estuarine with freshwater drainage from large crop farms. The towns of Atlantic at the northern end, Harkers Island at the southern end, and Beaufort are the most densely developed areas within the subbasin. There are four individual NPDES wastewater discharge permits in this subbasin.

Surface water classifications and the amount of acreage or miles in subbasin 03-05-04 are listed in Table *iv*. Of the monitored waters, 68 percent and 35 percent of saltwater acres are Impaired for aquatic life and shellfish harvesting, respectively. There are 11,535 Impaired acres on the 2004 303(d) list in this subbasin. Chapter 4 presents specific water quality information for each monitored waterbody in the subbasin.

Table *iv* Subbasin 03-05-04 DWQ Classifications by Acres and Miles

DWQ Classification	Freshwater Acres	Freshwater Miles	Saltwater Acres	Saltwater Miles
SA HQW	--	--	13,411	--
SA ORW	--	--	26,017	--
SC	--	--	321	3
Total	--	--	39,749	3

SC= Aquatic life propagation/protection and secondary recreation, SA= Shellfish waters, HQW= High Quality Waters, ORW= Outstanding Resource Waters

Subbasin 03-05-05

The eastern most subbasin (03-05-05) is sparsely populated, and most of the land area is in the Cape Lookout National Seashore. There are 22,575 estuarine acres and 43 miles of Atlantic coastline in this subbasin; shown in the subbasin map in Chapter 5.

Surface water classifications and the amount of acreage or miles in subbasin 03-05-05 are listed in Table *v*. No waters in this subbasin are listed on the 2004 303(d) list as Impaired.

Table *v* Subbasin 03-05-05 DWQ Classifications by Acres and Miles

DWQ Classification	Freshwater Acres	Freshwater Miles	Saltwater Acres	Saltwater Miles
SA HQW	--	--	1,889	--
SA ORW	--	--	20,686	--
Total	--	--	22,575	--

Surface Water Classifications and Use Support Assessment of Water Quality

Surface waters are classified according to their best-intended uses. Determining how well a waterbody supports its designated uses (use support rating) is an important method of interpreting water quality data to assess water quality. The terms Impaired and Supporting refer to whether the classified uses (e.g., aquatic life protection, recreation, shellfish harvesting, and fish consumption) of the water are being met. For example, waters classified for aquatic life protection and secondary recreation (Class C for freshwater or SC for saltwater) are rated Supporting if data used to determine use support did not exceed specific criteria. However, if these criteria were exceeded, then the waters would be rated as Impaired. A single waterbody could have more than one use support rating corresponding to one or more of the multiple use support categories. Use support assessments based on surface water classifications form the foundation of this basinwide plan.

DWQ use support methods were developed to assess ecosystem health and human health risk through the development of use support ratings for five categories: aquatic life, fish consumption, recreation, shellfish harvesting, and water supply. These categories are tied to the uses associated with the primary classifications applied to North Carolina rivers, streams and lakes. A full description of the classifications is available in the DWQ document titled *Classifications and Water Quality Standards Applicable to Surface Waters of North Carolina* (www.newaterquality.org/csu/).

Use support methodology has changed significantly since the 2001 revision of the *White Oak River Basinwide Water Quality Plan*. In the previous plan, surface waters were rated fully supporting (FS), partially supporting (PS), not supporting (NS) and not rated (NR). The 2002 *Integrated Water Quality Monitoring and Assessment Report Guidance* issued by the Environmental Protection Agency (EPA) requests that states no longer subdivide the Impaired category. In agreement with this guidance, North Carolina no longer subdivides the Impaired category and rates waters as Supporting (S), Impaired (I), Not Rated (NR), or No Data (ND). These ratings refer to whether the classified uses of the water are being met. Detailed information on use support methodology is provided in Appendix IV.

White Oak River Basin Use Support Summary

Each subbasin chapter (Chapters 1 – 5) provides a summary of use support ratings for all categories assessed in that subbasin.

The fish consumption use support category is applied to all waters in the state. Fish consumption use support ratings are based on fish consumption advice issued by the NC Department of Health and Human Services (DHHS). Currently, there is a statewide advice limiting consumption of several fish species due to high mercury concentrations. Because of this concern, all waters in the state are considered Impaired in the fish consumption use support category on an evaluated basis. The aquatic life use support category is applied to all waters in North Carolina. A basinwide summary of current aquatic life use support ratings is presented in Table vi.

Table vi Aquatic Life Use Support Summary

Aquatic Life Use Support Ratings	Freshwater Acres	Freshwater Miles	Saltwater Acres	Saltwater Miles	Coast Miles
Supporting	949	91	23,340	--	--
Impaired	--	--	7,942	13	--
Not Rated	--	24	443	6	--
No Data	--	201	99,250	59	91
Total	949	316	130,974	78	91

DWQ and the Division of Environmental Health (DEH) monitor waters for primary recreation (Class B). A basinwide summary of current primary recreation use support ratings is presented in Table vii.

Table vii Primary Recreation Use Support Summary

Primary Recreation Use Support Ratings	Freshwater Acres	Freshwater Miles	Saltwater Acres	Saltwater Miles	Coast Miles
Supporting	--	40	69,515	13	91
Impaired	--	--	148	--	--
Not Rated	--	14	--	--	--
No Data	949	262	61,311	65	--
Total	949	316	130,974	78	91

There are 118,369 estuarine acres and nine miles classified for shellfish harvesting (Class SA) in the White Oak River basin. The DEH Shellfish Sanitation Section growing area classification is used to determine use support ratings in the shellfish harvesting category. A basinwide summary of current shellfish harvest use support ratings is presented in Table viii.

Table viii Shellfish Harvest Use Support Summary

Shellfish Waters Use Support Ratings	Saltwater Acres	Saltwater Miles
Supporting	80,787	--
Impaired	37,582	9
Total	118,369	9

Since shellfish harvesting is the primary designated use assessed in the White Oak River basin, a comparison between the use support assessments conducted for the 2001 basin plan and this plan are provided in Table ix. It is important to note that there are considerable increases in shellfish harvesting acreage considered impaired in this 2007 basin plan over the 2001 basin plan. Not all of this acreage should be considered a degradation in water quality because there are several reasons for the changes in acreage, as follows:

- 1) The 2001 basin plan used an interim frequency of closures based method for assessment (Refer to the 2001 basin plan, Section A, Chapter 4 for more information) until DEH could fully develop a database of closures;
- 2) DEH Shellfish Sanitation Section developed the database and GIS expertise to assess shellfish harvesting closures more accurately in terms of days of closure, closure lines and acreage associated with these lines;
- 3) DEH is required to reclassify some portions of growing areas to conditional or prohibited due to land use changes (presence of marinas or stormwater outfalls, etc.) rather than on actual data;

- 4) GIS technology has improved and changes in acreage can partially be attributed to technology improvements that allow more accurate mapping.

Table ix Comparison of Shellfish Harvesting Acres Impaired in the White Oak River Basin between the 2001 and 2007 Basin Plan

2001		2007		
Subbasin	Acres Impaired	Subbasin	Miles Impaired	Acres Impaired
03-05-01	6,630.6	03-05-01	3.8	6,917.8
03-05-02	2,430.5	03-05-02	0	2,779.7
03-05-03	7,462.3	03-05-03	5.2	14,510.3
03-05-04	11,535.1	03-05-04	0	13,374.0
03-05-05	0	03-05-05	0	0
Total	28,058.5		9.0	37,581.8

Water Quality Standards and Classifications

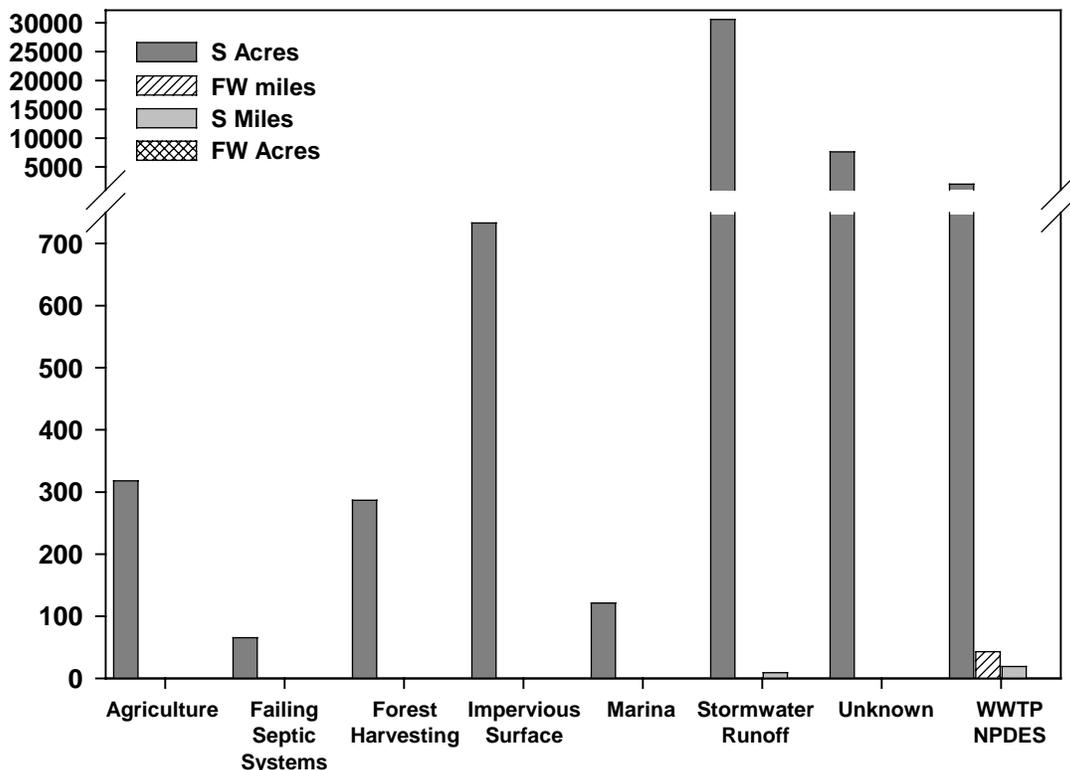
Chapter 6 discusses water quality standards and classifications and includes maps showing the designated High Quality Waters (HQW), Outstanding Resource Waters (ORW) and Nutrient Sensitive Waters (NSW). There are 57,784 acres and 12 miles of HQW waters, 61,229 acres of ORW waters, and 10,816 acres and 201 miles of Nutrient Sensitive Waters (NSW) in the White Oak River basin.

Coastal growth in the White Oak River basin involves construction and/or development along areas of HQWs and ORWs. Management strategies are associated with these supplemental classifications and are intended to prevent degradation of water quality below present levels from point and nonpoint sources of pollution. The previous NSW strategies undertaken in portions of the New River have resulted in improved water quality conditions (See Chapter 2).

Water Quality Stressors and Sources

DWQ identifies the stressors of water quality impact as specifically as possible depending on the amount of information available in a watershed. Most often, the source of the stressor is based on predominant land use in the watershed. In the White Oak River basin, new development/ construction, impervious surfaces, stormwater outfalls, and inadequate human and animal waste management were all identified as possible sources. Figure *ii* shows identified sources for all monitored waters. However, unknown sources of stressors impact many surface waters. The accumulation of multiple stressors leads to water quality degradation. In some way, every resident, tourist, landowner, industry, and municipality in the basin impacts water quality. Therefore, it is important that all stakeholders play a role in management strategies designed to protect and restore water quality in the White Oak River basin.

Figure ii Freshwater and Saltwater Sources

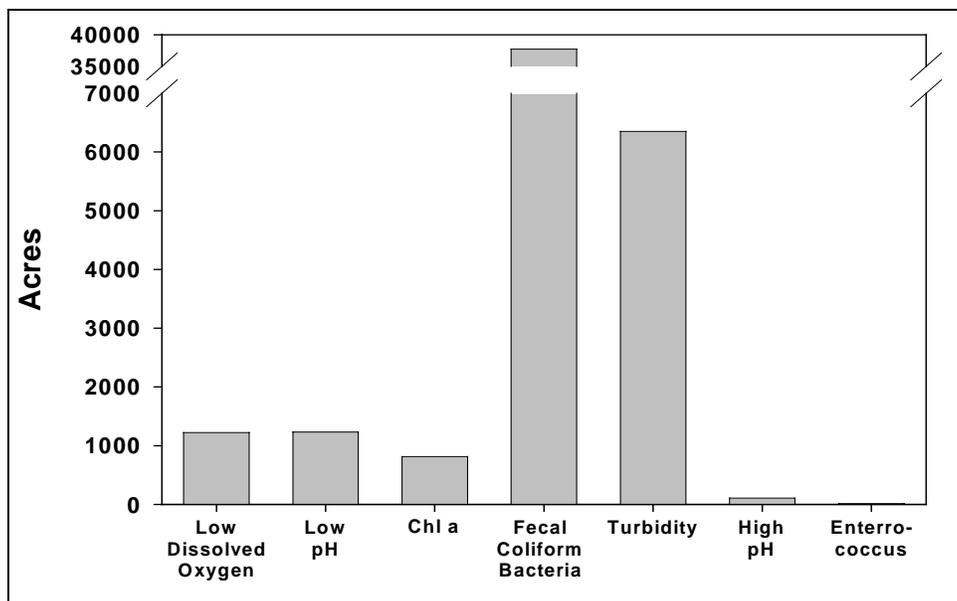


Stressors to recreational use of surface waters include pathogenic indicators such as fecal coliform bacteria, *escheria coli* (*E. coli*), and *enterrococci*. In the White Oak River basin, there are 140.2 acres where the fecal coliform bacteria standard was exceeded, causing these waters to be rated as Impaired for recreation. In 14.2 stream miles, fecal coliform bacteria are the noted stressor because annual screening criteria were exceeded but did not lead to listing the waterbody as Impaired for recreation. Waters are Impaired for recreation when swimming advisories are posted for more than 61 days during the five-year assessment period. Waters with beach monitoring sites with advisories posted less than 61 days are Supporting. In the White Oak River basin 8.0 estuarine acres are Impaired for recreation because of swimming advisories posted during the assessment period. Enterrococcus is the stressor in these waters. Between 2003-2005, DEH Recreational Water Quality Monitoring Program in the White Oak River Basin reported 283 postings for beach closure days.

Fecal coliform bacteria are the primary stressor for shellfishing waters accounting for the majority of Impaired waters in this basin. Within the shellfish harvesting areas of the White Oak River basin, there are 7,283.5 acres of prohibited waters, 3,860.3 acres of conditionally approved-closed waters, and 26,437.9 acres of conditionally approved-open waters. All of these waters (37,581.7 acres total) are Impaired for shellfish harvesting and the stressor is fecal coliform bacteria. An additional 80,787 acres are approved and Supporting for shellfish harvesting uses.

Water quality stressors are identified when impacts have been noted to biological (benthic and fish) communities or water quality standards have been violated. In the fish consumption category, mercury is typically the noted stressor. Whenever possible, water quality stressors are identified for Impaired waters as well as waters with notable impacts. Figure iii shows identified stressors for saltwater acres; see Chapter 7 for more identified water quality stressors.

Figure iii Stressors Identified in Impaired Saltwater Acres



Impacts from Stormwater Runoff

Stormwater runoff is precipitation that runs off the ground or impervious surfaces (i.e., buildings, roads, parking lots, etc.) instead of absorbing into the soil. In some cases, stormwater runoff drains directly into streams, rivers, lakes and oceans. In other cases, particularly in urbanized areas, stormwater drains into streets and man-made drainage systems consisting of inlets and underground pipes, commonly referred to as a storm sewer system. Stormwater runoff is a primary carrier of nonpoint source pollution in both urbanized and rural areas. The impact of stormwater runoff is severe in developing areas where recently graded lands are highly susceptible to erosion. Water quality impacts are also evident in urbanized areas where stormwater runoff is increased by impervious surfaces and is rapidly channeled through ditches and curb and gutter systems into nearby surface waters. Stormwater runoff is the largest source of Impairment (over 36,600 acres) to shellfish harvesting waters.

Communities in the White Oak River basin are experiencing significant and rapid population growth. Chapter 9 presents figures for population projections that estimate Jacksonville experienced a 54 percent population increase between 1990 and 2000, Morehead City experienced a 21 percent increase, and Emerald Isle a 30 percent increase. In addition, Onslow County is expected to experience a 16 percent population increase between 2000 and 2020, while Carteret County is expected to see an increase of 14 percent. These estimates do not take into account the significant population influxes during the tourist season.

There are several different stormwater programs administered by DWQ that apply to the coastal communities within the White Oak River Basin. In the White Oak River basin, the City of Jacksonville and Onslow County are identified as meeting the criteria for developing stormwater management programs as required under the Phase II Session Law.

In addition, Morehead City, Atlantic Beach and Emerald Isle are being assessed by DWQ to determine if these communities meet the criteria for inclusion in the Phase II stormwater program. These communities are being assessed at this time due to the direction of the EMC.

As noted above, the EMC was given authority by rule to delineate regulated coverage areas in accordance with the schedule for review and revision of basinwide water quality management plans.

Morehead City Council has instructed staff to begin development of a locally administered stormwater ordinance and stormwater utility. DWQ recommends that other local governments in the basin develop stormwater management programs voluntarily to begin the process of restoring and improving water quality in the region. DWQ and other NCDENR agencies will continue to provide information on funding sources and technical assistance to support local government and county stormwater program development.

The goal of DWQ stormwater discharge permitting regulations and programs is to prevent pollution from entering the waters of the state via stormwater runoff. These programs accomplish this goal by controlling the source(s) of pollution. Chapter 8 contains more information on federal and state stormwater programs.

Wastewater Management

In the White Oak River basin, wastewater is treated by municipal wastewater treatment plants, package plants and on-site septic systems. Each of these systems requires a permit, but spills can occur, often resulting in the closure of shellfish harvesting areas and recreational beaches. These facilities that are noncompliant are discussed in the Subbasin chapters. There are 44 permitted wastewater dischargers in the White Oak River basin. In some cases, wastewater can also enter streams through failing septic systems. In highly susceptible areas, wastewater from failing septic systems or straight pipes can contaminate a drinking water supply or recreational water with nutrients, disease pathogens and endocrine disturbing chemicals. Precautions should be taken by local septic system permitting authorities to ensure that failing systems are repaired, older systems are updated and new systems are sited and constructed properly allowing an adequate repair area. Chapter 8 provides more information on permitting regulations and on-site waste system activities within the White Oak River basin.

Population Growth and Changes in Land Use

There are four counties and 16 municipalities located in whole or in part in the basin. Based on 2000 data, the population of the basin is estimated at 311,680 people. The most populated areas are located in Jacksonville and Camp Lejeune on the New River, and Morehead City and Beaufort on Bogue Sound and the Newport River. There are also areas in the basin with very sparse populations (subbasins 03-05-04 and 03-05-05). Large portions of the basin are publicly-owned areas, such as the Croatan National Forest on the White Oak River, and the Hoffman State Forest and Camp Lejeune on the New River.

The coastal communities in the White Oak River basin are changing. Traditional uses of waterfront property are shifting to accommodate increase in permanent residents, seasonal rental properties, and development. Development has also moved inland along tidal creeks and rivers. However, many of the water dependent resources that people seek out from the NC coastal communities are diminishing. Public waterfront access is limited, high fecal coliform levels prevent shellfish harvesting and beach recreation, fish houses have closed, and fish harvests have declined in the White Oak River basin. During this assessment period, DEH recommended 121

acres of shellfishing waters to be closed because of marina slips between growing areas C-1 to F-4 in the White Oak River basin.

Growing populations and a greater numbers of homes, stores, and businesses not only require more water, but they also lead to the discharge and runoff of greater quantities of waste and pollutants into the state's surface waters. As watershed vegetation is replaced with impervious surfaces in the form of paved roads, buildings, parking lots, and residential homes and driveways, the ability of the environment to absorb and diffuse the effects of natural rainfall is diminished. Urbanization results in increased surface runoff and correspondingly earlier and higher peak streamflows after rainfall. Flooding frequency also increases.

The rural areas have also begun to shift from agriculture fields to housing developments. Statistics provided by the US Department of Agriculture, Natural Resources Conservation Service indicates that between 1982 and 1997 (the most recent update available) there was a 35,000-acre (65.6 percent) increase in the amount of developed land, a 9,000-acre (15.1 percent) decrease in cultivated cropland, and a 29,000-acre (9.7 percent) decrease in forestland. Uncultivated cropland and pastureland increased by nine acres.

A total of 127 sedimentation and erosion control permits were issued in 2005 for the White Oak River basin. These permits were issued for general construction activities that disturbed more than one acre of land, totaling approximately 1,134 acres disturbed. Chapter 9 presents information regarding population, growth and development in the White Oak River Basin.

Water Quality Management Strategies

The N.C. Divisions of Water Quality, Coastal Management, Land Resources, Marine Fisheries, Soil and Water Conservation, Parks and Recreation and Environmental Health are responsible for many coastal activities and policies including stormwater management, development permits, erosion control programs, agriculture and land preservation, shellfish protection and recreation monitoring. Additional state programs and many interagency and group partnerships work together to protect the resources found in coastal waters and communities. The Coastal Habitat Protection Plan is a plan to manage and restore aquatic habitats critical to North Carolina's commercial and recreational fisheries resources. The Oyster Action Plan was developed to restore and protect North Carolina's native oyster populations. High priority areas for oyster protection and restoration include growing areas in Sneads Ferry, Stones Bay, White Oak River, Newport River and the North River. The Coastal Nonpoint Source Program was developed to coordinate the state's efforts on managing nonpoint source pollution from agriculture, forestry, urban areas, marinas and recreational boating, and hydrologic modification. The Community Conservation Assistance Program managed by Soil and Water Conservation Districts was developed to focus its efforts on stormwater retrofits to existing land uses that are non-agricultural. Chapter 10 presents more information regarding these programs and strategies to manage coastal waters.

Land Use Plans

The Coastal Area Management Act (CAMA) requires each of the 20 coastal counties to have a local land use plan in accordance with guidelines established by the Coastal Resources Commission (CRC). A land use plan is a collection of policies, maps, and implementation actions that serves as a community's blueprint for growth. The management goal for water

quality is to maintain, protect, and where possible enhance water quality in all coastal wetlands, rivers, streams and estuaries. The CRC's planning objective is for communities to adopt policies for coastal waters within the planning jurisdiction to help ensure that water quality is maintained if not impaired and improved if impaired. Local communities are required to devise policies that help prevent or control nonpoint source discharges (sewage and stormwater) through strategies such as impervious surface limits, vegetated riparian buffers, maintenance of natural areas, natural area buffers, and wetland protection. They are also required to establish policies and future land use map categories that are aimed at protecting open shellfishing waters and restoring closed or conditionally closed shellfishing waters. In the White Oak River basin, three communities have completed their land use plans and ten others are in the process. Chapter 10 presents specific information regarding land use plans in communities of the White Oak River basin.

Agriculture and Water Quality

Excess nutrient loading, pesticide and/or herbicide contamination, bacterial contamination, and sedimentation are often associated with agricultural activities, and all can impact water quality. Chapter 11 provides information related to agricultural activities in the White Oak River basin and also identifies funding opportunities for best management practices (BMPs). During this five-year assessment period, the North Carolina Agricultural Cost Share Program (NCACSP) funded BMPs totaling more than \$290,382. During this assessment period, Environmental Quality Improvement Program (EQIP) funds in Onslow County helped assist in the management of over 1,213 acres for nutrient and pesticides, establishment of 212 acres of permanent vegetative cover, and the implementation of 286 acres in long-term no-till management. During the next few years, a \$128,088 allocation for Onslow County will include the following practices; waste storage facilities, fencing, cattle crossings, grade stabilization structures, critical area planting and long-term no-till practices. Carteret County did not use any EQIP funds in the past five years.

Forestry and Water Quality

The majority of forestland in the White Oak River basin is publicly owned, amounting to approximately 59 percent of the forested acres in the basin. Public forestland ownership is mainly composed of the Croatan National Forest and Camp Lejeune Marine Corps Base. State-owned forestland includes approximately one-half of the Hoffman Forest. Ownership of the remaining timberland in the White Oak River basin includes 23 percent with private individuals, and 18 percent with either forest industry or other corporate ownership.

Forest Management in the White Oak River basin has undertaken several initiatives to protect water quality. Multi-agency partnerships resulted in the permanent protection of 2.4 miles of Pettiford Creek through the acquisition of 841 acres of forestland adjacent to Croatan National Forest. At least 8,065 acres of land were established or regenerated with forest trees across the basin from September 1999 through August 2004. Over 328 individual forest management plans were written for forest landowners that encompass nearly 20,700 acres in the basin. For more information on forestry activities in the White Oak River basin, see Chapter 12.

Water Resources

All the White Oak River basin is in the designated Central Coastal Plain Capacity Use Area established by the Environmental Management Commission in 2002. Water users that withdraw more than 100,000 gallons per day of ground water within the designated area must obtain a permit from the Division of Water Resources and regularly report the quantity of water withdrawn. In April 2004, the Public Water Supply (PWS) Section completed source water assessments for all drinking water sources and generated reports for the PWS systems using these sources. In the White Oak River basin, 257 public water supply sources were identified. All of the public water supply sources are ground water wells. Of the 257 ground water sources, 28 have a High susceptibility rating, 141 have a Moderate susceptibility rating and 88 have a Low susceptibility rating. Chapter 13 presents water supply and source information, federal cataloging units, or hydrologic units, as they relate to state subbasin boundaries.

Natural Resources

The White Oak River basin contains some of the most biologically significant habitats along the entire Atlantic Coast. There are almost 100 rare species of vascular plants; 68 of those species are associated with wetland habitats. There are very important bird habitats in the basin, including dozens of gull/tern/skimmer colonies and colonial wading bird colonies, as well as marsh bird nesting areas. The estuarine waterbodies provide critical habitat for multiple life-cycle periods of aquatic species. The decline in fish, shellfish harvests and submerged aquatic vegetation could be the result of multiple factors, including water quality. A decline in oyster, hard clams and scallops landings has occurred in the White Oak River basin. The White Oak River basin lies within the focus area of the Onslow Bight Conservation Forum, a landscape-scale collaborative conservation effort. Chapter 14 presents information related to the ecological significance of the basin and identifies endangered and threatened species, significant natural heritage areas, public conservation lands that are locally significant, and fishery concerns.

Local Involvement

Local organizations and agencies are able to combine professional expertise and local knowledge not present at the state and federal level. This allows groups to holistically understand the challenges and opportunities of local water quality concerns. Involving a wide array of people in water quality projects also brings together a wide range of knowledge and interests and encourages others to become involved and invested in these projects. Working in cooperation across jurisdictional boundaries and agency lines opens the door to additional funding opportunities and eases the difficulty of generating matching or leveraged funds. This could potentially allow local entities to do more work and be involved in more activities because funding sources are diversified. The most important aspect of these local endeavors is that the more localized the project, the better the chances for success.

The collaboration of local efforts is key to water quality improvements, and DWQ applauds the foresight and proactive response by locally based organizations and agencies to protect water quality. There are many excellent examples of local agencies and groups using these cooperative strategies throughout the state. Several local conservation and water quality improvement projects are highlighted in the subbasin chapters. Chapter 15 also examines the local, regional and federal initiatives underway in the White Oak River basin.

Restoring Impaired Waters

The long-range mission of basinwide planning is to provide a means of addressing the complex problem of planning for increased development and economic growth while maintaining, protecting and enhancing water quality and intended uses of the White Oak River basin's surface waters. Within this basinwide plan, DWQ presents management strategies and recommendations for those waters rated Impaired or that exhibit some notable water quality problems.

Addressing water quality impairment in waters that are on the state's 303(d) list are a DWQ priority. Section 303(d) of the federal Clean Water Act requires states to develop a list of waters not meeting water quality standards or which have impaired uses. The waters in the White Oak River basin that are on this list are discussed in the individual subbasin chapters. States are also required to develop Total Maximum Daily Loads (TMDLs) or management strategies for 303(d) listed waters to address impairment. EPA issued guidance in August 1997 that called for states to develop schedules for developing TMDLs for all waters on the 303(d) list within 8-13 years. More information on the TMDL process is found in Chapter 16.

Cumulative Effects

While any one activity may not have a dramatic effect on water quality, the cumulative effect of land use activities in a watershed can have a severe and long-lasting impact.

Challenges and Recommendations for Achieving Water Quality Improvements

Point source impacts on surface waters can be measured and addressed through the basinwide planning process and do not represent the greatest threat to water quality in the basin. A major water quality problem in the basin is fecal coliform bacteria contamination (affecting shellfish harvesting). Fecal coliform bacteria contamination is primarily attributed to nonpoint source pollution associated with runoff from urban areas and agricultural lands. The task of quantifying nonpoint sources of pollution and developing management strategies for these impaired waters is very resource intensive. Federal and state stormwater regulations and initiatives are in place to help reduce and prevent stormwater runoff in developing coastal communities.

The cumulative effects of nonpoint source pollution are the primary threat to water quality across the state and throughout the White Oak River basin. Nonpoint source pollution can be identified through the basinwide plan and the DEH Sanitary Surveys, but actions to address these impacts must be taken at the local level. Such actions should include:

- Require stormwater best management practices for existing and new development,
- Develop and enforce buffer ordinances,
- Conduct comprehensive land use planning that assesses and reduces the impact of development on natural resources, and
- Develop and enforce local erosion control ordinances.

Without proactive land use planning initiatives and local water quality strategies, population growth and development in the basin increases the risk of surface water impairment. Balancing economic growth and water quality protection will continue to be an immense challenge. This basinwide plan presents many water quality initiatives and accomplishments that are underway throughout the basin. These actions provide a foundation on which future initiatives can be built.

