

## 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. The NC Division of Water Quality (DWQ) prepares basinwide water quality plans 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 DWQ, implementation and protection of water quality involves 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:

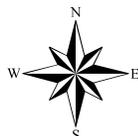
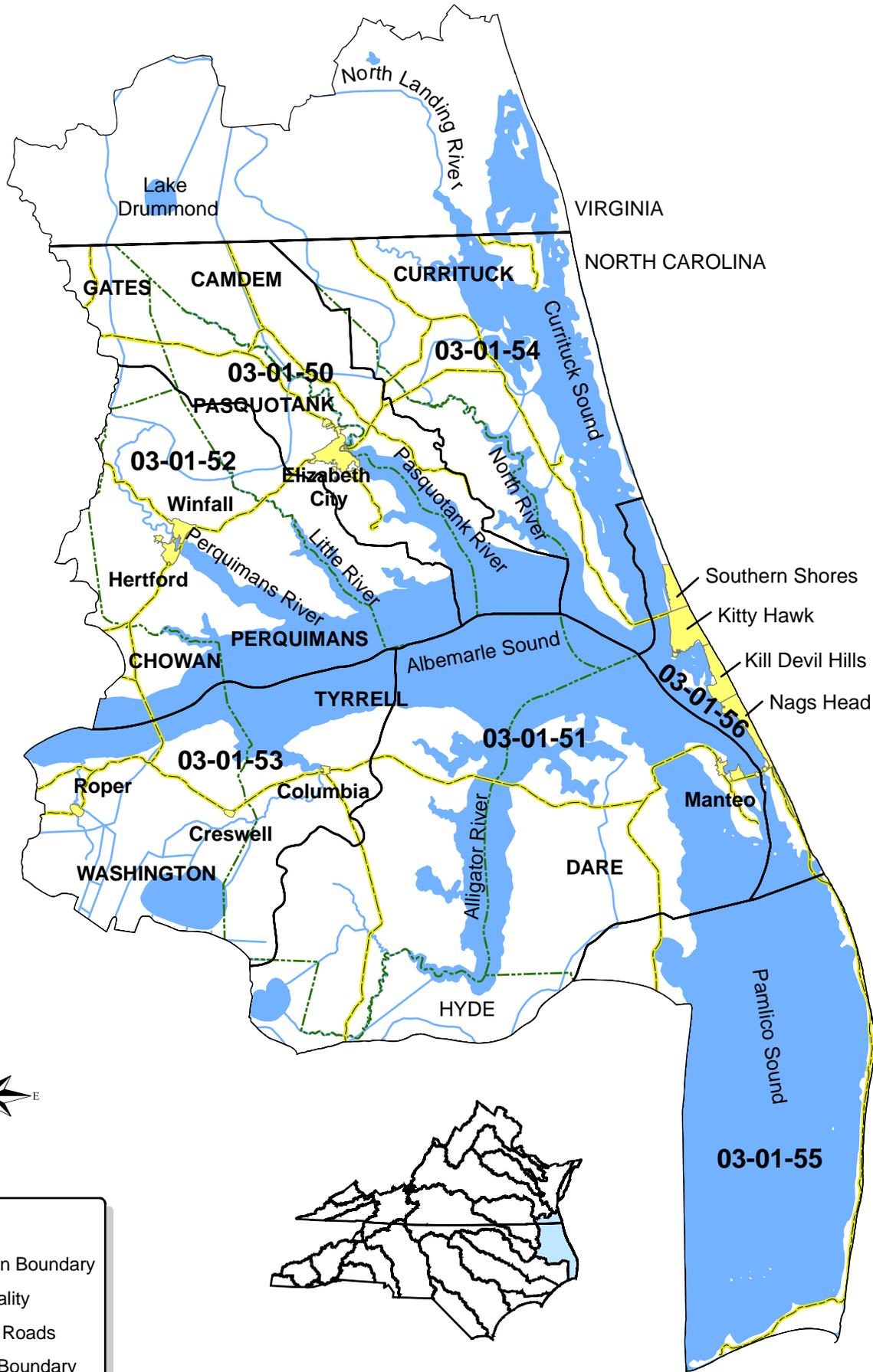
- Evaluate cumulative effects of pollution,
- Assure equitable distribution of waste assimilative capacity for dischargers,
- Regulate point and nonpoint source pollution where other approaches were unsuccessful,
- Improve public awareness and involvement, and
- Collaborate with other agencies to develop 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 *Pasquotank River Basinwide Water Quality Plan* updated on a five-year cycle. The first basinwide plan for the Pasquotank River basin was completed in 1997 and the second in 2002. 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 Pasquotank 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.

### Pasquotank River Basin Overview

The Pasquotank River basin encompasses 3,635 square miles of low-lying lands and vast open waters, including Albemarle Sound, in the state's northeast outer coastal plain (Figure *ii*). The basin includes all or portions of Camden, Chowan, Currituck, Dare, Gates, Hyde, Pasquotank, Perquimans, Tyrrell and Washington counties. The basin also contains numerous small watersheds that drain into Albemarle, Currituck, Croatan, Roanoke and Pamlico Sounds. A small portion (~577 acres) of the Pasquotank River basin is located in Virginia. The Pasquotank River basin is part of the Albemarle-Pamlico Estuarine system, the second largest estuarine system in the United States.

# Figure i General Map of the Entire Pasquotank River Basin in North Carolina and Virginia



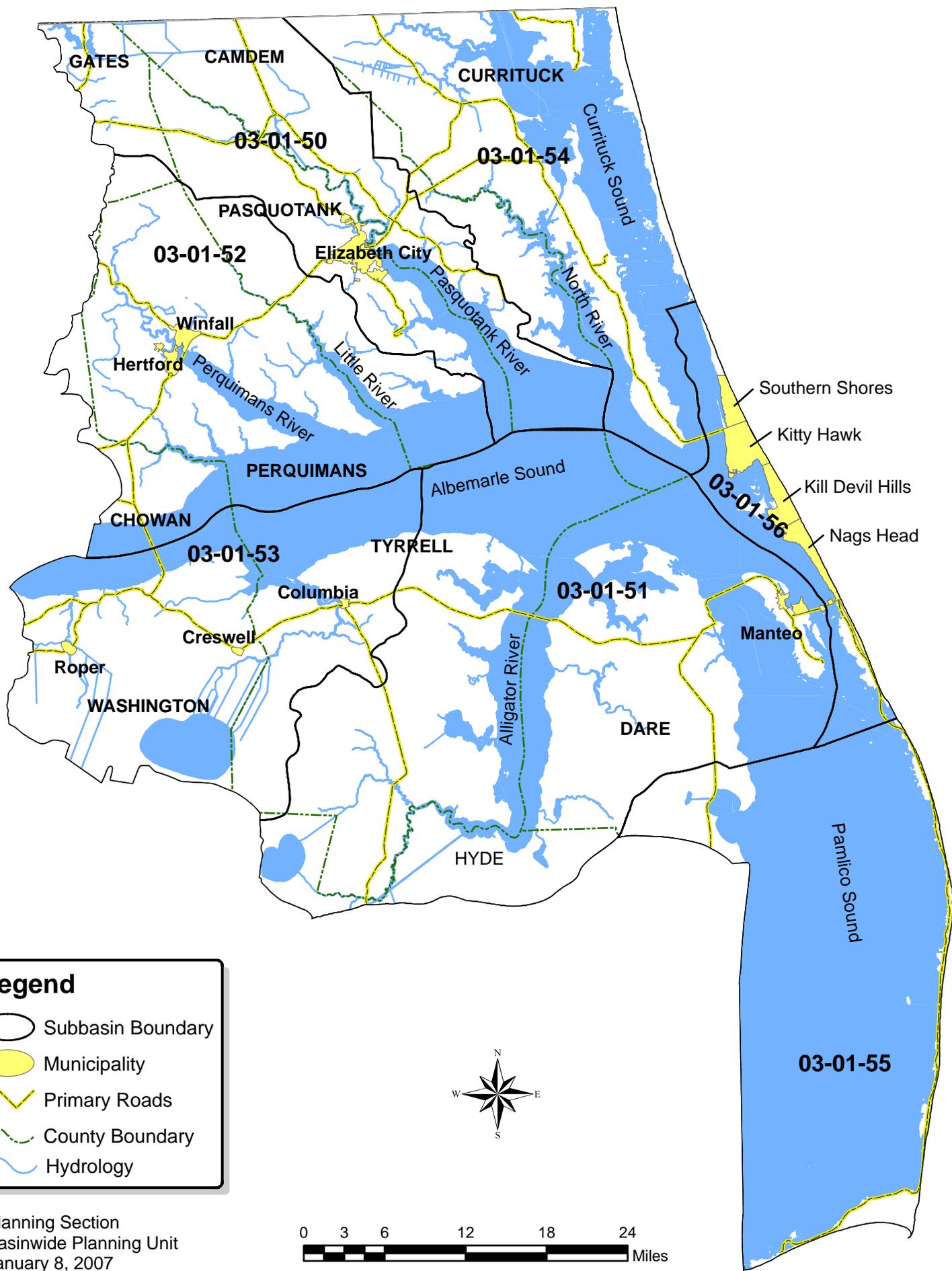
**Legend**

-  Subbasin Boundary
-  Municipality
-  Primary Roads
-  County Boundary
-  Hydrography



Planning Section  
 Basinwide Planning Unit  
 May 8, 2007

**Figure ii General Map of the Pasquotank River Basin in North Carolina**



**Legend**

-  Subbasin Boundary
-  Municipality
-  Primary Roads
-  County Boundary
-  Hydrology



Planning Section  
 Basinwide Planning Unit  
 January 8, 2007



Information presented in this basinwide water quality plan is based on information collected from September 2000 to March 2007 to describe water quality conditions and issues in each of the five subbasins. Specific water quality assessments were based on biological, chemical and physical monitoring data collected between September 2000 and August 2005. A discussion of conditions reflecting whether specific waterbodies support their best-intended use and maps of each subbasin are included in each subbasin chapter (Chapters 1 – 7). Each subbasin has its own unique characteristics and water quality concerns. 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. Below is a brief description of each subbasin and their water classifications.

**Subbasin 03-01-50**

This subbasin contains the headwaters of the Pasquotank River and its headwaters from the Great Dismal Swamp. Most streams are of low relief and swampy and channelized ditches are common. A significant portion of the waters in this subbasin are brackish estuarine, including Albemarle Sound and the Pasquotank River below Elizabeth City. Land cover generally consists of evergreen forests, mixed forests, forested wetlands and marshes, cultivated crops, such as wheat, cotton and peanuts. Portions of Gates, Pasquotank and Camden Counties are found in this subbasin with the largest population centered around urbanized areas. The population of the subbasin is expected to continue to increase over the next twenty years.

Table *i* Subbasin 03-01-50 DWQ Classifications by Acres and Miles

DWQ Classification	Freshwater Miles	Saltwater Acres	Saltwater Miles
C	6.9		
C; Sw	1,057.2		
SB		38,617.2	
SC		12,941.7	2.2
WS-IV;Sw	13.7		
WS-IV; Sw, CA	0.7		
WS-V;Sw	15.9		

C/SC= Aquatic life propagation/protection and secondary recreation, **SB**= Primary recreation and Class C uses, **Sw** = *Swamp Waters*: Recognizes waters that will naturally be more acidic and have lower levels of dissolved oxygen, **WS** = *Water Supply watershed*. There are five WS classes ranging from WS-I through WS-V.

Surface water classifications and the amount of acreage or miles in subbasin 03-01-50 are listed in Table *i*. No previously or newly impaired waters were identified in this subbasin. Chapter 1 presents specific water quality information for each monitored waterbody in this subbasin.

**Subbasin 03-01-51**

This subbasin contains the Alligator River and several tributaries including Callaghan and Broad Creeks. Most streams are of low relief and often swampy. Channelized ditches are common. Most waters in this subbasin are brackish estuarine, including Albemarle, Croatan and Roanoke Sounds, and the Alligator River to the Intracoastal Waterway (ICWW). Portions of Dare, Hyde and Tyrrell Counties can be found in this subbasin with the highest concentration of urbanized areas located on Roanoke Island in the Towns of Manteo and Wanchese. Rapid population growth is occurring in Dare County and along coastal areas.

Table *ii* Subbasin 03-01-51 DWQ Classifications by Acres and Miles

DWQ Classification	Freshwater Acres	Freshwater Miles	Saltwater Acres	Saltwater Miles
C;Sw	4,980.6	12.3		
C;Sw,ORW		484.9		
SA;HQW			54,628.7	
SB			107,485.9	
SC			4,988.3	1.1
SC;HQW			32.9	
SC;Sw			23,364.1	8.8
SC;Sw,ORW			43,154.4	

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, **Sw** = *Swamp Waters*: Recognizes waters that will naturally be more acidic and have lower levels of dissolved oxygen, **WS** = *Water Supply watershed*. There are five WS classes ranging from WS-I through WS-V.

Surface water classifications and the amount of acreage or miles in subbasin 03-01-51 are listed in Table *ii*. Water quality Impairments in this subbasin are in the shellfish harvesting category (2,081.5 ac). Chapter 2 presents specific water quality information for each monitored waterbody in this subbasin.

**Subbasin 03-01-52**

This subbasin consists of the northwestern edge of Albemarle Sound and the rivers that empty to it. The largest of these rivers are the Little River and the Perquimans River. Most streams are low gradient with substrates of silt and sand. Portions of Perquimans, Pasquotank, Chowan and Gates Counties can be found in this subbasin with the highest concentration of urbanized areas around the Town of Hertford. Although the Town of Hertford experienced a net decline in population based on the 2000 census data, trends for the subbasin show expected growth in all four counties over the next 20 years.

Surface water classifications and the amount of acreage or miles in subbasin 03-01-52 are listed in Table *iii*. The Little River and the Perquimans River both have segments that are Impaired in the aquatic life category, the Albemarle Sound is Impaired for fish consumption because of a dioxin advisory and all monitored waters are Supporting for recreation. Chapter 3 presents specific water quality information for each monitored waterbody in the subbasin.

Table *iii* Subbasin 03-01-52 DWQ Classifications by Acres and Miles

DWQ Classification	Freshwater Miles	Saltwater Acres
C; Sw	88.8	
SB		83,576.9
SC		9,087.6

*C/SC*= Aquatic life propagation/protection and secondary recreation, *SB*= Primary recreation and Class C uses, *Sw* = *Swamp Waters*: Recognizes waters that will naturally be more acidic and have lower levels of dissolved oxygen.

**Subbasin 03-01-53**

This subbasin contains the Scuppernong River, Deep Creek, Kendrick Creek and several tributaries, many of which are channelized. Most streams are of low relief and often swampy. Western Tyrrell County and most of Washington County are found in this subbasin with the highest concentration of urbanized areas around the small towns of Columbia, Creswell and Roper.

Surface water classifications and the amount of acreage or miles in subbasin 03-01-53 are listed in Table *iv*. Kendrick Creek and Main Canal both are Impaired in the aquatic life category, the Albemarle Sound is Impaired for fish consumption because of a dioxin advisory and all monitored waters are Supporting for recreation. Chapter 4 presents specific water quality information for each monitored waterbody in the subbasin.

Table *iv* Subbasin 03-01-53 DWQ Classifications by Acres and Miles

DWQ Classification	Freshwater Acres	Freshwater Miles	Saltwater Acres
B;Sw,ORW	15,938.3		
C;Sw		113.2	
SB			64,313.6
SC			1,813.9

*C/SC*= Aquatic life propagation/protection and secondary recreation, *B/SB*= Primary recreation and Class C uses, *ORW*= Outstanding Resource Waters, *Sw* = *Swamp Waters*: Recognizes waters that will naturally be more acidic and have lower levels of dissolved oxygen.

**Subbasin 03-01-54**

This subbasin contains portions of the Currituck Sound and several tributaries, many of which are channelized. Except for the barrier islands, most streams are of low relief and often swampy. A portion of this subbasin is located on the Outer Banks where there is the potential for high population growth and development. Most of Currituck County and the eastern portion of Camden County can be found in this subbasin, both counties have an estimated population growth of over 45 percent by 2020.

Surface water classifications and the amount of acreage or miles in subbasin 03-01-54 are listed in Table v. Portions of the Currituck Sound are Impaired for recreation in this subbasin. Chapter 5 presents specific water quality information for each monitored waterbody in the subbasin.

Table v Subbasin 03-01-54 DWQ Classifications by Acres and Miles

DWQ Classification	Freshwater Miles	Saltwater Acres
B;Sw	25.1	
C;Sw	1,003.0	
SB		10,412.2
SC		113,572.6

C/SC= Aquatic life propagation/protection and secondary recreation, B/SB= Primary recreation and Class C uses, ORW= Outstanding Resource Waters, Sw = Swamp Waters: Recognizes waters that will naturally be more acidic and have lower levels of dissolved oxygen.

**Subbasin 03-01-55**

This subbasin consists of Pamlico Sound from Oregon Inlet to Hatteras Inlet and the Outer Banks in Dare County. Subbasin 03-01-55 contains Black Lake and Stumpy Point Bay on the mainland and the Pea Island National Wildlife Refuge and Cape Hatteras National Seashore on the Outer Banks. Streams on the mainland are few and low gradient with channelized ditches being common and all are either estuarine or oceanic. Dare County experiences a high seasonal population fluctuation with tourists visiting the Outer Banks. Dare County is estimated at having a population increase of 35 percent by 2020.

Table vi Subbasin 03-01-55 DWQ Classifications by Acres and Miles

DWQ Classification	Freshwater Miles	Saltwater Acres
C;Sw	117.6	
SA; HQW		319,557.8
SC		22.2

C/SC = Aquatic life propagation/protection and secondary recreation, SA = Shellfish Waters, HQW = High Quality Waters, Sw = Swamp Waters: Recognizes waters that will naturally be more acidic and have lower levels of dissolved oxygen.

Surface water classifications and the amount of acreage or miles in subbasin 03-01-55 are listed in Table vi. There are 2,605 acres Impaired for shellfish harvesting in this basin. Chapter 6 presents specific water quality information for each monitored waterbody in the subbasin.

**Subbasin 03-01-56**

This subbasin includes the Outer Banks from the northern portion of Dare County south to Oregon Inlet. It also includes portions of Currituck Sound, Albemarle Sound and Roanoke Sound. Portions of Currituck and Dare Counties are in this subbasin. The Outer Banks have experienced rapid population growth and development with the Towns of Kill Devil Hills and Nags Head experiencing growth estimated at an increase of 39 and 47 percent by 2020, respectively.

Table vii Subbasin 03-01-56 DWQ Classifications by Acres and Miles

DWQ Classification	Freshwater Miles	Saltwater Acres	Coast Miles
SA;HQW		21,049.4	
SB		7,713.6	111.1
SC		8.4	
WS-III; CA	23.8		

SC= Aquatic life propagation/protection and secondary recreation, SB= Primary recreation and Class C uses, SA= Shellfish waters HQW= High Quality Waters, WS = Water Supply watershed. There are five WS classes ranging from WS-I through WS-V.

Surface water classifications and the amount of acreage or miles in subbasin 03-01-56 are listed in Table *vii*. Colington Creek, portions of the Atlantic coastline and portions of the Roanoke and Albemarle Sounds are Impaired for recreation in this subbasin. Over 1,700 acres of shellfish harvesting waters are Impaired. Chapter 7 presents specific water quality information for each monitored waterbody in the subbasin.

## **Waterbody 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: water supply, fish consumption, aquatic life, recreation, and shellfish harvesting. 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* (<http://h2o.enr.state.nc.us/csu/>).

Use support methodology has changed significantly since the 2002 revision of the *Pasquotank 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 II.

Many waterbodies in this basin are classified as swamp waters or receive swamp drainage. Some creeks and rivers flushing rates are influenced by tides and wind. Coastal B rivers are defined as waters in the coastal plain that are deep (nonwadeable), freshwater systems with little or no visible current under normal or low flow conditions. There are three waterbody segments that were not rated because DWQ criteria for Coastal B waters have not been finalized. DWQ has developed draft biological criteria that may be used in the future to assign bioclassifications to Coastal B streams. However, validation of these criteria will require collecting data for several years from Coastal B stream reference sites. The criteria will remain in draft form until DWQ is better able to evaluate such things as: year-to-year variation at reference sites, effects of flow interruption, and variation among reference sites and habitat evaluation.

## Pasquotank River Basin Use Support Summary

### Water Supply

There are 54.1 stream miles currently classified for water supply in the Pasquotank River basin. All are considered Supporting on an evaluated basis, based on information provided by the regional water treatment plant consultant. Local water treatment plant operators monitored all during the past five years.

### Fish Consumption

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. Specifically, high mercury levels have been found in catfish, warmouth, blackfish (bowfin), and jack fish (chain pickerel) caught south and east of Interstate 85. Because of this advisory, all waters are considered Impaired for the fish consumption use on an evaluated basis. An advisory is also posted for western portion of the Albemarle Sound due to elevated levels of dioxin. The dioxin advisory recommends that women of childbearing age and children should not eat catfish and carp and others should limit their consumption.

### Aquatic Life

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 *viii*.

Table *viii* Aquatic Life Use Support Summary

<b>Aquatic Life Use Support Ratings</b>	<b>Freshwater Acres</b>	<b>Freshwater Miles</b>	<b>Saltwater Acres</b>	<b>Saltwater Miles</b>	<b>Coast Miles</b>
Supporting	----	53.1	272,273.8	8.8	----
Impaired	----	12.3	772.7	----	----
Not Rated	15,938.3	49.8	328,006.9	14.7	0.5
No Data	4,980.6	2,847.8	314,357.7	3.3	110.6
<b>Total</b>	20,918.9	2,963.0	915,411.1	26.8	111.1

### Recreation

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

Table *ix* Recreation Use Support Summary

<b>Primary Recreation Use Support Ratings</b>	<b>Freshwater Acres</b>	<b>Freshwater Miles</b>	<b>Saltwater Acres</b>	<b>Saltwater Miles</b>	<b>Coast Miles</b>
Supporting	----	45.3	721,530.1	8.8	110.6
Impaired	----	----	5.1	----	0.5
Not Rated	----	----	----	----	----
No Data	20,918.9	2,917.8	194,806.2	3.3	----
<b>Total</b>	20,918.9	2,963.0	916,341.4	12.1	111.1

### Shellfish Harvesting

There are 395,236 estuarine acres classified for shellfish harvesting (Class SA) in the Pasquotank 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 x.

Table x Shellfish Harvest Use Support Summary

Shellfish Waters Use Support Ratings	Saltwater Acres
Supporting	388,762.7
Impaired	6,473.2
<b>Total</b>	<b>395,236.0</b>

Since shellfish harvesting is the primary designated use assessed in the Pasquotank River basin, a comparison between the use support assessments conducted for the 2002 basin plan and this plan are provided in Table xi. It is important to note that there are considerable increases in shellfish harvesting acreage considered impaired in this 2007 basin plan over the 2002 basin plan. Not all of this acreage should be considered to be a degradation in water quality because there are several reasons for the changes in acreage, as follows:

1. The 2002 basin plan used an interim frequency of closures based method for assessment (Refer to the 2002 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 xi Comparison of Shellfish Harvesting Acres Impaired in the Pasquotank River Basin between the 2002 and 2007 Basin Plan

Subbasin	2002	2007
	Acres Impaired	Acres Impaired
03-01-51	1,959.3	2,081.5
03-01-55	1,361.1	2,604.8
03-01-56	1,712.9	1,786.9
<b>Total</b>	<b>5,033.3</b>	<b>6,473.2</b>

### **Water Quality Standards and Classifications**

Chapter 8 discusses water quality standards and classifications and includes maps showing the designated High Quality Waters (HQW) and Outstanding Resource Waters (ORW). There are 395,269 acres of HQW, and 485 miles, 15,938 freshwater acres and 43,154 saltwater acres of ORW in the basin.

Much of the coastal growth in the Pasquotank 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.

### **Water Quality Stressors**

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 Pasquotank River basin, new

development/construction, impervious surfaces, stormwater outfalls, and inadequate human and animal waste management were all identified as possible sources. However, unknown sources of stressors impact many waterbodies. 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 Pasquotank River basin.

Stressors to recreational use of a waterbody include pathogenic indicators such as fecal coliform bacteria, *escheria coli* (*E. coli*), and *enterrococci*. In the Pasquotank River basin, there are 5.1 acres and 0.5 coast miles where the enterrococcus bacteria standard was exceeded, causing these waters to be rated 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. Between 2003-2006, DEH Recreational Water Quality Monitoring Program in the Pasquotank River Basin reported 1,259 postings of beach closure days.

Fecal coliform bacteria is the primary stressor for shellfishing waters accounting for the majority of Impaired waters in this basin. Within the shellfish harvesting areas of the Pasquotank River basin, there are 6,473 acres are Impaired and prohibited waters and an additional 388,763 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 and dioxin are the noted stressors. Whenever possible, water quality stressors are identified for Impaired waters as well as waters with notable impacts. Figures *iii* - *iv* show identified stressors and/or sources freshwater miles; see Chapter 9 for more information.

Figure *iii* Stressors Identified in Impaired Freshwater Miles for Aquatic Life

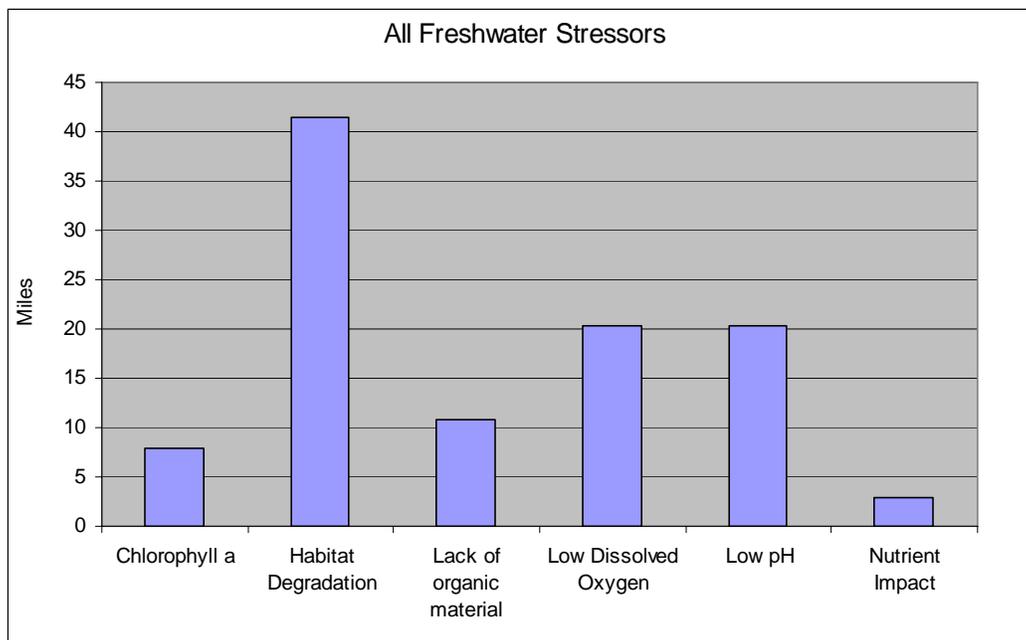
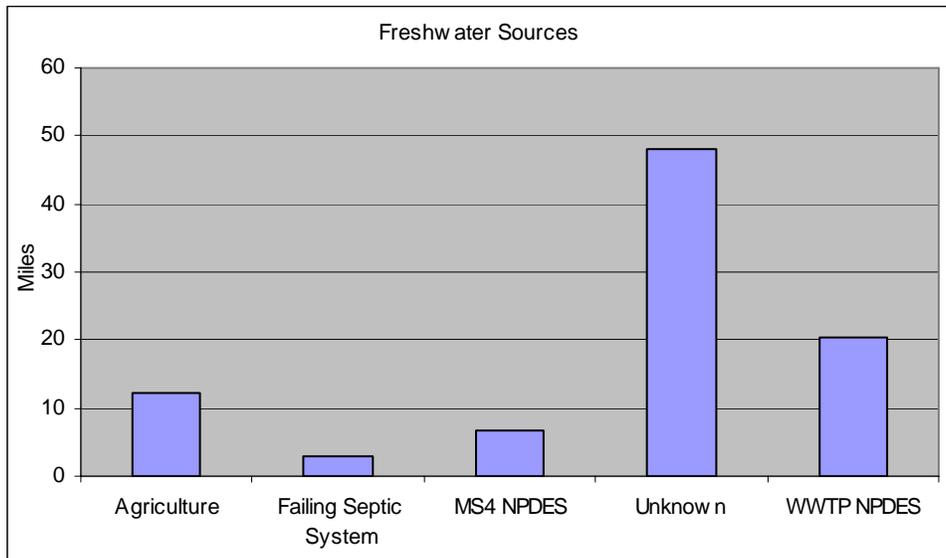


Figure iv Sources Identified in Impaired Freshwater Miles for Aquatic Life



### Impacts from Stormwater Runoff

Stormwater runoff is rainfall or snowmelt 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 manmade 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. Stormwater runoff is a particular concern in the agricultural areas of the Pasquotank River basin. Previous hydrologic alterations of the landscape have ditched and channelized the land to improve drainage. Stormwater currently moves quickly off the land bypassing swamps and enters directly into creeks and rivers untreated. The impact of stormwater runoff is also 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 waterbodies.

Coastal communities in the Pasquotank River basin are experiencing significant and rapid population growth. Chapter 11 presents figures for population projections that estimate Camden, Currituck and Dare counties to have over a 35 percent increase in population, between 2000 and 2020. 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 will apply to the coastal communities within the Pasquotank River Basin. In 2009 the communities in the Pasquotank River basin will be assessed by DWQ to determine if they meet the criteria for inclusion in the Phase II stormwater program or these communities may be assessed sooner due to the direction of the EMC. The EMC was given authority by rule to delineate regulated coverage in accordance with the schedule for review and revision of basinwide water quality management plans.

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 10 contains more information on federal and state stormwater programs.

## **Wastewater Management**

In the Pasquotank River basin, wastewater is treated by discharge, non-discharge and on-site systems. Discharges that enter surface waters through a pipe, ditch or other well-defined point of discharge are broadly referred to as 'point sources'. Wastewater point source discharges include municipal and industrial wastewater treatment plants and small domestic wastewater treatment systems serving schools, commercial offices, residential subdivisions and individual homes. Dischargers in North Carolina must apply for and obtain a NPDES permit. Currently, there are 34 permitted wastewater dischargers in the Pasquotank River basin.

Many municipalities, residential developments, and commercial/industrial operations located in northeastern North Carolina utilize wastewater treatment systems that dispose of the wastewater through land application methods. Such systems are referred to as non-discharge systems, as there is no direct discharge to surface water of the state. Although non-discharge systems should not present high potentials for surface water impacts, some systems within the Pasquotank River basin have problems that may result in impaired surface water quality. In the Pasquotank River basin, 20 non-discharge permits have been issued.

Within the Pasquotank River basin, it is important to note that there is a direct connection between groundwater and surface water in many places. Drainage ditches and canals are widespread in northeastern NC and function as a direct pathway for groundwater that may be impacted from nutrients and coliform bacteria, especially in rural areas where agriculture is widespread, to enter into the surface water system. In other cases, surface water bodies, directly border areas where groundwater quality may be impaired. In many areas, the time it takes for groundwater to move into the surface water system is brief. Although groundwater quality at non-discharge facilities may be compliant with groundwater quality standards, groundwater flux moving into the surface water system has the ability to transport contaminants into surface water bodies and add to total mass loadings. It is recommended that research be conducted to better establish and understand the relationship between groundwater and surface water in eastern North Carolina. Such understanding would provide for more accurate assessment of surface water impairments resulting from groundwater discharges and enable the state to make sound permitting judgments and recommendations to better protect water quality in general.

On-site septic systems are common throughout the Pasquotank River basin. However, soil conditions in the basin may limit the functionality of the septic system treatment allowing untreated effluent to reach surface waters. 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 10 provides more information on wastewater permitting regulations.

## **Population Growth and Changes in Land Use**

There are ten counties and 11 municipalities located in whole or in part in the basin. Based on the 2000 Census, the overall population of the Pasquotank basin is 118,786. The most populated areas are located on the Outer Banks and along waterways. The coastal communities in the Pasquotank 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 and high fecal coliform levels prevent shellfish harvesting and beach recreation. 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 31,800ac. increase in the amount of developed land, a 56,100ac. decrease in cultivated cropland, and a 177,000ac. decrease in forestland. Chapter 11 presents information regarding population, growth and development in the Pasquotank 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. Chapter 12 presents more information regarding these programs and strategies to manage coastal waters.

- Army Corps of Engineers and the State of North Carolina are partnering to conduct a Feasibility Study on the Currituck Sound to identify ways to improve water quality and restore the Sound.
- Coastal Habitat Protection Plan is a plan to manage and restore aquatic habitats critical to North Carolina's commercial and recreational fisheries resources.
- Oyster Action Plan was developed to restore and protect North Carolina's native oyster populations.
- 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.
- 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.
- Albemarle-Pamlico National Estuary Program (APNEP) has supported a number of research, restoration, and demonstration projects. Several demonstration projects are designed to mitigate the effects of stormwater runoff and pollution.
- Albemarle Resource Conservation and Development Council is leading a 10 county regional study to identify regional water quality, water management, and recreational concerns resulting from land-use changes associated with unprecedented development in these counties.

- Section 319 Nonpoint Source Grant program has allocated over \$660,000 for projects.
- Clean Water Trust Fund has allocated over \$34,000,000 for projects in the Pasquotank basin.

### **Land Use Planning and Sea Level Rise**

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 Pasquotank River basin, two counties and three communities have completed their land use plans and nine others are in the process. Chapter 12 presents specific information regarding land use plans in communities of the Pasquotank River basin.

Sea level rise has the potential to dramatically alter North Carolina's coast and estuary systems. Coastal infrastructure, residential properties and industry are threatened and water quality conditions will change. Research is currently being conducted by several universities in North Carolina to predict changes in our environmental and economic resources. Links to resources about sea level rise are provided in Chapter 12.

### **Agriculture and Water Quality**

There are 74 animal operations in the Pasquotank basin. Excess nutrient loading, pesticide and/or herbicide contamination, bacterial contamination, and sedimentation are often associated with agricultural activities, and all can impact water quality. In the Pasquotank basin, significant efforts have been made to reduce nitrogen and phosphorus loads originating from agricultural land uses through the implementation of best management practices (BMPs). Additional efforts are needed to redesign drainage from agricultural fields to help filter runoff. The Soil and Water Conservation Districts are working on establishing Special Use Water Management Districts to help identify and manage stormwater issues and drainage. During this five-year assessment period, the North Carolina Agricultural Cost Share Program (NCACSP) funded BMPs totaling more than \$1,280,000. Chapter 13 provides information related to agricultural activities in the Pasquotank River basin and also identifies funding opportunities for BMPs.

### **Natural Resources**

The land comprising the Pasquotank River basin is dominated by open water. Most of the water for human consumption in the basin comes from surface water and groundwater sources, but the vast majority comes from groundwater sources. Forty-one percent of the land use in the basin is water with another 38 percent characterized as forest/wetlands. Approximately 44 percent of forestland in the Pasquotank basin is privately owned, 10 percent is owned by forest industry and the remaining 46 percent is publicly owned. At least 22,362 acres of land were planted or

regenerated with forest trees across the basin from September 1, 2000 through August 31, 2005. During this assessment period, Division of Forest Resources provided 467 written or verbal BMP recommendations on tracts totaling 18,910 acres in the Pasquotank River Basin. Important natural resources in the basin include wetlands, marshes, pocosins, anadromous fish spawning areas, National Seashore and National Wildlife Refuges. There are five federally listed threatened and endangered aquatic species in the basin. Natural resource agencies advocate the priority conservation activities should include the establishment of buffer strips and conservation easements and continued refinement and monitoring of BMPs on lands used primarily for agriculture and silviculture. These activities are also needed for industrial and residential developments. For more information about the natural resources found in the Pasquotank River basin see Chapter 14.

## **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 Pasquotank 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 Pasquotank 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 15.

## **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 Pasquotank 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:

### ***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.

- 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 waterbody 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.

### **General Recommendations for the Pasquotank River Basin**

Maintenance and continual improvements in water quality are dependent on proactive planning. The following recommendations are compiled from natural resource agencies and stakeholders working and/or living within the Pasquotank River basin:

- Conduct additional research to understand possible surface-ground water interactions and possible water quality issues associated with non-discharge wastewater disposal.
- Continue efforts to focus on proper training of facility operators to address non-compliance issues associated with permitted facilities, both non-discharge and discharge, often associated with operator mismanagement.
- Protect human health and maintain water quality by repairing failing septic systems, update older systems, and eliminate straight pipes. Additional monitoring of fecal coliform bacteria throughout tributary watersheds will aid in identifying where straight pipes and failing septic systems are problems. Septic system maintenance outreach is needed in rural areas dependent on on-site wastewater disposal.
- Develop stormwater management programs for new development and to retrofit existing development.
- Develop additional outreach opportunities to incorporate smart growth technologies or low impact development techniques for municipal planners to incorporate into land use plans.
- Establish riparian buffers, as needed throughout the basin, both in residential and agricultural land use areas.
- Reestablish natural drainage and associated wetlands to reduce stormwater runoff, assist with flood control and improve water quality.
- Support the development and implementation of best management practices (BMPs) to help reduce nonpoint source pollution. Monitoring of these BMPs should also be required to improve maintenance, design and functionality. BMPs applicable in residential areas need to be encouraged through public education campaigns.
- Support the implementation of the Coastal Habitat Protection Plan at all levels of government and amongst citizens.
- Continue collaborative efforts between natural resource agencies within North Carolina and Virginia to improve adaptive management and policies on a watershed ecosystem scale.