Chapter 4 -
Water Quality Issues Related to the Entire Pasquotank River Basin

4.1 Overview

The 1997 Pasquotank River Basinwide Water Quality Management Plan included several recommendations to address water quality issues in the basin. Most of these recommendations were for specific stream segments, and they are discussed separately in the individual subbasin chapters in Section B. This chapter discusses water quality issues that relate to the entire Pasquotank River basin. Habitat degradation, including loss of riparian vegetation and channelization and erosion, is the main water quality issue in the basin.

4.2 Shellfish Harvest Issues

Water polluted by human or animal wastes can harbor numerous pathogens that may threaten human health. This is of particular concern in waters where shellfish are harvested for human consumption. Because of the tendency of clams and oysters to concentrate the material they filter from the water column, shellfish can potentially become too contaminated for safe consumption by humans, even when fecal coliform concentrations are relatively low. Therefore, while water quality may be safe enough for swimming, fishing or other forms of recreation, the waters may be closed to shellfish harvesting and require both corrective and preventive action.

Since routine tests for individual pathogens are not practical, fecal coliform bacteria are widely used as an indicator of the potential presence of disease-causing microorganisms. Fecal coliform bacteria are typically associated with the intestinal tract of warm-blooded animals, and their number is generally assumed to be correlated with the number of pathogens in a water sample. They enter surface waters from a number of sources including urban stormwater, agricultural runoff, improperly designed or managed animal waste facilities, failing on-site wastewater systems, broken sewer lines, improperly treated discharges of domestic wastewater, and wild or domestic animal waste.

There are 395,371.3 acres of shellfish harvesting waters (Class SA) in the Pasquotank River basin. There are 5,033.3 (1.3%) acres currently rated as impaired in the shellfish harvesting use support category. Many of the impaired waters are in areas that have a high value shellfish resource. The following sections describe programs that monitor shellfish harvesting waters, methods for determining use support in class SA waters, and recommendations for addressing impairment class SA waters.

4.2.1 Division of Environmental Health Shellfish Sanitation (DEH SS)

The Division of Environmental Health Shellfish Sanitation (DEH SS) is the agency responsible for monitoring shellfish and shellfish harvesting waters in North Carolina to evaluate the risk to

public health from consuming shellfish meats. DEH SS monitors all coastal waters that have the potential to support shellfish. Table A-29 and the following paragraphs describe DEH SS growing area classifications. In the Pasquotank River basin, there are approximately 917,348 acres of estuarine waters (SC, SB and SA) monitored by DEH SS. Waters are closed to shellfish harvest because of contamination by fecal coliform bacteria.

Table A-29 DEH Shellfish Sanitation Growing Area Classifications

DEH Classification	DEH Criteria
Approved	The median fecal coliform Most Probable Number (MPN) or geometric mean MPN of water shall not exceed 14 per 100 milliliters, and the estimated 90th percentile shall not exceed an MPN of 43 per 100 milliliters for a five tube decimal dilution test.
Conditionally Approved-Open	Sanitary Survey indicates an area can meet approved area criteria for a reasonable period of time, and the pollutant event is known and predictable and can be managed by a plan.
Conditionally Approved-Closed	Sanitary Survey indicates an area can meet approved area criteria for a reasonable period of time, and the pollutant event is known and predictable and can be managed by a plan.
Restricted	Sanitary Survey indicates limited degree of pollution, and the area is not contaminated to the extent that consumption of shellfish could be hazardous after controlled depuration or relaying.
Prohibited	No Sanitary Survey; point source discharges; marinas; data does not meet criteria for Approved, Conditionally Approved or Restricted Classification.

Approved

There are 390,338.0 acres of shellfish harvesting (Class SA) waters that are classified as approved by DEH Shellfish Sanitation in the Pasquotank River basin. These areas are always open to shellfishing harvesting and close only after rare heavy rainfall events such as hurricanes.

Conditionally Approved Shellfish Areas

As of 2001, there were no Conditionally Approved-Open or Conditionally Approved-Closed shellfish harvesting waters in the Pasquotank River basin.

Prohibited/Restricted Shellfish Harvest Areas

There are 5,033.3 acres of shellfish harvesting (Class SA) waters that are prohibited or restricted for shellfish harvesting in the Pasquotank River basin. Most of these areas receive runoff that consistently results in fecal coliform bacteria levels above the state standard. As noted above, the sources of fecal coliform bacteria may be many. DEH Shellfish Sanitation shoreline surveys attempt to identify possible sources. In many areas, the contamination may be from several different sources at different times of the year including, but not limited to, adjacent development and marinas.

4.2.2 Changes in Shellfish Harvesting Use Support Assessment

The 1997 Pasquotank River basin use support assessment rated Approved waters as fully supporting (FS), Conditionally Approved waters as fully supporting but threatened (ST), and Prohibited waters as partially supporting (PS). As described in Section A, Part 3.4, the ST subcategory of fully supporting is no longer used. In the 1997 assessment, there were 862,813 acres rated fully supporting and 5,987 acres rated partially supporting. Of the impaired acres, 1,125 are in Class SC waters which are not designated for shellfish harvesting through the DWQ surface water classification system. In the 1997 basin plan, acres were reported by the 20 DEH SS growing areas (e.g., Roanoke Sound H1 - 1,950 partially supporting acres).

Interim Frequency of Closures Based Method

DWQ and DEH SS are developing the database and expertise necessary to assess shellfish harvesting use support using a frequency of closure based approach. This database will allow DWQ to better assess the extent and duration of closures in Class SA waters. These tools are not available for use support determinations in Class SA waters for the 2001 Pasquotank River basin assessment. DWQ believed it important to identify frequency of closures in Conditionally Approved-Open waters, so an interim methodology was used based on existing databases and GIS shapefiles. Since there are no Conditionally Approved waters in the basin, there is no resultant impact on use support determinations for this designation during this five-year basinwide cycle. There will likely be changes in reported acreages in future assessments using the permanent methods and tools that define areas and closure frequency.

The Pasquotank River basin contains many Prohibited shellfish harvesting areas, which are now given a use suppoprt rating of not supporting (NS) shellfish harvesting based on the DEH designation. This use support rating differs significantly from the historical use support ratings of partially supporting (PS) for Prohibited shellfish harvesting areas. Changes that are related to water quality or DEH SS growing area reclassifications are explained in detail in the subbasin chapters of Section B. Refer to Appendix III and the subbasin chapters in Section B for more specific information on individual waters.

4.2.3 Recommendations for Addressing Impaired Shellfish Harvest Waters

Fecal coliform bacteria are the primary pollutant that causes closures in shellfish harvesting waters. Fecal coliform bacteria are relatively short lived in saltwater. Many of the impacted waters are where freshwater flows from the land into shellfish harvesting areas. Larger waters are impacted from the cumulative effect of freshwater runoff transporting bacterial contaminants farther out into the estuary. The runoff increases with increasing development (impervious surface). Research over the past 15 years consistently demonstrates a strong correlation between the imperviousness of a drainage basin and the health of its receiving waters (Arnold and Gibbons, 1996). Mallin et al. (2000) showed that with increasing impervious surfaces there is an increase in fecal coliform delivery to estuarine waters. Larger waters are being impacted from the cumulative effect of freshwater runoff from increasing upstream development, which in turn is transporting bacterial contaminants farther out into the estuary. Restoration strategies that address the source and transport of bacterial contamination are more appropriate than developing

complicated models, because of the complex hydrology of coastal waters and the life-cycle of fecal coliform bacteria.

A study by Duke University Marine Labs (Reilly and Kirby-Smith, 1999) developed recommendations to restore impaired shellfish harvesting waters that included controlling the sources of fecal coliform bacteria and slowing the movement of fecal coliform bacteria from source to receiving waters.

North Carolina Blue Ribbon Advisory Council on Oysters

The NC Blue Ribbon Advisory Council on Oysters (NCBRACO) issued its final *Report on Studies and Recommendations* in October 1995. In the report, the council "reaches the inescapable conclusion that oyster harvests have declined sufficiently in North Carolina to justify bold new action and to require initiation of that action immediately."

The council's report along with a report from the Council's Public Bottom Production Committee makes a series of specific water quality recommendations (NC Blue Ribbon Advisory Council on Oysters, 1995). The objective of these recommendations is to "restore and protect coastal water quality to create an environment suitable for oysters that are safe for human consumption." These recommendations include, but are not limited to:

- Institution of regulatory mechanisms for control of NPS runoff, particularly fecal coliform bacteria and nutrients.
- Mandatory 100-foot buffers along all SA waters.
- Reducing the allowable built-upon area for low density development.
- Promote and fund research on oyster reefs that documents their positive impact on water quality.
- Urge the Marine Fisheries and Environmental Management Commissions to work together to establish and implement a "Use Restoration Waters" classification in order to restore closed shellfish beds.
- DEHNR should "augment its basinwide management plans to include mechanisms for controlling both point and nonpoint source nutrient additions" and "develop and fund a coastal water quality monitoring system capable of measuring oxygen levels in bottom waters in historically important shellfish grounds."
- Work with the NCDOT to reverse past road construction activity that has adversely affected oyster beds through restrictions on normal water flow.

The following sets of recommendations address or start to address some of the recommendations from the Blue Ribbon Advisory Panel listed above. The NCDENR agencies will first work to identify and quantify the extent and duration of shellfish harvest area closures. Then through education and involvement in land use plan review help, local governments identify these closed areas. The various agencies will work together with local governments to reduce frequency and duration of closures.

Recommendations for NCDENR Agencies to Address Impairment in Class SA Waters

Better Identification of Growing Areas and Database Development

To better identify impairment of shellfish waters, DWQ, DEH SS, DCM and DMF are developing the tools necessary to use a frequency of closures based assessment of Class SA waters as described above. DWQ, DEH SS and DMF have received funding from the NC Coastal Nonpoint Source Program (described below) to georeference growing areas and monitoring sites and develop a new tracking database. Shellfish harvesting use support assessments will be completed for the next assessment period using these tools. The tools will also help:

- identify waters where bacterial contamination is increasing or decreasing with changes in land use;
- provide a means to share this information with the public and local governments; and
- identify areas where best management practices and restoration projects are needed, as well as providing a means of evaluating the implementation of these projects.

Continued Enforcement of DWQ ORW Program

In addition to the stringent water quality standards for Class SA waters, DWQ also has the supplemental classification of ORW (Outstanding Resource Waters). In the Pasquotank River basin there are no SA ORW waters. There are 17,043.7 freshwater acres, 51.3 miles and 43,154.6 estuarine acres of ORW waters. The largest areas are Phelps Lake and the Alligator River. All these waters are currently not rated. DWQ will continue to implement this program.

Reclassification of Waters to Identify Shellfish Harvesting Uses

DWQ, DMF and DEH SS may pursue the reclassification of some segments that are currently classified as SC waters. DWQ, DMF and DEH SS will continue to pursue reclassifications to Class SA of areas that are approved for shellfish harvesting.

Developing Coastal Habitat Protection Plans

DMF is in the process of developing Coastal Habitat Protection Plans (CHPP) with DWQ and DCM. These plans will identify existing and potential threats to habitats important to coastal fisheries and recommend actions to restore and protect them. The plans will also provide a framework for adoption of rules to protect habitats vital to coastal fisheries. The plans will help to assure consistent actions among the Coastal Resources Commission (CRC), Environmental Management Commission (EMC) and the Marine Fisheries Commission (MFC). For more information on these plans, contact the Habitat Protection Section at (252) 726-7021 or visit the CHPP website at http://www.ncfisheries.net/habitat/chpp1.htm.

Oyster and Clam Fisheries Management Plans Recommendations

The major recommendations of the most recent oyster and clam fisheries management plans include increasing use of existing authority to reverse trends in shellfish closures and to restore

conditionally approved-open areas. For more information on these plans, contact the Division of Marine Fisheries at (252) 726-7021 or visit the website at http://www.ncfisheries.net/.htm.

North Carolina Coastal Nonpoint Source Program (Section 6217)

Section 6217 of the Federal 1990 Coastal Zone Act Reauthorization Amendments (CZARA) requires every state participating in the Coastal Zone Management Act program to develop a Coastal Nonpoint Pollution Control Program (CNPCP). The purpose of this requirement, as stated in the Act, is to "strengthen the links between Federal and State coastal zone management and water quality management programs and to enhance State and local efforts to manage land use activities that degrade coastal waters and coastal habitats." To accomplish these goals, the federal agencies established 56 Management Measures that are to be used by each state to address the following nonpoint source pollution categories:

- *Agricultural Sources*
- *Forestry*
- *Urban Areas* (urban runoff; construction activities; existing development; on-site disposal systems; pollution prevention; and roads, highways and bridges)
- *Marinas and Recreational Boating* (siting and design; and marina and boat operation/maintenance)
- *Hydrologic Modification* (channelization and channel modification; dams; and streambank and shoreline erosion)
- *Wetlands, Riparian Areas and Vegetated Treatment Systems*

At the federal level, the CNPCP is administered jointly by the National Oceanic and Atmospheric Administration (NOAA) and the Environmental Protection Agency (EPA). Within North Carolina, the state program, referred to as the Coastal Nonpoint Source Program (CNPSP), is administered by DWQ and the DCM. The state program currently has one full-time staff person located in the Nonpoint Source Planning Unit of DWQ.

The core of the state's CNPSP will be increased through communication and coordination between DWQ and key state agencies that have regulatory responsibilities for controlling nonpoint sources of pollution. This increased dialogue will be facilitated in part by the state's CNPSP Coordinator and will allow for identification of gaps, duplications, inadequacies or inefficiency of existing programs and policies. Responsibilities of the state program coordinator will include participation in the NPS Workgroup to represent coastal water quality interests. The workgroup is involved with the continual refinement of the 319 Grant Program and development of North Carolina's 2001 NPS Management Program Update. The CNPSP Coordinator will also participate in the development and implementation of the basinwide management plans for the coastal draining rivers; serve as a liaison between DWQ and DCM; and participate in the development of nonpoint source educational materials. For more information about this program, contact the Coastal Nonpoint Source Program Coordinator at (919) 733-5083 or visit http://h2o.enr.state.nc.us/nps/czara.htm.

Implementation of Coastal Resources Commission 30-Foot Buffer Rules

In November 1999, the Coastal Resources Commission (CRC) enacted rules designed to protect coastal waters. The rules require a 30-foot buffer for new development along coastal shorelines in the 20 CAMA counties. The new rules became effective in August 2000. Visit http://dcm2.enr.state.nc.us/ for more information on these rules.

Land Use Planning

A Land Use Plan Review Team authorized by the CRC has recommended better implementation of land use plans and involvement of local governments in the basinwide planning process. In 1998, the CRC suspended the Coastal Area Management Act land use plan updates in order to review and improve the program. Seeking input from local stakeholders, DCM convened a group of external experts, the Land Use Plan Review Team, representing different interests in coastal North Carolina. In September 2000, the team provided the CRC with a set of recommendations to restructure the existing land use planning program. Since land use plans affect permit decisions, growth patterns and community visions, any revisions to the process can potentially have widespread impact to coastal decision-making and inevitably water quality. Therefore, DWQ will play an active role in land use planning discussions, especially with respect to water quality concerns.

The team developed several recommendations, some of which directly impact DWQ. DWQ provided feedback during the development of these recommendations, actively seeks to improve existing communication links with DCM, and continues to stay abreast of events as the recommendations evolve into implementation.

The new coastal land use planning guidelines under consideration by the CRC stress the importance of healthy water. From the requirements of the pre-planning scoping process to the elements of local plans, the new guidelines will ask local governments to do more to protect water quality. One of the goals of the proposed guidelines is to maintain, protect and, where possible, enhance water quality in all coastal wetlands, rivers, streams and estuaries. That effort begins at the local level. The guidelines will require local governments to adopt policies to ensure that coastal water quality is improved or maintained. Chief among these policies are those that prevent or control stormwater discharges, as it is a leading cause of water quality problems along the coast. Local policies, such as impervious surface limits, vegetated riparian buffer creation and wetlands protection, can help lessen the negative impacts of stormwater runoff on coastal waters. The guidelines also will require local governments to develop policies and land use categories that protect open shellfish waters and restore closed or conditionally approved shellfish waters. The Coastal Resources Commission anticipates the revision and adoption of new land use planning rules to go into effect by August 2002.

A detailed summary of the Land Use Plan Review Team recommendations is available through the DCM website at http://dcm2.enr.state.nc.us/. DWQ continues to support these team suggestions, including:

- Development of a "how to" manual to assist local governments in developing high quality land use plans.

- Involvement of coastal local governments in state basinwide planning and seeking application of a land use planning requirement in all areas of coastal river basins are strongly encouraged.
- Strengthen the ties between basinwide planning for water quality and CAMA land use plans, especially focusing on participation in basinwide planning. The team also recommends that the CRC coordinate with the Environmental Management Commission to expand the role of local government and local land use plans in the basinwide water quality planning process. Three specific steps are recommended:
    - ► The database and strategies contained in the basinwide plans should be loosely tailored to the requirements for land use plans.
    - ► The EMC should incorporate local land use policies in basinwide plans.
    - ► Local governments should be encouraged by the CRC to participate in the scoping process for basinwide plans.
- Measures to encourage greater intergovernmental coordination in the development of land use plans.

DWQ will review local land use plans with DCM for communities in the Pasquotank River basin to help identify impaired or impacted shellfish harvesting waters and make recommendations to reduce future increases in bacterial contamination related to development and land use changes. DWQ will also support local government and community group endeavors to protect and improve shellfish harvesting waters. This will include providing educational opportunities to increase the understanding of technical issues, as well as assisting with identifying funds for restoration and protection projects.

For more information on the CAMA land use process, contact a DCM land use planner at (252) 808-2808 or visit the program on-line at http://dcm2.enr.state.us/.

Recommendations for Local Governments, Community Groups and Pasquotank River Basin Citizens to Address Impairment in Class SA Waters

Because of limited resources and authority, the various state agencies listed above cannot completely address impairment in shellfish harvesting waters. Shellfish harvesting is a potentially stable and sustainable economic resource for coastal areas and for the state. The state agencies can help to reduce temporary closures, restore areas that are permanently closed, and help in managing a healthy shellfish harvesting industry through existing regulations and authorities. Local governments, community groups and citizens have more local knowledge and are directly affected by a degraded coastal environment, and therefore, have a responsibility for protecting and restoring shellfish harvesting in coastal waters.

Local Governments

Local governments should consider water quality impacts in all aspects of government operations. Land use planning should discourage development in wetlands and areas draining to sensitive coastal areas. Land use plans should incorporate preservation and limited development of land adjacent to approved shellfish harvesting areas. Best management practices should be implemented during all land-disturbing activities to reduce runoff and delivery of bacterial contaminants to shellfish harvesting waters. Local governments with jurisdictions around the

large areas of conditionally approved-open waters should work together and with the NCDENR agencies to develop strategies for reducing sources and delivery of bacterial contaminants to these waters in an effort to reduce the extent and duration of temporary closures. A long-term strategy should be put in place to eventually restore shellfish harvesting to prohibited areas where human activities have caused these closures.

Community Groups

Environmental groups, community organizations and fisherman groups should make efforts to address coastal water quality issues by becoming involved. Attendance and participation in DWQ's Basinwide Planning Program, The Coastal Habitat Protection Planning Program, City Council meetings, County Commissioner and Planning Board meetings will be essential in addressing coastal water quality issues.

Marina Operators

Many marina areas on the coast are closed to shellfish harvesting. Marina operators should enroll in programs like the Clean Marinas Program to minimize impacts of these activities on coastal water quality. For more information on this program, visit the NC Marine Trade Association's webpage at http://www.ncmta.com/ or call (910) 962-3351.

4.3 Biological Monitoring Issues

DWQ strives to properly evaluate the health of biological communities throughout the state. Swamp stream systems, nonwadeable waters and coldwater fisheries have presented unique challenges. This section discusses some of these challenges. Refer to Appendix III for further information.

4.3.1 Draft Criteria for Assessing Benthic Macroinvertebrates in Swamp Streams

Extensive evaluation, conducted by DWQ, of swamp streams across eastern North Carolina suggests that different criteria must be used to assess the condition of water quality in these systems. Swamp streams are characterized by seasonally interrupted flows, lower dissolved oxygen and sometimes, lower pH. Sometimes they also have very complex braided channels and dark-colored water. Since 1995, benthic macroinvertebrates swamp sampling methods have been used at over 100 sites in the coastal plain of North Carolina, including more than 20 reference sites. In 1999, 10 sites on swamp streams in the Pasquotank River basin were sampled by DWQ as well. Preliminary investigations indicate that there are at least five unique swamp ecoregions in the NC coastal plain, and each of these may require different biocriteria. The lowest "natural" diversity has been found in low-gradient streams (especially in the outer coastal plain) and in areas with poorly drained soils.

DWQ has developed draft biological criteria that may be used in the future to assign bioclassifications to these streams (as is currently done for other streams and rivers across the state). However, validation of the swamp criteria will require collecting data for several years from swamp 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 swamp sites, effects of flow

interruption, variation among reference swamp sites, and the effect of small changes in pH on the benthos community. Other factors, such as whether the habitat evaluation can be improved and the role fisheries data should play in the evaluation, must also be resolved. While it may be difficult to assign use support ratings to these swamp streams, these data can be used to evaluate changes in a particular stream between dates or to evaluate effects of different land uses on water quality within a relatively uniform ecoregion.

4.3.2 Draft Criteria for Assessing Fish Communities

In the past, fish communities in some streams were sampled by DWQ, and scores were assigned using the North Carolina Index of Biotic Integrity (NCIBI). The NCIBI uses a cumulative assessment of twelve parameters or metrics. Each metric is designed to contribute unique information to the overall assessment. The scores for all metrics are then summed to obtain the overall NCIBI score.

However, during the late 1990s, application of the NCIBI was restricted to wadeable streams that can be sampled by a crew of 2-4 persons using backpack electrofishers and following the DWQ Standard Operating Procedures (NCDEHNR, 1997). Work began in 1998 to develop a fish community boat sampling method that could be used in nonwadeable coastal plain streams. Plans are to sample 10-15 reference sites with the boat method once it is finalized. As with the benthos in swamp streams, several years of reference site data will be needed before criteria can be developed with confidence to evaluate the biological integrity of large streams and rivers using the fish community.

4.4 Fish Consumption Advisories

The NC Department of Health and Human Services (NCDHHS) has developed guidelines to advise people to what fish are safe to eat. DWQ considers uses of waters with a consumption advisory for one or more species of fish to be impaired. Elevated methylmercury levels have been found in shark, swordfish, king mackerel, tilefish, largemouth bass, bowfin (or blackfish), and chain pickerel (or jack). As of April 2002, these fish are under an advisory.

4.4.1 Mercury Related Fish Consumption Advisories

The presence and accumulation of mercury in North Carolina's aquatic environment is similar to contamination observed throughout the country. Mercury has a complex life in the environment, moving from the atmosphere to soil, to surface water and into biological organisms. Mercury circulates in the environment as a result of natural and human (anthropogenic) activities. A dominant pathway of mercury in the environment is through the atmosphere. Mercury that has been emitted from industrial and municipal stacks into the ambient air can circulate across the globe. At any point, mercury may then be deposited onto land and water. Once in the water, mercury can accumulate in fish tissue and humans. Mercury is also commonly found in wastewater. However, mercury in wastewater is typically not at levels that could be solely responsible for elevated levels in fish.

The NC Department of Health and Human Services issues fish consumption advisories for those fish species which have median and/or average methylmercury levels of 0.4 mg/kg or greater. These fish include shark, swordfish, king mackerel, tilefish, largemouth bass, bowfin (or blackfish), and chain pickerel (or jack) caught in North Carolina waters south and east of Interstate 85. As a result of these advisories, DWQ considers all waters in the Pasquotank River basin to be partially supporting the fish consumption use support category. Refer to Appendix III for more information regarding use support ratings and assessment methodology.

Specific Fish Consumption Advisories

Lake Phelps: Due to higher than normal levels of mercury in Phelps Lake, NCDHHS posted a limited consumption advisory in June 1996. Consumption of bass and blackfish should be limited to no more than two meals per person per month, and women of childbearing age and children should eat no bass or blackfish.

Fish is an excellent source of protein and other nutrients. However, several varieties of saltwater and NC freshwater fish may contain high levels of mercury, which may pose a risk to human health. These guidelines will help you make healthy food choices.

Women of Childbearing Age (15-44 years), Pregnant Women, Nursing Women and Children under 15:

- **Do not eat** shark, swordfish, tilefish or king mackerel; or blackfish (bowfin), largemouth bass or jack fish (chain pickerel) caught in North Carolina waters south and east of Interstate 85. These fish are all high in mercury.
- **Eat up to two meals* per week of other fish.**

Other Women, Men and Children 15 years and older:

- **Eat no more than one meal* per week** of shark, swordfish, tilefish or king mackerel; or blackfish (bowfin), largemouth bass or jack fish (chain pickerel) caught in North Carolina waters south and east of Interstate 85. These fish are all high in mercury.
- **Eat up to four meals* per week of other fish.**

* A "meal" is 6 ounces of cooked fish for adults and children 15 years and older, and 2 ounces of cooked fish for younger children.

4.4.2 Dioxin Related Fish Consumption Advisories

Dioxin contamination is found worldwide, including a portion of the Albemarle Sound westward of Bull Bay and Harvey Point to the Roanoke River. Dioxin is typically generated through high temperature combustion processes, chemical bleaching of pulp, and through the production of chlorinated phenols and their derivatives. Dioxins can bioaccumulate in animal tissues, creating human health concerns such as reproductive impairment, carcinogencity and even death. Dioxin binds tightly with sediment, food particles and organic matter in the water column, thus, leaving only low concentrations dissolved in the water column.

Due to dioxin's bioaccumulation properties, the Department of Health and Human Services (NCDHHS) recommends that in fish advisory areas fish consumption should be limited to two meals per person per month. Children and pregnant or nursing women should not consume any fish from the Albemarle Sound. Consumption of herring, shellfish and shad (including roe) is not considered a health risk.

Specific Fish Consumption Advisories

Albemarle Sound: Dioxin has prompted an advisory since March 2001 in the Albemarle Sound from Bull Bay to Harvey Point, west to the mouth of the Roanoke River and north to the mouth of the Chowan River at the US Highway 17 Bridge. Weyerhaeuser Company, located at the mouth of Welch Creek in the Roanoke River basin, previously discharged directly to the creek. During the 1980s, officials recognized that dioxin, a carcinogenic by-product of the chlorine bleaching process, was accumulating in fish tissue. In 1988, Weyerhaeuser made improvements and relocated the discharge to the Roanoke River. Weyerhaeuser is required by DWQ to provide extensive monitoring in the Roanoke River from Williamston down the Roanoke and out into the Albemarle Sound as far as Bull Bay. Data recently collected by Weyerhaeuser Company indicate a decline in dioxin concentrations. In October 2001, the advisory was partially lifted for game fish. However, an advisory remains in place for bottom-dwelling fish such as carp and catfish.

For more information regarding fish consumption advisories, visit the NC Department of Health and Human Services website at http://www.schs.state.nc.us/epi/fish/current.html or call (919) 733-3816.

4.4.3 2002 Recommendations

DWQ, in cooperation with Weyerhaeuser Company, will continue to monitor for dioxin contamination and will work closely with the Department of Health and Human Service's Division of Public Health to lift the advisory when there is no longer a risk to human health from consumption of fish.

DWQ Mercury Workgroup

DWQ is committed to characterizing methylmercury exposure levels and determining if NPDES sources need to be controlled. DWQ formed an internal Mercury Workgroup to improve communication which directly affect mercury issues (i.e., Pretreatment, Environmental Sciences, Basinwide and Estuary Planning, etc.). The workgroup meets as needed to share information and determine next steps in addressing mercury issues associated with the aquatic environment.

Improved Ambient Sampling Techniques

DWQ aims to stay abreast of new technology and sampling techniques to ensure that water quality data are accurate, precise and of highest value. In 2000, DWQ started training water quality sampling staff on the new EPA Method 1631 technique. Current monitoring using a higher detection limit (EPA Method 245.1) has consistently yielded non-detected values, and DWQ aims to use the 1631 method to allow detection levels three orders of magnitude lower than EPA Method 245.1.

Regional Mercury Study

In an effort to better manage state waters that may have methylmercury issues, DWQ initiated a study through EPA 104(b)(3) funds. The study aims to provide information that may be used in water quality standard and TMDL development. The study goals include:

- determining levels of ambient mercury in the surface water system;
- estimating site-specific total mercury: methylmercury translators to evaluate water quality criteria;
- develop site-specific water to fish bioaccumulation factors; and
- determine levels of mercury in treatment plant effluent.

DWQ aims to complete this study in 2003, and results will be available to the public. For more information, contact the DWQ Planning Branch Modeling/TMDL Supervisor at (919) 733-5083.

DWQ will continue to host an internal workgroup to stay abreast of current mercury issues. The public has voiced concerns that DWQ should be working on the ecological components and consequences of mercury bioavailability to biota in these areas and the biogeochemical cycling and production of methylmercury from associated wetlands along these streams. Though the workgroup does not have a mandate to conduct research into mercury, the workgroup will better communicate its purpose and accomplishments to the public through periodic updates on the DWQ website.

DWQ will also provide interested members of the public with an overview of the new ambient monitoring sampling technique to gather feedback and insights on how DWQ can best accomplish its data collecting goals.

DWQ will continue to monitor concentrations of various contaminants in fish tissue across the state and will work to identify and reduce wastewater contributions of mercury to surface waters. The Division of Air Quality (DAQ) evaluates mercury levels in rainwater on a regular basis through the EPA Mercury Deposition Network. EPA continues to focus on nationwide mercury reductions from stack emissions and through pollution prevention efforts. Pollution prevention efforts are being investigated on a state and federal level to reduce mercury emissions.

4.5 Wetland Loss

4.5.1 Introduction

Wetlands provide a variety of benefits to society and are very important in watershed planning because of the functions they perform. Wetlands provide important protection for flood prevention to protect property values; streambank stabilization to prevent erosion and downstream sedimentation; water purification and pollutant removal (especially for nitrogen and phosphorus); habitat for aquatic life and wildlife and endangered species protection. These values vary greatly with wetland type. Wetlands adjacent to intermittent and permanent streams are most important to protecting water quality in those streams, as well as downstream lakes and estuaries. However, wetlands located away from streams also have important water storage

capacity and pollutant removal potential. Section A, Part 2.6 contains more specific information on the ecological significance of wetlands in the Pasquotank River basin.

4.5.2 Physical Impacts to Wetlands and Streams

DWQ has issued approvals for wetland filling activities since the mid-1980s; however, in 1989, the Environmental Management Commission directed DWQ to begin reviewing wetland fill and stream alteration activities using a review sequence of (1) avoidance, (2) minimization, and (3) mitigation of wetland impacts. Rules finalized in 1996 required that wetland values, such as whether or not the wetland is providing significant uses or whether the filling activity would remove or degrade those uses, be considered. The rules also specify wetland and stream mitigation ratios and type and location of projects to make the mitigation process more predictable and manageable for the regulated community. DWQ's emphasis continues to be on water quality and the essential role that wetlands play in maintaining water quality. The issuance of a 401 Water Quality Certification by DWQ is required before the US Army Corps of Engineers can issue a Section 404 Permit authorizing the fill or alteration of wetlands and/or streams in North Carolina.

Despite efforts to protect and restore wetland and stream functions on the part of DWQ and many other agencies and organizations in North Carolina, there is still an annual net loss of wetlands and streams statewide. DWQ and Division of Land Resources (DLR) regulate construction activities near streams and wetlands. These regulatory programs ensure that construction projects cause minimal damage to these resources and that unavoidable impacts are addressed through mitigation projects. Restoration projects are also funded through the Wetland Restoration Program (WRP), Section 319 Program, Clean Water Management Trust Fund, and Division of Water Resources Grant Program that can help offset stream and wetland impacts (NCDENR-DWQ-WRP, 1998).

DWQ tracks wetland and stream losses that are authorized through the issuance of a 401 Water Quality Certification. In addition to the permitted wetland and stream impacts that are tracked by DWQ, an unknown amount of permanent wetland and stream losses also occurs. Projects that affect less than one-third of an acre of wetland or less than 150 linear feet of stream are not required to receive written confirmation from DWQ, and therefore, might not be reported. The magnitude of unauthorized impacts to wetlands and streams is not known.

In June 1998, a federal court declared that the US Army Corps of Engineers' Tulloch Rule, which prohibited the ditching and draining of wetlands, was illegal. As a result, during FY 1999-2000, approximately 9,220 acres of wetlands on about 80 sites (mostly in southeastern NC) were ditched and drained. This activity stopped in March 1999 when DWQ began to enforce its wetland standards. DWQ, EPA and DLR have spent an extensive amount of time visiting each of these sites to check for compliance with environmental rules. Most of these wetlands were slated to be restored by December 2000.

Over the past six years (1995-2000), DWQ issued permits for approximately 369.62 acres of wetland fill activities and alteration activities in the Pasquotank River basin (Table A-30). One of the largest impacts occurred in the Pasquotank River subbasin which includes Currituck Sound and the North River subbasin (subbasin 03-01-54) involving 242.63 acres of permitted

wetland impacts. Overall, there have 4,790.63 acres of wetlands mitigated than impacted in the basin.

Table A-30 Permitted Wetland Impacts Activities (in Acres) by Subbasin and Year

Subbasin Number	1995	1996	1997	1998	1999	2000	Total
03-01-50	1.25	2.59	10.56	1.57	0.51	0.5	**16.98**
03-01-51	0.53	1.04	0.26	40.35	10.74	1.44	**54.36**
03-01-52	28.73	5.09	1.05	0.07	1.02	1.41	**37.37**
03-01-53	0.67	0	0.33	0	0.6	0.06	**1.66**
03-01-54	242.63	1.72	1.23	1.32	0.74	1.44	**249.08**
03-01-55	0.62	1.34	3.05	1.67	1.42	1.62	**9.72**
03-01-56	0.16	0	0.14	0.01	0.01	0.13	**0.45**
Total Acres	**274.59**	**11.78**	**16.62**	**44.99**	**15.04**	**6.60**	**369.62**

Table A-31 Permitted Wetland Mitigation Activities (in Acres) by Subbasin and Year

Subbasin Number	1995	1996	1997	1998	1999	2000	Total
03-01-50	0.5	0	20.6	0	0	0	**21.1**
03-01-51	0	4000	0	42.9	0	0	**4,042.9**
03-01-52	0	0	0	0	0	0.25	**0.25**
03-01-53	640	0	0	0	0	0	**640**
03-01-54	74.74	0	0.2	0	0	0	**74.94**
03-01-55	0	0	11.44	0	0	0	**11.44**
03-01-56	0	0	0	0	0	0	**0**
Total Acres	**715.24**	**4,000**	**32.24**	**42.9**	**0**	**0.25**	**4,790.63**

4.5.3 2002 Recommendations

Through protecting wetlands, local decision-makers can reduce the likelihood of nonpoint source contamination of surface waters. DWQ recommends that local governments consider the value of wetlands and include protection of wetlands in land use plans. DWQ will provide funding source information upon request to local governments for opportunities to restore, enhance or create wetlands.

4.6 Effects of Hurricanes on Water Quality

The Pasquotank River basin in North Carolina is periodically subjected to hurricanes and tropical storms. Aquatic ecosystems and water quality can, and do, recover from the wind damage and

extensive flooding that result from these storms. However, human activities in hurricane-prone areas can greatly increase the extent and severity of water quality and ecosystem impacts, as well as the system's recovery time.

In September 1999, Hurricane Floyd made landfall in North Carolina, only a few days after Hurricane/Tropical Storm Dennis made two passes across the eastern part of the state. Flooding in eastern North Carolina was higher and more extensive than any ever recorded. Many towns and homes were completely flooded, bridges and buildings were washed downstream, animal waste lagoons breached, and wastewater treatment plants were inundated. Floyd resulted in more fatalities than any hurricane since 1972 and thousands were left homeless (Bales, 2000). In terms of water quality impacts, DWQ scientists note that the Pasquotank River basin did not experience hurricane-related fish kills in recent years as compared with the more southern areas such as the Neuse River and Cape Fear River basins (NCDENR-DWQ, 1999).

4.6.1 Contaminants

Floods can transport large amounts of materials from the land into surface waters, inundate areas that are contaminated with various substances, flood wastewater treatment facilities that may be located in or near the floodplain, and result in the failure of animal waste lagoons. The large volume of water transported during Hurricane Floyd demonstrated that flooding could result in the transport of a large mass of pollutants through watersheds and into the estuaries of eastern North Carolina. Pollutants that can be carried into waters during large floods include excess nutrients (nitrogen, phosphorus and organic carbon), bacteria and other pathogens, pesticides and fuels, and sediment. As a result of contamination by these pollutants, dissolved oxygen can be depleted, causing stress (or death) to fish and other aquatic life. Salt concentrations in the estuaries can also be affected by the large volume of freshwater flowing into the system within a short period of time.

4.6.2 De-Snagging

The Natural Resources Conservation Services' (NRCS) Emergency Watershed Protection (EWP) is responsible for emergency de-snagging (removal of piles of woody debris from stream and river channels) activities. The EWP program is intended to respond to watersheds impacted by natural disasters such as hurricanes, floods and fire. The purpose of the program is to restore watershed functions to predisaster conditions. Areas selected for debris removal are based on the amount and location of debris and the increased risk of flooding to improved property (including cropland), or public safety (primarily roads and bridges). Location maps and a description of all proposed work is sent to appropriate federal and state agencies for review and comment prior to contracting the work. The programs' intent is to consider environmental concerns.

The activity of debris removal is of great interest to DWQ as the excessive removal of debris can impact the aquatic habitat and aquatic life within a stream reach. The decision to remove debris is made by considering topography, proximity of improved property subject to damage, location of culverts, bridges and other restrictions, comparison of costs and benefits, and potential environmental impacts. NRCS, along with other state and federal agencies, is in the process of developing guidelines for debris removal that will improve the decision-making process with regard to eligibility and damage thresholds, as well as improving the standards and specifications

for removing woody debris in a manner that leaves enough to provide suitable habitat. Debris removal under EWP is not intended to remove all debris from stream channels, only that which causes or may cause an increased risk of flooding or streambank erosion.

Woody debris is the predominant habitat for benthic macroinvertebrates in larger, slower-moving coastal stream and wetland systems. Therefore, removal of these snags removes the habitat available for aquatic life. If care is not taken in properly removing woody debris, the streambanks and streambed can be altered as well as causing moderate to severe habitat degradation.

4.6.3 2002 Recommendations

DWQ is aware of the need to remove obstructions to water flow, including snags, near bridges or other structures in emergency situations because of safety concerns, to reduce economic loss in the event of natural disasters, and to reduce the risk of flooding. NRCS has recently adopted an Interagency Coordination and Implementation Plan for the EWP program that allows for a direct and ongoing role for several agencies to play in the implementation process. The method in which snags are removed, the amount of debris that is removed, and the sites selected should all be chosen following a thorough review by the various agencies responsible for the implementation of the EWP program. Local governments that receive additional funding for this type of activity should also implement the same management strategies as outlined in the EWP implementation plan to reduce impacts to water quality, aquatic habitat and aquatic life.

4.7 Aquaculture

North Carolina has a growing aquaculture industry. The industry is considered an agricultural venture in the state. Aquaculture is the business of farming aquatic plants and animals. In North Carolina, farmers grow trout, catfish, hybrid striped bass, crawfish, ornamental fish, baitfish, clams and oysters. The NC Department of Agriculture is the lead agency for aquaculture, and it considers North Carolina one of the most aquaculture-friendly states in the US (http://www.agr.state.nc.us/fooddist/aquacult/general.html). Given the state's promotion of the industry, the state should expect to see an increase in production in the upcoming years.

DWQ has concerns about the amount of fish tissue that is produced by each facility, specifically regarding the tracking mechanisms in place. DWQ also has concerns about the potential discharge of high salinity waters into adjacent SA waters and primary nursery areas.

4.7.1 2002 Recommendations

DWQ will develop a workgroup to look at the potential impacts of aquaculture on surface and groundwater quality. DWQ will generate a strategic plan for addressing aquaculture facilities, and DWQ will share the information with the public through its website.

4.8 Water Control Structures

Due to the high groundwater table in eastern North Carolina, agriculturalists tend to alter the local hydrology in an effort to maximize their crop. This alteration can take the form of channelizations and water control structures.

In addition, there are a multitude of stormwater discharges into the Atlantic Ocean. These discharges can affect public health, and thus, swimming use support.

4.8.1 2002 Recommendations

DWQ has begun discussions with Weyerhaeuser in southeast North Carolina. DWQ will facilitate an information exchange between major landholders in the basin that currently use or may use water control structures in the future. This information exchange will hopefully lead to better technology transfer between large landholders, ultimately improving the local water quality around the large plats of land.

DEH is currently mapping the geographic location of stormwater drains in the coastal area. DEH is sharing this information with DWQ. Both Divisions will discuss effective use support methodology to ensure that current and proposed stormwater discharges minimize their impairment of surface waters in the Pasquotank River basin.

4.9 Growth Management

Urbanization often has greater hydrologic effects than any other land use, as native watershed vegetation is replaced with impervious surfaces in the form of paved roads, buildings, parking lots, and residential homes and yards. Urbanization results in increased surface runoff and correspondingly earlier and higher peak flows after storms. Flooding frequency is also increased. These effects are compounded when small streams are channelized (straightened) or piped and storm sewer systems are installed to increase transport of drainage waters downstream. Bank scour from these frequent high flow events tends to enlarge urban streams and increases suspended sediment. Scouring also destroys the variety of habitat in streams leading to degradation of benthic macroinvertebrate populations and loss of fisheries (EPA, 1999).

The population in the Pasquotank River basin is expected to increase significantly along the coastline by 2020. Most of the growth will be on the coast and around existing urban areas. As populations expand, so do developed areas. Some local governments have prioritized water quality planning. However, proactive planning efforts at the local level are needed across the entire basin in order to assure that development is done in a manner that minimizes impacts to water quality.

Urban runoff also carries a wide variety of contaminants to streams including oil and grease from roads and parking lots, street litter, bacterial contaminates and pollutants from the atmosphere. Generally, there are a larger number of point source discharges in urban areas. Cumulative impacts from habitat alterations, point and nonpoint source pollution can cause severe impairment to urban streams.

The presence of intact riparian buffers and/or wetlands in urban areas can lessen these impacts, and restoration of these watershed features should be considered where feasible; however, the amount of impervious cover should be limited as much as possible. Wide streets, huge cul-de-sacs, long driveways and sidewalks lining both sides of the street are all features of urban development that create excess impervious cover and consume natural areas.

Public education is needed in the Pasquotank River basin in order for citizens to understand the value of urban planning and stormwater management. Action should be taken by county governments and municipalities to plan for new development in urban and rural areas. For more detailed information regarding recommendations for new development found in the text box, refer to EPA's website at www.epa.gov/owow/watershed/wacademy/acad2000/protection.

Proactive planning efforts at the local level are needed to assure that development is done in a manner that maintains water quality. These planning efforts will need to find a balance between water quality protection, natural resource management and economic growth. Growth management requires planning for the needs of future population increases, as well as developing and enforcing environmental protection measures. These actions are critical to water quality management and the quality of life for the residents of the basin.

Planning Recommendations for New Development

- Minimize number and width of residential streets.
- Minimize size of parking areas (angled parking & narrower slots).
- Place sidewalks on only one side of residential streets.
- Minimize culvert pipe and hardened stormwater conveyances.
- Vegetate road right-of-ways, parking lot islands and highway dividers to increase infiltration.
- Plant and protect natural buffer zones along streams and tributaries.

4.9.1 Stormwater Programs

In addition to the current NPDES stormwater permitting, DWQ is developing a permitting and program strategy to address the EPA proposed Phase II stormwater permitting program requirements. The Phase II program will be directed towards smaller municipalities and construction sites. At present, Phase II requirements will be handled with existing state staff. Elizabeth City will fall within the Phase II requirements. For more information on the state NPDES stormwater program, contact the Stormwater and General Permits Unit at (919) 733-5083.

DWQ administers a number of programs aimed at controlling stormwater runoff in the Pasquotank River basin. These include: 1) in the "coastal" counties as defined by the Coastal Area Management Act (CAMA); 2) NPDES stormwater permit requirements for industrial activities and municipalities; and 3) NPDES stormwater permit requirements for construction or land development activities on one acre of land or more. For more detailed information on current and proposed stormwater rules, refer to Section 2.7.

4.10 Priority Issues for the Next Five Years

4.10.1 Introduction

Clean water is crucial to the health, economic and ecological well-being of the state. Tourism, water supplies, recreation and a high quality of life for residents are dependent on the water resources within any given river basin. Water quality problems are varied and complex. Inevitably, water quality impairment is due to human activities within the watershed. Solving these problems and protecting the surface water quality of the basin in the face of continued growth and development will be a major challenge. Looking to the future, water quality in this basin will depend on the manner in which growth and development occur.

The long-range mission of basinwide management is to provide a means of addressing the complex problem of planning for increased development and economic growth while protecting and/or restoring the quality and intended uses of the Pasquotank River basin's surface waters. In striving towards its mission, DWQ's highest priority near-term goals are to:

- identify and restore impaired waters in the basin;
- identify and protect high value resource waters and biological communities of special importance; and
- protect unimpaired waters while allowing for reasonable economic growth.

4.10.2 Strategies for Restoring and Protecting Impaired Waters

Impaired waters are those waters identified in Section A, Chapter 3 as partially supporting (PS) or not supporting (NS) their designated uses based on DWQ monitoring data. These waters are summarized by subbasin in Table A-25. The impaired waters are also discussed individually in the subbasin chapters in Section B.

These waters are impaired, at least in part, due to nonpoint sources (NPS) of pollution. The tasks of identifying NPS pollution and developing management strategies for these impaired waters are resource intensive. Accomplishing these tasks is overwhelming, given the current limited resources of state and local governments. Therefore, only limited progress towards restoring NPS impaired waters can be expected during this five-year cycle unless substantial resources address NPS problems.

DWQ plans to further evaluate the impaired waters in the Pasquotank River basin in conjunction with other NPS agencies and develop management strategies for a portion of these impaired waters for the next Pasquotank River Basinwide Water Quality Plan, in accordance with the requirements of Section 303(d) (see Part 4.10.3 below).

4.10.3 Addressing Waters on the State's 303(d) List

For the next several years, addressing water quality impairment in waters that are on the state's 303(d) list will be a priority. The waters in the Pasquotank River basin that are on this list are

presented in the individual subbasin descriptions in Section B. For information on listing requirements and approaches, refer to Appendix IV.

Section 303(d) of the federal Clean Water Act requires states to develop a 303(d) list of waters not meeting water quality standards or which have impaired uses. States are also required to develop Total Maximum Daily Loads (TMDLs) or management strategies for 303(d) listed waters to address impairment. In the last few years, the TMDL program has received a great deal of attention as the result of a number of lawsuits filed across the country against EPA. These lawsuits argue that TMDLs have not adequately been developed for specific impaired waters. As a result of these lawsuits, EPA issued a guidance memorandum in August 1997 that called for states to develop schedules for developing TMDLs for all waters on the 303(d) list. The schedules for TMDL development, according to this EPA memo, are to span 8-13 years.

There are approximately 2,387 impaired stream miles on the 303(d) list in NC. The rigorous and demanding task of developing TMDLs for each of these waters during an 8 to 13-year time frame will require the focus of much of the water quality program's resources. Therefore, it will be a priority for North Carolina's water quality programs over the next several years to develop TMDLs for 303(d) listed waters.