Chapter 4 -
Water Quality Issues Related to Multiple Watersheds in the White Oak River Basin

4.1 Overview

The 1997 White Oak River Basinwide Water Quality Management Plan included a number of recommendations to address water quality issues in the basin. Some of these recommendations were pertinent to several watersheds or the basin as a whole, while others were specific to a particular stream or area within a subbasin. Status of the more specific recommendations is reported within the subbasin chapters in Section B. This chapter will present issues that are not related to a specific watershed.

4.2 Shellfish Harvesting 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 117,659 acres of shellfish harvesting waters (Class SA) in the White Oak River basin. There are 28,058 (24%) 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)

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 (refer to page 40). DEH SS monitors all coastal waters that have the potential to support shellfish. Table A-25 and the following paragraphs describe DEH SS growing area classifications. In the White Oak River basin, there are approximately 130,000 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-25 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 89,600 acres of shellfish harvesting (Class SA) waters that are classified as approved by DEH Shellfish Sanitation in the White Oak River basin. These areas are always open to shellfishing harvesting and close only after rare heavy rainfall events such as hurricanes.

Conditionally Approved-Open Shellfish Areas

There are 18,187 acres of shellfish harvesting (Class SA) waters that are classified as conditionally approved-open by DEH Shellfish Sanitation in the White Oak River basin. This growing area classification allows for the utilization of valuable shellfish resources by permitting harvesting when environmental conditions result in fecal coliform bacteria levels lower than the state standard in areas that otherwise might be closed to harvesting. These areas are open to harvesting much of the year, but are immediately closed after certain rainfall events (refer to DEH Shellfish Sanitation growing area management plans for specific closure strategies). There are concerns that these areas may be closed more often and stay closed for longer periods as development proceeds in coastal areas adjacent to Class SA waters. Refer to the subbasin chapters in Section B for more specific information on individual conditionally approved-open waters.

Conditionally Approved-Closed Shellfish Areas

There are 4,007 acres of shellfish harvesting (Class SA) waters that are classified as conditionally approved-closed by DEH Shellfish Sanitation in the White Oak River basin. This growing area

classification allows for the utilization of valuable shellfish resources by permitting harvesting when environmental conditions result in fecal coliform bacteria levels lower than state standards in areas that are typically closed to shellfish harvesting. These areas are regularly monitored to determine if temporary openings are possible. These waters are rarely opened to shellfish harvesting. Refer to the subbasin chapters in Section B for more specific information on individual conditionally approved-closed waters.

Prohibited/Restricted Shellfish Harvest Areas

There are 5,865 acres of shellfish harvesting (Class SA) waters that are prohibited or restricted for shellfish harvesting in the White Oak 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.

4.2.2 Changes in Shellfish Harvesting Use Support Assessment

The 1997 White Oak River basin use support assessment rated approved waters as fully supporting, conditionally approved waters as fully supporting but threatened (ST), and prohibited waters as partially supporting (PS). As described on page 41, the ST subcategory of fully supporting is no longer used. In the 1997 assessment, there were 109,934 acres rated FS and 11,941 acres rated partially supporting (PS). Of the impaired acres, 3,005 were in Class SC waters where DEH classifications were not used to make use support determinations. Class SA acres were reported by the 17 DEH SS growing areas (e.g., C1: Chadwick Bay, 223 acres). For the 2001 White Oak River basin assessment, DWQ will use an interim frequency of closures based method to assign use support ratings to Class SA waters.

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 White Oak River basin assessment. DWQ believed it important to identify frequency of closures in these waters, so an interim methodology was used based on existing databases and GIS shapefiles. There will likely be changes in reported acreages in future assessments using the permanent methods and tools that define areas and closure frequency.

Based on preliminary evaluation of DEH SS Reports of Sanitary Survey for the White Oak River basin growing areas, conditionally approved-closed and prohibited/restricted Class SA waters were closed from 87 percent to 100 percent of the time. These waters are rated not supporting (NS) for shellfish harvesting. Approved Class SA waters were closed less than 10 percent of the time and are rated fully supporting (FS) for shellfish harvesting. The conditionally approved-open Class SA waters were found to be closed from 4.67 percent to 21 percent of the time. After more rigorous evaluation (described below) of the conditionally approved-open waters in the

White Oak River basin, interim frequency of closure based use support ratings of partially supporting were assigned.

DWQ worked with DEH SS to determine the number of days and acreages that identified conditionally approved-open Class SA waters were closed to shellfish harvesting in the White Oak River basin during the assessment period (September 1, 1994 to August 31, 1999). For each of the eight growing areas with conditionally approved-open Class SA waters, DEH SS and DWQ staff defined subareas (within the larger conditionally approved-open area) that were opened and closed at the same time. The number of days these conditionally approved-open waters were closed was determined using proclamation summary sheets and the original proclamations. The number of days that approved areas in the growing area were closed due to pre-emptive closures because of named storms was not counted. For example, all waters in growing area E-9 were pre-emptively closed for Hurricane Fran on September 5, 1996. Approved waters were reopened September 20, 1996. Nelson Bay (conditionally approved-open) was reopened September 30, 1996. This area was considered closed for 10 days after the approved waters were reopened.

It is important to note that the interim methodology makes use support determinations and reports acreages using existing closure data and non-georeferenced areas. Future assessments using the permanent methodology will likely report different acreages that may not necessarily be associated with water quality changes or changes in DEH SS growing area classifications. Changes that are related to water quality or DEH SS growing area reclassifications will be explained in detail in the subbasin chapters. Refer to Appendix III and the subbasin chapters in Section B for more specific information on individual waters.

4.2.3 Addressing Impaired Shellfish Harvesting 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 like the Newport and North Rivers 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 surface there is an increase in fecal coliform delivery to estuarine waters. Larger waters like the Newport and North Rivers 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 DENR 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 DENR 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 on page 51. 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) for 61,133 acres of Class SA waters in the White Oak River basin. The rules provide for stormwater management and shellfish habitat protection. Currently 3,155 acres (five percent) of Class SA ORW waters are considered impaired for shellfish harvesting in the White Oak River basin. These waters are more specifically identified in Section B subbasin chapters. DWQ will continue to implement this program.

Reclassification of Waters to Identify Shellfish Harvesting Uses

DWQ, DMF and DEH SS are pursuing the reclassification of segments of the New River that are currently classified as SC waters. These waters were recently reopened to shellfish harvesting by DMF based on recommendations from DEH SS after removal of discharges in these areas (refer to page 33). 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). The CHPPs for the New and White Oak Rivers and for the Core and Bogue Sounds are expected to be finalized in August 2002. 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 White Oak 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.

Recommendations for Local Governments, Community Groups and White Oak 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 DENR 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 Growth and Development and Stormwater 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 White Oak River basin is expected to increase by 40,000 people in the next 15 years (OSP, 1999). 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. A lack of good environmental planning was identified by participants at the public workshops as a threat to water quality in the White Oak River basin.

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.

4.3.1 Planning Efforts

At the Governor's request, a series of public meetings were held across the state in 1999 to kick off the "21st Century Communities Task Force". The seven-member task force conducted public meetings to look at growth issues across the state. The task force will report its findings to a special legislative commission on growth and issue a final report in January 2001.

Public education is needed in the White Oak 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.

4.3.2 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. Onslow County and Jacksonville in the White Oak River basin 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 White Oak 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, visit the NPDES website at http://h2o.enr.state.nc.us/su/stormwater.html.

4.4 Biological Monitoring Issues

DWQ strives to properly evaluate the health of biological communities throughout the state. Swamp stream systems, small streams, and estuarine waters have presented unique challenges for

benthic macroinvertebrate evaluation, while non-wadeable waters and trout streams have done the same for fish community evaluations. This section discusses some of these challenges. Refer to Appendix II for further information.

4.4.1 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 White Oak River basin were sampled by DWQ. 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.

4.4.2 Assessing Benthic Macroinvertebrate Communities in Small Streams

The benthic macroinvertebrate community of small streams is naturally less diverse than the streams used to develop the current criteria for freshwater, flowing streams. The benthic macroinvertebrate database is being evaluated, and a study to systematically look at small reference streams in different ecoregions is being developed with the goal of finding a way to evaluate water quality conditions in such small streams.

4.4.3 Assessing Fish Communities

Fish communities in most wadeable streams can be sampled by a crew of 2-4 persons using backpack electrofishers and following the DWQ Standard Operating Procedures. The data are evaluated using the North Carolina Index of Biotic Integrity (NCIBI) (NCDENR, 2001). 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.

In order to obtain data from non-wadeable coastal plain streams (that are difficult to evaluate using benthic macroinvertebrates), a fish community boat sampling method is being developed with the goal of expanding the geographic area that can be evaluated using fisheries data. This project may many years to complete.

The naturally less diverse fish fauna of high elevation trout streams also cannot be evaluated using the NCIBI. A multiagency workgroup is looking at ways to evaluate fish communities in these waters. Current benthic macroinvertebrate monitoring provides a good tool for evaluation of these waters.

4.5 Fish Consumption Advisories

The NC Department of Health and Human Services (DHHS) has developed guidelines to advise people as to safe levels of fish consumption. DWQ considers uses of waters with a consumption advisory for one or more species of fish to be impaired. Currently, there are two different fish consumption advisories in the White Oak River basin.

In 1997, DHHS issued a statewide fish consumption advisory due to elevated levels of mercury in bowfin (also known as blackfish). As a result of this advisory, DWQ considers all waters in the White Oak 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.) DWQ has sampled a variety of fish species from three locations in the White Oak River basin. Mercury levels in bowfin from the New River, Brinson Creek and Northeast Creek did not exceed the North Carolina action level for mercury in fish.

From August 1998 through August 1999, the Division of Marine Fisheries collected samples of king mackerel off the coast for mercury contaminant analysis. The samples were collected after health agencies in Texas and Florida issued consumption advisories for king mackerel due to potentially harmful levels of mercury.

King mackerel larger than 95 cm or 6.5 kg were found to have concentrations of mercury in excess of the North Carolina criteria of 1 µg/g. Based on these results, North Carolina joined together with South Carolina, Georgia and Florida in March 2000 to issue a joint health advisory concerning high levels of mercury in large king mackerel. The advisory states:

- king mackerel less than 33 inches fork-length (from nose to where the tail forks) are safe to eat;
- king mackerel over 39 inches should not be eaten;
- people should limit their consumption of 33 to 39-inch fish;
- women of child bearing age and children age 12 and younger should eat no more than one, 8-ounce portion a month; and
- other adults should eat no more than four, 8-ounce portions a month.

The advisory does not prevent commercial fisherman or recreational anglers from landing king mackerel. Recreational anglers are allowed to land three fish/person/day with a minimum-size limit of 24-inch fork length. Federally permitted commercial fishermen are limited to 3,500 pounds/trip with a 24-inch fork length minimum size.

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.

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. Given the global scale of mercury cycling, it may be difficult for state and federal agencies to recognize significant reductions of mercury in fish over the short-term. Governmental and scientific agencies and organizations will continue efforts to reduce mercury cycling on a national and global scale.

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.

4.6 White Oak River Basin Wastewater Discharger Issues

4.6.1 New River Nutrient Sensitive Waters (NSW) Strategy

1997 Recommendations

In 1991, much of the New River drainage was classified as nutrient sensitive waters (NSW). There had been persistent water quality problems associated with algal blooms, especially in the upper estuary. Prior to 1997, point sources accounted for 59 percent of the phosphorus load and 44 percent of the nitrogen load. Four Camp Lejeune discharges and the City of Jacksonville discharge contributed over 94 percent of point source nutrient inputs. The 1997 plan recommended the following as part of the New River NSW strategy to reduce point source contributions of nutrients to the upper New River estuary.

- Existing facilities with permitted capacity of 0.05 MGD or greater should continue to receive total phosphorus (TP) limits of 2.0 mg/l.
- New and expanding facilities should continue to receive TP limits of 0.5 mg/l.
- New and expanding facilities greater than 1 MGD should receive total nitrogen limits (TN) similar to Camp Lejeune of 5.0 mg/l (summer) and 10.0 mg/l (winter).
- All facilities without limits will be required to monitor TN and TP.

It was also recommended that no new discharges be permitted and expansions of existing facilities only be allowed if there is no increase in permitted loading of oxygen-consuming waste.

Current Status
The City of Jacksonville is now land applying 6 MGD of wastewater and ceased to discharge into the New River in 1998. Camp Lejeune has consolidated its discharges into one advanced wastewater treatment facility at Frenchs Creek. Preliminary results of a DWQ phytoplankton study indicate that algal blooms in the New River estuary have declined in extent and duration since removal of the discharges. The removal of the Jacksonville discharge and the higher quality effluent from Hadnot Point have also greatly reduced the load of oxygen-consuming waste in the New River.

2001 Recommendations
The New River NSW recommendations from 1997 will remain in effect.

4.6.2 Discharges of Oxygen-Consuming Waste to Swamp Waters

1997 Recommendations
Most of the freshwater in the White Oak River basin is swampy with naturally low dissolved oxygen (DO), low pH, and low or zero flow during summer months. There are a few small point source discharges that may further reduce DO in these swampy streams. Models to evaluate the impact of discharges to swamp streams have not been developed. The 1997 plan recommended that new discharges be permitted at limits no less stringent than 15 mg/l BOD_5 and 4 mg/l NH_3-N. More stringent limits may be required on a case-by-case basis. Expanding facilities will receive current permit limits unless available information indicates that more stringent limits are required.

2001 Recommendations
DWQ will pursue reclassification of streams that have swampy characteristics to include the supplemental classification Sw that identifies the swampy nature of these streams. New and expanding discharges will be carefully considered on a case-by-case basis.

4.7 Habitat Degradation

Instream habitat degradation is identified in the use support summary (Appendix III) where there is a notable reduction in habitat diversity or a negative change in habitat. This term includes sedimentation, bank erosion, channelization, lack of riparian vegetation, loss of pools or riffles, loss of woody habitat, and streambed scour. Good instream habitat is necessary for aquatic life to survive and reproduce. Streams that typically show signs of habitat degradation are in watersheds that have a large amount of land-disturbing activities (construction, mining, timber harvest and agricultural activities) or a large percentage of impervious surfaces. A watershed in which most of the riparian vegetation has been removed from streams or channelization has occurred also exhibits instream habitat degradation. Streams that receive a discharge quantity that is much greater than the natural flow in the stream often have degraded habitat as well.

Determining the cause and quantifying amounts of habitat degradation is very difficult in most cases. To assess instream habitat degradation in most streams would require extensive technical and monetary resources and perhaps even more resources to restore the stream. DWQ is working to develop a reliable habitat assessment methodology.

Although DWQ and other agencies are starting to address this issue, local efforts are needed to prevent further instream habitat degradation and to restore streams that have been impaired by activities that cause habitat degradation. As point sources become less of a source of water quality impairment, nonpoint sources that pollute water and cause habitat degradation will need to be addressed to further improve water quality in North Carolina's streams, rivers and estuaries.

4.8 Wetland Loss

4.8.1 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. Chapter 2, Part 2.6.2 contains more specific information on the ecological significance of wetlands in the White Oak River basin.

4.8.2 Wetland Fill Activities

In 1989, the Environmental Management Commission passed a rule directing DWQ to review wetland fill using a review sequence of avoidance, minimization and mitigation of wetland fill. After extensive public review, the EMC passed rules, effective October 1, 1996, to restructure the 401 Water Quality Certification Program. These rules are not a new regulatory program since DWQ has issued approvals for wetland fill since the mid-1980s. The rules consider wetland values - whether or not the wetland is providing significant uses or whether the activity would remove or degrade uses. The rules also specify mitigation ratios, locations and types to make the mitigation process more predictable and certain for the regulated community. DWQ's emphasis continues to be on water quality and the essential role that wetlands play in maintaining water quality.

4.9 Effects of Hurricanes on Water Quality

The White Oak 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. Wind damage was not as severe as what has occurred during these types of storms in the past; however, flooding in eastern North Carolina was higher and more extensive than any ever recorded. Many

towns and homes were completely inundated, and in some areas because of extended rainfall after Floyd, flooding continued for weeks. Bridges and buildings were washed downstream, animal waste lagoons breached, and wastewater treatment plants were inundated. Floyd resulted in more fatalities than any hurricane to strike the United States since 1972. More than 50 people in North Carolina were killed and thousands were left homeless.

4.9.1 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 the Hurricane Floyd flooding demonstrated that even low concentrations of pollutants can result in the transport of an extremely large mass of these materials 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.

4.9.2 De-Snagging

Emergency de-snagging (removal of piles of woody debris from stream and river channels) began after the storm as part of Natural Resources Conservation Services' (NRCS) Emergency Watershed Protection (EWP). NRCS intends for this activity to be used only to prevent imminent flooding around bridges and economic loss of property. Therefore, much of the NRCS-supervised de-snagging operations affected only the areas in streams and rivers immediately upstream and downstream of road crossings. NRCS also intends to remove only debris that was deposited during the storm, leaving in place snags that predated the event such as those associated with beavers. However, there were difficulties assessing snag origins and ages because most of the de-snagging projects did not start until almost a year after the storm.

In addition to the Emergency Watershed Protection program, funding from the Federal Emergency Management Agency (FEMA) was also made available to some local governments for additional de-snagging activities. There was no requirement associated that the operations be monitored to prevent excessive or improper removal of woody debris. Several stream segments and wetland areas in nonemergency situations were completely cleared of debris and snags and, in some cases, relocated and channelized using this funding.

Woody debris is the predominant habitat for benthic macroinvertebrates in larger, slower-moving coastal stream and wetland systems. Therefore, removal of these snags removes most of 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. Although no de-snagging activities have been reported or observed in the White Oak River basin following Hurricane Floyd, it is important for citizens to be aware of water quality concerns associated with this activity.

4.9.3 Recommendations

Benthic macroinvertebrate data collected prior to the hurricanes in coastal river basins were from summer or winter collections with little fall sampling available for comparisons. It is not yet possible to conduct a detailed analysis of post-hurricane samples at many stream sites, because some normal seasonal differences would be present in fall samples. However, some sampling of reference swamp streams was conducted by DWQ in November 1999. These collections did not indicate any significant damage from Hurricane Floyd (DENR-DWQ, December 1999). The next *White Oak River Basinwide Water Quality Plan* will summarize data collected in the basin over the next five-year (2000-2004) cycle.

DWQ is aware of the need to remove obstructions to water flow, including snags, in the vicinity of bridges or other structures in emergency situations because of safety concerns and to reduce economic loss in the event of natural disasters. However, NRCS should reevaluate allowing de-snagging after the immediate emergency situation has passed. The method in which snags are removed, the amount of debris that is removed, and the sites selected could all be approached, during a non-emergency situation, in such a manner as to reduce impacts to the stream channel and aquatic communities. Local governments that receive additional funding for this type of activity should also take water quality into consideration.

4.10 Protecting Headwaters

Many streams in a given river basin are only small trickles of water that emerge from the ground. A larger stream is formed at the confluence of these trickles. This constant merging eventually forms a large stream or river. Most monitoring of fresh surface waters evaluates these larger streams. The many miles of small trickles, collectively known as headwaters, are not directly monitored and in many instances are not even indicated on maps. However, impairment of headwater streams can (and does) impact the larger stream or river.

Headwater areas are found from the mountains to the coast along all river systems and drain all of the land in a river basin. Because of the small size of headwater streams, they are often overlooked during land use activities that impact water quality. All landowners can participate in the protection of headwaters by keeping small tributaries in mind when making land use management decisions on the areas they control. This includes activities such as retaining vegetated stream buffers and excluding cattle from streams. Local rural and urban planning initiatives should also consider impacts to headwater streams when land is being developed.

For a more detailed description of watershed hydrology, refer to EPA's Watershed Academy website at http://www.epa.gov/OWOW/watershed/wacademy/acad2000/watershedmgt/principle1.html.

4.11 Priority Issues for the Next Five Years

Clean water is crucial to the health, economic and ecologic 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 White Oak 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.

4.11.1 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 impaired, mostly due to nonpoint sources (NPS) of pollution. The tasks of identifying nonpoint sources of pollution and developing management strategies for these impaired waterbodies are very resource intensive. Accomplishing these tasks is overwhelming, given the current limited resources of DWQ, other agencies (e.g., Division of Land Resources, Division of Soil and Water Conservation, Cooperative Extension Service, etc.) and local governments. Therefore, only limited progress towards restoring NPS impaired waters can be expected during this five-year cycle unless substantial resources are put toward solving NPS problems. Due to these restraints, this plan has no specific NPS management strategies for most of the streams with identified NPS problems.

DWQ plans to further evaluate the impaired waterbodies in the White Oak River basin in conjunction with other NPS agencies and develop management strategies for a portion of these impaired waterbodies for the next White Oak River Basinwide Water Quality Plan, in accordance with the requirements of Section 303(d) (see Part 4.11.2 below).

4.11.2 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 White Oak River basin that are on the state's year 2000 (not yet EPA approved) 303(d) list are presented in the individual subbasin chapters in Section B.

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. This task will be accomplished through the basinwide planning process and schedule.