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

4.1 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 Cape Fear 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.

The 1996 Cape Fear River Basin Management Plan included several recommendations to address water quality issues in the basin. Most of these recommendations are for specific stream segments and are discussed separately in the individual subbasin chapters in Section B. There are a few recommendations that apply to areas that extend across more than one subbasin. These issues are discussed below, as well as other issues and recommendations that apply to all waters of the state.

4.2 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-30 and indicated on Figures A-32 to A-34. 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 nonpoint sources of pollution and developing management strategies for these impaired waters is 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 NPS management strategies for many of the streams with NPS problems.

DWQ plans to further evaluate the impaired waters in the Cape Fear River basin in conjunction with other NPS agencies and develop management strategies for a portion of these impaired waters for the next Cape Fear River Basinwide Water Quality Plan, in accordance with the requirements of Section 303(d) (see Part 4.3 below).

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

4.4 Nutrient Sensitive Waters Strategy for Jordan/Haw River Watershed

The 1996 Cape Fear River Basinwide Plan recommended that a nutrient fate and transport model be developed to better identify point and nonpoint source impacts and to evaluate the Nutrient Sensitive Waters strategy. It was determined that water in the Haw River was high in nutrients and that conditions existed for potential algal growth. Ambient monitoring data indicate high nutrient loads at both high and low flows, implicating point and nonpoint sources.

Status of Progress

In 1983, the Haw River and Jordan Reservoir (subbasins 03-06-01 to 03-06-06) were classified as nutrient sensitive waters (NSW). The NSW strategy mandated effluent total phosphorus (TP)

of 2.0 mg/l for all discharges of 50,000 GPD or greater. Currently all subject discharges are meeting this limit. Nutrient overenrichment is a continuing potential source of impairment to the waters in this watershed. The Clean Water Responsibility Act (House Bill 515) was enacted in 1997 to further address ongoing problems associated with waters classified as NSW. The Act sets limits for nitrogen (TN) and phosphorus (TP) discharges to NSW waters. The limits apply to facilities discharging more than 0.5 MGD that were in operation or had authorization to construct prior to July 1,1997, and all facilities issued authorization to construct after that date.

Senate Bill 1366 granted extensions to compliance dates in watersheds affected by House Bill 515. The extension includes conditions that the dischargers must meet, including development of a calibrated nutrient response model. The municipalities of Greensboro, Mebane, Reidsville, Graham, Pittsboro, Burlington, and the Orange Water and Sewer Authority requested compliance extensions from the nutrient limits, primarily because of the nitrogen reduction requirements. Compliance extension requests were received by DWQ prior to the statutory deadline of January 1, 1999. South Durham, Durham RTP and Cone Mills did not apply for the extension. Triangle J and Piedmont Council of Governments are administering the project and have hired a consultant to perform the modeling tasks. Progress on the compliance extension will be reported to the Environmental Management Commission two times a year.

4.5 Randleman Reservoir

In November 1998, waters in the proposed Randleman Reservoir watershed were reclassified to WS-IV CA. Rules have been adopted (15A NCAC 2B .0248 through .0251) to help prevent potential water quality problems in the proposed reservoir. The rules address point source discharges by not allowing new or expanding discharges into the watershed except for High Point Eastside WWTP. This facility will have to meet phosphorus limits established to protect water quality standards. The rules also address nonpoint source pollution in the Randleman Reservoir watershed with management strategies that maintain and protect riparian areas and require urban stormwater programs to be developed by local governments having land use authority in the watershed.

Local governments are required to develop ordinances or modify existing water supply ordinances to protect riparian areas and implement stormwater management plans by January 1, 2000. All of the affected local governments have submitted their revised ordinances to meet the specifications set forth in the Randleman Lake Water Supply Watershed Nutrient Management Strategy (15A NCAC 2B .0248 through .0251) for approval by the EMC's Water Quality Committee.

4.6 Modeling Efforts in the Lower Cape Fear River and Estuary

DWQ, in cooperation with the Lower Cape Fear River Program (LCFRP), (see Section C, Chapter 1, Part 1.4.1), EPA and other interested stakeholders are developing a dynamic water quality model for the Cape Fear River from Lock and Dam #1 downstream to near the mouth of the estuary. The modeling domain will also include portions of the Black and Northeast Cape Fear Rivers. The model will be used as a tool for assessing the assimilative capacity of the system and for the development of a TMDL for oxygen-consuming wastes. DWQ is working

closely with stakeholders to ensure that the modeling framework ultimately chosen will not only meet the requirements for a TMDL but will also support, to the extent possible, the research needs and interests of the stakeholders.

Although a considerable amount of data has been collected by DWQ, LCFRP, USACOE and others, an extensive amount of data remains to be gathered to support the calibration and verification of the model. For example, streamflow gages on the Black and Northeast Cape Fear Rivers will need to be installed for quantifying background loadings from these two major drainages. Given the costs, complexity and substantial data collection requirements of the modeling effort, DWQ anticipates the TMDL development process to proceed over the next couple of years with the goal of having an approved TMDL in place by the next Cape Fear basin cycle. In recognition of the persistent DO water quality violations documented within the estuary, DWQ is recommending an interim NPDES permitting strategy for new and expanding discharges within subbasin 03-06-17 (see Section B, Chapter 17 for more details).

4.7 Growth and Development

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.

These actions should include, but not be limited to:

- preservation of open spaces;
- provisions for controlled growth;
- development and enforcement of buffer ordinances and water supply watershed protection ordinances more stringent than state requirements;
- halt on floodplain development and protection of wetland areas;
- examination of zoning ordinances to ensure that they limit large, unnecessary parking lots; allow for vegetation and soil drainage systems; and build in green spaces in parking lots to limit and absorb runoff; and
- sustainable land use planning that considers long-term effects of development.

Phase II of the NPDES stormwater permitting program, promulgated by EPA and administered by DWQ, will help address stormwater runoff from additional municipal areas. Some local initiatives are presented in Section C.

4.7.1 Stormwater Management

DWQ administers a number of programs aimed at controlling urban stormwater runoff. These include: 1) programs for the control of development activities near High Quality Waters (HQW) and Outstanding Resource Waters (ORW) and activities within designated Water Supply (WS) watersheds; and 2) NPDES stormwater permit requirements for industrial activities and municipalities.

Throughout the Cape Fear River basin, various types of activities with point source discharges of stormwater are required to be permitted under the Phase I NPDES stormwater program. These include industrial discharges related to manufacturing, processing and materials storage areas. Construction activities with greater than five acres of disturbance are also required to obtain an NPDES permit. All of those areas requiring coverage must develop Stormwater Pollution Prevention Plans (SPPP) to minimize and control pollutants discharged from their stormwater systems. Municipal areas with populations greater than 100,000 are also required to obtain Phase I NPDES stormwater permit and develop a stormwater program. In the Cape Fear River basin, the cities of Greensboro, Durham and Fayetteville (including Cumberland County) have Phase I NPDES stormwater permits. Additional information on these stormwater programs can be found in Section C.

Status of Progress

On October 29, 1999, a second phase of the NPDES stormwater program was signed into law. Phase II of the NPDES stormwater program lowers the construction activity threshold to one or more acres of land disturbance and allows a permitting exemption for industrial facilities that do not have significant materials or activities exposed to stormwater. Phase II also pulls many small local governments into the NPDES stormwater program, potentially an additional 54 cities and 24 counties or more in the Cape Fear River basin. Additional information can be found in Section A, Chapter 2, Part 2.7.2.

For more information on municipal NPDES stormwater programs, contact Jeanette Powell at (919) 733-5083 ext. 537. For industrial NPDES stormwater programs, contact Bill Mills at (919) 733-5083 ext. 548.

4.7.2 Protecting Headwaters

Many stream miles in any river basin are 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 indicated on maps. 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 in land use activities.

Impairment of headwater streams can impact the larger stream or river. All landowners can participate in the protection of headwaters by keeping water quality issues in mind when making land use management decisions on the areas they control. This includes activities such as retaining forested stream buffers, driveway paving, lawn fertilizing, car maintenance, proper disposal of pet waste, and excluding cattle from streams.

The streams in the Cape Fear River basin are affected by the rapidly expanding urban areas of Greensboro, High Point, Fayetteville, Research Triangle Park, Burlington and Wilmington. Continued urbanization of rural areas adjacent to these municipalities has the potential to adversely affect groundwater and surface water quality and quantity. These headwater areas are important as sources of water for downstream water supplies and as potential recolonization

areas for aquatic life. Local rural and urban planning initiatives should consider impacts to headwater streams when developing land around the urban areas. Efforts should be made to protect headwater streams during development. Construction projects should be required to use BMPs to reduce acute impacts.

4.8 Biological Monitoring Issues

4.8.1 Development of Draft Benthic Macroinvertebrate Swamp Criteria

Recent extensive work on swamp streams suggested that different criteria should be used for slow-flowing, swamp-like systems. DWQ has developed draft biological criteria ratings more specific to swamp waters. Draft swamp stream rating criteria evaluate a stream based on benthic macroinvertebrate data collected in winter, fish community data and a habitat score. Benthos data collected outside of the winter high flow period are not used to assign ratings. At least two of the data types (benthic macroinvertebrates, fish or habitat score) must be collected to assign a rating. Each of these components is assigned a point value, and the points are averaged to assign an overall site rating. Ratings for the benthos are based entirely on the Biotic Index value. Deep (nonwadeable) coastal rivers with little or no visible current have different EPT criteria (Coastal B) that are being used on a provisional basis until more data can be gathered. Details of benthos sampling, criteria and data analysis can be found in the *Biological Monitoring SOP Manual* (NCDEHNR, 1997).

The draft swamp criteria were developed after collecting data for over four years. That data indicated that the BI values could separate differences in impact, but only during winter high flow conditions. During normal summer sampling, all sites were too similar to provide meaningful data. However, DWQ believes there is insufficient sampling of reference swamp streams to use the ratings without reservation for use support determinations. It must be stressed that the criteria are draft and will remain so until DWQ is better able to evaluate such things as: year-to-year variation at reference swamp sites, variation among reference swamp sites, the effect of small changes in pH on the benthos community, whether the habitat evaluation can be improved, and the role fisheries data should play in the evaluation. The ratings have not been used for use support and should be used for comparative purposes only.

However, much work has and will continue to be done to allow biological communities to provide meaningful information for swamp-like waters. For example: In 1992, 1993 and 1995 benthos samples were collected each year from 27 swamp streams during February or March throughout the NC coastal plain. The intent of this sampling was to develop draft swamp stream criteria, primarily using benthos data and habitat evaluations. Since 1995, benthos swamp sampling methods have been used at almost 40 sites, including 13 reference sites sampled in 1998.

Validation of the swamp criteria will require several years of data from the reference sites to determine variations due to flow conditions and changes in pH, and to see if the present draft criteria will allow differentiation between reference sites and known impacted sites.

4.8.2 Fish Community Assessment Draft Criteria

The NCIBI has been revised since the 1996 Cape Fear River basinwide monitoring was conducted. Recently, the focus of using and applying the Index has been restricted to wadeable streams that can be sampled by a crew of 2-4 persons using backpack electrofishers and following the NCDWQ Standard Operating Procedures (NCDENR, 1997). The fish community integrity classes have been modified in an effort to simplify and standardize the evaluation of a stream's ecological integrity and water quality bioclassification across both fish community and benthic invertebrate assessments. The fish community assessment criteria will continue to be evaluated and adjusted to better reflect the conditions of nonwadeable coastal plain streams.

4.8.3 Estuarine Waters Criteria Development

Draft criteria have been developed to evaluate the level of anthropogenic impact in estuarine waters with greater than 8-10 parts per thousand salinity. Bioclassifications of Heavy, Moderate or No Impact are based on the total number of taxa, the number of taxa from intolerant groups (amphipods and caridian shrimp), and the average sensitivity of all the taxa living at a site (Estuarine Biotic Index). Higher values of each of these metrics reflect better water quality. The ranges of metric values were found to be different in the mesohaline and polyhaline salinity regimes and criteria have been developed for each. The range of values for each metric was divided into five categories and each category was given points. The points scored from each metric were summed to give a final water quality rating. The estuarine rating will not be used for use support determinations until the draft estuarine criteria are finalized.

4.8.4 Fish Advisories Related to Mercury Contamination

During 1992 and 1993, DWQ conducted extensive fish tissue surveys in southeastern North Carolina in an effort to assess mercury contamination in several fish species associated with the region. The studies revealed mercury levels approaching or exceeding EPA and FDA criteria in largemouth bass and/or bowfin across a wide geographic area.

The presence and accumulation of mercury in North Carolina's aquatic environment is similar to contamination observed in other states. Atmospheric deposition may be a significant source of the observed levels of mercury, but the exact pathways and extent of mercury contamination in North Carolina fish, or across the nation, have yet to be characterized.

DWQ will continue to monitor fish tissue in the Cape Fear River basin to assess mercury contamination. Given the likelihood that the source of mercury is atmospheric and of a global/regional scale, use support determinations have been revised to not include waters with fish consumption advisories related to mercury. Waters with fish consumption advisories related to mercury remain on the North Carolina 303(d) List (see Appendix IV), and a TMDL approach is being developed.

4.8.5 Habitat Degradation

Instream habitat degradation is identified 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 exhibit 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 to a supporting rating. DWQ is working to develop a reliable habitat assessment methodology.

Although DWQ and other agencies are starting to address this issue, it requires local efforts 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 and rivers.

4.9 Clean Water Act of 1999 (House Bill 1160)

The General Assembly has expressed interest in protecting water quality in the Cape Fear River basin through the ratification of the Clean Water Act of 1999 (HB 1160, Part VII). This Act gives authority to the Environmental Management Commission (EMC) to adopt temporary rules to protect the Cape Fear, Catawba and Tar-Pamlico River basins. The intent of the bill is to allow for development of rules for basinwide buffers or other water quality protection measures as required in these three river basins.

DWQ will continue to maintain the schedule for developing basinwide plans. The basinwide plans are planning tools, rather than regulatory documents. The plans are intended to present current water quality information and recommend management strategies to protect or restore water quality. Temporary rule making for the Cape Fear River basin cannot begin until the Cape Fear River Basinwide Water Quality Plan has been approved by the EMC. At the time of approval, DWQ staff will alert the EMC to recommendations and comments made by the public to support rule making. The EMC will determine if rule making is warranted by current information. This is a new authority for the EMC, and they will be looking for comments and input on the need for temporary rules. There will be opportunities for stakeholder input into temporary rule making as set out by HB 1160. The bill also requires public notice and public hearings to be held after the rule-making language is developed.

There have been some efforts at the local level to protect stream water quality through buffer requirements. For example, Mecklenburg County adopted a Stream Buffer Plan that is flexible

and establishes a buffer width based on the number of acres in the watershed. This buffer plan could be used as a model for counties in this basin. In addition to state mandated requirements, interested citizens have the option to petition their local government representatives to establish a buffer plan for their county.

4.10 Water Supply Watershed Protection

There are 32 surface water supply watersheds in the Cape Fear River basin. Local governments that have land use jurisdiction within these watersheds are responsible for the adoption, implementation and enforcement of the state's water supply watershed minimum requirements. Local governments can adopt and enforce more stringent water supply watershed protection ordinances if they choose. For example, the state's rules require the use of a 30-foot vegetated buffer (for low density development) along all waters in the water supply watershed that appear as solid blue lines on USGS 1:24,000 scale topographical maps. The state's rules allow the buffer's vegetation to consist entirely of grass rather than natural vegetation. However, a local government can require a larger and undisturbed (natural vegetation) buffer. If a local government adopts a more stringent ordinance, the state cannot require the local government to enforce anything more stringent than the state's minimum requirements. However, the state does have statutory authority to assess local governments or developers civil penalties for not administering the state's minimum requirements.

Some recent development may have received valid local approval (under vested rights) to develop under previous building requirements. Vested rights may be granted by the local government as allowed under state statutes (NCGS 153A-344.1 or NCGS 160A-385.1). This can be confusing seeing "new" development occurring in the water supply watershed that does not appear to comply with the current ordinance.

Since its inception in 1993, the DWQ's Water Supply Watershed Protection Program has focused on assuring that affected local governments are aware of their responsibility to adopt and enforce water supply watershed protection ordinances, review local ordinances to assure that they meet the state's minimum requirements, and provide technical assistance. Now that the majority of ordinances have been reviewed and approved by the state's Water Quality Committee of the Environmental Management Commission, it is DWQ's intent to refocus the program. Although technical assistance will still be a major component of the program's function, it will be DWQ's intent to direct more effort to ensuring that local governments are complying with the state's minimum requirements.

DWQ is in the process of developing an audit/enforcement component for the water supply watershed protection program. This process is expected to take about a year to set up using existing programs as models.

4.11 Effects of Hurricanes on Water Quality

The Cape Fear River basin is subjected to hurricanes and tropical storms on a yearly basis. In the last five years the basin has been impacted by Hurricanes Bertha and Fran (1996), Bonnie (1998), and Dennis and Floyd (1999). Fran and Floyd caused the most economic damage and water

quality problems. Aquatic ecosystems and water quality can and do recover from wind damage and extensive flooding. However, human activities in hurricane prone areas can greatly increase the extent and severity of water quality problems and ecosystem impacts, as well as increase recovery time.

In September 1996, Hurricane Fran made landfall at Wilmington and traveled up the Cape Fear River into Virginia. The storm dropped several inches of rain in the basin, and flooding and wind damage ensued. It is estimated that $3.2 billion in damage was caused by Fran. The affects of Fran were not only felt by local economies, but by the various surface waters in the Cape Fear River basin.

Several million gallons of untreated human sewage were released into the river as a result of Fran. Many animal operations experienced ruptured lagoons and inundation. Large amounts of debris were generated causing flooding and adding organic matter to the river. This loading decreased dissolved oxygen (DO) levels in the Northeast Cape Fear River and the Cape Fear Estuary, causing fish kills. Hypoxic conditions were present in the Cape Fear River for several days after the hurricane.

Also of concern are the human activities that went on before and after the hurricane as part of preparation for and recovery from the problems associated with a hurricane. Emergency de-snagging was started after the storm as part of NRCS Emergency Watershed Protection (EWP). The de-snagging was mostly carried out to prevent imminent flooding around bridges and to prevent economic loss of property.

Much of the initial NRCS supervised de-snagging operations affected areas immediately upstream and downstream of road crossings. There was an effort to remove only debris that was deposited during the storm and leave in place snags that predated the event or were associated with beavers. 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. Funding was also made available to local governments to do nonemergency de-snagging. These operations were not monitored to prevent excessive removal of debris. Several stream segments and wetland areas were completely cleared of debris and snags.

Snags are the predominant habitat for invertebrates in these systems. Removal of large proportions of snag habitat would make it difficult to assess the health of the macroinvertebrate community in these waters. During the recent sampling (1998) DWQ biologists noted that snag habitat had been removed from many segments of rivers in the lower Cape Fear River subbasins.

In September 1999, Hurricane Floyd made landfall near Wilmington only a few days after Hurricane, then Tropical Storm Dennis, made two passes through the eastern part of the state. Wind damage was not nearly as severe as that from Fran in 1996; however, flooding in eastern North Carolina was higher and more extensive than any recorded. Several towns were completely inundated, and floodwaters did not recede for several days. In some areas, because of more rainfall after Floyd, flooding continued for weeks. Animal operations lost lagoons as well as millions of animals to floodwaters. Over 40 people were killed and thousands were left homeless.

Mallin et al. (1999) studied the effects of the 1996 hurricanes on the lower Cape Fear River subbasins. This study documents dissolved oxygen (DO) problems and identifies problems associated with human activities in hurricane affected areas.

2000 Recommendations

NRCS should reevaluate de-snagging practices after hurricanes. Selecting sites and amounts of snag to be removed should reduce the recovery times of populations of aquatic macroinvertebrates after storms and reduce habitat degradation caused by de-snagging activities and equipment.

There has not been an environmental assessment of water quality after Floyd. Areas were flooded that have never flooded before. It is expected that, because of the record rainfall, problems after Hurricane Fran will pale in comparison to that of Floyd. All water quality information presented in this document is based on data collected prior to 1998. It is highly likely that current water quality conditions, especially in the coastal subbasins, has changed substantially; and the recovery of these waters will not be known for sometime. DWQ will continue to assess the impacts of this storm on water quality.

4.12 Discharges to Zero Flow Streams

Due to the preponderance of low flow streams across the state, the Division developed regulations for evaluating discharges to such waters. In 1980, a study was performed on zero flow streams (7Q10 = 0 cfs and 30Q2 = 0 cfs) to determine the effect of wastewater discharges. The study concluded that:

- Steady-state models do not apply to zero flow streams, particularly those receiving waste from small discharges.
- The pool/riffle configuration of these small streams results in violations of the DO standard even when wastewater is well treated.
- Small streams receiving wastes from schools, mobile home parks, subdivisions, etc. flow through populated areas where children have easy access to streams.
- Noxious conditions were found in the low flow streams that were part of the study.

As a result of the study, regulations [15A NCAC 2B .0206 (d)] were developed that prohibit new or expanded discharges of oxygen-consuming wastes to zero flow streams. Existing facilities discharging to zero flow streams were evaluated for alternatives to discharge. Many facilities found alternatives to a surface water discharge, and some built new treatment plants to meet advanced tertiary limits for BOD_5 and NH_3-N.

This policy typically covers small discharges such as schools, mobile home parks, subdivisions and rest homes, which discharge to zero flow streams in headwater areas. Such discharges generally do not cause significant water quality problems in the mainstem of the Cape Fear or larger tributaries, but they can cause localized problems in the zero flow receiving streams.

The results of the 1980 study were extrapolated to facilities discharging to low flow streams (those with a 7Q10 = 0 but with a 30Q2 > 0) since similar adverse impacts are expected in these waters. Regulations [15A NCAC 2B .0206 (d)] were developed to set effluent limitations for new and expanding discharges to 5 mg/l BOD_5, 2 mg/l NH_3-N and 6 mg/l dissolved oxygen (DO) unless it is determined that these limitations will not protect water quality standards.

4.13 Sedimentation

Soil erosion, transport and redeposition are among the most essential natural processes occurring in watersheds. However, land-disturbing activities such as the construction of roads and buildings, crop production, livestock grazing and logging can accelerate erosion rates by causing more soil than usual to be detached and moved by water. If best management practices (BMPs) are not used effectively, accelerated erosion can strip the land of its topsoil, decreasing soil productivity, and causing sedimentation in streams and rivers (DENR-DLR, 1998).

Sedimentation is the process by which eroded soil is deposited into waters. Sediment that accumulates on the bottom of streams and rivers smothers fish habitat vital to reproduction and impacts aquatic insects that fish feed upon. Sediment filling rivers and streams decreases their storage volume and increases the frequency of floods. Suspended sediment increases the cost of treating municipal drinking water supplies (DENR-DLR, 1998).

Major Causes of Sedimentation in the Cape Fear River Basin

- Construction and land development
- Agricultural practices
- Streambank erosion
- Runoff from urban areas with high percentage of impervious surface

During 1998 basinwide monitoring, DWQ aquatic biologists reported streambank erosion and sedimentation in many subbasins in the Cape Fear River basin that was moderate to severe. Some streams are currently considered biologically impaired due to habitat degradation related in part to these impacts. Even in streams that were not listed as impaired, lower bioclassification ratings were assigned because of sedimentation; bottom substrate was embedded by silt, and/or pools were partially filled with sediment. Unstable and/or undercut (eroding) streambanks were also noted in explanation of lower ratings (DENR-DWQ, July 1999).

4.13.1 Land Clearing Activities

Erosion and sedimentation can be controlled during most land-disturbing activities by using appropriate BMPs. In fact, substantial amounts of erosion can be prevented by planning to minimize the (1) amount and (2) time the land is exposed. Land clearing activities that contribute to sedimentation in the Cape Fear River basin include: construction of homes and subdivisions as well as commercial and public buildings; plowing soil to plant crops; and road projects. DWQ's role in sediment control is to work cooperatively with those agencies that administer sediment control programs in order to maximize the effectiveness of the programs and protect water quality. Where programs are not effective, as evidenced by violation of instream water quality standards, and where DWQ can identify a source, then appropriate enforcement action can be taken. Generally, this would entail requiring the landowner or responsible party to install acceptable BMPs.

As a result of new stormwater rules enacted by EPA in 1999, construction or land development activities that disturb one acre or more are required to obtain a NPDES stormwater permit (refer to Part 4.7.1 of this section for more information). An erosion and sediment control plan must also be developed for these sites under the state's Sedimentation Pollution Control Act (SPCA) administered by the NC Division of Land Resources. Site disturbances of less than one acre are required to use BMPs, but a plan is not required.

Some Best Management Practices

Agriculture

- Using no till or conservation tillage practices
- Strip cropping, contour farming and use of terraces
- Maintaining buffers along streambanks

Construction

- Using phased grading/seeding plans
- Limiting time of exposure
- Planting temporary ground cover
- Using sediment basins and traps

Forestry

- Controlling runoff from logging roads and other areas
- Replanting vegetation on disturbed areas
- Leaving natural buffer areas around small streams and rivers

For activities not subject to these rules, such as agriculture and forestry, sediment controls are carried out on a voluntary basis through programs administered by several different agencies. Forestry operations, however, must comply with nine performance standards to remain exempt from permitting requirements of the SPCA. The performance standards can be found in the document *Forest Practice Guidelines Related to Water Quality.*

4.13.2 Streambank Erosion and Loss of Riparian Vegetation

Removing trees, shrubs and other vegetation to plant grass or place rock (also known as rip-rap) along the bank of a river or stream degrades water quality. Removing riparian vegetation eliminates habitat for aquatic macroinvertebrates that are food for trout and other fish. Rocks lining a bank absorb the sun's heat and warm the water even more. Trees, shrubs and other native vegetation cool the water by shading it. Straightening a stream, clearing streambank vegetation, and lining the banks with grass or rock severely impact the habitat that aquatic insects and fish need to survive (WNCT, 1999).

Livestock grazing with unlimited access to the stream channel and banks can cause severe streambank erosion resulting in degraded water quality. Although they often make up a small percentage of grazing areas by surface area, riparian zones (vegetated stream corridors) are particularly attractive to cattle that prefer the cooler environment and lush vegetation found beside rivers and streams. This concentration of livestock can result in increased sedimentation of streams due to "hoof shear", trampling of bank vegetation, and down-cutting by the destabilized stream. Despite livestock's preference for frequent water access, farm veterinarians have reported that cows are healthier when stream access is limited (USEPA, 1999).

Probably the best-known and most widely used category of BMPs is the retention of naturally vegetated buffer strips along streams. Streamside buffers serve many functions including nutrient filtering, bank stabilization, reduction of soil and land loss, moderating water temperature (which helps maintain higher levels of dissolved oxygen and hence a more suitable fish environment), and providing wildlife habitat and corridors for movement (EPA, 1999).

4.13.3 New Rules Regarding Sediment Control

The Division of Land Resources (DLR) has the primary responsibility for assuring that erosion is minimized and sedimentation is reduced. For the past several years, there were inadequate staff to achieve the mission of the agency; however, in its 1999-2001 biennial budget, the NC General Assembly provided funding for 10 new positions in the Land Quality Section of DLR.

In February 1999, the NC Sedimentation Control Commission adopted significant changes for strengthening the Erosion and Sedimentation Control Program. The following rule changes were filed as temporary rules, subject to approval by the Rules Review Commission and the NC General Assembly:

- Allows state and local erosion and sediment control programs to require a preconstruction conference when one is deemed necessary.
- Reduces the number of days allowed for establishment of ground cover from 30 working days to 15 working days and from 120 calendar days to 90 calendar days. (Stabilization must now be complete in 15 working days or 90 calendar days, whichever period is shorter.)
- Provides that no person may initiate a land-disturbing activity until notifying the agency that issued the plan approval of the date the activity will begin.
- Allows assessment penalties for significant violations upon initial issuance of a Notice of Violation (NOV).

Additionally, during its 1999 session, the NC General Assembly passed House Bill 1098 to strengthen the Sediment Pollution Control Act of 1973 (SPCA). The bill made the following changes to the Act:

- Increases the maximum civil penalty for violating the SPCA from $500 to $5000 per day.
- Provides that a person may be assessed a civil penalty from the date a violation is detected if the deadline stated in the Notice of Violation is not met.
- Provides that approval of an erosion control plan is conditioned on compliance with federal and state water quality laws, regulations and rules.
- Provides that any erosion control plan that involves using ditches for the purpose of dewatering or lowering the water table must be forwarded to the Director of DWQ.
- Amends the General Statutes governing licensing of general contractors to provide that the State Licensing Board for General Contractors shall test applicants' knowledge of requirements of the SPCA and rules adopted pursuant to the Act.
- Removes a cap on the percentage of administrative costs that may be recovered through plan review fees.

In August 1999, the Sedimentation Control Commission initiated rule making to increase plan review fees to $40 per acre. In addition, the Commission voted to request that Governor Hunt use his authority to put into effect at an earlier date (before August 1, 2000) the rules adopted in February. For information on North Carolina's Erosion and Sedimentation Control Program or to report erosion and sedimentation problems, visit the new website: http://www.dlr.enr.state.nc.us/ or you may call the NC Division of Land Resources, Land Quality Section at (919) 733-4574.

4.13.4 Recommendations

DWQ will continue to work cooperatively with DLR and other agencies that administer sediment control programs in order to maximize the effectiveness of the programs and to take appropriate enforcement action when necessary to protect or restore water quality. However, more voluntary implementation of BMPs is needed for activities that are not subject to these rules in order to substantially reduce the amount of widespread sedimentation present in the Cape Fear River basin. Public education is needed basinwide to educate landowners about the value of riparian vegetation and the impacts of sedimentation.

Funding is available for cost sharing with local governments that set up new erosion and sedimentation control programs or conduct their own training workshops. The Sediment Control Commission will provide 40% of the cost of starting a new local erosion and sedimentation control program for up to 18 months. Two municipalities or a municipality and county can develop a program together and split the match. It is recommended that local governments draft and implement local erosion and sedimentation control programs.

Funding is also available through numerous federal and state programs for farmers to restore and/or protect riparian buffer zones along fields or pastures, develop alternative watering sources for livestock, and fence animals out of streams. EPA's *Catalog of Federal Funding Sources for Watershed Protection* (Document 841-B-99-003) outlines these and other programs aimed at protecting water quality. A copy may be obtained by calling the National Center for Environmental Publications and Information at (800) 490-9198. Local contacts for various state and local agencies are listed in Appendix V.

4.14 Issues in the Development of Management Strategies for Coastal Waters

The NC Blue Ribbon Advisory Council

The NC Blue Ribbon Advisory Council on Oysters 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. ... Because of the economic, cultural, and environmental value of healthy oyster populations, the council judges the perpetuation of this decline in an important component of our coastal heritage to be unacceptable to the citizens of our state." The report cites a number of reasons for this decline, including outbreaks of oyster diseases (mostly weather driven), physical degradation of oyster reefs, overharvest and to "substantial deterioration of coastal water quality". Both the Albemarle-Pamlico Estuarine Study and Governor Hunt's Coastal Futures Committee, which preceded the council, have also recognized the importance of protecting and restoring shellfish waters.

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; and
- DENR 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".

Restoring water quality in all closed SA waters may not be an attainable objective, particularly in the short run. Contamination in some waters, especially some of those in which harvesting has been prohibited for a long time, may be due to natural conditions (e.g., poor flushing or fecal coliform inputs from wildlife) or to long-standing inputs from developed areas that cannot be effectively or economically mitigated. Other waters may now be threatened by the growth pressures and runoff associated with urban development.

Development Thresholds

Identifying a development threshold, beyond which contamination of shellfish waters is likely to occur, would be useful. Establishing such a threshold is a difficult task because of the wide variety of factors that must be considered: the amount of development, its type, the specific practices used, and the nature of the land prior to initiation of development. Research has shown that degradation of water quality often becomes significant once watershed development exceeds 10-15% impervious cover (Schueler, 1995). These studies have been conducted primarily on freshwater streams; however, and to date no systematic effort has been undertaken to establish a relationship between shellfish closures and the extent of imperviousness (Schueler, 1995).

Research (Tschetter and Maiolo, 1984) has confirmed the correlation between coastal population growth in North Carolina and the closure of waters to shellfishing, but this work is too general to be useful for management purposes. A study of coastal watersheds in New Hanover County (Duda and Cromartie, 1982) found that closings generally occurred where more than one septic system drainfield was present per every seven acres of watershed. It is not clear how much subsurface drainage networks contributed to the problem or how widely the results of this investigation should be generalized. The bottom line is that there is a strong relationship between land development and shellfish water closures that cannot be ignored if shellfish waters are to be protected or restored.

Construction, Stormwater and Land Use Issues

While no development threshold can be identified at present, it is apparent that closings have increased despite the management policies currently in place. The reasons for this are not clear. There are many aspects of the development process that relate to factors influencing fecal coliform export from urban areas. These aspects include size of disturbed area, length of nonvegetated stage, size of vegetated buffer, impervious level, and design of sediment or stormwater control devices.

Shellfish closures due to developed areas may be related to improper installation or maintenance of best management practices, lack of stream buffers, or ditching and piping land areas. Recent closings may be related in part to:

- Developments approved prior to January 1, 1988 (and thus not subject to the current stormwater regulations) which have been gradually built out over the past few years.
- Density levels allowed without stormwater BMPs may be too high.
- Required buffers for both low and high density development may be too small.
- The cumulative impact of numerous small projects that are not subject to the regulations.
- The lack of vegetative buffers or stringent revegetation schedule during the construction phase.
- Animal populations (both wildlife and livestock), timber harvesting and associated land disturbance, and crop preparation all may contribute to fecal coliform bacteria levels in adjacent waters.

Most likely recent closings may be attributed to a combination of these factors, but adequate information does not exist to confirm this. DEH shoreline surveys, for example, most often do not verify specific causes of contamination or identify specific aspects of stormwater management or erosion/sediment control which may need attention. Changes in DWQ's stormwater rules became effective at the end of 1995. The intent of these changes was in part to address some of the above issues, including enhancing long-term enforcement and managing the cumulative effects of smaller projects. It is still too early to assess the impact of the modified rules.

Septic System Impacts

Dealing with contamination from septic systems is also a difficult issue, but increasingly local governments around the country are finding innovative ways to address these impacts. In order to protect water quality in the Chesapeake Bay, Arlington County, Virginia has adopted an ordinance requiring that all septic tanks be pumped at least once every 5 years (USEPA, 1993b). In the Puget Sound area, where a significant shellfish resource has been threatened by fecal coliform contamination from a number of sources, most counties have established revolving loan funds to facilitate the repair of failing systems (Center for Watershed Protection, 1995). Experience has shown that widespread community support is generally necessary to mount an effective effort, and that this support is unlikely to be forthcoming in the absence of significant perceived benefits (Herring, 1996).

State and Local Interaction through CAMA

The need for both state and local actions to protect coastal water quality was the basis for establishing the Coastal Area Management Act (CAMA) in the 1970s. Since the enactment of CAMA, the state's role in coastal water quality has continued to evolve, encompassing permitting by the Division of Coastal Management in Areas of Environmental Concern, DWQ's coastal stormwater rules, and the continuing development of the Sedimentation and Erosion Control Program by the Division of Land Resources. Local governments have also implemented the local planning requirements of CAMA.

Since additional limitations on shellfish harvesting have occurred under current policies, it seems clear that simply continuing these activities will not adequately protect water quality. All parties in this state-local partnership, as well as private landowners, must accept more responsibility for protecting coastal resources. The Division of Coastal Management (DCM) is currently assessing the adequacy of existing land use planning requirements for providing water quality protection. DWQ will work cooperatively with DCM to evaluate coastal water quality protection measures.

Actions that Can Reduce Impacts to Coastal Waters

Improvements to Stormwater Control Programs

Changes to or better enforcement of present stormwater regulations appear to be necessary to ensure that shellfish waters are adequately protected from runoff from developed areas. Changes in regulations which may be worth investigating include:

- modification of the size, nature or extent of vegetative buffers for both the construction and stormwater phase of the project;
- lowering the allowable built upon area for low density development draining to SA waters;
- increasing the size of vegetative filters for outflows from stormwater management devices;
- developing requirements for maximum size of disturbed area or a revegetation schedule; and
- modified design standards for stormwater and sediment control BMPs to maximize fecal coliform die-off.

Local Growth Management Initiatives

Growth management--defined here as local planning and development review requirements designed to maintain or improve water quality (Center for Watershed Protection, 1995)--has often been unpopular among local governments for a variety of reasons. While it is important to acknowledge this, it must also be acknowledged that further improvements in state programs are, by themselves, unlikely to prevent further deterioration of coastal water quality. Local governments should be taking steps to manage growth. Increasingly, local governments in areas such as the Chesapeake Bay and Puget Sound watersheds have recognized that a more proactive approach is essential to protect their coastal resources. Seventy percent of the local governments in the 12 county Puget Sound region, for example, have adopted some form of a stormwater management plan (Dohrmann, 1995).

Over the past several years DWQ, DCM and other agencies have been involved in a number of projects to encourage and assist local governments in carrying out wastewater planning and growth management activities. One of these projects was the development of the *Blueprint to Protect Coastal Water Quality: A Guide to Successful Growth Management in the Coastal Region of North Carolina* (Center For Watershed Protection, 1995). This guide was developed as part of a federal grant project sponsored by DWQ and carried out by the Neuse River Council of Governments. Local governments should consider the application of growth management techniques outlined in the "Blueprint" document. It provides practical concepts and tools that can be implemented at the local level to protect coastal water quality.

Local governments should consider the application of growth management techniques outlined in the *Blueprint to Protect Coastal Water Quality*. This document provides practical concepts and tools that can be implemented at the local level to protect coastal water quality. Copies are available free of charge from DWQ's Planning Branch at (919) 733-5083.

The following two tables summarize key features of the document. Each element listed in Table A-33 can be tailored to both rural and developed areas and to inland, soundside and barrier island locations. Growth management tools in Table A-34 range from on-the-ground best management practices, such as modifying parking areas to reduce impervious surfaces, to establishing regional wastewater and/or stormwater authorities.

Table A-33 Growth Management Elements Applicable to the North Carolina Coast

• Use Watershed-Based Land Use Planning	• Minimize Impervious Cover in Site Design
• Protect Sensitive Natural Areas	• Limit Erosion During Construction
• Establish Buffer Network	• Maintain Coastal Growth Measures
• Treat Stormwater	• Implement Stormwater Management Plans

Table A-34 Growth Management Tools

• Overlay Zoning	• Greenbelts
• Transfer of Development Rights	• Watershed Impervious Limits
• Marina Siting and Design	• Forest Conservation
• Septic System Siting Criteria	• Shoreline and Wetlands Buffers
• Modification of Street Standards	• Modification of Parking Areas
• Siting Clearing Standards	• Stormwater Treatment
• Cluster Zoning	• Marina Pumpout
• Septic System Alternatives	• Regional CAMA Planning
• Wastewater Authority	• Stormwater Authority
• Wastewater/Stormwater Authority	• Waste Quality Authority
• Sensitive Habitat Protection Ordinance	• Septic System Inspection and Maintenance

The NC Division of Coastal Management has been providing extensive GIS information to local governments to aid in development of local land use plans. These plans must be consistent with state guidelines and address a wide range of issues, including resource protection and conservation, hazard mitigation, economic development and public participation. The 1995 revisions to the land use planning guidelines strengthened the connection between land use

planning and surface water quality. Future land use plan updates must consider water quality use classifications, watershed planning and problems identified in the basin plans.

4.15 Coastal Habitat Protection Plans

The North Carolina General Assembly established the Coastal Habitat Protection Plan Program within the North Carolina Department of Environment and Natural Resources with passage of the Fisheries Reform Act of 1997. The Act (NCGS 143B-279.8) requires preparation of Coastal Habitat Protection Plans for critical fisheries habitats in the coastal area. The goal of the plans shall be the long-term enhancement of coastal fisheries associated with each coastal habitat. The divisions of the Department dealing with marine fisheries, water quality and coastal management were designated as the lead agencies for the program. Other agencies are to be included as necessary. The Coastal Habitat Protection Plan for the Cape Fear River basin is scheduled for completion in 2003.