WATER QUALITY PLAN

GOAL

Restore, maintain or enhance water quality in the Albemarle-Pamlico region so that it is fit for fish, wildlife and recreation.

OBJECTIVE A: IMPLEMENT A COMPREHENSIVE BASINWIDE APPROACH TO WATER QUALITY MANAGEMENT.

Strategy: Effective management of water resources ultimately relies on the consideration of system-wide processes and the cumulative impacts of activities across a river basin. To this end, the Division of Environmental Management (DEM) is approaching water quality research, management, and discharge permitting from a basinwide scale. This approach allows for a balancing of point and nonpoint source contributions and control strategies. The goal of the Department of Environment, Health, and Natural Resources (DEHNR) is to protect the basin's surface waters while accommodating reasonable growth and development. Using this framework requires the availability of river basin models. Several agencies are working to develop models that can be used to demonstrate how all these factors affect water quality. The Water Quality Section of DEM has recently initiated a basinwide approach to water quality management. The Neuse River Basinwide Management Plan is the first of a series of basinwide plans that will be prepared by DEM for all seventeen of the state's major river basins over the next five years. Table 2 represents the basinwide permitting schedule for the river basins located in the APES region, denoting when discharge permit issuance begins in each basin. The basinwide approach to water management considers the assimilative capacity of a river basin as well as the relationship between wetlands and water bodies.

BASIN	MONTH/YEAR
Neuse	April 1993
Tar Pamlico	January 1995
Roanoke	January 1997
White Oak * (Core/Bogue Sounds)	June 1997
Chowan	January 1998
Pasquotank	January 1998
Neuse (2nd Cycle)	April 1998

* *The APES study area includes portions of the White Oak River drainage basin, including Core and Bogue Sounds. See Appendix A, Regional Summaries of Bogue and Core Sounds for more information.*

Table 2 *Basinwide Permitting Schedule for River Basins of the APES Region*

Figure 15 demonstrates the differential contribution of point and nonpoint sources to impaired waters in each basin. Water quality modeling at the basin and sub-basin scale enhances the ability to establish realistic pollutant loading estimates for development of proper management strategies and will eventually assist in the prediction of impacts to water quality and flows from land use alterations including wetland loss and restorations.

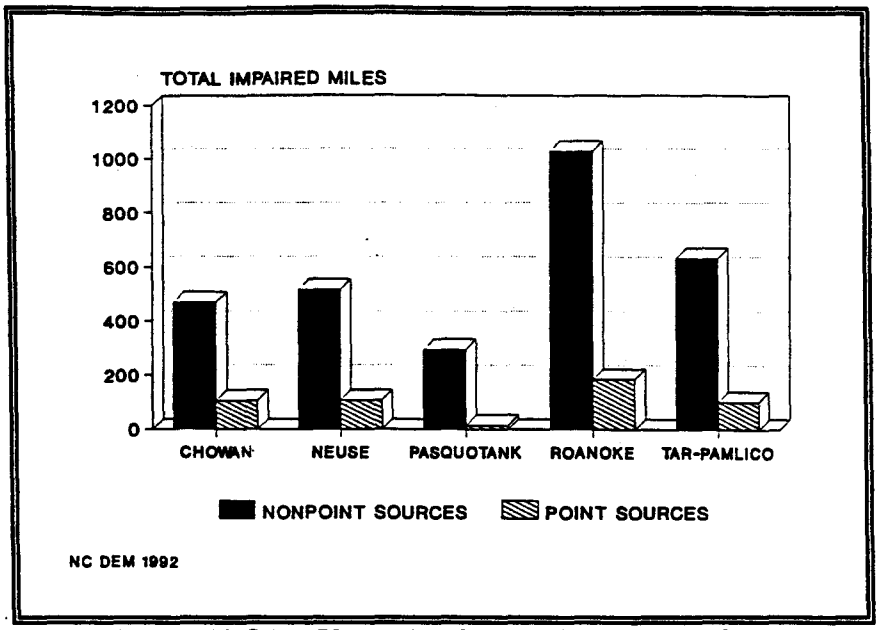

FIGURE 15 *MILES OF FRESHWATER STREAMS AND RIVERS IMPAIRED BY POINT AND NONPOINT SOURCES FOR EACH RIVER BASIN IN THE APES REGION*

Management Action 1: Develop and begin implementing basinwide plans to protect and restore water quality in each basin according to the schedule established by the Division of Environmental Management's Water Quality Section. The plans would include provisions for basinwide wetland protection and restoration.

Explanation: *Basinwide plans are comprehensive, targeted strategies for managing water quality. They assess the cumulative impact of individual projects on water quality within a basin. They can identify and manage pollutants in a way that protects water quality while accommodating economic growth. Basinwide protection and restoration also can help assess and preserve wetlands functions.*

Critical Steps:

1. The Division of Environmental Management (DEM) will continue to utilize the combined expertise of state and federal staff (U.S. Environmental Protection Agency-EPA, U.S. Geological Survey-USGS, National Oceanic and Atmospheric Association-NOAA, U.S. Fish and Wildlife Service-USFWS, Division of Marine Fisheries- DMF, and Division of Coastal Management-DCM) to develop comprehensive basinwide plans that will provide mechanisms to characterize water quality and biological resources within basins, target problematic watersheds, and manage water resources to support long-term growth.

2. With input from the Regional Councils (see Implementation Plan), DEM will continue to establish total maximum daily loads (TMDLs) for each targeted watershed, synchronize the National Pollution Discharge Elimination System (NPDES) permitting process, and include nonpoint source controls in each basinwide plan.

3. DEM with the assistance of other state and federal agencies (U.S. Army Corps of Engineers-USACE, DMF, DCM, EPA, and USFWS), would refine a wetlands evaluation system to better classify wetlands function on a basinwide scale.

4. The basinwide plans should include information (maps and graphics) that promotes an understanding of the importance of wetland types to overall water management.

5. DEM will use agricultural cost share and other non-regulatory programs to increase the restoration of degraded wetlands. The Division will incorporate effective best management practices such as the Forested Wetlands BMP document (Division of Forest Resources-DFR) into wetland management programs.

6. DEM would consider the efforts by DCM in wetlands identification and evaluation on a county level basis (See Vital Habitats Plan, Objective C, Management Action 3).

7. DEM would include the delineated wetlands information (maps and graphics) in basinwide plans that promotes an understanding of the importance of wetland types to overall water quality management.

Evaluation Methods

1. DEM will track the completion of each critical step. The Division currently plans to review basinwide plans and management strategies every five years following implementation. At that time modifications and additions will be made as necessary in the plans to provide continued water quality improvement and maintenance.
2. The basinwide comprehensive baseline data set characterizing the water quality and biological resources would be used to evaluate the success of management strategies. Limited degradation of the water quality and improvements in degraded waters would indicate successful management practices.

Costs and Economic Considerations

Program costs of this action are estimated at $50,000 per year to fund an environmental planner with skills in modeling to work in DEM. This management action would result in an increase in water quality improvements achieved per dollar spent on the planning, administration, implementation, and monitoring of water quality programs. Improved coordination of activities to protect and restore water quality within each basin would allow geographical targeting of resources spent on environmental protection and identification of the most cost-effective control strategies, which in turn would result in cost savings to the public and private sectors. The development of a system for evaluating the impact of wetlands alterations on basinwide hydrology and water quality would allow those who administer wetlands permitting programs to consider the basinwide and cumulative impacts of permitting decisions. In addition, it would help decision makers to focus regulatory and mitigation efforts on those wetlands most important for water quality, and to channel and concentrate mitigation and protection efforts to areas where the need is greatest. By incorporating wetlands impacts into basinwide planning, government agencies, private firms, and individual landowners can better tell where development will be most compatible with protecting water and wetland resources. This reduction in uncertainty should lower the overall costs of the permitting process over time for both the public and private sector. Other benefits of deliberate, coordinated, and scientifically based wetlands management on a basinwide scale could include avoided, reduced, or postponed expenditures on flood control structures and waste treatment facilities. Planning allows local governments to assess the physical capacity of land in their jurisdiction and to plan ahead for the highest quality growth possible within the constraints of the natural resource base. At a regional level, planning maximizes the effectiveness of efforts to identify and protect habitats vital to wildlife, rare species, rare natural communities, and fisheries (see the Vital Habitat Section). Finally, this

approach would help local governments and landowners understand how land use decisions made elsewhere in their river basin affect the values of their land. For instance, a number of wetlands alterations which individually do not have a critical impact on water quality could cumulatively increase the intensity or periodicity of flooding for a downstream landowner or community. Understanding and measuring these effects is critical to sound basinwide management and to reducing future conflicts over land use.

Funding Strategy

An environmental planner with modeling skills would require a $50,000 appropriation by the General Assembly.

Management Action 2: Establish total maximum daily loads (TMDLs) and associated control strategies for all impaired streams in the Albemarle-Pamlico region by 1999.

Explanation: *Total maximum daily loads estimate the amount of pollution that can safely enter a body of water. To determine limits to these daily loads, current and projected levels of pollution must be considered in relation to what the system can absorb. Proper use of TMDLs will allow development of management strategies to ensure long-term sustainable growth that does not harm the state's water resources.*

Critical Steps:

1. The Division of Environmental Management (DEM) will continue to establish total maximum daily loads (TMDLs) for targeted watersheds within a basin to be used in the development of water quality management plans. DEM will continue to evaluate physical, chemical, and biological parameters basinwide and amend management strategies as necessary to ensure limited degradation of water resources.

2. Using total maximum daily loads (TMDLs) as guidelines, and input from the Regional Councils (see Implementation Plan), the Division will target critical point and nonpoint source inputs for priority management efforts.

Evaluation Methods

1. Continued basinwide monitoring of water quality parameters will be used to assess ecosystem integrity within each river basin and determine if established TMDLs are effective in preventing degradation of water resources and improving impaired systems.
2. The success of this management action can be determined by documented improvements in water quality.

Costs and Economic Considerations

Under the Clean Water Act, the state is required to establish TMDLs to determine the total pollutant loadings that a degraded water body can assimilate while still maintaining its water quality classification and standards. DEM will require two modelers to establish TMDLs for the Albemarle-Pamlico region. An estimated $100,000 per year is needed to fund these positions. TMDLs are used as a tool in developing point source control strategies and targeting areas for nonpoint source management. When new permit levels are set, point source dischargers may have to pay increased costs of secondary treatment to comply with these new limits, and additional costs may be incurred by the private and public sector to reduce nonpoint source pollution. While TMDLs may require increased investments in pollution control, they can also facilitate cost savings by allowing DEM and the Division of Soil and Water Conservation (DSWC) to focus efforts and resources on geographically targeted areas of concern. This can help minimize governmental expenditures and better utilize taxpayers' dollars, while at the same time increasing environmental benefits per dollar spent on point and nonpoint source controls.

Funding Strategy

Two modelers to develop TMDLs for each river basin in the APES region would require a $100,000 appropriation from the General Assembly.

Management Action 3: Renew all discharge permits in a river basin simultaneously by 1999.

Explanation: *Renewing permits simultaneously allows the Division of Environmental Management (DEM) to consider the total impact from all dischargers when determining how much pollution each may release into the basin.*

Critical Steps:

1. DEM will place expiration dates on all permits within a basin that expire in the same year.

2. New or revised limits will be incorporated into permits, as appropriate, to meet safe wasteload allocations developed under the basinwide plans.

Evaluation Methods

1. DEM will cross-reference on a yearly basis the permit expiration date for each discharger with its basin location and the basinwide schedule to ensure synchronous renewal.

2. The success of this management action can be determined by decreases in permit processing backlogs.

Costs and Economic Considerations

In the past, permits have been reissued randomly as they came up for renewal. Synchronous renewal of NPDES permits is now a major part of the basinwide initiative through the DEM. In 1990, to allow for better water quality management, the Water Quality Section of DEM began implementing a basinwide NPDES permitting schedule. In 1993, the Neuse River Basin became the first basin where all discharge permits expire and are renewed in the same year. DEM's schedule will allow for synchronous renewal of discharge permits for the other river basins in the Albemarle-Pamlico region and across the state. Permits will be reviewed and reissued at 5 year intervals. This is a cost effective measure of reducing

administrative costs and averting some potential environmental costs. Synchronous renewal will facilitate data gathering for water quality and wasteload modelling, TMDL development, and basin plan development. It allows the Water Quality Section to allocate staff and resources more efficiently.

Funding Strategy
No increased funding is necessary to continue this initiative.

Management Action 4: Consider the potential for long-term growth and its impacts when determining how a basin's assimilative capacity will be used.

Explanation: *Assimilative capacity is the ability of a river basin to safely absorb pollutants. Basinwide planning should ensure that this capacity is used in a way that sustains long-term growth. However, planning for long-term growth also must consider how secondary impacts such as runoff from new roads will affect water quality.*

Critical Steps

1. The Division of Environmental Management (DEM), based on best available data, will establish a cap on wasteload allocations to point and nonpoint sources.

2. The Division will review existing permits to determine how much of the utilizable capacity has been distributed.

3. The Division will not issue a permit if it is determined that a discharge will result in loss of any existing use or result in violations of established water quality standards in receiving waters. DEM will consult with the Division of Coastal Management (DCM) during the permitting process to ensure all state resources are conserved and secondary impacts are considered.

Evaluation Method
The success of this action can be determined by documented improvements in water quality and continued environmentally sound economic growth in each of the basins.

Costs and Economic Considerations
No new governmental costs are expected to be associated with this action. However, if managing assimilative capacity involves setting new permit levels, then dischargers may have to pay increased costs of advanced treatment to comply with these new limits. The remaining assimilative capacity of water bodies could be increased by reducing the amount of allocated discharge as well as the pursuit and utilization of technology to improve secondary treatment. This would protect water bodies from unforeseen cumulative impacts and would establish a margin of safety.

Funding Strategy
No funding increases are required for this management action.

Management Action 5: Improve the scientific models for understanding the estuarine system, the effects of human activities on the system and the viability of alternative management strategies.

Explanation: *Scientists use models to understand how systems work. Models for the Albemarle-Pamlico's river basins have been developed, but further refinement and calibration are needed to determine how much pollution can be safely released into the estuary (i.e., total maximum daily loads). This would allow regulators to focus on the most critical sources of pollution, thereby reducing the cost of regulation, monitoring and enforcement. Increased knowledge gained from models will help planners manage water resources to allow for future growth.*

Critical Steps

1. A work group would be assembled to coordinate current and future hydrologic and water quality modeling by responsible agencies, including the Division of Environmental Management (DEM), Division of Water Resources (DWR), U.S. Geological Survey, U.S. Army Corps of Engineers, U.S. Soil Conservation Service, Water Resources Research Institute, and the state university system. This group would choose specific models for each basin system. The models would consider terrestrial and airborne nutrient loadings; surface and ground water cycling; toxicant loadings, fate and transport; cumulative effects of loadings of different constituents on water quality and biotic health; functions of wetlands on a landscape level; the impact of drainage and other hydro-modifications; and the cumulative impacts of marina siting. The work group also would identify additional research that improves and integrates current area-wide databases, such as tracking hydrologic modifications, stream channelization, ditching, and subsurface and/or control systems.

2. The work group would determine which agencies will conduct monitoring and modeling efforts for each basin. The responsible agencies then would request sufficient funding to accomplish the work. DEM would be the lead agency in coordinating the modeling effort. All modeling would be accomplished in five years.

3. Water quality and hydrodynamic models would then be used to make permitting decisions (such as point source discharges, dredge and fill of wetlands, channelization projects, and dams) to target nonpoint source control efforts and to support long-term comprehensive planning.

Evaluation Method

Agencies would report annually on their progress toward completing the models. Once these models have been incorporated into the basinwide plans, their success will be evaluated in accordance with DEM's basinwide schedule.

Costs and Economic Considerations

Average cost for this action is estimated at $400,000 per year for five years to refine and develop hydrodynamic and water quality models for the A-P region. A model that has already been developed for the Tar-Pamlico Basin will be refined and adapted as needed for use in the other river basins of the A-P region. The additional cost for each basin is expected to be considerably less than the cost of developing the original model. Improved

information on the effect of specific loadings, cumulative impacts, surface and ground water cycling, wetland functions, and the impacts of drainage and other hydromodifications would allow policy makers to set appropriate discharge limits and to target policy and implementation efforts at the most damaging discharges and loadings. This could reduce the cost of regulation, monitoring, enforcement, and compliance while at the same time reducing the most harmful loadings.

Funding Strategy

Money to develop scientific models for four river basins in the APES area would be acquired from USGS Cooperative Funds. This program provides 100% matching funds and would be available to DEM upon receipt of an expansion budget item from the General Assembly. Another possibility for funding would be through federal Grants applications.

Management Action 6: Continue long-term, comprehensive monitoring of water quality in the APES system, collecting data to assess general system health and target regional problems.

Explanation: *On a system-wide basis, water quality monitoring allows managers to assess the effectiveness of management strategies. In addition, monitoring data may be used to develop scientific models or other methods of evaluating water quality on a smaller scale. Continued monitoring also would assess long-term trends.*

Critical Steps

1. The Division of Environmental Management (DEM) and the U.S. Geological Survey (USGS) would continue monitoring water quality through the network of fixed stations throughout the system. This would help assess general and long-term trends and identify possible problems. At these stations, DEM collects grab samples and the USGS monitors continuously.

2. The EPA Environmental Monitoring and Assessment Program and the APES Citizens Water Quality Monitoring Network would collect grab samples to supplement data collected by USGS and DEM.

3. DEM's basinwide planning initiative, along with USGS' National Water Quality Assessment Program, would make area-intensive assessments of water quality on a rotating basis. Data collected through these assessments would be used to revise management strategies in specific basins.

4. DEM, USGS, the Citizen Water Quality Monitoring Network (CWQMN), and other appropriate agencies and organizations would collect water quality data as needed in response to possible concerns. This data would identify immediate problems, guide corrective management strategies, and measure the effectiveness of those strategies.

5. Water quality data collected through the fixed station network would be expanded to include biological monitoring in estuarine waters and pesticide monitoring. Area intensive assessments would be used to characterize water quality inputs during high flow periods when loadings are greatest to target regional problems and to evaluate the effects of management actions.

Evaluation Method

DEM and USGS would annually review station locations in the monitoring network and change them as necessary to give a representative picture of system health.

Costs and Economic Considerations

In addition to currently funded monitoring programs, annual costs to DEM would be $50,000 for an environmental field technician to perform water quality sampling and $100,000 to maintain the ambient water monitoring network in the APES region. The implementation of this management action is critical to the successful implementation of several other elements of the CCMP and to the protection of water quality in the APES region. Water quality monitoring allows agencies to assess the effectiveness of pollution control programs, land and water use planning, and other resource management programs.

Funding Strategy

Money to fund the expanded ambient water quality network in the APES area would be acquired from USGS Cooperative Funds. This program provides 100% matching funds and would be available to DEM upon receipt of an expansion budget item from the General Assembly. The environmental field technician position would require a $50,000 appropriation from the General Assembly.

OBJECTIVE B: REDUCE SEDIMENTS, NUTRIENTS AND TOXICANTS FROM NONPOINT SOURCES.

Strategy: Nonpoint sources of pollution are varied and are usually difficult to regulate. Targeted reductions can be accomplished by building on present programs and efforts. A three-pronged approach consisting of research and demonstration projects, incentive-based programs, and regulatory action and enforcement is necessary to accomplish true reductions. As part of the basinwide management plan, a nonpoint source pollution control plan would be developed for each river basin to address all sources of nonpoint source pollution. By characterizing individual basins, this plan would create management strategies that identify problem areas and implement control measures necessary to reduce nonpoint source pollution. Figure 16 demonstrates the amount of freshwater miles from each river basin impaired due to nonpoint sources. Research and demonstration of on-site control methods for nonpoint sources, often referred to as best management practices, provide increased opportunities for the reduction of nonpoint source loadings. Incentive programs, such as cost share programs, would be used whenever possible to control existing sources of pollution. Regulatory enforcement action would be used as a tool whenever water quality violations occur or when established minimum criteria are not met in spite of available cost share assistance. Therefore, the nonpoint source pollution enforcement program within the Division of Environmental Management (DEM) would be strengthened. Other efforts to reduce basinwide nonpoint

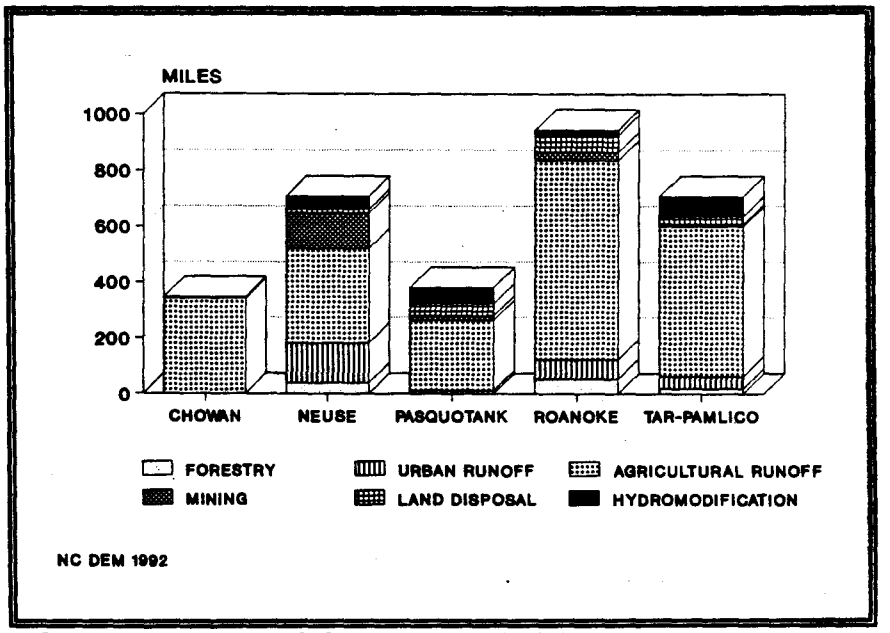

FIGURE 16 *MILES OF FRESHWATER STREAMS AND RIVERS IMPAIRED FROM NONPOINT SOURCES FOR EACH BASIN IN THE APES REGION*

sources of pollution would include changes in the management of marinas, stormwater runoff, wastewater treatment, and forestry practices. Additionally, the development and implementation of nonpoint source control plans on a basinwide level will support future initiatives required by Section 6217 of the Coastal Zone Act Reauthorization Amendments of 1990.

Management Action 1: For each river basin, develop and implement a plan to control nonpoint source pollution as part of the basinwide management plans.

Explanation: *Plans would address all nonpoint sources of pollution in each basin, targeting the most critical areas for controls. These plans would identify the nonpoint source pollution problems specific to each basin. Implementation would vary according to each basin's needs. Plans also would include strategies to control nonpoint source pollution in accordance with the total maximum daily loads (TMDLs) established for each basin. Possible measures include targeted funds for implementation of BMPs, buffer strips along waterways, and continued use of BMPs for highway construction.*

Critical Steps

1. The Department of Environment, Health, and Natural Resources (DEHNR), in cooperation with state and federal agencies, the Regional Councils, universities, and other members of the public and private sector, will develop a comprehensive nonpoint source control plan specific to each river basin.

2. These basinwide plans will develop methods of controlling pollution from land-disturbing activities, such as agriculture, forestry, and construction and other types of potential pollution sources, such as urban runoff and on-site wastewater disposal.

3. Highly degraded areas would be targeted for immediate nonpoint source pollution controls, while the entire river basin would be monitored by comprehensive measures. The plans will consider all control options including new regulations, incentive programs, and locally implemented programs as necessary.

4. A central database compiling all available information about each river basin would be established to better characterize the nonpoint source pollution parameters on a basinwide scale. This data would be highlighted through the use of Geographic Information Systems (GIS) capabilities.

Evaluation Method

Lead nonpoint source pollution control agencies, as identified in the Nonpoint Source Management Program (319 Report), would report on an annual basis the number of controls applied, the amount of acres treated, and provide a map of the areas treated. New controls applied to reduce nonpoint source pollution should be monitored to evaluate their effectiveness. Total load reductions for sediment and nutrients would be calculated based on performance expectations and actual data for each basin. This data could be used to compare data generated previous to the newly implemented controls. The success of this management action would be determined by documented improvements in water quality.

Costs and Economic Considerations

A basinwide nonpoint source control plan would function as part of an integrated point and nonpoint source control and management plan for each basin. A comprehensive plan for each basin utilizing incentive and regulatory based programs should help to lower the costs and increase the effectiveness of resources spent on reducing nonpoint source pollution. Planning would allow incentives for implementation of BMPs in geographically specific areas important for the protection of water quality in each basin. In addition, it would focus resources on ensuring that measures are taken to control and reduce nonpoint source pollution in areas of the river basin where water quality is at greatest risk.

Funding Strategy

Any additional costs of this management action are addressed under previous management actions.

Management Action 2: Expand funding to implement nonpoint source pollution controls, particularly agricultural best management practices through the N.C. Agriculture Cost Share Program, and also to develop a broader Water Quality Cost Share Program. Expand the cost share programs to include wetlands restoration. Increase cost share funds to problem areas.

Explanation: *Economic incentives and technical assistance have been effective in promoting nonpoint source pollution controls in agriculture. Under this initiative, the Agriculture Cost Share Program would expand and a new Water Quality Cost Share Program, modeled after the one for agriculture, would be created. Cost-sharing would give farmers, marina owners, forestry operations and individual land owners greater incentive to reduce nonpoint source pollution.*

Critical Steps

1. The General Assembly would be asked to increase appropriations to the Division of Soil and Water Conservation (DSWC) for the existing Agriculture Cost Share Program in the 1994 session. Funding is necessary for technical assistance and installation of best management practices. A list of best management practices eligible for the Agriculture Cost Share Program and a description of practices as outlined in a detailed implementation plan for nonpoint source pollution control is presented in Appendix E.

2. DSWC would pursue avenues to target the increased funding and technical assistance to priority areas identified through the basinwide nonpoint source control plans.

3. The General Assembly would be asked to authorize and appropriate funding for a new Water Quality Cost Share Program in the 1995

session. Funding is necessary for technical assistance, administration, public outreach, and installation of best management practices.

4. The Water Quality Cost Share Program will be set up in DEHNR and administered by a division selected by the Department. Upon receipt of authorization and funding, DEHNR would hire technical and outreach staff to implement the programs. Technical assistance staff would be located in offices throughout the APES region.

5. Using technical experts from the Department as well as from other agencies and from private industry, DEHNR will develop a manual of acceptable controls for the land uses managed under the Water Quality Cost Share Program. The Department will include effective best management practices that will protect wetlands. Information, such as the Forested Wetlands BMP document from the Division of Forest Resources (DFR), will be revised, updated, and incorporated.

6. DEHNR would target the most cost-effective controls on a case by case basis to achieve desired reductions of nonpoint source pollution in critical areas identified by the basinwide nonpoint source control plans based on water quality standards.

7. Using the existing Agriculture Cost Share Program as a model, land owners would share in the cost of nonpoint source controls at a rate of 25 percent of the total cost of the controls on their property. The program would supply the other 75 percent. Technical assistance is provided through funding from local districts with matching funds from the state.

Evaluation Methods

1. Report on an annual basis the number of controls applied, the amount of acres treated, and map the areas treated.
2. Conduct demonstration site monitoring to evaluate the effectiveness of each type of practice.
3. Calculate the total load reductions for sediment and nutrients based on performance expectations and actual data for each basin.
4. Regulatory enforcement action would be used as a tool whenever water quality violations and rule infractions occur in spite of available cost share assistance.

Costs and Economic Considerations

A total of $5,000,000 per year would be needed to implement this action. The Agriculture Cost Share program for the APES region requires an

additional estimated $2.5 million in fiscal year 1994-95 to hire additional technical outreach personnel and provide ample support for BMPs. Funding needs for the broader Water Quality Cost Share Program are estimated at $2.5 million per year. For each of the programs, $500,000 would be used to fund administration and technical assistance, $2 million would be used to fund on-the-ground practices. The agricultural cost share program offers farmers not only strong economic incentives to implement BMPs (the program will pay 75 percent of implementation costs), but technical assistance to help them determine the most appropriate BMPs for each farming operation. In addition, technical assistance personnel who are familiar with local conditions would be located in each district office. These factors help control the cost of reducing nonpoint source pollution from agricultural operations. As is the case in the agricultural BMP program, BMP implementation through the broader Water Quality Cost Share Program is intended to improve water quality on the landowner's property as well as in adjacent areas and downstream. In the same way the agricultural program aims to improve the efficiency of farm operations, the same would be true for homeowners and foresters. For example, upgrading obsolete and non-compliant septic systems would also improve the efficiency of the homeowner's septic system. Controlling soil erosion can save topsoil and increase the productivity of forester's soil. If pesticide use is reduced, pesticide costs for urban and suburban homeowners, as well as foresters, may be lowered. In addition to the above benefits, urban and suburban homeowners could benefit from an increase in land value due to upgrading obsolete and non-compliant septic systems. Private foresters may benefit from an increase in land value through the use of BMP's which decrease erosion. BMPs that reduce erosion of construction site areas and of forestry logging and replanting sites could reduce turbidity caused by sediment loadings, and thus benefit fish and other aquatic life who are harmed by it. Reduction of water pollution from suburban and urban nonpoint sources, which would lower bacteria and pathogen inputs, can lessen the threat of groundwater and drinking water contamination and algal blooms which result in fish kills and diseases thereby reducing the risk of harm to shellfish, finfish and human health.

Funding Strategy

The expansion of the Agriculture Cost Share Program in the APES region would require a $2.5 million increase to the present program by the General Assembly. Other potential funding sources would include the USDA Agriculture Conservation Program to restore wetlands. Additional funding may be obtained from the Tar-Pamlico Basin Association. The development of a Water Quality Cost Share Program would require an additional $2.5 million appropriation from the General Assembly.

Management Action 3: Continue to research and develop alternative septic systems and new best management practices to reduce nonpoint source pollution.

Explanation: *Alternative septic systems will help protect the environment and support long-term growth by providing effective waste treatment for eastern North Carolina. BMPs improve septic system performance and reduce costly repairs. Developing and demonstrating additional BMPs for other sources of pollution, such as runoff from agricultural lands, urban lands, and highways, would provide proactive, cost-effective means to reduce nonpoint source pollution.*

Critical Steps

1. The General Assembly would be asked to consider requests by the Division of Environmental Health (DEH) to establish a research center in the coastal plain of North Carolina. This would facilitate efforts by the On-site Wastewater Section to develop and demonstrate alternative septic systems for porous soils of this region.

2. Demonstration projects would be set up in counties within the Albemarle-Pamlico region. These projects would determine the effectiveness of alternative systems under a variety of site and soil conditions. The demonstration projects would be modelled after successful demonstration projects that already exist in Chatham and Craven counties.

3. The demonstration projects would include outreach components to educate the public about alternative systems. These efforts would emphasize the importance of maintenance for effective system operation.

4. The Division of Soil and Water Conservation (DSWC), would meet with the Cooperative Extension Service, North Carolina State University, Division of Water Resources (DWR), and others to determine priority research initiatives and to aid in securing funding to research the effects of best management practices on groundwater.

5. The federal Agricultural Research Service, North Carolina State University Agricultural Research Service, DSWC, Department of Agriculture (DA), Cooperative Extension Service, and farm organizations would provide information on, and help to develop, agricultural and non-agricultural BMPs to reduce nonpoint source pollution caused by the leaching of nitrates, salts, and pesticides. Agricultural BMPs that can help reduce this pollution include: controlling the rate, method, and timing of manure, fertilizer, and pesticide applications; scheduling irrigation to minimize water use and excessive leaching, which also may reduce runoff if infiltration capacity is not exceeded; and tilling conservatively for runoff and erosion control.

6. The Groundwater Section and Wellhead Protection Program of the Division of Environmental Management (DEM) would work with other relevant agencies and local governments to develop non-agricultural BMPs. Non-agricultural BMPs that can help to reduce groundwater pollution include improved siting, installation, and maintenance of septic systems. In addition, minimum lot size requirements reduce the risk of drinking water contamination by preventing the concentration of wastewater and sewage treatment near water supplies. Non-agricultural BMPs to protect surface water and groundwater resources also include the adequate management and maintenance of stormwater structures.

7. Stream-side buffer strips would be promoted for both agricultural and non-agricultural land use practices to help minimize groundwater and surface water pollution. The transport of discharging waters through these buffer areas reduces nitrates, other nutrients, and sediments before they enter the surface waters.

8. The Environmental Management Commission (EMC), Wildlife Resources Commission (WRC), Coastal Resources Commission (CRC), Division of Forest Resources (DFR), Soil and Water Conservation Commission (SWCC), US Fish and Wildlife Service, and US Soil Conservation Service will form a task force to develop technical specifications for stream-side buffer strips. These specifications will include buffer width and type of vegetation to be used while incorporating ecological function

as a primary design criterion. These specifications should also consider the amount and type of land disturbance allowed within the buffer zone.

9. The task force will use Geographic Information Systems (GIS) technology to analyze the current extent of stream-side buffers in critical sub-basins. This information would be used to target those areas that lack buffer strips for outreach and technical assistance.

Evaluation Methods

1. Research would be evaluated to determine whether the alternative septic systems are effective in the soils of the Piedmont and in those soils of the coastal plain that are not suitable for conventional septic systems.
2. The costs of the alternative systems would be compared to the costs of conventional systems to determine whether the systems are price competitive.
3. Groundwater and well water would be monitored and tested for pollutants before, during and after experimental best management practices were implemented.
4. Data collected on water quality and hydrologic research will be analyzed to determine the effectiveness of the best management practices in pollutant removal. The results will be provided to the public through technical assistance and education on the proper usage of best management practices.

Costs and Economic Considerations

It is anticipated that $350,000 per year for five years will be needed to fund a research center for DEH in the coastal region of North Carolina. A portion of this total may be used to fund research on the development of alternative septic systems. BMPs such as improved siting, installation, and maintenance of septic systems, and proper construction, operation, and maintenance of stormwater structures offer ground and surface water protection as well as cost savings. These preventative BMPs not only improve the performance of septic systems and stormwater structures, they also are less costly than repairing or replacing systems and structures. Many agricultural BMPs have been effective in increasing productivity as well as reducing nonpoint source pollution. For example, agricultural BMPs such as erosion control techniques that can retain fertile topsoil also help to maximize yield. Yield can also be improved by controlling the rate, method, and timing of fertilizer and pesticide application while reducing agricultural runoff. Demonstration of the effectiveness of best management

practices that offer ease of integration into existing practices and that provide economic or labor saving benefits can help to increase the understanding, acceptance, and use of these practices by local citizens.

Funding Strategy

To fund a research center and conduct research on alternative septic systems, a $350,000 appropriation would be needed from the General Assembly. An additional amount of money is necessary to research the effects of BMPs on groundwater. This funding would be sought as grant money opportunities become available.

Management Action 4: Strengthen current enforcement to detect and correct ground and surface water quality violations from nonpoint sources.

Explanation: *Although current enforcement authority exists, nonpoint sources of water quality violations are difficult to identify because they are varied and often widespread. The Division of Environmental Management's (DEM's) Water Quality and Groundwater Sections would strengthen enforcement to ensure that these violations are identified and corrected.*

Critical Steps

1. The General Assembly would be asked to authorize increased funding to DEM to hire three additional staff members for the Washington regional office.

2. The additional staff members would be responsible for addressing concerns related to nonpoint source pollution, including inspections and enforcement procedures.

3. The additional staff members would use the basinwide monitoring data to evaluate water quality violations and prioritize these violations according to severity.

4. The Division would respond with technical assistance and education initiatives to promote the use of best management practices by landowners.

5. Notice of Violations (NOVs) and assessments would be issued according to the severity and frequency of water quality standard violations.

6. Based on staff assessment of contaminated sites, DEM would recommend appropriate remedial action.

Evaluation Method

DEM would evaluate the number of exceedances of water quality standards to determine the effectiveness of best management practices and overall enforcement efforts. The success of this strategy can be measured by documented water quality improvement due to remediation and enforcement efforts.

Costs and Economic Considerations

Funding needs are estimated at $200,000 per year for staffing, administration, and implementation. This would include three additional staff members to be hired by DEM, as well as equipment and supplies. The staff would be stationed in the regional office in Washington, NC and provided with continuous monitoring equipment. Enforcing regulations would protect the public's drinking water and water resources from nonpoint source violations that otherwise could threaten human and environmental health, with associated health, environmental, and economic costs. Enforcement that begins by identifying nonpoint source pollution violations and is solution-oriented can help reduce future violations. By doing so, the future costs of enforcement and pollution are reduced.

Funding Strategy

To fund three additional staff members and operational support, a $200,000 appropriation would be required from the General Assembly.

Management Action 5: Strengthen implementation of forestry best management practices through training, education, technical assistance and enforcement.

Explanation: *Proper use of forestry best management practices is critical for water quality protection in the APES region. Additional professional foresters would provide needed outreach and technical assistance to forestry operators and landowners regarding implementation of BMPs. Enhanced enforcement would ensure proper use of forestry BMPs and help to eliminate improper forestry practices. Participation by loggers and landowners in education programs, such as the Professional Loggers Program, is vital to the expanding goals of the forest products industry. Forestry workshops create an opportunity for landowners to learn about forestry management and the use of acceptable forestry BMPs.*

Critical Steps

1. The General Assembly would be asked to authorize increased funding to the Division of Forest Resources (DFR) to hire five professional foresters, one for each district in the APES region, to provide outreach and technical assistance on forestry best management practices.

2. The General Assembly would be asked to authorize increased funding to the Division of Land Resources (DLR) to hire two additional staff members to enforce the requirements of the Sedimentation Pollution Control Act as it relates to forestry requirements.

3. DFR, the Forestry Association, and the Cooperative Forest Extension Service would continue to promote and conduct educational workshops, such as the Professional Loggers Program, to expand knowledge and

encourage industry to continue promoting activities that ensure environmentally sound forestry practices. The intention of these educational workshops is to "pull together" the broad interest of the forest products industry while expanding upon the necessity for compliance with forestry performance standards. Previous workshops have focused on sediment control, wetland issues, wildlife considerations, preharvest planning, and critical habitat protection.

Evaluation Method

To determine the rate of noncompliance, the DFR and the DLR would compile enforcement data through their inspection process to determine the number of sites penalized for not following best management practices or found in violation of the Sedimentation Pollution Control Act. A best management practice noncompliance rate would demonstrate the success of this action. The effectiveness of education workshops would also be reflected by this rate.

Costs and Economic Considerations

The DFR would require $250,000 to hire five professional foresters. The DLR would need $100,000 to hire two additional staff members for enforcement activities. Possible benefits may include more profitable logging operations if operators learn techniques that make their operations more economically efficient. As a result of best management practices being implemented, landowners may benefit from a decrease of soil loss and erosion on their property. The benefits to water quality from the implementation of forestry best management practices include decreased sediment pollution of estuarine waters as a result of BMP implementation, with a resulting decrease in damage to aquatic life, including ecologically, commercially, and recreationally valuable fish.

Funding Strategy

The hiring of additional staff members by DLR and DFR would require a $350,000 appropriation from the General Assembly.

Management Action 6: Enhance stormwater runoff control by strengthening existing regulations and developing new ones, if needed, by 1995. Improve enforcement to ensure that stormwater management systems are properly installed and regularly maintained.

Explanation: *At present, the North Carolina Stormwater Management Program targets priority areas and high risk pollutant sources. Additional benefits from this program may be realized by evaluating expansion of the areas of coverage to target more -- or potentially all -- waters. Under this initiative, various regulating agencies would coordinate their efforts to protect all state waters. The Division of Environmental Management (DEM) would dedicate more staff time to monitoring the installation, operation and maintenance of stormwater systems. A critical part of enforcement would be providing education and technical assistance to private land owners, industries, municipalities and others required to comply with these regulations.*

Critical Steps

1. DEM will evaluate current stormwater management rules for comprehensive coverage of all state waters and to ensure that all current stormwater programs are integrated.

2. The Division of Coastal Management (DCM) will evaluate current enforcement of its rules for Outstanding Resource Waters as they apply to stormwater management within the CAMA permitting process.

3. DEM will evaluate the effectiveness of management practices in protection of water quality in coastal areas.

4. DEM would hire more staff to monitor the construction, operation, and maintenance of stormwater control facilities. In addition, the state stormwater control program would dedicate more staff to education and technical assistance of private land owners, industries, municipalities, and regions required to comply with the state or federal stormwater control regulations, so that these parties understand the reasons for the regulations and how to improve maintenance.

Evaluation Method

The state would hold biannual meetings between the regulating agencies to discuss goals and strategies and to determine if the stormwater runoff program is being implemented properly. At this time, changes may be made as necessary to meet the goals of the program. Changes in water quality within significant water body classifications will be analyzed using trend analysis to determine whether pollutant loads have been reduced or water quality improved.

Costs and Economic Considerations

DEM would require $150,000 per year for three staff persons to evaluate current stormwater management rules; monitor coastal and inland stormwater control facilities to ensure proper construction, operation, and maintenance; and to provide outreach education and technical assistance to private landowners, industries, municipalities, and counties to ensure proper maintenance of stormwater management facilities. Improvement of stormwater management through education, technical assistance, monitoring, and certification could reduce loadings of sediment and toxicants from stormwater runoff from inland as well as coastal sources. This could provide more comprehensive water quality protection for estuarine and coastal waters, and would also benefit inland waters. Proper maintenance of stormwater systems such as wet detention ponds provides for continued flood control and retention of sediment and other pollutants associated with particulates that settle in the ponds.

Funding Strategy

The hiring of additional staff members by DEM would require a $150,000 appropriation from the General Assembly.

Management Action 7: Implement an inter-agency state policy that addresses marina siting and integrates best management practices through permitting and better public education.

Explanation: *There is no consensus on the cumulative impact of marinas on the estuary or on how to manage marina development. A state marinas policy would coordinate agencies concerned with regulating and planning for marinas. It would address such issues as public trust rights and siting, and would integrate new best management practices. New BMPs include designing marinas to contain oil spills and pollution, minimizing the impact of turbulence from boating outside marinas, and controlling pollution from fish wastes and boat cleansers. A marinas policy, along with the appropriate regulations, would be a guide for local government planning. Public education, particularly boater education, plays an integral role in encouraging best management practices.*

Critical Steps

1. The current permitting process allows for interagency coordination for the review of new marina permits; however, consensus between the agencies has not been achieved regarding the cumulative impacts of marinas on the coastal zone. Therefore, the Division of Coastal Management (DCM), Division of Environmental Management (DEM), Division of Marine Fisheries (DMF), and Division of Environmental Health's Shellfish Sanitation Branch (SSB) (forming a marina policy committee) would address cumulative impacts of marina siting by: a) defining potential impacts of marina development, b) assessing the impact of multiple marinas in terms of conflicting public trust issues, effects on water quality, nursery areas, degradation of habitat, coastal

erosion, and coastal land use planning, and c) defining the difference in impacts of existing marinas on the marine environment from the impacts of new marinas.

2. The marina policy committee would create a comprehensive state marina policy, outlining its goals, scope, and the role of each agency in its implementation.

3. The Coastal Resources Commission (CRC), Environmental Management Commission (EMC), and Marine Fisheries Commission (MFC) would expand current permit requirements or develop supporting regulations to meet the goals of the aforementioned policy.

4. To define a state marina policy, the marina policy committee would outline specific criteria for evaluating the implementation of policy goals.

5. In defining a comprehensive marinas policy, the staff of DCM, DEM, DMF, and SSB would require permits to include best management practices. Some best management practices which have not yet been addressed in permitting procedures include, for example: marina design to include oil spill and pollution containment; the impacts of turbulence from boating outside the marina; and control over pollutants such as boat sewage, fish wastes, and boat cleansers.

6. The comprehensive state marinas policy would promote additional programs to broaden public understanding of what individuals can do to assist in marina management (such as proper disposal of fish wastes, boat sewage disposal, or the use of safe cleansing agents). Current approaches for educating the public would be assessed in terms of its effectiveness and scope. DCM would continue this process by providing information on pump-out stations within marinas.

Evaluation Method

Information collected from the evaluation of permit compliance would be used to determine whether best management practices have been implemented, operated, and maintained properly at marinas. The marina policy committee would meet annually using pre-established evaluation criteria to assess the implementation of the program. Any changes in policy or management practices could be added at this time. Enforcement mechanisms may be discussed and assessed for their effectiveness.

Costs and Economic Considerations

No additional program costs for this coordinating action are anticipated. A comprehensive, interagency, statewide approach to marina siting and management can help reduce user conflicts, increase total economic benefits, and preserve and enhance the natural resources of the area for future production of goods and services. In addition, implementation of the marinas policy could serve to enhance the economic vitality of coastal, estuarine, river and lakeside areas of the state by contributing to the quality of the region's amenities, providing an attractive inducement for continued growth of tourism and water related recreation. Although marinas would incur some additional short-term costs to implement additional best management practices, most of these measures are preventative, and can actually reduce costs in the long-term. For example, design criteria for marina fueling stations protect the public and the environment from serious health risks and costs when they require that design allows for the containment of spills in a limited area.

Funding Strategy

Not applicable.

OBJECTIVE C: REDUCE POLLUTION FROM POINT SOURCES, SUCH AS WASTEWATER TREATMENT FACILITIES AND INDUSTRY.

Strategy: In addition to the reduction of point source impacts gained through the utilization of basinwide management planning (see Objective A), further gains can be made through the use of proactive management strategies such as pollution prevention and increased emphasis on facility inspections and monitoring. In general, focus would be placed on reducing waste at the source. Figure 17 shows all permitted point source dischargers in the APES region. Pollution Prevention Programs are an excellent means of achieving waste reductions and, in some cases, production cost reductions. The Department of Environment, Health, and Natural Resources' (DEHNR) Office of Waste Reduction's (OWR) Pollution Prevention Program provides multi-media waste reduction technical assistance to industries. The Division of Environmental Management's (DEM) Pretreatment Program works to protect municipal or publicly owned wastewater treatment works and their receiving waters from the detrimental impacts of industrial users. Locations of wastewater treatment systems in the region are illustrated in Figure 18. Better use of these programs would be instrumental in helping reduce inputs to all systems operating under regulatory water quality control. The Department's goal is to incorporate pollution prevention into all aspects of environmental protection programs. A 1991 grant

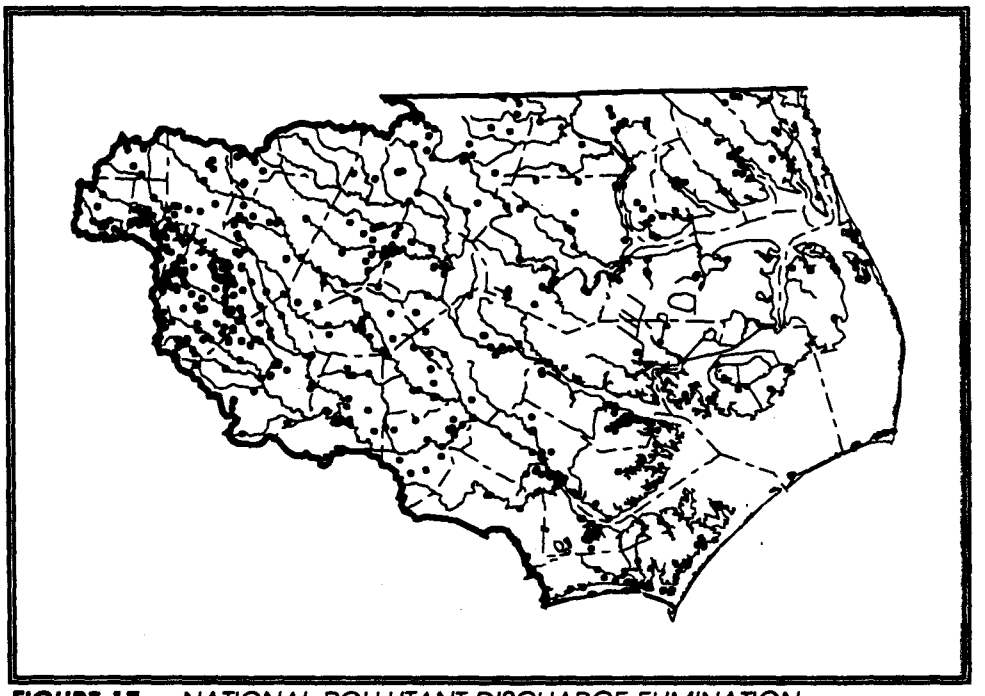

FIGURE 17 *NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEMS (NPDES) PERMIT LOCATIONS IN THE APES REGION*

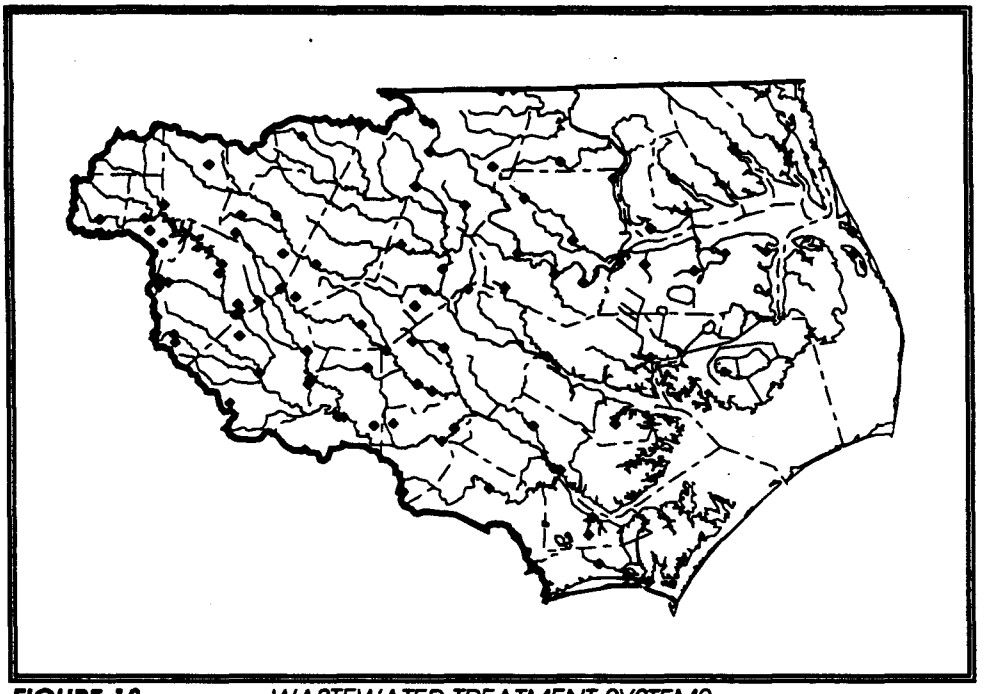

FIGURE 18 *WASTEWATER TREATMENT SYSTEMS IN THE APES REGION*

from the U.S. Environmental Protection Agency (EPA) is supporting pollution prevention projects in Winston-Salem and Troy. According to records maintained in the DEM's Compliance Monitoring System, the percentage of dischargers found operating in violation of their permit (out-of-compliance) has decreased over the years. Increased computerization of DEM's compliance monitoring activities have assisted in an increase in administrative assessments and civil penalty cases. However, in order to be more proactive in preventing permit violations and resulting water quality degradation, the Division requires more staff for review of monitoring data and for conducting inspections. Increased inspections provide the benefit of improved communication between the Division and dischargers and early detection of potential problems which prevents some violations before they occur.

Management Action 1: Promote pollution prevention planning and alternatives to discharge, where feasible, for all point sources to reduce the volume and toxicity of discharges.

Explanation: *Environmental problems surface when inadequately controlled or treated wastewater is discharged into the system. Pollution prevention programs are a proactive measure aimed at reducing waste at its source. These programs make treatment more efficient, reduce pollutants in the waste stream, and lower cleanup costs for industry and government. When appropriate, alternatives to discharge should be encouraged.*

Critical Steps

1. OWR's Pollution Prevention Program and DEM's Facility Assessment Unit would strengthen coordination to provide technical and regulatory assistance.

2. With assistance from DEM, OWR would prioritize and target those facilities found in violation of their NPDES permit or municipal pretreatment permit.

3. OWR would coordinate with all permitted facilities concerning the implementation of pollution prevention planning.

4. To establish compliance with NPDES and municipal pretreatment permits and to reduce waste generation, industries would seek technical assistance and policy support from DEM and OWR.

5. Municipal wastewater treatment plants, with state approved pretreatment programs, would be encouraged to develop pollution prevention programs to assist indirect dischargers with implementing industrial pollution prevention programs.

6. DEM would require the use of non-discharge alternatives where feasible.

Evaluation Methods

1. Once a pollution prevention program has been established at a facility, periodic inspections by DEM would document the status (improvement) of that facility's compliance record.
2. Comparisons can be made of previous compliance records versus present status. Documentation of improvement in plant performance could be the result.
3. Timely reports would be prepared by DEM and OWR including updated compliance information.

Economic Costs and Considerations

With recent increases in staffing, this action is not anticipated to require an additional increase in staff or funding in OWR or in DEM's Facility Assessment Unit. Better inter-governmental coordination and cooperation can help reduce the costs of ensuring compliance with environmental regulations. In addition, coordinating DEM's Compliance Group and OWR is a cost-effective method that uses existing government programs to target firms that may need technical assistance and training to establish pollution prevention methods and technology in their plants. Although costs may be incurred to establish pollution prevention programs in industrial plants, many firms have found that waste reduction often results in savings in operating costs that more than offset the costs of implementing the plan.

Funding Strategy

No additional funding is necessary to implement this management action.

Management Action 2: Expand and strengthen enforcement of National Pollutant Discharge Elimination System (NPDES) permits. Increase site inspections and review of self-monitoring data to improve facility compliance by 1995.

Explanation: *Increasing the staff of the Division of Environmental Management's (DEM) Compliance Group would allow for more frequent site inspections and would enhance enforcement. More frequent inspections would improve communication between the Division and*

dischargers, and would help prevent some violations before they occur. Stronger enforcement would dampen incentives for dischargers to violate their permits.

Critical Steps

1. The General Assembly would be asked to increase permit fees for DEM in order to hire additional personnel for their compliance program.

2. DEM would increase personnel in their central and regional offices to provide for more frequent and comprehensive inspections of permitted dischargers and provide more staff time to the Notice of Violation and assessment process.

3. As required by the U.S. Environmental Protection Agency (EPA), DEM would maintain its Enforcement Management System, which is a complete set of written enforcement policies ensuring consistent and adequate enforcement procedures.

4. When a facility is found in violation of its discharge permit, DEM's Facility Assessment Unit would investigate appropriate enforcement actions to achieve compliance as quickly as feasible.

5. DEM would review the permits and effluent data for all facilities identified whose effluent concentrations could result in potential water quality exceedances.

6. DEM would continue to investigate and propose innovative methods of enforcement to increase efficiency.

Evaluation Methods

DEM would continue to track on a quarterly basis the percentage of NPDES dischargers operating in violation of their permit. A decrease in permit violations would be considered successful implementation of this management action.

Economic Costs and Considerations

DEM would require $300,000 per year to hire six additional personnel and to purchase additional monitoring equipment. If facilities were aware that more frequent and comprehensive inspections of permitted dischargers were taking place, higher rates of compliance could be expected, which would result in lower governmental costs of pollution clean-up.

Funding Strategy

The hiring of six staff members by DEM would require a $300,000 appropriation from the General Assembly. Another possible source of funding for this action would be revenues generated from permit fees.

OBJECTIVE D: REDUCE THE RISK OF TOXIC CONTAMINATION TO AQUATIC LIFE AND HUMAN HEALTH.

Strategy: Several sites within the APES area were identified as exceeding levels of concern for toxic contaminants in ambient water, sediment, and/or fish tissue using protocols suggested by Cunningham, et al. (1992a). For example, concentrations of mercury exceeding 0.15 ppm in sediments of the Albemarle sound and its tributaries are illustrated in Figure 19. The Division of Environmental Management (DEM), U.S. Fish and Wildlife Service (USFWS), and other state or federal agencies should coordinate monitoring efforts for these environmental media to provide the maximum geographic and most cost-effective monitoring coverage. Resources should be concentrated to evaluate the potential impact to aquatic life, wildlife, and human health, and to identify additional contaminated sites.

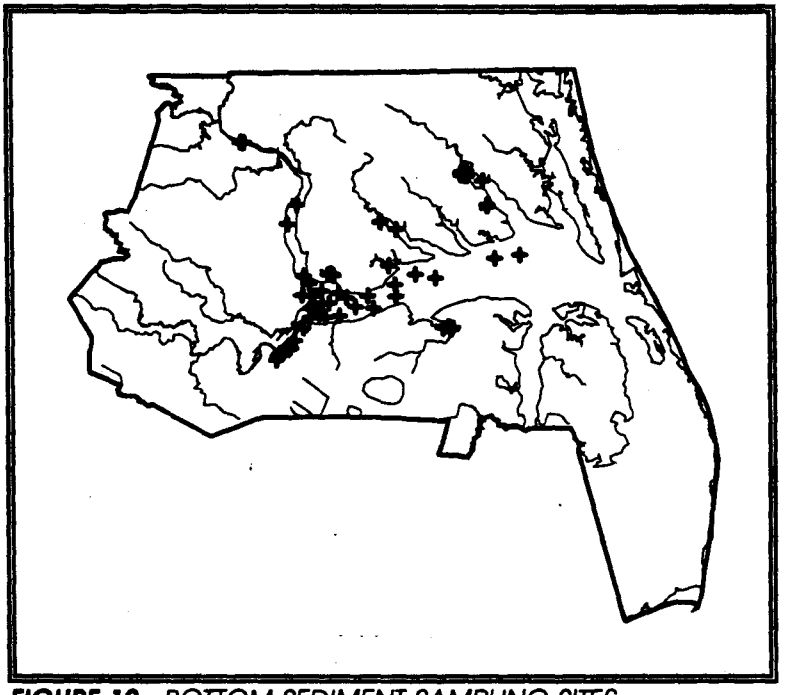

FIGURE 19 *BOTTOM SEDIMENT SAMPLING SITES WITH MERCURY CONCENTRATIONS EXCEEDING 0.15 PPM IN THE ALBEMARLE SOUND DRAINAGE REGION*

Management Action 1: Increase efforts to assess and monitor the extent of estuarine sediment contamination, fish and shellfish tissue contamination, water quality violations, and to identify the causes and sources of these problems.

Explanation: *Several areas within the Albemarle-Pamlico region have been identified as exceeding levels of concern for toxicity in water, sediment and fish tissue. Any additional contaminated sites should be identified. Existing contaminated sites would be evaluated to determine the extent of the problem and its impact on aquatic life, wildlife and human health. Management actions should focus on reducing or eliminating further contamination in areas of concern.*

Critical Steps

1. DEM will remain current on developing U.S. Environmental Protection Agency (EPA) and National Oceanic and Atmospheric Administration (NOAA) protocols for collection, analyses, and criteria for sediment toxicity; and incorporate EPA approved protocols into existing programs.

2. Once EPA protocols are approved and adopted, DEM would conduct sediment toxicity testing at sites identified as being most contaminated or where specific pollutants (e.g., mercury) repeatedly occur at toxic levels.

3. DEM will continue ambient water quality monitoring at those sites identified as being most contaminated.

4. DEM, using products produced by the Center for Geographic Information and Analysis (CGIA), would analyze data concerning water quality standards exceedances and their proximity to known point and nonpoint source pollution and enter this information into a geographic database

using quality assured layers. DEM would review this information and attempt to determine the potential sources and causes.

5. DEM would utilize the information in the geographic database concerning sites identified as exceeding water quality standards and target them for sediment toxicity analyses (once sediment criteria are adopted).

6. DEM, with assistance from the Office of Waste Reduction (OWR), would initiate action to reduce or eliminate further pollutant loading to the identified contaminated sediment and ambient water quality sites; considering possible remedial efforts of the contaminated area. (Refer to Objective D, Management Action 3)

7. To determine the extent of fish and shellfish contamination, DEM and USFWS would increase efforts to monitor the concentrations of chemical contaminants in fish and shellfish tissues to identify additional areas where fisheries resources are contaminated. The Division would target areas where contaminant loadings are most likely to occur (e.g., areas where sediment or ambient water quality exceedances have been identified or where point source loadings or nonpoint sources of pollutants are greatest).

8. The Environmental Epidemiology Section (EES) will continue to evaluate fish data and develop criteria for appropriate action to protect public health.

9. DEM will continue to conduct intensive monitoring of fish and shellfish at those sites where tissue concentrations are a human health concern based on criteria developed by EES.

Evaluation Methods

1. Upon adoption of EPA and NOAA protocol currently under development, DEM would utilize the EPA and NOAA methodology and draft guidance to evaluate analytical techniques and sediment criteria relative to the character of North Carolina sediment and make appropriate amendments to its methodology.

2. Map reports would be generated annually from Geographic Information Systems (GIS) data layers of contaminated sediment and ambient water quality sites to track the extent of point and nonpoint source pollution throughout each basin.

3. DEM would report on a periodic basis (e.g., as part of the State of North Carolina biennial 305(b) Water Quality Report or according to the five year

basinwide review schedule), the number of sites where exceedances of sediment (once adopted) and ambient water quality standards were detected. Documented improvements in overall water quality would indicate successful management practices.

Costs and Economic Considerations

This action would require an additional $150,000 to fund contract analysis for toxic contamination evaluation and risk assessment. Monitoring and GIS mapping of sediment toxicity, point source dischargers, marinas, treatment, storage, and disposal facilities (TSDFs), Superfund sites and landfills may be a cost-effective method to assist DEM in identifying possible sources of pollutants near contaminated sites, and in beginning actions to reduce or eliminate pollutant emissions from those sites. Enhanced inter-governmental coordination and cooperation can help reduce the costs of monitoring fish contamination and issuing public health advisories. In addition, coordination among DEM, CGIA, SSB, DMF, DWR, EPA, and the Research Triangle Institute is a cost-effective method that uses existing government programs and research institutions to target areas and populations of concern.

Funding Strategy

To fund additional water quality analyses, a $150,000 appropriation would be needed from the General Assembly.

Management Action 2: Continue to issue fish advisories as necessary to protect public health. Improve communication and education about the risks associated with eating contaminated fish and shellfish.

Explanation: *Regional fish advisories alert the public to the potential health hazards of eating contaminated fish. The Environmental Epidemiology Section (EES) would continue to review fish tissue analyses and issue advisories as necessary.*

Public outreach and education should stress the risks associated with eating contaminated seafood to the general population and sensitive populations (e.g., women of child-bearing age and children).

Critical Steps

1. The Division of Environmental Management (DEM) will continue to conduct intensive monitoring of fish and shellfish at those sites where tissue concentrations are of concern to human health based on criteria developed by EES.

2. EES will continue to evaluate the Environmental Protection Agency (EPA) risk assessment approach for issuing fish consumption advisories and adopt as appropriate. It affords the state flexibility to adjust various parameters (e.g., consumption rate, body weight, risk level).

3. The Wildlife Resources Commission (WRC) and/or Division of Marine Fisheries (DMF) would conduct creel surveys of fishermen at sites where elevated concentrations of contaminants have exceeded levels of concern to determine the consumption rate of recreational and subsistence fishermen, the fish species most often consumed, and the method of cleaning and cooking used to prepare the fish. Participation from citizen groups, such as the APES Citizens Water Quality Monitoring Network, would be considered in this effort.

4. EES will continue to conduct a risk assessment for consumption of fish and shellfish at sites where contaminated fish are identified and disseminate information on fish consumption advisories to reach the widest audience of the fish-consuming public. Fish consumption advisories will be posted at affected water body sites. Information regarding advisories would be disseminated to purchasers of fishing licenses. The Department of Environment, Health, and Natural Resources (DEHNR) will arrange public meetings, issue press releases, and public information announcements and will notify the local health department of the fish consumption advisory.

Evaluation Methods

1. DEM will report results of fish tissue analyses to EES to evaluate human health risks associated with consumption of contaminated fish.

2. Additional contaminated sites (those sites where fish tissue samples exceed human screening values) would be added to the existing Geographic Information Systems (GIS) data layer of contaminated fish sites by CGIA as they are identified by DEM. Map reports would be generated annually to track the extent of waters with fishing advisories or potentially needing advisories.
3. EES will report on a periodic basis the issuance of any new fish consumption advisories to DEM. DEM would include this data as part of the State of North Carolina biennial 305(b) Report. EES will also report new advisories to the National Fish Advisory Database maintained by the EPA Office of Science and Technology and the Research Triangle Institute.

Costs and Economic Considerations
No additional program costs are anticipated for this action. Protecting public health through the activities mentioned in this recommendation could result in preventing or lowering the incidence of illness due to ingestion of chemically contaminated fish and shellfish, and consequently lowering the costs of health care for those individuals who might otherwise require treatment for chemical poisoning.

Funding Strategy
This action will not require additional costs to implement.

Management Action 3: Remediate toxic contamination where necessary and feasible.

Explanation: *Considerable efforts should be made to remedy contamination that is an immediate threat to human health and aquatic life. The Division of Environmental Management (DEM) would proceed with sediment cleanup only where necessary and where remediation activities would not cause further damage to ecological communities.*

Critical Steps

1. DEM, in conjunction with the Division of Solid Waste Management (DSWM), would evaluate remediation actions, including containment or removal options for those sites deemed to be contaminated at levels hazardous to aquatic life or of human health concern.

2. DEM and DSWM would identify responsible parties, where possible, and proceed with sediment cleanup only where necessary and where remediation activities would not cause further impacts. Remediation can have a greater impact on ecological communities than allowing the system to assimilate and detoxify in-place contaminants.

3. If responsible parties are not identified for sediment contamination, then the Superfund Program of DSWM would consider placement of that site on the National Priority List (NPL).

Evaluation Method

DEM would require responsible parties to implement an environmental impact assessment at priority sites before conducting any remediation activities. Continued monitoring of remediated sites will provide DEM with important data that can be used in evaluating future sites for clean-up.

Costs and Economic Considerations

Costs of remediation will be determined by monitoring and evaluation efforts (see Objective D, Management Action 1). Where sediments are contaminated with toxic pollutants, one method of remediation is the removal of the contaminated sediment. This can be extremely costly, both in terms of the environment and the economy. The overall cost of remediation could be reduced by using feasibility studies to determine whether sediment cleanup is necessary and whether the cleanup will cause further damage.

Funding Strategy

The cost of remediation of contaminated sites would be sought from those parties found responsible for the contamination.

OBJECTIVE E: EVALUATE INDICATORS OF ENVIRONMENTAL STRESS IN THE ESTUARY AND DEVELOP NEW TECHNIQUES TO BETTER ASSESS WATER QUALITY DEGRADATION.

Strategy: Several highly visible indicators of environmental stress include chronic algal blooms, fish and shellfish kills, and fish and shellfish diseases. The Division of Environmental Management (DEM), Division of Marine Fisheries (DMF), National Marine Fisheries Service (NMFS), Shellfish Sanitation Branch (SSB), various academic and private sector researchers, and citizen monitoring groups would coordinate monitoring efforts to track these indicators of environmental stress to provide the widest geographic and most cost-effective monitoring coverage of the APES area. Resources should be concentrated to establish a response network to identify and collect data on algal blooms, fish and shellfish kills, and fish and shellfish disease outbreaks; improve management tools to address shellfish contamination; and accelerate the development and application of new bio-assessment techniques to evaluate cumulative environmental impacts in estuarine waters. Algal blooms and fish and shellfish kills and disease outbreaks have been monitored by various groups including DEM, DMF, Wildlife Resources Commission (WRC), the U.S. Fish and Wildlife Service (USFWS), NMFS, Pamlico Environmental Response Team (PERT), and academic and private researchers. However, this effort has not been fully coordinated to cover all waters of the APES area. SSB has monitored the extent of bacterial contamination in shellfish harvest areas, identifying potential sources of contamination and issuing shellfish harvest area closures as necessary to protect the public health. Bio-assessment techniques have the advantage of detecting water quality problems that chemical or toxicological monitoring may miss or underestimate. The resident estuarine biota act as continuous monitors of environmental quality, increasing the likelihood of detecting episodic events (e.g., spills), nonpoint sources, or other highly variable impacts that chemical sampling often misses. Bio-assessments also provide a means of directly assessing the biological integrity of the estuarine community. This assessment can serve as a basis for identifying high quality water deserving special protection, implementing state anti-degradation policies, confirming in-stream impacts predicted by fate and transport modeling (e.g., waste load allocation), and toxicity testing. The advantage of bio-assessments is their ability to assess ecosystem health -- one of the principal goals of the Clean Water Act.

Management Action 1: Continue to track and evaluate indicators of environmental stress, including algal blooms, fish kills, and fish and shellfish diseases.

Explanation: *Biological assessments are useful in evaluating the integrity of the estuarine system. Traditional biological indicators such as algal blooms and fish kills can signify water quality problems that chemical and toxicological monitoring may have missed or underestimated.*

Critical Steps

1. DMF, DEM, NMFS, USFWS, and other researchers would establish an environmental stress indicators response network to collect the data necessary to determine the sources and causes of these events. DMF would be the lead agency responsible for developing and maintaining the response network.

2. The information collected would be used to establish a database to help develop management strategies concerning algal blooms, fish and shellfish kills, and outbreaks of fish and shellfish diseases.

3. The response network program would incorporate relevant experts with the technical expertise necessary to collect appropriate data for studying each type of environmental stress indicator.

4. The network would standardize the investigation and reporting of these environmental stress indicator events by preparing protocols and standardized reporting sheets so that causes and trends are reliably documented. Investigations also would sample a standard set of water quality parameters and collect biological samples for examination and/or autopsy.

5. The environmental stress indicators network would consider the role of private citizens, such as the APES Citizen Water Quality Monitoring Network (CWQMN), in acquiring data for algal blooms, fish and shellfish kills, and fish and shellfish diseases.

6. The response network will continue necessary research to determine the causes of algal blooms, fish and shellfish kills, and fish and shellfish diseases, and to determine the role of anthropogenic activities in the occurrence of these events.

7. The information on geographic location and other environmental attributes for each event would be sent to the Center for Geographic Information and Analysis (CGIA). CGIA staff would create maps for each of the environmental stress indicators (only algal blooms currently have been mapped). As the database evolves, DEM with CGIA assistance, would conduct Geographic Information Systems (GIS) evaluations to assess potential pollutant sources in proximity to the event site that could have triggered an event.

8. Additional event sites periodically would be added to the existing GIS data layer of environmental stress indicators as they are identified. Map reports would be generated periodically to track the extent and occurrence of the appropriate environmental stress indicators.

Evaluation Method

CGIA would oversee the database. The divisions conducting the monitoring would update network data at least annually. Data would be analyzed and reported in the biennial 305(b) report.

Costs and Economic Considerations

$125,000 per year would be allocated to DEM and DMF for two additional staff members for regional offices, equipment, and data base establishment. Costs would include sampling costs and contracts to research institutions. Using a response network that includes and promotes information sharing, skills and management tools can help reduce the cost of monitoring, evaluation, and source identification, as well as reduce response time. The network and database would document the magnitude and probable cause of a kill so an attempt to recover costs associated with the resource injury can be made. Major data elements for each event can include location, land use cause, source, incident, direct cause, and specific pollutant. The data can provide useful insights to analysts and decision makers regarding

problem areas and sources. For example, fish kill data can be used to identify and correct discharge problems from single sources, or can lead to more in-depth investigations of water quality problems.

Funding Strategy
To fund two additional staff members for DEM and DMF, a $100,000 appropriation would be needed from the General Assembly. An additional $25,000 for equipment, sampling, and research contracts would also be needed.

Management Action 2: Improve the techniques for evaluating the overall environmental health of estuarine waters.

Explanation: *The sensitivity and diversity of organisms inhabiting an area can be an indication of the system's overall environmental health. Further research is needed to target these "indicator species" in the estuary. Once found, these organisms could be used to monitor the general state of the system and indicate areas that warrant further attention.*

Critical Steps

1. The Division of Environmental Management (DEM) would conduct a comprehensive survey and evaluate the current extent of development and application of bio-assessment techniques in estuarine waters. Bioassessment techniques often are based on the use of biotic community indices for a given water body to establish a baseline for such properties as species richness, abundance, and composition as well as trophic structure.

2. DEM would select appropriate bio-assessment techniques for the area based on best professional judgement and would prepare standardized protocols for the bio-assessment technique chosen.

3. DEM would continue to develop standard protocols for selecting unpolluted reference sites with similar hydrologic, physical, and chemical characteristics, and for calculating norms for these reference sites against which potentially degraded sites may be compared.

4. DEM would continue to develop statistical procedures and biocriteria (if data warranted) for evaluating whether sites differed significantly from the norm or showed indications of biological impairment. DEM and Environmental Management Commission (EMC) would establish narrative or numerical criteria for bio-assessment techniques in estuarine waters.

Evaluation Method
DEM would report periodically (e.g., as part of the State of North Carolina 305(b) Water Quality Report) the results of the application and evaluation of bio-assessment techniques in estuarine waters.

Costs and Economic Considerations
Program costs for this action are estimated at $100,000 per year to improve DEM's techniques for evaluating cumulative environmental impacts in estuarine waters. This action would help researchers, planners and regulators understand and monitor health indicators and water quality in the APES region, and would provide better protection for special communities from chronic and acute toxicity and general cumulative degradation. These efforts may help focus efforts to protect water quality, which could reduce the costs of regulation and compliance.

Funding Strategy
To fund research within DEM, a $100,000 appropriation would be needed from the General Assembly. Funds required by CGIA relating to this management action are addressed in the Stewardship Plan, Objective A, Management Action 2.

Management Action 3: Develop and adopt better indicators of shellfish contamination as soon as possible.

Explanation: *The presence of fecal coliform bacteria currently is used to detect sewage contamination in shellfish beds. This practice has been criticized, however,*

and the National Oceanic and Atmospheric Administration's (NOAA) National Indicator Study is investigating better indicator tests. These tests, which assess both bacterial and viral contamination, better indicate the health risk from eating contaminated shellfish. They also would establish more reliable criteria for closing shellfish areas or re-opening previously closed areas.

Critical Steps

1. The Department of Environment, Health, and Natural Resources (DEHNR) would fully adopt appropriate new indicator tests for assessing bacterial or viral contamination currently under evaluation and development by NOAA's National Indicator Study after these tests receive approval by the U.S. Food and Drug Administration (FDA) and the Interstate Shellfish Sanitation Conference.

2. The Division of Environmental Health's Shellfish Sanitation Branch (SSB) will continue to monitor bacterial contamination levels in water and shellfish to identify areas where these resources are contaminated at levels of concern to public health. SSB would adopt, upon FDA approval, indicators to replace or be used in conjunction with the existing broad-spectrum fecal coliform test.

3. SSB, in conjunction with the Center for Geographic Information Analysis (CGIA) would continue to develop Geographic Information Systems (GIS) maps of shellfish closure areas for all shellfish harvesting waters in the region.

Evaluation Methods

1. Map reports would be generated annually to track the extent of shellfish producing waters closed to harvesting and evaluate trends in the amount of acreage closed to harvesting.

2. SSB would continue to report on a periodic basis (e.g., in the State of North Carolina biennial 305(b) Water Quality Report) the closure of any new areas, reopening of previously closed areas or other changes in status of

harvestable shellfish waters. Sanitary survey reports containing information on shoreline surveys of septic tanks, municipal facilities, and livestock operations would continue to be prepared triennially.

Costs and Economic Considerations

Economic, as well as public health benefits, would be provided by the establishment of more reliable criteria for the closure of shellfish areas and/or the re-opening of previously closed areas. Development of more precise indicators to test for sewage contamination in shellfish beds and to assess the risk to human health from the consumption of shellfish from these beds would help researchers, planners, and regulators understand and monitor health indicators and water quality for better protection. Economic benefits would result if tests using an improved indicator found that shellfish from formerly closed beds are safe for public consumption. In addition, better indicators may help focus efforts to protect water quality, which could reduce the costs of regulation and compliance. If indicators demonstrate that formerly opened beds should be closed, public health benefits would result in terms of reduced health care expenses.

Funding Strategy

Funds required by CGIA relating to this management action are addressed in the Stewardship Plan, Objective A, Management Action 2.