CHAPTER 9. MANAGEMENT RECOMMENDATIONS

9.1 INTRODUCTION

The discussions of the six major habitat types in the preceding chapters demonstrate the importance of coastal fish habitats, threats to those habitats, and the need to take actions to achieve the stated goal of the Coastal Habitat Protection Plan as provided by the North Carolina General Assembly: "long-term enhancement of coastal fisheries associated with each coastal habitat." This chapter provides management recommendations based on scientific studies cited in chapters 2 – 7, deliberations of the Environmental Management, Coastal Resources, and Marine Fisheries commissions, and citizen input (verbal comments received in person or by telephone; written comments received in person or via mail and e-mail) from two series of well-attended public meetings (20 in all) held during the summers of 2003 and 2004, as well as additional comments obtained during the CHPP process.

The public cited coastal development as the issue most needing immediate attention, followed by enforcement of existing statutes, rules, and permit conditions, and then environmental education and research. Threats associated with development included polluted stormwater runoff, wastewater discharges, and wetland filling. Meeting attendees agreed that existing laws and rules might be sufficient for habitat protection, but that they are not adequately enforced largely due to insufficient staffing and resources. Educating the public about the importance of coastal habitats and the threats they face was repeatedly mentioned as being critical for successful habitat protection and enhancement.

9.2 THREATS

The CHPP law specifically requires identification of "existing and potential threats to the habitats" and "actions to protect and restore the habitats" (G.S. 143B-279.8). Threats to coastal fish habitat come from many sources and usually affect more than one habitat. Table 9.1 provides a listing and evaluation of the principal threats to the six types of coastal fish habitats identified previously in this report. The water column and shell bottom are the most threatened habitats (shell bottom because there is so little of it, and the water column because there are so many pollution sources). All habitats are subject to multiple threats.

Table 9.1. Evaluation of specific threats to coastal fish habitats based on hydrologic, physical, and water quality alterations. Darker shading indicates greater impact[1].

ACTIVITY TYPE	THREAT / ACTIVITY	Coastal Fish Habitats[1]					
		Water column	Shell bottom	SAV	Wetlands	Soft bottom	Hard bottom
AGRICULTURE/ AQUACULTURE RELATED	Animal operations						
	Aquaculture (incl. discharges, exotic species)						
	Cropland						
	Forestry						
WATER CONTROL	Dams						
	Water withdrawal						
DEVELOPMENT RELATED	Urban/suburban construction activities						
	Urban stormwater runoff (impervious surface)						
	On-site wastewater disposal						
	Permitted industrial wastewater discharges						
	Permitted domestic wastewater discharges						
	Waste disposal (landfills, ocean dumping)						
	Fiber optic cables/utility pipelines						
	Estuarine shoreline stabilization						
	Ocean shoreline hardening						
	Ocean beach nourishment						
TRANSPORTATION RELATED	Impervious roadways						
	Culverts, bridges, and fill (physical blockages)						
FISHING RELATED	Bottom trawl						
	Clam trawl (clam kicking)						
	Toothless dredge (bay scallop)						
	Toothed dredge (crab and oyster)						
	Long haul seines						
	Pots (crab)						
	Rakes, tongs						
	Rod and reel						
NAVIGATION RELATED	Marinas and docks (construction, assoc. NPS)						
	Ports (incl. exotic species via ballast water)						
	Boating activity						
	Channel and inlet dredging						
	Dredge material disposal (on submerged land)						
MINING RELATED	Phosphate and other minerals						
	Log salvage						
	Oil and gas exploration/drilling						
OTHER	Sea level rise						
	Storm events						
	Disease						
	Introduced or nuisance species						
	Marine debris/litter						

[1]Impact ranking: Black - severe; Dark gray - moderate; Light gray - minor; White - none, unknown or potential

Broad coast-wide threats to fish habitat identified below were discussed throughout the plan as they apply to each coastal fish habitat. These threats are well documented, as indicated by the literature citations shown below and as previously discussed in chapters 2 – 7:

- Fishing gear impacts: Negative impacts of fishing gear on habitat have been the subject of numerous studies (Adkins et al. 1983; Van Dolah et al. 1991; Dorsey and Pederson 1992; Collie 1997; Auster and Langton 1999; ASMFC 2000). Effects include uprooting vegetation, breaking physical structures, and digging and suspending sediment. Oyster dredging, in particular, may have played a significant role in the eutrophication of Pamlico Sound (Jackson et al. 2001).
- Marina and dock siting, and boating: The cumulative effects of increasing boater access facilities and associated boating activities are a concern due to documented negative impacts from operation of individual boats (Lockwood 1990; Milliken and Lee 1990; Wisby and Lopazanski 1995; Stephan and Bigford 1997; Crawford et al. 1998; Fonseca et al. 1998; SAFMC 1998a) and access facilities (Allen and Hardy 1980; DWQ 1990; Wendt et al. 1990; DEHNR 1991; Weis and Weis 1994; Wisby and Lopazanski 1995; McAllister et al. 1996; SAFMC 1998a; Weis et al. 1998). Some effects include disturbance and removal of sediment, changes in currents, and degradation/loss of wetlands and SAV.
- Shoreline stabilization: The increasing modification of natural shorelines to prevent or reduce landward migration of the shoreline (a natural process) is a major concern documented in numerous studies (Mock 1966; Ellifrit et al. 1972; Garbisch et al. 1973; Gilmore and Trent 1974; Knutson 1977; Walton and Sensabaugh 1979; O'Rear 1983; Reilly and Bellis 1983; Pilkey and Wright 1989; Van Dolah et al. 1992; Byrne 1995; Hackney et al. 1996; Pilkey et al. 1998; SAFMC 1998a; Titus 1998; Donaghue 1999; Jutte et al. 1999; Taylor 1999; Cahoon et al. 2000; Peterson et al. 2000c; Waters and Thomas 2001). These modifications often result in loss of wetlands and shallow water habitats, reduced fish diversity and abundance, and changes in runoff patterns.
- Nonpoint source (NPS) pollution: While great advances in the control and reduction of point source pollution have been made in the past 25 years (<http://www.epa.gov/OWOW/NPS/facts/point1>, 2002), NPS pollution has become the most widespread source of water quality degradation in North Carolina's streams and estuaries (DWQ 2000a). The impacts and contribution of nonpoint source pollutants have been well documented (DEHNR 1995b; Mallin et al. 1997; SAFMC 1998a; Paerl et al. 1999; Mallin et al. 2000). Some impacts include reduced availability of dissolved oxygen, reduced water clarity, and excessive nutrients that trigger algal blooms.
- Habitat loss: The physical degradation and loss of habitat is the most widespread source of impairment in coastal North Carolina streams (DWQ 2000a). Sources of physical degradation and loss include:
    - Dredging and draining of wetlands (Sutter 1999; Dahl 2000; DWQ 2000a);
    - Conversion of habitat to impervious surfaces (Mallin et al. 1998; Mallin et al. 2000; White et al. 2000; Natural Resources Conservation Service (NRCS), unpub. data); and
    - Installation of dams, culverts, bulkheads (Mock 1966; Ellifrit et al. 1972; Garbisch et al. 1973; Gilmore and Trent 1974; Knutson 1977; Walton and Sensabaugh 1979; O'Rear 1983; Reilly and Bellis 1983; Pilkey and Wright 1989; Van Dolah et al. 1992; Byrne 1995; Hackney et al. 1996; Pilkey et al. 1998; SAFMC 1998a; Titus 1998; Donaghue 1999; Jutte et al. 1999; Taylor 1999; Cahoon et al. 2000; DMF 2000a; Peterson et al. 2000a; DCM, unpub. data), and jetties (Kapolnai et al. 1996; Churchill et al. 1997; Blanton et al. 1999).
- Shellfish harvest area closures: The increasing closure to harvest of shellfishing waters has been correlated with increasing coastal development and stormwater runoff (Maiolo and Tschetter 1981; DEM 1994; Frankenberg 1995; Reilly and Kirby-Smith 1999; DWQ 2001a; and DMF 2001a,b). Although such closures have no direct impact on shellfish (only human harvest is affected), presence of indicator bacteria is strongly correlated with presence of other pollutants and nutrients (Mallin et al. 2000b, 2001b).

In spite of the great stresses on North Carolina's coastal ecosystem, it has proven to be quite resilient, and

it is generally healthy (DWQ 2000a). However, the number of water bodies showing danger signs is growing as human activities further stress the coastal area (Maiolo and Tschetter 1981; DWQ 2000a). The trend toward a largely degraded coastal ecosystem is alarming and must be reversed. A major purpose of the CHPP is to implement strategies to halt habitat degradation and promote restoration.

9.3 RECOMMENDATIONS

The CHPP development process identified hundreds of management needs, as shown in chapters 2 – 7. The members of the three Commissions reviewed the issues, along with suggested management actions to address those needs. The Commissions selected four general goals and a series of recommended actions to reach each goal, as shown below and in Table 9.2. The goals and recommendations shown below are not listed in any kind of priority order. Implementation of any of the recommendations below through specific rules or policies may involve further discussion with stakeholders and, in some cases, the balancing of competing ecological and economic values.

GOAL 1. IMPROVE EFFECTIVENESS OF EXISTING RULES AND PROGRAMS PROTECTING COASTAL FISH HABITATS

Every year, an average of more than 100 acres of Outstanding Resource Waters (the highest quality waters in North Carolina) are closed permanently to shellfish harvest, and miles of previously unaltered estuarine shoreline are artificially hardened with vertical shoreline stabilization structures. Thousands of acres of farmland and forests are uprooted, developed, and paved annually, and nutrient-contaminated Public Trust waters suffer from low oxygen events and fish kills. Existing rules and programs have had only limited success in protecting and enhancing coastal fish habitats and fisheries resources. The following non-regulatory actions must be taken for existing management strategies to be effective:

- Enhance enforcement of, and compliance with, Coastal Resources Commission (CRC), Environmental Management Commission (EMC), and Marine Fisheries Commission (MFC) rules and permit conditions.
- Coordinate and enhance water quality, physical habitat, and fisheries resource monitoring (including data management) from headwaters to the nearshore ocean.
- Enhance and expand educational outreach on the value of fish habitat, threats from human activities, effects of non-native species, and reasons for management measures.
- Coordinate rulemaking and enforcement among regulatory commissions and agencies.

GOAL 2. IDENTIFY, DESIGNATE, AND PROTECT STRATEGIC HABITAT AREAS

Growing resident and visitor populations in coastal North Carolina will further stress productive coastal habitats and fisheries resources through expansion of support services and infrastructure. Inland development degrades the water quantity and quality of streams that flow to the coastal sounds, as do increased boating and some fishing activities. Certain areas are especially important to fish production, and others are particularly vulnerable to these threats. Greater protection for these "Strategic Habitat Areas" must be a high priority in order to maintain a healthy coastal ecosystem. The following regulatory and non-regulatory management actions should be implemented:

- Evaluate potential Strategic Habitat Areas by:
    a) Coordinating, completing, and maintaining baseline habitat mapping (including seagrass, shell bottom, and other bottom types) using the most appropriate technology.
    b) Selective monitoring of the status of those habitats.
    c) Assessing effects of land use and human activities on those habitats.
- Identify and designate Strategic Habitat Areas using ecologically based criteria.
- Analyze existing rules and enact measures needed to protect Strategic Habitat Areas.

- Improve programs for conservation (including voluntary actions) and acquisition of areas supporting Strategic Habitat Areas.

GOAL 3. ENHANCE HABITAT AND PROTECT IT FROM PHYSICAL IMPACTS

Studies estimate that up to 50% of North Carolina's original wetlands have been destroyed since colonial times. Development continues to cause degradation and permanent loss of coastal and non-coastal wetlands. Significant negative impacts to wetlands may occur through a combination of larger projects that require state and federal permits and numerous small, unrecorded actions. Regardless of magnitude, each impact contributes to the cumulative loss of habitat functions and biological productivity. Shell bottoms (oyster reefs) in coastal North Carolina were decimated by uncontrolled fishing methods more than a century ago, and later by construction of the Atlantic Intracoastal Waterway in the 1930s. Since that time, hurricanes, mechanical harvest methods, small scale dredging and filling projects, and diseases and parasites have continued to reduce remaining shellfish bottoms, particularly subtidal oyster beds in the Pamlico Sound system, and impede establishment of new shell bottoms. Submerged aquatic vegetation (SAV, seagrass) in low salinity areas, such as Albemarle Sound and western Pamlico Sound, has all but disappeared. Submerged aquatic vegetation is highly vulnerable to physical disturbances, as well as to water quality degradation, especially turbidity. Strong management actions are necessary to reverse historic and current habitat losses and restore wetlands, shellfish beds, and SAV. The following regulatory and non-regulatory measures are recommended:

- Greatly expand habitat restoration, including:
    a) Creation of subtidal oyster reef no-take sanctuaries.
    b) Re-establishment of riparian wetlands and stream hydrology.
- Prepare and implement a comprehensive beach and inlet management plan that addresses ecologically based guidelines, socio-economic concerns, and fish habitat.
- Protect Submerged Aquatic Vegetation (SAV), shell bottom, and hard bottom areas from fishing gear effects through improved enforcement, establishment of protective buffers around habitats, and further restriction of mechanical shellfish harvesting.
- Protect fish habitat by revising estuarine and public trust shoreline stabilization rules using best available information, considering estuarine erosion rates, and the development and promotion of incentives for use of alternatives to vertical shoreline stabilization measures.
- Protect and enhance habitat for anadromous fishes by:
    a) Incorporating the water quality and quantity needs of fish in surface water use planning and rule making.
    b) Eliminating obstructions to fish movements, such as dams, locks, and road fills.

GOAL 4. ENHANCE AND PROTECT WATER QUALITY

Because all fish habitats are connected through the water column, maintaining and restoring water quality is the basic component of habitat protection and enhancement. Runoff from developed lands (structures, parking lots, roads, residential yards), agricultural fields and facilities, and some intensively managed forests carries excess nutrients into surface waters, which can lead to algal blooms that reduce water clarity and lower dissolved oxygen in the water column. Turbidity from runoff can suppress SAV growth, cause low oxygen events leading to fish kills, and cause mortality of organisms in the bottom community, including oysters. Excess sediment clouds the water, reduces SAV growth and survival, fills in creeks and small water bodies with silt, and degrades spawning and nursery habitats. Heavy metals and pesticides transported into the water with storm water can accumulate in the bottom sediments and organisms. Through the food chain, such pollutants may contaminate fish, affecting their survival and growth, and making them unsafe for human consumption. Runoff also carries fecal material to surface waters after rain events, requiring closure of tens of thousands of acres of shellfishing waters to harvest in order to protect human health.

Spills and other failures of municipal and on-site wastewater treatment facilities and infrastructure often send sewage pollution downstream, contributing to algal blooms, and causing shellfishing closures and restrictions on swimming in public waters. Some coastal towns dispose of stormwater on the ocean beaches, while others drain it to the ocean or estuaries. These discharges degrade water quality, leading to shellfishing closures and notifications warning of possible public health dangers from contact with contaminated water. These warnings have a detrimental effect on tourism. Marinas also degrade water quality and restrict use of Public Trust waters via mandatory shellfish harvest closures. Large-scale animal farming expanded rapidly in eastern North Carolina in the 1990s, and management of hog waste became a major environmental problem. Current methods generally used for hog waste management can greatly increase nutrient loading to adjacent waters through excessive spraying on fields, aerial deposition, and spills. The following regulatory and non-regulatory management measures are necessary to address a diversity of point and non-point pollution sources:

Point sources

- Reduce point source pollution from wastewater by:
    a) Increasing inspections of wastewater treatment facilities, collection infrastructure, and land disposal sites.
    b) Providing incentives for upgrading all types of wastewater treatment systems.
- Adopt or modify rules or statutes to prohibit ocean wastewater discharges.
- Prohibit new or expanded stormwater outfalls to coastal beaches and to coastal shellfishing waters (EMC surface water classifications SA and SB) except during times of emergency (as defined by the Division of Water Quality's Stormwater Flooding Relief Discharge Policy) when public safety and health are threatened, and continue to phase-out existing outfalls by implementing alternative stormwater management strategies.

Non-point sources

- Enhance coordination with, and financial/technical support for, local government actions to better manage stormwater and wastewater.
- Improve land-based strategies throughout the river basins to reduce non-point pollution and minimize cumulative losses to wetlands and streams through voluntary actions, assistance, and incentives, including:
    a) Improved methods to reduce sediment pollution from construction sites, agriculture, and forestry.
    b) Increased on-site infiltration of stormwater.
    c) Documentation and monitoring of small but cumulative impacts to wetlands and streams from approved, un-mitigated activities.
    d) Incentives for low impact development.
    e) Increased inspections of onsite wastewater treatment facilities.
    f) Increased water re-use and recycling.
- Improve land-based strategies throughout the river basins to reduce non-point pollution and minimize cumulative losses to wetlands and streams through rule making, including:
    a) Increased use of effective vegetated buffers.
    b) Reduction of impervious surfaces where feasible and reduction of the level of impervious surface allowable in the absence of engineered stormwater controls.
    c) Expansion of CAMA Areas of Environmental Concern (AECs) upstream and landward.
    d) Consideration of erosion rates as an additional factor in the siting of structures along estuarine and public trust shorelines.
- Develop and implement a comprehensive coastal marina and dock management plan and policy for the protection of shellfish harvest waters and fish habitat.
- Reduce non-point source pollution from large-scale animal operations by the following actions:
    a) Support early implementation of environmentally superior alternatives to the current

lagoon and spray field systems as identified under the Smithfield Agreement and continue the moratorium on new/expanded swine operations until alternative waste treatment technology is implemented.

b) Seek additional funding to phase-out large-scale animal operations in sensitive areas and relocate operations from sensitive areas.

c) Use improved siting criteria to protect fish habitat.

9.4. POSSIBLE FUNDING SOURCES

Implementation of the above recommendations will involve new program activities and revised priorities for existing programs within DENR and other agencies. Significant new funding is essential to expand and improve enforcement and compliance monitoring to fully implement existing laws and rules. Coordinating and expanding DENR biological, physical, and water quality monitoring and data management within the eight coastal river basins will provide local and state environmental managers and regulatory commissions, as well as the development, agriculture, and forestry communities, with data and analyses necessary to make informed decisions, and to evaluate the effects of those decisions. Implementation of coordinated interagency management requires a significant infusion of personnel, equipment, and operations monies. These funds must be considered as an investment in greatly enhanced environmental productivity that will benefit all citizens and provide important dividends over the long-term. Possible funding sources listed below are suggestions only. No specific proposals have been developed, although the Saltwater Fishing License enacted by the North Carolina General Assembly in July 2004 includes a provision to fund habitat restoration activities.

- Request expansion funds from the North Carolina General Assembly.
- Dedicate funds collected through sale and renewal of a Coastal Recreational Fishing License to manage coastal fish habitats.
- Dedicate funds collected through sale and renewal of a Coastal Recreational Fishing License to environmental education and outreach.
- Incorporate CHPP recommendations into North Carolina Clean Water Management Trust Fund priorities.
- Establish severance fees for commercial extraction of non-renewable, natural resources from coastal lands and waters and utilize such funds to enhance, protect, restore, and manage coastal fisheries resource habitats.
- Support protection, enhancement, restoration, and management of coastal fish habitats by establishing a Coastal Fish Habitat Protection Fund supported by impact fees on development in the vicinity of coastal fish habitats.
- Work with the DENR Ecosystem Enhancement Program to implement coastal habitat restoration projects.
- Develop partnerships to restore and protect coastal fish habitats through private and federal programs, such as the FishAmerica Foundation, Restore America's Estuaries, NOAA Restoration Center, and the U.S. Fish and Wildlife Service.
- Seek direct federal funding through the U.S. Congress, similar to funding provided for the Chesapeake Bay program.

Table 9.2 Recommended actions to protect, enhance, restore, and manage habitats important for North Carolina's coastal fisheries resources.

Reference No.	Recommended actions to protect, enhance, restore, and manage coastal fish habitats	Responsible commission or agency [Lead group(s) in bold]	Require rule making?
	GOAL 1. IMPROVE EFFECTIVENESS OF EXISTING RULES AND PROGRAMS PROTECTING COASTAL FISH HABITATS		
1.1	Enhance enforcement of, and compliance with, Coastal Resources Commission (CRC), Environmental Management Commission (EMC), and Marine Fisheries Commission (MFC) rules and permit conditions.	**CRC/DCM**, **EMC/DWQ**, **MFC/DMF**, CHS, SCC, WRC, DFR, DLR, S&WCC	No
1.2	Coordinate and enhance water quality, physical habitat, and fisheries resource monitoring (including data management) from headwaters to the nearshore ocean.	**DENR**, DMF, DWQ, DCM, WRC	No
1.3	Enhance and expand educational outreach on the value of fish habitat, threats from human activities, effects of non-native species, and reasons for management measures.	DENR	No
1.4	Coordinate rulemaking and enforcement among regulatory commissions and agencies.	EMC, CRC, MFC, DENR, WRC, SWCC, DFR	No
	GOAL 2. IDENTIFY, DESIGNATE, AND PROTECT STRATEGIC HABITAT AREAS		
2.1	Evaluate potential Strategic Habitat Areas by a) coordinating, completing, and maintaining baseline habitat mapping (including seagrass, shell bottom, and other bottom types) using the most appropriate technology, b) selective monitoring of the status of those habitats, and c) assessing effects of land use and human activities on those habitats.	**MFC/DMF**, CRC/DCM, DENR	No
2.2	Identify and designate Strategic Habitat Areas using ecologically based criteria, analyze existing rules and enact measures needed to protect Strategic Habitat Areas, and improve programs for conservation (including voluntary actions) and acquisition of areas supporting Strategic Habitat Areas.	**DENR**, CRC, EMC, MFC, WRC	Yes

Reference No.	Recommended actions to protect, enhance, restore, and manage coastal fish habitats	Responsible commission or agency [Lead group(s) in bold]	Require rule making?
	GOAL 3. ENHANCE HABITAT AND PROTECT IT FROM PHYSICAL IMPACTS		
3.1	Greatly expand habitat restoration, including a) creation of subtidal oyster reef no-take sanctuaries, and b) re-establishment of riparian wetlands and stream hydrology.	**DMF**, EEP, CRC	No
3.2	Prepare and implement a comprehensive beach and inlet management plan that addresses ecologically based guidelines, socio-economic concerns and fish habitat.	**CRC/DCM,** EMC/DWQ, MFC/DMF, DWR, WRC, DENR	Yes
3.3	Protect Submerged Aquatic Vegetation (SAV), shell bottom, and hard bottom areas from fishing gear effects through improved enforcement, establishment of protective buffers around habitats, and further restriction of mechanical shellfish harvesting.	MFC/DMF	Yes
3.4	Protect fish habitat by revising estuarine and public trust shoreline stabilization rules using best available information, considering estuarine erosion rates, and the development and promotion of incentives for use of alternatives to vertical shoreline stabilization measures.	CRC/DCM	Yes
3.5	Protect and enhance habitat for anadromous fishes by a) incorporating the water quality and quantity needs of fish in surface water use planning and rule making, and b) eliminating obstructions to fish movements, such as dams, locks and road fills.	**DENR**, EMC, DWQ, DWR, WRC, DMF	Yes
	GOAL 4. ENHANCE AND PROTECT WATER QUALITY		
4.1	Reduce point source pollution from wastewater by a) increasing inspections of wastewater treatment facilities, collection infrastructure, and land disposal sites, and b) providing incentives for upgrading all types of wastewater treatment systems.	**EMC**, DWQ, CHS, DEH	No
4.2	Adopt or modify rules or statutes to prohibit ocean wastewater discharges.	**EMC**	Yes

Reference No.	Recommended actions to protect, enhance, restore, and manage coastal fish habitats	Responsible commission or agency [Lead group(s) in bold]	Require rule making?
	GOAL 4. ENHANCE AND PROTECT WATER QUALITY (*continued*)		
4.3	Prohibit new or expanded stormwater outfalls to coastal beaches and to coastal shellfishing waters (EMC surface water classifications SA and SB) except during times of emergency (as defined by the Division of Water Quality's Stormwater Flooding Relief Discharge Policy) when public safety and health are threatened, and continue to phase-out existing outfalls by implementing alternative stormwater management strategies.	**EMC**, DWQ, CRC, DCM, CHS, DEH	Yes
4.4	Enhance coordination with, and financial/technical support for, local government actions to better manage stormwater and wastewater.	**DENR**, DWQ, DCM, DEH	No
4.5	Improve land-based strategies throughout the river basins to reduce non-point pollution and minimize cumulative losses to wetlands and streams through voluntary actions, assistance, and incentives, including a) improved methods to reduce sediment pollution from construction sites, agriculture, and forestry, b) increased on-site infiltration of stormwater, c) documentation and monitoring of small but cumulative impacts to wetlands and streams from approved, un-mitigated activities, d) incentives for low-impact development, e) increased inspections of onsite wastewater treatment facilities, and f) increased water re-use and recycling.	**DENR**, EMC, CRC, DWQ, DCM, SCC, DLR, S&WCC, DS&WC, Dept. of Agriculture & Consumer Services, DFR	No
4.6	Improve land-based strategies throughout the river basins to reduce non-point pollution and minimize cumulative losses to wetlands and streams through rule making, including a) increased use of effective vegetated buffers, b) reduction of impervious surfaces where feasible and reduction of the level of impervious surface allowable in the absence of engineered stormwater controls, c) expansion of CAMA Areas of Environmental Concern (AECs) upstream and landward, and d) consideration of erosion rates as an additional factor in the siting of structures along estuarine and public trust shorelines.	**EMC**, **CRC**, DWQ, DCM, SCC, DLR	Yes
4.7	Develop and implement a comprehensive coastal marina and dock management plan and policy for the protection of shellfish harvest waters and fish habitat.	**CRC/DCM**, EMC, DWQ, DMF, WRC	Yes

Reference No.	Recommended actions to protect, enhance, restore, and manage coastal fish habitats	Responsible commission or agency [Lead group(s) in bold]	Require rule making?
	GOAL 4. ENHANCE AND PROTECT WATER QUALITY (*continued*)		
4.8	Reduce non-point source pollution from large-scale animal operations by the following actions: a) support early implementation of environmentally superior alternatives to the current lagoon and spray field systems as identified under the Smithfield Agreement and continue the moratorium on new/expanded swine operations until alternative waste treatment technology is implemented, b) seek additional funding to phase-out large-scale animal operations in sensitive areas and relocate operations from sensitive areas, and c) use improved siting criteria to protect fish habitat.	**General Assembly**, **DENR**, EMC, DWQ, S&WCC, DS&WC, Dept. of Agriculture & Consumer Services	Yes