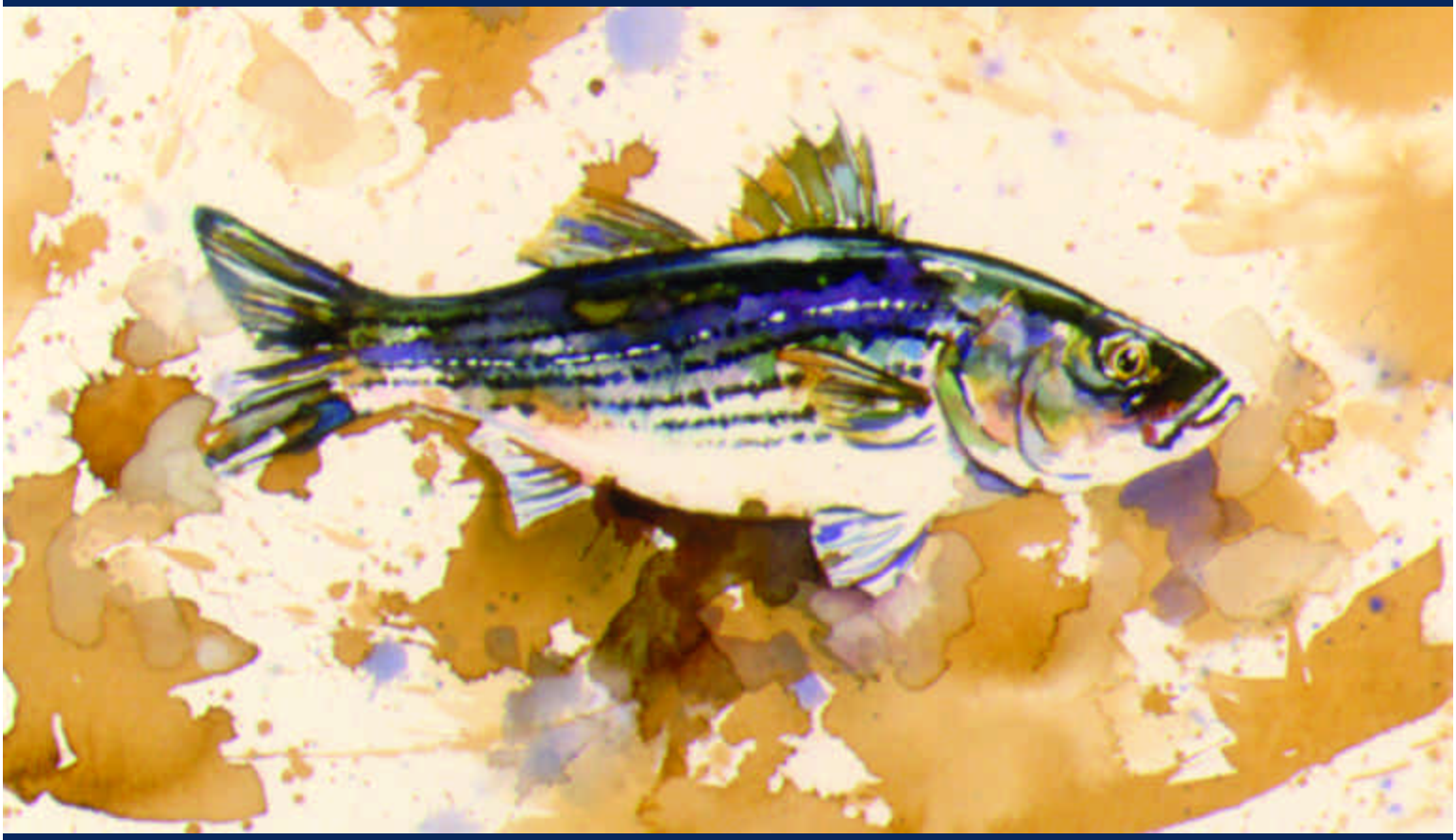
Hudson River Estuary Action Plan 2001



The Hudson River Estuary Program

New York State Department of Environmental Conservation

George E. Pataki, Governor Erin M. Crotty, Commissioner

Hudson River Estuary

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February 2002

The Hudson River Estuary Program of the New York State Department of Environmental Conservation (DEC) is a unique regional partnership leading the restoration of the Hudson through implementation of the Hudson River Estuary Action Plan. The principal purposes are to:

- Conserve natural resources
- Clean up pollution
- Promote public use and enjoyment of the river

Partners in the program include: DEC as project manager; NYS Office of Parks, Recreation and Historic Preservation; NYS Department of State; NYS Office of General Services; NYS Department of Transportation; NYS Department of Agriculture and Markets, Empire State Development Corporation; Metro-North Railroad; the Hudson River Valley Greenway; the Hudson River Foundation, Cornell University, New England Interstate Water Pollution Control Commission, and a citizen advisory committee.

Local governments along the estuary, from the Troy Dam to the Verrazano Narrows, and the State of New Jersey also take part. Federal agencies, such as the Environmental Protection Agency, Army Corps of Engineers, Department of Commerce and Department of Interior and the American Heritage Rivers Program, also have a stake in the plan and participate actively.

Additional information and copies of this report are available through:

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STATE OF NEW YORK

GEORGE E. PATAKI
GOVERNOR

Dear New Yorker:

The Hudson River Estuary today has taken its rightful place as one of New York State's great natural resources and has been nationally recognized as an American Heritage River.

Much remains to be done, however. In 1996, we released the first Hudson River Estuary Action Plan to guide priority initiatives for restoring fisheries, preserving open space, enhancing habitat, and improving water quality. Under this Plan, New York State has acquired nearly 2,000 acres of open space along the Hudson, established coordination for marine law enforcement, constructed or renovated sixteen boating access facilities, petitioned the federal government to declare key portions of the River as "No Discharge Zones," mapped key underwater habitats, and supported the research needed to maintain surging striped bass populations and arrest declines in shad and sturgeon stocks.

The Action Plan for 2001 addresses new challenges and opportunities. The knowledge we've gained over the past four years must be disseminated to local decision makers, enabling them to promote effective estuary conservation measures at the community level. Our estuary grants program will facilitate local efforts to conserve the estuary, restore valuable habitat, and promote environmental stewardship. Water quality problems will be addressed through a continued contaminant track down project and Clean Water/Clean Air Bond Act funded water quality improvement projects. We will also begin to integrate air quality issues into water quality management.

Many New Yorkers have contributed to this updated Estuary Action Plan: scientists, anglers, business representatives, environmental advocates, educators, local officials, and agency professionals. Today, I see not only a glorious River coming back into its own, but a firm resolve among our citizens to continue our progress. This Estuary Action Plan embodies our commitment to achieve full restoration of a healthy, bountiful, inspiring Hudson River for the next generation.

Very truly yours,

George E. Pataki

EXECUTIVE CHAMBER STATE CAPITOL ALBANY 12224
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GEORGE E. PATAKI
GOVERNOR

STATE OF NEW YORK
DEPARTMENT OF ENVIRONMENTAL CONSERVATION
ALBANY, NEW YORK 12233-1010

ERIN M. CROTTY
COMMISSIONER

To the Citizens of the Hudson River Valley:

Governor George Pataki's first Hudson River Estuary Action Plan (Plan), released in 1996, was a pioneering initiative in promoting management of a vital natural resource. It provided a framework whereby all of the New York State Department of Environmental Conservation's (Department) resources, and those of other government agencies, academic institutions, and concerned citizens, could be joined in a effort to restore and protect an entire ecosystem.

Through the Plan and its 1998 update, the Department is now tracing contaminants from tributaries in the watershed all the way to New York Harbor. We are cataloging the rich tapestry of terrestrial life that gives the Hudson Valley region one of the highest biodiversity rankings in New York State, and we are conducting intensive studies of key estuarine fishes, including striped bass, sturgeon, and shad. As a result of the Plan, the Department has provided increased public access to the Hudson through land acquisition, fishing access and boat launch improvements, and tracked the increasing use of the River by bald eagles.

Action Plan 2001 continues this comprehensive approach. The Department is committed to management of the Hudson River ecosystem based on sound scientific information and principles. Collecting the baseline data needed to measure our success in meeting objectives will be a focus for the next two years. In addition, new emphasis will be placed on local involvement in estuary conservation through our grants program and an extension outreach effort in support of tributary management, habitat restoration, and biodiversity protection. We will assess the success of policies designed to restore the estuary's famed Atlantic sturgeon population. The Department's commitment to ecologically sound waterfront revitalization and brownfields cleanup will continue, and to encourage better coordination in state/federal permitting of small floating structures and piers, we will seek to better understand the impacts of such structures on aquatic life.

This year our commitment to restoration of the Hudson River Estuary has topped the $173 million mark with appropriations from many funding sources, including the State Environmental Protection Fund, the Clean Water/Clean Air Bond Act and the NY-NJ Port agreements. This is an unprecedented level of support, but it marks just the beginning of what the Department hopes to accomplish for the future.

I am proud to present to you a Hudson River Estuary Action Plan that will insure continued progress into the new century.

Sincerely,

Erin M. Crotty

Table of Contents

Executive Summary

A River of National Significance

The Hudson River estuary is one of New York's outstanding natural resources, world renowned for its history and scenery and vital as part of the Atlantic coast ecosystem. It has been and continues to be one of New York State's premier natural assets and is an engine of the state's economy, attracting tourist dollars, providing for high value residential and commercial development, sustaining multi-million dollar coastal fisheries and providing a critical transportation link in New York's import and export economy. In 1998, the Hudson River was designated as one of the nation's first American Heritage Rivers, a much deserved recognition of its central place in American history and culture.

The estuary provides crucial nursery and spawning grounds for a wide variety of fish species and is part of the great Atlantic flyway for migratory birds. The river's marshes and tidal flats contribute essential nutrients to the first links in a food web that extends throughout the river and far into the Atlantic Ocean. Last but not least, the Hudson nourishes our souls. It is a beloved river, beautiful, dynamic and ever-changing, a resource to protect, not only for ourselves but for generations to come.

The Hudson River Estuary Program

In 1987, the New York State Legislature passed Section 11-0306 of the Environmental Conservation Law (Appendix A). Known as the Hudson River Estuary Management Act, this law directs the Department of Environmental Conservation (DEC) to develop a management program for the newly-created Hudson River Estuarine District and its associated shorelands. The Estuarine District is defined as the tidal waters of the Hudson River, including the tidal waters of its tributaries and wetlands from the Federal Lock and Dam at Troy to the Verrazano Narrows. The terms estuary or Hudson River estuary refer to the designated estuarine district.

The associated shorelands have not been defined by law; however, for purposes of developing the estuary management program, the east-west boundary has been established as those areas included within New York State's Coastal Management Program boundary. The Estuary Management Act also gives consideration to the remainder of the Hudson River watershed, New York Bight and the waters around Long Island as they impact the Hudson River estuary. Certain issues may require a broader geographic scope. In such cases, these are defined within the context of

specific initiatives, such as the Estuary Grants Program, biodiversity inventories and watershed management.

The Hudson River Estuary Program's integrated approach to the estuary's ecosystem combines scientific research, active resource protection and management, and public involvement and education in a concurrent implementation program. It offers an excellent opportunity for DEC to provide responsible protection, to attain sustainable use, to ensure diverse opportunities, and to achieve quality through measurable goals and objectives. Implementation of the Estuary Action Plan is the first step in that process. The Estuary Program is housed in the office of the Special Assistant and Hudson River Estuary Coordinator located in DEC Region 3 headquarters in New Paltz, NY.

Governor George E. Pataki released the first Estuary Action Plan in 1996, and it is updated every two years. Action Plan 1998 carried the program forward through the state fiscal year 2000-2001. Action Plan 2001 continues, amends and expands the action agenda through fiscal year 2002-2003. Funding to implement the program has been appropriated by the Governor and the Legislature in the Environmental Protection Fund (EPF) and other funding sources, including the Clean Water/Clean Air Bond Act (see Appendices K. and L.).

The term Estuary Action Plan refers to the overall planning process being implemented through a continuum of action plan documents and includes previous, present, and future action plans. Discussions targeted at specific action plans identify each plan by date (i.e., Action Plan 1998, Action Plan 2001).

The Hudson River Estuary Management Advisory Committee

In accordance with the Estuary Management Act, DEC established a Hudson River Estuary Management Advisory Committee, consisting of members representing interests directly involved in the estuary, including commercial fishing, recreation, research, conservation, education, local government and industry. The committee meets quarterly to review program activities and advise DEC on proposed agency actions. Since its appointment in 1988, the committee has provided valuable insight into the development of the estuary program and has participated in the debate and resolution of key issues involving the estuary. Continuation of the committee is an important component during implementation of the Estuary Action Plan and its subsequent biennial revisions and updates. A list of current Advisory Committee members is included in Appendix I.

A Partnership Approach

The primary strategy for implementing the Estuary Action Plan is for the state government to work cooperatively and in partnership with local governments, the federal government, not-for-profit organizations, the private sector and individual property owners for the benefit of the Hudson River ecosystem, around which all New York State residents can build better and more rewarding lives.

In addition, the presence of other state and federal programs actively involved in the Hudson Valley provides opportunities for cooperative approaches to many of the estuary's most pressing issues.

Programs especially important to the Estuary Program include:

- The Rivers and Estuaries Center on the Hudson: Initiated by Governor George E. Pataki in 2000, the creation of this world-class research and educational institute will work toward fostering a deep understanding of how rivers and estuaries function, describe how the ecosystem processes of rivers and estuaries interact with humans, and develop tools for river and estuary conservation. To achieve these goals, the Center will: conduct research on physical, chemical and biological processes in rivers and estuaries around the globe; translate research for use by policy and decision makers; educate students; develop outreach for education and extension; provide facilities for research and technology collaboration, and host a technology and business incubator for river and estuary conservation.

- The American Heritage Rivers Program: The Hudson received this Presidential designation in 1998. The program is a partnership between the state and federal government designed to foster improved government coordination and to support local actions and needs in the Hudson Valley.

- The NY-NJ Harbor Estuary Program: Designated in 1987 by the EPA to develop a comprehensive management plan for the harbor area, this program links New York State, the federal government and the State of New Jersey together to address ecosystem-related issues.

- The New York State Coastal Management Program, Article 42 of the Executive Law: Managed by the New York State Department of State

(DOS), this program oversees compliance of federal and state actions with the state's 44 coastal policies. Coastal Management programs of particular importance to the Hudson Valley include: Local Waterfront Revitalization Programs, Significant Coastal Fish and Wildlife Habitats, Scenic Areas of Statewide Significance, and the NYS Coastal Non-point Pollution Control Program. The Department of State also works with municipalities to prepare harbor management plans and watershed management plans for Hudson River tributaries.

- The Joint Dredging Plan for the Ports of New York and New Jersey (the Bistate Plan): A blueprint for restoration of New York Harbor for navigation, including trackdown and cleanup of contaminants entering harbor sediments.

- The Hudson River Valley Greenway: Created by state legislation in 1991, this initiative focuses on voluntary regional planning, resource conservation, economic growth, the Hudson River Greenway Trail, and enabling cultural, historic and environmental linkages throughout the valley. The Greenway Conservancy also is responsible for management of the Hudson River Valley National Heritage Area, created in 1996.

- Other partners include NYS Office of Parks, Recreation and Historic Preservation (OPRHP); NYS Department of Transportation (DOT); NYS Office of General Services (OGS); Lower Hudson Coalition of Conservation Districts; Hudson River Foundation; MetroNorth; local governments along the estuary; private research institutions; and the nonprofit community. Federal agencies include the Environmental Protection Agency, Army Corps of Engineers, Department of Commerce and Department of Interior.

Within DEC, nearly every program and division is involved in some aspect of environmental protection of the estuary. However, four basic programs focus specifically on the estuary as a resource. In order for DEC to meet existing program needs, as well as address many of the new challenges outlined in this plan, core programs must be continued and maintained because they form the foundation on which the estuary program will build. These programs include the following:

- Hudson River Fisheries Unit (HRFU) and Anadromous Fisheries Section (AFS): These units collect and report biological and public use data required to manage Hudson River fish resources within New York State.

They also participate in management activities of the Atlantic States Marine Fisheries Commission (ASMFC) and support DEC efforts to reduce environmental impacts of various activities.

- Hudson River National Estuarine Research Reserve: Established in 1982 under the Coastal Zone Management Act, this cooperative state-federal program implements education and research programs, including the management of four major tidal wetlands: Stockport Flats, Tivoli Bays, Iona Island, and Piermont Marsh.

- DEC Region 2 Marine Program: The marine habitat protection staff in the New York regional office assure coordination and compliance with estuary management goals in regional program implementation.

- Hudson River Estuary Program: The Estuary Program is charged with development and implementation of the Estuary Action Plan. It also conducts special projects and educational outreach to citizens.

Funding for Implementation of the Estuary Action Plan

Since Governor George E. Pataki released the first action plan in 1996, nearly $173.3 million has been assembled to improve the Hudson River estuary including the following (through 3/31/01):

- $30 million from the Environmental Protection Fund (EPF), an average of $6 million annually since 1996, including the state fiscal year 2000-2001 for implementation of the 1998 Estuary Action Plan.

- $50 million of Clean Water/Clean Air Bond Act funds earmarked for water quality and habitat restoration projects from NY Harbor to Troy. (Of this amount, $39.2 million has been approved in grants to date.)

- $19.6 million for a river-wide monitoring and trackdown of contaminant sources and pollution cleanup funded through the New York-New Jersey Port Restoration Agreement. (Of this amount, $5 million has been spent to date.)

- $22 million additional funds have been approved from the Bond Act for open space, state and municipal park improvements and brownfields cleanups.

- $51.7 million in other state EPF and federal funds for waterfront revitalization, habitat restoration, public access and non-point source pollution control.

Estuary Grants Program

The Estuary Grants Program was initiated in 1999 to implement certain commitments of the Estuary Action Plan through local partnerships. Estuary grants range from a minimum of $2,500 to a maximum of $100,000 in five categories:

- Interpretation and Education
- Habitat Preservation and/or Restoration
- Local Scenic Resources
- Community Conservation and Stewardship
- River Access: Boating, Fishing, Swimming and Wildlife-related Recreation

Municipalities and non-profit organizations are eligible to apply for the grants, which are awarded annually. For state fiscal year 1999-2000, DEC awarded 33 grants totaling $1,177,000. The Estuary Grants Program will continue to fund the local implementation of commitments where appropriate, in order to strengthen partnerships. See Appendix J for 1999/2000 grant awards.

Goal Statement and Guiding Principles

The GOAL of the Hudson River Estuary Program is to protect and conserve, restore and enhance the productivity and diversity of natural resources of the Hudson River estuary to sustain a wide array of present and future human benefits.

Guiding Principles

- The Hudson River estuary is an integral part of the North Atlantic Coast and our global environment. Activities and conditions within the estuary affect these greater systems. Likewise, conditions and activities occurring outside the boundaries of the estuarine district affect the estuary. Management of the estuary recognizes these interrelationships and shall take into consideration the impacts of actions on shared resources.

- Protection, restoration, and enhancement of the natural resources of the Hudson River estuary is the goal of the Hudson River Estuary Program and deserves equal consideration among other goals of the state. Measures and policies that sustain the natural resources of the Hudson over time shall be given priority over actions that exploit or deplete resources for short-term gain.

- Protecting and sustaining the Hudson River estuary as an integrated estuarine ecosystem is recognized as a human benefit. Additional benefits are derived from the uses a healthy ecosystem supports, including water supply, food production from fisheries, recreation, education, navigation, residential and commercial development, and sustainable community growth.

- Achievement of restored and sustained environmental quality is necessary to realize the full extent and diversity of benefits inherent in the estuary.

- It is the intent of the Estuary Program to identify and foster those uses of the estuary that utilize the estuary's many renewable resources and, while providing for appropriate uses that may permanently alter and cause significant impact to the ecosystem, to minimize any negative impacts associated with such uses.

- The primary strategy for achieving this goal is for the state government to work cooperatively and in partnership with local governments, the federal government, not-for-profit organizations, the private sector and individual property owners for the benefit of the Hudson River estuarine ecosystem, around which all New York State residents can build better, more rewarding lives.

Action Plan Commitments for 2001-2002

Drawing on the strategic Estuary Management Plan adopted in 1996, an action plan of short-term immediate actions is developed every two years. Action Plan 2001 sets priority goals and describes projects that will realize them. The descriptions detail specific tasks, provide associated cost estimates, and assign responsibility for their accomplishment. The plan recognizes that DEC and its partners currently have many Hudson River projects underway. It describes how these initiatives will be enhanced and supported by the proposed actions.

Action Plan 2001 will focus on science related to the estuary and public outreach, building on our accomplishments to date. Since the first Action Plan was adopted in 1996, researchers and scientists have learned some revolutionary new information about the estuary and its environs. River bottom mapping of a 40-mile stretch of the river has revealed many surprises, including giant sand waves that help to explain the transport of sediments and may be important wintering areas for fish. It also has revealed the location of old oyster beds. Scientific studies on underwater vegetation in the estuary have helped scientists understand how nonnative plant species affect dissolved oxygen in the river and how these plant beds are changing in response to zebra mussels. Inventories and mapping efforts have revealed that the Hudson Valley is one of the richest and most biologically diverse regions in all of New York State.

Action Plan 2001 will use the information gathered since 1996 to address today's priorities. It calls for collecting scientific information on Hudson River resident and migratory fish, including attention for the first time on the American eel, and new work on striped bass nursery areas. The plan extends the range of river bottom mapping from the initial 40 miles to cover the entire 154 mile extent of the estuary from Manhattan to Troy. It intensifies the mapping of biodiversity in the valley and begins to explore relationships of breeding birds to habitat patterns, as well as changes in waterfowl use of the estuary over the last 20 years.

Through the Plan, scientific discoveries will be more broadly communicated to the public, local governments, schools, and others who might be interested. New outreach efforts will be designed to communicate specific results to the groups or individuals most actively involved in using the estuary's natural resources.

Another major emphasis for Action Plan 2001 is the expansion of conservation and stewardship efforts from the main stem of the estuary to its tributaries. What happens in the watershed has a profound effect on the estuary, and this link will be explored.

Action Plan 2001 pledges to address the following commitments as a supplement to the ongoing work of DEC and other partners to conserve the Hudson River. The actions listed below target the most pressing needs for the next two years. The 2001 Plan adds some new projects and adjusts or continues multi-year projects from prior action plans as needed.

The issues and problems of the estuary and the details of projects for 2001-2002 are more fully described in the action plan chapters which follow. The "Action Agenda" which appears in each chapter repeats the action plan commitments shown below and provides information on projected cost and funding sources, lead program in charge of implementing the project and a list of project partners. Accomplishments on action plan priorities since 1996 also are reported in each "Action Agenda." A summary of costs contained in Action Plan 2001 appears in Appendix L. A list of completed action plan reports is contained in Appendix G.

Theme I: Conserving Natural Resources

1. Finfish, Shellfish and Crustaceans

Issue: The Hudson is home to many fish of commercial, recreational and ecological importance. Of these, American shad, Atlantic sturgeon, river herring, American eel and largemouth bass currently are in decline, and it is difficult to assess the situation of blue crab, smallmouth bass, and other species about which little is known. Striped bass have increased over the last few decades, but fishing pressure in the estuary and along the Atlantic coast could lower current population levels. All of these species must be managed carefully on the basis of sound scientific information. Action Plan projects have gathered essential data and formed a solid foundation for new research on key species.

Action Plan 2001 Commitments:

1a. Migratory Species (striped bass, American shad, Atlantic sturgeon, American eel and river herring)

- Survey juvenile Atlantic sturgeon for signs of stock recovery
- Conduct baseline assessment of American eel abundance, begin annual monitoring program, and evaluate management options that will support recovery

- Quantify ocean losses of American shad, Atlantic sturgeon and other species

- Complete three-year baseline assessment of river herring population status

- Collect data needed to maintain the estuary's healthy striped bass population, including:

    a. Conduct annual, long-term monitoring of young-of-year striped bass population size

    b. Collect information on striped bass nursery areas, rates of emigration to the ocean, abundance of species eaten by bass, and ocean losses from commercial "bycatch" harvest

1b. Resident Species (blue crab, black bass)

- Continue to obtain information on blue crab biology by completing three-year baseline study of population levels

- Continue to determine habitat requirements for black bass by completing three-year study of wintering and spawning habitat locations. Complete study of causes of decline in largemouth bass stocks.

1c. Contaminants in Fish

- Collect information on local variation in fish contaminant levels by testing fish from sites of concern. Determine how local sources of pollution affect these levels

2. Biological Indicators of Ecosystem Health

Issue: DEC has historically assessed water quality through chemical analysis of water and sediments measuring levels of oxygen, nitrogen, phosphorus, and metals, for example. While this approach has been part of successful efforts to improve the estuary's health, it does not always capture the big picture of how water quality affects living organisms. Measuring the abundance of biological "indicator species" can detect problems that chemical analysis alone might miss or underestimate. By monitoring a small number of

sensitive indicator species, it is possible to assess how changes in water quality impact a wider array of organisms. USEPA is encouraging states to adopt and use such "biocriteria". Under the action plan to date, DEC has been developing a model for selecting and monitoring indicator species. The model will be completed in the spring of 2001.

Action Plan 2001 Commitments:

- Field test the biocriteria model in water quality assessments on the estuary. Integrate it with other ecosystem monitoring programs currently underway.

3. Submerged Habitat

Issue: Underwater habitats, such as submerged aquatic plant beds, bottom sediments, and human artifacts, play a crucial role in the life cycles of species that live in the estuary. Some of them also influence levels of oxygen and nutrients in the water and affect the movement of pollutants in the ecosystem. Until recently, little effort was put into mapping these habitats. This made it difficult to track changes in the variety and extent of habitat types and, in turn, to assess the impact of such changes on the ecology of the estuary. For example, research by the Institute of Ecosystem Studies has recently revealed that the relative amounts of water chestnut and water celery influence oxygen levels in the freshwater portion of the estuary. The first action plan, adopted in 1996, initiated a comprehensive effort that included mapping beds of underwater plants and surveying 40 miles of river bottom. Completing the surveys, and detailing the ecological function of the submerged plant beds will help define spawning, nursery, and foraging areas for Hudson River fishes, blue crabs, and food chain species. Understanding how human structures affect habitat also is important.

Action Plan 2001 Commitments:

- Extend river bottom mapping to cover the entire area from the Troy Dam to the Battery in Manhattan

- Monitor how the extent of submerged aquatic vegetation beds changes over time, evaluate factors contributing to these changes, and detail the function of these habitats in the ecosystem

- Assess the impact of smaller piers and floating structures to determine whether design features and size guidelines could be developed to

reduce their habitat impacts.

4. Aquatic and Shoreline Habitat Restoration

Issue: Up until the 1970s, it was common practice to use Hudson River marshes as municipal landfills. Wetlands and shallows also were filled with sediments dredged from the navigation channel. The impacts have been dramatic. Between the Cities of Hudson and Albany, one-third of what used to be river has been filled in. Elsewhere, significant wetland acreage also was lost. Railroad construction in the mid-nineteenth century altered habitat too; shorelines were hardened with rip-rap, marshes and coves were cut off from the river, and circulation of tidal water into bays was restricted. For several years, the Estuary Program has been working in partnership with state and federal agencies to identify habitats that have been altered and opportunities for restoration. The Army Corps of Engineers, which filled many wetlands as part of its channel maintenance program, is a key partner in the restoration effort and is providing federal cost-sharing funds. Techniques for restoring tidal habitats are being explored in feasibility studies underway now.

Action Plan 2001 Commitments:

- Implement three wetland restoration projects in partnership with the Army Corps of Engineers
- If feasible, restore historic fish passage at one to two locations on tributaries of the estuary
- Continue to study the feasibility of restoring additional Hudson River habitats at up to 15 locations. Develop habitat restoration designs and an overall plan to guide future efforts
- Assist communities in efforts to enhance natural features and develop local habitat restoration plans as part of waterfront revitalization efforts
- Continue the Estuary Grants Program to support habitat restoration and restoration feasibility studies and acquisition of lands or easements which conserve habitat

5. Tidal Wetlands

Issue: The Hudson is unique in its mix of marshes, swamps and flats spanning a range of salt influence from seawater to freshwater. These habitats are the cornerstone of the

ecosystem, playing a critical role as nursery grounds for fish and shellfish species, nesting sites and migration stops for birds, and sources of nutrients to the food chain. Tidal wetlands have been protected by state and federal law since the 1970s. However, erosion, sea level rise, changes in salinity, introductions of nonnative species and other factors cause changes over time, not only in acreage but also in the types of plants and animals that live there. Through the action plan, baseline mapping of all estuary wetlands is underway and soon will be completed. The next step is to compare wetlands today with historic records, including maps from the turn of the century and aerial photographs from more recent times. This will help determine where there have been losses, where there have been gains, and what types of wetland vegetation and habitat have been most affected, and will help identify potential restoration sites. This information will guide restoration efforts and build understanding of how habitat change has affected river life so that DEC and local decision makers can best manage this vitally important part of the ecosystem.

Action Plan 2001 Commitments:

- Assess changes in wetland acreage and vegetation types from the Tappan Zee bridge to the Troy Dam between the mid-1970s and the present. Assess the causes of these changes

- Determine the historic extent of all estuary wetlands circa 1900

6. Community-based Conservation and Stewardship

Issue: Decisions made every day by river users, local governments and valley residents can affect the natural resources of the Hudson and its watershed, often in unintended ways. Information about how best to support conservation of the estuary's ecosystem needs to get into their hands. Many municipalities and community groups are interested in carrying out conservation and stewardship activities at the local level. The action plan will encourage responsible use and stewardship of estuarine resources by user groups (boaters, anglers, etc.) and support voluntary community involvement in projects that can assist with conservation of Hudson River resources.

Action Plan 2001 Commitments:

- Provide extension services to educate people who use the estuary for recreation or other purposes about ways they can contribute to the conservation of natural resources

- Through the Estuary Grants Program, continue to support local projects that promote conservation and stewardship of the estuary

- Conduct conferences and seminars to publicize information collected under the Action Plan

7. Terrestrial Biodiversity

Issue: Many rare, threatened and endangered species, such as the bald eagle and peregrine falcon, inhabit the estuary and its associated environs. Numerous other wildlife species and plant communities form the basic fabric of the region's biodiversity. Habitat mapping conducted under the Estuary Action Plan to date has revealed areas that may have special significance in maintaining this rich natural heritage. The next step is to conduct intensive studies of areas thought to be most significant and to begin to reach out to landowners and local decision makers with tools and information on ways they can voluntarily support conservation of these habitats. Additional projects will study the habitats used by birds and seek to assess and reduce the impacts of invasive species.

Action Plan 2001 Commitments:

- Conduct intensive inventories and assessments of areas thought to have great significance for regional biodiversity and promote their conservation through voluntary measures

- Provide training on biodiversity conservation and offer technical resources to local decision makers, community groups and landowners who request assistance

- Survey migrating waterfowl to explore relationship to habitat; assess change over time since the last survey was conducted in 1978

- Survey mute swan populations and assess their impact on native shorebirds and waterfowl

- Study the relationship of breeding bird diversity to habitat patterns and trends in the Hudson Valley

- Continue to use biological controls to reduce purple loosestrife in selected areas and assess the results

8. Conservation of Tributaries

Issue: Conservation of the Hudson estuary cannot be separated from conservation of its tributaries. Migratory fish, like herring and eels, and resident species, such as black bass, rely on tributary habitats to complete their life cycles. Pollutants released in the watershed find their way to the estuary through tributaries, as do sediments and nutrients. The Estuary Program will reach out to communities in the Hudson River Valley to encourage local stewardship of tributaries in the watershed. Successful projects, such as the one currently being developed for Wappingers Creek in Dutchess County, will be promoted as models of voluntary conservation working toward sustainable end products.

Action Plan 2001 Commitments:

- Work with communities, watershed organizations and the Lower-Hudson Coalition of Conservation Districts (LHCCD) to provide technical assistance to support watershed planning efforts, such as watershed restoration and protection strategies for the tributaries that enter the Hudson south of the Troy Dam

- Support tributary stewardship projects through the Estuary Grants Program

9. Open Space Acquisition

Issue: As the pace of development continues in the Hudson Valley, it is important to permanently protect key open space properties which provide river access, scenic vistas and habitat. In 1996, the action plan set a goal of 4,000 acres to be acquired. To date, about 2,000 acres have been protected at 7 locations, and additional acquisitions are under consideration. In addition, nearly 1,000 acres of state lands with conservation value have been transferred between agencies to assure their long-term protection. The Estuary Program will complete the acquisition of 4,000 acres of open space lands along the Hudson River from willing sellers and the transfer of additional state lands where appropriate. This will be accomplished in partnership with the NYS Office of Parks, Recreation and Historic Preservation, the Hudson River Valley Greenway Conservancy, and local partners. In addition, farmland is being preserved through the purchase of development rights, coordinated by the NYS Department of Agriculture and Markets.

Action Plan 2001 Commitments:

- Continue to acquire open space lands along or in sight of the Hudson to reach the goal of 4000 acres. Explore opportunities to conserve additional acreage identified as significant for biodiversity in the Hudson River estuary watershed.

- Develop management plans and implement capital improvements and stewardship measures for properties acquired

- Continue Estuary Grants Program support for local acquisition by municipalities and land trusts

- Assist local communities with development of new or improved access to existing locally owned public lands along the estuary

10. Protect or Enhance Scenic Resources

Issue: Hudson Valley scenery has been world renowned since it was captured on canvas by the artists of the Hudson River School. New York State residents have done a great deal to preserve this heritage for more than a century. River scenery enriched by the history and culture of the region continues to attract tourists as it has for almost two centuries. In 1997, the Estuary Program convened a task force to explore ways to conserve river scenery. Participants in the task force recommended a program of financial and technical assistance to local governments and community organizations. Initiated in 1999, the Estuary Grant Program provides this assistance.

Action Plan 2001 Commitments:

- Continue Estuary Grants Program support for local projects that protect or enhance views of and from the river and promote the conservation of the scenic quality of the region

- Acquire properties or conservation easements to provide scenic views and conserve river scenery

Theme II: Promoting Use and Enjoyment of the River

11. Enhance Recreational Opportunities

Issue: Improved water quality in the estuary has made it possible for people to enjoy the river in many ways, including fishing, swimming, boating or just plain relaxing. A resurgence of striped bass has created an economically valuable recreational fishery that contributes to the tourism economy. To sustain this fishery will require an understanding of the factors that affect survival and mortality of this important fish. In addition to studies discussed above in "Finfish, Shellfish and Crustaceans," annual surveys are essential to determine recreational fishing effort and to calculate the harvest in the sport fishery. Sound fishing practices to reduce mortality need to be promoted.

Access across railroad tracks is important, not only for fishing but for other forms of recreation. In 1999, Governor Pataki convened a task force to evaluate estuary access opportunities, working with Metro-North railroad, DOT and other state agencies. The task force recommended development of nine access sites. In addition, the Estuary Program supported development of dedicated fishing areas, as well as other public uses of shoreline access properties.

Also, a consultant study started in 2000 is evaluating opportunities for increased swimming in the river. Continuing these programs will lead to increased recreational opportunity for all valley residents and visitors.

Action Plan 2001 Commitments:

11a. Recreational Fishing

- Conduct annual creel surveys to provide information on recreational fisheries for important species such as striped bass, black bass and bluecrab
- Identify options, such as angling methods, to reduce mortality from catch-and-release sport fishing for striped bass and American shad
- Support the development of local fishing access sites

- Calculate the economic value of the recreational fisheries of the estuary

11b. Access Across Railroad Tracks

- Evaluate shoreline access opportunities throughout the railroad corridors on both sides of the river to determine whether additional railroad crossing access sites can be developed beyond the nine announced by the Governor's Task Force on Estuary Access

11c. Swimming

- Identify opportunities to enhance swimming, including local water quality improvements and potential beach development where suitable

12. Boating Access Facilities

Issue: Boating access is limited in many reaches of the river, and providing boat launching facilities requires a substantial public investment. An inventory of existing sites and new opportunities was completed in 1998. The Estuary Action Plan has funded new boating access facilities for trailer launching, hand launching and community boating needs. Where suitable sites can be identified, the Estuary Program will continue to support this type of access.

Action Plan 2001 Commitments:

- Create and/or upgrade two or more boating access sites in areas of greatest need, using the Estuary Grant Program and direct investment of state funds, where appropriate, to support trailer and hand launching as well as community boating needs, such as floating docks in New York City, rowing facilities for crew, and docking for educational and research purposes.

13. Interpretation and Education

Issue: The active participation of citizens, river users, scientists and policy-makers in development of the action plan is a key to its success, but long-term support for conservation depends on building public and community awareness of the estuarine ecosystem and the myriad benefits it provides. Many people in the Hudson Valley are not aware that the lower Hudson River is an estuary that provides critical habitat for numerous

plant and animal species of the Atlantic coast. There is a great deal of confusion about ways in which the Hudson is polluted and ways in which it is now cleaner. Public appreciation for the river can be fostered in many ways. Providing opportunities for learning through experiences on or near the water, publishing reports and working with the media to get the word out are all ways of doing this. Programs started under the action plan to date will be continued and expanded. The Estuary Grants Program will be a principal means of fostering local, community-driven projects. Technical assistance also will be provided by Estuary Program staff.

Action Plan 2001 Commitments:

- Continue to support the development of interpretive and educational programs that contribute to enhanced public understanding of estuary management issues through the Estuary Grants Program

- Continue to support development or improvement of facilities for interpretation and education through the Estuary Grants Program, emphasizing opportunities to observe and directly experience fish, wildlife and the river environment

- Provide technical assistance to community groups and municipalities seeking to promote understanding and appreciation of the estuary, and provide training for teachers

- Support the *Hudson River Almanac* as a key tool to encourage outreach and expand citizen stewardship and understanding of the entire Hudson River watershed

Theme III: Cleaning Up Pollution

14. Waterfront Revitalization

Issue: The Hudson Valley economy is diversifying, and a key element of the region's economic strategy is to strengthen and revitalize riverfront communities and waterfront areas as destinations for tourists and vibrant places to live and work. Projects such as the Hudson River Park will recreate significant waterfront linkages to the river in close proximity to the homes and work places of millions of New York State residents. The Hudson River Valley Greenway will continue to foster revitalization efforts at the local level as well as continue to connect the valley through the Greenway Trail. Directing new

growth to urban and community centers also will help to protect open space and prevent habitat fragmentation. Governor Pataki has created a Quality Communities Task Force to study community growth in New York State and develop measures to help communities implement effective land development preservation and rehabilitation strategies.

As municipalities adjust to new economic opportunities, many riverfront communities find that environmental conservation plays a key role. Governor Pataki has established the Waterfront Rediscovery Program to accelerate redevelopment of former industrial commercial waterfronts in target communities with abandoned buildings and vacant waterfront parcels. Interagency coordination of grant programs for economic development, parks, historic preservation, waterfront revitalization, brownfields cleanup, and water quality improvement support the revitalization efforts of riverfront communities and can protect the estuary by guiding new development to population centers and avoid continued sprawl into pristine areas. Both the Quality Communities Initiative and the Waterfront Rediscovery Program will be coordinated by New York State Department of State (DOS) and will bring together a wide range of involved agencies.

Thousands of New York State residents and visitors enjoy boating on the river and rely on public and private marinas and boat club facilities for access both to and from the river. These facilities offer an excellent vehicle to provide environmental and safety information to the public. Many boating facilities are rapidly losing dockage areas and navigable channels because of sediment deposition. Dredging of these facilities is necessary to insure continued facility operation and boater access to the Hudson. Organizations representing marine interests have requested that DEC and NY Sea Grant assist them in dealing with dredging and disposal, which has become costly and often impracticable.

Action Plan 2001 Commitments:

14a. Riverfront Communities

- Continue a coordinated approach to the economic revitalization of waterfronts through state grant programs

- Support infrastructure needs for waterfront revitalization efforts, especially in urban areas where public access is provided

14b. Marina Assistance

- Provide technical assistance to marinas and boat clubs in managing environmental concerns

15. Brownfields

Issue: Brownfields are contaminated industrial sites that can be cleaned up and turned to new productive uses either as parks or as new development sites. Because of the potentially high cost of cleanup, many of these sites have been abandoned by their owners and taken over by municipalities through tax foreclosure. The 1996 Clean Water/Clean Air Bond Act provides grants to municipalities to clean up brownfield sites, including the studies needed to investigate the type, amount and location of pollution. In the Hudson Valley, since the adoption of the action plan, more than $7 million in grants have been approved for 13 brownfield projects. On the riverfront, cleanups in Irvington, Cortlandt, Yonkers and Hudson will result in new parks, trails and public access to the waterfront. Brownfield cleanups will continue to be a priority of the action plan.

Action Plan 2001 Commitments:

- Continue to seek the participation of municipalities in the voluntary clean-up and restoration of contaminated urban waterfront sites. Provide technical and financial support to preliminary investigations and cleanups. Seek the passage of the Governor's proposed Superfund Bill to provide continued funding for clean-up of priority sites.

16. Abandoned Boats and Derelict Structures

Issue: Abandoned barges, derelict piers and old railroad ties, dumped in the days when that was legal, can be found along the shoreline in some places. Many of these decaying structures have become habitat for fish and birds. They detract, however, from waterfront revitalization. Because of potential impacts, full or partial removal requires coordination with multiple agencies to assure that habitat concerns are considered.

Action Plan 2001 Commitments:

- Conduct demonstration projects on how to remove abandoned structures without damaging habitat values

17. Water Quality - Point and Non-Point Source

Issue: Great progress has been made in cleaning up sewage pollution in the Hudson, yet problems remain which must be addressed. These include accidental sewage discharges during power outages and sewer overflows, which occur in many places during periods of rainfall. In addition, pollution from runoff needs to be addressed. Vessel waste discharges into the river have been substantially curtailed by designating vessel no-discharge areas, but there is a need for additional pumpouts at marinas. Sediment from construction sites, oil and gasoline from parking lots, and fertilizers from lawns and farms end up in tributaries and the estuary. This is known as "non-point source" pollution. Through the EPF and Clean Water/Clean Air Bond Act, New York State has funded projects which address these problems in the estuary. This work will continue.

Action Plan 2001 Commitments:

- Support projects which reduce impairments to water quality and habitat caused by discharges from combined sewer overflows (CSOs), boats, accidental discharges, non-point sources, or other causes

- Local municipalities shall develop a long term plan for the communities in the Albany/Capital District area that will minimize combined sewer overflows in a cost-effective manner, thereby reducing or eliminating impairments in the Hudson River associated with wet weather conditions

18. Track Down and Clean Up Chemical Contaminants

Issue: During the past 30 years, levels of contaminants have decreased in the water, sediments, and fish of the estuary. However, some chemicals remain in the ecosystem. Primarily, these are persistent organic chemicals, such as PCBs, discharged into the river prior to the passage of the Clean Water Act in 1972. Heavy metals once used in manufacturing batteries, paints and dyes also remain. Continuing sources of chemical pollution include pesticides applied to lawns, farms and golf courses, which enter the Hudson as runoff, and airborne contaminants such as polycyclic aromatic hydrocarbons in the air contaminating the earth. Because chemical pollutants in the river move through the food chain, the NYS Health Department recommends limited consumption of estuary fish. The shipping industry too is affected by the difficulty of disposing of contaminated sediments from dredging.

In 1998, New York State committed $12.4 million to a comprehensive track down of contaminants, funded by the NY/NJ Port agreement and supplemented by funds from the Estuary Program. This multi-year effort continues.

Action Plan 2001 Commitments:

- Continue to track down sources of contaminants in the Hudson River estuary and monitor response to pollution reduction activities. In particular, identify and quantify sources of contaminants of concern such as dioxin, PCBs, PAHs, metals, pesticides, and volatile organic compounds; identify changes or trends over time

- Evaluate opportunities to reduce contamination at the source in order to facilitate future navigational dredging of New York Harbor and other ports on the estuary and to minimize uptake of these chemicals into the food chain. Support the continuing efforts of USEPA to implement the active remediation of upper Hudson PCBs, and work with federal partners to seek recovery of natural resource damages caused by PCBs.

- Expand analysis of pesticides and air pollutants

- Explore the feasibility of establishing a system to monitor sediment transport in the estuary

19. Funding for Long-term Monitoring

Issue: From managing fish populations to ensuring adequate water supplies, New York State needs improved data on environmental conditions to make informed decisions. The state does not have an early warning or reliable forecasting system to detect significant changes in the estuary and prevent future problems. Presently, limited monitoring programs are conducted by DEC, other agencies and the private sector. A comprehensive long-term monitoring program is being developed to establish a scientific basis for decision making and to track progress in conserving the region's natural resources. To assure the ongoing effectiveness of the program, a stable funding mechanism must be established that is potentially funded by the multiple partners who would benefit. Through action plan activities, a long-term monitoring plan is being developed. The next step is to determine the best way to fund its implementation.

Action Plan 2001 Commitments:

- Complete development of a plan for a long-term monitoring program

- Explore mechanisms to create a stable fund for ecosystem monitoring and education to establish a scientific basis for management decisions and public support for carrying them out; explore options for creating cost-sharing mechanisms through public-private partnerships involving resource users, private foundations and government agencies; conduct projects that address current monitoring needs and priorities; support creation of a center on the shores of the Hudson which will conduct world-class research and education on rivers and estuaries

20. Core Programs

Issue: The action plan initiates many projects and programs that address pressing immediate needs of the estuary. However, these actions should not be undertaken at the expense of the ongoing DEC programs that carry out the state's conservation mission on the Hudson. Therefore, a key element of the plan is to maintain the core programs that have helped DEC achieve great progress to date. This includes providing administrative support to carry out the Estuary Action Plan.

Action Plan 2001 Commitments:

- Maintain core Hudson River programs in DEC and build on them to accomplish the Estuary Action Plan. These programs include the Hudson River Estuary Program, the Hudson River Fisheries Unit and Anadromous Fisheries Section, the Hudson River National Estuarine Research Reserve, the Regional Marine Program and others

- Continue to coordinate and integrate the Estuary Action Plan agenda in partnership with state agencies such as the NYS Office of Parks, Recreation and Historic Preservation, Departments of State, Transportation, General Services, Agriculture and Markets, Empire State Development Corporation, and the Hudson River Valley Greenway. Involve additional federal partners such as the US Army Corps of Engineers, US Departments of Commerce and Interior, and the American Heritage Rivers program

Hudson River Estuary Action Plan 2001

Environmental Setting

From the Adirondack Mountains to New York Harbor, the Hudson River flows through New York State for 315 miles. It begins as a small mountain lake on the side of the state's highest peak, Mt. Marcy, and ends in New York Harbor, one of the world's busiest and most populated metropolitan ports.

Halfway along its course, the Hudson River changes. About 150 miles north of the sea, the Hudson flows over the Federal Lock and Dam at Troy. From there the river becomes an estuary, flowing at sea level, where saltwater mixes with freshwater and the ocean's tides rise and fall 3 to 5 feet twice daily.

The Hudson River estuary has long been recognized as a valuable state and local resource, as well as an integral part of the North Atlantic coast environment. The estuary contains important spawning and nursery grounds for many commercially valuable fish and shellfish, such as striped bass, shad, sturgeon and blue crab. The Hudson estuary contains the only significant acreage of tidal freshwater wetlands within the state. These wetlands, along with the river's brackish tidal wetlands and stands of submerged aquatic vegetation, contribute essential nutrients that drive and support the Hudson's rich diversity of life linked in a complex web. Over 16,500 acres along the estuary from Albany-Rensselaer to Rockland-Westchester Counties have been inventoried and designated "significant coastal fish and wildlife habitat" jointly by the New York State Department of Environmental Conservation and the Department of State. The New York Natural Heritage Program has identified numerous significant sites along the estuary where rare plant and animal species or natural communities occur. The estuary also serves as an important resting and feeding area for migratory birds such as eagles, osprey, and a variety of songbirds and waterfowl.

Vegetation along the estuary's shores in undeveloped areas generally is deciduous forest, which includes oak, maple, beech, birch, hemlock, white pine and other trees. Dry rocky slopes, such as the Palisades Ridge and Hudson Highlands, support red oak and chestnut oak. Areas with deeper soils, generally located in the mid-upper reaches of the estuary, as well as moist ravines downriver, support oak, sugar maple, tulip tree, black birch, beech, hemlock and flowering dogwood.

Human Uses and Value of the Estuary

The Hudson Estuary serves one of the most densely populated areas in the country. The estuary's north end is flanked by the cities of Albany and Troy. Numerous smaller communities are located along both banks of the river to the southern Rockland-Westchester County lines. From here south, the greater New York Metropolitan area,

with its estimated population of nearly 8 million, dominates the shoreline of the estuary. Nearly one half of the population of New York State lives within the fifteen counties bordering the estuary, the largest proportion being located in the New York metropolitan area. Part of New Jersey's major metropolitan area, likewise, borders on the estuary.

People within the Hudson Basin rely on the estuary for many things: for municipal and industrial water supplies; commercial and recreational fishing; boating; relaxation and inspiration; an outdoor laboratory for education and research; commercial shipping and transportation; and the disposal of sewage effluent.

Several major power generating facilities, manufacturing plants, petroleum terminals, and cement and aggregate plants are located along the banks of the estuary, as are various mining operations. More recently, several resource recovery facilities have been built along the river, utilizing river water for cooling. Railroad tracks hug the shores of the estuary, on the east from Riverdale to Rensselaer and on the west from Haverstraw State Park in Rockland County to central Ulster County.

Economic Benefits of the Estuary Action Plan

Although the costs of implementing the plan are substantial, they are expected to produce economic benefits to the Hudson Valley region that would not otherwise be realized. The achievement of New York State in the last 30 years in cleaning up the Hudson River and its tributaries has been an essential element of the economic growth of the region and has increased real estate values of waterfront areas substantially. Maintaining high quality water resources in times of growth requires ongoing and sometimes increasing costs for sewage treatment and pollution control. Waterfront revitalization plans now underway in many communities will require open space acquisition, park development and related infrastructure to fulfill their vision.

Tourism is one of the economic mainstays of the Hudson Valley that continues to grow and offer opportunities for expansion. To improve the region as a destination for tourists and to serve the needs of a growing population, the infrastructure of river access sites, nature preserves and scenic opportunities must be maintained, developed and increased. Parks, preserves, boat launches and other access facilities have proved to be an economic engine for the communities in which they are located, stimulating the growth of businesses that serve river users and tourists.

A relatively new and promising state initiative incorporated into this Estuary Action Plan is the reuse of abandoned industrial properties on the waterfront. Proposed new uses may be industrial, commercial or recreational. Returning polluted sites to environmentally sound new uses will restore and revitalize blighted waterfronts with a spinoff of economic benefits. Opportunities for revitalization will be explored in riverfront communities.

Recent accomplishments in Beacon, NY illustrate how restoration can stimulate the revival of river cities. Focused attention on the waterfront district by NYS DEC, DOS, OPRHP and the Empire State Development Corporation has fostered improvements to Dennings Point State Park, including: development of a trail linking the train station with Dennings Point and the Madam Brett Mill Park (owned by Scenic Hudson on the adjoining Fishkill Creek); water quality improvements to the creek and the river; removal of a visually distracting industrial chimney and reuse of an old paper box printing factory by the Dia Center Art Museum. Beacon now is attracting additional arts and tourism related business on its own as a result of these improvements.

The maintenance of safe navigation channels and berthing areas is essential to the continued commercial use of the estuary. The international Port of New York and New Jersey, as well as the Port of Albany, play vital roles in the regional economy. Since sediments are continuously transported and deposited throughout the estuary, periodic dredging of the river bottom is necessary to keep these ports viable. A major goal of the New York/New Jersey Harbor Estuary Program (HEP) is to reduce inputs of toxic chemicals to insure that all dredged materials within the harbor complex will become sufficiently free of contaminants and, therefore, not pose a problem with respect to disposal or other management approaches. Due to the increased demand for marina development and expansion of recreational use of the river, there has been a parallel demand for more localized, nearshore dredging. The major factor constraining the selection of dredged management techniques and management site locations is the contamination of sediments. Environmental and economic benefits would accrue if dredged sediments were free of harmful contaminants.

The Hudson River fishery generates millions of dollars of revenue from sport and commercial fishing in the Hudson Valley and coastwide. The estuary is the nursery ground for striped bass, Atlantic sturgeon and American shad, commercial and recreational fishes that historically have been caught not only in the river, but also along the shores of Long Island, New Jersey, Connecticut and, indeed, the entire Atlantic coast. Many of these species are in crisis, their populations threatened by overfishing in coastal waters, habitat destruction, environmental impacts and other, sometimes unknown, factors. Management structures have been put in place coastwide to assure that over-fishing will be curbed, and in some cases, fisheries have been closed to allow stocks to recover. The continuation of population studies is essential to evaluate and fine tune these management decisions. Ecological monitoring and research are needed to assure that other factors affecting species viability are understood and managed. Scientists and managers agree that the function of the Hudson River's dynamic ecosystem must be better understood. This is key to future management decisions and essential for restoring the economic uses the estuary supports.

If No Action is Taken

Because of the substantial gains achieved in recent years, it is tempting to think the job is done and to move on to other things. However, it is important to recognize that maintaining the existing quality of the Hudson at a time of population growth and expansion will require ongoing expenditures for expanded amenities such as sewage treatment capacity, recreational facilities and open space protection.

Without aggressive and sustained action, the water quality of the Hudson River will deteriorate, overshadowing recent improvements. If action is not taken to control the discharge of pollutants and to restore and maintain habitats, continued growth and development in the Hudson River Valley will result in declines in the populations of fish and wildlife, in the commercial fishing industry, and in recreational opportunities and uses. Communities will bump up against limits to growth due to water supply and sewage treatment constraints. The sustainability of human communities will diminish just as it will for natural communities.

In light of increasing pressures from fishing coastwide, fish populations cannot be maintained at sustainable levels without enhanced management measures and interstate coordination. Two populations in particular, the American shad and the Atlantic sturgeon, appear to be at risk.

Action is required to improve public access to open space and to preserve the scenic values of the Hudson River Valley that draws millions of tourists to its shores. Long lines at the few boat launching facilities in the river will increase. Deteriorated launch sites will fall into greater disrepair. Key landscapes, taken for granted as part of the region's scenic heritage, can be lost permanently if development is poorly planned.

Although many hazardous waste sites have been cleaned up in recent years, an unfortunate legacy of contaminants remains that have made waterfront properties unusable and many fish unsuitable for human consumption. The potential value of resources will be lost if they are not attended to. Concerted and committed action, as outlined in this plan, is necessary to achieve the full value of the natural resources of the Hudson River estuary.

Plan Implementation

A key to the Estuary Action Plan's success is the continuation of an administrative structure that insures its implementation and subsequent updating, reflects progress made through completion of tasks, and identifies new actions to be undertaken. The Estuary Program has identified the following areas as critical to implementing the Estuary Action Plan:

- The Estuary Program must continue to track, monitor and report on program implementation, as well as maintain and improve communication and coordination among different units of government, research, and educational institutions, as well as concerned groups and individuals

- The Estuary Action Plan will be reviewed and reissued every two years to incorporate accomplishments and establish new commitments

- Adequate resources for new initiatives must be available, and funding for core programs that have been successful must be continued, utilizing funding from a variety of sources

- Partnerships with local government and the nonprofit sector should be created and funded through grants, contracts and other means to fulfill the commitments of the plan. Additional partnerships with participating agencies, conservationists, sports people, local governments, the private sector, and the public should be developed

- Participation by state and federal agencies will be focused to achieve the Estuary Action Plan objectives. This will include partnerships with the NYS Office of Parks, Recreation and Historic Preservation, Departments of State, Transportation, General Services, Agriculture and Markets, Empire State Development Corporation, and the Hudson River Valley Greenway. In addition, participants will include federal partners such as the US Army Corps of Engineers, US Departments of Commerce and Interior, and the American Heritage Rivers program

- Ecosystem-wide management of the estuarine environment will be implemented through a team approach to assure that all aspects of actions and issue resolution are considered in decision making to provide an objective analysis of the state's resources. DEC's internal Hudson River Policy Group will serve as the main focal point for this coordinated effort.

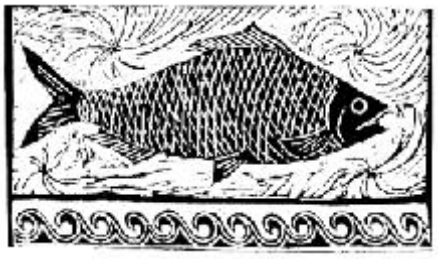
- The plan will continue to create a scientific basis for making decisions and incorporate this new information to enhance implementation of actions and subsequent management decisions over time and accomplish environmental quality by meeting goals and measurable objectives

- The Estuary Action Plan will continue to encourage public involvement and promote public education through active participation of the Hudson River Estuary Advisory Committee, special projects such as the *Hudson River Almanac*, citizen monitoring and stewardship initiatives, and expanded public outreach efforts to local governments and citizen groups to assure stakeholder involvement and incorporate the informed and

valuable ideas of the public, local government and the private sector

The achievement of New York State in the last 30 years in cleaning up the Hudson River and its tributaries has been essential to the economic growth of the region and has increased quality of life and natural resource values throughout the greater Hudson River Valley. The Estuary Action Plan leads the way into this new century for residents of the Hudson Valley to expand their vision for the stewardship of the estuary to assure that priceless resources will be available to support and enhance the lives of future generations.

Theme I - Conserving Natural Resources



Finfish, Shellfish and Crustaceans

Priority:

- Conduct stock assessment and management programs to protect and restore populations of key Hudson River fish, including shad, striped bass, Atlantic sturgeon, shortnose sturgeon, American eel and black bass

Introduction

Hudson estuary finfish have been an important food source and basis of commerce throughout the history of human habitation of the Hudson Valley. Archeological evidence indicates that the estuary's fishery resources have been utilized for well over 6,000 years. Since European settlement, fish stocks have supported subsistence, recreational, and commercial fishing.

Both migratory and resident species of fish are important in the Hudson estuary. Resident species including smallmouth and largemouth bass (collectively known as black bass), catfish, and white perch are managed exclusively by DEC. Coastal species such as American shad, river herring, striped bass, American eel, rainbow smelt, and Atlantic sturgeon, travel through the jurisdictions of many coastal states and Canadian provinces during their life cycles. Management of these species is coordinated by the Atlantic States Marine Fisheries Commission (ASMFC), an interstate agency comprised of the 15 Atlantic coastal states. Management plans are developed by representatives of states within the migratory range of the species of concern. Interstate plans then are carried out by each state for fish in waters within their jurisdiction.

State participation and implementation of ASMFC Interstate Fisheries Management Plans is required under the Atlantic Striped Bass Conservation Act of 1991 and the Atlantic Coastal Marine Fisheries Cooperative Management Act of 1993. Any state not in compliance with an ASMFC management plan is subject to a moratorium on all fishing activities for the species in question.

Several Hudson River fish populations have declined in recent years. Focused information on these stocks is needed to guide DEC's response and to effectively participate in the development of interstate management plans. Other fish stocks, such as striped bass, are abundant and may offer increased recreational and tourism opportunities if properly managed.

Status of Key Populations of Fish and Blue Crab

American shad

American shad is one of the few species commercially fished on the Hudson. Shad spend most of their lives in the ocean but return to the fresh water portion of the estuary to spawn (lay eggs) when they reach the age of four or five. After spawning, they return to the ocean. Shad spawn in the spring about the time when the shad bush, or serviceberry, is blooming along the Hudson's shores. Shad eggs need clear, clean water in order to develop. Shad do not eat during their two-month spawning run in the river. This helps them avoid exposure to contaminants like PCBs.

Shad populations have been declining in the Hudson since the 1980s. Through studies assisted by the Estuary Action Plan, DEC biologists have traced the decline to overfishing on the Atlantic coast. Other studies have shown that shad also may be severely affected by power plants in the areas of the river where the fish spawn. Shad are unintentionally drawn into the power plants along with cooling water and are killed.

The Hudson River Fisheries Unit in DEC annually collects data required to manage the Hudson shad stock. Through the Estuary Action Plan, additional information now will be collected on coastal fishing impacts. The interstate management plan for shad, adopted in October 1998, provides for a five-year phase out of the ocean "intercept" fishery for American shad, beginning in the year 2001. The additional information to be collected will help refine interstate guidelines for regulating shad fishing on the Hudson and in interstate coastal waters.

River Herring

Blueback herring and alewife, known as "river herring," spawn in the Hudson in the spring like their cousin the American shad. Herring are fished commercially, primarily as bait for striped bass fishing. They are important not only for their commercial value but also for their place in the food chain as prey for striped bass and other predatory fish.

Spawning stocks of river herring have declined in the estuary over the last ten years. Possible causes include overfishing, predation by other fish, and changes in spawning location to the Mohawk River system. Through the Estuary Action Plan, fishery managers are now collecting data on age structure and mortality rates to document change, suggest causes of change, and identify potential management responses.

Striped bass

Striped bass roam widely along the Atlantic coast, migrating throughout a range that covers more than 2,500 miles from Maine to North Carolina. In the spring mature striped bass move into estuaries where they seek fresh water to lay their eggs. In the Hudson, they spawn from Croton Point in Westchester County to Catskill in Greene County. When in the estuary, striped bass feed mainly on smaller fish, particularly herring. They need water rich in oxygen and may live as long as 30 years.

Striped bass are an extremely popular food and recreational fish. Commercial sale of Hudson River striped bass has been prohibited since 1976 because of PCBs contamination. Charter boat and sport fishing for striped bass is permitted. With PCBs levels declining in striped bass, state and federal agencies now are considering whether commercial shad fishers can be allowed to keep and sell the striped bass taken as bycatch in their shad nets. Before 1976, commercial fishing that included striped bass was a way of life for generations of New York State residents as far back as colonial times.

Recreational fishing for striped bass has increased dramatically since the mid 1980s, because, unlike shad and river herring, striped bass now are plentiful. Their numbers have increased significantly since the early 1980s, when DEC began annual monitoring of the stocks. This increase has been in response to a number of factors. In the mid 1980s, the ASMFC implemented a management plan to rebuild stocks of striped bass coastwide. The plan established size and bag limits for recreational and commercial fishers in Atlantic coastal states and achieved its desired result very quickly. The regulations in place are regularly updated in response to changes in bass populations. Mandated power plant “outages” also have benefited striped bass and other species. These outages shut down cooling water intake systems at times when these plants are most likely to kill young fish. Water quality improvements have likewise aided the recovery of striped bass.

Sport fishing for stripers is sustainable in the Hudson River at this time, but the stock may not be able to accommodate increased fishing pressure. Scientific information is needed to determine sustainable harvest levels and to continue to manage the striped bass stock in compliance with the interstate management plan.

Under Action Plan 2001, DEC will continue to expand and improve understanding of how striped bass use the estuary and what factors affect their population levels. This

will include studies of nursery areas, rates of emigration to the ocean, abundance of prey species, and ocean bycatch losses. The plan also will support the continuation of a monitoring program started in 1976 to conduct annual assessments of young-of-the-year population size.

Atlantic sturgeon

Like shad, river herring and striped bass, Atlantic sturgeon are born in the Hudson River estuary. By the time they are five years old, sturgeon depart for the ocean. Many years later, as mature adults, they return to the river to spawn. Females become sexually mature for the first time at 18-19 years. Atlantic sturgeon are bottom feeders. They eat tiny mussels, worms and insects. As young fish, they may be affected by contaminants. During spawning runs, adult sturgeon eat very little.

Sturgeon have been on the earth since the age of dinosaurs. The Atlantic sturgeon is the largest fish in the Hudson. Adults usually are 6 to 8 feet long but have been known to grow as large as 14 feet. They can live longer than 60 years.

Historically, the Hudson River estuary supported one of the largest spawning populations of Atlantic sturgeon on the Atlantic coast. However, in recent years, overharvest of adults coastwide has reduced the number of fish spawning and stocks are considered depleted throughout their range. As a result there are noticeably fewer young sturgeon in the estuary. Even so, the Hudson has one of the few remaining spawning populations on the Atlantic coast.

The NYS Cooperative Fish and Wildlife Research Unit estimates that juvenile Atlantic sturgeon declined 82% between 1977 and 1995, based on mark-and-recapture studies. In 1996, New York State adopted a moratorium on fishing for Atlantic sturgeon. By 1998, harvest moratoria were enacted in all Atlantic coastal states and in federal ocean waters.

The current ASMFC management plan for Atlantic sturgeon advises that states cannot resume harvest of sturgeon until data verify that spawning stocks and production of juveniles have recovered to acceptable levels. The plan requires states to monitor and report abundance of juveniles. Under Estuary Action Plan 1996, Cornell University conducted preliminary sampling of juvenile Atlantic sturgeon. Action Plan 2001 will develop a method for measuring juvenile abundance and stock recovery.

Action Plan 2001 also will support studies of other factors which may affect sturgeon. Off-shore commercial fishers often catch Atlantic sturgeon when netting other fish. Even when returned to the water, some of these sturgeon die. Estuary Action Plan studies to date show that accidental catches may interfere with the ability of the sturgeon population to rebuild to healthy numbers. Further work on this issue will continue.

Shortnose sturgeon

Shortnose sturgeon look similar to Atlantic sturgeon but usually grow to be only three feet long. Shortnose sturgeon use the entire estuary during different stages of their life cycle. They spawn from Coxsackie to Troy and are known to overwinter in the deepwater sections near Hyde Park. Many grow to maturity in the Hudson Highlands section of the river. Their spawning, wintering and nursery areas must all be conserved.

Shortnose sturgeon have been protected as an endangered species since the 1970s. Recent studies by Cornell University determined that the Hudson River population is the largest on the East Coast and appears to be increasing. A federal sturgeon recovery plan adopted in 1998 will establish nationwide criteria for upgrading shortnose sturgeon from endangered to threatened or for removing them from the endangered species list. When complete, these criteria will be applied to assess the status of Hudson River shortnose sturgeon.

Smelt

Smelt, an important food source for larger fish, have almost disappeared from the estuary. The Hudson River is near the southern end of its range but smelt may be easy to reestablish if the habitat can support them. Studies may be warranted to evaluate the status of the existing population and the potential to expand reproducing populations in the Hudson River and tributaries.

American eel

American eel occupy a significant and unique niche along the Atlantic Coast and its tributaries. Their life cycle is the opposite of the other migratory fish described above, in that American eels spawn at sea, then drift and swim to coastal rivers to grow and mature to adulthood. Hudson River eels, born in the Sargasso Sea off Bermuda, migrate to New York Harbor and swim up the estuary as tiny, one-year-old, transparent “glass eels,” only a few inches long. They become brown in color and change into elvers as they find their way into freshwater tributaries. There, they may eventually reach a length of up to three and a half feet. Young eels eat insects; older ones eat fish and crustaceans. Around the age of ten, American eels return to the Sargasso Sea to breed and a new life cycle begins. Eels spawn only once and then die.

Historically, American eels were very abundant in east coast streams, comprising more than 25 percent of the total fish biomass. After declining from historic levels, their abundance remained relatively stable until the 1970s. More recently, anglers, resource managers and scientists have expressed concern over a possible ongoing decline in abundance. However, there is little information on eel populations in the Hudson River to establish their status.

Small eels (between 6"-14") are caught commercially for use as bait. Research is needed to determine which life stages are being harvested and whether the Hudson is a refuge for American eel. Harvest of eels longer than 14 inches has been prohibited in the mainstem of the Hudson since 1982 due to PCBs contamination. An “eat none” health advisory has existed since February 1976. Harvest of eels shorter than 6" is not permitted to protect early life stages. However, there is some evidence that elvers and glass eels shorter than 6" in size are being harvested illegally for export to Asia.

Contaminant levels in eels are being reevaluated. The last large-scale testing for PCBs was in 1993. Substantial fisheries now exist for American eels in Mid and North Atlantic Bight watersheds and with declining PCBs levels in the Hudson Estuary, American eel fisheries might become important once again. The Hudson River Foundation recently has funded research to examine ecological and contaminant gradients in eels from the Troy Dam to New York Harbor. Regional estimates of eel dispersal and production will be linked with measures of body contamination and models of bioaccumulation to forecast whether, when, and where eel fishing can resume in the estuary.

In 1999, the ASMFC approved the first interstate management plan for American eel, which requires all participating states and jurisdictions to implement a young-of-the-year survey. Hudson River surveys will begin under Action Plan 2001.

Black Bass: Largemouth and smallmouth

There are two kinds of black bass in the Hudson estuary: largemouth and smallmouth. Both are popular among sport fishers. Black bass live in the river year round. In late spring, they build nests in the shallow water of tributaries, where the male guards the eggs and newly hatched fry from predators. In springtime, smallmouths may also travel up the tributaries to nontidal waters, while largemouths remain in shallow areas in tidal waters. In summer, both species spread throughout the freshwater Hudson and its tributaries. In winter, most largemouth bass congregate in five known areas: the Rondout, Wappingers, Esopus and Catskill Creeks and Coxsackie Cove. These largemouth bass wintering areas have been identified and are currently designated by the state coastal program as Significant Habitats. Less is known about areas used by smallmouth bass in winter. Estuary Action Plan studies have shown that smallmouth bass use the same areas as largemouth bass and also move to deepwater sections of the main river, in particular areas with rip-rap, bridge abutments and stationary navigation structures.

Populations of black bass declined between the mid 1980s and the 1990s. However, Estuary Action Plan estimates in 1999 show that populations have stabilized or increased slightly. Fish in wintering areas are concentrated and vulnerable. Protecting or

enhancing habitat for that period of their life may allow the population to stabilize or increase. DEC will continue to locate winter habitat areas, and try to determine what factors impact bass populations.

Blue crab

Blue crabs live in the river year round and feed on the bottom. Male and immature female blue crabs prefer areas of the estuary where the water is less salty. However, newly hatched larvae require salt water to survive, so males and females move toward the ocean to mate. As the young develop, they migrate back upriver to less salty nursery areas. New maps of the river bottom, commissioned by the Estuary Action Plan, will help locate blue crab nursery areas that may need to be protected.

Blue crabs grow by molting (shedding their shells). Molting occurs from spring through fall, when water temperatures are 60 degrees and higher. A blue crab molts an average of 26 times before it completely matures. The normal life span of a blue crab is about 18-26 months.

Blue crab is a popular recreational species as well as a valuable commercial one. Abundance and harvest have fluctuated within the estuary during recent years. It is illegal to harvest egg-bearing, female blue crabs. Very little is known about the details of its life history in the estuary, including the presence of vulnerable life stages over time and space, as well as characteristics of the commercial harvest. This lack of information hinders protection efforts, as well as the development of effective management responses to population changes. Through the Estuary Action Plan, DEC has begun to monitor the Hudson River blue crab fishery to determine catch rates, and the size, sex and location of catches. This work will continue.

White perch and Atlantic tomcod

These are common species that play important roles as forage fish in the estuary. Limited data have been collected on white perch populations. Fish that are stunted and diseased have been reported but not verified. Information on population trends is needed.

Tomcod populations have declined over time. The Hudson River marks the southern end of their range, which could be a factor in their decline. DEC will determine whether there is anything New York State should do to manage and benefit the stock. Possible areas of study include contaminants and population trends.

Contaminants in fish

Contaminants found throughout the Hudson River estuary ecosystem include PCBs, mercury, PAHs, dioxins and dibenzofurans. These contaminants move from the water and sediments through the food chain and end up in fish and blue crabs in concentrated amounts. People who eat the fish and the crabs may ingest these substances as well.

Fish, wildlife and the people who eat them must be protected from the risks associated with contaminants. Until the problem of contaminants in the Hudson is solved, fish consumption advisories should be strictly followed by the public. Under Estuary Action Plan 1998, the Estuary Program monitored levels of PCBs and mercury in commonly eaten fish in order to better advise the public on health concerns. Estuary Action Plan projects also are studying the effects contaminants may have on the hormonal systems of Hudson River fish.

Hudson River Utilities Impacts

Withdrawal of river water by the cooling systems of the seven power plants on the Hudson kills fish eggs and larvae and other aquatic organisms small enough to pass through the plants' cooling systems. Larger fish and invertebrates can be trapped on the cooling water intake screens and may be killed as well.

In its October 2000 report to EPA, ‹New York State Water Quality 2000', DEC said, "the use of the Hudson River to provide once-through cooling water, primarily at stream-electric generating facilities, also impacts fishery resources. Cooling water intake structures often kill fish by impingement on debris screens. But of even greater significance is the entrainment mortality as the water passes through the plant screens, pumps, heat exchanger, and discharge structure. Tens-to hundreds-of-millions of eggs, larvae, and juvenile fishes of several species are killed per year for the large volume, once-through users. The cumulative impact of multiple facilities substantially reduces the young-of-year (YOY) population for the entire river. For example, based on 24 years of study, the September 1 YOY fish populations have been reduced by as much as 25-79% for spottail shiner (1977), 27-63% for striped bass (1986), 52-60% for American Shad (1992), 44-53% for Atlantic tomcod (1985), 39-45% for alewife and blueback herring combined (1992), 30-44% for white perch (1983), and 33% for bay anchovy (1990). (The higher percentage assumes no through-plant survival; the lower number incorporates power company estimate of through-plant survival)."

Fisheries impacts are typically evaluated, for regulatory purposes, on an individual plant basis. However, that is not the case for the three power plants that were subject to the Hudson River Settlement Agreement, (Bowline, Indian Point, Roseton). Their current SPDES permit renewal proceedings are dependent on a Draft Environmental Impact Statement (DEIS) that will estimate the cumulative

mortality of major fish species at the three plants and at all other power plant intakes withdrawing more than 50 million gallons per day.

These estimates depend on historical data as well as data from ongoing riverwide monitoring programs conducted by the utilities. The DEIS uses population models to describe fish stocks, and evaluates both existing and alternative mitigation practices for the three plants.

Representatives of state and federal natural resource agencies, the utility plants' owners, and environmental organizations are participating in the SPDES permit renewal proceedings for the three plants. Methodologies developed during these proceedings may be adapted for evaluating impacts of other water withdrawals in the future. In addition, DEC will encourage new power plants to meet best- technology-available standards for clean operation and to minimize the use of cooling water from the Hudson River.

Traditional Fishing Skills

Traditional fishing methods in the Hudson River are becoming a lost art. It is important to preserve the skills and methods of the traditional Hudson River commercial fishery through youth and adult training programs using the knowledge and experience of the Hudson's remaining commercial fishers. These individuals also could instill a love of fishing on the Hudson.

The Hudson Fisheries Trust, with support from DEC, has initiated an effort to address this need. Based out of a marina in Upper Nyack, the trust will develop a program of research and education to preserve the skills, history, lore, and methods of the traditional Hudson River commercial fishing culture.

Ongoing Activities and Cooperative Research Initiatives

In addition to the ongoing work undertaken by DEC, important studies have been conducted and are underway by others. There is opportunity for partnership in these initiatives, with matching funds from the Hudson River Foundation, Sea Grant, Cornell University, the federal government and others.

The DEC Hudson River Fisheries Unit, the Hudson River Utilities Biological Monitoring Programs and Hudson River Foundation maintain ongoing activities on the Hudson River. The Hudson River Fisheries Unit's current programs include: annual stock assessments, contaminant monitoring, species management, and fish population modeling. The Hudson River Utilities Biological Monitoring Programs include winter Atlantic tomcod and striped bass surveys, among other studies. The Joint Dredging Plan for the Port of New York and New Jersey (the Bistate Plan) will conduct contaminant analysis on striped bass, winter flounder, mummichog, zooplankton,

various invertebrates and shellfish, blue crab and cormorants. Through the various monitoring programs that have been conducted by the Hudson River power companies and DEC in the Hudson River since the 1970s, a wealth of information has been compiled in databases that can help answer important management questions.

Action Agenda: Finfish, Shellfish and Crustaceans

Accomplishments to Date

The agenda for Action Plan 2001 builds on past accomplishments. Since the first Action Plan was adopted in 1996, the Estuary Program has:

- Determined that the cause of decline in shad stocks is due to overfishing, mostly in the coastal ocean. Classic signs include fewer fish that also are smaller and younger than previously observed in the shad population.

- Studied young shad and young Atlantic sturgeon to determine their sensitivity to contaminants. Conclusions indicate possible sensitivity, but testing methods need to be changed to provide greater certainty.

- Collected data on levels of contaminants in commonly eaten fish and blue crabs. Provided the Department of Health with data on contaminant levels in fish for use in considering annual public health advice on consumption of fish.

- Studied the effects that contaminants may have on the hormonal system of Hudson River fish.

- Incorporated all fish contaminant studies into a single database.

- Estimated the number of largemouth and smallmouth bass in the estuary for baseline information. Located wintering areas of smallmouth bass.

- Monitored the Hudson River blue crab fishery for baseline information.

- Mapped aquatic vegetation which provides habitat for many species.

- Supported the establishment of the Hudson Fisheries Trust to develop programs to preserve the skills, history, lore and methods of the traditional Hudson River commercial fishery.

Commitment 1. Finfish, Shellfish and Crustaceans

1a. Migratory Species (striped bass, American shad, Atlantic sturgeon, American eel, river herring)

- Survey juvenile Atlantic sturgeon for signs of stock recovery

- Conduct baseline assessment of American eel abundance, begin annual monitoring program, and evaluate management options that will support recovery

- Quantify ocean losses of American shad, Atlantic sturgeon and other species

- Complete three-year baseline assessment of river herring population status

- Collect data needed to maintain the estuary's healthy striped bass population, including:

    a. Conduct annual, long-term monitoring of young-of-the-year striped bass population size

    b. Collect information on striped bass nursery areas, rates of emigration to the ocean, abundance of species eaten by bass, and ocean losses from commercial "bycatch" harvest

1b. Resident Species (blue crab, black bass)

- Continue to obtain information on blue crab biology by completing three-year baseline study of population levels

- Continue to determine habitat requirements for black bass by completing three-year study of wintering and spawning habitat locations. Complete study of causes of decline in largemouth bass stocks

1c. Contaminants in Fish

- Collect information on local variation in fish contaminant levels by testing fish from sites of concern. Determine how local sources of pollution affect these levels.

Implementation

Lead DEC Division:	Division of Fish, Wildlife and Marine Resources
Others Involved:	Cornell University, Hudson River Foundation, Hudson River Utilities, SUNY Stonybrook Marine Sciences Research Center
Funding Estimates:	Environmental Protection Fund: $1,473,263

Aquatic Habitat

Priorities:

- Identify habitat needs to preserve biodiversity in the estuary
- Promote management strategies that support objectives for ecosystem function and sustainable human benefits
- Protect and restore wetland, shallow and aquatic habitat in the estuary through restoration and enhancement programs, as well as application of regulatory authority
- Promote public involvement in conservation and stewardship of aquatic resources

Introduction

Estuaries are among the most biologically productive areas in the world. Providing critical habitat, feeding and spawning areas, they are home to thousands of estuarine species, from birds of prey to migratory fish, to microscopic plankton. Protecting the diversity of habitats that provide ecological richness, and the quality of the waters that flow into and out these dynamic systems is essential for maintaining strong populations of fish and wildlife.

The estuary has been subject to particularly heavy use in the past. The river still serves as a corridor for ocean-going ships transporting goods to and from the inland port of Albany. The construction of major railway systems along the estuary's shores and other development of the shoreline has degraded and destroyed wetlands. Recent years have witnessed marked improvements in the estuary's condition, especially with respect to water quality and protection of important wetland habitats. Projects on the scale of shipping channel dredging, dredged material management, railroad construction, dam and lock construction and the unrestricted dumping of chemicals and waste into the river are now history. However, the harmful effects of these past activities continue today. Current environmental regulations and restrictions would not allow such projects to proceed today without adequate protection for the natural resources of the estuary.

The basis of ecosystem protection is habitat protection and management. Habitat, simply defined, is the place where a plant or animal occurs and obtains its needs to support life and perpetuate the species. Every physical feature or condition found within the estuary or along its shores is a form of habitat. Human activities alter habitats through the creation of significantly different environmental conditions that change plant and animal communities. If alterations in the quality or quantity of the original habitat are severe enough, plant and animal populations may be altered substantially, resulting in

displacement or even elimination of species. Changes in quality can be more subtle, yet the effects can be just as real and disruptive. Herein lies the major problem experienced throughout the estuary: the alteration, degradation and contamination of habitats.

Life in the Estuary: Biodiversity & Habitat

The Hudson River estuary is host to a wide diversity of plants and animals, each requiring specific conditions to live, grow and reproduce. The Hudson estuary supports this rich living resource through its varied wetland habitats, tributary streams, an aquatic system that provides an assortment of physical and chemical properties associated with the estuary's dynamic salinity gradient, and the associated uplands bordering the estuary. Although there are large gaps in our knowledge of the estuary's biological, chemical, and physical interworkings, we can make the following generalizations about life in the estuary.

Water salinity is a key factor in the distribution of life in the Hudson Estuary. Salinity in the Hudson ranges from freshwater in the northern sections of the river to salt water at its mouth. The degree of saltiness in any given location depends on the amount of freshwater flowing over the Troy Dam and entering from other tributaries. During a wet spring with heavy freshwater runoff, the river may be fresh throughout most of its length. During a summer drought, freshwater runoff drops to a fraction of spring flood conditions, and ocean water is able to penetrate far into the estuary, with brackish water present 75 miles north at Poughkeepsie. In a hypothetical "typical" year, the Hudson is freshwater from Troy to Newburgh Bay, and increasingly salty from Newburgh Bay south through the Tappan Zee to New York Harbor.

Unlike many other estuaries, the waters of the Hudson are relatively well mixed and turbulent. Except for the narrow, straight section of river from the Tappan Zee south, there is little stratification of freshwater flowing out over an intruding layer of salt water; as a result there is only a limited "nutrient trap" effect. Still, the Hudson remains enormously productive, fueled by inputs of detritus and nutrients from the watershed, and by planktonic primary production and macrophytes in the estuary.

Biodiversity in the Hudson River has yet to be characterized in detail, in part because the distribution of life is complex and changing; it varies by life stage, season, year, and habitat, and is influenced by range expansions and contractions, accidental introductions, and climatic changes. Estuarine and marine life forms swim all the way to Troy, where blue crabs, American shad, and striped bass regularly appear, and even seals occasionally make the headlines. In the Hyde Park to Castleton section of the river, biodiversity is high, where freshwater, estuarine, and occasional marine species meet and mix. Every spring, the Hudson's striped bass and American shad return here to spawn. Farther south, in the wide and shallow Haverstraw Bay/Tappan Zee, even more marine and salt-tolerant species contribute to the estuary's biodiversity, including marine mammals, tropical fishes spun off from the Gulf Stream, fiddler crabs,

diamondback terrapins, and an occasional sea turtle. Here, too, is a key nursery area for many young-of-the-year anadromous fish drifted down from upriver spawning grounds on their way to the lower estuary or ocean.

The Hudson's richness and diversity of life is related to the wide range of habitats present in its channel, shallows, intertidal fringes, and tributary streams. Waterfowl, shorebirds, birds of prey, and a host of other vertebrate and invertebrate life forms depend on food and shelter found in the Hudson's freshwater tidal marshes, mud flats, and vegetated shallows. These habitats are most abundant north of Poughkeepsie. The mouths of tributary streams, such as the Rondout Creek in Kingston, are hot spots of biological activity where migratory river herring spawn, resident fish overwinter in large concentrations, and water birds forage. Finally, the channel and other deepwater areas also critical habitats for fish and invertebrates, now are being explored with detailed benthic habitat studies.

Understanding the relationship between the assemblages of species and their habitat needs and protecting these habitat conditions is essential to the maintenance of a healthy, productive ecosystem. Maintaining a variety of habitat types within the estuary, as well as diversity within each habitat protects many less conspicuous species that are nonetheless important to the system's functioning as a whole. Habitat protection is a key element in preserving biodiversity.

Sea Level Changes

The effects of sea level rise on the shoreline and aquatic habitats of the estuary is an area of growing concern. Scientists believe that sea level around the world is rising at a rate of 1.2 millimeters (mm)/year according to studies conducted by the National Research Council. The rate of sea level rise varies along the estuary due to local variations in land subsidence and/or rise. For example, at the mouth of the Hudson, the current rate of sea level rise is about one inch per decade (2.7 mm/year) due to the sinking of the bedrock in the New York City area, while at Troy, the rate is only .7 mm/year because the land in this area is slowly rising.

According to the USEPA Office of Policy, Planning and Evaluation, potential effects from sea level rise may impact both natural and artificial environments along the shores of the estuary, including tidal marshes, urban waterfronts and the many miles of stabilized riverbank constructed for railroad lines. As sea level rises, the salt front will encroach farther up the estuary, and the river's water level will rise. Marshes will need to expand in order to keep pace with rising water levels or they may literally drown. Urban waterfront areas and other stabilizing structures will be challenged by both the natural processes of aging, as well as by rising water levels.

Changes in River Habitat Resulting from Zebra Mussels

The introduction and establishment of nonnative species also can result in significant changes to the estuary's aquatic habitats. For example, zebra mussels now are distributed throughout the estuary from Haverstraw Bay to Albany. The mussels form dense colonies of up to 50,000 individuals per square meter and can clog drinking water supply intake pipes and encrust boats, docks and submerged aquatic habitat.

Since their first appearance in the river in 1991, research conducted by the Institute for Ecosystem Studies in the freshwater portion of the river between Albany and Newburgh has documented changes that include:

- significantly reduced dissolved oxygen levels that, at times, could be harmful to fish and other aquatic life

- significant decreases in phytoplankton

- increases in water clarity and improved light penetration, allowing increases in submerged aquatic vegetation (SAV) production by 40% (1992) This increase in SAV appears to moderate the severity of oxygen depletion that otherwise would be expected to occur due to the mussel's impact.

- a significant decline in other benthic filter feeder species. Species that were abundant in 1992 now appear to be on the verge of extirpation in the river due to starvation.

- significant changes in zooplankton, and bacteria populations as well as significant decline in forage invertebrates including zooplankton, insects, crustaceans, oligocheates

Habitat Protection Issues

Future DEC activities in the estuary will focus on reclaiming degraded habitats and combating new threats to the river. Environmental laws such as the Water Resources Law, Freshwater Wetlands Law, Tidal Wetlands Law, Water Pollution Control Law, Article 15 Protection of Waters, 401 Water Quality Certifications and SPDES provide the legal backing needed to prevent future degradation of the estuary. These laws will prevent and mitigate habitat alteration from residential and commercial development, marina development, and chemical and wastewater discharges. Aquatic habitat protection issues of particular concern to this Estuary Action Plan are developing indicators of ecosystem health, submerged and benthic habits, wetlands, habitat restoration and enhancement, rare communities and species.

Biological Indicators of Ecosystem Health

Biocriteria

To assess and regulate water quality and, hence, aquatic habitat, DEC has historically relied on the chemical-specific approach. While this approach has been instrumental in making great strides in water quality improvement, there is a need to explore and integrate the use of innovative tools to assess the need for further improvements. The USEPA is promoting adoption and use of biocriteria by the states as a major new tool to assess water quality.

The USEPA defines biocriteria as "numeric values or narrative expressions that describe the reference biological integrity of aquatic communities inhabiting waters of a given designated aquatic life use." USEPA states that, when implemented, biological criteria will expand and improve water quality standards programs, help identify impairment of beneficial uses and help set program priorities. Biocriteria are valuable because they directly measure the condition of the resource (assess the biological integrity), detect problems other methods may miss or underestimate, and provide a systematic process for measuring progress resulting from the implementation of water quality programs. Biocriteria should not be the sole basis for assessment and environmental controls, but as a complement to chemical criteria and in addition to bioassays. This is the triad approach and it should be employed in the Hudson River estuary. Aquatic and terrestrial biological measures should be integrated with this.

Sediment Criteria

As discussed above, one of the most important habitat quality problems in the estuary is chemical contaminants. Once introduced, these chemicals may persist for a long time, moving between the water column, sediments and biota, being transported from the area of discharge to other parts of the estuary, as well as being passed through the food chain to higher trophic levels. The effects of PCBs, cadmium and dibenzodioxins and dibenzofurans at the population level are of particular concern. Other substances requiring further assessment of impacts in the estuary include polycyclic aromatic hydrocarbons (PAHs), lead, mercury and hexavalents.

DEC's Division of Fish, Wildlife and Marine Resources has developed sediment criteria for organic chemicals and sediment guidelines for metals. While not formal regulatory standards, these criteria and guidelines represent a best judgement of the threshold of impairment (or no-effect level) by these substances on aquatic biota and their uses. Protection of living resources and the issue of bioavailability to humans and other organisms has been fully considered by protecting for the most sensitive organism known for each chemical. The division believes that sediments that contain chemicals at

concentrations less than the criteria or guidelines pose little risk of impairment to biota. Sediments that contain chemicals in excess of the criteria or guidelines have a potential for adversely affecting living resources.

The criteria and guidelines, in conjunction with regulations, will be used to develop protective measures to provide assessment of contaminated sediments for activities such as hazardous waste site cleanup, determining impairment of aquatic resources for purposes of natural resource damage claims under CERCLA/SARA (Federal Superfund) and the Clean Water Act, issuing dredging permits and other Estuary Program planning efforts. While the sediment criteria and guidelines represent current best judgement, it is uncertain whether the sediments that exceed the guidelines or criteria are in fact problematic. Additional site-specific studies may be recommended to confirm predictions and assess the extent and severity of effects and impairment at a site. Such studies may include acute and chronic toxicity tests, benthic faunal community evaluation and analysis of tissue residues for bioaccumulable chemicals. This information allows regulators and managers to anticipate the degree of impact expected from various dredging or remedial actions when considering "how clean is clean."

Submerged Habitat

While the importance of exposed or partially exposed wetland plant communities has been recognized and studied for some time, the river's bottom (benthos) and submerged aquatic vegetation (SAV) are habitat types that until recently have received little attention.

Submerged Aquatic Vegetation (SAV)

Submerged aquatic vegetation (SAV) beds are subtidal plant communities that occur in water as much as six feet below low tide. The ecological functions of these beds are diverse. They act as nurseries for numerous fish species, including alewife, banded killifish, white perch and carp and produce organic matter that is an integral part of the river's food web. SAV beds also improve the clarity of the river. The submerged plants take in nutrients through their roots and leaves, reducing the likelihood of algal blooms. During calm periods in the river, they can filter suspended sediments leading to increased water clarity. Hudson River SAV includes native plants such as water celery and clasping-leaved pondweed, as well as nonnative species such as curly pondweed and Eurasian water milfoil.

SAV communities also provide important habitat and feeding areas for waterfowl. A number of diving ducks rely on the Hudson's SAV beds. Water celery is a favorite food of canvasbacks. Bufflehead, common goldeneye, merganser and scaup feed on plants, fish and invertebrates in vegetated shallows. Wading birds such as the snowy egret and the great blue heron frequently have been observed feeding in SAV at low tide.

Abundance of SAV varies dramatically among different reaches of the Hudson with maximum coverage of approximately 20 percent of the river's area between Kingston and Catskill. Distribution of plants is light-limited, with the highest abundances in water less than three feet deep at low tide. Water celery is by far the most common species. Water chestnut, while a conspicuous plant, does not occupy nearly as large an area as SAV.

The Hudson River SAV Project

The Hudson River SAV project began in 1993 with a workshop to identify information gaps and research needs. Good information on abundance, distribution and ecological functions of SAV is necessary for understanding and managing this important resource. Mapping bed location and extent was a valuable and important first step.

Initially, beds were identified and mapped using true-color aerial photographs for a 45-mile area extending from Norrie Point to Castleton. SAV beds were shown to make up about 14 percent of the river area in this stretch. Large-scale maps were created and data were field-verified with sampling of SAV beds to describe biomass and species composition. Presently underway is the larger and final phase of mapping which covers the area from the Troy Dam to Castleton and from Norrie Point south to Hastings-on-Hudson.

Detailed spatial analyses may be completed once the entire estuary is mapped. Other factors affecting SAV, such as exposure and proximity to sources of sediment, sea level rise or human disturbance, then can be measured. Ultimately, repeat mapping is likely to become part of the Estuary Program's monitoring plan to track changes in cover and species composition in the future.

Mapping the River's Bottom

The food chain for many aquatic species ultimately depends on invertebrate fauna that live either in or on the river's bottom. Variations in benthic substrates produce variations in invertebrate fauna. Many aquatic species spawn or seek refuge over particular substrate types. In order to manage aquatic species in the estuary, it is important to know the location and extent of different types of benthic substrates that make up the river bottom's environment.

In addition, it is known that many contaminants adhere to fine-grained sediments. Natural sediment remobilization constitutes an important source of contaminants for the water column. Understanding areas of benthic erosion and deposition will permit a more systematic approach to sampling sediments for contaminant content and will provide a better understanding of the movement of contaminants in the river.

Initiated under Action Plan 1998, the benthic substrate of the estuary is now being mapped. Once complete, there will be an entire baseline of sediment classification maps for the estuary from the Troy Dam to the Battery, NYC, based on side-scan sonar surveys, swath bathymetry surveys, sub-bottom radar and acoustic profiling, and sediment sampling. A benthic substrate analysis will include bathymetry, identification of substrate particle size and geology and measurements of sediment depths.

Under Action Plan 2001, portions of the estuary that were surveyed under Action Plan 1998 will be resurveyed in order to evaluate changes that may have occurred on the river bottom since the initial surveys. This will be a pilot study to develop techniques of change analysis. A third component of the project will conduct pilot benthic invertebrate assemblage studies in order to generate benthic habitat maps from the maps created under the baseline benthic mapping project. Ultimately, repeat mapping and trend analysis will become part of the Estuary Program's monitoring plan.

Underwater Land Management

A particularly important category of lands along the river are those that are or were once underwater. Subsequent disposal of dredged material from the navigation channel has made areas that were once underwater into a varied habitat of forested upland, marshes, sandbanks and beaches. These properties are environmentally sensitive habitat for flora and fauna that utilize freshwater tidal wetlands as well as species of special concern, such as bank swallows and bald eagles. Some of these lands are owned by other state agencies and should be transferred to DEC or OPRHP for conservation and compatible public access and recreation. Similarly, some state agencies own lands on the river that have conservation value. When such lands are no longer needed for that original purpose, they also can be transferred. To date, 785 acres have been transferred for conservation and/or river access purposes.

Coordinated management of underwater lands among state agencies is an essential element in assuring the long-term health and viability of the natural resources of the estuary, while providing for other uses such as marina development, commercial fishing, dredging and dredged material management.

Passage of the "Underwater Lands" bill in 1992 addressed several important areas concerning underwater lands. The law does the following:

- provides controls and procedures for the NYS Office of General Services (OGS) to better regulate the placement of structures or fill on or above state-owned lands by adjacent upland owners.

- provides for environmental review by DEC and DOS of proposed OGS leases and easements and requires OGS to incorporate conditions recommended by DEC, or deny the conveyance if DEC finds that resources cannot be adequately protected

- clarifies the ability of OGS to transfer jurisdiction over underwater lands to other state agencies, DEC and OPRHP, for the purpose of protecting environmentally sensitive lands, even if that agency is not the upland owner. Previously, underwater grants of land could be issued only to the adjacent upland owner

- gives DEC new regulatory authority over docks and other structures above specified thresholds in underwater lands not owned by the state

- authorizes local government to develop local comprehensive harbor management programs as part of local waterfront revitalization programs

Coordination of activities between the involved agencies will be carried out through a mutually agreed upon Memorandum of Understanding (MOU). The result will be better protection of the public's interest in underwater lands for traditional issues as well as protection of environmentally sensitive areas. DEC and OGS also will develop a methodology to allow DEC to hold the management rights to environmentally sensitive lands previously managed by OGS.

A full study should be undertaken in the future to identify the extent of state ownership along the Hudson River from Troy to New York City. An ecological inventory through the New York Natural Heritage Program should be completed to establish priorities for transfer from OGS to DEC or OPRHP.

Effects of Piers, Platforms and Moored Barges

DEC is expecting an increased number of permit requests for new structures to be located either in state waters or on permanently moored barges. Permanently moored barges currently are planned for electric generating facilities and large platforms on pilings have been proposed for New York Harbor as sites for public access and commercial/residential uses. There is growing interest in the Hudson Valley for municipal piers to serve as docking facilities, fishing access, and local water-based amenities, many of which may be incorporated into local waterfront revitalization plans.

New evidence indicates that large structures may have serious effects on the attractiveness and utility of fish habitat due to a lack of light under such structures. There also is evidence that small piers may be used actively by fish for shelter and feeding.

More detailed studies are needed to determine thresholds relating to size, height, and orientation and modifications of designs to allow some of these structures to be constructed with either neutral or beneficial effects on aquatic resources.

The most pressing need is for reliable determination of a size (length/width) threshold below which no adverse effects would be expected. Determination of this threshold would allow small facilities to be permitted without establishment of precedents that could thwart denial of permits for large detrimental structures.

Habitat Restoration and Enhancement

A variety of human activities, including routine channel maintenance undertaken by the U.S. Army Corps of Engineers (ACOE) in the last century have resulted in loss of or damage to substantial acres of intertidal wetlands and other important estuarine habitats. Action Plan 2001 will continue to support the Hudson River Habitat Restoration Project, a cooperative effort between DEC, the Department of State, and the U.S. Army Corp of Engineers, which is working toward restoring a portion of the habitat lost as a result of past activities.

Through the Habitat Restoration Project, a number of habitat types and restoration techniques have been identified as being feasible in the estuary. Among the habitat types being considered for restoration are: deep water, subtidal shallows, tidal wetland (tidal swamp, mudflat, upper tidal marsh), lower tidal marsh and tide creek. Techniques used either could reconnect wetlands with the tidal estuary or improve the tidal flushing of the existing wetlands. Some stands of invasive plants also could be eliminated.

The Army Corp's initial Reconnaissance Report, completed in July 1995, recommended feasibility studies for possible restoration of initial sites. Feasibility studies and development of habitat restoration plans have been developed for three sites in the Interim I phase of the project; these projects are proceeding to construction. A second set of sites will be investigated in the Interim II phase, with physical, biological, and geochemical studies that provide the basis for restoration design and planning, culminating in conceptual plans and preliminary engineering specifications. The knowledge gained about these and reference study sites will guide restoration design and planning at other sites in the estuary.

Habitat Restoration Plan and Manual

Wetlands restoration includes rehabilitating degraded wetland functions or reestablishing a wetland that was previously altered or converted. Restoration of lost and damaged habitats is important to sustain the vitality of the Hudson River ecosystem, particularly in an era of continued disturbance, such as that caused by the recent invasion of zebra mussels. It is important to plan for restoration in a larger, long-term context to insure that cumulative impacts from multiple restoration efforts is positive.

Under Action Plan 2001, a restoration plan will be developed to set priorities, provide a framework, and establish guidelines for a myriad of restoration efforts being undertaken at the local, state, and federal levels. A manual will be developed to support and foster small-scale restoration projects by municipalities searching for ways to restore "living waterfronts" in urban and developed settings.

Wetlands

As one of the most vital and productive areas of the natural world, wetlands are of particular concern. Wetlands have many values including: marine food production, wildlife habitat, flood and storm water control, as well as providing a natural cleansing function for the ecosystem. Knowing the extent and causes of wetland loss and/or impact can help prevent additional losses in the future and guide current management and restoration efforts.

Three areas of management concern currently being focused on include: achieving a no-net-loss of wetland and littoral zone resources; improving the state's regulatory management of the estuary's tidal wetlands; and managing and improving wetland resources through restoration and enhancement activities.

The estuary's wetlands currently are regulated by the state under the Freshwater Wetlands Act, Article 24 of the ECL from the Tappan Zee Bridge north, and under the Tidal Wetlands Act, Article 25, of the ECL from the Tappan Zee Bridge south. Federal authority is administered by the Army Corps of Engineers through section 404 of the Clean Water Act and applies throughout the estuary.

The wetlands north of the Tappan Zee Bridge are both tidal and freshwater in nature. Determining whether these tidal wetland resources are sufficiently protected by current regulatory procedures or whether additional regulatory protection is needed in order to fill existing gaps is a major focus of the Estuary Action Plan.

Under Action Plan 1998, wetlands less than 12.4 acres, located north of the Tappan Zee Bridge were mapped for the first time. These are wetlands not currently regulated under the Freshwater Wetlands Act. Mapping all of the Hudson River tidal wetlands north of the Tappan Zee Bridge will establish a baseline to achieve a no-net-loss policy and to improve wetland conservation and restoration. South of the Tappan Zee Bridge, existing 1974 tidal wetland maps are being digitized. New photos and maps are now being created to document current conditions. These tidal wetland boundaries are being entered into a Geographic Information System and updated periodically. A video will be developed for public distribution illustrating these changes in wetland boundaries.

Under Action Plan 2001, trends in tidal wetland change will be identified and the causes of observed trends assessed to enable development of strategies to most effectively prevent, manage and regulate future losses and minimize negative impacts. Knowing the

location of and how wetland loss has occurred in the past can help prevent loss or impact in the future. Once completed, wetland regulatory procedures can be assessed to determine what revisions, if any, would be appropriate to better address observed or predicted wetland loss or degradation due to inadequate regulatory protection.

Community-based Conservation and Stewardship

Local governments and community groups in the Hudson River Valley are showing an increased interest in developing watershed and tributary management plans through community based watershed partnerships. DEC, in partnership with other agencies, will provide training in resource assessment and funding for community level programs and projects that promote resource protection. The Estuary Program supports citizen involvement, including stream corridor management and citizen water quality monitoring, and will train citizens in other types of monitoring and inventory that can assist with management of Hudson River resources. The Department of State, which provides grants and technical assistance for development of watershed plans, will be a partner in this.

The Estuary Program in partnership with Soil, Water Conservation Districts, and others, will provide training and financial support to groups such as local boards, and commissions, county environmental councils and other local entities to develop local conservation programs, develop expertise in local management of tributaries and biodiversity conservation and advise county and municipal governments on estuary management issues.

A citizen's water quality monitoring program could provide the state with a greater database in order to assess a much larger percentage of the watershed's rivers and streams for their designated uses. This effort also would allow DEC to improve the quality of the information it uses in its biennial report on water quality (305b) data for the state.

Action Agenda: Aquatic Habitat

Accomplishments to Date

The agenda for Action Plan 2001 builds on past accomplishments. Since the first Action Plan was adopted in 1996, the Estuary Program has:

- Initiated the development of biological indicators to measure water quality and ecosystem health. The goal is to establish guidelines for defining normal river bottom species (benthos). It then will be possible to compare actual benthos to the criteria for normal benthos (expected completion 2001).

- Mapped 39 miles of Hudson River bottom habitats using sonar technology. Initiated plans to map an additional 115 miles.

- Mapped 125 miles of aquatic plant habitat from Yonkers to Troy. Identified types of plants in these beds, which are primarily water celery and water chestnut.

- Mapped tidal wetlands from New York City to the Troy Dam using aerial photography. Entered information into computer geographic information maps to create a baseline for measuring changes over time. Assessed changes since 1974 in tidal wetlands of New York harbor.

- Designed a plan to remove railroad ties from the Croton Bay river mouth. Project partners include Village of Croton-on-Hudson and the U.S. Military Academy at West Point.

- Initiated preliminary plan to restore two wetland habitat areas at Schodack Island. Project partners are NYS OPRHP, NYS DOS, Army Corps of Engineers and The Nature Conservancy. Goals are to restore tidal flow and control invasive plant species.

- Provided technical assistance on feasibility of restoration at sites in Yonkers, Beacon, Kingston, Rondout Creek, Hudson, Haverstraw, Coxsackie, Athens and Philipstown.

- Approved grants and environmental benefit funds to support local habitat assessment at Wicker's Creek, Westchester County; wetland restoration at Beczak Environmental Center in Yonkers; and a Cornell project to raise the awareness of recreational boaters about submerged aquatic vegetation.

- Worked with Governor Pataki's Hudson River Task Force for Marine Law Enforcement to assure improved coordination in the protection of natural resources. The task force ensures that different police agencies along the length

of the river are communicating, sharing resources and conducting cooperative training.

- Supported technical training program on stream system assessment and restoration methods, which will build local capacity for technical assistance to tributary or watershed restoration efforts.

- Worked in partnership with the Lower Hudson Coalition of Conservation Districts to provide technical assistance to local initiatives associated with the assessment, protection or restoration of natural resources in the estuary watershed.

Commitment 2. Biological Indicators of Ecosystem Health

- Field test the biocriteria model in water quality assessments on the estuary. Integrate it with other ecosystem monitoring programs currently underway.

Commitment 3. Submerged Habitat

- Extend river bottom mapping to cover the entire area from the Troy Dam to the Battery in Manhattan.

- Monitor how the extent of submerged aquatic vegetation beds changes over time; evaluate factors contributing to these changes; and detail the function of these habitats in the ecosystem.

- Assess the impact of smaller piers and floating structures to determine whether design features and size guidelines could be developed to reduce their habitat impacts.

Commitment 4. Aquatic and Shoreline Habitat Restoration

- Implement three wetland restoration projects in partnership with the Army Corps of Engineers

- If feasible, restore historic fish passage at one to two locations on tributaries of the estuary

- Continue to study the feasibility of restoring additional Hudson River habitats at up to 15 locations. Develop habitat restoration designs and an overall plan to guide future efforts

- Assist communities in efforts to enhance natural features and develop local habitat restoration plans as part of waterfront revitalization efforts

- Continue the Estuary Grants Program to support habitat restoration and restoration feasibility studies, and acquisition of lands or easements which conserve habitat

Commitment 5. Tidal Wetlands

- Assess changes in wetland acreage and vegetation types from the Tappan Zee bridge to the Troy Dam between the mid 1970s and the present. Assess the causes of these changes

- Determine the historic extent of all estuary wetlands circa 1900

Commitment 6. Community-based Conservation and Stewardship

- Provide extension services to educate people who use the estuary for recreation or other purposes about ways they can contribute to the conservation of natural resources

- Through the Estuary Grants Program, continue to support local projects that promote conservation and stewardship of the estuary

- Conduct conferences and seminars to publicize information collected under the Action Plan

Implementation

Commitment 2. Biological Indicators of Ecosystem Health

Lead DEC Division:	Fish, Wildlife and Marine Resources
Others Involved:	USEPA
Funding Estimates:	Environmental Protection Fund: $100,000

Commitment 3. Submerged Habitat

Lead DEC Division:	Hudson River National Estuarine Research Reserve (Bureau of Marine Resources)
Others Involved:	Cornell, Institute of Ecosystem Studies, Columbia University, SUNY Stony Brook, Queens College, federal agencies
Funding Estimates:	Environmental Protection Fund: $1,248,000, possible federal cost sharing

Commitment 4. Aquatic and Shoreline Habitat Restoration

Lead DEC Division:	Fish, Wildlife and Marine Resources
Others Involved:	Local Soil and Water Conservation Districts, The Natural Resource Conservation Service
Funding Estimates:	Environmental Protection Fund: $482,315; additional Bond Act and federal funds will be sought, up to about $1 million

Commitment 5. Tidal Wetlands

Lead DEC Division: Fish, Wildlife and Marine Resources
Others Involved: DEC Division of Environmental Permits, NEIWPCC
Funding Estimates: Environmental Protection Fund: $234,797

Commitment 6. Community Based Conservation and Stewardship

Lead DEC Division: Division of Public Affairs
Others Involved: Cornell University Water Resources Institute, Soil and Water Conservation Districts
Funding Estimates: Environmental Protection Fund: $316,138

Upland Habitat and Watersheds

Priorities:

- Define baseline biodiversity resources of the Hudson River estuary shore lands.
- Develop an outreach and technical assistance program for local governments, land trusts, and communities in the Hudson Valley.
- Promote conservation of biodiversity of the Hudson Valley.
- Enhance protection over the tributary streams of the estuary watershed.

The Hudson Valley hosts a remarkable variety of landscapes from large tracts of mature forest and agricultural fields to dry rocky ledges, from fast flowing tributaries to a wide array of tidal habitats, all of which contribute to the exceptionally rich biodiversity found in the Hudson Valley. These habitats and the biodiversity they support are critical to ecosystem functioning, and provide valuable services to the human community including flood control, and recreational and scenic opportunities. However, they are increasingly threatened by habitat conversion, fragmentation, invasive species, pollution and poorly informed local land use decisions. The development and implementation of a biodiversity conservation program for the Hudson River estuary shorelands and the tributary systems of the watershed is essential to reduce these threats and sustain a healthy fully functional ecosystem.

Biodiversity Conservation Framework

A draft Hudson River Estuary Biodiversity Conservation Framework, a product of Action Plan 1998, is being developed under the direction of the Hudson River Estuary Biodiversity Project Steering Committee, a group representing more than twenty organizations interested and experienced in conservation in the Hudson Valley. Based on information compiled from extensive inventories the framework, when completed, will suggest key conservation strategies and actions for conserving biodiversity in the Hudson River estuary watershed and will establish the foundation for future efforts. The framework will emphasize voluntary conservation measures that can be undertaken within the context of local home rule.

The development and implementation of this framework will require the development of a Hudson River biodiversity geographic information system (GIS) to show the location of biodiversity elements as well as the status of conservation protection in areas of ecological significance. In addition, the incorporation of human demographics will enable a better determination of the most imperiled biodiversity elements. Development of terrestrial environmental indicators and a long-term monitoring program will be incorporated as part of the estuary monitoring plan. Lastly, the conservation framework

will promote efforts to better understand the diversity of biological resources on public lands and their role in helping to meet regional conservation objectives.

Biodiversity Inventories

Adequate information on the abundance and distribution of the ecosystem's biological resources is the foundation of an effective conservation program. In 1996, under the Estuary Action Plan, DEC and its partners conducted an intensive "Gap Analysis". The Gap Analysis Program (GAP) is a nationwide effort under the direction of the Biological Resources Division of the US Geological Survey. It is the first time in the history of the United States that a comprehensive effort has been made to inventory and computerize the kinds and geographic distributions of species of plants and animals that contribute to national biodiversity. In 1996, Cornell University and the NY Natural Heritage Program began an intensive effort to apply GAP in the Hudson Valley. GAP uses satellite and other remote sensing imagery to make detailed maps of land-cover types, including the distribution of plants and animals.

To date, results from the analysis have revealed that the Hudson River Valley supports a remarkable array of vegetative cover types, which is reflected in an abundance of wildlife species, many of which have all or a significant proportion of their entire New York range within the Valley. For example, 25 of 31 vegetative cover types identified for all of New York, occur within the Valley's 4.2 million acres, an area representing about 13.5% of the land area of New York. For all New York terrestrial vertebrates combined, 83% (324 species) have documented occurrences from the valley. Within this total, the Hudson Valley study area provides habitat for 69% (25 species) of New York's total amphibian species, 58% (28 species) of New York's total reptile species, 87% (214 species) of New York's total breeding bird species, and 90% (57 species) of New York's total mammal species. This remarkable diversity has implications that in some instances take on global significance. In the case of turtles, a 200 million year old group of reptiles, the Hudson River and its tributaries has a rich diversity of species, many that are endangered. These percentages are significantly more than would be expected by chance alone for a land area of similar size in the state. This can be attributed to many factors including the range in elevation from lowlands to high peaks, a diversity of soil and bedrock geology and a gradient of fresh to salt water. Open space protected under New York State's park and forest preserve system also contributes significantly to this high level of biodiversity.

Additionally, surveys of rare species and exemplary natural communities conducted by the NY Natural Heritage Program and DEC's Endangered Species Unit have been conducted. These inventories document that the non-tidal areas of the Hudson River Valley alone provide habitat for a large percentage of New York State's rare plant species, rare animal species, and significant ecological community types. As noted in the March 2000 report, *Rare Species and Significant Ecological Communities of the counties Bordering the Hudson River Estuary North of New York City*, the

Natural Heritage Program has documented 60 different ecological community types within the study area. This number represents 47% of the state's 106 terrestrial and wetland types in an area that comprises only 13.5% of the land area of the state. This percentage rises above 50% when the New York City Burroughs are included. Researchers expect additional community types to be documented as the inventory project continues.

Some species, such as fence lizard, northern cricket frog and sable clubtail dragonfly have their only known New York State occurrences in the valley, while other species have the majority of their occurrences or some of their best remaining occurrences located withing the valley (Kentucky warbler, brook floater freshwater mussel, Karner blue butterfly, bog turtle, Indiana bat, timber rattlesnake, eastern worm snake, copperhead snake, black vulture, blue grosbeak and New England cottontail). In addition, the estuary and its associated tidal habitats contain some of the state's and the valley's rarest plants, animals and communities.

Examples of the Hudson Valley's more significant contributions to the region's biodiversity include:

Birds

Songbirds, Shorebirds, Waterfowl and Birds of Prey

The varied habitats of the Hudson River Valley support a diversity of rare and common songbirds, birds of prey, shorebirds, and waterfowl. Forest, grassland, wetland and coastal habitats within the valley are all important and unique for the bird species that they support.

The large unfragmented forests of the Catskill Mountains, Hudson Highlands, Shawangunk Ridge, and Rensselaer Plateau support populations of woodland warblers and forest thrushes as well as many birds of prey, including Cooper's hawk, sharp-shinned hawk, red-shouldered hawk, and goshawk. Rare species of these forest habitats include Bicknell's Thrush, found in high elevation spruce-fir forest of the Catskills, and the cerulean warbler, found within the extensive forests of the Hudson Highlands. Additionally, the Catskills are home to more than 120 species of breeding birds.

Grassland habitats of the Hudson Valley support several rare or declining species including Henslow's grasshopper, vesper, and savannah sparrows, sedge wren, northern harrier, meadowlark, and bobolink. Opportunities exist to conserve grassland birds in the Hudson valley in collaboration with the U.S. Fish and

Wildlife Service at the newly created Shawangunk Grasslands National Wildlife Refuge as well as on adjacent grasslands in Ulster County.

Wetlands and coastal areas greatly contribute to the diversity of birds found in this region. Tidal wetlands along the estuary support egrets, least bittern, American bittern, black rail, osprey, and many species of waterfowl. The extensive wooded swamps of the Harlem Valley (Columbia, Dutchess, Putnam counties) support breeding red-shouldered hawk and concentrations of migrating warblers. The Narrows (westernmost section of Long Island Sound) contain significant offshore island habitat for colonial wading bird rookeries and the three north shore bays of this area are among the most important waterfowl wintering concentration areas in the surrounding region. Marshes associated with the bays are valuable feeding and nesting areas for Green Heron and clapper rail. Sand beaches in this area provide essential nesting habitat for piping plover, a federally listed threatened species, and least tern. The Arthur Kill area of the lower estuary is significant for major nesting colonies and foraging areas of herons, egrets and ibises. The three island colonies established in the area represent the largest heronry complex in New York State and support a variety of species of colonial wading birds. This area also serves as an important location for nesting waterfowl and many Neotropical migrant songbirds.

Once extirpated as a breeding species in New York and until recently included on the federal Endangered Species List, the peregrine falcon has made a remarkable comeback since the 1950s. Reestablished through captive breeding programs throughout the Northeast, this falcon now breeds at about 40 sites in New York State annually. The DEC Endangered Species Unit has documented 11 peregrine falcon nests in the Hudson Valley including the ledges of tall buildings in New York City, all of the Hudson River bridges, and cliffs in the Shawangunks and the Hudson Highlands. Roughly one quarter of all the active nests in the state in any one year occur in the Hudson river study area.

Historic records of eagle sightings along the river date back to the 1880s, when large numbers were seen and recorded by naturalists. By 1900, bald eagles were no longer breeding along the Hudson River, although numbers of birds continued to spend the winter months along the lower river, utilizing the area for feeding. By 1960, even wintering birds had disappeared as a result of habitat loss and alteration, human disturbance, and chemical contaminants.

In response to active reintroduction efforts, contaminant cleanup, and most significantly, habitat protection and restoration, eagle populations have now rebounded along the Hudson. Since 1997, when a pair of eagles fledged the first known eaglet in 100 years, 20 eaglets have fledged on the Hudson estuary, half of them in 2000 when four pairs of eagles nested on the river, producing ten eaglets. Wintering numbers also continue to grow, with up to 100 eagles using the Hudson for winter feeding and roosting. The neighboring Delaware River supports the largest wintering bald eagle concentrations in NYS and one of the largest in the northeastern US. Together, the Hudson and

Delaware rivers are crucial for the life cycle of eagles which summer throughout the northeast and eastern Canada. The Estuary Action Plan has supported monitoring of eagles to develop information related to their status and needs along the Hudson River. Through this work and other related efforts, the DEC Endangered Species Unit, with partners such as the US Military Academy at West Point and the NYS OPRHP, has been able to determine that eagles which winter on the Hudson disperse near and far, with some traveling to other locations on the Hudson while most migrate north well into Canada. This will facilitate DEC's ability to manage and perpetuate the species in the future. (For more information on the migration of Hudson Valley wintering bald eagles, visit on the internet; www.learner.org/jnorth).

Reptiles and Amphibians

The Hudson River Valley offers a unique opportunity in New York State for the conservation of amphibian and reptile biodiversity because of the variety of species found here. Many of these species have all or a significant proportion of their entire New York range within the study area. Of particular importance are turtles, salamanders and frogs.

Turtles

Large wetlands scattered across Dutchess, Putnam, Ulster, and Orange counties support the highest diversity of turtles in New York State including some of New York's most imperiled species.

This resource is of global significance as well. The number of species found in the Hudson River watershed is matched in only a few other river systems in the world, including the Suwannee, the Mekong and the Irrawaddy.

Important concentration areas include the Fishkill Creek, Wallkill River, Sprout Creek, and Wappinger Creek drainage basins, as well as the Great Swamp and Taconic Ridge. These sites include rare and significant ecological communities such as floodplain forest, dwarf shrub bogs, shrub swamps and calcareous fens and provide habitat for five species of State-listed endangered, threatened and special concern species, including the bog turtle, Blanding's turtle and eastern box turtle. The Shawangunk ridge and Hudson Highlands are also important habitat areas for turtles including spotted and wood turtles. The Palisades support two declining turtle species, wood turtle and eastern box turtle. The diamondback terrapin can be found in the lower Hudson estuary as well as Jamaica Bay.

Salamanders and Frogs

Numerous areas throughout the Hudson Valley have been documented as containing crucial habitat for many species that are of state or local importance including: northern cricket frog, blue spotted salamander, marbled salamander, four-toed salamander,

spotted salamander, Jefferson salamander, and longtail salamander. Important concentration areas for these species include: Esopus/Lloyd Wetlands, Dutchess County wetlands, Hudson Valley Limestone /Shale ridges, the Palisades, Rosendale Limestone Caves, and Shawangunk Ridge.

Next Steps in Biodiversity Inventories

Under Action Plan 2001, further inventories to address the most significant data gaps will be conducted by the New York Natural Heritage Program. The project will thoroughly document globally rare plants and animals, and plants and animals listed as endangered or threatened in New York State in 18 areas of the Hudson Valley where significant biodiversity resources have been identified. It will provide an ecosystem-level understanding of each significant area by thoroughly documenting the most important rare and exemplary natural communities as defined by the New York Natural Heritage Program methodology.

Additional inventory information will be included from the NYS Amphibian and Reptile Atlas Project completed in 1999 and the NYS Breeding Bird Atlas Project, which is currently being updated with support from the Estuary Program.

Breeding Bird Atlas and New York State Bird Conservation Area Program

Information from the original *1988 Atlas of Breeding Birds in New York State* database has been valuable to DEC and other state agencies for migratory bird conservation planning and has been fully integrated into the NY Gap Analysis Project. Updating the Breeding Bird Atlas and integrating this data into the Gap Analysis Project database will allow the comparison of current and historic breeding bird distributions. This information will be useful for determining potential threats to breeding birds in the Hudson Valley, thereby supporting research activities outlined in the Hudson River Estuary Biodiversity Conservation Framework. It will also help determine if changes in land use or other factors have led to detectable changes in distributions of breeding birds in the Hudson Valley in the 20-year period between the two atlases. Because the Hudson Valley has seven bird clubs with nearly 3500 members, the region is ideal for testing new atlas methods and technologies, serving as a springboard for the state effort. Additionally, the project uses a volunteer approach, and therefore provides an excellent means to get groups and individuals active in conservation efforts in the Hudson Valley.

Fieldwork will include collecting information on breeding bird abundance and distribution. This work will also include evaluating and field testing procedures for collecting abundance data relative to specific habitat types, as well as determining ways to collect more detailed, spatially referenced information about occurrences of state-listed endangered, threatened, and special concern bird species during the atlas project.

Through Action Plan 2001, an assessment will be made to quantify the kinds of associations that can be documented between occurrences of breeding birds and land-cover types. This project will build upon existing efforts to link elements of the Hudson Valley land-cover map with spatially referenced field data about breeding bird distributions and abundances.

Information about what kinds and what proportions of land-cover types contribute to breeding bird species presence and diversity can provide guidance to managers of state lands for maintaining or enhancing breeding bird species diversity on the lands they manage. Related questions include assessment of effects of timber management practices on state forest lands, or maintenance of early stages of succession (e.g., grasslands or shrub lands) within state park or wildlife management area boundaries.

The New York State Bird Conservation Area (BCA) Program was established in 1997 to safeguard and enhance bird populations and their habitats on state lands and waters. The goal of the program is to integrate bird conservation interests for wild birds of New York and the habitats that these birds depend upon for breeding, migration, shelter and feeding, into agency planning, management and research projects, within the context of agency missions. The BCA is modeled after the National Audubon Society's Important Bird Areas (IBA) program, which began in New York in 1996. The BCA program applies criteria developed under the IBA program to state-owned properties.

To date, eleven BCAs have been designated statewide, including one site on the Hudson River, Iona Island, part of Bear Mountain State Park and a designated National Estuarine Research Reserve site. Efforts are currently ongoing to designate more BCAs. Work to be undertaken through Action Plan 2001 could aid in determining if designation of additional Hudson River estuary sites is warranted.

Waterfowl Surveys

The Hudson River corridor is an important region for waterfowl along the Atlantic Flyway. Migrating waterfowl along the Hudson River and associated wetlands have not been surveyed since 1978. Through Action Plan 2001, a project will be initiated to continue a long-term data set established in the late 1940s documenting the abundance and distribution of waterfowl in the Hudson Valley.

The project will address several management concerns including the current status of waterfowl, waterfowl habitat, hunting and recreational uses and potential conflicts between different user groups.

Using aerial survey techniques, seasonal waterfowl abundance and distribution will be documented as well as use of the estuary by hunters. Information on waterfowl hunting will help managers address issues of access and potential conflicts. A final report will outline recommendations for waterfowl conservation in the Hudson River estuary.

This project is important because it addresses two areas of biodiversity conservation planning that require more attention in the Hudson Valley. Given the importance of the Hudson Valley in the Atlantic Flyway, waterfowl (and shorebird) conservation deserves attention in this planning process. Waterfowl surveys will also compliment efforts of the Breeding Bird Atlas.

Biodiversity Conservation on Public Land

A key component to conserving biodiversity in the Hudson Valley is the sound management of natural resources on state-owned public lands. New York State owns a significant amount of land in the Hudson Valley and has the authority to make land-use decisions that could potentially influence the ecological communities present on these lands. These lands are especially important because they represent areas where management activities can be planned and implemented to meet regional conservation objectives. Furthermore, many of these land holdings overlap with significant biodiversity areas that were identified by the New York Natural Heritage Program, U.S. Fish and Wildlife Service, and the Biodiversity Project steering committee. Because of this, understanding the contribution of public lands to the overall biodiversity of the area and region is critical to establishing priorities for research and management.

State-owned public lands in the Hudson Valley include forests, and preserves managed by DEC, parks and historic sites managed by OPRHP, and lands managed by the NYS Department of Transportation and Office of General Services. Although not in state ownership, other public lands in the Hudson Valley include New York City watershed properties, and the U.S. Military Academy at West Point.

New York State public lands are classified with regard to affording protection and providing for public use. Therefore, each parcel has a different mandate and capacity for protecting sensitive species and their habitat. In general, variable mandates relate to differences in priorities given to public use and access, which influence agency policies. Despite agency and land-specific priorities, broad-based recommendations that transcend these differences should be developed for conservation of significant biodiversity elements.

In addition, the recent recognition and inclusion of biodiversity preservation and conservation as a specific goal in the NYS Open Space Plan will be an important step for insuring that biodiversity factors critical to maintaining the areas' biological significance are considered in future state acquisitions.

The overall goal of this project is to develop scientifically-based recommendations for managers of state-owned lands that will prioritize and direct future conservation efforts. Specific objectives include assessing the diversity of biological resources (both common and rare) on state-owned public lands in the Hudson Valley, determining the contribution of each land holding to the biodiversity of the region, and assessing actual or potential threats to biodiversity from internal and external sources. This project will

compliment inventory work conducted by the New York Natural Heritage Program in significant biodiversity areas and will facilitate sound open space planning. It may also lead to the designation of additional Bird Conservation Areas on state lands.

As a pilot project, comprehensive inventories of rare and endangered species, breeding birds and significant natural communities at Iona Island have resulted in recommendations for revisions to the management plan for this portion of Bear Mountain State Park.

Invasive Species

A serious threat to the estuary's biodiversity is the arrival of invasive exotic species of plants and animals. Water chestnut, purple loosestrife, and phragmites are examples of invasive plants that have displaced native wetland and aquatic species such as cattail, pickerel weed and other emergent marsh plants. Successful invasive plants tend to form solitary species stands, which are thought to have low wildlife value compared to the native species that generally grow in more diverse communities. The introduction and expansion of forest insect pests such as the gypsy moth and the wooly adelgid can create significant environmental stresses resulting in long term changes in forest composition.

Purple Loosestrife

Purple loosestrife is an exotic wetland perennial responsible for the degradation of many prime wetland habitats throughout the Hudson watershed. Cornell University has developed a biological control for purple loosestrife to maintain and restore the biodiversity of wetlands.

Through Action Plan 2001, steps will be taken to implement and monitor the use of biocontrol agents for the management of purple loosestrife in the Hudson Valley. The goal of the project is to reduce the amount of purple loosestrife in the valley and to develop techniques to map the distribution of this invasive plant. Using remote sensing techniques, such as satellite photography, characteristics specific to purple loosestrife are being distinguished that will make identification of loosestrife from satellite photographs easier. This tool will be extremely useful for documenting abundance and distribution, thereby making it easier for managers to track the spread of this invasive exotic plant, as well as follow the progress of control efforts.

Mute Swans

Mute swans are of particular interest because of rapidly expanding populations in the Atlantic Flyway. Mute swans were introduced from Europe to the lower Hudson Valley and Long Island in the late 1800s as an ornamental species. Release of these birds resulted in a wild breeding population located mainly in the lower Hudson Valley and Long Island and recent data suggests that their range may be expanding. Although they are beautiful, these birds can displace native shorebirds and waterfowl, most notably mallard and black ducks, damage native vegetation, reduce water quality, and have interfered with efforts to restore wetland vegetation along the lower Hudson River.

An understanding of mute swan abundance and distribution in the Hudson Valley is vital to assessing potential impacts on native flora and fauna. In conjunction with the waterfowl surveys described above, mute swan abundance and distribution will be documented. These surveys would further the goals of the Invasive Exotic Species Program and the Hudson River Estuary Biodiversity Conservation Framework and will be useful for assessing potential impacts on biodiversity and developing a management program.

Contaminants in the Ecosystem: Impacts of Concern

Just as chemical contaminants can impact the aquatic resources of the Hudson River ecosystem, resident species associated with upland habitat areas can also be negatively impacted by contaminants in the environment. As discussed throughout this plan, chemical contaminants in the ecosystem present significant impairments to uses such as fishing, hunting, navigation, and waterfront revitalization as well as impacts on the natural resources within the ecosystem itself. Some contaminants may impact resources at very low concentrations while other contaminants bioaccumulate and build up to toxic levels within animals high up on the food web. Potential ecosystem level impacts from contaminants may include decreased population levels due to reproductive, behavioral, and developmental changes.

Through Action Plan 1998, mink, river otter, and muskrats were collected from the upper Hudson River drainage during 1998-2000. Liver samples from 162 animals (102 mink, 40 otter, 20 muskrats) were analyzed for PCBs. Analysis of the distribution of PCB-contaminated animals indicate that levels were elevated for mink and otter collected from this section of the river which is most contaminated with PCBs. Preliminary screening for toxicological effects suggest that maximum PCB levels in mink and otter exceed the level for reproductive impairment by factors of 3 and 8.5, respectively. Screening for potential health impairment suggest that maximum levels of PCBs in mink and otter exceed criteria by factors of 6.6 and 20.5, respectively. Levels of PCBs in mink and otter collected from uncontaminated tributaries or river sections were below no-effect levels for toxicological effects. To further refine the toxicological assessment of PCB exposure for mink and otter, the liver samples are currently being

analyzed for congener-specific levels of PCBs. Additional analysis will be conducted for pesticides, lead, cadmium and mercury.

Research staff conducted a trapping survey for mink in the upper Hudson River drainage during the 1999-2000 season. A substantially lower return of mink relative to trap effort was evident for trap sites located on the contaminated section of the Hudson River downstream of Hudson Falls as comparted to sites greater than 6 kilometers from the river or upstream from Hudson Falls. The number of mink trapped per 1000 trap nights for downstream sites as compared to upstream or distant sites was 3 and 26, respectively. To further investigate the apparent decrease in abundance of mink, a more extensive assessment of mink abundance that employs the use of scent-stations equipped with track boards is currently underway. Surveys are being conducted on the most contaminated section of the Hudson River with comparable surveys on the Mohawk River and Schoharie Creek as reference.

Outreach and Technical Assistance

As more detailed information on biodiversity in the Hudson Valley is accumulated, the dissemination of information and implementation of recommendations outlined in the Biodiversity Conservation Framework will pose a challenge. Requests from local governments, land trusts and conservation organizations for assistance with biodiversity conservation and associated Geographic Information Systems are expected to increase. The use of GIS at all levels of government and the private sector to manage and manipulate digital spatial data is rapidly expanding. With the creation of National Spatial Data Infrastructure web sites, the availability of spatial data is growing. Individuals searching for data are accessing the web to locate digital sources making it essential that all who are using these data have an understanding of the complexities of GIS.

Under Action Plan 2001, three projects will be initiated to provide technical assistance on biodiversity and data management systems to fill the gap between data collection/information synthesis and the use of that information by decision makers at all levels of involvement.

- Through the Natural Heritage Program, maps of areas containing significant biodiversity resources will be created and distributed to towns and counties to promote voluntary conservation at the local level.

- The Cornell Institute for Resource Information Systems will conduct workshops throughout the Hudson Valley using a newly developed mobile GIS teaching facility. The workshops will expand the current knowledge base at the local and state government levels, while also addressing information needs of other private, state and federally funded projects, cooperative extension, and citizen groups. Increasing the awareness of existing data sets will be an integral part of the

workshop's focus. By providing an information source and training, DEC can empower land trusts, local governments and conservation organizations to conduct biodiversity conservation at the local level.

- DEC will seek a conservation partner to undertake a project to develop and support an ecologically informed community planning and decision making process. This model will be used in selected areas of significant biodiversity. Research will be conducted to determine what geographic areas are of particular ecological importance. At the same time, the Estuary Program and its partners will work with communities to build constituencies and provide tools that can be used to implement conservation measures in the context of local home rule. Concurrent efforts by the New York State Natural Heritage Program in the same areas, but focused specifically on state and federally listed species and Natural Heritage Program ecological communities of special significance, will complement these efforts. Representative sites for intensive surveys will be selected from within the significant biodiversity areas.

Tributary and Watershed Planning

The tributaries to the Hudson River estuary are a distinct yet vital component of the estuarine ecosystem and deserve special attention. Tributary streams have a direct and measurable effect on the estuary, transporting nutrients, pollutants, organisms, dissolved minerals of various kinds, and organic and inorganic suspended materials into the Hudson's main river channel. The tributaries themselves and the area of confluence with the main stem provide important habitat for migratory fishes, including striped bass, American shad, rainbow smelt, river herring, alewife, and blueback herring, as well as resident species, such as white sucker, yellow perch, spottail shiner, white perch and smallmouth bass. Long-term maintenance of fish populations that use Hudson River tributaries will require improved understanding of the biological dynamics of these areas as well as protection and improvement of water quality and possible modification of physical barriers.

The Hudson estuary is intimately connected to its watershed. The environmental health of the estuary is closely linked to the quality of the water that flows into it from its tributaries. Fundamental components of the estuary's ecosystem, such as carbon, are derived from the watershed, providing a significant portion of the 'fuel' needed to support the estuary's complex web of life. Restoration and protection of the estuary ecosystem will be in vain if the quality of its tributary waters and the natural resources (i.e., fisheries and wildlife) within its watershed are not equally restored and protected. Sediments, nutrients and chemical contaminants, that contribute to impairments in the estuary may be originating from upstream sources that are also causing problems in tributary watersheds.

An important aspect of tributary management is the protection of riparian buffers. Riparian buffers are corridors of natural trees, shrubbery, and other plants located adjacent to streams and rivers. Riparian buffers are transitional areas between the water and uplands, and provide critical habitat to plant and animal communities from both the water and upland systems. Depending on the composition of species being managed for, the width of the buffer area needed to meet the needs of the natural community will vary. For example, while many common songbirds (cardinal, blue jay, black capped chickadee) will require a buffer of 40-50 feet, more environmentally sensitive species (bald eagle, herons, scarlet tanager, American redstart) will require a buffer of more than 600', and cold water fishes will require 100-300 feet to insure clean, cool water in the stream itself.

Some of the numerous benefits of streamside, riparian buffers include:

- *Water Quality Protection* - Sediment and pollutants are ?filtered" and settle out as water passes through a buffer.

- *Flood Protection* - Buffers slow the runoff water as it rushes from the land to the river during storms and helps streams stay within their channels.

- *Erosion Control* - Plant roots and other natural streamside materials stabilize stream banks and reduce erosion of soil.

- *Wildlife Habitat* - Buffers provide cover and migration corridors for birds and terrestrial wildlife , sometimes providing a natural link for wildlife to move between critical habitats in suburban settings.

- *Fisheries* - Buffers contain forest canopies that help streams stay cool and provide a critical source of food and cover.

- *Natural Aesthetics* - Buffers provide natural beauty and a peaceful setting for hiking, river paddling, and other outdoor activities.

Although riparian corridors are important components to healthy watersheds, they face constant pressure from commercial and residential development and agricultural uses, such as grazing and cropland. Once disturbed these areas can rarely return to their original state without intervention. The Estuary Program will support the involvement of local governments, interested groups and landowners in the development of cooperative programs aimed towards protecting riparian buffers and restoring damaged buffer areas back to functional and effective habitat areas as part of the programs overall approach to tributary resource management.

There are many local, state and federal programs that support water and natural resource restoration and protection efforts. Watershed planning can provide a framework for communication and coordination among projects and participants, support information gathering and the exchange of information (data) on issues, such as contaminated sediments, and point and nonpoint sources. Planning strategies can promote successful projects implemented at the local level, as well as create and encourage pilot and full-scale projects that address problems in a watershed.

The role of the Hudson Estuary Program in tributary stewardship is to bring together interested parties to create watershed partnerships and alliances. Watershed alliances can serve as a clearing house for information and educational resources to communicate progress reports, share resources and assist in priority setting; and to promote tributary and watershed planning within the Hudson River estuary community. The Estuary Program is committed to supporting the development and initiatives of watershed alliances and serves as a partner and resource to grassroots watershed efforts throughout the Hudson River Estuary watershed.

Watershed Restoration and Protection Strategies (WRAPS) are being developed by DEC in cooperation with state, federal and local entities, such as USEPA, NRCS, DOS counties, municipalities, regional planning boards, Soil and Water Conservation Districts, Environmental Management Councils, planning boards, and Cooperative Extension. WRAPS will address the priority water quality and natural resource needs of individual watershed tributaries. Other activities that support watershed planning, such as training, resource assessment, public outreach, and implementation of actions recommended in these strategies, will be considered for funding.

Opportunities to increase federal funding or cost-sharing, for example, through the USDA Farm Bill Wildlife Habitat Incentive Program (WHIP) as well as the Wetland Reserve Program, (a cost share and easement program for restoration of wetlands on agricultural lands) could also be explored.

Actions that result from a strategy that addresses problems within the tributary watersheds ultimately benefit the estuary by improving the waters that feed the system and by providing habitat for the species that inhabit the estuary ecosystem. Often, the sources of contaminants or land-use practices that adversely affect tributary waters are non-point in nature. These sources are the result of land use, erosion and flooding, stormwater management and other activities and practices that are not linked to a facility with a wastewater discharge pipe that would be regulated by discharge permits. The development of recommendations for actions to address non-point sources, in particular, requires the input and involvement of local entities supported by the fiscal and technical resources of state and federal agencies.

Action Agenda: Protecting Upland Habitat and Watersheds

Accomplishments to Date

The agenda for Action Plan 2001 builds on past accomplishments. Since the first Action Plan was adopted in 1996, the Estuary Program has:

- Conducted a ?GAP analysis" using satellite photos to identify major habitat types in the Hudson Valley. This intensive analysis will compliment the broad-scale national GAP project currently underway.

- Continued biodiversity inventories of rare plant and animal species and significant ecological communities through the New York Natural Heritage Program. The information will be digitized so it can be used as part of the Geographical Information System (GIS). The goal is to create the finest and most extensive databases ever focused on the counties bordering the Hudson estuary.

- Developed a Hudson River Estuary Corridor Biodiversity Conservation Framework to identify important areas of biodiversity within the Hudson Valley, locate threats to biodiversity in these areas, and develop strategies for dealing with such threats through voluntary measures consistent with home rule.

- Monitored PCB levels to determine potential effects on nesting eagles along the Hudson. Fitted four adult eagles with radio transmitters so that biologists can monitor the birds' movements. Created public programs on other native Hudson River raptors. Educated the public about the role the Hudson River plays in the recovery and continued survival of the bald eagle and other birds of prey.

- Expanded the Hudson Valley portion of the *NYS Amphibian and Reptile Atlas*. Compiled 10 years of data containing more than 55,000 reports on amphibians and reptiles of the Hudson. Elicited the cooperation of 353 volunteers from 153 towns in gathering the information and began analyzing the data. Project partner is Cornell University.

- Began compiling a *Hudson River Valley Breeding Bird Atlas* in 2000 to expand and complement the statewide effort. This is the first year of a five-year project in partnership with Cornell University.

- Supported development of a *Biodiversity Assessment Manual for the Hudson River Estuary Corridor*. The manual, developed by Hudsonia Ltd., will be used by local planning boards, landowners and conservation groups to help them make informed environmental decisions in their communities. (Will be available in 2001).

- Collected and continued to analyze movement of contaminants in the food chain. These studies include: uptake by land species from the consumption of aquatic insects, injury to river otter, mink and muskrat, and contaminants in reptiles and amphibians in the Hudson River ecosystem.

- Approved grants for conservation and stewardship projects totaling $136,549 in 2000.

    - Arbor Hill Environmental Justice Corporation, Upper Hudson River Stream Keeper Project (Albany County)
    - Dutchess County EMC, Dutchess County watershed program
    - Town of Putnam Valley, Peekskill Hollow Brook Conservation and River Stewardship project (Putnam County)

- Surveyed bog turtle sites in the lower Hudson watershed. Established baseline population data for bog turtles.

- Worked in partnership with the Hudson Basin River Watch to establish water monitoring projects with students. Sixty schools, more than 100 streams and 1,800 students were involved in the program. The projects were so successful they have been used as a pilot program for citizen monitoring of water throughout the state. A new grant will include 12 more schools in monitoring water in the New York City watershed.

Commitment 7. Terrestrial Biodiversity

- Conduct intensive inventories and assessments of areas thought to have great significance for regional biodiversity and promote their conservation through voluntary measures

- Provide training on biodiversity conservation and offer technical resources to local decision-makers, community groups and landowners who request assistance

- Survey migrating waterfowl to explore relationship to habitat; assess change over time since the last survey was conducted in 1978

- Survey mute swan populations and assess their impact on native shorebirds and waterfowl

- Study the relationship of breeding bird diversity to habitat patterns and trends in the Hudson Valley

- Continue to use biological controls to reduce purple loosestrife in selected areas and assess the results

Commitment 8. Conservation of Tributaries

- Work with communities, watershed organizations and the Lower-Hudson Coalition of Conservation Districts (LHCCD) to provide technical assistance to support watershed planning efforts, such as watershed restoration and protection strategies for the tributaries that enter the Hudson south of the Troy Dam.

- Support tributary stewardship projects through the Estuary Grants Program.

Implementation

Commitment 7. Terrestrial Biodiversity

Lead DEC Division:	Fish, Wildlife and Marine Resources
Others Involved:	Cornell University, DEC Natural Heritage Program, USMA at West Point, National Audubon Society - Constitution Marsh, Nature Conservancy, Hudsonia Ltd., NYS OPRHP, Wildlife Conservation Society, Metropolitan Conservation Alliance
Funding Estimates:	Environmental Protection Fund: $1,411,746

Commitment 8. Conservation of Tributaries

Lead DEC Division:	Division of Water
Others Involved:	USEPA, NYS DOS, NRCS, County Water Quality Coordinating Committees, municipal, regional planning boards, Environmental Management Councils, Cooperative Extension, NY Sea Grant, Lower Hudson Coalition of Soil and Water Conservation Districts and watershed associations and alliances
Funding Estimates:	Environmental Protection Fund: $600,000, additional federal funding

Open Space

Priority:

- Consistent with the New York State Open Space Plan, increase coastal land conservation to protect habitat, provide public access to the river and preserve the open and scenic landscape for which the Hudson Valley is world famous.

Introduction

Open space along the Hudson River is an important component of the estuarine ecosystem and human environment. In the Hudson River corridor, open space is composed, for the most part, of undeveloped forests and agricultural fields as well as the river proper. All three components provide habitat for many migratory and resident species of wildlife, while providing products for human uses. Vegetation produced on these areas contributes organic matter to the Hudson River ecosystem, which supports life at the base of the food chain and filters pollutants before they enter the estuary. In addition, forest shading of tributary streams and the river shoreline contributes to cooler and better oxygenated water. Open space also enhances opportunities for shoreline oriented recreation and public access to the river. Finally, the views afforded by broad expanses of forests and fields enhance the scenic values of this renowned regional landscape.

To accomplish its goal of open space protection, New York State will acquire lands and easements and also will provide grants to localities and conservation nonprofits to protect river shorelines and habitats. Local support through the Estuary Program will be more focused on natural areas for which local public dollars and matching funds tend to be less available. The state Open Space Plan will be updated to include habitat and biodiversity management objectives. To date, of the Estuary Action Plan's 4,000 acre goal, more than 2,000 acres of land on or in sight of the river have been protected through acquisition.

Farmland contributes significantly to open space in the Hudson Valley and its preservation is important to the maintenance of the Hudson Valley's scenic and historic landscape, as well as to the sustainability of agriculture as a way of life. Governor Pataki's Farmland Preservation Program offers funding to protect farmland through purchase of development rights. The Farm Property School Tax Credit also provides tax relief for farmers whose major source of income is derived from agricultural property.

Development of management plans and implementation of stewardship practices for state lands along the Hudson will assure that properties are quickly made accessible to the public while protecting natural resources. Stewardship includes:

addressing infrastructure needs such as trail maintenance, electric facilities, waste management and parking, roads and bridges, where appropriate, to provide access.

Although many public agencies and private organizations have acquired conservation lands along the shores of the Hudson River, there is no mechanism for coordinating management of these lands. Increasing recreational use of the estuary must be managed in the context of habitat protection. A master plan for state lands on the Hudson could promote the following:

- Consistent and integrated management of natural and cultural resources
- Understanding of the economic benefits of open space as an asset to local economies
- Development of sustainable levels of public access
- Protection of natural resources
- Multiple use and resolution of possible conflict among user groups
- Regional interpretation
- Coordinated management-driven monitoring of resources and public use

As a first step in this coordinated planning and stewardship, DEC and OPRHP are conducting assessments of state park and conservation lands using Natural Heritage Program guidelines. (See discussion on Biodiversity conservation framework, previous chapter, for additional information on this topic). Once inventoried and mapped, state-owned lands containing plants, animals and natural communities that are rare in the state, as well as exemplary occurrences of more common natural communities, can be managed and protected better.

Action Agenda: Open Space

Accomplishments to Date

The agenda for Action Plan 2001 builds on past accomplishments. Since the first Action Plan was adopted in 1996, the Estuary Program has:

- Approved grants for local acquisition of 121.4 acres of habitat lands:
  - 31.4 acres at Stony Point Marsh/Minisceongo Creek (Rockland County)
  - 90 acres of conservation easement at Mill Creek (Columbia County) by The Nature Conservancy
- Protected 1,900 acres of lands and conservation easements through the following acquisitions:
  - 62 acres at Turkey Point in the town of Saugerties (Ulster County)
  - 1,024 acres proposed at Fishkill Ridge in Fishkill (Dutchess County)
  - 9.9 acres at Arden Point in Garrison (Putnam County)
  - 69 acres at Bristol Beach State Park and Eve's Point in Saugerties (Ulster County)
  - 450 acres of easements and conservation lands protecting views from Olana State Historic Site, former home of landscape painter Frederic Church, in Greenport (Columbia County)
  - 88 acres of upland and 35 underwater acres at Rockwood Hall property in Tarrytown (Westchester County)
  - 50 acres of conservation easement and 50 acres of fee acquisition on Montrose Point in the Town of Cortlandt (Westchester County)
  - 60 acres of Moodna Marsh in New Windsor (Orange County)

- **T** Transferred 974 acres of state land to other state or local agencies to assure their use for conservation and/or recreation:

  - 11 acres in Ossining for addition to the Crawbuckie Nature Preserve. (NYSOGS/DHCR to the Village)

  - 192 acres at Papscanee Island Nature Preserve (NYSOGS to Rensselaer County)

  - 401 acres of underwater lands in Manhattan (NYSDOT to DEC)

  - 180 acres at Anthony's Nose (U.S. Division of Military and Naval Affairs, Camp Smith to NYS OPRHP)

  - 190 acres at Schodack Island (NYS OGS to NYS OPRHP)

- **T** Endorsed NYS OPRHP Hudson Estuary Local Aid Grants for Land Acquisition since 1996 total 550.37 acres at a cost of $3,372,809 from Clean Water/Clean Air Bond Act and EPF funds:

  - Hudson Waterfront Acquisition, 2.6 acres (City of Hudson)

  - Acquisition of Verplanck Landing, 32 acres (Dutchess County)

  - Thomas Cole House Rehabilitation (Greene County)

  - Haverstraw Riverfront Park Purchase, 30 acres (Rockland County)

  - Clausland Mountain Open Space Acquisition, 50 acres (Rockland County)

  - Sleightsburgh Spit Park, Town of Esopus, 79.279 acres (Ulster County)

  - Acquisition of Habishaw Property, Yonkers waterfront 3.5 acres (Westchester County)

- **T** Improved the state's Geographic Information System to map protected open space, scenic areas and other natural resources of the estuary ecosystem.

Commitment 9. Open Space Acquisition

- Continue to acquire open space lands along or in sight of the Hudson to reach the goal of 4000 acres. Explore opportunities to conserve additional acreage identified as significant for biodiversity in the Hudson River estuary watershed.

- Develop management plans and implement capital improvements and stewardship measures for properties acquired

- Continue Estuary Grants Program support for local acquisition by municipalities and land trusts

- Assist local communities with development of new or improved access to existing locally owned public lands along the estuary

Implementation

Lead DEC Division:	Office of Land Planning
Others Involved:	Division of Lands and Forests, Fish, Wildlife and Marine Resources, Regions 3 and 4, Hudson River Valley Greenway Conservancy, NYS Office of Parks, Recreation, and Historic Preservation
Funding Estimates:	Environmental Protection Fund: $500,000 for grants; additional funds from Bond Act and other sources to be determined based on fair-market value appraisals, estimated $2-10 million

Scenic Resources

Priority:

- Enhance local and state expertise to protect scenic values of the Hudson River shoreline.

Introduction

Hudson Valley scenery has been world renowned since it was captured on canvas by the painters of the Hudson River School. It is an ever changing landscape from New York Harbor to the cliffs of the Palisades, the broad expanse of the Tappan Zee and Haverstraw Bay, the drama of the Highlands Gorge, the sweep past the monasteries and estates of Ulster, Dutchess and Columbia counties, to the flats, wetlands, sandy beach islands and bottomland forests south of Albany and Troy. While very much has changed from a century ago, the Hudson Valley remains a beautiful and ecologically significant place, enriched by the history and culture of the past and offering the opportunity for quiet reflection and recreation to residents and visitors alike. New York State residents have taken aggressive action since 1895 to protect the Palisades, the Highlands, and the historic estates, principally through acquisition of such scenic properties for parkland. Nonprofit organizations have played and continue to play a major role in this.

However, despite the remarkable achievements of the last hundred years in preserving Hudson Valley scenery, it is not yet clear that these values will survive the stresses placed on this landscape in the coming years. Because the Hudson Valley is renowned worldwide for its scenic, historic and cultural attributes, and because the region's economy depends on tourism, it is critical that these resources be safeguarded. Protecting the scenic quality of the estuary is an important component of the Estuary Program.

New York State has several laws and programs available to protect the scenic quality of the estuary, including land acquisition, regulatory review of proposed developments, and designation of scenic roads and districts. These programs are carried out by DEC, the Department of State, OPRHP and the Hudson River Valley Greenway.

In 1993, the Secretary of State designated approximately half of the Hudson River shoreline as Scenic Areas of Statewide Significance (SASS) under Article 42 of the Executive Law. Through the consistency provisions of the Coastal Management Program, state and federal agencies must ensure that permits, funding, and direct actions do not impair the scenic quality of a designated SASS. Where a SASS is located within a community with a local waterfront revitalization pan, local actions also must protect the SASS. Involvement of local governments is not complete however. In

addition, for areas outside the SASS, state and federal agencies must protect the overall scenic quality of the coastal area.

In many cases, for lands not owned by New York State, the permit review process continues to be the only significant approach to protection of scenic resources. DEC management of the river's scenery currently is divided among the state's foresters, permit analysts and planners. Like other natural resources, such as forests and fisheries, management of scenic resources requires specific training and warrants an institutional focus both at the regional and division levels. Such a focus exists for all other natural resources managed by DEC. However, many developments on or near the shore of the estuary may not require DEC permits if existing water and sewer infrastructure can be used and no disturbance of the Hudson River or other waterway is involved. While local approvals still would apply, local agencies often are unprepared to address scenic considerations.

Scenic protection can go hand in hand with economic development but must be factored into decision making at an early stage. For example, some types of development, at certain densities and heights, may have only minor impacts on the character of the estuary, while others may significantly detract from it.

Management of the scenic quality of the estuary will require multiple approaches, including acquisition and stewardship of exceptionally beautiful sites, modification of development plans to protect visual resources, and coordination between state and local government. Development of technical assistance for local and state officials is needed to assure greater protection of this natural heritage. Assistance can be provided through the Local Waterfront Revitalization Program as well as through coordination of consistency reviews by the programs of the state's agencies, including DEC, DOT, DOS, OPRHP, the Public Service Commission and the Hudson River Valley Greenway.

A task force convened by the Hudson River Estuary Program met in 1997 and developed recommendations for state action to better protect scenery. The task force report recommended technical and financial assistance to local government and listed numerous opportunities to support development and implementation of local scenic resource protection programs and training of local officials.

The Estuary Program will support conservation of scenic resources through its estuary grant program and through acquisition of open space properties which conserve valley scenery and scenic vistas.

Action Agenda: Scenic Resources

Accomplishments to Date

The agenda for Action Plan 2001 builds on past accomplishments. Since the first Action Plan was adopted in 1996, the Estuary Program has:

- Convened a task force to explore ways to conserve river scenery.
- Awarded grants for local conservation of scenic vistas at Untermyer Park in Yonkers and Manitoga Preserve in Philipstown.

Commitment 10. Protect or Enhance Scenic Resources

- Continue Estuary Grants Program support for local projects that protect or enhance views of and from the river and promote the conservation of the scenic quality of the region
- Acquire properties or conservation easements that provide scenic views and conserve river scenery

Implementation

Lead DEC Division:	HREP/Environmental Permits
Others Involved:	DOS, Hudson River Valley Greenway, DOT, OPRHP, Public Service Commission
Funding Estimates:	Environmental Protection Fund: $200,000 for grants Additional funds for land acquisition are included in cost estimates under Open Space

Theme II - Promoting Use and Enjoyment of the River

Recreation

Priority:

- Enhance and restore the recreational use of outstanding natural resources of the Hudson River estuary on a sustainable basis and, where appropriate, promote their use as a stimulus to tourism

Recreational Fishing

Understanding patterns of recreational fishing is critical to management of fish in the Hudson River estuary. Limited data based on aerial angler counts suggest that the Hudson estuary recreational fishery is among the fastest growing fisheries in New York State. Information on angler harvest and use patterns are important to evaluate the status of resident and anadromous fish stocks, impacts of management actions, and economic value of recreational use.

Popularity of the striped bass and black bass fishery has led to an increase in recreational fishing for all Hudson River species. Needed information about these existing recreational fisheries in the Hudson River includes the following: recreational fishing effort by river section and season; size, age and weight composition of the recreational catch by location and season; catch rates and disposition of the catch by fishing mode, and estimates of the total catch and harvest in numbers and pounds.

NYS Sea Grant, in partnership with DEC, is quantifying the annual dollar value of the Hudson River estuary's recreational fisheries. The Hudson River estuary economic assessment is part of a broader statewide effort to develop a model for determining the economic value of recreational fishing and then applying the model to determine the value of various regional fisheries in the state.

Creel Survey

Through Action Plan 2001, a comprehensive creel survey of sport fishing in the Hudson River Estuary will begin in spring 2001 and continue into 2002. The primary objective of the survey is to identify and quantify recreational fisheries that occur along the river. This will provide DEC with necessary data for sound management of the diverse recreational fishery resources in the Hudson River.

Ground and aerial surveys of the Hudson River estuary recreational fishery will provide estimates of catch rates, effort, total catch, disposition of catch, and size/age distribution of fish and blue crabs taken or released in the recreational fishery. Popular sport fishing targets of Hudson River anglers include striped bass, largemouth and smallmouth bass, American shad, river herring, blue crab, catfish, and Atlantic tomcod. Lower estuary anglers also can catch marine species such as bluefish, weakfish, and flounder.

Characteristics of most of the river's fisheries have not been quantified systematically. The creel survey data will provide important information to DEC on how the recreational fishery may impact fish stocks. Estimates of striped bass and American shad losses to the recreational fishery are required for compliance with Atlantic States Marine Fisheries Commission interstate fisheries management plans. The data will document the importance of the Hudson River as a fishing area and help to evaluate the economic value of the fisheries to the Hudson Valley. Additional uses of the creel data can assist NYS Department of Health in determining what is being harvested and consumed, and in development of effective fish consumption advisories for resource users.

This survey's data will be used to develop additional future surveys in subsequent years focused on selected high-priority fisheries, such as those for striped bass, American shad, black bass, and blue crab.

Catch and Release Mortality

Given the state of many of the nation's marine fisheries, the recovery of the coastal striped bass stocks, including the Hudson River, is an exceptional accomplishment. After more than a decade of severe management restrictions and patience on the part of those who pursue this species, appropriate fishing of the Hudson River striped bass resource should be provided for, while ensuring that safe levels of harvest are not exceeded, thereby causing stock declines. State management of the stock should remain consistent with the ASMFC interstate plan. This is especially true for the Hudson River estuary, where anglers are pursuing spawning striped bass on spawning grounds. The ASMFC Fishery Management Plan strongly discourages states from establishing recreational fisheries on spawning grounds during the spawning season. Angler education is needed to ensure that recreational anglers understand the limitations and sensitive nature of the striped bass fishery in the estuary.

Interstate management plans for both American shad and striped bass require states to quantify kill in state waters, whether by direct harvest or indirect kill through catch and release. To comply with interstate management plans, it is important to understand which portion of mortality is from catch and release and whether mortality can be managed by improved fishing practices. Continued growth of these fisheries may impact fish stocks and may not be sustainable if anglers shift their angling techniques to those that may be more harmful to fish. An example of this is the shift from the use of lures, which usually hook fish in the mouth, to that of live bait, which usually is swallowed and can cause internal bleeding if hooked in the gut of the fish. Mortality from catch and release occurs for both striped bass and American shad during their spawning runs. Mortality of released fish can be higher when fish are under spawning stress and being released into the freshwater conditions present in the Hudson during spring runs, especially as water temperatures warm. Initial studies in 1999 found much higher values of mortality from catch and release than previously reported. Continued work is necessary to identify the influence of angling method and water temperature on rates of mortality. Results will allow DEC to provide responsible advice to users and to develop effective fishing restrictions if needed to protect the resource.

Volunteer anglers will catch striped bass and American shad during spring spawning runs by using a variety of methods at different water temperatures. Control fish will be collected by electro fishing. All fish will be held in shore-based holding tanks for ten days to measure both immediate and delayed mortality. Results will be estimates of percent mortality by fishing method and water temperature. This work will allow DEC and anglers to identify options, such as which angling methods (lures versus live bait) and tackle (treble, versus "J", versus circle hooks) can reduce mortality caused by recreational fishing.

Black Bass

Black bass populations of the estuary have supported a high quality recreational fishery of national reputation, which has stimulated a dramatic growth in tournament and general fishing activity. Recent data on population size and tournament catch rates suggest a dramatic decline in population size and a reduction in fishing success. Current information on population size and structure is needed to update understanding of the problem. Information also is needed on potential critical habitat needs, such as overwintering locations. Work initiated under Action Plan 1998 will be continued and completed to help address these information needs.

Access Across Railroad Tracks

An increasing number of anglers have been crossing railroad tracks to fish from shore, and there is a need to provide safe access across the tracks. In 1998, Metro- North Commuter Railroad held hearings on opportunities to establish safe access for shore fishing on the estuary and its tributaries, as well as for other public uses of shoreline

access properties such as hiking, picnicking, etc. In 1999, Governor Pataki formed a task force to investigate these opportunities and make recommendations for action. The task force identified the following nine locations along the Metro-North line on the east side of the river for immediate implementation:

- Greystone station, Yonkers, Westchester County
- Riverdale station, Bronx, Bronx County
- Sparta Dock, Ossining, Westchester County
- Arden Point, Philipstown, Putnam County
- Little Stony Point, Philipstown , Putnam County
- Dennings Point, Beacon, Dutchess County
- Cold Spring Station, Putnam County
- Beacon riverfront, Dutchess County
- Annsville Creek, Cortlandt, Westchester County

Of these, three (Greystone, Riverdale and Beacon) will provide fishing access specifically.

In addition, the Estuary Program has developed shore fishing access in Verplanck, and the Estuary Grant Program has supported development of a handicapped accessible fishing access site in Castleton-on-Hudson.

A goal of three or more additional fishing access sites has been established for Action Plan 2001.

Recreational Fishing License

Presently, the Hudson River from the Tappan Zee Bridge to the Troy Dam is the only major inland water body in New York State for which no recreational fishing license is required. Although this portion of the river is tidal, it is largely freshwater, and its fisheries are managed by DEC's Division of Fish, Wildlife and Marine Resources. Exemption of a fishing license requirement for the Hudson River remains an anomaly within DEC's resource management regulations. A license is required in tidal portions of tributary streams accessible from the Hudson mainstem. It is not currently proposed to require a fishing license on the Estuary, however, this issue should be revisited in the future.

Requiring a fishing license for the Hudson River would result in numerous benefits including the following:

- Potential annual increases of dedicated resource management revenues
- Increases in NYS eligibility for additional federal Wallop-Breaux matching funds

- Increased capability to distribute fish contaminant and regulatory management information to anglers at the point of license sale through the Fishing Regulations Guide. This guide currently is given to anglers when they purchase a freshwater fishing license. Without a fishing license requirement, there currently is no direct way to deliver this guide to all Hudson River anglers.

- Improved DEC capability to obtain fisheries management information and angler preferences. Routine surveys of licensed anglers provide data on fishing activities, harvests and angler opinions. DEC cannot obtain information on Hudson River fisheries resource values and trends at present. In addition, without a known pool of potential anglers, annual harvest monitoring required under ASMFC species management plans becomes prohibitively expensive.

- Improved enforcement and compliance. Through distribution of the Fishing Guide, angler awareness of fishing regulation changes will increase as will voluntary compliance. Regulatory actions to control and manage fish harvest are the mainstay of the Hudson River fisheries management program and their effectiveness would be enhanced if a license were required.

Swimming

In the past, residents of the Hudson Valley up and down the river enjoyed swimming in the estuary. A hundred years ago, New York City's waterfront was a major attraction for swimmers. There were fifteen "baths" anchored around Manhattan and fed by river water. Four million people annually came to these "swimming pools." Pollution put an end to safe swimming for most of the river until the passage of the Pure Waters Bond Act in 1965. Slowly, the river's water quality is returning to a "swimmable" classification. Although local conditions may be unsuitable for swimming in some places, the river is classified as swimmable from Spuyten Duyvil to Coxsackie (Southern tip of Houghtaling Island), and there are public beaches at Kingston and Croton which now are quite popular. (See Appendix C. for water classifications)

Providing for increased contact recreation, including swimming, waterskiing and small craft boating, is an important element of New York's waterfront revitalization strategy. Water quality impairments affecting contact recreation need to be reduced. Often these effects are localized and related to management of municipal discharges.

Opportunities and constraints relating to swimming and other contact recreation on the Hudson are now being explored. Under Action Plan 1998, a study was undertaken in 2000 to address increased use of the Hudson River for swimming, including water quality, health, location, design and other considerations and needed actions. Combined

sewer overflows (CSOs) are a major source of pollutants that affect the classification of waters to support swimming. In addition, in some areas of the river, new beaches could be created. Preservation of these developing beach areas should be considered. Through grants to localities and possibly through land acquisition, DEC and its cooperating partners will support measures to establish new beaches for public swimming, where appropriate. Through the Clean Water/Clean Air Bond Act, remediation of CSOs will be supported in areas where the potential for contact recreation is possible.

Action Agenda: Enhance Recreational Opportunities

Accomplishments to Date

The agenda for Action Plan 2001 builds on past accomplishments. Since the first Action Plan was adopted in 1996, the Estuary Program has:

- Funded a municipal fishing pier for Verplank in the town of Cortlandt and grants for handicapped shore fishing access in the Village of Castleton-on-Hudson and for shore fishing access in Peekskill.

- Conducted surveys of recreational bass fishing on the Hudson. Estimated catch rates and total harvest for striped bass. Four season survey currently underway.

- Planned four-season creel survey of recreational fishing for all species.

- Secured $1 million in Environmental Benefit Funds for a new 1.7 mile fishing and recreation trail on the shore of Beacon. The 10-foot wide trail will make it easier for the public to reach the river for fishing, hiking and other recreation.

- Worked with Governor's Task Force on Estuary Access to establish three new shore-fishing sites and six river-access sites at railroad crossings in the Metro-North corridor.

- Initiated survey of past and present public swimming sites on the Hudson. Safety issues will be analyzed and opportunities to increase swimming on the Hudson will be explored.

- Approved Estuary Grants for the following:

    - Wildlife observation and bird banding station platform at Livingston•Ramshorn Marsh (Greene County)

    - Waterfront trail in Peekskill (Westchester County)

    - Walkway for Wildlife Observation at Sleightsburgh Spit, Town of Esopus (Ulster County)

- Provided $7,830,156 in estuary access improvements through NYSDOT ISTEA Transportation Enhancements.

Commitment 11. Enhance Recreational Opportunities

11a. Recreational fishing

- Conduct annual creel surveys to provide information on recreational fisheries for important species such as striped bass, black bass and blue crab
- Identify options, such as angling methods, to reduce mortality from catch-and-release sport fishing for striped bass and American shad
- Support the development of local fishing access sites
- Calculate the economic value of the recreational fisheries of the estuary

11b. Access Across Railroad Tracks

- Evaluate shoreline access opportunities throughout the railroad corridors on both sides of the river to determine whether additional railroad crossing access sites can be developed beyond the nine announced by the Governor's Task Force on Estuary Access

11c. Swimming

- Identify opportunities to enhance swimming, including local water quality improvements and potential beach development, where suitable

Implementation

Commitment 11a. Recreational fishing

Lead DEC Division: Fish, Wildlife and Marine Resources
Others Involved: Consultants, municipalities, nonprofits
Funding Estimates: Environmental Protection Fund: $520,000

Commitment 11b. Access Across Railroad Tracks

Lead DEC Division: Fish, Wildlife and Marine Resources
Others Involved: MetroNorth, OPRHP, NYDOS, NYDOT, municipalities, nonprofit organizations
Funding Estimates: Environmental Protection Fund: $400,000

Commitment 11c. Swimming

Lead DEC Division: Executive
Others Involved: OPRHP, municipalities, nonprofits
Funding Estimates: Environmental Protection Fund: $200,000

Boating Access

Priority:

- Expand public facilities and destinations for access and enjoyment of the Hudson River, its shorelands and natural resources

Introduction

During the past three decades, the state's effort to produce public access facilities to the Hudson has not kept pace with increased recreational opportunity and public demand. Recently, with funding from the Estuary Action Plan, DEC has made significant improvements, but much remains to be done. Throughout the Hudson estuary, the number of publicly owned launch sites still is inadequate to meet growing demand. In some areas, the stretch between sites is more than 30 miles. Some popular sites are in poor condition, and use exceeds existing capacity. Facilities in the north stretch of the river, while in good condition, often exceed capacity during summer weekends. In addition, access to the river is severely limited by railroad tracks. There is little land on the river side of the tracks, and that land is not always accessible by public railroad crossings. The high-speed-rail initiative may result in additional crossing closures and further loss of access to the river.

The need for public access has increased because of a growing population in the Hudson Valley, as well as improved water quality and the recreational opportunities this has created. For example, the resurgence of Hudson River fish stocks in response to the pure waters programs of the 1960s and early 1970s has been phenomenal. The infamous "Albany Pool," a 30-mile reach of river formerly uninhabitable by fish during portions of the year, now supports burgeoning populations of resident and migratory fish.

In addition, there is a need for other forms of water-related access, such as swimming, deepwater docking access and facilities for rowing and crew, recreational fishing, picnicking, hunting and trapping, camping and hiking, viewpoints for access to areas of scenic quality, and accessibility to handicapped users. While DEC is not charged with managing some of these types of access development, the agency can play a supportive role through its permit and other programs while working in partnership with other agencies involved in providing access, including DOS, OPRHP and the Hudson River Valley Greenway.

Collectively, these access opportunities could become a major element of the state's economic strategy for the region. By restoring deepwater docks, for example, education, research and excursion boats will be able to expand their activities. Tourists will be able to explore the region's rich heritage of parks and

historic sites. New and restored boat launching facilities will provide secondary economic benefits through the sale of fishing gear, boats and related equipment.

Boating Access Improvements

Action Plan 1996 launched a program of ecologically sustainable river access development. This program aims to add launching ramps to reaches of the river not presently served with public facilities, to restore deteriorated facilities to a functional condition, and to expand the infrastructure of sites and facilities suitable for multiple public access uses, especially where safe access across the railroad is available.

The *Hudson River Estuary Boating Access Need and Opportunities Plan and Generic Environmental Impact Statement* was released by DEC in November 1998. This plan governs the selection of new state-funded sites for boating access development under the Hudson River Estuary Action Plan. To date, eight trailer launches and 11 hand launches have been approved for funding by the Estuary Program, including sites that have received estuary grants. Preliminary designs are underway at two additional sites for trailer launches. Cartop launching for canoes and kayaks, as well as Hudson River Watertrail access needs and landings, will be considered, and linkages with Metro-North railroad stops will be explored.

Boat launch sites that have been approved through the Action Plan to date include:

Trailer boat launch sites: 8 and plans for 2

-Bethlehem, Albany County (new)
-Newburgh, Orange County (upgrade)
-Peekskill, Westchester County (upgrade)
-Athens, Greene County (upgrade)
-Mills-Norrie State Park, Dutchess County (upgrade)
-Schodack Island State Park, Rensselaer and Columbia Counties (new)
-Coxsackie, Greene County (upgrade)
-Cold Spring, Putnam County (new)
- Stuyvesant, Columbia County (plans announced)
- Haverstraw, Rockland County (funded a feasibility study for proposed county boat launch)

Eleven sites have been approved for hand launches and community boating access:

- Seven floating piers around Manhattan
- Newburg Rowing Club in Orange County
- Oscawana Island in Cortlandt, Westchester County
- Cold Spring in Putnam County (upgrade)

- Croton River in Westchester County (undertaken as an Environmental Benefit Project)

Access needs also are addressed through the state's Open Space Plan. Two reports, *Between the Railroads and the River* (1989) and *Recommendations for Improving Public Recreational Access to the Hudson River* (1984), identify needs and opportunities for enhancing access. More recently, the Hudson River Valley Greenway has adopted plans to address these needs, including support for local site development. The NYS Coastal Management Program assures that access is addressed in all approved local waterfront revitalization plans for the Hudson Valley.

Hudson River access sites also offer an opportunity for public education. Through the Estuary Program, interpretive facilities are being developed at 10 to 12 such sites, which will feature information on ecological characteristics, and the history of each particular reach of the river.

Action Agenda: Boating Access

Accomplishments to Date

The agenda for Action Plan 2001 builds on past accomplishments. Since the first Action Plan was adopted in 1996, the Estuary Program has:

- Inventoried current boat launch sites and identified possible locations for new state-sponsored launch sites.
- Upgraded trailer boat launch sites in Newburgh, Peekskill, Mills-Norrie State Park and Athens. Initiated development of an upgrade at Coxsackie.
- Built a new boat launch site in Bethlehem and initiated development of a bridge providing access to Schodack Island State Park and a planned new boat launch site there. Announced plans to construct a boat launch in Stuyvesant.
- Secured $1 million in Environmental Benefit Funds for a new 1.7 mile fishing and recreation trail on the shore of the Hudson at Beacon. The ten-foot wide trail will make it easier for the public to reach the river for fishing, hiking and other recreation.
- Approved grants to fund eleven hand launches on the estuary (Newburgh, Cortlandt, Cold Spring and Croton River, and seven in New York City,) and a feasibility study for a county boat launch proposed for Haverstraw.

Commitment 12. Boating Access Facilities

- Create and/or upgrade two or more boating access sites in areas of greatest need using the Estuary Grant Program and direct investment of state funds, where appropriate, to support trailer and hand launching, as well as community boating needs, such as floating docks in New York City, rowing facilities for crew, and docking for educational and research purposes

Implementation

Lead DEC Division:	Fish, Wildlife and Marine Resources with the NYS Office of Parks and Recreation and NYSDOS
Others Involved:	DEC HRNERR, Regions 2, 3, and 4, local governments, and nonprofits
Funding Estimates:	Environmental Protection Fund: $800,000

Interpretation and Education

Priorities:

- Expand education and ecotourism by developing a system of public and private interpretive centers and programs focused on the natural resources of the estuary

- Promote prudent management and public knowledge and appreciation of the Hudson River ecosystem through a coordinated program of environmental education, public information, interpretation, and technical assistance

Introduction

A key aspect of managing the Hudson estuary on an ecosystem basis is educating the public about the estuarine ecosystem and the myriad benefits it provides. In particular, it is important to demonstrate how human activities can positively or negatively affect the quality of the estuary and its resources, including upland watershed areas and tributaries.

The Estuary Program provides DEC with a unique opportunity to promote natural resource enhancement and better management of the estuarine ecosystem through a broad-based, regionally coordinated education program. Defined broadly, this would include environmental education, information, interpretation, and technical assistance. An educated, involved public is critical to achievement of DEC's mission to conserve, improve, and protect natural resources and to control pollution in order to enhance the economic and social well being of the people of the state.

Through Action Plan 2001, DEC will implement a plan for environmental education, public information, interpretation, and technical assistance along the estuary. The plan will promote inter- and intra-agency coordination and other potential partnerships and identify target audiences, facility needs, education programs and products, and funding. As part of this priority initiative, DEC will provide services that meet the needs of the agency's many customers, including students, teachers, land-use decision makers, and the general public. This will compliment Governor Pataki's initiative to create an institute on the shores of the Hudson, which will conduct world-class research and education on rivers and estuaries.

The resulting interpretive efforts will be a combination of facilities, programs, signage and other methods for achieving the following goals:

- The public will understand that they are members of the Hudson River ecosystem and will modify their behavior as a result of this understanding

- The public will understand their role in stewardship and how they fit into existing programs that have responsibility for the river

- The public will understand the importance of maintaining the river's quality and will become an active participant in stewardship activities that will restore/improve the river and deliver interpretive messages

- The public will understand and support state management programs (including but not limited to, the Estuary Program) with responsibilities for the Hudson

- The public will understand and treasure the Hudson's natural history

- The public will know where, when, and how to enjoy the river

Interpretive Facilities and Community Programs

An existing and growing network of parks and preserves represents a valuable opportunity to stimulate ecotourism along the Hudson River estuary. DEC should build on this network to create destinations for public enjoyment of its fish, wildlife and natural resources. Because it is a long corridor, the Hudson River does not lend itself to development of a single interpretive facility. However, a network of smaller interpretive centers focused on the natural resources of distinct reaches of the river can enhance the experience of visitors while also creating an economic stimulus for the area. Such economic development also serves to support sustained management and protection of natural resources as the basic "infrastructure" for the tourist economy.

The Hudson River Estuary Grants Program, initiated under Action Plan 1998, will continue enhancing facilities and programs on a community basis. The grants will strengthen existing facilities and programs that have proven effective in interpreting the estuary's natural resources. They also will promote creation of fresh and promising initiatives that reach new or underserved audiences. Awards will be made in each of the fiscal years covered by the Estuary Action Plan on an annual basis.

Community and individual participation in building estuary understanding also will be encouraged and supported through the continuation of the *Hudson River Almanac*. This publication offers unique insights into the natural history of the Hudson, collected and distilled from the observations of residents. The opportunity to have their observations published reinforces public interest and interaction with the resource. Promoted in bookstores and the media, the Almanac is a useful outreach tool for raising

awareness of the Hudson's resources. Through Action Plan 2001, publication of the *Almanac* will continue.

The number of schools and community groups conducting river education is increasing. The Estuary Program will support these efforts and provide a link between educators and resource managers and interpretive facilities and programs.

DEC education staff, with supporting lecturers, will conduct residential Hudson River Teacher Institutes serving educators along the entire length of the estuary. These teachers are in turn expected to reach an anticipated 40,000 students, with the potential to reach even more in the future. Support materials in the form of a Hudson River Estuarine Manual will complement this effort by supplying solid curriculum enhancement ideas, background information on estuarine ecology/ issues and a section listing local field trip sites where educators can access the estuary.

Action Plan 2001 will continue the Estuary Management Program's participation in AmeriCorps. AmeriCorps members will provide presentations, exhibits, and educational materials to schools, youth and service organizations, and the general public.

Several interpretive signage efforts were initiated under Action Plan 1998. The sturgeon logo project, undertaken in partnership with the New York State Thruway Authority, Bridge Authority, and Department of Transportation, has been very successful in creating an ecological sense of place. Through logo and stream identification signs, the project has highlighted tributary links between the watershed and the estuary and created an association between the Hudson and its natural resources in the minds of residents and visitors.

Based on recommendations in *The Nature of the Hudson*, a report on interpretive strategies completed under Action Plan 1998, the Estuary Program initiated an interpretive kiosk project. The goal is to provide stewardship messages to audiences already interested in the river (boaters, anglers) and promote new interest in the estuary in settings where visual access offers special opportunities to engage an audience (train stations, historic sites). Under Action Plan 2001, the interpretive sign/kiosk system will be expanded to provide general and site-specific ecology and stewardship messages for selected audiences at strategically selected sites. The first set of kiosks will include many boat launch sites, with the goal of communicating a stewardship message to boaters. In adding to the sign/kiosk system, likely areas of concentration will be train station platforms and historic sites, both of which have large audience potential. An estimated 15-20 additional kiosks will be added to the system.

Community Outreach and Extension

Decisions impacting the Hudson Estuary often are made at the local level by planning boards, city councils, and boards of supervisors, as well as community organizations such as land trusts. It is important that these decision makers be aware of data, resources, and information relevant to activities that may impact the estuary.

Many action plan commitments call for technical assistance to community officials for the purpose of initiating or guiding efforts to protect natural resources through local regulation and planning. Biodiversity conservation, habitat protection and restoration, scenic resources and open-space preservation, and tributary stream management will benefit from such outreach.

Through Action Plan 2001, an effort to utilize extension specialists to create an interface between resource managers and community officials will be initiated. These specialists will be familiar with both the range of government programs relevant to estuary management and the information generated by these programs.

In order to promote local decision making that better recognizes and protects regional resources, data and information generated at the state and regional level must be made available to local governments, where it can be incorporated into comprehensive plans and local land-use regulations. Improved outreach will require effective means of presenting data to a desired audience. An example would be establishing a user friendly GIS system that puts relevant information on significant habitats, biodiversity, endangered species, etc. at the fingertips of local decision makers. Methods previously discussed under the biodiversity section of this plan will augment this effort.

Stewardship by River Users

Recreational use of the river is increasing dramatically. The addition of new and improved launch sites and expanded island camping opportunities create the potential for use conflicts and environmental impacts making it incumbent on state and local jurisdictions to monitor use of the river. It will be increasingly important to promote responsible use and stewardship of estuarine resources among user groups (boaters, anglers, etc.), including protection of the estuary's habitat and the flora and fauna that make the river their home.

Law enforcement should be an integral part of the development and protection of the estuary. In the summer of 1999, Governor Pataki announced the formation of the Hudson River Estuary Law Enforcement Task Force, a cooperative effort among local police, county sheriffs, state police, state park police, and DEC Environmental Conservation Officers and Forest Rangers. The purpose of the Task Force is to improve and enhance public safety and natural resource protection by ensuring that police agencies are communicating effectively, sharing resources and conducting

cooperative training. It will ensure that officers on the river have the best safety and environment training and will maximize river coverage and improve response times for emergencies. Task Force members also will reach out to the community through programs and publications promoting environmental awareness and water safety.

Action Agenda: Interpretation and Education

Accomplishments to Date

The agenda for Action Plan 2001 builds on past accomplishments. Since the first Action Plan was adopted in 1996, the Estuary Program has:

- Assisted Orange County with the construction of an interpretive center at the Kowawese Unique Area at Plum Point.

- Installed material to alleviate shoreline damage from the 1996 floods and to prevent shoreline erosion near the Nutten Hook Ice House historic site.

- Approved grants to support six additional interpretive sites along the Hudson, including:

    - a boat for education programs at Norrie Point Environmental Education Center (Dutchess County BOCES)

    - plans for an interpretive center at Hudson River Park in New York City (The River Project)

    - plans for interpretive exhibits at Riverbank State Park in northern Manhattan (NYC Soil and Water Conservation District)

    - development of a major multimedia exhibit about the natural and cultural history of the Hudson River at an art museum in Yonkers (The Hudson River Museum)

    - winterization of the Constitution Marsh Nature Center so that it can be used year round (National Audubon)

    - creation of a major new exhibit on the Hudson watershed at the Mud Creek Environmental learning center (Columbia County Soil and Water Conservation District)

- Approved eight grants for local interpretation and education programs to be conducted by municipalities and nonprofit organizations.

- T In cooperation with the NYS Department of Transportation and the Thruway Authority, erected more than 50 new signs at major highway crossings and on Hudson River bridges with the estuary logo identifying tributaries in the watershed.

- T Create pages on DEC's website to make Hudson River estuary information available worldwide. <<http://www.dec.state.ny.us>>

- T Hosted an AmeriCorps member to educate the public about the Hudson River estuary.

- T Published *The Nature of the Hudson* report to identify strategies for improving Hudson River interpretive centers and signage, and designed a system of information kiosks to be installed in 2001 at 11 access sites.

- T Published six annual editions of the *Hudson River Almanac*.

- T Presented conferences on river habitat and estuary management through the Hudson River Environmental Society.

- T Provided grant assistance to local Soil and Water Conservation Districts to conduct educational programs in the estuary.

- T Assisted Governor Pataki in the creation of the Hudson River Task Force for Marine Law Enforcement. The task force ensures that different police agencies along the length of the river are communicating, sharing resources and conducting cooperative training.

Commitment 13. Interpretation and Education

- ‘ Continue to support the development of interpretive and educational programs that contribute to enhanced public understanding of estuary management issues through the Estuary Grants Program.

- ‘ Continue to support development or improvement of facilities for interpretation and education through the Estuary Grants Program, emphasizing opportunities to observe and directly experience fish, wildlife and the river environment

- Provide technical assistance to community groups and municipalities seeking to promote understanding and appreciation of the estuary, and provide training for teachers

- Support the *Hudson River Almanac* as a key tool to encourage outreach and expand citizen stewardship and understanding of the entire Hudson River watershed.

Implementation

Lead DEC Division:	Hudson River Estuary Program
Others Involved:	Division of Public Affairs and Education, Cornell University Water Resources Institute, New England Interstate Water Pollution Control Commission
Funding Estimates:	Environmental Protection Fund: $1,486,498

Theme III - Cleaning Up Pollution

Waterfront Revitalization

Priorities:

- Promote cleanup and reuse of contaminated sites along the Hudson estuary
- Increase opportunities for appropriate use of private and public lands
- Provide scenic, ecological and recreational enhancements to riverfront sites which have been or are being developed under approved waterfront revitalization strategies

Introduction

As the Hudson Valley's economy continues to diversify, a key element of the region's economic strategy will be to strengthen and revitalize riverfront communities, both as destinations for tourists and as vibrant places to live and work. Directing new growth to urban and community centers will reduce suburban sprawl, thereby protecting the open space and agricultural lands that support the region's quality of life and diversified economic base.

Riverfront Communities

The Hudson River corridor has a long history of human settlement and economic development. The Hudson was the region's first transportation corridor, and, after construction of the Erie Canal, the region became the main gateway to the interior of our young nation.

The importance of the river as a transportation route gradually yielded, however, to the railroads and then to the extensive highway systems of today. In many places, the railroad tracks and highway corridors were constructed close to the river, cutting off access to the water. Population centers concentrated around the historic ports and

landings where access to the water was available, keeping development from much of the river's shores and helping to preserve its natural resources and scenic integrity.

Reduced dependence on water-borne transportation gradually lead to the deterioration of waterfront infrastructure. Evolution of the regional economy away from heavy industry resulted in abandonment of large structures on prime waterfront parcels with unsightly and environmentally negative consequences. For some time, the Hudson River was considered the unappealing back yard of most communities, a place to be avoided.

Today, however, the Hudson's improved water quality and the increasing demand for recreation has turned attention once more to the river's assets. The Hudson remains most accessible from historic ports and landings. These waterfront areas offer the most environmentally compatible opportunities for siting new commercial and recreational facilities. Recreating viable and attractive waterfront cities and villages reinforces historic development patterns and preserves the natural resources that support diverse habitats and contribute to the highly scenic character of the Hudson River corridor, setting a standard for quality economic development in the region.

To support redevelopment of local waterfront areas, state assistance can repair or replace deteriorated infrastructure, clean up industrial wastes, foster reuse of notable industrial structures or demolish those beyond repair, and provide public attractions that will draw people to the waterfront as well as to urban amenities in adjacent areas.

Recently, Governor Pataki has established two new programs to redevelop urban waterfronts and guide new development to population centers, the Waterfront Rediscovery Program and the Quality Communities Initiative. Both programs are administered by the Department of State and include involvement of many state agencies such as, DEC, DOH, ESD, DOT, Agriculture and Markets, OPRHP, Office of Real Property Services, and the Hudson River Valley Greenway.

In addition, Clean Water/Clean Air Bond Act and EPF grants support revitalization efforts through the programs of DEC, OPRHP, DOS, and the Greenway. These grant programs include the following:

- Municipal Park category of the Bond Act, which provides funds to localities for park acquisition and development

- State Park Improvement Projects under the Bond Act, which help develop and maintain the state park system along the Hudson and elsewhere

- Waterfront Revitalization grants from the Environmental Protection Fund managed by the DOS Coastal Program

- Local Assistance grants for planning and project implementation pursuant to the Hudson River Valley Greenway

- Water quality infrastructure grants to localities under the municipal water quality section of the Bond Act

Collectively, these state efforts, in partnership with local communities, constitute a significant public effort to recapture the economic and quality of life benefits offered by the Hudson.

Local Waterfront Revitalization Program

Combining Environmental Protection Fund grants with technical assistance, the Department of State helps municipalities plan, design, and construct the infrastructure and amenities that will turn their waterfronts into community assets and economic generators. Projects to date have included: linking downtowns and waterfronts (Albany and Rensselaer); redeveloping abandoned industrial areas (Troy, Hudson, Newburgh, Peekskill); constructing new parks and boat launches (Yonkers, Beacon, Castleton, Croton-on-Hudson, Sleepy Hollow, Stony Point, Esopus, and Coeymans); and overcoming highway or rail barriers that prevent or hinder access to the river (Albany and the Village of Tivoli). Municipalities also may use local waterfront revitalization grants to prepare intermunicipal watershed management plans, habitat restoration plans, and harbor management plans.

Hudson River Marina Assistance

Thousands of New York State residents gain access to the Hudson River annually by boating and they rely on public and private marinas and boat club facilities for river access. These facilities afford an excellent vehicle to provide environmental and safety information to the public. Many boating facilities are rapidly losing dockage areas and navigable channels because of sediment deposition. Dredging of these facilities is necessary to insure continued boater access onto the Hudson. Organizations representing marine interests have requested that DEC assist them in dealing with dredging and disposal, which has become costly and often impracticable.

Through Action Plan 2001, the Estuary Program will work with local, state and federal agencies and the private sector to develop a regional strategy to provide assistance to marinas and boat clubs including the following:

- Promote the implementation of Best Management Practices at marinas and boat clubs along the Hudson River to reduce or eliminate the impacts of contaminants discharged from these facilities. A companion program for marina operators and boat clubs on the Hudson River to assist them in educating the boating public on matters of safety,

pollution prevention, habitat protection and other environmental issues related to the Hudson will be conducted. Hudson River interpretive stations will be established at participating marinas and clubs, with information provided by NYSOPRHP and NYSDEC.

- Develop a database of sediment contaminants, using existing data from DEC sampling efforts and applications submitted for dredging projects. The information will be utilized to categorize contaminant types in various segments of the estuary. Once completed this information will be analyzed to determine whether nonpoint contaminant sources can be identified and remediated. A mechanism to create a fund to mitigate the costs of dredge material management, similar to that proposed for the Long Island Sound, also will be explored. In addition, the data sets may enable regulatory agencies to reduce the number of substances required for testing for dredging projects, if it can be shown that such substances are not known to occur in the Hudson. This will further reduce costs.

- Evaluate environmentally protective disposal options and uses of dredged materials and pursue options for federal funding assistance.

Brownfields

An important DEC initiative known as the Voluntary Cleanup Program has the potential to clean up contaminated industrial sites (brownfields) and return them to productive use. In response to interest expressed by developers, lending institutions and investors to return contaminated sites to the economic base, the program promotes cleanup of contaminated sites while addressing concerns of liability and accountability by those legally responsible for cleanup of the sites. Once a volunteer enters into a voluntary clean up agreement, DEC sets standards for the identification of contamination at the site, specifies a remediation plan and schedule, and releases the volunteer from liability after agreed-upon cleanup levels are reached. Cleanups ensure full protection of public health and the environment. The intended use of the site determines the nature of the cleanup that the state will require.

Under the Brownfields program, the Clean Water/Clean Air Bond Act established a $200 million Environmental Restoration Projects Fund to provide financial assistance to municipalities to investigate and/or remediate brownfield properties.

Abandoned Boats and Derelict Structures

The Hudson River shoreline is littered with abandoned pleasure craft and debris such as old railroad ties. While many of these structures have been assimilated into the river's

environment and potentially provide desirable habitat, they also impair waterfront revitalization and tourism initiatives. Removal and proper disposal of these materials would be very costly.

Under Action Plan 2001, a project will be initiated to develop an evaluation methodology for the types of abandoned materials present in the river, a protocol for developing an inventory of structures in the estuary and criteria to assess impacts on aesthetics, habitat and other identified factors. Two or more demonstration projects will be undertaken to assess a multi-agency review and coordination process for this kind of undertaking. When completed, the demonstration projects will serve as the basis for the development of a guidance document which can be used by local municipalities and others with an interest in abandoned structures and will provide local communities, as well as state and federal agencies, with guidance on abandoned structure management activities.

Action Agenda: Waterfront Revitalization

Accomplishments to Date

The agenda for Action Plan 2001 builds on past accomplishments. Since the first Action Plan was adopted in 1996, the Estuary Program has:

- Established interagency coordination on grant programs for economic development, parks, historic preservation, waterfront revitalization, brownfields cleanup, and water quality improvement. Along the Hudson Estuary, this process supports revitalization efforts of riverfront communities and is coordinated with the Estuary Action Plan.

- Completed the investigation of five brownfield sites and continued the investigation of eight brownfield sites. Additional sites will be investigated this year.

- Began or completed brownfield cleanups at the following locations:

    - City of Troy, South River Street Site, proposed location for new office facilities and truck garage

    - Irvington Waterfront Park. The site will be transformed into a public park.

    - Town of Cortland, Steamboat River Front Park. Property will be developed as part of a larger public park and recreation area

    - The former Hudson Petroleum site on the city of Hudson's waterfront scheduled for reclamation this year (NYSDOS provided grants for survey of the tank farm, tank removal and preliminary site remediation) the area will be turned into a combined public park/commercial site

    - Two sites in the City of Poughkeepsie:

        - The Former Hamilton Reproduction Site, which the city plans to sell to an adjacent manufacturing facility for use as a parking lot

        - The Qual Krom Site, which the city plans to redevelop for residential use

- City of Beacon, Brunetto Cheese property. The city plans to use this property for transitional housing for older homeless adults

- The Yonkers Downtown Waterfront; 4 contaminated properties totaling 8.4 acres are involved; Phase I has been approved for reclamation; the area will be developed into a mixed-use site including a public trail

- Three sites in Albany County:

    - Former Railroad Operations site; the County plans to market the site for redevelopment

    - Gansevoort/Franklin St; the County plans to market the site for redevelopment

    - Former Jared Holt manufacturing site; the City plans to use the site for residential or commercial development

- Two sites in the City of Newburgh, Orange County:

    - Provan/Ford site; the City plans to sell the property for commercial or industrial purposes.

    - Jonas Automotive; the City plans to redevelop and market the site.

T Explored permit issues for removal of abandoned structures and identified model project opportunities underway.

T Supported 78 local projects totaling $7,442,048 for waterfront revitalization through EPF grants awarded by DOS Coastal Program.

T Provided grant assistance for local Soil and Water Conservation Districts to offer technical and project management assistance to communities seeking to undertake waterfront revitalization efforts.

Commitment 14. Waterfront Revitalization

14a. Riverfront Communities

- Continue a coordinated approach to the economic revitalization of waterfronts through state grant programs

- Support infrastructure needs for waterfront revitalization efforts, especially in urban areas where public access is provided

14b. Marina Assistance

- Provide technical assistance to marinas and boat clubs in managing environmental concerns

Commitment 15. Brownfields

- Continue to seek the participation of municipalities in the voluntary clean-up and restoration of contaminated urban waterfront sites. Provide technical and financial support to preliminary investigations and cleanups. Seek the passage of the Governor's proposed Superfund Bill to provide continued funding for clean-up of priority sites.

Commitment 16. Abandoned Boats and Derelict Structures

- Conduct demonstration projects on how to remove abandoned structures without damaging habitat values

Implementation

Commitment 14a. Riverfront Communities

Lead Division:	DOS Waterfront Revitalization Program/Coastal Resources
Others Involved:	DEC, OPRHP, Greenway, DOT, Empire State Development Corps.
Funding Estimates:	Grants to be determined from Environmental Protection Fund and Clean Water Clean/Air Bond Act based on competitive process

Commitment 14b. Marina Assistance

Lead DEC Division:	Environmental Permits
Others Involved:	Divisions of: Pollution Prevention; Water, Solid and Hazardous Materials; Hazardous Waste Remediation; Spill Prevention and Response; NYS OPRHP, New York Sea Grant, Army Corps,

	Marine Trades Assn., Hudson River Boat and Yacht Clubs
Estimated Cost:	Environmental Protection Fund: $100,000

Commitment 15. Brownfields

Lead DEC Division:	Regions 2, 3, and 4
Others Involved:	Division of Legal Affairs, Solid Waste, Water, Hazardous Waste Remediation, DOS
Funding Estimates:	Clean Water/Clean Air Bond Act Grants to localities to be determined by competitive process

Commitment 16. Abandoned Boats and Derelict Structures

Lead DEC Division:	Fish, Wildlife and Marine Resources
Others Involved:	Army Corps, DOS
Funding Estimates:	Environmental Protection Fund: $50,000; additional federal cost-sharing will be sought

Water Quality - Conventional and Chemical Pollutants

Priorities:

- Remediate contaminants and pollutants that impair beneficial uses of water resources, ports and harbors, and fish and wildlife, with a focus on reducing heavy metals, eliminating sewer overflows, and improving capacity at sewage treatment plants to accommodate future economic growth in the region.

- Reduce PCBs contamination in estuarine waters with a goal of eliminating the health advisory regarding human consumption of fish.

- Develop an effective program to control and manage non-point source pollution, especially vessel discharges in the estuary and in tributary streams where fish survival is impaired

- Develop a coordinated review program for navigational dredging and dredged material management; seek long-term management sites for dredged materials

- Update oil and chemical spill response contingency plans to foster improved communication and coordination between DEC environmental quality and natural resources program

Introduction

The achievement of New York State in the last 30 years in cleaning up the Hudson River and its tributaries has been an essential element of the economic growth of the region and has increased the value of waterfront areas substantially. Full sustainable use of the natural resources of the estuary will require elimination of water quality impairments that affect navigation, commercial and recreational fishing, residential development, marinas, tourism and other uses. Maintaining high quality water resources in times of growth often requires ongoing and sometimes increasing financial support for sewage treatment, pollution control, and remediation of past pollution.

The communities of living resources found within the estuary are in continual contact with and respond to the physical components of the system. The quality of the water in the Hudson River can affect the variety, distribution, quantity and health of plant and animal life found in the estuary. This Estuary Action Plan focuses on minimizing and remediating impairments to human uses and the ecosystem, such as restrictions on fish and shellfish consumption, closure of bathing beaches, or reduced propagation of aquatic and benthic organisms.

Two categories of pollutants require management to ensure ecosystem protection and unimpaired human use—conventional pollutants and chemical pollutants. Examples of conventional pollutants are five-day biochemical oxygen demand (BOD), oils and grease, suspended solids, fecal coliform, and pH. Chemical pollutants include heavy metals, pesticides, and other synthetic compounds. While conventional pollutants in low concentrations do not damage organic life, the effects of larger amounts of these pollutants often are readily apparent, showing up as fish kills, oil slicks, colors or odors. While under control throughout most of the estuary, conventional pollutants are contained in combined sewer overflows and continue to be a problem in some areas. Chemical pollutants, however, present significant impairments to uses, such as commercial and recreational fishing, as well as impacts on fish and wildlife resources. Understanding and controlling chemical pollutants, as well as reducing conventional pollutant impacts from combined sewer overflows, are major priorities of the Estuary Program.

Conventional Pollutants

Municipal Wastewater Treatment

Sewage treatment continues to be a priority strategy for maintaining water quality throughout the estuary and for achieving further improvements in the lower Hudson and harbor areas. Throughout the estuary, sewage treatment plants (STP) are designed to provide an acceptable level of treatment for a specific design capacity. Significant growth in the Hudson Valley during the last ten years, however, has caused many facilities to reach their design capacity. In areas where this has occurred, the hookup of new buildings to existing facilities, without regard to the plant's ability to provide the necessary treatment, could cause water quality to suffer. DEC has placed moratoria on the construction of sewer line extensions to several sewage treatment facilities along the estuary whose current loadings are at or near capacity. These moratoria must be maintained to assure adequate treatment capacity for municipal wastewater discharges to the estuary. Long-range planning is to provide for the upgrade of sewage treatment plants in the region if the economy is to grow.

DEC will conduct a needs assessment of existing and future municipal wastewater treatment facilities. This assessment will better define what actions are necessary to insure compliance, reduce impairments and/or improve water quality. The need for facilities and/or actions to address the control of combined sewer overflows and non-point sources also will be identified. DEC will also assist communities with Combined Sewer Overflows (CSOs) that impact the Hudson River in the Albany/Troy (Albany Pool) area with the development of long term control plans. When implemented, these plans, required by federal CSO policy and New York State SPDES permits, will result in minimization of CSOs, compliance with Clean Water Act requirements and improved water quality in the Hudson River.

Chlorine has been an important disinfectant tool used to reduce pathogens and protect public health. However, chlorine also can kill beneficial microscopic aquatic organisms. Concern over the potential impacts on aquatic life from chlorine in sewage treatment plant effluent led DEC to manage chlorine in discharges many years ago. Seasonal disinfection is practiced in much of the river above the Interstate Environmental Commission boundary. As of September 1, 1991 there is a new ambient water quality standard for chlorine. If necessary, existing facilities will require retrofitting to meet the standard.

The two most urban portions of the estuary have had the greatest water quality impact from conventional pollutants. Major investments have been and continue to be made in improving water quality in the Albany Pool and New York Harbor. Since the early 1900s, New York City has monitored the water quality in New York Harbor. In their most recent report, *1999 New York Harbor Water Quality Regional Report*, the NYC Department of Environmental Protection states that, "... there is overwhelming evidence that New York Harbor's environment is cleaner and the water quality better than at any time since the early 1900s." Improvements noted include: the opening of all NYC public beaches since 1992 and the lifting of wet-weather swimming advisories for all but 3 beaches; the upgrading of 68,000 acres of shellfish beds since 1985, including the removal of shellfishing restrictions for 30,000 acres off the Rockaways and in Raritan Bay; the return of a variety of marine and aquatic organisms to the Harbor; 50-90% reduction from peak levels of priority pollutants in fine-grained sediment in the Hudson River.

The report attributes these improvements to the development and upgrading of the City's sewage treatment system and the implementation of various pollution control programs. In the Capitol District, with support of the Hudson River Estuary Program through CWCA Bond Act grants, improvements are being funded that will reduce impairments from municipal waste treatment and combined sewer overflows.

Combined Sewer Overflows

Wet Weather Discharges

During the last 30 years, municipalities have constructed wastewater treatment facilities to ensure that all dry weather flows receive full secondary treatment. However, accidents and emergency conditions sometimes occur that can cause the discharge of raw sewage. Most of the larger, older cities on the Hudson use sewage systems to carry both sewage and stormwater runoff to the sewage treatment plants. During heavy rains, overflow carrying sewage, debris, pesticides and automotive fluids washed from the streets may be discharged untreated into the river. Where this is a problem, control measures are needed to maximize the treatment of wet weather sewage flows and minimize the discharge of overflows.

Currently there are sixteen SPDES permittees with approximately 183 permitted combined sewer overflow (CSO) outfalls discharging to the tidal portion of the Hudson River between the Troy Dam and the New York City line. In addition, New York City owns numerous permitted CSOs that discharge to the Hudson River. These CSOs discharge floatable solids from untreated or partially treated wastewater during periods of precipitation and snowmelt that contribute to aesthetic impairments to water quality.

For example, the completion of the "North River" and "Red Hook" sewage treatment plants in the early 1990s in conjunction with 12 other facilities, now provides secondary treatment for New York City's dry weather sewage. Even with these facilities in operation, maintenance, repairs and other unforeseen events cause the direct discharge of approximately "less than one tenth of one percent" (<0.1%) of the city's estimated 1,707 million gallons per day average wastewater flow. This value increases during periods of rain, when overflow conditions occur as a result of sanitary and stormwater sewers being interconnected. As little as .05 inches of rain in some portions of the NYC metropolitan area can initiate overflow conditions causing up to 10% of the city's raw wastes to enter the estuarine system through more than 450 existing overflow points.

In 1988, DEC issued SPDES permits for each of New York City's 14 sewage treatment plants that included conditions directed toward improving the quality and usability of the marine waters receiving flows from those plants. The city was divided into four distinct geographic areas, each of which was addressed with a separate action plan.

DEC worked with the city in 1992 to establish, through a consent order, a system of CSO control in two stages, or "Tracks." Track I addressed dissolved oxygen and coliform bacteria, while Track II dealt with floatables and settleable solids. Also in 1992, the city was directed to establish an environmental benefit fund (EBF) of at least $250,000 and a schedule for proposing and completing projects to benefit local waterways. Implementation of CSO Order Tracks I and II is ongoing at this time.

In 1996, the CSO plan was modified to address USEPA's 1994 issuance of a national policy on CSOs. The modified order calls for the city to undertake a number of structural and nonstructural projects, including interim floatables control measures and catch basin inspection, inventory, mapping and cleaning to be performed in two phases.

The DEC combined sewer overflow control strategy and the USEPA CSO control policy require compliance with the technology based and water quality based requirements of the Clean Water Act. In order to achieve compliance with these technology based requirements, DEC will require, on a statewide basis, all of the CSO permittees to implement the DEC 13 best management practices (BMPs) for combined sewer overflows. These BMPs will be implemented through SPDES permits. The DEC BMPs are equivalent to the EPA "nine minimum measures."

These BMPs minimize pollution from CSOs by maximizing the capabilities of the collection system and host wastewater treatment plant during wet weather, instituting educational and institutional pollution prevention measures, implementing comprehensive drainage area planning and construction of low capital cost measures to control and contain floatable solids (e.g., catch basin modifications, containment booms, and netting).

To date, the Estuary Action Plan has invested over $6.1 million in Clean Water Clean Air Bond Act grants to reduce overflows from combined sewers in the class C waters of the Capital District. Improvements made to the Albany County North Wastewater Treatment Plant are a good example of the progress being made in this area. During a significant rain event in December 2000, this facility, with newly upgraded influent pumps, was able to treat 115 mgd (million gallons/day) vs. its previous capacity of 88 mgd, allowing an additional 27 mgd to be treated rather than discharged into the river through a CSO. By the year 2003, additional CSOs affecting the estuary are expected to be addressed through approved Bond Act grants, with projects scheduled for completion by 2006.

The following areas continue to experience impaired conditions due in large part to CSOs:

- The New York City area, from the Battery to twenty miles upstream, is impaired due to nontoxic pollutant impacts for swimming and shellfishing. Water quality standards are exceeded in this lower reach of the river due to combined sewer from and on both the New York and New Jersey sides of the river. This area is classified for fish propagation and secondary contact recreation.

- Although the water is officially classified SB indicating its best use as primary contact recreation, the Hudson River from the southerly Westchester County line to the Harlem River presently is impaired for that use because of high bacteria counts and floatable solids. These conditions are caused primarily by combined sewer overflows and leakage and by-passes from sewer regulators and pumping stations. New York City has undertaken CSO abatement efforts which should address this impairment.

- A combined sewer overflow study done for the Yonkers Sewer District by Westchester County indicates that violations of water quality standards for coliform bacteria occurred in the vicinity of Irvington. Construction has been completed to provide treatment of the combined sewer overflows in Yonkers Sewer District. It is anticipated that this standard violation will be eliminated.

- North of Westchester County, between Peekskill and Newburgh, the water is class B suitable for swimming, fishing and boating. Between Newburgh and the southern tip of Schodack/Houghtaling Island, the water is class A, suitable for drinking, swimming, fishing and boating. From the southern tip of Schodack/Houghtaling Island north to the Federal Dam at Troy, the water is class C, thereby determining its best use as fishing and boating. In this section of the river, water quality is impaired for swimming due to combined sewer overflows. This class C classification does not intend to support primary contact recreation. (See Appendices C, D, E)

Accidental Dry Weather Discharges

Power outages and other equipment failures at pump stations and sewage treatment plants can cause the discharge of raw sewage. It is necessary to provide standby power and telemetering to ensure that discharges during power and equipment failures are minimized.

Non-point Source Pollution

With point source control programs established, non-point sources (NPS) are now recognized as a relatively important source of water quality problems and water use impairments. Non-point sources may include atmospheric deposition, contaminated sediments, urban and agricultural stormwater runoff, leachate from landfills, leaks from petroleum and chemical storage tanks, poor storage and handling practices, and repair and maintenance practices (i.e., bridge maintenance). In addition, vessels and construction activities contribute to NPS. Unlike point sources, non-point sources cannot be managed at a specific point of discharge, but must be prevented or remediated by modifying land use activities and practices or by controlling air emissions.

Non-point source pollution problems in Hudson River tributaries have been identified and in some cases impair or preclude fish survival or propagation. New York State's statewide non-point source management program, which was approved by EPA in 1989 and updated in April 2000, has the potential to address these problems. Program emphasis is focused on agricultural, urban and on-site disposal system non-point sources. Attention to identified tributaries is needed. Non-point sources are not known to contribute significantly to identified impairments in the mainstem of the river.

Revisions made in the Coastal Zone Act Reauthorization Amendments of 1990 relieve regulators from having to prove specific cause and effect relationships before addressing non-point source problems. Section 6217, known as the Coastal Non-point Source Pollution Control Program, assumes the potential for pollution to occur from land use activities and requires states with approved coastal management plans, such as New York, to develop and implement a program to control and manage non-point

pollution from sources which, individually or cumulatively, affect or may affect coastal waters. The Hudson River drainage is part of the coastal management area included in the Coastal Non-point Program. States address pollution from a wide range of sources, including forestry, agriculture, urban development and infrastructure, marinas, hydromodifications such as dredging, and other potentially harmful land uses. Wetland preservation and restoration and monitoring and protection of "critical coastal areas" also are part of the program. All of these activities and conditions occur within the estuary justifying the need to apply control strategies in the area. DEC will work with NYS DOS and other entities to address non-point source pollution through preparation and implementation of watershed management plans, harbor management plans and local waterfront revitalization programs.

Clean Water/Clean Air Bond Act

Using the Clean Water/Clean Air Bond Act funds, the Estuary Program has and will continue to encourage municipalities to: implement measures to prevent the discharge of sewage during power outages and other emergency conditions; implement measures to reduce, control or eliminate discharges from non-point sources and combined sanitary sewer overflows; install equipment which provides alternatives to chlorine disinfection or reduces chlorine residual; and restore habitats.

Highest priority will be given to projects which do any of the following:

a. protect, restore, enhance, or reduce impairments to aquatic habitat, (this includes, but is not limited to, habitat restoration projects which enhance tidal flow, improve riparian habitat, enhance fish passage or reduce invasive or exotic species); and non-point source pollution projects to control stream bank erosion or reduce nutrient, suspended solids, herbicide and pesticide inputs

b. remove or reduce toxic contaminants from the estuarine ecosystem, including remediation of contaminated sediments

c. contribute to reduction of known impairments of water quality affecting contact recreation

d. reduce or eliminate chlorine discharges while providing adequate disinfection (projects on tributaries will be given priority as well as projects on the river)

e. support water quality infrastructure needs for waterfront revitalization projects that include a component for public use of the waterfront, such as swimming and contact recreation or public access to waterfronts, consistent with local waterfront revitalization

Secondary priorities include the following:

a. general non-point source program implementation

b. wastewater treatment plant compliance assurance

c. water quality infrastructure projects not including a public use component but needed to support water dependent commercial uses, such as port development, tourism and other commercial activities, consistent with local waterfront revitalization plans

Vessel Waste No-Discharge Zone

Over 64 miles of the estuary's waters are classified A, suitable for drinking water purposes after filtering and disinfection. Currently, the Village of Rhinebeck, the Hamlet of Rhinecliff, the Hyde Park Fire and Water District, the City and Town of Poughkeepsie, the Port Ewen Water District and the Highland Water District use the Hudson River for their municipal water supplies. New York City maintains an emergency pump station at Chelsea, Dutchess County, which most recently has been used during periods of drought in 1985 and 1989. Protection of water quality at this high level of use is essential to protect these existing supplies and provide for new supplies as need is demonstrated in the future.

In an effort to control one route of non-point source pollution in 1996, the EPA designated two reaches of the Hudson River as "drinking water intake zones" under Section 312(f)(4)(B) of the Clean Water Act. This designation prohibits the discharge of sewage from vessels into these waters. The lower of these two reaches is located within the estuary and extends from Newburgh to the southern tip of Schodack/Houghtaling Island, all Class A waters. Compliance with the drinking water intake zones requires boats to use pumpout facilities. The Hudson River Marine Sanitation Act, signed into law in July 1999, provides DEC with the authority to regulate the no-discharge zone designation and provides funding in the form of grants for the purchase and installation of pumpout facilities and dump stations at public and commercial marine facilities.

The State Clean Vessel Act Plan prepared by the DOS Division of Coastal Resources and DEC recommended designating the remaining portions of the Hudson Estuary as part of an all-inclusive no discharge zone covering the 153 miles of river from the Troy Dam to the Battery, an area that encompasses approximately 81,000 acres of tidal waters and wetlands. In April 1999, Governor Pataki announced that New York State petitioned the EPA for this designation and a public comment period was conducted during the fall/winter of 2000. The EPA has determined that an adequate number of pumpout facilities exists to receive vessel waste from the estimated 7,300 boats that occupy the river on peak days. The designation, when finalized, would prohibit both

treated and untreated vessel sewage from being discharged into the river. Treated wastes from vessels can have localized effects on water quality by contributing to pathogen, toxic and nutrient loadings. Treated wastes often contain chemical additives such as formaldehyde, phenyls, and chlorine.

In order to fulfill the calculated number of pumpouts necessary to meet the requirements for the no-discharge zone designation, DEC and the DOS Coastal Management Program prepared a pumpout plan to provide approximately one pumpout for every 300 to 600 vessels requiring such services. As of June 2000, 26 new pumpouts had been completed, 4 are approved and under contract for installation for a total of 30 pumpouts. The completed pumpout projects are located as follows:

Albany County:
Dutch Apple Cruises
Ravena-Coeymans Yacht Club (mobile)
Ravena-Coeymans Yacht Club (stationary)

Dutchess County:
White's Hudson River Marina (stationary)
White's Hudson River Marina Pumpout Boat
Roger's Point Boating Association

Greene County:
Catskill Marina Corp.
Coxsackie Yacht Club
Shady Harbor Marina

Orange County:
Cornwall Yacht Club

Rensselaer County:
Castleton Boat Club

Rockland County:
Julius Peterson, Inc.
Tappan Zee Marina
Pennybridge Marina
Panco Marine, Inc.

Ulster County:
Certified Marine Service, Inc.
City of Kingston - West Strand Park
Hideaway Marina
Jeff's Yacht Haven
Marlboro Yacht Club

Westchester County:
Cortlandt Yacht Club
Half Moon Bay Marina
Hudson Valley Marine
Peekskill Yacht Club
Tarrytown Marina, Inc.
Westerly Marina, Inc.

The development of a pumpout facility in the vicinity of the Port of Albany could address anticipated needs of large commercial vessels that may exceed the capacity of their holding tanks if they are not able to discharge while in the river.

Additional funding allocations will follow the NYS Department of State's recommendations developed in 1996 for locations requiring additional pumpout

facilities. Funding for development of new pumpouts is available from the Federal Clean Vessel Act.

Ongoing efforts in the areas of education, pumpout facility construction and enforcement will be necessary to make this approach effective over the long term.

Chemical Pollutants

Over the past 25 years, water quality in the Hudson Estuary has improved dramatically and levels of chemical contaminants in some fish have gone down. However, some impairments due to bioaccumulative chemicals, such as PCBs, remain throughout the ecosystem, and localized impacts of lead, mercury, and DDT continue to preclude or limit use of the estuary's natural resources. The Department of Health recommends against consuming fish and wildlife in unlimited quantities. Economic activities (e.g., construction, marina maintenance, commercial fishing) are hindered because of contaminated sediments. Dredged materials from some areas require secure disposal because of a high level of contaminants. Other examples of impaired uses include closed beaches and shellfish beds and reduced aquatic and wildlife populations.

New York's waters are managed to meet the goals of ensuring human health, maintaining economic well being, and protecting ecosystem health and diversity. Waterbodies are classified according to one or more of the following uses: a) water supply, b) primary contact, such as swimming, c) fish propagation and d) fish survival. Standards for the allowable concentrations of specific chemicals that will not adversely affect these uses are set for water quality. While much has been and is being accomplished through existing programs to resolve impairments due to persistent chemicals, DEC is committed to restoring additional beneficial uses. (See Appendices C, D, E).

Summary of Sources

The major contaminant problems currently threatening the estuary as an ecosystem and habitat area include PCBs, other organic chemicals, and heavy metals.

USEPA's *Hudson River PCBs Superfund Site, New York; Proposed Plan, December 2000* states, "The area of the site upstream of the Thompson Island Dam represents the primary source of PCBs to fish within the freshwater Hudson. This includes the GE Hudson Falls and Fort Edward plants, the Remnant Deposits, and the sediments of the Thompson Island Pool."

The design of the remedy for the highly contaminated riverbank soils and sediments at the Fort Edward plant site is underway and construction is planned for 2002. At Hudson Falls, the groundwater and oil recovery system and treatment plant continues to operate. In addition, the investigation of bedrock contamination and evaluation of

enhancements to the existing bedrock, groundwater and oil recovery system are ongoing. DEC analysis indicates that contaminated sediments in other parts of the river also may contribute PCBs to the water column.

Sources of contaminants other than upriver PCBs include the following:

- Contaminated sediments resulting from past discharges and suspected groundwater seepage from operational facilities or sites not yet fully remediated

- Heavy metals (cadmium, chromium, lead and mercury) formerly discharged from the Hercules (Glens Falls) pigment manufacturing plant have contaminated sediments adjacent to and downstream of the site. The site, now owned by Ciba-Specialty Chemicals, has undertaken interim corrective measures to minimize seepage of contaminated groundwater into the Hudson River. Through the RCRA Corrective Action Program, a final remedy addressing the removal of contaminated sediments is expected to be completed by Hercules/Ciba Specialty Chemicals in 2001.

- Localized sources of contaminants other than PCBs, e.g., sediments at Marathon Battery (Cold Spring) and several RCRA sites. The Marathon Battery Site recently has been remediated, greatly reducing the impact to the river.

- Diamond Shamrock plant on the Passaic River in Newark, New Jersey, formerly a major producer and distributor of DDT. Residues from this facility and others still impact the quality of New York Harbor sediments.

- Hastings-on-Hudson site has at least 20 acres of sediments that exceed cleanup guidelines for PCBs, with concentrations reaching 5000 ppm near the source area. Localized impacts to fish and benthos have been found, and a site-specific fish consumption advisory has been issued. A feasibility study is underway to evaluate potential cleanup alternatives for this contamination. In 2000, the site owner repaired a section of the shoreline bulkhead to prevent further releases of contaminants to the river.

In 1997, the US Geological Survey published results from a study of 45 sites in the Hudson River Basin. The study concluded that residues of DDT, chlordane, and PCBs can be detected, even though these compounds have not been produced for domestic use for ten or more years. The study further concluded that urban watersheds in general continue to be an important source of organochlorine residues; however, major sources

of PCBs are limited to a few locations. By and large, state and federal programs are overseeing the control of these sources. Programs dealing with contaminated sediments are difficult to maintain because of the high volume and costs associated with addressing this type of contamination.

Summary of Impairments

Impairments to Human Health

Because many persistent chemical contaminants (e.g., PCBs, cadmium, mercury) can accumulate to high levels in fish, fish consumption poses a risk to human health. Potential human health impacts may include greater risk of cancer and potential for dysfunction of the neurological, endocrine and reproductive systems. All species of fish and some species of wildlife caught in the Hudson River estuary carry advisories that recommend limited or no consumption. New York State fish and wildlife consumption advisories are based on established standards and guidelines. These chemical contaminants are at much lower concentrations in the water so swimming in or swallowing Hudson River water are not significant routes of exposure.

The U.S. Food and Drug Administration (FDA) has set a tolerance limit of 2 ppm (parts per million) PCBs for fish sold in interstate commerce. The state uses this limit as a guideline for developing advisories on human consumption of fish containing PCBs. Very extensive sampling and analysis of fish for PCBs shows that fish in the estuary commonly exceed the FDA limit. For example, white catfish from the Albany area contained, on average, 6.97 ppm PCBs (Spring 1998) and white perch contained, on average, 4.32 ppm PCBs (Spring 1998). Lower in the estuary, at Poughkeepsie, white catfish contained, on average, a concentration of 2.35 ppm PCBs (Spring 1998) while white perch contained, on average, a concentration of 2.41 ppm PCBs (Spring 1998). While there is no regulatory limit for cadmium in fish and shellfish, the State Department of Health has issued a health advisory regarding cadmium contamination in Hudson River blue crabs. The health advisory recommends eating no more than six crabs per week, eating no hepatopancreas and discarding all cooking liquids.

New York State Health Advisory 2000-2001			
Location	Fish Species	Advice	Chemical(s) of Concern
Troy Dam south to bridge at Catskill	All species, except alewife, American shad, blueback herring, rock bass and yellow perch	Eat none	PCB
	Alewife, blueback herring, rock bass and yellow perch	Eat no more than one meal per month	PCB
	American shad (general advisory)	Eat no more than one meal per week	PCB
Bridge at Catskill south to and including the Upper Bay of New York Harbor (north of Verrazano Narrows Bridge), the Arthur Kill and Kill Van Kull	American eel, Atlantic needlefish, bluefish, carp, goldfish, largemouth bass, smallmouth bass, rainbow smelt, striped bass, walleye, white catfish and white perch	Eat no more than one meal per month	PCB
	Blue crab	Eat no more than six crabs per week	Cadmium, PCB
	– hepatopancreas (mustard, tomalley, or liver)	Eat none	Cadmium, PCB
	– cooking liquid	Discard	Cadmium, PCB
Dobbs Ferry south to Greystone	American eel	Eat none	PCB
	Other species	See advisories for Hudson River south of Catskill (above)	

Health advisories were first issued in 1976 and have been modified several times since then as new data on PCB levels in fish became available. The NYS Department of Health also certified in 1976 that a significant human health risk existed due to consumption of PCB-contaminated fish in commercial fisheries of the Hudson River. As

a consequence, DEC closed the commercial fisheries for striped bass, American eel (greater than 14 inches in length), black crappie, brown bullhead, carp (except as bait), goldfish (except as ornamentals), pumpkinseed, white catfish and white perch (except as bait). These commercial fisheries remain closed.

Impairments to Economic Vitality

Restrictions on beneficial uses resulting from contamination have negative economic consequences. The impacts on local communities from closed recreational and commercial fisheries include both economic and cultural consequences. The traditional commercial striped bass fishery has been closed since 1976. Resulting increases in striped bass populations (along with other factors) have adversely impacted shad fishing because commercial fishers catch large numbers of bass that must be returned to the river and cannot be sold, rather than the targeted fish, shad.

In 1999, at the request of Governor Pataki, the Hudson River Estuary Advisory Committee (HREMAC) developed recommendations regarding reopening a limited commercial fishery for striped bass below the Bear Mountain Bridge. In 2000, the NYS Legislature established a temporary advisory committee to study, obtain public comment and report to the DEC Commissioner on the striped bass fishery in the river by March 2001. Any recommendations will require subsequent review and approval from DEC and DOH and the ASMFC.

Shipping, boating, tourism and shorefront activities also are impacted when contaminated sediments require special handling and secure disposal. The costs and constraints associated with managing contaminated sediments can hinder or preclude construction projects and dredging operations critical to waterfront development and maintenance of commercial ports, recreational marinas, and navigable channels.

Impairments to the Ecosystem

The presence of ecological stress in different segments of the river's fish and wildlife resources also indicates unresolved contamination problems. Examples include the following:

- A great horned owl was found along the Hudson River sick and incapacitated with a brain level of PCBs found to be lethal in other avian species.

- Altered behavior and plumage development have been documented in tree swallows along the upper Hudson River. High concentrations of PCBs in egg and tissue samples from these birds suggest a link to PCBs contamination.

- Documented historic impairments include the toxic effects of cadmium-contaminated sediments on aquatic organisms and benthic invertebrates at the Foundry Cove/Marathon Battery Superfund site. Muskrat populations have reduced in size at Foundry Cove and Constitution Marsh, possibly a result of cadmium contamination. The site has been remediated, and studies currently underway will determine whether muskrat populations increase at the remediated site.

- PCBs are believed to have reduced the abundance of mink and possibly river otter in riparian habitats of the Hudson River. Research conducted by Foley, et al. in 1988, found PCBs levels in mink and otter from the Hudson River drainage to be among the highest in a survey of mink and otter from a variety of locations in New York State. The PCBs levels in mink and otter were near or exceeded levels that were associated with reproductive failure in controlled laboratory studies of the effects of PCBs on mink reproduction, suggesting a potential for reproductive failure in wild mink and otter in riparian habitats of the Hudson River drainage. These findings imply that an absence or reduction in these furbearers may exist. Studies designed to evaluate the effects of PCBs contamination on associated mink and otter populations in the Hudson River drainage were initiated in 1998 but are not complete yet.

While the reduction of PCBs to concentrations under the FDA limit of 2.0 ppm will reduce human health risk to levels potentially allowing the fishery to reopen, it will not go far enough to protect wildlife that consume fish. It is estimated that wildlife will not be protected from the effects of PCBs until a PCBs concentration in whole fish of 0.11 ppm is reached. Most fish in the estuary contain PCBs at concentrations in excess of 0.11 ppm.

Cadmium contamination in the estuary is of particular concern due to cadmium levels found in blue crabs and in benthic invertebrates in certain areas. Cadmium concentrations appear highest in the estuary at Albany, Foundry Cove and the New York Harbor area. However, the relationship between cadmium sources and cadmium in blue crab are poorly understood. Further study of this concern is needed.

Summary of Contaminants Causing Impairment to the Hudson River Ecosystem and Human Uses It Supports

The term contaminant refers to chemicals such as PCBs, heavy metals, and pesticides that are known or are believed to cause impairments. The chemicals are a concern because they persist for long times in the environment and they can bioaccumulate to harmful levels in organisms high up on the food chain. The contaminants of concern to the Hudson are listed below in order of importance.

Polychlorinated Biphenyls (PCBs)

PCBs refers to a large group of highly stable synthetic organic chemical compounds widely used in industrial applications until 1977. The presence of PCBs in the Hudson River ecosystem is extensively documented. PCBs tend to adhere to sediments and are ingested or absorbed by bottom-dwelling organisms or released by processes of remobilization resulting in their availability to biota within the water column. PCBs are fat soluble and bioaccumulate in fish, mammals, amphibians and reptiles, generating concentrations much greater than the concentrations found in the surrounding environment.

PCBs are the most significant contaminant condition inhibiting full use of estuarine resources. The principal identified source of the PCBs are discharges into the river by the General Electric Co. including PCB-contaminated sediments in the upper Hudson River. The major impaired uses caused by this pollutant are the DEC prohibition of commercial harvest and sale of striped bass and the fish consumption advisories issued by the NYS Health Department, both imposed due to high PCBs levels found in fish flesh.

Although PCBs were banned from use in 1977, large quantities remain in the river. More than one million pounds of PCBs were discharged into the Hudson River from two General Electric (GE) capacitor manufacturing facilities in Fort Edward and Hudson Falls over a 25-year period. Removal of the Fort Edward Dam in 1973 and flood events in subsequent years mobilized approximately one million cubic yards of contaminated sediments down river. Geochemists have been able to trace this sediment transport all the way to New York Harbor. Sediment deposits 40 miles downstream of the GE facilities are significantly contaminated by PCBs. Some of these PCBs are located in sediment "hot spots," having concentrations greater than 50 parts per million. It is estimated that up to 9,000 pounds of the chemical may have washed over the dam at Troy in 1977. However, an estimated 1,000 to 2,000 pounds of PCBs is the average annual transport of PCBs over the Troy Dam during the 1980s. In the 1990s, the annual PCB mass transported over the Troy Dam has been approximately 500 pounds.

In 1989, the EPA decided to undertake a reassessment of its 1984 Record of Decision for the Hudson River Superfund site. In December 2000, EPA announced its proposed plan for cleanup of the Hudson River. Based on determinations by EPA scientists and engineering experts that active remediation of PCBs in the river is the most appropriate and effective way to mitigate the risks those contaminants pose to public health and the environment, the plan recommends dredging 2.65 million cubic yards of PCBs contaminated sediment along a 40-mile stretch of the river south of Fort Edward. The project would remove a total of 100,000 pounds of PCBs from the riverbed.

Under the proposed plan, dredging would be conducted within three sections of the river: Section 1, Fort Edward to the Thompson Island Dam, removal of 1.56 million cubic yards; Section 2, Thompson Island Dam to Northumberland Dam, removal of 0.58 million cubic yards, and Section 3, Northumberland Dam to Troy Dam, removal of 0.51 million cubic yards. Disposal of dredged materials would occur at existing disposal facilities outside the Hudson Valley.

In 1989, the EPA decided to undertake a reassessment of its 1984 Records of Decision for the Hudson River Superfund site. In December 2000, EPA announced its proposed plan for cleanup of the Hudson River and on February 1, 2002, the final Record of Decision was signed. Under the Plan, 2.65 million cubic yards of PCBs contaminated sediment will be dredged along a 40-mile stretch of the river south of Fort Edward. The project will remove an estimated 150,000 pounds of PCBs from the riverbed.

In addition to these areas of contaminated sediments, the General Electric facilities and surrounding areas are highly contaminated with PCBs. In the early 1990s, new releases of PCBs from the Hudson Falls facility entered the waters of the Hudson River, increasing concentrations of PCBs in upper Hudson fish flesh by more than 300%. DEC is committed to reducing PCB releases from these plant sites to the maximum extent feasible through the implementation of interim remedial measures and final site remedies to prevent further PCB migration downstream and the associated uptake of PCBs into the food chain.

Heavy Metals

Heavy metals enter the Hudson River system as a result of industrial operations, burning of fossil fuels, mining, and natural geologic weathering. Metals tend to accumulate in sediments and are ingested or absorbed by bottom dwelling organisms or released by processes of remobilization, resulting in their availability to biota within the water column.

Heavy metals, including copper, lead, mercury, nickel, zinc, chromium and cadmium have been identified at significant levels in the water column in the heavily urban and industrial areas of New York Harbor. Some of these contaminants pose a risk to human health from direct consumption of the water or fish. Mercury is known to cause neurological damage, and cadmium can affect the kidneys. Wildlife also are affected, especially by bioaccumulation.

Mercury levels currently exceed the water quality standard throughout New York Harbor. In addition, they exceed state advisory levels in fish tissue in some large fish from the Hudson Estuary, and exceed federal levels in sediments, affecting biota health and the state's ability to dredge sediments in the harbor. New York and New Jersey have identified the need to establish effluent limits for discharges of mercury to New

York Harbor to meet water quality standards. Additional sources of mercury need to be further defined as well. In developing the mass balances for mercury, it was determined that most of the load comes from a source not identified during HEP monitoring. New York State has determined that existing discharges of lead, copper and nickel should be limited to current levels in New York Harbor to ensure that water quality standards for these substances will continue to be met. Cadmium is also of great concern. High concentrations have been found at Albany, Foundry Cove in Cold Spring, and in New York Harbor. Health advisories to limit consumption of blue crabs from parts of the Hudson Estuary are primarily the consequence of elevated cadmium in blue crabs.

A major goal of the NY/NJ Harbor Estuary Program is to reduce continuing input of pollutants to insure that all dredged materials within the harbor complex will become sufficiently free of contaminants and, therefore, not pose a problem with respect to disposal or other management options. The major factor constraining the selection of dredged materials management techniques and management site locations is the contamination of harbor sediments.

Polychlorinated dibenzodioxins and dibenzofurans

"Dioxins" and "furans" are contaminant byproducts from the manufacture of chlorinated phenol and chlorinated benzene compounds, such as plastics, chlorinated solvents, chlorinated pesticides and PCBs. They also form from incomplete incineration of municipal solid waste, sewage sludge, hospital waste, hazardous materials, PCBs, and other synthetic chlorinated compounds.

Dioxin

Dioxins are contaminants produced by the manufacture of trichlorophenol, the herbicide 2,4,5-T, other chlorinated phenol and chlorinated benzene compounds, and as a product of incomplete incineration. The only known manufacturing source of dioxin in the Hudson River basin is from the former production of 2,4,5-T by Diamond Shamrock Corporation located in Newark Bay drainage basin, New Jersey. The waters of Newark Bay intermingle with waters from the Hudson River; thus, migratory species found in the estuary, such as striped bass, may be exposed to dioxins. DEC studies have reported dioxin (2,3,7,8-TCDD) at an average concentration of 42 ppt in four Hudson River striped bass collected in 1983, with one fish containing 120 ppt.

There are no regulatory limits for dioxins. However, guidelines are provided by the FDA and DOH, based on the presence of 2,3,7,8 TCDD as follows:

Agency	*Guidelines*
FDA	20 to 50 parts per trillion (ppt) - limit fish consumption; greater than 50 ppt - no consumption, close commercial fisheries
DOH	restrict fish consumption - do not sell fish commercially where 2, 3, 7, 8-TCDD is greater than 10 ppt

Other dioxins (and furans) may be incorporated in decision making by the use of 2,3,7,8-TCDD toxicity equivalents. The criteria for decision making remains the same.

Currently, fisheries restrictions and health advisories are not based on the presence of dioxins, since the presence of PCBs requires fisheries restrictions or advisories similar to those that could be instituted by the presence of dioxins.

Furans

Furans may be generated as a byproduct of PCBs or some herbicide production, as a result of improper incineration of PCBs or municipal waste, or in the effluents of pulp mills using chlorine in the bleaching process. The impacts of furans on fish and wildlife may be similar to PCBs-induced impacts because of the similar physical properties between furans and some of the PCBs congeners. Like PCBs, furans come in many forms, the most toxic being 2,3,7,8-pentachlorodibenzo furan. The toxicity of furans can be expressed as 2,3,7,8-TCDD toxicity equivalents (see dioxins) for regulatory purposes. There are no regulatory limits or guidelines currently available for any furan.

DEC studies have reported 2,3,7,8-TCDF concentrations averaging 56 ppt in 1983 collections of Hudson River striped bass. Updated analyses of furans in striped bass and in other fish species and other environmental media is warranted.

Polycyclic aromatic hydrocarbons (PAHs)

PAHs are a huge family of compounds that are more toxic than simple hydrocarbons. They occur naturally and also form as a result of incomplete combustion of organic materials, such as gasoline, coal, wood and garbage. Polycyclic aromatic hydrocarbons are one of four contaminants that have been identified as probable causative agents in classifying New York Harbor sediments as contaminated. The results of ongoing and new toxic identification evaluations are needed to clarify the role of PAHs and other chemicals in causing observed toxic effects in fish and wildlife.

Pesticides and Other Related Chemicals:

DEC's Pesticide Compliance Inspection/Enforcement Program oversees hundreds of aquatic permits for the use and application of pesticides and related chemicals throughout the Hudson Valley. These permits represent the use and application of numerous pesticide-type chemicals, all of which have the potential to impact the estuarine environment. As pesticide chemistry has evolved, the chemicals used today are very different from the broad spectrum, environmentally persistent chemicals of the past, and are extremely effective, highly species specific, and more short lived.

Through Action Plan 2001, DEC will install a state-of-the art liquid chromatograph/mass spectrometer detector (LC/MS) system at the Pesticide Analysis Laboratory in Rensselaer. This laboratory currently provides analytical support for DEC's statewide pesticide compliance/enforcement inspection program. The LC/MS system will significantly improve the accuracy and turn around time of laboratory results. The LC/MS system is ideal for the low-level detection and identification of these chemicals, and their metabolites. The addition of this capability to the laboratory will enhance DEC's ability to protect the estuary and its surrounding environment from misuse of these chemicals.

Contaminated Sediments

The maintenance of safe navigation channels and berthing areas is essential to the continued commercial use of the Hudson River estuary. The international Port of New York and New Jersey, as well as the Port of Albany, play a vital role in the regional economy. New York Harbor, the third largest port in the country and the largest on the East Coast, contributes $20 billion in economic activity to the region and creates nearly 200,000 jobs. Since sediments are continuously transported and deposited, periodic dredging of the riverbottom is necessary to maintain these uses. If these areas are not dredged to adequate depths to accommodate the vessels they service, there is an increased potential for grounding of vessels and barges, as well as the potential for an increase in oil and chemical spills. Due to the increased demand for marina development and expansion of recreational use of the river, there has been a parallel demand for more localized, nearshore dredging. (See Hudson River Marine Assistance discussion under Waterfront Revitalization section).

Impediments to maintenance of dredged areas most often involve the management of the dredged material. Impacts on the estuary's littoral zone and the living resources that depend on these shallow estuarine areas raise additional issues. While environmental concerns from dredging typically can be addressed through the existing regulatory framework, finding acceptable management sites that minimize risk to sensitive environmental habitats and living resources often is difficult.

The presence of organic pollutants in sediments to be dredged, such as dioxins, PCBs and polycyclic aromatic hydrocarbons (PAHs) is a major obstacle to management alternatives. Dioxins and PAHs are present in substantial amounts throughout the estuarine system. However, their distribution and sources in the estuary and harbor are poorly documented.

National testing protocols for dredged material now include more sensitive and costly biological tests to determine the level of toxicity of the sediments if in-water management is considered. As a result, a greater amount of dredged material will require alternative management approaches.

Several regional management sites are needed throughout the estuary. State coastal and environmental protection policies require that such sites be appropriately located. There is one site in the Port of Albany that has been used for decades. A regional management site has been identified in the Town of New Baltimore, and a suitable site near Haverstraw Bay also is needed. Due to changing federal standards for ocean disposal of dredged sediments, ocean dumping of contaminated sediments at the Mud Dump Site, an area six miles east of Sandy Hook, NJ, was restricted in the early 1990s and halted in September 1997. This area became part of an Historic Area Remediation Site which still allows relatively clean sediments (class 1) to be disposed of for remediation purposes.

In October 1996, Governor Pataki and NJ Governor Christine Whitman signed an agreement, the New York-New Jersey Port Restoration Agreement (the Bi-state Plan) that specifies the funding and programs to be carried out by the two states to manage dredged materials from the New York/New Jersey Harbor while protecting both port commerce and the environment. Under the Bi-state Plan, New York and New Jersey have committed to spending $65 million each to dredge the harbor and develop long-term management options for the future.

DEC is undertaking several initiatives to advance dredged materials management, including contaminant source reduction. Working in partnership with the Empire State Development Corporation (ESDC), the public agency charged with overall implementation of the Bi-state Plan in New York State, and using the Bi-state Plan as a blueprint, DEC has been allocated, through a revenue agreement, $19.6 million to promote sound dredged materials management through expanded permitting, enforcement, compliance assistance and pollution prevention programs. Of that amount, $12.4 million is for contaminant identification and trackdown, and $7.2 million is for dredged material management. The major task underway is the identification and quantification of sources of contaminants of concern, particularly metals, PCBs, dioxin and PAHs. This information will allow DEC and other agencies to determine where contaminant loadings must be reduced and then initiate pollution prevention and enforcement measures to accomplish those reductions. In addition, $40 million will be spent on other dredge material management projects. Under Action Plan 2001, the

opportunity to better understand sediment transport in the Hudson River will be evaluated.

DEC also conducts an ongoing sediment sampling program in the Hudson estuary. Core samples are collected, subsampled and then submitted to analytical laboratories for chemical and radiometric analysis. The resultant data are used to detail contaminant trends, identify contaminants of concern and prove useful in source trackdown processes. Surficial sediment samples also are collected and submitted for chemical and biological testing. The biological monitoring includes toxicity and bioaccumulation testing and benthic community structure analysis. These data are used to identify the impacts of contaminated sediments.

In addition, DOS provides financial assistance to municipalities and public/private ventures, through the EPF local waterfront revitalization grants to implement innovative and alternative dredged material management options. DOS also reviews federal dredging projects as well as federally permitted dredging for consistency with the NYS Coastal Management Program.

New York and New Jersey will continue to investigate feasible ways to manage dredged materials safely and constructively. This will include making beneficial use of the material as construction aggregate, roadbed, contained fill and landfill cover, subject to appropriate environmental health and safety reviews. As discussed under Waterfront Revitalization, an initiative will be undertaken under Action Plan 2001 to assist area marinas with contaminated sediment related issues.

Spills Management

Each year a variety of spills occur on or along the estuary, posing a range of impacts from slight to potentially severe. Spills can originate from a number of sources and from a variety of causes: barge groundings and other vessel accidents, spillage during transfer operations and equipment failure (i.e., pipelines and storage tanks and deliberate dumping and vandalism). Freight trains that run along the shores of the river and spills that occur on tributaries also pose potential risks for the estuary.

Spills that have occurred on the Hudson range from a gallon or two, to hundreds or thousands of gallons. Many have involved petroleum products such as gasoline, kerosene, various grades of fuel oil and waste oil. Some of the larger spills which have occurred in the river include 480,000 gallons of petroleum in the Hudson Highlands area in 1977 and over 200,000 gallons of kerosene from a grounded barge on Diamond Reef in 1990.

The Hudson River estuary and its associated natural resources form a coastal ecosystem that is unique and fragile. The traffic routes used by barges and tankers to transport petroleum products into towns and cities along the Hudson make the entire

shoreline vulnerable in the event of an oil spill. Located along this shoreline are a number of invaluable resources that require protection from catastrophic or chronic oil spills associated with petroleum product shipments.

When a spill occurs, birds and mammals may become coated with oil, causing deleterious effects. Once coated, the animal's feathers and/or fur lose the ability to insulate and repel water and may result in direct mortality or predispose the animal to other mortality factors (e.g., predation). Ingestion of oil can cause direct mortality or predispose the animal to other mortality factors. Amphibians also may absorb oil through their skin, causing the same results as oil ingestion.

Spills may have serious implications for fish as well. Depending on the conditions of the spill, effects on fish may include mortality from direct contact, and life cycle disruption (spawning, feeding, overwintering) due to habitat and food chain destruction and sediment contamination. Surviving fish may be left with a bad taste in their flesh, affecting both recreational and commercial uses of the resource. Health implications from consuming fish that may contain residual petroleum by-products are not clearly understood.

Contingency planning is one of the most effective means to minimize the adverse impacts of an oil spill on critical and vulnerable areas and requires the following elements:

- identification and mapping of estuarine resources that would be adversely affected by an oil spill and an assessment of their risk
- development of a plan with feasible strategies to protect these resources
- identification of navigational hazards and other areas that could potentially cause an accident in the Hudson
- procedures for natural resource damage assessment and preparation of claims
- development of cost effective cleanup strategies
- identification of areas for pre-staging response equipment
- improved coordination and communication between responders and natural resource trustees

On November 17, 1995, DEC and the U.S. Coast Guard signed an agreement, the first in the nation between a state and two separate Coast Guard districts, that will

enhance oil spill prevention and planning and response efforts for New York's navigable waters. The goal of the agreement is to avoid dual sets of regulatory requirements regarding spills, which waste state and federal resources and may actually hinder spill prevention and environmental protection. The agreement designates DEC as the initial responder to all spills north of the Bear Mountain Bridge, and, for the first time, the Coast Guard officer in charge at a spill can immediately authorize DEC to use federal funds to quickly contain and clean up spills in navigable waters.

Remediation of Contamination

Control of contaminants affecting the Hudson River ecosystem will require a comprehensive approach and better identification of current sources, concentrations, locations, and impacts. The Hudson River historically has been monitored by many groups and institutions for various reasons and with variable outcomes. To fully understand the state of the river's ecosystem, DEC needs data obtained by modern techniques and realistic assessments based on current analytical methods. This information will be used to guide future monitoring and assessment efforts, focus resources on "solvable" problems, maximize the effectiveness of available resources, and ensure that actions taken will improve the health of the ecosystem.

The focus of the Estuary Program in remediating contaminants will be to do the following:

- Develop and implement a long term comprehensive and targeted monitoring plan to better identify sources of contaminants and determine cost effective remedial actions
- Continue to refine and coordinate programs that prevent contaminants from entering the river
- Direct additional attention to contaminated sediments and sediment transport
- Expedite a socially and environmentally acceptable solution for managing materials from navigational dredging
- Coordinate with other federal, state and local agencies
- Develop a strategy to increase public awareness, understanding and involvement in protecting and improving the Hudson River ecosystem

Through the Estuary Action Plan and the New York Harbor Program (HEP), DEC will develop and implement a contaminant assessment and long term monitoring plan that incorporates the following five integrated components:

- Database Management
- Identification of Contaminants of Concern
- Source Trackdown
- Control Scenarios
- Effectiveness Monitoring

The focus of the plan is to obtain useful knowledge and to link that knowledge to the identification of sources and control options. For example, the plan will address the status of water quality of the Hudson River, establish trend analysis and address the effectiveness of various actions taken that target controlling sources of contamination on both spatial and temporal scales. Furthermore, HREP and HEP will verify the effectiveness of selected control and action measures or, if found lacking, identify options to improve those measures and, if necessary, modify the assessment/monitoring plan itself.

A key element of the plan is development and implementation of a comprehensive, system wide ecological assessment. Its purpose is to characterize the biological health of the resource, identify contaminants of concern, and guide follow up monitoring. The follow up monitoring will be aimed at identifying the sources of those contaminants and investigating whether control scenarios would be appropriate.

Over the last 20 plus years, there always have been ad hoc requirements to monitor certain segments of the river for particular contaminants, but long term plans to commit resources in an integrated fashion are lacking. For example, much information is available on PCBs in fish, but little is known about other contaminants of concern, including mercury. A comprehensive plan encompassing several strata across a broad array of materials is the necessary next step.

A coordinated contaminant monitoring plan should be undertaken in light of the fact that a similar plan for the NY/NJ harbor has been developed and funds have been secured. Such an effort would provide the best vehicle for addressing the monitoring needs of the Hudson River basin, including the harbor, while maximizing the available resources of the state. The monitoring needs of the Hudson River basin can compliment the needs of the harbor.

Central to this effort is the “Contaminant Identification and Trackdown” initiative being undertaken as part of the Bi-state Plan. While some information is available about harbor sediment contamination, it is inadequate regarding some specific contaminants and geographical areas of concern. The sum of $12.4 million dollars has been allocated to implement a comprehensive monitoring and data management program to document the current status of the ecosystem and to identify key sources of sediment contamination. The information on sediment contamination will be used to focus enforcement activities, provide compliance and pollution prevention assistance and support cleanup efforts of the sources most likely to be causing significant impacts to

sediment quality and the harbor ecosystem as a whole. Sampling will cover harbor sediment and ambient water conditions, point and non-point sources of pollution, and various harbor biota. DEC staff will work with NJDEP to facilitate development of similar information in New Jersey waters. To date this effort has identified a new source of PCBs in New York Harbor. This source was not previously recognized. DEC will continue to work with NYCDEP to design and implement a trackdown program. In addition, work to reconfirm the presence of DDT in the Wallkill River Basin was done. DEC has collected additional data (including fish tissue data) and is sharing this information with DOH and the Department of Agriculture and Markets.

Initial results from the Hudson River Toxics Trackdown Project Plan, (Action Plan, 1998 #18) indicate a need to understand "natural" variations in source trackdown data; i.e., seasonal, geographic and annual variation due to changing hydrologic conditions. Under the Estuary Action Plan, a three-year monitoring effort for PCBs, PAHs and pesticides at three sites along the Hudson River will help distinguish between multiple contaminant sources and subsequently identify appropriate remedial actions. PISCES samples will be taken four times a year (seasonally) at Waterford, Poughkeepsie and a site in NY Harbor where fish and conventional water samples also are being collected. Data and interpretation will be provided in an annual report and fit into the larger contaminant trackdown picture.

Using the information base developed above, DEC is now developing a monitoring plan which will target specific needs; i.e., identifying contaminants, filling in data gaps, conducting ecological assessments and validating and/or resolving discrepancies in claims and data. A coordinating group will be established to guide the development of the monitoring plan, to evaluate its progress on an ongoing basis and recommend refinements.

When discussing remediation of contamination, it should be understood that remediation can involve different statutes. There are various state and federal statutes that can and should be applied, based on the particular site conditions. For example, the federal statutes related to contaminated sediments include the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), Resource Conservation and Recovery Act (RCRA), the Clean Water Act (CWA), the Toxic Substance Control Act (TSCA), the Rivers and Harbors Act, and the Oil Pollution Act.

To determine if additional investigation and remediation of potential problem areas are warranted, some initial biotic sampling and analysis by DEC may be needed. The Estuary Action Plan will support this effort. Several sites along the river, including the north turning basin in Albany, a scrapyard in Newburgh, another facility in Poughkeepsie, disposal areas along the upper Hudson River and others, may warrant investigation. Once the source is pinpointed or the significance is determined, funds to more fully evaluate a particular situation could be expected from sources such as the superfund, other divisions or responsible parties.

Biological sampling, including "indicator species," should play an important role in providing valuable information within the system and how it might be changing as effective remediation programs are implemented. (See Commitment #2). The long term monitoring program, along with improved geographical information systems, data management and mathematical models, will allow DEC to develop much improved trend analysis and predictive mechanisms for policy and decision makers.

The Contaminant Assessment and Reduction Program (CARP) of HEP is now collecting data to track sediment and contaminant transport in New York Harbor. CARP has focused on the contribution of contaminants from Hudson River tributaries to the harbor; however, a gap exists in understanding how and how much of these sediments and contaminants get from the mouth of the tributaries to the harbor area.

Little is actually known about how sediments move through the freshwater-tidal Hudson. Physical data (i.e., currents and suspended sediment) are lacking, and very little research and monitoring of the physics of this stretch of river has ever been done. It is generally assumed that a large percentage of the sediment transport occurs during high freshwater flows in the spring, but how significant an August thunderstorm or hurricane might be, or how the timing of tidal effects can dampen or amplify the sediment load associated with a freshwater pulse is not known.

An understanding of how the river flows and how much sediment it carries, is essential to the understanding of how contaminants move within the estuarine system. These data will be important especially to the CARP modeling effort which is about to get underway.

In partnership with the USGS and Woods Hole Institute, Action Plan 2001 will explore the possibility of establishing new monitoring sites in the tidal freshwater section of the estuary. The goal will be to obtain short and long term information about the transport of water, sediments and contaminants in the mid-estuary area in an effort to provide the necessary links between data collected above the Troy Dam and data collected in NY Harbor so that river-wide transport can be better understood. This information could also link biological studies in the freshwater-tidal portion of the estuary to the river's physical processes.

Air data are needed to balance contaminant budgets for the estuary and to understand the difference between airborne input and input from local sources. Values for contaminants in air are being gathered in the New York City area. Under Action Plan 2001, DEC will coordinate the installation of a weather station and air sampling

equipment at the water sampling station at Waterford, just above Albany, to address conditions north of the harbor. Roughly 26 wet and dry samples per year will be collected for three years. In conjunction with DEC Division of Water's contaminant loading estimates, these data will be incorporated into Division of Water's Hudson River Contaminant Trackdown and Assessment and reported on a yearly basis.

Action Agenda: Water Quality - Conventional and Chemical Pollutants

Accomplishments to Date

The agenda for Action Plan 2001 builds on past accomplishments. Since the first Action Plan was adopted in 1996, the Estuary Program has:

- **T** Funded 67 projects totaling $39.2 million with the Clean Water/Clean Air Bond Act (Hudson River Estuary and New York Harbor water quality categories • see Appendix K) in order to:
  - reduce sewer overflows from rainfall
  - prevent untreated sewage discharges during power outages
  - control pollution from runoff
  - restore aquatic habitat
  - provide water quality improvements at waterfront revitalization sites
- **T** Petitioned the EPA to expand the Hudson River no-discharge zone to include the entire estuary.
- **T** Took 210 sediment samples from 62 sites as part of a program to track down the sources of contaminants in the river.
- **T** Developed a computerized database for the identification and location of contaminated sediments.
- **T** Continued to assess the impact of sediment contamination on Hudson River ecosystems.
- **T** Department of Agriculture and Markets provided $3,225,684 from Bond Act and EPF funding for agricultural non-point source abatement in counties bordering the Hudson.

Commitment 17. Water Quality - Point and Non-Point Source

- **‘** Support projects which reduce impairments to water quality and habitat caused by discharges from combined sewer overflows (CSOs), boats, accidental discharges, non-point sources, or other causes.

- Local municipalities shall develop a long term plan for the communities in the Albany/Capital District area that will minimize combined sewer overflows in a cost-effective manner, thereby reducing or eliminating impairments in the Hudson River associated with wet weather conditions.

Commitment 18. Track Down and Clean Up Chemical Contaminants

- Continue to track down sources of contaminants in the Hudson River estuary, and monitor response to pollution reduction activities. In particular, identify and quantify sources of contaminants of concern such as dioxin, PCBs, PAHs, metals, pesticides, and volatile organic compounds; identify changes or trends over time.

- Evaluate opportunities to reduce contamination at the source in order to facilitate future navigational dredging of New York Harbor and other ports on the estuary and to minimize uptake of these chemicals into the food chain. Support the continuing efforts of USEPA to implement the active remediation of upper Hudson PCBs, and work with federal partners to seek recovery of natural resource damages caused by PCBs.

- Expand analysis of pesticides and air pollutants.

- Explore the feasibility of establishing a system to monitor sediment transport in the estuary.

Implementation

Commitment 17. Point and Non-Point Sources

Lead DEC Division:	Division of Water
Others Involved:	EFC
Funding Estimates:	Clean Water/Clean Air Bond Act grants; amount to be determined based on competitive process

Commitment 18. Source Track Down and Reduction

Lead DEC Division:	Division of Water
Others Involved:	Division of Air, USGS, Wood's Hole Institute, Bureau of Solid Waste and Land Management
Funding Estimates:	Environmental Protection Fund: $668,199, plus $7.2 million continued funding from the N.Y. Harbor Port Agreement for dredged material management. See commitment 19 for additional monitoring on this topic

Managing Water Supply Resources

Priority:

- Develop a water budget for the estuary which assures that water resources will be available according to the needs of current and future uses, including sufficient in-stream flow in tributary streams to maintain natural populations of aquatic life

Introduction

Through its dual responsibilities as protector of the estuary's natural resources and regulator of public water supply users, DEC faces a special challenge to balance the needs of the district's estuarine ecosystem while providing an adequate water supply for the area. The most urgent water quantity issue to be addressed within the estuary is its future use as a source of water for municipal and industrial purposes.

The Division of Water's regulatory authority for quantity management centers around the requirement that all public water supply systems seeking to take a new or additional supply of water or to expand their service area, obtain a water supply permit. In the Hudson Valley, there are no regulatory restrictions for other than the public water supply that pertain to withdrawal of water from either surface or groundwater resources, with the exception of the so called "water lifting" statute, which regulates water taking for export purposes.

Compounding this limitation on control of withdrawals, DEC lacks the authority in the Hudson River basin to require any type of mandatory reporting of water use by nonpermitted entities; thus, reliable water use information is difficult to obtain. This limitation on control of withdrawals challenges the state's ability to obtain valid data that are needed to manage the water resources of the Hudson River.

Developing a Water Budget

A water budget will aid the evaluation of resource availability and help define the data requirements to address instream flow needs for the estuary.

The water budget is, in effect, a water balance that reflects the water entering, the water used or lost, seasonal variations, and the water exiting for a particular reach or cross section of the river. A complete understanding of each of these factors and their component parts is necessary to evaluate the ability of the resource to support the demands placed on it.

Salt Front Study

In response to concerns over the potential impact of substantial water withdrawals on existing water supplies, a study of the estuary's salt front has been initiated as a cooperative effort between DEC, the NYC Department of Environmental Protection and the USGS. This study will identify and describe the driving forces that characterize the location and shape of the saltwater-freshwater boundary, describe the rate of salt front movement with respect to the driving forces, and describe the associated profile of the saltwater interface. The model developed from this study will consider tidal effects and channel configuration.

An important next step will be to conduct a follow up study to determine the effects of salt front movement on estuarine species. Permanent changes in the movements and average location of the salt front and the salinity regime in the river are likely to result in permanent changes to the river's ecosystem, including the distribution of estuarine and freshwater species. While such changes will be difficult to predict and even more difficult to detect, given the high variability in salt front location caused by seasonal variations in precipitation and runoff, ecosystem changes can occur and can be predicted. A study of the river's biotic community distribution, as related to salinity, should be performed following completion of the physical modeling of the effect of water withdrawal. In-stream flows required to minimize impacts of proposed withdrawals, if any, should be established.

Conservation

For many years, the Hudson River was targeted to become a major municipal water supply for New York City. More recently, however, New York City has adopted a bold water conservation program that has proven far more cost effective than the proposed expansion of Chelsea Pump Station or flood-skimming the Hudson River.

A broad range of conservation measures is underway to assure water is used efficiently. To sustain implementation of measures over the long term effort and direction are now required. In addition, 90 percent of the water supply for Westchester County comes from the New York City water system, but conservation measures have yet to be implemented there. Institutionalization of these conservation programs is necessary to avoid the future possibility of Hudson River withdrawals.

Despite these efforts, the New York City Department of Environmental Protection has begun a five-year study called the Hudson River Alternatives Study that evaluates mid- and long-range alternatives for emergency planning and increased need for the NYC water supply based on Hudson River withdrawals. The mid-range alternatives consider measures that could be implemented by 2010 and the long-range alternatives project the anticipated need for 2050. Development of the water budget and management of water resources will require consideration of the results of this study.

Set Asides

If, as anticipated, a water supply project to withdraw sizable quantities of freshwater from the Hudson is proposed for the future, an environmental impact statement will be required. A major product of this statement will be how the applicant will mitigate the impact described in the follow up to the salt front study.

Monitoring and Applied Research

Priorities:

- Develop and implement an ambient water and sediment quality and natural resource monitoring plan for the estuary to establish a baseline data set for key parameters and to evaluate conditions over time; provide a secure long-term funding source for ecosystem monitoring and education in support of resource management decision making

- Promote management-oriented research about key ecosystem processes, habitats, living resources, environmental conditions, and human impact on them in order to provide a basis for managing the Hudson Estuary as an ecosystem.

Introduction

From managing fish populations to ensuring adequate water supplies, New York State needs improved data on the environmental conditions of the estuary for management. Without a comprehensive monitoring program, the state does not have an early warning or reliable forecasting system to detect significant changes in the estuary and is, therefore, unprepared to prevent future problems or to track response to management. Two tools, research and monitoring, are necessary to aid management decision making and are best undertaken in partnership. Many local, state and federal agencies, as well as private sector institutions play a role in research and monitoring in the estuary. Coordination is required to promote cost effectiveness and to maximize the usefulness of data collected.

Monitoring is the continued, systematic observation of predetermined pollutants or pertinent components of the ecosystem over a period of time sufficient to determine:

- existing conditions
- trends
- natural variations of measured components
- response of the ecosystem to known changes, including management actions

Presently, limited monitoring programs are conducted by DEC, various universities, utility companies, and governmental agencies, and there is a need to coordinate these efforts. The Hudson estuary does not have a comprehensive and coordinated, long term ambient water and sediment quality and natural resource monitoring program.

For example, anglers have indicated that declines have occurred in bait and resident fish of the upper estuary during the last 15 years. Current data on abundance and distribution of fish in the estuary are not sufficient to verify, characterize, and respond to the problem. Similarly, the monitoring of PCBs in fish has identified potential human health risks associated with fish consumption and triggered DEC PCBs control efforts. However, the monitoring effort does not address the range of fish species eaten by people. In addition, long term monitoring will be necessary to document the effectiveness of remedial actions to control PCBs releases or remove PCBs from the Hudson River environment.

To effectively manage, enhance, restore, and maintain the estuary, a coordinated long term monitoring program is being developed that will establish a scientific basis for management decisions and public support. Over time, trend reporting will allow confirmation of estuary management effectiveness or demonstrate the need for modification. Development and implementation of a comprehensive monitoring program will give the Hudson Estuary ecosystem the service and protection it deserves.

The immediate need is to review and evaluate all existing monitoring programs and develop a proposal that fills in the gaps for a program that includes both water and sediment quality and natural resources and is coordinated with other existing monitoring programs. The plan will state clear goals and objectives, be sustainable, take full advantage of existing monitoring programs and new technologies, and provide a structure for data management, synthesis, analysis, integration, transformation, and dissemination of useful information.

DEC will develop an estuary-wide monitoring plan that will provide data needed for all estuarine management needs, along with an assessment of implementation costs and data management strategies. It will identify a long term multi-partner funding strategy to implement and administer the plan and begin implementation. During the plan development period, DEC will conduct monitoring projects that address current monitoring needs and priorities. An important component of the plan will be education of the public.

Carrying out this policy will require that New York State create a stable fund for ecosystem research and monitoring. Further, it will be necessary to develop and implement options for creating cost sharing mechanisms through public-private partnerships involving resource users, private foundations and government agencies. This will compliment Governor Pataki's initiative to create an institute on the shores of the Hudson which will conduct world-class research and education on rivers and estuaries.

Long term Monitoring of Fishery Resources

A key element in DEC management activities is to collect baseline data to detect and document changes in abundance, quality, or utilization of fishery resources. Current monitoring and research programs include the following:

- status assessment of spawning runs of American shad and striped bass
- monitoring the catch of American shad and the bycatch of striped bass and juvenile Atlantic sturgeon in the commercial shad fishery
- monitoring abundance of juvenile American shad, river herring and juvenile striped bass
- characterizing the recreational fishery for striped bass and other species
- sampling and analysis of fish flesh for persistent toxicants

Data from these programs form the basis for regulatory response to changes in status of fish or fish communities. Moreover, many data collection programs are or will be required components of ASMFC management plans. Lack of required programs will be considered lack of compliance. The monitoring programs required by the striped bass plan have been identified. However, they may be changed under plan amendments being developed. Monitoring requirements of other species' management plans currently are being identified.

The Hudson River Fisheries Unit and Anadromous Fish Unit and Bureau of Habitat conduct these monitoring programs for DEC. Over the last decade, these programs have been cut back. Mechanisms should be found to restore monitoring programs and to expand in the areas identified in this chapter.

In addition, DEC will continue to explore opportunities for shared data collection with the utilities. A cooperative monitoring program could promote efficiencies and result in better, more widely accepted data for making management decisions. A mechanism such as a research corporation or dedicated fund could be explored to facilitate future cooperation and to make it possible for other partners, such as the anglers, the federal government and private foundations to participate.

Research Needs in the Estuary

Ecosystems are highly complex and interactive systems consisting of many components, both living (i.e., humans, fish, invertebrates) and nonliving (i.e., nutrients, dissolved oxygen and water currents). The linkages between these components in many, if not most, ecosystems are not always obvious or direct. The Estuary Action Plan's

integrated approach recognizes that, while managers must often consider components in isolation, understanding the structure and function of the ecosystem as a whole is desirable and will aid management efforts.

Two basic approaches to research are needed in the estuary and should be carried out along with appropriate monitoring and modeling efforts to develop this fundamental understanding.

- Research focusing on basic ecosystem processes will contribute toward developing a working knowledge of how the ecosystem works biologically, hydrodynamically, chemically, and geologically

- Research focusing on specific components of the ecosystem rather than overall ecosystem function oriented toward specific management-related questions

In both cases, the data gathered must be transformed into useful information, and regular, periodic communication must occur between the research community and managers to incorporate results into the day-to-day activities of the decision makers.

Research, monitoring and modeling currently are undertaken by a variety of institutions that share the need for information and include: federal and state government agencies, the Sea Grant Institute, universities, utility companies, and research institutions.

Many of these institutions have developed research agendas that help guide their particular program toward accomplishing specific goals and objectives. The Hudson River Foundation serves as a major funding source for much of the basic ecosystem research currently being conducted on the river by nongovernment organizations.

In 1988, DEC, in consultation with the Hudson River Estuary Management Advisory Committee, initiated a special effort to define a research agenda focused on managing the estuary as a distinct ecosystem. Through a series of workshops and interviews, *A Research Program for the Hudson River Estuary* was issued in September 1990, followed by *A Report on the Development of an Estuarine Science Paradigm*. in 1992.

The process aimed to:

- define research needs, short and long term, which are required to develop a working understanding of how the overall ecosystem functions

- define research needs, short and long term, which are critical to the management of specific present and future environmental problems in the estuary, focusing on the ways in which research programs can be developed to inform management policy and guide specific practical decisions

- outline the key elements of an ideal program, or paradigm, for research-management relationships; the paradigm should support the development of sustained partnerships among government resource managers, the scientific community and interested members of the public

Successful application of this paradigm has been made by the Hudson River Foundation in the areas of fisheries management, PCBs contamination, and sewage treatment discharges. In all three cases, the Hudson River Foundation used recommendations that came out of cooperative assessment processes involving scientists, managers and the public to fund research projects specific to the needs identified by those managing the resource.

Establishing a stable, sustained funding source is key to long term research and monitoring. The Estuary Action Plan supports the development of a program that will build on and expand the initial work of the Hudson River Foundation and bring that institution into partnership with other institutions that support research on the Hudson and need research information. Ideally, such a program would be funded at $5 million per year, or a five-fold increase over the amount currently spent by the Hudson River Foundation.

Action Agenda: Monitoring and Applied Research

Accomplishments to Date

The agenda for Action Plan 2001 builds on past accomplishments. Since the first Action Plan was adopted in 1996, the Estuary Program has:

- **T** Begun development of a comprehensive monitoring plan to track river health and to establish a data management system to assure effective storage, retrieval and use of the data by all users. The goal is to systematically and efficiently collect the water quality, contaminant and biological data needed to monitor progress in meeting the goals of this Estuary Management Plan.

- **T** Funded $65 million in monitoring projects aimed at understanding water quality, fish and wildlife and toxic chemicals in the ecosystem.

- **T** Continued the Estuary Program's progress protecting the river, enjoying the river and cleaning up the river into the future with Action Plan 2001.

Commitment 19. Funding for Long-term monitoring

- **‘** Complete development of a plan for a long-term monitoring program

- **‘** Explore mechanisms to create a stable fund for ecosystem monitoring and education to establish a scientific basis for management decisions and public support for carrying them out; explore options for creating cost-sharing mechanisms through public-private partnerships involving resource users, private foundations and other government agencies; conduct projects that address current monitoring needs and priorities; support creation of a center on the shores of the Hudson which will conduct world-class research and education on rivers and estuaries

Implementation

Lead DEC Division:	Fish, Wildlife and Marine Resources
Others Involved:	DEC Division of Water
Funding Estimates:	Environmental Protection Fund: $492,675. Additional funds for monitoring are included in the cost estimates for Commitments 1, 2, 3, 5, 7, and 18: N.Y. Harbor Agreements $12.4 million has been approved for track down of contaminants, of which $5.6 million has been spent to date

Integrating DEC Programs

Priority:

- Maintain and build on core Hudson River programs in DEC to accomplish the Estuary Action Plan's agenda

Introduction

In order for DEC to meet existing program needs, and address many of the new challenges outlined in Action Plan 2001, the department's efforts on the Hudson River estuary must be integrated to insure that divisional and regional jurisdictions are bridged and partnerships with other agencies fostered. Existing mechanisms intended to coordinate and integrate these efforts include the Hudson River Policy Group, the Project Managers Group, the Division of Environmental Permits and the Hudson River Estuary Management Advisory Committee.

Within DEC, nearly every program is involved in some aspect of environmental protection of the estuary, with four core programs focusing specifically on the estuary as a resource. These Hudson River programs, working in concert with one another, form the foundation on which the department's holistic approach to management of the estuary will be built and must be continued and maintained.

DEC core Hudson River programs include the following:

- Hudson River Estuary Program; The HREP is charged with development of a 15-year ecosystem oriented management plan for the estuary, implementation of the Estuary Action Plan, coordination of the Hudson River Estuary Management Advisory Committee and initiates special projects

- Hudson River Fisheries Unit and Anadromous Fisheries Section; These units collect and report biological and public use data required to manage Hudson River fish resources within NYS; they also participate in management activities of the Atlantic States Marine Fisheries Commission (ASMFC) and support DEC efforts to reduce environmental impacts of various activities

- Hudson River National Estuarine Research Reserve; Established in 1982 under the Coastal Zone Management Act, this cooperative state-federal program implements education and research programs, including the management of four major tidal wetland areas: Stockport Flats, Tivoli Bays, Iona Island, and Piermont Marsh

- DEC Region 2 Marine Program; Coordinates a variety of marine programs in the New York City area, including regulating wetlands through Articles 15 and 25, participating in the NY/NJ Harbor Estuary Program, and coordinating with the Hudson River Park initiative. An important function of this program is the tracking and utilization of natural resource damage claim funds for habitat acquisition and restoration. Significant opportunities currently exist from a variety of settlement agreements in the New York City area

- Other DEC programs that support the achievement of management objectives for the Hudson River include: the Natural Heritage Program, the state stream classification system, State Pollutant Discharge Elimination System (SPDES) permits, boating access program, the NYS Open Space Plan, Environmental Permits, Bureau of Habitat, spill response, marine resource programs, endangered species unit and various land, air, and water environmental quality programs

In addition, several major efforts are underway that compliment the Estuary Program's approach to the resource. Coordination with these programs will be essential to the successful implementation and ongoing incorporation of an ecosystem approach to management of the resource. These programs include: American Heritage Rivers Program, the NY-NJ Harbor Estuary Program, the Hudson River Valley Greenway and the Department of State's Coastal Zone Management Program. Coordination will occur through the Hudson River Estuary Management Advisory Committee, the Hudson River Policy Group, Hudson River National Estuarine Research Reserve and through staff assignments made to related programs that create linkages at the technical level.

Action Agenda: Integrating DEC Programs

Accomplishments to Date

The agenda for Action Plan 2001 builds on past accomplishments. Since the first Action Plan was adopted in 1996, the Estuary Program has:

- Created two "general fund" positions to hire technicians to support the Hudson River Fisheries Unit.
- Provided administrative assistance to support the Hudson River National Estuarine Research Reserve.
- Provided administrative assistance to support the implementation of the Estuary Action Plan.

Commitment 20. Core Programs

- Maintain core Hudson River programs in DEC and build on them to accomplish the Estuary Action Plan. These programs include the Hudson River Estuary Program, the Hudson River Fisheries Unit and Anadromous Fisheries Section; the Hudson River National Estuarine Research Reserve; the Regional Marine Program; and others
- Continue to coordinate and integrate the Estuary Action Plan agenda in partnership with state agencies such as the NYS Office of Parks, Recreation and Historic Preservation, Departments of State, Transportation, General Services, Agriculture and Markets, Empire State Development Corporation, and the Hudson River Valley Greenway. Involve additional federal partners such as the U.S. Army Corps of Engineers, US Departments of Commerce and Interior, and the American Heritage Rivers Program

Implementation

Lead DEC Division:	Executive, with support from Fish, Wildlife and Marine Resources
Others Involved:	N/A
Funding Estimates:	Environmental Protection Fund: $716,369

Appendix A Hudson River Estuary Management Act 1987

§ 11-0306 THE HUDSON RIVER ESTUARY MANAGEMENT PROGRAM

Section 1. Short title. This act may be known as the "Hudson River Estuary Management Act"

§2. Legislative findings and declaration. The legislature finds and declares that the Hudson River estuary is a distinct and valuable ecosystem to the people of the state of New York and that its management as a distinct ecosystem is essential to the well being of the people of the state.

The legislature further finds that the Hudson River estuary is of statewide and national importance as a habitat for marine, anadromous, catadromous, riverine and freshwater fish species and that it is the only major estuary on the East Coast to still retain strong populations of its historical spawning stocks. Such species are of vital importance to the ecology and the economy of the state and to the recreational and commercial needs of the people of New York State and neighboring states. A lack of sufficient and reliable research and documentation has resulted in recurring disputes on the movements, life cycles and habitats of these species.

The legislature further finds that the Hudson River estuary possesses a fishery of outstanding commercial and recreational value, and the economic potential of the Hudson River estuary's fishery is at present underdeveloped. Improper management and use of the Hudson River estuary will deprive present and future generations of the benefit and enjoyment of this valuable resource.

The legislature further finds that the protection of estuarine species throughout their life history; the protection of their spawning habitat, nursery habitat, wintering habitat and feeding and foraging habitat; and the protection, enhancement and restoration of the state's natural resources upon which these species and their habitat depend requires a specific program for the proper management of the Hudson River estuary.

It is hereby declared to be the policy of the state to preserve, protect and, where possible, restore and enhance the natural resources, the species, the habitat and the commercial and recreational values of the Hudson River estuary.

11-0306 THE HUDSON RIVER ESTUARY MANAGEMENT PROGRAM

1. There is established a Hudson River estuarine district which shall include the tidal waters of the Hudson River, including the tidal waters of its tributaries and wetlands from the federal lock and dam at Troy to the Verrazano-Narrows.

2. The department shall establish a Hudson River estuary management program for the Hudson River estuarine district and associated shorelands, with consideration to the remainder of the Hudson River, New York Bight, and the waters around Long Island only as they impact the Hudson River estuary, in order to protect, preserve and where possible, restore and enhance the Hudson River estuarine district.

3. The commissioner shall appoint a Hudson River estuary management advisory committee with whom he or she shall consult on regulatory, policy and other matters affecting the management, protection and use of the Hudson River estuarine district and on the formulation of a Hudson River estuary management program. Such committee shall consist of not less than 11 members who represent interests directly involved in the Hudson River estuarine district and shall include representatives of commercial fishing, sportsman, research, conservation, and recreation. For the purpose of immediate implementation of this section, the committee shall consist of the current members of the Hudson River fishery advisory committee.

4. The commissioner shall maintain in the department the position of Hudson River estuary coordinator to manage the Hudson River estuary management program and to assist the commissioner and the advisory committee in its development and implementation.

5. There is established a Hudson River estuarine sanctuary for the purpose of protecting areas of special ecological significance within the Hudson River estuarine district and associated shorelands. The estuarine sanctuary shall be managed as a long term estuarine field laboratory for research and education concerning the Hudson River ecosystem. The estuarine sanctuary shall be composed initially of the four sites within the Hudson River national estuarine research reserve (HRNERR). The department shall adopt the Hudson River national estuarine research reserve program as a program of the department for the purpose of operating the estuarine sanctuary. The sanctuary shall be managed by the department in cooperation with the Hudson River estuary management advisory committee and the commissioner shall have the authority to designate additional sites for inclusion within the estuarine sanctuary. The estuarine sanctuary shall be open to those activities that are compatible with the primary purposes and management goals of the estuarine sanctuary and its individual sites.

6. The department, in cooperation with the Hudson River estuary management advisory committee, shall report to the chairpersons assembly committee on environmental conservation and the senate committee on environmental conservation on or before March first, nineteen hundred eighty-eight with an estuary management strategy for the development of a continuing fifteen-year estuary management program for the preservation, protection, restoration and

enhancement of the Hudson River estuarine district and associated shorelands, including but not limited to its natural resources, its fish and wildlife, and the habitants within it. The estuary management strategy shall include but not be limited to the following:

a. A discussion of how the Hudson River estuary functions, and, the relative role of different species and an explanation of the role of the Hudson River estuary as a distinct ecosystem as a habitat for fish and wildlife, as a commercial fishery and as a recreational resource.

b. Identification of areas of special ecological significance within the estuarine district and associated shoreland, including but not limited to spawning, nursery, wintering, feeding and foraging habitat for marine, anadromous, catadromous, riverine, and freshwater species and a description of the annual dynamics of such habitats including the geochemical, thermodynamic, biological, hydrodynamic and hydrological states and mechanisms critical to habitat maintenance.

c. A plan for the development and operation of the Hudson River estuarine sanctuary which shall include criteria for the identification of additional areas of special ecological significance and for additions to the Hudson River estuarine sanctuary and a program of education and research which shall be consistent with the purposes of subdivision five of this section.

d. A status report on the populations and relative abundance of species that have potential or existing recreational or commercial value or that play a key role in the functioning of the estuary and on the diversity of species in the estuarine district, including a plan for maintaining an accurate evaluation of populations and relative abundance and diversity on an annual basis.

e. Evaluation of the impact of the uses of water on the Hudson River estuarine district, including present and future demands for water and their impact on the balance of fresh and salt water in the estuary and the role of the location of the salt front in the estuary.

f. Identification of areas of potential ecological significance which may require rehabilitation.

g. A status report on the levels of toxicants in and their effects on important estuarine indicator species and for species that have potential or existing recreational or commercial value.

h. Identification of the anthropogenic activities and the conservation and management problems that pose an existing or potential threat to the resources and the functioning of the estuary.

i. An inventory of ownership and tenancy of underwater land in the estuarine district.

j. Recommendation for developing the economic potential of the Hudson River fishery and maintaining its traditional commercial fishery.

k. Recommendations for implementation of a fifteen-year estuary management program, including a list of tasks that must be accomplished to implement the purposes stated in this subdivision and address the findings and implement the recommendations of the estuary management strategy.

l. Evaluation of the existing resources and authority of the department to implement the estuary management program including research, information and data needs and legislative, administrative and regulatory recommendations and the potential role of private sources and institutions.

7. On or before January first, nineteen hundred eighty-nine, the commissioner shall present the department's Hudson River estuary management program at a public hearing. This public hearing shall be advertised in official newspapers in each county along the Hudson River corridor from the city of New York to Albany and Rensselaer counties. The program and public comments regarding it shall be included in a report on the program to be filed with the chair of the assembly environmental conservation committee and the chair of the senate committee on environmental conservation on or before March first, nineteen hundred eighty-nine.

8. On or before the first day of March of each year, commencing on March first, nineteen hundred ninety, the commissioner shall prepare a report detailing the progress of the estuary management program, including but not limited to consideration of those matters listed in subdivision six of this section, as well as any planned or anticipated regulatory or policy changes which may affect the estuarine district. The commissioner shall present the department's annual report at a special public meeting for the purpose of public review and to hear public comment on the annual report. The report shall be filed with the chairman of the assembly committee on environmental conservation and the senate committee on conservation and recreation.

9. The commissioner shall consult with the advisory committee regularly and in a timely fashion in the preparation of the estuary management strategy, the estuary management program and his or her yearly report to the legislature regarding any planned or anticipated regulatory or policy changes which will affect the estuarine district. The commissioner shall include in his or her reports to the legislature the comments, recommendations and observations of the advisory committee and a discussion of the consulting role that was played by the advisory committee.

10. The advisory committee shall consult with department personnel on matters affecting the Hudson River estuary on a regular basis and report to the commissioner on or before the first day of December of each year on its activities and concerns.

11. Any agreement or negotiated settlement which existed between the commissioner and the previously existing Hudson River fishery advisory committee, whose membership will comprise the Hudson River estuary management advisory committee for the immediate purposes of implementing this section, shall be binding between the commissioner and the Hudson River estuary management advisory committee.

Appendix B Objectives of the 1996 Hudson River Estuary Management Plan

The following objectives have been identified for the Hudson River Estuary Management Plan, July 1996.

BENEFIT: **Ecosystem Protection**

Living Resources:

1. Measure and/or determine the quality, quantity, diversity and distribution of Hudson River habitats.

2. Maintain Hudson River habitats in quantity, quality, diversity and distribution sufficient to optimize production of living estuarine resources.

3. Achieve no net loss of Hudson River wetlands and littoral zones.

4. Prevent the further expansion of exotic and/or nuisance aquatic vegetation in the estuary and develop strategies for reducing the extent of existing exotic/nuisance vegetation.

5. Identify and protect habitat areas for state or federally listed endangered or threatened species or other species of special concern in quantities sufficient to maintain or enhance species populations.

6. Restore secure populations of bald eagle, osprey, shortnose sturgeon and locally extirpated species to appropriate habitat in the Hudson River estuary.

7. Preserve and manage those natural ecosystems and communities found in and adjacent to the estuary which are regionally important.

8. Manage the physical and chemical properties of the estuary's water column and sediments (substrate) to insure optimal production of the estuary's living resources.

9. Reduce chemical contaminant levels to concentrations that will not impair the successful survival, reproduction and growth of sensitive species, nor impair secondary consumers of fish, shellfish and wildlife.

10. Manage the underwater lands of the estuary to assure long term viability of the habitats they support and to minimize the impacts of competing demands for the use of such resources.

11. Restore and maintain an ecosystem which supports an optimum diversity of living resources on a sustained basis.

12. Increase benthic species diversity and recover pollution intolerant species.

13. Maintain, or, where appropriate, restore native populations of fish, shellfish and crustaceans.

Water Quality:

1. Achieve habitat protection by assuring that water quality standards are met.

2. Support diverse human uses (swimming, navigation, water supply) by assuring that water quality standards are met, and, where appropriate, stream classifications are upgraded.

3. Abate or remediate existing sources of pollution entering the Hudson estuary such as sediments, contaminants and pathogens.

4. Manage watersheds and tributary systems to contribute to overall ecosystem health.

Water Quantity:

1. Maintain in-stream flows at historic levels until the ecological impacts of water flow change are better understood.

2. Develop and expand understanding of the ecological effects of changes in the in-stream flow.

3. Incorporate in-stream flow needs, as they are developed, into future revisions of the Water Resources Management Strategies as part of the allocation process, and provide for their management.

Associated Shorelands:

1. Maintain a natural vegetative edge along the estuary and tributaries to protect water quality and provide wildlife habitat.

2. Maintain natural communities and forest cover adjacent to the estuary which have been shown to be important contributors to estuarine ecosystem processes associated with upland habitat for living resources or protection of water quality.

3. Expand protection of natural communities found in and adjacent to the estuary which now are rare elsewhere in the State.

BENEFIT: **Harvest and Resource Use**

Living Resources:

1. Protect and, where possible, enhance aquatic habitats to maintain or restore high carrying capacity for finfish.

   1.A. Protect, maintain and restore aquatic habitat

   1.B. Minimize disturbances that could affect all life stages of fish negatively

1.C. Reduce impacts of water use associated with industrial cooling and domestic water supply

2. Manage sport and commercial fishing activities to maintain fish stocks at desirable population levels and appropriate population age structures.

    - Maintain Hudson River American shad, Atlantic sturgeon, and striped bass stocks to meet requirements for sport and commercial fisheries as stated in the species Interstate Fishery Management Plan developed under ASMFC

3. Restore depleted fish populations to high levels of abundance.

    - Facilitate recovery of shortnose sturgeon populations to a level which will permit removal from endangered or threatened species lists and resumption of viable fisheries

4. Maintain and perpetuate traditional Hudson River commercial fishing opportunities consistent with historical patterns and levels of harvest and compatible with the status of fish stocks.

5. Determine the feasibility of restoring the lower estuary for use as an oyster producing area for seed production purposes.

6. Sustain and enhance the blue crab fishery in the lower Hudson estuary.

7. Increase the potential for participation in the commercial blue crab fishery.

8. Reduce chemical contaminant concentrations in fish, shellfish and wildlife to levels which are within DEC guidelines.

9. Prevent the commercial taking of fish and shellfish whose contaminant levels exceed DEC guidelines.

10. Advise consumers of fish, shellfish and wildlife when chemical contaminants exceed levels acceptable for unrestricted human consumption. Instruct consumers on proper preparation of fish, shellfish and wildlife to reduce exposure to chemical contaminants.

11. Develop standards defining acceptable concentrations of chemicals in edible fish and wildlife.

Water Quality:

1. Reduce contaminants in fish, shellfish and crustaceans to levels that are safe for unrestricted human consumption assuring water quality standards are met.

Associated Shorelands:

1. Encourage owners of forested shoreline to retain the full compliment of forest resource values for their lands.

2. Provide for, maintain and support with proper incentives agricultural use of lands currently farmed.

3. Limit the conversion of farmland for development.

4. Control adverse impacts of agricultural production on estuarine resources.

BENEFIT: **Recreation**

Living Resources:

1. Increase recreational fishing opportunity to provide at least 500,000 angler-days per year of recreation by the year 2005. This represents an estimated doubling in use from present levels. Sheppard (1976), in his evaluation of the Hudson fishery resource for the G.E. PCBs case, projected an angler potential of 500,000-1,500,000 angler trips annually.

2. Maintain angler success rates, expressed in catch-per-unit effort, at not less than 75 percent of 1990 levels while maintaining age structure of fished populations.

3. Maintain a black bass fishery (smallmouth and largemouth bass) which will provide for a largemouth bass average size Relative Stock Density* $(RSD)_{15}$ of 40 or greater for spring electrofishing, RSD_{05} of 45 or greater in tournament entries, or maintain an average weight of 1.9 lbs. per bass in tournament catches and abundance, which will support electrofishing catch rates of greater than 20 largemouths over 12 inches per hour in at least 75 percent of samples during March-April wintering area surveys, and/or maintain tournament catch rates over 1.4 black bass/trip based upon a sample of 500 trips spread over several tournaments between Catskill and Kingston.

4. Manage sport and commercial fishing activities to maintain fish stocks of desirable population levels and population age structures.

5. Maintain opportunities for sustainable hunting, trapping, birdwatching/ nature observation and other wildlife recreational use in the Hudson estuary.

6. Enhance factors such as access, habitat diversity and water quality, that affect the quality and enjoyment of outdoor activities.

7. Develop and maintain public access for a broad range of purposes relating to the enjoyment of the natural beauty of Hudson River resources.

8. Maintain and enhance public access to the estuary for a wide range of living resource-oriented recreation activities, including hunting, fishing, trapping, birdwatching and nature study.

Water Quality:

1. Attain water quality conditions necessary to support unrestricted use for primary and secondary recreational contact opportunities in accordance with existing or revised surface water quality standards.

Associated Shorelands:

1. Increase opportunities for appropriate public use of private and public lands.

BENEFIT: **Domestic Water Supply**

Water Quality:

1. Attain and maintain water quality conditions necessary to support safe human consumption of treated Hudson River water along the stretch of the estuary where water segments are classified A.

Water Quantity:

1. Implement recommendations of present report and future updates of the *Delaware-Lower Hudson Region Water Resource Management Strategy* and applicable portions of the *Capital Region Water Resources Management Strategy*.

BENEFIT: **Aesthetics**

Water Quality:

1. Remediate adverse water quality conditions that cause foul odors, unpleasant taste and visual blight.

Associated Shorelands:

1. Maintain and enhance existing scenic resources.

2. Conserve historic landscape patterns of greenbelts between urban waterfronts.

3. Protect viewsheds from historically significant vantage points.

4. Protect scenic resources of and adjacent to designated scenic districts and along designated scenic roads.

5. Protect resources of exceptional scenic beauty.

BENEFIT: **Industrial Use**

Water Quantity:

1. Implement recommendations of present report and future updates of the *Delaware-Lower Hudson Regional Water Resource Management Strategy*

and applicable portions of the *Capital Region Water Resources Management Strategy*.

2. Assure that industrial water use includes protective measures to prevent adverse impacts on aquatic resources.

BENEFIT: **Commercial and Residential Land Use**

Associated Shorelands:

1. Preserve a natural vegetative edge along the shores of the estuary and its tributary streams, marshes and wetlands to provide watershed protection, recreational uses, and maintain scenic and visual resources.

2. Minimize environmental impacts of traditional commercial use of the shorelands, applying current environmental regulations where needed.
3. Assure that new development along the shoreline minimizes impacts on water quality, habitat and scenery and maximizes opportunities for access along and to the river.
4. Establish green belts between developed riverfront areas.

5. Provide scenic, ecological and recreational enhancements to riverfront sites which have been or are being developed.

BENEFIT: **Monitoring Research and Education**

1. Develop scientific information as a basis for making management decisions.

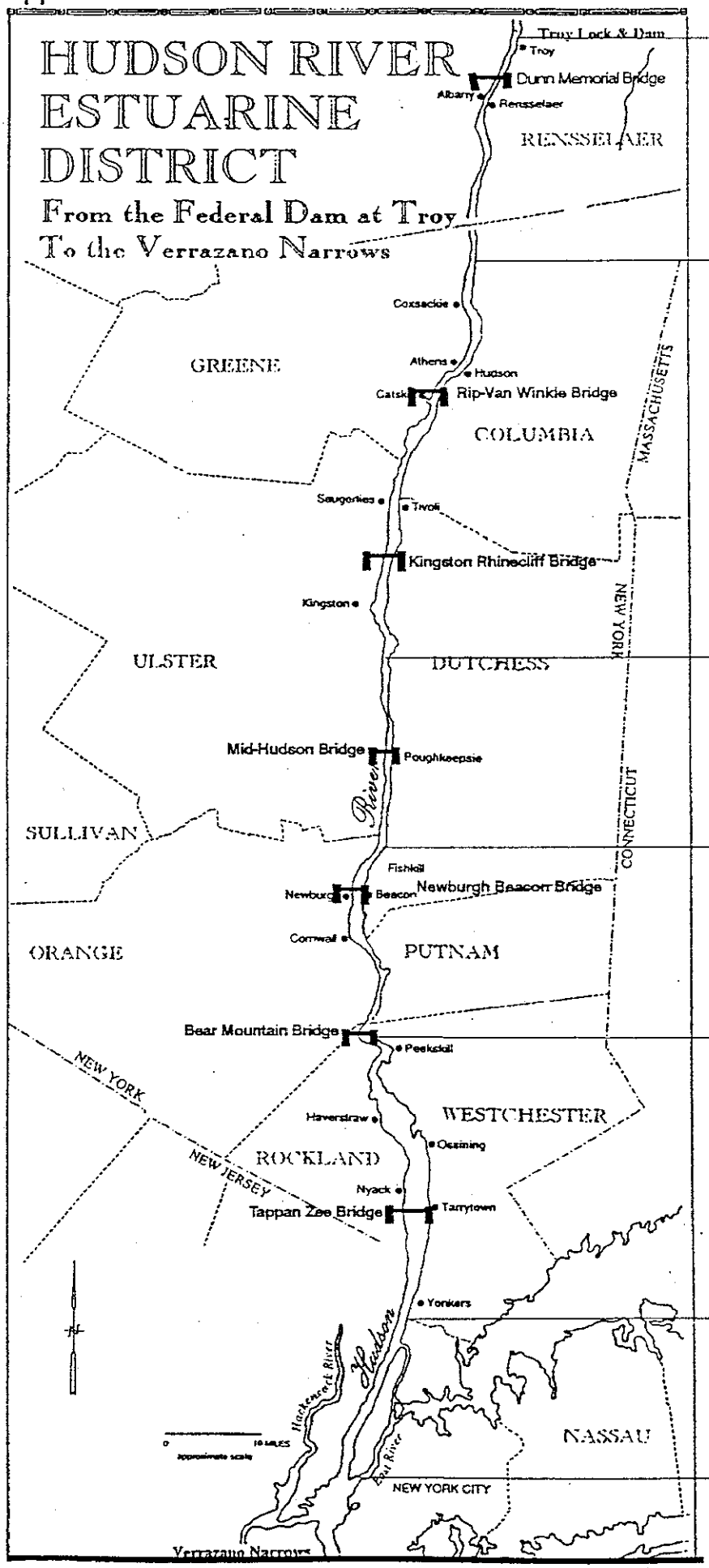
2. Inform citizens of the Hudson Valley about natural resource management needs to assure public involvement in and support for management actions.

BENEFIT: **Navigation**

Water Quality:

1. Attain environmental conditions to support safe and cost-effective navigational dredging and dredged material management to ensure continued use of the river as a transportation corridor.

Appendix C. Water Classifications



Nothern confluence of Mohawk and Hudson Rivers

Class "C"

Light no 72 South End Houghtaling Island

Class "A"

Light No. 28, South End of Esopus Island

Class "A"

Roseton Power Plant general area of Chelsea Pump Station

Class "B"

Rockland/Westchester County line (Bear Mt. Bridge)

Class "SB"

New York/Bronx County line

Class "I"

Battery, Manhattan

Class "I"

Verrazano Narrows

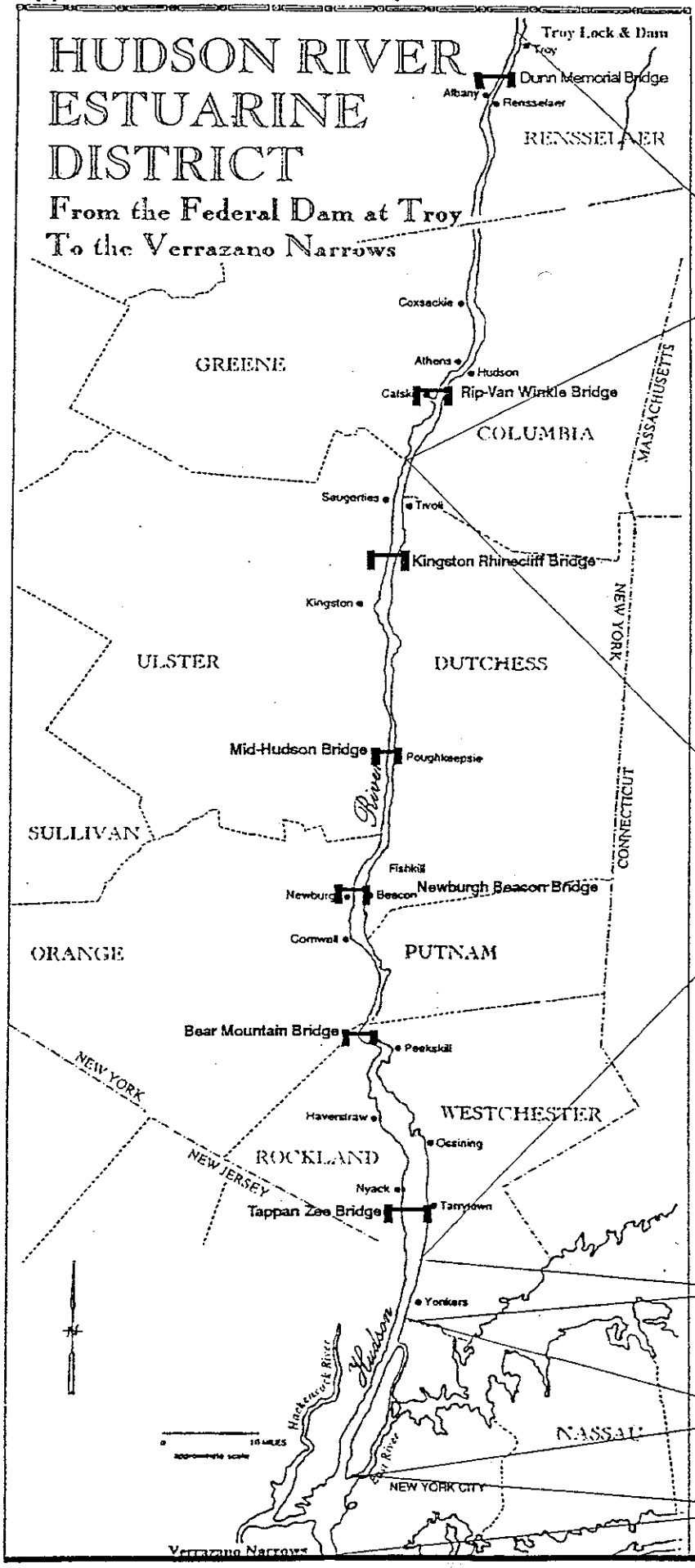
Class "A"
drinking and all other uses

Class "B"
swimming

Class "C"
fish propagation and fishing

Class "SB"
saline swimming

Class "I"
secondary contact recreation (fishing and boating)



Appendix D

45 Miles:
Class C/Fishing
Moderate Impairment due to :
Priority organics
PCB contaminated sediments

85 Miles:
Class A/Fishing
Moderate Impairments due to:
Priority organics
PCB
Contaminated sediments

4 Miles:
Class SB/Bathing
Severe impairment due to sediments

15 Miles:
Class I/Fishing
Severe Impairment due to sediments

Upper NY Bay:
Class I /Fishing
Slight Impairment due to aesthetics, municipal STP, CSOs, sediments

Appendix E Priority Water Problem List: Definitions

In response to several needs, including the Non-point Source Assessment and the CWA 304 lists, the Water Division has expanded its parent Priority Water Problem List to include four (4) types of waters:

Use Precluded: Water quality and/or habitat characteristics virtually preclude, eliminate, or do not support a classified use. Natural ecosystem functions may be significantly disrupted.

Use Impaired: Water quality and/or habitat characteristics frequently impair a classified use. Also applied when the designated use is supported but at a level significantly less than would be anticipated otherwise. Natural ecosystem functions may be disrupted.

Stressed: Reduced water quality occasionally is evident and/or designated uses are intermittently or marginally restricted. Natural ecosystems may exhibit adverse changes.

Threatened: Water quality presently supports designated use, and ecosystems exhibit no obvious signs of stress; however, existing or changing land use patterns may result in restricted usage or ecosystem disruption.

As one element of its review process, EPA has statistically evaluated New York State ambient toxic compound data as recorded in STORET, the national ambient water quality database. This was done because the agency believes that the Act requires listing waters with standard violations in addition to existing impaired waters.

No technically sound definition of "standard violation" exists. Consequently, EPA Region II developed a reasonable definition which New York State accepts for the Priority Water Problem List (and thus, 304[1]) as follows:

- based upon appropriate data, ambient concentrations exceed the water quality criteria for one substance in at least 25% of the observations

- based upon appropriate data, ambient concentrations exceed the water quality criteria for more than one substance in at least 10% of the total number of observations.

Therefore, waterbodies that meet this criteria due to toxic compounds, but are otherwise unimpaired, appear as an appendix to the Section 304(1)(A)(I) list - waterbodies impaired by toxins. Impaired waterbodies which also demonstrate water quality standard excesses will be so noted within the waterbody data sheet in the next revision to the Priority Water Problem List.

Appendix F List of Acronyms

ACOE	United States Army Corps of Engineers (federal)
ASMFC	Atlantic States Marine Fisheries Commission (multi-state)
BMP	Best Management Practices
BCA	NYS Bird Conservation Area Program
CSO	Combined Sewer Overflow
CWA	Clean Water Act
DDT	Dichlorodiphenyltrichloroethane
DEC	Department of Environmental Conservation (state)
DOH	Department Of Health (state)
DOS	Department Of State (state)
DOT	New York State Department of Transportation
DEP	Department of Environmental Protection (NY City)
DHCR	Division of Housing and Community Renewal
ECL	Environmental Conservation Law (state)
EPA	Environmental Protection Agency (federal)
EPF	Environmental Protection Fund
ESDC	Empire State Development Corporation (or ESD) (state)
FDA	United States Food and Drug Administration (federal)
GAP	Gap Analysis Program
GIS	Geographic Information System
HEP	NY/NJ Harbor Estuary Program (state/federal)
HREP	Hudson River Estuary Program (state)
HRFU	Hudson River Fisheries Unit (state)
HRNERR	Hudson River National Estuarine Research Reserve (state/federal)
ISTEA	Intermodel Surface Transportation Efficiency Act grants (federal)
MOU	Memorandum of Understanding
NAWQA	National Water Quality Assessment Program
NDZ	No-Discharge Zone
NJDEP	New Jersey Department Environmental Protection (state)
NMFS	National Marine Fisheries Service (federal)
NOAA	National Oceanic and Atmospheric Administration (federal)
NPS	Non-point Source Pollution
NYCDEP	New York City Department of Environmental Protection
NRCS	National Resources Conservation Service (federal)
OGS	Office of General Services (state)
OPRHP	Office of Parks, Recreation and Historic Preservation (state)
ORPS	Office of Real Property Services (state)
PAHs	Polycyclic Aromatic Hydrocarbons
PCBs	Polychlorinated Biphenyls
PISCES	Passive In-Site Chemical Extraction Sampler
POTW	Publicly Owned Treatment Works
ppm	Parts Per Million
ppt	Parts Per Trillion
RCRA	Resource Conservation Recovery Act
RIBS	Rotating Intensive Basin Study (state)
RM	River Mile
SASS	Scenic Areas of Statewide Significance
SAV	Submerged Aquatic Vegetation
SEQR	State Environmental Quality Review Act
SPDES	State Pollution Discharge Elimination System
STP	Sewage Treatment Plant
USDA	United States Department of Agriculture (federal)
USFWS	United States Fish and Wildlife Service (federal)
USGS	United States Geological Survey (federal)
WRAPS	Watershed Restoration and Protection Action Strategies

Appendix G Estuary Action Plan Completed Reports

Benthic Mapping

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Appendix H Acknowledgments

The development of Action Plan 2001 involved the participation and cooperation of many people. Policy guidance and goal setting was provided by the Hudson River Policy Group, an internal DEC committee consisting of the Special Assistant and Hudson River Estuary Coordinator as chairperson, the regional directors of Regions 2, 3, and 4, directors from the Division of Lands & Forests, Division of Fish, Wildlife and Marine Resources, Division of Environmental Permits, Counsel's Office, and Division of Water. Technical guidance was provided by staff members of the above Divisions and Regions who wrote sections of the plan related to their area of expertise. The Hudson River Estuary Management Advisory Committee reviewed the document and provided input on policies, programs, goals and objectives. Additional citizen input was sought through public meetings.

The project was managed by Frances Dunwell, Special Assistant and Hudson River Estuary Coordinator. This report was compiled and edited by Fran Dunwell, Nancy W. Beard, Citizen Participation Specialist, Bethia Waterman, Information Officer, New England Interstate Water Pollution Control Commission, Steve Stanne, Extension Support Specialist, NYS Water Resources Institute, Cornell University and Megan Molique, Assistant to the Coordinator, NYS Water Resources Institute, Cornell University. Word processing and secretarial support was provided by Brenda Bubenicek and Patricia McGovern.

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Federal agencies, such as the Environmental Protection Agency, the Army Corps of Engineers, Departments of Commerce and Interior, and the American Heritage Rivers Program also have participated actively in the plan.

Appendix I Hudson River Estuary Management Advisory Committee

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Appendix J Hudson River Estuary Grants 1999-2000

Hudson River Estuary Grants 1999-2000		**Total $1,177,000**
1. Interpretation and Education		**$419, 732 total**
County	Applicant	Project Name/Location/Funding
Columbia	Columbia Co. Soil and Water Conservation District	Exhibit, "Meeting the Hudson River Estuary" at Mud Creek Environmental Learning Center, Ghent, $25,500
Dutchess	Dutchess County BOCES	Purchase of boat for education programs at Norrie Point, $75,000
Dutchess and Ulster	Hudson River Sloop Clearwater	"Operation Kid Steward", field trips for kids and programs for their parents at libraries and community centers, $24,975
Dutchess	Scenic Hudson	Interpretive Kiosks, Madame Brett Park, Beacon, $27,000
Dutchess	Vassar College	Series of Hudson River radio programs, $45,000
Greene	Greene Co. Soil and Water Conservation and District	Environmental Education Program at Cohotate Center of Columbia-Greene Community College, $22,750
New York City	The River Project	Community Education Initiative, Pier 26, $20,000
New York City	NYC Soil & Water Conservation District	Design Community Interpretive Center, Riverbank State Park, $20,000
Orange	Newburgh Free Library	Hudson River Resource Center On Line, Newburgh, $18,146
Ulster	Arm-of-the-Sea Theater	Develop Hudson estuary show, $24,500
Putnam	National Audubon Society	Nature Center Winterization Project, Constitution Marsh Sanctuary, $14,987
Ulster	Town of Esopus	Environmental Education Program, Sleightsburgh Spit Park, $4,874
Westchester	Beczak Environmental Education Center	River-based education program, Yonkers, $63,000
Westchester	Hudson River Museum	"Hudson Stories" multimedia production, $34,000
2. Habitat Preservation and/or Restoration		**$165,125 Total**
Columbia	Nature Conservancy	Mill Creek, 90 acres, land acquisition, $74,000

Rockland	Rockland County	Grassy Point Marsh, 31.4 acres, land acquisition, $85,125
Westchester	Village of Dobbs Ferry	Wickers Creek, biological assessment, habitat restoration feasibility study, $6,000
3. Local Scenic Resources Projects		**$56,710 Total**
Putnam	Manitoga	Restoring views, $5,210
Westchester	City of Yonkers	Restoration of views of the Hudson from Untermyer Park and Gardens, $51,500
4. Community Conservation and Stewardship		**$136,549 Total**
Albany	Arbor Hill Environmental Justice Corporation	Upper Hudson River Stream Keeper Project, $62,531
Dutchess	Dutchess County EMC	Dutchess County Watershed Program , $44,000
Putnam	Town of Putnam Valley	Peekskill Hollow Brook Conservation and River Stewardship Project, $5,800
Rockland	Rockland County	Natural Resource Plan for Waterfront Park, $2,625
Ulster	Cornell University	Recreational Boaters and Conservation of Submerged Aquatic Vegetation, $21,593
5. River Access: **Boating, Fishing, Swimming, Wildlife-related Recreation**		**$398,887 Total**
Greene	Northern Catskills Chapter, National Audubon Society	Wildlife observation platform and bird banding station at Livingston-Ramshorn Marsh, $2,500
New York City	Municipal Art Society	Seven docks/floating piers at various locations on the Hudson and East River for hand launching, $34,147
Orange	Newburgh Rowing Club	Construction of hand boat launch, $52,365
Putnam	Putnam County	Construction of hand boat launch, Cold Spring, $100,000
Rensselaer	Village of Castleton	Handicapped accessible fishing access, reclamation of industrial site, $38,000
Rockland	Rockland County	Design of trailer boat launch, Haverstraw, $26,250
Ulster	Town of Esopus	Walkway for wildlife observation at Sleightsburgh Spit, $49,250
Westchester	Town of Cortland	Construction of hand boat launch, Oscawana Island, $21,375
Westchester	City of Peekskill	Waterfront Trail, $75,000

Appendix K Hudson River Estuary Clean Water Clean Air Bond Act Projects 1996-2001

A. Brownfield Projects		
Location	**Fiscal Year**	**Funding**
Albany County		
Albany Former Railroad Operations site - Investigation	1996-1997	$59,306
Gansevoort / Franklin St. Parcel - Investigation	1996-1997	$68,510
City of Albany Former Jared Holt Manufacturing Site - Investigation	1996-1997	$22,500
Columbia County		
City of Hudson Former Hudson Petroleum site - Investigation	1996-1997	$102,160
City of Hudson Former Hudson Petroleum site - Remediation	1996-1997	$90,863
Dutchess County		
City of Beacon - Brunetto Cheese - Investigation	1996-1997	$93,750
City of Poughkeepsie - Former Hamilton Reproduction site - Investigation	1996-1997	$123,750
City of Poughkeepsie - Former Hamilton Reproduction site - Remediation	1996-1997	$412,500
City of Poughkeepsie - Qual Krom site - Investigation	1996-1997	$135,375
City of Poughkeepsie - Qual Krom site - Remediation	1996-1997	$208,375
Orange County		
City of Newburgh - Provan / Ford Site Investigation	1996-1997	$168,750
City of Newburgh - Jonas Automotive Site Investigation	1996-1997	$76,500
Rensselaer County		
City of Troy - South River Street Site Investigation	1996-1997	$93,931
Westchester County		
Town of Cortlandt - Steamboat River Front Park - Investigation of 3.5 Acre parcel Former Marina	1996-1997	$276,000
Village of Irvington -Irvington Waterfront Park - Investigation	1996-1997	$142,500
Village of Irvington - Irvington Waterfront Park - Remediation	1996-1997	$4,176,275
City of Yonkers - Yonkers Downtown Waterfront - Phase I - Investigation	1996-1997	$243,750
City of Yonkers - Yonkers Downtown Waterfront - Phase I - Remediation	1996-1997	$507,000
City of Yonkers - Yonkers Downtown Waterfront - Phase II - Investigation	1996-1997	$32,777
Total Funded for Brownfield Projects		**$7,034,572**

B. Water Quality Improvement Projects

Location	Fiscal Year	Funding
1. Contact Recreation Projects (Improve Class C Waters and Vicinity)		
Albany County		
Watervliet, City of -Wiswall Ave Sewer Separation	1997-1998	$212,500
Beaver Creek Sewer District Improvement - Phase IV Albany Municipal Water Finance Authority/City of Albany	1997-1998	$343,575
Albany Water Board- Fox Creek Sewer	1998-1999	$1,062,500
North & South Plant Influent Pump Station Rehabilitation	1999-2000	$1,052,399
Greene County		
Infiltration/Inflow Remediation - Hudson River Town of New Baltimore	1998-1999	$614,125
Rensselaer County		
Rensselaer (C) LWRP Implementation-Sanitary Sewer Overflow/Storm Water Remediation	1998-1999	$407,150
Rensselaer County Sewer District - Construction of an Additional Final Clarifier	1998-1999	$1,742,500
City of Troy 102nd Street Sewer Separation & CSO Elimination Project	1999-2000	$1,275,000
City of Rensselaer CSO Elimination Project Albany - Pool Hudson Scope limited to 2nd Ave portion	1999-2000	$192,695
2. Water Quality Infrastructure to Assist Local Waterfront Revitalization Projects		
Dutchess County		
Town of Poughkeepsie - Longview Park Sanitary Sewer	1997-1998	$68,000
Westchester County		
Yonkers - New Waterfront Development Utilities (Sanitary & Stormwater Sewer Lines)	1998-1999	$1,205,937
Croton-on-Hudson - Installation of Sanitary Sewer Line to Village Water	1997-1998	$206,000
3. Sewage Reduction Projects (Reduce raw sewage effluent into Class A and B waters)		
Dutchess County		
City of Beacon - Beacon Waterfront - Lift Station	1997-1998	$250,000
Greene County		
Village of Catskill - Phase 2 CSO Corrective Measures (abate CSO into Catskill Creek)	1999-2000	$297,500

B. Water Quality Improvement Projects

Location	Fiscal Year	Funding
Village of Catskill - CSO Corrective Measures	1997-1998	$541,900
Town of Catskill - Infiltration/Inflow Correction - Smith's Landing (S.D. #4)	1998-1999	$306,850
Village of Catskill - Sewage Treatment Plant Emergency Generator	1999-2000	$73,000
Rockland County		
Town of Orangetown - Pump Station Telemetry	1997-1998	$264,000
Town of Orangetown - Pump Station Emergency Generator	1997-1998	$574,000
Ulster County		
City of Kingston - Pretreatment and Diversion Chamber - Wilbur Avenue (abate CSO into Rondout Creek)	1999-2000	$464,950
City of Kingston - Rondout Interceptor Inverted Sewer Siphon Replacement	1998-1999	$1,515,000
Town of Ulster - Modifications& Expansion to the Ulster Wastewater STP	1997-1998	$1,792,500
Town of Ulster - Modifications and Expansion to the Ulster Wastewater Treatment Facility	1998-1999	$250,000
City of Kingston - Wastewater Treatment Improvements	1997-1998	$98,600
4. Nonpoint Source		
Albany County		
Albany County - SWCD Barnyard water diversion and relocation	1996-1997	$7,538
Columbia County		
Columbia County SWCD Nonpoint controls for Roxbury Road - Claverack Creek	1996-1997	$89,750
Mill Creek Watershed - Nonpoint source pollution abatement project - J&J's	1998-1999	$100,000
Stuyvesant - Mill Creek Watershed Manure Composting Project (nutrients)	1999-2000	$93,000
Dutchess County		
Dutchess County SWCD - Barnyard Relocation - Wappinger Creek Watershed	1996-1997	$12,000
Dutchess County SWCD - Nutrient Loading Reduction Controls	1996-1997	$51,300
Dutchess County SWCD - Nonpoint - Waste Management Wappinger Creek	1996-1997	$166,275
Wappinger Lake Water Quality Improvement - Stormwater pollution reduction	1998-1999	$249,534
Dutchess County SWCD - Any water AEM Tier III on five farms in the Wappinger Creek	1997-1998	$242,000
Greene County		

B. Water Quality Improvement Projects		
Location	**Fiscal Year**	**Funding**
Greene County SWCD - Farm Land Streambank stabilization and buffers	1996-1997	$66,000
Orange County		
Orange County SWCD - Nutrient and Ag waste management - Wallkill watershed	1996-1997	$80,000
Rensselaer County		
Rensselaer County SWCD - Nutrient Loading Reduction Controls	1996-1997	$59,180
Rockland County		
Rockland County Drainage Agency - Beach Road Stream Improvements	1997-1998	$75,000
Stormwater Quality Improvement Plan - Minisceongo Creek Buffers	1998-1999	$50,000
Stormwater Quality Improvement Plan - Minisceongo Creek Basins	1998-1999	$50,000
Ulster County		
Ulster County SWCD - Nonpoint - Water Diversion, Relocation	1996-1997	$66,000
Ulster County SWCD - Nutrient Loading Control - Wallkill River/ Rondout Creek	1996-1997	$42,695
Ulster County SWCD - Farm Water Diversion - Lower Esopus Creek	1996-1997	$65,163
Westchester County		
Village of Croton-on-Hudson -Salt Storage Facility	1997-1998	$75,000
5.Chlorine Reduction Projects		
Columbia County		
Hudson (C) -Alternative Disinfection - Pilot Project	1998-1999	$85,000
Greene County		
Alternative Disinfection Pilot Project - Catskill	1998-1999	$85,000
Westchester County		
Yonkers Dechlorination	1999-2000	$1,000,000
6. Habitat Restoration Projects		
Columbia County		
Stuyvesant - Mill Creek Marsh Restoration	1999-2000	$325,000
Rensselaer County		
Schodack Island State Park wetland Restoration	1999-2000	$368,980

B. Water Quality Improvement Projects		
Location	**Fiscal Year**	**Funding**
Westchester County		
Croton -on-Hudson - Croton Bay River Mouth/Wetland Restoration	1997-1998	$50,000
7. Habitat Impact Reduction (Municipal water quality projects affecting habitat)		
Columbia County		
Hudson (C) - Pump Station Upgrade - North Bay Wetland	1998-1999	$141,666
Hudson River Estuary Sub-Total		**$18,506,762**
8. New York Harbor Projects (Wastewater and Habitat Protection)		
Bronx County		
NYC - Regulator Improvements: Hunts Point / Wards Island	1997-1998	$950,000
NYC Parks & Recreation, NA - Riverdale Park	1997-1998	$300,000
NYC Parks & Recreation, NA - Bronx River Park	1997-1998	$850,000
King's County		
NYC - Inner Harbor CSO Control	1997-1998	$500,000
NYC Parks and Recreation, NA Four Sparrow Marsh	1997-1998	$400,000
NYC Parks Gerritsen Creek Maritime Ecosystem Restoration	1998-1999	$550,000
Brooklyn - Dreier Offerman Park Habitat Restoration	1999-2000	$561,050
Salt Marsh Restoration at Bergen Beach	1999-2000	$379,000
Queen's County		
NYC - Flushing Bay - First Phase of CSO Project	1996-1997	$10,000,000
NYC Parks - Spring Creek Park	1998-1999	$800,000
NYC DEP Meadowmere Sewers and STP	1998-1999	$2,577,349
Meadow Lake Water Quality and Habitat Improvement	1999-2000	$541,673
Vernam Barbados Saltmarsh Restoration	1999-2000	$250,000
Richmond County		
NYC Parks Old Place Creek	1996-1997	$109,922
NYC Parks Saw Mill Creek Park Dike Removal and Salt Marsh Restoration	1998-1999	$268,000
NYSDEC - Wilpon- Phase 1 of the Geothals Complex	1998-1999	$682,000

B. Water Quality Improvement Projects		
Location	**Fiscal Year**	**Funding**
Staten Island - Pralls Island complex nesting habitat for colonial wading birds	1999-2000	$205,000
Staten Island - Salt Marsh restoration	1999-2000	$63,277
NY Harbor Estuary Sub-Total		**$19,987,271**

Appendix L Estimated Action Plan 2001 Implementation Costs

Funding is anticipated from multiple sources. The basic funding for the Estuary Action Plan implementation is a $6 million annual appropriation in the Environmental Protection Fund (EPF). Additional funds from other EPF categories, Bond Act funds and other sources also will be used to support the plan. Matching funds, including from federal sources and private foundations are estimated at approximately $35 million for the period 1996-2003. Some monitoring projects will fulfill commitments 1-18 and are budgeted for those commitments in this chart. The notation TBD in the chart stands for "To Be Determined" on receipt of grant applications and appropriations from the legislature.

	Prior Estuary Action Plans To Date (as of 3/31/01)			Estuary Action Plan 2001-2002			7-YEAR TOTAL
ACTION/COMMITMENT	SPENT HREP-EPF	CWCA Bond Act	Other	Projected Spending HREP-EPF	CWCA Bond Act	Other	
1. Finfish & Crustaceans	$2,491,802	$0	$0	$1,473,263	$0	$0	$3,965,065
2. Biological Indicators	$464,900	$0	$0	$100,000	$0	$0	$564,900
3. Submerged Habitat	$1,930,327	$0	$0	$1,248,000	$0	$0	$3,178,327
4. Habitat Restoration**	$682,974	$6,162,229	$384,500	$482,315	TBD	$1,000,000	$8,712,018
5. Tidal Wetlands	$881,118	$0	$0	$234,797	$0	$0	$1,115,915
6. Community Conservation	$261,072	$0	$0	$316,138	$0	$0	$577,210
7. Terrestrial Biodiversity	$2,060,662	$0	$0	$1,411,746	$0	$0	$3,472,408
8. Tributaries & Watersheds*	$104,000	$0	$0	$600,000	$0	$0	$704,000
9. Open Space Acquisition	$1,951,235	$4,806,625	$16,115,584	$500,000	TBD	$0	$23,373,444
10. Scenic Resources	$261,310	$0	$0	$200,000	$0	$0	$461,310
11. Recreation	$1,544,796	$0	$0	$1,120,000	$0	$0	$2,664,796
12. Boat Access	$6,744,030	$0	$0	$800,000	$0	$0	$7,544,030
13. Interpretation and Education	$2,238,598	$0	$0	$1,486,498	$0	$0	$3,725,096
14.Waterfront Revitalization	$0	$10,210,445	$8,363,687	$100,000	TBD	TBD	$18,674,132
15. Brownfields	$0	$7,034,572	$0	$0	TBD	$0	$7,034,572
16. Abandoned Structures	$54,666	$0	$0	$50,000	$0	$0	$104,666
17. Water Quality**	$431,963	$33,042,679	$2,380,951	$0	TBD	TBD	$35,855,593
18.Chemical Contaminants	$903,117	$0	$7,200,000	$668,199	$0	$0	$8,771,316
19. Long Term Monitoring***	$5,432,456	$0	$5,600,000	$492,675	$0	$6,800,000	$18,325,131
20. Core Programs	$1,560,974	$0	$0	$716,369	$0	$0	$2,277,343
TOTAL	$30,000,000	$61,256,550	$40,044,722	$12,000,000	TBD	$7,800,000	$151,101,272

* Federal funding authorized under section 319 of the Clean Water Act is specifically targeted for the development of Watershed Restoration and Protection Strategies (WRAPS) as well as for the implementation of the strategies in priority watersheds such as the Hudson River Estuary.

** Total Bond Act funding authorized for the Hudson Estuary, including NY Harbor, is $50 million, of which $39.2 million has been approved as of 3/31/01 for 68 water quality improvement projects. This includes $18.3 million for 50 projects funded from the Hudson River Estuary category of the Bond Act; $20 million for 18 projects funded under the NY/NJ Harbor Estuary category of the Bond Act; and $410,875 for 2 projects funded under the Small Communities Wastewater category of the Bond Act. Eligible categories of funding are wastewater treatment, non-point source pollution control, aquatic habitat restoration, and pollution prevention projects. Additional funds for water quality projects also have been approved from other bond act categories.

*** A minimum of $2.5 million per year will be spent on ecosystem monitoring out of the $6 million per year EPF funds appropriated for the Estuary Action Plan. Some of these funds are allocated in commitments 1, 2, 3, 5, 7, and 18. The 12.4 million combined total of "other" funds for monitoring is funded through the NY Harbor agreement.

Appendix L. Hudson River Estuary
Clean Water/Clean Air Bond Act Funding

The 1996 Clean Water/Clean Air Bond Act authorizes $1.75 billion for much needed environmental improvement projects across New York State. Municipalities and other eligible applicants within the Hudson estuary are eligible under a number of Bond Act programs. As the figures on the table below demonstrate, since passage of the Bond Act, these applicants have been successful in securing Bond Act funding, and it is expected that future applicants will receive Bond Act funding.

Information through 3/31/01. All figures are in $ millions (unless noted otherwise)

Bond Act Category	Authorized by Bond Act	Amount Appropriated (SFYs 96-97, 97-98, 98-99, 99-00 and 00-01)	Committed in Hudson River Estuary (SFYs 96-97, 97-98 98-99, 99-00, and 00-01)*
Water Quality *	$100	$90.1	$39.2
Open Space **	$150	$146.5	$4.8
State Parks Improvement	$50	$42.7	$3.2
Municipal Parks and Historic Preservation	$50	$33.9	$7.0
Brownfields	$200	$100.0	$7.0

Other Hudson River Estuary EPF and Federal ISTEA Projects

Category	Agency	Fiscal Year	Source	Amount
Open Space Land Acquisition	DEC, OPRHP	1994-2001	EPF	$16.5
Local Aid Grants for Land Acquisition	OPRHP		EPF	$985,084 (thousands)
Waterfront Revitalization	Department of State	1994-2001	EPF	$8.4
Public Access	DOT	1996-2001	ISTEA	$23.4
Agricultural Non-Point Source	Agriculture and Markets	1994-2001	EPF	$2.1
Non Agricultural Non-Point Source	DEC	1994-2001	EPF	$280,951 (thousands)

* Water Quality: Applicants in the Hudson River Estuary are eligible under the following Water Quality Improvement categories: Hudson River Estuary ($25 million), NY/NJ Harbor ($25 million), and Wastewater/ Flood Control for communities with populations under 75,000 ($50 million). The authorized and appropriated figures represent figures for these categories.

**The figure reflects completed purchases and projects with executed purchase agreements.

Appendix M Other Potential Sources of Funding

A number of funding sources must be targeted to help meet the need for enhanced program and project implementation funding. Where possible partnerships with the for-profit private sector should be explored. For example, it may be possible for DEC and the Hudson River utilities which use river water for power plant cooling to share in data collection, storage and analysis efforts. The Hudson Valley is unique in that two major private foundations have been established to promote the protection and enhancement of river resources. Other foundations historically have been interested in the Hudson River as well. Partnerships with these foundations should be pursued actively. The municipal and nonprofit sectors provide other partnering opportunities. The Estuary Program will support local government and grassroots community projects through grants, partnerships, and technical assistance. The following list includes potential public and private funding sources, which may be available to support the actions identified in this plan:

- Environmental Protection Fund, a legislatively designated long term source of revenues available to meet the pressing environmental needs of the State

- Clean Water/Clean Air Bond Act, including $25 million for Hudson River Estuary water quality improvement projects, $25 million for NY Harbor water quality projects, as well as other bond act funds for brownfield cleanup, open space protection and habitat restoration, and agricultural and farmland protection efforts

- U.S. Department of Housing and Urban Development - Small Cities Community Block Grant Program administered by the Empire State Development Corp. These are grants awarded annually to smaller communities and rural areas for use in revitalizing neighborhoods, expanding affordable housing and economic opportunities

- Land and Water Conservation Fund, federal monies allocated to the States by the Department of the Interior for land acquisition and development of outdoor recreation

- Pittman-Robertson Program, federal monies from the Federal Aid in Wildlife Restoration Act, apportioned to the states for wildlife conservation and hunter education

- Sport Fish Restoration Program, also known as the Dingell-Johnson program and amended by the Wallop Breaux Act, collects taxes on sport fishing related items and returns the monies to the states for use in fisheries management and research programs

- Biodiversity Stewardship and Research Fund, a legislatively designated vehicle to receive funds from a variety of sources, federal, state and private, to support biodiversity stewardship, research and education in New York State

- Joint Dredging Plan for the Port of New York and New Jersey, (the Bi-state Plan), a blueprint for restoration of New York Harbor for navigation, including trackdown and cleanup of contaminants entering harbor sediments

- Transportation Equity Act (TEA-21) a federal authorization to be allocated to the states for construction and maintenance of trails, 30% of which must be used for non-motorized trails. Funds also are available for related enhancements such as scenic easements, conservation of abandoned railways to trails, bicycle and pedestrian facilities, removal of outdoor advertising, archaeological planning, scenic byways, and landscape beautification, including restoration of native species in disturbed habitats

- Forest Legacy Program, federal monies designed to identify and protect environmentally sensitive forests that are threatened with conversion to non-forest uses

- Environmental Benefit Project Funds and Natural Resource Damages, if appropriate and in accord with law and guidance, may be provided for conservation

- Migratory Bird Stamp and Print, a dedicated source of revenue for management and acquisition of wetlands and associated migratory bird habitat in New York State and Canada

- Return a Gift to Wildlife, a state income tax donation program, revenues are used for a variety of projects that benefit fish and wildlife

- State Revolving Loan Fund provides low-interest loans to municipalities to construct and expand sewage treatment facilities and to implement non-point source and estuary pollution abatement projects, continuation of the state revolving loan fund depends on reauthorization of the Clean Water Act with grants to states to capitalize the loan fund

- Drinking Water State Revolving Fund provides subsidized low interest loans to private and public water systems for construction of needed drinking water infrastructure improvements such as treatment plants, distribution mains, and storage facilities; DWSRF is administered jointly by the NYS Department of Health and the NYS Environmental Facilities corporation

- Farmland Protection Program has since 1996 committed more than $40 million to farmland protection projects around the state; this competitive grants program awards funds to municipalities to purchase development rights on farms, keeping them in agriculture forever

- Federal Non-Game Wildlife Funding Initiative, under consideration by the International Association of Fish and Wildlife Agencies, would provide a flexible program of grants to the states, funded through a federal excise tax on backpacks, mountain bicycles, tents, climbing gear, and similar outdoor recreational equipment

- Army Corps of Engineers, Civil Work Water Resources Development Program monies have been committed for the purpose of determining ecosystem restoration opportunities on the Hudson River. Additional federal funds are available on a matching basis for feasibility studies and implementation

- Gifts and donations, a direct way for individuals and businesses to contribute directly to the conservation of open space through donations of land or easements

- Natural resource damage claims for harm to natural resources within the Hudson River ecosystem may be used for restoration projects to the extent consistent with law

- Nonprofit organizations such as Scenic Hudson Land Trust, the Open Space Institute, Trust for Public Land, the Nature Conservancy and local land trusts may be able to obtain charitable funding for properties identified; shared funding may be possible for properties identified for acquisition in this plan

- Hudson River Foundation is a private foundation supporting research, education and public access to the river; its purpose is to contribute to the development of sound public policy concerning the river's ecosystem.

- NYC Environmental Fund (administered by the Hudson River Foundation) provides financial support for projects that will foster restoration, care, public enjoyment of and education about the natural resources of New York City and the Consolidated Edison service area in Westchester